# Pariksha Saathi — General Awareness Notes

**11 topics • 121 lessons • updated 28 October 2026**

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## Ancient and Medieval Indian History

### Ancient and Medieval Indian History

**What the exam asks:** In SSC, Railway, state police and state PSC prelims, ancient and medieval history is a fact-dense area worth 4 to 8 questions in a typical General Awareness section. They ask who built what, who wrote which book, which traveller visited which court, which inscription belongs to which ruler, and in what order dynasties and battles came. Revise it as linked tables: ruler, capital, achievement, text, traveller.

**Indus Valley and the Vedic age:** The Harappan civilisation (about 2600 to 1900 BC) was a Bronze Age urban culture with burnt bricks, grid-planned streets, covered drains and an undeciphered script, but no iron. Attach each site to its signature find: Mohenjo-daro has the Great Bath, the Pashupati seal and the bronze Dancing Girl; Harappa (excavated by Daya Ram Sahni in 1921) has the granaries; Lothal has the dockyard; Kalibangan has a ploughed field and fire altars; Dholavira has water reservoirs and a large signboard. The Rigveda is the oldest Veda and contains the Gayatri Mantra and the Purusha Sukta; the Samaveda is the Veda of melodies. Rigvedic society was pastoral and tribal with assemblies called Sabha and Samiti; rigid caste and land taxes belong to the later Vedic age. The Upanishads, also called Vedanta, give us Satyameva Jayate from the Mundaka Upanishad.

**Buddhism, Jainism and the Mahajanapadas:** Gautama Buddha was born at Lumbini, enlightened at Bodh Gaya, preached first at Sarnath and died at Kushinagar. The four Buddhist councils were held at Rajgir (Ajatashatru), Vaishali (Kalashoka), Pataliputra (Ashoka) and Kundalvana in Kashmir (Kanishka, in the Sarvastivada tradition; the Theravada tradition counts a different fourth council, in Sri Lanka). The Tripitaka is the Vinaya (monastic rules), the Sutta (sermons) and the Abhidhamma (philosophy). Mahavira, the 24th Tirthankara, added Brahmacharya to the four vows of Parshvanatha, the 23rd, and died at Pavapuri. Jainism split into Digambara (Bhadrabahu) and Svetambara (Sthulabhadra); according to Jain tradition Bhadrabahu led Chandragupta Maurya to Shravanabelagola. The sixteen Mahajanapadas are listed in the Anguttara Nikaya; Magadha rose under Bimbisara, Ajatashatru and Udayin, who made Pataliputra the capital (the fort at Pataligrama had first been built in Ajatashatru's time).

**Mauryas and their successors:** Chandragupta Maurya, guided by Chanakya (Kautilya, author of the Arthashastra), received Seleucus Nicator's envoy Megasthenes, who wrote the Indica. Ashoka's Kalinga war (c. 261 BC) and remorse are recorded in Rock Edict XIII; his personal name appears only in the Maski, Gujarra, Nittur and Udegolam

minor edicts. The last Maurya, Brihadratha, was killed by Pushyamitra Shunga. Kanishka of the Kushanas, by tradition the founder of the Saka era of 78 AD (historians now place his accession at about 127 AD), patronised the Gandhara school. The Satavahanas are known through the Nasik inscription of Gautami Balashri, mother of Gautamiputra Satakarni. Rudradaman's Junagadh inscription is the first long Sanskrit inscription. Early Tamil literature gives us the Tolkappiyam (the oldest surviving Tamil grammar, of the Sangam tradition) and the later, post-Sangam works Tirukkural, Silappadikaram (Ilango Adigal) and Manimekalai (Sattanar).

**Guptas, Harsha and the South:** Samudragupta's conquests are described by Harisena in the Allahabad pillar; Chandragupta II (Vikramaditya) hosted Fa-Hien and a court that, by the most popular tradition, included Kalidasa; Kumaragupta I is credited with founding Nalanda; Skandagupta repelled the Hunas. Aryabhata and Varahamihira (Brihat Samhita) were scientists of the Gupta age; Brahmagupta (born 598 AD) belongs to the later seventh-century period. Harsha wrote Ratnavali, Priyadarshika and Nagananda, was described by Banabhatta in the Harshacharita, hosted Hiuen Tsang, and was stopped at the Narmada by the Chalukya Pulakeshin II. In the south, the Pallava Mahendravarman I wrote Mattavilasa Prahasana and Narasimhavarman I built the Mahabalipuram rathas; the Rashtrakuta Krishna I built the Kailasa temple at Ellora and Amoghavarsha wrote Kavirajamarga; the Cholas are asked for their administration (Ur, Sabha, Nagaram, the Uttaramerur inscriptions of Parantaka I) and navy (Rajendra I's Srivijaya expedition).

**Delhi Sultanate and regional kingdoms:** The order is Mamluk, Khalji, Tughlaq, Sayyid, Lodi. Iltutmish introduced the tanka and jital and the iqta system; Balban preached kingship as Zil-i-Ilahi with sijda and paibos; Alauddin Khalji introduced dagh, chehra and market control described by Barani; Muhammad bin Tughlaq shifted the capital to Daulatabad and issued token currency; Firoz Tughlaq built canals and brought Ashokan pillars to Delhi; Sikandar Lodi founded Agra. Vijayanagara was founded in 1336 by Harihara and Bukka, reached its peak under Krishnadevaraya (Amuktamalyada) and fell at Talikota in 1565; the rival Bahmani kingdom was founded by Hasan Gangu in 1347. The Bhakti movement runs from Ramanuja (Vishishtadvaita) through Kabir, Ravidas, Mirabai, Tulsidas and Chaitanya; the Sufi Chishti order was brought to Ajmer by Moinuddin Chishti and the Suhrawardi order was based at Multan.

**Mughals and Marathas:** Babur won Panipat (1526, Ibrahim Lodi), Khanwa (1527, Rana Sanga). Sher Shah expelled Humayun and introduced the rupiya and repaired, widened and realigned the old Uttarapatha as the Sadak-e-Azam (the later Grand Trunk Road). Akbar won the second battle of Panipat (1556, Hemu), built the Ibadat Khana at Fatehpur Sikri, introduced the mansabdari system (zat and sawar ranks), and used Todar Mal's dahsala revenue system. Jahangir received Sir Thomas Roe; Shah Jahan built the Taj Mahal, Delhi's Jama Masjid and the Peacock Throne; Aurangzeb reimposed jizya in 1679. Shivaji's Ashtapradhan included the Peshwa, Amatya, Sumant (foreign affairs) and Panditrao; he levied chauth and sardeshmukhi and signed the Treaty of Purandar with Jai Singh in 1665. Power later passed to the Peshwas, who were defeated at Panipat in 1761.

**Traps students fall into:** Do not confuse Fa-Hien (Chandragupta II) with Hiuen Tsang (Harsha), or Megasthenes (Chandragupta Maurya) with Ibn Battuta (Muhammad bin Tughlaq) and Abdur Razzaq (Devaraya II). Harshacharita is by Banabhatta, but Ratnavali is by Harsha himself. The Dancing Girl, Great Bath and Pashupati seal are all Mohenjo-daro, not Harappa. The first Buddhist council is at Rajgir, the first Jain council at Pataliputra. Alauddin introduced dagh and chehra; Sher Shah only revived them. Prinsep, not Cunningham, deciphered Ashoka's Brahmi script in 1837-38.

### Examples

- Site-find pairs: Mohenjo-daro (Great Bath, Pashupati seal, Dancing Girl), Lothal (dockyard), Kalibangan (ploughed field, fire altars), Dholavira (reservoirs, signboard), Rakhigarhi (largest site in India).
- Buddha's life mnemonic L-B-S-K: Lumbini (birth), Bodh Gaya (enlightenment), Sarnath (first sermon), Kushinagar (death). Symbols: lotus, Bodhi tree, wheel, stupa.
- Four Buddhist councils, remember R-V-P-K: Rajgir (Ajatashatru), Vaishali (Kalashoka), Pataliputra (Ashoka), Kundalvana (Kanishka, Sarvastivada tradition).
- Traveller-ruler pairs: Megasthenes-Chandragupta Maurya, Fa-Hien-Chandragupta II, Hiuen Tsang-Harsha, Al-Biruni-Mahmud of Ghazni, Ibn Battuta-Muhammad bin Tughlaq, Abdur Razzaq-Devaraya II, Thomas Roe-Jahangir, Bernier-

Aurangzeb.

- Ashoka's name appears only in the Maski, Gujarra, Nittur and Udegolam minor edicts; everywhere else he is Devanampiya Piyadasi. The Kalinga war is in Rock Edict XIII.
- Author-book pairs: Kautilya-Arthashastra, Vishakhadatta-Mudrarakshasa, Harisena-Prayag Prashasti, Banabhatta-Harshacharita, Harsha-Ratnavali, Barani-Tarikh-i-Firozshahi, Krishnadevaraya-Amuktamalyada, Abul Fazl-Akbarnama.
- Chola self-government: the Uttaramerur inscriptions of Parantaka I describe the kudavolai (pot-ticket) method of choosing village committee members.
- Sultanate firsts: Iltutmish (tanka, jital, iqta), Balban (sijda, paibos, Zil-i-Ilahi), Alauddin (dagh, chehra, market control), Muhammad bin Tughlaq (token currency, Daulatabad), Firoz (canals, Ashokan pillars to Delhi).
- Battle chain: Panipat I 1526 (Babur vs Ibrahim Lodi), Khanwa 1527 (Babur vs Rana Sanga), Chausa 1539 and Kannauj 1540 (Sher Shah vs Humayun), Panipat II 1556 (Akbar vs Hemu), Haldighati 1576 (Man Singh vs Maharana Pratap), Talikota 1565 (Vijayanagara vs Deccan Sultans), Panipat III 1761 (Abdali vs Marathas).
- Mansabdari: zat fixes personal rank and salary, sawar fixes the number of horsemen a mansabdar must maintain; Akbar introduced it, and Jahangir added the du-aspa sih-aspa rank.
- Chauth was one-fourth of the revenue of a territory; sardeshmukhi was an additional ten per cent claimed by Shivaji as hereditary sardeshmukh.
- Bhakti philosophies: Shankara-Advaita, Ramanuja-Vishishtadvaita, Madhva-Dvaita, Vallabha-Shuddhadvaita; Jnaneshwar wrote the Jnaneshwari, Tulsidas the Ramcharitmanas.

> **Quick revision:** Harappans knew bronze but not iron; Great Bath at Mohenjo-daro, dockyard at Lothal; Rigveda oldest Veda (Gayatri Mantra); First Buddhist council Rajgir, fourth under Kanishka; Mahavira died at Pavapuri; Megasthenes (Indica) under Chandragupta Maurya; Kalinga war in Rock Edict XIII, Ashoka named in Maski edict; Harisena's Prayag Prashasti on Samudragupta; Fa-Hien under Chandragupta II, Hiuen Tsang under Harsha; Iltutmish tanka-jital, Alauddin market control, M.b. Tughlaq token currency; Vijayanagara 1336, Talikota 1565; Panipat 1526 Babur, 1556 Akbar, 1761 Abdali; Aurangzeb jizya 1679.

### Prehistoric India and the Indus Valley (Harappan) Civilisation

**The Stone Age sequence:** Prehistory is rebuilt from tools, bones, pottery and paintings and divided by the kind of tools people made. The Palaeolithic or Old Stone Age was the long age of hunter-gatherers using hand-axes, cleavers and choppers, often of quartzite. Robert Bruce Foote found the first Palaeolithic tool in India at Pallavaram near Chennai in 1863 and is called the father of Indian prehistory. The Bhimbetka rock shelters near Bhopal in Madhya Pradesh, discovered by V. S. Wakankar in 1957, hold hundreds of paintings of animals, hunting and dancing.

**Mesolithic, Neolithic and Chalcolithic:** The Mesolithic or Middle Stone Age is marked by microliths, tiny stone blades set in wooden or bone handles. Bagor in Rajasthan and Adamgarh in Madhya Pradesh give the earliest evidence of animal domestication in India, and Sarai Nahar Rai and Mahadaha in Uttar Pradesh have Mesolithic burials. The Neolithic or New Stone Age brought polished stone tools, farming, pottery and villages. Mehrgarh in Balochistan, from about 7000 BC, is the earliest farming site in the subcontinent, with wheat and barley; Burzahom in Kashmir had pit dwellings and dogs buried with their masters; Chirand in Bihar is known for bone tools; and Koldihwa in Uttar Pradesh is linked with early rice. The Chalcolithic or copper-stone age added copper tools and painted black-and-red pottery, seen in the Ahar (Banas) culture of Rajasthan, the Malwa culture at Navdatoli and the Jorwe culture of Maharashtra, with Inamgaon.

**Discovery and extent of the Harappan civilisation:** The civilisation is called Harappan after Harappa, the first site excavated. Charles Masson noticed its mounds in 1826 and Alexander Cunningham, the first Director General of the Archaeological Survey of India, found a seal there, but excavation began only when Daya Ram Sahni dug Harappa in 1921 and R. D. Banerji dug Mohenjo-daro in 1922. Sir John Marshall, then Director General, announced a new civilisation in 1924. Its mature phase lasted from about 2600 to 1900 BC, and it covered a larger area than ancient Egypt or Mesopotamia: Sutkagendor in Balochistan in the west, Alamgirpur near Meerut in the east, Manda in Jammu in the north and Daimabad in Maharashtra in the south, with a trading outpost at Shortughai in Afghanistan.

**Sites and what each is known for:** Harappa, on the Ravi in Pakistani Punjab, has rows of granaries, working floors and the cemetery R-37. Mohenjo-daro, on the Indus in Sindh, has the Great Bath, the Great Granary, an assembly hall, the Pashupati seal, the bronze Dancing Girl, the steatite priest-king and woven cotton. Chanhudaro in Sindh had a bead-making workshop and no citadel. Lothal in Gujarat, excavated by S. R. Rao, has a dockyard, a bead factory and rice husk. Kalibangan in Rajasthan, on the Ghaggar, has a ploughed field of the pre-Harappan level, fire altars and the black bangles that gave it its name. Banawali in Haryana gave a clay model of a plough, Dholavira in Kutch has a city in three parts with large water reservoirs and a signboard of ten signs, Ropar in Punjab has a dog buried with a human, and Rakhigarhi in Haryana is among the largest Harappan sites.

**Town planning:** Harappan cities were laid out on a grid, with main streets crossing at right angles. Most had a raised citadel on the west, holding public buildings, and a larger lower town on the east where people lived. Houses were of burnt bricks in the standard proportion 1:2:4, often had their own wells and bathrooms, and opened on to side lanes rather than main roads. Streets had covered drains with manholes, unmatched by other civilisations of the time. The Great Bath, made watertight with bitumen, was probably used for ritual bathing.

**Economy, seals and script:** Wheat and barley were the staples, with peas, sesame and mustard, and the Harappans are conventionally credited as the earliest people to grow cotton, which the Greeks later called sindon, after Sindh. They used copper and bronze but not iron, had no coins, and traded by barter with cubical weights based on 16 and its multiples. Mesopotamian texts call the region Meluhha, and Harappan seals have been found in Mesopotamia. Seals, mostly square and of steatite, show an animal and a line of script; the one-horned unicorn is the commonest motif and the horse is absent. The script has about 400 signs, ran mostly from right to left and is still undeciphered. Religion is read from mother-goddess figurines, the Pashupati seal (a seated figure surrounded by an elephant, a tiger, a rhinoceros and a buffalo), tree worship and the fire altars of Lothal and Kalibangan.

**Why it declined:** By about 1900 BC the cities were being abandoned and the culture became rural and regional, the Late Harappan phase. Mortimer Wheeler blamed an Aryan invasion, but most historians reject this for lack of evidence of a massacre. Other theories point to floods at Mohenjo-daro, the shifting and drying of rivers such as the Ghaggar-Hakra, a drier climate, the decline of trade with Mesopotamia and damage to the environment. Most scholars now see a gradual decline with several causes.

### Examples

- Robert Bruce Foote found India's first Palaeolithic tool at Pallavaram near Chennai (1863); V. S. Wakankar discovered the Bhimbetka rock shelters, Madhya Pradesh (1957).
- Earliest evidence: farming at Mehrgarh, Balochistan (about 7000 BC, wheat and barley); animal domestication at Bagor and Adamgarh; pit dwellings and dog burials at Burzahom, Kashmir.
- Chalcolithic cultures: Ahar or Banas (Rajasthan), Malwa (Navdatoli), Jorwe (Maharashtra, with Inamgaon); they used copper tools and black-and-red pottery.
- Harappan discovery: Harappa by Daya Ram Sahni (1921), Mohenjo-daro by R. D. Banerji (1922); John Marshall announced the civilisation in 1924.
- Boundary sites: Sutkagendor (west), Alamgirpur (east), Manda (north), Daimabad (south); Shortughai in Afghanistan was a trading outpost.
- Lothal (Gujarat, S. R. Rao): dockyard, bead factory, rice; Kalibangan (Rajasthan): ploughed field, fire altars, black bangles; Banawali (Haryana): clay plough model; Dholavira (Kutch): reservoirs and signboard.
- Mohenjo-daro (mound of the dead) has the Great Bath, Great Granary, Pashupati seal, bronze Dancing Girl and priest-king; Chanhudaro had a bead workshop and no citadel.
- Harappan bricks were burnt and in the ratio 1:2:4; weights were cubical and based on 16; the unicorn is the commonest seal animal; the script of about 400 signs runs right to left and is undeciphered.
- Harappans knew copper and bronze but not iron, the horse is absent from the seals, and Mesopotamian records call the Indus region Meluhha.
- Decline theories: Aryan invasion (Mortimer Wheeler, now rejected), floods, shifting and drying of the Ghaggar-Hakra, a drier climate and the end of trade with Mesopotamia.

**Quick revision:** Foote found first Palaeolithic tool at Pallavaram 1863; Bhimbetka paintings found by Wakankar 1957; microliths mark the Mesolithic; Mehrgarh earliest farming; Burzahom pit dwellings; Harappa 1921 (Sahni), Mohenjo-daro 1922 (Banerji), Marshall 1924; mature phase 2600-1900 BC; Great Bath at Mohenjo-daro, dockyard at Lothal, ploughed field at Kalibangan, signboard at Dholavira; bricks 1:2:4; weights on 16; unicorn seals; script undeciphered; no iron; gradual decline.

### The Vedic Age: Rigvedic and Later Vedic Periods

**Two phases and their sources:** The Vedic Age is named after the Vedas, composed in Vedic Sanskrit and passed down orally long before they were written. Historians divide it into the Early or Rigvedic period (about 1500 to 1000 BC), when the Indo-Aryans lived in the land of seven rivers, Sapta Sindhu, in the north-west, and the Later Vedic period (about 1000 to 600 BC), when they spread into the Ganga plains. The Rigveda is the source for the first phase; the other three Vedas, the Brahmanas, the Aranyakas and the Upanishads describe the second, which archaeology links with the Painted Grey Ware of the Ganga-Yamuna doab.

**The Vedic texts:** The Rigveda has 10 mandalas and 1028 hymns. Mandalas 2 to 7, the family books, are the oldest, and mandala 10, with the Purusha Sukta that first names the four varnas, is the latest. The Gayatri Mantra, addressed to Savitri (the sun god) and composed by Vishvamitra, is in mandala 3, and mandala 9 is devoted to Soma. The Samaveda is a book of chants mostly drawn from the Rigveda and is the root of Indian music; the Yajurveda gives sacrificial formulas in two recensions, Shukla (white) and Krishna (black); the Atharvaveda holds charms, spells and folk medicine. The Brahmanas (such as the Aitareya and Shatapatha) explain rituals, the Aranyakas are forest texts, and the Upanishads, the philosophical end of the Vedas called Vedanta, discuss Brahman and Atman. The six Vedangas are Shiksha, Kalpa, Vyakarana, Nirukta, Chhanda and Jyotisha.

**Rivers of the Rigveda:** The Indus (Sindhu) is the river mentioned most often, and the Saraswati, called naditama (best of rivers), the most revered. The Punjab rivers appear under older names: Vitasta (Jhelum), Asikni (Chenab), Parushni (Ravi), Vipas (Beas) and Shutudri (Sutlej); the Kubha (Kabul), Krumu (Kurram) and Gomati (Gomal) are western rivers. The Ganga is mentioned only once. The Battle of Ten Kings (Dasarajna), told in mandala 7, was fought on the Parushni, where Sudas of the Bharata tribe defeated a confederacy of ten tribes.

**Polity:** Rigvedic polity was tribal. The tribe was the jana, and its chief, the rajan, was mainly a war leader and protector of cattle, helped by the purohita (priest) and the senani (army chief). Assemblies checked him: the Sabha (council of elders), the Samiti (general assembly of the people) and the Vidatha, the oldest; women attended the Sabha and the Vidatha. Bali was a voluntary offering. In the Later Vedic age tribes merged into territorial kingdoms (janapadas, rashtras), and the king proved his greater power through grand sacrifices: the Rajasuya (consecration), the Ashvamedha (horse sacrifice) and the Vajapeya (chariot race). Bali became a compulsory tax, officials called ratnins appeared, the Vidatha disappeared and women were excluded from the Sabha. The Atharvaveda calls the Sabha and Samiti the two daughters of Prajapati.

**Society and varna:** The family was patriarchal and people prayed for sons and cattle. Varna, based on occupation, was not yet rigid in Rigvedic times; one hymn says the poet's father was a physician and his mother ground corn. Women had a respectable place: Lopamudra, Ghosha, Apala and Vishvavara composed hymns, there was no child marriage, and widow remarriage and niyoga (levirate) were practised. In the Later Vedic age the four varnas hardened into hereditary groups with the Shudras at the bottom, the gotra system appeared, and women lost status and their place in the assemblies. The ashramas took shape; the Jabala Upanishad is usually cited as the first text to name all four: brahmacharya, grihastha, vanaprastha and sannyasa.

**Economy and the shift east:** The Rigvedic people were mainly pastoral. Cattle were wealth, the word gavishti (search for cows) meant war, and they grew barley (yava) and knew copper or bronze (ayas). In the Later Vedic age agriculture became the main occupation, rice (vrihi) and wheat were grown, and iron, called krishna ayas or shyama ayas (black metal), came into use around 1000 BC and helped clear the forests of the Ganga valley. The Shatapatha Brahmana tells how Videgha Madhava followed the fire god Agni, who burned his way east up to the Sadanira (Gandak), and settled beyond it in Videha, a memory of the eastward spread. The Kurus, with their capital at Hastinapur, and the Panchalas became the leading peoples of the doab.

**Religion:** Rigvedic gods were forces of nature. Indra, the war god and rain-bringer called Purandara (breaker of forts), has about 250 hymns, the most of any god; Agni, the fire god and messenger between gods and men, has about 200; Varuna upheld rita, the cosmic order; and Soma was the god of a sacred drink. Worship was through prayers and simple sacrifices for cattle, sons and victory, without temples or idols. In the Later Vedic age Indra and Agni lost importance, Prajapati the creator became the chief god, Vishnu and Rudra rose, and sacrifices became elaborate and costly. The Upanishads reacted against this ritualism by stressing knowledge, preparing the ground for the reform movements of the sixth century BC.

**Examples**

- Rigveda: 10 mandalas and 1028 hymns; Gayatri Mantra in mandala 3 (Vishvamitra, to Savitri); Purusha Sukta naming the four varnas in mandala 10; mandala 9 is on Soma.
- Rigvedic river names: Vitasta-Jhelum, Asikni-Chenab, Parushni-Ravi, Vipas-Beas, Shutudri-Sutlej, Kubha-Kabul, Krumu-Kurram, Gomati-Gomal; Sadanira is the Gandak.
- Battle of Ten Kings (Dasarajna): fought on the Parushni (Ravi) and won by Sudas of the Bharata tribe; described in mandala 7.
- Assemblies: Sabha (elders), Samiti (people), Vidatha (oldest; women attended); the Atharvaveda calls the Sabha and Samiti the two daughters of Prajapati.
- Later Vedic royal sacrifices: Rajasuya (consecration), Ashvamedha (horse sacrifice) and Vajapeya (chariot race); bali turned from voluntary gift to compulsory tax.
- Gods: Indra (about 250 hymns, called Purandara), Agni (about 200 hymns), Varuna (guardian of rita); Prajapati became the chief god in the Later Vedic age.
- Women who composed Rigvedic hymns: Lopamudra, Ghosha, Apala and Vishvavara; the Jabala Upanishad is usually cited as the first to mention all four ashramas.
- Iron came into use around 1000 BC (krishna ayas or shyama ayas); Later Vedic culture matches the Painted Grey Ware of the Ganga-Yamuna doab.
- Six Vedangas: Shiksha (phonetics), Kalpa (ritual), Vyakarana (grammar), Nirukta (etymology), Chhanda (metre), Jyotisha (astronomy).

> **Quick revision:** Rigvedic age 1500-1000 BC in Sapta Sindhu, Later Vedic 1000-600 BC in the Ganga plains; Rigveda 10 mandalas, 1028 hymns; Gayatri Mantra in mandala 3, Purusha Sukta in mandala 10; Indus most mentioned river, Saraswati most revered, Ganga once; Dasarajna on the Parushni won by Sudas; Sabha, Samiti, Vidatha; bali voluntary then compulsory; Indra 250 hymns, Agni 200; iron around 1000 BC; Videgha Madhava to Videha; Jabala Upanishad names four ashramas.

### Mahajanapadas, the Rise of Magadha, Buddhism and Jainism

**The sixteen Mahajanapadas:** By the sixth century BC the janapadas had grown into larger states, and the Buddhist Anguttara Nikaya lists sixteen Mahajanapadas: Anga (capital Champa), Magadha (Rajagriha), Kashi (Varanasi), Kosala (Shravasti), Vajji (Vaishali), Malla (Kushinara and Pava), Chedi (Shuktimati), Vatsa (Kaushambi), Kuru (Indraprastha), Panchala (Ahichhatra and Kampilya), Matsya (Viratnagar), Surasena (Mathura), Assaka (Potali, on the Godavari, the only one in the south), Avanti (Ujjayini and Mahishmati), Gandhara (Taxila) and Kamboja. Most were monarchies, but the Vajjis and Mallas were ganas or sanghas, republics governed by assemblies of clan heads; the Vajji confederacy was led by the Lichchhavis of Vaishali. This was the age of the second urbanisation, of iron tools, punch-marked coins and Northern Black Polished Ware.

**Why Magadha rose:** Magadha had fertile soil, iron ore in the nearby hills, forests that gave elephants for its army, and capitals that were natural fortresses: Rajgir was ringed by five hills, and Pataliputra stood near the meeting of the Ganga, the Son and the Gandak. Under the Haryanka dynasty, Bimbisara, a contemporary of the Buddha, expanded through marriages with the royal houses of Kosala (which brought part of Kashi as dowry), the Lichchhavis and the Madras, annexed Anga, and sent his physician Jivaka to treat Pradyota of Avanti. His son Ajatashatru, who killed him, defeated Kosala and the Vajjis, using, Jain texts say, two new weapons, the mahashilakantaka (a catapult) and the rathamusala (a chariot fitted with a mace). The first Buddhist council met in his reign, and his son Udayin made Pataliputra the capital.

**Shishunagas and Nandas:** Shishunaga, founder of the next dynasty, destroyed the power of Avanti; his son Kalashoka (Kakavarna) held the second Buddhist council at Vaishali. Mahapadma Nanda, called Ekarat (sole ruler) and Sarvakshatrantaka (destroyer of all Kshatriyas), was the first non-Kshatriya empire-builder of north India; the Hathigumpha inscription of Kharavela mentions a canal dug in Kalinga by a Nanda king. The last Nanda, Dhana Nanda, ruled a rich but unpopular kingdom with a huge army, said to be one reason Alexander's soldiers refused to cross the Beas in 326 BC. Chandragupta Maurya overthrew him around 321 BC.

The Buddha's life: Siddhartha Gautama was born, by the traditional date, in 563 BC at Lumbini in the Shakya clan of Kapilavastu, to Suddhodana and Mahamaya; he married Yashodhara and had a son, Rahula. Moved by four sights, an old man, a sick man, a corpse and an ascetic, he left home at 29, the Mahabhinishkramana. He studied under Alara Kalama and Udraka Ramaputra, then attained enlightenment at 35 under a pipal tree at Bodh Gaya on the Niranjana. He gave his first sermon, the Dharmachakra Pravartana, at the Deer Park in Sarnath, spent many rainy seasons at Shravasti, and died at 80 at Kushinagar in 483 BC, the Mahaparinirvana.

**Teachings, councils and sects:** The Four Noble Truths say that life is suffering (dukkha), that desire (tanha) causes it, that it can end, and that the Eightfold Path ends it: right view, resolve, speech, action, livelihood, effort, mindfulness and concentration. This is the Middle Path, and the goal is nirvana. The Buddha rejected the authority of the Vedas, animal sacrifice and caste privilege, and taught in the language of the people; the canon, the Tripitaka (Vinaya, Sutta and Abhidhamma), is in Pali. The first council (483 BC) met in the Saptaparni cave at Rajgir under Mahakassapa, where Ananda recited the Sutta and Upali the Vinaya; the second (383 BC) at Vaishali split the order into Sthaviravadins and Mahasanghikas; the third (about 250 BC) at Pataliputra under Moggaliputta Tissa compiled the Abhidhamma; and the fourth, at Kundalvana in Kashmir under Kanishka, with Vasumitra presiding and Ashvaghosha as deputy, marked the split into Hinayana and Mahayana. Mahayana worships the Buddha in images and stresses the Bodhisattva ideal.

**Mahavira and the tirthankaras:** Jains revere 24 tirthankaras, from Rishabhadeva (Adinath), the first, to Parshvanath, the 23rd, who taught four vows (non-violence, truth, non-stealing and non-possession), and Vardhamana Mahavira, the 24th, who added brahmacharya. Mahavira was born at Kundagrama near Vaishali to Siddhartha of the Jnatrika clan and the Lichchhavi princess Trishala; by the dates many historians and exam books use he lived from 540 to 468 BC, while Jain tradition gives 599 to 527 BC. He left home at 30 and attained kaivalya (supreme knowledge) at 42, after 12 years of austerity, under a sal tree at Jrimbhikagrama, becoming the Jina (conqueror) and Nirgrantha (free from bonds). He died at 72 at Pavapuri. Jainism teaches the triratna of right faith, right knowledge and right conduct, strict ahimsa, and anekantavada, the view that truth has many sides; Mahavira preached in Ardhamagadhi Prakrit.

**Jain councils and sects:** During a 12-year famine in Magadha in Chandragupta Maurya's reign, Bhadrabahu led a group of monks south to Karnataka while Sthulabhadra stayed behind. The first Jain council, at Pataliputra under Sthulabhadra, compiled the teachings into 12 Angas. Those who stayed began wearing white and became the Svetambaras; Bhadrabahu's followers, who kept to nudity, became the Digambaras. The second council, at Vallabhi in Gujarat under Devarddhi Kshamashramana, gave the canon its final written form. Royal patrons included Chandragupta Maurya, Kharavela of Kalinga and the Rashtrakuta Amoghavarsha.

### Examples

- Sixteen Mahajanapadas are listed in the Anguttara Nikaya; Assaka on the Godavari was the only one in the south; Vajji and Malla were republics (ganas).
- Magadha's dynasties in order: Haryanka (Bimbisara, Ajatashatru, Udayin), Shishunaga (Shishunaga, Kalashoka), Nanda (Mahapadma, Dhana Nanda), then Maurya.
- Ajatashatru's new weapons (Jain texts): mahashilakantaka, a catapult, and rathamusala, a chariot fitted with a mace; Udayin made Pataliputra the capital.
- Mahapadma Nanda: Ekarat and Sarvakshatrantaka; Kharavela's Hathigumpha inscription mentions a Nanda king's canal in Kalinga.
- Buddha's teachers: Alara Kalama and Udraka Ramaputra; first sermon at Sarnath (Dharmachakra Pravartana); left home at 29, enlightened at 35, died at 80 at Kushinagar.

- Tripitaka: Vinaya (rules for monks), Sutta (discourses), Abhidhamma (philosophy), in Pali; at the first council Ananda recited the Sutta and Upali the Vinaya.
- Buddhist councils: Rajgir 483 BC (Mahakassapa), Vaishali 383 BC (Sabakami, split into Sthaviravadins and Mahasanghikas), Pataliputra about 250 BC (Moggaliputta Tissa), Kashmir (Vasumitra, Hinayana-Mahayana split).
- Parshvanath (23rd tirthankara) gave four vows; Mahavira (24th) added brahmacharya; Rishabhadeva was the first tirthankara.
- Mahavira: born at Kundagrama, kaivalya at 42 under a sal tree at Jrimbhikagrama, died at 72 at Pavapuri; titles Jina and Nirgrantha.
- Jain councils: Pataliputra (Sthulabhadra, 12 Angas) and Vallabhi (Devarddhi Kshamashramana, final written canon); Svetambara (white-clad) and Digambara (sky-clad) sects.

> **Quick revision:** Sixteen Mahajanapadas in Anguttara Nikaya; Vajji and Malla republics; Magadha rose through iron, elephants, fertile land; Bimbisara annexed Anga; Ajatashatru used mahashilakantaka; Udayin to Pataliputra; Mahapadma Nanda Ekarat; Buddha 563-483 BC, Lumbini-Bodh Gaya-Sarnath-Kushinagar; Four Noble Truths, Eightfold Path; councils Rajgir, Vaishali, Pataliputra, Kashmir; Mahavira 24th tirthankara, kaivalya at 42, died at Pavapuri; Svetambara and Digambara; Jain councils Pataliputra and Vallabhi.

### The Mauryan Empire: Chandragupta, Bindusara and Ashoka

**Sources:** The Mauryan age (about 321 to 185 BC) is the first period of Indian history with rich and varied sources. Kautilya's Arthashastra is a manual of statecraft in 15 books; Megasthenes' Indica survives only in quotations by later Greek writers such as Strabo and Arrian; Vishakhadatta's play Mudrarakshasa, written in the Gupta age, tells of Chandragupta's rise; Buddhist works such as the Divyavadana and the Sri Lankan chronicles Dipavamsa and Mahavamsa tell of Ashoka; and Ashoka's own inscriptions, first read by James Prinsep in 1837, speak in his voice. Rudradaman's Junagadh inscription adds that Chandragupta's governor Pushyagupta built the Sudarshana lake in Saurashtra.

**Chandragupta Maurya:** Guided by the Brahmin Kautilya (Chanakya or Vishnugupta), Chandragupta overthrew Dhana Nanda around 321 BC. In about 305 BC he fought Seleucus Nicator, Alexander's general; the treaty that followed gave Chandragupta the regions around Kabul, Kandahar and Balochistan in return for 500 elephants and was sealed by a marriage alliance, and Seleucus sent Megasthenes as ambassador to Pataliputra. Megasthenes described the city as ringed by a wooden wall with 570 towers and 64 gates and run by six committees of five members each, and divided Indian society into seven classes. Jain tradition says Chandragupta became a Jain, went south with Bhadrabahu during a famine, and ended his life by fasting (sallekhana) at Shravanabelagola in Karnataka.

Bindusara and Ashoka's rise: Bindusara (about 297 to 273 BC), called Amitraghata (slayer of enemies), kept up ties with the Seleucids; Antiochus I sent the envoy Deimachus to his court, and Bindusara is said to have asked for sweet wine, dried figs and a philosopher. His son Ashoka served as viceroy at Taxila and Ujjain, won a war of succession and was crowned around 269 BC. In the eighth year of his reign, about 261 BC, he conquered Kalinga. Rock Edict XIII says 1.5 lakh people were carried away, 1 lakh killed and many more died, and records his remorse. He turned to Buddhism, guided by the monk Upagupta in the northern tradition, and replaced bherighosha (the sound of war drums) with dhammaghosha (the call of dhamma).

**Dhamma:** Ashoka's dhamma was a moral code, not a sect: obedience to parents, respect for elders and teachers, kindness to slaves and servants, generosity to Brahmins and Shramanas, non-violence to living beings, and tolerance of all sects, the subject of Rock Edict XII. Rock Edict I banned animal sacrifice at festivals, Rock Edict V records the appointment of Dhamma Mahamattas to spread dhamma, and Rock Edict VIII tells how he replaced royal pleasure tours with dhamma yatras. The third Buddhist council at Pataliputra sent missionaries abroad: his son Mahendra and daughter Sanghamitra to Sri Lanka, where King Devanampiya Tissa accepted Buddhism, Sona and Uttara to Suvarnabhumi and Majjhantika to Kashmir and Gandhara. Rock Edict XIII names five Greek kings, including Antiochus II of Syria and Ptolemy II of Egypt, and Rock Edict II names the Cholas, Pandyas, Satiyaputras and Keralaputras as neighbours.

**The edicts by type and place:** The edicts are in Prakrit, mostly in the Brahmi script; at Shahbazgarhi and Mansehra in the north-west they use Kharoshthi, and at Kandahar Greek and Aramaic. The 14 Major Rock Edicts are found at Girnar, Kalsi, Dhauli, Jaugada, Sopara, Yerragudi, Shahbazgarhi and Mansehra; at Dhauli and Jaugada in Kalinga, two Separate Edicts replace numbers XI to XIII. The Minor Rock Edicts include Maski, Gujarra, Brahmagiri, Rupnath, Sahasram and Bairat; the Bhabru edict shows his faith in the Buddha, the Dhamma and the Sangha. The 7 Pillar Edicts appear together only on the Delhi-Topra pillar. Minor Pillar Edicts include the Sarnath schism edict and the Rummindei pillar at Lumbini, which cut the village's land tax to one-eighth. The four-lion capital of Sarnath became India's national emblem on 26 January 1950.

**Administration:** The Mauryan state was highly centralised. The king was advised by a council of ministers (mantriparishad); the Arthashastra lists 18 high officers called tirthas and many superintendents (adhyakshas) for trade, tolls, agriculture, mines and weights. The samaharta collected revenue and the sannidhata kept the treasury. Provinces were ruled by princes from Taxila in the north-west, Ujjain in the west, Tosali in Kalinga and Suvarnagiri in the south, with the centre ruled from Pataliputra; below them rajukas, pradeshikas and yuktas ran districts and the gramika the village. Land tax (bhaga) was usually one-sixth of the produce, spies (gudhapurushas) watched officials, and silver punch-marked coins were in use. Kautilya's saptanga theory names the seven limbs of the state: king, minister, territory, fort, treasury, army and ally.

**Decline:** Ashoka died around 232 BC. The empire was divided among weak successors, among them his grandson Dasharatha, who gave the Nagarjuni caves to the Ajivikas. The cost of a large army and bureaucracy strained the treasury, distant provinces broke away, and Bactrian Greeks pressed in from the north-west. Historians have also blamed a Brahmanical reaction against Ashoka's policies (H. P. Shastri) or his pacifism (H. C. Raychaudhuri), though both views are debated. The end came around 185 BC, when the commander Pushyamitra Shunga killed the last Mauryan king, Brihadratha, during an army review.

### Examples

- Kautilya (Chanakya, Vishnugupta) wrote the Arthashastra in 15 books; its saptanga theory names king, minister, territory, fort, treasury, army and ally.
- Seleucus Nicator ceded the regions around Kabul, Kandahar and Balochistan to Chandragupta for 500 elephants (about 305 BC) and sent Megasthenes, author of the Indica.
- Megasthenes: Pataliputra had a wooden wall with 570 towers and 64 gates and was run by six committees of five members; he wrote of seven classes in Indian society.
- Bindusara was called Amitraghata; Antiochus I sent Deimachus to his court; he patronised the Ajivikas.
- Kalinga war about 261 BC, in Ashoka's eighth regnal year; Rock Edict XIII records the deaths, deportations and his remorse.
- Rock Edict I bans animal sacrifice, V appoints Dhamma Mahamattas, VIII replaces pleasure tours with dhamma yatras, XII preaches tolerance of all sects, XIII describes Kalinga.
- Scripts of the edicts: Brahmi in most places, Kharoshthi at Shahbazgarhi and Mansehra, Greek and Aramaic at Kandahar; James Prinsep first read the Brahmi script in 1837.
- All 7 Pillar Edicts are found together only on the Delhi-Topra pillar; the Rummindei pillar at Lumbini cut the village's land tax to one-eighth.
- Ashoka's missions: Mahendra and Sanghamitra to Sri Lanka, Sona and Uttara to Suvarnabhumi, Majjhantika to Kashmir and Gandhara.
- The last Mauryan, Brihadratha, was killed by his commander Pushyamitra Shunga around 185 BC.

> **Quick revision:** Mauryas about 321-185 BC; Kautilya's Arthashastra (15 books, saptanga); Chandragupta defeated Seleucus, got Kabul-Kandahar for 500 elephants; Megasthenes' Indica (570 towers, 64 gates, committees of five); Chandragupta died at Shravanabelagola (Jain tradition); Bindusara Amitraghata; Kalinga about 261 BC in Rock Edict XIII; Dhamma Mahamattas in Rock Edict V; 14 rock edicts, 7 pillar edicts (Delhi-Topra); Brahmi, Kharoshthi, Greek, Aramaic; Prinsep 1837; Sarnath capital emblem 26 January 1950; Brihadratha killed by Pushyamitra.

## Post-Mauryan Kingdoms and the Sangam Age

**Shungas and Kanvas:** Pushyamitra Shunga, a Brahmin commander, founded the Shunga dynasty around 185 BC. He performed two Ashvamedha sacrifices, recorded in the Ayodhya inscription of Dhanadeva, and resisted the Greeks; Buddhist texts call him a persecutor. His son Agnimitra is the hero of Kalidasa's Malavikagnimitram, and the grammarian Patanjali lived in this age. The Shungas enlarged the Sanchi stupa and built the stone railing at Bharhut. At Besnagar (Vidisha), Heliodorus, envoy of the Indo-Greek king Antialcidas, raised a Garuda pillar to Vasudeva and called himself a Bhagavata. The last Shunga, Devabhuti, was killed by his minister Vasudeva Kanva, whose short-lived Kanva dynasty the Satavahanas ended.

**Indo-Greeks, Shakas and Parthians:** Bactrian Greeks crossed the Hindu Kush in the second century BC. Their best-known king, Menander (Milinda), ruled from Sakala (Sialkot) and discussed Buddhism with the monk Nagasena in the Pali text Milindapanho. The Indo-Greeks were the first rulers in India to issue coins that can be clearly attributed to kings, and standard textbooks also credit them with the first gold coins, though gold was issued on a large scale only by the Kushanas; their Hellenistic art fed the Gandhara school. The Shakas (Scythians) came next; tradition says a king of Ujjain drove them out in 57 BC, the start of the Vikram Samvat. Their greatest ruler, Rudradaman I of Ujjain, issued the Junagadh inscription of AD 150, the first long inscription in chaste Sanskrit, which records his repair of the Sudarshana lake. The Parthian king Gondophernes is linked by Christian tradition with St Thomas.

**The Kushanas:** The Kushanas, a branch of the Yuezhi of north-west China, built an empire from Central Asia to the Ganga valley. Vima Kadphises issued gold coins in large numbers and was a devotee of Shiva. Kanishka, the greatest Kushana, ruled from Purushapura (Peshawar) with Mathura as a second centre; tradition makes him the founder of the Saka era of AD 78, which India adopted as its national calendar in 1957, though his accession is now dated later. His Rabatak inscription in Afghanistan gives the dynasty's line. He held the fourth Buddhist council in Kashmir and patronised Ashvaghosha (Buddhacharita), Vasumitra and, by tradition, the physician Charaka. Controlling the Silk Route, the Kushanas grew rich, and Mahayana Buddhism spread from their lands to Central Asia and China.

**Three schools of art:** The Gandhara school of the north-west blended Greek and Roman style with Buddhist themes; its Buddha, carved mostly in grey-blue schist, has wavy hair, a muscular body and heavy folded robes. The Mathura school was indigenous and used spotted red sandstone; its Buddha has a shaven head and a smiling face, and it also made Jain and Hindu images, including the headless statue of Kanishka found at Mat. The Amaravati school, patronised by the Satavahanas in Andhra, used a pale greenish-white limestone that exam books call white marble, and carved narrative panels of the Buddha's life.

**The Satavahanas:** Also called the Andhras, the Satavahanas ruled the Deccan from Pratishthana (Paithan) on the Godavari; Simuka founded the dynasty. The Naneghat inscription of Queen Naganika records the sacrifices of Satakarni I. The greatest king, Gautamiputra Satakarni, defeated the Shaka ruler Nahapana and restruck his coins; the Nasik inscription of his mother Gautami Balashri calls him the destroyer of Shakas, Yavanas and Pahlavas. Kings bore their mothers' names, though the royal family was patriarchal. The Satavahanas were the first rulers to grant tax-free land to Brahmins and Buddhist monks, used Prakrit in the Brahmi script, issued many lead coins, and supported Buddhist sites such as Karle and Amaravati. King Hala compiled the Prakrit Gathasaptashati.

**The Sangam literature:** Sangam means an assembly of Tamil poets; tradition speaks of three Sangams under Pandya patronage, the last at Madurai, and the surviving poems date roughly from the third century BC to the third century AD. The corpus includes the Tolkappiyam (grammar), the Ettuthogai (eight anthologies) and the Pattuppattu (ten idylls), with poems of akam (love) and puram (war and public life). The Tirukkural of Tiruvalluvar and the twin epics, Silappadikaram by Ilango Adigal (the story of Kovalan and Kannagi) and Manimekalai by Sattanar, came later.

**The three kingdoms:** The Cheras of Kerala had the bow as emblem, Vanji as capital and Muziris and Tondi as ports; Senguttuvan, the Red Chera, began the Pattini (Kannagi) cult. The Cholas of the Kaveri delta had the tiger emblem, Uraiyur as capital and Puhar (Kaveripattinam) as port; Karikala is credited with the Kallanai dam on the Kaveri. The Pandyas had the fish emblem, Madurai as capital and Korkai, famous for pearls, as port. Ashoka's Rock Edict II already names the Cholas, Pandyas and Keralaputras.

**Trade with Rome:** In the first century AD sailors learned to use the monsoon winds, a discovery credited to the Greek pilot Hippalus, to cross the Arabian Sea directly. The Periplus of the Erythraean Sea, an anonymous Greek guide, lists Indian ports and goods, and Pliny's Natural History complains of Roman gold draining to India. India sent pepper (called yavanapriya, dear to the Yavanas), spices, pearls, ivory, gems and fine cotton, and received wine, pottery and gold and silver coins. Arikamedu near Puducherry, excavated by Mortimer Wheeler, was an Indo-Roman trading station with Roman amphorae and Arretine pottery.

**Examples**

- Pushyamitra Shunga performed two Ashvamedhas (Ayodhya inscription of Dhanadeva); his son Agnimitra is the hero of Kalidasa's Malavikagnimitram.
- Heliodorus, envoy of the Indo-Greek king Antialcidas, raised the Garuda pillar at Besnagar (Vidisha) and called himself a Bhagavata.
- Menander (Milinda) ruled from Sakala; his dialogue with the monk Nagasena is the Milindapanho; textbooks credit the Indo-Greeks with India's first gold coins, but the Kushanas issued gold on a large scale.
- Rudradaman I's Junagadh inscription (AD 150) is the first long inscription in chaste Sanskrit and records the repair of the Sudarshana lake.
- Kanishka: capital Purushapura, fourth Buddhist council in Kashmir, patron of Ashvaghosha (Buddhacharita); the Saka era of AD 78 is India's national calendar (adopted 1957).
- Art schools: Gandhara (grey-blue schist, Greco-Roman style), Mathura (spotted red sandstone, indigenous), Amaravati (white marble, strictly a pale limestone; Satavahana patronage).
- Gautamiputra Satakarni defeated Nahapana; his mother Gautami Balashri's Nasik inscription praises him; the Satavahanas were the first to give tax-free land grants to Brahmins.
- Sangam emblems: Cheras bow, Cholas tiger, Pandyas fish; ports Muziris (Chera), Puhar (Chola), Korkai (Pandya, pearls).
- Silappadikaram (Ilango Adigal) tells of Kovalan and Kannagi; Manimekalai is by Sattanar; Tirukkural is by Tiruvalluvar; Tolkappiyam is a grammar.
- Arikamedu near Puducherry was an Indo-Roman trading station; the Periplus of the Erythraean Sea and Pliny describe the Rome-India trade.

> **Quick revision:** Shungas from about 185 BC (Pushyamitra, two Ashvamedhas); Heliodorus' Garuda pillar at Besnagar; Menander and Nagasena (Milindapanho); Indo-Greek gold coins; Rudradaman's Junagadh inscription AD 150; Kanishka, Saka era AD 78, fourth council, Ashvaghosha; Gandhara, Mathura, Amaravati art; Gautamiputra Satakarni, Nasik inscription, first land grants; Sangam Tolkappiyam, Silappadikaram; Chera bow, Chola tiger, Pandya fish; Karikala's Kallanai; Arikamedu and Roman trade.

### The Gupta Empire and the Age of Harsha

**Rise of the Guptas:** The Guptas began in Magadha and eastern Uttar Pradesh with Sri Gupta and Ghatotkacha. Chandragupta I (about 319 to 335 AD) took the title Maharajadhiraja, married the Lichchhavi princess Kumaradevi and issued gold coins showing the king and queen together; the Gupta era starts in 319-320 AD, probably with his accession. Samudragupta (about 335 to 375 AD) is known from the Prayag Prashasti, composed by his court poet Harisena and engraved on the Ashokan pillar at Allahabad. It says he uprooted nine kings of Aryavarta and annexed their lands, defeated twelve kings of the south (Dakshinapatha), including Vishnugopa of Kanchi, but released and reinstated them, made the forest kingdoms his servants, and took tribute from frontier states and republics. He performed the Ashvamedha, his coins show him playing the veena, and V. A. Smith called him the Napoleon of India.

**Chandragupta II Vikramaditya:** Chandragupta II (about 380 to 415 AD) married his daughter Prabhavati Gupta to the Vakataka king Rudrasena II, securing the Deccan flank, and then ended Shaka rule in Gujarat and Malwa, gaining the western ports; he issued silver coins there, took the title Vikramaditya and made Ujjain a second capital. The rust-free iron pillar at Mehrauli in Delhi honours a king Chandra, usually identified with him. The Chinese monk Fa-Hien, whose journey is usually dated 399 to 414 AD, visited India in his reign, though his account never names the king; he found the people prosperous, punishments mild and without the death penalty, and Chandalas living outside the villages. Tradition places nine gems (navaratnas), among them Kalidasa and Amarasimha, at his court.

**Later Guptas and decline:** Kumaragupta I (about 415 to 455 AD) is credited with founding Nalanda. Skandagupta (about 455 to 467 AD) repelled the Hunas, and his Junagadh inscription records that Chakrapalita, son of the governor Parnadatta, repaired the Sudarshana lake. Later Huna chiefs, Toramana and Mihirakula, broke into the north; Mihirakula was defeated by Yashodharman of Malwa and by Narasimhagupta Baladitya. Huna attacks, the rise of feudatories such as the Maitrakas of Valabhi and the Maukharis of Kannauj, falling trade and the growth of land grants ended the empire by the middle of the sixth century.

**Administration and society:** Gupta kings took grand titles such as Maharajadhiraja and Parama-bhattaraka, but rule was less centralised than under the Mauryas. The empire was divided into bhuktis (provinces) under uparikas, vishayas (districts) under vishayapatis, and villages; town boards included guild leaders. The sandhivigrahika was the minister for peace and war, and kumaramatyas were senior officers. The Guptas issued the largest number of gold coins (dinaras) of any ancient dynasty. Land grants to Brahmins (agraharas), with rights of administration, encouraged feudal tendencies. Caste became more rigid, untouchability grew and women's status declined; the Eran inscription of 510 AD is the first epigraphic evidence of sati.

**Literature, science and art:** The Gupta age is called the classical age of Sanskrit. Kalidasa wrote the plays Abhijnanashakuntalam, Malavikagnimitram and Vikramorvashiyam and the poems Meghadutam, Raghuvamsham, Kumarasambhavam and Ritusamhara; William Jones translated Shakuntala into English in 1789. Shudraka wrote Mrichchhakatika, Vishakhadatta Mudrarakshasa and Devichandraguptam, Vishnu Sharma the Panchatantra and Amarasimha the Amarakosha, and the Puranas reached their final form. Aryabhata, born in 476 AD, wrote the Aryabhatiya in 499 AD; he said the earth rotates on its axis, explained eclipses and gave pi as 3.1416. Varahamihira wrote the Pancha Siddhantika and Brihat Samhita. The Dashavatara temple at Deogarh and the brick temple at Bhitargaon mark the start of the Nagara style, and many Ajanta paintings, made under the Vakatakas, belong to this period.

**Harshavardhana:** The Pushyabhuti (Vardhana) dynasty ruled from Thanesar. After his brother-in-law Grahavarman, the Maukhari king of Kannauj, was killed by Devagupta of Malwa, and his brother Rajyavardhana by Shashanka of Gauda, Harsha became king in 606 AD, the start of the Harsha era. He rescued his sister Rajyashri and moved his capital to Kannauj. His southward advance was stopped on the Narmada by the Chalukya Pulakeshin II, as the Aihole inscription records. Called Siladitya, he turned from Shaivism to Mahayana Buddhism, held a great assembly at Kannauj in 643 AD in honour of Hiuen Tsang, and gave away his wealth at Prayag every five years. He wrote the Sanskrit plays Ratnavali, Priyadarshika and Nagananda, and his court poet Banabhatta wrote the Harshacharita and Kadambari. He died in 647 AD without an heir.

**Hiuen Tsang and Nalanda:** The Chinese pilgrim Hiuen Tsang (Xuanzang), called the Prince of Pilgrims, left China in 629 AD and returned in 645 AD. He studied at Nalanda under its head Shilabhadra and described his travels in the Si-yu-ki (Records of the Western World). Nalanda in Bihar was a residential Buddhist university maintained from the revenue of donated villages; it taught Mahayana philosophy, logic, grammar and medicine and admitted students after an oral test at the gate. I-tsing (Yijing) studied there later in the seventh century. Nalanda flourished under the Palas and was destroyed by Bakhtiyar Khalji around 1200.

### Examples

- Chandragupta I married the Lichchhavi princess Kumaradevi and took the title Maharajadhiraja; the Gupta era begins in 319-320 AD.
- Harisena's Prayag Prashasti on the Allahabad pillar lists Samudragupta's conquests; V. A. Smith called him the Napoleon of India; his coins show him playing the veena.
- Chandragupta II (Vikramaditya) defeated the Shakas of western India, married his daughter Prabhavati Gupta into the Vakataka family, and Fa-Hien (399-414 AD) visited India in his reign without naming him.
- Kumaragupta I is credited with founding Nalanda; Skandagupta repelled the Hunas; Mihirakula was defeated by Yashodharman and Narasimhagupta Baladitya.
- Eran inscription of 510 AD is the first epigraphic evidence of sati; the Guptas issued the most gold coins (dinaras) of any ancient dynasty.

- Aryabhata (born 476 AD) wrote the Aryabhatiya in 499 AD; earth's rotation, causes of eclipses, pi as 3.1416; Varahamihira wrote the Brihat Samhita.
- Kalidasa: Abhijnanashakuntalam, Meghadutam, Raghuvamsham, Kumarasambhavam, Malavikagnimitram; Shudraka: Mrichchhakatika; Amarasimha: Amarakosha.
- Gupta temples: Dashavatara temple at Deogarh and brick temple at Bhitargaon, early examples of the Nagara style.
- Harsha: accession 606 AD (Harsha era), capital Kannauj, defeated by Pulakeshin II on the Narmada, wrote Ratnavali, Priyadarshika and Nagananda; Banabhatta wrote Harshacharita.
- Hiuen Tsang (629-645 AD) studied at Nalanda under Shilabhadra and wrote the Si-yu-ki; Harsha's Kannauj assembly of 643 AD honoured him.

> **Quick revision:** Gupta era 319-320 AD; Chandragupta I married Kumaradevi; Samudragupta's Prayag Prashasti by Harisena, Napoleon of India; Chandragupta II Vikramaditya ended Shaka rule, Fa-Hien 399-414 AD, Mehrauli iron pillar; Kumaragupta founded Nalanda; Skandagupta repelled Hunas; Eran 510 AD sati; Aryabhatiya 499 AD; Kalidasa; Deogarh temple; Harsha 606-647 AD, Kannauj, Pulakeshin II, Ratnavali; Banabhatta; Hiuen Tsang at Nalanda under Shilabhadra.

### Early Medieval Kingdoms: Tripartite Struggle, Rajputs, Chalukyas, Pallavas and Cholas

**The tripartite struggle and the Palas:** After Harsha, Kannauj became the symbol of power in north India, and from the eighth to the tenth century three dynasties fought for it: the Palas of Bengal and Bihar, the Gurjara-Pratiharas of western India and the Rashtrakutas of the Deccan. The Pala founder Gopala was chosen king around 750 AD to end matsyanyaya, the anarchy in which the strong swallowed the weak. Dharmapala placed his nominee Chakrayudha on the throne of Kannauj and founded Vikramashila university and the Somapura Mahavihara at Paharpur (now in Bangladesh). Devapala granted villages to Nalanda for a monastery built by Balaputradeva, the Shailendra king of Suvarnadvipa. The Palas were Mahayana and Vajrayana Buddhists, and the monk Atisha Dipankara went from Vikramashila to Tibet.

**Pratiharas and Rashtrakutas:** The Pratihara Nagabhata I checked the Arabs, who had conquered Sindh in 712 AD, and Nagabhata II took Kannauj. Mihira Bhoja was the greatest Pratihara; the Arab merchant Sulaiman praised his cavalry and called him an enemy of the Arabs. The poet Rajashekhara lived at the court of Mahendrapala I. The Rashtrakutas were founded by Dantidurga, who overthrew the Chalukyas of Badami in the eighth century; their capital was later Manyakheta (Malkhed). Krishna I built the rock-cut Kailasa temple at Ellora, and Dhruva and Govinda III defeated both the Palas and the Pratiharas. Amoghavarsha I, a patron of Jainism to whom the Kannada Kavirajamarga is credited, was counted by Sulaiman among the four great kings of the world. Indra III sacked Kannauj, and Krishna III defeated the Cholas at Takkolam in 949 AD.

**Rajput dynasties:** From the eighth century Rajput clans rose in Rajasthan, Gujarat and central India. The Agnikula legend of Chand Bardai's Prithviraj Raso traces four clans, the Pratiharas, Chauhans, Paramaras and Chalukyas (Solankis), to a sacrificial fire at Mount Abu. The Chauhans ruled from Ajmer; their greatest king, Prithviraj III, fought Muhammad Ghori. The Paramaras ruled Malwa from Dhar, where Raja Bhoja was a scholar-king. The Chandelas of Bundelkhand built the Khajuraho temples, including the Kandariya Mahadeva. The Solankis of Gujarat built the Sun temple at Modhera, and Vimal Shah, a minister of Bhima I, built the Jain Vimal Vasahi temple at Dilwara, Mount Abu. The Tomaras founded Dhillika (Delhi), and the Gahadavalas ruled Kannauj until Jaichand's fall.

**Chalukyas of Badami and the Pallavas:** Pulakeshin II, the greatest Chalukya of Vatapi (Badami), stopped Harsha on the Narmada and defeated the Pallava Mahendravarman I, as told in the Aihole inscription (634 AD) by the Jain poet Ravikirti. But the Pallava Narasimhavarman I took Vatapi in 642 AD, Pulakeshin II died, and the victor took the title Vatapikonda. Chalukya temples at Aihole, Badami and Pattadakal mix the Nagara and Dravida styles; Queen Lokamahadevi built the Virupaksha temple at Pattadakal to mark her husband Vikramaditya II's victory over the Pallavas. The Pallavas of Kanchipuram were great builders: Mahendravarman I, author of the Sanskrit farce Mattavilasa Prahasana, began rock-cut temples; Narasimhavarman I (Mamalla) carved the Pancha Rathas at Mamallapuram; and Narasimhavarman II (Rajasimha) built the Shore Temple there and the Kailasanatha temple at Kanchipuram.

**The Cholas:** Vijayalaya founded the imperial Chola line around 850 AD by taking Thanjavur. Rajaraja I (985 to 1014 AD) conquered northern Sri Lanka and the Maldives and built the Brihadeshwara (Rajarajeshwara) temple at Thanjavur. His son Rajendra I (1014 to 1044 AD) sent an army to the Ganga, took the title Gangaikonda Chola and built a new capital, Gangaikonda Cholapuram; his navy attacked the Srivijaya kingdom of Malaya and Sumatra, and the Bay of Bengal became a Chola lake. Chola temples have tall vimanas, as at the Airavateshvara temple of Darasuram, and their bronze Nataraja is world-famous.

**Chola village self-government:** The kingdom was divided into mandalams (provinces), valanadus, nadus and villages. The ur was the assembly of ordinary villages, the sabha or mahasabha that of Brahmin villages (brahmadeya), and the nagaram that of merchants; work was done through committees called variyams, for tanks, gardens, justice and so on. The Uttaramerur inscriptions of Parantaka I (919 and 921 AD) set out how sabha members were chosen: a candidate had to own tax-paying land and a house, be between 35 and 70 years old and know the Vedas, and names written on palm leaves were drawn from a pot, the kudavolai system.

**Mahmud of Ghazni and Muhammad Ghori:** Mahmud of Ghazni raided India 17 times between 1000 and 1027 AD for its wealth, defeating the Hindu Shahi kings Jayapala and Anandapala and plundering Nagarkot, Thanesar, Mathura and Kannauj; in 1025 AD he sacked the Somnath temple. The scholar Al-Biruni, author of Kitab-ul-Hind, and the poet Firdausi were at his court. Muhammad Ghori came to conquer: he took Multan in 1175 AD, was beaten near Mount Abu by the Chalukyas of Gujarat in 1178 AD, lost the first battle of Tarain to Prithviraj Chauhan in 1191 AD, won the second in 1192 AD and defeated Jaichand at Chandawar in 1194 AD. His general Qutbuddin Aibak held Delhi and Bakhtiyar Khalji overran Bihar and Bengal; after Ghori's death in 1206 AD, Aibak founded the Delhi Sultanate.

### Examples

- Tripartite struggle for Kannauj: Palas (Bengal), Gurjara-Pratiharas (western India) and Rashtrakutas (Deccan), from the 8th to the 10th century.
- Pala firsts: Gopala elected to end matsyanyaya; Dharmapala founded Vikramashila and Somapura Mahavihara (Paharpur); Atisha Dipankara went to Tibet.
- Rashtrakutas: founded by Dantidurga, capital Manyakheta; Krishna I built the Kailasa temple at Ellora; Kavirajamarga is credited to Amoghavarsha I; Krishna III won at Takkolam (949 AD).
- Rajput monuments: Khajuraho (Chandelas), Modhera Sun temple (Solankis), Dilwara Vimal Vasahi temple at Mount Abu (Vimal Shah, minister of Bhima I).
- Aihole inscription (634 AD) by Ravikirti records Pulakeshin II's victory over Harsha; Narasimhavarman I took Vatapi in 642 AD and was called Vatapikonda.
- Pallava monuments: Pancha Rathas (Narasimhavarman I), Shore Temple and Kailasanatha temple, Kanchipuram (Narasimhavarman II Rajasimha).
- Rajaraja I built the Brihadeshwara temple, Thanjavur; Rajendra I built Gangaikonda Cholapuram and led a naval expedition to Srivijaya.
- Uttaramerur inscriptions (919 and 921 AD, Parantaka I): sabha members aged 35-70, owning land and a house, chosen by kudavolai (palm leaves drawn from a pot).
- Mahmud of Ghazni: 17 raids (1000-1027 AD), Somnath sacked 1025 AD; Al-Biruni wrote Kitab-ul-Hind; Firdausi was his court poet.
- Muhammad Ghori: Tarain I 1191 (lost to Prithviraj Chauhan), Tarain II 1192 (won), Chandawar 1194 (defeated Jaichand); died 1206.

> **Quick revision:** Tripartite struggle for Kannauj: Palas, Pratiharas, Rashtrakutas; Gopala ended matsyanyaya; Dharmapala founded Vikramashila; Mihira Bhoja greatest Pratihara; Krishna I built Kailasa at Ellora; Agnikula clans; Khajuraho by Chandelas; Aihole inscription 634 AD; Vatapi taken 642 AD; Shore Temple by Rajasimha; Rajaraja I Brihadeshwara; Rajendra I Gangaikonda Cholapuram, Srivijaya; Uttaramerur 919 and 921 AD, kudavolai; Mahmud 17 raids, Somnath 1025; Tarain 1191 and 1192.

## The Delhi Sultanate (1206-1526): Dynasties, Reforms and Architecture

**Five dynasties:** The Delhi Sultanate lasted 320 years under five dynasties: the Mamluk or Slave dynasty (1206-1290), the Khaljis (1290-1320), the Tughlaqs (1320-1414), the Sayyids (1414-1451) and the Lodis (1451-1526). The first three were Turkish and the Lodis Afghan. Persian was the language of government, and our main sources are court histories such as Minhaj-us-Siraj's Tabaqat-i-Nasiri and Ziauddin Barani's Tarikh-i-Firozshahi, and the account of the Moroccan traveller Ibn Battuta.

**The Mamluks:** Qutbuddin Aibak (1206-1210), a slave of Muhammad Ghori, ruled from Lahore, was famous for generosity (Lakh Baksh), began the Qutub Minar, and built the Quwwat-ul-Islam mosque in Delhi and the Adhai Din ka Jhonpra at Ajmer; he died after a fall while playing chaugan (polo). Iltutmish (1211-1236), the real founder, made Delhi the capital, completed the Qutub Minar, organised the Turkan-i-Chahalgani (the Forty), introduced the iqta system and the silver tanka and copper jital, and received investiture from the Abbasid Caliph in 1229. He kept the Mongols away by refusing shelter to Jalaluddin Mangbarni, whom Chengiz Khan was chasing. His daughter Razia Sultan (1236-1240), the only woman to rule Delhi, was overthrown by nobles who resented her favour to the Abyssinian Yaqut. Balban (1266-1287) held that the king was the shadow of God (Zil-i-Ilahi), introduced sijda (prostration), paibos (kissing the king's feet) and the Persian festival of Nauroz, broke the power of the Forty, created a military department (Diwan-i-Arz), and used spies (barids) and a policy of blood and iron.

Alauddin Khalji's reforms: Alauddin (1296-1316) killed his uncle Jalaluddin Khalji and seized the throne with gold from Devagiri. He took Gujarat (1299), Ranthambore (1301), Chittor (1303) and Malwa (1305), and his general Malik Kafur raided the far south: Devagiri, Warangal of the Kakatiyas, Dwarasamudra of the Hoysalas and Madurai of the Pandyas. Against repeated Mongol attacks he kept a large standing army paid in cash and introduced dagh (branding of horses) and chehra (a descriptive roll of each soldier). To pay it he controlled prices: separate markets for grain, for cloth and costly goods (Sarai-i-Adl), and for horses, slaves and cattle, run by the Shahna-i-Mandi and the Diwan-i-Riyasat, with spies watching the traders. He measured land, raised the land tax to half the produce, added house and grazing taxes, and issued ordinances to curb the nobles. Barani is the main source for these measures. He built Siri fort, the Hauz-i-Khas tank and the Alai Darwaza, and Amir Khusrau was his court poet.

Muhammad bin Tughlaq's experiments: Ghiyasuddin Tughlaq (1320-1325) founded the dynasty and built Tughlaqabad. His son Muhammad bin Tughlaq (1325-1351), learned but impatient, is remembered for bold schemes that failed: raising taxes in the Doab during a famine, which caused revolt; shifting the capital from Delhi to Daulatabad (Devagiri) in 1327; issuing bronze and copper token coins around 1330, which were forged on a large scale and had to be withdrawn; planning a Khurasan expedition; and sending an army into the Qarachil (Kumaon) hills, where it perished. He set up an agriculture department, Diwan-i-Amir-Kohi, and gave taccavi loans to farmers. Ibn Battuta reached India in 1333 and Delhi in 1334, served as qazi of Delhi and was sent as his envoy to China. Revolts in his reign led to the founding of Vijayanagara (1336) and the Bahmani kingdom (1347).

**Firoz Shah Tughlaq to the Lodis:** Firoz Shah Tughlaq (1351-1388) ruled by Islamic law; he abolished many taxes, kept the four allowed by sharia (kharaj, khams, jizya and zakat), and imposed jizya on Brahmins as well. He dug canals from the Yamuna and the Sutlej, founded towns such as Firozabad, Hisar and Jaunpur, set up departments for slaves (Diwan-i-Bandagan) and charity (Diwan-i-Khairat) and a hospital (Dar-ul-Shifa), made iqtas hereditary, brought two Ashokan pillars from Topra and Meerut to Delhi, and wrote the Futuhat-i-Firozshahi. After him Timur sacked Delhi in 1398. Timur's nominee Khizr Khan founded the Sayyid dynasty in 1414. Bahlul Lodi founded the Lodi dynasty in 1451; Sikandar Lodi founded Agra in 1504 and introduced the gaz-i-Sikandari (a measuring yard); and Ibrahim Lodi was killed by Babur at Panipat in 1526.

**Administration:** The Sultan was head of the state, the army and justice. The wazir ran finance (Diwan-i-Wizarat), the ariz-i-mamalik the army (Diwan-i-Arz), the dabir-i-mamalik royal correspondence (Diwan-i-Insha), and the sadr-us-sudur religious affairs and grants; qazis gave justice under sharia. Nobles held iqtas, assignments of land revenue in return for military service, while khalisa land was managed directly for the Sultan. Provinces were divided into shiqs and parganas, and villages were run through hereditary headmen such as the khut, muqaddam and chaudhari, with the patwari keeping records.

**Architecture:** The Sultanate brought the true arch and dome, minarets, lime mortar and decoration with calligraphy and arabesque (geometric and floral patterns) in place of human figures. Key buildings are the Qutub Minar, the Sultan Ghari (built by Iltutmish for his son, the first Islamic tomb in India), Balban's tomb and the Alai Darwaza (1311), usually cited as the first examples of the true arch and the true dome respectively, Ghiyasuddin Tughlaq's tomb with sloping walls, Firoz Shah Kotla, and the octagonal tombs of the Sayyids and Lodis in Delhi's Lodi Garden.

**Examples**

- Order of Sultanate dynasties: Mamluk (1206-1290), Khalji (1290-1320), Tughlaq (1320-1414), Sayyid (1414-1451), Lodi (1451-1526).
- Qutbuddin Aibak: Lakh Baksh, began the Qutub Minar, built Quwwat-ul-Islam (Delhi) and Adhai Din ka Jhonpra (Ajmer); died playing chaugan.
- Iltutmish: Delhi capital, Turkan-i-Chahalgani, iqta, silver tanka and copper jital, investiture from the Abbasid Caliph in 1229.
- Balban: Zil-i-Ilahi, sijda and paibos, Nauroz, Diwan-i-Arz, blood and iron; Razia Sultan was the only woman ruler of Delhi.
- Alauddin Khalji: dagh and chehra, market control (Shahna-i-Mandi, Sarai-i-Adl), land tax at half the produce, Alai Darwaza (1311); Malik Kafur's southern raids.
- Muhammad bin Tughlaq: capital to Daulatabad (1327), token currency, Diwan-i-Amir-Kohi, taccavi loans; Ibn Battuta was his qazi and envoy to China.
- Firoz Shah Tughlaq: canals, towns (Firozabad, Hisar, Jaunpur), Diwan-i-Bandagan, Diwan-i-Khairat, Dar-ul-Shifa, Ashokan pillars to Delhi, Futuhat-i-Firozshahi.
- Timur sacked Delhi in 1398; Khizr Khan founded the Sayyids (1414); Sikandar Lodi founded Agra (1504); Ibrahim Lodi fell at Panipat (1526).
- Architectural firsts as usually cited: Sultan Ghari (first Islamic tomb), Balban's tomb (first true arch), Alai Darwaza (first true dome).

> **Quick revision:** Mamluk, Khalji, Tughlaq, Sayyid, Lodi (1206-1526); Aibak began Qutub Minar; Iltutmish iqta, tanka, jital, Chahalgani; Razia only woman ruler; Balban Zil-i-Ilahi, sijda, paibos; Alauddin dagh, chehra, market control, half-produce land tax; Malik Kafur in the south; Muhammad bin Tughlaq Daulatabad 1327, token currency; Ibn Battuta 1333; Firoz canals, jizya on Brahmins; Timur 1398; Agra 1504; Sultan Ghari first tomb; Alai Darwaza 1311 first true dome.

### Vijayanagara, the Bahmani Kingdom and the Bhakti-Sufi Movements

**Founding of Vijayanagara:** Vijayanagara was founded in 1336 by the brothers Harihara I and Bukka I of the Sangama family, inspired, by tradition, by the sage Vidyaranya. Its capital, Vijayanagara (modern Hampi), stood on the south bank of the Tungabhadra. Four dynasties ruled: Sangama (1336-1485), Saluva (1485-1505), Tuluva (1505-1570) and Aravidu (from 1570). The Italian Nicolo de Conti visited under Devaraya I, and the Persian envoy Abdur Razzaq came in 1443 under Devaraya II, who recruited Muslim cavalry and archers into his army.

**Krishnadeva Raya:** The Tuluva king Krishnadeva Raya (1509-1529) was the greatest ruler of Vijayanagara. He defeated the Sultan of Bijapur and took Raichur in 1520, beat the Gajapati king Prataparudra of Odisha, and kept good relations with the Portuguese, who supplied horses. He wrote the Telugu Amuktamalyada, which also discusses statecraft, and the Sanskrit Jambavati Kalyanam, and was called Andhra Bhoja. Eight poets known as the Ashtadiggajas, including Allasani Peddana and Tenali Ramakrishna, adorned his court. The Portuguese Domingo Paes described his capital, and Fernao Nuniz wrote about the empire soon after. Hampi's Vitthala temple with its stone chariot and the Hazara Rama temple are among the best-known Vijayanagara monuments.

**Administration and Talikota:** Under the nayankara system, military chiefs called nayakas or amaranayakas received territories (amaram) in return for keeping troops and paying tribute; many later became independent, like the Nayaks of Madurai and Thanjavur. Villages were served by a hereditary body of twelve functionaries, the ayagars. After Krishnadeva Raya and his brother Achyuta Deva Raya, power passed to Aliya Rama Raya, regent for Sadashiva Raya. His meddling in Deccan politics united Bijapur, Ahmednagar, Golconda and Bidar, which crushed him at

Talikota (also called Rakshasa-Tangadi or Bannihatti) on 23 January 1565. Rama Raya was killed and the capital plundered and abandoned; the Aravidus ruled on from Penukonda and later Chandragiri.

**The Bahmani kingdom and its successors:** In 1347 Alauddin Hasan Bahman Shah (Hasan Gangu) rebelled against Muhammad bin Tughlaq and founded the Bahmani kingdom with its capital at Gulbarga; the capital later moved to Bidar. The Bahmanis fought Vijayanagara repeatedly for the fertile Raichur doab between the Krishna and the Tungabhadra. The Persian Mahmud Gawan, prime minister under Muhammad Shah III, reorganised the provinces, took Goa and built a great madrasa at Bidar, but was executed in 1481 on a forged charge, after which the kingdom broke up. The Russian merchant Afanasy Nikitin visited it between 1469 and 1472. Its five successor states were Bijapur (Adil Shahi), Ahmednagar (Nizam Shahi), Berar (Imad Shahi), Golconda (Qutb Shahi) and Bidar (Barid Shahi). Bijapur's Gol Gumbaz is the tomb of Muhammad Adil Shah, and the Charminar (1591) was built by Muhammad Quli Qutb Shah, founder of Hyderabad. Chand Bibi defended Ahmednagar against Akbar, and Aurangzeb annexed Bijapur in 1686 and Golconda in 1687.

**Bhakti in the south:** Bhakti, loving devotion to a personal god open to all castes and to women, began in the Tamil country between the sixth and ninth centuries with the 63 Nayanars, devotees of Shiva such as Appar, Sambandar and Sundarar, and the 12 Alvars, devotees of Vishnu, among whom Andal was the only woman. Teachers later gave bhakti a philosophical basis: Ramanuja taught Vishishtadvaita (qualified non-dualism), Madhva Dvaita (dualism), Nimbarka Dvaitadvaita and Vallabha Shuddhadvaita, against Shankaracharya's Advaita (non-dualism) of the eighth century. In Karnataka, Basavanna, a minister of the Kalachuri king Bijjala, led the Virashaiva (Lingayat) movement in the twelfth century, rejecting caste and ritual through his vachanas.

**Bhakti in the west, north and east:** In Maharashtra the Varkari saints worshipped Vithoba of Pandharpur: Jnaneshwar wrote the Jnaneshwari, a Marathi commentary on the Gita, and Namdev, Eknath and Tukaram, whose songs are called abhangas, followed. In the north Ramananda opened bhakti to all castes. Kabir, a weaver, taught devotion to a formless (nirguna) God, attacked idol worship and caste, and his dohas are collected in the Bijak; Ravidas, Dadu Dayal and Guru Nanak (1469-1539), founder of Sikhism, belong to the same nirguna stream. Saguna saints worshipped God in form: Tulsidas wrote the Ramcharitmanas in Awadhi, Surdas the Sursagar, and Mirabai, a Rajput princess, sang of Krishna. In Bengal Chaitanya Mahaprabhu spread Krishna bhakti through kirtan, and in Assam Shankaradeva founded the Ekasarana dharma with its namghars and satras.

**The Sufis:** Sufism is the mystical side of Islam, stressing love of God, devotion to a pir (master) and service to people. Sufis lived in khanqahs, were organised into silsilas (orders), used sama (devotional music), and their tombs (dargahs) became places of pilgrimage. The Chishti order was brought to India by Khwaja Moinuddin Chishti, who settled at Ajmer; it continued through Qutbuddin Bakhtiyar Kaki in Delhi, Baba Farid at Pakpattan, whose verses are in the Guru Granth Sahib, Nizamuddin Auliya of Delhi, whose disciple was Amir Khusrau, and Nasiruddin Chirag-i-Dilli; Shaikh Salim Chishti of Fatehpur Sikri blessed Akbar. The Chishtis kept away from the court, while the Suhrawardi order, led in India by Bahauddin Zakariya of Multan, accepted state patronage. The Naqshbandi order, brought by Khwaja Baqi Billah, was orthodox; its Shaikh Ahmad Sirhindi, in letters written mostly under Jahangir, condemned the religious liberalism of Akbar's reign. Dara Shikoh followed the Qadiri order.

### Examples

- Vijayanagara: founded 1336 by Harihara I and Bukka I; dynasties Sangama, Saluva, Tuluva, Aravidu; capital Hampi on the Tungabhadra.
- Foreign visitors to Vijayanagara: Nicolo de Conti (Italian, Devaraya I), Abdur Razzaq (Persian, Devaraya II, 1443), Domingo Paes and Fernao Nuniz (Portuguese).
- Krishnadeva Raya (1509-1529): Amuktamalyada (Telugu), Jambavati Kalyanam (Sanskrit); title Andhra Bhoja; Ashtadiggajas including Allasani Peddana; took Raichur in 1520.
- Battle of Talikota (Rakshasa-Tangadi), 23 January 1565: Bijapur, Ahmednagar, Golconda and Bidar defeated Rama Raya.
- Bahmani kingdom: founded 1347 by Hasan Gangu (Alauddin Bahman Shah) at Gulbarga, later Bidar; Mahmud Gawan executed 1481; Afanasy Nikitin visited.

- Deccan Sultanates: Bijapur (Adil Shahi, Gol Gumbaz), Ahmednagar (Nizam Shahi, Chand Bibi), Golconda (Qutb Shahi, Charminar 1591), Berar (Imad Shahi), Bidar (Barid Shahi).
- Philosophers: Shankaracharya-Advaita, Ramanuja-Vishishtadvaita, Madhva-Dvaita, Nimbarka-Dvaitadvaita, Vallabha-Shuddhadvaita; Basavanna founded the Lingayat movement.
- Tamil bhakti: 63 Nayanars (Shiva) and 12 Alvars (Vishnu); Andal was the only woman Alvar.
- Nirguna saints: Kabir (Bijak), Ravidas, Dadu, Guru Nanak; saguna saints: Tulsidas (Ramcharitmanas), Surdas (Sursagar), Mirabai; Chaitanya in Bengal, Shankaradeva in Assam.
- Sufi orders: Chishti (Moinuddin, Ajmer; Nizamuddin Auliya, Delhi), Suhrawardi (Bahauddin Zakariya, Multan), Naqshbandi (Baqi Billah, Ahmad Sirhindi), Qadiri (Dara Shikoh).

> **Quick revision:** Vijayanagara 1336 (Harihara, Bukka), four dynasties; Abdur Razzaq 1443; Krishnadeva Raya 1509-1529, Amuktamalyada, Ashtadiggajas; nayankara and ayagar systems; Talikota 23 January 1565; Bahmani 1347 Gulbarga then Bidar; Mahmud Gawan; five Deccan Sultanates; Gol Gumbaz, Charminar; 63 Nayanars, 12 Alvars; Ramanuja Vishishtadvaita; Basavanna Lingayat; Jnaneshwar, Tukaram; Kabir, Nanak, Tulsidas, Mirabai, Chaitanya; Chishti at Ajmer, Suhrawardi at Multan, Naqshbandi orthodox.

### The Mughal Empire from Babur to Aurangzeb and the Rise of the Marathas

**Babur, Humayun and Sher Shah:** Babur, a descendant of Timur and, through his mother, of Chengiz Khan, came from Ferghana. He defeated Ibrahim Lodi at the first battle of Panipat on 21 April 1526 using field artillery and the tulughma flanking tactic, beat Rana Sanga at Khanwa in 1527, after which he took the title Ghazi, and defeated the Afghans at the Ghaghra in 1529. He died in 1530, leaving his memoirs, the Baburnama, in Turki. Humayun lost to the Afghan Sher Shah at Chausa (1539) and Kannauj (1540) and regained Delhi in 1555. Sher Shah (1540-1545) issued the silver rupiya, measured land and fixed revenue at one-third of the produce, gave peasants patta and qabuliyat deeds, built sarais and rebuilt the great road from Bengal to the Indus.

**Akbar:** Akbar (1556-1605) came to the throne at 13 under the regent Bairam Khan, whose army defeated Hemu at the second battle of Panipat on 5 November 1556. He married a Kachhwaha princess of Amber in 1562, abolished the pilgrim tax (1563) and the jizya (1564), and took Chittor (1568), Ranthambore (1569) and Gujarat (1572-73), a victory celebrated by the Buland Darwaza at Fatehpur Sikri. At Haldighati in 1576 his general Man Singh fought Maharana Pratap. He built the Ibadat Khana (1575) for religious debates, issued the Mahzar (1579), which gave him the final word in religious disputes, and in 1582 began the Din-i-Ilahi, based on sulh-i-kul (peace with all). Abul Fazl wrote the Akbarnama and the Ain-i-Akbari.

**Mansabdari and revenue:** Under Akbar's mansabdari system every officer held a mansab, a rank from 10 to 10,000. The zat rank fixed personal status and pay, and the sawar rank the number of horsemen to be kept. Mansabdars were paid in cash or by jagirs, revenue assignments that were transferable and not hereditary; Jahangir added the du-aspa sih-aspa rank. Raja Todar Mal's zabt or dahsala system (1580) measured land and fixed the state's share, about one-third of the produce, in cash, using the average yield and prices of the previous ten years. The empire was divided into subas (12 in 1580, later 15), sarkars and parganas, with the subedar, diwan, faujdar and kotwal as key officials.

**Jahangir and Shah Jahan:** Jahangir (1605-1627) had Guru Arjan Dev executed in 1606 for helping his rebel son Khusrau, and gave great power to his wife Nur Jahan. William Hawkins (1608) and Sir Thomas Roe (1615-1619) came to his court. Mughal painting peaked under him with Ustad Mansur and Abul Hasan, and Nur Jahan built the marble tomb of Itimad-ud-Daulah at Agra with pietra dura inlay. Shah Jahan (1628-1658) was the great builder: the Taj Mahal for Mumtaz Mahal, the Red Fort and Jama Masjid of Shahjahanabad in Delhi, and the Peacock Throne. In the war of succession among his sons, Aurangzeb won at Samugarh in 1658, imprisoned his father and executed Dara Shikoh, who had translated the Upanishads into Persian as Sirr-i-Akbar.

**Aurangzeb and decline:** Aurangzeb (1658-1707) ruled the largest Mughal empire but strained it. He reimposed the jizya in 1679, banned music at court and had Guru Tegh Bahadur executed in 1675. The Jats, the Satnamis, the Sikhs, the Rajputs of Marwar and the Marathas revolted. He spent his last 25 years in the Deccan, annexing Bijapur (1686) and Golconda (1687), and died at Ahmednagar in 1707. After him the empire declined through wars of

succession, a shortage of jagirs for too many mansabdars, weak emperors, the rise of regional states and invasions: Nadir Shah carried off the Peacock Throne and the Kohinoor in 1739, and Ahmad Shah Abdali raided repeatedly.

**Shivaji:** Shivaji (1630-1680), son of Shahji Bhonsle and Jijabai, was born at Shivneri and began by seizing Bijapur forts such as Torna. He killed the Bijapur general Afzal Khan in 1659, raided the Mughal governor Shaista Khan at Pune in 1663 and plundered Surat in 1664. Pressed by Jai Singh, he signed the Treaty of Purandar in 1665, giving up 23 forts, and in 1666 escaped from house arrest at Aurangzeb's court in Agra. He was crowned Chhatrapati at Raigad in 1674. His council of eight ministers, the Ashtapradhan, had the Peshwa (prime minister), Amatya (finance), Mantri (records), Sachiv (correspondence), Sumant (foreign affairs), Senapati (army), Panditrao (religious affairs) and Nyayadhish (justice). He paid soldiers in cash and collected chauth, one-fourth of the revenue, and sardeshmukhi, a further one-tenth, from neighbouring lands.

**The Peshwas:** Sambhaji was executed by Aurangzeb in 1689, and Rajaram and then his widow Tarabai led the resistance. When Shahu, Sambhaji's son, was released in 1707, his Peshwa Balaji Vishwanath became the real power and in 1719 won from the Mughals the right to chauth and sardeshmukhi of the Deccan. Baji Rao I (1720-1740) defeated the Nizam at Palkhed in 1728 and raided Delhi in 1737. Under Peshwa Balaji Baji Rao (Nana Saheb) the Marathas reached Punjab but were crushed by Ahmad Shah Abdali at the third battle of Panipat on 14 January 1761. Maratha power then rested on a confederacy of the Peshwa at Pune, the Gaekwads of Baroda, the Holkars of Indore, the Scindias of Gwalior and the Bhonsles of Nagpur.

### Examples

- Babur's battles: Panipat I (21 April 1526, Ibrahim Lodi), Khanwa (1527, Rana Sanga), Chanderi (1528), Ghaghra (1529); he wrote the Baburnama in Turki.
- Sher Shah Suri: silver rupiya, land measured and revenue at one-third, patta and qabuliyat, sarais, the great road from Bengal to the Indus; tomb at Sasaram.
- Akbar's religious steps: pilgrim tax abolished 1563, jizya abolished 1564, Ibadat Khana 1575, Mahzar 1579, Din-i-Ilahi 1582 (sulh-i-kul).
- Panipat II (5 November 1556): Bairam Khan's army defeated Hemu; Haldighati (1576): Man Singh against Maharana Pratap.
- Mansabdari: ranks from 10 to 10,000; zat = personal rank and pay, sawar = horsemen to be kept; Jahangir added du-aspa sih-aspa.
- Dahsala or zabt (1580, Todar Mal): revenue in cash based on ten-year average yield and prices; state share about one-third.
- Englishmen at Jahangir's court: William Hawkins (1608) and Sir Thomas Roe (1615-1619); Guru Arjan Dev executed 1606.
- Shah Jahan built the Taj Mahal, Red Fort and Jama Masjid (Delhi), Moti Masjid (Agra Fort) and the Peacock Throne; Dara Shikoh wrote Sirr-i-Akbar.
- Aurangzeb: jizya reimposed 1679, Guru Tegh Bahadur executed 1675, Bijapur annexed 1686, Golconda 1687, died 1707 at Ahmednagar.
- Shivaji: Afzal Khan killed 1659, Treaty of Purandar 1665 (23 forts), coronation at Raigad 1674; Ashtapradhan of eight ministers; chauth one-fourth, sardeshmukhi one-tenth.

> **Quick revision:** Panipat I 1526, Khanwa 1527; Sher Shah rupiya, one-third revenue; Panipat II 1556; Akbar abolished jizya 1564, Ibadat Khana 1575, Din-i-Ilahi 1582; mansab 10 to 10,000, zat and sawar; dahsala 1580; Hawkins 1608, Roe 1615; Taj Mahal by Shah Jahan; Aurangzeb jizya 1679, Bijapur 1686, Golconda 1687, died 1707; Shivaji crowned 1674, Purandar 1665, Ashtapradhan, chauth and sardeshmukhi; Balaji Vishwanath 1719; Panipat III 14 January 1761.

Free practice questions: parikshasaathi.com/q/ancient-medieval-history/

# Environment and Ecology

## Environment and Ecology

**What the exam asks:** Environment and Ecology is a fixed 3 to 6 mark block in SSC, RRB, state police and state PSC prelims General Awareness papers. Questions are almost always one-line facts: who coined a term, which law or convention came in which year, which park protects which animal, which pollutant causes which disease, and which day is observed when. Concept questions on food chains, pyramids and cycles are easy marks once the basics are clear.

**Ecosystem basics:** Ecology (term by Ernst Haeckel, 1866) studies organisms and their environment; the term ecosystem was given by A.G. Tansley in 1935. An ecosystem has abiotic components (sunlight, temperature, water, soil) and biotic components: producers (green plants), consumers and decomposers (bacteria, fungi). Energy flows one way through trophic levels and only about 10 percent passes to the next level (Lindeman's 10 percent law). A grazing food chain starts with green plants, a detritus food chain with dead organic matter; interlinked chains form a food web. The pyramid of energy is always upright, the pyramid of biomass is inverted in a pond and the pyramid of numbers is inverted for a single tree supporting thousands of insects. A habitat is the address of a species, a niche its functional role. An ecotone is the transition zone between two ecosystems and shows the edge effect, a greater number of species. In succession, lichens are pioneers on bare rock and a stable climax community comes last. A keystone species has an effect out of proportion to its numbers.

**Cycles and aquatic systems:** Rhizobium (in legume root nodules) and Azotobacter (free-living) fix nitrogen; Nitrosomonas converts ammonia to nitrite and Nitrobacter nitrite to nitrate; Pseudomonas returns nitrogen to the air (denitrification). The phosphorus cycle is sedimentary with no gaseous phase. Enrichment of water with nitrates and phosphates causes algal bloom, called eutrophication; a high BOD means heavy organic pollution. Mangroves (Sundarbans is the largest) have breathing roots called pneumatophores; corals live with symbiotic algae (zooxanthellae) and bleach when the sea warms; Chilika in Odisha is Asia's largest brackish water lagoon.

**Biodiversity:** Norman Myers gave the hotspot concept in 1988; a hotspot needs at least 1,500 endemic vascular plants and 70 percent habitat loss. India has parts of four hotspots: Himalaya, Indo-Burma, Western Ghats-Sri Lanka and Sundaland (Nicobar), and is one of 17 megadiverse countries. IUCN Red List categories run Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern. A flagship species (tiger) wins public support; an umbrella species (elephant) shelters many others. Animal-park pairs: rhino at Kaziranga, Asiatic lion only at Gir, hangul at Dachigam, barasingha at Kanha, Nilgiri tahr at Eravikulam, wild ass in the Little Rann of Kutch, Great Indian Bustard (state bird of Rajasthan) in the Desert National Park.

**Conservation:** In-situ conservation protects species in their natural home (national parks, sanctuaries, biosphere reserves, conservation and community reserves); ex-situ conservation moves them out (zoos, botanical gardens, seed banks). No human activity is allowed in a national park, while limited rights may continue in a sanctuary. A biosphere reserve (UNESCO Man and Biosphere programme, 1971) has core, buffer and transition zones; Nilgiri (1986) was India's first. Jim Corbett (Hailey) National Park, 1936, was the first national park. Project Tiger began in 1973, the Crocodile project in 1975, Project Elephant in 1992 and Project Snow Leopard in 2009. The drug diclofenac caused the vulture crash of the 1990s. The Ramsar Convention on wetlands (Iran, 1971) keeps a Montreux Record of threatened wetlands. The Gadgil panel (2011) wanted the whole Western Ghats declared ecologically sensitive; the Kasturirangan panel (2013) cut this to about 37 percent.

**Laws and institutions:** Wildlife (Protection) Act 1972 (Schedule I gives the highest protection), Water Act 1974 (created the CPCB and SPCBs), Forest (Conservation) Act 1980, renamed the Van (Sanrakshan Evam Samvardhan) Adhiniyam by the 2023 amendment (Central approval to divert forest land), Air Act 1981, Environment (Protection) Act 1986 (umbrella law after the Bhopal gas tragedy of 1984), Biological Diversity Act 2002 (National Biodiversity Authority, Chennai), Forest Rights Act 2006 and National Green Tribunal Act 2010. The National Board for Wildlife is chaired by the Prime Minister. Articles 48A and 51A(g) came with the 42nd Amendment, 1976.

**Pollution:** London smog (1952) was sulphurous smog from coal; photochemical smog forms from nitrogen oxides and hydrocarbons in sunlight, producing ozone and PAN. Acid rain comes from sulphur dioxide and nitrogen oxides.

Minamata disease is mercury, itai-itai is cadmium, blue baby syndrome is nitrate, fluorosis is fluoride, and arsenic contaminates groundwater in West Bengal. Bhopal (1984) released methyl isocyanate; Chernobyl (1986) was a nuclear accident in Ukraine. Biomagnification is the rise in concentration of a persistent toxin such as DDT along the food chain. India's AQI uses eight pollutants: PM10, PM2.5, NO2, SO2, CO, O3, NH3 and lead.

**Climate change and conventions:** Carbon dioxide contributes most to warming, methane comes from paddy and cattle, CFCs and SF6 have very high global warming potential. The IPCC was set up in 1988 by WMO and UNEP. The Rio Earth Summit (1992) produced the UNFCCC and the CBD; the Kyoto Protocol (1997, COP3) bound developed Annex I countries; the Paris Agreement (2015, COP21) keeps warming well below 2 degrees Celsius, pursuing 1.5, through each country's NDCs. The Montreal Protocol (1987) phases out ozone-depleting substances and its Kigali Amendment (2016) phases down HFCs. One carbon credit equals one tonne of CO2 equivalent. Remember CITES 1973 (wildlife trade), Bonn 1979 (migratory species), Basel 1989 (hazardous waste), Rotterdam 1998 (chemicals trade), Stockholm 2001 (persistent organic pollutants), Minamata 2013 (mercury), and under the CBD the Cartagena (biosafety) and Nagoya (benefit sharing) protocols. UNEP (Nairobi) dates from the Stockholm Conference of 1972, after which 5 June became World Environment Day.

**Movements, energy and sustainability:** Chipko (1973, Chamoli), Silent Valley (Kerala), Appiko (Karnataka, 1983), Narmada Bachao Andolan (Medha Patkar) and Khejarli (1730, Amrita Devi) are the standard movement questions. Biofuel generations run food crops, non-food biomass, algae and engineered organisms; green hydrogen comes from electrolysis using renewable power; the Gulfs of Kutch and Khambhat hold India's tidal potential. The Brundtland Report (1987) defined sustainable development; the UN adopted 17 SDGs in 2015 for 2030.

**Common traps:** Montreal is ozone, Kyoto and Paris are climate; Minamata is mercury but itai-itai is cadmium; Project Tiger is 1973 but the Wildlife Act is 1972; the Stockholm Conference is 1972 but the Stockholm Convention is 2001; the CPCB comes from the Water Act, not the Air Act.

### Examples

- IUCN ladder from most to least threatened: EX, EW, CR, EN, VU, NT, LC (Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern).
- Year ladder: Wildlife Act 1972, Project Tiger 1973, Water Act 1974, Forest (Conservation) Act 1980 (renamed Van Adhiniyam in 2023), Air Act 1981, Bhopal 1984, EPA 1986, Project Elephant 1992, Biodiversity Act 2002, FRA 2006, NGT 2010.
- Montreal 1987 = ozone (CFCs); Kyoto 1997 = greenhouse gases, binding only for developed Annex I countries; Paris 2015 = all countries, NDCs, well below 2 degrees Celsius.
- Disease-pollutant pairs: Minamata = mercury, itai-itai = cadmium, blue baby syndrome = nitrate, fluorosis = fluoride, black foot disease = arsenic.
- Animal-park pairs: rhino-Kaziranga, lion-Gir, hangul-Dachigam, barasingha-Kanha, Nilgiri tahr-Eravikulam, wild ass-Little Rann of Kutch, snow leopard-Hemis.
- Nitrogen cycle bacteria: Rhizobium fixes nitrogen, Nitrosomonas makes nitrite, Nitrobacter makes nitrate, Pseudomonas denitrifies it back to the air.
- Inverted pyramids: biomass in a pond, numbers on a single tree; the pyramid of energy is always upright because of the 10 percent law.
- India's four hotspots: Himalaya, Indo-Burma, Western Ghats-Sri Lanka, Sundaland (Nicobar). The Eastern Ghats and the Aravalli are NOT hotspots.
- Stockholm 1972 = UN conference that created UNEP and World Environment Day; Stockholm 2001 = convention on persistent organic pollutants. Same city, different question.
- Chemical conventions in order B-R-S-M: Basel (hazardous waste), Rotterdam (prior informed consent for chemical trade), Stockholm (POPs), Minamata (mercury).
- Days: 2 Feb Wetlands, 3 Mar Wildlife, 21 Mar Forests, 22 Mar Water, 22 Apr Earth, 22 May Biodiversity, 5 Jun Environment, 16 Sep Ozone.
- Movements: Chipko 1973 Uttarakhand (hug the trees), Appiko 1983 Karnataka (its southern echo), Silent Valley Kerala (dam stopped), Narmada Bachao (Medha Patkar), Khejarli 1730 Bishnoi (Amrita Devi).

**Quick revision:** Ecology term: Haeckel 1866; ecosystem: Tansley 1935; 10 percent law: Lindeman; energy pyramid always upright; Project Tiger 1973, Project Elephant 1992; first national park Jim Corbett 1936; first biosphere reserve Nilgiri 1986; Ramsar 1971 (Iran); hotspot concept Norman Myers, India in 4 hotspots, 17 megadiverse nations; Minamata = mercury, itai-itai = cadmium; Bhopal 1984 = methyl isocyanate; Montreal 1987 ozone, Kyoto 1997, Paris 2015 (well below 2 C); IPCC 1988; EPA 1986; NGT 2010; Brundtland 1987; 17 SDGs 2015; World Environment Day 5 June, Ozone Day 16 September.

### Ecosystems: Food Chains, Trophic Levels, Ecological Pyramids and Nutrient Cycles

**What an ecosystem is:** An ecosystem is a functional unit of nature in which living organisms interact with one another and with their physical surroundings. The term was coined by the British ecologist A.G. Tansley in 1935. An ecosystem can be as small as a pond or as large as a forest, and the biosphere is the largest of all. Its abiotic components are the non-living factors such as sunlight, temperature, rainfall, soil, air and minerals; its biotic components are the living organisms. Two processes keep every ecosystem running: a one-way flow of energy that starts from the sun, and a cyclic flow of nutrients that are used again and again.

**Producers, consumers and decomposers:** Producers, or autotrophs, make their own food. Green plants on land and phytoplankton in water use sunlight in photosynthesis, while some bacteria near deep-sea hydrothermal vents make food by chemosynthesis, without sunlight. Consumers, or heterotrophs, depend on others: primary consumers are herbivores such as deer, grasshoppers and zooplankton; secondary consumers are carnivores that eat herbivores, such as frogs; tertiary consumers are top carnivores such as the tiger, eagle and shark. Decomposers, mainly bacteria and fungi, break dead matter down into simple inorganic substances, while detritivores such as earthworms feed on the dead matter (detritus) itself.

**Food chains and food webs:** A food chain shows who eats whom, for example grass, grasshopper, frog, snake and eagle. A grazing food chain begins with living green plants, while a detritus food chain begins with dead organic matter. In a terrestrial ecosystem such as a forest, much more energy flows through the detritus food chain than through the grazing chain; in aquatic ecosystems the grazing chain is the main route. Food chains seldom have more than four or five links because energy is lost at every step. Interlinked chains form a food web, and a complex web makes an ecosystem more stable because the loss of one species does not break the whole system.

Trophic levels and the 10 per cent law: Each step of a food chain is a trophic level: producers form the first, herbivores the second, carnivores the third and top carnivores the fourth. Less than 50 per cent of the sunlight reaching the Earth is photosynthetically active radiation, and plants capture only 2 to 10 per cent of it. Raymond Lindeman gave the 10 per cent law in 1942: only about 10 per cent of the energy at one level passes to the next, because the rest is used in respiration and lost as heat. If plants store 10,000 joules, herbivores get about 1,000, carnivores about 100 and top carnivores about 10.

**Ecological pyramids:** Charles Elton introduced the pyramid idea in 1927, so these are also called Eltonian pyramids; producers form the base and each trophic level sits above the one it eats. The pyramid of numbers is upright in a grassland, spindle-shaped in a tree ecosystem where one tree supports thousands of insects, and fully inverted in a parasitic food chain. The pyramid of biomass is upright on land but inverted in the sea or a pond, because a small standing crop of fast-multiplying phytoplankton supports a larger mass of fish. The pyramid of energy is always upright.

**Ecological succession:** Succession is the gradual and fairly predictable change in the species of an area over time, until a stable climax community in balance with the climate develops. The whole sequence of communities is a sere, and each stage a seral stage. Primary succession starts where there was never any soil, such as bare rock, cooled lava or a new sand dune, and takes hundreds to thousands of years. Its pioneers on rock are lichens, which secrete acids that break the rock and begin soil formation; mosses, grasses, shrubs and finally trees follow. Secondary succession starts where a community was removed but soil remains, as on abandoned farmland or a burnt forest, and is much faster. Succession in water (hydrarch) and on dry rock (xerarch) both move towards a medium-moisture (mesic) climax.

**Biogeochemical cycles:** Gaseous cycles such as those of carbon and nitrogen have their reservoir in the atmosphere, while sedimentary cycles such as phosphorus and sulphur have it in the Earth's crust. In the carbon cycle, plants fix carbon dioxide by photosynthesis, and it returns to the air through respiration, decomposition, volcanoes and the burning of fossil fuels; by the NCERT textbook figure, about 71 per cent of the Earth's carbon is dissolved in the oceans. Nitrogen forms about 78 per cent of the atmosphere, but plants cannot use the gas directly. It is fixed by bacteria such as Rhizobium and Azotobacter, by cyanobacteria such as Anabaena and Nostoc, by lightning and by the industrial Haber process; decomposers turn dead protein into ammonia (ammonification); Nitrosomonas and Nitrobacter turn ammonia into nitrite and then nitrate (nitrification); plants absorb nitrates (assimilation); and Pseudomonas returns nitrogen gas to the air (denitrification). The water cycle, driven by solar energy, moves water through evaporation, transpiration, condensation, precipitation, infiltration and runoff; about 97 per cent of the Earth's water is saline ocean water.

**Examples**

- Ecosystem: term coined by A.G. Tansley in 1935; it has abiotic (non-living) and biotic (living) components, and the biosphere is the largest ecosystem.
- Producers are autotrophs (green plants, phytoplankton); consumers are heterotrophs; decomposers (bacteria, fungi) return nutrients to the soil; earthworms are detritivores.
- Grazing food chain starts from living plants; detritus food chain starts from dead organic matter and carries more energy in a forest.
- 10 per cent law (Raymond Lindeman, 1942): 10,000 J in plants gives about 1,000 J to herbivores, 100 J to carnivores and 10 J to top carnivores.
- Pyramid of numbers: upright in grassland, spindle-shaped in a tree ecosystem, inverted in a parasitic chain. Biomass pyramid: inverted in the sea. Energy pyramid: always upright.
- Ecological pyramids were introduced by Charles Elton in 1927 and are called Eltonian pyramids.
- Primary succession starts on bare rock with lichens as pioneers; secondary succession starts on abandoned farmland or burnt forest where soil remains, and is faster.
- Gaseous cycles: carbon and nitrogen (reservoir in the atmosphere); sedimentary cycles: phosphorus and sulphur (reservoir in the Earth's crust).
- Nitrogen cycle order: fixation (Rhizobium, Azotobacter, Anabaena, lightning), ammonification, nitrification (Nitrosomonas then Nitrobacter), assimilation, denitrification (Pseudomonas).
- About 71 per cent of the Earth's carbon is dissolved in the oceans (NCERT figure); nitrogen forms about 78 per cent of the air; about 97 per cent of the Earth's water is in the oceans.

> **Quick revision:** Ecosystem term: Tansley 1935; producers, consumers, decomposers; grazing vs detritus food chain; 10 per cent law: Lindeman 1942; Eltonian pyramids: Elton 1927; energy pyramid always upright, biomass inverted in sea, numbers inverted in parasitic chain; succession: lichens pioneer on rock, climax community last; carbon and nitrogen gaseous cycles, phosphorus sedimentary; Nitrosomonas to nitrite, Nitrobacter to nitrate, Pseudomonas denitrifies.

## Biodiversity: Levels, Hotspots, Megadiverse Countries and Conservation Methods

**What biodiversity means:** Biodiversity is the variety of life at every level of biological organisation, from genes to whole ecosystems. The term was popularised by the American biologist Edward O. Wilson. It matters because species-rich ecosystems are more productive and recover better from disturbance, and because people depend on biodiversity for food, medicine, fibre, timber and clean water. The ecologist Paul Ehrlich compared species to the rivets of an aeroplane: losing a few may go unnoticed, but every loss weakens the whole, and losing a key rivet can bring the plane down. This is called the rivet popper hypothesis.

**Three levels of diversity:** Genetic diversity is variation within one species. The NCERT textbook gives three examples: India has more than 50,000 genetically different strains of rice and about 1,000 varieties of mango, and the medicinal plant Rauwolfia vomitoria growing in different Himalayan ranges differs in the strength of its drug reserpine. Species diversity is the variety of species in a region; the Western Ghats, for example, have more amphibian species than the Eastern Ghats. Ecological or ecosystem diversity is the variety of habitats: India's

deserts, rainforests, mangroves, coral reefs, wetlands, estuaries and alpine meadows give it far more ecosystem diversity than a country such as Norway. Ecologists also speak of alpha diversity (within one community), beta diversity (change between communities) and gamma diversity (over a whole region). Diversity is highest in the tropics and falls towards the poles; the Amazon rainforest is the richest region on Earth.

India's share and endemic species: By the NCERT textbook figure, India has only 2.4 per cent of the world's land area but about 8.1 per cent of its recorded species. An endemic species is one found naturally in a single region and nowhere else in the wild. Indian examples are the Asiatic lion (wild only in and around Gir in Gujarat), the Nilgiri tahr and lion-tailed macaque of the Western Ghats, the sangai deer of Manipur and the pygmy hog of Assam. Endemic species are especially at risk because one habitat loss can wipe them out. The main threats are summed up as the 'evil quartet': habitat loss and fragmentation, over-exploitation, invasion by alien species, and co-extinction. Alien invaders in India include water hyacinth, Lantana and Parthenium (carrot grass), while the Nile perch introduced into Lake Victoria in Africa led to the extinction of more than 200 species of cichlid fish.

**Biodiversity hotspots:** The British ecologist Norman Myers gave the hotspot concept in 1988, and Conservation International later adopted it. A region qualifies if it has at least 1,500 species of endemic vascular plants (more than 0.5 per cent of the world's total) and has already lost at least 70 per cent of its original vegetation. Hotspots cover only a small part of the Earth's land yet hold a very large share of its endemic species, so protecting them saves many species at once. India includes parts of four hotspots: the Himalaya, Indo-Burma (the north-east), the Western Ghats and Sri Lanka, and Sundaland (the Nicobar Islands). The Western Ghats were also inscribed as a UNESCO World Heritage Site in 2012.

**Megadiverse countries:** In 1998 Conservation International identified 17 megadiverse countries which together hold most of the world's species; India is one of them, along with countries such as Brazil, Indonesia, China, Mexico and Australia. In 2002 the Cancun Declaration, signed in Mexico, created the Group of Like-Minded Megadiverse Countries, which speaks together on access to genetic resources and the sharing of benefits from them.

**In-situ conservation:** In-situ means 'on site': species are protected in their natural home together with their whole ecosystem, which also lets evolution continue. National parks, wildlife sanctuaries, biosphere reserves, conservation reserves and community reserves are its legal forms. India also has an old tradition of sacred groves, forest patches protected by communities for religious reasons, found in the Khasi and Jaintia Hills of Meghalaya, the Aravalli hills of Rajasthan, the Western Ghats of Karnataka and Maharashtra, and the Sarguja, Chanda and Bastar areas of central India; many of them shelter rare species.

**Ex-situ conservation:** Ex-situ means 'off site': threatened plants and animals are protected outside their natural habitat. Zoos, botanical gardens, wildlife safari parks and captive breeding centres are its familiar forms; the Indian Botanic Garden at Howrah, founded by Robert Kyd in 1787, is famous for its Great Banyan tree. Seed banks store seeds at low temperature and humidity, and gene banks keep pollen, tissue cultures and DNA. Gametes and embryos can be kept for long periods by cryopreservation in liquid nitrogen at minus 196 degrees Celsius. India's National Gene Bank is maintained by the National Bureau of Plant Genetic Resources (NBPGR) in New Delhi, and the Svalbard Global Seed Vault, opened in Norway's Arctic in 2008, keeps back-up seeds from gene banks all over the world. Ex-situ methods are a safety net; in-situ protection remains the main strategy because it saves species together with their habitats.

### Examples

- Biodiversity: term popularised by Edward O. Wilson; three levels are genetic, species and ecological (ecosystem) diversity.
- Genetic diversity in India (NCERT): more than 50,000 strains of rice and about 1,000 varieties of mango.
- Rivet popper hypothesis: Paul Ehrlich compared species to rivets in an aeroplane; each extinction weakens the ecosystem.
- Hotspot (Norman Myers, 1988): at least 1,500 endemic vascular plant species and at least 70 per cent of original vegetation lost.
- India's four hotspots: Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sundaland (Nicobar Islands).

- Megadiverse countries: 17 identified by Conservation International in 1998, India among them; Like-Minded Megadiverse Countries group formed by the Cancun Declaration, 2002.
- Evil quartet of threats: habitat loss and fragmentation, over-exploitation, alien species invasion, co-extinction; Nile perch wiped out over 200 cichlid species in Lake Victoria.
- In-situ: national parks, sanctuaries, biosphere reserves, sacred groves (Khasi and Jaintia Hills, Aravallis, Bastar). Ex-situ: zoos, botanical gardens, seed banks, cryopreservation.
- Cryopreservation stores gametes and embryos in liquid nitrogen at minus 196 degrees Celsius; NBPGR, New Delhi, keeps India's National Gene Bank.
- Svalbard Global Seed Vault in Norway opened in 2008; the Indian Botanic Garden, Howrah, was founded by Robert Kyd in 1787.

> **Quick revision:** Biodiversity term popularised by E.O. Wilson; genetic, species and ecosystem diversity; India 2.4 per cent of land, about 8.1 per cent of species (NCERT); hotspot concept Norman Myers 1988 (1,500 endemic plants, 70 per cent habitat lost); India in 4 hotspots; 17 megadiverse countries (1998); evil quartet; in-situ: parks, sanctuaries, sacred groves; ex-situ: zoos, seed banks, cryopreservation at minus 196 C; Svalbard vault 2008.

### Protected Areas of India: National Parks, Sanctuaries, Reserves and Biosphere Reserves

**The protected area network:** India protects wild habitats through categories created by law. The Wildlife (Protection) Act 1972 provides for wildlife sanctuaries and national parks, and its 2002 amendment added conservation reserves and community reserves. Tiger reserves, notified under the same Act since 2006, and elephant reserves are usually built around existing parks and sanctuaries. Biosphere reserves are a separate category designated by the Government of India on the UNESCO model. Together they form the backbone of in-situ conservation.

**National parks, sanctuaries and reserves:** A national park gives the strictest protection: no grazing, hunting or private rights are allowed inside it, and it is declared for its ecological, animal, plant or geological value. A wildlife sanctuary gives somewhat lesser protection: hunting is banned, but grazing, collection of forest produce and some rights of local people may be allowed and regulated. Both are usually declared by state governments. A conservation reserve is declared on government land, often next to a park or sanctuary as a buffer or corridor, after consulting local people; a community reserve is declared on community or private land where the people themselves volunteer to protect wildlife.

**The first national park:** India's first national park was set up in 1936 as Hailey National Park in the hills of the then United Provinces, now Uttarakhand, along the Ramganga river. It was later renamed Ramganga National Park and then Jim Corbett National Park, after the hunter turned conservationist and author Jim Corbett. Project Tiger was launched from Corbett in 1973. Many of today's famous parks began as royal hunting reserves, and their change from hunting grounds to protected areas is a common exam theme.

**Biosphere reserves:** A biosphere reserve protects a large natural landscape together with the people who live in it. Its core zone is legally protected and allows only research and monitoring; the buffer zone around it allows research, education, tourism and limited traditional use; and the outer transition zone has villages, farms and other sustainable activities. The idea comes from UNESCO's Man and the Biosphere (MAB) programme of 1971. India's first biosphere reserve was Nilgiri, created in 1986 across Tamil Nadu, Kerala and Karnataka; it was also the first Indian reserve placed on UNESCO's World Network of Biosphere Reserves, in 2000. Nanda Devi followed in 1988, and Gulf of Mannar, India's first marine biosphere reserve, and Sundarbans in 1989. A biosphere reserve can contain parks and sanctuaries: Nilgiri includes Mudumalai, Bandipur, Nagarhole and Silent Valley.

**Parks of the north and east:** Kaziranga in Assam, a UNESCO World Heritage Site, is famous for the great one-horned rhinoceros; Manas, also in Assam, shelters the pygmy hog, golden langur and hispid hare; and Pobitora has a very high density of rhinos. The Sundarbans in West Bengal is the mangrove home of the Royal Bengal tiger. Dachigam near Srinagar protects the hangul (Kashmir stag), Hemis in Ladakh the snow leopard, and Keibul Lamjao on Loktak Lake in Manipur, the world's only floating national park, the sangai deer. Namdapha in Arunachal Pradesh is often cited as home to four big cats: tiger, leopard, clouded leopard and snow leopard. Dudhwa in Uttar Pradesh is

known for swamp deer and for rhinos reintroduced there in 1984. The Great Himalayan National Park in Himachal Pradesh and the Nanda Devi and Valley of Flowers parks in Uttarakhand are World Heritage Sites.

**Parks of the west and centre:** Gir in Gujarat, with the landscape around it, is the only wild home of the Asiatic lion; Velavadar in Gujarat is known for blackbuck and the Little Rann of Kutch for the Indian wild ass, and the Marine National Park in the Gulf of Kutch is counted as India's first marine national park. In Rajasthan, Ranthambore and Sariska are tiger reserves, Keoladeo at Bharatpur is a bird paradise and World Heritage Site, and the Desert National Park near Jaisalmer protects the great Indian bustard. In Madhya Pradesh, Kanha saved the hard-ground barasingha and Bandhavgarh is known for its tigers. The National Chambal Sanctuary, shared by Rajasthan, Madhya Pradesh and Uttar Pradesh, protects the gharial.

**Parks of the south and Odisha:** Periyar in Kerala is known for elephants, Silent Valley for the lion-tailed macaque and Eravikulam for the Nilgiri tahr. Bandipur and Nagarhole in Karnataka and Mudumalai in Tamil Nadu form one continuous elephant and tiger landscape. The Gulf of Mannar Marine National Park protects coral islands off Tamil Nadu. In Odisha, Bhitarkanika is known for saltwater crocodiles and Simlipal is a tiger reserve.

**Examples**

- First national park: Hailey National Park, 1936, later renamed Ramganga and then Jim Corbett National Park (Uttarakhand); Project Tiger was launched from it in 1973.
- Wildlife (Protection) Act 1972 provides for sanctuaries and national parks; the 2002 amendment added conservation reserves and community reserves.
- National park: no grazing or private rights allowed; sanctuary: hunting banned but some regulated activities such as grazing may be permitted.
- Biosphere reserve zones: core (research only), buffer (research, education, limited use), transition (villages and sustainable activities); based on UNESCO's MAB programme, 1971.
- First biosphere reserve: Nilgiri, 1986 (Tamil Nadu, Kerala, Karnataka); first Indian reserve on UNESCO's world network, 2000.
- Gulf of Mannar (1989) was India's first marine biosphere reserve; Nanda Devi became a biosphere reserve in 1988 and Sundarbans in 1989.
- Animal-park pairs: rhino-Kaziranga, pygmy hog and golden langur-Manas, hangul-Dachigam, snow leopard-Hemis, sangai-Keibul Lamjao (floating park on Loktak).
- More pairs: Asiatic lion-Gir, blackbuck-Velavadar, great Indian bustard-Desert National Park, barasingha-Kanha, gharial-National Chambal Sanctuary, saltwater crocodile-Bhitarkanika.
- Namdapha (Arunachal Pradesh) is often cited for four big cats: tiger, leopard, clouded leopard and snow leopard; Dudhwa got reintroduced rhinos in 1984.

> **Quick revision:** First national park Hailey 1936 (now Jim Corbett, Uttarakhand); WPA 1972 gives sanctuaries and national parks, 2002 amendment adds conservation and community reserves; biosphere reserves from UNESCO MAB 1971: core, buffer, transition; first Nilgiri 1986, on UNESCO network 2000; Gulf of Mannar first marine BR 1989; Kaziranga rhino, Gir lion, Dachigam hangul, Hemis snow leopard, Keibul Lamjao sangai, Kanha barasingha, Chambal gharial.

### Wildlife Conservation in India: Project Tiger, Project Elephant, IUCN Red List and CITES

**Why species projects:** By the late 1960s hunting, the fur trade and the loss of forests had pushed many Indian animals close to extinction. The response came in stages: the Indian Board for Wildlife in 1952, the Wildlife (Protection) Act 1972, and then projects aimed at single species. A project built around a flagship species such as the tiger protects its whole forest, and with it thousands of other species. The tiger was adopted as India's national animal in 1973, the year Project Tiger began.

**Project Tiger:** Launched on 1 April 1973 with 9 tiger reserves, Project Tiger is one of the world's best-known conservation programmes. Each reserve has a core area kept free of human use and a buffer around it. After the tigers of Sariska disappeared in the early 2000s, the Wildlife (Protection) Amendment Act 2006 created the National Tiger Conservation Authority (NTCA), a statutory body chaired by the Union Environment Minister, and the Wildlife

Crime Control Bureau. Sariska was restocked with tigers moved from Ranthambore in 2008. Since 2006 tigers have been counted every four years in the All India Tiger Estimation, using camera traps, by the NTCA with the Wildlife Institute of India. International Tiger Day, 29 July, was fixed at the St Petersburg Tiger Summit of 2010.

**Project Elephant and other projects:** Project Elephant was launched in 1992 to protect elephants, their habitats and corridors, to reduce human-elephant conflict and to improve the welfare of captive elephants; elephant reserves are its units, and the elephant was declared India's National Heritage Animal in 2010. The Crocodile Conservation Project began in 1975 with help from the FAO and UNDP, breeding gharials and other crocodiles in captivity and releasing them into rivers. Project Snow Leopard began in 2009 for the high Himalaya. The Gangetic river dolphin was declared the National Aquatic Animal in 2009, and the Vikramshila Gangetic Dolphin Sanctuary near Bhagalpur in Bihar dates from 1991. Vulture numbers crashed in the 1990s because cattle carcasses carried the painkiller diclofenac, so its veterinary use was banned in 2006 and breeding centres such as the one at Pinjore in Haryana were set up.

**The IUCN Red List:** The International Union for Conservation of Nature (IUCN) was founded in 1948 at Fontainebleau in France and has its headquarters at Gland in Switzerland. It began its Red List of Threatened Species in 1964. The list sorts species into nine categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient and Not Evaluated. Only Critically Endangered, Endangered and Vulnerable together are called 'threatened'. Indian species long listed as Critically Endangered include the great Indian bustard, the gharial, three vultures (white-rumped, Indian and slender-billed), Jerdon's courser and the Bengal florican. The tiger, Asian elephant, red panda and Ganges river dolphin are listed as Endangered. Categories are revised as new data come in, so a status describes a species at a given time.

**CITES:** The Convention on International Trade in Endangered Species of Wild Fauna and Flora was signed in Washington DC on 3 March 1973 and came into force in 1975; India joined in 1976. Its secretariat in Geneva is administered by UNEP, and 3 March is now World Wildlife Day. CITES does not deal with hunting inside a country; it controls trade across borders through three appendices. Appendix I lists species threatened with extinction, in which commercial trade is generally banned, such as tigers and snow leopards. Appendix II lists species not necessarily threatened now, whose trade is allowed under permits so that it does not become harmful. Appendix III lists species protected in one country that has asked other parties to help control the trade.

**The Wildlife Protection Act schedules:** The Wildlife (Protection) Act 1972 bans the hunting of listed animals and regulates trade in wildlife products, grading protection through schedules. Until 2022 it had six: Schedule I and Part II of Schedule II gave absolute protection, Schedules III and IV gave lesser protection, Schedule V listed vermin that could be hunted, and Schedule VI, added by a 1991 amendment, listed protected plants. Schedule I animals such as the tiger, lion, elephant, rhino and great Indian bustard attract the heaviest penalties. The Wildlife (Protection) Amendment Act 2022 reduced the schedules to four: Schedule I (highest protection), Schedule II (lesser protection), Schedule III (protected plants) and Schedule IV (specimens listed in the CITES appendices), and removed the separate vermin schedule.

**Institutions:** The Wildlife Institute of India (WII), Dehradun, set up in 1982, is an autonomous institute of the environment ministry that trains wildlife managers and carries out research. The National Board for Wildlife, chaired by the Prime Minister, replaced the Indian Board for Wildlife in 2003 and must clear projects inside protected areas. The Central Zoo Authority (1992) regulates zoos, and the Wildlife Crime Control Bureau fights poaching and smuggling. Among non-government bodies, the Bombay Natural History Society (1883) is one of the oldest, and WWF, founded in 1961 with the giant panda as its symbol, works across the world.

### Examples

- Project Tiger: launched 1 April 1973 with 9 reserves; the tiger became the national animal the same year; Project Elephant: 1992.
- NTCA: statutory body created by the Wildlife (Protection) Amendment Act 2006, chaired by the Union Environment Minister; tigers are counted every four years.
- Crocodile project 1975 (FAO and UNDP help); Project Snow Leopard 2009; elephant made National Heritage Animal 2010; Gangetic dolphin made National Aquatic Animal 2009.

- Vikramshila Gangetic Dolphin Sanctuary, Bhagalpur (Bihar), 1991; diclofenac, which killed vultures, was banned for veterinary use in 2006.
- IUCN: founded 1948 at Fontainebleau (France), headquarters Gland (Switzerland); Red List since 1964; threatened = Critically Endangered, Endangered and Vulnerable.
- Critically Endangered Indian species: great Indian bustard, gharial, white-rumped, Indian and slender-billed vultures, Jerdon's courser, Bengal florican.
- CITES: signed in Washington DC on 3 March 1973 (now World Wildlife Day), in force 1975, India joined 1976; Appendix I bans commercial trade.
- WPA schedules: six until 2022 (Schedule V was vermin; Schedule VI, plants, was added in 1991); the 2022 amendment cut them to four (I highest, II lesser, III plants, IV CITES specimens).
- Wildlife Institute of India, Dehradun, 1982; Central Zoo Authority 1992; National Board for Wildlife (chaired by the Prime Minister) 2003; BNHS 1883; WWF 1961.

> **Quick revision:** Project Tiger 1 April 1973 (9 reserves); tiger national animal 1973; NTCA by 2006 amendment; Project Elephant 1992; crocodile project 1975; snow leopard project 2009; IUCN 1948, Gland, Red List 1964, 9 categories, CR-EN-VU are threatened; GIB, gharial, three vultures CR; CITES 3 March 1973, India 1976, Appendix I to III; WPA six schedules cut to four in 2022; WII Dehradun 1982; NBWL chaired by PM.

### Wetlands, Mangroves and Coral Reefs of India

**What wetlands are:** Wetlands are areas where water covers the soil or lies near the surface for at least part of the year: marshes, swamps, lakes, floodplains, peatlands, lagoons, estuaries, mangroves and even paddy fields. The Ramsar Convention's definition also includes marine water up to a depth of 6 metres at low tide. Wetlands are called the kidneys of the landscape because they filter sediments and pollutants. They also recharge groundwater, soak up floods, store carbon, support fisheries and give wintering grounds to migratory birds that reach India along the Central Asian Flyway.

**The Ramsar Convention:** The Convention on Wetlands of International Importance was signed on 2 February 1971 at Ramsar, a town on Iran's Caspian Sea coast, and came into force in 1975; 2 February is World Wetlands Day. It is the only global treaty devoted to a single ecosystem. India became a party in 1982, and its first two Ramsar sites, Chilika Lake in Odisha and Keoladeo National Park in Rajasthan, were designated in 1981. The Montreux Record, set up in 1990, lists Ramsar sites where harmful ecological change has occurred or is likely. Chilika was put on it in 1993 and removed in 2002, after a new mouth to the sea restored its salinity and fish catch; Keoladeo and Loktak have also been placed on the record.

**Important lakes and wetlands:** Chilika in Odisha is Asia's largest brackish-water lagoon, home to Irrawaddy dolphins and to the Nalabana bird sanctuary. Pulicat, on the Andhra Pradesh-Tamil Nadu border, is India's second-largest brackish lagoon and is separated from the sea by Sriharikota island. Loktak in Manipur, the largest freshwater lake of north-east India, has floating mats of vegetation called phumdis. Wular in Jammu and Kashmir, fed by the Jhelum, is one of Asia's largest freshwater lakes; Sambhar in Rajasthan is India's largest inland salt lake; Vembanad in Kerala is India's longest lake; Kolleru in Andhra Pradesh lies between the Godavari and Krishna deltas; and Harike in Punjab forms where the Beas meets the Sutlej. The East Kolkata Wetlands treat the city's sewage naturally through fish ponds, and Lonar in Maharashtra fills a crater made by a meteorite impact.

**Mangroves:** Mangroves are salt-tolerant trees and shrubs of the intertidal zone of tropical coasts, estuaries and deltas. They cope with salty, waterlogged, oxygen-poor mud through special adaptations: breathing roots (pneumatophores) that grow upward out of the mud, stilt or prop roots for support, and vivipary, in which seeds germinate while still on the parent tree. Mangroves act as a natural wall against cyclones, storm surges and tsunamis, as was seen in the 2004 Indian Ocean tsunami; they hold the soil against erosion, serve as nurseries for fish, prawns and crabs, and store large amounts of blue carbon. India's east coast has more mangroves than the west coast because its large river deltas have gentle slopes and broad mudflats.

**Mangrove regions of India:** The Sundarbans, in the delta of the Ganga, Brahmaputra and Meghna shared by India and Bangladesh, is the largest mangrove forest in the world. It is named after the sundari tree, is home to the Royal

Bengal tiger, and its Indian national park became a World Heritage Site in 1987. Bhitarkanika in Odisha, in the Brahmani-Baitarani delta, is India's second-largest mangrove ecosystem and is famous for saltwater crocodiles; the nearby Gahirmatha coast sees mass nesting (arribada) of olive ridley turtles. Other mangrove areas are Coringa in the Godavari delta of Andhra Pradesh, Pichavaram near Chidambaram in Tamil Nadu, the Gulf of Kutch in Gujarat and the creeks of the Andaman and Nicobar Islands.

**Coral reefs:** Corals are tiny marine animals called polyps, relatives of the jellyfish, that build skeletons of calcium carbonate. Reef-building corals live in partnership with algae called zooxanthellae, which live inside their tissues, give them colour and supply food by photosynthesis. They need warm, clear, shallow and salty water, and reefs are called the rainforests of the sea because of their rich life. Fringing reefs grow close to the shore, barrier reefs are separated from it by a lagoon, and atolls are rings of reef around a central lagoon, explained by Charles Darwin's subsidence theory. When the sea becomes too warm, corals expel their algae and turn white; this coral bleaching can kill whole reefs. Australia's Great Barrier Reef is the world's largest reef system.

**Coral reefs of India:** India has four main reef areas. The Gulf of Mannar, between Tamil Nadu and Sri Lanka, has fringing reefs around a chain of small islands and is both a marine national park and a biosphere reserve. The Gulf of Kutch in Gujarat has India's northernmost reefs, which survive wide changes in temperature and salinity. Lakshadweep is made up of coral atolls, and the Andaman and Nicobar Islands have rich fringing reefs with the greatest variety of corals. Smaller patches occur on the west coast, such as at Malvan in Maharashtra. Corals are protected under the Wildlife (Protection) Act, and coasts, mangroves and reefs are guarded by the Coastal Regulation Zone notification, first issued in 1991 under the Environment (Protection) Act 1986.

**Examples**

- Ramsar Convention: signed 2 February 1971 at Ramsar, Iran (Caspian Sea coast); in force 1975; 2 February is World Wetlands Day; India joined in 1982.
- India's first Ramsar sites (1981): Chilika Lake (Odisha) and Keoladeo National Park (Rajasthan).
- Montreux Record (1990): list of Ramsar sites under threat; Chilika was added in 1993 and removed in 2002 after restoration.
- Chilika: Asia's largest brackish-water lagoon, with Irrawaddy dolphins; Pulicat: India's second-largest brackish lagoon, separated from the sea by Sriharikota.
- Lake facts: Loktak (Manipur) has phumdis; Sambhar (Rajasthan) is the largest inland salt lake; Vembanad (Kerala) is the longest lake; Harike is at the Beas-Sutlej meeting point.
- Mangrove adaptations: pneumatophores (breathing roots), stilt roots and vivipary (seeds germinate on the parent tree).
- Sundarbans: world's largest mangrove forest, named after the sundari tree, Royal Bengal tiger, World Heritage Site 1987; Bhitarkanika (Odisha) is India's second-largest mangrove area.
- Coral bleaching: warm water makes corals expel their zooxanthellae algae and turn white.
- India's four reef areas: Gulf of Mannar and Gulf of Kutch (fringing reefs), Lakshadweep (atolls), Andaman and Nicobar Islands (richest fringing reefs).

> **Quick revision:** Ramsar Convention 2 February 1971, Iran, in force 1975; India party 1982; first Indian sites Chilika and Keoladeo 1981; Montreux Record 1990, Chilika removed 2002; Chilika largest brackish lagoon in Asia; Sambhar largest inland salt lake; Loktak phumdis; mangroves: pneumatophores, vivipary; Sundarbans largest mangrove forest, WHS 1987; Bhitarkanika second; corals with zooxanthellae; reefs: Gulf of Mannar, Gulf of Kutch, Lakshadweep atolls, Andaman and Nicobar; CRZ 1991.

## Pollution: Air, Water, Soil, Noise, Radioactive and Solid Waste

**Pollutants and their kinds:** Pollution is any undesirable change in the physical, chemical or biological character of air, water or soil that harms living things. Primary pollutants are released directly, such as sulphur dioxide, carbon monoxide and soot, while secondary pollutants form in the air through reactions, such as ground-level ozone and peroxyacetyl nitrate (PAN). Biodegradable pollutants such as sewage are broken down by microbes; non-biodegradable ones such as plastics, DDT and heavy metals persist.

**Air pollutants and the AQI:** Carbon monoxide from incomplete burning in vehicles binds to haemoglobin far more readily than oxygen. Sulphur dioxide comes mainly from coal-fired power plants and smelters, and nitrogen oxides from vehicles and power plants. Particulate matter is graded by size: PM10 particles are smaller than 10 micrometres and PM2.5 smaller than 2.5 micrometres, small enough to reach deep into the lungs. Electrostatic precipitators remove over 99 per cent of particulate matter from power-plant exhaust, scrubbers remove gases such as sulphur dioxide, and catalytic converters in cars, which need unleaded petrol, turn carbon monoxide and hydrocarbons into carbon dioxide and water. India's National Air Quality Index has six bands: Good (0-50), Satisfactory (51-100), Moderately Polluted (101-200), Poor (201-300), Very Poor (301-400) and Severe (401-500).

**Smog and acid rain:** Smog is smoke mixed with fog. Classical or sulphurous smog, like the London smog of December 1952, forms in cold, damp weather from coal smoke and sulphur dioxide. Photochemical smog forms on warm sunny days when nitrogen oxides and hydrocarbons from vehicles react in sunlight to make ozone and PAN, irritating the eyes and lungs. Smog worsens under a temperature inversion, when warm air sits over cooler air near the ground and traps pollutants. Normal rain is slightly acidic, with a pH of about 5.6, because carbon dioxide dissolves in it; acid rain is more acidic because sulphur dioxide and nitrogen oxides form sulphuric and nitric acids. It harms forests, lakes, crops and buildings, and the yellowing of the Taj Mahal's marble led to the Taj Trapezium Zone, where polluting industries are restricted.

**Water pollution, BOD and eutrophication:** The biggest source of water pollution in India is untreated domestic sewage, followed by industrial effluents and the run-off of fertilisers and pesticides from farms. Biochemical oxygen demand (BOD) is the oxygen that micro-organisms need to break down the organic matter in a water sample, usually measured over 5 days at 20 degrees Celsius; the higher the BOD, the more polluted the water. When nitrates and phosphates from fertilisers, detergents and sewage enrich a lake, algae multiply in a bloom; when they die, their decay uses up dissolved oxygen, fish die and the lake ages fast. This is eutrophication, called cultural or accelerated eutrophication when humans cause it. Water hyacinth, known as the terror of Bengal, chokes such nutrient-rich waters.

**Soil, noise and radioactive pollution:** Soil is polluted by excess fertilisers and pesticides, industrial and mining waste, and heavy metals. Noise is measured in decibels (dB), and a 1987 amendment to the Air Act brought noise within the meaning of air pollutant. The Noise Pollution (Regulation and Control) Rules 2000 set day and night limits of 75 and 70 dB for industrial areas, 65 and 55 for commercial areas, 55 and 45 for residential areas and 50 and 40 for silence zones (at least 100 metres around hospitals, schools and courts), with day counted from 6 am to 10 pm. A sound of 150 dB or more, as from a jet or rocket take-off, can permanently damage the eardrum. Radioactive pollution comes from nuclear tests, accidents, mining and nuclear waste. The Chernobyl disaster of 26 April 1986 in Ukraine, then in the Soviet Union, and the Fukushima accident in Japan after the 2011 earthquake and tsunami are the major examples.

**Solid waste, plastics and e-waste:** The Solid Waste Management Rules 2016 require waste to be segregated at source into wet (biodegradable), dry and domestic hazardous waste. Wet waste can be composted or turned into biogas and dry waste recycled; the rest should go to scientific sanitary landfills rather than open dumps. Plastics do not biodegrade; they break into microplastics, pieces smaller than 5 millimetres, now found in oceans, fish and drinking water. E-waste, from discarded computers, phones and appliances, contains lead, mercury and cadmium; India's e-waste rules, first notified in 2011, make producers responsible for collecting their products under Extended Producer Responsibility (EPR).

**Famous disasters:** In the Bhopal gas tragedy on the night of 2-3 December 1984, methyl isocyanate (MIC) gas leaked from the Union Carbide pesticide plant and killed thousands; it led to the Environment (Protection) Act 1986 and the Public Liability Insurance Act 1991. Minamata disease, identified in Japan in 1956, was caused by methylmercury that a chemical factory discharged into Minamata Bay and that people ate in fish; the Minamata Convention on mercury (2013) is named after it. Itai-itai disease in Japan came from cadmium in river water used for rice, and the Seveso accident in Italy in 1976 released dioxin.

**Examples**

- Primary pollutants are emitted directly (SO2, CO, soot); secondary pollutants form in the air (ground-level ozone, PAN, acid in acid rain).
- PM10 = particles below 10 micrometres; PM2.5 = below 2.5 micrometres, which reach deep into the lungs.
- India's AQI bands: Good 0-50, Satisfactory 51-100, Moderately Polluted 101-200, Poor 201-300, Very Poor 301-400, Severe 401-500.
- Control devices: electrostatic precipitator removes over 99 per cent of particulates; scrubbers remove SO2; catalytic converters need unleaded petrol.
- London smog (1952) = sulphurous smog from coal; photochemical smog = NOx plus hydrocarbons in sunlight, producing ozone and PAN; normal rain pH is about 5.6.
- BOD is measured over 5 days at 20 degrees Celsius; high BOD means heavy organic pollution; nitrates and phosphates cause eutrophication.
- Noise limits (day/night, dB): industrial 75/70, commercial 65/55, residential 55/45, silence zone 50/40; noise added to the Air Act in 1987.
- Microplastics are plastic pieces smaller than 5 mm; e-waste rules (first 2011) use Extended Producer Responsibility; Solid Waste Management Rules 2016 require segregation at source.
- Bhopal 1984: methyl isocyanate from Union Carbide, which led to the Environment (Protection) Act 1986 and the Public Liability Insurance Act 1991.
- Disaster pairs: Minamata (1956, Japan) = mercury; itai-itai (Japan) = cadmium; Seveso (1976, Italy) = dioxin; Chernobyl (1986) and Fukushima (2011) = radiation.

> **Quick revision:** Primary vs secondary pollutants; PM10, PM2.5; AQI six bands, 0-500; London smog 1952 sulphurous; photochemical smog gives ozone and PAN; normal rain pH 5.6; BOD over 5 days at 20 C; eutrophication by nitrates and phosphates; noise rules 2000, silence zone 50/40 dB; SWM Rules 2016; microplastics below 5 mm; Bhopal 1984 MIC; Minamata mercury; itai-itai cadmium; Chernobyl 1986.

### Climate Change, the Greenhouse Effect and Ozone Depletion

**The greenhouse effect:** Sunlight reaches the Earth mostly as short-wave radiation and warms the surface, which then gives off heat as long-wave infrared radiation. Greenhouse gases in the atmosphere absorb part of this infrared and send it back, keeping the planet warm. This natural effect is essential: without it the Earth's average surface temperature would be about minus 18 degrees Celsius instead of about 15 degrees Celsius. The problem is the enhanced greenhouse effect, the extra warming from gases added by human activity since the Industrial Revolution. The Swedish scientist Svante Arrhenius calculated in 1896 that a change in carbon dioxide could change the Earth's temperature, and since 1958 Charles David Keeling's measurements at Mauna Loa in Hawaii have recorded a steady rise of carbon dioxide (the Keeling curve) above its pre-industrial level of about 280 parts per million.

**The greenhouse gases:** Water vapour is the most abundant natural greenhouse gas, but the concern is the gases human activity adds. Carbon dioxide comes from burning coal, oil and gas and from deforestation; methane from paddy fields, cattle, landfills and wetlands; nitrous oxide from nitrogen fertilisers; and chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) from industry. The Kyoto Protocol's original basket has six: CO2, CH4, N2O, HFCs, PFCs and SF6; the Doha Amendment of 2012 added nitrogen trifluoride (NF3) for its second period. The NCERT textbook gives the relative contribution to warming as carbon dioxide 60 per cent, methane 20, CFCs 14 and nitrous oxide 6 per cent. Each gas has a global warming potential (GWP) measured against carbon dioxide, which is taken as 1, and SF6 has the highest GWP among the Kyoto gases.

**Effects of global warming:** Warming melts glaciers and ice sheets and makes sea water expand, so the sea level rises and threatens low-lying islands such as the Maldives and Tuvalu, deltas such as the Sundarbans, and coastal cities. Himalayan glaciers such as Gangotri are retreating, which affects the rivers they feed. Heat waves, droughts, very heavy rainfall and intense cyclones become more frequent; monsoon patterns become less reliable; and crops

and fisheries suffer. The oceans absorb part of the carbon dioxide and become more acidic, which, with warmer water, causes coral bleaching.

**The ozone layer:** Ozone (O3) is a molecule of three oxygen atoms. Most of it lies in the stratosphere, roughly 15 to 35 km above the Earth, where ultraviolet rays split oxygen molecules and the free atoms join other oxygen molecules to form ozone. This layer absorbs most of the Sun's harmful ultraviolet-B (UV-B) radiation, so it is called good ozone, while ozone at ground level is a harmful pollutant in smog. Ozone is measured in Dobson Units (DU); a normal column is about 300 DU, and an area where it falls below 220 DU is called an ozone hole. More UV-B at the ground causes skin cancer, cataract and snow blindness, weakens immunity, and harms phytoplankton and crops.

**Ozone depletion and the ozone hole:** CFCs, once used in refrigerators, air conditioners, aerosol sprays and foam, are stable near the ground and slowly drift up to the stratosphere. There ultraviolet rays break them and release chlorine atoms, which destroy ozone in a chain reaction, so one chlorine atom can destroy many thousands of ozone molecules. Halons from fire extinguishers release bromine, which is even more destructive, and carbon tetrachloride, methyl chloroform and methyl bromide also deplete ozone. Mario Molina and F. Sherwood Rowland warned about CFCs in 1974 and shared the 1995 Nobel Prize in Chemistry with Paul Crutzen. The Antarctic ozone hole was reported in 1985 by Joseph Farman and colleagues of the British Antarctic Survey. It forms every southern spring, in September and October, because very cold polar stratospheric clouds inside the polar vortex speed up the chlorine reactions. The Montreal Protocol of 1987 phased out CFCs, and 16 September is World Ozone Day.

**Carbon footprint:** A carbon footprint is the total greenhouse gas emission caused directly and indirectly by a person, organisation, event or product, expressed in tonnes of carbon dioxide equivalent. It can be reduced by saving energy, using public transport, switching to renewable power and cutting waste. Related exam terms: black carbon is soot from incomplete burning that darkens snow and ice and speeds melting; green carbon is the carbon stored in forests; blue carbon is the carbon stored in mangroves, seagrass and salt marshes.

**Carbon credits and offsets:** One carbon credit is a tradable certificate equal to one tonne of carbon dioxide, or its equivalent, reduced or removed. Under cap and trade, a government fixes a limit on total emissions; a company that emits less than its allowance can sell the surplus to one that emits more. The Kyoto Protocol created three market mechanisms: international emissions trading, Joint Implementation and the Clean Development Mechanism (CDM), under which developed countries earned Certified Emission Reductions (CERs) by funding clean projects in developing countries such as India, a major host of CDM projects. A carbon offset lets someone balance their own emissions by paying for an equal reduction elsewhere. Carbon neutral, or net zero, means emissions are balanced by removals.

### Examples

- Without the natural greenhouse effect the Earth's average surface temperature would be about minus 18 degrees Celsius instead of about 15 degrees Celsius.
- Keeling curve: carbon dioxide measured at Mauna Loa, Hawaii, since 1958; the pre-industrial level was about 280 ppm; Arrhenius linked CO2 and temperature in 1896.
- Kyoto's original basket of six gases: CO2, CH4, N2O, HFCs, PFCs, SF6 (NF3 added by the Doha Amendment, 2012); SF6 has the highest global warming potential among them.
- NCERT share of warming: CO2 60 per cent, methane 20, CFCs 14, nitrous oxide 6 per cent; methane comes from paddy fields, cattle and landfills.
- Ozone layer: in the stratosphere, about 15 to 35 km up; absorbs UV-B; measured in Dobson Units (normal about 300 DU; ozone hole below 220 DU).
- Ozone destroyers: CFCs (chlorine), halons (bromine), carbon tetrachloride, methyl chloroform, methyl bromide; one chlorine atom destroys thousands of ozone molecules.
- Ozone hole over Antarctica reported in 1985 (Farman, British Antarctic Survey); Molina, Rowland and Crutzen won the 1995 Nobel Prize in Chemistry.
- Carbon types: black carbon = soot; green carbon = forests; blue carbon = mangroves, seagrass and salt marshes.
- One carbon credit = one tonne of CO2 equivalent; Kyoto mechanisms: emissions trading, Joint Implementation, Clean Development Mechanism (CERs).

**Quick revision:** Natural greenhouse effect keeps Earth at about 15 C instead of minus 18 C; Arrhenius 1896; Keeling curve from 1958, pre-industrial CO2 280 ppm; Kyoto's original six gases; NCERT shares CO2 60, CH4 20, CFCs 14, N2O 6 per cent; ozone in stratosphere 15-35 km, Dobson Units, hole below 220 DU; CFC chlorine, halon bromine; ozone hole reported 1985; Nobel 1995; carbon credit = 1 tonne CO2e; CDM gives CERs.

### International Environmental Conventions: From Stockholm 1972 to the Paris Agreement

Stockholm 1972 and UNEP: The United Nations Conference on the Human Environment, held in Stockholm, Sweden, from 5 to 16 June 1972, was the first world conference to make the environment a major international issue. It adopted the Stockholm Declaration of 26 principles and an action plan, and led to the creation of the United Nations Environment Programme (UNEP) the same year, with headquarters in Nairobi, Kenya. The opening day, 5 June, became World Environment Day. Prime Minister Indira Gandhi spoke there, linking poverty with the environment, and India's Air Act 1981 and Environment (Protection) Act 1986 were passed to carry out the Stockholm decisions.

**The Brundtland Report:** The World Commission on Environment and Development, chaired by Gro Harlem Brundtland, former Prime Minister of Norway, published Our Common Future in 1987. It gave the best-known definition of sustainable development: development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Rio Earth Summit 1992: The UN Conference on Environment and Development (UNCED), called the Earth Summit, was held in Rio de Janeiro, Brazil, in June 1992. It produced the Rio Declaration of 27 principles, including the precautionary principle, the polluter pays principle and common but differentiated responsibilities; Agenda 21, a non-binding action plan for sustainable development in the 21st century; and the non-binding Forest Principles. Two binding conventions were opened for signature there: the UN Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). The UN Convention to Combat Desertification (UNCCD), adopted in 1994, completes the three Rio conventions. Rio+10 was held at Johannesburg in 2002 and Rio+20 in Rio in 2012.

**Climate treaties:** The UNFCCC came into force in 1994, has its secretariat in Bonn, Germany, and holds a yearly Conference of the Parties (COP), the first in Berlin in 1995. It divides countries into Annex I (industrialised countries and economies in transition) and non-Annex I countries such as India. The Kyoto Protocol, adopted at COP3 in Kyoto, Japan, in December 1997 and in force from 2005, set binding targets only for Annex I countries: an average cut of 5.2 per cent below 1990 levels in the first commitment period, 2008 to 2012; the Doha Amendment of 2012 added a second period up to 2020. The Paris Agreement, adopted at COP21 in December 2015 and in force from 4 November 2016, commits all parties to hold warming well below 2 degrees Celsius above pre-industrial levels and to try for 1.5 degrees. Each country sets its own Nationally Determined Contribution (NDC), renewed every five years. India ratified it on 2 October 2016, Gandhi Jayanti.

**Ozone treaties:** The Vienna Convention for the Protection of the Ozone Layer (1985) was the framework, and the Montreal Protocol on Substances that Deplete the Ozone Layer, signed on 16 September 1987 and in force from 1989, set binding phase-out schedules for CFCs, halons and other ozone-depleting substances. Its Multilateral Fund helps developing countries switch, and with the Vienna Convention it became the first UN treaty ratified by every country. The Kigali Amendment, agreed in Rwanda in October 2016, brought hydrofluorocarbons (HFCs), which do not harm ozone but are powerful greenhouse gases, under a phase-down; India's group must freeze HFC use in 2028 and cut it by 85 per cent by 2047.

**Chemicals and waste:** The Basel Convention (1989) controls the movement of hazardous wastes across borders and their disposal, after rich countries were found dumping toxic waste in poorer ones. The Rotterdam Convention (1998) sets up the Prior Informed Consent (PIC) procedure, so a country must be informed and must agree before certain hazardous chemicals and pesticides are exported to it. The Stockholm Convention (2001) aims to eliminate or restrict persistent organic pollutants (POPs), starting with the dirty dozen such as DDT, aldrin, dieldrin, PCBs, dioxins and furans; DDT is still allowed for malaria control. The three share a joint secretariat in Geneva, and the Minamata Convention (2013) controls mercury.

**Biodiversity treaties:** The CBD, in force from 29 December 1993 with its secretariat in Montreal, Canada, has three objectives: conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of the benefits from genetic resources. The Cartagena Protocol on Biosafety (adopted in 2000, in force 2003) governs the movement of living modified organisms, that is genetically modified organisms, across borders. The Nagoya Protocol on Access and Benefit Sharing (adopted in Japan in 2010, in force 2014) ensures that the countries and communities that provide genetic resources and traditional knowledge share in the benefits of their use. Other wildlife treaties are Ramsar (1971), CITES (1973) and the Bonn Convention on Migratory Species (1979).

**IPCC:** The Intergovernmental Panel on Climate Change was set up in 1988 by the World Meteorological Organization (WMO) and UNEP, with its secretariat in Geneva. It does no research of its own; it assesses published science and issues Assessment Reports, the first in 1990. It shared the 2007 Nobel Peace Prize with former US Vice-President Al Gore.

**Examples**

- Stockholm Conference, 5-16 June 1972: first UN environment conference; created UNEP (Nairobi); 5 June became World Environment Day.
- Brundtland Report, Our Common Future (1987): defined sustainable development as meeting present needs without compromising those of future generations.
- Rio Earth Summit 1992 outcomes: Rio Declaration (27 principles), Agenda 21, Forest Principles, UNFCCC and CBD; UNCCD followed in 1994.
- Kyoto Protocol: adopted at COP3, 1997; in force 2005; Annex I countries to cut 5.2 per cent below 1990 levels in 2008-2012.
- Paris Agreement: COP21, 2015; in force 4 November 2016; well below 2 degrees Celsius, aiming for 1.5; NDCs every five years; India ratified on 2 October 2016.
- Ozone: Vienna Convention 1985 (framework), Montreal Protocol 16 September 1987 (CFCs), Kigali Amendment 2016 (HFC phase-down; India's group freezes in 2028).
- Chemical conventions: Basel 1989 (hazardous waste), Rotterdam 1998 (prior informed consent), Stockholm 2001 (POPs, dirty dozen), Minamata 2013 (mercury).
- Under the CBD: Cartagena Protocol (biosafety, GMOs; adopted 2000) and Nagoya Protocol (access and benefit sharing; adopted 2010).
- Secretariats: UNEP Nairobi, UNFCCC Bonn, CBD Montreal, IPCC and the Basel-Rotterdam-Stockholm conventions Geneva.
- IPCC: set up in 1988 by WMO and UNEP; first Assessment Report 1990; shared the 2007 Nobel Peace Prize with Al Gore.

> **Quick revision:** Stockholm 1972 (UNEP, 5 June); Brundtland 1987; Rio 1992: Rio Declaration, Agenda 21, UNFCCC, CBD; UNCCD 1994; UNFCCC in force 1994, Bonn; Kyoto 1997 (COP3), in force 2005, 5.2 per cent cut; Paris 2015 (COP21), in force 2016, well below 2 C; Vienna 1985; Montreal 1987; Kigali 2016 (HFCs); Basel 1989, Rotterdam 1998, Stockholm 2001; Cartagena 2000; Nagoya 2010; IPCC 1988 (WMO, UNEP).

### Environmental Laws and Movements in India: Constitution, Acts, NGT and Chipko

**The Constitution:** The original Constitution had no direct provision on the environment. The 42nd Amendment of 1976 added Article 48A, a Directive Principle that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country, and Article 51A(g), a Fundamental Duty of every citizen to protect and improve the natural environment, including forests, lakes, rivers and wildlife, and to have compassion for living creatures. The same amendment moved forests and the protection of wild animals and birds from the State List to the Concurrent List. The Supreme Court has read the right to a clean and healthy environment into the right to life under Article 21. Article 253, which lets Parliament make laws to carry out international agreements, was the basis of the Air Act 1981 and the Environment (Protection) Act 1986.

**Wildlife, water and forest laws:** The Wildlife (Protection) Act 1972 bans hunting of listed species and provides for sanctuaries and national parks. The Water (Prevention and Control of Pollution) Act 1974 was India's first major

pollution law; because water is a State subject, it was passed under Article 252 after states asked for it. It set up the Central Pollution Control Board (CPCB) and the State Pollution Control Boards. The Forest (Conservation) Act 1980 requires the Central Government's prior approval before a state de-reserves a forest or uses forest land for non-forest purposes such as mining; it was amended and renamed the Van (Sanrakshan Evam Samvardhan) Adhiniyam in 2023. The National Forest Policy 1988 aims at one-third (33 per cent) of the land under forest or tree cover, and two-thirds in the hills.

**Air and umbrella laws:** The Air (Prevention and Control of Pollution) Act 1981 gave the pollution control boards power over air quality, and a 1987 amendment brought noise within the meaning of air pollutant. After the Bhopal gas tragedy, the Environment (Protection) Act 1986 was passed as an umbrella law. It empowers the Central Government to set emission and discharge standards, regulate hazardous substances and close polluting industries; the Environmental Impact Assessment (EIA) notification of 1994 (replaced in 2006), the Coastal Regulation Zone notification of 1991 and the rules on solid, plastic and e-waste are issued under it. The Public Liability Insurance Act 1991 makes industries handling hazardous substances insure against accidents.

**Biodiversity, forest rights and the NGT:** The Biological Diversity Act 2002, passed to carry out India's commitments under the CBD, set up a three-tier structure: the National Biodiversity Authority at Chennai, State Biodiversity Boards, and Biodiversity Management Committees in local bodies, which prepare People's Biodiversity Registers. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 recognises individual and community rights over forest land and produce; an individual claim can cover up to 4 hectares, the cut-off date is 13 December 2005, other traditional forest dwellers must show residence over three generations (75 years), and the Gram Sabha plays the central role. The National Green Tribunal, set up under the NGT Act 2010, hears civil cases under the environmental laws, sits at New Delhi with zonal benches at Bhopal, Pune, Kolkata and Chennai, and aims to decide cases within 6 months. India is often described as the third country, after Australia and New Zealand, to set up such a specialised tribunal.

**Court-made principles and the CPCB:** Indian courts have built environmental law through public interest litigation. The polluter pays principle (Indian Council for Enviro-Legal Action case, 1996), the precautionary principle (Vellore Citizens Welfare Forum case, 1996) and the public trust doctrine (M.C. Mehta v. Kamal Nath, judgment of December 1996, often cited as 1997) are now part of Indian law. The CPCB, a statutory body under the environment ministry, advises the Centre, sets standards, coordinates the state boards and runs national monitoring of air and water quality.

**Forest movements:** In 1730 at Khejarli near Jodhpur, Amrita Devi Bishnoi and 363 Bishnois gave their lives to stop the felling of khejri trees for the Maharaja of Marwar. The Chipko movement began in 1973 in Chamoli district of present-day Uttarakhand, when villagers hugged trees to stop commercial felling; Chandi Prasad Bhatt of the Dasholi Gram Swarajya Sangh, Sunderlal Bahuguna and Gaura Devi of Reni village were its leading figures. It led in 1980 to a 15-year ban on green felling in the Himalayan forests of Uttar Pradesh. Appiko, Chipko's southern echo, began in 1983 at Salkani in Uttara Kannada district of Karnataka under Panduranga Hegde.

**Dam and river movements:** The Silent Valley movement in Kerala's Palakkad district opposed a hydroelectric dam on the Kunthipuzha river that would have drowned a rare tropical evergreen rainforest, home of the lion-tailed macaque. The Kerala Sastra Sahitya Parishad and the poet Sugathakumari led the campaign; the project was dropped and Silent Valley was declared a national park in 1984. The Narmada Bachao Andolan, led from the mid-1980s by Medha Patkar with the support of Baba Amte, fought the displacement caused by the Sardar Sarovar and other Narmada dams; the World Bank withdrew its funding in 1993.

### Examples

- Articles 48A (Directive Principle) and 51A(g) (Fundamental Duty) on the environment were added by the 42nd Amendment, 1976; forests and wildlife moved to the Concurrent List.
- Article 21 (right to life) includes the right to a healthy environment; Article 253 was the basis of the Air Act 1981 and the Environment (Protection) Act 1986.
- Water Act 1974 was passed under Article 252 and created the CPCB; noise became an air pollutant through the 1987 amendment of the Air Act 1981.

- Forest (Conservation) Act 1980 needs Central approval for diverting forest land; renamed the Van (Sanrakshan Evam Samvardhan) Adhiniyam in 2023; National Forest Policy 1988 aims at 33 per cent cover.
- Biological Diversity Act 2002: National Biodiversity Authority (Chennai), State Biodiversity Boards, Biodiversity Management Committees with People's Biodiversity Registers.
- Forest Rights Act 2006: up to 4 hectares per individual claim; cut-off date 13 December 2005; 75 years of residence for other traditional forest dwellers; Gram Sabha decides.
- NGT Act 2010: principal bench New Delhi; zonal benches Bhopal, Pune, Kolkata, Chennai; cases to be decided within 6 months.
- Court principles: polluter pays and precautionary principle (both 1996 cases), public trust doctrine (M.C. Mehta v. Kamal Nath, decided December 1996, often cited as 1997).
- Movements: Khejarli 1730 (Amrita Devi, 363 Bishnois); Chipko 1973 (Chamoli; Bhatt, Bahuguna, Gaura Devi); Appiko 1983 (Panduranga Hegde); Silent Valley NP 1984; Narmada Bachao (Medha Patkar).

> **Quick revision:** Articles 48A and 51A(g) by 42nd Amendment 1976; Article 21 covers healthy environment; WPA 1972; Water Act 1974 (Article 252, CPCB); Forest Conservation Act 1980; Air Act 1981 (noise 1987); EPA 1986 after Bhopal; PLI Act 1991; Biological Diversity Act 2002 (NBA Chennai); FRA 2006 (4 ha, 13 Dec 2005); NGT 2010 (New Delhi, 6 months); Khejarli 1730; Chipko 1973; Appiko 1983; Silent Valley NP 1984; NBA Medha Patkar.

### Energy Resources and Sustainable Development: Renewables, Nuclear Power and the SDGs

**Kinds of energy:** Energy sources are non-renewable, such as coal, petroleum, natural gas and uranium, which took millions of years to form and will run out, or renewable, such as sunlight, wind, flowing water, biomass, geothermal heat and tides, which nature keeps replenishing. India's National Action Plan on Climate Change (2008) set out eight national missions, including the National Solar Mission and the National Mission for Enhanced Energy Efficiency.

**Solar and wind energy:** Solar photovoltaic (PV) cells, made mostly of silicon, turn sunlight directly into electricity, while solar thermal devices such as solar cookers, water heaters and concentrating solar plants use the sun's heat. Most of India gets about 250 to 300 clear sunny days a year. The Jawaharlal Nehru National Solar Mission was launched in 2010; Cochin International Airport became the world's first fully solar-powered airport in 2015; and the International Solar Alliance, launched by India and France at the Paris climate conference in 2015, has its headquarters in Gurugram, Haryana. A wind farm needs steady winds faster than about 15 km/h. Tamil Nadu, notably around Muppandal near Kanyakumari, and Gujarat have large wind farms, and the National Institute of Wind Energy is in Chennai.

**Hydro, biomass, geothermal and tidal energy:** Hydropower uses the energy of water stored behind dams; in India projects up to 25 MW count as small hydro. Large dams such as Bhakra Nangal on the Sutlej, which Jawaharlal Nehru called a temple of modern India, give power and irrigation but displace people. Biogas (gobar gas), made by anaerobic bacteria from dung and plant waste in a digester, contains up to about 75 per cent methane and leaves slurry that is good manure; biofuels include ethanol from sugarcane molasses blended with petrol and biodiesel from oilseeds such as jatropha. Geothermal energy taps the Earth's internal heat at hot springs; Puga valley in Ladakh is India's most promising site. Tidal energy uses the rise and fall of tides through a barrage; India's potential lies in the Gulf of Kutch and Gulf of Khambhat in Gujarat and in the Sundarbans, and France's La Rance plant (1966) was the world's first major tidal power station. Ocean thermal energy conversion needs a temperature difference of at least 20 degrees Celsius between surface and deep water.

**Nuclear power in India:** Nuclear power plants produce heat by the fission of uranium-235 and use it to raise steam; they emit almost no carbon dioxide but leave radioactive waste. Homi J. Bhabha, the father of India's nuclear programme, led the Atomic Energy Commission set up in 1948, and the Department of Atomic Energy followed in 1954. Apsara at Trombay (1956) was Asia's first research reactor, and Tarapur in Maharashtra (1969) was India's first nuclear power station. Bhabha's three-stage programme uses pressurised heavy water reactors burning natural uranium, then fast breeder reactors using plutonium (the Fast Breeder Test Reactor at Kalpakkam started in 1985), and finally reactors using thorium, which India has in plenty in the monazite sands of the Kerala and Odisha coasts. Other plants are at Rawatbhata (Rajasthan), Kalpakkam (Tamil Nadu), Narora (Uttar Pradesh), Kakrapar (Gujarat),

Kaiga (Karnataka) and Kudankulam (Tamil Nadu). Nuclear Power Corporation of India Limited (1987) runs them, and the Atomic Energy Regulatory Board (1983) oversees safety.

**Energy conservation:** Saving energy is the cheapest new source of energy. The Energy Conservation Act 2001 led to the Bureau of Energy Efficiency (BEE) in 2002, which runs the star labelling programme (more stars mean a more efficient appliance), the Energy Conservation Building Code and the Perform, Achieve and Trade (PAT) scheme for energy-intensive industries. The UJALA scheme of 2015 spread LED bulbs, and 14 December is National Energy Conservation Day.

**Sustainable development and the SDGs:** Sustainable development, as the Brundtland Report of 1987 defined it, meets present needs without harming the ability of future generations to meet theirs, balancing economic growth, social equity and environmental protection. The eight Millennium Development Goals (2000-2015) were followed by the 2030 Agenda for Sustainable Development, adopted by the UN General Assembly on 25 September 2015, with 17 Sustainable Development Goals and 169 targets to be met by 2030. Among them are Goal 1 (no poverty), Goal 2 (zero hunger), Goal 6 (clean water and sanitation), Goal 7 (affordable and clean energy), Goal 13 (climate action), Goal 14 (life below water) and Goal 15 (life on land).

**Rainwater harvesting:** Rainwater harvesting means catching rain where it falls, from rooftops and open ground, and either storing it in tanks or sending it into the ground through recharge pits, trenches and wells to raise the water table. Tamil Nadu was the first state to make rooftop rainwater harvesting compulsory for buildings. India has many traditional systems: khadins, kunds and tankas in the Thar desert, johads (small earthen check dams) in Rajasthan, kuls in Himachal Pradesh, zabo in Nagaland, eris (tanks) in Tamil Nadu and bamboo drip irrigation in Meghalaya. Rajendra Singh of the Tarun Bharat Sangh, called the Waterman of India, revived rivers such as the Arvari in Alwar district by building johads.

### Examples

- National Action Plan on Climate Change (2008) has eight missions; the Jawaharlal Nehru National Solar Mission began in 2010.
- International Solar Alliance: launched by India and France at Paris in 2015; headquarters Gurugram, Haryana. Cochin airport became the first fully solar-powered airport in 2015.
- Wind farms need steady winds above about 15 km/h; Muppandal near Kanyakumari (Tamil Nadu) is a major wind area; National Institute of Wind Energy, Chennai.
- Biogas contains up to about 75 per cent methane; hydro projects up to 25 MW are small hydro in India; Puga valley (Ladakh) is the leading geothermal site.
- Tidal energy: Gulf of Kutch, Gulf of Khambhat and Sundarbans; La Rance (France, 1966) was the first major tidal power station; OTEC needs a difference of 20 degrees Celsius.
- Nuclear firsts: Atomic Energy Commission 1948, Apsara reactor 1956 (Asia's first), Tarapur 1969 (first nuclear power station), Fast Breeder Test Reactor at Kalpakkam 1985.
- Three-stage nuclear programme (Homi Bhabha): natural uranium in heavy water reactors, plutonium in fast breeders, then thorium from monazite sands.
- Energy Conservation Act 2001; Bureau of Energy Efficiency 2002 (star labels); UJALA LED scheme 2015; National Energy Conservation Day 14 December.
- SDGs: adopted 25 September 2015; 17 goals, 169 targets, deadline 2030; Goal 7 is clean energy, Goal 13 climate action, Goal 14 life below water, Goal 15 life on land.
- Traditional water harvesting: khadins, kunds and tankas (Thar), johads (Rajasthan), kuls (Himachal), zabo (Nagaland), eris (Tamil Nadu), bamboo drip (Meghalaya).

> **Quick revision:** NAPCC 2008, eight missions; Solar Mission 2010; ISA 2015, Gurugram; wind needs over 15 km/h; small hydro up to 25 MW; biogas up to 75 per cent methane; Puga geothermal; La Rance 1966 tidal; AEC 1948, Apsara 1956, Tarapur 1969, FBTR 1985; three stages ending in thorium; BEE 2002; UJALA 2015; SDGs 25 September 2015, 17 goals, 169 targets, 2030; Tamil Nadu first to mandate rooftop harvesting.

Free practice questions: parikshasaathi.com/q/environment-ecology/

## General Science

### General Science (Physics, Chemistry, Biology)

**What the exam asks:** General Science is the biggest scoring block in RRB Group D and ALP (25 questions at Class 10 level) and gives 8 to 12 questions in RRB NTPC, SSC CGL/CHSL/GD, Agniveer, state police and state PSC prelims. Questions are factual, NCERT level: units and instruments, laws and their everyday applications, chemical names and formulae, human body numbers, vitamins, disease agents and discoverers. Physics, chemistry and biology carry roughly a third each.

**Physics - measurement and mechanics:** Learn SI units as pairs: force-newton, pressure-pascal, energy-joule, power-watt, frequency-hertz, charge-coulomb, current-ampere, resistance-ohm. Instruments: barometer (atmospheric pressure), hygrometer (humidity), hydrometer (density of liquids), anemometer (wind speed), ammeter (current), voltmeter (potential difference), sphygmomanometer (blood pressure). Newton's first law is the law of inertia, the second gives F = ma, the third explains rockets. Mass is constant everywhere; weight = mg is one-sixth on the Moon. Escape velocity from Earth is 11.2 km/s. One kWh = 3.6 x 10^6 J. Pascal's law runs hydraulic brakes; capillary action lifts kerosene in a wick.

**Physics - heat, sound and light:** Water is densest at 4 degrees C, so ice floats. Celsius and Fahrenheit read the same at -40; body temperature is 37 degrees C = 98.6 degrees F. A thermos flask blocks conduction and convection with vacuum and radiation with silvered walls. Sound needs a medium: fastest in solids (steel about 5000 m/s), then water (1500), then air (340), none in vacuum. Audible range is 20 Hz to 20 kHz; above that is ultrasonic. An echo needs about 17 m. Doppler effect: an approaching siren sounds higher. The sky is blue and sunsets red because of scattering; a rainbow is dispersion; mirage, diamond sparkle and optical fibre are total internal reflection. Convex mirrors are rear-view mirrors; concave mirrors are used in headlights. Myopia needs a concave lens, hypermetropia convex, astigmatism cylindrical, presbyopia bifocals.

**Physics - electricity and modern physics:** Ohm's law V = IR. A fuse has low melting point and high resistance and sits in series with the live wire. A transformer works by mutual induction and only on AC; a motor converts electrical to mechanical energy, a generator the reverse. Alpha is stopped by paper, beta by aluminium foil, gamma needs lead. Fission (U-235) runs reactors and the atom bomb; fusion powers the Sun. Silicon and germanium are semiconductors. Roentgen discovered X-rays, Becquerel radioactivity, Marie Curie radium.

**Chemistry - atom, periodic table and bonding:** Electron (Thomson), proton (Rutherford; Goldstein's canal rays were an earlier clue), neutron (Chadwick), nucleus (Rutherford's gold-foil experiment). Atomic number = protons; mass number = protons + neutrons. Isotopes: same atomic number, different mass number; isobars: same mass number, different atomic number. Mendeleev used atomic mass; the modern law uses atomic number. Group 1 alkali metals, group 2 alkaline earth metals, group 17 halogens, group 18 noble gases. Ionic bond = electron transfer; covalent = sharing. Reactivity series: K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Hg > Ag > Au.

**Chemistry - compounds, processes and everyday chemistry:** Baking soda NaHCO3; washing soda Na2CO3.10H2O; caustic soda NaOH; bleaching powder CaOCl2; plaster of Paris CaSO4.1/2H2O (from gypsum CaSO4.2H2O); quicklime CaO; slaked lime Ca(OH)2; marsh gas methane; laughing gas N2O; dry ice solid CO2; vinegar acetic acid. pH below 7 is acidic, above 7 basic; blood is about 7.4; litmus is red in acid and blue in base; phenolphthalein is pink in base. Processes: Haber (ammonia, iron catalyst), Contact (sulphuric acid, V2O5), Ostwald (nitric acid), galvanisation (zinc), vulcanisation (sulphur), hydrogenation (nickel). Alloys: brass Cu + Zn; bronze Cu + Sn; stainless steel Fe + Cr + Ni. Rusting needs both oxygen and moisture. Temporary hardness (bicarbonates) goes on boiling; permanent (chlorides, sulphates) does not. LPG is mainly butane, CNG methane; graphite conducts, diamond does not.

**Biology - cell, plants and classification:** Hooke named the cell, Robert Brown found the nucleus. Mitochondria are the powerhouse, ribosomes make proteins, lysosomes are suicide bags, the plant cell wall is cellulose. Mitosis gives two identical cells; meiosis halves the chromosome number. Whittaker gave the five kingdoms. In photosynthesis the oxygen comes from water. Xylem carries water, phloem carries food. Hormones: auxin (growth), gibberellin (stem elongation), cytokinin (cell division), ethylene (ripening). Stamen is male, carpel female.

**Biology - human body, nutrition and disease:** Ptyalin digests starch, pepsin protein, bile emulsifies fat; the liver is the largest gland. The heart has 4 chambers; RBCs live about 120 days; O negative is the universal donor, AB positive the recipient. Nephron is the unit of the kidney, alveolus of the lung. Cerebrum thinks, cerebellum balances, medulla controls heartbeat. Pituitary is the master gland; insulin from the pancreas, thyroxine from the thyroid. Adult: 206 bones, 46 chromosomes. Vitamins: A retinol (night blindness), B1 thiamine (beri-beri), B3 niacin (pellagra), B12 (pernicious anaemia), C ascorbic acid (scurvy), D calciferol (rickets), K (clotting); protein deficiency gives kwashiorkor. Bacterial: TB, cholera, typhoid; viral: polio, measles, rabies, dengue; protozoan: malaria, kala-azar; fungal: ringworm. Vectors: Anopheles (malaria), Aedes (dengue), Culex (filaria). Genetic: haemophilia, colour blindness. Jenner (smallpox vaccine), Pasteur (rabies vaccine), Fleming (penicillin), Mendel (genetics), Watson and Crick (DNA).

**Traps:** mass vs weight; 98.6 is Fahrenheit, not Celsius; sound does not travel in vacuum; myopia-concave, hypermetropia-convex; isotopes vs isobars; galvanisation is zinc, not tin; baking soda vs washing soda; malaria is protozoan, dengue viral; vitamin B1 vs B12; Jenner vs Pasteur; the universal donor is O negative, not O positive.

**Examples**

- SI unit pairs to chant: force-newton, pressure-pascal, energy-joule, power-watt, frequency-hertz, charge-coulomb, resistance-ohm, magnetic flux-weber.
- Mass never changes; weight = mg does. On the Moon your weight is one-sixth but your mass is the same. Escape velocity from Earth is 11.2 km/s.
- Celsius and Fahrenheit meet at -40. Normal body temperature is 37 degrees C = 98.6 degrees F. Water is densest at 4 degrees C, so ice floats.
- Sound: steel (about 5000 m/s) > water (1500) > air (340) > vacuum (nothing). Echo needs at least about 17 m. Above 20 kHz is ultrasonic.
- Eye defects: Myopia-Concave (M-C), Hypermetropia-Convex (both start with letters later in the alphabet), astigmatism-cylindrical, presbyopia-bifocal.
- Radiation penetration: alpha stopped by paper, beta by aluminium foil, gamma needs lead. Sun = fusion; reactor and atom bomb = fission.
- Discoverers: electron-Thomson, proton-Rutherford (Goldstein's canal rays were an earlier clue), neutron-Chadwick, nucleus-Rutherford, X-rays-Roentgen, radioactivity-Becquerel, radium-Marie Curie.
- Formula card: baking soda NaHCO3, washing soda Na2CO3.10H2O, bleaching powder CaOCl2, plaster of Paris CaSO4.1/2H2O, gypsum CaSO4.2H2O, quicklime CaO, slaked lime Ca(OH)2.
- Processes and catalysts: Haber-ammonia-iron; Contact-sulphuric acid-V2O5; Ostwald-nitric acid-platinum; hydrogenation-nickel; vulcanisation-sulphur; galvanisation-zinc.
- Alloys: brass = Cu + Zn, bronze = Cu + Sn, stainless steel = Fe + Cr + Ni, German silver = Cu + Zn + Ni, solder = Pb + Sn.
- Vitamin-disease chain: A (retinol) night blindness; B1 (thiamine) beri-beri; B3 (niacin) pellagra; B12 pernicious anaemia; C (ascorbic acid) scurvy; D (calciferol) rickets; K clotting.
- Disease-agent-vector: malaria-Plasmodium (protozoan)-female Anopheles; dengue-virus-Aedes; filaria-worm-Culex; kala-azar-protozoan-sandfly; TB-bacterium (Koch), vaccine BCG.

> **Quick revision:** Pressure unit pascal; 1 kWh = 3.6 x 10^6 J; escape velocity 11.2 km/s; weight on Moon one-sixth; water densest at 4 C; -40 same on C and F; sound fastest in solids, none in vacuum; sky blue by scattering; myopia concave, hypermetropia convex; fuse low melting point; transformer only AC; neutron Chadwick, nucleus Rutherford; periodic law atomic number; baking soda NaHCO3; bleaching powder CaOCl2; Haber ammonia, Contact H2SO4; galvanisation zinc; brass Cu+Zn; 206 bones; 46 chromosomes; O negative universal donor; insulin pancreas; vitamin C scurvy, D rickets; malaria protozoan, Anopheles.

### Physical Quantities, Units and Motion (Newton's Laws, Momentum, Friction)

**SI base and derived units:** A physical quantity is anything that can be measured and expressed as a number with a unit. The International System of Units (SI), adopted in 1960, rests on 7 base quantities: length (metre), mass (kilogram), time (second), electric current (ampere), temperature (kelvin), amount of substance (mole) and luminous intensity (candela). All other units are derived from these: force in newton (1 N = 1 kg m/s^2), work and energy in

joule (1 J = 1 N m), power in watt (1 W = 1 J/s) and pressure in pascal (1 Pa = 1 N/m^2). Exams often ask which unit in a list is not a base unit; newton, joule, watt and pascal are all derived. Tiny lengths use the angstrom (10^-10 m) and the nanometre (10^-9 m); astronomical distances use the light year (about 9.46 x 10^15 m), which is a distance and not a time, and the parsec (about 3.26 light years).

**Scalars, vectors and displacement:** A scalar has only magnitude (mass, time, distance, speed, work, energy, pressure); a vector has magnitude and direction (displacement, velocity, acceleration, force, weight, momentum). Electric current has a direction of flow but is a scalar because it does not add by the vector rule, a favourite trap. Distance is the total length of the path covered; displacement is the straight-line separation between the starting and finishing points, with direction. Distance is never less than displacement, and displacement can be zero when distance is not: an athlete who completes one lap of a circular track of radius r covers 2πr but ends with zero displacement, while after half a lap the displacement equals the diameter, 2r.

**Speed, velocity and acceleration:** Speed is distance divided by time; velocity is displacement divided by time, so velocity changes whenever the speed or the direction changes. Uniform circular motion, like that of a satellite in a circular orbit, is therefore accelerated motion even at constant speed. Acceleration is the rate of change of velocity (m/s^2); negative acceleration is called retardation. To convert, 1 km/h = 5/18 m/s, so 72 km/h = 20 m/s. A speedometer shows instantaneous speed and an odometer the distance covered. The slope of a distance-time graph gives speed, the slope of a velocity-time graph gives acceleration, and the area under a velocity-time graph gives displacement.

**Equations of motion and free fall:** For uniform acceleration, v = u + at, s = ut + (1/2)at^2 and v^2 = u^2 + 2as, where u is the initial velocity and v the final velocity. A freely falling body accelerates at g, about 9.8 m/s^2, so a stone dropped from rest moves at 19.6 m/s after 2 s. As Galileo argued, without air resistance heavy and light bodies fall together; in a tube emptied of air a feather and a coin land at the same moment.

Newton's three laws: Isaac Newton published his laws of motion in the Principia in 1687. The first law (law of inertia) says a body stays at rest or in uniform straight-line motion unless an unbalanced force acts on it; mass is the measure of inertia. Passengers lurch forward when a bus brakes suddenly and fall back when it starts suddenly, and dust leaves a carpet when it is beaten. The second law makes force equal to the rate of change of momentum, giving F = ma; 1 newton gives a mass of 1 kg an acceleration of 1 m/s^2. Force multiplied by time is impulse, equal to the change in momentum, so increasing the time of impact reduces the force: a fielder draws the hands back while catching, high jumpers land on foam or sand, and vehicles carry shock absorbers. The third law says every action has an equal and opposite reaction acting on a different body, so the pair never cancels; walking, swimming, a gun's recoil and rocket propulsion all show it.

**Momentum and its conservation:** Momentum is mass times velocity (p = mv), a vector measured in kg m/s. The law of conservation of momentum says the total momentum of a system stays constant when no external force acts on it. A gun and its bullet have zero momentum before firing; afterwards the light bullet flies forward fast and the heavy gun recoils slowly, so the total is still zero. A rocket throws hot gases backward and gains equal momentum forward, which is why it can accelerate even in empty space.

**Friction:** Friction opposes relative motion between surfaces in contact and arises from the interlocking of their tiny irregularities. Static friction is greater than sliding friction, which is greater than rolling friction, so wheels and ball bearings make movement easier. Friction wastes energy as heat and wears out shoe soles and machine parts, yet without it we could not walk, write, strike a match or stop a vehicle. Lubricants (oil, grease, graphite powder), polishing and ball bearings reduce it; treads on tyres and spikes on athletes' shoes increase grip. The friction of air and water is called drag, which is why birds, fish, boats and aircraft have streamlined shapes.

### Examples

- SI has 7 base units: metre, kilogram, second, ampere, kelvin, mole and candela; newton, joule, watt and pascal are derived units.
- A light year (about 9.46 x 10^15 m) measures distance, not time; 1 parsec is about 3.26 light years; 1 angstrom = 10^-10 m.

- Scalars: mass, speed, distance, work, energy, pressure, electric current. Vectors: displacement, velocity, acceleration, force, weight, momentum.
- One full lap of a circular track: distance = circumference, displacement = zero. Uniform circular motion is accelerated because the direction keeps changing.
- 1 km/h = 5/18 m/s, so 36 km/h = 10 m/s and 72 km/h = 20 m/s.
- Equations of motion (uniform acceleration only): v = u + at; s = ut + (1/2)at^2; v^2 = u^2 + 2as. Free-fall acceleration g is about 9.8 m/s^2.
- First law = inertia (passengers lurch forward when a bus brakes); second law F = ma (a fielder pulls the hands back to soften the catch); third law = equal and opposite reaction on a different body (rocket, gun recoil, swimming).
- Momentum p = mv (kg m/s) is conserved when no external force acts: the basis of gun recoil and rocket propulsion.
- Friction: static > sliding > rolling; ball bearings and lubricants reduce it, tyre treads and spiked shoes increase it; drag is friction in air and water.

> **Quick revision:** SI (1960) has 7 base units: m, kg, s, A, K, mol, cd; newton, joule, watt, pascal are derived; light year measures distance; current is a scalar; displacement can be zero; 1 km/h = 5/18 m/s; v = u + at, s = ut + 1/2 at^2, v^2 = u^2 + 2as; g about 9.8 m/s^2; first law is inertia; F = ma; action and reaction act on different bodies; p = mv is conserved; static > sliding > rolling friction.

### Work, Energy, Power, Gravitation and Pressure

**Work and power:** In physics, work is done only when a force moves a body: W = F x s x cos θ, where θ is the angle between the force and the displacement. Work is a scalar measured in joules (1 J = 1 N x 1 m). It is zero when nothing moves (pushing a fixed wall) or when the force is perpendicular to the motion: a porter carrying a load on his head along level ground does no work against gravity, and the Earth's pull does no work on a satellite in a circular orbit. Work is negative when the force opposes motion, as friction does. Power is the rate of doing work, P = W/t, measured in watts (1 W = 1 J/s). 1 kilowatt = 1000 W and 1 horsepower = 746 W; the kilowatt hour is a unit of energy, not of power.

**Energy and its conservation:** Energy is the capacity to do work and is also measured in joules. Kinetic energy is 1/2 mv^2, so doubling the speed makes it four times; potential energy due to height is mgh, and a stretched spring or a bent bow stores elastic potential energy. The law of conservation of energy says energy can neither be created nor destroyed, only changed from one form to another; in a freely falling body potential energy turns into kinetic energy while their sum stays constant. A motor turns electrical energy into mechanical energy, a generator mechanical into electrical, a cell chemical into electrical, a solar cell light into electrical and photosynthesis light into chemical energy. Other units: 1 calorie = 4.186 J and 1 kWh = 3.6 x 10^6 J.

**Gravitation and g:** Newton's law of gravitation says any two bodies attract each other with a force F = G m1 m2 / r^2, proportional to the product of their masses and inversely proportional to the square of the distance between them. G, the universal gravitational constant, is 6.67 x 10^-11 N m^2/kg^2 everywhere; Henry Cavendish first measured it. The acceleration due to gravity, g = GM/R^2, is about 9.8 m/s^2 at the Earth's surface but it varies: it decreases with height and with depth, is zero at the Earth's centre, and is greater at the poles than at the equator because the equatorial radius is larger and the Earth's rotation reduces it at the equator.

**Mass, weight and weightlessness:** Mass is the quantity of matter in a body, measured in kilograms with a beam balance, and it is the same everywhere. Weight is the force of gravity on the body, W = mg, measured in newtons with a spring balance, so a body weighs more at the poles than at the equator and about one-sixth as much on the Moon. In a lift accelerating upward a person's apparent weight increases; in a freely falling lift it becomes zero. Astronauts in an orbiting spacecraft feel weightless because they and the craft are falling freely around the Earth together, not because gravity is absent.

**Escape velocity and satellites:** Escape velocity is the least speed at which a body must be projected to escape a planet's gravity; for the Earth it is 11.2 km/s, whatever the mass of the body. On the Moon it is only about 2.4 km/s, so gas molecules escape easily and the Moon has no atmosphere. A satellite orbiting close to the Earth needs about 7.9 km/s, and escape velocity is √2 times this orbital velocity. A geostationary satellite circles about 36,000 km above

the equator, from west to east, with a period of 24 hours, so it appears fixed in the sky; such satellites serve communication, television and weather watch.

Pressure and Pascal's law: Pressure is force per unit area, P = F/A, measured in pascal. A sharp knife cuts well because a small area gives a large pressure, while wide bag straps and a camel's broad feet spread the force. Atmospheric pressure at sea level is about 1.013 x 10^5 Pa, equal to a 76 cm column of mercury; Torricelli invented the mercury barometer that measures it. It falls with height, so a fountain pen leaks in an aeroplane and water boils below 100 degrees C in the hills; a sudden fall in the barometer reading warns of a storm. Liquid pressure increases with depth (P = hρg), so dam walls are thicker at the bottom. Pascal's law says pressure applied to an enclosed fluid is transmitted equally in all directions; hydraulic lifts, presses and brakes work on it.

**Density, buoyancy and Archimedes:** Density is mass per unit volume; water is densest at 4 degrees C, at 1000 kg/m^3. Relative density has no unit and is measured with a hydrometer; a lactometer checks the purity of milk. A fluid pushes up on any body immersed in it, and Archimedes' principle says this upthrust equals the weight of the fluid displaced. A body floats if it is less dense than the fluid, and a floating body displaces its own weight of liquid. An iron ship floats because its hollow shape displaces a large weight of water, and it rises slightly when it sails from a river into the denser sea. Ice floats with about nine-tenths of its volume under water.

**Examples**

- Work W = Fs cos θ; no work is done when nothing moves or when the force is perpendicular to the motion (porter on level ground, satellite in a circular orbit).
- KE = 1/2 mv^2, so doubling the speed makes KE four times; PE = mgh; energy only changes form (law of conservation of energy).
- 1 horsepower = 746 W; 1 kWh = 3.6 x 10^6 J; 1 calorie = 4.186 J; the kilowatt hour is a unit of energy, the watt a unit of power.
- G = 6.67 x 10^-11 N m^2/kg^2 is universal (first measured by Cavendish); g is about 9.8 m/s^2, more at the poles, less at the equator, zero at the Earth's centre.
- Mass (kg, beam balance) never changes; weight = mg (newton, spring balance) does: zero in a freely falling lift, about one-sixth on the Moon.
- Escape velocity: Earth 11.2 km/s, Moon about 2.4 km/s (hence no lunar atmosphere); orbital velocity near the Earth about 7.9 km/s.
- Geostationary satellite: about 36,000 km above the equator, period 24 hours, moves west to east, used for communication and TV.
- Atmospheric pressure is about 1.013 x 10^5 Pa = 76 cm of mercury (barometer, Torricelli); a sudden fall in the barometer warns of a storm.
- Pascal's law runs hydraulic lifts, presses and brakes; Archimedes: upthrust = weight of fluid displaced; a lactometer tests milk, a hydrometer measures the density of liquids.

> **Quick revision:** W = Fs cos θ (joule); KE = 1/2 mv^2, PE = mgh; energy is conserved; P = W/t (watt); 1 hp = 746 W; kWh is energy; F = Gm1m2/r^2, G = 6.67 x 10^-11 (Cavendish); g = 9.8 m/s^2, more at poles, zero at centre; weight = mg changes, mass does not; escape velocity 11.2 km/s, orbital 7.9 km/s; geostationary 36,000 km, 24 h; pressure = F/A (pascal); Pascal's law: hydraulic brakes; Archimedes: upthrust = weight of fluid displaced.

## Heat, Temperature and Thermodynamics

**Heat and temperature:** Heat is energy that flows from a hotter body to a colder one; temperature is the degree of hotness that decides the direction of that flow. Heat is measured in joules (1 calorie, the heat that warms 1 g of water by 1 degree C, is 4.186 J) and temperature in kelvin. Mercury suits thermometers because it is shiny, expands uniformly, does not wet glass and stays liquid from about -39 degrees C to 357 degrees C; alcohol thermometers are used in very cold places, and pyrometers measure very high temperatures such as those of furnaces and the Sun. A clinical thermometer reads from 35 to 42 degrees C and has a kink that stops the mercury from falling back.

**Scales and conversion:** Celsius marks the ice point at 0 and the steam point at 100, Fahrenheit at 32 and 212, and Kelvin at 273.15 and 373.15. Use C/5 = (F - 32)/9 = (K - 273)/5, or simply K = C + 273. Absolute zero, 0 K or -273.15

degrees C, is the lowest possible temperature, so kelvin readings are never negative. Celsius and Fahrenheit agree at -40, and normal body temperature, 37 degrees C, is 98.6 degrees F or about 310 K.

**Thermal expansion:** Most substances expand on heating, so rails are laid with gaps, bridges have expansion joints, electric wires sag in summer and an iron rim is heated before being fitted on a cart wheel. A bimetallic strip, two metals that expand differently, bends on heating and works thermostats, electric irons and fire alarms. For solids, area expansion is twice and volume expansion three times the linear expansion ($\beta = 2\alpha$, $\gamma = 3\alpha$). Water is the exception: between 0 and 4 degrees C it contracts on heating, so it is densest at 4 degrees C. Lakes therefore freeze from the top while fish survive in water at 4 degrees C below, and pipes burst in severe winters because water expands on freezing.

**Specific heat and latent heat:** Specific heat capacity is the heat needed to raise 1 kg of a substance by 1 K. Water's is very high, about 4200 J/kg K, so it is used in hot-water bottles and car radiators, and it keeps coastal climates mild while land heats and cools faster than the sea. Latent heat is absorbed or released during a change of state without any change of temperature: about 80 cal/g to melt ice and about 540 cal/g to boil water. So steam at 100 degrees C burns more severely than boiling water. Higher pressure raises the boiling point, which is how a pressure cooker cooks faster; low air pressure in the hills lowers it, so food takes longer to cook there. Dissolved salt raises the boiling point and lowers the freezing point of water.

**Conduction, convection and radiation:** In conduction heat passes from particle to particle without the particles moving along, mainly in solids; metals conduct well (silver and copper best), while wood, plastic, glass wool and air conduct poorly, so pans have plastic or wooden handles and woollens keep us warm by trapping air. In convection the heated liquid or gas itself moves: sea breezes blow from sea to land by day and land breezes from land to sea at night, and ventilators sit near the ceiling because warm air rises. Radiation needs no medium and travels at the speed of light, which is how the Sun's heat reaches us. Dark, rough surfaces absorb and emit radiation best and white, shiny ones reflect it, so white clothes suit summer and solar cookers are black inside. A thermos flask blocks conduction and convection with a vacuum and radiation with silvered walls.

**Evaporation and cooling:** Evaporation turns a liquid into vapour at its surface at any temperature below the boiling point, and it cools because the escaping molecules carry latent heat away. It is faster with a larger surface, a higher temperature and wind, and slower in humid air. Water stays cool in an earthen pot (matka) because it seeps through the pores and evaporates; sweating cools the body; humid days feel sticky because sweat cannot evaporate. Boiling, by contrast, happens throughout the liquid at a fixed temperature for a given pressure. Camphor, naphthalene, iodine and dry ice sublime, turning straight from solid to vapour.

**Laws of thermodynamics:** The zeroth law says two bodies each in thermal equilibrium with a third are in equilibrium with each other; it is the basis of the thermometer. The first law is the conservation of energy: heat supplied equals the rise in internal energy plus the work done ($\Delta Q = \Delta U + \Delta W$), so no machine can work without an energy input. The second law says heat does not flow by itself from a colder body to a hotter one, and no heat engine turns all the heat it takes in into work, so no engine is 100% efficient. A refrigerator moves heat from its cold inside to the warmer room only because its compressor uses electrical energy. The third law says absolute zero cannot be reached in a finite number of steps.

### Examples

- 1 calorie = 4.186 J; heat is energy in transit (joule), while temperature (kelvin) decides which way heat flows.
- C/5 = (F - 32)/9 = (K - 273)/5; -40 is the same on the Celsius and Fahrenheit scales; 0 K = -273.15 degrees C is absolute zero.
- Body temperature 37 degrees C = 98.6 degrees F = about 310 K; a clinical thermometer reads 35 to 42 degrees C; a pyrometer measures furnace and solar temperatures.
- A bimetallic strip works thermostats and fire alarms; $\beta = 2\alpha$ and $\gamma = 3\alpha$; rails are laid with gaps to allow for expansion.
- Water is densest at 4 degrees C: lakes freeze from the top and fish survive below; pipes burst in winter because water expands on freezing.
- Latent heat: ice about 80 cal/g, steam about 540 cal/g, so steam burns are worse; a pressure cooker raises the boiling point, low pressure in the hills lowers it.

- Sea breeze by day and land breeze by night (convection); the Sun heats the Earth by radiation; dark surfaces absorb and emit best; a thermos flask blocks all three modes.
- A matka cools water by evaporation through its pores; humid days feel sticky; camphor, naphthalene, iodine and dry ice sublime.
- Zeroth law: basis of the thermometer; first law: energy conservation (ΔQ = ΔU + ΔW); second law: heat does not flow from cold to hot by itself and no engine is 100% efficient; third law: absolute zero cannot be reached.

> **Quick revision:** Heat in joule, temperature in kelvin; 1 cal = 4.186 J; C/5 = (F-32)/9 = (K-273)/5; -40 C = -40 F; absolute zero -273.15 C; 37 C = 98.6 F; clinical thermometer 35-42 C; β = 2α, γ = 3α; water densest at 4 C; latent heat ice 80 cal/g, steam 540 cal/g; pressure cooker raises boiling point; silver and copper best conductors; sea breeze by day; radiation needs no medium; evaporation cools; no engine is 100% efficient.

### Light: Mirrors, Lenses, Refraction and the Human Eye

**Reflection and plane mirrors:** Light is an electromagnetic wave that travels in straight lines at about 3 x 10^8 m/s in vacuum; sunlight takes about 8 minutes 20 seconds to reach the Earth. The angle of incidence equals the angle of reflection, and the incident ray, the reflected ray and the normal lie in one plane. A plane mirror forms a virtual, erect, same-sized image as far behind the mirror as the object is in front, and laterally inverted, which is why AMBULANCE is written in mirror letters on ambulances. Two mirrors inclined at an angle θ form (360/θ) - 1 images, so mirrors at 90 degrees form 3 images.

**Spherical mirrors:** A concave mirror converges light and a convex mirror diverges it; the focal length is half the radius of curvature (f = R/2) and the mirror formula is 1/v + 1/u = 1/f. A concave mirror gives real, inverted images, except an enlarged, erect, virtual image when the object is between the focus and the mirror, so it serves as a shaving or dentist's mirror and, with a bulb at its focus sending out a parallel beam, as the reflector of torches, headlights and searchlights. A convex mirror always gives a virtual, erect, diminished image over a wide field of view, so it is used as the rear-view mirror of vehicles.

**Refraction and refractive index:** Light bends when it passes from one medium into another because its speed changes; from a rarer to a denser medium it bends towards the normal. Snell's law says sin i / sin r is constant for a given pair of media. The refractive index, n = speed of light in vacuum / speed in the medium, is about 1.33 for water, about 1.5 for glass and 2.42 for diamond. On refraction the frequency stays the same while the speed and wavelength change. Refraction makes a pool look shallower than it is and a stick look bent in water. Atmospheric refraction makes stars twinkle (planets, being nearer, do not) and shows us the Sun about 2 minutes before actual sunrise and after actual sunset.

**Lenses and optical instruments:** A convex lens, thicker in the middle, converges light; a concave lens, thinner in the middle, diverges it. The lens formula is 1/v - 1/u = 1/f, and power P = 1/f (f in metres) is measured in dioptres, positive for convex and negative for concave lenses, so a convex lens of focal length 0.5 m has a power of +2 D. Convex lenses are used in magnifying glasses, cameras and projectors. A compound microscope has an objective and an eyepiece of short focal length; an astronomical telescope has an objective of large focal length and large aperture. A lens's effect depends on its surroundings: an air bubble in water acts as a diverging lens.

**Total internal reflection:** When light goes from a denser to a rarer medium at an angle of incidence greater than the critical angle, all of it is reflected back. The critical angle is about 42 degrees for glass and about 24 degrees for diamond; this small angle traps light inside a cut diamond and makes it sparkle. Optical fibres, used in telecommunication and in endoscopes to see inside the body, carry light by repeated total internal reflection. A mirage on a hot road or in a desert, and the prisms in binoculars, are further examples.

**Dispersion, rainbow and scattering:** A prism splits white light into seven colours, VIBGYOR, as Newton showed; red deviates least and has the longest wavelength (about 700 nm), violet deviates most and has the shortest (about 400 nm). A rainbow forms by dispersion, refraction and internal reflection in raindrops, so it is seen only with the Sun behind the observer, with red on its outer edge. The tiny particles of air scatter short wavelengths far more than long ones, so the sky looks blue. At sunrise and sunset light crosses a longer path through the air, the blue is scattered away and the Sun looks red; danger signals are red because red scatters least and is seen far in fog. C. V. Raman

discovered the Raman effect, a scattering of light by molecules, on 28 February 1928, now National Science Day, and won the Nobel Prize in Physics in 1930.

**The human eye and its defects:** Most refraction in the eye happens at the cornea; the iris controls the size of the pupil; the convex eye lens forms a real, inverted image on the retina, whose rods sense dim light and cones sense colour. Ciliary muscles change the lens's focal length (power of accommodation), so a normal eye sees clearly from 25 cm (the near point) to infinity. An image persists on the retina for about 1/16 of a second, which makes cinema possible. In myopia (short sight) the image falls in front of the retina and a concave lens corrects it; in hypermetropia (long sight) it falls behind the retina and a convex lens corrects it; presbyopia, the weakening of accommodation with age, needs bifocals; astigmatism needs a cylindrical lens; cataract, a clouding of the eye lens, is treated by surgery.

**Examples**

- The speed of light is about 3 x 10^8 m/s in vacuum; sunlight reaches the Earth in about 8 minutes 20 seconds.
- Plane mirror image: virtual, erect, same size, laterally inverted; two mirrors at 90 degrees give 3 images, from (360/θ) - 1.
- Concave mirror: shaving mirror, dentist's mirror, torch and headlight reflectors, solar furnace. Convex mirror: rear-view mirror (wide field, small erect image).
- Refractive index n = c/v: water 1.33, glass about 1.5, diamond 2.42; refraction makes pools look shallow and stars twinkle.
- Power P = 1/f (f in metres), unit dioptre; convex lens positive, concave lens negative; an air bubble in water acts as a diverging lens.
- Total internal reflection needs light going from denser to rarer at more than the critical angle (glass about 42 degrees, diamond about 24 degrees): diamond sparkle, optical fibre, mirage.
- VIBGYOR: red has the longest wavelength and deviates least, violet the shortest and deviates most; a rainbow is seen with the Sun behind you.
- Blue sky and red sunset are due to scattering; danger signals are red because red scatters least; Raman effect discovered on 28 February 1928 (National Science Day), Nobel Prize 1930.
- Myopia: concave lens; hypermetropia: convex; presbyopia: bifocal; astigmatism: cylindrical; cataract: surgery; near point of a normal eye: 25 cm.
- Telescope objective: large focal length; microscope objective: short focal length; persistence of vision about 1/16 second makes cinema work.

> **Quick revision:** c = 3 x 10^8 m/s; angle of incidence = angle of reflection; plane mirror image laterally inverted; concave mirror in headlights and shaving, convex as rear-view; n = c/v, water 1.33, diamond 2.42; P = 1/f in dioptre; total internal reflection in diamond, optical fibre, mirage; VIBGYOR, red least deviated; blue sky by scattering; Raman effect 1928; myopia concave, hypermetropia convex, presbyopia bifocal, astigmatism cylindrical; near point 25 cm.

## Sound, Waves and the Electromagnetic Spectrum

**What a wave is:** A wave carries energy from place to place while the particles of the medium only vibrate about their mean positions. Mechanical waves such as sound and water waves need a medium; electromagnetic waves such as light do not. In a transverse wave the particles vibrate at right angles to the direction of travel, forming crests and troughs (a wave on a string, all electromagnetic waves); in a longitudinal wave they vibrate along it, forming compressions and rarefactions (sound in air). Only transverse waves can be polarised, which shows that light is transverse. Transverse waves cannot pass through the bulk of a liquid, which is why seismic S-waves do not cross the Earth's liquid outer core.

**Frequency, wavelength and speed:** Amplitude, the largest displacement of a particle, decides loudness, measured in decibels (dB). Frequency, the number of vibrations per second in hertz (Hz), decides pitch, and the time period is T = 1/f. Wavelength (λ) is the distance between two consecutive crests or compressions, and every wave obeys v = fλ: a 340 Hz note in air, where sound travels at about 340 m/s, has a wavelength of 1 m. Women's and children's voices have a higher pitch than men's; a mosquito's buzz is high-pitched and a lion's roar low-pitched but loud. Quality, or timbre, lets us tell a flute from a violin playing the same note equally loudly. Normal conversation is about 60 dB.

**Infrasound and ultrasound:** Humans hear from about 20 Hz to 20,000 Hz (20 kHz). Sound below 20 Hz is infrasound: earthquakes produce it before the main shock waves, and whales, elephants and rhinoceroses use it to communicate. Sound above 20 kHz is ultrasound: dogs can hear it, and bats, dolphins and porpoises produce it, bats to navigate and hunt in the dark by its echoes. Ultrasound is used in ultrasonography to see the foetus, liver and kidneys, in echocardiography to image the heart, to break kidney stones into fine grains, to detect cracks in metal blocks and to clean hard-to-reach parts.

**Echo and SONAR:** An echo is a reflected sound heard distinctly. The sensation of a sound lasts about 0.1 s in our brain, so the echo must return at least 0.1 s later; at 344 m/s (its speed in air at about 22 degrees C) sound covers 34.4 m in that time, so the reflecting surface must be at least 17.2 m away. In large halls repeated reflections make sound linger (reverberation), which is reduced with curtains and sound-absorbing boards. Multiple reflection is used in megaphones, horns, curved auditorium ceilings and the stethoscope, invented by René Laennec. SONAR (Sound Navigation And Ranging) sends ultrasonic pulses from a ship and times their echo to find the depth of the sea or to locate submarines and shipwrecks: depth = speed x time / 2. An echo returning in 2 s in sea water, where sound travels at about 1500 m/s, means a depth of 1500 m.

**Speed of sound:** Sound needs a medium and cannot travel through a vacuum, as the bell-jar experiment shows, so astronauts on the Moon talk by radio. It is fastest in solids, slower in liquids and slowest in gases: about 6000 m/s in steel (5960 m/s in NCERT's table), about 1500 m/s in water and about 331 m/s in air at 0 degrees C. In air it increases with temperature and humidity, while a change of pressure alone does not affect it. We see lightning before we hear thunder because light is nearly a million times faster, and the time gap tells how far away the storm is. An aircraft faster than sound is supersonic and produces a sonic boom.

**Doppler effect:** When a source of sound and a listener move relative to each other, the pitch heard changes: it rises as they approach and falls as they move apart, which is why a passing train's whistle drops in pitch. The Austrian physicist Christian Doppler explained it in 1842. Police speed guns, Doppler weather radar and Doppler ultrasound of blood flow use it, and the red shift in the light of distant galaxies shows that they are moving away from us.

**The electromagnetic spectrum:** Electromagnetic waves are transverse, need no medium and all travel at 3 x 10^8 m/s in vacuum; James Clerk Maxwell predicted them and Heinrich Hertz first produced radio waves in a laboratory. In order of increasing wavelength they are gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves and radio waves. Gamma rays come from nuclear reactions and are used to treat cancer and sterilise equipment; X-rays, discovered by Wilhelm Roentgen in 1895, show bones and scan baggage; ultraviolet rays from the Sun are mostly absorbed by the ozone layer, cause sunburn and help the skin make vitamin D; infrared is felt as heat and used in TV remote controls and night vision; microwaves cook food and carry radar and satellite signals; radio waves carry radio and television broadcasts.

### Examples

- Transverse waves (crests and troughs): light and all EM waves, waves on a string. Longitudinal waves (compressions and rarefactions): sound in air. Only transverse waves can be polarised.
- v = f x λ; frequency (Hz) decides pitch, amplitude decides loudness (dB), and quality (timbre) tells two instruments apart.
- Audible range 20 Hz to 20 kHz; infrasonic below 20 Hz (earthquakes, whales, elephants); ultrasonic above 20 kHz (bats, dolphins; dogs can hear it).
- Uses of ultrasound: ultrasonography, echocardiography, breaking kidney stones, detecting cracks in metal, cleaning small parts, SONAR.
- An echo needs a 0.1 s gap, so the obstacle must be at least about 17.2 m away; SONAR depth = speed x time / 2.
- Sound travels fastest in solids, then liquids, then gases; in air about 331 m/s at 0 degrees C, faster when hot or humid; there is no sound in vacuum, so astronauts use radio.
- Doppler effect (Christian Doppler, 1842): an approaching source sounds higher in pitch; used in speed guns and weather radar, and the red shift shows galaxies receding.
- EM spectrum by increasing wavelength: gamma, X-rays, ultraviolet, visible, infrared, microwave, radio; all travel at 3 x 10^8 m/s in vacuum.

- X-rays: Roentgen, 1895; UV is mostly absorbed by ozone and helps make vitamin D; infrared: TV remote, night vision; microwaves: ovens, radar; gamma rays: cancer treatment.

> **Quick revision:** Transverse: crests and troughs, light; longitudinal: compressions and rarefactions, sound; v = f λ; pitch = frequency, loudness = amplitude (dB); audible 20 Hz-20 kHz; infrasonic below, ultrasonic above (bats, SONAR, ultrasonography); echo needs 17.2 m; sound fastest in solids, none in vacuum, 331 m/s in air at 0 C; Doppler 1842; EM order: gamma, X, UV, visible, IR, microwave, radio; X-rays Roentgen 1895.

### Electricity and Magnetism: From Ohm's Law to Household Wiring

**Charge and current:** Electric charge is positive or negative; like charges repel and unlike charges attract. Its SI unit is the coulomb, and one electron carries a charge of 1.6 x 10^-19 C. Materials are conductors (silver is the best, then copper and aluminium), insulators (rubber, glass, plastic, dry wood) or semiconductors (silicon, germanium). Current is the rate of flow of charge, I = Q/t, measured in amperes (1 A = 1 C/s) by an ammeter connected in series. By convention current flows from the positive to the negative terminal, opposite to the flow of electrons.

Potential difference and Ohm's law: Potential difference is the work done to move a unit charge between two points, V = W/Q, measured in volts (1 V = 1 J/C) by a voltmeter connected in parallel; a cell or battery maintains it. Georg Simon Ohm stated in 1827 that, at constant temperature, the current through a conductor is proportional to the potential difference across it: V = IR, where R is the resistance in ohms. An ammeter has very low resistance and a voltmeter very high resistance, so that neither disturbs the circuit.

**Resistance and resistivity:** A wire's resistance is R = ρL/A: it grows with length, falls with cross-sectional area, and depends on the material and the temperature. Resistivity (ρ, in ohm metre) is a property of the material. A wire stretched to twice its length has half the area and four times the resistance. Copper and aluminium, of low resistivity, make transmission wires; nichrome, an alloy of high resistivity that does not oxidise when red-hot, makes heating elements; tungsten, with its very high melting point, makes bulb filaments. The resistance of metals rises with temperature, while that of semiconductors falls.

**Series and parallel circuits:** In series the same current passes through each resistor and R = R1 + R2 + R3, more than the largest; one break stops the whole circuit. In parallel each branch has the same potential difference and 1/R = 1/R1 + 1/R2 + 1/R3, less than the smallest: two 4 ohm resistors give 8 ohm in series and 2 ohm in parallel. Houses are wired in parallel so that every appliance gets the full voltage and can be switched on and off independently.

**Electric power and energy:** Power is P = VI = I^2R = V^2/R, in watts. Energy is power multiplied by time, and its commercial unit is the kilowatt hour: 1 kWh = 1 unit = 3.6 x 10^6 J, so a 100 W bulb used for 10 hours consumes 1 unit. The heating effect of current follows Joule's law, H = I^2Rt, and is used in heaters, irons, kettles, bulbs and fuses.

**Magnetism from current and the motor:** In 1820 Hans Christian Oersted saw a current-carrying wire deflect a compass needle, showing that electricity produces magnetism. The right-hand thumb rule gives the direction of the magnetic field around a straight wire. A current-carrying coil (solenoid) acts like a bar magnet, and with a soft iron core it becomes an electromagnet, used in electric bells, relays and cranes that lift scrap iron. A current-carrying conductor in a magnetic field feels a force whose direction is given by Fleming's left-hand rule (forefinger field, middle finger current, thumb motion). This is the principle of the electric motor, which turns electrical energy into mechanical energy; a DC motor uses a split-ring commutator to reverse the current every half turn. Fans, mixers, pumps and washing machines run on motors.

**Induction, generators and transformers:** In 1831 Michael Faraday found that a changing magnetic field through a coil induces a current in it; this is electromagnetic induction, and Fleming's right-hand rule gives the direction of the current. A generator (dynamo) uses it to turn mechanical energy into electrical energy. A transformer works on mutual induction and only on AC: a step-up transformer, with more turns in the secondary coil, raises the voltage at power stations so that power can travel far with little loss, and a step-down transformer lowers it near homes. Alternating current reverses direction periodically; in India its frequency is 50 Hz, so it changes direction every 1/100 second. Cells and batteries give direct current, which flows one way. A rectifier changes AC to DC and an inverter DC to AC.

**Household wiring and safety:** Homes receive AC at about 220 to 230 V through a live wire, a neutral wire and an earth wire; NCERT gives their insulation colours as red, black and green, while many newer cables and appliance cords use the international code of brown (live), blue (neutral) and green with yellow stripes (earth). The earth wire connects the metal bodies of irons, refrigerators and toasters to the ground, so leaking current flows to earth instead of through the user. A fuse, a wire of low melting point placed in series with the live wire, melts when excess current flows because of a short circuit (live and neutral wires touching) or overloading (too many appliances on one socket); a miniature circuit breaker (MCB) does the same job and can simply be reset. Switches are always fitted in the live wire, and a bird sitting on a single wire is safe because there is no potential difference across its body.

**Examples**

- Charge on an electron = 1.6 x 10^-19 C; I = Q/t (ampere); ammeter in series (low resistance), voltmeter in parallel (high resistance).
- Ohm's law (1827): V = IR at constant temperature; R = ρL/A, so a wire stretched to double its length has four times the resistance.
- Heating elements: nichrome (high resistivity, does not oxidise); bulb filament: tungsten (very high melting point); transmission lines: copper and aluminium.
- Series: same current, R = R1 + R2; parallel: same voltage, 1/R = 1/R1 + 1/R2; houses are wired in parallel.
- P = VI = I^2R = V^2/R; 1 unit = 1 kWh = 3.6 x 10^6 J; a 100 W bulb used for 10 hours consumes 1 unit.
- Oersted (1820): current produces magnetism; Faraday (1831): a changing magnetic field produces current (electromagnetic induction).
- Fleming's left-hand rule: motor (electrical to mechanical energy); right-hand rule: generator (mechanical to electrical energy).
- Transformer: mutual induction, works only on AC; step-up at the power station, step-down near homes; rectifier AC to DC, inverter DC to AC.
- Indian mains: AC, 50 Hz, about 220-230 V; fuse in series with the live wire; the earth wire protects users from shocks through metal bodies; switches go in the live wire.

> **Quick revision:** Electron charge 1.6 x 10^-19 C; ampere = coulomb per second; V = IR (Ohm, 1827); R = ρL/A; nichrome heaters, tungsten filament; series resistances add, parallel reciprocals add; houses wired in parallel; P = VI; 1 kWh = 3.6 x 10^6 J; Oersted 1820, Faraday 1831; left-hand rule motor, right-hand rule generator; transformer works only on AC; India 50 Hz AC; fuse in live wire, low melting point; earth wire against shocks.

## Matter, Atomic Structure and the Periodic Table

**States of matter:** Matter has mass and occupies space; it is made of tiny particles with spaces between them that keep moving and attract each other. Solids have a fixed shape and volume, liquids a fixed volume only, and gases neither, so gases are highly compressible. Plasma, an ionised gas found in the Sun, the stars, fluorescent tubes and neon signs, is the fourth state; the Bose-Einstein condensate, based on the work of Satyendra Nath Bose and Albert Einstein and first made in a laboratory in 1995, is the fifth, formed close to absolute zero. In sublimation a solid such as camphor, naphthalene, iodine, ammonium chloride or dry ice turns directly into vapour.

**Elements, compounds and mixtures:** An element is made of one kind of atom and cannot be split into simpler substances by chemical means; elements are metals, non-metals or metalloids such as boron, silicon and germanium. A compound forms when elements combine chemically in a fixed ratio by mass, and its properties differ from theirs: hydrogen burns and oxygen helps burning, but water puts out fire. A mixture has components in any ratio that keep their own properties and can be separated physically. Solutions such as salt water, air and alloys are homogeneous mixtures; sand in water is heterogeneous. Colloids such as milk, fog and smoke look uniform but scatter a beam of light (Tyndall effect).

**Separation methods:** Salt is recovered from sea water by evaporation, cream from milk by centrifugation, the dyes in ink by chromatography, oil from water with a separating funnel, camphor or ammonium chloride from salt by sublimation, and pure copper sulphate by crystallisation. Distillation separates miscible liquids with widely different

boiling points; fractional distillation is used when the boiling points differ by less than 25 K, as in refining petroleum and in getting nitrogen, oxygen and argon from liquid air. Alum (fitkari) makes the mud in water settle.

**Inside the atom:** John Dalton (1808) described matter as made of indivisible atoms. J. J. Thomson discovered the electron in 1897 from cathode rays and proposed the plum pudding model. E. Goldstein's canal rays (1886) gave the first clue to positive particles, and Ernest Rutherford identified and named the proton. Rutherford's scattering of alpha particles by thin gold foil led him in 1911 to the nuclear model: the atom is mostly empty space with a tiny, dense, positive nucleus. Niels Bohr (1913) placed electrons in fixed shells (K, L, M, N), and James Chadwick discovered the neutron, which has no charge and about the mass of a proton, in 1932. A shell holds at most 2n^2 electrons (K 2, L 8, M 18), and the outermost shell holds at most 8.

**Atomic number, mass number, isotopes and isobars:** The atomic number (Z) is the number of protons, equal to the number of electrons in a neutral atom, and fixes the identity of the element; the mass number (A) is protons plus neutrons. Sodium has Z = 11 and A = 23, so it has 12 neutrons and the electronic arrangement 2, 8, 1. Isotopes have the same atomic number but different mass numbers and the same chemical properties: hydrogen has protium (no neutron), deuterium (one neutron; heavy water, D2O, slows neutrons in nuclear reactors) and radioactive tritium (two neutrons). Carbon-14 dates fossils, cobalt-60 treats cancer, iodine-131 is used to treat thyroid disorders such as an overactive thyroid and thyroid cancer (NCERT words this as the treatment of goitre) and uranium-235 fuels nuclear reactors. Isobars have the same mass number but different atomic numbers, such as calcium-40 and argon-40.

**Valency:** Valency is the combining capacity of an element, the number of electrons an atom loses, gains or shares to complete its outer octet (a duplet for hydrogen and helium). Sodium and chlorine have valency 1, magnesium and oxygen 2, aluminium and nitrogen 3, carbon 4, and the noble gases 0. Crossing over the valencies gives formulae such as Al2O3 and CaCl2.

**Towards the periodic table:** Döbereiner (1817) grouped similar elements in triads, such as lithium, sodium and potassium, in which the middle atomic mass is about the average of the other two. Newlands (1866) found every eighth element resembling the first, like the notes of music (law of octaves), but this held only up to calcium. Dmitri Mendeleev (1869) arranged the 63 elements then known by increasing atomic mass and similar properties, left gaps and predicted eka-aluminium and eka-silicon, later found as gallium and germanium. Henry Moseley showed that atomic number is the more basic property, and the modern periodic law says the properties of elements are a periodic function of their atomic numbers.

**Groups and periods:** The modern table has 18 groups (columns) and 7 periods (rows). Elements in a group have the same number of valence electrons and similar properties, and the period number equals the number of shells. Period 1 has 2 elements, periods 2 and 3 have 8 each, periods 4 and 5 have 18 each, and periods 6 and 7 have 32 each. Group 1 holds the alkali metals, group 2 the alkaline earth metals, groups 3 to 12 the transition metals, group 17 the halogens (fluorine is the most reactive non-metal) and group 18 the noble gases. Across a period atomic size and metallic character decrease; down a group they increase.

### Examples

- Plasma (Sun, stars, neon signs) is the fourth state of matter; the Bose-Einstein condensate (from the work of S. N. Bose and Einstein, first made in 1995) is the fifth.
- Sublimation: camphor, naphthalene, iodine, ammonium chloride, dry ice. The Tyndall effect shows in colloids (milk, fog, smoke), not in true solutions.
- Separation: cream from milk by centrifugation; ink dyes by chromatography; petroleum and liquid air by fractional distillation; oil and water by separating funnel; pure copper sulphate by crystallisation.
- Discoverers: electron - J. J. Thomson (1897); canal rays - Goldstein (1886); proton - Rutherford; nucleus - Rutherford (1911); shells - Bohr (1913); neutron - Chadwick (1932).
- Sodium: Z = 11, A = 23, so 12 neutrons; electronic configuration 2, 8, 1; valency 1.
- Hydrogen isotopes: protium, deuterium (heavy water D2O, a moderator) and radioactive tritium; C-14 dating, Co-60 cancer treatment, I-131 thyroid disorders (NCERT: goitre), U-235 nuclear fuel.
- Isotopes: same atomic number, different mass number; isobars: same mass number, different atomic number (calcium-40 and argon-40).

- Döbereiner's triads (1817), Newlands' octaves (1866), Mendeleev (1869: atomic mass, 63 elements, gaps for gallium and germanium), Moseley (atomic number).
- Modern table: 18 groups, 7 periods; group 1 alkali metals, 2 alkaline earth metals, 3 to 12 transition metals, 17 halogens, 18 noble gases; atomic size falls across a period and grows down a group.

> **Quick revision:** Plasma is the 4th state, Bose-Einstein condensate the 5th; camphor sublimes; compound has a fixed ratio, mixture any ratio; centrifugation for cream, chromatography for dyes, fractional distillation for petroleum; electron Thomson 1897, nucleus Rutherford 1911, Bohr shells 1913, neutron Chadwick 1932; Z = protons, A = protons + neutrons; isotopes same Z, isobars same A; heavy water moderator; Mendeleev 1869 by atomic mass; modern law by atomic number; 18 groups, 7 periods; 17 halogens, 18 noble gases.

### Chemical Reactions, Acids, Bases and Salts

**Physical and chemical change:** A physical change alters only form or state and makes no new substance (melting ice, dissolving sugar); a chemical change makes new substances (burning, rusting, curdling of milk, digestion, cooking). Its signs are a change of colour or state, evolution of a gas, a change in temperature or the formation of a precipitate. A chemical equation is balanced because mass is neither created nor destroyed (Lavoisier's law of conservation of mass): 2H2 + O2 gives 2H2O.

**Types of reactions:** In combination two or more substances form one, as when quicklime reacts vigorously with water to form slaked lime (CaO + H2O gives Ca(OH)2), used for whitewash. In decomposition one substance breaks up, by heat (limestone, CaCO3, gives CaO and CO2), by electricity (electrolysis of water gives hydrogen and oxygen in the ratio 2:1 by volume) or by light (silver chloride turns grey in sunlight, the basis of black-and-white photography). In displacement a more reactive metal pushes a less reactive one out of its salt solution: an iron nail turns blue copper sulphate solution green and gets a brown coat of copper. In double displacement ions are exchanged, often forming a precipitate, as barium chloride and sodium sulphate give white barium sulphate; neutralisation is of this type. Reactions that release heat are exothermic (burning, respiration); those that absorb heat are endothermic (most decompositions, photosynthesis).

**Oxidation, reduction, corrosion and rancidity:** Oxidation is the gain of oxygen or loss of hydrogen (loss of electrons); reduction is the loss of oxygen or gain of hydrogen (gain of electrons). They happen together in redox reactions: in CuO + H2 giving Cu + H2O, copper oxide is reduced and hydrogen is oxidised. Corrosion eats metals away: iron rusts to reddish-brown hydrated iron(III) oxide, which needs both air and moisture, silver turns black (silver sulphide) and copper gets a green coat (basic copper carbonate). Painting, oiling, galvanising with zinc, chrome plating and alloying prevent rusting. Rancidity is the oxidation of fats and oils in food, which spoils its smell and taste; antioxidants, airtight containers, refrigeration and filling chips packets with nitrogen slow it.

**Acids and bases:** Acids taste sour, turn blue litmus red and give H+ ions in water; bases taste bitter, feel soapy, turn red litmus blue and give OH- ions in water. Bases that dissolve in water are alkalis (sodium, potassium and calcium hydroxides), so every alkali is a base but not every base is an alkali. Natural acids: vinegar (acetic), lemon and orange (citric), tamarind (tartaric), tomato (oxalic), curd (lactic), ant and nettle stings (methanoic or formic) and our stomach (hydrochloric). Aqua regia, 3 parts concentrated hydrochloric acid to 1 part concentrated nitric acid, dissolves gold and platinum. Acids give hydrogen with metals, which burns with a pop sound, and carbon dioxide with carbonates, which turns lime water milky. Acid is always added slowly to water, never water to acid, because mixing releases great heat.

**Indicators:** Litmus, obtained from lichens, is red in acid and blue in base. Turmeric turns reddish-brown in base, so a turmeric stain turns red when washed with soap; red cabbage and some flower petals are other natural indicators. Phenolphthalein is colourless in acid and pink in base, and methyl orange is red in acid and yellow in base. Olfactory indicators change smell: onion, vanilla and clove oil cannot be smelt in a basic solution. A universal indicator shows a range of colours that give the pH.

**The pH scale:** pH, introduced by S. P. L. Sørensen in 1909, measures hydrogen ion concentration on a scale of 0 to 14: 7 is neutral, below 7 acidic and above 7 basic, each step being a tenfold change. Approximate values: gastric juice 1.2, lemon juice 2.2, pure water 7, blood 7.4, milk of magnesia 10 and sodium hydroxide solution 14. NCERT

says our body works within pH 7.0 to 7.8; blood itself is kept close to 7.4. Tooth decay starts when the pH in the mouth falls below 5.5, which is why toothpastes are basic, and rain with a pH below 5.6 is acid rain. Antacids such as milk of magnesia and baking soda relieve acidity, baking soda soothes an acidic bee sting, and lime corrects acidic soil.

**Common salts:** A salt forms when an acid neutralises a base. Electrolysis of brine (common salt solution), the chlor-alkali process, gives sodium hydroxide, chlorine and hydrogen. Baking soda ($NaHCO_3$) releases carbon dioxide on heating and makes cakes soft and spongy; baking powder is baking soda with a mild edible acid such as tartaric acid; baking soda is also an antacid and is used in soda-acid fire extinguishers. Washing soda ($Na_2CO_3.10H_2O$) removes the permanent hardness of water and is used in making glass, soap and paper. Bleaching powder ($CaOCl_2$), made by passing chlorine over dry slaked lime, bleaches cotton and wood pulp and disinfects drinking water. Plaster of Paris ($CaSO_4.1/2H_2O$), made by heating gypsum ($CaSO_4.2H_2O$) at 373 K, sets hard with water and is used for plasters on fractured bones, for statues and for smooth ceilings. Blue copper sulphate crystals ($CuSO_4.5H_2O$) turn white on heating as they lose their water of crystallisation.

**Examples**

- Combination: $CaO + H_2O$ gives $Ca(OH)_2$ (whitewash, exothermic); thermal decomposition: $CaCO_3$ gives $CaO + CO_2$; electrolysis of water gives hydrogen and oxygen in the ratio 2:1 by volume.
- Silver chloride turns grey in sunlight (decomposition by light, used in black-and-white photography); an iron nail turns copper sulphate solution from blue to green (displacement).
- Oxidation: gain of oxygen, loss of hydrogen or loss of electrons; reduction: the reverse; $CuO + H_2$ gives $Cu + H_2O$ is a redox reaction.
- Rust is hydrated iron(III) oxide; silver tarnishes black (silver sulphide); copper turns green (basic copper carbonate); chips packets are filled with nitrogen to prevent rancidity.
- Natural acids: vinegar - acetic; lemon, orange - citric; tamarind - tartaric; tomato - oxalic; curd - lactic; ant and nettle sting - methanoic (formic); stomach - hydrochloric.
- Litmus (from lichen): red in acid, blue in base; phenolphthalein: colourless in acid, pink in base; methyl orange: red in acid, yellow in base; turmeric: reddish-brown in base.
- pH: gastric juice about 1.2, lemon juice about 2.2, pure water 7, blood about 7.4, milk of magnesia about 10; tooth decay below 5.5; acid rain below 5.6.
- Aqua regia = 3 parts concentrated HCl + 1 part concentrated $HNO_3$; it dissolves gold and platinum.
- Baking soda $NaHCO_3$ (cakes, antacid, fire extinguisher); washing soda $Na_2CO_3.10H_2O$ (hard water, glass); bleaching powder $CaOCl_2$ (disinfects water); plaster of Paris $CaSO_4.1/2H_2O$ (fractures, statues).

> **Quick revision:** Combination, decomposition, displacement, double displacement; electrolysis of water gives $H_2$ and $O_2$ in 2:1; respiration exothermic, photosynthesis endothermic; oxidation = gain of oxygen or loss of electrons; rust is hydrated iron oxide; nitrogen in chips packets stops rancidity; alkalis are soluble bases; tomato oxalic, curd lactic, ant sting formic; phenolphthalein pink in base; pH 7 neutral, blood 7.4, acid rain below 5.6; aqua regia 3 HCl : 1 $HNO_3$; baking soda $NaHCO_3$; bleaching powder $CaOCl_2$; POP from gypsum at 373 K.

## Metals, Non-metals and Everyday Chemistry

**Metals and non-metals:** Metals are lustrous, malleable, ductile, sonorous and good conductors; gold is the most ductile (1 g of gold can be drawn into a wire about 2 km long) and, with silver, the most malleable. Silver conducts electricity best, then copper. Sodium and potassium are soft enough to cut with a knife, mercury is liquid at room temperature, and gallium and caesium melt on the palm. Non-metals are usually brittle, dull and poor conductors, but iodine is lustrous, graphite conducts electricity and diamond is the hardest natural substance; bromine is the only liquid non-metal. Metal oxides are basic, some (aluminium and zinc oxides) amphoteric; non-metal oxides are acidic or neutral.

**Reactivity and extraction:** In the reactivity series K, Na, Ca, Mg, Al, Zn, Fe, Pb, (H), Cu, Hg, Ag, Au, the metals above hydrogen displace it from dilute acids. Sodium and potassium react violently with water and are kept in kerosene; white phosphorus, which catches fire in air, is kept in water. Ores are minerals from which metals are

extracted profitably: bauxite (aluminium), haematite and magnetite (iron), cinnabar (mercury), galena (lead), zinc blende (zinc). Sulphide ores are roasted in excess air and carbonate ores calcined in limited air. The most reactive metals (K, Na, Ca, Mg, Al) are extracted by electrolysis of their molten compounds, zinc and iron by reduction with carbon, and copper is refined electrolytically. The thermit reaction of aluminium with iron oxide gives molten iron for welding railway tracks.

**Alloys:** An alloy is a homogeneous mixture of a metal with other metals or a non-metal; it is usually harder and more resistant to corrosion than the pure metal, with lower conductivity and melting point. Pure gold is 24 carat and too soft, so ornaments use 22 carat gold mixed with copper or silver. Stainless steel is iron with chromium and nickel; brass is copper and zinc; bronze copper and tin; German silver copper, zinc and nickel (with no silver); solder lead and tin (low melting point, for joining wires); duralumin aluminium with copper, magnesium and manganese (aircraft); nichrome nickel and chromium. An amalgam is any alloy of mercury.

**Carbon and its allotropes:** Carbon has valency 4 and links with itself into chains, branches and rings (catenation), which gives millions of carbon compounds. In diamond each carbon atom is bonded to four others in a rigid three-dimensional network, so it is the hardest natural substance and does not conduct electricity; it is used in jewellery and for cutting glass. In graphite each carbon is bonded to three others in hexagonal layers that slide over each other, so it is soft, slippery and a conductor; it is used as a lubricant, in electrodes and as pencil 'lead', which contains no lead at all. Fullerene C-60, a football-shaped molecule discovered in 1985, is named after the architect Buckminster Fuller.

**Hydrocarbons:** Alkanes have only single bonds (CnH2n+2: methane, ethane, propane, butane) and are saturated; alkenes have a double bond (CnH2n, such as ethene) and alkynes a triple bond (CnH2n-2, such as ethyne or acetylene, used in welding). Saturated hydrocarbons burn with a clean blue flame and unsaturated ones with a sooty flame. Methane is marsh gas and the main part of natural gas, CNG and biogas; LPG is mainly butane and propane, with ethyl mercaptan added so that leaks can be smelt. A 5 to 8 percent solution of ethanoic (acetic) acid is vinegar. Vegetable oils hydrogenated with a nickel catalyst give vanaspati ghee.

**Soaps, detergents and plastics:** Soaps are sodium or potassium salts of long-chain fatty acids, made by heating oils or fats with sodium hydroxide (saponification). A soap molecule has a water-loving ionic head and an oil-loving tail; the tails trap grease in clusters called micelles, which water washes away. In hard water, calcium and magnesium salts form scum with soap, but detergents still lather, though many do not biodegrade. Rubber is hardened by heating with sulphur (vulcanisation); rayon is artificial silk made from wood pulp and nylon a fully synthetic fibre. Thermoplastics such as polythene and PVC soften on heating and can be remoulded; thermosetting plastics such as bakelite (switches, pan handles) and melamine cannot.

**Fuels and calorific value:** Calorific value is the heat released by completely burning 1 kg of a fuel, in kJ/kg. NCERT lists cow dung cake 6000 to 8000, wood 17000 to 22000, coal 25000 to 33000, biogas 35000 to 40000, petrol, diesel and kerosene 45000, CNG 50000, LPG 55000 and hydrogen 150000, the highest, which is why liquid hydrogen is used as rocket fuel. Burning needs fuel, oxygen and heating to the ignition temperature; petrol and LPG catch fire easily because their ignition temperature is low. Incomplete burning gives poisonous carbon monoxide. The outermost, non-luminous zone of a candle flame is the hottest.

**Everyday chemical names:** Caustic soda is sodium hydroxide and caustic potash potassium hydroxide; limestone, chalk and marble are all calcium carbonate. Blue vitriol is copper sulphate, green vitriol ferrous sulphate and Epsom salt magnesium sulphate; sal ammoniac is ammonium chloride; muriatic acid is hydrochloric acid and oil of vitriol sulphuric acid; laughing gas is nitrous oxide; potash alum (fitkari) purifies water; and silver nitrate makes the indelible ink used in elections.

### Examples

- 1 g of gold can be drawn into a wire about 2 km long; silver is the best conductor of electricity, then copper; mercury is the only liquid metal and bromine the only liquid non-metal.
- Sodium and potassium are kept in kerosene, white phosphorus in water; gold and platinum occur free in nature.
- Ores: bauxite - aluminium; haematite, magnetite - iron; cinnabar - mercury; galena - lead; zinc blende, calamine - zinc.

- Roasting: sulphide ore heated in excess air; calcination: carbonate ore heated in limited air; thermit (aluminium + iron oxide) welds railway tracks.
- Ornament gold is 22 carat (pure 24 carat gold is too soft); solder = Pb + Sn; duralumin = Al + Cu + Mg + Mn; gun metal = Cu + Sn + Zn; amalgam = any alloy of mercury.
- Diamond: each carbon bonded to 4 others, hardest, non-conductor; graphite: bonded to 3 in layers, conductor, lubricant, pencil 'lead'; fullerene C-60 discovered in 1985.
- Alkane CnH2n+2, alkene CnH2n, alkyne CnH2n-2; vinegar is 5-8% acetic acid; ethyl mercaptan is added to LPG so that leaks can be smelt.
- Soap forms scum in hard water, detergents do not; bakelite and melamine are thermosetting, polythene and PVC thermoplastic; Teflon coats non-stick pans.
- Calorific value (kJ/kg): cow dung cake 6000-8000, wood 17000-22000, coal 25000-33000, petrol 45000, CNG 50000, LPG 55000, hydrogen 150000 (highest).
- Names: blue vitriol $CuSO_4.5H_2O$, green vitriol $FeSO_4.7H_2O$, Epsom salt $MgSO_4.7H_2O$, sal ammoniac $NH_4Cl$, muriatic acid HCl, oil of vitriol $H_2SO_4$, lunar caustic $AgNO_3$.

> **Quick revision:** Gold most ductile; silver best conductor; mercury liquid metal, bromine liquid non-metal; Na and K kept in kerosene; reactivity K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Hg > Ag > Au; bauxite Al, haematite Fe, cinnabar Hg, galena Pb; thermit welds rails; ornaments 22 carat; solder Pb + Sn; diamond 4 bonds, graphite 3 bonds and conducts; C-60 found 1985; alkane CnH2n+2; vinegar 5-8% acetic acid; soap fails in hard water; bakelite thermosetting; hydrogen highest calorific value, 150000 kJ/kg.

### The Cell, Tissues and Classification of Living Things

**Discovery and cell theory:** Robert Hooke (1665) saw box-like compartments in a thin slice of cork under his microscope and named them cells. Anton van Leeuwenhoek (1674), with his improved microscope, first saw free-living cells in pond water, and a few years later he also saw bacteria. Robert Brown discovered the nucleus in 1831, and Purkinje coined the term protoplasm in 1839. Matthias Schleiden (1838) and Theodor Schwann (1839) stated the cell theory, that all plants and animals are made of cells and the cell is the basic unit of life; Rudolf Virchow (1855) added that all cells arise from pre-existing cells. The ostrich egg is the largest single cell, the nerve cell the longest cell in the human body and Mycoplasma (PPLO) the smallest known cell.

**Prokaryotes, eukaryotes and the cell membrane:** Prokaryotic cells (bacteria and blue-green algae) have no nuclear membrane, their DNA lying in a region called the nucleoid, and no membrane-bound organelles. Eukaryotic cells (protists, fungi, plants and animals) have a true nucleus and membrane-bound organelles. The plasma membrane, made of lipids and proteins, is selectively permeable. Water crosses it by osmosis from a dilute to a concentrated solution, which is why raisins swell in water and why salt and sugar preserve pickles and jams; a plant cell in strong salt solution loses water and its contents shrink away from the wall (plasmolysis).

**Cell organelles:** The nucleus is the control centre and holds chromosomes made of DNA and protein. Mitochondria are the powerhouses where aerobic respiration releases energy as ATP; like chloroplasts, they have their own DNA and ribosomes. Plastids occur only in plant cells: chloroplasts carry chlorophyll for photosynthesis, chromoplasts colour flowers and fruits, and leucoplasts store starch, oil and protein. Ribosomes, which have no membrane, make proteins; rough endoplasmic reticulum bears ribosomes, while smooth endoplasmic reticulum makes lipids and, in liver cells, detoxifies drugs and poisons. The Golgi apparatus, named after Camillo Golgi, packages and dispatches materials and forms lysosomes, the suicide bags whose enzymes can digest the cell itself. Vacuoles store sap and wastes, and centrioles help animal cells divide.

**Plant and animal cells:** A plant cell has a rigid cell wall of cellulose, plastids and a large central vacuole that keeps it turgid, and usually no centrioles; an animal cell has no cell wall or plastids, has small vacuoles and has centrioles. Plants store food as starch and animals as glycogen. The cell wall of fungi is made of chitin. Mature red blood cells of mammals have no nucleus.

**Cell division:** Mitosis takes place in body cells for growth and repair: one division gives two daughter cells with the same chromosome number as the parent, through prophase, metaphase, anaphase and telophase. Meiosis takes

place in the reproductive organs to form gametes: two divisions give four cells, each with half the chromosome number, and crossing over during meiosis creates variation. Human body cells have 46 chromosomes (23 pairs) and gametes 23, so fertilisation restores the number to 46. Uncontrolled cell division causes cancer.

**Tissues:** A tissue is a group of similar cells doing one job. In plants, meristems divide: apical meristem at root and shoot tips adds length, lateral meristem (cambium) adds girth, and intercalary meristem at the base of leaves lets grass regrow after grazing. Permanent plant tissues include parenchyma (storage), collenchyma (flexibility), sclerenchyma (hard, dead cells, as in coconut husk and jute), xylem (carries water and minerals) and phloem (carries food). Animal tissues are epithelial (covering and lining), connective (bone, cartilage, fat, blood, which is a fluid connective tissue, tendons joining muscle to bone and ligaments joining bone to bone), muscular (striated voluntary, smooth involuntary, and cardiac, which is striated yet involuntary) and nervous.

**The five kingdoms:** R. H. Whittaker (1969) replaced the old two-kingdom system of plants and animals with five kingdoms, based on cell type, body organisation and mode of nutrition. Monera are prokaryotes (bacteria, cyanobacteria, Mycoplasma); Protista are unicellular eukaryotes (Amoeba, Paramecium, Euglena, Plasmodium); Fungi are heterotrophs, mostly saprophytes, with chitin walls (yeast, mushroom, Penicillium, bread mould); Plantae are multicellular autotrophs, from algae (Spirogyra) and bryophytes (mosses, the amphibians of the plant kingdom) to pteridophytes (ferns), gymnosperms with naked seeds (pine, cycas, deodar) and angiosperms with seeds inside fruits; Animalia are multicellular heterotrophs without cell walls, from sponges to mammals. Lichens, a partnership of an alga and a fungus, are sensitive indicators of air pollution by sulphur dioxide.

**Names, viruses and bacteria:** Carolus Linnaeus, the father of taxonomy, popularised binomial nomenclature: a genus name with a capital letter followed by a species name in small letters, printed in italics, as Homo sapiens (human), Panthera tigris (tiger), Panthera leo (lion), Mangifera indica (mango) and Pavo cristatus (peacock). The ranks are kingdom, phylum, class, order, family, genus and species. Viruses fit none of the five kingdoms: they are DNA or RNA in a protein coat, can be crystallised, and reproduce only inside living cells; Dmitri Ivanovsky (1892) first detected one, the tobacco mosaic virus, and antibiotics do not act on viruses. Bacteria may be cocci (round), bacilli (rods), spirilla (spirals) or vibrio (comma-shaped); Lactobacillus sets milk into curd and Rhizobium fixes nitrogen in the root nodules of legumes.

### Examples

- Hooke named the cell (1665, cork); Leeuwenhoek saw living cells (1674); Brown found the nucleus (1831); Schleiden (1838) and Schwann (1839) gave the cell theory; Virchow (1855): all cells come from cells.
- Prokaryotes (bacteria, blue-green algae) have no nuclear membrane; eukaryotes have a true nucleus and membrane-bound organelles.
- Mitochondria: powerhouse (ATP, own DNA); ribosome: protein synthesis; lysosome: suicide bag; Golgi: packaging; chloroplast: photosynthesis; smooth ER: detoxification.
- Plant cell: cellulose wall, plastids, large vacuole, no centrioles; animal cell: no wall, small vacuoles, centrioles; fungal wall: chitin.
- Mitosis: body cells, 2 identical cells, growth and repair; meiosis: gametes, 4 cells with half the chromosomes (46 becomes 23 in humans).
- Tendon joins muscle to bone, ligament joins bone to bone; blood is a fluid connective tissue; cardiac muscle is striated but involuntary.
- Whittaker (1969): Monera, Protista, Fungi, Plantae, Animalia; bryophytes are the amphibians of the plant kingdom; gymnosperms have naked seeds.
- Binomial names: Homo sapiens (human), Panthera tigris (tiger), Panthera leo (lion), Mangifera indica (mango), Pavo cristatus (peacock), Oryza sativa (rice).
- Viruses: nucleic acid in a protein coat, multiply only inside living cells, belong to none of the five kingdoms; tobacco mosaic virus found by Ivanovsky (1892); antibiotics do not act on viruses.
- Bacterial shapes: cocci, bacilli, spirilla, vibrio; Lactobacillus sets curd; Rhizobium fixes nitrogen in legume root nodules.

**Quick revision:** Hooke 1665 named cell; Leeuwenhoek 1674; Brown nucleus 1831; Schleiden and Schwann cell theory; Virchow 1855; prokaryotes lack nuclear membrane; mitochondria powerhouse; lysosome suicide bag; ribosome makes protein; plant cell wall cellulose, fungal wall chitin; mitosis 2 identical cells, meiosis 4 cells with half chromosomes; 46 chromosomes; tendon muscle-bone, ligament bone-bone; Whittaker 1969 five kingdoms; bryophytes amphibians of plants; Homo sapiens; virus TMV Ivanovsky 1892.

### The Human Body: Organ Systems, Glands and Bones

**Digestive system:** An adult has 32 teeth (8 incisors, 4 canines, 8 premolars and 12 molars) and a child 20 milk teeth; tooth enamel is the hardest substance in the body. In the mouth, salivary amylase (ptyalin) begins turning starch into sugar. In the stomach, hydrochloric acid kills germs and provides the acidic medium for pepsin, which digests proteins, while mucus protects the stomach lining. The liver, the largest gland, makes bile, which is stored in the gall bladder; bile has no enzyme but emulsifies fats. Pancreatic juice adds trypsin for proteins and lipase for fats. Digestion is completed in the small intestine, the longest part of the alimentary canal, whose villi absorb the digested food; the large intestine absorbs water. Humans cannot digest cellulose.

**Respiratory system:** Air passes through the nose, pharynx, larynx (voice box) and trachea (windpipe, held open by rings of cartilage) to the bronchi, bronchioles and alveoli, tiny air sacs where oxygen enters the blood and carbon dioxide leaves it. When the diaphragm contracts and flattens, the chest expands and air rushes in. An adult at rest breathes about 15 to 18 times a minute. In the mitochondria of cells, aerobic respiration breaks glucose into carbon dioxide and water and releases energy; muscles short of oxygen during hard exercise respire anaerobically and form lactic acid, which NCERT links to muscle cramps.

**Heart and blood:** William Harvey described the circulation of blood in 1628. The heart has 4 chambers, two atria and two ventricles; the left ventricle has the thickest wall because it pumps blood to the whole body, and blood passes through the heart twice in one round (double circulation). Arteries carry blood away from the heart and veins towards it; the exceptions are the pulmonary artery, which carries deoxygenated blood, and the pulmonary vein, which carries oxygenated blood. The aorta is the largest artery. The heart beats about 72 times a minute, normal blood pressure is about 120/80 mm Hg (measured with a sphygmomanometer) and an adult has about 5 to 6 litres of blood. Red blood cells carry oxygen with iron-containing haemoglobin, are made in the bone marrow, live about 120 days and are destroyed in the spleen; white blood cells fight infection; platelets help blood to clot.

**Blood groups:** Karl Landsteiner discovered the ABO blood groups in 1900. Group A has antigen A on its red cells and anti-B antibodies in its plasma, group B the reverse, group AB both antigens and no antibodies (universal recipient) and group O no antigens but both antibodies (universal donor). The Rh factor, named after the rhesus monkey, was discovered by Landsteiner and Wiener in 1940; an Rh-negative mother can form antibodies that harm a later Rh-positive baby.

**Excretory system:** The kidneys filter the blood and remove urea, which the liver makes from excess amino acids. The nephron is the structural and functional unit of the kidney; filtration happens at the glomerulus inside Bowman's capsule. Urine passes through the ureters to the urinary bladder and out through the urethra. When the kidneys fail, blood is cleaned by dialysis. The skin and lungs also help in excretion.

**Nervous system:** The neuron, the longest cell in the body, is the unit of the nervous system. The brain and spinal cord form the central nervous system; 12 pairs of cranial nerves and 31 pairs of spinal nerves form the peripheral system. The cerebrum, the largest part of the brain, controls thinking, memory and voluntary actions; the hypothalamus regulates body temperature, hunger and thirst; the cerebellum maintains balance and posture; the medulla oblongata controls involuntary actions such as heartbeat, breathing and blood pressure. Reflex actions, such as pulling the hand away from a flame or the knee jerk, are controlled by the spinal cord.

**Endocrine glands and hormones:** Endocrine glands are ductless and release hormones straight into the blood. The pituitary, controlled by the hypothalamus, is the master gland; excess growth hormone causes gigantism and its deficiency dwarfism. The thyroid, the largest endocrine gland, makes thyroxine, which needs iodine and controls metabolism; iodine deficiency causes goitre. The parathyroids regulate blood calcium. The adrenal glands, on top of the kidneys, release adrenaline, the fight-or-flight hormone. The pancreas is both an exocrine and an endocrine

gland: its islets of Langerhans release insulin, which lowers blood sugar (its lack causes diabetes; Banting and Best isolated it in 1921), and glucagon, which raises it. The thymus aids immunity and the pineal gland makes melatonin.

**Skeleton and classic one-liners:** An adult has 206 bones, 80 in the axial skeleton and 126 in the appendicular skeleton; a newborn has more, which fuse during growth. The femur (thigh bone) is the longest and strongest bone and the stapes in the ear the smallest. The neck has 7 cervical vertebrae, as in a giraffe. Ball-and-socket joints are at the shoulder and hip, hinge joints at the knee and elbow, and a pivot joint where the neck joins the head. The skin is the largest organ, the liver the largest internal organ and the ovum the largest human cell; the cornea has no blood supply and is the part transplanted after eye donation.

**Examples**

- Teeth: adult 32 (incisors 8, canines 4, premolars 8, molars 12), milk teeth 20; enamel is the hardest substance in the body.
- Digestion: ptyalin (starch) in the mouth; pepsin and HCl in the stomach; bile (no enzyme, emulsifies fat) from the liver; trypsin and lipase from the pancreas; villi absorb food.
- Gas exchange happens in the alveoli; the larynx is the voice box; an adult at rest breathes 15-18 times a minute; anaerobic respiration in muscles makes lactic acid, which NCERT links to cramps.
- Heart: 4 chambers, thickest wall in the left ventricle; the pulmonary artery carries deoxygenated blood and the pulmonary vein oxygenated blood; normal BP 120/80 mm Hg.
- RBCs carry oxygen (haemoglobin, about 120 days, made in bone marrow, destroyed in the spleen), WBCs fight infection, platelets clot blood; ABO groups by Landsteiner (1900), Rh factor 1940.
- Universal donor: O (no antigens); universal recipient: AB (no antibodies).
- The nephron is the unit of the kidney; urea is made in the liver and removed by the kidneys; dialysis cleans blood when kidneys fail.
- Cerebrum: thinking and memory; cerebellum: balance; medulla: heartbeat and breathing; hypothalamus: temperature, hunger and thirst; reflexes run through the spinal cord.
- Pituitary: master gland (growth hormone); thyroid: thyroxine, iodine, goitre; adrenal: adrenaline (fight or flight); pancreas: insulin lowers blood sugar (Banting and Best, 1921).
- 206 bones in adults (80 axial + 126 appendicular); femur longest, stapes smallest; skin largest organ, liver largest internal organ and gland, thyroid largest endocrine gland.

> **Quick revision:** 32 adult teeth; enamel hardest; ptyalin starch, pepsin protein, bile emulsifies fat; liver largest gland; villi absorb; alveoli exchange gases; breathing 15-18 per minute; heart 4 chambers, 72 beats per minute, BP 120/80; RBC 120 days, spleen graveyard; Landsteiner ABO 1900; O universal donor, AB universal recipient; nephron unit of kidney; 12 cranial, 31 spinal nerve pairs; cerebellum balance, medulla heartbeat; pituitary master gland; insulin 1921; 206 bones; femur longest, stapes smallest.

### Nutrition, Diseases, Vaccines, Plants and Heredity

**Nutrients:** Carbohydrates are the main source of energy and proteins build and repair the body, each giving about 4 kcal per gram; fats give about 9 kcal per gram. Vitamins and minerals protect the body, and roughage (dietary fibre) prevents constipation. Lack of protein causes kwashiorkor (swollen belly and limbs) and lack of both protein and energy causes marasmus (wasting). Iodine solution turns starch blue-black. Casimir Funk coined the word vitamine in 1912.

**Vitamins and minerals:** Vitamins A, D, E and K are fat-soluble and stored in the body; B-complex and C are water-soluble. Deficiencies: A (retinol) causes night blindness and xerophthalmia; B1 (thiamine) beri-beri; B2 (riboflavin) cracked lips; B3 (niacin) pellagra; B9 (folic acid) anaemia; B12 (cobalamin, which contains cobalt) pernicious anaemia; C (ascorbic acid, from amla and citrus fruits) scurvy with bleeding gums; D (calciferol), made in the skin in sunlight, rickets in children and osteomalacia in adults; and K, made by gut bacteria, poor blood clotting. Vitamin E (tocopherol) is an antioxidant. Vitamin C is destroyed by cooking. Iron deficiency causes anaemia and iodine deficiency goitre; calcium builds bones and teeth; excess fluoride causes fluorosis.

**Communicable diseases:** Bacterial diseases include tuberculosis (Mycobacterium tuberculosis, discovered by Robert Koch in 1882), cholera (Vibrio cholerae; treated with ORS), typhoid (Salmonella typhi; Widal test), tetanus, diphtheria, whooping cough, leprosy and plague (spread by rat fleas). Viral diseases include the common cold, influenza, measles, mumps, chickenpox, polio, rabies, hepatitis, dengue and chikungunya (both spread by the Aedes mosquito) and AIDS (HIV; ELISA test); smallpox was declared eradicated in 1980. Protozoan diseases include malaria (Plasmodium, spread by the female Anopheles; Alphonse Laveran discovered the parasite in human blood in 1880, and in 1897 Ronald Ross found it developing inside an Anopheles mosquito, the key step in proving that mosquitoes spread malaria), kala-azar (Leishmania, sandfly), amoebic dysentery (Entamoeba) and sleeping sickness (tsetse fly). Ringworm and athlete's foot are fungal; filaria is caused by a worm spread by the Culex mosquito.

**Vaccines and discoverers:** A vaccine contains killed or weakened germs or their parts and trains the body to make antibodies and memory cells (active immunity). Edward Jenner made the first vaccine, against smallpox, in 1796 using cowpox; the word comes from the Latin vacca, cow. Louis Pasteur made the rabies vaccine in 1885 and devised pasteurisation. Jonas Salk developed the injectable polio vaccine and Albert Sabin the oral polio drops; BCG against tuberculosis is named after Calmette and Guérin. Alexander Fleming discovered penicillin, from the mould Penicillium, in 1928. Ready-made antibodies, as in anti-venom, give passive immunity.

**Photosynthesis:** Green plants make food from carbon dioxide and water using sunlight absorbed by chlorophyll in chloroplasts: $6CO_2 + 12H_2O$ gives $C_6H_{12}O_6 + 6O_2 + 6H_2O$. Water is split in the light reaction, so the oxygen released comes from water; carbon dioxide is turned into glucose in the dark reaction and stored as starch. Chlorophyll absorbs mainly red and blue light. Gases pass through stomata, which guard cells open and close, and the water lost through them (transpiration) pulls water up the xylem. Cuscuta (amarbel) is a parasite with no chlorophyll.

**Plant hormones and movements:** Auxins promote cell elongation and rooting of cuttings and cause phototropism, as a shoot bends towards light because auxin gathers on its shaded side; the synthetic auxin 2,4-D is a weedicide. Gibberellins lengthen stems and enlarge grapes; cytokinins promote cell division and delay the ageing of leaves; abscisic acid inhibits growth, closes stomata and causes dormancy; ethylene, the only gaseous plant hormone, ripens fruit. Roots grow towards gravity and water and shoots towards light. The folding of touch-me-not (Mimosa pudica) leaves is a quick movement, not growth.

**Reproduction in plants:** Vegetative propagation produces new plants from stems (potato tubers, ginger rhizomes, sugarcane and rose cuttings), roots (sweet potato, dahlia) and leaves (Bryophyllum); yeast reproduces by budding and ferns and fungi by spores. In a flower the stamens (male) make pollen in their anthers, and the carpel (female) has a stigma, a style and an ovary with ovules. Pollination carries pollen to the stigma by wind, water, insects or birds. Fertilisation in flowering plants is double: one male gamete fuses with the egg to form the zygote and another with the polar nuclei to form the endosperm. The ovule becomes the seed and the ovary the fruit.

**Mendel, heredity and DNA:** Gregor Mendel, the father of genetics, crossed garden peas for seven pairs of contrasting traits and published his work in 1866; it was rediscovered in 1900. Crossing pure tall (TT) and dwarf (tt) plants gave only tall plants in F1, as tall is dominant, and tall and dwarf plants in the ratio 3:1 in F2, with genotypes in the ratio 1:2:1; a dihybrid cross gives 9:3:3:1. His laws are dominance, segregation and independent assortment. James Watson and Francis Crick proposed the double-helix model of DNA in 1953, using X-ray work by Rosalind Franklin and Maurice Wilkins; adenine pairs with thymine and guanine with cytosine, and RNA has uracil instead of thymine. Humans have 23 pairs of chromosomes, 22 pairs of autosomes and one pair of sex chromosomes (XX in females, XY in males), so the father's sperm decides the sex of the child. Haemophilia and colour blindness are sex-linked; Down syndrome results from an extra chromosome 21.

### Examples

- Energy per gram: carbohydrate and protein about 4 kcal, fat about 9 kcal; kwashiorkor = protein deficiency, marasmus = protein and energy deficiency.
- Fat-soluble vitamins: A, D, E, K; water-soluble: B-complex and C. D is made in the skin in sunlight, K by gut bacteria; B12 contains cobalt.

- Deficiency diseases: A night blindness; B1 beri-beri; B3 pellagra; B12 pernicious anaemia; C scurvy; D rickets (osteomalacia in adults); K poor clotting; iron anaemia; iodine goitre.
- Bacterial: TB (Koch, 1882; BCG vaccine), cholera (Vibrio; ORS), typhoid (Salmonella; Widal test), tetanus, diphtheria, whooping cough, leprosy, plague.
- Viral: polio, measles, mumps, chickenpox, rabies, dengue, hepatitis, influenza, AIDS (HIV; ELISA). Protozoan: malaria (parasite found by Laveran, 1880; mosquito link shown by Ronald Ross, 1897), kala-azar, amoebic dysentery, sleeping sickness.
- Vaccines: Jenner - smallpox (1796); Pasteur - rabies (1885); Salk - injectable polio vaccine; Sabin - oral polio vaccine; BCG - Calmette and Guérin; Fleming - penicillin (1928).
- Photosynthesis: the oxygen released comes from water; it takes place in chloroplasts; gases pass through stomata; iodine turns starch blue-black.
- Plant hormones: auxin (phototropism, rooting; 2,4-D weedicide), gibberellin (stem elongation, bigger grapes), cytokinin (cell division), abscisic acid (stress, closes stomata), ethylene (ripening; the only gaseous one).
- Vegetative propagation: potato (stem tuber), ginger (rhizome), sweet potato (root), Bryophyllum (leaf); after fertilisation the ovule becomes the seed and the ovary the fruit.
- Mendel's peas: F2 monohybrid ratio 3:1 (genotypes 1:2:1), dihybrid 9:3:3:1; DNA double helix by Watson and Crick (1953); A pairs with T, G with C; the father's sperm decides the child's sex.

> **Quick revision:** Fat 9 kcal/g, carbohydrate and protein 4; kwashiorkor protein deficiency; A, D, E, K fat-soluble; B1 beri-beri, C scurvy, D rickets, K clotting, B12 has cobalt; TB Koch 1882; typhoid Widal; HIV ELISA; malaria Plasmodium (Laveran 1880), female Anopheles (Ross 1897); smallpox eradicated 1980; Jenner 1796, Pasteur rabies 1885, Fleming penicillin 1928; oxygen of photosynthesis from water; ethylene ripens fruit; ovule becomes seed; Mendel 1866, 3:1 and 9:3:3:1; DNA double helix 1953; XY male.

Free practice questions: parikshasaathi.com/q/general-science/

## Indian Art and Culture

### Indian Art and Culture

**What the exam asks:** Art and Culture is a scoring part of General Awareness in SSC, Railway, state police and state PSC prelims. Questions are almost always one-line matches: a dance, painting, craft, festival or monument paired with its state, builder, dynasty or exponent. Breadth and precision matter more than depth, so revise this topic as tables.

**Classical and folk dance:** The Sangeet Natak Akademi recognises eight classical dances: Bharatanatyam (Tamil Nadu, earlier called Sadir), Kathak (North India, with Lucknow, Jaipur and Banaras gharanas), Kathakali (Kerala, elaborate make-up, traditionally performed by men), Mohiniyattam (Kerala, graceful dance of women), Kuchipudi (Andhra Pradesh, systematised by Siddhendra Yogi), Odissi (Odisha, tribhanga and chowk postures), Manipuri (Raslila, pung cholom, cylindrical kumil skirt) and Sattriya (Assam, begun by Srimanta Sankardeva, recognised in 2000). Folk dances are a state-matching game: Bhangra and Giddha (Punjab), Garba (Gujarat), Ghoomar and Kalbelia (Rajasthan), Bihu (Assam), Lavani (Maharashtra), Chhau (Seraikela in Jharkhand, Mayurbhanj in Odisha, Purulia in West Bengal), Dumhal and Rouf (Jammu and Kashmir), Karma (Jharkhand, Chhattisgarh).

**Music:** Hindustani (north) and Carnatic (south) traditions separated after the 13th century. Dhrupad is the oldest surviving Hindustani vocal form, Khayal the most popular, Thumri and Tappa are semi-classical. Gharanas take their names from towns: Gwalior (the oldest khayal gharana), Agra, Kirana, Patiala and Jaipur-Atrauli. Carnatic music rests on the 72 melakarta ragas of Venkatamakhin; its trinity is Tyagaraja, Muthuswami Dikshitar and Syama Sastri, while Purandara Dasa is its Pitamaha. Bhatkhande classified Hindustani ragas into ten thaats. Instrument-exponent pairs: Bismillah Khan shehnai, Ravi Shankar sitar, Amjad Ali Khan sarod, Shivkumar Sharma santoor, Hariprasad Chaurasia flute, Zakir Hussain tabla.

**Architecture:** Harappan cities had grid planning, burnt-brick drains and the Great Bath at Mohenjo-daro. Ashoka gave us pillars, the original brick stupa at Sanchi (the carved stupas of Bharhut and Amaravati belong to the post-

Mauryan period) and the Barabar caves for the Ajivikas, the earliest surviving rock-cut caves. Ajanta (murals), Ellora (Kailasa temple of Rashtrakuta Krishna I) and Elephanta (Trimurti) are all in Maharashtra. Temple styles: Nagara (north, curvilinear shikhara: Khajuraho by the Chandelas, Konark by Narasimhadeva I of the Eastern Gangas, Lingaraja at Bhubaneswar), Dravida (south, pyramidal vimana and gopurams: Brihadeeswara at Thanjavur by Rajaraja Chola I, Meenakshi at Madurai rebuilt by the Nayakas) and Vesara (Karnataka hybrid: Chalukyas at Badami and Pattadakal, Hoysalas at Belur and Halebidu). Chola bronzes such as Nataraja were cast by the lost-wax method. Indo-Islamic architecture brought the true arch, dome, minaret and pietra dura: Qutub Minar (Aibak and Iltutmish), Alai Darwaza (Alauddin Khalji), Tughlaqabad (Ghiyasuddin Tughlaq). Mughal landmarks: Humayun's Tomb (first charbagh garden tomb), Fatehpur Sikri and Buland Darwaza (Akbar, Gujarat victory), Taj Mahal and Red Fort (Shah Jahan). Colonial: Victoria Memorial (Emerson), Rashtrapati Bhavan (Lutyens), Parliament House (Baker).

**Sculpture and painting:** Gandhara (Greco-Roman, grey schist, Kushana), Mathura (red sandstone, indigenous) and Amaravati (white limestone, locally called Palnad marble, Satavahana and Ikshvaku) are the three early schools; the Didarganj Yakshi of Patna shows the Mauryan polish. Painting runs from Bhimbetka rock shelters (Madhya Pradesh) and Ajanta murals (Padmapani) to Mughal miniatures (Humayun brought Mir Sayyid Ali and Abdus Samad; Jahangir's court had Ustad Mansur), Rajasthani schools (Kishangarh's Bani Thani, Mewar, Bundi), Pahari schools (Basohli, Kangra), Deccani, Tanjore (gold foil) and Mysore. Folk painting by state: Madhubani (Bihar), Warli (Maharashtra), Pattachitra (Odisha), Kalamkari (Andhra Pradesh), Phad and Pichwai (Rajasthan), Gond (Madhya Pradesh), Cheriyal (Telangana). Modern: Raja Ravi Varma, Abanindranath Tagore's Bengal School (Bharat Mata), Amrita Sher-Gil, Progressive Artists' Group (Bombay, 1947).

**Heritage, festivals and crafts:** India's first UNESCO sites (1983) were Ajanta, Ellora, Agra Fort and Taj Mahal; later came Khajuraho and Hampi (1986), Sanchi (1989), Bhimbetka (2003), Ahmedabad as the first heritage city (2017) and Jaipur (2019). The three mountain railways are Darjeeling, Nilgiri and Kalka-Shimla; Khangchendzonga is the only mixed site. Festivals: Pongal (Tamil Nadu), Onam (Kerala, Mahabali), Bihu (Assam), Hornbill (Nagaland), Hemis and Losar (Ladakh), Chhath (Bihar, Sun God), Durga Puja (Bengal), Pushkar fair (Rajasthan), Sonepur cattle fair (Bihar), Kumbh at Prayagraj, Haridwar, Ujjain and Nashik. Crafts: Pashmina (Kashmir), Phulkari (Punjab), Chikankari (Lucknow), Banarasi silk, Blue pottery (Jaipur), Bidriware (Bidar), Channapatna toys (Karnataka), Kanjeevaram silk (Tamil Nadu), Dhokra lost-wax metal craft (Chhattisgarh, Odisha).

**Literature, theatre and philosophy:** Panini's Ashtadhyayi, Kalidasa's Abhijnanashakuntalam and Meghadutam, Shudraka's Mrichchhakatika, Vishakhadatta's Mudrarakshasa; Tamil classics: the Sangam-tradition grammar Tolkappiyam and the later, post-Sangam works Silappadikaram (Ilango Adigal), Manimekalai (Sattanar) and Tirukkural (Thiruvalluvar). Bhakti poets by language: Tulsidas (Awadhi), Surdas (Braj), Tukaram (Marathi), Basavanna (Kannada vachanas), Narsinh Mehta (Gujarati), Shankardeva (Assamese). Abul Fazl's Ain-i-Akbari is part of the Akbarnama; Jayasi's Padmavat is in Awadhi; Tagore's Gitanjali won the 1913 Nobel. Jnanpith (first given in 1965 to G. Sankara Kurup) is the highest literary award; eleven classical languages as of October 2024: Tamil, Sanskrit, Telugu, Kannada, Malayalam and Odia (recognised by 2014), and Marathi, Pali, Prakrit, Assamese and Bengali (added in October 2024). Theatre and puppets: Kutiyattam (Kerala), Yakshagana (Karnataka), Jatra (Bengal), Nautanki (Uttar Pradesh), Bhavai (Gujarat), Tamasha (Maharashtra), Kathputli (Rajasthan), Tholu Bommalata (Andhra Pradesh). Martial arts: Kalaripayattu (Kerala), Silambam (Tamil Nadu), Thang-Ta (Manipur), Gatka (Punjab). Philosophy: Nyaya-Gautama, Vaisheshika-Kanada, Samkhya-Kapila, Yoga-Patanjali, Mimamsa-Jaimini, Vedanta-Badarayana; four Buddhist councils at Rajgir, Vaishali, Pataliputra and Kundalvana (Kanishka); Parshvanatha was the 23rd Tirthankara; Guru Arjan Dev compiled the Adi Granth and Guru Gobind Singh founded the Khalsa in 1699. Institutions: Sangeet Natak Akademi (1953), Lalit Kala and Sahitya Akademi (1954), ASI (1861, Cunningham), National Museum (New Delhi), IGNCA.

**Common traps:** Chhau is not a classical dance; Konark was built by the Eastern Gangas, not the Cholas; Humayun's Tomb, not the Taj, is the first charbagh tomb; Purandara Dasa is the Pitamaha, not a trinity member; Bani Thani is Kishangarh, not Kangra; Sonepur fair is in Bihar, Pushkar in Rajasthan.

### Examples

- Eight classical dances, two from Kerala: Kathakali (men, heavy make-up) and Mohiniyattam (women). Remember K and M both belong to Kerala.

- Chhau is NOT classical: it is a martial folk dance with Seraikela (Jharkhand) and Purulia (West Bengal) styles using masks, while Mayurbhanj (Odisha) is performed without masks.
- Carnatic trinity = Tyagaraja, Muthuswami Dikshitar and Syama Sastri, all born in Thiruvarur; Purandara Dasa is the Pitamaha of Carnatic music, not a trinity member.
- Temple styles in one line: Nagara = curved shikhara (north); Dravida = pyramidal vimana plus gopuram (south); Vesara = hybrid (Karnataka, Chalukya and Hoysala).
- Firsts of Indo-Islamic architecture: Alai Darwaza (Alauddin Khalji, earliest surviving true dome; the first true arch is credited to Balban's tomb, c. 1287); Humayun's Tomb (first charbagh garden tomb); Itmad-ud-Daulah's tomb (first Mughal structure built entirely of white marble, with pietra dura inlay).
- Three early sculpture schools: Gandhara = grey schist and Greek look; Mathura = spotted red sandstone and Indian look; Amaravati = white limestone (called Palnad marble) and Satavahana narrative panels.
- Folk painting state map: Madhubani-Bihar, Warli-Maharashtra, Pattachitra-Odisha, Kalamkari-Andhra Pradesh, Phad and Pichwai-Rajasthan, Gond-Madhya Pradesh, Cheriyal-Telangana.
- UNESCO first four (1983): Ajanta, Ellora, Agra Fort, Taj Mahal. The only mixed (natural plus cultural) site in India is Khangchendzonga National Park, Sikkim.
- Kumbh cities and rivers: Prayagraj (Sangam), Haridwar (Ganga), Ujjain (Shipra), Nashik (Godavari). Varanasi is NOT a Kumbh city.
- Six darshanas and founders: Nyaya-Gautama, Vaisheshika-Kanada, Samkhya-Kapila, Yoga-Patanjali, Mimamsa-Jaimini, Vedanta-Badarayana.
- Fair map: Pushkar camel fair (Rajasthan, Kartik Purnima) versus Sonepur cattle fair (Bihar, at the Gandak-Ganga confluence, Harihar Kshetra).
- Great Living Chola Temples (UNESCO): Brihadeeswara at Thanjavur, Gangaikonda Cholapuram and Airavatesvara at Darasuram, all in Tamil Nadu.

> **Quick revision:** 8 classical dances (SNA): Bharatanatyam-TN, Kathak-North, Kathakali and Mohiniyattam-Kerala, Kuchipudi-AP, Odissi-Odisha, Manipuri, Sattriya-Assam; Carnatic trinity: Tyagaraja, Dikshitar, Syama Sastri; Kailasa (Ellora)-Rashtrakuta Krishna I; Brihadeeswara-Rajaraja I; Khajuraho-Chandela; Konark-Narasimhadeva I (Eastern Ganga); Humayun's Tomb-first charbagh tomb; Gandhara grey schist, Mathura red sandstone, Amaravati marble; Bani Thani-Kishangarh; UNESCO 1983: Ajanta, Ellora, Agra Fort, Taj; Kumbh: Prayagraj, Haridwar, Ujjain, Nashik; first Jnanpith 1965 G. Sankara Kurup.

### Ancient Indian Architecture: Harappan Cities, Stupas, Rock-cut Caves and Temple Styles

**Harappan town planning:** Mohenjo-daro (on the Indus in Sindh) and Harappa (on the Ravi in Punjab, both now in Pakistan) were laid out on a grid, with streets crossing at right angles, a raised citadel on the west and a lower town on the east. Builders used standard burnt bricks in the ratio 1:2:4, with covered street drains. The best-known structures are the Great Bath of Mohenjo-daro, a brick tank sealed with bitumen, the granaries of Harappa, the dockyard of Lothal (Gujarat), the fire altars of Kalibangan (Rajasthan) and the reservoirs of Dholavira (Gujarat), a city divided into three parts instead of the usual two.

**Mauryan pillars and stupas:** Under Ashoka (third century BCE) stone replaced wood in royal art. His pillars are single shafts of Chunar sandstone with a glass-like Mauryan polish, set without a base and crowned by an inverted-lotus capital and an animal. The Sarnath Lion Capital, four lions back to back above an abacus carved with an elephant, a bull, a horse and a lion separated by wheels, was adopted as the National Emblem on 26 January 1950. A stupa is a solid hemispherical mound (anda) over relics, topped by a harmika and a chhatra and ringed by a railing (vedika) and a path for circumambulation. The Great Stupa at Sanchi (Madhya Pradesh) began as Ashoka's brick stupa, was enlarged and cased in stone under the Shungas, and received four carved gateways (toranas) in the first century BCE. Bharhut (Madhya Pradesh, second century BCE) is known for railing panels of Jataka stories with inscribed labels.

**Rock-cut caves:** Cutting halls into living rock began in the Barabar hills near Gaya (Bihar), where Ashoka gave caves to the Ajivika sect; the Lomas Rishi cave's doorway copies a wooden hut. In the Deccan two forms followed: the chaitya, an apsidal prayer hall with a stupa at the far end, and the vihara, a monastery of cells around a hall. Karle

(Maharashtra) has one of the largest chaitya halls, with wooden ribs still in its vaulted roof. Ajanta, a horseshoe of about 30 Buddhist caves above the Waghora river, was cut in the second and first centuries BCE and again in the fifth century CE under the Vakatakas. Ellora has 34 caves of Buddhists, Hindus and Jains; its Kailasa temple (Cave 16), cut from the top down out of a single rock under the Rashtrakuta king Krishna I in the eighth century, is among the world's largest monolithic structures. Elephanta, on an island near Mumbai, is best known for its main cave, a Shaiva shrine of about the sixth century with the three-faced Maheshmurti.

**Parts of a temple:** The structural Hindu temple took shape under the Guptas, as in the Dashavatara temple at Deogarh (Uttar Pradesh), one of the first with a tower. A temple has a sanctum (garbhagriha) for the deity, a hall (mandapa) for worshippers, often a vestibule (antarala) between them, and a tower over the sanctum, called shikhara in the north and vimana in the south. Temples are grouped into three main styles: Nagara, Dravida and Vesara.

**Nagara style:** The north Indian temple stands on a raised platform, usually without a large boundary wall or gateway, and rises in a curvilinear shikhara topped by a ribbed stone disc (amalaka) and a pot finial (kalasha). In Odisha the tower is called the deul and the hall the jagamohana, as at the Lingaraja temple of Bhubaneswar (11th century), the Jagannath temple of Puri (12th century) and the Konark Sun Temple, built by the Eastern Ganga king Narasimhadeva I in the 13th century as the Sun's chariot with 24 wheels and seven horses. The Chandelas built the Khajuraho group (Madhya Pradesh), finest of all the Kandariya Mahadeva, and the Solankis of Gujarat built the Sun Temple at Modhera in the 11th century.

**Dravida style:** The south Indian temple stands inside a walled enclosure (prakara) entered through gateways (gopurams), with a pyramidal, storeyed vimana over the sanctum and often a tank. The Pallavas moved from rock-cut monoliths, such as the Pancha Rathas of Mahabalipuram (Narasimhavarman I, seventh century), to structural temples, the Shore Temple at Mahabalipuram and the Kailasanatha temple at Kanchipuram, both of Narasimhavarman II (Rajasimha). The Cholas raised the vimana to its height in the Brihadeeswara temple at Thanjavur, completed by Rajaraja I in 1010, followed by Gangaikonda Cholapuram (Rajendra I) and the Airavatesvara temple at Darasuram. Later, under the Pandyas, Vijayanagara and the Nayakas, the gopuram grew taller than the vimana and long pillared corridors appeared, as at Hampi's Vitthala temple with its stone chariot, Madurai's Meenakshi temple and Rameswaram.

**Vesara style:** Vesara blends the two and belongs mainly to Karnataka. Its roots lie in the experiments of the Chalukyas of Badami at Aihole, called the cradle of Indian temple architecture, where the Durga temple is apsidal, and at Pattadakal, where Nagara temples such as Papanatha stand beside Dravida ones such as the Virupaksha temple, built by Queen Lokamahadevi to mark Vikramaditya II's victory over the Pallavas. It matured under the later Chalukyas of Kalyani and above all the Hoysalas, whose star-shaped (stellate) temples stand on raised platforms in soft soapstone, covered with fine carving: the Chennakeshava temple at Belur, built by Vishnuvardhana, and the Hoysaleswara temple at Halebidu.

### Examples

- Harappan planning: grid streets, citadel on the west and lower town on the east, burnt bricks in the ratio 1:2:4; Great Bath at Mohenjo-daro, dockyard at Lothal, fire altars at Kalibangan, three-part city at Dholavira.
- Sarnath Lion Capital: four lions on an abacus with an elephant, bull, horse and lion separated by wheels; adopted as the National Emblem on 26 January 1950.
- Sanchi Great Stupa: begun in brick by Ashoka, enlarged and cased in stone by the Shungas, four toranas carved in the first century BCE; Bharhut railing panels carry labelled Jataka scenes.
- Barabar caves (near Gaya, Bihar): earliest rock-cut caves, given by Ashoka to the Ajivikas; the Lomas Rishi doorway copies a wooden hut.
- Chaitya = apsidal prayer hall with a stupa (Karle); vihara = monastery of cells around a hall (Ajanta has both).
- Ellora: 34 caves of Buddhists, Hindus and Jains; Kailasa temple (Cave 16) carved top-down from one rock under Rashtrakuta Krishna I.
- Konark Sun Temple: Eastern Ganga king Narasimhadeva I, 13th century, a stone chariot with 24 wheels and seven horses.

- Pallava firsts: Pancha Rathas (rock-cut, Narasimhavarman I); Shore Temple and Kailasanatha, Kanchipuram (structural, Rajasimha).
- Brihadeeswara, Thanjavur: completed by Rajaraja I in 1010, the classic Dravida vimana; later gopurams outgrew the vimana (Madurai, Hampi).
- Vesara: roots in Badami Chalukya experiments at Aihole (cradle of temple architecture, apsidal Durga temple) and Pattadakal (Virupaksha by Queen Lokamahadevi); matured in the Hoysala star-shaped soapstone temples at Belur and Halebidu.

> **Quick revision:** Harappa: grid, citadel, 1:2:4 bricks, Great Bath (Mohenjo-daro), dockyard (Lothal); Sarnath capital = National Emblem 26 Jan 1950; Sanchi: Ashoka brick, Shunga stone, toranas 1st century BCE; Barabar caves for Ajivikas; Karle chaitya; Ajanta ~30 Buddhist caves; Ellora 34 caves, Kailasa by Krishna I; Nagara (shikhara, amalaka): Konark, Khajuraho, Lingaraja; Dravida (vimana, gopuram): Brihadeeswara 1010; Vesara: Aihole, Pattadakal, Belur, Halebidu.

### Indo-Islamic and Later Architecture: Sultanate, Mughal, Rajput and Colonial Buildings

**What the new rulers brought:** Earlier Indian builders spanned openings with beams laid across pillars, the trabeate system. From the end of the 12th century the Turkish rulers brought the arcuate system: the true arch, locked by a keystone, and the dome, raised over a square room on corner squinches, both bonded with lime mortar. Because Islam discourages images of living beings, decoration came from calligraphy, geometric patterns, arabesques and pierced stone screens (jali). Minarets came with them too, and in time the charbagh (a garden in four parts divided by water channels), the double dome and, under the Mughals, pietra dura, the inlay of coloured stones in marble.

**Delhi Sultanate:** Qutbuddin Aibak built the Quwwat-ul-Islam mosque in Delhi, using pillars from demolished temples, and the Adhai Din ka Jhonpra at Ajmer. He began the Qutub Minar around 1199; Iltutmish added three storeys, and after lightning damage Firoz Shah Tughlaq rebuilt the top and added a fifth, bringing it to 72.5 metres of red and buff sandstone banded with inscriptions. The iron pillar in the same complex is a rust-resistant Gupta work. The first true arch is credited to Balban's tomb (about 1287) and the first true dome to the Alai Darwaza (1311), the gateway Alauddin Khalji added to the Qutub complex in red sandstone with white marble and horseshoe arches; Alauddin also built Siri and the Hauz-i-Alai tank. The Tughlaqs built massive, plain forts with sloping walls, such as Tughlaqabad of Ghiyasuddin Tughlaq, and Firoz Shah moved two Ashokan pillars to Delhi. The Sayyids and Lodis built octagonal tombs, and the double dome appears in the Lodi period, as in Sikandar Lodi's tomb.

**Provincial styles:** As the Sultanate weakened, regional kingdoms built in their own ways. The Sharqi rulers of Jaunpur built the Atala Masjid with a huge gateway-like screen in place of minarets. Bengal built in brick and terracotta, as in the vast Adina mosque at Pandua, and borrowed the curved roof of village huts. Gujarat's sultans blended Hindu and Jain carving into mosques such as the Jama Masjid of Ahmedabad and the Sidi Saiyyed mosque with its tree-of-life jali. Mandu in Malwa has the Jahaz Mahal, the Hindola Mahal and the marble tomb of Hoshang Shah. In the Deccan the Bahmanis built at Gulbarga and Bidar, the Adil Shahis built the Gol Gumbaz at Bijapur, the tomb of Muhammad Adil Shah with one of the world's largest domes and a whispering gallery, and the Qutb Shahi ruler Muhammad Quli Qutb Shah built the Charminar at Hyderabad in 1591.

**Mughal architecture:** Babur laid out gardens such as the Aram Bagh at Agra, and Sher Shah Suri built his octagonal tomb in the middle of a tank at Sasaram (Bihar). The Mughal style proper begins with Humayun's Tomb in Delhi, built by his widow Bega Begum and completed in 1570 to the design of the Persian architect Mirak Mirza Ghiyas: the first garden tomb of the subcontinent, set in a charbagh, in red sandstone with white marble under a Persian double dome. Akbar mixed Persian and Indian forms in red sandstone at Agra Fort and at Fatehpur Sikri, whose Buland Darwaza celebrates his conquest of Gujarat and whose Panch Mahal and Diwan-i-Khas use Indian brackets, beams and chhatris. Nur Jahan built the tomb of her father Itimad-ud-Daulah at Agra, the first Mughal building wholly in white marble with pietra dura. Shah Jahan, whose reign is the age of marble, built the Taj Mahal at Agra on the Yamuna for Mumtaz Mahal, with Ustad Ahmad Lahori as chief architect, and at his new city of Shahjahanabad in Delhi the Red Fort (begun in 1639) and the Jama Masjid. Under Aurangzeb building declined; the Bibi ka Maqbara at Aurangabad, built in memory of his wife Dilras Banu Begum, is called the Taj of the Deccan.

**Rajput forts and palaces:** Rajput rulers built hill forts and palaces that borrowed Mughal chhatris (domed kiosks), jharokhas (projecting balconies) and gardens. Chittorgarh has the nine-storey Vijay Stambha raised by Rana Kumbha of Mewar after his victory over the Sultan of Malwa, beside the older Jain Kirti Stambha; Rana Kumbha also built Kumbhalgarh, whose walls run for about 36 kilometres. Other landmarks are Mehrangarh at Jodhpur (Rao Jodha), the yellow sandstone fort of Jaisalmer, Amber near Jaipur, the Man Mandir palace in Gwalior fort (Raja Man Singh Tomar), the Hawa Mahal of Jaipur (Sawai Pratap Singh, 1799) and the Jantar Mantar observatories of Sawai Jai Singh II at Jaipur, Delhi, Ujjain, Varanasi and Mathura.

**Colonial buildings:** The Portuguese built Baroque churches in Goa, such as the Basilica of Bom Jesus, which holds the remains of St Francis Xavier. The British used Gothic Revival and Indo-Saracenic styles: Chhatrapati Shivaji Terminus (formerly Victoria Terminus) in Mumbai by F. W. Stevens, the Gateway of India by George Wittet, and the Victoria Memorial in Kolkata, in white Makrana marble, by William Emerson. New Delhi was planned by Edwin Lutyens and Herbert Baker, with Rashtrapati Bhavan and India Gate by Lutyens and the circular Parliament House, opened in 1927.

**Examples**

- Trabeate (beam and pillar) was the older Indian system; the Turks brought the arcuate system of true arch and dome, held with lime mortar.
- Qutub Minar: begun by Aibak around 1199, three storeys added by Iltutmish, top rebuilt and a fifth storey added by Firoz Shah Tughlaq; Quwwat-ul-Islam mosque stands beside it.
- First true arch: Balban's tomb (about 1287); first true dome: Alai Darwaza (1311) of Alauddin Khalji; double dome in Lodi-period tombs such as Sikandar Lodi's.
- Deccan landmarks: Gol Gumbaz, Bijapur (tomb of Muhammad Adil Shah, whispering gallery); Charminar, Hyderabad (Muhammad Quli Qutb Shah, 1591).
- Humayun's Tomb: built by Bega Begum, designed by Mirak Mirza Ghiyas, completed 1570; first garden tomb in a charbagh, the model for the Taj.
- Itimad-ud-Daulah's tomb, Agra: built by Nur Jahan for her father; first Mughal building wholly of white marble with pietra dura.
- Shah Jahan: Taj Mahal (Ustad Ahmad Lahori, for Mumtaz Mahal), Red Fort begun 1639 and Jama Masjid at Shahjahanabad; Bibi ka Maqbara at Aurangabad is the Taj of the Deccan.
- Vijay Stambha, Chittorgarh: nine storeys, built by Rana Kumbha after defeating the Sultan of Malwa; Kumbhalgarh's walls run about 36 km.
- Colonial pairs: CST Mumbai - F. W. Stevens; Gateway of India - George Wittet; Victoria Memorial - William Emerson; Rashtrapati Bhavan and India Gate - Edwin Lutyens.

> **Quick revision:** Arcuate (arch, dome, mortar) replaced trabeate; Qutub Minar: Aibak c.1199, Iltutmish, Firoz Tughlaq; Balban's tomb first true arch; Alai Darwaza 1311 first true dome; Atala Masjid (Jaunpur); Gol Gumbaz (Bijapur); Charminar 1591; Humayun's Tomb 1570 (Bega Begum, Mirak Mirza Ghiyas); Buland Darwaza (Gujarat victory); Itimad-ud-Daulah first all-marble; Taj (Ustad Ahmad Lahori); Red Fort 1639; Vijay Stambha (Rana Kumbha); CST (Stevens); Victoria Memorial (Emerson).

### Indian Sculpture and Painting: From Mauryan Polish to Pahari Miniatures

**Mauryan court and popular art:** Large-scale stone sculpture begins with the Mauryas. Court art produced the polished pillar capitals of Chunar sandstone; popular art produced big free-standing yakshas and yakshis, folk deities of wealth and fertility. The Didarganj Yakshi, a life-size fly-whisk (chauri) bearer found at Patna in 1917, is commonly attributed to the Mauryan period for its glossy polish, though some scholars date it later, and the Parkham Yaksha comes from near Mathura. Long before, the Harappans had cast the bronze Dancing Girl of Mohenjo-daro by the lost-wax method and carved the steatite bust called the Priest-King.

**From symbols to images of the Buddha:** The reliefs of Bharhut and Sanchi tell the Buddha's life and the Jataka tales without showing him: he appears as a footprint, an empty seat, the Bodhi tree, a wheel or a stupa. The Buddha in human form appears in the Kushana period in two centres. Gandhara in the north-west (around Taxila and

Peshawar) worked in grey-blue schist and stucco under Greco-Roman influence: wavy hair, muscular bodies, heavy drapery in deep folds and a calm, spiritual face. Mathura worked in spotted red sandstone in an Indian idiom: a shaven head with a coiled top-knot, a smiling face, a large halo and thin drapery over a strong body; it made Buddhist, Jain and Hindu images and the headless portrait statue of Kanishka. In the Krishna valley of Andhra, the Amaravati school under the Satavahanas and Ikshvakus carved white limestone panels crowded with lively narrative, a style also seen at Nagarjunakonda.

**Gupta and later sculpture:** The Gupta age set the classical norm. The Sarnath school made Buddhas of cream sandstone with transparent drapery and downcast eyes, the finest being the seated Buddha preaching the first sermon in the dharmachakra mudra. Hindu sculpture matured in the Varaha panel at Udayagiri near Vidisha and the Vishnu panels of the Dashavatara temple at Deogarh. The Pallavas carved the huge open-air relief of the Descent of the Ganga (Arjuna's Penance) at Mahabalipuram in the seventh century, and the Pala kings of Bihar and Bengal (eighth to 12th centuries) patronised black-stone and bronze images linked with Nalanda.

**Chola bronzes:** South Indian bronze casting reached its height under the Cholas, especially in the 10th to 12th centuries, by the lost-wax method (cire perdue): a wax model is coated with clay, heated so that the wax runs out, and the mould filled with molten metal, so every image is unique; Swamimalai in Tamil Nadu still practises it. The best-known image is Nataraja, Shiva as Lord of Dance performing the ananda tandava within a ring of fire: he holds a drum (damaru) in the upper right hand and fire in the upper left, shows the abhaya (fear-not) gesture with the lower right hand, crushes the dwarf Apasmara, who stands for ignorance, under his right foot and raises his left leg. Bronzes of Parvati, Rama and the saints were made to be carried in temple processions.

**Wall painting:** Painting begins in the prehistoric rock shelters of Bhimbetka (Madhya Pradesh), found by V. S. Wakankar in 1957, with hunting and dancing scenes in red and white. The Ajanta murals, in mineral colours on lime-coated plaster, show Jataka stories and the Buddha's life; Cave 1 has the Bodhisattva Padmapani, and Cave 16 the scene called the Dying Princess. The Bagh caves in Dhar district (Madhya Pradesh) have murals close to Ajanta in style but more worldly in mood. Later murals survive at Ellora, in the Jain cave of Sittanavasal (Tamil Nadu), in the Brihadeeswara temple of the Cholas and at Lepakshi (Andhra Pradesh) of the Vijayanagara period.

**Mughal miniatures:** Miniature painting began with illustrated palm-leaf manuscripts of the Pala school (Buddhist texts) and of the Western Indian or Jain school (texts such as the Kalpasutra). The Mughal school began when Humayun brought two Persian masters, Mir Sayyid Ali and Abdus Samad, from the Safavid court. Akbar's studio illustrated the Hamzanama, the Razmnama (the Persian Mahabharata) and the Akbarnama with Indian painters such as Daswanth and Basawan. Under Jahangir the school peaked in portraits and nature studies: Ustad Mansur painted birds and animals, Abul Hasan excelled at portraits, and Jahangir claimed he could name the painter of every face in a picture. The style grew formal under Shah Jahan, and under Aurangzeb painters moved to Rajput and provincial courts.

**Rajasthani and Pahari schools:** The Rajasthani schools painted Krishna legends, Ragamala (pictures of musical modes), Barahmasa (the twelve months) and court life in bright colours. Mewar (Udaipur) is among the earliest centres, with Sahibdin's Ramayana; Bundi and Kota are known for hunting and rain scenes; Kishangarh, under Raja Sawant Singh, produced the Bani Thani of Nihal Chand, with long curved eyes and a sharp profile. The Pahari schools of the hill states began at Basohli (Jammu) with bold colours and beetle-wing pieces used as jewels, and matured at Guler and at Kangra under Raja Sansar Chand, whose lyrical Gita Govinda and Bihari Satsai sets are the most delicate in Indian painting. In the 20th century Nandalal Bose of Santiniketan and his students decorated the pages of the original Constitution of India.

### Examples

- Didarganj Yakshi: life-size chauri-bearer in polished Chunar sandstone, found at Patna in 1917; commonly attributed to the Mauryan period and cited for Mauryan polish on a human figure, though its date is debated.
- Early Buddhist reliefs (Bharhut, Sanchi) are aniconic: the Buddha is shown by a footprint, empty seat, Bodhi tree, wheel or stupa; the human image comes in the Kushana period.
- Gandhara = grey schist, Greco-Roman, wavy hair, heavy folds; Mathura = spotted red sandstone, Indian, smiling face, thin drapery; Amaravati = white limestone narrative panels.

- Sarnath school (Gupta): seated Buddha preaching the first sermon in the dharmachakra mudra, transparent drapery.
- Nataraja (Chola bronze, lost-wax): ananda tandava in a ring of fire, damaru in the upper right hand, right foot on Apasmara (ignorance).
- Ajanta: Bodhisattva Padmapani in Cave 1, Dying Princess in Cave 16; Bagh caves (Dhar district) have Ajanta-like murals; Bhimbetka found by V. S. Wakankar in 1957.
- Mughal painting: Humayun brought Mir Sayyid Ali and Abdus Samad; Akbar's Hamzanama and Razmnama; Jahangir's Ustad Mansur (birds) and Abul Hasan (portraits).
- Bani Thani: Nihal Chand, Kishangarh school, under Raja Sawant Singh; Kangra school flowered under Raja Sansar Chand; Basohli used beetle-wing jewels.
- Nandalal Bose and his Santiniketan students decorated the pages of the original Constitution of India.

> **Quick revision:** Mauryan: Chunar polish, Didarganj Yakshi (Patna, 1917, usually called Mauryan); early Buddhist art aniconic; Kushana: Gandhara (schist, Greco-Roman) and Mathura (red sandstone, Indian, Kanishka statue); Amaravati white limestone; Gupta Sarnath Buddha (dharmachakra mudra); Chola Nataraja by lost-wax (Swamimalai); Ajanta Padmapani (Cave 1); Bagh; Mughal: Mir Sayyid Ali, Abdus Samad, Ustad Mansur; Bani Thani (Nihal Chand, Kishangarh); Basohli, Kangra (Sansar Chand).

### Folk Paintings, Textiles and Crafts of the Indian States

**Why folk art matters:** Folk and tribal painting is made by communities, often by women, for rituals, weddings and festivals, with natural colours and inherited motifs rather than the rules of a court studio. Exams pair each form with its state and its signature feature. Many of these paintings, textiles and crafts are protected as Geographical Indications under the Geographical Indications of Goods (Registration and Protection) Act, 1999, which came into force in 2003; Darjeeling tea was the first Indian product registered, and a registration lasts 10 years and can be renewed.

**Paintings of the east:** Madhubani (Mithila) painting of Bihar was painted by women on mud walls and floors for weddings and festivals, with double-line borders, no empty space and themes from the Ramayana, Krishna and nature; its styles include Bharni, Kachni, Godna and Kohbar, and it drew wide notice after the British officer W. G. Archer saw it on walls broken by the 1934 Bihar earthquake. Pattachitra of Odisha is painted on treated cloth (patta) with Jagannath and Krishna themes; Raghurajpur near Puri is its crafts village, and a palm-leaf version is etched with a stylus. Kalighat painting grew near the Kalighat temple of Kolkata in the 19th century: quick, bold watercolours on mill paper of gods and satirical scenes of city life, sold to pilgrims. Manjusha painting of Bhagalpur (Bihar) tells the Bihula-Vishahari legend, Saura painting is the wall art of the Saura tribe of Odisha, and Sohrai and Khovar are wall paintings of Hazaribagh (Jharkhand).

**Paintings of the west and centre:** Warli painting, by the Warli tribe of Thane and Palghar in Maharashtra, uses white rice paste on a mud or ochre wall and builds figures from circles, triangles and squares, with the tarpa dance shown as a spiral of people; Jivya Soma Mashe made it famous. Phad of Bhilwara (Rajasthan) is a long cloth scroll of the epics of the folk deities Pabuji and Devnarayan, unrolled at night by Bhopa priest-singers. Pichwai of Nathdwara (Rajasthan) is a cloth hanging behind the image of Shrinathji (Krishna), changed with the seasons and festivals. Gond painting of Madhya Pradesh builds animals, trees and myths from dots and dashes in bright colours, and Jangarh Singh Shyam took it from walls to canvas. Pithora is the ritual wall painting of the Rathwa and Bhil tribes of Gujarat and Madhya Pradesh.

**Paintings of the south:** Kalamkari, meaning pen-work, comes from Andhra Pradesh in two styles: the Srikalahasti style, drawn freehand with a bamboo pen (kalam) and natural dyes, mostly on temple and epic themes, and the Machilipatnam style, printed with carved wooden blocks. Tanjore (Thanjavur) painting of Tamil Nadu, which flourished under the Maratha rulers of Thanjavur, paints deities on a wooden board and raises them with gesso, gold foil and glass or stone pieces. Mysore painting of Karnataka is a quieter cousin with thin gold leaf, and Cheriyal scrolls of Telangana narrate local legends on bold red backgrounds.

**Textiles tied to places:** Banarasi silk of Varanasi is a brocade woven with gold and silver zari in Mughal floral motifs; Kanjeevaram silk of Kanchipuram (Tamil Nadu) is heavy mulberry silk whose wide contrasting border is woven

separately and interlocked with the body. Chikankari of Lucknow is fine white-on-white embroidery on muslin and cotton; Phulkari of Punjab is flower embroidery in silk floss on coarse cotton; Kantha of West Bengal is running-stitch embroidery on layers of old saris. Bandhani of Gujarat and Rajasthan is tie-and-dye, in which tiny knots resist the dye, while Leheriya of Rajasthan makes diagonal waves. Patola of Patan (Gujarat) is double ikat silk, with both warp and weft dyed before weaving; Pochampally (Telangana) and Sambalpuri (Odisha) are other ikats. Paithani (Maharashtra) has peacock borders, Baluchari of Bishnupur (West Bengal) weaves epic scenes into the pallu, Muga is the golden silk of Assam, and Chanderi and Maheshwari are light weaves of Madhya Pradesh. Pashmina is woven in Kashmir from the fine undercoat of the Changthangi goat of Ladakh, and the Kani shawl is woven with small wooden spools called kanis.

**Metal, pottery and toys:** Bidriware of Bidar (Karnataka), dating from the Bahmani period, is cast in an alloy of zinc and copper, inlaid with silver and blackened with soil from the Bidar fort, so the silver shines on black. Dhokra is lost-wax brass casting by tribal artisans of Chhattisgarh (Bastar), Odisha, Jharkhand and West Bengal. The blue pottery of Jaipur, of Turko-Persian origin, uses quartz paste instead of clay; Meenakari, also of Jaipur, is enamel work on metal; and Thewa of Pratapgarh (Rajasthan) fuses patterned gold sheet onto glass. Channapatna (Karnataka) makes lacquered wooden toys, Kondapalli and Etikoppaka (Andhra Pradesh) make wooden toys, and the Bankura horse of West Bengal is a terracotta icon. Kerala's Aranmula kannadi is a mirror made of polished metal alloy, not glass.

**Examples**

- Madhubani (Mithila, Bihar): women's wall and floor painting, double-line borders, no empty space; styles Bharni, Kachni, Godna, Kohbar; noticed by W. G. Archer after the 1934 earthquake.
- Warli (Thane-Palghar, Maharashtra): white rice paste on mud walls, figures of circles, triangles and squares, tarpa dance spiral; Jivya Soma Mashe.
- Pattachitra (Odisha): cloth painting of Jagannath and Krishna, village Raghurajpur near Puri; Kalighat (Kolkata): 19th-century watercolours sold to pilgrims.
- Phad (Bhilwara, Rajasthan): scrolls of Pabuji and Devnarayan sung by Bhopas; Pichwai (Nathdwara): cloth hangings behind Shrinathji.
- Gond (Madhya Pradesh): dots and dashes, Jangarh Singh Shyam; Pithora: ritual wall art of the Rathwas (Gujarat); Saura: Odisha; Sohrai-Khovar: Hazaribagh, Jharkhand.
- Kalamkari (Andhra Pradesh): Srikalahasti = freehand pen; Machilipatnam = block-printed. Tanjore painting: gold foil and gesso on wood, Maratha patronage.
- Silk map: Banarasi brocade (Varanasi), Kanjeevaram (Tamil Nadu), Patola double ikat (Patan, Gujarat), Paithani (Maharashtra), Baluchari (Bishnupur, West Bengal), Muga golden silk (Assam).
- Embroidery and dyeing: Chikankari (Lucknow), Phulkari (Punjab), Kantha (West Bengal), Bandhani tie-dye (Gujarat, Rajasthan), Leheriya waves (Rajasthan).
- Crafts: Bidriware (Bidar, zinc-copper alloy with silver inlay), Dhokra (tribal lost-wax brass), Blue pottery (Jaipur, quartz paste), Channapatna toys (Karnataka), Aranmula metal mirror (Kerala).
- GI tags: Geographical Indications of Goods Act, 1999, in force 2003; Darjeeling tea was India's first GI; registration valid for 10 years, renewable.

> **Quick revision:** Madhubani-Bihar (women, double borders, Kohbar); Warli-Maharashtra (rice paste, geometry); Pattachitra-Odisha (Raghurajpur); Kalighat-Kolkata; Phad-Bhilwara (Pabuji); Pichwai-Nathdwara; Gond-MP; Kalamkari-Andhra (Srikalahasti pen, Machilipatnam block); Tanjore gold foil; Banarasi, Kanjeevaram, Patola double ikat, Paithani, Muga; Chikankari-Lucknow; Bandhani; Pashmina-Changthangi goat; Bidriware-Bidar; Dhokra lost-wax; GI Act 1999, first GI Darjeeling tea.

### Classical Dances of India: The Eight Forms, Their Texts and Exponents

**Roots in the Natya Shastra:** Every Indian classical dance traces its grammar to the Natya Shastra of Bharata Muni, compiled roughly between the second century BCE and the second century CE and called the fifth Veda. It divides performance into nritta (pure dance of rhythm and movement), nritya (expressive dance that conveys meaning) and natya (drama). It names four kinds of abhinaya or expression: angika (body), vachika (speech and song), aharya (costume and make-up) and sattvika (inner feeling). Its theory of rasa lists eight emotional flavours, to which shanta

(peace) was added later. Nandikeshvara's Abhinaya Darpana is the other key text, especially for hand gestures (hastas or mudras). Dance is also divided into tandava, vigorous and linked with Shiva, and lasya, graceful and linked with Parvati.

**What makes a dance classical:** The Sangeet Natak Akademi, the national academy of music, dance and drama set up in 1953, recognises eight classical dances. The Ministry of Culture's list also includes Chhau, which is why some books count nine. They share a codified technique going back to these texts, a fixed repertoire, a guru-shishya line of teaching and roots in temple or court performance. Folk dances, by contrast, belong to communities and seasons and have no written grammar.

**Bharatanatyam and Kuchipudi:** Bharatanatyam of Tamil Nadu grew out of Sadir, danced by devadasis in temples. The Tanjore Quartet, four brothers at the court of the Maratha ruler Serfoji II in the early 19th century, fixed its concert order (margam): alarippu, jatiswaram, shabdam, varnam, padam and tillana. In the 1930s E. Krishna Iyer and Rukmini Devi Arundale revived and renamed it, and Rukmini Devi founded Kalakshetra at Madras in 1936; T. Balasaraswati is its other great name. A solo dancer often plays many roles (ekaharya), and the half-seated araimandi is its basic stance. Kuchipudi takes its name from a village in Krishna district of Andhra Pradesh; Siddhendra Yogi shaped it as a dance-drama performed by Brahmin men, with Bhama Kalapam as its classic piece. In its tarangam the dancer moves on the rim of a brass plate, sometimes with a pot of water on the head. Vempati Chinna Satyam modernised it, and Yamini Krishnamurthy and Raja and Radha Reddy made it famous.

**Kathakali and Mohiniyattam:** Kerala has two classical forms. Kathakali, a 17th-century dance-drama that grew from Ramanattam and Krishnattam, tells stories from the epics through a strict gesture language, with chenda and maddalam drums and singers, and was traditionally danced by men through the night. Its make-up shows character: pacha (green) for noble heroes, kathi (knife) for proud villains, thadi (beard) in red, white and black types, kari (black) for demonesses and forest dwellers, and minukku (radiant) for women and sages. The poet Vallathol Narayana Menon founded the Kerala Kalamandalam in 1930 to revive it. Mohiniyattam, the dance of Mohini, the enchantress form of Vishnu, is a graceful solo dance of women in white and gold with gentle swaying movements; Swati Tirunal of Travancore patronised it, Vallathol revived it at Kalamandalam, and Kalamandalam Kalyanikutty Amma is called its mother.

**Kathak:** Kathak, from katha (story), began with temple storytellers (kathakars) of north India and grew in the Mughal and Nawabi courts; it is usually described as the only classical dance wedded to Hindustani music. Its signatures are fast footwork (tatkar) with ankle bells, rapid spins (chakkars) and storytelling through gesture. The Lucknow gharana, patronised by Nawab Wajid Ali Shah, stresses grace and expression; the Jaipur gharana stresses footwork and rhythm; Banaras is a third gharana. Bindadin Maharaj of Lucknow and his family line, down to Shambhu Maharaj and Birju Maharaj, shaped the modern form, and Sitara Devi and Kumudini Lakhia are other famous names.

**Odissi:** Odissi of Odisha is often called the oldest surviving classical dance on archaeological evidence: dancing figures were carved more than 2,000 years ago in the Rani Gumpha of the Udayagiri caves near Bhubaneswar. It was kept alive by the maharis, temple dancers of Jagannath at Puri, and by the gotipuas, boys dressed as girls, and Jayadeva's 12th-century Gita Govinda supplies much of its lyric. Its two basic positions are the chowk, a square stance, and tribhanga, the body bent at head, torso and knee. It was reconstructed in the 1950s, and Kelucharan Mohapatra, Sanjukta Panigrahi and Sonal Mansingh are its great names.

**Manipuri and Sattriya:** Manipuri grew out of the ancient ritual festival Lai Haraoba and took its Vaishnava form under King Bhagyachandra in the 18th century, centred on the Ras Lila of Krishna and the gopis. Women wear a stiff, cylindrical embroidered skirt (kumil) and a veil; movements are soft and rounded, no ankle bells are worn, and men perform the vigorous Pung Cholom (drum dance) and Kartal Cholom. Rabindranath Tagore brought Manipuri to Santiniketan, and Guru Bipin Singh and the Jhaveri sisters spread it. Sattriya of Assam was created by Srimanta Sankardeva in the 15th-16th centuries as part of his Ankiya Naat one-act plays and preserved in the sattras, Vaishnava monasteries, by male monks. The Sangeet Natak Akademi recognised it as classical on 15 November 2000; Guru Jatin Goswami is a leading exponent.

**Examples**

- Natya Shastra (Bharata Muni): nritta = pure dance, nritya = expressive dance, natya = drama; four abhinayas: angika, vachika, aharya, sattvika; eight rasas, shanta added later.
- Tandava = vigorous dance linked with Shiva; lasya = graceful dance linked with Parvati; Abhinaya Darpana of Nandikeshvara is the key text on hand gestures.
- Bharatanatyam: earlier Sadir; margam fixed by the Tanjore Quartet under Serfoji II; renamed and revived by E. Krishna Iyer and Rukmini Devi Arundale, who founded Kalakshetra in 1936.
- Kuchipudi: village in Krishna district, Andhra Pradesh; Siddhendra Yogi; Bhama Kalapam; tarangam on the rim of a brass plate; Vempati Chinna Satyam.
- Kathakali make-up: pacha (green) = noble hero, kathi = proud villain, thadi = bearded types, kari (black) = demoness, minukku = women and sages; Kerala Kalamandalam founded by Vallathol in 1930.
- Mohiniyattam: solo dance of women in white and gold, patronised by Swati Tirunal; Kalamandalam Kalyanikutty Amma is called its mother.
- Kathak: tatkar and chakkars; Lucknow gharana (Wajid Ali Shah, expression), Jaipur gharana (footwork), Banaras; Birju Maharaj and Sitara Devi.
- Odissi: chowk and tribhanga; earliest evidence in the Rani Gumpha of Udayagiri; maharis and gotipuas; Kelucharan Mohapatra.
- Manipuri: Ras Lila under King Bhagyachandra, kumil skirt, no ankle bells, Pung Cholom; Tagore took it to Santiniketan.
- Sattriya: created by Srimanta Sankardeva in the Ankiya Naat of Assam's sattras; recognised as classical by the Sangeet Natak Akademi on 15 November 2000.

> **Quick revision:** Natya Shastra (Bharata): nritta, nritya, natya; 4 abhinayas; 8 rasas; SNA (1953) recognises 8 classical dances (Ministry of Culture list adds Chhau); Bharatanatyam-TN (Sadir, Tanjore Quartet, Rukmini Devi, Kalakshetra 1936); Kuchipudi-AP (Siddhendra Yogi, tarangam); Kathakali-Kerala (pacha, Kalamandalam 1930); Mohiniyattam-Kerala; Kathak (tatkar, chakkar, Lucknow-Jaipur-Banaras); Odissi (tribhanga, chowk); Manipuri (Ras Lila, kumil); Sattriya-Assam (Sankardeva, 2000).

### Folk Dances, Folk Theatre and Puppetry of India by State

**Folk forms and how they differ:** Folk dances and theatre belong to a community, a season or a ritual rather than to a codified text. They mark harvests, weddings, festivals and worship, use local songs and instruments, and are learned by joining in. Exams test them as state-and-form pairs, so remember them region by region.

**North and west:** Punjab has Bhangra, the men's harvest dance of Baisakhi, and Giddha, the women's dance; Haryana has Phag in the month of Phalgun. Jammu and Kashmir has Rouf, danced by women in facing rows, and Dumhal of the Wattal men; Himachal Pradesh has Nati, a line dance of Kullu; Uttarakhand has Chholiya, a sword dance of Kumaon weddings. Rajasthan has Ghoomar, the swirling dance of women in long skirts, Kalbelia of the snake-charmer community, Chari, in which women balance brass pots with lit lamps on their heads, Terah Taali, in which seated women strike 13 manjiras tied to their bodies, and Kachchhi Ghodi with dummy horses. Gujarat has Garba around a lamp at Navratri, Dandiya Raas with sticks and Tippani of Saurashtra; Maharashtra has Lavani, sung and danced to the dholki, Koli of the fisherfolk and Dhangari Gaja of shepherds; Goa has Dekhni and Fugdi.

**East and north-east:** Uttar Pradesh has Charkula of Braj, danced with a tiered pyramid of lamps on the head. Bihar has Jat-Jatin and Jhijhiya of Mithila; Jharkhand has Jhumair, Paika and Karma; West Bengal has Gambhira of Malda; Odisha has Ghumura, a drum dance of Kalahandi, and Dalkhai of Sambalpur. Chhau, a martial dance, has three styles: Seraikela (Jharkhand) and Purulia (West Bengal), danced with masks, and Mayurbhanj (Odisha), danced without them. Assam's Bihu is danced at Rongali Bihu in April, and the Bodo dance Bagurumba imitates butterflies. Mizoram has Cheraw, danced between clapping bamboo poles; Meghalaya has Nongkrem of the Khasis and Wangala, the harvest dance of the Garos; Tripura has Hojagiri, in which Reang women balance pitchers and lamps; Manipur has Thang-Ta, a martial art, and the ritual dances of Lai Haraoba; Sikkim has Singhi Chham, a snow-lion mask dance; and Ladakh has the masked Cham dances of its monasteries.

**South and centre:** Kerala has Theyyam, the ritual dance of north Kerala in which the performer becomes the deity, Thiruvathirakali of women, Oppana at Muslim weddings and Margamkali of the Syrian Christians. Tamil Nadu has Karagattam, danced with a decorated pot on the head in honour of Mariamman, Kummi and Kolattam of women, and Mayilattam, the peacock dance. Karnataka has Dollu Kunitha, a vigorous drum dance; Telangana has Perini Sivatandavam, the warrior dance of the Kakatiya age; Andhra Pradesh and Odisha share Dhimsa, a tribal ring dance. Chhattisgarh has Panthi of the Satnami community, Raut Nacha of the Yadavs after Diwali and the Gaur (bison-horn) dance of the Marias of Bastar; Madhya Pradesh has Matki of Malwa.

**Folk theatre of the north, west and east:** Nautanki of Uttar Pradesh, with Kanpur, Lucknow and Hathras styles, is musical verse drama led by the nagara drum. Swang of Haryana mixes song and dialogue; Ramlila stages the Ramayana, often from Tulsidas's Ramcharitmanas, at Dussehra; Bhand Pather of Kashmir is satire by Bhands. Bhavai of Gujarat, credited to Asait Thakar in the 14th century, is a chain of short plays (vesh) with the long trumpet bhungal; Tamasha of Maharashtra, built around Lavani, is unusual in giving the lead roles to women. Jatra of Bengal and Odisha, open-air musical drama, spread with the Krishna devotion of Chaitanya in the 16th century; Ankiya Naat (Bhaona) of Assam was created by Sankardeva; Bidesia of Bihar, shaped by Bhikhari Thakur, tells of migrant workers and the families they leave behind.

**Folk theatre of the south:** Yakshagana of coastal Karnataka is an all-night dance-drama on stories from the epics, with towering headgear and a lead singer-narrator called the Bhagavata. Koodiyattam (Kutiyattam) of Kerala is one of the oldest living traditions of Sanskrit theatre, performed in temple theatres (koothambalam) by Chakyar men, with Nangiar women in the female roles and the mizhavu drum. Krishnattam, on Krishna's life, was composed by the Zamorin Manavedan of Calicut; Mudiyettu enacts the goddess Kali's battle with the demon Darika; Therukoothu is the street theatre of Tamil Nadu, often on Mahabharata themes.

**Puppetry:** India has four kinds of puppets. String puppets include the Kathputli of Rajasthan, the Kundhei of Odisha and the Gombeyata of Karnataka, while Bommalattam of Tamil Nadu combines strings and rods. Shadow puppets, flat leather figures behind a lit screen, include the large coloured Tholu Bommalata of Andhra Pradesh, the Togalu Gombeyata of Karnataka, the Tolpava Koothu of Kerala, which narrates the Kamba Ramayana, and the Ravanachhaya of Odisha, cut from uncoloured deer skin without joints. Rod puppets include the Putul Nach of West Bengal and the Yampuri of Bihar, and the Pavakoothu of Kerala uses glove puppets.

### Examples

- Rajasthan dances: Ghoomar (swirling women), Kalbelia (snake-charmer community), Chari (pots with lit lamps), Terah Taali (13 manjiras), Kachchhi Ghodi (dummy horses).
- Gujarat: Garba (around a lamp at Navratri), Dandiya Raas (sticks), Tippani (Saurashtra); Maharashtra: Lavani (dholki), Koli (fisherfolk), Dhangari Gaja (shepherds).
- Himalayan belt: Rouf and Dumhal (Jammu and Kashmir), Nati (Himachal Pradesh), Chholiya sword dance (Uttarakhand), Singhi Chham (Sikkim), Cham mask dances (Ladakh).
- North-east: Bihu and Bagurumba (Assam), Cheraw bamboo dance (Mizoram), Nongkrem and Wangala (Meghalaya), Hojagiri (Tripura), Thang-Ta (Manipur).
- East: Jat-Jatin (Bihar), Jhumair and Karma (Jharkhand), Gambhira (Malda, West Bengal), Ghumura and Dalkhai (Odisha), Charkula (Braj, Uttar Pradesh).
- South: Theyyam, Oppana, Margamkali (Kerala); Karagattam, Kummi, Mayilattam (Tamil Nadu); Dollu Kunitha (Karnataka); Perini (Telangana); Dhimsa (Andhra-Odisha).
- Chhattisgarh: Panthi (Satnamis), Raut Nacha (Yadavs, after Diwali), Gaur bison-horn dance (Marias of Bastar).
- Theatre pairs: Nautanki-UP, Swang-Haryana, Bhand Pather-Kashmir, Bhavai-Gujarat (Asait Thakar), Tamasha-Maharashtra, Jatra-Bengal, Ankiya Naat-Assam, Bidesia-Bihar (Bhikhari Thakur).
- Southern theatre: Yakshagana (Karnataka, Bhagavata narrator), Koodiyattam (Kerala, Chakyars and Nangiars, koothambalam), Krishnattam (Zamorin Manavedan), Mudiyettu (Kali and Darika), Therukoothu (Tamil Nadu).
- Puppets: string - Kathputli, Kundhei, Gombeyata; shadow - Tholu Bommalata, Togalu Gombeyata, Tolpava Koothu, Ravanachhaya; rod - Putul Nach, Yampuri; glove - Pavakoothu.

**Quick revision:** Bhangra-Giddha (Punjab); Rouf (Kashmir); Chholiya (Uttarakhand); Ghoomar, Kalbelia, Chari, Terah Taali (Rajasthan); Garba, Tippani (Gujarat); Lavani (Maharashtra); Cheraw (Mizoram); Hojagiri (Tripura); Wangala (Meghalaya); Theyyam (Kerala); Karagattam (TN); Dollu Kunitha (Karnataka); Panthi (Chhattisgarh); theatre: Yakshagana, Koodiyattam, Jatra, Nautanki, Tamasha, Bhavai, Bidesia; puppets: Kathputli string, Tholu Bommalata shadow, Putul Nach rod, Pavakoothu glove.

### Indian Classical Music: Hindustani and Carnatic Traditions, Ragas, Gharanas and Instruments

**Roots and the great split:** Indian music traces its origin to the chanting of the Samaveda and its theory to the Natya Shastra. Matanga's Brihaddeshi is the first text to define the raga, and Sharngadeva's Sangita Ratnakara (13th century) is the last major text shared by north and south. After it the traditions drifted apart: north Indian music absorbed Persian influences in the Sultanate and Mughal courts and became Hindustani music, while the south kept a more devotional, composition-centred path that became Carnatic music. Tradition credits Amir Khusrau, the poet of Alauddin Khalji's court, with forms such as qawwali and tarana.

**Swara, raga and tala:** The seven notes (sapta swara) are sa, re, ga, ma, pa, dha and ni, and the octave is further divided into 22 microtones (shrutis). A raga is a melodic framework defined by its ascending (aroha) and descending (avaroha) scale, its most important note (vadi) and the second most important (samvadi); by number of notes a raga is audava (five), shadava (six) or sampurna (seven). Hindustani ragas are linked to times of day and seasons, such as Malhar for the rains. A tala is a cycle of beats (matras): Teentaal has 16, Jhaptaal 10, Ektaal 12, Rupak 7, Dadra 6 and Keherwa 8, while Adi tala, the commonest Carnatic cycle, has 8. Vishnu Narayan Bhatkhande grouped Hindustani ragas into 10 thaats, and Venkatamakhin's scheme of 72 melakarta (parent) ragas, from the 17th century, organises Carnatic music.

**Hindustani vocal forms:** Dhrupad is the oldest surviving form, a grave, devotional style with a long alap on syllables like nom-tom, accompanied by the pakhawaj; Raja Man Singh Tomar of Gwalior patronised it, Tansen of Akbar's court sang it, and the Dagar family preserves it. Dhamar, sung in a 14-beat cycle, is linked with Holi. Khayal, meaning imagination, became the main classical form in the 18th century through Sadarang (Niyamat Khan) at the court of Muhammad Shah Rangila, with a slow bada khayal and a fast chhota khayal. Thumri, a romantic semi-classical form, grew in Lucknow under Wajid Ali Shah; Tappa, from the songs of Punjab's camel drivers, was refined by Shori Miyan; Tarana uses fast rhythmic syllables.

**Gharanas:** A gharana is a family-and-disciple lineage with its own style. Gwalior is the oldest khayal gharana; Agra is known through Faiyaz Khan; Kirana, founded by Abdul Karim Khan, gave Bhimsen Joshi and Gangubai Hangal; Patiala gave Bade Ghulam Ali Khan; Jaipur-Atrauli, founded by Alladiya Khan, gave Kesarbai Kerkar, Mallikarjun Mansur and Kishori Amonkar; Mewati gave Pandit Jasraj. In instrumental music the Maihar gharana of Allauddin Khan trained Ravi Shankar, Ali Akbar Khan, Annapurna Devi and Nikhil Banerjee. Vishnu Digambar Paluskar opened the Gandharva Mahavidyalaya at Lahore in 1901 to teach music to the public.

**Carnatic music:** Purandara Dasa (16th century, Vijayanagara) is the Pitamaha (grandfather) of Carnatic music; he wrote in Kannada and devised the graded lessons still used, beginning with raga Mayamalavagowla. The kriti, a composition in three parts (pallavi, anupallavi and charanam), was perfected by the Carnatic trinity of the 18th-19th centuries, all born in Thiruvarur: Tyagaraja, who wrote mainly in Telugu and whose Pancharatna kritis are sung at the Tyagaraja Aradhana at Thiruvaiyaru; Muthuswami Dikshitar, who wrote mainly in Sanskrit, including the Navagraha kritis; and Syama Sastri, known for his swarajatis. Other forms are the varnam, padam, javali, tillana and the improvised ragam-tanam-pallavi. Carnatic music is voice-centred, follows a single broad style rather than gharanas, and observes the time-of-day rule less strictly.

**Instruments and maestros:** The Natya Shastra divides instruments into four classes: tata (stringed, such as sitar, sarod, veena, violin and santoor), sushira (wind, such as bansuri, shehnai and nadaswaram), avanaddha (skin-covered drums, such as tabla, pakhawaj and mridangam) and ghana (solid, struck instruments, such as manjira and jal tarang). Famous pairs are Ravi Shankar and Vilayat Khan on sitar, Ali Akbar Khan on sarod, Bismillah Khan on shehnai, Hariprasad Chaurasia on flute, Shivkumar Sharma on santoor, Ram Narayan on sarangi, Alla Rakha and Zakir Hussain on tabla, Lalgudi Jayaraman on Carnatic violin, Palghat Mani Iyer on mridangam and T. N.

Rajarathinam Pillai on nadaswaram. M. S. Subbulakshmi became the first musician to receive the Bharat Ratna, in 1998.

**Examples**

- Sangita Ratnakara (Sharngadeva, 13th century) is the last major text common to both traditions; Matanga's Brihaddeshi first defined the raga.
- Tala beats: Teentaal 16, Jhaptaal 10, Ektaal 12, Rupak 7, Dadra 6, Keherwa 8; Carnatic Adi tala 8.
- Raga classification: Bhatkhande's 10 thaats (Hindustani); Venkatamakhin's 72 melakartas (Carnatic, 17th century).
- Dhrupad: oldest Hindustani form, pakhawaj, nom-tom alap; patron Raja Man Singh Tomar; Tansen; Dagar family. Dhamar uses a 14-beat cycle.
- Khayal spread through Sadarang at Muhammad Shah Rangila's court; Thumri grew in Lucknow under Wajid Ali Shah; Tappa was refined by Shori Miyan.
- Gharana-singer pairs: Kirana - Bhimsen Joshi, Gangubai Hangal; Patiala - Bade Ghulam Ali Khan; Jaipur-Atrauli - Alladiya Khan, Kishori Amonkar; Mewati - Pandit Jasraj; Maihar - Allauddin Khan.
- Carnatic trinity, all born in Thiruvarur: Tyagaraja (Telugu, Pancharatna kritis), Muthuswami Dikshitar (Sanskrit, Navagraha kritis), Syama Sastri (swarajatis); Purandara Dasa is the Pitamaha.
- Four instrument classes: tata (strings: sitar, veena), sushira (wind: bansuri, shehnai), avanaddha (drums: tabla, mridangam), ghana (solid: manjira, jal tarang).
- Maestros: Bismillah Khan - shehnai; Shivkumar Sharma - santoor; Ram Narayan - sarangi; Lalgudi Jayaraman - violin; Palghat Mani Iyer - mridangam; M. S. Subbulakshmi - first musician with the Bharat Ratna (1998).

> **Quick revision:** Sangita Ratnakara (13th century) last shared text; 7 swaras, 22 shrutis; raga = aroha, avaroha, vadi, samvadi; Teentaal 16, Jhaptaal 10, Ektaal 12, Rupak 7; 10 thaats (Bhatkhande), 72 melakartas (Venkatamakhin); dhrupad oldest (pakhawaj, Dagar); khayal (Sadarang); thumri (Lucknow); Gwalior oldest khayal gharana; Purandara Dasa Pitamaha; trinity: Tyagaraja, Dikshitar, Syama Sastri; tata, sushira, avanaddha, ghana; MS Subbulakshmi Bharat Ratna 1998.

### Indian Languages, Scripts and Literature: Eighth Schedule, Brahmi and the Classics

**Language in the Constitution:** Part XVII (Articles 343 to 351) deals with official language. Article 343 makes Hindi in the Devanagari script the official language of the Union, adopted by the Constituent Assembly on 14 September 1949, now observed as Hindi Diwas; Article 345 lets each state choose its own official language; Article 350A asks states to provide primary education in the mother tongue; and Article 351 directs the Union to develop Hindi. Census 2011 recorded Hindi as the mother tongue of 43.63 per cent of Indians, followed by Bengali at 8.03 per cent.

**The Eighth Schedule:** The Eighth Schedule began in 1950 with 14 languages: Assamese, Bengali, Gujarati, Hindi, Kannada, Kashmiri, Malayalam, Marathi, Odia, Punjabi, Sanskrit, Tamil, Telugu and Urdu. The 21st Amendment (1967) added Sindhi; the 71st Amendment (1992) added Konkani, Manipuri and Nepali; and the 92nd Amendment (2003) added Bodo, Dogri, Maithili and Santhali, bringing the total to 22. The 96th Amendment (2011) changed the spelling Oriya to Odia. The languages come from four families: Indo-Aryan, Dravidian, Austro-Asiatic (Santhali) and Tibeto-Burman (Bodo and Manipuri).

**Classical languages:** In 2004 the Government of India created a category of classical languages for languages with a long recorded history, an ancient body of literature regarded as a heritage, and an original literary tradition. Tamil was the first, declared in 2004, followed by Sanskrit in 2005, Telugu and Kannada in 2008, Malayalam in 2013 and Odia in 2014; more have been added since. Recognition brings international awards for eminent scholars, centres of excellence for study and professional chairs in universities.

**Ancient scripts:** The Indus script, mostly written right to left, is still undeciphered. Brahmi, written left to right, is the script of most Ashokan edicts and the parent of nearly all later Indian scripts, Devanagari, Bengali, Gujarati, Tamil, Telugu and Kannada among them; James Prinsep deciphered it in 1837. Kharosthi, written right to left and derived from Aramaic, was used in the north-west, as in Ashoka's edicts at Shahbazgarhi and Mansehra. The Maski edict in Karnataka, found in 1915, was the first to name Ashoka himself. Gurmukhi is credited to Guru Angad Dev, and Ol Chiki, the script of Santhali, was created by Raghunath Murmu in 1925.

**Sanskrit literature:** The Rigveda, oldest of the four Vedas, has 10 mandalas and 1,028 hymns; the Upanishads gave the motto Satyameva Jayate (Mundaka Upanishad). Valmiki's Ramayana is the adikavya, the first poem, and Ved Vyasa's Mahabharata has 18 parvas. Panini's Ashtadhyayi is the classic grammar, Kautilya's Arthashastra the classic of statecraft, and Vishnu Sharma's Panchatantra the classic of fables. Kalidasa wrote the plays Abhijnanashakuntalam, Malavikagnimitram and Vikramorvashiyam and the poems Meghadutam, Raghuvamsha, Kumarasambhava and Ritusamhara. Bhasa wrote Svapnavasavadattam, Shudraka Mrichchhakatika, Vishakhadatta Mudrarakshasa, Banabhatta the Harshacharita and Kadambari, King Harsha Ratnavali, Nagananda and Priyadarshika, Kalhana the Rajatarangini (12th century, a history of Kashmir) and Jayadeva the Gita Govinda.

**Tamil literature:** Sangam literature, linked by tradition with academies at Madurai under the Pandyas, includes the grammar Tolkappiyam and the anthologies Ettuthokai (Eight Anthologies) and Pattuppattu (Ten Idylls). Thiruvalluvar's Tirukkural has 1,330 couplets in three parts, on virtue, wealth and love. The twin epics are Ilango Adigal's Silappadikaram, the story of Kannagi and her anklet, and Sattanar's Manimekalai, a Buddhist sequel. The 12 Alvars sang of Vishnu (their hymns form the Nalayira Divya Prabandham) and the 63 Nayanars of Shiva; Kamban wrote the Tamil Ramayana in the Chola period.

**Persian, Arabic and Hindi works:** Amir Khusrau, called Tuti-i-Hind (parrot of India), wrote the Khazain-ul-Futuh on Alauddin Khalji's conquests; Ziauddin Barani wrote the Tarikh-i-Firoz Shahi; Al-Biruni's Kitab-ul-Hind and Ibn Battuta's Rihla are in Arabic. Babur wrote the Baburnama in Turki, which Abdul Rahim Khan-i-Khanan translated into Persian; Abul Fazl wrote the Akbarnama, whose third part is the Ain-i-Akbari; Badauni wrote the Muntakhab-ut-Tawarikh; and Dara Shikoh translated the Upanishads into Persian as Sirr-i-Akbar. In Hindi, Chand Bardai's Prithviraj Raso belongs to the heroic age; Kabir's verses are collected in the Bijak; Malik Muhammad Jayasi wrote Padmavat and Tulsidas the Ramcharitmanas in Awadhi; Surdas wrote the Sursagar and Bihari the Satsai in Braj.

### Examples

- Eighth Schedule growth: 14 languages (1950) + Sindhi (21st Amendment, 1967) + Konkani, Manipuri, Nepali (71st, 1992) + Bodo, Dogri, Maithili, Santhali (92nd, 2003) = 22.
- Article 343: Hindi in Devanagari is the official language of the Union; adopted on 14 September 1949, marked as Hindi Diwas. Article 350A: primary education in the mother tongue.
- Census 2011: Hindi was the mother tongue of 43.63 per cent of Indians, Bengali second at 8.03 per cent.
- Classical language category created in 2004; Tamil was the first (2004), then Sanskrit (2005); benefits include scholar awards and centres of excellence.
- Brahmi: left to right, parent of most Indian scripts, deciphered by James Prinsep in 1837; Kharosthi: right to left, Aramaic-derived, north-west (Shahbazgarhi, Mansehra).
- Kalidasa: Abhijnanashakuntalam, Malavikagnimitram, Vikramorvashiyam (plays); Meghadutam, Raghuvamsha, Kumarasambhava, Ritusamhara (poems).
- Author-work pairs: Shudraka - Mrichchhakatika; Vishakhadatta - Mudrarakshasa; Banabhatta - Harshacharita; Kalhana - Rajatarangini; Jayadeva - Gita Govinda.
- Tamil: Tolkappiyam (grammar), Tirukkural (1,330 couplets, Thiruvalluvar), Silappadikaram (Ilango Adigal), Manimekalai (Sattanar), Kamba Ramayanam (Kamban).
- Language traps: Baburnama in Turki; Kitab-ul-Hind (Al-Biruni) and Rihla (Ibn Battuta) in Arabic; Akbarnama and Ain-i-Akbari (Abul Fazl) in Persian.
- Hindi classics: Prithviraj Raso (Chand Bardai), Bijak (Kabir), Padmavat (Jayasi, Awadhi), Ramcharitmanas (Tulsidas, Awadhi), Sursagar (Surdas, Braj), Satsai (Bihari, Braj).

> **Quick revision:** Part XVII, Articles 343-351; Hindi Diwas 14 Sept (1949); Eighth Schedule 14 (1950), Sindhi 21st Amdt 1967, Konkani-Manipuri-Nepali 71st 1992, Bodo-Dogri-Maithili-Santhali 92nd 2003 = 22; classical languages from 2004, Tamil first; Brahmi left-right, Prinsep 1837; Kharosthi right-left; Rigveda 10 mandalas 1,028 hymns; Kalidasa; Rajatarangini (Kalhana); Tirukkural 1,330 couplets; Khusrau Tuti-i-Hind; Baburnama Turki; Ramcharitmanas Awadhi.

### Indian Philosophy, Religious Texts, Fairs, Festivals and the National Calendar

**The six orthodox schools:** Indian philosophy is divided into astika schools, which accept the authority of the Vedas, and nastika schools, which do not. The six astika darshanas form three pairs. Nyaya (Gautama) is the school of logic and valid knowledge, and Vaisheshika (Kanada) explains the world through atoms (paramanu). Samkhya (Kapila), usually regarded as the oldest, is a dualism of spirit (purusha) and matter (prakriti), and Yoga (Patanjali) adds the eightfold practice of yama, niyama, asana, pranayama, pratyahara, dharana, dhyana and samadhi in the Yoga Sutra. Purva Mimamsa (Jaimini) defends Vedic ritual and duty, and Uttara Mimamsa or Vedanta rests on Badarayana's Brahma Sutra and the Upanishads. Vedanta later divided into the Advaita (non-dualism) of Adi Shankaracharya, who founded mathas at Sringeri, Dwarka, Puri and Jyotirmath, the Vishishtadvaita of Ramanuja, the Dvaita of Madhva and the Shuddhadvaita of Vallabha. The nastika schools are Buddhism, Jainism, Charvaka (Lokayata) materialism and the fatalism of the Ajivikas.

**Buddhist and Jain texts:** The Buddhist canon, the Tripitaka, is in Pali: the Vinaya Pitaka holds the monastic rules, recited by Upali at the first council at Rajagriha; the Sutta Pitaka holds the discourses, recited by Ananda, and includes the Dhammapada and the Jataka tales; and the Abhidhamma Pitaka holds philosophy, which tradition says was completed at the third council at Pataliputra under Ashoka. The Milindapanho records King Menander's questions to the monk Nagasena, and Ashvaghosha's Buddhacharita, in Sanskrit, belongs to Kanishka's age. Jain scripture, the Agamas, is in Ardha-Magadhi Prakrit and was written down at the council of Vallabhi in Gujarat; the Kalpasutra of Bhadrabahu gives the lives of the Tirthankaras. Jainism's three jewels are right faith, right knowledge and right conduct, and Mahavira added brahmacharya to Parshvanatha's four vows.

**Festivals through the year:** Mid-January brings harvest festivals as the Sun enters Capricorn: Makar Sankranti, Pongal in Tamil Nadu, Lohri in Punjab, Magh (Bhogali) Bihu in Assam and Uttarayan kite-flying in Gujarat. Spring brings Vasant Panchami and Holi, and the new year falls in Chaitra as Ugadi in Karnataka, Andhra Pradesh and Telangana, Gudi Padwa in Maharashtra and Cheti Chand for Sindhis; mid-April brings Baisakhi in Punjab, Rongali Bihu in Assam, Vishu in Kerala, Puthandu in Tamil Nadu and Pohela Boishakh in Bengal. The monsoon has the Rath Yatra of Puri, Teej in Rajasthan, Onam in Kerala, which welcomes King Mahabali, Nuakhai in Odisha and Ganesh Chaturthi, made a public festival by Tilak in 1893. Autumn brings Navratri, Durga Puja in Bengal, Dussehra (famous at Mysuru and Kullu), Bathukamma in Telangana, Diwali and Chhath in Bihar. Nagaland's Hornbill Festival is held in December, and Losar, the Tibetan new year, is celebrated in Ladakh and Sikkim.

**The Kumbh Mela:** The Kumbh Mela, a mass pilgrimage of ritual bathing, rotates among four places where, in legend, drops of amrit fell during the churning of the ocean: Haridwar on the Ganga, Prayagraj at the Sangam of the Ganga, the Yamuna and the mythical Saraswati, Ujjain on the Shipra, and Nashik on the Godavari. Each place holds it about every 12 years, its date set by the positions of Jupiter, the Sun and the Moon; the Ujjain and Nashik melas are called Simhastha because Jupiter is then in Leo, and an Ardh Kumbh is held at Haridwar and Prayagraj in between.

**Great fairs:** The Pushkar fair in Rajasthan and the Sonepur fair at the meeting of the Gandak and the Ganga in Bihar are both held at Kartik Purnima. The Gangasagar Mela on Sagar Island (West Bengal) is held at Makar Sankranti where the Ganga meets the sea; the Ambubachi Mela is held at the Kamakhya temple in Guwahati in the monsoon; the Shravani Mela sees pilgrims carry Ganga water from Sultanganj to Baidyanath at Deoghar; and the Baneshwar fair of the Bhil tribe is held in Dungarpur (Rajasthan) at Magh Purnima.

**The national calendar:** On the advice of the Calendar Reform Committee headed by Meghnad Saha, India adopted the Saka calendar as its national calendar from 22 March 1957, alongside the Gregorian calendar. The Saka era begins in 78 CE, so the Saka year is the Gregorian year minus 78 for most of the year. Its first month is Chaitra, which begins on 22 March (21 March in a leap year); it is used in the Gazette of India, news broadcasts of All India Radio and government calendars. The Vikram Samvat, used in north India, begins in 57 BCE.

#### Examples

- Six darshanas in pairs: Nyaya (Gautama) - Vaisheshika (Kanada, atoms); Samkhya (Kapila, purusha-prakriti) - Yoga (Patanjali, eight limbs); Purva Mimamsa (Jaimini) - Vedanta (Badarayana).

- Vedanta schools: Advaita - Shankaracharya; Vishishtadvaita - Ramanuja; Dvaita - Madhva; Shuddhadvaita - Vallabha. Shankara's mathas: Sringeri, Dwarka, Puri, Jyotirmath.
- Tripitaka (Pali): Vinaya (rules, Upali), Sutta (discourses, Ananda; includes Jatakas and Dhammapada), Abhidhamma (philosophy). Milindapanho: Menander and Nagasena.
- Jain Agamas in Ardha-Magadhi, written down at Vallabhi; Kalpasutra by Bhadrabahu; Mahavira added brahmacharya as the fifth vow.
- Mid-January harvest: Pongal (Tamil Nadu), Lohri (Punjab), Magh Bihu (Assam), Uttarayan (Gujarat), Makar Sankranti across India.
- New year festivals: Ugadi (Karnataka, Andhra, Telangana), Gudi Padwa (Maharashtra), Cheti Chand (Sindhis); mid-April: Baisakhi, Rongali Bihu, Vishu, Puthandu, Pohela Boishakh.
- Kumbh cities and rivers: Haridwar-Ganga, Prayagraj-Sangam, Ujjain-Shipra, Nashik-Godavari; Ujjain and Nashik melas are called Simhastha.
- Fairs: Pushkar (Rajasthan) and Sonepur (Bihar) at Kartik Purnima; Gangasagar at Makar Sankranti; Ambubachi at Kamakhya; Shravani Mela at Deoghar; Baneshwar at Dungarpur.
- National calendar: Saka era from 78 CE, adopted from 22 March 1957 on the Meghnad Saha committee's advice; first month Chaitra; Vikram Samvat begins 57 BCE.

> **Quick revision:** Astika darshanas: Nyaya-Gautama, Vaisheshika-Kanada, Samkhya-Kapila, Yoga-Patanjali, Mimamsa-Jaimini, Vedanta-Badarayana; Advaita-Shankara, Vishishtadvaita-Ramanuja, Dvaita-Madhva; Tripitaka in Pali (Vinaya, Sutta, Abhidhamma); Jain Agamas Ardha-Magadhi, Vallabhi; Pongal, Lohri, Bihu; Onam (Mahabali); Kumbh: Haridwar, Prayagraj, Ujjain (Shipra), Nashik (Godavari); Pushkar, Sonepur at Kartik Purnima; Saka calendar from 22 March 1957, era 78 CE.

### India on the UNESCO Lists: World Heritage Sites and Intangible Cultural Heritage

**How the lists work:** UNESCO's World Heritage Convention of 1972 protects places of outstanding universal value, and India ratified it in 1977. Sites are inscribed by the World Heritage Committee as cultural, natural or mixed (both); for India the Archaeological Survey of India prepares cultural nominations. A separate convention of 2003 safeguards intangible cultural heritage, living traditions such as performing arts, rituals, festivals and crafts, which UNESCO places on its Representative List. Exams ask the year of inscription and the state, so learn sites in batches.

The first wave, 1983 to 1989: India's first four sites, in 1983, were Ajanta Caves, Ellora Caves, Agra Fort and the Taj Mahal. In 1984 came the Sun Temple at Konark and the Group of Monuments at Mahabalipuram; in 1986 the Churches and Convents of Goa, Khajuraho, Hampi and Fatehpur Sikri; in 1987 Pattadakal, the Elephanta Caves and the Brihadeeswara temple of Thanjavur, extended in 2004 as the Great Living Chola Temples with Gangaikonda Cholapuram and Darasuram; and in 1989 the Buddhist Monuments at Sanchi.

**Later cultural sites:** Humayun's Tomb and the Qutb Minar and its Monuments were inscribed in 1993; the Mahabodhi Temple Complex at Bodh Gaya (Bihar) in 2002; the Rock Shelters of Bhimbetka (Madhya Pradesh) in 2003; Champaner-Pavagadh Archaeological Park (Gujarat) and Chhatrapati Shivaji Terminus (Mumbai) in 2004; the Red Fort Complex in 2007; the Jantar Mantar of Jaipur in 2010; the Hill Forts of Rajasthan (Chittorgarh, Kumbhalgarh, Ranthambore, Gagron, Amber and Jaisalmer) in 2013; Rani-ki-Vav, the stepwell at Patan (Gujarat), in 2014; and the Nalanda Mahavihara (Bihar) and the Capitol Complex of Chandigarh, part of a site of Le Corbusier's works spread over several countries, in 2016. Cities followed: the Historic City of Ahmedabad, India's first World Heritage City, in 2017, the Victorian Gothic and Art Deco Ensembles of Mumbai in 2018 and Jaipur City in 2019.

Inscriptions since 2021: In 2021 came Dholavira, the Harappan city in Kutch (Gujarat), and the Kakatiya Rudreshwara (Ramappa) Temple in Telangana, named after its sculptor Ramappa. In 2023 came Santiniketan (West Bengal), linked with Rabindranath Tagore, and the Sacred Ensembles of the Hoysalas, the temples of Belur, Halebidu and Somanathapura (Karnataka). In 2024 the Moidams, the mound-burial system of the Ahom dynasty in Assam, were inscribed at the 46th session of the World Heritage Committee, held in New Delhi. In 2025 came the Maratha Military Landscapes of India, 12 forts: 11 in Maharashtra and Gingee in Tamil Nadu. In 2026 the Ancient Buddhist Site of

Sarnath (Uttar Pradesh) was inscribed at the 48th session in Busan, South Korea; it covers the Chaukhandi Stupa and the archaeological remains of Sarnath, among them the Dhamek Stupa.

**Serial sites:** Some sites are groups. The Mountain Railways of India began with the Darjeeling Himalayan Railway in 1999 and were extended to the Nilgiri Mountain Railway in 2005 and the Kalka-Shimla Railway in 2008. The Western Ghats, inscribed in 2012, are a natural serial site of many component areas in Kerala, Karnataka, Tamil Nadu and Maharashtra.

**Natural and mixed sites:** In 1985 three parks were inscribed: Kaziranga (Assam, the one-horned rhinoceros), Manas (Assam), which was on the List of World Heritage in Danger from 1992 to 2011, and Keoladeo (Bharatpur, Rajasthan), a wetland for migratory birds that was once the winter home of the Siberian crane. The Sundarbans (West Bengal), the largest mangrove forest and home of the Bengal tiger, followed in 1987, and Nanda Devi National Park (Uttarakhand) in 1988, extended in 2005 with the Valley of Flowers. The Great Himalayan National Park Conservation Area (Himachal Pradesh) was inscribed in 2014. India's first mixed site, Khangchendzonga National Park (Sikkim), was inscribed in 2016 for both its mountain landscape and its sacred meaning for the people of Sikkim.

**Intangible cultural heritage:** Before the 2003 convention took effect, UNESCO proclaimed Masterpieces of the Oral and Intangible Heritage, and three Indian traditions were among them: Kutiyattam, Sanskrit theatre of Kerala (2001), the Tradition of Vedic Chanting (2003) and Ramlila, the traditional performance of the Ramayana (2005); all were moved to the Representative List in 2008. Later inscriptions include Ramman, the religious festival and ritual theatre of the Garhwal Himalayas (2009); Mudiyettu of Kerala, Kalbelia folk songs and dances of Rajasthan and Chhau dance (2010); Buddhist chanting of Ladakh (2012); Sankirtana, the ritual singing, drumming and dancing of Manipur (2013); the brass and copper utensil craft of the Thatheras of Jandiala Guru, Punjab (2014); Yoga and Nowruz (2016); the Kumbh Mela (2017); Durga Puja in Kolkata (2021); and Garba of Gujarat (2023). The list continues to grow.

### Examples

- World Heritage Convention 1972, ratified by India in 1977; intangible heritage convention 2003. India's first four sites (1983): Ajanta, Ellora, Agra Fort, Taj Mahal; 1984: Konark Sun Temple and Mahabalipuram.
- 1986: Churches and Convents of Goa, Khajuraho, Hampi, Fatehpur Sikri. 1987: Pattadakal, Elephanta, Brihadeeswara (Great Living Chola Temples from 2004), Sundarbans.
- 1993: Humayun's Tomb and Qutb Minar; 2002: Mahabodhi Temple, Bodh Gaya; 2003: Bhimbetka; 2004: Champaner-Pavagadh and CST Mumbai; 2007: Red Fort.
- Mountain Railways of India: Darjeeling Himalayan (1999), Nilgiri (2005), Kalka-Shimla (2008).
- Natural sites: Kaziranga, Manas, Keoladeo (1985); Sundarbans (1987); Nanda Devi (1988) with Valley of Flowers (2005); Western Ghats (2012); Great Himalayan National Park (2014).
- 2016 brought three: Nalanda Mahavihara (Bihar), Khangchendzonga (Sikkim, India's first mixed site) and Le Corbusier's Capitol Complex (Chandigarh).
- Cities: Ahmedabad (2017, first World Heritage City), Mumbai's Victorian Gothic and Art Deco Ensembles (2018), Jaipur (2019). Rani-ki-Vav, Patan: 2014.
- Since 2021: Dholavira and Ramappa Temple (2021); Santiniketan and the Sacred Ensembles of the Hoysalas (2023); Moidams of the Ahom dynasty, Assam (2024); Maratha Military Landscapes, 12 forts (2025); Ancient Buddhist Site, Sarnath (2026).
- Intangible heritage: Kutiyattam (2001), Vedic chanting (2003), Ramlila (2005), Ramman (2009), Mudiyettu, Kalbelia and Chhau (2010), Buddhist chanting of Ladakh (2012).
- More intangible heritage: Sankirtana of Manipur (2013), Thathera brass craft of Jandiala Guru (2014), Yoga and Nowruz (2016), Kumbh Mela (2017), Durga Puja in Kolkata (2021), Garba of Gujarat (2023).

> **Quick revision:** Convention 1972, India ratified 1977; 1983: Ajanta, Ellora, Agra Fort, Taj; 1984: Konark, Mahabalipuram; 1986: Goa churches, Khajuraho, Hampi, Fatehpur Sikri; 1987: Pattadakal, Elephanta, Thanjavur, Sundarbans; 1985: Kaziranga, Manas, Keoladeo; DHR 1999; Mahabodhi 2002; Bhimbetka 2003; Red Fort 2007; Rajasthan hill forts 2013; Khangchendzonga mixed 2016; Ahmedabad 2017; Dholavira, Ramappa 2021; Santiniketan, Hoysalas 2023; Moidams 2024; Maratha forts 2025; Sarnath 2026; ICH: Kutiyattam 2001, Vedic chanting 2003, Ramlila 2005, Yoga 2016, Kumbh 2017, Durga Puja 2021, Garba 2023.

# Indian Economy

## Indian Economy

**What the exam asks:** In SSC, Railway and state exams, Indian Economy questions are mostly definition and fact based. Examiners love national income aggregates, RBI tools, deficit formulas, Five-Year Plans, scheme years and index publishers.

**Basic concepts:** GDP is the market value of all final goods and services produced within the domestic territory of a country in a year. GNP adds net factor income from abroad to GDP. NNP is GNP minus depreciation, and NNP at factor cost is National Income. Factor cost equals market price minus indirect taxes plus subsidies. Nominal GDP is at current prices; real GDP is at constant base-year prices, so real growth excludes price changes. GDP deflator is nominal GDP divided by real GDP multiplied by 100. Per capita income is national income divided by population. National income estimates come from the National Statistical Office (NSO), formed by merging the CSO and the NSSO (decided in 2005; restructured in May 2019). India is a mixed economy; services (tertiary sector) contribute the largest share of GDP, while agriculture (primary sector) still employs the most workers.

**Planning:** The Planning Commission was created on 15 March 1950 by a Cabinet resolution, headed by the Prime Minister. The First Plan (1951-56) followed the Harrod-Domar model and stressed agriculture; the Second Plan (1956-61) followed the Mahalanobis model and stressed heavy industry. The three annual plans of 1966-69 are the plan holiday. The Twelfth Plan (2012-17) was the last; NITI Aayog replaced the Planning Commission on 1 January 2015.

**Money and banking:** Money is a medium of exchange, a unit of account and a store of value. The RBI started on 1 April 1935 under the RBI Act 1934 and was nationalised on 1 January 1949. Its tools: repo rate (RBI lends short term to banks against securities), reverse repo (RBI borrows from banks), CRR (share of deposits kept as cash with RBI), SLR (share kept by the bank itself in cash, gold and approved securities), bank rate (the rate at which the RBI rediscounts bills; now aligned with the MSF rate and charged as the penalty rate on CRR/SLR shortfalls) and open market operations (buying and selling government securities). Raising rates or reserves fights inflation. The six-member Monetary Policy Committee (three RBI, three government nominees, Governor as chair) sets the repo rate. Fourteen banks were nationalised in 1969 and six in 1980. NABARD (1982) is the apex body for rural credit, SIDBI (1990) for MSMEs; EXIM Bank (1982) finances trade; RRBs began in 1975. A loan becomes an NPA when overdue for more than 90 days. Basel norms set bank capital adequacy standards; payment banks cannot lend.

**Inflation and public finance:** Demand-pull inflation comes from excess demand, cost-push from rising input costs, and stagflation is high inflation with stagnant output. WPI is published by the Office of the Economic Adviser (DPIIT); CPI Rural, Urban and Combined by the NSO. Core inflation excludes food and fuel. The Union Budget is the Annual Financial Statement under Article 112. Revenue receipts are taxes and non-tax income; capital receipts include borrowings, disinvestment and loan recoveries. Fiscal deficit is total expenditure minus receipts excluding borrowings; revenue deficit is revenue expenditure minus revenue receipts; primary deficit is fiscal deficit minus interest payments. The FRBM Act came in 2003. The Finance Commission is set up under Article 280 every five years. GST began on 1 July 2017 through the 101st Constitutional Amendment; the GST Council (Article 279A) is chaired by the Union Finance Minister. Income tax and corporation tax are direct taxes; GST, customs and excise are indirect.

**Poverty, unemployment and development:** Disguised unemployment means more workers than needed, common in agriculture; frictional unemployment is temporary joblessness between jobs; structural unemployment comes from a skills mismatch. The Tendulkar (2009) and Rangarajan (2014) committees estimated poverty lines. HDI, published by UNDP since 1990, combines life expectancy, education and GNI per capita. The Gini coefficient, derived from the Lorenz curve, measures inequality from 0 (equality) to 1. Demographic dividend is the growth potential of a large working-age population.

**Agriculture, industry and external sector:** MSP is recommended by the CACP. The Green Revolution of the mid-1960s, linked with M.S. Swaminathan, spread HYV wheat in Punjab, Haryana and western UP. Land reforms covered zamindari abolition, tenancy reform and land ceilings; the Kisan Credit Card began in 1998. The 1991 LPG reforms were introduced by Finance Minister Manmohan Singh under PM Narasimha Rao after the 1991 crisis; the rupee was devalued in 1966 and 1991. The Industrial Policy Resolution 1956 is the economic constitution of India. CPSEs are graded Maharatna, Navratna and Miniratna. In the balance of payments, the current account covers goods, services, income and transfers; the capital account covers FDI, FII and loans. India adopted current account convertibility in 1994. SEBI (1988, statutory 1992) regulates markets; BSE dates from 1875, NSE from 1992; Sensex tracks 30 BSE companies and Nifty 50 NSE companies. IMF and the World Bank were born at Bretton Woods in 1944; WTO replaced GATT in 1995; NDB is in Shanghai, AIIB in Beijing, ADB in Manila.

**Schemes by year:** MGNREGA 2005 (100 days of wage employment; repealed from 1 July 2026 and replaced by the VB-G RAM G Act 2025, which guarantees 125 days), PMJDY 2014, Make in India 2014, Digital India 2015, PMJJBY and PMSBY 2015, Atal Pension Yojana 2015, MUDRA 2015, Startup India 2016, Ujjwala 2016, Ayushman Bharat PM-JAY 2018 (Rs 5 lakh health cover) and PM-KISAN 2019 (Rs 6,000 a year).

**Traps:** GNP includes income from abroad, GDP does not; CRR is kept with RBI, SLR with the bank; fiscal deficit is not revenue deficit; WPI is from DPIIT, CPI from NSO; National Income is NNP at factor cost; Finance Commission is Article 280, Budget is Article 112.

**Examples**

- Chain to remember: GDP + net factor income from abroad = GNP; GNP - depreciation = NNP; NNP at factor cost = National Income.
- Market price to factor cost: subtract indirect taxes, add subsidies. Think 'taxes inflate the price, subsidies deflate it'.
- Plan models: First Plan = Harrod-Domar (agriculture), Second Plan = Mahalanobis (heavy industry). Plan holiday = 1966-69.
- CRR is cash kept WITH RBI; SLR is liquid assets kept BY the bank itself (cash, gold, government securities).
- Repo: RBI lends to banks. Reverse repo: RBI borrows from banks. Raising them tightens money and fights inflation.
- Bank nationalisation: 14 banks in 1969, 6 banks in 1980. NABARD 1982, RRBs 1975, SIDBI 1990.
- Deficit formulas: Fiscal deficit = total expenditure - receipts excluding borrowings; Primary deficit = fiscal deficit - interest payments.
- Index publishers: WPI by Office of Economic Adviser (DPIIT); CPI Rural/Urban/Combined by NSO; CPI-IW by Labour Bureau.
- Articles: 112 Annual Financial Statement (Budget), 280 Finance Commission, 279A GST Council. GST from 1 July 2017 via the 101st Amendment.
- Scheme years: PMJDY 2014, MUDRA 2015, Ujjwala 2016, Ayushman Bharat 2018, PM-KISAN 2019, MGNREGA 2005 (replaced by the VB-G RAM G Act from 1 July 2026).
- Gini coefficient: 0 means perfect equality, 1 means perfect inequality; it is derived from the Lorenz curve.
- Curves: Phillips (inflation vs unemployment), Laffer (tax rate vs tax revenue), Engel's law (food share falls as income rises).

> **Quick revision:** National Income = NNP at factor cost; GNP = GDP + net factor income from abroad; Planning Commission 1950, NITI Aayog 1 Jan 2015; First Plan Harrod-Domar, Second Plan Mahalanobis, plan holiday 1966-69; RBI 1 April 1935, nationalised 1949; bank nationalisation 1969 (14) and 1980 (6); NABARD 1982, RRBs 1975; NPA = overdue above 90 days; WPI by DPIIT, CPI by NSO; Budget Art 112, Finance Commission Art 280, GST 1 July 2017 (101st Amendment); fiscal deficit = expenditure - non-debt receipts; HDI by UNDP; SEBI statutory 1992, BSE 1875; WTO 1995; MGNREGA 2005, PMJDY 2014, PM-KISAN 2019.

## National Income: GDP, GNP, NNP and the Three Sectors of the Economy

**What national income measures:** National income accounting measures the value of all final goods and services an economy produces in a year. It is a flow, measured over a period, not a stock held at a point in time. Only final goods are counted, because adding intermediate goods such as the steel inside a car or the flour inside bread would count

the same value twice (double counting). The safest way to avoid this is to add the value added at each stage of production, which is the value of output minus intermediate consumption. Second-hand sales, transfer payments such as old-age pensions and scholarships, and purely financial deals such as buying shares are left out, because they create no new output in that year.

**Domestic versus national, gross versus net:** Domestic product (GDP) counts what is produced inside the economic territory of a country, whoever produces it, so the output of a foreign-owned factory in India is part of India's GDP. Economic territory also includes Indian embassies abroad and ships and aircraft run by Indian residents, while foreign embassies in New Delhi are excluded. National product (GNP) counts what is produced by the normal residents of a country wherever they are, so GNP = GDP + net factor income from abroad (NFIA), where NFIA is the factor income residents earn abroad minus the factor income non-residents earn in India. Gross figures include depreciation, the wear and tear of machines and buildings (consumption of fixed capital); net figures subtract it. So NDP = GDP - depreciation and NNP = GNP - depreciation.

**Market prices, factor cost and basic prices:** A value at market prices includes the indirect taxes on goods and is reduced by subsidies, so it is what buyers actually pay. Factor cost is what the factors of production (land, labour, capital and enterprise) receive as rent, wages, interest and profit. The link is: factor cost = market price - indirect taxes + subsidies. National income in the strict sense is NNP at factor cost. In January 2015 the CSO released a new series that shifted the base year from 2004-05 to 2011-12 and measured sector-wise output as gross value added (GVA) at basic prices, which is GVA at factor cost plus production taxes minus production subsidies; GDP is then GVA at basic prices plus product taxes minus product subsidies.

**Real, nominal and per capita:** Nominal GDP values output at the prices of the current year, so it rises even when only prices rise. Real GDP values the same output at the prices of a fixed base year, so its growth shows the change in actual quantities. The ratio (nominal GDP / real GDP) x 100 is the GDP deflator, the broadest measure of price change because it covers every good and service in GDP. The base year is revised from time to time so that prices and the weights of sectors stay representative of the present economy. Per capita income is national income divided by population; being an average, it hides how unequally income is shared.

**Three methods of measurement:** The production or value-added method adds the value added by every producing unit in each sector. The income method adds the factor incomes generated in production: compensation of employees, rent, interest, profit and the mixed income of the self-employed. The expenditure method adds final spending: private consumption (C), investment (I), government consumption (G) and net exports (X - M). In theory all three give the same total, because one person's spending is another's income. India's estimates rely mainly on the production method, combined with the income method for sectors whose output is hard to value; the expenditure side is estimated separately and the gap is shown as discrepancies.

**Who measures it, and a little history:** Dadabhai Naoroji made the first estimate of India's per capita income, Rs 20 per head for 1867-68, in Poverty and Un-British Rule in India (1901). V.K.R.V. Rao made the first scientific estimate, for 1931-32. After independence the National Income Committee of 1949, chaired by P.C. Mahalanobis, laid the groundwork for official estimates. The Central Statistical Organisation (CSO), set up in 1951, compiled the national accounts, and the National Sample Survey (NSS), started in 1950 and later run by the National Sample Survey Office (NSSO), ran household surveys. In 2019 the CSO and the NSSO were merged into the National Statistical Office (NSO) under the Ministry of Statistics and Programme Implementation (MoSPI), which now releases the GDP estimates.

**The three sectors:** The primary sector uses natural resources directly: agriculture, forestry, fishing, and mining and quarrying. The secondary sector transforms materials: manufacturing, construction, and electricity, gas and water supply. The tertiary or service sector serves the others and households: trade, hotels, transport, communication, banking, insurance, real estate, public administration, education and health. As economies develop, the share of the primary sector in output falls and that of the other two rises. India's path is unusual: services became the largest part of GDP while agriculture still employs the largest share of workers, so output per worker on farms is low and much farm labour is disguised unemployment.

**Examples**

- GNP = GDP + net factor income from abroad (NFIA); NFIA = factor income earned by residents abroad minus factor income earned by non-residents at home.
- Net = gross - depreciation (consumption of fixed capital): NDP = GDP - depreciation; NNP = GNP - depreciation.
- Factor cost = market price - indirect taxes + subsidies; National Income = NNP at factor cost.
- GDP deflator = (nominal GDP / real GDP) x 100; it covers all goods and services in GDP, unlike WPI or CPI.
- Three methods: production (value added), income (wages, rent, interest, profit, mixed income) and expenditure (C + I + G + X - M).
- Not counted in GDP: intermediate goods, second-hand sales, transfer payments such as pensions and scholarships, and purchases of shares.
- Dadabhai Naoroji gave the first per capita income estimate (Rs 20 for 1867-68); V.K.R.V. Rao the first scientific one (1931-32).
- National Income Committee 1949 chaired by P.C. Mahalanobis; the CSO (1951) and the NSSO (which ran the NSS, begun in 1950) merged into the NSO under MoSPI in 2019.
- The January 2015 series moved the base year from 2004-05 to 2011-12 and introduced GVA at basic prices for sector-wise output.
- Sectors: primary (agriculture, forestry, fishing, mining), secondary (manufacturing, construction, utilities), tertiary (services); services lead in GDP, agriculture in employment.

> **Quick revision:** National Income = NNP at factor cost; GNP = GDP + NFIA; net = gross - depreciation; factor cost = market price - indirect taxes + subsidies; GDP deflator = nominal / real x 100; methods: production, income, expenditure (India mainly production + income); Naoroji 1867-68, V.K.R.V. Rao 1931-32, Mahalanobis committee 1949; CSO 1951 + NSSO (NSS from 1950) = NSO 2019 (MoSPI); 2015 series: base 2011-12, GVA at basic prices; services lead GDP, agriculture leads jobs.

### Five-Year Plans, the Planning Commission and NITI Aayog

**Why India chose planning:** At independence India had low incomes, a weak industrial base and mass poverty, and its leaders believed the state had to direct investment. Ideas of planning came earlier: M. Visvesvaraya's Planned Economy for India (1934), the National Planning Committee set up by the Congress in 1938 under Jawaharlal Nehru, the Bombay Plan of 1944 by leading industrialists, the Gandhian Plan of 1944 by S.N. Agarwal, the People's Plan of 1945 by M.N. Roy and the Sarvodaya Plan of 1950 by Jayaprakash Narayan. Economic and social planning is Entry 20 of the Concurrent List, but the Planning Commission itself was neither a constitutional nor a statutory body.

**The Planning Commission and the NDC:** The Planning Commission was set up on 15 March 1950 by a resolution of the Union Cabinet. The Prime Minister was its chairman, Jawaharlal Nehru being the first, and the Deputy Chairman was its working head, Gulzarilal Nanda being the first. Plans drafted by the Commission were approved by the National Development Council (NDC), formed in August 1952, which brought together the Prime Minister, Union Cabinet ministers and the Chief Ministers of the states. The Commission also decided plan assistance to the states; from the Fourth Plan this followed the Gadgil formula, later revised as the Gadgil-Mukherjee formula.

**The early plans:** The First Plan (1951-56) used the Harrod-Domar model and gave priority to agriculture, irrigation and power, including multipurpose river valley projects such as Bhakra-Nangal and Hirakud; it met its targets. The Second Plan (1956-61), based on P.C. Mahalanobis's model, pushed heavy and basic industry; the public sector steel plants at Bhilai (Soviet help), Rourkela (West German help) and Durgapur (British help) belong to it. The Third Plan (1961-66) aimed at a self-reliant and self-generating economy but failed because of the 1962 war with China, the 1965 war with Pakistan and the drought of 1965-66. Three annual plans followed in 1966-69, the first plan holiday.

**From the Fourth to the Seventh Plan:** The Fourth Plan (1969-74) aimed at growth with stability and progressive achievement of self-reliance; 14 major banks were nationalised in 1969, during this plan. The Fifth Plan (1974-79) put poverty removal (Garibi Hatao) and self-reliance first and introduced the Minimum Needs Programme; the Janata government ended it a year early, in 1978, and adopted a Rolling Plan (1978-80), an idea associated with Gunnar

Myrdal. The Sixth Plan (1980-85) targeted poverty and employment, and the Integrated Rural Development Programme was extended across the country during it. The Seventh Plan (1985-90) stressed food, work and productivity. Political uncertainty and the balance of payments crisis then led to two annual plans in 1990-92, the second plan holiday.

**From the Eighth to the Twelfth Plan:** The Eighth Plan (1992-97) ran alongside the 1991 reforms and made human development the core of planning. The Ninth Plan (1997-2002) sought growth with social justice and equality. The Tenth Plan (2002-07) set monitorable targets for poverty, literacy and other social goals. The Eleventh Plan (2007-12) was titled Towards Faster and More Inclusive Growth and the Twelfth Plan (2012-17) Faster, More Inclusive and Sustainable Growth. The Twelfth was the last Five-Year Plan. As the private sector and markets grew, planning had already shifted from detailed central allocation towards indicative goals.

**NITI Aayog:** On 1 January 2015 a Cabinet resolution replaced the Planning Commission with the National Institution for Transforming India (NITI Aayog), after the Prime Minister announced the change on 15 August 2014. The Prime Minister is its Chairperson. Its Governing Council has the Chief Ministers of all states and of union territories with legislatures and the Lieutenant Governors of the other union territories, and in practice it has taken over the role of the NDC; Regional Councils meet for specific regions. The body is run by a Vice-Chairperson appointed by the Prime Minister, full-time members, up to two part-time members from universities and research bodies, up to four Union ministers as ex-officio members, and a Chief Executive Officer of the rank of Secretary, with experts as special invitees.

**What NITI does differently:** NITI Aayog is a policy think tank and advisory body, not an allocator of money; the power to give grants to states moved to the Finance Ministry. It follows cooperative federalism, treating states as partners, and a bottom-up approach in which plans are built from the village and district level upwards. It encourages competitive federalism through indices that compare states, evaluates schemes through its Development Monitoring and Evaluation Office, and hosts the Atal Innovation Mission (2016). Like the Planning Commission, it is neither constitutional nor statutory, having been created by an executive resolution.

### Examples

- Planning Commission: 15 March 1950 by Cabinet resolution; PM as chairman; first Deputy Chairman Gulzarilal Nanda; neither constitutional nor statutory.
- NDC formed August 1952 to approve the plans; members were the PM, Union Cabinet ministers and the Chief Ministers.
- First Plan 1951-56: Harrod-Domar model, agriculture and irrigation; Second Plan 1956-61: Mahalanobis model, heavy industry (Bhilai, Rourkela, Durgapur steel plants).
- Third Plan 1961-66 failed due to the 1962 and 1965 wars and the drought; annual plans 1966-69 = first plan holiday.
- Fifth Plan 1974-79: Garibi Hatao and the Minimum Needs Programme; ended early in 1978; Rolling Plan 1978-80 under the Janata government.
- Second plan holiday: annual plans 1990-92; Eighth Plan 1992-97 made human development the core of planning.
- Eleventh Plan (2007-12): faster and more inclusive growth; Twelfth Plan (2012-17): faster, more inclusive and sustainable growth - the last plan.
- NITI Aayog: 1 January 2015 by Cabinet resolution; PM is Chairperson; Governing Council of all CMs and LGs; CEO of Secretary rank; a think tank with no power to allocate funds.
- Pre-independence plans: Visvesvaraya 1934, National Planning Committee 1938 (Nehru), Bombay Plan 1944, Gandhian Plan 1944 (S.N. Agarwal), People's Plan 1945 (M.N. Roy).

> **Quick revision:** Planning Commission 15 March 1950 (Cabinet resolution, PM chairman, Nanda first Deputy Chairman); NDC 1952; Plan 1 Harrod-Domar (agriculture), Plan 2 Mahalanobis (heavy industry), Plan 3 failed (wars, drought); plan holidays 1966-69 and 1990-92; Rolling Plan 1978-80; Plan 8 human development; Plan 12 (2012-17) last; NITI Aayog 1 Jan 2015: PM chairs, Governing Council, CEO, think tank, cooperative federalism, no fund allocation; Atal Innovation Mission 2016.

## Money, Money Supply, Inflation and Price Indices (CPI and WPI)

**Functions and forms of money:** Money removes the main problem of barter, the need for a double coincidence of wants. Its primary functions are to act as a medium of exchange and a measure of value (unit of account); its secondary functions are to serve as a store of value and a standard of deferred payments, so that loans can be repaid later in the same unit. Money has moved from commodity money such as grain and cattle to metal coins, then to paper money and now to bank deposits and digital money. Modern paper money is fiat money: it has value because the government declares it legal tender, not because of the material it is made of.

**Who issues money in India:** The RBI issues currency notes under Section 22 of the RBI Act 1934, while coins and one-rupee notes are issued by the Government of India; that is why a one-rupee note carries the signature of the Finance Secretary and other notes that of the RBI Governor. Coins are minted at government mints in Mumbai, Hyderabad, Kolkata and Noida. Since 1957 the RBI has followed the Minimum Reserve System: it must hold gold and foreign exchange worth at least Rs 200 crore, of which gold must be worth at least Rs 115 crore, and the amount of notes issued is not tied to this reserve.

**Measures of money supply:** M0, reserve money or high-powered money, is currency in circulation plus bankers' deposits with the RBI plus other deposits with the RBI; it is the base on which bank money is built. Above it are the RBI's four measures of money supply, adopted in 1977 and running from the most liquid to the least. M1, narrow money, is currency with the public plus demand deposits with banks plus other deposits with the RBI. M2 is M1 plus savings deposits with post office savings banks. M3, broad money, is M1 plus time deposits with banks and is the measure most used in policy. M4 is M3 plus all deposits with post office savings banks other than National Savings Certificates. The ratio of broad money to reserve money is the money multiplier: a change in M0 causes a larger change in M3 because banks lend out part of every deposit.

**What inflation is and why it happens:** Inflation is a sustained rise in the general price level, which means a fall in the purchasing power of money. Demand-pull inflation arises when total demand runs ahead of supply, often because of fast money growth or heavy government spending: too much money chasing too few goods. Cost-push inflation arises when costs such as wages, oil or raw materials rise, or when a drought or another supply shock cuts output. By speed, inflation is called creeping (mild), walking, running or galloping, and hyperinflation when prices rise extremely fast. Inflation helps borrowers and hurts lenders and people on fixed incomes, because their money buys less.

**Related terms:** Stagflation is high inflation together with stagnant output and high unemployment, as many countries saw after the oil shocks of the 1970s. Deflation is a fall in the general price level; it is harmful because people postpone spending and the real burden of debt rises. Disinflation is a fall in the rate of inflation: prices still rise, only more slowly. Reflation is a deliberate policy push to raise output and prices after a slump. Headline inflation covers all items in an index, while core inflation leaves out volatile food and fuel prices to show the underlying trend.

**WPI and CPI:** The Wholesale Price Index (WPI) is published by the Office of the Economic Adviser in the Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry. It covers only goods, in three groups: primary articles, fuel and power, and manufactured products, the last having the largest weight; services are not included. The Consumer Price Index (CPI) measures the retail prices households pay for goods and services, and food has a large weight in it. The NSO publishes CPI (Rural), CPI (Urban) and CPI (Combined), a series begun in 2011, while the Labour Bureau, Shimla, publishes the CPI for Industrial Workers (CPI-IW) and for agricultural and rural labourers. WPI was India's main inflation measure until 2014; since then CPI (Combined) has been the headline measure and the basis of the RBI's inflation target.

**The Phillips curve in plain words:** In 1958 the economist A.W. Phillips, studying British data, found that years of low unemployment were years of fast-rising wages, while years of high unemployment had slow wage growth. Drawn as a downward-sloping curve, this suggests a short-run trade-off: lower unemployment can be had at the cost of higher inflation, and lower inflation at the cost of more unemployment. The stagflation of the 1970s, when both were high together, showed that the trade-off is not stable. Economists such as Milton Friedman argued that in the long run the curve is vertical, because people come to expect inflation and unemployment returns to its natural rate.

**Examples**

- Functions of money: primary - medium of exchange and measure of value; secondary - store of value and standard of deferred payments.
- Currency notes are issued by the RBI (Section 22, RBI Act 1934); coins and one-rupee notes by the Government of India (signed by the Finance Secretary).
- Minimum Reserve System since 1957: at least Rs 200 crore of gold and foreign exchange, of which at least Rs 115 crore in gold.
- M0 = reserve (high-powered) money; M1 = narrow money (currency with public + demand deposits + other deposits with RBI); M3 = broad money (M1 + time deposits).
- Liquidity order: M1 is the most liquid and M4 the least; money multiplier = M3 / M0.
- Demand-pull: excess demand; cost-push: rising input costs or supply shocks; stagflation: high inflation with stagnation and unemployment.
- Deflation = falling prices; disinflation = falling rate of inflation; reflation = deliberate revival of prices and output.
- WPI: Office of the Economic Adviser, DPIIT; goods only, no services; groups - primary articles, fuel and power, manufactured products.
- CPI Rural/Urban/Combined: NSO; CPI-IW, CPI-AL and CPI-RL: Labour Bureau; CPI (Combined) has been the headline inflation measure since 2014 and is the basis of the RBI's inflation target.
- Phillips curve (A.W. Phillips, 1958): inverse short-run link between unemployment and inflation; vertical in the long run.

> **Quick revision:** Money: medium of exchange, measure of value, store of value, deferred payments; notes by RBI (Sec 22), coins and Re 1 note by GoI; Minimum Reserve System 1957 (Rs 200 crore, gold Rs 115 crore); M0 reserve money, M1 narrow, M3 broad (measures from 1977); demand-pull vs cost-push; stagflation, deflation, disinflation; WPI by OEA (DPIIT), goods only; CPI by NSO, CPI-IW by Labour Bureau; CPI (Combined) headline since 2014; Phillips curve 1958.

## RBI and Monetary Policy: CRR, SLR, Repo, MSF and the MPC

**The central bank:** The Hilton Young Commission (Royal Commission on Indian Currency and Finance, 1926) recommended setting up a central bank for India. The RBI Act 1934 created the Reserve Bank, which began work on 1 April 1935 in Calcutta, moved its central office to Bombay in 1937 and was nationalised on 1 January 1949. Its first Governor was Sir Osborne Smith and its first Indian Governor C.D. Deshmukh. The RBI issues currency notes, is banker to the government and the bankers' bank, acts as lender of last resort, regulates banks, keeps the foreign exchange reserves and manages public debt. Its central task is monetary policy: using interest rates and the supply of money to keep prices stable while supporting growth.

The framework since 2016: After the Urjit Patel Committee (2014) and a Monetary Policy Framework Agreement signed by the government and the RBI in February 2015, the Finance Act 2016 amended the RBI Act to give flexible inflation targeting a legal basis. The primary objective of monetary policy became price stability, keeping in mind the objective of growth. The central government, in consultation with the RBI, sets the inflation target in terms of CPI (Combined) once every five years; the first target, notified in 2016, was 4 per cent with a tolerance band of 2 to 6 per cent. If average inflation stays outside the band for three consecutive quarters, the RBI is held to have failed and must report to the government the reasons and the remedial action it proposes.

**The Monetary Policy Committee:** The Monetary Policy Committee (MPC), first constituted in 2016, fixes the policy repo rate. It has six members: the RBI Governor as chairperson, the Deputy Governor in charge of monetary policy, one RBI officer nominated by the central board, and three external experts appointed by the central government for four years, who cannot be reappointed. It must meet at least four times a year, the quorum is four, each member has one vote, and the Governor has a second or casting vote in a tie. The minutes, published after each meeting, show every member's vote and statement.

**Reserve ratios and the repo rate:** The Cash Reserve Ratio (CRR, Section 42 of the RBI Act) is the share of a bank's net demand and time liabilities that must be kept as cash with the RBI; it earns no interest. The Statutory Liquidity Ratio (SLR, Section 24 of the Banking Regulation Act 1949) is the share a bank must hold itself in cash, gold or approved government securities. The repo rate is the rate at which the RBI lends short-term money to banks against

government securities under the Liquidity Adjustment Facility (LAF, introduced in 2000); it is the policy rate that signals the stance of policy. The reverse repo rate is the rate at which the RBI absorbs surplus money from banks against securities.

**The corridor and other quantitative tools:** The Marginal Standing Facility (MSF), introduced in 2011, lets banks borrow overnight at a rate above the repo rate, even by dipping into their SLR securities, so the MSF rate is the ceiling of the interest-rate corridor. The Standing Deposit Facility (SDF), introduced in April 2022, lets the RBI absorb surplus money without giving securities as collateral; its rate, below the repo rate, replaced the fixed reverse repo rate as the floor of the corridor. The bank rate (Section 49 of the RBI Act) is the rate at which the RBI rediscounts bills; it is now aligned with the MSF rate and used for penalties on reserve shortfalls. Open market operations (OMO) are purchases and sales of government securities: buying injects money, selling absorbs it. The Market Stabilisation Scheme (2004) lets the RBI absorb money created by large foreign inflows.

**Qualitative tools:** Selective or qualitative tools direct credit towards or away from particular uses rather than changing its total. They include margin requirements (raising the margin on loans against a commodity cuts the credit available for hoarding it), credit rationing and ceilings, regulation of consumer credit, directed lending such as priority sector lending, moral suasion (persuading banks through advice and meetings) and direct action against banks that ignore RBI directions.

**How a repo change reaches borrowers:** When the MPC raises the repo rate, banks pay more for funds from the RBI and the money market, so they raise deposit and lending rates; borrowing becomes costlier, spending cools and inflation eases. A cut works the other way. Transmission used to be slow because loans were priced on internal benchmarks: the Benchmark Prime Lending Rate, then the Base Rate from July 2010 and the Marginal Cost of Funds based Lending Rate (MCLR) from April 2016. From 1 October 2019 the RBI required banks to link new floating-rate loans to retail borrowers and to micro and small enterprises to an external benchmark such as the repo rate, so a repo change now reaches home and vehicle loan EMIs much faster.

### Examples

- RBI: Hilton Young Commission 1926; RBI Act 1934; began 1 April 1935 in Calcutta; moved to Bombay 1937; nationalised 1 January 1949; first Indian Governor C.D. Deshmukh.
- CRR: share of NDTL kept as cash with the RBI, no interest (Section 42, RBI Act); SLR: cash, gold and approved securities kept by the bank itself (Section 24, BR Act 1949).
- Repo: RBI lends to banks against securities (the policy rate, under LAF from 2000); reverse repo: RBI absorbs money from banks.
- Corridor: SDF (April 2022, no collateral) is the floor, MSF (2011) the ceiling, repo in between; the bank rate is aligned with MSF.
- OMO: RBI buys government securities to inject money and sells them to absorb it; the Market Stabilisation Scheme (2004) absorbs liquidity from foreign inflows.
- Flexible inflation targeting: RBI Act amended by the Finance Act 2016; target set by the government every five years on CPI (Combined); first target 4 per cent within a 2-6 per cent band.
- MPC: 6 members (3 from RBI with the Governor as chair, 3 external for 4 years, not reappointable); quorum 4; at least 4 meetings a year; Governor has a casting vote.
- Qualitative tools: margin requirements, credit rationing, consumer credit regulation, priority sector lending, moral suasion, direct action.
- Lending benchmarks: Base Rate (July 2010), MCLR (April 2016), external benchmark such as the repo rate for new floating-rate retail and MSE loans (1 October 2019).
- Failure of the target: average inflation outside the band for three consecutive quarters; the RBI must explain the reasons and remedies to the government.

**Quick revision:** RBI Act 1934, began 1 April 1935, nationalised 1949; flexible inflation targeting via Finance Act 2016 (Urjit Patel Committee 2014), target on CPI (Combined) every 5 years, first 4% (2-6%); MPC 6 members, Governor casting vote, quorum 4; CRR with RBI (Sec 42), SLR with bank (BR Act Sec 24); repo = policy rate under LAF; SDF floor (2022), MSF ceiling (2011), bank rate = MSF; OMO, MSS 2004; qualitative: margins, moral suasion; MCLR 2016, external benchmark 1 Oct 2019.

### Union Budget, Deficits, Taxes, GST and the Finance Commission

**The budget in the Constitution:** The word budget does not appear in the Constitution; Article 112 calls it the Annual Financial Statement, the estimated receipts and expenditure of the Government of India for a financial year (1 April to 31 March). Article 265 says no tax can be levied or collected except by authority of law. Article 266 creates the Consolidated Fund of India and the Public Account, and Article 267 the Contingency Fund. Expenditure charged on the Consolidated Fund is discussed but not voted; other spending is voted as demands for grants and then authorised by the Appropriation Bill (Article 114). James Wilson presented the first budget in India in 1860, and R.K. Shanmukham Chetty the first budget of independent India on 26 November 1947. From 2017 the budget has been presented on 1 February, and the separate Railway Budget, presented since 1924, was merged into it.

**Revenue and capital budget:** The revenue budget has revenue receipts, which neither create a liability nor reduce assets (tax revenue, and non-tax revenue such as interest, dividends and profits of public enterprises, fees and fines), and revenue expenditure, which creates no assets (salaries, pensions, interest payments, subsidies and grants to states). The capital budget has capital receipts, which either create a liability or reduce assets (market borrowings, recovery of loans and disinvestment proceeds), and capital expenditure, which creates assets or reduces liabilities (roads, railways, machinery, loans to states and repayment of debt).

**Deficits:** Revenue deficit = revenue expenditure - revenue receipts; it shows the government borrowing to meet day-to-day expenses. Effective revenue deficit is the revenue deficit minus grants given for creating capital assets. Fiscal deficit = total expenditure - (revenue receipts + non-debt capital receipts); it equals the government's total borrowing requirement for the year and is the most watched measure. Primary deficit = fiscal deficit - interest payments; a primary deficit of zero means the government is borrowing only to pay interest. The part of a deficit financed by borrowing from the central bank is called the monetised deficit.

**Direct and indirect taxes:** A direct tax is paid by the person on whom it is imposed and cannot be shifted, such as income tax and corporation tax, so its impact and incidence fall on the same person. An indirect tax is collected from one person but passed on to the buyer, such as GST and customs duty. A progressive tax takes a higher rate as income rises, a proportional tax the same rate, and a regressive tax a larger share of a poor person's income; indirect taxes tend to be regressive.

**GST:** The Goods and Services Tax came through the Constitution (101st Amendment) Act 2016 and began on 1 July 2017. It is a destination-based tax on the supply of goods and services that replaced many central and state taxes, such as central excise, service tax, VAT and entry tax, and it gives credit for tax paid on inputs so that tax is not charged on tax. Article 246A gives Parliament and the state legislatures power to make GST laws; Article 269A provides for Integrated GST (IGST) on inter-state supplies, while intra-state supplies carry Central GST plus State or Union Territory GST. The GST Council under Article 279A is chaired by the Union Finance Minister and includes a Union Minister of State for Finance and a minister from each state; the Centre's vote carries one-third weight and the states together two-thirds, and decisions need three-fourths of the weighted votes. Alcohol for human consumption is outside GST, and five petroleum products stay outside until the Council decides otherwise. The Council sets and revises the rate slabs, keeping essentials exempt or lowest and luxury and sin goods highest; GST began with four main slabs of 5, 12, 18 and 28 per cent, a structure later revised.

**Finance Commission:** Article 280 requires the President to set up a Finance Commission every fifth year or earlier, with a chairman and four other members whose qualifications are laid down by the Finance Commission (Miscellaneous Provisions) Act 1951. It recommends how the net proceeds of shareable central taxes are divided between the Centre and the states (vertical devolution) and among the states (horizontal devolution), the principles for grants-in-aid to states under Article 275, and measures to support panchayats and municipalities based on State

Finance Commission reports. Its recommendations are advisory. The First Finance Commission (1951) was chaired by K.C. Neogy.

The FRBM Act 2003: The Fiscal Responsibility and Budget Management Act 2003, in force from July 2004, binds the Union government to fiscal discipline. It originally aimed to eliminate the revenue deficit and bring the fiscal deficit down to 3 per cent of GDP, and it requires fiscal policy statements, such as the Medium-term Fiscal Policy Statement, the Fiscal Policy Strategy Statement and the Macro-economic Framework Statement, to be laid with the budget. Its deadlines have been changed several times by amendment, and the N.K. Singh Committee (2017) recommended making government debt the main anchor of fiscal policy.

**Examples**

- Article 112: Annual Financial Statement (Budget); 114: Appropriation Bill; 265: no tax without authority of law; 266: Consolidated Fund and Public Account; 267: Contingency Fund.
- Charged expenditure (President's emoluments, Supreme Court judges' salaries) is discussed but not voted by Parliament.
- First budget in India: James Wilson, 1860; first of independent India: R.K. Shanmukham Chetty, 26 November 1947; Railway Budget merged and 1 February date from 2017.
- Revenue deficit = revenue expenditure - revenue receipts; fiscal deficit = total expenditure - (revenue receipts + non-debt capital receipts); primary deficit = fiscal deficit - interest payments.
- Capital receipts create a liability or reduce assets: borrowings, recovery of loans, disinvestment.
- Direct taxes (cannot be shifted): income tax, corporation tax; indirect taxes (passed on to buyers): GST, customs duty.
- GST: 101st Amendment Act 2016; launched 1 July 2017; Articles 246A, 269A (IGST) and 279A (GST Council chaired by the Union Finance Minister).
- GST Council voting: Centre one-third weight, states two-thirds, decisions by three-fourths of weighted votes; alcohol for human consumption is outside GST.
- Finance Commission: Article 280, every 5 years, chairman + 4 members, vertical and horizontal devolution of taxes; first chaired by K.C. Neogy (1951).
- FRBM Act 2003 (in force July 2004): original goals - no revenue deficit and a fiscal deficit of 3 per cent of GDP; N.K. Singh Committee 2017: debt as the anchor.

> **Quick revision:** Budget = Annual Financial Statement, Art 112; Art 114 Appropriation Bill, 265 no tax without law, 266 Consolidated Fund, 267 Contingency Fund; revenue vs capital (capital receipts create liability or reduce assets); fiscal deficit = borrowing; primary = fiscal - interest; GST: 101st Amendment 2016, from 1 July 2017, Council Art 279A (Centre 1/3, states 2/3, 3/4 majority); Finance Commission Art 280, every 5 years, first K.C. Neogy; FRBM Act 2003.

## Poverty Lines, Types of Unemployment and Welfare Schemes

**Measuring poverty:** Absolute poverty is the inability to afford a minimum basket of food and other essentials; relative poverty compares a person's position with others in the same society. India measures absolute poverty with a poverty line, an amount of monthly consumption spending per person, and the head count ratio is the share of people below it. The Planning Commission made the official estimates using the large consumption expenditure surveys of the NSSO. Before independence Dadabhai Naoroji discussed a subsistence-based poverty line, and after it a Planning Commission working group proposed a national minimum in 1962.

**From calories to a basket of goods:** The Task Force led by Y.K. Alagh (1979) defined the poverty line by calorie needs: the spending needed for 2400 kilocalories per person per day in rural areas and 2100 in urban areas. The Lakdawala Expert Group (report 1993) kept this calorie base but made poverty lines state-specific, updating them with the Consumer Price Index for Agricultural Labourers (rural) and for Industrial Workers (urban). The Tendulkar Expert Group (report 2009) moved away from calorie norms to a poverty line basket that also covered spending on health and education, used one basket for rural and urban areas adjusted for prices, and used the mixed reference period for data; for 2011-12 its line was about Rs 27 a day in rural areas and Rs 33 in urban areas. The Rangarajan Expert Group (report 2014) returned to separate rural and urban baskets based on norms for calories, protein and fat

plus essential non-food items, with lines of about Rs 32 a day (rural) and Rs 47 (urban) for 2011-12; the government did not formally adopt it.

**Multidimensional poverty:** Income or spending alone misses deprivations such as poor health or lack of schooling. The Global Multidimensional Poverty Index (MPI), introduced in 2010 by the UNDP and the Oxford Poverty and Human Development Initiative (OPHI), uses three equally weighted dimensions, health, education and standard of living, measured through 10 indicators: nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, drinking water, electricity, housing and assets. A person is multidimensionally poor if deprived in at least one-third of the weighted indicators. NITI Aayog's National MPI uses the same three dimensions and adds indicators such as maternal health and bank accounts.

**Types of unemployment:** Disguised unemployment exists when more people work on a task than are needed, so removing some does not reduce output; their marginal productivity is zero, as on small family farms. Seasonal unemployment comes with the off-season in agriculture or tourism. Frictional unemployment is the short gap while people change jobs. Structural unemployment is long-term, caused by a mismatch between workers' skills and available jobs or by a shortage of capital; technological unemployment, when machines replace labour, is a form of it. Cyclical unemployment rises in recessions when demand falls. Educated unemployment and underemployment, where people work less than they wish or below their skills, are common in India.

**Measuring unemployment:** The NSSO uses three approaches: usual status (a reference period of 365 days, divided into principal and subsidiary status), current weekly status (a reference week of 7 days) and current daily status (activity on each day of the reference week, the most detailed measure). The Periodic Labour Force Survey (PLFS), launched by the NSSO in 2017, now gives the main labour indicators: the labour force participation rate, the worker population ratio and the unemployment rate, which is the unemployed as a share of the labour force, not of the whole population.

**Long-running welfare schemes:** The Integrated Child Development Services (ICDS) began on 2 October 1975. The Integrated Rural Development Programme (IRDP, 1978-79) was extended to all blocks on 2 October 1980; the National Rural Employment Programme (1980) and the Rural Landless Employment Guarantee Programme (1983) were merged into the Jawahar Rozgar Yojana in 1989. The National Social Assistance Programme (NSAP), which now gives pensions to the elderly, widows and persons with disabilities, and the national mid-day meal programme both began on 15 August 1995. The Swarnjayanti Gram Swarozgar Yojana (1999) for self-employment through self-help groups became the National Rural Livelihoods Mission (Aajeevika) in 2011, later renamed Deendayal Antyodaya Yojana-NRLM. The Indira Awaas Yojana (1985-86) for rural housing was restructured as the Pradhan Mantri Awas Yojana-Gramin in 2016, while PMAY-Urban began in 2015.

**MGNREGA:** The National Rural Employment Guarantee Act was passed in 2005 and came into force on 2 February 2006 in 200 districts, starting from Anantapur in Andhra Pradesh, before covering all rural districts; Mahatma Gandhi's name was added on 2 October 2009. It gave every rural household whose adult members asked for unskilled manual work a legal right to at least 100 days of wage employment in a financial year, work within 5 km of home, an unemployment allowance if work was not given within 15 days, at least one-third of the beneficiaries women, and social audits by the gram sabha. The Viksit Bharat - Guarantee for Rozgar and Ajeevika Mission (Gramin) Act 2025 (VB-G RAM G Act) was enacted to replace MGNREGA, raising the guarantee to 125 days.

### Examples

- Alagh Task Force 1979: calorie-based poverty line - 2400 kcal rural and 2100 kcal urban per person per day.
- Lakdawala Expert Group (1993): state-specific poverty lines updated with CPI-AL (rural) and CPI-IW (urban).
- Tendulkar Expert Group (2009): basket including health and education, mixed reference period; 2011-12 line about Rs 27 rural and Rs 33 urban per day.
- Rangarajan Expert Group (2014): separate rural and urban baskets; 2011-12 line about Rs 32 rural and Rs 47 urban per day.
- Global MPI (2010, UNDP and OPHI): 3 dimensions - health, education, standard of living - and 10 indicators; poor if deprived in at least one-third of weighted indicators.

- Disguised unemployment: marginal productivity zero (agriculture); frictional: between jobs; structural: skill or capital mismatch; cyclical: recession.
- NSSO approaches: usual status (365 days), current weekly status (7 days), current daily status; PLFS launched in 2017.
- ICDS 1975; IRDP nationwide 1980; JRY 1989; NSAP and national mid-day meal 15 August 1995; SGSY 1999; NRLM (Aajeevika) 2011.
- MGNREGA: Act 2005, in force 2 February 2006 (Anantapur), Mahatma Gandhi's name 2009; 100 days of wage work, one-third women, social audit; the VB-G RAM G Act 2025 was enacted to replace it, raising the guarantee to 125 days.

> **Quick revision:** Poverty line = consumption spending per person; Alagh 1979 calories (2400 rural, 2100 urban); Lakdawala 1993 state lines; Tendulkar 2009 basket with health and education (Rs 27/33 a day, 2011-12); Rangarajan 2014 (Rs 32/47); Global MPI 2010 UNDP-OPHI, 3 dimensions, 10 indicators; disguised, seasonal, frictional, structural, cyclical unemployment; PLFS 2017; ICDS 1975, IRDP 1980, JRY 1989, NSAP 1995, NRLM 2011; MGNREGA 2005/2006, 100 days; VB-G RAM G Act 2025 enacted to replace it (125 days).

### Agriculture, MSP, Public Distribution and Food Security

**Land reforms:** After independence the states passed land reform laws in three main areas. Abolition of intermediaries ended the zamindari, jagirdari and similar systems and was largely done in the 1950s. Tenancy reforms regulated rent, gave tenants security of tenure and, in some states, ownership. Land ceiling laws fixed the maximum land a family could hold and gave the surplus to the landless. Consolidation of scattered holdings was most successful in Punjab, Haryana and western Uttar Pradesh. The First Amendment (1951) created the Ninth Schedule to protect land reform laws from challenge in court. Vinoba Bhave began the voluntary Bhoodan movement at Pochampally in Telangana in 1951, and West Bengal's Operation Barga (1978) recorded the rights of sharecroppers. Kerala and West Bengal carried land reform furthest.

**The Green Revolution:** In the mid-1960s, after two droughts and heavy food imports, India adopted a strategy of high-yielding variety (HYV) seeds, mainly wheat derived from Norman Borlaug's Mexican varieties, together with chemical fertilisers, pesticides, assured irrigation and credit. M.S. Swaminathan is called the father of India's Green Revolution, and C. Subramaniam was the Agriculture Minister who backed it; the High Yielding Varieties Programme began in 1966-67. Wheat output rose sharply in Punjab, Haryana and western Uttar Pradesh, and India became self-sufficient in food grains. Its limits were regional inequality, a narrow focus on wheat and later rice, and environmental costs such as falling groundwater and damaged soils. Operation Flood (from 1970, led by Verghese Kurien) later brought a White Revolution in milk.

**MSP and the CACP:** The Minimum Support Price is the price at which the government stands ready to buy a crop, so that a bumper harvest does not crash farm prices. It is recommended by the Commission for Agricultural Costs and Prices (CACP), set up in 1965 as the Agricultural Prices Commission and renamed in 1985, and approved by the Cabinet Committee on Economic Affairs. MSP is announced for 22 mandated crops (14 kharif crops, 6 rabi crops and two commercial crops, jute and copra), while sugarcane gets a Fair and Remunerative Price. Since 2018-19 MSP has been fixed at no less than 1.5 times the all-India weighted average cost of production (the A2+FL cost, which adds the value of family labour to paid-out costs).

**FCI and the public distribution system:** The Food Corporation of India (FCI), set up in 1965 under the Food Corporations Act 1964, buys grain at MSP, stores it, moves it across the country, keeps buffer stocks and hands it to the states for distribution. Under decentralised procurement (from 1997-98) some states buy and distribute grain themselves. The public distribution system (PDS) grew out of wartime rationing in the 1940s and supplies grain through fair price shops, under the joint responsibility of the Centre and the states. The Revamped PDS (1992) focused on hilly and remote areas, the Targeted PDS (1997) separated families below and above the poverty line, and the Antyodaya Anna Yojana (AAY, December 2000) targeted the poorest families with 25 kg of grain per family per month at launch, later raised to 35 kg.

The National Food Security Act 2013: The NFSA, notified in September 2013, made subsidised food grain a legal right. It covers up to 75 per cent of the rural and 50 per cent of the urban population, about two-thirds of all people. Priority households are entitled to 5 kg of grain per person per month and AAY households to 35 kg per household,

at Rs 3, 2 and 1 per kg for rice, wheat and coarse grains as set in the Act; the Centre later decided to supply this grain free of cost. Pregnant women and lactating mothers get a maternity benefit of at least Rs 6,000 and meals, and children from 6 months to 14 years get meals through anganwadis and schools. The eldest woman of the household, aged 18 or above, is treated as its head for ration cards, and each state has a State Food Commission.

**Crop insurance and income support:** The first nationwide crop insurance scheme was the Comprehensive Crop Insurance Scheme (1985), followed by the National Agricultural Insurance Scheme (1999) and its modified version. The Pradhan Mantri Fasal Bima Yojana (PMFBY, 2016) charges farmers a premium of only 2 per cent for kharif crops, 1.5 per cent for rabi crops and 5 per cent for commercial and horticultural crops. The Kisan Credit Card (1998) gives farmers flexible short-term credit, and PM-KISAN, launched in February 2019 with effect from December 2018, pays Rs 6,000 a year in three instalments of Rs 2,000 into the bank accounts of landholding farmer families.

**Agricultural marketing:** Agriculture and markets are state subjects, so produce is sold in regulated markets (mandis) set up under each state's Agricultural Produce Market Committee (APMC) Act. The Centre has promoted reform through the Model APMC Act 2003, the Model Agricultural Produce and Livestock Marketing Act 2017 and e-NAM, a national electronic trading platform launched on 14 April 2016 that links mandis online. AGMARK quality grading rests on the Agricultural Produce (Grading and Marking) Act 1937, and the Central Warehousing Corporation (1957) provides scientific storage.

**Examples**

- Land reforms: abolition of intermediaries, tenancy reform, land ceilings, consolidation of holdings; Ninth Schedule added by the First Amendment 1951.
- Bhoodan: Vinoba Bhave, Pochampally (Telangana), 1951; Operation Barga: West Bengal, 1978, for sharecroppers.
- Green Revolution (mid-1960s): HYV wheat, fertilisers, irrigation; M.S. Swaminathan and C. Subramaniam; Punjab, Haryana, western UP.
- White Revolution: Operation Flood from 1970, Verghese Kurien; Yellow Revolution: oilseeds, Technology Mission on Oilseeds 1986.
- MSP: recommended by the CACP (1965, renamed 1985), approved by the CCEA; 22 mandated crops; FRP for sugarcane; at least 1.5 times the A2+FL cost since 2018-19.
- FCI: 1965 under the Food Corporations Act 1964; procurement, storage, buffer stocks; decentralised procurement from 1997-98.
- PDS stages: Revamped PDS 1992, Targeted PDS 1997, Antyodaya Anna Yojana December 2000 (25 kg per family per month at launch, now 35 kg).
- NFSA 2013: up to 75% rural and 50% urban population; 5 kg per person per month; AAY 35 kg per household; maternity benefit at least Rs 6,000; eldest woman (18+) as head of household.
- PMFBY 2016: farmer premium 2% kharif, 1.5% rabi, 5% commercial and horticultural; KCC 1998; PM-KISAN 2019: Rs 6,000 a year in 3 instalments.
- Marketing: state APMC Acts; Model APMC Act 2003; e-NAM 14 April 2016; AGMARK under the 1937 Act; Central Warehousing Corporation 1957.

> **Quick revision:** Land reforms: intermediaries abolished, tenancy reform, ceilings, consolidation; Ninth Schedule 1951; Bhoodan 1951; Operation Barga 1978; Green Revolution mid-1960s (Swaminathan, HYV wheat); MSP by CACP (1965), 22 crops, at least 1.5 x A2+FL since 2018-19; FCI 1965; TPDS 1997, AAY 2000; NFSA 2013 (75% rural, 50% urban, 5 kg); PMFBY 2016 (2/1.5/5%); KCC 1998; PM-KISAN 2019 Rs 6,000; e-NAM 2016.

### Industrial Policy, the 1991 LPG Reforms and Public Sector Enterprises

Industrial Policy Resolution 1948: The first industrial policy, announced on 6 April 1948, laid down a mixed economy. Arms and ammunition, atomic energy and railways became a Central government monopoly. In six basic industries, including coal, iron and steel, aircraft manufacture, shipbuilding and mineral oils, new units were to be set up by the state while existing private units could continue. Eighteen industries of national importance were placed under government regulation, and the rest were left to the private sector. The Industries (Development and Regulation) Act 1951 then gave the government power to license industries.

Industrial Policy Resolution 1956: Adopted on 30 April 1956, after the socialistic pattern of society had been accepted as the national goal, and closely tied to the Second Plan's heavy-industry strategy, it is called the economic constitution of India. Schedule A listed 17 industries that would be the exclusive responsibility of the state; Schedule B listed 12 industries that would be progressively state-owned but open to private firms as well; all others, in Schedule C, were left to private enterprise. It gave the public sector the commanding heights of the economy and also stressed small and cottage industries and balanced regional development.

**The licence raj:** For decades firms needed government licences to set up, expand or change products. The Monopolies and Restrictive Trade Practices (MRTP) Act 1969 restricted large business houses, the Foreign Exchange Regulation Act (FERA) 1973 controlled foreign firms, and many items were reserved for small-scale units from 1967. These controls aimed at equity and self-reliance but brought delays, corruption, inefficiency and slow growth, a system nicknamed the licence-permit-quota raj.

The 1991 crisis: By 1990-91 India faced a balance of payments crisis caused by large fiscal deficits, rising foreign debt, the oil price shock of the Gulf War, falling remittances and political instability. Foreign exchange reserves fell to barely a few weeks of imports, India's credit rating was cut, and gold was pledged with the Bank of England and the Bank of Japan to raise funds. The government of P.V. Narasimha Rao, with Manmohan Singh as Finance Minister, devalued the rupee in two steps in July 1991, took IMF support and announced the New Industrial Policy on 24 July 1991, the day the budget was presented.

**The LPG reforms:** Liberalisation removed controls: industrial licensing was abolished for all but a short list of industries, the asset limit on MRTP companies was dropped, and import and foreign exchange controls were eased. Privatisation reduced the state's role: industries reserved for the public sector were cut from 17 to 8 and later to very few, and government shares in public enterprises began to be sold. Globalisation linked India to the world economy: foreign investment up to 51 per cent was allowed automatically in high-priority industries and tariffs were cut. Committees shaped the reforms, such as the Narasimham Committee (1991) on banking, the Raja Chelliah Committee (1991) on taxes, the Rangarajan Committee (1993) on disinvestment and the Malhotra Committee (1993) on insurance. The MRTP Act was later replaced by the Competition Act 2002.

**Disinvestment and CPSE status:** Disinvestment is the sale of part or all of the government's stake in public sector enterprises, either as minority stake sales or as strategic sales that hand over management control, as with BALCO in 2001. A Department of Disinvestment was created in 1999 and renamed the Department of Investment and Public Asset Management (DIPAM) in 2016. To give successful central public sector enterprises (CPSEs) more freedom, the government created the Navratna and Miniratna categories in 1997, starting with nine Navratnas, and approved the Maharatna category in 2009, the first Maharatnas being named in 2010. A Maharatna must already be a Navratna, be listed on an Indian stock exchange and, on a three-year average, have turnover above Rs 25,000 crore, net worth above Rs 15,000 crore and net profit above Rs 5,000 crore. Miniratnas are consistently profit-making CPSEs in Category I or II, and each higher status gives more power to invest without government approval.

**MSMEs and Make in India:** Micro, small and medium enterprises are defined under the MSMED Act 2006, which classified them by investment in plant and machinery for manufacturing and in equipment for services, with separate limits for each. In 2020 the definition was changed to a composite test of investment and annual turnover with the same limits for manufacturing and services, export turnover being excluded, and registration moved online through Udyam; the limits are revised from time to time. Make in India, launched on 25 September 2014 with a lion as its symbol, aims to make India a global manufacturing hub by easing business rules and attracting investment.

### Examples

- IPR 1948: mixed economy; Central monopoly on arms and ammunition, atomic energy and railways; the Industries (Development and Regulation) Act 1951 brought licensing.
- IPR 1956: Schedule A 17 industries (state), Schedule B 12 (state-led, private allowed), Schedule C (private); called the economic constitution of India.
- Licence raj laws: MRTP Act 1969, FERA 1973, reservation for small-scale units from 1967; MRTP replaced by the Competition Act 2002.

- 1991 crisis: Gulf War oil shock, very low reserves, gold pledged with the Bank of England and the Bank of Japan; PM P.V. Narasimha Rao, FM Manmohan Singh; New Industrial Policy 24 July 1991.
- LPG: licensing abolished for most industries, public sector reservation cut from 17 to 8 industries, foreign investment up to 51% automatic in high-priority industries.
- Reform committees: Narasimham 1991 (banking), Raja Chelliah 1991 (tax), Rangarajan 1993 (disinvestment), Malhotra 1993 (insurance).
- Department of Disinvestment 1999, renamed DIPAM 2016; BALCO (2001) was an early strategic sale.
- Navratna and Miniratna from 1997 (nine original Navratnas); Maharatna approved 2009 (first companies 2010) - three-year average turnover above Rs 25,000 crore, net worth above Rs 15,000 crore, net profit above Rs 5,000 crore.
- MSMED Act 2006: investment-based, separate limits for manufacturing and services; 2020 revision: investment plus turnover, same for both, Udyam registration.
- Make in India: launched 25 September 2014, lion logo; aim - make India a global manufacturing hub.

> **Quick revision:** IPR 1948 (mixed economy, 3 Central monopolies); IDRA 1951 licensing; IPR 1956: 17 Schedule A, 12 Schedule B, economic constitution; MRTP 1969, FERA 1973; 1991 BoP crisis, gold pledged, rupee devalued July 1991, New Industrial Policy 24 July 1991; public sector reservation 17 to 8; Competition Act 2002; Department of Disinvestment 1999, DIPAM 2016; Navratna/Miniratna 1997, Maharatna 2009; MSMED Act 2006, revised 2020; Make in India 25 Sept 2014.

### Balance of Payments, Exchange Rates, FDI, FEMA and the WTO

**Balance of payments:** The balance of payments (BoP) is a systematic record of all economic transactions between the residents of a country and the rest of the world over a period, usually a year; in India the RBI compiles it. It is kept by double entry, so in accounting terms it always balances; a surplus or deficit means the balance before the change in foreign exchange reserves. The current account records exports and imports of goods (visible trade, whose difference is the trade balance), services such as software, tourism and transport, primary income such as interest, dividends and wages, and secondary income, mainly remittances and gifts. India usually has a deficit in goods trade that is partly offset by a surplus in services and large remittance inflows.

**Capital account and reserves:** The capital account records changes in foreign assets and liabilities: foreign direct investment, portfolio investment, external commercial borrowings, external assistance, non-resident Indian deposits and other banking capital. A current account deficit must be financed by a capital account surplus or by drawing down reserves. India's foreign exchange reserves, held and managed by the RBI, have four parts: foreign currency assets, gold, Special Drawing Rights (SDRs) and the reserve tranche position with the IMF. Errors and omissions is the balancing item for statistical gaps.

**Exchange-rate regimes:** Under a fixed or pegged regime the government sets the value of the currency; under a floating regime demand and supply in the foreign exchange market decide it; a managed float lets the market decide while the central bank steps in to curb sharp swings. Devaluation is an official cut in the value of a pegged currency and depreciation a fall caused by the market; their opposites are revaluation and appreciation. India devalued the rupee in 1949, 1966 and 1991. It moved from a basket peg to the Liberalised Exchange Rate Management System (LERMS) in March 1992, which had a dual rate, and to a unified market-determined rate, a managed float, in March 1993.

**Convertibility:** Convertibility is the freedom to change domestic currency into foreign currency and back at the market rate. India made the rupee fully convertible on the current account in August 1994 by accepting Article VIII of the IMF's Articles of Agreement, so that payments for trade, travel, education and remittances can be made freely within rules. Capital account convertibility, the freedom to move capital in and out for investment, is only partial; the Tarapore Committees of 1997 and 2006 laid out a gradual path towards it.

**FDI, FPI and FEMA:** Foreign direct investment (FDI) carries a lasting interest and some management control, often with technology; foreign portfolio investment (FPI) buys shares and bonds for financial returns and can leave quickly, which is why it is called hot money. In India an investment of 10 per cent or more of a listed company's equity is treated as FDI, and less than that as FPI, which SEBI regulates. FDI comes through the automatic route, needing no

prior approval, or the government route, needing approval from the ministry concerned since the Foreign Investment Promotion Board was abolished in 2017; a few sectors such as lottery, gambling and chit funds are closed to it. The Foreign Exchange Management Act (FEMA) 1999, in force from 1 June 2000, replaced FERA 1973: FERA was a strict control law under which violations were criminal offences, while under FEMA most violations are civil, and its aim is to facilitate external trade and payments and develop the foreign exchange market. The Enforcement Directorate enforces it.

**GATT and the WTO:** The General Agreement on Tariffs and Trade (GATT), signed at Geneva in 1947 with India among its founding members, reduced tariffs through rounds of negotiation. Its last, the Uruguay Round (1986-94), ended with the Marrakesh Agreement of 1994, which created the World Trade Organization (WTO) on 1 January 1995, with headquarters in Geneva and India as a founder member. The WTO covers goods, services (GATS), intellectual property (TRIPS), investment measures (TRIMS) and agriculture, where subsidies are sorted into amber, blue and green boxes. Its top body, the Ministerial Conference, meets at least once every two years, its dispute settlement system rules on trade disputes, and its core principles are most-favoured-nation treatment and national treatment.

**The IMF and the World Bank group:** Both were planned at the Bretton Woods Conference in New Hampshire, USA, in July 1944, both are based in Washington, D.C., and India is a founding member of both. The International Monetary Fund lends to countries with balance of payments problems, monitors members' economies and created Special Drawing Rights in 1969; each member's quota decides its contribution, voting power and access to loans. The World Bank group has five institutions: the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA, 1960) for soft loans to the poorest countries, the International Finance Corporation (IFC, 1956) for the private sector, the Multilateral Investment Guarantee Agency (MIGA, 1988) and the International Centre for Settlement of Investment Disputes (ICSID, 1966). The IBRD and IDA together are called the World Bank; India is not a member of ICSID.

### Examples

- Current account: goods (trade balance), services, primary income, secondary income (remittances); capital account: FDI, FPI, ECBs, external assistance, NRI deposits.
- Forex reserves (managed by the RBI): foreign currency assets, gold, SDRs and the reserve tranche position with the IMF.
- Devaluation (official, fixed regime) vs depreciation (market, floating regime); the rupee was devalued in 1949, 1966 and 1991.
- LERMS March 1992 (dual rate); unified market-determined rate March 1993; current account convertibility August 1994 (IMF Article VIII).
- Tarapore Committees 1997 and 2006: road map for capital account convertibility, which remains partial.
- FDI: 10 per cent or more of a listed company's equity; FPI: below 10 per cent, regulated by SEBI; FIPB abolished in 2017.
- FERA 1973 (control, criminal) replaced by FEMA 1999, in force 1 June 2000 (management, civil); enforced by the Enforcement Directorate.
- GATT 1947, Geneva; Uruguay Round 1986-94; Marrakesh Agreement 1994; WTO 1 January 1995, Geneva; Ministerial Conference at least every two years.
- Bretton Woods, July 1944: IMF and IBRD, both in Washington, D.C.; SDR created 1969; World Bank = IBRD + IDA.
- World Bank group: IBRD, IDA (1960), IFC (1956), MIGA (1988), ICSID (1966); India is not a member of ICSID.

> **Quick revision:** BoP: current account (goods, services, income, remittances) + capital account (FDI, FPI, ECB, NRI deposits); reserves = FCA, gold, SDR, IMF reserve tranche; rupee devalued 1949, 1966, 1991; LERMS 1992, unified rate 1993; current account convertible Aug 1994; Tarapore 1997, 2006; FDI = 10% or more; FEMA 1999 (from 1 June 2000) replaced FERA 1973; GATT 1947, WTO 1 Jan 1995 Geneva; IMF and World Bank from Bretton Woods 1944; WB group: IBRD, IDA, IFC, MIGA, ICSID.

## Financial Markets: Money Market, Capital Market, SEBI, Insurance and Pensions

**The financial system:** Financial markets bring together those who save and those who need funds for investment. By the length of the funds they divide into the money market, for short-term funds of up to one year, and the capital market, for long-term funds. Each part has a regulator: the RBI for banks, the money market, government securities and foreign exchange; SEBI for the securities market; IRDAI for insurance; and PFRDA for pensions. The Financial Stability and Development Council (FSDC), set up in 2010 and chaired by the Union Finance Minister, coordinates them.

**The money market:** Its instruments are short-term and highly liquid. Call money is lent overnight between banks, notice money for 2 to 14 days, and term money for longer periods up to one year. Treasury bills are short-term borrowing by the central government, issued by the RBI on its behalf for 91, 182 and 364 days at a discount and repaid at face value. Certificates of deposit (from 1989) are issued by banks and commercial paper (from 1990) by companies to raise short-term funds. The RBI regulates the money market.

**The capital market:** The capital market deals in long-term instruments such as equity shares, debentures and bonds. The primary market, or new issue market, is where securities are sold for the first time and the money goes to the issuer: through an initial public offering (IPO) for a first listing, a follow-on public offer (FPO), a rights issue to existing shareholders or a private placement. The secondary market is where existing securities are traded among investors on stock exchanges; it gives liquidity and price discovery but raises no new money for the company. Shares are now held in electronic (demat) form with the depositories NSDL (1996) and CDSL (1999) under the Depositories Act 1996.

**SEBI:** The Securities and Exchange Board of India was set up on 12 April 1988 by a government resolution as a non-statutory body and became statutory on 30 January 1992 through an ordinance, later replaced by the SEBI Act 1992; its headquarters is in Mumbai. Its three aims are to protect investors, to promote the development of the securities market and to regulate it. It registers and regulates stock exchanges, brokers, merchant bankers, mutual funds, credit rating agencies and foreign portfolio investors, prohibits insider trading and fraudulent practices, and regulates takeovers. The Controller of Capital Issues, which earlier fixed the prices of new issues, was abolished in 1992. In 2015 the Forward Markets Commission, the commodity futures regulator, was merged into SEBI. Appeals against SEBI orders go to the Securities Appellate Tribunal and then to the Supreme Court.

**Stock exchanges and indices:** The Bombay Stock Exchange (BSE), on Dalal Street in Mumbai, began in 1875 as the Native Share and Stock Brokers' Association and is Asia's oldest stock exchange. The National Stock Exchange (NSE), set up in 1992, began trading in 1994 and introduced nationwide, fully automated screen-based trading. A stock index tracks the overall movement of a chosen group of shares. The BSE Sensex (Sensitive Index), launched in 1986 with 1978-79 as its base year and a base value of 100, follows 30 large companies; the NSE's Nifty 50 follows 50 companies, with a base value of 1000 as of November 1995. Both are weighted by free-float market capitalisation, counting only shares available for trading.

**Mutual funds and bonds:** A mutual fund pools money from many investors and invests it in a spread of securities through a professional asset management company; investors hold units whose value is the net asset value (NAV). Open-ended funds take in and pay out money at any time, while closed-ended funds have a fixed term. The Unit Trust of India (1963) was the first mutual fund, public sector funds came in 1987 and private funds in 1993, and SEBI regulates all of them. A bond is a loan to the issuer, who pays fixed interest called the coupon and repays the face value at maturity; when market interest rates rise, existing bond prices fall, so price and yield move in opposite directions. Common types are government securities, corporate bonds, zero-coupon bonds, masala bonds (rupee-denominated bonds sold abroad) and Sovereign Gold Bonds (first issued in 2015).

**Insurance and pensions:** Life insurance was nationalised when the Life Insurance Corporation of India (LIC) was formed on 1 September 1956, and general insurance under the General Insurance Business (Nationalisation) Act 1972. The Malhotra Committee (1993) recommended opening the sector to private companies, and the IRDA Act 1999 set up the Insurance Regulatory and Development Authority of India (IRDAI), based in Hyderabad. The Pension Fund Regulatory and Development Authority (PFRDA), set up in 2003 and made statutory by the PFRDA Act 2013, regulates the National Pension System (NPS). NPS became compulsory for central government employees (except

the armed forces) joining from 1 January 2004 and was opened to all citizens in 2009; PFRDA also runs the Atal Pension Yojana (2015) for workers in the unorganised sector.

**Examples**

- Money market (up to one year, regulated by RBI): call money (overnight), notice money (2-14 days), treasury bills (91, 182, 364 days), CDs (1989), CP (1990).
- Capital market: long-term funds; primary market = new issues (IPO, FPO, rights issue); secondary market = trading of existing securities on exchanges.
- SEBI: 12 April 1988 (non-statutory), statutory 30 January 1992, SEBI Act 1992; HQ Mumbai; Forward Markets Commission merged into it in 2015; appeals go to SAT.
- BSE 1875, Asia's oldest exchange; NSE 1992, nationwide fully automated screen-based trading; depositories NSDL 1996 and CDSL 1999.
- Sensex: 30 stocks, base 1978-79 = 100; Nifty 50: 50 stocks, base value 1000 (November 1995); both free-float weighted.
- Mutual funds: UTI 1963 was the first; public sector funds 1987, private funds 1993; unit value = NAV; regulated by SEBI.
- Bond price and yield move in opposite directions; masala bonds are rupee-denominated bonds issued abroad; Sovereign Gold Bonds were first issued in 2015.
- Insurance: LIC 1 September 1956; general insurance nationalised 1972; Malhotra Committee 1993; IRDA Act 1999; IRDAI based in Hyderabad.
- Pensions: PFRDA 2003, statutory under the PFRDA Act 2013; NPS for central employees from 1 January 2004, open to all citizens 2009; Atal Pension Yojana 2015.
- Regulators: RBI (money market, banks, forex), SEBI (securities, mutual funds), IRDAI (insurance), PFRDA (pensions); FSDC 2010, chaired by the Finance Minister.

> **Quick revision:** Money market up to 1 year (RBI): call, notice, T-bills 91/182/364 days, CD 1989, CP 1990; capital market long-term (SEBI): primary (IPO, FPO) and secondary; SEBI 1988, statutory 30 Jan 1992, HQ Mumbai, FMC merged 2015; BSE 1875, NSE 1992; Sensex 30 (base 1978-79 = 100), Nifty 50 (base 1000, 1995); UTI 1963; NSDL 1996, CDSL 1999; LIC 1956, IRDA Act 1999 (Hyderabad); PFRDA 2003/2013, NPS 2004; FSDC 2010.

Free practice questions: parikshasaathi.com/q/indian-economy/

## Indian Geography

### Indian Geography: Physical, Economic and Human

**What the exam asks:** Indian Geography is a scoring, fact-heavy part of General Awareness in SSC, Railway, state police and state PSC prelims. Questions are mostly one-liners: which river a dam is on, which state a national park or coal field lies in, which range a pass belongs to, which crop is kharif, and a few Census 2011 superlatives. Learn facts in pairs (feature plus state, river plus tributary, project plus river) and revise the superlatives (longest, highest, largest, first) separately.

**Location and extent:** Mainland India lies between 8 degree 4 minutes N and 37 degree 6 minutes N latitude and 68 degree 7 minutes E and 97 degree 25 minutes E longitude. Indira Point on Great Nicobar is the southernmost point of the country; Kanyakumari is the southern tip of the mainland. The Tropic of Cancer crosses eight states: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura and Mizoram. The Standard Meridian, 82 degree 30 minutes E, passes through Mirzapur (UP) and gives IST, five and a half hours ahead of GMT. Land border order by length: Bangladesh, China, Pakistan, Nepal, Myanmar, Bhutan, Afghanistan. The coastline is about 11,099 km as re-measured in 2025 (the earlier official figure was 7,516.6 km); Gujarat has the longest state coastline and nine states touch the sea. Uttar Pradesh borders the maximum number of states (eight) plus Delhi.

**Physiography:** The Himalayas run in three parallel ranges: Himadri (Greater Himalaya, average 6,000 m; Kangchenjunga, 8,586 m, in Sikkim is the highest peak in India), Himachal (Lesser Himalaya, with the Pir Panjal and Dhauladhar ranges) and Shivalik (Outer Himalaya, with Dun valleys). The Trans-Himalaya holds the Karakoram (K2, Siachen glacier), Ladakh and Zanskar ranges. Key passes: Zoji La and Banihal (J and K), Shipki La and Rohtang

(HP), Lipulekh (Uttarakhand), Nathu La (Sikkim), Bomdila (Arunachal). The Northern Plains are divided into Bhabar (pebble belt where streams disappear), Terai (marshy re-emergence zone), Bangar (old alluvium with kankar) and Khadar (new flood-plain alluvium). The Peninsular Plateau is the oldest landmass, with the Aravalli, Malwa plateau, Vindhya and Satpura ranges, Chotanagpur plateau (Jharkhand, mineral store-house) and the basaltic Deccan Trap. The Western Ghats (Anamudi 2,695 m is the highest peak of peninsular India) are continuous; the Eastern Ghats (Nallamala, Javadi, Shevaroy hills) are broken by rivers. The west coast is Konkan (Daman to Goa), Kanara (Goa to Mangaluru) and Malabar (Mangaluru to Kanyakumari); the east coast is Northern Circars and Coromandel. Lakshadweep islands are coral; Barren Island in the Andamans is the only active volcano.

**Rivers, dams and lakes:** Himalayan rivers are perennial; peninsular rivers are seasonal. The Ganga begins as the Bhagirathi at Gangotri, meets the Alaknanda at Devprayag, enters the plains at Haridwar and splits at Farakka into the Hugli and the Padma. Yamuna (longest tributary, joins at Prayagraj), Son, Ghaghara, Gandak and Kosi (Sorrow of Bihar) are its tributaries. The Brahmaputra is Tsangpo in Tibet, Dihang or Siang in Arunachal and Jamuna in Bangladesh, and holds Majuli island. East-flowing peninsular rivers (Mahanadi, Godavari, Krishna, Kaveri) make deltas; west-flowing Narmada and Tapi flow in rift valleys to the Gulf of Khambhat and form estuaries. Godavari (Dakshin Ganga) is the longest peninsular river. Lakes: Wular (largest freshwater, J and K), Chilika (largest brackish lagoon, Odisha), Sambhar (salt, Rajasthan), Loktak (floating phumdis, Manipur), Vembanad (Kerala), Pulicat (Andhra-Tamil Nadu), Lonar (crater, Maharashtra). Dam-river pairs are listed in the examples.

**Climate, soils and vegetation:** The south-west monsoon arrives in Kerala around 1 June in two branches, Arabian Sea and Bay of Bengal; Mawsynram in Meghalaya is the wettest place. The retreating or north-east monsoon (October to December) gives Tamil Nadu its main rain, and western disturbances from the Mediterranean bring winter rain to Punjab, Haryana and western UP, helping wheat. Local winds: Loo (north-west India), Kalbaisakhi (West Bengal and Assam), Mango showers (Kerala and Karnataka). El Nino weakens the monsoon. Soils: alluvial (most widespread), black regur from Deccan basalt (cotton, self-ploughing), red (iron oxide), laterite (leaching under heavy rain and heat; cashew, tea), arid, saline and peaty. Forests: tropical evergreen above 200 cm rainfall, tropical deciduous (most widespread; sal, teak), thorn below about 50-70 cm, montane, and mangroves (Sundarbans, named after the Sundari tree). The 1988 Forest Policy targets 33 percent forest cover; as of ISFR 2023, Madhya Pradesh has the largest forest cover by area and Mizoram the highest percentage among states (the UT of Lakshadweep is higher).

**Wildlife:** Jim Corbett (1936, Uttarakhand) is the first national park and Project Tiger (1973) started there. Nilgiri (1986) is the first biosphere reserve. Chilika and Keoladeo (Bharatpur) were the first Ramsar sites (1981). Animal-park pairs such as Gir-lion, Kaziranga-rhino and Keibul Lamjao-Sangai are in the examples.

**Minerals, energy and industry:** Coal: Jharia and Bokaro (Jharkhand), Raniganj (West Bengal), Korba (Chhattisgarh), Singrauli (MP), Talcher (Odisha), Singareni (Telangana), Neyveli lignite (Tamil Nadu). Iron ore: Bailadila (Chhattisgarh), Keonjhar (Odisha), Noamundi (Jharkhand), Kudremukh and Bellary (Karnataka). Copper: Khetri (Rajasthan), Malanjkhand (MP). Mica: Koderma (Jharkhand). Bauxite: Koraput (Odisha). Uranium: Jaduguda (Jharkhand). Oil: Digboi (1901, oldest refinery, Assam), Mumbai High (offshore), Ankleshwar (Gujarat). Nuclear plants: Tarapur (first, Maharashtra), Rawatbhata (Rajasthan), Kalpakkam and Kudankulam (Tamil Nadu), Narora (UP), Kakrapar (Gujarat), Kaiga (Karnataka). Steel: Jamshedpur (TISCO, 1907), Bhilai and Bokaro (USSR), Rourkela (West Germany), Durgapur (UK), Visakhapatnam (shore-based). Ahmedabad is the Manchester of India; jute mills cluster along the Hugli.

**Agriculture, transport and people:** Kharif (June to October: rice, maize, cotton, jute, groundnut), rabi (October to March: wheat, gram, mustard) and zaid (March to June: melons, cucumber). Leading states: West Bengal (jute; also a top rice producer along with Telangana, UP and Punjab), UP (wheat, sugarcane), Assam (tea), Karnataka (coffee), Kerala (rubber), J and K (saffron). Green Revolution (1960s, M S Swaminathan), White Revolution or Operation Flood (Verghese Kurien), Yellow Revolution (oilseeds). Major ports: Kandla or Deendayal (tidal, Gujarat), Mumbai and JNPT, Mormugao (Goa), Kochi, Tuticorin, Chennai, Visakhapatnam, Paradip, Kolkata-Haldia (riverine). The Golden Quadrilateral links Delhi, Mumbai, Chennai and Kolkata; National Waterway 1 is the Ganga (Haldia to Prayagraj). Railway HQs: Northeast Frontier at Maligaon (Guwahati), East Central at Hajipur, South Western at Hubballi. Census 2011 (among states, not UTs): UP most populous, Sikkim least; Bihar densest, Arunachal least dense; Kerala tops

literacy and sex ratio; Bihar lowest literacy, Haryana lowest sex ratio. Tribes: Bhil (largest), Gond, Santhal, Toda (Nilgiris), Khasi-Garo-Jaintia (Meghalaya), Jarawa and Sentinelese (Andaman).

**Common traps:** Anamudi, not Doddabetta, is the highest peak of the Western Ghats; Kosi is the Sorrow of Bihar and Damodar the Sorrow of Bengal; Krishnaraja Sagar is on the Kaveri, not the Krishna; Narmada and Tapi form estuaries, not deltas; Tamil Nadu is wet in winter, not in July; Jharia and Koderma are in Jharkhand, not Bihar; Keibul Lamjao is in Manipur, not Assam.

**Examples**

- Tropic of Cancer states, west to east: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura, Mizoram (mnemonic: Great Rajas May Catch Juicy Wild Tiger Meat).
- Border length order: Bangladesh > China > Pakistan > Nepal > Myanmar > Bhutan > Afghanistan (mnemonic: BCPNMBA, Bangladesh Comes Prior to Nepal, Myanmar, Bhutan, Afghanistan).
- Northern plain belts from the hills downward: Bhabar (pebbles, streams vanish), Terai (marsh, streams reappear), Bangar (old alluvium, kankar), Khadar (new alluvium, most fertile).
- Panch Prayag of the Alaknanda: Vishnuprayag (Dhauliganga), Nandprayag (Nandakini), Karnaprayag (Pindar), Rudraprayag (Mandakini), Devprayag (Bhagirathi): the Ganga gets its name only after Devprayag.
- Dam-river pairs: Bhakra-Sutlej, Tehri-Bhagirathi, Hirakud-Mahanadi, Nagarjuna Sagar-Krishna, Mettur and Krishnaraja Sagar-Kaveri, Sardar Sarovar-Narmada, Ukai-Tapi, Gandhi Sagar-Chambal.
- Sorrow rivers: Kosi is the Sorrow of Bihar, Damodar the Sorrow of Bengal; Godavari is the Dakshin Ganga (longest peninsular river) and Kaveri the Ganga of the South.
- Rain calendar: SW monsoon hits Kerala around 1 June; retreating NE monsoon waters Tamil Nadu in October to December; western disturbances give Punjab winter rain for wheat.
- Soil-crop links: black regur (basalt) for cotton; alluvial for wheat and rice; laterite for cashew, tea and coffee; red soil (iron oxide) for millets and groundnut.
- Animal-park pairs: Gir-lion, Kaziranga-rhino, Keibul Lamjao-Sangai deer, Dachigam-Hangul, Hemis-snow leopard, Desert NP-Great Indian Bustard, Eravikulam-Nilgiri tahr.
- Steel plant collaborators: Bhilai and Bokaro with the USSR, Rourkela with West Germany, Durgapur with the UK; Jamshedpur (TISCO, 1907) was the first modern plant.
- Census 2011 extremes among states (not UTs): UP most populous, Sikkim least; Bihar densest, Arunachal Pradesh least dense; Kerala best literacy and sex ratio; Bihar lowest literacy, Haryana lowest sex ratio.
- City nicknames: Ahmedabad is the Manchester of India, Coimbatore the Manchester of South India, Kochi the Queen of the Arabian Sea, Shillong the Scotland of the East, Jamshedpur the Steel City.

> **Quick revision:** Standard Meridian 82.5 E (Mirzapur); Tropic of Cancer crosses 8 states; longest border Bangladesh; Kangchenjunga highest peak in India, Anamudi highest in Western Ghats; Ganga = Bhagirathi + Alaknanda at Devprayag; Kosi Sorrow of Bihar; Hirakud on Mahanadi, Bhakra on Sutlej, Sardar Sarovar on Narmada; Wular largest freshwater lake, Chilika largest lagoon; Mawsynram wettest; black regur soil from basalt; Corbett first NP (1936), Project Tiger 1973, Nilgiri first biosphere reserve; Jharia coal and Koderma mica in Jharkhand; Census 2011: UP most populous, Bihar densest, Kerala most literate.

## India's Location, Extent, Neighbours and Boundary Lines

**Where India lies:** India lies wholly in the Northern and Eastern Hemispheres, in South Asia, at the head of the Indian Ocean, the only ocean named after a country. The mainland stretches from 8°4'N to 37°6'N latitude and from 68°7'E to 97°25'E longitude, so both its latitudinal and its longitudinal extent are about 30 degrees. Even so, the north-south length (about 3,214 km) is greater than the east-west width (about 2,933 km), because the distance between two lines of longitude shrinks away from the Equator. Its central place on the sea routes between Europe and Africa to the west and East Asia to the east has linked India to both sides of the ocean since ancient times.

**Area and extreme points:** With an area of 32,87,263 sq km (about 3.28 million sq km), India is the seventh largest country in the world after Russia, Canada, the USA, China, Brazil and Australia, and has about 2.4 percent of the world's land area. Rajasthan is the largest state by area and Goa the smallest. The southernmost point of the country

is Indira Point on Great Nicobar, while Kanyakumari (Cape Comorin) is the southern tip of the mainland. The northernmost point lies in Ladakh (Indira Col, in the Siachen area), the easternmost in the Anjaw district of Arunachal Pradesh (usually given as Kibithu) and the westernmost at Guhar Moti in the Kachchh district of Gujarat.

**Tropic of Cancer and Standard Meridian:** The Tropic of Cancer (23°30'N) runs almost through the middle of the country and crosses eight states, west to east: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura and Mizoram. Land to its south lies in the tropical zone and land to its north in the sub-tropical zone. The sun takes 4 minutes to cross each degree of longitude, so the 30 degrees between Gujarat and Arunachal Pradesh mean a time difference of about 2 hours: the sun rises in Arunachal about two hours before it rises in Kachchh. To keep one time for the whole country, the Standard Meridian of 82°30'E, passing through Mirzapur in Uttar Pradesh, sets Indian Standard Time (IST), which is 5 hours 30 minutes ahead of Greenwich Mean Time (GMT). This meridian crosses five states: Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Odisha and Andhra Pradesh.

**Land frontier and coastline:** India's land border is about 15,200 km long (15,106.7 km by the Home Ministry's count) and is shared with seven countries. In order of length they are Bangladesh (4,096.7 km, the longest), China (3,488 km), Pakistan (3,323 km), Nepal (1,751 km), Myanmar (1,643 km), Bhutan (699 km) and Afghanistan (106 km, the shortest). For decades the official length of the coastline, mainland plus islands, was 7,516.6 km; a re-measurement on larger-scale maps by the National Hydrographic Office and the Survey of India, adopted by the government in 2025, gives 11,098.81 km, so read the options carefully. Nine states touch the sea: Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal, and Gujarat has the longest coastline of any state.

**Neighbours and the states on each border:** Pakistan borders Gujarat, Rajasthan, Punjab and the Union Territories of Jammu and Kashmir and Ladakh. China borders Ladakh, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh. Nepal borders five states: Uttarakhand, Uttar Pradesh, Bihar, West Bengal and Sikkim. Bhutan borders four: Sikkim, West Bengal, Assam and Arunachal Pradesh. Myanmar borders four: Arunachal Pradesh, Nagaland, Manipur and Mizoram. Bangladesh borders five: West Bengal (the longest stretch), Assam, Meghalaya, Tripura and Mizoram. The short border with Afghanistan lies in Ladakh, in the Gilgit-Baltistan area under Pakistan's occupation. Sikkim, West Bengal and Arunachal Pradesh each touch three countries. Across the sea lie Sri Lanka and the Maldives.

**Boundary lines:** The Radcliffe Line, drawn by Sir Cyril Radcliffe in 1947, is India's boundary with Pakistan and with Bangladesh (then East Pakistan). The McMahon Line, named after Sir Henry McMahon and agreed at the Simla Convention of 1913-14, is the India-China boundary in the eastern sector along Arunachal Pradesh; China does not accept it. The Durand Line of 1893, after Sir Mortimer Durand, divides Pakistan and Afghanistan. In Jammu and Kashmir the Line of Control (LoC) separates the areas held by India and Pakistan, and the Line of Actual Control (LAC) is the working line between India and China.

**Palk Strait, channels and islands:** The Palk Strait separates Tamil Nadu from Sri Lanka and joins the Bay of Bengal to Palk Bay; south of it lies the Gulf of Mannar, and between them runs Adam's Bridge (Ram Setu), a chain of shoals from Pamban Island (Rameswaram) to Mannar Island. India has two island groups. In the Bay of Bengal, the Ten Degree Channel separates the Andaman Islands from the Nicobar Islands, the Duncan Passage lies between South Andaman and Little Andaman, and the Coco Channel separates North Andaman from Myanmar's Coco Islands. In the Arabian Sea, the Nine Degree Channel separates Minicoy from the main group of the Lakshadweep coral islands (36 islands in all), and the Eight Degree Channel separates Minicoy from the Maldives.

**Examples**

- Mainland India: 8°4'N to 37°6'N and 68°7'E to 97°25'E; about 30 degrees of latitude and of longitude; north-south about 3,214 km, east-west about 2,933 km.
- Area 32,87,263 sq km, about 2.4 percent of the world's land; seventh largest after Russia, Canada, USA, China, Brazil and Australia; Rajasthan largest state, Goa smallest.
- Tropic of Cancer (23°30'N) crosses 8 states: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura, Mizoram.

- Standard Meridian 82°30'E passes Mirzapur (UP) and five states (UP, MP, Chhattisgarh, Odisha, Andhra Pradesh); IST is GMT plus 5 hours 30 minutes; east-west time gap about 2 hours.
- Land border lengths: Bangladesh 4,096.7 km, China 3,488, Pakistan 3,323, Nepal 1,751, Myanmar 1,643, Bhutan 699, Afghanistan 106 km; total about 15,200 km.
- Nepal touches Uttarakhand, UP, Bihar, West Bengal, Sikkim; Bhutan touches Sikkim, West Bengal, Assam, Arunachal; Myanmar touches Arunachal, Nagaland, Manipur, Mizoram.
- Bangladesh touches West Bengal, Assam, Meghalaya, Tripura and Mizoram; China touches Ladakh, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh.
- Radcliffe Line (1947): India-Pakistan and India-Bangladesh; McMahon Line (Simla Convention, 1913-14): India-China in Arunachal; Durand Line (1893): Pakistan-Afghanistan.
- Ten Degree Channel: Andaman from Nicobar; Duncan Passage: South Andaman from Little Andaman; Nine Degree Channel: Minicoy from the main Lakshadweep islands; Eight Degree Channel: Minicoy from the Maldives.
- Extreme points: Indira Point (Great Nicobar) south, Kanyakumari mainland south, Kibithu (Anjaw, Arunachal) east, Guhar Moti (Kachchh, Gujarat) west, Indira Col (Ladakh) north.

> **Quick revision:** Mainland 8°4'N-37°6'N and 68°7'E-97°25'E; area 32,87,263 sq km, 7th largest, 2.4% of world land; Tropic of Cancer crosses 8 states; Standard Meridian 82°30'E at Mirzapur, IST = GMT + 5:30; land border about 15,200 km with 7 countries, longest with Bangladesh, shortest with Afghanistan; coastline 7,516.6 km (11,098.81 km in the re-measurement adopted in 2025), Gujarat longest; Radcliffe 1947, McMahon 1913-14, Durand 1893; Palk Strait to Sri Lanka; Ten Degree Channel splits Andaman and Nicobar.

### The Himalayas and the Northern Plains: Ranges, Peaks, Passes and Plain Belts

**How the Himalayas formed:** The Himalayas are young fold mountains, raised when the Indian plate moved north and pressed against the Eurasian plate, folding up the sediments of the Tethys Sea that lay between them. They curve for about 2,400 km from the Indus in the west to the Brahmaputra in the east. They are about 400 km wide in Kashmir and about 150 km wide in Arunachal Pradesh, and the eastern half rises more steeply than the western. They shield India from the cold winds of Central Asia, make the monsoon winds shed their rain over the plains, and feed the perennial rivers with snow and glaciers.

**The parallel ranges:** The Trans-Himalaya, north of the main ranges, holds the Karakoram, Ladakh and Zaskar ranges and the Siachen glacier. K2 or Godwin-Austen (8,611 m), the world's second highest peak, stands in the Karakoram in Pakistan-occupied territory that India claims, so it is the highest peak of the territory India claims; Kangchenjunga (8,586 m) in Sikkim, the third highest in the world, is the highest peak in the area India administers. The Himadri or Greater Himalaya is the northernmost and most continuous range, about 6,000 m high on average, with a granite core and the great peaks: Kangchenjunga, Nanda Devi (7,816 m, Uttarakhand, the highest peak wholly within India) and Kamet. South of it the Himachal or Lesser Himalaya, 3,700 to 4,500 m high, holds the Pir Panjal (its longest and most important range), the Dhauladhar and the Mahabharat ranges, the valleys of Kashmir, Kangra and Kullu, and hill stations such as Shimla, Mussoorie and Nainital. The Shiwalik or Outer Himalaya, 900 to 1,100 m high and 10 to 50 km wide, is made of loose river sediments; the flat valleys between it and the Lesser Himalaya are called duns, such as Dehradun, Kotli Dun and Patli Dun.

**Regional divisions, west to east:** The Himalayas are also divided by the rivers that cut across them. The Punjab Himalaya lies between the Indus and the Sutlej (locally the Kashmir and Himachal Himalaya), the Kumaon Himalaya between the Sutlej and the Kali, the Nepal Himalaya between the Kali and the Teesta, and the Assam Himalaya between the Teesta and the Dihang (Brahmaputra). Beyond the Dihang gorge the mountains bend south as the Purvanchal or eastern hills along the Myanmar border: the Patkai Bum, Naga hills, Manipur hills and Mizo (Lushai) hills. The Garo, Khasi and Jaintia hills of Meghalaya look like part of this chain but are an extension of the Peninsular Plateau, cut off by the Garo-Rajmahal gap.

**Passes by state:** Exams pair each pass with its state. Ladakh has the Karakoram Pass towards Xinjiang, Khardung La between Leh and the Nubra valley, and Zoji La on the Srinagar-Leh road. Jammu and Kashmir has the Banihal pass on the Jammu-Srinagar route through the Pir Panjal, with the Jawahar Tunnel beneath it. Himachal Pradesh has

Shipki La, where the Sutlej enters India, Rohtang between Kullu and Lahaul-Spiti, and Bara Lacha La on the Manali-Leh road. Uttarakhand has Lipulekh on the Kailash-Mansarovar route, Mana and Niti. Sikkim has Nathu La and Jelep La, old routes to Lhasa through the Chumbi valley. Arunachal Pradesh has Bomdi La, Diphu near the India-China-Myanmar tri-junction, and Pangsau on the Myanmar border, crossed by the Stilwell (Ledo) road.

**The plain belts:** The Northern Plains were built by the alluvium that the Indus, Ganga, Brahmaputra and their tributaries laid in a vast depression south of the Himalayas. They cover about 7 lakh sq km, are about 2,400 km long and 240 to 320 km wide, and are among the most fertile and crowded regions of the world. From the hills southward the land changes in four belts. The Bhabar is a belt 8 to 16 km wide of pebbles and boulders at the foot of the Shiwaliks, where streams sink and disappear. The Terai, south of it, is a wet, marshy, once thickly forested belt where those streams re-emerge; much of it has been cleared for farming, and it still holds parks such as Dudhwa. The Bhangar is the older alluvium lying above flood level, with calcareous kankar nodules, and the Khadar is the newer, finer alluvium of the flood plains, renewed almost every year and the most fertile.

**Divisions of the plains:** The Punjab plains in the west are formed by the Indus and its tributaries; most of this plain lies in Pakistan, and it is made of doabs, the land between two rivers (do means two and ab means water), such as the Bist doab between the Beas and the Sutlej and the Bari doab between the Beas and the Ravi. The Ganga plains stretch from the Ghaggar to the Teesta across Haryana, Delhi, Uttar Pradesh, Bihar, part of Jharkhand and West Bengal, ending in the Ganga-Brahmaputra delta of the Sundarbans, the largest delta in the world. The Brahmaputra plains lie mostly in Assam, where the braided river holds Majuli, the largest inhabited river island in the world.

**Examples**

- Himalayas: young fold mountains from the Tethys Sea; about 2,400 km from the Indus to the Brahmaputra; about 400 km wide in Kashmir and 150 km in Arunachal Pradesh.
- Three ranges, north to south: Himadri (Greater, average 6,000 m), Himachal (Lesser, 3,700-4,500 m; Pir Panjal, Dhauladhar), Shiwalik (Outer, 900-1,100 m; duns).
- Peaks: Kangchenjunga 8,586 m (Sikkim, highest in the area India administers), Nanda Devi 7,816 m (highest wholly within India, Uttarakhand), K2 8,611 m (Karakoram, in PoK).
- Divisions: Punjab Himalaya (Indus-Sutlej), Kumaon Himalaya (Sutlej-Kali), Nepal Himalaya (Kali-Teesta), Assam Himalaya (Teesta-Dihang).
- Passes: Karakoram, Khardung La, Zoji La (Ladakh); Banihal (J and K); Shipki La, Rohtang, Bara Lacha La (Himachal); Lipulekh, Mana, Niti (Uttarakhand); Nathu La, Jelep La (Sikkim); Bomdi La (Arunachal).
- Purvanchal: Patkai Bum, Naga, Manipur and Mizo hills; the Garo, Khasi and Jaintia hills of Meghalaya belong to the Peninsular Plateau.
- Plain belts from the hills: Bhabar (8-16 km, pebbles, streams vanish), Terai (marshy, streams reappear), Bhangar (old alluvium, kankar), Khadar (new alluvium, most fertile).
- Northern Plains: about 7 lakh sq km, 2,400 km long, 240-320 km wide; Punjab plains (doabs), Ganga plains (Ghaggar to Teesta), Brahmaputra plains (Assam).
- Bist doab lies between the Beas and Sutlej, Bari doab between the Beas and Ravi; Majuli is the largest inhabited river island, the Sundarbans the largest delta.

> **Quick revision:** Himalayas: young fold mountains, about 2,400 km; Himadri averages 6,000 m with Kangchenjunga (8,586 m) and Nanda Devi (7,816 m); Himachal has Pir Panjal and Dhauladhar; Shiwalik has duns like Dehradun; divisions Punjab, Kumaon, Nepal, Assam; passes Zoji La, Banihal, Shipki La, Rohtang, Lipulekh, Nathu La, Bomdi La; Meghalaya hills are peninsular; plain belts Bhabar, Terai, Bhangar, Khadar; Punjab, Ganga and Brahmaputra plains; Majuli largest inhabited river island.

### The Peninsular Plateau, Western and Eastern Ghats, Coasts, Islands and the Thar

**The oldest landmass:** The Peninsular Plateau is a tableland of old crystalline, igneous and metamorphic rocks, a part of the ancient Gondwana land and the oldest, most stable landmass of India. It is roughly triangular and slopes gently to the east, which is why most of its big rivers flow into the Bay of Bengal. Its old rocks make it the store-

house of India's minerals. The Narmada divides it into the Central Highlands to the north and the Deccan Plateau to the south.

**Central Highlands and their ranges:** The Central Highlands lie north of the Narmada and cover most of the Malwa plateau. The rivers here, the Chambal, Sind, Betwa and Ken, flow from south-west to north-east, showing the slope. The eastward extensions are Bundelkhand and Baghelkhand, and further east the Chotanagpur plateau of Jharkhand, drained by the Damodar and rich in coal and iron ore. The Aravalli range in the north-west, among the oldest fold mountains in the world, runs from Gujarat to Delhi; its highest peak is Guru Shikhar (1,722 m) at Mount Abu in Rajasthan. The Vindhya range lies north of the Narmada and the Satpura range between the Narmada and the Tapi; Dhupgarh (1,350 m) near Pachmarhi in Madhya Pradesh is the highest point of the Satpuras. The Maikal range at Amarkantak is the source of the Narmada and the Son.

**Deccan Plateau and the Ghats:** The Deccan Plateau, south of the Narmada, is bounded by the Satpura range in the north, with the Mahadev, Kaimur and Maikal ranges as its eastern extensions. Its north-west is the Deccan Trap, sheets of basalt laid down by volcanic eruptions, which weathered into black soil. The Western Ghats or Sahyadri run along the west coast from the Tapi to Kanyakumari; they are continuous and higher (900 to 1,600 m), and are crossed through passes such as the Thal Ghat (Mumbai-Nashik), the Bhor Ghat (Mumbai-Pune) and the Palghat (Palakkad) gap between Kerala and Tamil Nadu. Their highest peak, Anamudi (2,695 m) in the Anaimalai hills of Kerala, is the highest point of peninsular India; Doddabetta (2,637 m) in the Nilgiris is the highest peak of Tamil Nadu. The Eastern Ghats are lower (about 600 m on average) and broken by the Mahanadi, Godavari, Krishna and Kaveri; they include the Javadi and Shevaroy hills and the Nallamala range. NCERT names Mahendragiri (1,501 m) in Odisha as their highest peak, though some peaks in Andhra Pradesh, such as Arma Konda, are higher. The two Ghats meet in the Nilgiri hills.

**Coastal plains:** The western coastal plain, between the Western Ghats and the Arabian Sea, is narrow and is divided into the Konkan coast (Mumbai to Goa), the Kannad or Kanara plain (Goa to Mangaluru) and the Malabar coast (Mangaluru to Kanyakumari). It is a submerged coast with no large deltas but good natural harbours, and the Malabar coast of Kerala has backwaters called kayals, of which Vembanad is the largest. The eastern coastal plain along the Bay of Bengal is wider and level, built by the deltas of the Mahanadi, Godavari, Krishna and Kaveri. Its northern part is called the Northern Circars and its southern part the Coromandel coast. Chilika lake in Odisha, the largest saltwater lagoon of India, lies south of the Mahanadi delta.

**Island groups:** The Andaman and Nicobar Islands in the Bay of Bengal are the raised tops of a submarine mountain chain that continues the Arakan Yoma of Myanmar. They lie close to the Equator, have an equatorial climate with thick forests, and the Ten Degree Channel divides the Andaman group in the north from the Nicobar group in the south. Barren Island is India's only active volcano and Narcondam a dormant one; Saddle Peak in North Andaman is the highest point; and Indira Point on Great Nicobar is the southernmost point of India. The islands are home to old tribes such as the Great Andamanese, Onge, Jarawa and Sentinelese, and the Shompen of Great Nicobar. Lakshadweep, in the Arabian Sea off Kerala, is a group of 36 small coral islands, many of them atolls; Kavaratti is its headquarters, Minicoy lies alone in the south, and Pitti island has a bird sanctuary.

**The Thar Desert:** West of the Aravallis lies the Thar or Great Indian Desert, an undulating sandy plain mostly in Rajasthan that extends into Pakistan. It gets less than 150 mm of rain a year, has scanty vegetation, and is covered with crescent-shaped dunes called barchans. Streams appear only in the rainy season and then sink into the sand; the Luni is the only large river, flowing south-west from the Aravallis near Ajmer into the Rann of Kachchh without reaching the sea. Inland drainage has left salt lakes such as Sambhar, Didwana and Pachpadra. The semi-arid strip east of the Thar is called the Bagar. The Indira Gandhi Canal, fed from the Harike barrage at the Beas-Sutlej confluence in Punjab, has brought irrigation to the desert, and the Desert National Park near Jaisalmer shelters the Great Indian Bustard. Ladakh, by contrast, is a cold desert.

### Examples

- Peninsular Plateau: oldest landmass, part of Gondwana land; the Narmada divides it into the Central Highlands (north) and the Deccan Plateau (south).

- Aravalli, among the oldest fold mountains: highest peak Guru Shikhar (1,722 m), Mount Abu, Rajasthan; Satpura's highest point is Dhupgarh (1,350 m) near Pachmarhi.
- Western Ghats (Sahyadri): continuous, 900-1,600 m; Anamudi 2,695 m (Kerala) highest of peninsular India; Doddabetta 2,637 m (Nilgiris); passes Thal Ghat, Bhor Ghat, Palghat.
- Eastern Ghats: broken by rivers, about 600 m; Javadi, Shevaroy, Nallamala; Mahendragiri (1,501 m, Odisha) highest in NCERT; the two Ghats meet in the Nilgiris.
- West coast: Konkan (Mumbai-Goa), Kanara (Goa-Mangaluru), Malabar (Mangaluru-Kanyakumari, with kayals); east coast: Northern Circars (north) and Coromandel (south).
- Andaman and Nicobar: Ten Degree Channel between them; Barren Island the only active volcano, Narcondam dormant; Saddle Peak highest; Indira Point southernmost.
- Lakshadweep: 36 coral islands in the Arabian Sea; Kavaratti headquarters; Minicoy in the far south; Pitti island bird sanctuary.
- Thar: under 150 mm of rain, barchan dunes; Luni ends in the Rann of Kachchh; salt lakes Sambhar, Didwana, Pachpadra; Indira Gandhi Canal from the Harike barrage.
- Chotanagpur plateau (Jharkhand), drained by the Damodar, is the mineral store-house; the Deccan Trap's basalt weathers into black soil.

> **Quick revision:** Peninsular Plateau: oldest, Gondwana, slopes east; Central Highlands (Malwa, Bundelkhand, Baghelkhand, Chotanagpur) and Deccan; Guru Shikhar 1,722 m (Aravalli), Dhupgarh 1,350 m (Satpura); Western Ghats continuous, Anamudi 2,695 m; Eastern Ghats broken, Mahendragiri 1,501 m; Konkan, Kanara, Malabar on the west, Northern Circars and Coromandel on the east; Barren Island active volcano; Lakshadweep 36 coral islands; Thar under 150 mm rain, Luni into the Rann of Kachchh.

### Himalayan River Systems: Indus, Ganga and Brahmaputra with Their Tributaries

**Why Himalayan rivers are different:** The Himalayan rivers are perennial, fed by rain as well as by melting snow and glaciers, so they flow all year. Some, such as the Indus, Sutlej and Brahmaputra, are older than the ranges they cross and cut deep gorges as the mountains rose. In the plains they meander, shift course and build wide flood plains and deltas. Three great systems drain northern India: the Indus, the Ganga and the Brahmaputra. For each river, learn where it rises, which tributaries join it and on which bank, and which cities stand on it.

**The Indus system:** The Indus rises in Tibet near Lake Mansarovar, enters India in Ladakh, flows north-west between the Ladakh and Zaskar ranges past Leh, and turns south through Pakistan to the Arabian Sea near Karachi. It is about 2,880 km long, 1,114 km of it in India. In Ladakh it receives the Zaskar, Shyok and Nubra. Its five Punjab tributaries unite as the Panjnad and join it near Mithankot in Pakistan. The Jhelum rises at the Verinag spring in the Kashmir valley, flows through Srinagar and Wular lake and joins the Chenab in Pakistan. The Chenab, the largest tributary, forms where the Chandra and the Bhaga meet at Tandi in Himachal Pradesh, so it is also called the Chandrabhaga. The Ravi rises near the Rohtang pass and drains the Chamba valley. The Beas rises at Beas Kund near Rohtang, flows through the Kullu valley and meets the Sutlej at Harike in Punjab, staying wholly within India. The Sutlej rises at Rakas lake near Mansarovar and enters India at Shipki La.

Indus Waters Treaty, 1960: Because these rivers flow from India into Pakistan, the two countries signed the Indus Waters Treaty at Karachi on 19 September 1960, with the World Bank as broker; it was signed by Prime Minister Jawaharlal Nehru and President Ayub Khan. India received the three eastern rivers, the Ravi, Beas and Sutlej, and Pakistan the three western rivers, the Indus, Jhelum and Chenab, on which India may make limited use for domestic needs, irrigation and run-of-river hydropower. In all, India may use only about 20 percent of the water of the Indus system. The treaty set up a Permanent Indus Commission, with a commissioner from each country, to share data and settle questions about the rivers. Projects on these rivers include Bhakra on the Sutlej, Pong on the Beas, Ranjit Sagar on the Ravi and Salal and Baglihar on the Chenab.

**The Ganga and its course:** The Ganga, about 2,525 km long, is the longest river of India. It rises as the Bhagirathi at Gaumukh, the snout of the Gangotri glacier in Uttarakhand, and is joined at Devprayag by the Alaknanda, which rises from the Satopanth glacier above Badrinath; only after Devprayag is it called the Ganga. It enters the plains at

Haridwar and flows through Uttar Pradesh, which has its longest stretch, Bihar, a short stretch of Jharkhand and West Bengal. At Farakka it splits: the Bhagirathi-Hugli flows south past Kolkata to the Bay of Bengal, while the main stream enters Bangladesh as the Padma, is joined by the Brahmaputra and then the Meghna, and forms the Sundarbans delta. The Ganga was declared the National River in 2008. Haridwar, Kanpur, Prayagraj, Varanasi, Patna and Bhagalpur stand on its banks.

**Tributaries of the Ganga:** From the left (northern) bank, mostly from the Himalayas and Nepal, come the Ramganga, Gomti (Lucknow, Jaunpur), Ghaghara (called the Sarayu at Ayodhya, joining near Chhapra), Gandak (joining near Patna), Kosi (the Sorrow of Bihar, known for shifting its course) and Mahananda. From the right (southern) bank come the Yamuna and the Son. The Yamuna, the longest tributary, rises at the Yamunotri glacier on the Bandarpunch range, flows past Delhi, Mathura and Agra and meets the Ganga at Prayagraj; its right-bank tributaries, the Chambal (Kota), Sind, Betwa and Ken, come from the plateau. The Son rises at Amarkantak and joins the Ganga west of Patna. The Damodar, the Sorrow of Bengal, flows through a rift valley in the Chotanagpur plateau and joins the Hugli.

**The Brahmaputra system:** The Brahmaputra rises in the Chemayungdung glacier of the Kailash range near Mansarovar and flows east across southern Tibet as the Tsangpo. Near Namcha Barwa it takes a hairpin turn and enters Arunachal Pradesh through a deep gorge as the Siang or Dihang. Joined by the Dibang and the Lohit near Sadiya, it becomes the Brahmaputra and flows west through Assam past Dibrugarh, Tezpur and Guwahati in a wide braided channel full of islands such as Majuli. Its right-bank tributaries include the Subansiri (the largest), Kameng, Manas and Sankosh, and the Teesta, which joins it in Bangladesh; its left-bank tributaries include the Burhi Dihing, Dhansiri and Kopili. In Bangladesh it is called the Jamuna. It is about 2,900 km long, carries a huge load of water and silt, and floods Assam almost every year.

**Examples**

- Indus: rises near Mansarovar (Tibet), enters India in Ladakh, flows past Leh; about 2,880 km, 1,114 km in India; the Panjnad joins it at Mithankot (Pakistan).
- Jhelum: Verinag spring, Srinagar, Wular lake. Chenab (largest Indus tributary): Chandra and Bhaga meet at Tandi (HP). Beas: Beas Kund, Kullu valley, meets the Sutlej at Harike.
- Sutlej: Rakas lake (Tibet), enters India at Shipki La, Bhakra dam; Ravi: near Rohtang, Chamba valley, Ranjit Sagar dam.
- Indus Waters Treaty: 19 September 1960, Karachi, World Bank broker, Nehru and Ayub Khan; eastern rivers (Ravi, Beas, Sutlej) to India, western rivers (Indus, Jhelum, Chenab) to Pakistan.
- Ganga: Bhagirathi (Gaumukh, Gangotri glacier) and Alaknanda (Satopanth glacier) meet at Devprayag; about 2,525 km; National River since 2008; splits at Farakka into Hugli and Padma.
- Left-bank Ganga tributaries: Ramganga, Gomti, Ghaghara, Gandak, Kosi, Mahananda; right-bank: Yamuna (longest tributary, meets at Prayagraj) and Son (from Amarkantak).
- Yamuna's right-bank tributaries from the plateau: Chambal, Sind, Betwa, Ken. Kosi is the Sorrow of Bihar and the Damodar the Sorrow of Bengal.
- Brahmaputra names: Tsangpo in Tibet, Siang or Dihang in Arunachal, Brahmaputra after the Dibang and Lohit join near Sadiya, Jamuna in Bangladesh.
- Brahmaputra tributaries: right bank Subansiri (largest), Kameng, Manas, Sankosh, Teesta; left bank Burhi Dihing, Dhansiri, Kopili.
- City-river pairs: Leh-Indus, Srinagar-Jhelum, Delhi and Agra-Yamuna, Lucknow-Gomti, Ayodhya-Sarayu, Kota-Chambal, Varanasi and Patna-Ganga, Kolkata-Hugli, Guwahati-Brahmaputra.

> **Quick revision:** Himalayan rivers perennial; Indus about 2,880 km (1,114 km in India), Leh on it, Panjnad joins at Mithankot; Chenab largest tributary (Chandra + Bhaga); Indus Waters Treaty 19 September 1960: Ravi, Beas, Sutlej to India; Ganga about 2,525 km, Bhagirathi + Alaknanda at Devprayag, National River 2008; Yamuna longest tributary; Kosi Sorrow of Bihar, Damodar Sorrow of Bengal; Brahmaputra = Tsangpo, Siang, Jamuna; Subansiri largest tributary.

### Peninsular Rivers, Lakes, Waterfalls and Multipurpose River Projects

**How peninsular rivers differ:** The peninsular rivers are older, flow in broad, shallow valleys along fixed courses, and are mostly rain-fed, so many shrink in the dry season. The Western Ghats form the main water divide. Most rivers

rise there and flow east into the Bay of Bengal, building deltas, while a few flow west into the Arabian Sea through rift valleys or short, steep courses and end in estuaries instead of deltas. The Kaveri flows more evenly than the others because its basin gets rain from both the south-west and the north-east monsoons.

**East-flowing rivers:** The Mahanadi (about 851 km) rises near Sihawa in Chhattisgarh, flows through Odisha past Sambalpur and Cuttack and forms a delta; the Hirakud dam stands on it. The Godavari (about 1,465 km), the largest peninsular river and called the Dakshin Ganga, rises at Trimbakeshwar near Nashik in Maharashtra and flows through Telangana and Andhra Pradesh; its tributaries include the Purna, the Pranhita (which gathers the Wainganga, Wardha and Penganga), the Indravati and the Manjra. The Krishna (about 1,401 km) rises near Mahabaleshwar in the Sahyadri and flows through Maharashtra, Karnataka, Telangana and Andhra Pradesh to its delta below Vijayawada; the Koyna, Bhima, Tungabhadra and Musi (Hyderabad) are its tributaries. The Kaveri (about 800 km) rises at Talakaveri in the Brahmagiri hills of Kodagu, Karnataka, and flows through Tamil Nadu to its delta around Thanjavur, the rice bowl of Tamil Nadu; the Kabini, Hemavati, Bhavani and Amaravati join it, and Tiruchirappalli stands on it. Smaller east-flowing rivers include the Subarnarekha, Brahmani, Baitarani, Penneru and Vaigai (Madurai).

**West-flowing rivers:** The Narmada (about 1,312 km), the largest west-flowing river, rises at Amarkantak in Madhya Pradesh and flows west in a rift valley between the Vindhya and Satpura ranges; near Jabalpur it cuts the Marble Rocks gorge at Bhedaghat and drops over the Dhuandhar falls, and it reaches the Gulf of Khambhat through an estuary near Bharuch. The Tapi (about 724 km) rises at Multai in Betul district of Madhya Pradesh, flows in a parallel rift valley south of the Satpuras and reaches the sea near Surat. The Sabarmati (Ahmedabad, Gandhinagar) and the Mahi, which crosses the Tropic of Cancer twice, also enter the Gulf of Khambhat. Short, swift west-flowing rivers include the Mandovi and Zuari in Goa, the Sharavathi in Karnataka and the Periyar in Kerala.

**Lakes:** Wular in Jammu and Kashmir, on the Jhelum and formed partly by tectonic activity, is the largest freshwater lake of India; Dal lake is in Srinagar. Chilika in Odisha is the largest brackish-water lagoon, and Pulicat, on the Andhra Pradesh-Tamil Nadu border, is the second largest, with Sriharikota island between it and the sea. Kolleru is a freshwater lake between the Godavari and Krishna deltas. Vembanad in Kerala is the longest lake of India, and Sambhar in Rajasthan the largest inland salt lake. Loktak in Manipur has floating islands of vegetation called phumdis, on which Keibul Lamjao, the only floating national park, protects the Sangai deer. Lonar in Maharashtra is a crater lake made by a meteorite striking basalt.

**Waterfalls:** Jog (Gersoppa) falls is on the Sharavathi in Karnataka; Shivasamudram (Karnataka) and Hogenakkal (Tamil Nadu) are on the Kaveri; Dudhsagar is on the Mandovi on the Goa-Karnataka border; Chitrakote, the widest fall in India and called the Niagara of India, is on the Indravati in Bastar, Chhattisgarh; Dhuandhar is on the Narmada near Jabalpur; and Hundru is on the Subarnarekha near Ranchi.

**Multipurpose projects:** Jawaharlal Nehru called dams the temples of modern India because one project can give irrigation, hydropower, flood control and drinking water together. The Damodar Valley Corporation (1948), modelled on the Tennessee Valley Authority of the USA, was the first multipurpose river valley project of independent India, with dams such as Tilaiya, Konar, Maithon and Panchet. Learn these pairs: Bhakra Nangal on the Sutlej (Himachal Pradesh-Punjab, Gobind Sagar lake); Tehri on the Bhagirathi (Uttarakhand), the tallest dam of India; Hirakud on the Mahanadi (Odisha), one of the longest dams in the world; Sardar Sarovar (Gujarat) and Indira Sagar (Madhya Pradesh) on the Narmada; Ukai on the Tapi (Gujarat); Nagarjuna Sagar and Srisailam on the Krishna (Telangana-Andhra Pradesh); Tungabhadra on the Tungabhadra (Karnataka); Krishnaraja Sagar (Karnataka) and Mettur (Tamil Nadu) on the Kaveri; Gandhi Sagar, Rana Pratap Sagar and Jawahar Sagar on the Chambal; Rihand on the Rihand, a tributary of the Son (Govind Ballabh Pant Sagar, Uttar Pradesh); and Idukki on the Periyar (Kerala). The Farakka barrage on the Ganga in West Bengal sends water into the Hugli to keep Kolkata port navigable.

### Examples

- East-flowing rivers make deltas: Mahanadi (Sihawa, Chhattisgarh; about 851 km), Godavari (Trimbakeshwar; about 1,465 km, Dakshin Ganga), Krishna (Mahabaleshwar; about 1,401 km), Kaveri (Talakaveri; about 800 km).
- West-flowing rivers make estuaries: Narmada (Amarkantak; about 1,312 km, rift valley between Vindhya and Satpura) and Tapi (Multai, Betul; about 724 km); both reach the Gulf of Khambhat.

- Tributaries: Godavari - Pranhita, Indravati, Manjra, Purna; Krishna - Koyna, Bhima, Tungabhadra, Musi; Kaveri - Kabini, Hemavati, Bhavani, Amaravati.
- Lakes: Wular (largest freshwater, J and K), Chilika (largest lagoon, Odisha), Pulicat (Andhra-Tamil Nadu), Kolleru (Andhra), Vembanad (longest, Kerala), Sambhar (salt, Rajasthan), Loktak (phumdis, Manipur), Lonar (crater, Maharashtra).
- Falls-river pairs: Jog-Sharavathi, Shivasamudram and Hogenakkal-Kaveri, Dudhsagar-Mandovi, Chitrakote-Indravati, Dhuandhar-Narmada, Hundru-Subarnarekha.
- Dam-river pairs: Bhakra-Sutlej, Tehri-Bhagirathi, Hirakud-Mahanadi, Sardar Sarovar and Indira Sagar-Narmada, Ukai-Tapi, Nagarjuna Sagar and Srisailam-Krishna, Mettur and Krishnaraja Sagar-Kaveri, Idukki-Periyar.
- Damodar Valley Corporation (1948), modelled on the Tennessee Valley Authority, was the first multipurpose project of independent India; Tehri is India's tallest dam.
- Chambal dams: Gandhi Sagar (MP), Rana Pratap Sagar and Jawahar Sagar (Rajasthan); Rihand dam forms Govind Ballabh Pant Sagar (UP); Farakka barrage feeds the Hugli.

> **Quick revision:** Peninsular rivers old, rain-fed, fixed courses; east-flowing Mahanadi, Godavari (largest, about 1,465 km, Dakshin Ganga), Krishna, Kaveri form deltas; west-flowing Narmada and Tapi flow in rift valleys and form estuaries; Wular largest freshwater lake, Chilika largest lagoon, Sambhar salt lake, Loktak phumdis; Jog on Sharavathi, Chitrakote on Indravati; DVC 1948 first multipurpose project; Bhakra-Sutlej, Hirakud-Mahanadi, Tehri tallest dam.

### Climate of India and the Monsoon Mechanism: Seasons, Local Winds and Rainfall

**Climate type and controls:** India has a tropical monsoon climate, marked by a seasonal reversal of winds and by rain packed into a few months. The word monsoon comes from the Arabic mausim, meaning season. Several factors shape it: latitude, since the Tropic of Cancer divides the country into a tropical south and a sub-tropical north; the Himalayas, which block the cold winds of Central Asia; pressure and winds; distance from the sea, which gives coastal places an even climate and interior places such as Delhi extremes of heat and cold; relief, which makes windward slopes wet and leeward slopes dry; and the jet streams of the upper air. The India Meteorological Department (IMD) was set up in 1875, and meteorologists divide the Indian year into four seasons.

**The four seasons:** The cold weather season (December to February) brings clear skies and dry north-east winds blowing from land to sea. Western disturbances, low-pressure systems that start over the Mediterranean Sea and travel east with the westerly jet stream, bring light winter rain, locally called mahawat, to Punjab, Haryana, Delhi and western Uttar Pradesh and snow to the hills; this rain is valuable for rabi wheat. The hot weather season (March to May) brings rising heat that moves north with the sun. The advancing monsoon or rainy season lasts from June to September, and the retreating monsoon or post-monsoon season covers October and November.

**Local winds of the hot season:** The loo is a hot, dry, gusty wind that blows over the northern plains from Punjab to Bihar on May and June afternoons. Kalbaisakhi or nor'westers are violent evening thunderstorms in West Bengal and Assam; in Assam they are called Bardoli Chheerha. They help tea, jute and rice. Mango showers are pre-monsoon showers on the coasts of Kerala and Karnataka that help mangoes ripen early, and blossom showers make coffee plants flower. Dust storms called aandhi are common in Rajasthan, Punjab and Haryana.

**The monsoon mechanism:** In summer the land heats much faster than the sea, so an intense low-pressure area forms over north-western India and Pakistan while the Indian Ocean stays under higher pressure. The Inter Tropical Convergence Zone (ITCZ) shifts north over the Ganga plain, where it is called the monsoon trough. The south-east trade winds of the southern hemisphere cross the Equator, are turned to the right by the Coriolis force and arrive as the south-west monsoon. The heating of the Tibetan plateau, the shift of the subtropical westerly jet stream to the north of the Himalayas, and the Tropical Easterly Jet over the peninsula all help the monsoon set in. El Nino, the periodic warming of the eastern Pacific off Peru, linked with the pressure see-saw called the Southern Oscillation, often weakens the Indian monsoon and brings drought, while a positive Indian Ocean Dipole tends to help it.

**Onset, branches, break and retreat:** The monsoon reaches the Kerala coast around 1 June with a sudden heavy downpour called the burst, and covers the whole country by early to mid-July. It comes in two branches. The Arabian Sea branch strikes the Western Ghats, drenching the windward side while the Deccan interior lies in the rain-

shadow. The Bay of Bengal branch hits Myanmar and Bangladesh, sweeps into the north-east, where the funnel-shaped Khasi hills give Mawsynram and Cherrapunji (Sohra) their huge rainfall, and is turned west by the Himalayas along the Ganga plain, so rain decreases from east to west: about 119 cm at Kolkata, 105 cm at Patna, 76 cm at Prayagraj and 56 cm at Delhi. The Tamil Nadu coast stays fairly dry in this season because it lies parallel to the Bay branch and in the rain-shadow of the Arabian Sea branch. Breaks are dry spells within the rainy season, often when the monsoon trough moves to the Himalayan foothills. From September the monsoon withdraws from the north-west; October brings humid heat called the October heat, and the north-east or retreating monsoon then gives Tamil Nadu most of its rain, while cyclones strike the east coast.

**Rainfall distribution:** About three-fourths of India's rain falls in the four monsoon months, and the average annual rainfall is about 125 cm, but it varies widely. More than 200 cm falls on the west coast and Western Ghats, the north-east hills and the Andaman and Nicobar Islands, and over 400 cm in parts of Meghalaya, where Mawsynram records the highest average rainfall in the world. Western Rajasthan, Kachchh and Ladakh get less than 50 cm, and parts of Ladakh and western Rajasthan get less than 10 cm, the driest in India. Low-rainfall areas also have the most uncertain rain.

**Examples**

- Climate controls: latitude, the Himalayan barrier, pressure and winds, distance from the sea, relief and jet streams; IMD was set up in 1875.
- Four seasons: cold weather (December-February), hot weather (March-May), advancing monsoon (June-September), retreating monsoon (October-November).
- Western disturbances: born over the Mediterranean, carried by the westerly jet; winter rain (mahawat) in Punjab, Haryana, Delhi and western UP, good for rabi wheat.
- Local winds: Loo (hot, dry; northern plains), Kalbaisakhi or nor'westers (Bengal and Assam; Bardoli Chheerha in Assam), mango showers (Kerala and Karnataka), blossom showers (coffee).
- Monsoon causes: land-sea heating contrast, ITCZ moving north as the monsoon trough, SE trades crossing the Equator and turning SW (Coriolis force), Tibetan heating, Tropical Easterly Jet.
- El Nino (warm eastern Pacific) with the Southern Oscillation (ENSO) often means a weak monsoon; a positive Indian Ocean Dipole helps the monsoon.
- Onset in Kerala about 1 June (burst); two branches, Arabian Sea and Bay of Bengal; Ganga plain rain falls east to west: Kolkata 119 cm, Patna 105, Prayagraj 76, Delhi 56 cm.
- Tamil Nadu gets most of its rain from the north-east (retreating) monsoon in October to December; October heat follows the withdrawal.
- Rainfall: average about 125 cm; over 400 cm in Meghalaya (Mawsynram wettest); under 10 cm in parts of Ladakh and western Rajasthan.

> **Quick revision:** Tropical monsoon climate; monsoon from Arabic mausim; IMD set up 1875; seasons: Dec-Feb cold, Mar-May hot, Jun-Sep SW monsoon, Oct-Nov retreat; western disturbances from the Mediterranean bring winter rain for wheat; loo, Kalbaisakhi (Bardoli Chheerha), mango showers; ITCZ, Coriolis, Tibetan heating, Tropical Easterly Jet; El Nino weakens monsoon; onset Kerala about 1 June; Tamil Nadu rain Oct-Dec; average rain about 125 cm; Mawsynram wettest; Ladakh and western Rajasthan driest.

## Soils of India and Natural Vegetation: Soil Types, Forest Types and Conservation

**How soils are classified:** Soil is the thin top layer of the land, formed from weathered rock mixed with humus, and it takes a very long time, centuries or more, to build even a few centimetres. Its type depends on the parent rock, climate, relief, vegetation and time. The Indian Council of Agricultural Research (ICAR), set up in 1929, groups Indian soils into eight major types: alluvial, black, red and yellow, laterite, arid, saline, peaty (marshy) and forest soils. Exams ask where each is found, what gives it its colour or character, and which crops suit it.

**Alluvial and black soils:** Alluvial soil, laid down by rivers, is the most widespread, covering about 40 percent of the country across the Northern Plains, the river valleys and the deltas of the east coast. It is rich in potash but poor in phosphorus; the old alluvium (bhangar) has kankar nodules, while the new alluvium (khadar) is finer and more fertile.

It suits rice, wheat, sugarcane, pulses and oilseeds. Black soil, or regur, formed from the weathering of the basalt of the Deccan Trap, covers most of Maharashtra and parts of Gujarat, Madhya Pradesh, Karnataka, Telangana, Andhra Pradesh and Tamil Nadu. It is clayey and holds moisture for long, and in summer it develops deep cracks that let air in, so it is called self-ploughing. It is rich in lime, iron, magnesia and potash but poor in phosphorus, nitrogen and organic matter. It is ideal for cotton, hence the name black cotton soil.

**Red, laterite and other soils:** Red and yellow soil forms on old crystalline rocks in the low-rainfall eastern and southern Deccan, in Tamil Nadu, Karnataka, Odisha, Chhattisgarh and Jharkhand; it is red because iron is spread through the rock and yellow where that iron is hydrated, and it grows millets, pulses and groundnut. Laterite soil (from the Latin later, meaning brick) forms under high temperature and heavy rainfall, which wash away lime and silica and leave iron and aluminium oxides; found in Kerala, Karnataka, Tamil Nadu and the hills of Odisha and Assam, it is used for bricks and, with manure, grows tea, coffee and cashew. Arid soil of Rajasthan is sandy and saline, with a kankar layer below, and yields well when irrigated. Saline soil (usar, reh or kallar) holds too much sodium and magnesium; it occurs in western Gujarat, the eastern deltas, the Sundarbans and over-irrigated parts of Punjab and Haryana, and is treated with gypsum. Peaty soil, rich in organic matter, forms in waterlogged areas of north Bihar and the coasts of West Bengal, Odisha and Tamil Nadu. Forest soils on Himalayan slopes are thin and acidic higher up.

**Soil erosion and conservation:** Soil erosion is the removal of top soil by running water and wind, speeded up by deforestation, over-grazing, mining and careless farming. Running water causes sheet, rill and gully erosion, and deep gullies turn land into badlands, like the Chambal ravines, while wind blows away the loose soil of the desert. Conservation methods include contour ploughing across the slope, terrace or step farming on hill slopes, strip cropping with grass between crops, shelter belts of trees to break the wind in western India, afforestation, check dams across gullies, and controlled grazing.

**Forests by rainfall:** The type of natural forest in India depends mainly on rainfall. Tropical evergreen forests grow where rain is over 200 cm, on the Western Ghats, in the north-east hills and in the Andaman and Nicobar Islands; they are dense, tall, many-layered and green all year, with ebony, mahogany, rosewood, rubber and cinchona. Tropical deciduous or monsoon forests are the most widespread and shed their leaves in the dry season. The moist deciduous type (200 to 100 cm of rain) has teak, sal, shisham, sandalwood and bamboo and grows in the north-east, along the Himalayan foothills and in Jharkhand, Odisha and Chhattisgarh; the dry deciduous type (100 to 70 cm) has teak, peepal and neem. Tropical thorn forests and scrub grow where rain is below 70 cm, in Rajasthan, Gujarat and the dry Deccan, with acacia, babool, khejri, cactus and euphorbia.

**Mountain forests and mangroves:** In the mountains vegetation changes with height: wet temperate forests of oak and chestnut between 1,000 and 2,000 m; coniferous forests of pine, deodar, silver fir and spruce between 1,500 and 3,000 m; alpine forests of silver fir, juniper and birch above about 3,600 m; then alpine meadows, called bugyals in Uttarakhand and margs in Kashmir, and mosses and lichens near the snow line. Mangrove or tidal forests grow in salt water on the deltas of the Ganga, Mahanadi, Godavari, Krishna and Kaveri. The Sundarbans of West Bengal, named after the sundari tree and home of the Royal Bengal tiger, form part of the largest mangrove forest in the world; Bhitarkanika (Odisha) and Pichavaram (Tamil Nadu) are other mangroves. The National Forest Policy of 1988 aims to keep one-third (33 percent) of the land under forest or tree cover, and two-thirds in the hills.

### Examples

- ICAR (1929) groups Indian soils into eight types: alluvial, black, red and yellow, laterite, arid, saline, peaty and forest.
- Alluvial soil: most widespread (about 40 percent of the area), rich in potash, poor in phosphorus; bhangar is old alluvium, khadar new; rice, wheat, sugarcane.
- Black soil (regur): from Deccan Trap basalt; holds moisture, self-ploughing cracks; rich in lime, iron, magnesia, potash; poor in phosphorus and nitrogen; best for cotton.
- Red soil gets its colour from iron in crystalline rock (yellow when hydrated); laterite (Latin later = brick) forms by leaching in hot, wet areas and suits tea, coffee and cashew.
- Saline soil (usar, reh, kallar) is treated with gypsum; peaty soil forms in waterlogged north Bihar and the coasts of West Bengal, Odisha and Tamil Nadu.

- Conservation: contour ploughing, terrace farming, strip cropping, shelter belts, check dams, afforestation; Chambal ravines are badlands formed by gully erosion.
- Forest by rainfall: evergreen over 200 cm (ebony, mahogany, rosewood), moist deciduous 200-100 cm (teak, sal), dry deciduous 100-70 cm, thorn below 70 cm (babool, khejri).
- Montane zones: oak and chestnut 1,000-2,000 m; pine, deodar, silver fir 1,500-3,000 m; alpine above 3,600 m; meadows are bugyals in Uttarakhand.
- Mangroves: Sundarbans (sundari tree, Royal Bengal tiger), Bhitarkanika (Odisha), Pichavaram (Tamil Nadu); Forest Policy 1988 aims at 33 percent forest cover.

> **Quick revision:** ICAR (1929): 8 soil groups; alluvial most widespread (about 40%), rich in potash; black regur from Deccan basalt, self-ploughing, cotton; red from iron; laterite from leaching, tea, coffee, cashew; saline (usar, reh) treated with gypsum; contour ploughing, terracing, shelter belts check erosion; evergreen forests over 200 cm, deciduous most widespread (teak, sal), thorn below 70 cm; conifers 1,500-3,000 m; Sundarbans mangroves; Forest Policy 1988 aims at 33%.

### Agriculture in India: Kharif, Rabi and Zaid Crops, Leading States and Farm Revolutions

**Cropping seasons:** Indian farming follows the monsoon, so crops are grouped by season. Kharif crops are sown with the onset of the monsoon in June-July and harvested in September-October: rice, maize, jowar, bajra, tur (arhar), moong, urad, cotton, jute, groundnut and soybean. Rabi crops are sown in winter, from October to December, and harvested from April to June: wheat, barley, gram, peas and mustard; winter rain from western disturbances helps them. Zaid is the short summer season between rabi and kharif, for watermelon, muskmelon, cucumber, vegetables and fodder. Sugarcane stays in the field for about a year. In Assam, West Bengal and Odisha three crops of paddy are grown in a year: aus, aman and boro. Shifting or slash-and-burn cultivation survives in the hills and is called jhum in the north-east.

**Food crops and leading states:** Rice, the main food crop, needs a temperature above 25°C, high humidity and more than 100 cm of rain; West Bengal has traditionally been the largest producer, and Punjab and Haryana grow it with canal and tube-well irrigation. Wheat, the main rabi crop, needs 50 to 75 cm of rain spread over a cool growing season and bright sunshine at ripening; Uttar Pradesh is the largest producer, and Punjab and Haryana have the highest yields. Among millets, Maharashtra leads in jowar, Rajasthan in bajra and Karnataka in ragi. India is the largest producer and consumer of pulses in the world, and Madhya Pradesh leads in pulses, especially gram. Sugarcane, a tropical and sub-tropical crop, is grown most in Uttar Pradesh, followed by Maharashtra.

**Commercial and plantation crops:** Cotton, a kharif crop, grows best on the black soil of the Deccan and needs at least 210 frost-free days; Gujarat and Maharashtra are the leading producers. Jute, the golden fibre, grows on the flood-renewed soils of the Ganga-Brahmaputra delta, and West Bengal grows most of it. Among oilseeds, Gujarat leads in groundnut and Rajasthan in rapeseed and mustard. Plantation crops are grown as a single crop on large estates with heavy investment, a system introduced by the British. Tea needs well-drained hill slopes and a warm, moist, frost-free climate with frequent showers; Assam is the largest producer, followed by West Bengal (Darjeeling and the Duars). Coffee, first grown from Arabica seeds brought from Yemen and planted in the Baba Budan hills, comes mostly from Karnataka. Rubber comes mainly from Kerala and saffron from Pampore in Jammu and Kashmir. The Tea Board (Kolkata), Coffee Board (Bengaluru), Rubber Board (Kottayam) and Spices Board (Kochi) look after these crops.

**The Green Revolution:** After the food shortages of the mid-1960s, India adopted high-yielding variety (HYV) seeds of wheat and rice together with assured irrigation, chemical fertilisers and pesticides. The dwarf wheat varieties came from Mexico, where Norman Borlaug, winner of the Nobel Peace Prize in 1970, developed them. In India the scientist M S Swaminathan, called the father of the Green Revolution in India, led the effort, with C Subramaniam as Agriculture Minister. Wheat output rose sharply, first in Punjab, Haryana and western Uttar Pradesh, and India became self-sufficient in food grains. The costs were regional imbalance, falling groundwater, damaged soils and heavy use of chemicals.

**White, Blue and Yellow Revolutions:** The White Revolution was Operation Flood, launched in 1970 by the National Dairy Development Board (set up in 1965 at Anand); it linked village dairy cooperatives on the Amul model of Anand in Gujarat into a national milk grid. Its architect, Verghese Kurien, is called the father of the White Revolution, India became the world's largest milk producer, and his birthday, 26 November, is observed as National Milk Day. The Blue Revolution is the rise in fish production through fisheries and aquaculture; Hiralal Chaudhuri, a pioneer of induced breeding of carp, and Arun Krishnan are named as its fathers. The Yellow Revolution raised oilseed output under the Technology Mission on Oilseeds of 1986, and Sam Pitroda is called its father.

**Irrigation:** Because rain is seasonal and uneven, irrigation is vital. Wells and tube-wells, which draw groundwater, irrigate the largest share of the net irrigated area, especially in Uttar Pradesh, Punjab, Haryana, Rajasthan and Gujarat. Canals matter most in the northern plains, where perennial rivers feed them; the Indira Gandhi Canal in Rajasthan, fed from the Harike barrage, is the longest canal of India. Tanks, small reservoirs held by earthen bunds, are common in the hard-rock, uneven peninsula, in Tamil Nadu, Karnataka, Telangana and Andhra Pradesh. Drip and sprinkler irrigation save water and suit dry areas and orchards. Punjab has the highest share of its cropped area under irrigation.

**Examples**

- Kharif (sown June-July, harvested September-October): rice, maize, jowar, bajra, tur, moong, urad, cotton, jute, groundnut, soybean.
- Rabi (sown October-December, harvested April-June): wheat, barley, gram, peas, mustard; zaid (summer): watermelon, muskmelon, cucumber, vegetables, fodder.
- Aus, aman and boro are the three paddy crops of Assam, West Bengal and Odisha; shifting cultivation is called jhum in the north-east.
- Leading states: rice - West Bengal; wheat and sugarcane - Uttar Pradesh; jowar - Maharashtra; bajra - Rajasthan; ragi - Karnataka; pulses (gram) - Madhya Pradesh; jute - West Bengal.
- Plantations: tea - Assam (then West Bengal); coffee - Karnataka (Arabica from Yemen, Baba Budan hills); rubber - Kerala; saffron - Pampore (J and K); groundnut - Gujarat; mustard - Rajasthan.
- Crop boards: Tea Board, Kolkata; Coffee Board, Bengaluru; Rubber Board, Kottayam; Spices Board, Kochi.
- Green Revolution (mid-1960s): HYV seeds, irrigation, fertilisers; M S Swaminathan in India, Norman Borlaug (Nobel Peace Prize 1970) worldwide; Punjab, Haryana, western UP.
- White Revolution: Operation Flood 1970, NDDB (1965, Anand), Verghese Kurien, National Milk Day 26 November; Blue: fisheries; Yellow: oilseeds, Technology Mission 1986, Sam Pitroda.
- Irrigation: wells and tube-wells have the largest share; Indira Gandhi Canal (Rajasthan) the longest canal; tanks in the peninsula; Punjab most irrigated.

> **Quick revision:** Kharif June-October (rice, cotton, jute, groundnut), rabi October-June (wheat, gram, mustard), zaid summer (melons); aus, aman, boro paddy; West Bengal rice and jute, UP wheat and sugarcane, Rajasthan bajra, Karnataka coffee and ragi, Assam tea, Kerala rubber; Green Revolution mid-1960s, Swaminathan and Borlaug; Operation Flood 1970, Kurien; Yellow Revolution, oilseeds, 1986; wells and tube-wells lead irrigation; Indira Gandhi Canal longest.

## Minerals, Energy Resources and Industries: Mines, Power Plants and Steel Centres

**Where minerals lie:** Most of India's metallic minerals and coal lie in the old rocks of the Peninsular Plateau, and the Chotanagpur plateau with the nearby parts of Odisha and Chhattisgarh forms the richest mineral belt. Petroleum, by contrast, lies in younger sedimentary rocks in Assam, Gujarat and offshore near Mumbai. Learn minerals as mine-and-state pairs, since that is how exams ask them.

**Iron ore and other metals:** Haematite is the most used iron ore, and magnetite the richest, with up to about 70 percent iron. The main iron-ore belts are the Odisha-Jharkhand belt (Mayurbhanj and Keonjhar in Odisha, Noamundi and Gua in Jharkhand); the Durg-Bastar-Chandrapur belt, with the Bailadila hills of Chhattisgarh, whose high-grade ore is exported through Visakhapatnam; the Ballari-Chitradurga-Chikkamagaluru-Tumakuru belt of Karnataka, including Kudremukh; and the Maharashtra-Goa belt, which exports through Mormugao. Odisha is the largest

producer of iron ore. Manganese, about 10 kg of which goes into each tonne of steel, comes from Balaghat (Madhya Pradesh), Nagpur and Bhandara (Maharashtra) and Keonjhar (Odisha). Bauxite, the ore of aluminium, comes from the Amarkantak plateau, the Maikal hills and the Panchpatmali deposits of Koraput in Odisha. Copper comes from Khetri (Rajasthan), Malanjkhand in Balaghat (Madhya Pradesh) and Singhbhum (Jharkhand). Mica, an electrical insulator, comes from the Koderma-Gaya-Hazaribagh belt of Jharkhand and Bihar, Ajmer (Rajasthan) and Nellore (Andhra Pradesh).

**Coal, petroleum and atomic minerals:** Most Indian coal is Gondwana coal, about 200 million years old, found in the Damodar valley (Jharia, the largest coking-coal field, Raniganj, Bokaro and Giridih) and in the Godavari, Mahanadi, Son and Wardha valleys (Singareni in Telangana, Talcher in Odisha, Korba in Chhattisgarh and Singrauli on the Madhya Pradesh-Uttar Pradesh border). Coal mining in India began at Raniganj in 1774. Tertiary coal, about 55 million years old, occurs in Meghalaya, Assam, Arunachal Pradesh and Nagaland, and lignite is mined at Neyveli in Tamil Nadu. Oil was struck at Digboi in Assam in 1889, and India's oldest working refinery opened there in 1901; Naharkatiya and Moran-Hugrijan are other Assam fields. Gujarat has Ankleshwar, Kalol and the Khambhat basin, and Mumbai High is an offshore field found in 1974. Uranium is mined at Jaduguda in Jharkhand, and the monazite sands of Kerala contain thorium.

**Power:** Coal-based thermal power is India's largest source of electricity; NTPC, set up in 1975, runs plants such as Vindhyachal (Madhya Pradesh), Singrauli (Uttar Pradesh), Korba (Chhattisgarh), Ramagundam (Telangana) and Talcher (Odisha). Hydroelectricity comes from projects such as Bhakra Nangal, Tehri, Nathpa Jhakri on the Sutlej, Koyna and Srisailam. Nuclear power began at Tarapur in Maharashtra in 1969; other plants are Rawatbhata (Rajasthan), Kalpakkam and Kudankulam (Tamil Nadu, the latter built with Russia), Narora (Uttar Pradesh), Kakrapar (Gujarat) and Kaiga (Karnataka). Wind farms cluster at Muppandal in Tamil Nadu, large solar parks stand at Bhadla in Rajasthan and Charanka in Gujarat, and Puga valley in Ladakh is a geothermal site.

**Industrial regions and steel plants:** Industry gathers where raw material, power, labour, markets and transport meet. India's major industrial regions are Mumbai-Pune, Hugli, Bengaluru-Tamil Nadu, Gujarat, Chotanagpur, Visakhapatnam-Guntur, Gurugram-Delhi-Meerut and Kollam-Thiruvananthapuram. The Tata Iron and Steel Company (TISCO) was founded in 1907 at Sakchi, now Jamshedpur in Jharkhand, as India's first large modern steel plant; Visvesvaraya Iron and Steel at Bhadravati in Karnataka dates from 1923, and the Indian Iron and Steel Company works at Burnpur in West Bengal. Of the public sector plants, Bhilai (Chhattisgarh) was built with help from the USSR, Rourkela (Odisha) with West Germany, Durgapur (West Bengal) with the United Kingdom, and Bokaro (Jharkhand) also with the USSR. Visakhapatnam (Andhra Pradesh) is the first shore-based integrated steel plant.

**Textiles:** The first successful cotton mill opened in Mumbai in 1854, and the industry grew in Maharashtra and Gujarat thanks to cotton from the black soil, a humid climate that keeps yarn from snapping, ports, capital and markets. Ahmedabad is the Manchester of India, Mumbai the Cottonopolis of India and Coimbatore the Manchester of South India; Surat, Solapur, Nagpur and Indore are other centres, and Tirupur is known for knitwear. The first jute mill was set up at Rishra near Kolkata in 1855, and jute mills still line the Hugli because of nearby jute fields, cheap water transport, plenty of water for processing, cheap labour and the port of Kolkata. India is the largest producer of raw jute and jute goods.

### Examples

- Iron ore: Bailadila (Chhattisgarh), Keonjhar and Mayurbhanj (Odisha), Noamundi and Gua (Jharkhand), Kudremukh and Ballari (Karnataka), Goa (exports via Mormugao); Odisha produces the most.
- Magnetite has up to about 70 percent iron (richest); haematite is the most used ore; about 10 kg of manganese goes into a tonne of steel.
- Bauxite: Panchpatmali (Koraput, Odisha), Amarkantak plateau; copper: Khetri (Rajasthan), Malanjkhand (MP), Singhbhum (Jharkhand); mica: Koderma (Jharkhand), Nellore (Andhra).
- Coal: Jharia (largest coking coal), Raniganj (mining from 1774), Bokaro, Korba, Talcher, Singrauli, Singareni; lignite at Neyveli (Tamil Nadu); tertiary coal in Meghalaya and Assam.
- Oil: Digboi (struck 1889, refinery 1901), Naharkatiya (Assam); Ankleshwar, Kalol (Gujarat); Mumbai High (offshore, 1974); uranium at Jaduguda, thorium in Kerala's monazite sands.

- Nuclear plants: Tarapur (Maharashtra, first, 1969), Rawatbhata (Rajasthan), Kalpakkam and Kudankulam (Tamil Nadu), Narora (UP), Kakrapar (Gujarat), Kaiga (Karnataka).
- Steel collaborators: Bhilai - USSR, Rourkela - West Germany, Durgapur - UK, Bokaro - USSR; TISCO Jamshedpur 1907; Visvesvaraya Bhadravati 1923; Visakhapatnam first shore-based plant.
- Textiles: first cotton mill Mumbai 1854; Ahmedabad Manchester of India; Coimbatore Manchester of South India; first jute mill Rishra 1855; jute mills along the Hugli.

> **Quick revision:** Chotanagpur and Odisha richest mineral belt; Odisha leads iron ore; Bailadila, Keonjhar, Noamundi, Kudremukh; bauxite Koraput; copper Khetri, Malanjkhand; mica Koderma; Jharia coking coal, Raniganj 1774, Neyveli lignite; Digboi 1889 oil, refinery 1901; Mumbai High 1974; Tarapur first nuclear plant 1969; TISCO 1907; Bhilai and Bokaro USSR, Rourkela West Germany, Durgapur UK; first cotton mill Mumbai 1854; first jute mill Rishra 1855.

### Transport and Population: Highways, Railways, Ports, Waterways and Census 2011

**Roads:** India has one of the largest road networks in the world. Roads are classed as National Highways, built and maintained by the central government through the National Highways Authority of India (set up under a 1988 Act); State Highways; district and rural roads, the latter linked under the Pradhan Mantri Gram Sadak Yojana of 2000; border roads built by the Border Roads Organisation (1960); and expressways. Under the numbering adopted in 2010, north-south highways carry even numbers and east-west highways odd numbers; NH 44, from Srinagar to Kanyakumari, is the longest. The Golden Quadrilateral, the first phase of the National Highways Development Project, is a 5,846 km four- and six-lane network linking Delhi, Mumbai, Chennai and Kolkata. The North-South corridor (Srinagar to Kanyakumari) and the East-West corridor (Silchar in Assam to Porbandar in Gujarat) cross at Jhansi.

**Railways:** The first passenger train in India ran on 16 April 1853 from Bori Bunder (Mumbai) to Thane, a distance of 34 km, and the second line opened from Howrah to Hooghly in 1854. Indian Railways uses three gauges: broad gauge (1.676 m), metre gauge (1 m) and narrow gauge (0.762 m and 0.610 m); under Project Unigauge, begun in 1992, most lines are being turned into broad gauge. The railways were regrouped into zones from 1951. The Konkan Railway runs along the west coast through Maharashtra, Goa and Karnataka, and the Darjeeling Himalayan, Nilgiri and Kalka-Shimla lines together form the Mountain Railways of India, a UNESCO World Heritage Site. Kolkata got India's first metro in 1984.

**Ports:** On the west coast stand Deendayal (Kandla) in Gujarat, a tidal port built after Partition to replace the loss of Karachi; Mumbai, with a large natural harbour; Jawaharlal Nehru Port (Nhava Sheva) in Navi Mumbai, built to ease the load on Mumbai and a major container port; Mormugao in Goa, long the chief iron-ore exporting port; New Mangalore in Karnataka; and Kochi in Kerala, a natural harbour at the entrance of a lagoon. On the east coast stand V O Chidambaranar (Tuticorin), Chennai, one of the oldest artificial harbours, and Kamarajar (Ennore) in Tamil Nadu; Visakhapatnam in Andhra Pradesh, the deepest landlocked and well-protected port; Paradip in Odisha, which exports iron ore; and Kolkata with Haldia, an inland riverine port on the Hugli.

**Inland waterways:** The Inland Waterways Authority of India (1986) develops navigable rivers and canals. National Waterway 1, on the Ganga-Bhagirathi-Hugli from Haldia to Prayagraj (1,620 km), is the longest; National Waterway 2 is the Brahmaputra from Sadiya to Dhubri (891 km); and National Waterway 3 is the West Coast Canal in Kerala from Kottapuram to Kollam (205 km). The National Waterways Act, 2016 declared 111 national waterways in all.

Census 2011 at a glance: Census 2011 was the 15th census of India and the 7th after independence; the first census was held in 1872 and the first synchronous one in 1881. India's population was about 121.09 crore, some 17.5 percent of the world's people on 2.4 percent of its land. Growth in the decade 2001-2011 was 17.7 percent, a clear fall from the decade before. Uttar Pradesh was the most populous state (about 19.98 crore), followed by Maharashtra and Bihar, and Sikkim the least populous. Meghalaya had the highest decadal growth among states, and Nagaland a negative growth. About 31 percent of Indians lived in towns and cities; Goa was the most urbanised state and Himachal Pradesh the least.

**Density, sex ratio and literacy:** Density was 382 persons per sq km, up from 325 in 2001. Among states, Bihar was the most densely populated (1,106) and Arunachal Pradesh the least (17); among Union Territories, Delhi was the

densest (11,320). The sex ratio, females per 1,000 males, was 943 (940 in the provisional figures); Kerala was the highest (1,084) and Haryana the lowest (879) among states, and among Union Territories Puducherry was the highest and Daman and Diu the lowest. Literacy, counted for people aged 7 and above, was 74.04 percent in the provisional figures that most exam books quote (72.98 percent in the final tables), with male literacy above 80 percent and female literacy about 65 percent. Kerala was the most literate state and Bihar the least; Rajasthan had the lowest female literacy in the provisional figures, and Bihar in the final tables. Census 2011 counted Jammu and Kashmir as a state; it became a Union Territory in 2019.

**Examples**

- Golden Quadrilateral: 5,846 km, links Delhi, Mumbai, Chennai and Kolkata; North-South (Srinagar-Kanyakumari) and East-West (Silchar-Porbandar) corridors cross at Jhansi; NH 44 is the longest highway.
- First train: 16 April 1853, Bori Bunder (Mumbai) to Thane, 34 km; second: Howrah to Hooghly, 1854; first metro: Kolkata, 1984.
- Gauges: broad 1.676 m, metre 1 m, narrow 0.762 m and 0.610 m; Project Unigauge from 1992.
- West coast ports: Deendayal (Kandla, tidal), Mumbai, JNPT (container), Mormugao (iron ore), New Mangalore, Kochi; east coast: Tuticorin, Chennai, Ennore, Visakhapatnam (deepest landlocked), Paradip, Kolkata-Haldia (riverine).
- National Waterways: NW 1 Haldia-Prayagraj on the Ganga (1,620 km, longest); NW 2 Sadiya-Dhubri on the Brahmaputra (891 km); NW 3 Kottapuram-Kollam, Kerala (205 km); IWAI set up 1986.
- Census 2011: 15th census, 7th after independence; population about 121.09 crore; decadal growth 17.7 percent; density 382; sex ratio 943; literacy 74.04 percent (provisional).
- Most populous state UP, least Sikkim; densest Bihar (1,106), least dense Arunachal Pradesh (17); Delhi densest overall (11,320).
- Sex ratio: highest Kerala (1,084), lowest Haryana (879) among states; literacy: highest Kerala, lowest Bihar; lowest female literacy Rajasthan (provisional; Bihar in the final tables).
- Fastest decadal growth among states Meghalaya, negative growth Nagaland; most urbanised state Goa, least Himachal Pradesh; urban share about 31 percent.

> **Quick revision:** Golden Quadrilateral 5,846 km; NS-EW corridors cross at Jhansi; NH 44 longest; first train 16 April 1853, Mumbai-Thane, 34 km; broad gauge 1.676 m; Kandla tidal, JNPT container, Mormugao iron ore, Visakhapatnam deepest landlocked, Kolkata riverine; NW 1 Haldia-Prayagraj 1,620 km; Census 2011: 121.09 crore, growth 17.7%, density 382, sex ratio 943, literacy 74.04%; UP most populous, Bihar densest, Kerala highest sex ratio and literacy, Haryana lowest sex ratio.

Free practice questions: parikshasaathi.com/q/indian-geography/

## Indian Polity and Constitution

### Indian Polity and Constitution

**What the exam asks:** Indian Polity is one of the most predictable sections of General Awareness in SSC CGL/CHSL/GD, RRB NTPC/Group D, state police and state PSC prelims. Questions are fact-based: article, schedule and amendment numbers, who appoints or removes whom, ages, time limits and landmark cases. Learn the Constitution as a map of numbers.

**Making of the Constitution:** The Constituent Assembly, formed under the Cabinet Mission Plan of 1946, first met on 9 December 1946 under temporary chairman Dr Sachchidananda Sinha; Dr Rajendra Prasad became its permanent President. Nehru moved the Objectives Resolution on 13 December 1946, the basis of the Preamble. The Drafting Committee (29 August 1947) was chaired by Dr B.R. Ambedkar, with B.N. Rau as Constitutional Adviser. The Constitution was adopted on 26 November 1949 and commenced on 26 January 1950, the date of Purna Swaraj Day 1930. It took 2 years, 11 months and 17 days (many textbooks say 18, counting both end days). The original text had 395 Articles, 22 Parts and 8 Schedules; today there are 25 Parts and 12 Schedules.

**Sources and the Preamble:** Fundamental Rights and judicial review come from the USA; parliamentary government and single citizenship from Britain; Directive Principles from Ireland; the Concurrent List and joint sitting from

Australia; the federal scheme from the Government of India Act 1935; Fundamental Duties from the USSR. The words Socialist, Secular and Integrity were inserted in the Preamble by the 42nd Amendment of 1976. In Kesavananda Bharati (1973) the Supreme Court held the Preamble is part of the Constitution, reversing Berubari Union (1960).

**Rights, Directives and Duties:** Fundamental Rights are in Part III, Articles 12 to 35. Article 14 is equality before law, Article 17 abolishes untouchability, Article 19 gives six freedoms, Article 21 protects life and liberty, Article 21A (86th Amendment, 2002) gives free education to children of 6 to 14 years, and Article 32, which Ambedkar called the heart and soul of the Constitution, lets the Supreme Court issue five writs: habeas corpus, mandamus, prohibition, certiorari and quo warranto. The right to property was removed from Part III by the 44th Amendment of 1978 and survives under Article 300A. Directive Principles (Part IV) are not enforceable in courts (Article 37); remember Article 40 (village panchayats), Article 44 (uniform civil code) and Article 39A (free legal aid). Fundamental Duties were added as Article 51A by the 42nd Amendment on the Swaran Singh Committee's advice; the eleventh duty came with the 86th Amendment.

**Union executive and Parliament:** The President is elected by elected MPs and elected MLAs of states, Delhi and Puducherry, and can be impeached under Article 61 for violation of the Constitution. Key articles: 72 (pardon, including death sentences), 123 (ordinances lapse six weeks after Parliament reassembles), 76 (Attorney General). The Vice-President is elected by all MPs. Rajya Sabha has at most 250 members, is permanent, and one-third retire every two years. A money bill (Article 110) is certified by the Speaker, is introduced only in Lok Sabha and can be held by Rajya Sabha for only 14 days. Joint sittings (Article 108) are chaired by the Speaker and exclude money bills and constitutional amendment bills. A no-confidence motion needs 50 supporters and lies only in Lok Sabha. The Public Accounts Committee has 22 members (15 from Lok Sabha, 7 from Rajya Sabha).

**Judiciary, states and Centre-State relations:** Supreme Court judges retire at 65, High Court judges at 62. Article 141 makes Supreme Court law binding on all courts, Article 143 is advisory jurisdiction, and Article 226 gives High Courts writ power wider than Article 32. The collegium emerged from the Second Judges case (1993). The Governor is appointed by the President and holds office during his pleasure; Parliament creates or abolishes a Legislative Council under Article 169 on the state assembly's resolution. The Seventh Schedule has Union, State and Concurrent Lists; residuary powers rest with Parliament (Article 248). The 42nd Amendment shifted education, forests, weights and measures, wildlife and administration of justice to the Concurrent List. The Inter-State Council is under Article 263 and the Sarkaria Commission (1983) studied Centre-State relations.

**Emergency, local government and bodies:** Article 352 (national emergency: war, external aggression or armed rebellion, imposed in 1962, 1971 and 1975), Article 356 (President's rule) and Article 360 (financial emergency, never imposed). Articles 20 and 21 are never suspended. The 73rd and 74th Amendments (1992) added Parts IX and IXA, the Eleventh Schedule (29 subjects) and the Twelfth Schedule (18 subjects); the 73rd came into force on 24 April 1993. Balwant Rai Mehta (1957) proposed three tiers and Ashok Mehta (1977) two tiers. Constitutional bodies: Election Commission (324), CAG (148), UPSC (315), Finance Commission (280), NCSC (338), NCST (338A). Non-constitutional: NHRC (1993 Act), CVC (1964), NITI Aayog (2015).

**Amendments and landmark cases:** 1st (1951, Ninth Schedule), 7th (1956, states reorganisation), 42nd (1976), 44th (1978), 52nd (1985, anti-defection), 61st (Act of 1988, in force from 28 March 1989, voting age 18), 86th (2002), 91st (2003, ministry size), 101st (2016, GST). Cases: Golaknath (1967) barred amending Fundamental Rights; Kesavananda Bharati (1973) gave the basic structure doctrine; Maneka Gandhi (1978) widened Article 21; Minerva Mills (1980) balanced rights and directives; S.R. Bommai (1994) checked Article 356.

**Traps:** adoption (26 November 1949) versus commencement (26 January 1950); 42nd versus 44th Amendment; Article 32 versus 226; the Governor cannot pardon a death sentence; Rajya Sabha cannot reject a money bill, which the Speaker certifies; the Vice-President is elected by all MPs, the President only by elected members.

### Examples

- Date pairs to never mix: Constituent Assembly first met 9 December 1946; Constitution adopted 26 November 1949; commenced 26 January 1950.
- Mnemonic for the 42nd Amendment words in the Preamble: S-S-I: Socialist, Secular, Integrity (1976).

- Five writs under Article 32: Habeas corpus (produce the body), Mandamus (we command), Prohibition (stop proceedings), Certiorari (quash the order), Quo warranto (by what authority).
- Age ladder: Lok Sabha 25, Rajya Sabha 30, President 35, Vice-President 35, Governor 35; retirement: High Court judge 62, Supreme Court judge 65.
- Money bill test: Introduced only in Lok Sabha, needs President's recommendation, certified by Speaker, Rajya Sabha gets 14 days and cannot reject it.
- Emergency trio: Article 352 national (3 times: 1962, 1971, 1975), Article 356 President's rule (over 100 times), Article 360 financial (never).
- Local government pair: 73rd Amendment = Panchayats, Part IX, Eleventh Schedule, 29 subjects; 74th = Municipalities, Part IXA, Twelfth Schedule, 18 subjects.
- Committee sequence for Panchayati Raj: Balwant Rai Mehta 1957 (three tiers), Ashok Mehta 1977 (two tiers), G.V.K. Rao 1985, L.M. Singhvi 1986 (constitutional status).
- Case chain on amending power: Shankari Prasad 1951 (yes) to Golaknath 1967 (no) to 24th Amendment 1971 to Kesavananda Bharati 1973 (yes, but basic structure) to Minerva Mills 1980.
- Pardon contrast: President (Article 72) can pardon a death sentence and court-martial sentences; Governor (Article 161) cannot.
- Only Rajya Sabha can pass a resolution under Article 249 to let Parliament legislate on a State List subject, and under Article 312 to create a new All India Service.
- Eighth Schedule growth: 14 languages originally; Sindhi (1967, 21st Amendment); Konkani, Manipuri, Nepali (1992, 71st); Bodo, Dogri, Maithili, Santhali (2003, 92nd) = 22.

> **Quick revision:** Constituent Assembly first met 9 Dec 1946; Constitution adopted 26 Nov 1949, in force 26 Jan 1950; 42nd Amendment (1976) added Socialist, Secular, Integrity; Fundamental Rights Articles 12-35, Article 32 writs; DPSP Part IV not enforceable (Art 37); Fundamental Duties Art 51A, 11 duties; Money bill Art 110, Rajya Sabha 14 days; Ordinance Art 123 lapses 6 weeks after reassembly; Emergency Arts 352, 356, 360; 73rd/74th Amendments 1992, Eleventh (29) and Twelfth (18) Schedules; Kesavananda Bharati 1973 basic structure; S.R. Bommai 1994 on Art 356.

### Making of the Constitution: Constituent Assembly, Committees and Sources

**From demand to Assembly:** The idea of a Constituent Assembly for India was first put forward by M.N. Roy in 1934, and the Congress formally demanded a Constituent Assembly in 1935. The British accepted it in principle in the August Offer of 1940, but the Assembly was finally formed under the Cabinet Mission Plan of 1946. It was to have 389 members: 296 from British India and 93 from the princely states, roughly one seat for every ten lakh people. Members from the provinces were elected indirectly by the provincial legislative assemblies through proportional representation by single transferable vote. In the elections of July-August 1946 the Congress won 208 seats and the Muslim League 73.

**Sessions and timeline:** The Assembly first met on 9 December 1946 with 211 members present, as the Muslim League boycotted it. Dr Sachchidananda Sinha, the oldest member, was temporary President, and on 11 December 1946 Dr Rajendra Prasad was elected permanent President; H.C. Mukherjee served as Vice-President and B.N. Rau as Constitutional Adviser. Jawaharlal Nehru moved the Objectives Resolution on 13 December 1946, and it was adopted on 22 January 1947. The Indian Independence Act 1947 made the Assembly fully sovereign and also the first Parliament of free India, which G.V. Mavalankar chaired when it sat as a legislature. After partition its strength fell to 299. It adopted the National Flag on 22 July 1947, and on 24 January 1950 it adopted the National Anthem and National Song and elected Dr Rajendra Prasad as the first President.

**Drafting the text:** The Drafting Committee, set up on 29 August 1947, was chaired by Dr B.R. Ambedkar. Its other six members were N. Gopalaswamy Ayyangar, Alladi Krishnaswamy Ayyar, K.M. Munshi, Syed Mohammad Saadullah, N. Madhava Rau (who replaced B.L. Mitter) and T.T. Krishnamachari (who replaced D.P. Khaitan after his death in 1948). The first draft was published in February 1948, and after three readings the Constitution was adopted on 26 November 1949; 284 members signed it on 24 January 1950. In 11 sessions the Assembly took nearly three years: 2 years, 11 months and 18 days in most exam books, which count both the first and the last day (17 days

otherwise), and it spent 114 days on the draft. Ambedkar is called the father of the Indian Constitution, and Prem Behari Narain Raizada hand-wrote its original English text.

**Other key committees and chairs:** Jawaharlal Nehru chaired the Union Powers Committee, the Union Constitution Committee and the States Committee for negotiating with the princely states. Sardar Vallabhbhai Patel chaired the Provincial Constitution Committee and the Advisory Committee on Fundamental Rights, Minorities and Tribal and Excluded Areas; under it, J.B. Kripalani headed the Fundamental Rights Sub-Committee and H.C. Mukherjee the Minorities Sub-Committee. Dr Rajendra Prasad chaired the Rules of Procedure Committee, the Steering Committee and the ad hoc committee on the National Flag, and K.M. Munshi the Order of Business Committee.

**Commencement:** A few provisions, such as those on citizenship and elections, came into force on 26 November 1949 itself, a date observed since 2015 as Constitution Day. The rest commenced on 26 January 1950, chosen because on that day in 1930 the Congress had celebrated Purna Swaraj Day. Article 395 repealed the Indian Independence Act 1947 and the Government of India Act 1935.

**Sources by country:** The largest single source was the Government of India Act 1935: the federal scheme, the office of Governor, the judiciary, public service commissions and emergency provisions. Britain gave parliamentary government, the rule of law, single citizenship, the cabinet system, prerogative writs and bicameralism. The USA gave Fundamental Rights, judicial review, independence of the judiciary, impeachment of the President, removal of judges and the post of Vice-President. Ireland gave the Directive Principles, the method of electing the President and nomination to the Rajya Sabha. Canada gave a federation with a strong Centre, residuary powers with the Centre, appointment of Governors by the Centre and the Supreme Court's advisory jurisdiction. Australia gave the Concurrent List, freedom of trade and commerce and the joint sitting. Weimar Germany gave suspension of Fundamental Rights during an emergency, the former USSR Fundamental Duties, France the republic and the ideals of liberty, equality and fraternity, South Africa the amendment procedure, and Japan procedure established by law.

**Parts and Schedules:** The original Constitution had a Preamble, 395 Articles in 22 Parts and 8 Schedules. New articles are inserted with letters (21A, 51A, 243A), so the last article is still numbered 395; Parts too have been added and deleted, and after the 97th Amendment (2011) there were 25 Parts. Four Schedules were added: the Ninth (First Amendment, 1951, laws shielded from challenge), the Tenth (52nd Amendment, 1985, anti-defection), the Eleventh (73rd Amendment, 1992, panchayats) and the Twelfth (74th Amendment, 1992, municipalities). The First Schedule lists states and union territories, the Second the emoluments of high office-holders, the Third the forms of oaths, the Fourth the allocation of Rajya Sabha seats, the Fifth and Sixth the administration of Scheduled Areas and tribal areas (the Sixth for Assam, Meghalaya, Tripura and Mizoram), the Seventh the three Lists and the Eighth the languages.

### Examples

- Constituent Assembly under the Cabinet Mission Plan 1946: 389 seats (296 for British India, 93 for princely states); strength reduced to 299 after partition.
- First meeting 9 December 1946 with 211 members and temporary President Sachchidananda Sinha; Rajendra Prasad elected permanent President on 11 December 1946.
- Objectives Resolution: moved by Nehru on 13 December 1946, adopted on 22 January 1947; it became the basis of the Preamble.
- Drafting Committee: set up 29 August 1947, seven members, chaired by B.R. Ambedkar; B.N. Rau was the Constitutional Adviser to the Assembly.
- Committee chairs: Nehru - Union Powers, Union Constitution and States Committees; Patel - Provincial Constitution and Advisory Committees; Rajendra Prasad - Rules of Procedure and Steering Committees.
- Adopted 26 November 1949 (Constitution Day since 2015); signed by 284 members on 24 January 1950; in force 26 January 1950; 11 sessions in all.
- Borrowed: USA - Fundamental Rights, judicial review; Ireland - Directive Principles; Canada - residuary powers with the Centre; Australia - Concurrent List; Weimar Germany - suspension of rights in emergency; South Africa - amendment procedure.
- Schedules added later: Ninth (1951, First Amendment), Tenth (1985, anti-defection), Eleventh (1992, panchayats, 29 subjects), Twelfth (1992, municipalities, 18 subjects).

- As a legislature (the Dominion Parliament) the Assembly was chaired by G.V. Mavalankar; it adopted the National Flag on 22 July 1947.
- Key Parts: III Fundamental Rights, IV Directive Principles, IVA Fundamental Duties, V the Union, VI the States, IX Panchayats, IXA Municipalities, XVIII Emergency, XX Amendment (Article 368).

> **Quick revision:** Idea: M.N. Roy 1934; Cabinet Mission 1946, 389 seats; first met 9 Dec 1946; Rajendra Prasad President; Objectives Resolution 13 Dec 1946; Drafting Committee 29 Aug 1947 under Ambedkar; 11 sessions; adopted 26 Nov 1949, in force 26 Jan 1950; originally 395 Articles, 22 Parts, 8 Schedules; GoI Act 1935 largest source; Fundamental Rights USA, Directive Principles Ireland, Concurrent List Australia, residuary powers Canada.

### Preamble, Union and Its Territory (Articles 1-4) and Citizenship (Articles 5-11)

**What the Preamble says:** The Preamble opens with We, the people of India, showing that the Constitution draws its authority from the people. It declares India a Sovereign, Socialist, Secular, Democratic Republic and promises all citizens Justice (social, economic and political), Liberty (of thought, expression, belief, faith and worship), Equality (of status and of opportunity) and Fraternity (assuring the dignity of the individual and the unity and integrity of the Nation). It ends with the date of adoption, 26 November 1949. The ideal of justice was drawn from the Russian Revolution, and liberty, equality and fraternity from the French Revolution.

**Its status and its one amendment:** The Preamble is based on Nehru's Objectives Resolution. In the Berubari Union reference (1960) the Supreme Court said it was not part of the Constitution, but in Kesavananda Bharati (1973) it held that it is, so it can be amended under Article 368 without touching the basic structure. It has been amended only once, by the 42nd Amendment (1976), which added Socialist, Secular and Integrity. It is not enforceable in a court and is neither a source of power nor a limit on power, but it guides interpretation where an article is ambiguous. K.M. Munshi called it the political horoscope of the Constitution.

**A Union of States:** Article 1 says India, that is Bharat, shall be a Union of States. Ambedkar explained that Union means the federation did not arise from an agreement among states and no state can secede. Article 2 lets Parliament admit or establish new states; Sikkim became an associate state by the 35th Amendment (1974) and a full state by the 36th (1975). Article 3 lets Parliament form a new state or change the area, boundaries or name of a state by a simple-majority law; the bill needs the President's prior recommendation, and the President must refer it to the state legislature for its views, which are not binding. Article 4 says such laws are not amendments under Article 368. Ceding territory to a foreign country, however, needs a constitutional amendment (Berubari, 1960), hence the 9th Amendment (1960) and the 100th Amendment (2015) on the land boundary agreement with Bangladesh.

**Reorganisation of states:** When the Constitution came into force in 1950, the states were grouped into Part A, B, C and D categories. The S.K. Dhar Commission (1948) preferred administrative convenience to language, and the JVP Committee of Jawaharlal Nehru, Vallabhbhai Patel and Pattabhi Sitaramayya also rejected language as the basis in 1949. After Potti Sriramulu died in December 1952 on a fast unto death, Andhra State was created on 1 October 1953 as the first linguistic state. The States Reorganisation Commission of December 1953, under Fazl Ali with K.M. Panikkar and H.N. Kunzru, accepted language as a broad basis in 1955 but rejected one language, one state. The States Reorganisation Act 1956 and the 7th Amendment (1956) abolished the four categories and created 14 states and 6 union territories from 1 November 1956.

**Citizenship in the Constitution:** Part II (Articles 5 to 11) only identified who became a citizen on 26 January 1950: persons domiciled in India (Article 5), migrants from Pakistan (Article 6), those who went to Pakistan but returned under a resettlement permit (Article 7) and persons of Indian origin abroad (Article 8). Under Article 9, voluntarily acquiring a foreign citizenship ends Indian citizenship, and Article 11 gives Parliament full power to regulate citizenship. India has single citizenship, taken from Britain, and some rights are for citizens only, such as those in Articles 15, 16, 19, 29 and 30.

Acquiring citizenship under the 1955 Act: The Citizenship Act 1955 provides five ways. By birth: a person born in India from 26 January 1950 to 30 June 1987 is a citizen whatever the parents' nationality; one born from 1 July 1987 to 2 December 2004 if either parent was a citizen; one born on or after 3 December 2004 if both parents are citizens, or one is a citizen and the other not an illegal migrant. By descent: birth abroad to an Indian parent, subject to

registration. By registration: persons of Indian origin, spouses of citizens and similar categories. By naturalisation: a foreigner resident in India for 12 months before applying and for 11 of the 14 years before that; the Citizenship (Amendment) Act 2019 provides that Hindu, Sikh, Buddhist, Jain, Parsi and Christian migrants from Afghanistan, Bangladesh and Pakistan who entered India on or before 31 December 2014 are not to be treated as illegal migrants, and cuts the 11 years to 5 for them. By incorporation of territory, as when Goa became part of India.

**Losing citizenship:** Renunciation is voluntary: an adult citizen makes a declaration, and a minor child of that person also loses citizenship but may resume it within a year of turning 18. Termination is automatic when a citizen voluntarily acquires another country's citizenship, except during a war in which India is engaged. Deprivation is compulsory termination by the Central Government of citizenship acquired by registration or naturalisation, for fraud, disloyalty to the Constitution, helping an enemy in war, imprisonment for 2 years within 5 years of registration or naturalisation, or 7 years' continuous residence abroad.

**Examples**

- Preamble amended only once: the 42nd Amendment (1976) added Socialist, Secular and Integrity.
- Is the Preamble part of the Constitution? Berubari Union 1960 said no; Kesavananda Bharati 1973 and LIC of India 1995 said yes.
- Article 1: India, that is Bharat, shall be a Union of States; Union because no state can secede and the federation did not arise from an agreement among states.
- Article 3 law (new state, change of area, boundary or name): simple majority, President's prior recommendation, state legislature's views not binding; Article 4: not an amendment under Article 368.
- First linguistic state: Andhra State, 1 October 1953, after Potti Sriramulu's death on a fast unto death in December 1952.
- States Reorganisation Commission (1953-55): Fazl Ali, K.M. Panikkar, H.N. Kunzru; the 1956 Act and 7th Amendment created 14 states and 6 union territories on 1 November 1956.
- Later states: Maharashtra and Gujarat 1960, Nagaland 1963, Haryana 1966, Himachal Pradesh 1971, Manipur, Tripura and Meghalaya 1972, Sikkim 1975, Mizoram, Arunachal Pradesh and Goa 1987, Chhattisgarh, Uttarakhand and Jharkhand 2000, Telangana 2014.
- Citizenship Act 1955: five ways to acquire (birth, descent, registration, naturalisation, incorporation of territory) and three ways to lose (renunciation, termination, deprivation).
- Citizen-only rights: Articles 15, 16, 19, 29 and 30; Article 9: voluntarily taking foreign citizenship ends Indian citizenship; Overseas Citizenship of India (2005) is not dual citizenship.
- Birth rule cut-offs: born in India from 26 January 1950 to 30 June 1987 - citizen whatever the parents' nationality; 1 July 1987 to 2 December 2004 - if either parent is a citizen; on or after 3 December 2004 - both parents citizens, or one a citizen and the other not an illegal migrant.

> **Quick revision:** Preamble: Sovereign Socialist Secular Democratic Republic; justice, liberty, equality, fraternity; 42nd Amendment 1976 its only amendment; Kesavananda 1973: part of Constitution; Art 1 Union of States; Art 3 new states by simple majority, Art 4 not an Art 368 amendment; Andhra 1953 first linguistic state; SRC Fazl Ali 1953-55; 14 states and 6 UTs on 1 Nov 1956; Arts 5-11 citizenship; 1955 Act: 5 ways to acquire, 3 to lose.

### Fundamental Rights (Articles 12-35), Reasonable Restrictions and Writs

**Why Part III matters:** Fundamental Rights, in Part III (Articles 12 to 35), are called the Magna Carta of India. They are justiciable: a person can go straight to the Supreme Court under Article 32 or to a High Court under Article 226. Article 12 defines the State against which they are enforced: the Union and state governments and legislatures, local authorities and other authorities such as statutory bodies. Article 13 makes void any law inconsistent with these rights; it is the textual basis of judicial review. The right to property (Article 31) was deleted by the 44th Amendment (1978) and is now a legal right under Article 300A, leaving six groups of rights.

Right to equality (Articles 14 to 18): Article 14 guarantees equality before law (a British idea) and equal protection of laws (an American idea) to every person, citizen or foreigner. Article 15 bars discrimination on grounds only of religion, race, caste, sex or place of birth; Clause 15(4), added by the First Amendment (1951), allows special

provisions for backward classes, SCs and STs, and the 103rd Amendment (2019) allowed up to 10 per cent reservation for economically weaker sections. Article 16 guarantees equality of opportunity in public employment; in Indra Sawhney (1992) the Court upheld OBC reservation, excluded the creamy layer and set a 50 per cent ceiling. Article 17 abolishes untouchability, punishable under the Protection of Civil Rights Act 1955. Article 18 abolishes titles except military and academic distinctions; national awards such as the Bharat Ratna have been held not to be titles.

Right to freedom (Articles 19 to 22): Article 19 gives citizens six freedoms: speech and expression; assembling peaceably without arms; forming associations, unions or co-operative societies (the last added by the 97th Amendment, 2011); moving freely; residing and settling anywhere in India; and practising any profession, trade or business. These are subject to reasonable restrictions for the sovereignty and integrity of India, security of the State, friendly relations with foreign states, public order, decency or morality, contempt of court, defamation and incitement to an offence; the 16th Amendment (1963) added sovereignty and integrity. Article 20 bars ex post facto criminal laws, double jeopardy and self-incrimination. Article 21 protects life and personal liberty except by procedure established by law; A.K. Gopalan (1950) read it narrowly, Maneka Gandhi (1978) required the procedure to be just, fair and reasonable, and K.S. Puttaswamy (2017) held privacy to be part of it. Article 21A (86th Amendment, 2002) gives free and compulsory education to children of 6 to 14 years. Article 22 lets a person arrested under an ordinary law know the grounds, consult a lawyer and be produced before a magistrate within 24 hours; under preventive detention, holding a person beyond 3 months needs an advisory board's report that there is sufficient cause (the 44th Amendment's cut of this period to 2 months has not been brought into force).

**Exploitation, religion and culture:** Article 23 prohibits traffic in human beings, begar and other forced labour, and Article 24 bars employing children below 14 years in factories, mines or other hazardous work. Article 25 gives every person freedom of conscience and the right to profess, practise and propagate religion, and treats carrying the kirpan as part of the Sikh religion. Article 26 lets religious denominations manage their own affairs, Article 27 bars taxes for promoting a particular religion, and Article 28 bars religious instruction in institutions wholly maintained by state funds. Article 29 protects the distinct language, script or culture of any section of citizens, and Article 30 lets all minorities, religious or linguistic, establish and administer educational institutions of their choice.

**Saving clauses and limits:** Articles 31A, 31B and 31C protect certain laws from challenge. Article 31B and the Ninth Schedule were added by the First Amendment (1951) to protect land reform laws; in I.R. Coelho (2007) the Court held that laws put in the Ninth Schedule after 24 April 1973 can be reviewed against the basic structure. In a national emergency declared for war or external aggression, Article 358 suspends Article 19 automatically, and Article 359 lets the President suspend the enforcement of other rights; since the 44th Amendment, Articles 20 and 21 can never be suspended.

Article 32 and the five writs: Article 32 is itself a Fundamental Right and part of the basic structure; Ambedkar called it the heart and soul of the Constitution. Habeas corpus orders that a detained person be produced before the court and lies against both public authorities and private individuals. Mandamus commands a public official, body or lower court to perform a public duty; it does not lie against a private person, the President or a Governor. Prohibition stops a lower court or tribunal from exceeding its jurisdiction in a pending case, while certiorari quashes an order already passed without jurisdiction or with an error of law. Quo warranto asks the holder of a public office by what authority he holds it. Under Article 226 the High Courts can issue writs not only for Fundamental Rights but also for any other purpose, so their writ jurisdiction is wider; but Article 32 is a guaranteed right, whereas Article 226 is discretionary.

### Examples

- Six Fundamental Rights groups: Equality (14-18), Freedom (19-22), Against exploitation (23-24), Freedom of religion (25-28), Cultural and educational (29-30), Constitutional remedies (32).
- Right to property: removed from Part III by the 44th Amendment (1978); now a legal right under Article 300A in Part XII.
- Rights only for citizens: Articles 15, 16, 19, 29 and 30; Articles 14, 20, 21 and 25 protect foreigners too.
- Article 21 journey: A.K. Gopalan 1950 (narrow reading) to Maneka Gandhi 1978 (just, fair and reasonable procedure) to K.S. Puttaswamy 2017 (privacy is a Fundamental Right).

- Article 21A: 86th Amendment 2002, free and compulsory education for children of 6-14 years; Right to Education Act 2009.
- Article 20: no ex post facto criminal law, no double jeopardy, no self-incrimination; Articles 20 and 21 can never be suspended in an emergency (44th Amendment).
- Mandamus does not lie against the President, a Governor or a private person; habeas corpus lies against both public authorities and private persons.
- Prohibition stops a pending proceeding in a lower court; certiorari quashes an order already passed; quo warranto tests a claim to a public office.
- Article 226 writs are wider than Article 32 (also for any other purpose), but Article 32 is itself a Fundamental Right; Ambedkar called it the heart and soul of the Constitution.
- Indra Sawhney 1992: OBC reservation upheld, creamy layer excluded, 50 per cent ceiling; 103rd Amendment 2019: up to 10 per cent reservation for economically weaker sections.

> **Quick revision:** Part III Arts 12-35; Art 12 defines State, Art 13 basis of judicial review; equality 14-18, freedom 19-22, against exploitation 23-24, religion 25-28, cultural and educational 29-30, remedies 32; property removed by 44th Amendment 1978 (now Art 300A); Art 21A by 86th Amendment 2002; Maneka Gandhi 1978; Puttaswamy 2017 privacy; writs: habeas corpus, mandamus, prohibition, certiorari, quo warranto; Art 226 wider; Arts 20 and 21 never suspended.

### Directive Principles of State Policy and Fundamental Duties

**Nature of the Directives:** Part IV (Articles 36 to 51) contains the Directive Principles of State Policy, borrowed from the Irish Constitution. Article 37 says they are not enforceable by any court but are fundamental in the governance of the country, and the State must apply them in making laws. Granville Austin described the Fundamental Rights and Directives together as the conscience of the Constitution. They resemble the Instrument of Instructions of the 1935 Act. The Constitution does not classify them, but writers group them as socialistic, Gandhian and liberal-intellectual.

**Socialistic principles:** Article 38 asks the State to secure a social order based on social, economic and political justice and, under Clause 38(2) added by the 44th Amendment (1978), to minimise inequalities in income. Article 39 covers adequate means of livelihood for all, distribution of material resources for the common good (39b), preventing concentration of wealth (39c), equal pay for equal work for men and women (39d), and opportunities for the healthy development of children (39f). Article 39A provides equal justice and free legal aid. Article 41 covers the right to work, to education and to public assistance in unemployment, old age, sickness and disablement; Article 42 just and humane conditions of work and maternity relief; Article 43 a living wage; Article 43A workers' participation in management; and Article 47 nutrition, the standard of living and public health.

**Gandhian and liberal-intellectual principles:** The Gandhian group includes Article 40 (organise village panchayats), Article 43 (promote cottage industries in rural areas), Article 43B (promote co-operative societies), Article 46 (promote the educational and economic interests of SCs, STs and weaker sections), Article 47 (prohibit intoxicating drinks and drugs injurious to health) and Article 48 (prohibit the slaughter of cows, calves and other milch and draught cattle). The liberal-intellectual group includes Article 44 (uniform civil code), Article 45 (early childhood care and education until 6 years), Article 48 (modern scientific agriculture and animal husbandry), Article 48A (protect the environment, forests and wildlife), Article 49 (protect monuments of national importance), Article 50 (separate the judiciary from the executive) and Article 51 (promote international peace and security).

**Amendments to Part IV:** The 42nd Amendment (1976) added four directives: Article 39(f), Article 39A, Article 43A and Article 48A. The 44th Amendment (1978) added Article 38(2). The 86th Amendment (2002) rewrote Article 45: it originally asked for free and compulsory education for all children up to 14 years, and once that became a Fundamental Right under Article 21A, Article 45 was changed to early childhood care and education below 6 years. The 97th Amendment (2011) added Article 43B.

**Conflict with Fundamental Rights:** In Champakam Dorairajan (1951) the Supreme Court held that the Directives must run subsidiary to the Fundamental Rights. In Golaknath (1967) it held that Parliament cannot amend Fundamental Rights even to implement Directives. The 24th Amendment (1971) reasserted Parliament's amending power, and the 25th Amendment (1971) inserted Article 31C, protecting laws that implement Article 39(b) and (c)

from challenge under Articles 14, 19 and 31. Kesavananda Bharati (1973) upheld this but struck down the clause that barred courts from checking whether a law really gave effect to those directives. The 42nd Amendment (1976) extended Article 31C to all Directives, but Minerva Mills (1980) struck down that extension and held that harmony and balance between Fundamental Rights and Directives is part of the basic structure. So the Fundamental Rights prevail, except that laws implementing Article 39(b) and (c) cannot be challenged under Articles 14 and 19.

**Directives in action:** Measures taken to give effect to Directives include land reform laws, the 73rd Amendment on panchayats (Article 40), the Legal Services Authorities Act 1987 (Article 39A), the Environment (Protection) Act 1986 (Article 48A) and the Mahatma Gandhi National Rural Employment Guarantee Act 2005 (Article 41); the Code of Criminal Procedure 1973 (since replaced by the Bharatiya Nagarik Suraksha Sanhita 2023, in force from 1 July 2024) separated the judiciary from the executive in the public services of the State (Article 50).

**Fundamental Duties:** Part IVA, with the single Article 51A, was added by the 42nd Amendment (1976) on the recommendation of the Swaran Singh Committee (1976), an idea taken from the former USSR. The Committee suggested 8 duties, but 10 were added; the 11th came with the 86th Amendment (2002). Citizens must abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem; cherish the ideals of the freedom struggle; uphold the sovereignty, unity and integrity of India; defend the country and render national service when called upon; promote harmony and renounce practices derogatory to the dignity of women; preserve the heritage of our composite culture; protect the natural environment and have compassion for living creatures; develop the scientific temper, humanism and the spirit of inquiry and reform; safeguard public property and abjure violence; strive towards excellence; and, as parents or guardians, provide opportunities for education to children between 6 and 14 years. The duties apply only to citizens and are not directly enforceable, though laws such as the Prevention of Insults to National Honour Act 1971 enforce some of them, as the Verma Committee (1999) noted.

### Examples

- Article 37: Directive Principles are not enforceable by any court but are fundamental in the governance of the country.
- 42nd Amendment (1976) added four Directives: 39(f) healthy development of children, 39A free legal aid, 43A workers in management, 48A environment, forests and wildlife.
- Article 40 village panchayats, Article 44 uniform civil code, Article 48 cattle and modern agriculture, Article 50 separation of judiciary from executive, Article 51 international peace.
- Article 45 after the 86th Amendment (2002): early childhood care and education until 6 years; education for 6-14 years moved to Article 21A.
- 97th Amendment (2011): Article 43B (promote co-operative societies) plus the freedom to form co-operative societies in Article 19.
- Minerva Mills (1980): harmony and balance between Fundamental Rights and Directive Principles is a basic feature; the 42nd Amendment's extension of Article 31C struck down.
- Directives outside Part IV: Article 335 (claims of SCs and STs to services), Article 350A (mother-tongue instruction at the primary stage), Article 351 (development of Hindi).
- Fundamental Duties: Article 51A in Part IVA, added in 1976 on the Swaran Singh Committee's advice; 10 originally, the 11th (education of children of 6-14 years) added in 2002.
- Duty (g): protect the natural environment including forests, lakes, rivers and wildlife; duty (h): develop the scientific temper, humanism and the spirit of inquiry and reform.
- Sources: Directive Principles from Ireland; Fundamental Duties from the former USSR; Fundamental Duties apply only to citizens.

> **Quick revision:** DPSP Part IV Arts 36-51, Irish source, Art 37 not justiciable; socialistic (38, 39, 39A, 41, 42, 43, 43A, 47), Gandhian (40, 43, 43B, 46, 47, 48), liberal (44, 45, 48, 48A, 49, 50, 51); 42nd Amendment added 39(f), 39A, 43A, 48A; Champakam 1951, Golaknath 1967, Kesavananda 1973, Minerva Mills 1980; Fundamental Duties Art 51A, Swaran Singh Committee 1976, 11th duty by 86th Amendment 2002.

### The President and the Vice-President of India

**Place in the system:** Article 52 says there shall be a President of India, and Article 53 vests the executive power of the Union in the President. Because India has a parliamentary system, the President is the constitutional head and acts on the aid and advice of the Council of Ministers headed by the Prime Minister (Article 74). The 42nd Amendment (1976) made that advice binding, and the 44th Amendment (1978) let the President return it once for reconsideration, after which the reconsidered advice binds.

**Election:** Under Article 54 the President is elected by an electoral college of the elected members of both Houses of Parliament, the elected members of the state Legislative Assemblies and, since the 70th Amendment (1992), the elected members of the Assemblies of Delhi and Puducherry. Article 55 prescribes proportional representation by single transferable vote through secret ballot. The value of an MLA's vote is the state's population divided by its number of elected MLAs, divided again by 1000; the value of an MP's vote is the total value of all MLAs' votes divided by the number of elected MPs. The population used is that of the 1971 Census until figures of the first census after 2026 are published. Under the Presidential and Vice-Presidential Elections Act 1952, as amended in 1997, a candidate's nomination needs 50 proposers and 50 seconders, and election disputes are decided by the Supreme Court (Article 71).

**Qualifications, oath and term:** A candidate must be a citizen, at least 35 years old, qualified for election to the Lok Sabha and not hold an office of profit (Article 58). The oath is administered by the Chief Justice of India (Article 60). The term is 5 years (Article 56), and the President may resign by writing to the Vice-President. Dr Rajendra Prasad is the only President elected twice. A vacancy must be filled within 6 months (Article 62), and meanwhile the Vice-President acts as President (Article 65); if that office is also vacant, the Chief Justice of India acts, as Justice M. Hidayatullah did in 1969.

**Impeachment:** Under Article 61 the only ground is violation of the Constitution, which the Constitution does not define. The charge may begin in either House by a resolution signed by one-fourth of its total members after 14 days' notice, and must be passed by two-thirds of the total membership of that House. The other House then investigates, and if it also passes the resolution by two-thirds of its total membership, the President stands removed. Nominated members of Parliament take part in impeachment though they do not vote in the election, while elected MLAs, who vote in the election, have no role in it.

**Executive, legislative and ordinance powers:** All executive action is taken in the President's name. The President appoints the Prime Minister and ministers, the Attorney General, the CAG, the Election Commissioners, UPSC members, Governors, the Finance Commission and judges of the Supreme Court and High Courts. The President summons and prorogues Parliament, dissolves the Lok Sabha, summons joint sittings (Article 108), addresses Parliament (Article 87) and nominates 12 members to the Rajya Sabha (Article 80). Under Article 123 the President can issue an ordinance when either House is not in session; it must be laid before Parliament and lapses 6 weeks after Parliament reassembles unless approved, so its maximum life is 6 months and 6 weeks. An ordinance cannot amend the Constitution.

**Pardon and veto:** Under Article 72 the President can grant a pardon (removing sentence and conviction), commutation (a lighter form of punishment), remission (a shorter period of the same punishment), respite (a lesser sentence because of a special fact such as pregnancy) and reprieve (a temporary stay of execution). This covers offences against Union laws, court-martial sentences and all death sentences; the Governor's power under Article 161 covers offences against laws on matters to which the state's executive power extends, and does not reach court-martial sentences. In the Maru Ram and Kehar Singh cases the Supreme Court held that the power is exercised on the advice of the Council of Ministers and is open to only limited judicial review. On bills, the President has an absolute veto (withholding assent), a suspensive veto (returning a bill other than a money bill once for reconsideration) and a pocket veto, since the Constitution fixes no time limit for the President's decision; President Zail Singh used it on the Indian Post Office (Amendment) Bill in 1986. There is no veto over constitutional amendment bills, as the 24th Amendment (1971) made assent obligatory.

**The Vice-President:** Article 63 creates the office and Article 64 makes the Vice-President the ex officio Chairman of the Rajya Sabha. Under Article 66 the Vice-President is elected by all members of both Houses of Parliament,

elected and nominated, but not by state legislators, through proportional representation by single transferable vote. A candidate must be a citizen, at least 35 and qualified for election to the Rajya Sabha, and needs 20 proposers and 20 seconders. The term is 5 years; the Vice-President takes oath before the President and resigns to the President. Removal under Article 67(b) needs a Rajya Sabha resolution passed by a majority of all its then members and agreed to by the Lok Sabha, after 14 days' notice; no ground is specified. Dr S. Radhakrishnan was the first Vice-President.

**Examples**

- Electoral college for President: elected MPs, elected MLAs of states, and elected MLAs of Delhi and Puducherry (70th Amendment 1992); nominated members and MLCs excluded.
- Electoral college for Vice-President: all MPs of both Houses, elected and nominated; no state legislators; the 11th Amendment (1961) replaced election at a joint meeting with this electoral college.
- Oath: the President takes it before the Chief Justice of India, the Vice-President before the President; the President resigns to the Vice-President, the Vice-President to the President.
- Impeachment (Article 61): only ground violation of the Constitution; 14 days' notice signed by one-fourth of the House; two-thirds of total membership in each House.
- Ordinance (Article 123): only when a House is not in session; lapses 6 weeks after Parliament reassembles; maximum life 6 months and 6 weeks; cannot amend the Constitution.
- Five forms of clemency under Article 72: pardon, commutation, remission, respite, reprieve; only the President can grant clemency for court-martial sentences.
- Vetoes: absolute, suspensive, pocket (Zail Singh, 1986, Indian Post Office Bill); no qualified veto; no veto on constitutional amendment bills (24th Amendment).
- Presidential vacancy filled within 6 months; Chief Justice M. Hidayatullah acted as President in 1969 when both offices were vacant.
- Vice-President removal (Article 67b): Rajya Sabha resolution by majority of all members, agreed by the Lok Sabha, 14 days' notice; no ground needed.
- The President is the first citizen of India and the supreme commander of the defence forces; executive power of the Union is vested in the President by Article 53.

> **Quick revision:** Arts 52-62 President, 63-71 Vice-President; President elected by elected MPs and MLAs (incl. Delhi, Puducherry) by single transferable vote; age 35; 5-year term; oath by CJI; impeachment Art 61 for violation of Constitution, two-thirds of total membership; ordinance Art 123; pardon Art 72; absolute, suspensive and pocket veto; VP ex officio Rajya Sabha Chairman, elected by all MPs, removed under Art 67(b); election disputes to Supreme Court (Art 71).

### Prime Minister, Council of Ministers and the Attorney General

**The real executive:** In India's parliamentary system the President is the nominal head and the Council of Ministers headed by the Prime Minister is the real executive. Article 74 provides the Council to aid and advise the President, and no court can inquire into the advice given. Under Article 75 the President appoints the Prime Minister, and other ministers on the Prime Minister's advice; ministers hold office during the President's pleasure; the Council is collectively responsible to the Lok Sabha; and a minister who is not a member of either House for 6 consecutive months ceases to be a minister. Article 77 says all executive action is taken in the President's name. Article 78 makes it the Prime Minister's duty to communicate the Council's decisions to the President and furnish information the President asks for.

**Appointing the Prime Minister:** By convention the President appoints the leader of the majority party or coalition in the Lok Sabha. When no party has a clear majority, the President uses personal judgement and may ask the appointee to prove a majority within a set time; this was first done in 1979, when Charan Singh was appointed. A non-member can be appointed for 6 months, and the Prime Minister may belong to either House; Indira Gandhi (1966), I.K. Gujral (1997) and Manmohan Singh (2004) were Rajya Sabha members when they took office. Jawaharlal Nehru was the first Prime Minister and held office from 1947 until his death in 1964, Gulzarilal Nanda was interim Prime Minister twice (1964 and 1966), and Morarji Desai headed the first non-Congress government (1977). The

death or resignation of the Prime Minister dissolves the Council. The post of Deputy Prime Minister is not in the Constitution; Vallabhbhai Patel was the first to hold it.

**Collective and individual responsibility:** Collective responsibility (Article 75(3)) means the Council stands or falls together: if the Lok Sabha passes a no-confidence motion, all ministers, including those from the Rajya Sabha, must resign. Cabinet decisions bind every minister, and one who cannot accept a decision must resign. Individual responsibility (Article 75(2)) flows from the President's pleasure: the President can dismiss a minister on the Prime Minister's advice. Unlike Britain, India has no legal responsibility of ministers, since no minister has to countersign the President's orders. Ministers take the oaths of office and secrecy before the President in the forms given in the Third Schedule.

**Size limit and ranks:** The 91st Amendment (2003) added Article 75(1A): the total number of ministers, including the Prime Minister, must not exceed 15 per cent of the total strength of the Lok Sabha. Article 164(1A) applies the same limit to states, with a minimum of 12 ministers. The Amendment also barred a legislator disqualified for defection from becoming a minister, and deleted the Tenth Schedule's protection for a split by one-third of a legislature party. The Council has three ranks: Cabinet ministers, Ministers of State (with independent charge or attached to Cabinet ministers) and Deputy Ministers. The Cabinet is the smaller core of the Council; the word cabinet appears in the Constitution only in Article 352, where the 44th Amendment (1978) put it.

**Cabinet committees:** Cabinet committees are extra-constitutional bodies set up under the Government of India (Transaction of Business) Rules 1961; the Prime Minister decides their number and membership. They may be standing or ad hoc and reduce the Cabinet's workload. Well-known examples are the Cabinet Committee on Political Affairs, often called a super-cabinet, the Cabinet Committee on Economic Affairs, the Appointments Committee of the Cabinet and the Cabinet Committee on Security. An informal inner circle of advisers around the Prime Minister is called the kitchen cabinet.

**Attorney General for India:** Article 76 creates the office of the Attorney General, the highest law officer of the country. The President appoints a person qualified to be a Supreme Court judge. The Constitution fixes neither the term nor the procedure for removal; the Attorney General holds office during the President's pleasure and receives the remuneration the President decides. The duties are to advise the Government of India on legal matters and perform legal duties the President assigns. The Attorney General has the right of audience in all courts in India and, under Article 88, may speak and take part in the proceedings of both Houses, their joint sitting and any committee, but cannot vote; Article 105 gives the Attorney General the privileges of a member of Parliament. The Attorney General is not a member of the Cabinet and may take private practice, but not against the Government of India. M.C. Setalvad was the first Attorney General.

**Solicitor General and Advocate General:** The Solicitor General and the Additional Solicitors General assist the Attorney General, but these offices are not mentioned in the Constitution; their service conditions come from the Law Officers (Conditions of Service) Rules 1987. The state counterpart of the Attorney General is the Advocate General (Article 165), appointed by the Governor from persons qualified to be High Court judges and holding office during the Governor's pleasure; under Article 177 the Advocate General can speak in the state legislature but cannot vote.

### Examples

- Article 74: Council of Ministers with the Prime Minister at its head to aid and advise the President; Article 75(3): collective responsibility to the Lok Sabha.
- 91st Amendment (2003): ministers including the PM at most 15 per cent of Lok Sabha strength; in a state at most 15 per cent of the assembly, with a minimum of 12.
- A person who is not an MP can be a minister or even PM for 6 months, within which he must become a member of either House.
- First use of presidential discretion in choosing a PM: Charan Singh, 1979; first non-Congress PM: Morarji Desai, 1977.
- PMs who were Rajya Sabha members when appointed: Indira Gandhi (1966), I.K. Gujral (1997), Manmohan Singh (2004).
- The word cabinet appears in the Constitution only once, in Article 352, added there by the 44th Amendment (1978).

- Cabinet committees are extra-constitutional, set up under the Transaction of Business Rules 1961; the Cabinet Committee on Political Affairs is called the super-cabinet.
- Attorney General (Article 76): qualified as a Supreme Court judge, holds office during the President's pleasure, may speak in Parliament but not vote (Article 88); the first was M.C. Setalvad.
- Solicitor General: not a constitutional office; Advocate General of a state: Article 165, appointed by the Governor, may speak in the state legislature (Article 177).

> **Quick revision:** Arts 74-78: PM heads Council of Ministers, appointed by President; collective responsibility to Lok Sabha (75(3)); non-member may serve 6 months; 91st Amendment 2003: 15% cap, state minimum 12; Cabinet ministers, Ministers of State, Deputy Ministers; word cabinet only in Art 352; cabinet committees under 1961 Rules; Attorney General Art 76, audience in all courts, speaks in Parliament without vote (Art 88); Advocate General Art 165.

### Parliament: Lok Sabha, Rajya Sabha, Bills, Budget and Committees

**Composition:** Under Article 79 Parliament consists of the President, the Council of States (Rajya Sabha) and the House of the People (Lok Sabha). Article 80 fixes the Rajya Sabha at a maximum of 250 members: up to 238 representatives of states and union territories, elected by the elected MLAs by proportional representation by single transferable vote, and 12 nominated by the President for literature, science, art and social service. The Rajya Sabha is a permanent House: one-third of its members retire every second year, and a member's term is 6 years. Article 81 fixes the Lok Sabha at a maximum of 550 elected members (530 from states and 20 from union territories); the 104th Amendment (2019) ended the nomination of two Anglo-Indians from January 2020. The Lok Sabha's term is 5 years, extendable during a national emergency one year at a time.

**Members and presiding officers:** The minimum age is 25 for the Lok Sabha and 30 for the Rajya Sabha (Article 84). The Lok Sabha elects a Speaker and a Deputy Speaker (Article 93); the Speaker resigns to the Deputy Speaker and can be removed by a resolution passed by a majority of all the then members after 14 days' notice (Article 94). The Speaker has only a casting vote (Article 100), certifies money bills, presides over joint sittings and decides defection cases under the Tenth Schedule, subject to judicial review after Kihoto Hollohan (1992). G.V. Mavalankar was the first Speaker. The Vice-President is ex officio Chairman of the Rajya Sabha, which elects a Deputy Chairman.

**Sessions and devices:** Under Article 85 six months must not pass between two sessions; by convention there are three: Budget, Monsoon and Winter. The first hour of a sitting is Question Hour: starred questions get oral answers with supplementaries, unstarred questions written answers, and short notice questions are asked on less than 10 days' notice. Zero Hour, an Indian innovation from 1962, follows Question Hour and is not in the rules of procedure. An adjournment motion raises a definite matter of urgent public importance, needs 50 members' support and is allowed only in the Lok Sabha. A no-confidence motion also needs 50 members, need not state reasons, is moved only in the Lok Sabha and, if passed, brings down the whole Council of Ministers; a censure motion must state reasons, can target one minister and does not force resignation.

**Types of bills:** An ordinary bill can be introduced in either House. A money bill (Article 110) deals only with taxes, borrowing, the Consolidated Fund and similar matters; it is introduced only in the Lok Sabha on the President's recommendation, the Speaker's certificate is final, and the Rajya Sabha can only make recommendations within 14 days; the President cannot return it. Financial bills under Article 117(1) also start only in the Lok Sabha but are otherwise treated like ordinary bills. A constitutional amendment bill (Article 368) can start in either House; it needs a special majority in each House (a majority of the total membership and two-thirds of those present and voting) and, if it affects the federal structure, ratification by half the state legislatures.

**Joint sitting:** Under Article 108 the President may summon a joint sitting when one House rejects a bill passed by the other, when the Houses disagree on amendments, or when more than 6 months pass without the other House passing it. The Speaker presides, and a majority of members of both Houses present and voting decides. Money bills and constitutional amendment bills cannot go to a joint sitting. Joint sittings were held on the Dowry Prohibition Bill (1961), the Banking Service Commission (Repeal) Bill (1978) and the Prevention of Terrorism Bill (2002).

**Budget procedure:** Article 112 calls the budget the annual financial statement; the word budget does not appear. Only the Lok Sabha votes on demands for grants, and charged expenditure, such as the emoluments of the

President, the salaries of Supreme Court judges and the CAG, and debt charges, is not voted (Article 113). In cut motions, a policy cut reduces a demand to 1 rupee, an economy cut by a stated amount and a token cut by 100 rupees. The Appropriation Bill (Article 114) authorises withdrawals from the Consolidated Fund of India (Article 266), the Finance Bill carries tax proposals, and a vote on account (Article 116) lets the government draw money until the budget is passed. Since 2017 the budget has been presented on 1 February, with the railway budget merged into it.

**Parliamentary committees:** The Public Accounts Committee (first set up in 1921) has 22 members, 15 from the Lok Sabha and 7 from the Rajya Sabha; it examines the CAG's audit reports, is chaired by an opposition member by convention since 1967, and no minister can be a member. The Estimates Committee (1950) has 30 members, all from the Lok Sabha, and suggests economies. The Committee on Public Undertakings (1964) has 22 members (15 plus 7) and examines public sector enterprises. Departmentally related standing committees, set up in 1993, examine ministries' demands for grants and bills.

**Examples**

- Rajya Sabha: maximum 250 (238 elected + 12 nominated), permanent House, one-third retire every 2 years, member's term 6 years, minimum age 30.
- Lok Sabha: maximum 550 elected (530 from states + 20 from UTs), term 5 years, minimum age 25; Anglo-Indian nomination ended by the 104th Amendment (2019).
- Speaker: certifies money bills, presides over joint sittings, has only a casting vote, resigns to the Deputy Speaker; first Speaker G.V. Mavalankar; quorum is one-tenth of a House's members.
- Questions: starred (oral, supplementaries allowed), unstarred (written), short notice (less than 10 days); Zero Hour began in 1962; calling attention motion is an Indian innovation of 1954.
- No-confidence motion: support of 50 members, no reasons needed, only in the Lok Sabha, against the whole Council; censure motion: must state reasons, can target one minister.
- Money bill (Article 110): only in the Lok Sabha, on the President's recommendation, Speaker's certificate final, Rajya Sabha has 14 days, President cannot return it.
- Joint sitting (Article 108): presided over by the Speaker; not for money or amendment bills; held in 1961 (dowry), 1978 (banking service commission) and 2002 (prevention of terrorism).
- Cut motions: policy cut (demand reduced to 1 rupee), economy cut (reduced by a stated amount), token cut (reduced by 100 rupees).
- PAC: 22 members (15 + 7), opposition chair by convention; Estimates Committee: 30 members, all from the Lok Sabha; Committee on Public Undertakings: 22 members.
- Budget terms: annual financial statement (Article 112), Appropriation Bill (Article 114), vote on account (Article 116), Contingency Fund (Article 267); presented on 1 February since 2017.

> **Quick revision:** Art 79 Parliament = President + Rajya Sabha + Lok Sabha; RS max 250, LS max 550 elected; ages 30 and 25; Speaker Arts 93-94, casting vote; max 6-month gap between sessions (Art 85); question hour, zero hour 1962; adjournment and no-confidence motions need 50 members; money bill Art 110, RS 14 days; amendment Art 368 special majority; joint sitting Art 108 (1961, 1978, 2002); budget Art 112; PAC 22, Estimates 30, COPU 22.

### The Judiciary: Supreme Court, High Courts, Subordinate Courts and Tribunals

**One integrated judiciary:** India has a single integrated judicial system, with the Supreme Court at the top, High Courts below it and subordinate courts in the districts, an arrangement taken from the Government of India Act 1935. The Supreme Court, dealt with in Articles 124 to 147, was inaugurated on 28 January 1950, succeeding the Federal Court of 1937. It began with a Chief Justice and 7 other judges, and Parliament can raise the number by law. Its seat is Delhi (Article 130).

**Appointment of judges:** The President appoints judges under Article 124(2) after consulting such judges of the Supreme Court and High Courts as necessary, and the Chief Justice of India must be consulted for every appointment other than his own. The Second Judges case (1993) created the collegium of the Chief Justice and the two senior-most judges, and the Third Judges case (1998), a presidential reference, widened it to the Chief Justice and the four senior-most judges. The 99th Amendment (2014) set up a National Judicial Appointments Commission,

which the Court struck down in the Fourth Judges case in 2015. A judge must be a citizen and have been a High Court judge for 5 years or a High Court advocate for 10 years, or be a distinguished jurist in the President's opinion. Supreme Court judges retire at 65 and High Court judges at 62.

**Removal and independence:** A judge can be removed only by the President after each House, in the same session, passes an address by a majority of its total membership and two-thirds of members present and voting, on the ground of proved misbehaviour or incapacity (Article 124(4)). Under the Judges (Inquiry) Act 1968 the motion needs 100 Lok Sabha or 50 Rajya Sabha signatures, and if admitted goes to a three-member inquiry committee. The first such motion, against Justice V. Ramaswami, failed in the Lok Sabha in 1993. Judges' salaries are charged on the Consolidated Fund of India, their conduct cannot be discussed in Parliament except during removal (Article 121), and the Court can punish for its contempt as a court of record (Article 129).

**Jurisdictions of the Supreme Court:** Original jurisdiction (Article 131) is exclusive and covers legal disputes between the Centre and states or between states, but not disputes under pre-constitution treaties. Writ jurisdiction under Article 32 is shared with the High Courts. Appellate jurisdiction covers constitutional cases on a High Court's certificate (Article 132), civil cases (Article 133) and criminal cases (Article 134). Under Article 136 the Court may grant special leave to appeal against any judgment of any court or tribunal except military ones, its widest discretionary power. Under Article 143 the President may seek its opinion on a question of law or fact of public importance; the opinion is not binding and may be declined, but on disputes from pre-constitution treaties the Court must give it.

**Judicial review and PIL:** Judicial review, the power to strike down laws and executive actions that violate the Constitution, flows from Articles 13, 32 and 226 among others and is part of the basic structure (Minerva Mills 1980; L. Chandra Kumar 1997 for the writ powers of the High Courts). Public interest litigation, pioneered by Justices P.N. Bhagwati and V.R. Krishna Iyer, relaxed the rule that only an affected person can approach the court. Hussainara Khatoon (1979), on undertrial prisoners, is regarded as the first reported PIL. Landmark PILs include Vishaka (1997) on sexual harassment at the workplace.

**High Courts:** Article 214 provides a High Court for each state, and Article 231 allows a common High Court for two or more states. The Calcutta, Bombay and Madras High Courts, set up in 1862, are the oldest. The President appoints judges after consulting the Chief Justice of India, the Governor and, for other judges, the High Court's Chief Justice (Article 217). A judge needs 10 years in judicial office or 10 years as a High Court advocate; there is no distinguished jurist category. The oath is taken before the Governor. Article 226 lets High Courts issue writs for Fundamental Rights and for any other purpose, and Article 227 gives them superintendence over all courts and tribunals in their territory except military ones.

**Subordinate courts, tribunals and Lok Adalats:** Under Articles 233 to 237, district judges are appointed by the Governor in consultation with the High Court, and the High Court controls subordinate courts. The district judge is the highest judicial officer in a district; hearing criminal cases he is the sessions judge, whose death sentence needs the High Court's confirmation. The 42nd Amendment (1976) added Part XIVA: Article 323A lets Parliament set up administrative tribunals for public service matters (Administrative Tribunals Act 1985), and Article 323B lets Parliament and state legislatures set up tribunals for taxation, industrial disputes, land reforms and other matters. Lok Adalats got statutory status under the Legal Services Authorities Act 1987; the first was held at Junagadh in Gujarat in 1982. A Lok Adalat award is deemed a civil court decree, is final with no appeal, and no court fee is payable.

### Examples

- Supreme Court inaugurated 28 January 1950, replacing the Federal Court (1937); original strength Chief Justice + 7 judges; Parliament can raise the number by law.
- Judges cases: First (S.P. Gupta 1981, consultation not concurrence), Second (1993, collegium of CJI + 2), Third (1998, CJI + 4), Fourth (2015, NJAC struck down).
- Retirement age: Supreme Court judge 65; High Court judge 62 (raised from 60 by the 15th Amendment, 1963).
- Removal motion: signed by 100 Lok Sabha or 50 Rajya Sabha members; special majority in both Houses in the same session; grounds are proved misbehaviour or incapacity.

- Article 131 original (Centre-state and inter-state disputes), Article 136 special leave, Article 143 advisory (opinion not binding), Article 141 its law binds all courts, Article 142 complete justice.
- Oath: Supreme Court judges before the President; High Court judges before the Governor; retired Supreme Court judges cannot plead in any court in India.
- Oldest High Courts: Calcutta, Bombay and Madras, 1862; Article 222: the President transfers High Court judges after consulting the CJI.
- PIL pioneers: Justices P.N. Bhagwati and V.R. Krishna Iyer; Hussainara Khatoon (1979) first reported PIL; Vishaka (1997) workplace harassment guidelines.
- Tribunals: Part XIVA added by the 42nd Amendment; Article 323A administrative tribunals (Parliament only), Article 323B other tribunals (Parliament and state legislatures); L. Chandra Kumar (1997) kept High Court review over them.
- Lok Adalat: statutory under the Legal Services Authorities Act 1987; first held at Junagadh, Gujarat, in 1982; award final, no appeal, no court fee.

> **Quick revision:** Integrated judiciary from GoI Act 1935; SC inaugurated 28 Jan 1950; Arts 124-147; collegium from Second Judges case 1993; NJAC struck down 2015; SC judges retire at 65, HC at 62; removal Art 124(4) and Judges (Inquiry) Act 1968; jurisdiction: original 131, writ 32, appellate 132-134 and 136, advisory 143; HCs Arts 214-231, writs Art 226; district judges Art 233; tribunals 323A, 323B; Lok Adalats under 1987 Act.

### Centre-State Relations, the Governor and Emergency Provisions

**Legislative relations:** Part XI (Articles 245 to 263) and Part XII govern Centre-state relations. Article 246 divides subjects through the Seventh Schedule: the Union List (originally 97 subjects, such as defence, foreign affairs and railways), the State List (originally 66, such as police, public order and agriculture) and the Concurrent List (originally 47, such as criminal law, marriage and economic planning). The 42nd Amendment (1976) moved five subjects to the Concurrent List: education, forests, weights and measures, protection of wild animals and birds, and administration of justice. Residuary powers belong to Parliament (Article 248), as in Canada. In a conflict on a Concurrent subject, the Union law prevails unless the state law was reserved for and received the President's assent (Article 254).

**Parliament on State subjects:** Parliament can legislate on a State List subject when the Rajya Sabha resolves by two-thirds of members present and voting that it is in the national interest (Article 249, valid for one year at a time); during a national emergency (Article 250); when two or more states request it (Article 252), as for the Wildlife Protection Act 1972; to implement international agreements (Article 253); and during President's rule.

**Administrative and financial relations:** States must comply with Union laws and the Centre may give them directions (Articles 256 and 257). All-India Services under Article 312 include the IAS, the IPS and the Indian Forest Service (1966). Under Article 262 Parliament passed the Inter-State River Water Disputes Act 1956. In finance, Article 268 covers duties levied by the Union but collected by states, Article 269 taxes assigned to states, Article 269A GST on inter-state trade and Article 270 taxes shared between the Union and the states; Article 275 provides grants-in-aid and Article 282 discretionary grants. The 101st Amendment (2016) created the GST Council (Article 279A), chaired by the Union Finance Minister, where decisions need a three-fourths weighted majority, the Centre holding one-third of the weight and the states two-thirds.

**Finance Commission and cooperative bodies:** Under Article 280 the President constitutes a Finance Commission every fifth year or earlier, with a chairman and 4 members. It recommends how shared taxes are divided between the Centre and the states and among the states, the principles of grants-in-aid, and measures to augment state funds for panchayats and municipalities; its advice is not binding. The first, in 1951, was chaired by K.C. Neogy. An Inter-State Council under Article 263 was set up in 1990 on the Sarkaria Commission's advice and is chaired by the Prime Minister. The five zonal councils, chaired by the Union Home Minister, are statutory bodies under the States Reorganisation Act 1956.

**The Governor and the state legislature:** The Governor is appointed by the President (Article 155) and holds office during the President's pleasure (Article 156), normally for 5 years; the appointee must be a citizen aged at least 35 (Article 157). The oath is taken before the Chief Justice of the High Court, and B.P. Singhal (2010) held that a Governor cannot be removed arbitrarily. The Governor acts on the advice of the Council of Ministers headed by the

Chief Minister (Article 163), except in discretionary matters such as reserving bills or reporting a breakdown of government; the Governor can issue ordinances (Article 213) and, under Article 161, grant pardons, reprieves, respites or remissions, or suspend, remit or commute sentences, for offences against laws on matters to which the state's executive power extends. Under Article 169 Parliament creates or abolishes a Legislative Council on the assembly's resolution passed by a special majority; a Council has at most one-third of the assembly's strength and at least 40 members (Article 171).

National emergency (Article 352): The President can proclaim it if India's security is threatened by war, external aggression or armed rebellion; the 44th Amendment (1978) replaced internal disturbance with armed rebellion and required the Cabinet's written advice. Each House must approve it within one month by a special majority; it then lasts 6 months and can be renewed every 6 months without limit. The Lok Sabha can end it by a simple-majority resolution. During it, Parliament can legislate on the State List, Article 358 suspends Article 19 (for war or external aggression only), and Article 359 allows other rights to be suspended except Articles 20 and 21. It was proclaimed in 1962 (Chinese aggression), 1971 (war with Pakistan) and 1975 (internal disturbance).

President's rule and financial emergency: Under Article 356 the President may take over a state's government when satisfied that it cannot be carried on according to the Constitution. Parliament must approve within 2 months by simple majority; it lasts 6 months, renewable up to 3 years, but beyond one year only if a national emergency is in force and the Election Commission certifies that elections cannot be held. In S.R. Bommai (1994) the Court held that the proclamation is open to judicial review and that a majority must be tested on the floor of the House. Article 360 allows a financial emergency when India's financial stability or credit is threatened; approved within 2 months, it continues until revoked and allows cuts in salaries, including those of Supreme Court and High Court judges. It has never been proclaimed.

### Examples

- Seventh Schedule originally: Union List 97, State List 66, Concurrent List 47 subjects; residuary powers with Parliament (Article 248, idea from Canada).
- 42nd Amendment moved five subjects to the Concurrent List: education, forests, weights and measures, protection of wild animals and birds, administration of justice.
- Article 249: a Rajya Sabha resolution (two-thirds present and voting) lets Parliament legislate on a State List subject for one year at a time.
- Article 263: Inter-State Council, set up 1990 on the Sarkaria Commission's advice, chaired by the PM; zonal councils: States Reorganisation Act 1956, chaired by the Union Home Minister.
- Reviews of Centre-state relations: Rajamannar Committee (1969, set up by Tamil Nadu), Sarkaria Commission (1983), Punchhi Commission (2007).
- Finance Commission (Article 280): every 5 years, chairman + 4 members; the first (1951) was chaired by K.C. Neogy. GST Council (Article 279A, 101st Amendment 2016): chaired by the Union Finance Minister.
- Governor: appointed by the President (Article 155), minimum age 35, oath before the High Court Chief Justice; B.P. Singhal (2010) bars arbitrary removal.
- Legislative Council (Article 171): at most one-third of the assembly and at least 40 members; one-third elected by MLAs, one-third by local bodies, one-twelfth each by graduates and teachers, the rest nominated by the Governor.
- Approval of emergencies: national (352) within one month by special majority; President's rule (356) and financial emergency (360) within 2 months by simple majority.
- National emergency proclaimed in 1962, 1971 and 1975; President's rule first used in Punjab in 1951; financial emergency never; S.R. Bommai (1994) requires a floor test.

> **Quick revision:** Arts 245-263 Centre-state; Seventh Schedule lists originally 97/66/47; residuary Art 248; Arts 249, 250, 252, 253 let Parliament legislate on State List; Art 254 repugnancy; Art 312 All-India Services; Art 262 water disputes; Art 263 Inter-State Council 1990; Finance Commission Art 280; GST Council Art 279A; Governor Arts 153-161; Legislative Council Arts 169, 171; emergencies Arts 352, 356, 360; 44th Amendment: armed rebellion; Bommai 1994.

## Panchayats, Municipalities and Constitutional and Non-Constitutional Bodies

73rd Amendment, the framework: The 73rd Amendment Act 1992 came into force on 24 April 1993, observed as National Panchayati Raj Day. It added Part IX, The Panchayats (Articles 243 to 243O), and the Eleventh Schedule with 29 subjects (Article 243G), giving constitutional status to panchayats as the L.M. Singhvi Committee (1986) had recommended. The Gram Sabha of all registered voters of a village is the base (Article 243A). There must be three tiers, village, intermediate and district, but a state with a population not exceeding 20 lakh may skip the intermediate tier (Article 243B). All members are directly elected, chairpersons of the intermediate and district tiers indirectly, and the minimum age to contest is 21.

**Reservation, term and supporting bodies:** Seats are reserved for SCs and STs in proportion to their population, and at least one-third of all seats, and of chairpersons' posts, are reserved for women (Article 243D); reservation for backward classes is left to the states. Every panchayat has a 5-year term, and after an early dissolution elections must be held within 6 months (Article 243E). A State Election Commission, appointed by the Governor and removable only like a High Court judge, conducts the elections (Article 243K), and a State Finance Commission, constituted every 5 years, reviews panchayat finances (Article 243I). Part IX does not apply to Nagaland, Meghalaya, Mizoram and Scheduled and tribal areas, but the PESA Act 1996 extended it, with changes, to Fifth Schedule areas. The 29 subjects include agriculture, drinking water, rural roads, primary and secondary education, and health and sanitation.

74th Amendment, urban bodies: The 74th Amendment Act 1992 came into force on 1 June 1993 and added Part IXA, The Municipalities (Articles 243P to 243ZG), and the Twelfth Schedule with 18 subjects (Article 243W). Article 243Q provides a Nagar Panchayat for an area in transition from rural to urban, a Municipal Council for a smaller urban area and a Municipal Corporation for a larger one. Ward committees are required where the population is 3 lakh or more (Article 243S). Reservation, the 5-year term, the State Election Commission and the State Finance Commission apply as for panchayats. Article 243ZD provides a District Planning Committee and Article 243ZE a Metropolitan Planning Committee for areas of 10 lakh or more. The 18 subjects include urban planning, water supply, fire services, slum improvement, and registration of births and deaths.

**Election Commission and public service commissions:** The Election Commission (Article 324), set up on 25 January 1950, now National Voters' Day, controls elections to Parliament, state legislatures and the offices of President and Vice-President, but not to local bodies. It was a single-member body until 1989, had two Election Commissioners besides the CEC briefly in 1989-90, and has been a three-member body (a Chief Election Commissioner and two Election Commissioners) since 1993. The Chief Election Commissioner can be removed only like a Supreme Court judge, and other Election Commissioners only on the CEC's recommendation; their term, fixed by law and not by the Constitution, is 6 years or until age 65, whichever comes first. Sukumar Sen was the first CEC. The UPSC (Articles 315 to 323) conducts examinations for the All-India and central services and advises on recruitment, promotion and discipline; its members are appointed by the President for 6 years or until 65 and can be removed for misbehaviour only after a Supreme Court inquiry (Article 317). State PSC members are appointed by the Governor, removable only by the President, and serve 6 years or until 62.

**CAG and the national commissions:** The Comptroller and Auditor General (Articles 148 to 151) is appointed by the President, removable only like a Supreme Court judge, and serves 6 years or until 65 under the CAG Act 1971, with no further government office afterwards. The CAG audits the accounts of the Union and the states and reports to the President, who lays the reports before Parliament, and to the Governors (Article 151); the Public Accounts Committee examines them, so the CAG is called its friend, philosopher and guide. The 65th Amendment (1990) created a combined National Commission for SCs and STs, which the 89th Amendment (2003) split into the National Commission for Scheduled Castes (Article 338) and the National Commission for Scheduled Tribes (Article 338A). The 102nd Amendment (2018) gave constitutional status to the National Commission for Backward Classes (Article 338B).

**Statutory and executive bodies:** The National Human Rights Commission was set up on 12 October 1993 under the Protection of Human Rights Act 1993; it is headed by a former Chief Justice of India or, since a 2019 amendment to the Act, a former Supreme Court judge, has the powers of a civil court, and makes recommendations that are not

binding. The Central Vigilance Commission was set up in 1964 by an executive resolution on the Santhanam Committee's advice and became statutory under the CVC Act 2003. The Central Bureau of Investigation was set up in 1963 by a Home Ministry resolution; it is not statutory and draws its powers from the Delhi Special Police Establishment Act 1946. The Lokpal was created by the Lokpal and Lokayuktas Act 2013, in force from 16 January 2014, with a chairperson and up to 8 members, half of them judicial; the first Administrative Reforms Commission had proposed it in 1966, and Maharashtra was the first state to set up a Lokayukta, under its 1971 Act (Odisha had passed such a law in 1970, but it came into force only in 1983).

**Examples**

- 73rd Amendment: in force 24 April 1993 (National Panchayati Raj Day); Part IX, Articles 243-243O; Eleventh Schedule, 29 subjects.
- 74th Amendment: in force 1 June 1993; Part IXA, Articles 243P-243ZG; Twelfth Schedule, 18 subjects.
- Panchayat rules: three tiers (intermediate tier optional where state population is 20 lakh or less), minimum age 21, one-third seats for women, 5-year term, election within 6 months of dissolution.
- State Election Commission (Article 243K) and State Finance Commission (Article 243I) serve both panchayats and municipalities; the Finance Commission (Article 280) also recommends measures to augment their funds.
- Urban bodies: Nagar Panchayat (transitional area), Municipal Council (smaller urban area), Municipal Corporation (larger urban area); ward committees at 3 lakh, Metropolitan Planning Committee at 10 lakh population.
- Election Commission: Article 324, set up 25 January 1950 (National Voters' Day); CEC removed like a Supreme Court judge; first CEC Sukumar Sen.
- UPSC (Article 315): term 6 years or age 65; State PSC: 6 years or age 62, appointed by the Governor but removable only by the President.
- CAG (Article 148): 6 years or age 65, removed like a Supreme Court judge; reports under Article 151; friend, philosopher and guide of the PAC.
- NCSC Article 338, NCST Article 338A (split by the 89th Amendment, 2003); National Commission for Backward Classes Article 338B (102nd Amendment, 2018).
- Non-constitutional bodies: NHRC (1993 Act), CVC (1964, statutory 2003), CBI (1963, powers from the DSPE Act 1946), Lokpal (2013 Act), NITI Aayog (2015).

> **Quick revision:** 73rd Amendment 1992 (in force 24 Apr 1993): Part IX, Arts 243-243O, Eleventh Schedule 29 subjects; 74th (1 Jun 1993): Part IXA, Arts 243P-243ZG, Twelfth Schedule 18; women one-third; SEC 243K, SFC 243I; Election Commission Art 324; UPSC Arts 315-323; CAG Arts 148-151; NCSC 338, NCST 338A; NHRC 1993, CVC 1964 (statutory 2003), CBI 1963, Lokpal 2013 Act.

Free practice questions: parikshasaathi.com/q/indian-polity/

## Modern Indian History and Freedom Struggle

### Modern Indian History and the Freedom Struggle

**What the exam asks:** SSC, Railway, state police and state PSC prelims papers draw three to six questions from Modern India. Almost all are precision questions: a year, a treaty-war pair, a Governor-General-policy pair, a founder-organisation pair, a Congress session and its president, a slogan or a newspaper and its author. Fixing these pairs firmly in memory matters more than reading long narratives.

**Arrival of Europeans and Company rule:** The Portuguese came first (Vasco da Gama at Calicut, 1498; Albuquerque took Goa from Bijapur, 1510), then the Dutch (1602), the English East India Company (charter of 31 December 1600; Surat factory 1613; Madras 1639; Bombay 1668; Calcutta 1690) and the French (1664; Pondicherry 1674). The three Carnatic Wars (1746-63) decided the Anglo-French contest: Treaty of Aix-la-Chapelle 1748, Battle of Wandiwash 1760 (Eyre Coote beat Lally), Treaty of Paris 1763. Plassey (23 June 1757) saw Clive defeat Siraj-ud-Daulah through Mir Jafar's treachery. Buxar (1764) saw Hector Munro defeat Mir Qasim, Shuja-ud-Daulah and Shah Alam II together; the Treaty of Allahabad (1765) gave the Company the Diwani of Bengal, Bihar and Orissa. Clive's Dual Government (1765-72) was ended by Warren Hastings.

**Governors-General and their policies:** Regulating Act 1773 made Hastings Governor-General of Bengal and set up the Supreme Court at Calcutta (1774). Pitt's India Act 1784 created the Board of Control. Cornwallis gave the Permanent Settlement (1793) and the covenanted civil service. Wellesley introduced the Subsidiary Alliance (1798; Nizam of Hyderabad first). Bentinck, the first Governor-General of India under the Charter Act of 1833, abolished Sati (Regulation XVII, 1829) and accepted Macaulay's Minute (1835). Dalhousie applied the Doctrine of Lapse (Satara 1848, Jhansi 1853, Nagpur 1854), annexed Awadh for misgovernment (1856) and started the railway and telegraph (1853); Wood's Despatch came in 1854. Canning faced 1857 and became the first Viceroy. Lytton passed the Vernacular Press Act and Arms Act (1878); Ripon repealed the Press Act (1882), gave local self-government (1882) and the Ilbert Bill (1883). Curzon partitioned Bengal (16 October 1905); Hardinge II annulled it at the Delhi Durbar of 1911 and shifted the capital to Delhi. Minto II gave separate electorates (1909), Chelmsford dyarchy in provinces (1919), and the Act of 1935 provincial autonomy. Charter Acts: 1813 ended the trade monopoly (except tea and China) and funded education; 1833 ended the Company's commercial role; 1853 brought open competition for the civil service.

**Wars with Indian powers:** Anglo-Mysore wars ended with the treaties of Madras (1769), Mangalore (1784), Seringapatam (1792) and Tipu's death in 1799. Anglo-Maratha wars: Salbai (1782) ended the first; Bassein (1802, Baji Rao II) preceded the second; the third (1817-18) abolished the Peshwaship. Anglo-Sikh wars: Treaty of Lahore (1846) ended the first; Punjab was annexed in 1849 after Chillianwala and Gujarat.

The Revolt of 1857: Mangal Pandey fired at Barrackpore on 29 March; the sepoys rose at Meerut on 10 May and proclaimed Bahadur Shah II at Delhi. Leaders: Bakht Khan (Delhi), Nana Sahib and Tantia Tope (Kanpur), Begum Hazrat Mahal (Lucknow), Rani Lakshmibai (Jhansi), Khan Bahadur Khan (Bareilly), Kunwar Singh (Arrah). Consequences: the Act of 1858 ended Company rule and created the Secretary of State; Queen Victoria's Proclamation (1 November 1858, read by Canning at Allahabad) renounced further annexation. V.D. Savarkar called it the First War of Independence.

**Socio-religious reform:** Brahmo Samaj 1828 (Rammohan Roy), Young Bengal (Derozio), Prarthana Samaj 1867 (Atmaram Pandurang, Ranade), Satyashodhak Samaj 1873 (Jyotiba Phule), Arya Samaj 1875 (Dayananda, Satyarth Prakash), Theosophical Society 1875 (Blavatsky and Olcott; Adyar 1882; Annie Besant), Aligarh movement (Sir Syed, MAO College 1875), Deoband 1866 (Nanautawi and Gangohi), Ramakrishna Mission 1897 (Vivekananda, Belur Math). Vidyasagar secured the Widow Remarriage Act 1856.

**Peasant and tribal revolts:** Santhal rebellion 1855-56 (Sidhu and Kanhu), Indigo revolt 1859-60 (Digambar and Bishnu Biswas; Neel Darpan by Dinabandhu Mitra), Deccan riots 1875 (against moneylenders), Munda Ulgulan 1899-1900 (Birsa Munda).

**Congress and the national movement:** INC founded 1885 by A.O. Hume; first session Bombay under W.C. Bonnerjee; Tyabji the first Muslim president (1887); Naoroji declared Swaraj the goal at Calcutta 1906; Surat split 1907; Muslim League at Dhaka 1906; Ghadar Party 1913; Home Rule Leagues of Tilak and Besant 1916; Lucknow Pact 1916. Gandhi arrived in 1915 and led Champaran (1917), Ahmedabad and Kheda (1918). Then came the Rowlatt Act and Jallianwala Bagh (13 April 1919), Khilafat and Non-Cooperation (1920-22, withdrawn after Chauri Chaura, 5 February 1922), Swaraj Party 1923, Simon Commission 1928, Nehru Report 1928, Jinnah's 14 points 1929, Purna Swaraj at Lahore 1929, Dandi March (12 March to 6 April 1930), Gandhi-Irwin Pact 1931, Round Table Conferences, Communal Award and Poona Pact 1932, the Act of 1935 and 1937 elections, Lahore Resolution 1940, August Offer 1940, Cripps Mission 1942, Quit India (8 August 1942), INA and the Red Fort trials, RIN mutiny 1946, Cabinet Mission 1946, Mountbatten Plan (3 June 1947) and the Indian Independence Act (18 July 1947). The revolutionary stream ran parallel: Anushilan Samiti 1902, Kakori 1925, HSRA 1928, Chittagong raid 1930, Bhagat Singh hanged 23 March 1931.

**Traps to avoid:** Plassey and Buxar are different in opponents and results; Awadh was annexed for misgovernment, not under Lapse; 1909 means separate electorates, 1919 dyarchy, 1935 provincial autonomy; Besant (1917) was the first woman president but Sarojini Naidu (1925) the first Indian woman; Mangal Pandey (29 March) came before Meerut (10 May); Gandhi attended only the Second Round Table Conference; Bhagat Singh was hanged in 1931, not 1930.

**Examples**

- Order of European arrival: Portuguese (1498), Dutch (company 1602, first Indian factory Masulipatnam 1605), English (charter 1600, Surat factory 1613), French (1664). Remember 'Po-Du-En-Fr'.
- Plassey 1757 = Clive versus Siraj-ud-Daulah (won by Mir Jafar's treachery); Buxar 1764 = Munro versus Mir Qasim, Shuja-ud-Daulah and Shah Alam II together. Buxar was the bigger result: it gave the Diwani (Treaty of Allahabad, 1765).
- Acts ladder: 1773 Regulating (Governor-General of Bengal), 1784 Pitt's (Board of Control), 1833 Charter (Governor-General of India), 1858 (Viceroy and Secretary of State), 1909 (separate electorates), 1919 (dyarchy), 1935 (provincial autonomy).
- Doctrine of Lapse annexations in order: Satara 1848, Jaitpur and Sambalpur 1849, Udaipur 1852, Jhansi 1853, Nagpur 1854. Awadh (1856) was taken on grounds of misgovernment, not Lapse.
- Treaty pairs: Madras 1769 (1st Mysore), Mangalore 1784 (2nd Mysore), Seringapatam 1792 (3rd Mysore), Salbai 1782 (1st Maratha), Bassein 1802 (before 2nd Maratha), Lahore 1846 (1st Sikh), Sugauli 1816 (Nepal), Yandabo 1826 (Burma).
- 1857 centres and leaders: Delhi - Bakht Khan; Kanpur - Nana Sahib and Tantia Tope; Lucknow - Begum Hazrat Mahal; Jhansi - Rani Lakshmibai; Bareilly - Khan Bahadur Khan; Arrah - Kunwar Singh; Faizabad - Maulvi Ahmadullah.
- Reform founders: Brahmo Samaj 1828 (Rammohan Roy), Deoband 1866, Prarthana Samaj 1867 (Atmaram Pandurang), Satyashodhak Samaj 1873 (Phule), Arya Samaj 1875 (Dayananda), Theosophical Society 1875 (Blavatsky and Olcott), Ramakrishna Mission 1897 (Vivekananda).
- Congress 'firsts': W.C. Bonnerjee (first president, 1885), Badruddin Tyabji (first Muslim, 1887), George Yule (first Englishman, 1888), Annie Besant (first woman, 1917), Sarojini Naidu (first Indian woman, 1925); Gandhi presided only once, at Belgaum 1924.
- Gandhi's three early satyagrahas, 'C-A-K': Champaran 1917 (indigo, tinkathia), Ahmedabad 1918 (mill strike, first fast), Kheda 1918 (revenue remission, Vallabhbhai Patel).
- Dates to fix: Jallianwala Bagh 13 April 1919; Chauri Chaura 5 February 1922; Dandi March 12 March to 6 April 1930; Gandhi-Irwin Pact 5 March 1931; Bhagat Singh hanged 23 March 1931; Poona Pact 24 September 1932; Quit India 8 August 1942; Mountbatten Plan 3 June 1947.
- Newspapers: Hicky's Bengal Gazette 1780 (first in India), Udant Martand 1826 (first Hindi), Kesari and Mahratta (Tilak), Al-Hilal (Azad), Comrade (Mohammad Ali), Young India and Harijan (Gandhi), Amrita Bazar Patrika (Sisir Kumar Ghosh), Mooknayak (Ambedkar).
- Slogans: 'Swaraj is my birthright' (Tilak); 'Inquilab Zindabad' (coined by Hasrat Mohani, popularised by Bhagat Singh); 'Do or Die' (Gandhi, 1942); 'Jai Hind' (the INA greeting popularised by Bose; its coinage is credited to Abid Hasan Safrani, or to Champakaraman Pillai), 'Dilli Chalo' and 'Give me blood' (Bose); 'Simon Go Back' and 'Quit India' (Yusuf Meherally); 'Vande Mataram' (Bankim Chandra).

> **Quick revision:** Vasco da Gama 1498; EIC charter 1600; Plassey 1757, Buxar 1764, Diwani 1765; Regulating Act 1773, Pitt's Act 1784; Permanent Settlement 1793 (Cornwallis); Subsidiary Alliance (Wellesley); Doctrine of Lapse (Dalhousie); Sati banned 1829 (Bentinck); 1857 began at Meerut 10 May; Queen's Proclamation 1 Nov 1858; INC 1885 (Bonnerjee); Bengal partition 1905; Muslim League 1906 Dhaka; Lucknow Pact 1916; Jallianwala Bagh 13 Apr 1919; Chauri Chaura 1922; Purna Swaraj Lahore 1929; Dandi 1930; Poona Pact 1932; Quit India 8 Aug 1942; Cabinet Mission 1946; Independence Act 18 Jul 1947

### The Europeans Arrive and the British Win Bengal (1498-1772)

**Why the Europeans came:** Spices, indigo, saltpetre and Indian cloth fetched huge profits in Europe, but Arab and Ottoman middlemen controlled the land routes. The search for a direct sea route ended when Vasco da Gama rounded the Cape of Good Hope and reached Calicut in May 1498, where the Zamorin received him. Other European traders followed; each built fortified settlements, and their rivalry, together with the decline of Mughal power after 1707, slowly turned trade into conquest.

**The Portuguese and the Dutch:** Francisco de Almeida, the first Portuguese viceroy (1505), followed the Blue Water policy of sea control. Afonso de Albuquerque captured Goa from the Sultan of Bijapur in 1510; Daman, Diu, Salsette, Bassein and Hooghly were other settlements, and Asian ships had to buy Portuguese passes called cartaz. The Portuguese were the first Europeans to come and the last to leave, holding Goa until 1961. The Dutch East India

Company, formed in 1602, set up its first Indian factory at Masulipatnam in 1605. Marthanda Varma of Travancore defeated the Dutch at Colachel in 1741, and the English beat them at Bedara in Bengal in 1759.

**The English, the Danes and the French:** The English East India Company received its charter from Queen Elizabeth I on 31 December 1600. Its first permanent factory was set up at Surat in 1613; Fort St George at Madras followed in 1639, Bombay, part of the Portuguese dowry of Charles II, was leased to the Company in 1668, and Job Charnock founded the Calcutta settlement in 1690. In 1717 the Mughal emperor Farrukhsiyar allowed the Company duty-free trade in Bengal for 3,000 rupees a year; this farman is called the Magna Carta of the Company, and the misuse of its trade passes (dastaks) later angered the Nawabs. The Danish East India Company was formed in 1616; the Danes settled at Tranquebar and Serampore and sold them to the British in 1845. The French company was formed in 1664; its first factory was at Surat (1668), and Francois Martin founded Pondicherry in 1674, with Chandernagore, Mahe, Karaikal and Yanam as other settlements.

**The Carnatic Wars:** The Anglo-French contest was fought in the Carnatic, on the Coromandel coast. In the First Carnatic War (1746-48), an offshoot of the War of Austrian Succession, the French fleet under La Bourdonnais captured Madras, which Dupleix, the governor of Pondicherry, then held, and at St Thome (1746) a small French force routed Nawab Anwaruddin's large army, proving the strength of European-trained troops; the Treaty of Aix-la-Chapelle (1748) returned Madras to the English. The Second Carnatic War (1749-54) arose from succession disputes in Hyderabad and the Carnatic; Robert Clive's seizure and defence of Arcot (1751) turned the tide, and Dupleix was recalled in 1754. The Third Carnatic War was part of the Seven Years' War (1756-63): Sir Eyre Coote defeated Count de Lally at Wandiwash on 22 January 1760, and the Treaty of Paris (1763) returned the French settlements only as unfortified trading posts.

Plassey, 1757: In Bengal, Alivardi Khan was succeeded in 1756 by his grandson Siraj-ud-Daulah. The Company's misuse of dastaks, its unauthorised fortification of Calcutta and its shelter to the Nawab's opponents led Siraj to capture Calcutta in June 1756. Clive and Admiral Watson recaptured it early in 1757 and then won over the Nawab's commander Mir Jafar, Jagat Seth, Rai Durlabh and Omichand. At Plassey on the Bhagirathi, on 23 June 1757, most of the Nawab's army did not fight; only Mir Madan and Mohan Lal stayed loyal. Siraj fled and was killed, Mir Jafar became Nawab, and the Company received the zamindari of the 24 Parganas. Plassey was more a conspiracy than a battle, but it made the Company master of Bengal.

Buxar, 1764: Mir Jafar could not meet the Company's demands and was replaced in 1760 by his son-in-law Mir Qasim, who ceded Burdwan, Midnapore and Chittagong. Mir Qasim proved an able ruler: he shifted his capital from Murshidabad to Munger, and, when the English kept abusing dastaks, abolished internal duties for all traders. War broke out in 1763; defeated, he fled to Awadh and allied with its Nawab Shuja-ud-Daulah and the Mughal emperor Shah Alam II. Major Hector Munro defeated the three together at Buxar in October 1764. As a real battle against the combined forces of the emperor and two Nawabs, Buxar was more decisive than Plassey.

**Treaty of Allahabad and dual government:** Clive signed two treaties at Allahabad in 1765. Shah Alam II granted the Company the Diwani, the right to collect revenue, of Bengal, Bihar and Orissa in return for 26 lakh rupees a year and the districts of Kora and Allahabad. Shuja-ud-Daulah got Awadh back, except Kora and Allahabad, and paid 50 lakh rupees as war indemnity. In Bengal Clive set up the dual government (1765-72): the Company held the Diwani, while the Nizamat (police and justice) stayed nominally with the Nawab but was run by Company-nominated deputies, Muhammad Reza Khan in Bengal and Raja Shitab Rai in Bihar. Power without responsibility led to oppression and the Bengal famine of 1770. Warren Hastings ended the system in 1772 and moved the treasury from Murshidabad to Calcutta.

### Examples

- First to come, last to leave: the Portuguese arrived with Vasco da Gama at Calicut (1498) and held Goa, taken by Albuquerque from Bijapur in 1510, until 1961.
- Companies founded: English 1600, Dutch 1602, Danish 1616, French 1664. First factories: Dutch at Masulipatnam 1605, English at Surat 1613 (first permanent), French at Surat 1668.
- English bases: Fort St George, Madras 1639; Bombay leased to the Company 1668; Calcutta founded by Job Charnock 1690.

- Farrukhsiyar's farman of 1717, called the Magna Carta of the Company, allowed duty-free trade in Bengal for 3,000 rupees a year.
- Carnatic Wars: First ended by the Treaty of Aix-la-Chapelle (1748); Second saw Clive at Arcot (1751); Third decided at Wandiwash (22 January 1760, Eyre Coote beat Lally) and ended by the Treaty of Paris (1763).
- Colachel 1741: Marthanda Varma of Travancore defeated the Dutch. Bedara 1759: the English defeated the Dutch in Bengal.
- Plassey, 23 June 1757: Clive versus Siraj-ud-Daulah; won over Mir Jafar, Rai Durlabh, Jagat Seth and Omichand; Mir Madan and Mohan Lal stayed loyal.
- Buxar, October 1764: Hector Munro defeated Mir Qasim, Shuja-ud-Daulah and Shah Alam II together; Mir Qasim had shifted his capital to Munger.
- Treaty of Allahabad, 1765: Diwani of Bengal, Bihar and Orissa to the Company for 26 lakh rupees a year to Shah Alam II; Awadh returned to Shuja-ud-Daulah for 50 lakh rupees.
- Dual government 1765-72: Diwani with the Company, Nizamat with the Nawab; deputies Muhammad Reza Khan (Bengal) and Shitab Rai (Bihar); ended by Warren Hastings in 1772.

> **Quick revision:** Vasco da Gama at Calicut 1498; Albuquerque took Goa 1510; Dutch company 1602, Masulipatnam 1605; English charter 31 Dec 1600, Surat 1613, Madras 1639, Bombay 1668, Calcutta 1690; Danes 1616; French 1664, Pondicherry 1674; farman of 1717; Aix-la-Chapelle 1748, Wandiwash 1760, Paris 1763; Plassey 23 Jun 1757; Buxar Oct 1764; Treaty of Allahabad 1765 (Diwani); dual government 1765-72, ended by Hastings

### British Expansion: Mysore, Maratha and Sikh Wars, Subsidiary Alliance and Lapse

**How the Company expanded:** After Bengal the Company used three tools: war, the Subsidiary Alliance and annexation by decree. Its main rivals were Mysore under Hyder Ali and Tipu Sultan, the Maratha confederacy (the Peshwa at Poona with the Scindia, Holkar, Bhonsle and Gaekwad houses) and the Sikh kingdom of Punjab. Each was defeated separately, often while the others stood aside, and each war ended in a treaty that exams pair with it.

**Anglo-Mysore Wars:** Hyder Ali, a soldier who rose to power in the Wodeyar kingdom of Mysore, fought the First War (1767-69), reached the outskirts of Madras and forced the Treaty of Madras (1769), which restored conquests and promised mutual help. In the Second War (1780-84) Hyder routed Colonel Baillie at Pollilur (1780), lost to Eyre Coote at Porto Novo (1781) and died in 1782; Tipu fought on until the Treaty of Mangalore (1784). The Third War (1790-92) began after Tipu attacked Travancore; Cornwallis allied with the Marathas and the Nizam, and by the Treaty of Seringapatam (1792) Tipu gave up half his kingdom, paid a heavy indemnity and handed over two sons as hostages. In the Fourth War (1799) under Wellesley, Tipu died defending Seringapatam, and the Wodeyar dynasty was restored to a smaller Mysore under a Subsidiary Alliance. Tipu sought French help and planted a Tree of Liberty at Seringapatam.

**Anglo-Maratha Wars:** The First War (1775-82) began when the Bombay government backed Raghunath Rao (Raghoba), a claimant to the Peshwaship, by the Treaty of Surat (1775); after a humiliating British defeat at Wadgaon (1779), the Treaty of Salbai (1782), mediated by Mahadji Scindia, restored the earlier position and kept peace for about twenty years. Peshwa Baji Rao II, driven out of Poona by Yashwantrao Holkar, signed the Treaty of Bassein on 31 December 1802 and accepted a Subsidiary Alliance. The Scindia and Bhonsle chiefs saw this as the surrender of Maratha independence, and the Second War (1803-05) followed; Arthur Wellesley won at Assaye and Lake at Laswari in 1803, and the chiefs signed the treaties of Deogaon (Bhonsle) and Surji-Arjungaon (Scindia). The Third War (1817-18), fought under Lord Hastings, ended Maratha power: the Peshwa was defeated at Kirkee and Koregaon, the Peshwaship was abolished, Baji Rao II was pensioned off to Bithur near Kanpur, and a small state of Satara was created for Shivaji's descendant Pratap Singh.

**Anglo-Sikh Wars:** Ranjit Singh had accepted the Sutlej as his boundary with the British by the Treaty of Amritsar (1809), signed with Charles Metcalfe. After his death in 1839 Punjab fell into disorder. In the First War (1845-46), under Governor-General Hardinge, the Sikhs lost at Mudki, Ferozeshah, Aliwal and Sobraon; the Treaty of Lahore (1846) took the Jalandhar Doab, kept the boy Duleep Singh as ruler with his mother Rani Jindan as regent and a British Resident at Lahore, and Kashmir was sold to Gulab Singh of Jammu. The Second War (1848-49) began with

Mulraj's revolt at Multan; after Chillianwala and the decisive British victory at Gujrat, Dalhousie annexed Punjab in 1849, sent Duleep Singh to England and took the Koh-i-Noor.

**Subsidiary Alliance:** Lord Wellesley (1798-1805) turned a device first used by Dupleix into a system. An allied ruler had to keep a British force in his territory and pay for it in cash or by ceding land, accept a British Resident at his court, employ no other Europeans, and make no war or alliance without British consent; in return the Company protected him from enemies at home and abroad. The Nizam of Hyderabad was the first to accept, in 1798, followed by Mysore (1799), Awadh (1801) and the Peshwa (1802). The ruler kept his throne but lost his independence, disbanded his own army and often sank into debt, while the Company gained a large army paid for by Indian rulers.

**Doctrine of Lapse:** Lord Dalhousie (1848-56) held that if the ruler of a dependent state died without a natural heir, the state lapsed to the Company; an adopted son could inherit private property but not the throne. Under it he annexed Satara (1848), Jaitpur and Sambalpur (1849), Udaipur in Chhattisgarh (1852), Jhansi (1853) and Nagpur (1854). He also stopped the pension of Nana Sahib, the adopted son of Baji Rao II, and ended the titles of the Nawab of the Carnatic and the Raja of Tanjore. In the same years he annexed Lower Burma (1852) after the Second Anglo-Burmese War and took Berar from the Nizam (1853).

Annexation of Awadh, 1856: Awadh had been a loyal ally under a Subsidiary Alliance since 1801, and Lapse could not be applied to it. Dalhousie annexed it in 1856 on the ground of misgovernment, relying on the reports of the Residents Sleeman and Outram, and sent Nawab Wajid Ali Shah to Calcutta. The annexation angered the many sepoys of the Bengal army who came from Awadh, and its taluqdars lost estates in the revenue settlement that followed. Lapse and the Awadh annexation together explain why Jhansi, Kanpur and Lucknow became major centres of the Revolt a year later.

**Examples**

- Mysore war treaties: First, Madras 1769; Second, Mangalore 1784; Third, Seringapatam 1792 (Tipu lost half his kingdom); Fourth, 1799, Tipu killed at Seringapatam under Wellesley.
- Hyder Ali beat Baillie at Pollilur (1780) but lost to Eyre Coote at Porto Novo (1781); he died in 1782 during the Second Mysore War.
- Maratha treaties: Surat 1775 (with Raghoba), Salbai 1782 (ended the First War), Bassein 1802 (Baji Rao II accepted a Subsidiary Alliance), Deogaon and Surji-Arjungaon 1803 (Second War).
- Third Anglo-Maratha War (1817-18) under Lord Hastings abolished the Peshwaship; Baji Rao II was pensioned to Bithur; Koregaon (1 January 1818) was one of its battles.
- Sikh treaties: Amritsar 1809 (Ranjit Singh and Metcalfe, Sutlej boundary); Lahore 1846 (after the First War); Punjab annexed 1849 under Dalhousie after Chillianwala and Gujrat.
- Subsidiary Alliance (Wellesley): first accepted by the Nizam of Hyderabad (1798), then Mysore (1799), Awadh (1801) and the Peshwa (1802).
- Doctrine of Lapse annexations in order: Satara 1848, Jaitpur and Sambalpur 1849, Udaipur 1852, Jhansi 1853, Nagpur 1854.
- Awadh was annexed in 1856 on the ground of misgovernment, not under Lapse; Nawab Wajid Ali Shah was sent to Calcutta.
- Governor-General and war: Warren Hastings - First Maratha, Second Mysore; Cornwallis - Third Mysore; Wellesley - Fourth Mysore, Second Maratha; Lord Hastings - Third Maratha; Hardinge - First Sikh; Dalhousie - Second Sikh.

> **Quick revision:** Mysore: Madras 1769, Mangalore 1784, Seringapatam 1792, Tipu killed 1799; Maratha: Surat 1775, Salbai 1782, Bassein 31 Dec 1802, Assaye 1803, Peshwaship ended 1818; Sikh: Amritsar 1809, Lahore 1846, Punjab annexed 1849; Subsidiary Alliance by Wellesley, Nizam first 1798; Doctrine of Lapse by Dalhousie, Satara 1848 to Nagpur 1854; Awadh annexed 1856 for misgovernment

### Land Revenue Systems, Drain of Wealth and Early Peasant and Tribal Revolts

**Why the economy changed:** The Company came to trade, but after the Diwani of 1765 land revenue became its main income, and the goods it exported were bought with Indian revenue itself. Three land revenue systems were

created, the old handicraft economy collapsed and wealth flowed to Britain without return. The burden fell on peasants, artisans and forest tribes, who rose in a long series of revolts well before 1857.

**Permanent Settlement:** Lord Cornwallis, advised by John Shore, made the ten-year settlement of 1789-90 permanent in 1793 in Bengal, Bihar and Orissa; it was later extended to the Banaras region and parts of northern Madras. Zamindars became hereditary owners of the land, and the revenue they paid was fixed forever at about ten-elevenths of the rent they collected, one-eleventh being left to them. Under the Sunset Law an estate whose revenue was not paid by sunset on the due date was auctioned. The state gained a fixed income and a loyal landed class, but it lost any share of later increases in land value, peasants became tenants at will, and many old zamindari families lost their estates to new, often absentee, buyers.

**Ryotwari and Mahalwari:** The Ryotwari system was first tried by Alexander Read in Baramahal in 1792 and developed by Thomas Munro, who extended it across the Madras Presidency as Governor from 1820; it was later applied in the Bombay Presidency, Assam and Coorg. Here the state settled directly with each ryot (cultivator), who was treated as owner as long as he paid the revenue; there was no middleman, but rates were high and were revised every 20 to 30 years. The Mahalwari system was proposed by Holt Mackenzie in 1822 for the North-Western Provinces and revised under William Bentinck in 1833 by Robert Bird and James Thomason; it was also used in Punjab and parts of Central India. The settlement was made with the village or group of villages (mahal) as a unit, and the headman (lambardar) collected the revenue on behalf of the community.

**Drain of wealth and deindustrialisation:** Dadabhai Naoroji put forward the drain theory in 1867 and set it out fully in Poverty and Un-British Rule in India (1901), where he estimated India's per capita income at 20 rupees a year for 1867-68. The drain was the part of India's wealth sent to Britain without economic return: salaries and pensions of British officials, interest on loans, the home charges, profits of British firms and the cost of the India Office in London. R.C. Dutt's Economic History of India and M.G. Ranade carried this critique forward. Meanwhile Indian handicrafts collapsed. After the Charter Act of 1813 ended the Company's monopoly of trade with India (except in tea), machine-made British cloth entered India almost duty-free while Indian textiles faced heavy duties in Britain; famous centres such as Dhaka (muslin) and Murshidabad (silk) declined, artisans were pushed onto the land, and agriculture was turned towards indigo, cotton, jute and opium for export.

**Early revolts in Bengal and the east:** The Sanyasi and Fakir rebellion in Bengal in the late 18th century, linked to leaders such as Majnu Shah, Bhawani Pathak and Debi Chaudhurani, grew out of the famine of 1770, high revenue and curbs on pilgrims; Bankim Chandra Chattopadhyay's novel Anandamath (1882) is set against it. The Paika rebellion (1817) in Khurda, Odisha, was led by Bakshi Jagabandhu. The Kol uprising (1831-32) in Chhotanagpur, led by Buddho Bhagat, was against outsiders who took tribal land. The Faraizi movement of Haji Shariatullah and his son Dudu Miyan in eastern Bengal turned against zamindars and indigo planters.

**Santhal, Indigo and later revolts:** The Santhal Hul (1855-56), led by the brothers Sidhu and Kanhu in the Rajmahal hills (Damin-i-Koh), targeted zamindars, moneylenders and police, the dikus or outsiders; after it was crushed a separate Santhal Parganas district was created. In the Indigo revolt (1859-60) in Nadia and Jessore, ryots led by Digambar and Bishnu Biswas refused to grow indigo for European planters; Dinabandhu Mitra's play Neel Darpan (1860) exposed the planters, Harish Chandra Mukherjee's Hindoo Patriot backed the ryots, and the government set up an Indigo Commission in 1860. Later came the Pabna agrarian league (1873) against rent increases and the Deccan riots (1875) against moneylenders, which led to the Deccan Agriculturists Relief Act (1879).

**Birsa Munda and the meaning of the revolts:** The Munda Ulgulan (1899-1900) of Birsa Munda, called Dharti Aba, opposed the breakdown of the khuntkatti system of joint tribal landholding, the dikus and missionary interference; Birsa died in Ranchi jail in 1900, and the Chhotanagpur Tenancy Act followed in 1908. These revolts were local, fought with traditional weapons and crushed by superior force, but they showed how deeply Company rule had disturbed rural life, and several of them forced protective laws.

### Examples

- Permanent Settlement 1793: Cornwallis (advised by John Shore); Bengal, Bihar and Orissa; zamindars made owners; revenue fixed forever; Sunset Law for defaulters.

- Ryotwari: Alexander Read (Baramahal, 1792) and Thomas Munro (Madras, 1820); direct settlement with the cultivator; also Bombay, Assam and Coorg.
- Mahalwari: Holt Mackenzie 1822, revised in 1833 under Bentinck (Bird and Thomason); village (mahal) as the unit; North-Western Provinces, Punjab and parts of Central India.
- Drain theory: Dadabhai Naoroji, Poverty and Un-British Rule in India (1901); per capita income 20 rupees (1867-68). R.C. Dutt wrote Economic History of India.
- Sanyasi and Fakir rebellion (Bengal, late 18th century): Majnu Shah and Bhawani Pathak; background of Bankim Chandra's Anandamath (1882), which contains Vande Mataram.
- Paika rebellion 1817: Bakshi Jagabandhu, Khurda (Odisha). Kol uprising 1831-32: Buddho Bhagat, Chhotanagpur.
- Santhal Hul 1855-56: Sidhu and Kanhu, Rajmahal hills, against the dikus; led to the Santhal Parganas district.
- Indigo revolt 1859-60: Digambar and Bishnu Biswas (Nadia); play Neel Darpan by Dinabandhu Mitra; Indigo Commission 1860.
- Deccan riots 1875 against moneylenders led to the Deccan Agriculturists Relief Act 1879; Pabna agrarian league 1873 fought rent increases.
- Munda Ulgulan 1899-1900: Birsa Munda (Dharti Aba), Chhotanagpur; died in Ranchi jail 1900; Chhotanagpur Tenancy Act 1908.

> **Quick revision:** Permanent Settlement 1793 (Cornwallis, zamindars, Bengal, Sunset Law); Ryotwari - Read 1792, Munro in Madras 1820; Mahalwari - Holt Mackenzie 1822, Bird and Thomason 1833; drain theory - Naoroji, per capita income 20 rupees; Charter Act 1813 opened India to British goods; Sanyasi revolt (Anandamath); Paika 1817; Kol 1831-32; Santhal 1855-56; Indigo 1859-60 (Neel Darpan); Deccan riots 1875; Munda Ulgulan 1899-1900

### The Revolt of 1857: Causes, Centres, Failure and the Act of 1858

**Political and economic causes:** The Revolt of 1857 drew on grievances built up over a century. The Doctrine of Lapse and the annexation of Awadh (1856) alarmed princes and nobles; Nana Sahib's pension had been stopped, and the Mughal family was told that after Bahadur Shah II the imperial title would end and the family would have to leave the Red Fort. High land revenue, the loss of estates by Awadh's taluqdars in the settlement of 1856 and the ruin of artisans spread distress through the countryside.

**Social, religious and military causes:** Many Indians feared that the British meant to convert them to Christianity; missionary activity, a law that let converts inherit ancestral property, and reforms such as the abolition of sati and the Widow Remarriage Act (1856) were read in that light. The sepoys had their own grievances: low pay and few chances of promotion, the withdrawal of the foreign service allowance (batta) for service in Sindh and Punjab, and Canning's General Service Enlistment Act (1856), which bound new recruits to serve overseas, a journey many high-caste sepoys considered polluting. The immediate cause was the new Enfield rifle, whose cartridges had to be bitten open and were rumoured to be greased with cow and pig fat.

**Outbreak at Barrackpore and Meerut:** At Barrackpore, Mangal Pandey of the 34th Native Infantry attacked his officers on 29 March 1857 and was hanged on 8 April. At Meerut, 85 sepoys of the 3rd Light Cavalry who had refused the cartridges were sentenced and paraded in fetters on 9 May; on 10 May their comrades rose, freed them, killed their officers and marched to Delhi, where on 11 May they proclaimed the aged Bahadur Shah II emperor of Hindustan. The revolt then spread across the Ganga plain and central India.

**Centres and leaders:** At Delhi the real command lay with Bakht Khan, who came from Bareilly. At Kanpur Nana Sahib led, with Tantia Tope and Azimullah Khan. At Lucknow Begum Hazrat Mahal proclaimed her son Birjis Qadir the Nawab, and Henry Lawrence died defending the Residency. Rani Lakshmibai led at Jhansi, Kunwar Singh of Jagdishpur, about 80 years old, at Arrah in Bihar, Khan Bahadur Khan at Bareilly, Maulvi Ahmadullah Shah at Faizabad and Liaqat Ali at Allahabad. The British recaptured Delhi in September 1857 after a long siege in which John Nicholson was killed; Hodson captured Bahadur Shah and shot the Mughal princes, and the emperor was exiled to Rangoon, where he died in 1862. Colin Campbell recovered Kanpur (December 1857) and Lucknow (March 1858), Havelock and Outram having relieved the Residency earlier. Hugh Rose took Jhansi in April 1858; the Rani

escaped to Kalpi, joined Tantia Tope, seized Gwalior with him and died fighting near Gwalior in June 1858. Kunwar Singh died in April 1858, and Tantia Tope, betrayed and captured, was hanged in April 1859.

**Why the revolt failed:** It was confined mainly to north and central India; Punjab, most of Bengal and the south stayed largely quiet. Most big princes, including Scindia, Holkar, the Nizam and the Rajput rulers, and Jang Bahadur of Nepal helped the British, and Canning called the loyal princes breakwaters to the storm. Sikh and Gurkha troops fought for the British. The modern educated class stayed aloof, the rebels had no unified leadership or common programme beyond restoring the old order, and they faced a power with better weapons, the telegraph, ample money and command of the sea. Historians still debate its nature: British writers called it the Sepoy Mutiny, V.D. Savarkar's book of 1909 called it the First War of Indian Independence, R.C. Majumdar held it was neither first, nor national, nor a war of independence, and S.N. Sen's official centenary history Eighteen Fifty-Seven (1957) saw a mutiny that took on a political character.

Act of 1858 and the Queen's Proclamation: The Government of India Act 1858 (the Act for the Better Government of India) ended the rule of the East India Company and transferred power to the British Crown. A Secretary of State for India, a member of the British cabinet assisted by a 15-member Council of India, took over the powers of the Board of Control and the Court of Directors, both abolished; Lord Stanley was the first. The Governor-General also became the Viceroy, the Crown's representative, Canning being the first. Queen Victoria's Proclamation, read by Canning at a durbar at Allahabad on 1 November 1858, promised no further annexations, respect for the rights and dignity of princes, non-interference in religion, equal access to public office regardless of race or creed, and pardon to rebels except those guilty of murdering British subjects.

**Changes in the army and policy:** The army was reorganised on the advice of the Peel Commission: the proportion of European troops was raised, artillery was kept in European hands, and Indian regiments were mixed by caste, community and region so that they could not unite again. The policy of annexation gave way to preserving princely states as allies, and the British increasingly played communities against one another, a policy described as divide and rule.

### Examples

- Mangal Pandey (34th Native Infantry) attacked his officers at Barrackpore on 29 March 1857 and was hanged on 8 April; the revolt proper began at Meerut on 10 May 1857.
- The Meerut sepoys reached Delhi on 11 May 1857 and proclaimed Bahadur Shah II emperor; Bakht Khan led the rebel army at Delhi.
- Centres and leaders: Kanpur - Nana Sahib, Tantia Tope; Lucknow - Begum Hazrat Mahal; Jhansi - Rani Lakshmibai; Arrah - Kunwar Singh; Bareilly - Khan Bahadur Khan; Faizabad - Maulvi Ahmadullah Shah.
- British commanders: Delhi - Nicholson and Hodson; Kanpur and Lucknow - Colin Campbell, with Havelock and Outram; Jhansi - Hugh Rose.
- Immediate cause: greased cartridges of the Enfield rifle. Military causes also included the General Service Enlistment Act of 1856, which required overseas service.
- Fates: Bahadur Shah exiled to Rangoon (died 1862); Rani Lakshmibai died fighting near Gwalior (June 1858); Tantia Tope hanged in April 1859.
- Views: First War of Indian Independence - V.D. Savarkar (1909); Eighteen Fifty-Seven - S.N. Sen (1957); R.C. Majumdar - neither first, nor national, nor a war of independence.
- Act of 1858: Company rule ended; Secretary of State for India with a 15-member Council of India; Lord Stanley the first Secretary of State; Canning the first Viceroy.
- Queen's Proclamation, 1 November 1858, read by Canning at Allahabad: no more annexations, religious non-interference, equal access to public office, pardon for most rebels.

> **Quick revision:** Causes: Lapse, Awadh 1856, General Service Enlistment Act 1856, greased Enfield cartridges; Mangal Pandey at Barrackpore 29 Mar 1857; Meerut 10 May; Delhi 11 May, Bahadur Shah II; Kanpur - Nana Sahib, Lucknow - Hazrat Mahal, Jhansi - Lakshmibai, Arrah - Kunwar Singh; Tantia Tope hanged 1859; failed - limited spread, loyal princes, no common plan; Act of 1858 - Crown rule, Secretary of State; Queen's Proclamation 1 Nov 1858

### Socio-Religious Reform Movements and Social Reform Laws

**Why reform began:** Western education, the printing press, missionary criticism and the work of Orientalist scholars led educated Indians in the 19th century to re-examine their society. Reformers attacked sati, child marriage, the ban on widow remarriage, purdah, caste rigidity and idolatry, appealing both to reason and to the authority of the Vedas and Upanishads. Reform began in Bengal, spread to Bombay, Punjab and the south, and built the self-confidence on which political nationalism later grew.

**Rammohan Roy and the Brahmo Samaj:** Raja Rammohan Roy, often called the father of the Indian Renaissance, founded the Atmiya Sabha in Calcutta and then the Brahmo Sabha on 20 August 1828, later renamed the Brahmo Samaj. It preached monotheism and opposed idol worship, sati, polygamy and caste rigidity, and supported women's property rights and English education; Rammohan also set up the Vedanta College in Calcutta. His campaign helped Governor-General William Bentinck ban sati by Regulation XVII of 1829. The Mughal emperor Akbar II gave him the title Raja and sent him to England, where he died at Bristol in 1833. Debendranath Tagore, founder of the Tattvabodhini Sabha (1839), revived the Samaj and Keshab Chandra Sen spread it, but it split in 1866 into the Adi Brahmo Samaj of Debendranath and Keshab's Brahmo Samaj of India. When Keshab married his under-age daughter into the Cooch Behar royal family, his followers formed the Sadharan Brahmo Samaj (1878).

**Young Bengal and Vidyasagar:** Henry Louis Vivian Derozio, a teacher at Hindu College, Calcutta, inspired the radical Young Bengal movement; influenced by the French Revolution, his students questioned all authority and custom. Derozio was dismissed in 1831 and died the same year, aged 22. Ishwar Chandra Vidyasagar, principal of Sanskrit College, Calcutta, used the shastras to argue for widow remarriage; his campaign produced the Hindu Widows' Remarriage Act (Act XV of 1856), passed under Canning. He also worked for girls' schools and against child marriage and polygamy.

**Reform in western India:** The Prarthana Samaj was founded in Bombay in 1867 by Atmaram Pandurang, inspired by Keshab Chandra Sen; M.G. Ranade and R.G. Bhandarkar gave it strength. It worked for inter-caste dining and marriage, widow remarriage and the education of women and the depressed classes, and Ranade later founded the Indian National Social Conference (1887). Jyotiba Phule challenged Brahmin dominance itself: with his wife Savitribai he opened a school for girls in Pune in 1848, and on 24 September 1873 he founded the Satyashodhak Samaj (Society of Truth Seekers) for the rights of lower castes. His book Gulamgiri (1873) compared their condition to slavery.

**Arya Samaj:** Swami Dayananda Saraswati, born Mool Shankar at Tankara in Gujarat, founded the Arya Samaj at Bombay in 1875; its centre later moved to Lahore. With the call Go back to the Vedas, he held the Vedas infallible but rejected idolatry, ritualism, caste by birth and child marriage, and supported widow remarriage and women's education; his Satyarth Prakash sets out these ideas. The shuddhi movement brought converts back to Hinduism. After his death in 1883 the Samaj divided: Lala Hansraj and Lala Lajpat Rai ran the Dayanand Anglo-Vedic (DAV) schools, starting at Lahore in 1886, while Swami Shraddhanand founded the Gurukul at Kangri near Haridwar in 1902.

**Ramakrishna Mission and the Theosophists:** Ramakrishna Paramahamsa, a priest at the Dakshineswar Kali temple, taught that all religions lead to the same God. His disciple Swami Vivekananda (Narendranath Datta) spoke at the Parliament of Religions in Chicago in 1893 and founded the Ramakrishna Mission on 1 May 1897, with its headquarters at Belur Math; it joined spiritual teaching with social service, and his birthday, 12 January, is observed as National Youth Day. The Theosophical Society was founded in New York in 1875 by Madame H.P. Blavatsky and Colonel H.S. Olcott and moved its headquarters to Adyar, Madras, in 1882. Annie Besant, its leader in India, founded the Central Hindu College at Banaras (1898), the nucleus of Banaras Hindu University (1916).

**Muslim reform:** Sir Syed Ahmad Khan believed Muslims had to take up modern Western education to progress. He wrote on the causes of the revolt (Asbab-e-Baghawat-e-Hind), set up the Scientific Society (1864) to translate Western works, and founded the Muhammadan Anglo-Oriental College at Aligarh in 1875, which became Aligarh Muslim University in 1920; his journal Tahzib-ul-Akhlaq spread his ideas, and he advised Muslims to keep away from the Congress. The orthodox Deoband school (1866) of Muhammad Qasim Nanautawi and Rashid Ahmad Gangohi took the opposite political line and welcomed the Congress.

**Laws that followed reform:** Regulation XVII of 1829 made sati illegal in the Bengal Presidency, and it was extended to Madras and Bombay in 1830. The Widow Remarriage Act came in 1856. The Native Marriage Act of 1872, pressed by Keshab Chandra Sen, legalised inter-caste civil marriages. The Age of Consent Act of 1891, after Behramji Malabari's campaign, raised the age of consent for girls to 12, and the Child Marriage Restraint Act (Sarda Act) of 1929 fixed the minimum age of marriage at 14 for girls and 18 for boys.

**Examples**

- Brahmo Samaj, 20 August 1828, Calcutta - Raja Rammohan Roy; split 1866 (Adi Brahmo Samaj and Brahmo Samaj of India); Sadharan Brahmo Samaj 1878.
- Sati banned by Bentinck's Regulation XVII of 1829 after Rammohan Roy's campaign; widow remarriage legalised by Act XV of 1856 after Vidyasagar's campaign.
- Young Bengal: Henry Louis Vivian Derozio, teacher at Hindu College, Calcutta; dismissed and died in 1831.
- Prarthana Samaj, Bombay, 1867 - Atmaram Pandurang, with M.G. Ranade and R.G. Bhandarkar.
- Satyashodhak Samaj, 24 September 1873, Pune - Jyotiba Phule; book Gulamgiri; girls' school with Savitribai Phule in 1848.
- Arya Samaj, Bombay, 1875 - Dayananda Saraswati; Go back to the Vedas; Satyarth Prakash; shuddhi; DAV school Lahore 1886; Gurukul Kangri 1902.
- Ramakrishna Mission, 1 May 1897 - Swami Vivekananda; Belur Math; Chicago Parliament of Religions 1893; 12 January is National Youth Day.
- Theosophical Society: New York 1875 (Blavatsky and Olcott), Adyar 1882; Annie Besant's Central Hindu College, Banaras, 1898.
- Aligarh movement: Sir Syed Ahmad Khan; Muhammadan Anglo-Oriental College 1875, Aligarh Muslim University 1920; journal Tahzib-ul-Akhlaq.
- Age of Consent Act 1891 (Behramji Malabari) and the Sarda Act 1929 (girls 14, boys 18) carried social reform into law.

> **Quick revision:** Brahmo Samaj 1828 (Rammohan Roy); sati banned 1829 (Bentinck); Young Bengal (Derozio); Tattvabodhini Sabha 1839; Widow Remarriage Act 1856 (Vidyasagar); Prarthana Samaj 1867; Satyashodhak Samaj 1873 (Phule); Arya Samaj 1875 (Dayananda); Theosophical Society 1875, Adyar 1882; MAO College Aligarh 1875 (Sir Syed); Deoband 1866; Ramakrishna Mission 1897 (Vivekananda); Age of Consent Act 1891; Sarda Act 1929

### Rise of Nationalism: Early Congress to the Morley-Minto Reforms (1885-1914)

**Roots of nationalism:** Economic exploitation, the shared experience of foreign rule, Western education, the press and the rediscovery of India's past created a national consciousness among educated Indians. Lytton's unpopular measures, the Vernacular Press Act and the Arms Act (both 1878) and the lavish Delhi Durbar of 1877 held during a famine, and the white backlash against Ripon's Ilbert Bill (1883), which would have let Indian judges try Europeans, showed the need for organised all-India agitation.

**Early political associations:** The Landholders' Society (1838) of Dwarkanath Tagore is usually called the first political association; the British Indian Association followed in Calcutta in 1851. Others were the Bombay Association and the Madras Native Association (both 1852), Dadabhai Naoroji's East India Association in London (1866), the Poona Sarvajanik Sabha (1870) associated with M.G. Ranade, and the Madras Mahajan Sabha (1884). The most important forerunner of the Congress was the Indian Association of Calcutta (1876) of Surendranath Banerjea and Ananda Mohan Bose, which held all-India National Conferences in 1883 and 1885.

**Founding of the Congress:** The Indian National Congress first met at Gokuldas Tejpal Sanskrit College, Bombay, on 28 December 1885 with 72 delegates under the presidency of W.C. Bonnerjee; A.O. Hume, a retired civil servant, was its organiser, and Dufferin was Viceroy. The safety valve theory claimed that Hume wanted a harmless outlet for educated Indians, but most historians see the Congress as the product of a political awakening that used Hume as a convenient organiser. Early sessions were Calcutta 1886 (Dadabhai Naoroji), Madras 1887 (Badruddin Tyabji, the first Muslim president) and Allahabad 1888 (George Yule, the first Englishman). Vande Mataram was first sung at a Congress session at Calcutta in 1896, by Rabindranath Tagore.

**Moderates and Extremists:** The Moderates, such as Dadabhai Naoroji, Pherozeshah Mehta, Surendranath Banerjea and Gopal Krishna Gokhale, believed in British justice and used constitutional methods of prayer, petition and protest. They demanded larger legislative councils, simultaneous civil service examinations in India and England, lower military spending and the separation of the judiciary from the executive; the Indian Councils Act of 1892 was their modest gain and their economic critique of British rule their lasting contribution. The Extremists, led by Lal-Bal-Pal (Lala Lajpat Rai, Bal Gangadhar Tilak and Bipin Chandra Pal) and Aurobindo Ghosh, demanded swaraj and relied on self-reliance and mass action; Tilak edited Kesari and Mahratta and used the public Ganapati festival (from 1893) and the Shivaji festival to reach the people.

**Partition of Bengal and Swadeshi:** Lord Curzon divided Bengal into Bengal and a new province of Eastern Bengal and Assam with its capital at Dacca, effective from 16 October 1905. The stated reason was administrative convenience; the real aim was to weaken Bengali nationalism and divide Hindus and Muslims. The Swadeshi movement was formally proclaimed at the Calcutta Town Hall on 7 August 1905 with a boycott resolution, and 16 October was observed as a day of mourning, with Rakhi Bandhan and Tagore's Amar Sonar Bangla. Its methods were boycott of British goods, swadeshi industry, national education (Bengal National College, National Council of Education) and volunteer bodies such as Ashwini Kumar Dutt's Swadesh Bandhab Samiti at Barisal; in the south V.O. Chidambaram Pillai started the Swadeshi Steam Navigation Company at Tuticorin. The Calcutta session of 1906 under Naoroji declared swaraj the goal and passed resolutions on swadeshi, boycott and national education. The partition was annulled at the Delhi Durbar of December 1911, where the transfer of the capital from Calcutta to Delhi was also announced.

**Muslim League and the Surat split:** A Muslim deputation led by the Aga Khan met Viceroy Minto at Simla on 1 October 1906 to ask for separate electorates. The All India Muslim League was founded at Dacca on 30 December 1906, with Nawab Salimullah of Dacca a leading founder and the Aga Khan its first president. In the Congress, Moderates and Extremists clashed over methods, and at the Surat session of December 1907, presided over by Rash Behari Ghosh, the party split. The Moderates kept control while the government crushed the Extremists; Tilak was sentenced in 1908 to six years in Mandalay jail.

**Morley-Minto Reforms and the revolutionaries:** The Indian Councils Act of 1909, named after Secretary of State John Morley and Viceroy Minto, enlarged the legislative councils, the central one from 16 to 60 members, allowed supplementary questions and resolutions on the budget, and introduced separate electorates for Muslims; Satyendra Prasanna Sinha became the first Indian in the Viceroy's Executive Council. A revolutionary stream ran alongside. The Chapekar brothers shot the plague commissioner Rand at Poona in 1897; the Anushilan Samiti (1902) and the Jugantar group worked in Bengal; Khudiram Bose and Prafulla Chaki threw a bomb at Muzaffarpur in 1908, which led to Khudiram's hanging and the Alipore bomb case, in which Aurobindo was acquitted. Abroad, Shyamji Krishna Varma set up India House in London (1905), Madan Lal Dhingra shot Curzon Wyllie (1909), Rash Behari Bose planned the bomb attack on Viceroy Hardinge at Delhi (1912), and Lala Har Dayal and Sohan Singh Bhakna led the Ghadar Party (1913), headquartered at San Francisco.

### Examples

- Usually called the first political association: Landholders' Society, Calcutta, 1838 (Dwarkanath Tagore). Indian Association, 1876 (Surendranath Banerjea and Ananda Mohan Bose).
- INC founded 28 December 1885 at Gokuldas Tejpal Sanskrit College, Bombay: 72 delegates, president W.C. Bonnerjee, organiser A.O. Hume, Viceroy Dufferin.
- Early presidents: 1886 Calcutta - Dadabhai Naoroji; 1887 Madras - Badruddin Tyabji (first Muslim); 1888 Allahabad - George Yule (first Englishman).
- Partition of Bengal: Curzon, effective 16 October 1905; Swadeshi proclaimed at Calcutta Town Hall on 7 August 1905; annulled at the Delhi Durbar, December 1911.
- Calcutta session 1906 (Dadabhai Naoroji): swaraj declared the goal, with resolutions on swadeshi, boycott and national education. Surat 1907 (Rash Behari Ghosh): the split.
- All India Muslim League: Dacca, 30 December 1906; Nawab Salimullah; first president Aga Khan; preceded by the Simla deputation of 1 October 1906.

- Morley-Minto Reforms (Indian Councils Act 1909): separate electorates for Muslims; S.P. Sinha the first Indian in the Viceroy's Executive Council.
- Lal-Bal-Pal: Lala Lajpat Rai (Punjab), Bal Gangadhar Tilak (Maharashtra), Bipin Chandra Pal (Bengal); Tilak's papers Kesari (Marathi) and Mahratta (English).
- Revolutionaries: Chapekar brothers (Rand, 1897); Khudiram Bose (Muzaffarpur, 1908); Madan Lal Dhingra (Curzon Wyllie, 1909); Ghadar Party (1913, San Francisco).

> **Quick revision:** Landholders' Society 1838; Indian Association 1876; INC 28 Dec 1885, Bombay, 72 delegates, W.C. Bonnerjee; Tyabji 1887; Moderates - prayer, petition, protest; Extremists - Lal-Bal-Pal; Bengal partition 16 Oct 1905 (Curzon); Swadeshi proclaimed 7 Aug 1905; Muslim League Dacca 30 Dec 1906; Surat split 1907; Morley-Minto 1909 separate electorates; partition annulled 1911; Ghadar Party 1913

### From Home Rule to Non-Cooperation (1914-1922)

**Home Rule Leagues:** The First World War (1914-18) brought high prices, forced recruitment and war loans. With Tilak released in 1914 and Annie Besant active, two Home Rule Leagues were set up in 1916 on the Irish model. Tilak's league, founded in April 1916 at Belgaum, worked in Maharashtra (except Bombay city), Karnataka, the Central Provinces and Berar; Besant's league, founded in September 1916 at Madras, covered the rest of India. Besant's papers New India and Commonweal and Tilak's Kesari and Mahratta spread the demand for self-government. Besant's arrest in 1917 caused nationwide protest; she was released and became the first woman president of the Congress at Calcutta in 1917. Secretary of State Montagu's August Declaration of 20 August 1917 promised the gradual development of responsible government in India.

Lucknow Pact, 1916: At Lucknow in December 1916 two reunions took place. The Extremists returned to the Congress, ending the split of 1907, and the Congress, under A.C. Mazumdar, and the Muslim League, whose session Jinnah presided over, agreed on joint demands for self-government. The Congress accepted separate electorates for Muslims, a concession later criticised, but the pact marked the high point of Hindu-Muslim political unity. Tilak and Jinnah were its main architects.

Gandhi's early struggles: Mohandas Karamchand Gandhi returned from South Africa on 9 January 1915, having developed satyagraha there against racial laws; Gokhale was his political guru. He first took up three local causes. In Champaran (Bihar, 1917), at the request of Rajkumar Shukla, he championed indigo cultivators forced under the tinkathia system to grow indigo on 3/20 of their land; joined by Rajendra Prasad, Mazharul Haq, J.B. Kripalani and Mahadev Desai, he defied an order to leave the district and won an inquiry that ended the system. This was his first civil disobedience in India. In Ahmedabad (1918) he backed mill workers in a dispute over a plague bonus, went on hunger strike for the first time in India, and the workers won a 35 percent wage increase; Anasuya Sarabhai helped him. In Kheda (1918) in Gujarat, where crops had failed, he supported the peasants' demand for remission of revenue; Vallabhbhai Patel joined him, and this is called his first non-cooperation.

**Rowlatt Act and Jallianwala Bagh:** The Rowlatt Act (Anarchical and Revolutionary Crimes Act) of March 1919, based on a committee chaired by Justice Sidney Rowlatt, allowed detention without trial for up to two years and trials without juries. Gandhi formed the Satyagraha Sabha and called a nationwide hartal on 6 April 1919, his first all-India protest. In Amritsar, after the arrest of Saifuddin Kitchlew and Satyapal, a peaceful crowd gathered at Jallianwala Bagh on Baisakhi day, 13 April 1919; Brigadier-General Reginald Dyer blocked the main exit and opened fire without warning. The official count of the dead was 379; Indian estimates were far higher. Rabindranath Tagore gave up his knighthood, Gandhi later returned his Kaiser-i-Hind medal, and the government's Hunter Committee let Dyer off lightly. In 1940 Udham Singh shot Michael O'Dwyer, the former Lieutenant-Governor of Punjab, in London.

**Montagu-Chelmsford Reforms:** Based on the 1918 report of Secretary of State Edwin Montagu and Viceroy Chelmsford, the Government of India Act 1919 introduced dyarchy in the provinces, dividing subjects into transferred ones run by ministers answerable to the legislature and reserved ones kept by the Governor and his executive council. It created a bicameral central legislature and extended separate electorates to Sikhs, Indian Christians, Anglo-Indians and Europeans. Coming with the Rowlatt Act and Jallianwala Bagh, the reforms satisfied few.

**Khilafat and Non-Cooperation:** After the war the Ottoman Sultan, regarded as the Khalifa of Islam, was stripped of power by the Treaty of Sevres (1920). The Ali brothers (Mohammad Ali and Shaukat Ali), Maulana Azad, Hakim Ajmal Khan and Hasrat Mohani led the Khilafat movement, and Gandhi saw in it a chance to unite Hindus and Muslims. The Non-Cooperation movement began on 1 August 1920, the day Tilak died; a special Congress session at Calcutta (September 1920, Lala Lajpat Rai) approved it, and the Nagpur session (December 1920, C. Vijayaraghavachariar) confirmed it and reorganised the party on the basis of linguistic provinces with a Working Committee. Indians surrendered titles and boycotted government schools, courts, foreign cloth and the council elections of 1920; national institutions such as Jamia Millia Islamia, Kashi Vidyapith and Gujarat Vidyapith were founded; the Tilak Swaraj Fund was raised; and the visit of the Prince of Wales in November 1921 was met with a hartal. Gandhi promised swaraj within a year.

**Chauri Chaura and withdrawal:** On 5 February 1922 at Chauri Chaura in Gorakhpur district of the United Provinces, an angry crowd set fire to the police station, killing 22 policemen by the usual count (some accounts say 23). Gandhi, feeling the people were not yet ready for non-violence, withdrew the movement, and the Working Committee confirmed this at Bardoli on 12 February 1922. Gandhi was arrested in March 1922 and sentenced to six years in prison, and the Khilafat issue itself ended when Mustafa Kemal abolished the caliphate in 1924. Even so, the movement had turned the Congress into a mass organisation.

**Examples**

- Home Rule Leagues 1916: Tilak's (April, Belgaum) and Annie Besant's (September, Madras); Besant's papers New India and Commonweal.
- Lucknow Pact, December 1916: Congress-League unity; the Congress accepted separate electorates; Extremists readmitted; architects Tilak and Jinnah.
- August Declaration, 20 August 1917: Montagu promised gradual progress towards responsible government in India.
- Gandhi's early struggles: Champaran 1917 (indigo, tinkathia, Rajkumar Shukla) - first civil disobedience; Ahmedabad 1918 (first hunger strike, 35 percent rise); Kheda 1918 (revenue remission, Patel) - first non-cooperation.
- Rowlatt Act, March 1919: detention without trial; Gandhi's Satyagraha Sabha; nationwide hartal on 6 April 1919.
- Jallianwala Bagh, Amritsar, 13 April 1919: General Dyer; Hunter Committee; Tagore gave up his knighthood; Udham Singh shot O'Dwyer in London in 1940.
- Government of India Act 1919: dyarchy in the provinces (transferred and reserved subjects), bicameral central legislature, separate electorates extended to Sikhs and others.
- Non-Cooperation began on 1 August 1920 (Tilak died that day); approved at the Calcutta special session (September 1920) and Nagpur (December 1920).
- Chauri Chaura, Gorakhpur, 5 February 1922: 22 policemen killed (the usual count; some sources say 23); the movement was withdrawn at Bardoli on 12 February 1922.

> **Quick revision:** Home Rule Leagues 1916 (Tilak - April, Besant - September); Lucknow Pact Dec 1916; August Declaration 1917; Gandhi back 9 Jan 1915; Champaran 1917, Ahmedabad and Kheda 1918; Rowlatt Act Mar 1919; Jallianwala Bagh 13 Apr 1919 (Dyer); Act of 1919 - dyarchy; Khilafat; Non-Cooperation 1 Aug 1920, Nagpur Dec 1920; Chauri Chaura 5 Feb 1922; withdrawn at Bardoli

## From the Swaraj Party to Provincial Ministries (1922-1939)

**Swaraj Party:** After Non-Cooperation was withdrawn, C.R. Das (president) and Motilal Nehru (secretary) formed the Congress-Khilafat Swaraj Party on 1 January 1923 to enter the councils and obstruct them from within. The no-changers, such as Vallabhbhai Patel, Rajendra Prasad and C. Rajagopalachari, preferred Gandhi's constructive programme. The Swarajists did well in the 1923 elections, and Vithalbhai Patel became the first Indian President (Speaker) of the Central Legislative Assembly in 1925, but the party weakened after Das died that year.

**Simon Commission and Nehru Report:** The Simon Commission was appointed in November 1927 to review the 1919 Act; its seven members, chaired by Sir John Simon and including Clement Attlee, were all British. Boycotted by the Congress, it met black flags and the slogan Simon Go Back from its arrival in Bombay on 3 February 1928. At Lahore, Lala Lajpat Rai was beaten in a police lathi-charge and died on 17 November 1928. Answering Birkenhead's

challenge, an all-parties committee headed by Motilal Nehru produced the Nehru Report (August 1928), proposing dominion status, joint electorates with reserved seats for minorities, linguistic provinces and 19 fundamental rights. Jinnah answered with his Fourteen Points (1929), while younger leaders wanted complete independence.

**Purna Swaraj and the Dandi March:** The Lahore session of December 1929, presided over by Jawaharlal Nehru, declared Purna Swaraj (complete independence) the goal; the tricolour was hoisted on the bank of the Ravi on 31 December 1929, and 26 January 1930 was observed as Independence Day, which is why the Constitution came into force on 26 January 1950. When Viceroy Irwin ignored his eleven demands, Gandhi chose salt: he set out from Sabarmati Ashram with 78 followers on 12 March 1930 and broke the salt law at Dandi on 6 April 1930. Civil disobedience spread fast: C. Rajagopalachari marched to Vedaranyam in Tamil Nadu, and Sarojini Naidu led the raid on the Dharasana salt works; Khan Abdul Ghaffar Khan's Khudai Khidmatgars (Red Shirts) were active in the North-West Frontier, where the Garhwal Rifles refused to fire on crowds at Peshawar, and Rani Gaidinliu led resistance in the north-east.

**Gandhi-Irwin Pact and the Round Tables:** The First Round Table Conference (1930-31) in London met without the Congress. The Gandhi-Irwin Pact of 5 March 1931 released political prisoners not convicted of violence, allowed coastal villagers to make salt for their own use and permitted peaceful picketing; the Congress in turn suspended civil disobedience and agreed to attend the next conference. The Karachi session (March 1931, Vallabhbhai Patel) endorsed the pact and passed resolutions on Fundamental Rights and a National Economic Programme. Gandhi was the sole Congress representative at the Second Round Table Conference (1931), which broke down over separate electorates for minorities. Civil disobedience resumed in 1932 under Viceroy Willingdon and was withdrawn in 1934. The Congress stayed away from the Third Round Table Conference (1932); B.R. Ambedkar attended all three.

**Communal Award and Poona Pact:** British Prime Minister Ramsay MacDonald announced the Communal Award on 16 August 1932, extending separate electorates to the depressed classes. Gandhi, in Yerawada jail at Poona, saw this as a division of Hindu society and began a fast unto death on 20 September 1932. The Poona Pact of 24 September 1932, between Gandhi and Ambedkar, replaced separate electorates for the depressed classes with joint electorates and raised their reserved seats in the provincial legislatures from 71 to 148. Gandhi then founded the Harijan Sevak Sangh (1932).

Act of 1935 and the 1937 elections: The Government of India Act 1935 brought provincial autonomy and proposed an All-India Federation that never came into being. In the provincial elections of early 1937 the Congress won majorities in Madras, the United Provinces, the Central Provinces, Bihar and Orissa, was the largest party in Bombay, and in time formed ministries in eight of the eleven provinces; the Muslim League fared poorly. The ministries resigned in October and November 1939 when Viceroy Linlithgow made India a party to the Second World War without consulting Indians, and the League celebrated a Day of Deliverance on 22 December 1939. Subhas Chandra Bose, president at Haripura (1938), was re-elected at Tripuri (1939) but resigned after differences with Gandhi and formed the Forward Bloc.

**Bhagat Singh and the HSRA:** The Hindustan Republican Association (1924) of Sachindranath Sanyal, Ramprasad Bismil and others carried out the Kakori train action of 9 August 1925, for which Bismil, Ashfaqulla Khan, Roshan Singh and Rajendra Lahiri were hanged. In September 1928, at Ferozeshah Kotla in Delhi, Chandrashekhar Azad, Bhagat Singh, Sukhdev and others renamed it the Hindustan Socialist Republican Association. To avenge Lajpat Rai, Bhagat Singh, Rajguru and Azad shot the police officer Saunders at Lahore on 17 December 1928. On 8 April 1929 Bhagat Singh and Batukeshwar Dutt threw harmless bombs in the Central Legislative Assembly against the Public Safety and Trade Disputes Bills and courted arrest, shouting Inquilab Zindabad. Jatin Das died after a 63-day hunger strike in Lahore jail in 1929; Azad fell in Alfred Park, Allahabad, on 27 February 1931; and Bhagat Singh, Sukhdev and Rajguru were hanged at Lahore on 23 March 1931.

### Examples

- Swaraj Party: 1 January 1923, C.R. Das (president) and Motilal Nehru (secretary); council entry; Vithalbhai Patel the first Indian President of the Central Legislative Assembly (1925).

- Simon Commission: appointed November 1927, seven British members under Sir John Simon (Attlee among them); reached Bombay 3 February 1928; Lala Lajpat Rai died after a lathi-charge at Lahore (17 November 1928).
- Nehru Report, August 1928 (Motilal Nehru): dominion status, joint electorates, linguistic provinces, 19 fundamental rights; answered by Jinnah's Fourteen Points (1929).
- Lahore session, December 1929 (Jawaharlal Nehru): Purna Swaraj; flag hoisted on the Ravi on 31 December 1929; 26 January 1930 the first Independence Day.
- Dandi March: Sabarmati, 12 March 1930, with 78 followers; salt law broken at Dandi on 6 April 1930. Vedaranyam - Rajagopalachari; Dharasana - Sarojini Naidu; Red Shirts - Ghaffar Khan.
- Gandhi-Irwin Pact, 5 March 1931: prisoners released, salt-making for coastal villages, civil disobedience suspended; Karachi session 1931 (Patel) passed the Fundamental Rights resolution.
- Round Table Conferences: First 1930-31, Second 1931 (Gandhi attended), Third 1932; Ambedkar attended all three, the Congress only the second.
- Communal Award 16 August 1932 (Ramsay MacDonald); Gandhi's fast in Yerawada; Poona Pact 24 September 1932 - joint electorate, 148 reserved seats instead of 71.
- 1937 elections: Congress ministries in eight provinces; resigned October-November 1939; the League's Day of Deliverance on 22 December 1939.
- HSRA: Ferozeshah Kotla, September 1928; Assembly bomb 8 April 1929 (Bhagat Singh and B.K. Dutt); Bhagat Singh, Sukhdev and Rajguru hanged 23 March 1931.

> **Quick revision:** Swaraj Party 1 Jan 1923 (Das, Motilal); Simon Commission Nov 1927, reached India 1928; Nehru Report Aug 1928; Lahore Dec 1929 Purna Swaraj; 26 Jan 1930 Independence Day; Dandi 12 Mar - 6 Apr 1930; Gandhi-Irwin Pact 5 Mar 1931; Round Tables 1930, 1931, 1932; Communal Award 16 Aug 1932; Poona Pact 24 Sep 1932; Act of 1935; Congress ministries 1937-39; Kakori 1925; HSRA 1928; Bhagat Singh hanged 23 Mar 1931

### From the Second World War to Independence and Integration (1939-1947)

**War, the August Offer and Individual Satyagraha:** When the Second World War began in September 1939, Viceroy Linlithgow declared India at war without consulting its leaders, and the Congress ministries resigned. The Muslim League's Lahore Resolution of 23 March 1940 demanded separate Muslim-majority states. The August Offer of 8 August 1940 promised dominion status as the eventual goal, more Indians in the Executive Council and an Indian body to frame a constitution after the war, with a veto for minorities; the Congress rejected it. Gandhi, avoiding a mass movement during the war, launched the Individual Satyagraha on 17 October 1940; Vinoba Bhave was the first satyagrahi and Jawaharlal Nehru the second.

Cripps Mission, 1942: As Japan advanced through South-East Asia, Sir Stafford Cripps came to India in March 1942 offering dominion status and a constitution-making body after the war, with the right of any province to stay out of the new union; defence would stay in British hands. The Congress and the League both rejected it, and Gandhi called it a post-dated cheque.

Quit India, 1942: The Working Committee passed the Quit India resolution at Wardha on 14 July 1942, and the All India Congress Committee adopted it at Gowalia Tank, Bombay, on 8 August 1942, where Gandhi gave the call Do or Die. Early on 9 August all major leaders were arrested; Gandhi was held in the Aga Khan Palace at Poona, where Kasturba died in 1944. The leaderless people rose: Aruna Asaf Ali hoisted the flag at Gowalia Tank, Usha Mehta ran an underground Congress Radio and Jayaprakash Narayan led underground resistance. Parallel governments arose at Ballia (Chittu Pandey), Tamluk (Jatiya Sarkar) and Satara (Prati Sarkar). The Muslim League, the Communists and the Hindu Mahasabha stayed away; though crushed, the movement showed that British rule could no longer rest on consent.

**Subhas Chandra Bose and the INA:** Bose escaped from house arrest in January 1941, reached Germany via Kabul and in 1943 came to South-East Asia by submarine. Captain Mohan Singh had first raised the Indian National Army in 1942 from Indian prisoners of war with Japanese help; Subhas took command in July 1943 and proclaimed the Provisional Government of Free India (Azad Hind) at Singapore on 21 October 1943, and its women's Rani Jhansi Regiment was led by Lakshmi Swaminathan. The INA fought in the Imphal-Kohima campaign (1944), raising the

tricolour at Moirang in Manipur, but retreated with Japan's defeat; Bose is reported to have died in an air crash at Taipei on 18 August 1945. He gave the slogans Dilli Chalo and Give me blood and I will give you freedom, and in 1944 he addressed Gandhi as the Father of the Nation.

**INA trials and the naval mutiny:** The Red Fort trial (November 1945) of INA officers Shah Nawaz Khan, Prem Kumar Sahgal and Gurbaksh Singh Dhillon, defended by Bhulabhai Desai and Nehru, set off nationwide protests, and their sentences were remitted. On 18 February 1946 ratings of HMIS Talwar in Bombay struck against bad food and racial discrimination; the naval mutiny spread to Karachi and Calcutta until the ratings surrendered on the advice of Patel and Jinnah, showing that Britain could no longer rely on Indian forces.

**Cabinet Mission and Direct Action:** After Viceroy Wavell's Shimla Conference (1945) failed, Attlee's Labour government sent the Cabinet Mission of Pethick-Lawrence, Stafford Cripps and A.V. Alexander. Its plan of 16 May 1946 rejected Pakistan and proposed a Union in charge of defence, foreign affairs and communications, grouping of provinces into three groups, a Constituent Assembly of 389 members and an interim government. Disputes over grouping led the League to withdraw and call Direct Action Day on 16 August 1946, setting off the Great Calcutta Killings and riots in Noakhali and Bihar. The interim government headed by Nehru took office on 2 September 1946, and the Constituent Assembly first met on 9 December 1946 without the League.

**Mountbatten Plan and the Independence Act:** Attlee announced on 20 February 1947 that Britain would leave India by June 1948. Lord Mountbatten, the last Viceroy, announced the plan of 3 June 1947: the Punjab and Bengal assemblies would vote on partition, the North-West Frontier Province and Sylhet would hold referendums, Cyril Radcliffe would draw the boundaries, and power would pass earlier, on 15 August 1947. The Indian Independence Act (royal assent 18 July 1947) created the dominions of India and Pakistan, ended British paramountcy over the princely states and abolished the office of Secretary of State for India. Mountbatten stayed on as free India's first Governor-General, followed by C. Rajagopalachari, the only Indian to hold the post.

**Integration of the princely states:** Vallabhbhai Patel, heading the States Department with V.P. Menon as its secretary, brought over 560 princely states into India, mostly through Instruments of Accession ceding defence, external affairs and communications. Junagadh joined after a plebiscite in 1948, Hyderabad after the police action called Operation Polo in September 1948, and Jammu and Kashmir when Maharaja Hari Singh, facing a tribal invasion from Pakistan, signed the Instrument of Accession on 26 October 1947.

### Examples

- August Offer, 8 August 1940 (Linlithgow): dominion status as the goal, an enlarged Executive Council, a constitution-making body after the war - the first admission of Indians' right to frame their constitution; rejected by the Congress.
- Individual Satyagraha from 17 October 1940: the first satyagrahi was Vinoba Bhave, the second Jawaharlal Nehru.
- Cripps Mission, March 1942: dominion status after the war, provinces could opt out; Gandhi called it a post-dated cheque.
- Quit India: resolution at Wardha 14 July 1942, adopted at Gowalia Tank, Bombay, 8 August 1942; Do or Die; Aruna Asaf Ali hoisted the flag; Usha Mehta's Congress Radio.
- Parallel governments of 1942: Ballia (Chittu Pandey), Tamluk (Jatiya Sarkar) and Satara (Prati Sarkar).
- Azad Hind government, Singapore, 21 October 1943; INA's Rani Jhansi Regiment under Lakshmi Swaminathan; Andaman and Nicobar renamed Shaheed and Swaraj.
- INA trial at the Red Fort, 1945: Shah Nawaz Khan, P.K. Sahgal and G.S. Dhillon, defended by Bhulabhai Desai. Naval mutiny: HMIS Talwar, Bombay, 18 February 1946.
- Cabinet Mission 1946: Pethick-Lawrence, Cripps and A.V. Alexander; plan of 16 May 1946; Constituent Assembly of 389 members; Direct Action Day 16 August 1946.
- Mountbatten Plan 3 June 1947; Indian Independence Act, royal assent 18 July 1947; independence 15 August 1947; Radcliffe drew the boundaries.
- Integration: Patel and V.P. Menon; Junagadh by plebiscite (1948), Hyderabad by Operation Polo (September 1948), Kashmir's accession on 26 October 1947.

> **Quick revision:** India declared at war Sept 1939; Lahore Resolution 23 Mar 1940; August Offer 8 Aug 1940; Individual Satyagraha 17 Oct 1940 (Vinoba first); Cripps Mar 1942; Quit India 8 Aug 1942, Do or Die; Azad Hind govt 21 Oct 1943; INA trials 1945; naval mutiny 18 Feb 1946; Cabinet Mission plan 16 May 1946; Direct Action 16 Aug 1946; Mountbatten Plan 3 Jun 1947; Independence Act 18 Jul 1947; Patel integrated the states

### Constitutional Development (1773-1935) and the Governors-General

**Why these Acts matter:** From 1773 the British Parliament steadily took control of the Company's government in India, and from 1858 it ruled India directly. Each Act added a piece, from central control and legislative councils to elections, provincial autonomy and federalism, and many features of the Constitution of India grew out of them, which is why both history and polity papers ask about them.

**Acts of the Company era:** The Regulating Act of 1773 was Parliament's first step to control the Company: the Governor of Bengal became the Governor-General of Bengal (Warren Hastings the first) with an executive council of four, Bombay and Madras were placed under him, and a Supreme Court was set up at Calcutta in 1774 with Elijah Impey as Chief Justice. Pitt's India Act of 1784 created a Board of Control for political affairs beside the Court of Directors for trade, a system of double government, and for the first time called the Company's territories British possessions in India. The Charter Act of 1813 ended the Company's trade monopoly in India, except in tea and trade with China, set aside one lakh rupees a year for education and let missionaries work in India. The Charter Act of 1833 made the Governor-General of Bengal the Governor-General of India (William Bentinck the first), gave him sole legislative power, and ended the Company's commercial role, making it a purely administrative body; Macaulay joined as Law Member and headed the first Law Commission. The Charter Act of 1853, the last, separated the legislative and executive functions of the Governor-General's council and opened the civil services to Indians through open competition.

Acts of the Crown era to 1909: The Act of 1858 transferred power to the Crown and created the Secretary of State for India. The Indian Councils Act of 1861 let the Viceroy nominate Indians as non-official members of his legislative council (Canning nominated the Raja of Benaras, the Maharaja of Patiala and Sir Dinkar Rao), restored legislative powers to Bombay and Madras, recognised Canning's portfolio system and allowed the Viceroy to issue ordinances in an emergency. The Indian Councils Act of 1892 increased the non-official members, introduced indirect election in all but name through bodies such as universities and municipalities, and let members discuss the budget and ask questions. The Indian Councils Act of 1909 enlarged the councils, allowed supplementary questions and resolutions, and introduced separate electorates for Muslims.

The Acts of 1919 and 1935: The Government of India Act 1919 separated central and provincial subjects, brought dyarchy to the provinces, created a bicameral central legislature, introduced direct elections on a limited franchise, required three of the six members of the Viceroy's Executive Council other than the Commander-in-Chief to be Indians, created a High Commissioner for India in London and provided for a public service commission, set up in 1926. The Government of India Act 1935 proposed an All-India Federation of provinces and princely states that never came into being, divided powers into Federal, Provincial and Concurrent lists, replaced provincial dyarchy with provincial autonomy (from 1937), proposed dyarchy at the centre, made six of the eleven provinces bicameral, extended separate electorates to the depressed classes, women and labour, provided for a Federal Court (1937) and public service commissions (the Reserve Bank of India itself was set up under a separate law, the RBI Act of 1934), abolished the Council of India and separated Burma from India.

**Governors-General of the Company era:** Warren Hastings ended dual government, fought the First Maratha and Second Mysore wars, backed William Jones's Asiatic Society of Bengal (1784) and was impeached in Britain. Cornwallis gave the Permanent Settlement and the Cornwallis Code (1793) and is called the father of the civil services in India. Wellesley imposed the Subsidiary Alliance and founded Fort William College (1800). Lord Hastings ended Maratha power. William Bentinck abolished sati, suppressed thugi and made English the medium of higher education after Macaulay's Minute (1835). Charles Metcalfe freed the press, and Ellenborough annexed Sindh (1843). Dalhousie applied the Doctrine of Lapse, annexed Punjab and Awadh, opened the first railway from Bombay to Thane (16 April 1853), started the telegraph and a modern postal system, and received Wood's Despatch on education (1854).

**Viceroys under the Crown:** Canning faced 1857, became the first Viceroy and saw universities founded at Calcutta, Bombay and Madras (1857) and the Indian Penal Code enacted (1860). Mayo began financial decentralisation and the first census (1872) and was assassinated in the Andamans. Lytton held the Delhi Durbar of 1877 and passed the Vernacular Press and Arms Acts (1878). Ripon, the father of local self-government (1882), repealed the Press Act, held the first synchronous census (1881), appointed the Hunter Commission on education and brought the Ilbert Bill. Dufferin saw the founding of the Congress, Lansdowne the Durand Line (1893), and Curzon the Universities Act and Ancient Monuments Act (1904) and the partition of Bengal. Then came Minto II (Morley-Minto reforms), Hardinge II (capital to Delhi, 1911), Chelmsford (dyarchy, Jallianwala Bagh), Reading (Chauri Chaura), Irwin (Dandi, Gandhi-Irwin Pact), Willingdon (Poona Pact), Linlithgow, the longest-serving Viceroy (August Offer, Quit India), Wavell (Shimla Conference, Cabinet Mission) and Mountbatten, the last Viceroy.

**Examples**

- Regulating Act 1773: Governor-General of Bengal (Warren Hastings), council of four, Supreme Court at Calcutta 1774 with Elijah Impey as Chief Justice.
- Pitt's India Act 1784: Board of Control for political affairs and Court of Directors for trade, a system of double government.
- Charter Acts: 1813 - trade monopoly ended except tea and China, one lakh rupees for education; 1833 - Governor-General of India (Bentinck), Company purely administrative; 1853 - open competition for the civil services.
- Indian Councils Acts: 1861 - Indians nominated, portfolio system, ordinances; 1892 - indirect election, budget discussion; 1909 - separate electorates for Muslims.
- Act of 1919: dyarchy in the provinces, bicameral centre, direct elections. Act of 1935: provincial autonomy, three lists, Federal Court, proposed federation, Burma separated.
- Cornwallis - Permanent Settlement and Cornwallis Code 1793; Wellesley - Subsidiary Alliance, Fort William College 1800; Bentinck - sati abolished 1829, Macaulay's Minute 1835.
- Dalhousie - Doctrine of Lapse, first railway Bombay to Thane on 16 April 1853, telegraph, Wood's Despatch 1854; Canning - first Viceroy, three universities 1857.
- Mayo - first census 1872, assassinated in the Andamans; Lytton - Vernacular Press Act 1878; Ripon - local self-government 1882, first synchronous census 1881.
- Curzon - partition of Bengal 1905; Hardinge II - shift of the capital to Delhi announced 1911; Linlithgow - longest-serving Viceroy; Mountbatten - last Viceroy and first Governor-General of free India.

> **Quick revision:** Regulating Act 1773 (Hastings, Supreme Court 1774); Pitt's India Act 1784 (Board of Control); Charter Acts 1813 (monopoly ended), 1833 (Governor-General of India, Bentinck), 1853 (open civil service); Act of 1858; Councils Acts 1861, 1892, 1909; Act of 1919 - dyarchy; Act of 1935 - provincial autonomy; key rulers - Cornwallis, Wellesley, Bentinck, Dalhousie, Canning, Mayo, Lytton, Ripon, Curzon, Linlithgow, Mountbatten

Free practice questions: parikshasaathi.com/q/modern-indian-history/

## Physical and World Geography

### Physical and World Geography

**What the exam asks:** Physical and World Geography gives 4 to 8 questions in SSC, RRB, state police and PSC prelims. Almost every question is a one-line fact: a planet, a latitude, a layer of the earth or atmosphere, a local wind, a current, a strait, a capital, a currency or a world superlative.

Solar system and earth's motions: The planets from the Sun are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Jupiter is the largest, Mercury the smallest, Venus the hottest. The Earth's axis is tilted 23.5 degrees from the perpendicular (66.5 degrees from the orbital plane), and this tilt, not distance from the Sun, causes seasons. Perihelion is about 3 January, aphelion 4 July. On 21 June the Sun is overhead at the Tropic of Cancer (summer solstice, longest day in the Northern Hemisphere), on 22 December at the Tropic of Capricorn, and on 21 March and 23 September at the Equator (equinoxes). A solar eclipse occurs on a new-moon day when the Moon comes between the Sun and Earth; a lunar eclipse on a full-moon day when the Earth comes between them.

**Latitudes, longitudes and time:** The Tropics lie at 23.5 N and S and the Arctic and Antarctic Circles at 66.5 N and S. The Prime Meridian passes through Greenwich; the Date Line roughly follows 180 degrees. 15 degrees of longitude = 1 hour and 1 degree = 4 minutes; places east of Greenwich are ahead. IST is based on 82.5 degrees E, 5 hours 30 minutes ahead of GMT. Crossing the Date Line from west to east you set the date back a day; from east to west you advance it.

**Interior, rocks and plate tectonics:** The crust (SIAL over SIMA), mantle and core (NIFE) are separated by the Moho (crust-mantle), Gutenberg (mantle-core) and Lehmann (outer-inner core) discontinuities. Granite is intrusive igneous and basalt extrusive; sedimentary rocks are layered and hold fossils; metamorphism turns limestone into marble, sandstone into quartzite, shale into slate and granite into gneiss. Alfred Wegener proposed continental drift (Pangaea); the Indian and Eurasian plates collided to raise the Himalayas; the Pacific Ring of Fire has most active volcanoes. An earthquake starts at the focus and the surface point above it is the epicentre; Richter measures magnitude, Mercalli intensity; S waves cannot cross the liquid outer core. Barren Island (Andaman) is India's only active volcano.

**Landforms and mountains:** Rivers cut V-shaped valleys and waterfalls in youth, form meanders in maturity and ox-bow lakes and deltas in old age. Glaciers carve U-shaped valleys, cirques and fjords and deposit moraines. Wind makes mushroom rocks, yardangs, barchans and loess. Groundwater in limestone makes karst caves with stalactites (ceiling) and stalagmites (floor). Young fold mountains are the Himalayas, Alps, Andes (longest range) and Rockies; block mountains (Black Forest, Vosges, Satpura) form by faulting. Elbrus (Caucasus) is the highest peak of Europe.

**Atmosphere, winds and climate:** Air is 78 per cent nitrogen, 21 per cent oxygen, 0.93 per cent argon and 0.04 per cent carbon dioxide. The troposphere holds the weather (temperature falls 6.5 degrees C per km); the stratosphere holds the ozone layer; the ionosphere reflects radio waves. Albedo is the share of insolation reflected to space. The equatorial low is the doldrums and the subtropical highs the horse latitudes. Trade winds are north-easterly in the Northern Hemisphere; southern westerlies are the Roaring Forties; the Coriolis force deflects winds right in the north and left in the south (Ferrel's law). Local winds: Chinook (Rockies), Foehn (Alps), Loo (north India), Mistral (France, cold), Sirocco (Sahara to Italy), Harmattan (West Africa). Rainfall is convectional (equatorial 4 o'clock rain), orographic (with a rain shadow) or cyclonic; cumulonimbus clouds give thunderstorms and hail. Tropical cyclones are hurricanes (Atlantic), typhoons (western Pacific), willy-willies (Australia) and baguios (Philippines); they rotate anticlockwise in the north and cannot form near the Equator where the Coriolis force is absent; anticyclones bring fair weather.

**Oceans:** The Pacific is the largest and deepest (Mariana Trench). Average salinity is 35 parts per thousand; the Red Sea is among the saltiest seas, the Baltic the least salty. Warm currents: Gulf Stream, Kuroshio, Brazil, Agulhas. Cold currents: Labrador, Canary, Benguela, Peru (Humboldt), Oyashio, California. Where they meet (Grand Banks) fog forms and fishing is rich. Spring tides come on new and full moon, neap tides at the quarters. El Nino is unusual warming off Peru that weakens the Indian monsoon; La Nina is the opposite.

**World features, countries and superlatives:** Sahara is the largest hot desert, Antarctica the largest overall, Atacama the driest. Nile is the longest river, Amazon the largest by volume, Volga the longest in Europe. Caspian is the largest lake, Superior the largest freshwater lake, Baikal the deepest. Angel Falls (Venezuela) is the highest waterfall. Grasslands: prairies (North America), pampas (Argentina), steppes (Eurasia), savanna (Africa), downs (Australia), veld (South Africa). Straits: Malacca (Indian Ocean-South China Sea), Hormuz (Persian Gulf-Gulf of Oman), Bab-el-Mandeb (Red Sea-Gulf of Aden), Bering (Russia-Alaska). Canals: Suez (Mediterranean-Red Sea, 1869), Panama (Atlantic-Pacific, 1914). Kazakhstan is the largest landlocked country; Uzbekistan and Liechtenstein are doubly landlocked. Greenland is the largest island, Russia the largest country, Vatican City the smallest.

**Common traps:** 23.5 degrees is the tilt from the perpendicular, 66.5 from the orbital plane; S waves, not P waves, stop at the outer core; the Brazil current is warm while the Benguela is cold; Bangladesh is neither landlocked nor a neighbour of China.

### Examples

- Planet order mnemonic: My Very Educated Mother Just Served Us Noodles = Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune. Jupiter is largest, Mercury smallest, Venus hottest.

- Time rule: 15 degrees of longitude = 1 hour, 1 degree = 4 minutes. IST is on 82.5 degrees E, so noon at Greenwich is 5:30 pm in India.
- Overhead Sun: 21 June on the Tropic of Cancer, 22 December on the Tropic of Capricorn, 21 March and 23 September on the Equator (equinoxes).
- Discontinuities from top to bottom: Conrad (within crust), Moho (crust-mantle), Gutenberg (mantle-core), Lehmann (outer core-inner core).
- Metamorphic pairs: limestone to marble, sandstone to quartzite, shale to slate, granite to gneiss, coal to graphite.
- Richter = magnitude (energy released), Mercalli = intensity (observed damage, I to XII). Focus is underground, epicentre is the surface point above it.
- Local winds: Chinook (Rockies, snow eater), Foehn (Alps), Mistral (France, cold), Sirocco (Sahara to Italy, hot), Harmattan (West Africa, the Doctor), Loo (north India).
- Cyclone names by region: hurricane (Atlantic and Caribbean), typhoon (China Sea and Japan), willy-willy (Australia), baguio (Philippines), cyclone (Indian Ocean).
- Cold currents: Labrador, Canary, Benguela, Peru (Humboldt), Oyashio, California. Warm currents: Gulf Stream, Kuroshio, Brazil, Agulhas.
- Grasslands by continent: Prairies (North America), Pampas (Argentina), Steppes (Eurasia), Savanna (Africa), Downs (Australia), Veld (South Africa), Llanos (Venezuela).
- Superlatives: Nile longest river, Amazon largest by volume, Caspian largest lake, Baikal deepest lake, Sahara largest hot desert, Greenland largest island, Angel Falls highest waterfall.
- Capital traps: Australia is Canberra (not Sydney), Canada is Ottawa, Turkey is Ankara, Switzerland is Bern, Brazil is Brasilia, New Zealand is Wellington.

> **Quick revision:** Planets: Mercury-Venus-Earth-Mars-Jupiter-Saturn-Uranus-Neptune; axis tilt 23.5 degrees; 21 June summer solstice; 1 degree longitude = 4 min, IST = GMT+5:30; Moho crust/mantle, Gutenberg mantle/core; S-waves stop at outer core; Richter magnitude, Mercalli intensity; nitrogen 78%, ozone in stratosphere; Chinook Rockies, Foehn Alps, Mistral France; hurricane Atlantic, typhoon W Pacific, willy-willy Australia; Labrador, Benguela, Peru cold currents; Nile longest, Amazon largest, Baikal deepest, Sahara largest hot desert; Suez Med-Red Sea, Panama Atlantic-Pacific; Kazakhstan largest landlocked.

### The Universe and the Solar System: Galaxies, the Sun, Planets, Moons and Eclipses

**The universe and galaxies:** The Big Bang theory, proposed by Georges Lemaitre in 1927 and supported by Edwin Hubble's discovery in 1929 that galaxies are moving apart, holds that the universe began about 13.8 billion years ago and is still expanding. A galaxy is a vast system of stars, gas and dust held together by gravity. Our galaxy, the Milky Way (Akashganga), is a barred spiral, and the solar system lies in one of its arms; the nearest large galaxy is Andromeda. A light year, the distance light travels in a year, is about 9.46 trillion km. After the Sun, the nearest star is Proxima Centauri, about 4.2 light years away.

**The Sun:** The Sun is a medium-sized star about 4.6 billion years old, holding about 99.8 per cent of the solar system's mass. It is mostly hydrogen and helium and shines by nuclear fusion of hydrogen into helium in its core, at about 15 million degrees Celsius. Its visible surface is the photosphere (about 5,500 to 6,000 degrees Celsius), above which lie the chromosphere and the corona, seen in a total solar eclipse. Sunspots are cooler, darker patches that follow a cycle of about 11 years. The Sun is about 150 million km away, a distance called one astronomical unit, and its light reaches us in about 8 minutes 20 seconds.

**Inner planets:** Mercury, Venus, Earth and Mars are small, rocky terrestrial planets. Mercury is the closest and smallest, with no moon, almost no atmosphere and the shortest year, 88 days. Venus is the hottest planet, because its thick carbon dioxide atmosphere traps heat, and the brightest after the Moon, seen as the morning or evening star. Called Earth's twin for its size, it spins slowly and backwards, so one spin (243 Earth days) takes longer than one orbit (225 days), and the Sun rises in the west. Earth is the densest planet and the only one known to have life. Mars, the Red Planet, owes its colour to iron oxide; it has two moons, Phobos and Deimos, and Olympus Mons, the highest volcano in the solar system. India's Mangalyaan entered Mars orbit on 24 September 2014, making India the first country to succeed at its first attempt.

**Outer planets:** Jupiter, Saturn, Uranus and Neptune are giants of gas and ice, and all four have rings. Jupiter is the largest and spins fastest, a day of about 10 hours; its Great Red Spot is a giant storm. Galileo discovered its four large moons, Io, Europa, Ganymede and Callisto, in 1610, and Ganymede is the largest moon in the solar system, bigger than Mercury. Saturn, with the grandest rings, is the least dense planet, lighter than water; its moon Titan is the only moon with a thick atmosphere. Uranus, found by William Herschel in 1781, the first planet discovered with a telescope, spins on its side (axis tilted about 98 degrees) and, like Venus, rotates from east to west. Neptune, the farthest, takes about 165 years to circle the Sun; it was found in 1846 where calculations had predicted, and its moon Triton orbits backwards.

**Dwarf planets and small bodies:** In August 2006 the International Astronomical Union (IAU) at Prague defined a planet as a body that orbits the Sun, is nearly round and has cleared its orbit of other objects. Pluto fails the last test and became a dwarf planet; the IAU recognises five: Ceres, Pluto, Eris, Haumea and Makemake. Ceres is the largest body in the asteroid belt between Mars and Jupiter, and Pluto, whose largest moon is Charon, lies in the Kuiper Belt beyond Neptune. Comets are lumps of ice and dust whose tails always point away from the Sun; Halley's Comet returns about every 76 years, was last seen in 1986 and is due in 2061. A meteor (shooting star) burns up in the air; one that reaches the ground is a meteorite, and Lonar Lake in Maharashtra fills a meteorite crater.

**The Moon:** The Moon, Earth's only natural satellite, is about 384,400 km away, and its gravity is about one-sixth of the Earth's. It takes about 27.3 days both to orbit the Earth and to spin once, so the same side always faces us; one cycle of phases takes about 29.5 days. Neil Armstrong of Apollo 11 first walked on it in July 1969, and India's Chandrayaan-1 (2008) helped detect water molecules on its surface.

**Eclipses:** A solar eclipse occurs on a new moon day (amavasya), when the Moon passes between the Sun and the Earth. It is total when the Moon hides the whole Sun and annular when the Moon, being farther away, looks too small and leaves a bright ring of the Sun showing. A lunar eclipse occurs on a full moon night (purnima), when the Earth comes between the Sun and the Moon; in a total lunar eclipse the Moon looks coppery red because the Earth's atmosphere bends red light onto it. Eclipses do not occur every month because the Moon's orbit is tilted about 5 degrees to the Earth's, so the three line up only at certain times.

### Examples

- Light year: the distance light travels in a year, about 9.46 trillion km; sunlight takes about 8 minutes 20 seconds to reach the Earth.
- Sun's layers from inside: core (about 15 million degrees C, hydrogen fused into helium), radiative zone, convective zone, photosphere (visible surface), chromosphere, corona (seen in a total solar eclipse).
- Mercury: smallest, closest to the Sun, no moon, 88-day year. Venus: hottest and brightest planet, spins east to west, no moon, Earth's twin.
- Mars: Red Planet (iron oxide), moons Phobos and Deimos, Olympus Mons; Mangalyaan entered Mars orbit on 24 September 2014 at the first attempt.
- Jupiter: largest planet, fastest spin (about 10 hours), Great Red Spot; Ganymede is the largest moon in the solar system. Saturn: least dense; its moon Titan has a thick atmosphere.
- Uranus: discovered by William Herschel in 1781, spins on its side (tilt about 98 degrees). Neptune: found in 1846 by calculation, about 165-year orbit, moon Triton.
- Dwarf planets recognised by the IAU: Ceres, Pluto, Eris, Haumea, Makemake. Pluto was reclassified in August 2006 at Prague; its largest moon is Charon.
- Halley's Comet returns about every 76 years (seen in 1986, next in 2061); a comet's tail always points away from the Sun.
- Solar eclipse: new moon, Moon between Sun and Earth; annular when the Moon looks too small. Lunar eclipse: full moon, Earth between Sun and Moon; the Moon looks red.

**Quick revision:** Big Bang about 13.8 billion years ago; Milky Way a barred spiral galaxy, Andromeda the nearest large galaxy; light year about 9.46 trillion km; Proxima Centauri nearest star after the Sun; Sun holds 99.8% of mass, core about 15 million C, corona seen in total eclipse, sunspot cycle 11 years; Mercury smallest, Venus hottest and spins backwards, Jupiter largest, Saturn least dense, Uranus on its side; Ganymede largest moon; Pluto a dwarf planet since 2006; Halley every 76 years; Moon's orbit tilted 5 degrees.

### The Earth's Motions, Seasons, Latitudes, Longitudes and Time Zones

**Shape and size:** The Earth is an oblate spheroid, flattened at the poles and bulging at the Equator, a shape also called a geoid. Its equatorial diameter is about 12,756 km, its polar diameter about 12,714 km and its circumference at the Equator about 40,075 km.

**Rotation:** The Earth spins from west to east, anticlockwise when seen from above the North Pole. One rotation measured against the stars takes 23 hours 56 minutes 4 seconds (the sidereal day); measured against the Sun it gives the 24-hour solar day. Rotation causes day and night, makes the Sun seem to rise in the east, and produces the Coriolis force that deflects winds and ocean currents. Its speed is about 1,670 km per hour at the Equator and zero at the poles.

**Revolution and the tilted axis:** The Earth orbits the Sun in about 365 days 6 hours, at about 30 km per second. The extra quarter day becomes 29 February in every leap year; a century year is a leap year only if divisible by 400, so 2000 was one and 1900 was not. The Earth is nearest the Sun (perihelion, about 147 million km) around 3 January and farthest (aphelion, about 152 million km) around 4 July, so distance does not cause the seasons. The tilt does: the axis leans 23.5 degrees from the perpendicular (66.5 degrees to the plane of the orbit) and always points towards the Pole Star, so each hemisphere leans towards the Sun for half the year.

**Solstices and equinoxes:** On 21 June the Sun is overhead at the Tropic of Cancer. This summer solstice brings the longest day of the Northern Hemisphere, 24 hours of daylight north of the Arctic Circle and winter in the south. On 22 December it is overhead at the Tropic of Capricorn, giving the winter solstice in the north and continuous daylight south of the Antarctic Circle. On 21 March (spring equinox) and 23 September (autumnal equinox) it is overhead at the Equator, and day and night are nearly equal everywhere. The Sun's apparent northward journey from 22 December to 21 June is called Uttarayan and the southward one Dakshinayan, and each pole gets about six months of day and six months of night.

**Latitudes and heat zones:** Latitude is the angular distance of a place north or south of the Equator, from 0 degrees to 90 degrees at the poles, and 1 degree of latitude is about 111 km. Parallels shrink towards the poles, and the Equator is the only parallel that is a great circle. The key parallels are the Tropics of Cancer and Capricorn (23.5 degrees N and S) and the Arctic and Antarctic Circles (66.5 degrees N and S). They mark the Torrid Zone between the tropics, where the noon Sun is overhead at least once a year, the two Temperate Zones, and the two Frigid Zones beyond the polar circles. Among the countries the Equator crosses are Ecuador, Colombia, Brazil, Gabon, both Congos, Uganda, Kenya, Somalia and Indonesia, and it passes through Lake Victoria; Brazil is the only country crossed by both the Equator and the Tropic of Capricorn. In India the Tropic of Cancer passes through 8 states: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura and Mizoram.

**Longitudes:** Longitude is the angular distance east or west of the Prime Meridian (0 degrees), which passes through Greenwich near London and was adopted at the International Meridian Conference in Washington in 1884. Meridians are equal half-circles from pole to pole, 180 degrees east and 180 degrees west, meeting at the 180-degree meridian. The gap between meridians is about 111 km per degree at the Equator and shrinks to nothing at the poles.

**Time and time zones:** The Earth turns 360 degrees in 24 hours, so 15 degrees of longitude make 1 hour and 1 degree makes 4 minutes. Each country adopts a standard meridian. Indian Standard Time is the local time of 82.5 degrees E, which passes near Mirzapur in Uttar Pradesh, and is 5 hours 30 minutes ahead of Greenwich Mean Time, while China, spanning about 60 degrees of longitude, keeps a single time zone 8 hours ahead of Greenwich. To find a time difference, take the difference in longitude (subtract if both places are on the same side of Greenwich, add if they are on opposite sides) and multiply by 4 minutes; then add the result for a place to the east and subtract it for one to the west. So noon at Greenwich is 4 pm at 60 degrees E and 9 am at 45 degrees W.

**International Date Line:** Going east, the 180-degree meridian is 12 hours ahead of Greenwich; going west, it is 12 hours behind, so its two sides differ by a full day. The Date Line follows this meridian roughly but zigzags around land, through the Bering Strait and past Fiji and Tonga, so that no country has two dates. A traveller crossing it from west to east (Asia to America) repeats a day; one crossing from east to west skips a day.

**Examples**

- Sidereal day: 23 hours 56 minutes 4 seconds; solar day: 24 hours. One revolution: about 365 days 6 hours, so a leap year comes every fourth year (century years only if divisible by 400).
- Perihelion around 3 January (about 147 million km) and aphelion around 4 July (about 152 million km): distance does not cause the seasons, the 23.5-degree tilt does.
- 21 June: Sun overhead at the Tropic of Cancer, longest day in the north. 22 December: overhead at the Tropic of Capricorn. 21 March and 23 September: overhead at the Equator (equinoxes).
- Key parallels: Equator 0, Tropics 23.5 degrees N and S, Arctic and Antarctic Circles 66.5 degrees N and S. The Torrid Zone lies between the tropics, the Frigid Zones beyond the polar circles.
- The Tropic of Cancer crosses 8 Indian states: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura, Mizoram.
- Brazil is the only country crossed by both the Equator and the Tropic of Capricorn; the Equator also passes through Lake Victoria.
- Prime Meridian (0 degrees) passes through Greenwich, adopted at the International Meridian Conference, Washington, 1884.
- Time rule: 15 degrees = 1 hour, 1 degree = 4 minutes; east is ahead, west is behind. Noon at Greenwich = 4 pm at 60 degrees E = 9 am at 45 degrees W.
- IST meridian 82.5 degrees E passes near Mirzapur (Uttar Pradesh); IST = GMT + 5 hours 30 minutes. China uses one time zone, 8 hours ahead of GMT.
- Date Line: about 180 degrees, bends around land and through the Bering Strait; crossing west to east repeats a day, crossing east to west skips a day.

> **Quick revision:** Earth an oblate spheroid (geoid), equatorial diameter about 12,756 km; rotates west to east in 23 h 56 min 4 s; revolves in about 365 days 6 hours; perihelion 3 January, aphelion 4 July; axis tilted 23.5 degrees, parallelism causes seasons; solstices 21 June and 22 December, equinoxes 21 March and 23 September; 1 degree of latitude about 111 km; Prime Meridian at Greenwich, 1884; 1 degree of longitude = 4 minutes; IST on 82.5 E near Mirzapur, GMT+5:30; Date Line about 180 degrees.

## The Earth's Interior, Rocks, Continental Drift and Plate Tectonics

**How we know the interior:** The deepest hole ever drilled, the Kola Superdeep Borehole in Russia, reached only about 12 km of the Earth's radius of about 6,371 km. So the interior is studied indirectly, above all through earthquake waves, whose speed and path change with the material they cross. The Earth's average density, about 5.5 grams per cubic centimetre, is about twice that of crustal rocks (about 2.7), so the interior must be much heavier.

**The crust:** The crust is the thin, rigid outer layer and forms less than 1 per cent of the Earth's volume. Oceanic crust is about 5 km thick on average, while continental crust averages about 30 km and reaches about 70 km under the Himalayas. The upper continental part, rich in silica and aluminium, is called SIAL and is granitic; the lower part, which also forms the ocean floor, is rich in silica and magnesium, is called SIMA and is basaltic. The Conrad discontinuity separates the two. By weight the crust is about 46.6 per cent oxygen, 27.7 per cent silicon and 8.1 per cent aluminium, followed by iron, so aluminium is the most abundant metal in the crust.

**The mantle:** The mantle extends from the base of the crust to about 2,900 km and holds roughly 84 per cent of the Earth's volume. Its upper boundary is the Moho discontinuity, identified by the Croatian seismologist Andrija Mohorovicic in 1909. The crust and the uppermost solid mantle together form the lithosphere, 10 to 200 km thick. Below it lies the asthenosphere, a soft, partly molten zone of the upper mantle extending to about 400 km (the NCERT figure); it is the main source of magma and the layer over which the plates move.

**The core:** The core begins at the Gutenberg discontinuity, about 2,900 km deep, and continues to the centre at about 6,371 km. It is made mainly of nickel and iron (NIFE). The outer core is liquid, which is why S waves cannot pass through it; the inner core, whose existence the Danish seismologist Inge Lehmann deduced in 1936, is solid because of enormous pressure. Exam books call the boundary between them, at about 5,150 km, the Lehmann discontinuity; seismologists call it the inner-core boundary. Movement of molten iron in the outer core generates the Earth's magnetic field. Earthquake waves reveal this structure (NCERT figures): within 105 degrees of the epicentre both P and S waves arrive, beyond 145 degrees only P waves arrive, and the belt between 105 and 145 degrees is a shadow zone for both.

**Three families of rocks:** Igneous rocks form from cooling magma and are called primary rocks because all others come from them. Intrusive or plutonic rocks such as granite cool slowly underground and have large crystals; extrusive or volcanic rocks such as basalt cool quickly at the surface and are fine-grained. The Deccan Traps are basalt, which weathers into black cotton soil (regur). Sedimentary rocks such as sandstone, shale, limestone and coal form in layers (strata) from deposited particles and preserve fossils; they cover about 75 per cent of the land surface but make up only about 5 per cent of the crust's volume. Metamorphic rocks form when heat and pressure change existing rocks: limestone becomes marble, sandstone becomes quartzite, shale becomes slate and granite becomes gneiss.

**Continental drift:** In 1912 the German meteorologist Alfred Wegener proposed that all continents once formed one supercontinent, Pangaea, surrounded by one ocean, Panthalassa. Pangaea split into Laurasia in the north and Gondwanaland in the south, separated by the Tethys Sea, from whose sediments the Himalayas later rose. His evidence was the jigsaw fit of South America and Africa, matching rock belts on both sides of the Atlantic, glacial deposits (tillite) in India and other southern continents, gold deposits in Ghana whose source rocks lie in Brazil, and fossils of the small reptile Mesosaurus found in southern Africa and in Brazil, now an ocean apart. Wegener could not convincingly explain the force behind the drift, which Arthur Holmes in the 1930s traced to convection currents in the mantle.

**Sea-floor spreading and plate tectonics:** Ocean-floor mapping after the Second World War found volcanic mid-ocean ridges, ocean rocks that grow older away from the ridges and are almost nowhere older than about 200 million years, and matching magnetic stripes on both sides. In the early 1960s Harry Hess explained this as sea-floor spreading: magma rising at the ridges forms new crust and pushes the old floor apart. In 1967 these ideas were combined into plate tectonics. The lithosphere is broken into seven major plates (Pacific, North American, South American, Eurasian, African, Indo-Australian and Antarctic) and minor ones such as the Nazca and Arabian plates. At divergent boundaries plates move apart and new crust forms, as on the Mid-Atlantic Ridge and in the East African Rift. At convergent boundaries one plate sinks (subducts) under another, forming trenches, volcanoes and fold mountains such as the Andes; where two continents collide, as when the Indian plate met the Eurasian plate about 40 to 50 million years ago, ranges like the Himalayas rise. At transform boundaries plates slide past each other, as along the San Andreas Fault.

### Examples

- Layers and depths: crust (oceanic about 5 km, continental about 30 km, up to about 70 km under the Himalayas), mantle to about 2,900 km, core to the centre at about 6,371 km.
- SIAL: silica and aluminium, continental, granitic. SIMA: silica and magnesium, ocean floor, basaltic. NIFE: nickel and iron, the core.
- Crust by weight: oxygen 46.6%, silicon 27.7%, aluminium 8.1%, then iron; aluminium is the most abundant metal in the crust.
- Discontinuities: Conrad (SIAL-SIMA), Moho, 1909 (crust-mantle), Gutenberg (mantle-core, about 2,900 km), Lehmann (outer core-inner core, about 5,150 km).
- Shadow zone (NCERT figures): between 105 and 145 degrees from the epicentre; S waves are absent everywhere beyond 105 degrees because the outer core is liquid.
- Asthenosphere: soft, partly molten upper mantle up to about 400 km (NCERT figure), the main source of magma; the lithospheric plates (10-200 km thick) move over it.

- Granite is intrusive igneous, basalt extrusive igneous (Deccan Traps, black soil); sedimentary rocks hold fossils and cover about 75% of the land but only about 5% of the crust's volume.
- Wegener (1912): Pangaea and Panthalassa; Laurasia (north) and Gondwanaland (south) separated by the Tethys; evidence: jigsaw fit, tillite, Mesosaurus fossils, Ghana gold.
- Plate boundaries: divergent (Mid-Atlantic Ridge, East African Rift), convergent (Andes, Mariana Trench, Himalayas), transform (San Andreas Fault).

> **Quick revision:** Earth's radius about 6,371 km; crust under 1% of volume, oceanic about 5 km, continental about 30 km; SIAL over SIMA with Conrad between; Moho (1909) crust-mantle; mantle to 2,900 km, about 84% of volume; asthenosphere up to about 400 km, source of magma; Gutenberg at 2,900 km; outer core liquid, inner core solid (found by Lehmann, 1936); NIFE core; shadow zone 105-145 degrees; granite intrusive, basalt extrusive; Wegener 1912 Pangaea; Hess sea-floor spreading; plate tectonics 1967; seven major plates; San Andreas transform fault.

### Landforms and Their Makers: Volcanoes, Earthquakes, Mountains, Rivers, Glaciers, Wind and Waves

**Building up and wearing down:** The Earth's relief is shaped by two sets of forces. Endogenic forces, powered by heat inside the Earth, build relief through folding, faulting, volcanoes and earthquakes; slow movements that bend or break the crust are called diastrophism. Exogenic forces, driven by the Sun's energy and gravity, wear relief down. Weathering breaks rocks where they lie: physically, as in exfoliation (onion-like peeling of rock in hot deserts) and frost wedging, and chemically, as in oxidation and carbonation, by which rainwater carrying carbon dioxide dissolves limestone. Erosion by rivers, glaciers, wind, waves and groundwater then carries the material away, and this levelling of the land is called gradation.

**Volcanoes:** A volcano is an opening in the crust through which molten rock, gases and ash escape; molten rock is called magma underground and lava once it erupts. Volcanoes are active (erupting from time to time, like Etna and Stromboli in Italy, Stromboli being called the Lighthouse of the Mediterranean), dormant (quiet for a long time but able to erupt) or extinct. Shield volcanoes such as Mauna Loa in Hawaii are broad and gently sloping, built of fluid basalt lava; composite or strato volcanoes such as Mount Fuji are steep cones of alternating lava and ash with explosive eruptions; a caldera is a huge crater left when a volcano collapses; and flood basalts, like the Deccan Traps, pour out of long fissures. Vesuvius in Italy buried the Roman town of Pompeii in AD 79. Magma that cools underground forms batholiths (large granite masses), laccoliths (domes), sills (horizontal sheets) and dykes (vertical walls). Most of the world's active volcanoes lie around the Pacific in the Ring of Fire, along the subduction zones of the Andes, Japan, the Philippines, Indonesia and New Zealand. In India, Barren Island in the Andaman Sea is an active volcano and Narcondam a dormant one.

**Earthquakes:** An earthquake is the shaking of the ground when stress built up along a fault is suddenly released. The point where the rupture starts is the focus or hypocentre, and the point on the surface directly above it is the epicentre. P (primary) waves are the fastest; they push and pull the rock like sound waves and pass through solids, liquids and gases. S (secondary) waves shake the rock at right angles to their path and pass only through solids. Surface waves (Love and Rayleigh waves) arrive last but do the most damage. The Richter scale, devised by Charles Richter in 1935, measures magnitude on a logarithmic scale, where each whole number means 10 times the ground motion and about 32 times the energy; for large quakes seismologists now mostly use the moment magnitude scale. The Mercalli scale grades intensity, the damage observed, from I to XII. The strongest earthquake ever recorded struck Chile in 1960 (magnitude 9.5), and the Sumatra earthquake of 26 December 2004 raised a tsunami across the Indian Ocean.

**Mountains:** Fold mountains form where compression crumples rock layers into upfolds (anticlines) and downfolds (synclines). Young fold mountains, the Himalayas, Alps, Andes, Rockies and Atlas, are high with sharp peaks; old fold mountains such as the Aravallis, the Appalachians and the Urals are worn down. Block mountains form by faulting: a block raised between faults is a horst, and one that sinks is a graben or rift valley. The Black Forest (Germany) and the Vosges (France) are block mountains with the Rhine rift valley between them, and the Great Rift Valley of East Africa is the best-known rift; in India the Narmada and Tapi flow west through rift valleys. Volcanic mountains such as Kilimanjaro and Fuji are built by eruptions.

**Rivers and groundwater:** In its upper course a river cuts V-shaped valleys, gorges, canyons, rapids and waterfalls; the Grand Canyon of the Colorado River (USA) is the classic canyon. In the middle course it swings in meanders across a flood plain, and at the foot of mountains it drops alluvial fans. In the lower course meanders are cut off as ox-bow lakes, natural levees line the banks, and the river ends either in a delta, a fan of sediment at the mouth, or in an estuary, where tides sweep the sediment away. The Ganga-Brahmaputra delta is the largest in the world, while the Narmada and Tapi form estuaries. In limestone (karst) areas, named after a region of Slovenia, groundwater dissolves rock into sinkholes and caves, where stalactites hang from the roof and stalagmites rise from the floor.

**Glaciers, wind and waves:** Glaciers carve bowl-shaped cirques, knife-edge ridges called aretes, pyramid peaks (horns) such as the Matterhorn, U-shaped valleys and hanging valleys; drowned glacial valleys on the coast are fjords, typical of Norway. They deposit unsorted debris (till) as moraines and drumlins, while their meltwater streams leave winding ridges of sand and gravel called eskers. In deserts the wind scoops out deflation hollows, carves mushroom rocks, yardangs and zeugen, and piles sand into crescent-shaped barchans and long seif dunes; fine wind-blown dust settles as loess, as on the Loess Plateau of China. Sea waves cut cliffs, wave-cut platforms, caves, arches and stacks, and deposit beaches, spits and bars; a bar can enclose a lagoon, as at Chilika Lake in Odisha.

**Examples**

- Endogenic forces (internal heat) build relief by folding, faulting, volcanoes and earthquakes; exogenic forces (Sun and gravity) wear it down by weathering and erosion (gradation).
- Shield volcano: gentle slopes of fluid basalt (Mauna Loa, Hawaii). Composite volcano: steep explosive cone of lava and ash layers (Fuji). Caldera: collapsed crater.
- Stromboli (Italy) is the Lighthouse of the Mediterranean; Vesuvius buried Pompeii in AD 79; Barren Island is India's active volcano and Narcondam a dormant one.
- Intrusive forms: batholith (huge granite mass), laccolith (dome), sill (horizontal sheet), dyke (vertical wall).
- P waves: fastest, push-pull, through solids, liquids and gases. S waves: sideways shaking, solids only. Surface (Love and Rayleigh) waves: slowest and most destructive.
- Richter scale (1935): magnitude, each step 10 times the ground motion and about 32 times the energy. Mercalli: intensity, I to XII. Strongest recorded: Chile, 1960, magnitude 9.5.
- Horst = raised block, graben = rift valley. Black Forest and Vosges are block mountains with the Rhine rift valley between them; the Narmada and Tapi flow through rift valleys.
- River landforms: V-shaped valley, gorge and waterfall (upper course); meander and flood plain (middle); ox-bow lake, levee and delta (lower). The Ganga-Brahmaputra delta is the world's largest.
- Glacial: cirque, arete, horn (Matterhorn), U-shaped valley, fjord (Norway), moraine. Wind: barchan, seif, yardang, zeugen, loess. Waves: cliff, arch, stack, spit, lagoon (Chilika).

> **Quick revision:** Endogenic forces build, exogenic forces wear down; exfoliation in deserts, carbonation dissolves limestone; magma underground, lava at the surface; shield (Mauna Loa), composite (Fuji), caldera; Ring of Fire around the Pacific; Barren Island active, Narcondam dormant; focus below, epicentre above; P fastest, S solids only, surface waves most destructive; Richter 1935 magnitude, Mercalli intensity; Chile 1960 9.5; horst and graben; V-valley, meander, ox-bow lake, delta; cirque, U-valley, fjord, moraine; barchan, loess; stack, spit, lagoon.

### The Atmosphere: Composition, Layers, Insolation, Heat Budget and Temperature Inversion

**Composition:** Dry air is about 78 per cent nitrogen, 21 per cent oxygen, 0.93 per cent argon and about 0.04 per cent carbon dioxide, with traces of neon, helium, ozone, hydrogen and methane. Water vapour varies from almost nil in cold, dry air to about 4 per cent in the humid tropics. Small as their shares are, carbon dioxide and water vapour matter most for climate, because they let sunlight through but absorb the heat the Earth radiates back. Dust and salt particles act as nuclei on which water vapour condenses into clouds and fog. About 99 per cent of the atmosphere's mass lies within 32 km of the surface.

**Troposphere and stratosphere:** The troposphere, the lowest layer, is (in NCERT figures) about 8 km thick at the poles and about 18 km at the Equator, where strong convection carries heat higher. It holds almost all the water vapour and dust, so all weather occurs here. Temperature falls with height at the normal lapse rate of about 6.5

degrees Celsius per km, reaching about minus 80 degrees Celsius over the Equator and minus 45 degrees over the poles at the tropopause. The stratosphere above extends to about 50 km. It holds the ozone layer, which absorbs harmful ultraviolet rays, so here temperature rises with height; its calm, cloud-free lower part suits jet aircraft.

**Upper layers:** The mesosphere, from about 50 to 80 km, is where temperature falls again, to about minus 100 degrees Celsius at the mesopause, the coldest part of the atmosphere; most meteors burn up here. The ionosphere, from about 80 to 400 km and part of the thermosphere, contains electrically charged particles (ions) produced by solar radiation. It reflects radio waves back to the Earth, making long-distance radio communication possible, and auroras glow in it; its layers include the Kennelly-Heaviside (E) layer and the Appleton (F) layer. The exosphere is the outermost, extremely thin layer that merges into space.

**The ozone layer:** Ozone (O3) is a molecule of three oxygen atoms concentrated in the stratosphere, measured in Dobson units. In 1985 scientists reported a seasonal ozone hole over Antarctica, caused mainly by chlorofluorocarbons (CFCs) from refrigerators, air conditioners and aerosol sprays. The Vienna Convention (1985) set up the framework for protecting the ozone layer, the Montreal Protocol (1987) under it phased these chemicals out, and 16 September, the day the protocol was signed, is the International Day for the Preservation of the Ozone Layer.

**Insolation and the heat budget:** Energy received from the Sun is insolation (incoming solar radiation). It arrives as short waves, about 1.94 calories per square centimetre per minute at the top of the atmosphere (the NCERT figure), a value called the solar constant. The amount reaching a place depends on the angle of the Sun's rays, the length of the day and the clearness of the air, so the highest insolation falls on the cloudless subtropical deserts, not on the cloudier Equator. In the NCERT heat budget, out of 100 units of insolation about 35 units are reflected back to space by clouds, ice and the air; this reflected share is the Earth's albedo. The atmosphere absorbs 14 units and the surface 51 units. The surface sends its 51 units back as long-wave terrestrial radiation: 17 units go straight to space and 34 are absorbed by the atmosphere, which radiates 48 units (14 plus 34) to space. As 35, 17 and 48 add up to 100, the Earth as a whole neither heats up nor cools down.

**Heating of the air and temperature inversion:** The atmosphere is heated mostly from below, by terrestrial radiation, conduction and convection, rather than directly by sunlight, which is why temperature normally falls with height. Horizontal transfer of heat by wind is called advection; the hot Loo of north India is an example. Sometimes temperature increases with height instead: this is temperature inversion. It forms on long winter nights with clear skies and calm, dry air, when the ground loses heat fast and chills the air touching it. Inversions make the air stable, stop convection and trap fog, smoke and pollution near the ground, as in winter smog over north Indian cities. In hills, cold, dense air drains down slopes at night into the valleys (air drainage), so frost forms in valley bottoms while the slopes stay warmer, and orchards and plantations are placed on the slopes.

**The greenhouse effect:** Like the glass of a greenhouse, some gases let sunlight in but keep heat from escaping. Carbon dioxide, water vapour, methane, nitrous oxide, ozone and CFCs absorb long-wave terrestrial radiation and send part of it back to the surface. This natural greenhouse effect keeps the Earth's average surface temperature at about 15 degrees Celsius instead of about minus 18 degrees. Burning fossil fuels and clearing forests have strengthened it, causing global warming, melting glaciers and rising seas. The Kyoto Protocol (1997) set binding cuts for developed countries, and the Paris Agreement (2015) aims to keep warming well below 2 degrees Celsius and to try to limit it to 1.5 degrees.

### Examples

- Dry air by volume: nitrogen 78%, oxygen 21%, argon 0.93%, carbon dioxide about 0.04%; water vapour varies from nil to about 4%.
- Troposphere: the weather layer, about 8 km thick at the poles and 18 km at the Equator (NCERT); temperature falls about 6.5 degrees C per km.
- Stratosphere (up to about 50 km): ozone layer, temperature rises with height, calm air used by jet aircraft.
- Mesosphere (50-80 km): coldest layer, about minus 100 degrees C at the mesopause; meteors burn up here.
- Ionosphere (80-400 km): ions reflect radio waves back to the Earth; auroras appear here; E layer = Kennelly-Heaviside, F layer = Appleton.
- Ozone hole over Antarctica reported in 1985, caused by CFCs; Montreal Protocol 1987; Ozone Day 16 September.

- Heat budget (NCERT): of 100 units, 35 reflected (albedo), 14 absorbed by the atmosphere, 51 by the surface; 17 + 48 units radiated back to space.
- Maximum insolation falls on the subtropical deserts (clear skies), not the cloudy Equator; solar constant about 1.94 calories per sq cm per minute (NCERT).
- Temperature inversion: long, clear, calm winter nights; brings fog, frost and smog; frost collects in valleys through air drainage.
- Greenhouse effect keeps the Earth at about 15 degrees C instead of about minus 18 degrees C; Kyoto Protocol 1997, Paris Agreement 2015.

> **Quick revision:** Nitrogen 78%, oxygen 21%, argon 0.93%, CO2 about 0.04%; 99% of mass within 32 km; troposphere 8 km at poles, 18 km at Equator, lapse rate 6.5 C per km; stratosphere to 50 km with ozone; mesosphere 50-80 km, coldest, meteors burn; ionosphere 80-400 km reflects radio waves; ozone hole 1985, Montreal Protocol 1987; insolation highest over subtropical deserts; albedo 35 units; inversion on clear calm winter nights; greenhouse effect keeps Earth at 15 C.

### Pressure Belts, Planetary and Local Winds, Jet Streams, Cyclones and Rainfall

**Air pressure:** Air pressure is the weight of the column of air above a place. It is measured with a mercury barometer, invented by Evangelista Torricelli in 1643, or an aneroid barometer; average sea-level pressure is 1013.25 millibars. Near the surface pressure falls about 1 millibar for every 10 m of height. Lines of equal pressure are isobars, and closely spaced isobars mean strong winds, since air always moves from high pressure to low.

**Pressure belts and planetary winds:** The Equatorial Low (about 5 degrees N to 5 degrees S) is a calm zone of rising hot air, the doldrums, where the trade winds of both hemispheres meet in the Inter-Tropical Convergence Zone (ITCZ). The Subtropical Highs (about 30 degrees N and S), the horse latitudes, have sinking dry air, and most hot deserts lie under them. The Subpolar Lows lie at about 60 degrees and the Polar Highs over the poles. The trade winds blow from the subtropical highs to the Equator, from the north-east in the north and the south-east in the south. The westerlies blow from the subtropical highs to the subpolar lows, from the south-west in the north and the north-west in the south; over the open southern oceans they are so strong that sailors named the Roaring Forties, Furious Fifties and Shrieking Sixties. The polar easterlies blow from the poles. The belts shift north in the northern summer and south in winter with the overhead Sun, which helps explain the monsoons and the winter rain of Mediterranean lands.

**The Coriolis effect:** Because the Earth rotates, moving air is deflected to the right in the Northern Hemisphere and to the left in the Southern. This Coriolis force, described by Gaspard-Gustave de Coriolis in 1835, is zero at the Equator and greatest at the poles; the rule of deflection is Ferrel's law. By Buys Ballot's law, if you stand with your back to the wind in the Northern Hemisphere, low pressure is on your left.

**Local winds of the world:** Warm, dry winds descending the lee side of mountains include the Chinook of the Rockies (the snow eater), the Foehn of the Alps, the Zonda of the Argentine Andes and the Santa Ana of southern California. Hot desert winds include the Sirocco, blowing from the Sahara to Italy, the Khamsin of Egypt, the Simoom of Arabia and the Sahara, the Harmattan of West Africa, called the Doctor because its dryness relieves humid heat, the Brickfielder of south-east Australia and the Loo of north India. Cold winds include the Mistral down the Rhone valley of France, the Bora of the Adriatic coast, the Pampero of the Argentine pampas, the Southerly Buster of New South Wales, the Purga of Siberia and the snowy Blizzard of North America and the polar lands.

**Jet streams:** Jet streams are narrow bands of very fast winds, mostly westerly, near the top of the troposphere, roughly 9 to 16 km up. They blow fastest in winter: NCERT gives their speed as about 110 km per hour in summer and about 184 km per hour in winter, and their cores can exceed 300 km per hour. In winter the subtropical westerly jet blows south of the Himalayas and steers the western disturbances that bring rain and snow to north-west India; in early summer it shifts north of the Tibetan plateau, which helps the monsoon burst, and a tropical easterly jet then blows over peninsular India.

**Cyclones and anticyclones:** A cyclone is a low-pressure system with winds spiralling inward, anticlockwise in the Northern Hemisphere and clockwise in the Southern; an anticyclone is a high with sinking air, outward winds and fair

weather. Tropical cyclones form over seas warmer than about 27 degrees Celsius, between about 5 and 30 degrees of latitude, since the Coriolis force needed to start the spin is missing near the Equator. They feed on latent heat released by condensation, so they weaken after landfall. The calm eye is ringed by the eyewall, where wind and rain are fiercest, and the storm surge causes most deaths. In the north Indian Ocean they are most frequent in the Bay of Bengal, before and after the monsoon. Temperate cyclones form in the middle latitudes along fronts where warm and cold air masses meet; they are larger, move west to east with the westerlies and bring days of rain, and the western disturbances are of this type.

**Humidity, clouds and rainfall:** Relative humidity is the water vapour in the air as a percentage of what it could hold at that temperature; air is saturated at 100 per cent, and the temperature at which this happens is the dew point. Cirrus clouds are high (8,000 to 12,000 m), feathery and made of ice crystals; cumulus are cotton-wool heaps of fair weather; and towering cumulonimbus bring thunder, lightning and hail. Convectional rain comes from strongly heated air rising, as in the afternoon thunderstorms of the equatorial belt. Orographic rain falls when moist winds are forced up mountains: the windward side is wet and the leeward side lies in a rain shadow, as with the Western Ghats and the dry Deccan interior. Cyclonic or frontal rain falls when warm air is lifted over cold air along fronts.

**Examples**

- Pressure belts: Equatorial Low (doldrums, ITCZ), Subtropical Highs at about 30 degrees (horse latitudes, hot deserts), Subpolar Lows at about 60 degrees, Polar Highs.
- Coriolis force: zero at the Equator, greatest at the poles; deflects to the right in the north and left in the south (Ferrel's law). Buys Ballot: back to the wind, low pressure on your left (north).
- Trade winds: north-east (north) and south-east (south), towards the Equator. Westerlies: south-west (north) and north-west (south). Roaring Forties, Furious Fifties, Shrieking Sixties.
- Warm descending winds: Chinook (Rockies, snow eater), Foehn (Alps), Zonda (Argentina), Santa Ana (California).
- Hot winds: Sirocco (Sahara to Italy), Khamsin (Egypt), Simoom (Arabia and Sahara), Harmattan (West Africa, the Doctor), Brickfielder (Australia), Loo (north India).
- Cold winds: Mistral (Rhone valley, France), Bora (Adriatic), Pampero (Argentina), Southerly Buster (New South Wales), Purga (Siberia), Blizzard (North America and polar lands).
- Subtropical westerly jet: south of the Himalayas in winter, steers western disturbances; moves north of Tibet as the monsoon bursts; tropical easterly jet over peninsular India in summer.
- Tropical cyclone: sea above 27 degrees C, latitude 5 to 30 degrees, calm eye, fiercest eyewall; anticlockwise in the north, clockwise in the south; weakens after landfall.
- Clouds: cirrus high and feathery (ice), cumulus fair-weather heaps, stratus grey layers, cumulonimbus thunder, lightning and hail.
- Rain types: convectional (equatorial afternoons), orographic (wet windward side, rain-shadow leeward side), cyclonic or frontal (along fronts).

> **Quick revision:** Sea-level pressure 1013.25 mb; air moves from high to low; doldrums near the Equator, horse latitudes at 30 degrees, subpolar lows at 60 degrees; trades NE and SE, westerlies SW and NW, polar easterlies; Coriolis zero at Equator; Roaring Forties; Chinook, Foehn, Zonda, Santa Ana warm; Mistral, Bora, Pampero cold; Sirocco, Khamsin, Harmattan hot; jet streams steer western disturbances; tropical cyclones need sea above 27 C; temperate cyclones form on fronts; cirrus high, cumulonimbus hail; convectional, orographic, cyclonic rain.

### The Oceans: Sea-Floor Relief, Trenches, Currents, Tides, Salinity and Coral Reefs

**The world ocean:** About 71 per cent of the Earth's surface is water, and about 97 per cent of all the Earth's water is salt water in the oceans. The oceans in order of size are the Pacific, Atlantic, Indian, Southern and Arctic. The Pacific is the largest and deepest, bigger than all the land put together. The S-shaped Atlantic is split down the middle by the Mid-Atlantic Ridge. The Indian Ocean is the only ocean named after a country, and the Arctic is the smallest and shallowest.

**Relief of the ocean floor:** The continental shelf is the gently sloping, shallow, submerged edge of a continent, usually less than about 200 m deep; it holds rich fishing grounds such as the Dogger Bank in the North Sea and oil

fields such as Mumbai High. It ends at the steeper continental slope, cut by submarine canyons, which leads down to the abyssal plains, the flattest and most extensive parts of the ocean floor, at about 3,000 to 6,000 m. Rising from the floor are mid-ocean ridges, together the longest mountain system on Earth, seamounts (underwater volcanic peaks) and guyots (flat-topped seamounts).

**Trenches:** Trenches are long, narrow, steep-sided depressions formed where one plate subducts under another, so most of them fringe the Pacific. The Mariana Trench in the western Pacific, near Guam, is the deepest; its Challenger Deep is nearly 11,000 m deep, so Mount Everest (8,849 m) placed in it would still have more than 2 km of water above its summit. The Puerto Rico Trench is the deepest in the Atlantic and the Sunda or Java Trench the deepest in the Indian Ocean.

**Ocean currents:** Currents are steady flows of surface water driven mainly by the planetary winds and steered by the Coriolis force and the shape of the coasts. They form large loops called gyres, clockwise in the Northern Hemisphere and anticlockwise in the Southern. In low and middle latitudes, warm currents flow from the Equator towards the poles mostly along the eastern coasts of continents, and cold currents flow towards the Equator along western coasts. The warm Gulf Stream leaves the Gulf of Mexico and crosses the Atlantic as the North Atlantic Drift, which keeps the ports of Norway free of ice in winter; where it meets the cold Labrador Current near Newfoundland, thick fog and the rich fisheries of the Grand Banks result. The Canary, Benguela and Falkland currents of the Atlantic are cold and the Brazil Current warm; in the Pacific the Kuroshio and East Australian currents are warm and the Oyashio, California and Peru (Humboldt) currents cold; in the Indian Ocean the Agulhas and Mozambique currents are warm and the West Australian cold, and in its north the currents reverse with the monsoon. Cold currents along tropical western coasts chill the air and stop rain, which is why the Atacama, Namib and Sahara deserts reach those coasts.

**Tides:** Tides are the regular rise and fall of sea level caused mainly by the Moon's gravitational pull and partly by the Sun's, whose tide-raising force is less than half the Moon's. Most coasts get two high and two low tides in about 24 hours 50 minutes, so high tide comes about 50 minutes later each day. Spring tides, with the largest range, occur on new moon and full moon days, when the Sun, Moon and Earth are in a line; neap tides, with the smallest range, come about 7 days later at the quarter moons, when the Sun and Moon pull at right angles. The Bay of Fundy in Canada has the highest tidal range in the world, and in India the Gulf of Khambhat has the highest, making it, with the Gulf of Kachchh, the best site for tidal power.

**Salinity:** Salinity is the salt dissolved in sea water, expressed in parts per thousand; the ocean average is 35, meaning 35 grams of salt in 1,000 grams of sea water. Evaporation raises salinity, while rain, river water and melting ice lower it, so salinity is highest in the subtropics, lower at the rainy Equator and lowest near the poles. Enclosed seas in hot, dry regions, such as the Red Sea and the Persian Gulf, are very salty, while the Baltic Sea, fed by many rivers, is among the least salty. Lake Van in Turkey, the Dead Sea and the Great Salt Lake in the USA are far saltier than the ocean.

**Coral reefs:** Corals are tiny marine animals called polyps that build skeletons of calcium carbonate, and algae living inside them give them food and colour. Tropical coral reefs grow only in warm (above about 20 degrees Celsius), clear, shallow, sunlit and salty water, so they lie mostly within 30 degrees of the Equator. Fringing reefs grow close to the shore; barrier reefs lie farther out behind a lagoon, like the Great Barrier Reef off Queensland, Australia, the largest reef system in the world; atolls are ring-shaped reefs around a lagoon, as in Lakshadweep and the Maldives. Water that is too warm makes corals expel their algae and turn white, which is coral bleaching.

### Examples

- Oceans by size: Pacific, Atlantic, Indian, Southern, Arctic. The Pacific is larger than all the land put together; the Arctic is the smallest and shallowest.
- Ocean floor: continental shelf (usually under 200 m, fisheries and oil such as Mumbai High), continental slope, abyssal plain, trench; a guyot is a flat-topped seamount.
- Deepest trenches: Mariana (Pacific, Challenger Deep, nearly 11,000 m), Puerto Rico (Atlantic), Sunda or Java (Indian Ocean).
- Warm currents: Gulf Stream, North Atlantic Drift, Brazil, Kuroshio, East Australian, Agulhas, Mozambique.
- Cold currents: Labrador, Canary, Benguela, Falkland, Oyashio, California, Peru (Humboldt), West Australian.

- Gulf Stream meets the Labrador Current near Newfoundland: fog and the rich Grand Banks fishery. The North Atlantic Drift keeps Norway's ports ice-free.
- Cold currents beside deserts: Peru Current and Atacama, Benguela and Namib, Canary and the Sahara coast.
- Spring tides: new and full moon, Sun, Moon and Earth in a line, largest range. Neap tides: quarter moons, at right angles, smallest range. High tide comes about 50 minutes later each day.
- Average ocean salinity 35 parts per thousand; highest in the subtropics; Red Sea very salty, Baltic Sea among the least; Lake Van, Dead Sea, Great Salt Lake far saltier.
- Coral reefs: fringing, barrier (Great Barrier Reef, Queensland, the largest), atoll (Lakshadweep, Maldives); need water above about 20 degrees C; bleaching when too warm.

> **Quick revision:** 71% of the surface is water, 97% of water is in the oceans; Pacific largest and deepest; continental shelf usually under 200 m, abyssal plain 3,000-6,000 m; Mariana Trench nearly 11,000 m; Puerto Rico Trench deepest in the Atlantic, Java Trench in the Indian Ocean; gyres clockwise in the north; Gulf Stream, Kuroshio, Brazil, Agulhas warm; Labrador, Canary, Benguela, Peru, California cold; spring tides at new and full moon; Bay of Fundy highest tides, Khambhat in India; salinity 35 per thousand; Great Barrier Reef largest.

### Climates and Natural Regions of the World: Koppen's Scheme, Vegetation and Peoples

Koppen's classification: The most widely used scheme of world climates was devised by the German climatologist Wladimir Koppen, who kept revising it until 1936. It uses monthly temperature and rainfall, matched to vegetation. Its five main groups are A, tropical humid, where every month averages above 18 degrees Celsius; B, dry, where evaporation exceeds precipitation; C, warm temperate, with the coldest month between 18 and minus 3 degrees; D, cold snow-forest, with the coldest month below minus 3 degrees; and E, polar, where even the warmest month stays below 10 degrees. Small letters show the rainfall pattern: f for no dry season, m for monsoon, w for a dry winter and s for a dry summer, while BW is desert, BS steppe, ET tundra and EF ice cap. In India, Amw covers the west coast south of Goa, As the Coromandel coast of Tamil Nadu, BWhw extreme western Rajasthan and Cwg much of the Ganga plain.

**Equatorial regions:** The equatorial climate (Af) lies within about 10 degrees of the Equator in the Amazon and Congo basins, Malaysia and Indonesia. It is hot and wet all year, around 27 degrees Celsius with a very small annual range, and rain falls almost daily in afternoon convectional thunderstorms, often more than 200 cm a year. The natural vegetation is tropical evergreen rainforest, called selvas in the Amazon: tall, dense, layered forest of hardwoods such as mahogany, ebony and rosewood. Traditional peoples include the Pygmies of the Congo forests and the Semang of Malaysia. Shifting cultivation has many local names: roca in Brazil, milpa in Mexico and Central America, conuco in Venezuela, masole in Central Africa, ladang in Indonesia and Malaysia, ray in Vietnam and jhum in north-east India.

**Monsoon and savanna regions:** The tropical monsoon climate (Am) of South and South-East Asia and northern Australia has a seasonal reversal of winds, a hot, wet summer and a dry winter; its deciduous forests shed their leaves in the dry season and yield teak, sal and bamboo. The tropical savanna or Sudan climate (Aw) lies between the equatorial forests and the hot deserts, with a wet summer and a long dry winter. Tall grasses with scattered trees such as acacia and baobab cover the savannas of Africa, the llanos of the Orinoco basin in Venezuela, the campos of Brazil and northern Australia. The Maasai of Kenya and Tanzania herd cattle, and the Hausa of northern Nigeria farm and trade.

**Hot and cold deserts:** Hot deserts (BWh) lie mostly on the western sides of continents between about 15 and 30 degrees of latitude, where the subtropical high brings sinking dry air, the trade winds blow offshore and cold currents chill the coast. Rain is usually under 25 cm a year, and blazing days and cold nights give the largest daily range of temperature of any climate. The Sahara is the largest hot desert, followed by the Arabian; others are the Kalahari and Namib, the Thar, the Australian deserts and the Atacama, the driest. Xerophytic plants such as cacti and thorny bushes survive here, and date palms grow at oases. Peoples include the Bedouins of Arabia, the Tuaregs of the Sahara, the San (Bushmen) of the Kalahari and the Aborigines of Australia. Cold deserts, such as the Gobi, Patagonia and Ladakh, lie deep inside continents or in rain shadows.

**Mediterranean regions:** The Mediterranean climate (Cs) lies on the western margins of continents between about 30 and 45 degrees: around the Mediterranean Sea, in central California, central Chile, the Cape Town region of South Africa, and south-western and southern Australia around Perth and Adelaide. Its unique feature is rain in winter. Summers are hot and dry under the subtropical high, while in winter the pressure belts shift towards the Equator and the westerlies bring cyclonic rain. Evergreen trees such as the cork oak and olive grow here, and these orchard lands of the world produce citrus fruits, grapes, olives and figs.

**Temperate grasslands:** Low rainfall and extreme temperatures in mid-latitude continental interiors produce treeless grasslands: the steppes of Eurasia, the prairies of North America, the pampas of Argentina, the veld of South Africa, the downs of Australia and the Canterbury plains of New Zealand. Once grazed by bison and wild horses, they are now the great wheat lands and cattle ranches of the world, and the Kirghiz and Kazakhs traditionally herded animals on the Central Asian steppes.

**Taiga and tundra:** Roughly between 50 and 70 degrees north lies the taiga or Siberian climate, with long, bitterly cold winters and short, cool summers. Found only in the Northern Hemisphere, because the Southern Hemisphere has no broad land masses at these latitudes, it supports vast coniferous forests of pine, fir, spruce and larch. Farther north, along the Arctic Ocean, the tundra (ET) is a treeless land of mosses, lichens and dwarf shrubs over permanently frozen ground (permafrost). Its peoples include the Inuit (once called Eskimos) of Canada, Alaska and Greenland; the Sami (Lapps) of northern Scandinavia, who herd reindeer; and the Samoyeds and Chukchi of Siberia. The ice cap climate (EF) covers Antarctica and the interior of Greenland.

**Examples**

- Koppen groups: A tropical (every month above 18 degrees C), B dry, C warm temperate, D cold snow-forest, E polar (warmest month below 10 degrees C); H highlands.
- Koppen small letters: f no dry season, m monsoon, w dry winter, s dry summer; BW desert, BS steppe, ET tundra, EF ice cap.
- India in Koppen's scheme: Amw west coast south of Goa, As Coromandel coast, Aw most of the peninsular plateau, BWhw western Rajasthan, Cwg Ganga plain.
- Equatorial (Af): about 27 degrees C all year, daily afternoon rain, over 200 cm; selvas of the Amazon; mahogany, ebony, rosewood; Pygmies of the Congo, Semang of Malaysia.
- Shifting cultivation names: roca (Brazil), milpa (Mexico), conuco (Venezuela), masole (Central Africa), ladang (Indonesia, Malaysia), ray (Vietnam), jhum (north-east India).
- Savanna: llanos (Venezuela), campos (Brazil), Serengeti (East Africa); acacia and baobab trees; Maasai herders (Kenya, Tanzania), Hausa farmers (Nigeria).
- Hot deserts on western margins at 15-30 degrees: Sahara, Arabian, Kalahari, Namib, Thar, Atacama; Bedouins (Arabia), Tuaregs (Sahara), San or Bushmen (Kalahari).
- Mediterranean (Cs): rain in winter, dry summer; Mediterranean basin, California, central Chile, Cape Town, Perth and Adelaide; olive, cork oak, citrus, grapes.
- Temperate grasslands: steppes (Eurasia), prairies (North America), pampas (Argentina), veld (South Africa), downs (Australia), Canterbury (New Zealand).
- Taiga: coniferous softwood forests, only in the Northern Hemisphere. Tundra: mosses, lichens, permafrost; Inuit (Canada, Alaska, Greenland), Sami or Lapps (Scandinavia), Samoyeds and Chukchi (Siberia).

> **Quick revision:** Koppen: groups A, B, C, D, E plus H; letters f, m, w, s; Af equatorial, 27 C, over 200 cm, selvas, Pygmies; Am monsoon forests of teak and sal; Aw savanna, llanos, campos, Maasai; BWh hot deserts on western margins at 15-30 degrees, Bedouin, Tuareg, Bushmen; Cs Mediterranean winter rain, orchard lands; steppes, prairies, pampas, veld, downs; taiga conifers only in the north; tundra mosses and permafrost, Inuit, Sami; shifting cultivation roca, milpa, ladang, jhum.

## The Continents: Highest Peaks, Longest Rivers, Largest Lakes, Deserts and World Records

**Seven continents and world records:** In order of area the continents are Asia, Africa, North America, South America, Antarctica, Europe and Australia. Asia covers about 30 per cent of the world's land. Among world records,

Russia is the largest country and Vatican City the smallest; Greenland is the largest island, followed by New Guinea and Borneo; the Arabian Peninsula is the largest peninsula, Indonesia the largest archipelagic country, the Bay of Bengal the largest bay and the Ganga-Brahmaputra delta the largest delta.

**Asia:** Asia has the world's highest peak, Mount Everest (8,849 m by the 2020 Nepal-China measurement; older books give 8,848 m) on the Nepal-China border, called Sagarmatha in Nepal and Chomolungma in Tibet, and the second highest, K2 or Godwin-Austen (8,611 m), in the Karakoram. Its great ranges radiate from the Pamir Knot, the Roof of the World, and the Tibetan plateau is the highest and largest plateau on Earth. The Yangtze of China, about 6,300 km long, is Asia's longest river and the third longest in the world. The Caspian Sea on the Europe-Asia border is the world's largest lake, and Lake Baikal in Siberia is the deepest lake and holds the most fresh water. By area the Arabian Desert is the largest desert in Asia; the Gobi of Mongolia and China, which many Indian books call Asia's largest desert, is its largest cold desert. The shore of the Dead Sea, more than 400 m below sea level, is the lowest land on Earth.

**Africa:** Africa is the only continent crossed by the Equator, both tropics and the Prime Meridian. Its highest peak is Kilimanjaro (5,895 m) in Tanzania, a snow-capped volcanic mountain close to the Equator. The Nile, about 6,650 km long, is the longest river in the world: the White Nile flows out of Lake Victoria and the Blue Nile from Lake Tana in Ethiopia, and they meet at Khartoum before the river flows north to the Mediterranean. The Congo crosses the Equator twice, and the Zambezi plunges over Victoria Falls on the Zambia-Zimbabwe border. Lake Victoria, shared by Uganda, Kenya and Tanzania, is Africa's largest lake, and Lake Tanganyika the longest freshwater lake in the world. The Sahara is the largest hot desert, and the Atlas Mountains of the north-west are young fold mountains.

**North America:** The highest peak is Denali, also called Mount McKinley (about 6,190 m), in Alaska. The Mississippi-Missouri is the longest river system, and the Mississippi drains into the Gulf of Mexico, the largest gulf in the world. The five Great Lakes, Superior, Michigan, Huron, Erie and Ontario, form the largest group of freshwater lakes; Lake Superior on the USA-Canada border is the largest freshwater lake by area, and Lake Michigan is the only one wholly inside the USA. Niagara Falls lies between Lakes Erie and Ontario. The young Rockies run down the west and the old Appalachians the east. Death Valley in California is the continent's lowest point and holds the highest air temperature on record, 56.7 degrees Celsius in 1913, the figure accepted by the World Meteorological Organization (WMO).

**South America:** The Andes, about 7,000 km long, are the longest mountain range on land, and Aconcagua (6,961 m) in Argentina is the highest peak outside Asia. The Amazon is the largest river by volume and by drainage basin, carrying about a fifth of all the river water that reaches the oceans. Angel Falls in Venezuela (979 m) is the highest waterfall in the world. Lake Titicaca, on the Peru-Bolivia border at about 3,800 m, is the highest navigable lake in the world and the largest lake of the continent by volume. The Atacama in Chile is the driest desert outside the polar regions, and the Patagonian Desert of Argentina, a cold rain-shadow desert, is the largest on the continent.

**Europe:** Europe's highest peak is Mount Elbrus (5,642 m) in the Caucasus in Russia, while Mont Blanc on the France-Italy border is the highest peak of the Alps. The Volga, which flows into the Caspian Sea, is Europe's longest river. The Danube, the second longest, rises in Germany's Black Forest, flows through or along ten countries, more than any other river, and passes four capitals, Vienna, Bratislava, Budapest and Belgrade, before entering the Black Sea. Lake Ladoga in Russia is the largest lake wholly in Europe. Its young fold ranges include the Alps, Pyrenees, Apennines, Carpathians and Caucasus, and the Meseta is the plateau of Spain.

**Australia and Antarctica:** Australia is the smallest, flattest and driest inhabited continent. Its highest mainland peak is Mount Kosciuszko (2,228 m) in the Great Dividing Range. The Murray with its tributary the Darling forms its longest river system, and Lake Eyre, a salt lake about 15 m below sea level and usually dry, is its largest lake and lowest point. The Great Victoria Desert is its largest desert. Antarctica, the coldest, windiest and, on average, highest continent, is a polar desert and the largest desert of all; its highest point is the Vinson Massif (4,892 m). Vostok station recorded minus 89.2 degrees Celsius in 1983, the lowest temperature ever measured at a weather station. The Antarctic Treaty of 1959 reserves the continent for peaceful science, and India's stations there are Dakshin Gangotri (the first, set up during the 1983-84 expedition), Maitri and Bharati.

**Examples**

- Continents by area: Asia, Africa, North America, South America, Antarctica, Europe, Australia.
- Highest peaks: Everest 8,849 m (Asia), Aconcagua 6,961 m (South America), Denali about 6,190 m (North America), Kilimanjaro 5,895 m (Africa), Elbrus 5,642 m (Europe), Vinson 4,892 m (Antarctica), Kosciuszko 2,228 m (Australia).
- Longest rivers: Nile (Africa, world's longest), Amazon (South America, largest by volume), Yangtze (Asia), Mississippi-Missouri (North America), Volga (Europe), Murray-Darling (Australia).
- Lakes: Caspian largest lake in the world, Superior largest freshwater lake by area, Baikal deepest, Victoria largest in Africa, Tanganyika longest, Titicaca highest navigable.
- Deserts: Antarctica largest of all, Sahara largest hot desert, Arabian largest in Asia by area (Gobi Asia's largest cold desert), Atacama driest outside the poles, Patagonian largest in South America, Great Victoria largest in Australia.
- Africa is the only continent crossed by the Equator, both tropics and the Prime Meridian; the Congo crosses the Equator twice.
- Danube: rises in the Black Forest, flows through ten countries, passes Vienna, Bratislava, Budapest and Belgrade, and ends in the Black Sea.
- Lowest points: Dead Sea shore (more than 400 m below sea level, the lowest land on Earth), Death Valley (North America), Lake Eyre (Australia).
- Largest islands: Greenland, New Guinea, Borneo, Madagascar. Indonesia is the largest archipelagic country and the Arabian Peninsula the largest peninsula.
- Plateaus: Tibet (highest and largest), Pamir Knot (Roof of the World), Bolivian plateau, Colorado Plateau (Grand Canyon), Meseta (Spain).

> **Quick revision:** Asia largest continent, Australia smallest; Everest 8,849 m, K2 8,611 m, Aconcagua 6,961 m, Denali, Kilimanjaro 5,895 m, Elbrus 5,642 m, Vinson 4,892 m, Kosciuszko 2,228 m; Nile longest, Amazon largest by volume, Yangtze longest in Asia, Volga in Europe; Caspian largest lake, Superior largest freshwater lake, Baikal deepest, Titicaca highest navigable; Sahara largest hot desert, Atacama driest outside the poles; Andes longest range on land; Angel Falls highest waterfall; Dead Sea lowest land; Greenland largest island.

### The World Map: Straits, Canals, Boundary Lines, Capitals, Landlocked and Island Countries

**Straits of Asia and Africa:** A strait is a narrow sea passage that joins two larger water bodies and separates two land masses. The Strait of Malacca, between the Malay Peninsula and Sumatra, joins the Andaman Sea of the Indian Ocean with the South China Sea; the Sunda Strait lies between Java and Sumatra. The Strait of Hormuz, between Iran and Oman, links the Persian Gulf with the Gulf of Oman. The Bab-el-Mandeb, between Yemen and Djibouti, joins the Red Sea with the Gulf of Aden. The Palk Strait separates India from Sri Lanka, and the Mozambique Channel separates Madagascar from mainland Africa.

**Straits of Europe, the Americas and Oceania:** The Strait of Gibraltar, between Spain and Morocco, joins the Mediterranean Sea with the Atlantic Ocean. The Bosphorus at Istanbul joins the Black Sea with the Sea of Marmara, and the Dardanelles join the Sea of Marmara with the Aegean Sea; together they separate Europe from Asia. The Strait of Dover separates England from France. The Bering Strait between Russia and Alaska joins the Arctic Ocean with the Pacific. The Strait of Magellan cuts across the tip of South America, and the Drake Passage separates South America from Antarctica. The Bass Strait separates Tasmania from mainland Australia, and the Cook Strait separates the North and South Islands of New Zealand.

**Canals and isthmuses:** An isthmus is a narrow strip of land joining two larger land masses, and ship canals are often cut through one. The Suez Canal, opened in 1869 under Ferdinand de Lesseps, cuts the Isthmus of Suez in Egypt to join the Mediterranean at Port Said with the Red Sea at Suez; it has no locks because the two seas are at nearly the same level. The Panama Canal, opened in 1914, cuts the Isthmus of Panama to join the Atlantic with the Pacific, lifting ships through locks; the USA handed it over to Panama at the end of 1999. The Kiel Canal in Germany links the North Sea with the Baltic Sea, the Corinth Canal cuts the Isthmus of Corinth in Greece, and the Welland Canal joins Lake Erie with Lake Ontario, bypassing Niagara Falls.

**Famous boundary lines:** The Radcliffe Line, drawn by Sir Cyril Radcliffe in 1947, separates India from Pakistan and Bangladesh. The Durand Line (1893), named after Sir Mortimer Durand, separates Afghanistan and Pakistan. The McMahon Line, drawn at the Simla Conference of 1914 by Sir Henry McMahon, is the India-China boundary in the east, which China does not accept. The Line of Control in Jammu and Kashmir began as the ceasefire line of 1949 and took its present name under the Simla Agreement of 1972. The 38th parallel divided Korea into northern and southern zones in 1945, and the armistice line of 1953 runs close to it; the 17th parallel divided North and South Vietnam from 1954 until reunification in 1976; and the 49th parallel forms much of the USA-Canada border west of the Great Lakes. The Oder-Neisse Line is the Germany-Poland border.

**Capitals on rivers:** In Europe, London stands on the Thames, Paris on the Seine, Rome on the Tiber, Berlin on the Spree, Moscow on the Moskva, Warsaw on the Vistula, Prague on the Vltava, Lisbon on the Tagus and Kyiv on the Dnieper, while Vienna, Bratislava, Budapest and Belgrade all stand on the Danube. In Asia, Baghdad is on the Tigris, Bangkok on the Chao Phraya, Hanoi on the Red River, Phnom Penh and Vientiane on the Mekong, Dhaka on the Buriganga and Seoul on the Han. In Africa, Cairo is on the Nile, Khartoum at the meeting of the Blue and White Nile, and Kinshasa and Brazzaville face each other across the Congo. In the Americas, Washington DC is on the Potomac, Ottawa on the Ottawa River, and Buenos Aires and Montevideo on the Rio de la Plata estuary.

**Landlocked countries:** A landlocked country has no sea coast. Kazakhstan is the largest landlocked country and Mongolia the second largest, while Ethiopia has the most people of any. Uzbekistan and Liechtenstein are doubly landlocked, surrounded only by other landlocked countries, and Lesotho, San Marino and Vatican City are enclaves, each wholly surrounded by one country. Asia's landlocked states include Afghanistan, Nepal, Bhutan, Mongolia, the five Central Asian republics and Laos, the only one in South-East Asia. Europe's include Switzerland, Austria, Hungary, the Czech Republic, Slovakia, Serbia and Belarus; Africa's include Chad, Niger, Mali, Ethiopia, South Sudan, Uganda, Rwanda, Zambia, Zimbabwe and Botswana; and South America has two, Bolivia and Paraguay.

**Island countries:** Indonesia is the largest archipelagic country, and the Philippines is another great archipelago. Japan has four main islands, Honshu (the largest), Hokkaido, Kyushu and Shikoku. Several islands are shared: New Guinea by Indonesia and Papua New Guinea, Borneo by Indonesia, Malaysia and Brunei, Hispaniola by Haiti and the Dominican Republic, and Timor by Indonesia and Timor-Leste. Madagascar, the fourth largest island, is famous for its lemurs. Sri Lanka, the Maldives (the lowest-lying country in the world), Iceland (astride the Mid-Atlantic Ridge), Cuba (the largest island of the Caribbean) and New Zealand are other island nations that exams ask about.

### Examples

- Malacca Strait: Andaman Sea (Indian Ocean) to South China Sea, between the Malay Peninsula and Sumatra. Sunda Strait: between Java and Sumatra.
- Hormuz: Persian Gulf to Gulf of Oman (Iran and Oman). Bab-el-Mandeb: Red Sea to Gulf of Aden (Yemen and Djibouti). Palk Strait: India and Sri Lanka.
- Gibraltar: Mediterranean to Atlantic (Spain and Morocco). Bosphorus and Dardanelles: Black Sea to Aegean Sea through the Sea of Marmara, separating Europe and Asia.
- Bering Strait: Russia and Alaska. Bass Strait: Australia and Tasmania. Cook Strait: North and South Islands of New Zealand. Drake Passage: South America and Antarctica.
- Suez Canal (1869): Port Said on the Mediterranean to Suez on the Red Sea, no locks. Panama Canal (1914): Atlantic to Pacific, with locks. Kiel Canal: North Sea to Baltic Sea.
- Boundary lines: Radcliffe (India-Pakistan, 1947), Durand (Afghanistan-Pakistan, 1893), McMahon (India-China, 1914), 38th parallel (the two Koreas), 49th parallel (USA-Canada), Oder-Neisse (Germany-Poland).
- Capitals on the Danube: Vienna, Bratislava, Budapest, Belgrade. Kinshasa and Brazzaville face each other across the Congo; Khartoum stands where the Blue and White Nile meet.
- Planned or split capitals: Nigeria's capital is Abuja, Pakistan's Islamabad, Myanmar's Naypyidaw; South Africa has three: Pretoria (executive), Cape Town (legislative), Bloemfontein (judicial).
- Landlocked: Kazakhstan largest, Mongolia second, Ethiopia most populous; Uzbekistan and Liechtenstein doubly landlocked; Bolivia and Paraguay in South America; Laos the only one in South-East Asia.

- Shared islands: New Guinea (Indonesia, Papua New Guinea), Borneo (Indonesia, Malaysia, Brunei), Hispaniola (Haiti, Dominican Republic), Timor (Indonesia, Timor-Leste).

> **Quick revision:** Malacca: Andaman Sea to South China Sea; Hormuz: Persian Gulf to Gulf of Oman; Bab-el-Mandeb: Red Sea to Gulf of Aden; Gibraltar: Mediterranean to Atlantic; Bosphorus and Dardanelles divide Europe and Asia; Bering: Russia and Alaska; Suez 1869 without locks; Panama 1914 with locks; Kiel: North Sea to Baltic; Radcliffe 1947, Durand 1893, McMahon 1914, 38th parallel Korea, 49th parallel USA-Canada; Danube capitals Vienna, Bratislava, Budapest, Belgrade; Kazakhstan largest landlocked; Uzbekistan and Liechtenstein doubly landlocked; Indonesia largest archipelagic country.

Free practice questions: parikshasaathi.com/q/world-physical-geography/

## Static General Knowledge

### Static General Knowledge: Symbols, Firsts, Awards, Sports and Organisations

**What the exam asks:** Static GK is the most predictable part of General Awareness in SSC, RRB, Agniveer and state police papers. Four to eight questions per paper come from facts that never change: national symbols, firsts and superlatives, important days, awards, books, sports, organisations and their headquarters, defence and space basics and famous places. These are pure recall questions, so the only strategy is a tight, repeatedly revised fact bank.

**National symbols:** The National Anthem Jana Gana Mana was written by Rabindranath Tagore, first sung at the Calcutta Congress session on 27 December 1911 and adopted on 24 January 1950. The National Song Vande Mataram comes from Bankim Chandra's novel Anandamath (1882). The National Emblem is adapted from the Lion Capital of Ashoka at Sarnath (adopted 26 January 1950); the motto Satyameva Jayate is from the Mundaka Upanishad. The flag, designed by Pingali Venkayya, was adopted on 22 July 1947, has a 2:3 width to length ratio and a navy blue Ashoka Chakra with 24 spokes. National animal: tiger (since 1972, replacing the lion); bird: peacock; flower: lotus; tree: banyan; fruit: mango; river: Ganga (2008); aquatic animal: Gangetic dolphin (2009); heritage animal: elephant (2010). The Saka calendar, adopted in 1957, begins with Chaitra. No game has been officially declared the national sport.

**States, capitals and nicknames:** Learn the north-eastern capitals as a set: Itanagar, Dispur, Imphal, Shillong, Aizawl, Kohima, Agartala and Gangtok. Statehood in order: Andhra Pradesh 1953 (first linguistic state), Gujarat and Maharashtra 1960, Nagaland 1963, Haryana 1966, Sikkim 1975, Goa 1987, Chhattisgarh, Uttarakhand and Jharkhand 2000, Telangana 2014. Rajasthan is the largest state by area and Goa the smallest. Chandigarh, designed by Le Corbusier, is the capital of both Punjab and Haryana. City nicknames are frequent one-mark questions: Pink City Jaipur, Manchester of India Ahmedabad, City of Joy Kolkata, Scotland of the East Shillong.

**Firsts in India and the world:** First President Rajendra Prasad, first woman Prime Minister Indira Gandhi (1966), first woman President Pratibha Patil (2007), first woman Chief Minister Sucheta Kripalani (1963), first woman IPS officer Kiran Bedi (1972), first Indian in space Rakesh Sharma (1984), first Nobel laureate Rabindranath Tagore (1913), first Indian woman Nobel laureate Mother Teresa (1979). First feature film Raja Harishchandra (1913), first talkie Alam Ara (1931), first newspaper Hicky's Bengal Gazette (1780), first railway Bombay to Thane (1853), first satellite Aryabhata (1975), first universities Calcutta, Bombay and Madras (1857). World: first in space Yuri Gagarin (1961), first on the Moon Neil Armstrong (1969), first woman Prime Minister Sirimavo Bandaranaike (1960).

**Superlatives:** Longest river of India Ganga; longest dam Hirakud (Mahanadi); highest dam Tehri (Bhagirathi); longest national highway NH 44, Srinagar to Kanyakumari; largest river island Majuli; largest freshwater lake Wular; largest lagoon Chilika; largest delta in the world the Ganga-Brahmaputra delta (the Sundarbans is its mangrove part). World: longest river Nile (about 6,650 km by the traditional measure; some recent measurements put the Amazon longer), largest ocean Pacific, smallest Arctic, deepest lake Baikal, largest lake Caspian Sea, highest waterfall Angel Falls, largest country Russia, smallest Vatican City.

**Important days:** 15 January Army Day, 25 January National Voters' Day, 28 February National Science Day (Raman Effect), 11 May National Technology Day (Pokhran-II), 5 June Environment Day, 21 June Yoga Day, 26 July Kargil

Vijay Diwas, 29 August National Sports Day (Dhyan Chand), 5 September Teachers' Day, 8 October Air Force Day, 24 October UN Day, 26 November Constitution Day, 4 December Navy Day, 10 December Human Rights Day, 16 December Vijay Diwas.

**Awards:** Bharat Ratna (1954) is the highest civilian award; the first recipients were C. Rajagopalachari, S. Radhakrishnan and C.V. Raman, and the first posthumous award went to Lal Bahadur Shastri (1966). Padma awards in descending order: Padma Vibhushan, Padma Bhushan, Padma Shri. Param Vir Chakra is the highest wartime gallantry award (first recipient Major Somnath Sharma) and Ashoka Chakra the highest peacetime award. Arjuna Award is for sportspersons, Dronacharya for coaches, Khel Ratna (first Viswanathan Anand) for the best sportsperson. Jnanpith (first G. Sankara Kurup, 1965) is for literature, Dadasaheb Phalke (first Devika Rani, 1969) for cinema, Ramon Magsaysay is from the Philippines. Nobel Prizes began in 1901 in five fields; Economics was added in 1969. The Peace Prize is given in Oslo, the rest in Stockholm. Booker is for English fiction; Pulitzer is an American award for journalism, literature and music.

**Sports, organisations, defence and space:** Team sizes: cricket, football and hockey 11, kabaddi 7, volleyball 6, basketball 5. Link cups to sports: Thomas and Uber to badminton, Davis to tennis, Ryder to golf, Durand and Santosh to football, Ranji to cricket, Beighton to hockey. India won its first hockey gold in 1928 and the cricket World Cup in 1983 and 2011; Abhinav Bindra won the first individual Olympic gold in 2008. The UN came into existence on 24 October 1945 (its Charter was signed at San Francisco on 26 June 1945; its headquarters is in New York); its Security Council has 15 members and the ICJ sits at The Hague. The service chiefs are General, Admiral and Air Chief Marshal; the IGMDP of 1983 produced Prithvi, Agni, Trishul, Akash and Nag. Space milestones: Aryabhata 1975, SLV-3 with Rohini 1980, Chandrayaan-1 2008, Mangalyaan 2013; ISRO is headquartered at Bengaluru and launches from Sriharikota.

**Traps:** The flag was adopted in 1947, the emblem and anthem in 1950. The lion was the national animal before 1972. Alam Ara is the first talkie, not the first film. The Trusteeship Council, not ECOSOC, was suspended in 1994. Hirakud is the longest dam, Tehri the highest. Khorana's Nobel was in Medicine, not Chemistry. BrahMos is not an IGMDP missile.

### Examples

- First three Bharat Ratna awardees (1954): C. Rajagopalachari, S. Radhakrishnan and C.V. Raman; first posthumous award: Lal Bahadur Shastri (1966); first sportsperson: Sachin Tendulkar (2014).
- Mnemonic for the five IGMDP missiles: PATNA = Prithvi, Agni, Trishul, Nag, Akash. BrahMos is a separate Indo-Russian joint venture.
- Service days: Army Day 15 January, Air Force Day 8 October, Navy Day 4 December (Operation Trident, 1971), Armed Forces Flag Day 7 December.
- Indian Nobel laureates by field: Tagore 1913 Literature, Raman 1930 Physics, Khorana 1968 Medicine, Mother Teresa 1979 Peace, Chandrasekhar 1983 Physics, Amartya Sen 1998 Economics, Venkatraman Ramakrishnan 2009 Chemistry, Kailash Satyarthi 2014 Peace, Abhijit Banerjee 2019 Economics.
- Cups by sport: Thomas, Uber and Sudirman = badminton; Davis and Billie Jean King (formerly Fed) = tennis; Ryder and Walker = golf; Swaythling and Corbillon = table tennis; Durand and Santosh = football; Ranji, Duleep and Irani = cricket; Agha Khan and Beighton = hockey.
- Headquarters by city: New York = UN, UNICEF; Geneva = WHO, ILO, WTO, UNHCR, Red Cross; Paris = UNESCO; Rome = FAO; Vienna = IAEA, OPEC; Washington DC = IMF, World Bank; The Hague = ICJ; Lyon = Interpol; Nairobi = UNEP; Kathmandu = SAARC; Jakarta = ASEAN.
- City nicknames: Jaipur Pink City; Udaipur City of Lakes; Ahmedabad Manchester of India; Kolkata City of Joy; Bengaluru Silicon Valley of India; Mumbai City of Seven Islands; Jamshedpur Pittsburgh of India; Coimbatore Manchester of South India; Shillong Scotland of the East.
- Nicknames of persons: Frontier Gandhi = Khan Abdul Ghaffar Khan; Nightingale of India = Sarojini Naidu; Missile Man = A.P.J. Abdul Kalam; Iron Man = Sardar Patel; Grand Old Man of India = Dadabhai Naoroji; Flying Sikh = Milkha Singh; Payyoli Express = P.T. Usha.
- Women firsts: Prime Minister Indira Gandhi 1966; President Pratibha Patil 2007; Governor Sarojini Naidu 1947; Chief Minister Sucheta Kripalani 1963; IPS Kiran Bedi 1972; Supreme Court judge Fathima Beevi 1989; Lok Sabha Speaker

Meira Kumar 2009; Everest climber Bachendri Pal 1984.

- India's eight Olympic hockey golds: 1928, 1932, 1936, 1948, 1952, 1956, 1964, 1980. Cricket World Cups: 1983 (Kapil Dev, Lord's) and 2011 (M.S. Dhoni, Wankhede); first T20 World Cup 2007 (Dhoni).
- Currencies: Japan yen, China yuan, Russia rouble, UK pound, Bangladesh taka, Myanmar kyat, Bhutan ngultrum, Maldives rufiyaa, South Africa rand, Kuwait dinar. Parliaments: Japan Diet, Israel Knesset, Iran Majlis, Russia Duma, USA Congress, Germany Bundestag.
- Books: Discovery of India (Nehru), Wings of Fire (Kalam), My Experiments with Truth (Gandhi, written in Gujarati), India Wins Freedom (Azad), Godan (Premchand), Arthashastra (Kautilya), Rajatarangini (Kalhana), Long Walk to Freedom (Mandela).

> **Quick revision:** Anthem: Tagore, adopted 24 Jan 1950; song: Vande Mataram (Anandamath); emblem: Sarnath Lion Capital, Satyameva Jayate (Mundaka Upanishad); flag 2:3, 24 spokes, Pingali Venkayya; first Bharat Ratna 1954 (Rajaji, Radhakrishnan, Raman); first PVC Major Somnath Sharma; Jnanpith 1965 G. Sankara Kurup; Phalke 1969 Devika Rani; UN 24 Oct 1945, UNSC 15 members; SAARC HQ Kathmandu; Hirakud longest, Tehri highest dam; NH 44 Srinagar to Kanyakumari; first hockey gold 1928; World Cups 1983, 2011; Aryabhata 1975, SLV-3 1980, Chandrayaan-1 2008, MOM 2013; IGMDP: Prithvi, Agni, Trishul, Akash, Nag; 22 Eighth Schedule languages.

### National Symbols of India: Flag, Emblem, Anthem, Song, Calendar and More

**The National Flag:** The tricolour was adopted by the Constituent Assembly on 22 July 1947, on a resolution moved by Jawaharlal Nehru, and it is based on a design by Pingali Venkayya. It has three equal horizontal bands: deep saffron at the top, white in the middle and dark green at the bottom, and the ratio of its width to its length is 2:3. In the centre of the white band is a navy blue wheel, the Ashoka Chakra, with 24 spokes; its diameter approximates the width of the white band, and it is taken from the wheel on the abacus of the Sarnath Lion Capital. The chakra replaced the spinning wheel (charkha) that the Congress tricolour of 1931 carried. Saffron stands for strength and courage, white for peace and truth, and green for the fertility, growth and auspiciousness of the land.

**Flag history and rules:** The first national flag is said to have been hoisted on 7 August 1906 at Parsee Bagan Square in Calcutta, and in 1907 Madame Bhikaji Cama unfurled a flag at Stuttgart in Germany. Today the display of the flag is governed by the Flag Code of India, 2002, which came into force on 26 January 2002, and by the Prevention of Insults to National Honour Act, 1971. In Union of India v. Naveen Jindal (2004) the Supreme Court held that flying the flag with respect and dignity is part of the freedom of expression under Article 19(1)(a).

**The State Emblem:** The emblem is an adaptation of the Lion Capital of Ashoka at Sarnath, carved from polished sandstone in the 3rd century BCE and now kept in the Sarnath Museum. The original has four lions standing back to back on a circular abacus whose frieze carries an elephant, a galloping horse, a bull and a lion separated by wheels, all resting on a bell-shaped lotus. In the emblem adopted on 26 January 1950 only three lions are visible, the wheel appears in the centre of the abacus with a bull on the right and a horse on the left, and the bell-shaped lotus is left out. Below the abacus is the motto Satyameva Jayate (Truth alone triumphs) in Devanagari script, taken from the Mundaka Upanishad. Its misuse is barred by the State Emblem of India (Prohibition of Improper Use) Act, 2005.

**The National Anthem:** Jana Gana Mana was written in highly Sanskritised Bengali by Rabindranath Tagore. It is the first stanza of a hymn of five stanzas that was first sung on 27 December 1911 at the Calcutta session of the Indian National Congress, and Tagore himself rendered it into English in 1919 as The Morning Song of India. The Constituent Assembly adopted it as the National Anthem on 24 January 1950. The full version takes about 52 seconds to play, and a short version of the first and last lines takes about 20 seconds. Tagore also wrote Amar Sonar Bangla, the national anthem of Bangladesh.

**The National Song:** Vande Mataram was composed by Bankim Chandra Chattopadhyay in a mix of Sanskrit and Bengali (the government's own description calls it a Sanskrit composition) and appeared in his novel Anandamath (1882). Rabindranath Tagore sang it at the 1896 session of the Congress in Calcutta, and it became the rallying cry of the Swadeshi movement after the partition of Bengal in 1905. On 24 January 1950 Rajendra Prasad, as President of the Constituent Assembly, declared that it would be honoured equally with Jana Gana Mana and have equal status with it. Sri Aurobindo translated it into English prose.

**The National Calendar:** The Saka calendar was adopted on 22 March 1957, on the recommendation of the Calendar Reform Committee headed by Meghnad Saha, for use alongside the Gregorian calendar in the Gazette of India, All India Radio news and official communications. Its first month is Chaitra, and 1 Chaitra falls on 22 March in a normal year and on 21 March in a leap year. The Saka era begins in 78 CE, so for most of the year the Saka year is the Gregorian year minus 78. A normal year has 12 months and 365 days.

**Animal, bird and the rest:** The tiger (Panthera tigris) is the national animal; it replaced the lion in 1972 on the decision of the Indian Board for Wildlife (some books give April 1973), and Project Tiger was launched on 1 April 1973. The Indian peafowl (Pavo cristatus) has been the national bird since 1963 and is fully protected under the Wildlife (Protection) Act, 1972. The lotus (Nelumbo nucifera) is the national flower, the banyan (Ficus benghalensis) the national tree and the mango (Mangifera indica) the national fruit. The Ganga was declared the national river in 2008, the Gangetic river dolphin (Platanista gangetica) the national aquatic animal in 2009 and the elephant the national heritage animal in 2010. The rupee symbol, designed by D. Udaya Kumar, was approved on 15 July 2010, and the national pledge was written in Telugu by Pydimarri Venkata Subba Rao in 1962.

**Exam traps:** The flag (1947) is older than the emblem, anthem and song (all 1950). Satyameva Jayate comes from the Mundaka Upanishad, not the Rigveda. No game, not even hockey, has been officially declared the national game.

**Examples**

- Flag: adopted 22 July 1947; ratio 2:3; saffron, white and green; navy blue Ashoka Chakra with 24 spokes; based on Pingali Venkayya's design; Flag Code of India in force from 26 January 2002.
- Emblem: from Ashoka's Lion Capital at Sarnath; adopted 26 January 1950; three lions visible, bull on the right and horse on the left of the wheel; motto Satyameva Jayate from the Mundaka Upanishad.
- Jana Gana Mana: Rabindranath Tagore; first sung 27 December 1911 at the Calcutta Congress; adopted 24 January 1950; full version about 52 seconds, short version about 20 seconds.
- Vande Mataram: Bankim Chandra Chattopadhyay; from the novel Anandamath (1882); sung by Tagore at the 1896 Congress session; given equal status with the anthem on 24 January 1950.
- Saka calendar: adopted 22 March 1957 on the Meghnad Saha committee's advice; first month Chaitra; 1 Chaitra = 22 March (21 March in a leap year); Saka era starts in 78 CE.
- Fauna and flora: animal tiger (1972; some books say 1973), bird peacock (1963), aquatic animal Gangetic dolphin (2009), heritage animal elephant (2010); flower lotus, tree banyan, fruit mango; river Ganga (2008).
- Early flags: 7 August 1906 at Parsee Bagan Square, Calcutta; Bhikaji Cama's flag at Stuttgart in 1907; Congress tricolour with the charkha in 1931; present flag 22 July 1947.
- Rupee symbol approved 15 July 2010 (designed by D. Udaya Kumar); national pledge written in Telugu by Pydimarri Venkata Subba Rao (1962).

> **Quick revision:** Flag adopted 22 July 1947, ratio 2:3, navy blue chakra with 24 spokes, Pingali Venkayya's design, Flag Code 2002; emblem from Sarnath Lion Capital, adopted 26 Jan 1950, Satyameva Jayate (Mundaka Upanishad); anthem by Tagore, first sung 27 Dec 1911, adopted 24 Jan 1950, 52 seconds; Vande Mataram from Anandamath (1882); Saka calendar 22 March 1957, first month Chaitra; tiger, peacock, lotus, banyan, mango; Ganga 2008, dolphin 2009, elephant 2010.

### Firsts and Superlatives of India: First Office-Holders, First Women, Largest and Longest

**Why firsts are asked:** Firsts and superlatives are one-line questions in almost every SSC and Railway paper. A first, once made, stays first, and the longest river does not move, so learn them in groups: offices, women, achievements and geography.

**First holders of high offices:** The first President was Rajendra Prasad (1950-1962), the only President to serve two terms, and the first Vice-President was Sarvepalli Radhakrishnan, who later became the second President. Jawaharlal Nehru was the first Prime Minister and Lord Mountbatten the first Governor-General of independent India, while C. Rajagopalachari (1948) was the first and only Indian Governor-General. H.J. Kania was the first Chief Justice of India, G.V. Mavalankar the first Speaker of the Lok Sabha and Sukumar Sen the first Chief Election Commissioner.

Zakir Husain (1967) was the first Muslim President and Giani Zail Singh the first Sikh President. In British India, Warren Hastings was the first Governor-General of Bengal (1773), Lord William Bentinck the first Governor-General of India (1833) and Lord Canning the first Viceroy (1858).

**First women:** Annie Besant was the first woman President of the Congress (1917) and Sarojini Naidu the first Indian woman to hold that post (1925); Sarojini Naidu also became the first woman Governor of a state (United Provinces, 1947). Sucheta Kripalani became the first woman Chief Minister (Uttar Pradesh, 1963), Indira Gandhi the first woman Prime Minister (1966) and Pratibha Patil the first woman President (2007). M. Fathima Beevi was the first woman judge of the Supreme Court (1989), Kiran Bedi the first woman IPS officer (1972), Anna Rajam Malhotra the first woman IAS officer (1951) and Meira Kumar the first woman Speaker of the Lok Sabha (2009). Vijaya Lakshmi Pandit was the first woman President of the UN General Assembly (1953). Kadambini Ganguly and Chandramukhi Basu were the first women graduates in India (1883).

**Firsts in service, science and adventure:** Satyendranath Tagore was the first Indian to qualify for the Indian Civil Service (1863). K.M. Cariappa became the first Indian Commander-in-Chief of the Army on 15 January 1949; Sam Manekshaw was the first Field Marshal (1973) and Arjan Singh the only Marshal of the Indian Air Force. Rakesh Sharma was the first Indian in space (1984, aboard Soyuz T-11), and Kalpana Chawla the first woman of Indian origin in space (1997). Tenzing Norgay and Edmund Hillary first reached the summit of Everest on 29 May 1953, and Bachendri Pal became the first Indian woman to climb it in 1984. Mihir Sen was the first Indian to swim the English Channel (1958), and Bhanu Athaiya the first Indian to win an Oscar, for costume design in Gandhi (1983).

**Largest and smallest:** By area Rajasthan is the largest state and Goa the smallest; among union territories Ladakh (since 2019) is the largest and Lakshadweep the smallest. By population (Census 2011) Uttar Pradesh is the largest state and Sikkim the smallest. Census 2011 also gives Bihar the highest density (1,106 persons per sq km) and Arunachal Pradesh the lowest (17), Kerala the highest literacy (94%) and the highest sex ratio (1,084 women per 1,000 men), and Haryana the lowest sex ratio (879). Gujarat has the longest coastline of any state. The Thar or Great Indian Desert, mostly in Rajasthan, is the largest desert, and Ladakh is a cold desert.

**Rivers, lakes and islands:** The Ganga, about 2,525 km long, is the longest river of India and has the largest river basin; the Godavari, about 1,465 km long, is the longest river of peninsular India and is called the Dakshin Ganga; and the Narmada is the longest west-flowing river. Wular in Jammu and Kashmir is the largest freshwater lake, Chilika in Odisha the largest coastal lagoon and Sambhar in Rajasthan the largest inland saline lake. Majuli on the Brahmaputra in Assam is the largest river island, while Umananda in the Brahmaputra at Guwahati is often called the smallest inhabited river island.

**Peaks, dams and bridges:** K2 (8,611 m), in Gilgit-Baltistan under Pakistan's occupation, is the highest peak on India's map, and Kangchenjunga (8,586 m) on the Sikkim-Nepal border is the highest peak in territory India administers. Anamudi (2,695 m) in Kerala is the highest peak of south India, Doddabetta the highest in the Nilgiris and Guru Shikhar at Mount Abu the highest in the Aravallis. Hirakud on the Mahanadi in Odisha is the longest dam and Tehri on the Bhagirathi in Uttarakhand the highest, while Bhakra on the Sutlej forms the Gobind Sagar reservoir. Pamban Bridge (1914) was India's first sea bridge, Howrah Bridge (1943) over the Hooghly is a famous cantilever bridge, the Dhola-Sadiya or Bhupen Hazarika Setu over the Lohit (about 9.15 km, 2017) was India's longest bridge when it opened, and Bogibeel over the Brahmaputra (2018) was its longest rail-cum-road bridge when it opened.

**Extreme points:** Indira Point on Great Nicobar is the southernmost point of India and Kanyakumari the southern tip of the mainland; Indira Col in the Siachen area is the northernmost point, Kibithu in Arunachal Pradesh the easternmost and Guhar Moti in Kutch, Gujarat, the westernmost.

### Examples

- First President Rajendra Prasad; first Vice-President S. Radhakrishnan; first Chief Justice H.J. Kania; first Lok Sabha Speaker G.V. Mavalankar; first Chief Election Commissioner Sukumar Sen.
- Only Indian Governor-General: C. Rajagopalachari (1948); first Governor-General of independent India: Lord Mountbatten; first Viceroy: Lord Canning (1858).
- Women firsts: Governor Sarojini Naidu (1947), Chief Minister Sucheta Kripalani (1963), Prime Minister Indira Gandhi (1966), Supreme Court judge Fathima Beevi (1989), President Pratibha Patil (2007), Lok Sabha Speaker Meira Kumar

(2009).

- Congress Presidents: Annie Besant (1917) was the first woman; Sarojini Naidu (1925) the first Indian woman.
- First Field Marshal Sam Manekshaw (1973), second K.M. Cariappa (1986); only Marshal of the Indian Air Force Arjan Singh; first Indian ICS officer Satyendranath Tagore (1863).
- Space and summits: Rakesh Sharma in space 1984; Kalpana Chawla 1997; Everest first climbed 29 May 1953 by Tenzing Norgay and Edmund Hillary; Bachendri Pal first Indian woman on Everest 1984.
- Census 2011: most populous state Uttar Pradesh, least Sikkim; highest density Bihar, lowest Arunachal Pradesh; highest literacy and sex ratio Kerala; lowest sex ratio Haryana.
- Longest river Ganga; longest peninsular river Godavari (Dakshin Ganga); largest freshwater lake Wular; largest lagoon Chilika; largest inland saline lake Sambhar; largest river island Majuli.
- Longest dam Hirakud (Mahanadi); highest dam Tehri (Bhagirathi); highest peak of south India Anamudi; highest in the Aravallis Guru Shikhar; Statue of Unity (182 m, Gujarat) was the world's tallest statue when unveiled in 2018.
- Extreme points: south Indira Point (Great Nicobar), north Indira Col, east Kibithu (Arunachal Pradesh), west Guhar Moti (Kutch); southern tip of the mainland Kanyakumari.

> **Quick revision:** First President Rajendra Prasad, PM Nehru, CJI H.J. Kania, Speaker Mavalankar, CEC Sukumar Sen; only Indian Governor-General Rajagopalachari; women: Governor Sarojini Naidu 1947, CM Sucheta Kripalani 1963, PM Indira Gandhi 1966, SC judge Fathima Beevi 1989, President Pratibha Patil 2007; Rakesh Sharma 1984; Everest 29 May 1953; largest state Rajasthan, smallest Goa; UP most populous (2011); Ganga longest, Godavari Dakshin Ganga; Wular, Chilika, Sambhar, Majuli; Hirakud longest, Tehri highest dam.

### Important Days: National and International Days Month by Month

**How to learn days:** Most important days are tied to a birth anniversary, a historic event or the founding of an organisation, and examiners often ask the reason rather than the date. Learn each date with its why: if you know that 28 February marks the discovery of the Raman Effect in 1928, you will not confuse National Science Day with National Technology Day (11 May, the Pokhran-II tests of 1998). The days below are grouped quarter by quarter.

**January to March:** 9 January is Pravasi Bharatiya Divas, recalling Mahatma Gandhi's return from South Africa on 9 January 1915. 10 January is World Hindi Day, marking the first World Hindi Conference held at Nagpur in 1975. 12 January is National Youth Day, the birth anniversary of Swami Vivekananda (born 1863). 15 January is Army Day (K.M. Cariappa took over as Commander-in-Chief in 1949), 25 January National Voters' Day (the Election Commission was set up on 25 January 1950), 26 January Republic Day and 30 January Martyrs' Day (Gandhi's assassination, 1948). 21 February is International Mother Language Day, recalling the language movement of 1952 in Dhaka. 8 March is International Women's Day, 15 March World Consumer Rights Day, 22 March World Water Day, 23 March World Meteorological Day (the WMO Convention came into force in 1950) and also the martyrdom day of Bhagat Singh, Rajguru and Sukhdev (1931), and 24 March World TB Day, the day Robert Koch announced the discovery of the TB bacterium in 1882.

**April to June:** 7 April is World Health Day, the founding day of the WHO in 1948. 14 April is Ambedkar Jayanti (born 1891). 21 April is Civil Services Day, recalling Sardar Patel's address to the officer trainees at Metcalfe House, Delhi, in 1947, and 24 April is National Panchayati Raj Day, the day the 73rd Amendment came into force in 1993. 22 April is Earth Day (first held in 1970) and 23 April World Book and Copyright Day. 1 May is International Labour Day and also Maharashtra and Gujarat Day (1960). 8 May is World Red Cross Day, the birth anniversary of Henry Dunant, 11 May National Technology Day, and 21 May Anti-Terrorism Day, the death anniversary of Rajiv Gandhi (1991). 31 May is World No Tobacco Day. 5 June is World Environment Day, the opening day of the Stockholm Conference of 1972, and 21 June, the summer solstice, is the International Day of Yoga, first observed in 2015.

**July to September:** 1 July is National Doctors' Day, the birth and death anniversary of Dr B.C. Roy. 11 July is World Population Day, chosen because the world's population reached about 5 billion around 11 July 1987. 26 July is Kargil Vijay Diwas (1999) and 29 July International Tiger Day. 6 August and 9 August recall the atomic bombings of Hiroshima and Nagasaki (1945); 9 August is also Quit India Day (1942). 29 August is National Sports Day, the birth anniversary of Major Dhyan Chand (born 1905). 5 September is Teachers' Day, the birth anniversary of S.

Radhakrishnan (born 1888), and 8 September International Literacy Day. 14 September is Hindi Diwas: on 14 September 1949 the Constituent Assembly adopted Hindi in Devanagari script as the official language of the Union. 15 September is Engineers' Day (M. Visvesvaraya, born 1861), 16 September World Ozone Day (the Montreal Protocol was signed in 1987) and 27 September World Tourism Day.

**October to December:** 2 October is Gandhi Jayanti and, by a UN resolution of 2007, the International Day of Non-Violence. 8 October is Air Force Day (the IAF was set up in 1932), 9 October World Post Day (the Universal Postal Union was founded at Bern in 1874), 16 October World Food Day (the FAO was founded in 1945), 24 October UN Day and 31 October Rashtriya Ekta Diwas, the birth anniversary of Sardar Patel (born 1875). 11 November is National Education Day (Maulana Abul Kalam Azad, born 1888) and 14 November Children's Day (Nehru, born 1889). 26 November is Constitution Day, the day the Constitution was adopted in 1949. 1 December is World AIDS Day, 2 December National Pollution Control Day (the Bhopal gas tragedy of 1984), 4 December Navy Day (Operation Trident against Karachi, 1971), 7 December Armed Forces Flag Day and 10 December Human Rights Day (the Universal Declaration of Human Rights, 1948). 16 December is Vijay Diwas (Pakistan's surrender at Dhaka in 1971), 22 December National Mathematics Day (Srinivasa Ramanujan, born 1887), 23 December Kisan Diwas (Chaudhary Charan Singh) and 24 December National Consumer Day (the Consumer Protection Act, 1986).

**Common traps:** National Science Day (28 February) honours a discovery, while National Technology Day (11 May) honours Pokhran-II. Teachers' Day in India is 5 September, but World Teachers' Day is 5 October. Constitution Day (26 November) marks the adoption of the Constitution, while Republic Day (26 January) marks its coming into force, a date chosen because the Congress had celebrated 26 January 1930 as Purna Swaraj Day. Kargil Vijay Diwas (26 July) and Vijay Diwas (16 December) mark two different wars, of 1999 and 1971.

**Examples**

- January: 9 Pravasi Bharatiya Divas (Gandhi's return, 1915); 12 National Youth Day (Vivekananda); 15 Army Day; 25 National Voters' Day; 30 Martyrs' Day.
- Science pair: 28 February National Science Day (Raman Effect, 1928); 11 May National Technology Day (Pokhran-II, 1998).
- Health days: 24 March World TB Day (Koch, 1882); 7 April World Health Day (WHO, 1948); 31 May World No Tobacco Day; 1 July National Doctors' Day (B.C. Roy); 1 December World AIDS Day.
- Environment days: 22 March World Water Day; 22 April Earth Day; 5 June World Environment Day (Stockholm, 1972); 29 July International Tiger Day; 16 September World Ozone Day (Montreal Protocol, 1987).
- Armed forces: Army Day 15 January; Kargil Vijay Diwas 26 July; Air Force Day 8 October; Navy Day 4 December; Armed Forces Flag Day 7 December; Vijay Diwas 16 December.
- Birth anniversaries: Vivekananda 12 January; Ambedkar 14 April; Dhyan Chand 29 August; Radhakrishnan 5 September; Visvesvaraya 15 September; Patel 31 October; Azad 11 November; Nehru 14 November; Ramanujan 22 December.
- Language days: 10 January World Hindi Day (Nagpur conference, 1975); 21 February International Mother Language Day; 14 September Hindi Diwas (Constituent Assembly decision, 1949).
- Governance days: 21 April Civil Services Day; 24 April National Panchayati Raj Day (73rd Amendment in force, 1993); 26 November Constitution Day; 10 December Human Rights Day.

> **Quick revision:** 9 Jan Pravasi Bharatiya Divas; 12 Jan Youth Day; 15 Jan Army Day; 25 Jan Voters' Day; 28 Feb Science Day (Raman Effect); 24 Mar TB Day; 7 Apr Health Day; 24 Apr Panchayati Raj Day; 11 May Technology Day (Pokhran-II); 5 Jun Environment Day; 21 Jun Yoga Day; 11 Jul Population Day; 26 Jul Kargil Vijay Diwas; 29 Aug Sports Day; 5 Sep Teachers' Day; 14 Sep Hindi Diwas; 15 Sep Engineers' Day; 8 Oct Air Force Day; 31 Oct Ekta Diwas; 26 Nov Constitution Day; 4 Dec Navy Day; 16 Dec Vijay Diwas.

### Books and Authors: Ancient Classics to Modern Indian and World Writers

**How books are asked:** Book and author questions come in two forms: name the author of a title, or name the book written by a person. The classics asked again and again fall into five groups: ancient texts, medieval chronicles, the

writing of the freedom struggle, modern Indian literature and world classics. Learn each book with one tag (its language, the court it came from or the prize it won) so that similar titles do not get mixed up.

**Ancient India:** Kautilya (Chanakya), minister of Chandragupta Maurya, wrote the Arthashastra on statecraft, and Megasthenes, the Greek envoy of Seleucus Nicator at Chandragupta's court, wrote Indica. Panini's Ashtadhyayi is the classic Sanskrit grammar, Patanjali wrote the Yoga Sutras and Bharata Muni the Natyashastra on drama and dance. Kalidasa wrote Abhijnanashakuntalam, Meghaduta, Raghuvamsha and Kumarasambhava. Shudraka wrote Mricchakatika, Vishakhadatta Mudrarakshasa and Ashvaghosha the Buddhacharita. Banabhatta, court poet of Harshavardhana, wrote Harshacharita and Kadambari, and Harsha himself wrote the plays Ratnavali, Nagananda and Priyadarshika. Aryabhata wrote the Aryabhatiya, Varahamihira the Brihat Samhita, Charaka and Sushruta the medical works named after them, and Vishnu Sharma the Panchatantra. In Tamil, Thiruvalluvar wrote the Tirukkural and Ilango Adigal the Silappatikaram.

**Medieval India:** Kalhana's Rajatarangini (12th century) is a history of Kashmir, Jayadeva wrote the Gita Govinda and Chand Bardai the Prithviraj Raso. Al-Biruni, who came with Mahmud of Ghazni, wrote Kitab-ul-Hind, and the Moroccan traveller Ibn Battuta described the India of Muhammad bin Tughlaq in his Rihla. Amir Khusrau wrote Tughlaqnama and Ziauddin Barani Tarikh-i-Firoz Shahi. Babur wrote his memoirs, the Baburnama (Tuzuk-i-Baburi), in Turki; Gulbadan Begum wrote the Humayun-nama; Abul Fazl wrote the Akbarnama and Ain-i-Akbari; and Jahangir wrote the Tuzuk-i-Jahangiri. In the Bhakti tradition Tulsidas wrote the Ramcharitmanas in Awadhi, Surdas the Sursagar and Malik Muhammad Jayasi the Padmavat.

**The freedom struggle:** Dadabhai Naoroji's Poverty and Un-British Rule in India (1901) set out the drain theory. Mahatma Gandhi wrote Hind Swaraj (1909) and his autobiography The Story of My Experiments with Truth, both first in Gujarati. Jawaharlal Nehru wrote Glimpses of World History, An Autobiography and The Discovery of India, the last in Ahmednagar Fort prison in 1944. Bal Gangadhar Tilak wrote Gita Rahasya in Mandalay jail, Maulana Abul Kalam Azad India Wins Freedom, Subhas Chandra Bose The Indian Struggle, Rajendra Prasad India Divided, B.R. Ambedkar Annihilation of Caste (1936), Jyotiba Phule Gulamgiri (1873), Swami Dayanand Saraswati Satyarth Prakash (1875), V.D. Savarkar The Indian War of Independence and Bhagat Singh the essay Why I Am an Atheist. Dinabandhu Mitra's play Nil Darpan (1860) exposed the indigo planters.

**Modern Indian writing in English:** R.K. Narayan created the town of Malgudi in Swami and Friends and Malgudi Days and won the Sahitya Akademi Award for The Guide. Mulk Raj Anand wrote Untouchable and Coolie, Raja Rao Kanthapura, Khushwant Singh Train to Pakistan, Vikram Seth A Suitable Boy, Amitav Ghosh The Shadow Lines and The Hungry Tide, and Ruskin Bond The Room on the Roof. A.P.J. Abdul Kalam's autobiography is Wings of Fire (1999). Booker winners of Indian birth include Salman Rushdie (Midnight's Children, 1981), Arundhati Roy (The God of Small Things, 1997), Kiran Desai (The Inheritance of Loss, 2006) and Aravind Adiga (The White Tiger, 2008).

**Indian languages:** In Hindi, Premchand wrote Godan, Gaban, Nirmala and the story Kafan; Jaishankar Prasad wrote the epic Kamayani; Maithili Sharan Gupt wrote Bharat-Bharati and Saket; Ramdhari Singh Dinkar wrote Rashmirathi and Urvashi; Harivansh Rai Bachchan wrote Madhushala; Phanishwar Nath Renu wrote Maila Anchal; and Shrilal Shukla wrote Raag Darbari. In Bengali, Rabindranath Tagore wrote Gitanjali, Gora and Ghare Baire, Bankim Chandra Chattopadhyay wrote Anandamath (1882) and Sarat Chandra Chattopadhyay wrote Devdas and Srikanta. In Urdu, Mirza Ghalib's ghazals are collected in his Diwan, and Muhammad Iqbal wrote Saare Jahan Se Achha (Tarana-e-Hind). In Punjabi, Amrita Pritam wrote Pinjar, and in Malayalam G. Sankara Kurup's Odakkuzhal won the first Jnanpith Award.

**World classics:** Homer wrote the Iliad and the Odyssey, Plato The Republic, Dante The Divine Comedy, Machiavelli The Prince, Cervantes Don Quixote and Shakespeare Hamlet, Macbeth and Othello. Adam Smith wrote The Wealth of Nations (1776), Rousseau The Social Contract, Karl Marx Das Kapital and, with Friedrich Engels, The Communist Manifesto (1848), and Charles Darwin On the Origin of Species (1859). Leo Tolstoy wrote War and Peace and Anna Karenina, Victor Hugo Les Miserables, Charles Dickens A Tale of Two Cities and Oliver Twist, George Orwell Animal Farm and Nineteen Eighty-Four, Ernest Hemingway The Old Man and the Sea, and Gabriel Garcia Marquez One Hundred Years of Solitude. Nelson Mandela's autobiography is Long Walk to Freedom.

**Traps to avoid:** Indica (Megasthenes) is a Greek account of Mauryan India, while Kitab-ul-Hind (Al-Biruni) is an Arabic work of the 11th century. The Baburnama was written in Turki, not Persian. Tagore won the Nobel Prize in 1913 for the English Gitanjali. The Discovery of India is Nehru's, India Wins Freedom is Azad's and India Divided is Rajendra Prasad's.

**Examples**

- Arthashastra: Kautilya; Indica: Megasthenes; Ashtadhyayi: Panini; Natyashastra: Bharata Muni; Panchatantra: Vishnu Sharma; Aryabhatiya: Aryabhata.
- Kalidasa: Abhijnanashakuntalam, Meghaduta, Raghuvamsha, Kumarasambhava; Banabhatta: Harshacharita, Kadambari; Harsha: Ratnavali, Nagananda, Priyadarshika.
- Rajatarangini: Kalhana (Kashmir); Gita Govinda: Jayadeva; Prithviraj Raso: Chand Bardai; Kitab-ul-Hind: Al-Biruni; Rihla: Ibn Battuta.
- Mughal memoirs: Baburnama (Babur, in Turki); Humayun-nama (Gulbadan Begum); Akbarnama and Ain-i-Akbari (Abul Fazl); Tuzuk-i-Jahangiri (Jahangir).
- Gandhi: Hind Swaraj (1909), My Experiments with Truth; Nehru: The Discovery of India, Glimpses of World History; Azad: India Wins Freedom; Bose: The Indian Struggle; Tilak: Gita Rahasya.
- Social reform: Gulamgiri (Jyotiba Phule, 1873); Satyarth Prakash (Dayanand Saraswati, 1875); Annihilation of Caste (Ambedkar, 1936); Nil Darpan (Dinabandhu Mitra, 1860).
- Booker: Midnight's Children (Rushdie, 1981); The God of Small Things (Arundhati Roy, 1997); The Inheritance of Loss (Kiran Desai, 2006); The White Tiger (Aravind Adiga, 2008).
- Hindi classics: Godan (Premchand); Kamayani (Jaishankar Prasad); Bharat-Bharati (Maithili Sharan Gupt); Rashmirathi (Dinkar); Madhushala (Harivansh Rai Bachchan); Maila Anchal (Renu); Raag Darbari (Shrilal Shukla).
- World: The Republic (Plato); The Prince (Machiavelli); The Wealth of Nations (Adam Smith, 1776); Das Kapital (Marx); War and Peace (Tolstoy); Animal Farm (Orwell); Long Walk to Freedom (Mandela).

> **Quick revision:** Arthashastra Kautilya; Indica Megasthenes; Ashtadhyayi Panini; Kalidasa: Shakuntalam, Meghaduta; Harshacharita Banabhatta; Rajatarangini Kalhana; Kitab-ul-Hind Al-Biruni; Baburnama in Turki; Akbarnama Abul Fazl; Ramcharitmanas Tulsidas; Hind Swaraj Gandhi 1909; Discovery of India Nehru (written 1944); India Wins Freedom Azad; Gita Rahasya Tilak; Gulamgiri Phule; Godan Premchand; Kamayani Prasad; Midnight's Children 1981; The God of Small Things 1997; Wealth of Nations 1776.

### Sports GK: Players per Side, Terms, Trophies, Olympics and National Sports Awards

**Team sizes:** Cricket, football and hockey have 11; kabaddi has 7, as do handball, netball and water polo; kho-kho puts 9 on the field; volleyball and ice hockey have 6; basketball has 5; polo has 4; baseball and softball have 9; and rugby union has 15 and rugby league 13. A cricket pitch is 22 yards long, a football match lasts 90 minutes in two halves, and a hockey match is played in 4 quarters of 15 minutes.

**Terms by sport:** Cricket has googly, doosra, yorker, LBW, maiden over and follow-on; football has offside, penalty kick and free kick; hockey has penalty corner, flick, scoop and the striking circle. Tennis uses love, deuce, ace, volley and let; badminton has the smash and drop shot; golf has par, birdie, eagle, bogey and tee; chess has castling, checkmate, stalemate, gambit and en passant; boxing has jab, hook and uppercut; polo has the chukker; and kabaddi has the raid, cant and lona. Grand slam is used in tennis and in the card game bridge.

**Trophies and cups:** In cricket, the Ranji Trophy (named after K.S. Ranjitsinhji, begun in 1934) is the national first-class championship, along with the Duleep Trophy, Irani Cup, Deodhar Trophy and Vijay Hazare Trophy; the Ashes are contested by England and Australia, and the Border-Gavaskar Trophy by India and Australia. In football, the Durand Cup (1888) is one of the oldest football tournaments in the world, the Santosh Trophy is the national championship for states and the Subroto Cup is for schools. Hockey has the Beighton Cup, Aga Khan Cup, Rangaswamy Cup and Obaidullah Gold Cup. Badminton has the Thomas Cup (men), Uber Cup (women) and Sudirman Cup (mixed teams); tennis has the Davis Cup (men) and the Fed Cup (women, now the Billie Jean King Cup); table tennis has the Swaythling Cup (men) and Corbillon Cup (women); and golf has the Ryder Cup and Walker Cup. The Nehru Trophy is Kerala's snake-boat race on Punnamada Lake.

**Olympic basics:** The modern Olympic Games were revived by Pierre de Coubertin, who founded the International Olympic Committee in 1894; the IOC is headquartered at Lausanne in Switzerland, and the first modern Games were held at Athens in 1896. The five interlocking rings, blue, yellow, black, green and red on a white background, stand for the union of the five continents and were first flown at the Antwerp Games of 1920. The motto is Citius, Altius, Fortius, Latin for Faster, Higher, Stronger, to which the IOC later added Communiter (Together). The Olympic flame was first lit at Amsterdam in 1928, and the torch relay began with the Berlin Games of 1936. The Winter Olympics began in 1924 at Chamonix and the Paralympics in 1960 at Rome. Closer home, the first Asian Games were held at New Delhi in 1951, and the Commonwealth Games began as the British Empire Games at Hamilton, Canada, in 1930; Delhi hosted them in 2010.

**India at the Olympics:** India's hockey team won its first gold at Amsterdam in 1928, with Dhyan Chand as its star, and went on to win 8 Olympic golds, the last at Moscow in 1980. K.D. Jadhav won independent India's first individual medal, a wrestling bronze at Helsinki in 1952. Karnam Malleswari became the first Indian woman to win an Olympic medal, a weightlifting bronze at Sydney in 2000. Rajyavardhan Singh Rathore won independent India's first individual silver (double trap shooting, Athens 2004), and Abhinav Bindra won the first individual gold (10 m air rifle, Beijing 2008). Milkha Singh (400 m, Rome 1960) and P.T. Usha (400 m hurdles, Los Angeles 1984) both finished fourth, the most famous near misses.

**Stadiums and venues:** Eden Gardens (Kolkata), Wankhede and Brabourne (Mumbai), M.A. Chidambaram or Chepauk (Chennai), M. Chinnaswamy (Bengaluru), Green Park (Kanpur) and Barabati (Cuttack) are well-known cricket grounds, and the Wankhede hosted the 2011 World Cup final. The Salt Lake Stadium (Yuva Bharati Krirangan) in Kolkata is a major football venue, the Major Dhyan Chand National Stadium in Delhi is a hockey ground, Kalinga Stadium in Bhubaneswar has hosted major hockey events, and the Jawaharlal Nehru Stadium and Indira Gandhi Indoor Stadium in Delhi were built for the 1982 Asian Games. Abroad, Lord's in London is called the home of cricket and hosted India's 1983 World Cup win, and Wimbledon (1877) is the oldest tennis tournament.

**National sports awards:** The Arjuna Award (1961) honours sportspersons for consistent outstanding performance. The Khel Ratna, the highest sporting honour, was instituted in 1991-92 as the Rajiv Gandhi Khel Ratna and is now named after Major Dhyan Chand; its first recipient was the chess player Viswanathan Anand, who in 1988 had become India's first Grandmaster. The Dronacharya Award (1985) is for coaches, and its first recipients were Bhalchandra Bhaskar Bhagwat (wrestling), O.M. Nambiar (athletics) and O.P. Bhardwaj (boxing). A lifetime-achievement award for sportspersons was added in 2002 as the Dhyan Chand Award, and the Maulana Abul Kalam Azad Trophy (1956-57) goes to the best university in inter-university sport. The Tenzing Norgay National Adventure Award honours adventure on land, at sea and in the air.

### Examples

- Players per side: cricket, football, hockey 11; kho-kho 9; kabaddi, handball, netball, water polo 7; volleyball 6; basketball 5; polo 4; rugby union 15.
- Badminton: Thomas Cup (men), Uber Cup (women), Sudirman Cup (mixed); tennis: Davis Cup (men); table tennis: Swaythling Cup (men), Corbillon Cup (women); golf: Ryder Cup, Walker Cup.
- Indian football: Durand Cup (1888), Santosh Trophy (states), Subroto Cup (schools); Indian cricket: Ranji Trophy, Duleep Trophy, Irani Cup, Deodhar Trophy; hockey: Beighton Cup, Aga Khan Cup.
- Terms: golf par, birdie, eagle, bogey; chess castling, gambit, en passant, stalemate; polo chukker; kabaddi raid, cant, lona; cricket googly, doosra, yorker.
- Olympics: IOC founded 1894 by Pierre de Coubertin, HQ Lausanne; first modern Games Athens 1896; rings first flown at Antwerp 1920; flame first lit at Amsterdam 1928; torch relay from Berlin 1936.
- India's Olympic firsts: hockey gold 1928; individual medal after independence K.D. Jadhav 1952; woman medallist Karnam Malleswari 2000; individual silver after independence Rathore 2004; individual gold Abhinav Bindra 2008.
- Awards: Arjuna 1961 (sportspersons); Dronacharya 1985 (coaches); Khel Ratna 1991-92 (first Viswanathan Anand); lifetime achievement 2002 (Dhyan Chand Award); MAKA Trophy for universities.
- Multi-sport firsts: Asian Games New Delhi 1951 (India hosted again in 1982); Commonwealth Games (as British Empire Games) Hamilton 1930, Delhi hosted 2010; Winter Olympics Chamonix 1924; Paralympics Rome 1960.

**Quick revision:** Players: cricket, football, hockey 11, kho-kho 9, kabaddi 7, volleyball 6, basketball 5, polo 4; Thomas, Uber = badminton; Davis = tennis; Swaythling = table tennis; Ryder = golf; Durand, Santosh = football; Ranji = cricket; Beighton = hockey; IOC 1894 Lausanne, Athens 1896; first hockey gold 1928, 8 golds; K.D. Jadhav 1952; Malleswari 2000; Bindra 2008; Arjuna 1961, Dronacharya 1985, Khel Ratna 1991-92 (Anand); Asian Games 1951 Delhi.

### Awards and Honours: Bharat Ratna, Gallantry, Literary, Film and International Prizes

**Civilian awards:** The Bharat Ratna and the Padma awards were instituted in 1954. The Bharat Ratna is the highest civilian honour, given for exceptional service in any field, and its medal is shaped like a peepal leaf. Its first recipients in 1954 were C. Rajagopalachari, S. Radhakrishnan and C.V. Raman. It could not at first be given after death; once that was allowed, Lal Bahadur Shastri became the first posthumous recipient (1966). Indira Gandhi was the first woman (1971), Mother Teresa the first naturalised citizen (1980), Khan Abdul Ghaffar Khan the first non-Indian (1987) and Sachin Tendulkar the first sportsperson (2014). The Padma awards, in descending order Padma Vibhushan, Padma Bhushan and Padma Shri, are announced on the eve of Republic Day.

**Awards are not titles:** Article 18 of the Constitution abolishes titles other than military and academic distinctions. In Balaji Raghavan v. Union of India (1995) the Supreme Court held that the Bharat Ratna and the Padma awards are not titles under Article 18, but that they must not be used as a prefix or suffix to a person's name. The civilian awards were suspended by the Janata government in 1977 and restored in 1980.

**Gallantry awards:** The wartime awards, for bravery in the face of the enemy, are, in descending order, the Param Vir Chakra, Maha Vir Chakra and Vir Chakra, all instituted on 26 January 1950 with effect from 15 August 1947. The peacetime awards, for bravery other than in the face of the enemy, are the Ashoka Chakra, Kirti Chakra and Shaurya Chakra, instituted in 1952 as three classes of the Ashoka Chakra and given their present names in 1967. The Param Vir Chakra was designed by Savitri Khanolkar, and its first recipient was Major Somnath Sharma, who fell defending Badgam in Kashmir on 3 November 1947. Flying Officer Nirmal Jit Singh Sekhon (1971) is the only Air Force recipient of the Param Vir Chakra. Rakesh Sharma received the Ashoka Chakra for his 1984 space flight, and Neerja Bhanot, the 22-year-old air hostess killed while saving passengers during a hijacking in 1986, received it posthumously and is often described as its youngest recipient.

**Literary awards:** The Jnanpith Award, given by the Bharatiya Jnanpith trust founded in 1944 by Sahu Shanti Prasad Jain, was instituted in 1961 and first given in 1965 to the Malayalam poet G. Sankara Kurup for Odakkuzhal. It carries a bronze image of Vagdevi (Saraswati). Sumitranandan Pant was its first Hindi winner (1968), Ashapurna Devi its first woman winner (1976) and Amitav Ghosh the first writer in English to receive it (2018). The Sahitya Akademi, set up on 12 March 1954 with Jawaharlal Nehru as its first President, gives annual awards in 24 languages (the 22 languages of the Eighth Schedule plus English and Rajasthani), and its highest honour is its Fellowship. The Saraswati Samman (1991) of the K.K. Birla Foundation was first given to Harivansh Rai Bachchan.

**Cinema:** The Dadasaheb Phalke Award, India's highest film honour, was instituted in 1969 in honour of Dadasaheb Phalke (born 1870), maker of Raja Harishchandra (1913), and is presented with the National Film Awards. Its first recipient was the actress Devika Rani (1969), and Prithviraj Kapoor was its first posthumous recipient (1971). Bhanu Athaiya was the first Indian to win an Oscar (costume design, Gandhi, 1983), and Satyajit Ray received an honorary Oscar in 1992.

**Nobel Prizes:** Alfred Nobel left his fortune by a will of 1895 for prizes first given in 1901 in Physics, Chemistry, Physiology or Medicine, Literature and Peace; the prize in Economic Sciences, funded by Sweden's central bank, was first given in 1969. The prizes are presented on 10 December, the anniversary of Nobel's death, the Peace Prize at Oslo and the rest at Stockholm. Indian citizens who have won are Rabindranath Tagore (Literature, 1913), C.V. Raman (Physics, 1930), Mother Teresa (Peace, 1979), Amartya Sen (Economics, 1998) and Kailash Satyarthi (Peace, 2014). Laureates of Indian origin include Har Gobind Khorana (Medicine, 1968), S. Chandrasekhar (Physics, 1983), V.S. Naipaul (Literature, 2001), Venkatraman Ramakrishnan (Chemistry, 2009) and Abhijit Banerjee (Economics, 2019), while Ronald Ross (1902) and Rudyard Kipling (1907) were born in India.

**Other international honours:** The Ramon Magsaysay Award, set up in the Philippines in 1957 in memory of its President Ramon Magsaysay, is often called Asia's Nobel Prize, and Vinoba Bhave was its first Indian recipient

(1958). The Booker Prize (1969) is given for a novel written in English and published in the UK or Ireland; Salman Rushdie's Midnight's Children (1981) was later named the Booker of Bookers. The Kalinga Prize (1952), given by UNESCO from a fund set up by Biju Patnaik, honours the popularisation of science. The Gandhi Peace Prize was instituted in 1995, Gandhi's 125th birth anniversary, and first given to Julius Nyerere of Tanzania.

**Examples**

- Bharat Ratna (1954): first C. Rajagopalachari, S. Radhakrishnan, C.V. Raman; first posthumous Lal Bahadur Shastri 1966; first woman Indira Gandhi 1971; first non-Indian Khan Abdul Ghaffar Khan 1987; first sportsperson Sachin Tendulkar 2014.
- Order of civilian awards: Bharat Ratna, Padma Vibhushan, Padma Bhushan, Padma Shri; all instituted in 1954; not titles under Article 18 (Balaji Raghavan case, 1995).
- Wartime order: Param Vir Chakra, Maha Vir Chakra, Vir Chakra; peacetime order: Ashoka Chakra, Kirti Chakra, Shaurya Chakra.
- First Param Vir Chakra: Major Somnath Sharma (Badgam, 3 November 1947, posthumous); PVC designed by Savitri Khanolkar; only Air Force PVC: Nirmal Jit Singh Sekhon (1971).
- Jnanpith: instituted 1961, first given 1965 to G. Sankara Kurup (Malayalam, Odakkuzhal); first Hindi winner Sumitranandan Pant 1968; first woman Ashapurna Devi 1976.
- Dadasaheb Phalke Award: instituted 1969 in honour of Phalke (born 1870, maker of Raja Harishchandra, 1913); first Devika Rani; first posthumous Prithviraj Kapoor (1971).
- Nobel: first given 1901; Economics from 1969; presented on 10 December; Peace Prize at Oslo, others at Stockholm.
- Indian citizens with a Nobel: Tagore 1913, C.V. Raman 1930, Mother Teresa 1979, Amartya Sen 1998, Kailash Satyarthi 2014.
- Ramon Magsaysay Award: Philippines, 1957, Asia's Nobel, first Indian Vinoba Bhave (1958); Gandhi Peace Prize: 1995, first Julius Nyerere; Kalinga Prize: UNESCO, 1952, science popularisation.

> **Quick revision:** Bharat Ratna and Padma awards 1954; first Bharat Ratna Rajaji, Radhakrishnan, Raman; first posthumous Shastri 1966; PVC, MVC, VrC (wartime, 1950); Ashoka, Kirti, Shaurya Chakra (peacetime, 1952, renamed 1967); first PVC Major Somnath Sharma; Jnanpith 1965 G. Sankara Kurup; Sahitya Akademi 1954, 24 languages; Phalke Award 1969 Devika Rani; Nobel 1901, Economics 1969, 10 December; Magsaysay 1957, Vinoba Bhave 1958; Booker 1969; Gandhi Peace Prize 1995 Nyerere.

## International Organisations: UN Organs, Agencies, Headquarters and Regional Groupings

**Birth of the UN:** The United Nations replaced the League of Nations (1920, Geneva), which had failed to prevent the Second World War. The name United Nations was first used in the Declaration by United Nations of 1 January 1942; the plan took shape at Dumbarton Oaks (1944) and Yalta (1945), and the Charter was signed at San Francisco on 26 June 1945 by 50 countries, with Poland signing later as the 51st original member. The UN came into existence on 24 October 1945, now UN Day. India, though not yet independent, was among the original members. The headquarters is in New York, and the six official languages are Arabic, Chinese, English, French, Russian and Spanish.

**The six principal organs:** The General Assembly includes every member state, each with one vote. The Security Council has 15 members: 5 permanent members with the veto (China, France, Russia, the United Kingdom and the United States) and 10 non-permanent members elected for 2-year terms; it had 11 members until it was enlarged in 1965. The Economic and Social Council (ECOSOC), with 54 members, coordinates economic and social work. The Trusteeship Council suspended its operation in 1994 after Palau, the last trust territory, became independent. The International Court of Justice at The Hague has 15 judges elected for 9-year terms. The Secretariat is headed by the Secretary-General, appointed by the General Assembly on the Security Council's recommendation; the first was Trygve Lie of Norway. Vijaya Lakshmi Pandit was the first woman President of the General Assembly (1953).

**Specialised agencies and their headquarters:** The International Labour Organization (1919, Geneva) is older than the UN and won the Nobel Peace Prize in 1969. The Food and Agriculture Organization (1945) is at Rome, UNESCO (1945) at Paris, the World Health Organization (1948) at Geneva, the International Civil Aviation Organization at Montreal, the International Maritime Organization at London, the Universal Postal Union (1874) at Bern, and the

International Telecommunication Union (1865), the World Meteorological Organization and the World Intellectual Property Organization at Geneva. UNIDO is at Vienna, the World Tourism Organization (UNWTO) at Madrid and IFAD at Rome. The International Monetary Fund and the World Bank, both planned at the Bretton Woods Conference of 1944, are at Washington DC.

**Funds, programmes and other bodies:** UNICEF (1946) and UNDP are based in New York, the UN Environment Programme (1972) at Nairobi, the UNHCR (1950) at Geneva and the World Food Programme at Rome. The International Atomic Energy Agency (1957) at Vienna reports to the UN but is not a specialised agency. The World Trade Organization, which replaced GATT (1947) on 1 January 1995, is at Geneva and is outside the UN system. Other headquarters: Interpol at Lyon, the International Committee of the Red Cross at Geneva, OPEC (founded at Baghdad in 1960) at Vienna, NATO (1949) and the European Union at Brussels, the Asian Development Bank (1966) at Manila and Amnesty International at London.

**Asian groupings:** SAARC was founded at Dhaka on 8 December 1985 by Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka; Afghanistan joined in 2007, and the secretariat is at Kathmandu. ASEAN was founded on 8 August 1967 by the Bangkok Declaration of Indonesia, Malaysia, the Philippines, Singapore and Thailand, with its secretariat at Jakarta; India became a sectoral dialogue partner in 1992, a full dialogue partner in 1996 and a summit-level partner in 2002, steps of its Look East Policy (1991), renamed Act East in 2014. BIMSTEC, begun at Bangkok on 6 June 1997, links Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand around the Bay of Bengal, and its secretariat is at Dhaka. The Shanghai Cooperation Organisation grew out of the Shanghai Five of 1996, was founded on 15 June 2001 and has its secretariat at Beijing; India and Pakistan became full members in 2017.

**Global economic groupings:** The G20 was set up in 1999, after the Asian financial crisis, as a forum of finance ministers and central bank governors; its leaders have met at summits since 2008, it has no permanent secretariat, and India has been a member from the start. BRIC, a term coined by the economist Jim O'Neill in 2001, held its first summit at Yekaterinburg in Russia in 2009; South Africa was invited to join in 2010, making it BRICS, and the New Development Bank, agreed at Fortaleza in 2014, is headquartered at Shanghai. India has attended summits of the G7, a group of major industrialised democracies, as an invited guest, not as a member.

**Other groupings with India:** The Non-Aligned Movement held its first summit at Belgrade in 1961, after the Bandung Conference of 1955; its founders included Jawaharlal Nehru, Josip Broz Tito, Gamal Abdel Nasser, Sukarno and Kwame Nkrumah. The Commonwealth took its modern form with the London Declaration of 1949, which let India stay a member as a republic; its secretariat is at Marlborough House, London. The Indian Ocean Rim Association (1997) has its secretariat in Mauritius, the Mekong-Ganga Cooperation dates from 2000, and IBSA (India, Brazil and South Africa) from the Brasilia Declaration of 2003. India is not a member of APEC.

### Examples

- UN: Charter signed 26 June 1945 at San Francisco; came into force 24 October 1945; HQ New York; first Secretary-General Trygve Lie; 6 official languages.
- Security Council: 15 members, 5 permanent with the veto (China, France, Russia, UK, USA) and 10 elected for 2 years; enlarged from 11 members in 1965.
- ICJ: The Hague, 15 judges, 9-year terms; Trusteeship Council suspended in 1994 after Palau's independence; ECOSOC has 54 members.
- Geneva: WHO, ILO, ITU, WMO, WIPO, UNHCR, WTO, Red Cross; Rome: FAO, WFP, IFAD; Paris: UNESCO; Vienna: IAEA, UNIDO, OPEC; Washington DC: IMF, World Bank.
- Nairobi: UNEP; Montreal: ICAO; London: IMO, Commonwealth Secretariat, Amnesty International; Bern: UPU; Madrid: UNWTO; Lyon: Interpol; Manila: ADB; Brussels: NATO, EU.
- SAARC: Dhaka, 8 December 1985, secretariat Kathmandu, Afghanistan joined 2007; ASEAN: Bangkok Declaration, 8 August 1967, secretariat Jakarta.
- BIMSTEC: Bangkok, 6 June 1997, secretariat Dhaka; SCO: 15 June 2001, secretariat Beijing, India a full member since 2017.

- G20: 1999, leaders' summits since 2008; BRIC first summit Yekaterinburg 2009, South Africa invited to join 2010; New Development Bank HQ Shanghai.
- NAM: first summit Belgrade 1961; founders Nehru, Tito, Nasser, Sukarno, Nkrumah; Bandung Conference 1955; Commonwealth: London Declaration 1949.

> **Quick revision:** UN Charter 26 June 1945 San Francisco, in force 24 Oct 1945, HQ New York, 6 languages; UNSC 15 (5 permanent, 10 for 2 years); ICJ The Hague, 15 judges, 9 years; Trusteeship Council suspended 1994; ILO 1919 Geneva; FAO Rome; UNESCO Paris; WHO 1948 Geneva; IMF and World Bank Washington; UNEP Nairobi; IAEA Vienna; WTO 1995 Geneva; SAARC 1985 Kathmandu; ASEAN 1967 Jakarta; BIMSTEC 1997 Dhaka; SCO 2001 Beijing, India 2017; G20 1999; BRICS NDB Shanghai; NAM Belgrade 1961.

### States and Union Territories: Formation, Capitals, High Courts and Borders

**Constitutional basis:** Article 1 declares that India, that is Bharat, shall be a Union of States, and the First Schedule lists the states and union territories. Under Article 3 Parliament can form a new state, change boundaries or rename a state by an ordinary law; the bill needs the President's recommendation and must be referred to the affected state legislature for its views, which are not binding. Article 2 lets Parliament admit into the Union, or establish, new states. Sikkim became an associate state by the 35th Amendment (1974) and a full state of the Union by the 36th Amendment (1975). Union territories are administered by the President through an administrator under Article 239; Puducherry has a legislature under Article 239A, and Delhi became the National Capital Territory with a legislature under Article 239AA, inserted by the 69th Amendment in 1991.

The 1956 reorganisation: In 1950 the states were grouped into Part A, B, C and D categories. After Potti Sriramulu died in December 1952 while fasting for a Telugu state, Andhra State was formed on 1 October 1953, the first state created on a linguistic basis. The States Reorganisation Commission (Fazl Ali as chairman, with K.M. Panikkar and H.N. Kunzru) reported in 1955, and the States Reorganisation Act and the 7th Amendment, effective from 1 November 1956, abolished the four categories and created 14 states and 6 union territories. Kerala, Mysore (now Karnataka), Andhra Pradesh and Madhya Pradesh in their new form date from 1 November 1956.

**Later new states:** Bombay State was divided into Maharashtra and Gujarat on 1 May 1960. Nagaland became a state on 1 December 1963. The Punjab reorganisation of 1 November 1966 created Haryana, made Chandigarh a union territory and the shared capital, and moved hill areas to Himachal Pradesh, which became a state on 25 January 1971. Manipur, Tripura and Meghalaya became states on 21 January 1972, Sikkim on 16 May 1975, Mizoram and Arunachal Pradesh on 20 February 1987, and Goa on 30 May 1987. In 2000 Chhattisgarh (1 November), Uttarakhand (9 November) and Jharkhand (15 November, Birsa Munda's birth anniversary) were carved out of Madhya Pradesh, Uttar Pradesh and Bihar. Telangana was formed from Andhra Pradesh on 2 June 2014.

The 2019 changes and renamings: The Jammu and Kashmir Reorganisation Act, 2019 turned the state of Jammu and Kashmir into two union territories from 31 October 2019: Jammu and Kashmir, with a legislature, and Ladakh, without one. On 26 January 2020 Dadra and Nagar Haveli and Daman and Diu were merged into one union territory, which left India with 28 states and 8 union territories as of 2020. Names have changed too: Madras State became Tamil Nadu (1969), Mysore became Karnataka (1973), the Laccadive, Minicoy and Amindivi Islands became Lakshadweep (1973), Pondicherry became Puducherry (2006), Uttaranchal became Uttarakhand (2007) and Orissa became Odisha (2011).

**Capitals worth noting:** Chandigarh is the capital of both Punjab and Haryana. Jammu and Kashmir has Srinagar as its summer and Jammu as its winter capital. Gandhinagar (Gujarat), Dispur (Assam), Raipur (Chhattisgarh), Ranchi (Jharkhand), Shillong (Meghalaya), Aizawl (Mizoram), Kohima (Nagaland), Itanagar (Arunachal Pradesh), Agartala (Tripura) and Gangtok (Sikkim) are capitals students often mix up. Kavaratti is the capital of Lakshadweep and Daman of Dadra and Nagar Haveli and Daman and Diu. Under the 2014 Act Hyderabad was to serve as the common capital of Andhra Pradesh and Telangana for up to 10 years, and Maharashtra holds a winter session of its legislature at Nagpur.

**High courts:** Article 214 provides a High Court for each state, and Article 231 lets Parliament set up a common High Court for two or more states and union territories. The oldest are Calcutta (1 July 1862), Bombay and Madras (both

August 1862), set up under the Indian High Courts Act, 1861; Allahabad followed in 1866. Several sit away from the state capital: Allahabad (Uttar Pradesh, with a bench at Lucknow), Jabalpur (Madhya Pradesh), Jodhpur (Rajasthan, with a bench at Jaipur), Cuttack (Odisha), Bilaspur (Chhattisgarh), Nainital (Uttarakhand), Ernakulam in Kochi (Kerala) and Ahmedabad (Gujarat). Shared jurisdictions: Bombay covers Maharashtra, Goa and Dadra and Nagar Haveli and Daman and Diu; Calcutta covers the Andaman and Nicobar Islands; Madras covers Puducherry; Kerala covers Lakshadweep; Punjab and Haryana, at Chandigarh, covers both states and Chandigarh; Gauhati covers Assam, Nagaland, Mizoram and Arunachal Pradesh; and Jammu and Kashmir and Ladakh share one High Court. Delhi got its own High Court in 1966.

**Borders and classic facts:** Uttar Pradesh touches the most states, 8 (Uttarakhand, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand and Bihar), besides Delhi and Nepal. Assam borders 7 states: Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya and West Bengal. Bangladesh shares India's longest land border (about 4,096 km), followed by China and Pakistan. West Bengal borders 3 countries (Bangladesh, Nepal and Bhutan), as do Sikkim (Nepal, Bhutan and China) and Arunachal Pradesh (Bhutan, China and Myanmar). 9 states have a coastline, from Gujarat round to West Bengal, and the Tropic of Cancer passes through 8 states: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura and Mizoram. Telangana, like Madhya Pradesh and Chhattisgarh, is landlocked.

**Examples**

- Article 1: India, that is Bharat, a Union of States; Article 3: Parliament forms new states or alters boundaries by ordinary law; Article 239AA: Delhi, inserted by the 69th Amendment (1991).
- Andhra State 1 October 1953 (after Potti Sriramulu's fast); States Reorganisation Act: 14 states and 6 UTs from 1 November 1956; Commission chaired by Fazl Ali.
- Maharashtra and Gujarat 1 May 1960; Nagaland 1963; Haryana 1966; Himachal Pradesh 1971; Manipur, Tripura, Meghalaya 1972; Sikkim 1975; Mizoram, Arunachal Pradesh, Goa 1987.
- 2000: Chhattisgarh 1 November, Uttarakhand 9 November, Jharkhand 15 November; Telangana 2 June 2014; UTs of Jammu and Kashmir and Ladakh 31 October 2019.
- Renamed: Madras State to Tamil Nadu 1969; Mysore to Karnataka 1973; Pondicherry to Puducherry 2006; Uttaranchal to Uttarakhand 2007; Orissa to Odisha 2011.
- High Courts away from the capital: Allahabad (UP), Jabalpur (MP), Jodhpur (Rajasthan), Cuttack (Odisha), Bilaspur (Chhattisgarh), Nainital (Uttarakhand), Ernakulam (Kerala).
- Shared High Courts: Bombay for Goa and Dadra and Nagar Haveli and Daman and Diu; Calcutta for Andaman and Nicobar; Madras for Puducherry; Kerala for Lakshadweep; Gauhati for Assam, Nagaland, Mizoram, Arunachal Pradesh.
- Oldest High Courts: Calcutta, Bombay and Madras (1862), under the Indian High Courts Act, 1861; Delhi High Court 1966.
- Uttar Pradesh borders 8 states plus Delhi; Assam borders 7 states; the Tropic of Cancer crosses 8 states; Bangladesh shares India's longest land border.

> **Quick revision:** Art 1 Union of States, Art 3 new states by ordinary law; Andhra State 1 Oct 1953; SRC Fazl Ali; 1 Nov 1956: 14 states, 6 UTs; Maharashtra, Gujarat 1960; Nagaland 1963; Haryana 1966; HP 1971; Manipur, Tripura, Meghalaya 1972; Sikkim 1975; Mizoram, Arunachal, Goa 1987; Chhattisgarh, Uttarakhand, Jharkhand 2000; Telangana 2 June 2014; J&K and Ladakh UTs 31 Oct 2019; Calcutta HC 1862 oldest; UP borders 8 states; Tropic of Cancer 8 states.

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## Banking and Financial Awareness

### Banking and Financial Awareness — Fundamentals

This topic covers the core, stable banking and financial-awareness facts commonly tested in bank PO/Clerk mains exams: the structure and role of the Reserve Bank of India (RBI) as the central bank, key monetary-policy tools (repo rate, reverse repo rate, CRR, SLR) and who sets them, common banking abbreviations (NPA, KYC, IFSC, MICR,

PAN), electronic payment systems (NEFT, RTGS, IMPS, UPI) and how they differ, negotiable instruments (cheques, demand drafts), account types (savings, current, fixed deposit, recurring deposit), major regulators (SEBI, IRDAI, NABARD) and their domains, and government financial-inclusion initiatives such as PMJDY. Focus on definitions and structural relationships (who lends to whom, which body regulates what) rather than exact current numeric rates, since policy rates change periodically and are covered separately under current affairs.

India's banking history is a frequently tested area in its own right: the Bank of Hindustan (1770) is considered the first bank established in India. The modern State Bank of India traces its lineage through the three Presidency banks - Bank of Bengal (1806), Bank of Bombay (1840), and Bank of Madras (1843) - which merged in 1921 to form the Imperial Bank of India, which in turn became the State Bank of India in 1955.

The major financial regulators each have a distinct domain and establishment year worth remembering as a set: RBI (1935) regulates banking and monetary policy, SEBI (statutory since 1992) regulates securities markets, IRDAI (Act passed 1999) regulates insurance, and NABARD (1982) is the apex bank for agricultural and rural credit - each one covers a completely separate sector, which is the detail most commonly tested.

**Examples**

- The repo rate is the rate at which RBI lends to commercial banks; the reverse repo rate is the rate at which RBI borrows from them - the direction of lending is the key thing to remember, not a specific number.
- NEFT settles transfers in batches at fixed intervals, while RTGS settles each transaction individually and immediately - RTGS is meant for high-value, time-critical transfers.
- A crossed cheque cannot be encashed directly at the counter and must be deposited into a bank account, unlike an open cheque which can be cashed there.
- The Bank of Hindustan, established in 1770, is considered the first bank in India, though it was later liquidated; it should not be confused with the State Bank of India, which has a separate, later origin.
- The three Presidency banks - Bank of Bengal (1806), Bank of Bombay (1840), and Bank of Madras (1843) - merged in 1921 to form the Imperial Bank of India, which became the State Bank of India in 1955.
- NABARD (established 1982) regulates agricultural and rural credit, SEBI (statutory since 1992) regulates securities markets, and IRDAI (Act passed 1999) regulates insurance - three separate regulators for three separate sectors.
- KYC (Know Your Customer) is the identity-verification process banks follow before opening an account, while IFSC is a code identifying a specific bank branch for electronic transfers - both are abbreviations but serve entirely different purposes.

> **Quick revision:** RBI is the central bank (est. 1935, nationalised 1949, HQ Mumbai); its Monetary Policy Committee decides only the policy repo rate, while RBI itself sets the other instruments - reverse repo rate, CRR and SLR; know your payment-system abbreviations (NEFT/RTGS/IMPS/UPI) and regulators (SEBI-securities [1992], IRDAI-insurance [1999], NABARD-agri/rural credit [1982]). Banking history: Bank of Hindustan (1770, first bank) → three Presidency banks merge into Imperial Bank of India (1921) → becomes SBI (1955).

### Indian Banking System: History, Nationalisation and Structure

**How the system grew:** India's banking system was built in layers over about two and a half centuries. European agency houses opened the first banks, the government backed the Presidency banks, the Swadeshi movement produced Indian-owned banks, and after Independence the state took control of most of the system through SBI and the nationalisations of 1969 and 1980. Liberalisation after 1991 let new private banks in, and from 2014 the RBI allowed specialised banks. Most layers survive, which is why the structure looks complicated.

**Early banks:** The Bank of Hindustan (1770, Calcutta) and the General Bank of India (1786) were among the earliest banks, and both later closed. The three Presidency banks, the Bank of Bengal (1806, first called the Bank of Calcutta), the Bank of Bombay (1840) and the Bank of Madras (1843), worked under government charters. Allahabad Bank was founded in 1865, and the Oudh Commercial Bank (1881) is often cited as the first bank with limited liability managed by Indians. Punjab National Bank was founded in Lahore in 1894, and the Swadeshi movement inspired Bank of India (1906) and Central Bank of India (1911), the latter often called the first bank fully owned and managed by Indians.

**Imperial Bank to SBI:** In 1921 the three Presidency banks were merged into the Imperial Bank of India, which did commercial banking and also served as banker to the government until the RBI began work in 1935. After Independence the All India Rural Credit Survey Committee, chaired by A.D. Gorwala, recommended a state-partnered bank to carry credit to rural India. Under the State Bank of India Act 1955, the Imperial Bank became the State Bank of India on 1 July 1955. Banks of former princely states became its associate banks under the SBI (Subsidiary Banks) Act 1959; the remaining associates and the Bharatiya Mahila Bank were merged into SBI on 1 April 2017.

**Nationalisation:** On 19 July 1969 the government of Prime Minister Indira Gandhi nationalised 14 major commercial banks, each with deposits of Rs 50 crore or more, through an ordinance, later given final legal form by the Banking Companies (Acquisition and Transfer of Undertakings) Act 1970. On 15 April 1980 six more banks with deposits above Rs 200 crore were nationalised. The aims were to take credit to agriculture, small industry and backward regions, to open branches in villages and to end the control of a few business houses over banks. In 1993 New Bank of India, one of the 1980 batch, was merged into Punjab National Bank, the first merger of two nationalised banks.

**Scheduled and non-scheduled banks:** A scheduled bank is one listed in the Second Schedule of the RBI Act 1934. Under section 42(6) of that Act a bank qualifies if its paid-up capital and reserves are at least Rs 5 lakh and its affairs are not conducted against the interests of depositors. Scheduled banks keep the cash reserve ratio with the RBI and in return can borrow from it and use its clearing facilities. Banks outside the Second Schedule are non-scheduled; most of them are small co-operative banks. Commercial banks are grouped by ownership and licence: public sector banks (SBI and the nationalised banks, where the government holds a majority), private sector banks, foreign banks working through branches or wholly owned subsidiaries, regional rural banks, small finance banks and payments banks.

**Rural, co-operative and differentiated banks:** Regional rural banks (RRBs) came from the Narasimham Working Group of 1975. The first, Prathama Bank at Moradabad in Uttar Pradesh, opened on 2 October 1975 under an ordinance replaced by the Regional Rural Banks Act 1976. Their capital is shared by the central government, a sponsor bank and the state government in the ratio 50:35:15. Co-operative banks are owned by their members; the rural short-term structure has state co-operative banks at the top, district central co-operative banks in the middle and primary agricultural credit societies in villages, while urban co-operative banks serve towns. Their management has traditionally come under the Registrar of Co-operative Societies and their banking functions under the RBI. Following the Nachiket Mor Committee (2013), which proposed payments banks, the RBI issued guidelines in November 2014 for small finance banks, which take deposits and lend mainly to small borrowers, and payments banks, which accept small deposits and offer remittances and debit cards but cannot lend or issue credit cards.

**The law and mergers:** The Banking Regulation Act 1949 came into force on 16 March 1949 as the Banking Companies Act and was renamed in 1966, when it was also extended to co-operative banks. It lets the RBI licence banks (section 22), set SLR (section 24), inspect banks and issue binding directions. Mergers are a policy choice: the Narasimham Committees of 1991 and 1998 argued for a few large, strong banks able to fund big projects and absorb losses. Supporters cite economies of scale, wider reach and stronger capital; critics cite the difficulty of joining staff, technology and work cultures, and the risk of banks becoming too big to fail. A weak bank can also be merged into a strong one to protect its depositors.

### Examples

- Presidency banks: Bank of Bengal (1806), Bank of Bombay (1840) and Bank of Madras (1843) merged in 1921 into the Imperial Bank of India, which became the State Bank of India on 1 July 1955.
- SBI was created by the SBI Act 1955 on the advice of the All India Rural Credit Survey Committee chaired by A.D. Gorwala.
- First nationalisation: 19 July 1969, 14 banks with deposits of Rs 50 crore or more; second: 15 April 1980, 6 banks with deposits above Rs 200 crore.
- Punjab National Bank was founded in Lahore in 1894; Central Bank of India (1911) is often called the first bank fully owned and managed by Indians.

- A scheduled bank is one in the Second Schedule of the RBI Act 1934; it keeps CRR with the RBI and can borrow from it.
- Regional rural banks: Narasimham Working Group 1975; first RRB Prathama Bank, Moradabad, 2 October 1975; RRB Act 1976; capital shared 50:35:15 by Centre, sponsor bank and state.
- Payments banks were proposed by the Nachiket Mor Committee (2013); RBI guidelines for small finance banks and payments banks came in November 2014; payments banks cannot lend or issue credit cards.
- Banking Regulation Act 1949: in force 16 March 1949 as the Banking Companies Act; renamed and extended to co-operative banks in 1966.
- New Bank of India was merged into Punjab National Bank in 1993, the first merger of two nationalised banks.

> **Quick revision:** Bank of Hindustan 1770; Presidency banks 1806, 1840, 1843 merged into Imperial Bank 1921, which became SBI on 1 July 1955 (Gorwala committee); PNB 1894 Lahore; nationalisation 19 July 1969 (14 banks) and 15 April 1980 (6 banks); scheduled bank = Second Schedule of RBI Act 1934; first RRB Prathama Bank 2 October 1975, RRB Act 1976, capital 50:35:15; SFB and payments bank guidelines November 2014 (payments banks proposed by Nachiket Mor); BR Act 1949, renamed 1966.

### Reserve Bank of India: Origin, Organisation, Functions and Subsidiaries

**Why a central bank:** A country needs one institution that issues currency, keeps the government's accounts, holds the reserves of banks, helps a bank facing a sudden run and looks after the value of the currency. Before 1935 these jobs were split: the Government of India issued notes through its Controller of Currency, and the Imperial Bank of India acted as banker to the government. The Royal Commission on Indian Currency and Finance of 1926, known as the Hilton Young Commission, recommended a separate central bank, and the Reserve Bank of India Act was passed in 1934.

**Start and nationalisation:** The RBI began operations on 1 April 1935. It was at first a shareholders' bank with a paid-up capital of Rs 5 crore held by private shareholders. Its central office opened in Calcutta and moved permanently to Bombay (now Mumbai) in 1937. Sir Osborne Smith was its first Governor and C.D. Deshmukh its first Indian Governor. The RBI also served as central bank for Burma until April 1947 and for Pakistan until June 1948. After Independence it was nationalised on 1 January 1949 under the Reserve Bank (Transfer to Public Ownership) Act 1948, and it has since been fully owned by the Government of India.

**Organisation:** The RBI is run by a Central Board of Directors appointed by the central government under section 8 of the RBI Act. Official directors are the Governor and not more than four Deputy Governors. Non-official directors are four nominated from the four Local Boards, ten nominated by the government from various fields and two government officials. The Governor and Deputy Governors hold office for up to five years and can be reappointed. The Local Boards cover the western, eastern, southern and northern areas from Mumbai, Kolkata, Chennai and New Delhi. Supervision is guided by the Board for Financial Supervision (1994), and payment systems by the Board for Regulation and Supervision of Payment and Settlement Systems. Under section 7 the government may, after consulting the Governor, give the RBI directions in the public interest.

**Issuer of currency:** Section 22 of the RBI Act gives the RBI the sole right to issue bank notes in India. The one-rupee note and all coins are issued by the Government of India, though the RBI puts them into circulation. Under the Minimum Reserve System, which replaced the proportional reserve system in 1956, the RBI must hold assets of at least Rs 200 crore, of which at least Rs 115 crore is in gold, against the notes it issues; these amounts were fixed in 1957. Notes are printed at four presses: Nashik and Dewas, run by the government's Security Printing and Minting Corporation of India, and Mysuru and Salboni, run by the RBI's subsidiary Bharatiya Reserve Bank Note Mudran. RBI notes carry the Governor's signature, while the one-rupee note carries the signature of the Finance Secretary.

**Banker to government and to banks:** The RBI is banker to the central government by law (sections 20 and 21) and to state governments by agreement (section 21A). It keeps their accounts, makes and receives payments for them, gives temporary ways and means advances and manages public debt by issuing government securities. As banker to banks it holds their cash reserves, runs clearing and settlement, and lends to them through its repo window. When

a sound bank faces a sudden shortage of cash it can turn to the RBI as the lender of last resort, which stops panic spreading through the system.

**Regulator, foreign exchange manager and builder:** Under the Banking Regulation Act 1949 and the RBI Act, the RBI licenses, inspects and directs banks and regulates non-banking financial companies. It frames monetary policy to keep prices stable while keeping growth in mind. Under the Foreign Exchange Management Act 1999, which replaced FERA 1973, it manages foreign exchange, holds the country's reserves and steps into the market to smooth sharp swings in the rupee. It has also had a developmental role, helping to set up the Deposit Insurance Corporation (1962), IDBI (1964), the Unit Trust of India (1964) and NABARD (1982).

**Subsidiaries:** The RBI's wholly owned subsidiaries include the Deposit Insurance and Credit Guarantee Corporation (DICGC), formed in 1978 by merging the Deposit Insurance Corporation with the Credit Guarantee Corporation of India; Bharatiya Reserve Bank Note Mudran Private Limited (BRBNMPL, 1995), which prints notes; and Reserve Bank Information Technology Private Limited (ReBIT, 2016), which handles information technology and cyber security. NABARD and the National Housing Bank were once owned by the RBI, but its stakes in them have been transferred to the government.

**Examples**

- Hilton Young Commission (Royal Commission on Indian Currency and Finance, 1926) recommended a central bank; the RBI Act was passed in 1934.
- The RBI began work on 1 April 1935 with a private paid-up capital of Rs 5 crore and was nationalised on 1 January 1949.
- The RBI's central office moved from Calcutta to Bombay (Mumbai) permanently in 1937.
- First Governor of the RBI: Sir Osborne Smith; first Indian Governor: C.D. Deshmukh.
- Central Board (section 8): Governor, up to four Deputy Governors, four directors from Local Boards, ten nominated directors and two government officials.
- Section 22 of the RBI Act gives the RBI the sole right to issue bank notes; the one-rupee note and coins are issued by the Government of India and the one-rupee note is signed by the Finance Secretary.
- Minimum Reserve System (introduced 1956, amounts fixed 1957): at least Rs 200 crore of assets, including Rs 115 crore in gold, back the note issue.
- Note presses: Nashik and Dewas (SPMCIL, government); Mysuru and Salboni (BRBNMPL, RBI subsidiary).
- RBI subsidiaries: DICGC (1978), BRBNMPL (1995) and ReBIT (2016).

> **Quick revision:** Hilton Young Commission 1926; RBI Act 1934; RBI from 1 April 1935 with Rs 5 crore private capital; HQ to Bombay 1937; nationalised 1 January 1949; first Governor Osborne Smith, first Indian C.D. Deshmukh; Central Board under section 8; sole note issuer (section 22), Re 1 note and coins by government; Minimum Reserve System Rs 200 crore incl. Rs 115 crore gold; banker to government and banks, lender of last resort, regulator, forex manager (FEMA 1999); subsidiaries DICGC, BRBNMPL, ReBIT.

### Monetary Policy Tools: CRR, SLR, Repo, SDF, MSF and the MPC

**What monetary policy does:** Monetary policy is the RBI's management of the cost and supply of money. When inflation is high the RBI tightens: it raises its policy rate or draws money out of the banking system, so loans become costlier and spending cools. When growth is weak and inflation is low it eases. Its tools are of two kinds. Quantitative or general tools, such as CRR, SLR, the repo rate, open market operations and the bank rate, change the total volume and price of credit. Qualitative or selective tools, such as margin requirements on loans against goods, credit ceilings, moral suasion and direct action, change where credit flows.

**CRR and SLR:** The cash reserve ratio (CRR) is the share of a bank's net demand and time liabilities (NDTL, broadly its deposits) that it must keep as a cash balance with the RBI under section 42 of the RBI Act; the RBI pays no interest on it. The statutory liquidity ratio (SLR) is the share of NDTL that a bank must keep with itself in cash, gold or approved government securities under section 24 of the Banking Regulation Act, which caps it at 40 per cent. Raising either ratio locks up more of each deposit and leaves banks less to lend, so liquidity tightens; cutting it frees funds. CRR acts directly on money, while SLR also makes banks hold safe government securities.

**Repo, reverse repo and SDF:** A repo (repurchase agreement) is a short-term loan in which a bank sells government securities to the RBI and agrees to buy them back at a higher price; the difference is interest at the repo rate. The repo rate is the policy rate, the main signal of the RBI's stance, and changes in it pass through to deposit and loan rates. In a reverse repo the RBI borrows surplus money from banks against securities. The standing deposit facility (SDF), recommended by the Urjit Patel Committee in 2014 and enabled by a 2018 amendment to section 17 of the RBI Act, lets the RBI absorb surplus funds without giving securities in return, so it is not limited by the stock of securities it holds.

**MSF and bank rate:** The marginal standing facility (MSF), introduced in 2011, lets a bank borrow overnight from the RBI at a rate above the repo rate, even by dipping into its SLR securities up to a set limit, when the interbank market dries up. It is a penal, emergency window. The bank rate, under section 49 of the RBI Act, is the standard rate at which the RBI buys or rediscounts bills of exchange and other commercial paper. It is now aligned with the MSF rate and is used mainly to fix penal interest on shortfalls in reserves.

**LAF and the corridor:** The liquidity adjustment facility (LAF), introduced in June 2000 on the advice of the Narasimham Committee (1998), is the framework through which the RBI adds or absorbs day-to-day liquidity using repo and reverse repo operations, fixed-rate and variable-rate auctions, the SDF and the MSF. The policy repo rate sits in the middle of a corridor. The MSF rate is the ceiling, because no bank should need to pay more overnight, and the absorption rate (the SDF rate, earlier the fixed reverse repo rate) is the floor. The RBI tries to keep the weighted average call rate, its operating target, close to the repo rate.

**Open market operations:** OMOs are outright purchases or sales of government securities by the RBI in the market. When the RBI buys securities it pays money into the banking system and adds lasting liquidity; when it sells them it pulls money out. The Market Stabilisation Scheme of 2004 lets the government issue extra securities to absorb surplus money, for example from large foreign inflows, keeping the proceeds in a separate account. OMOs, foreign exchange swaps and CRR changes deal with lasting liquidity, while the LAF handles daily needs.

**MPC and inflation targeting:** The Finance Act 2016 amended the RBI Act to give flexible inflation targeting a legal basis, following the Urjit Patel Committee report (2014) and a monetary policy framework agreement of February 2015. Under section 45ZA the central government, in consultation with the RBI, sets an inflation target based on the Consumer Price Index once every five years; the first target was 4 per cent with a tolerance band of 2 to 6 per cent. Under section 45ZB a six-member Monetary Policy Committee decides the policy repo rate: three members from the RBI (the Governor, who chairs and has a casting vote, the Deputy Governor in charge of monetary policy and one officer nominated by the Central Board) and three external members appointed by the government for four years. It meets at least four times a year, needs a quorum of four and decides by majority. If inflation stays outside the band for three consecutive quarters, the RBI must report the reasons and remedial steps to the government. The MPC sets only the repo rate; CRR, SLR and the other rates are decided by the RBI.

### Examples

- CRR: share of NDTL kept as cash with the RBI under section 42 of the RBI Act; the RBI pays no interest on it.
- SLR: share of NDTL held by the bank itself in cash, gold or approved government securities under section 24 of the BR Act; ceiling 40 per cent.
- Repo: the RBI lends to banks against government securities; reverse repo: the RBI borrows from banks; the repo rate is the policy rate set by the MPC.
- SDF absorbs liquidity without collateral; recommended by the Urjit Patel Committee (2014) and enabled by a 2018 amendment to the RBI Act.
- MSF (2011): overnight emergency borrowing above the repo rate, partly against SLR securities; the MSF rate is the ceiling of the LAF corridor and the bank rate is aligned with it.
- LAF began in June 2000 on the Narasimham Committee (1998) advice; the operating target is the weighted average call rate.
- OMO purchase of securities injects liquidity and OMO sale absorbs it; raising CRR or SLR absorbs liquidity and cutting them injects it.

- MPC: 6 members, 3 from the RBI and 3 external (four-year term); quorum 4; Governor has the casting vote; meets at least 4 times a year.
- First inflation target under the 2016 framework: CPI inflation of 4 per cent with a band of 2 to 6 per cent; failure means three consecutive quarters outside the band.

> **Quick revision:** CRR (section 42 RBI Act, cash with RBI, no interest); SLR (section 24 BR Act, cash, gold, G-secs, ceiling 40%); repo = RBI lends, reverse repo = RBI borrows; SDF absorbs without collateral (Urjit Patel Committee 2014, amendment 2018); MSF 2011 = corridor ceiling, bank rate aligned with it; LAF June 2000; OMO buy injects, sell absorbs; MSS 2004; MPC under section 45ZB, 6 members, quorum 4, sets only the repo rate; first CPI target 4% (2-6%).

### Bank Accounts, NRI Deposits, Cheques, Loans and Deposit Insurance

**Deposit accounts:** Deposits fall into two groups. Demand deposits, that is savings and current accounts, can be withdrawn at any time; time deposits, that is fixed and recurring deposits, are locked for a chosen period and so earn more. A savings account is for individuals; it pays interest calculated on the daily balance, and the RBI deregulated the savings rate in 2011, so each bank sets its own. A current account is for businesses with many transactions; it usually pays no interest but allows unlimited transactions and an overdraft. A fixed deposit is placed for a fixed period at a fixed rate, with a penalty for early withdrawal, while a recurring deposit collects a fixed sum every month. The share of current and savings deposits in total deposits, the CASA ratio, is watched closely because these are a bank's cheapest funds.

**NRI accounts and KYC:** Indians living abroad mainly use three accounts. The NRE (Non-Resident External) account is a rupee account for money earned abroad; principal and interest can be freely sent back (repatriated) and the interest is free of Indian income tax. The NRO (Non-Resident Ordinary) account is a rupee account for income earned in India, such as rent, pension or dividends; repatriation is limited and the interest is taxable. The FCNR(B) (Foreign Currency Non-Resident, Banks) account is a term deposit held in a foreign currency, which protects the depositor from exchange-rate risk. Before opening any account a bank must complete KYC (Know Your Customer), verifying identity and address through officially valid documents such as a passport, driving licence, voter ID or Aadhaar. KYC rests on the Prevention of Money Laundering Act 2002 and RBI directions, and is updated periodically according to the customer's risk category.

**Cheques and drafts:** A cheque, defined in section 6 of the Negotiable Instruments Act 1881, is a bill of exchange drawn on a specified banker and payable on demand. The person who writes it is the drawer, the bank is the drawee and the person to be paid is the payee. A bearer cheque is paid to whoever presents it; an order cheque only to the named payee or to the person he endorses it to. A crossed cheque, marked with two parallel lines, must be paid into a bank account, not over the counter; an account payee crossing means only the payee's account can be credited. A cheque is valid for three months from its date and becomes stale after that. Dishonour of a cheque for insufficient funds is an offence under section 138 of the Act. A demand draft is issued by a bank against money paid in advance, so it cannot bounce for lack of funds.

**Cheque truncation and nomination:** The Cheque Truncation System (CTS) stops the physical movement of cheques; the presenting bank sends an electronic image of the cheque, with its MICR data, for clearing. It began in the National Capital Region in 2008 and later spread across the country, using cheques of the CTS-2010 standard. Nomination, under sections 45ZA to 45ZF of the Banking Regulation Act, lets a depositor name a person to whom the bank pays the deposit, or hands over a safe-custody article or locker contents, after the depositor's death. The nominee receives the money as a trustee for the legal heirs, so nomination speeds up claims but does not decide inheritance.

**Loans and interest:** Banks give term loans repaid in equated monthly instalments (EMIs), and working-capital facilities such as cash credit and overdraft, where the borrower draws up to a limit and pays interest only on the amount used. Interest is either fixed, staying the same through the term, or floating, moving with a benchmark. Benchmarks have changed over time: the benchmark prime lending rate (2003) gave way to the base rate (July 2010) and then to the marginal cost of funds based lending rate, MCLR (April 2016), which reflects a bank's marginal cost

of funds, the cost of keeping CRR, operating costs and a tenor premium. From 1 October 2019 new floating-rate loans to individuals and to micro and small enterprises must be linked to an external benchmark, such as the RBI's repo rate or a Treasury bill yield, so that policy changes reach borrowers faster.

**Credit bureaus and deposit insurance:** Credit information companies, licensed under the Credit Information Companies (Regulation) Act 2005, collect repayment records from lenders and give each borrower a credit report and score. TransUnion CIBIL, set up in 2000, is the best known; Equifax, Experian and CRIF High Mark are others. A CIBIL score runs from 300 to 900; the higher the better. Deposits are protected by the Deposit Insurance and Credit Guarantee Corporation (DICGC), an RBI subsidiary; deposit insurance in India began in 1962. It covers savings, current, fixed and recurring deposits in commercial banks (including foreign bank branches, small finance banks and payments banks), regional rural banks and co-operative banks, for principal and interest together up to a set limit per depositor in each bank. The banks pay the premium, not the depositors, and deposits of governments and of other banks are not covered.

**Examples**

- Demand deposits: savings and current accounts; time deposits: fixed and recurring deposits; CASA = current and savings deposits, the cheapest funds for a bank.
- Savings bank interest is calculated on the daily balance and was deregulated by the RBI in 2011; current accounts usually pay no interest.
- NRE: rupee account for foreign earnings, fully repatriable, interest tax-free; NRO: income earned in India, limited repatriation, taxable; FCNR(B): term deposit in foreign currency.
- KYC rests on the Prevention of Money Laundering Act 2002 and RBI directions; officially valid documents include passport, driving licence, voter ID and Aadhaar.
- Cheque: section 6 of the Negotiable Instruments Act 1881; drawer writes it, drawee bank pays it, payee receives it; valid for three months from its date.
- Account payee crossing: only the payee's account can be credited; dishonour for insufficient funds is an offence under section 138 of the NI Act.
- CTS sends an image of the cheque instead of the paper; it began in the National Capital Region in 2008.
- Lending benchmarks: BPLR (2003), base rate (July 2010), MCLR (April 2016), external benchmark for new floating retail and MSE loans (1 October 2019).
- Credit Information Companies (Regulation) Act 2005; TransUnion CIBIL (2000) scores run from 300 to 900.
- DICGC, an RBI subsidiary, insures deposits per depositor in each bank up to a set limit; banks pay the premium; deposit insurance began in 1962.

> **Quick revision:** Demand deposits (savings, current) vs time deposits (FD, RD); savings rate deregulated 2011; NRE (repatriable, tax-free) vs NRO (Indian income) vs FCNR(B) (foreign currency); KYC under PMLA 2002; cheque = section 6 NI Act 1881, valid three months, dishonour = section 138; CTS from NCR 2008; nomination sections 45ZA-45ZF BR Act; BPLR 2003, base rate 2010, MCLR 2016, external benchmark 1 October 2019; CICRA 2005, CIBIL 300-900; DICGC insures deposits, insurance since 1962.

### Payment and Settlement Systems: NEFT, RTGS, IMPS, UPI and NPCI

**The legal base:** A payment system moves money from payer to payee, and a settlement system finally squares the accounts between the banks involved. The Payment and Settlement Systems Act 2007, in force from August 2008, makes the RBI the authority for all payment systems in India. No one may run a payment system without RBI authorisation, and the RBI oversees them through its Board for Regulation and Supervision of Payment and Settlement Systems (BPSS). Payments are settled either gross, one by one, or net, where many transactions are added up and only the net amount moves between banks at fixed times. Gross settlement removes the risk that one bank's failure upsets the others; net settlement needs less money in hand.

**RTGS and NEFT:** Real Time Gross Settlement (RTGS), started in March 2004, settles each instruction individually and immediately in the RBI's books, so the payment is final and cannot be reversed. It is meant for large transfers, with a minimum of Rs 2 lakh and no upper limit. National Electronic Funds Transfer (NEFT), started in November

2005, settles transfers in half-hourly batches on a deferred net basis and has no minimum amount, which suits everyday transfers. Both are run by the RBI and both became available round the clock, NEFT from December 2019 and RTGS from December 2020. Both need the beneficiary's account number and the branch's IFSC.

**NPCI:** The National Payments Corporation of India was set up in December 2008 by the RBI and the Indian Banks' Association under the PSS Act as the umbrella body for retail payments. It is a not-for-profit company owned by banks, with its head office in Mumbai. In 2009 it took over the National Financial Switch (NFS), which links the ATMs of different banks, from IDRBT. Its products include IMPS, UPI, RuPay, NACH, AePS, the Cheque Truncation System, the Bharat Bill Payment System and the National Electronic Toll Collection (FASTag) system.

**IMPS and UPI:** Immediate Payment Service (IMPS), launched by NPCI in November 2010, gives instant interbank transfers round the clock through mobile phones, internet banking or ATMs, using either account number and IFSC or a mobile number with a Mobile Money Identifier (MMID). Unified Payments Interface (UPI), built on the IMPS system, was launched by NPCI in 2016. It links several bank accounts to one mobile app and lets users pay with a virtual payment address (UPI ID) or a QR code, so the payer never needs the payee's account details; every payment is authorised with a UPI PIN. UPI supports both sending money (push) and collect requests (pull). The government's BHIM app (Bharat Interface for Money), released in December 2016, runs on UPI.

**NACH, AePS and BBPS:** National Automated Clearing House (NACH) handles bulk and repeat payments such as salaries, pensions, dividends, subsidies and loan EMIs, replacing the older Electronic Clearing Service (ECS); its Aadhaar Payment Bridge credits government benefits to Aadhaar-linked accounts. Aadhaar enabled Payment System (AePS) lets a customer withdraw or deposit cash, check the balance or transfer money at a business correspondent's micro-ATM using the Aadhaar number and a fingerprint instead of a card or PIN, which serves villages without branches. Bharat Bill Payment System (BBPS) is a single, interoperable platform for paying electricity, water, gas, telephone and other bills through any bank, app or agent; an NPCI unit acts as the Bharat Bill Payment Central Unit, and banks and other firms act as operating units.

**Cards and wallets:** A debit card draws money directly from the holder's account. A credit card gives a revolving line of credit; the holder pays later and is charged interest if the bill is not paid in full by the due date. Prepaid payment instruments (PPIs), such as mobile wallets and gift cards, store value paid in advance. A closed-system PPI can be used only with the firm that issued it, while other PPIs, issued by banks and RBI-authorised non-banks, can be used at many merchants. RuPay, launched by NPCI in 2012 (the name joins Rupee and Payment), is India's own card network; it keeps domestic card payments processed within India at lower cost than foreign networks. Point of sale (PoS) terminals accept cards at shops. The first ATM in India was set up by HSBC in Mumbai in 1987, and ATMs owned and run by non-bank companies are called white-label ATMs.

### Examples

- Payment and Settlement Systems Act 2007 (in force August 2008): the RBI authorises and oversees every payment system through the BPSS.
- RTGS (March 2004): real-time, one-by-one settlement for large transfers, minimum Rs 2 lakh; NEFT (November 2005): half-hourly batches, no minimum.
- NEFT became available round the clock in December 2019 and RTGS in December 2020; both are run by the RBI, not by NPCI.
- NPCI: set up December 2008 by the RBI and the Indian Banks' Association; a not-for-profit company owned by banks; head office Mumbai.
- IMPS (November 2010): instant transfers at any hour using account number and IFSC, or mobile number with MMID.
- UPI (2016) runs on the IMPS system with a virtual payment address and UPI PIN; the BHIM app was released in December 2016.
- NACH replaced ECS for bulk payments; AePS uses the Aadhaar number and a fingerprint at a micro-ATM; BBPS handles bill payments.
- RuPay (2012) = Rupee + Payment, India's own card network, run by NPCI.
- First ATM in India: HSBC, Mumbai, 1987; ATMs run by non-bank companies are white-label ATMs.

**Quick revision:** PSS Act 2007 (in force August 2008), RBI authorises payment systems via BPSS; RTGS March 2004, gross and real time, minimum Rs 2 lakh; NEFT November 2005, half-hourly deferred net batches; both run by RBI, 24x7 from 2019 (NEFT) and 2020 (RTGS); NPCI December 2008 by RBI and IBA, HQ Mumbai; IMPS 2010; UPI 2016, BHIM December 2016; NACH replaced ECS; AePS via Aadhaar and fingerprint; BBPS for bills; RuPay 2012; first ATM HSBC Mumbai 1987.

### NPAs, Debt Recovery Laws, IBC and Basel Capital Norms

**What an NPA is:** A loan becomes a non-performing asset (NPA) when it stops earning income for the bank. A term loan becomes an NPA when interest or an instalment of principal stays overdue for more than 90 days. An overdraft or cash credit account becomes an NPA when it remains out of order, and a bill purchased or discounted when it stays overdue, for more than 90 days. For farm loans the test is crop seasons: two crop seasons for short-duration crops and one for long-duration crops. The 90-day rule applies from March 2004; earlier the period was 180 days. Before a loan turns bad, banks flag stress as special mention accounts: SMA-0 when overdue up to 30 days, SMA-1 for 31 to 60 days and SMA-2 for 61 to 90 days.

**Asset classification and provisioning:** Banks sort loans into four groups. Standard assets are performing loans. A sub-standard asset has been an NPA for up to 12 months. A doubtful asset has stayed sub-standard for 12 months. A loss asset has been found uncollectible by the bank, its auditors or the RBI's inspectors, though not yet fully written off. Banks must set aside provisions from profits, and the provision rises as the asset ages: a small general provision on standard assets, more on sub-standard and doubtful assets, and 100 per cent on loss assets. Gross NPA is the total of bad loans; net NPA is gross NPA minus provisions.

**SARFAESI Act and ARCs:** The Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest Act 2002 lets banks enforce their security without going to court. Once a secured loan is an NPA, the lender serves a notice under section 13(2) giving the borrower 60 days to pay; if he does not, the lender can take possession of the secured asset, take over management or sell the asset. The borrower can appeal to the Debt Recovery Tribunal; the Act does not cover agricultural land. The same Act provides for asset reconstruction companies (ARCs), registered with the RBI under section 3, which buy bad loans from banks at a discount, usually paying partly in security receipts; ARCIL was the first.

**DRTs and Lok Adalats:** Debt Recovery Tribunals were set up under the Recovery of Debts Due to Banks and Financial Institutions Act 1993, renamed the Recovery of Debts and Bankruptcy Act in 2016, to decide bank recovery cases faster than civil courts. Appeals lie with the Debt Recovery Appellate Tribunals. DRTs are also the adjudicating authority for the insolvency of individuals and partnership firms under the Insolvency and Bankruptcy Code. Lok Adalats, set up under the Legal Services Authorities Act 1987, settle smaller dues by compromise between bank and borrower; their award is final, with no appeal.

Insolvency and Bankruptcy Code 2016: The IBC set up one time-bound process. When a company defaults, a financial creditor, an operational creditor or the company itself can apply to the National Company Law Tribunal (NCLT), the adjudicating authority for companies and limited liability partnerships. Once a case is admitted, a moratorium halts other recovery suits, an insolvency professional takes charge, and a committee of creditors made up of financial creditors considers resolution plans; a plan needs 66 per cent of their votes. The process must finish within 180 days, extendable by 90 days, and within 330 days including litigation; if no plan is approved, the company is liquidated. The Insolvency and Bankruptcy Board of India (IBBI), set up on 1 October 2016, regulates the process, and appeals against NCLT orders go to the NCLAT.

**Basel norms and capital:** The Basel Committee on Banking Supervision, set up in 1974 by the central banks of the G10 countries and housed at the Bank for International Settlements in Basel, Switzerland, issues global standards for bank capital. Capital matters because it absorbs losses before depositors suffer. The capital to risk-weighted assets ratio (CRAR) compares capital with assets weighted by risk: a government security carries little or no weight, an unsecured loan a high one. Tier 1 capital is core capital such as equity and disclosed reserves; Tier 2 is supplementary capital such as subordinated debt and general provisions. Basel I (1988) covered credit risk and set a minimum CRAR of 8 per cent; India adopted it from 1992 on the Narasimham Committee's advice, and the RBI later

raised India's minimum to 9 per cent. Basel II (2004) covered credit, market and operational risk and rested on three pillars: minimum capital, supervisory review and market discipline. Basel III (2010), framed after the 2008 global financial crisis, demands more and better capital, especially common equity, a capital conservation buffer of 2.5 per cent, a countercyclical buffer, a leverage ratio and two liquidity standards, the liquidity coverage ratio and the net stable funding ratio.

**Prompt corrective action:** The RBI's prompt corrective action (PCA) framework, introduced in December 2002 and revised since, lets it act early when a bank's health slips: a bank that breaches set thresholds on capital, net NPAs or leverage faces curbs on dividends, branch expansion, risky lending and management pay until it rebuilds its strength.

**Examples**

- A term loan becomes an NPA when interest or principal is overdue for more than 90 days; this norm applies from March 2004 (earlier 180 days).
- Sub-standard: NPA for up to 12 months; doubtful: sub-standard for 12 months; loss: found uncollectible but not fully written off.
- Special mention accounts: SMA-0 overdue up to 30 days, SMA-1 31 to 60 days, SMA-2 61 to 90 days.
- SARFAESI Act 2002: notice under section 13(2) gives 60 days; the lender can then take possession and sell without a court; it does not apply to agricultural land.
- DRTs: Recovery of Debts Due to Banks and Financial Institutions Act 1993; Lok Adalats: Legal Services Authorities Act 1987, award final with no appeal.
- IBC 2016: NCLT for companies and LLPs, DRT for individuals and firms; process in 180 + 90 days (330 with litigation); creditors' approval 66 per cent; IBBI from 1 October 2016.
- ARCs buy NPAs at a discount against security receipts and are registered with the RBI under section 3 of the SARFAESI Act; ARCIL was the first.
- Basel I 1988 (credit risk, 8 per cent CRAR); Basel II 2004 (three pillars); Basel III 2010 (better capital, buffers, leverage and liquidity ratios); India's minimum CRAR is 9 per cent.
- Basel Committee on Banking Supervision: set up in 1974 by G10 central banks, housed at the BIS in Basel, Switzerland.
- PCA (December 2002): RBI curbs on a bank that breaches thresholds on capital, asset quality or leverage.

> **Quick revision:** NPA = overdue more than 90 days (from March 2004, earlier 180); SMA-0/1/2 = up to 30/31-60/61-90 days; sub-standard up to 12 months, doubtful after 12 months, loss = uncollectible; SARFAESI 2002 (section 13(2) notice, 60 days, no court; ARCs under section 3); DRT Act 1993; Lok Adalat 1987; IBC 2016 (NCLT, CoC 66%, 180+90, 330 days; IBBI 1 October 2016); Basel Committee 1974; Basel I 1988 (8%), II 2004 (three pillars), III 2010 (buffers, LCR, NSFR); India CRAR 9%; PCA 2002.

### Financial Inclusion: Lead Bank Scheme, Priority Sector and Jan Dhan to MUDRA

**What financial inclusion means:** Financial inclusion is giving every household, especially the poor and people in villages, access to basic financial services, a bank account, credit, insurance, pension and remittances, at an affordable cost. The Rangarajan Committee on Financial Inclusion (2008) defined it as ensuring access to financial services, and timely and adequate credit, for vulnerable groups such as weaker sections and low-income groups at an affordable cost. It matters because a bank account lets subsidies reach people directly, protects savings from moneylenders and opens the way to formal credit and insurance. India built inclusion in stages: directing branches and credit to neglected areas after 1969, reaching villages through agents after 2006, and a mission-mode push for accounts and insurance after 2014.

**Lead banks and the priority sector:** The Lead Bank Scheme, introduced by the RBI in 1969 on the recommendations of the Gadgil Study Group and the Nariman Committee, gives each district to one bank as its lead bank. The lead bank coordinates all banks in the district, prepares the district credit plan and convenes the District Consultative Committee. Priority sector lending asks banks to give a fixed share of credit to sectors that would otherwise be neglected: agriculture, micro, small and medium enterprises, export credit, education, housing, social

infrastructure, renewable energy and weaker sections. Domestic commercial banks must lend 40 per cent of adjusted net bank credit (ANBC), or of the credit equivalent of off-balance-sheet exposure if that is higher, to the priority sector, while regional rural banks and small finance banks have higher targets. Banks that over-achieve can sell priority sector lending certificates (PSLCs) to banks that fall short. The Kisan Credit Card scheme of 1998 gives farmers a revolving credit limit for crop needs.

**Agents and Jan Dhan:** In 2006 the RBI allowed banks to use business correspondents (BCs), agents such as retired staff, shopkeepers or NGOs, who open accounts and handle small deposits and withdrawals in villages with a hand-held device or micro-ATM. The Pradhan Mantri Jan-Dhan Yojana (PMJDY), announced on 15 August 2014 and launched on 28 August 2014, aimed first at a bank account for every household and later for every adult. Its accounts are basic savings bank deposit accounts with no minimum balance, a RuPay debit card carrying accident insurance and an overdraft facility for regular users. Its motto is Mera Khata, Bhagya Vidhata. Jan Dhan accounts, Aadhaar and mobile phones together form the JAM trinity used for direct benefit transfer.

Insurance and pension schemes of 2015: Three schemes were launched together on 9 May 2015. Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) is a one-year renewable term life cover of Rs 2 lakh for death from any cause, for account holders aged 18 to 50. Pradhan Mantri Suraksha Bima Yojana (PMSBY) is a one-year renewable accident cover for ages 18 to 70: Rs 2 lakh for accidental death or total permanent disability and Rs 1 lakh for partial permanent disability. Premiums for both are auto-debited from the bank account each year. Atal Pension Yojana (APY), aimed mainly at workers in the unorganised sector aged 18 to 40, gives a guaranteed monthly pension of Rs 1,000 to Rs 5,000 from age 60, depending on contributions; it is administered by PFRDA and replaced the earlier Swavalamban scheme.

**Credit for small enterprises:** Pradhan Mantri MUDRA Yojana (PMMY), launched on 8 April 2015, gives collateral-free loans to non-corporate, non-farm micro and small enterprises for income-generating activities. MUDRA (Micro Units Development and Refinance Agency) is a subsidiary of SIDBI; it does not lend directly but refinances the banks, NBFCs and microfinance institutions that do. As designed in 2015 the loans had three stages named after stages of growth: Shishu, up to Rs 50,000; Kishore, above Rs 50,000 and up to Rs 5 lakh; and Tarun, above Rs 5 lakh and up to Rs 10 lakh. Stand-Up India, launched on 5 April 2016, supports bank loans of Rs 10 lakh to Rs 1 crore for a new (greenfield) enterprise to at least one Scheduled Caste or Scheduled Tribe borrower and at least one woman borrower per bank branch; refinance for these loans is available through SIDBI.

**Savings for the girl child:** Sukanya Samriddhi Yojana, launched on 22 January 2015 at Panipat (Haryana) under the Beti Bachao Beti Padhao campaign, is a small savings account that a parent or guardian opens for a girl below 10 years of age at a post office or an authorised bank. Deposits are made for 15 years and the account matures 21 years after it is opened; part of the balance can be withdrawn for higher education once the girl turns 18. It has exempt-exempt-exempt tax treatment, and its interest rate is notified by the government every quarter. Because the insurance, pension and benefit schemes run through a bank account, the Jan Dhan account is the base of the whole structure.

### Examples

- Lead Bank Scheme: RBI, 1969, on the Gadgil Study Group and Nariman Committee reports; one lead bank for each district.
- Priority sector target for domestic commercial banks: 40 per cent of adjusted net bank credit; surplus lending can be sold as PSLCs.
- Business correspondents were allowed by the RBI in 2006 to provide branchless banking in villages.
- PMJDY: announced 15 August 2014, launched 28 August 2014; zero-balance account, RuPay card with accident cover, overdraft; motto Mera Khata, Bhagya Vidhata.
- PMJJBY (9 May 2015): life cover of Rs 2 lakh for ages 18 to 50; PMSBY (9 May 2015): accident cover of Rs 2 lakh for ages 18 to 70.
- Atal Pension Yojana (9 May 2015): ages 18 to 40, pension of Rs 1,000 to Rs 5,000 a month from age 60, run by PFRDA, replaced Swavalamban.

- PM MUDRA Yojana (8 April 2015): bands at launch were Shishu up to Rs 50,000, Kishore up to Rs 5 lakh and Tarun up to Rs 10 lakh; MUDRA is a SIDBI subsidiary.
- Stand-Up India (5 April 2016): bank loans of Rs 10 lakh to Rs 1 crore for new enterprises of SC/ST and women entrepreneurs; refinance through SIDBI.
- Sukanya Samriddhi Yojana (22 January 2015, Panipat): girl below 10, deposits for 15 years, matures 21 years after opening.

> **Quick revision:** Rangarajan Committee 2008; Lead Bank Scheme 1969 (Gadgil, Nariman); priority sector 40% of ANBC, PSLCs; KCC 1998; BCs 2006; PMJDY 28 August 2014 (Mera Khata, Bhagya Vidhata); PMJJBY Rs 2 lakh life (18-50), PMSBY Rs 2 lakh accident (18-70), APY Rs 1,000-5,000 pension (18-40, PFRDA), all 9 May 2015; MUDRA 8 April 2015 (Shishu, Kishore, Tarun; SIDBI subsidiary); Stand-Up India 5 April 2016; Sukanya Samriddhi 22 January 2015.

### Development Banks, NBFCs and Financial Regulators (NABARD, SIDBI, SEBI, IRDAI, PFRDA)

**Why development banks:** Commercial banks take short-term deposits and so prefer short-term lending, but industry, farming, housing and exports need long-term finance and specialised knowledge. After Independence India created development financial institutions (DFIs) for this: IFCI (1948) was the first, followed by state financial corporations under an Act of 1951, ICICI (1955) and IDBI (1964), set up as an RBI subsidiary to be the apex body for industrial finance. Sector-specific apex banks for agriculture, small industry, exports and housing came later. ICICI and IDBI have since become commercial banks.

**NABARD:** The National Bank for Agriculture and Rural Development was set up on 12 July 1982 under the NABARD Act 1981, on the recommendation of the CRAFICARD committee headed by B. Sivaraman. It took over the agricultural credit functions of the RBI and the refinance work of the Agricultural Refinance and Development Corporation. With headquarters in Mumbai, it is the apex body for rural credit: it refinances banks that lend to farmers and rural enterprises, supervises regional rural banks and state and district co-operative banks, manages the Rural Infrastructure Development Fund and promotes self-help groups through the SHG-bank linkage programme begun in 1992.

**SIDBI, EXIM Bank and NHB:** The Small Industries Development Bank of India was set up on 2 April 1990 under the SIDBI Act 1989, first as a subsidiary of IDBI; with headquarters in Lucknow, it is the principal institution for financing and developing micro, small and medium enterprises, and MUDRA is its subsidiary. The Export-Import Bank of India, created under an Act of 1981 and set up in 1982 with headquarters in Mumbai, finances and promotes India's foreign trade and gives lines of credit to foreign governments and banks to buy Indian goods. The National Housing Bank, set up on 9 July 1988 under the NHB Act 1987 with headquarters in New Delhi, is the apex institution for housing finance and refinances housing finance companies and banks. In 2019 the regulation of housing finance companies moved from NHB to the RBI, which treats them as a category of NBFC; the 2019 change left their supervision with NHB.

**NBFCs and how they differ from banks:** A non-banking financial company is a company registered under the Companies Act whose principal business is financial, such as loans, asset finance, hire purchase or investment in securities; the RBI treats financial business as principal when financial assets are more than half of total assets and financial income more than half of gross income. NBFCs under the RBI must register with it under section 45-IA of the RBI Act. They differ from banks in key ways: they cannot accept demand deposits, they cannot issue cheques drawn on themselves, they are not part of the payment and settlement system as banks are, their depositors get no DICGC insurance and they keep no CRR. Types include investment and credit companies, infrastructure finance companies, microfinance institutions, core investment companies, factors, account aggregators and peer-to-peer lending platforms. Not all finance companies come under the RBI: merchant bankers and stock brokers are under SEBI, insurers under IRDAI, chit funds under state governments and Nidhi companies under the Ministry of Corporate Affairs.

**SEBI:** The Securities and Exchange Board of India was set up on 12 April 1988 by a government resolution and became a statutory body on 30 January 1992 under the SEBI Act 1992. With headquarters in Mumbai, it protects

investors and regulates and develops the securities market: stock exchanges, brokers, depositories, mutual funds, merchant bankers, credit rating agencies and the disclosures of listed companies. The Forward Markets Commission (1953), which regulated commodity futures, was merged into SEBI in September 2015.

**IRDAI and PFRDA:** The Insurance Regulatory and Development Authority of India was created under the IRDA Act 1999, on the recommendation of the Malhotra Committee (1994), and set up in 2000, and has its headquarters in Hyderabad; it regulates life, general and health insurance, a sector reopened to private companies from 2000. Life insurance had been nationalised in 1956 with the creation of LIC, and general insurance in 1972. The Pension Fund Regulatory and Development Authority was set up by a government resolution in 2003 and became statutory under the PFRDA Act 2013; with headquarters in New Delhi, it regulates the National Pension System, introduced for new central government employees from 1 January 2004, and the Atal Pension Yojana.

**Other regulators and coordination:** The Insolvency and Bankruptcy Board of India (2016) regulates insolvency professionals and processes. The International Financial Services Centres Authority (IFSCA), set up in 2020 under the IFSCA Act 2019 with headquarters at GIFT City, Gandhinagar, is the single regulator for financial services in international financial services centres. The Financial Stability and Development Council, set up by the government in December 2010 and chaired by the Union Finance Minister, brings the regulators together on financial stability. Exams test the matching: banks with the RBI, securities with SEBI, insurance with IRDAI and pensions with PFRDA.

**Examples**

- IFCI (1948) was India's first development financial institution; ICICI followed in 1955 and IDBI in 1964.
- NABARD: 12 July 1982, NABARD Act 1981, on the CRAFICARD (B. Sivaraman) recommendation; HQ Mumbai; supervises RRBs and co-operative banks.
- SIDBI: 2 April 1990, SIDBI Act 1989, HQ Lucknow; apex institution for MSMEs; MUDRA is its subsidiary.
- EXIM Bank: EXIM Bank Act 1981, set up 1982, HQ Mumbai; NHB: 9 July 1988, NHB Act 1987, HQ New Delhi.
- NBFCs register with the RBI under section 45-IA of the RBI Act; they cannot take demand deposits or issue cheques, and their deposits are not insured by DICGC.
- SEBI: set up 12 April 1988, statutory from 30 January 1992, HQ Mumbai; the Forward Markets Commission was merged into it in 2015.
- IRDAI: IRDA Act 1999 (Malhotra Committee), HQ Hyderabad; PFRDA: 2003 resolution, PFRDA Act 2013, HQ New Delhi, regulates NPS and APY.
- IFSCA (2020, HQ GIFT City, Gandhinagar) regulates international financial services centres; FSDC (December 2010) is chaired by the Union Finance Minister.
- Chit funds are regulated by state governments and Nidhi companies by the Ministry of Corporate Affairs, not by the RBI.

> **Quick revision:** IFCI 1948 first DFI, ICICI 1955, IDBI 1964; NABARD 12 July 1982 (Act 1981, CRAFICARD, Mumbai); SIDBI 2 April 1990 (Lucknow); EXIM Bank 1982 (Act 1981, Mumbai); NHB 9 July 1988 (New Delhi), HFC regulation to RBI 2019; NBFCs register under section 45-IA, no demand deposits, no cheques, no DICGC cover; SEBI 1988, statutory 1992, FMC merged 2015; IRDAI Act 1999, Hyderabad; PFRDA 2003, Act 2013; IFSCA 2020 Gandhinagar; FSDC 2010.

### Money Market and Capital Market: Instruments, IPOs, Exchanges and Mutual Funds

**Two markets for funds:** The financial market is divided by the length of the funds traded. The money market deals in short-term funds, from overnight up to one year, and lets banks, companies and the government manage day-to-day cash; the RBI regulates it and uses it to pass on monetary policy. The capital market deals in long-term funds, more than one year, such as shares and bonds; SEBI regulates it, while government securities come under the RBI. The Vaghul Working Group (1987) set out the plan for developing India's money market.

**Call money and repo:** In the call money market banks and primary dealers lend to each other without collateral: call money is for one day, notice money for 2 to 14 days and term money for 15 days up to one year. In a market repo one party sells securities and agrees to buy them back; in a tri-party repo a third agent manages the collateral. The

Clearing Corporation of India (CCIL, 2001) settles trades in government securities, money market and foreign exchange, and its tri-party repo (TREPS) replaced the older CBLO in 2018.

**Treasury bills, CPs and CDs:** Treasury bills are short-term borrowings of the central government, issued by the RBI through auctions in three tenors: 91, 182 and 364 days. They are zero-coupon instruments, issued at a discount and repaid at face value, the difference being the return. Commercial paper (CP), introduced in 1990, is an unsecured promissory note issued at a discount by highly rated companies, primary dealers and all-India financial institutions. A certificate of deposit (CD), introduced in 1989, is a negotiable deposit receipt issued at a discount by banks and some financial institutions; unlike an ordinary fixed deposit it can be sold before maturity.

**Shares and debt instruments:** An equity share is a unit of ownership in a company; its holder gets voting rights and dividends but is paid last if the company is wound up. A preference share gets a fixed dividend and is repaid before equity but usually carries no vote. A debenture or bond is a loan to the issuer: the holder is a creditor who gets fixed interest (the coupon) and repayment at maturity. Debentures may be secured or unsecured, convertible into shares or non-convertible. Government securities are issued through the RBI by the central government (dated securities) and state governments (state development loans); they carry practically no default risk and are called gilt-edged. Other forms include zero-coupon bonds, sovereign gold bonds (first issued in 2015), green bonds and masala bonds, which are rupee-denominated bonds sold outside India.

**Primary market and IPOs:** The primary market is where securities are issued for the first time. An initial public offer (IPO) is a company's first sale of shares to the public, after which the shares are listed on a stock exchange; a follow-on public offer (FPO) is a later public issue by a listed company. A rights issue offers new shares to existing shareholders in proportion to their holding, while a bonus issue gives them free shares out of reserves. The price is set either as a fixed price or by book building, where investors bid within a price band. In a book-built issue the company first files a draft red herring prospectus with SEBI. Investors apply through ASBA (Application Supported by Blocked Amount), under which the money stays blocked in their own account until shares are allotted.

**Stock exchanges and depositories:** The secondary market is where existing securities are traded, on stock exchanges recognised under the Securities Contracts (Regulation) Act 1956. The Bombay Stock Exchange, founded in 1875 as the Native Share and Stock Brokers' Association, is Asia's oldest stock exchange; its index SENSEX tracks 30 companies with 1978-79 as the base year. The National Stock Exchange, incorporated in 1992 and trading from 1994, brought nationwide screen-based trading; its index NIFTY 50 tracks 50 companies. Shares are now held in electronic (dematerialised) form with depositories set up under the Depositories Act 1996: National Securities Depository Limited (NSDL, 1996) and Central Depository Services (India) Limited (CDSL, 1999). Investors open a demat account through a depository participant such as a bank or broker.

**Mutual funds:** A mutual fund pools money from many investors and invests it in shares, bonds or money-market instruments under professional managers. Investors get units, valued at the net asset value (NAV) per unit. In India a mutual fund is set up as a trust, with a sponsor, trustees, an asset management company that manages the money and a custodian that holds the securities, and it is regulated by SEBI under the Mutual Funds Regulations of 1996. The Unit Trust of India, created by an Act of 1963 and working from 1964, was the first mutual fund; public sector banks and insurers could start funds from 1987 and private companies from 1993. Open-ended schemes can be bought and sold on any working day; close-ended schemes have a fixed term. Systematic investment plans let investors put in a fixed sum regularly, and equity-linked savings schemes give tax benefits with a three-year lock-in.

### Examples

- Money market: funds up to one year, regulated by the RBI; capital market: funds for more than one year, regulated by SEBI (government securities by the RBI).
- Call money: 1 day; notice money: 2 to 14 days; term money: 15 days to 1 year; all without collateral.
- Treasury bills: 91, 182 and 364 days; zero-coupon, issued at a discount by the RBI for the central government.
- Commercial paper (1990): unsecured, issued by companies; certificate of deposit (1989): negotiable, issued by banks.
- CBLO was replaced by tri-party repo (TREPS) in 2018; CCIL (2001) settles government securities, money market and forex trades.
- Masala bonds are rupee-denominated bonds issued outside India, so the foreign investor bears the currency risk.

- BSE (1875) is Asia's oldest stock exchange; SENSEX has 30 stocks with base year 1978-79; NSE (1992) runs NIFTY 50 with 50 stocks.
- Depositories Act 1996: NSDL (1996) and CDSL (1999) hold shares in demat form through depository participants.
- IPO = first public issue; FPO = later issue by a listed company; ASBA keeps the application money blocked in the investor's account.
- UTI (working from 1964) was India's first mutual fund; SEBI (Mutual Funds) Regulations 1996; ELSS has a three-year lock-in.

> **Quick revision:** Money market up to 1 year (RBI), capital market over 1 year (SEBI); Vaghul Group 1987; call 1 day, notice 2-14 days, term 15 days-1 year; T-bills 91/182/364 days at discount; CP 1990, CD 1989; CCIL 2001, TREPS replaced CBLO 2018; equity vs preference shares, debentures, G-secs (gilt-edged), masala bonds; IPO, FPO, rights, bonus, ASBA; BSE 1875 (SENSEX 30), NSE 1992 (NIFTY 50); Depositories Act 1996, NSDL 1996, CDSL 1999; UTI first mutual fund, SEBI MF Regulations 1996.

### Banking Terms, Bank Codes (IFSC, MICR, SWIFT) and International Financial Institutions

Terms about banks' money: Many questions only test whether you know a term. NDTL (net demand and time liabilities) is the base on which CRR and SLR are worked out. CASA means current and savings deposits. CRAR is the capital to risk-weighted assets ratio. Net interest margin (NIM) is the gap between interest earned and interest paid, as a share of earning assets, while the spread is the gap between lending and deposit rates. Bancassurance means a bank selling the policies of an insurance company. An account with no customer-initiated transaction for two years is treated as inoperative, and deposits unclaimed for ten years are moved to the RBI's Depositor Education and Awareness Fund (DEAF, 2014), from which the depositor can still claim them.

**Terms about loans and security:** Hypothecation is a charge on movable assets, such as a vehicle or stock, that stay with the borrower. A pledge means the goods, such as gold ornaments, are handed over to the lender. A mortgage is a charge on immovable property such as a house or land. A lien is the bank's right to keep a customer's property until dues are paid. A letter of credit is a bank's promise to pay a seller on behalf of a buyer when set documents are produced, and is widely used in trade. A bank guarantee is a promise to pay if the customer fails to perform. Factoring is selling receivables to a factor for immediate cash; forfaiting is the same idea for medium-term export receivables. A haircut is the margin cut from the value of collateral, or the loss creditors accept in a settlement.

**Codes used in banking:** The IFSC (Indian Financial System Code) is an 11-character code that identifies a bank branch for NEFT, RTGS and IMPS: the first four letters show the bank, the fifth character is 0, kept for future use, and the last six characters identify the branch. The MICR (Magnetic Ink Character Recognition) code is a 9-digit number printed in magnetic ink at the bottom of a cheque so that machines can read it: the first three digits stand for the city, the next three for the bank and the last three for the branch. The SWIFT code, also called the BIC (Bank Identifier Code), has 8 or 11 characters, four for the bank, two for the country, two for the location and an optional three for the branch, and is used for international transfers. SWIFT (Society for Worldwide Interbank Financial Telecommunication), founded in 1973 with its headquarters in Belgium, carries payment messages between banks; it does not itself move money. PAN (Permanent Account Number) is a 10-character code issued by the Income Tax Department.

**Bretton Woods institutions:** In July 1944 the United Nations Monetary and Financial Conference at Bretton Woods, New Hampshire (USA), created the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (IBRD). Both have their headquarters in Washington, D.C., and India is a founding member of both. The IMF came into being in December 1945 and began operations on 1 March 1947. It watches exchange rates and balances of payments, lends to countries facing balance-of-payments problems and gives technical advice. Each member has a quota that decides its contribution, its access to loans and its votes. In 1969 the IMF created the Special Drawing Right (SDR), an international reserve asset valued on a basket of major currencies.

**World Bank Group:** The World Bank Group has five institutions: the IBRD (1944), which lends to middle-income countries; the International Development Association (IDA, 1960), which gives soft loans and grants to the poorest

countries; the International Finance Corporation (IFC, 1956), which invests in private businesses; the Multilateral Investment Guarantee Agency (MIGA, 1988), which insures foreign investors against political risk; and the International Centre for Settlement of Investment Disputes (ICSID, 1966). The IBRD and IDA together are called the World Bank. India is a member of all except ICSID.

**Other international bodies:** The Bank for International Settlements (BIS), founded on 17 May 1930 and based in Basel, Switzerland, is the bank of central banks; it hosts the Basel Committee on Banking Supervision, and the RBI is a member. The Asian Development Bank (1966) is based in Manila, Philippines. The Asian Infrastructure Investment Bank (AIIB), proposed by China, began operations in January 2016 with headquarters in Beijing, and India is a founding member. The New Development Bank (NDB) was agreed by Brazil, Russia, India, China and South Africa at the BRICS summit in Fortaleza, Brazil, in July 2014, and began work in 2015 with headquarters in Shanghai; its founders hold equal shares, and its first president was K.V. Kamath of India. The Financial Action Task Force (FATF), set up in 1989 by the G7 in Paris, sets global standards against money laundering and terror financing.

### Examples

- IFSC: 11 characters; first 4 letters for the bank, the 5th character 0, last 6 characters for the branch.
- MICR: 9 digits printed in magnetic ink on cheques; 3 for the city, 3 for the bank and 3 for the branch.
- SWIFT (1973, headquarters in Belgium) is a messaging network; a SWIFT or BIC code has 8 or 11 characters.
- Hypothecation: movable asset stays with the borrower; pledge: goods handed to the lender; mortgage: charge on immovable property.
- Deposits unclaimed for 10 years go to the RBI's Depositor Education and Awareness Fund (2014); the depositor can still claim them.
- Bretton Woods Conference, July 1944: created the IMF and IBRD, both headquartered in Washington, D.C.; the IMF created the SDR in 1969.
- World Bank Group: IBRD, IDA (1960), IFC (1956), MIGA (1988) and ICSID (1966); India is not a member of ICSID.
- BIS: 17 May 1930, Basel, Switzerland, the bank of central banks; AIIB: operations from January 2016, headquarters Beijing.
- New Development Bank: BRICS, Fortaleza summit July 2014, headquarters Shanghai, equal shares for founders; first president K.V. Kamath.
- Asian Development Bank: 1966, Manila; FATF: 1989, Paris, sets standards against money laundering.

> **Quick revision:** NDTL, CASA, CRAR, NIM, bancassurance; inoperative after two years, unclaimed 10 years to DEAF (2014); hypothecation vs pledge vs mortgage vs lien; LC, bank guarantee, factoring, forfaiting; IFSC 11 characters (5th is 0), MICR 9 digits (city-bank-branch), SWIFT/BIC 8 or 11, SWIFT 1973 Belgium, PAN 10; Bretton Woods July 1944: IMF (operations 1 March 1947, SDR 1969) and IBRD, Washington; IDA 1960, IFC 1956, MIGA 1988, ICSID 1966; BIS 1930 Basel; ADB 1966 Manila; AIIB 2016 Beijing; NDB 2014 Shanghai; FATF 1989.

Free practice questions: parikshasaathi.com/q/banking-awareness/

# Revision sheet

Every lesson’s quick-revision box in one place, for the last read before the exam.

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| **Ancient and Medieval Indian History** | Harappans knew bronze but not iron; Great Bath at Mohenjo-daro, dockyard at Lothal; Rigveda oldest Veda (Gayatri Mantra); First Buddhist council Rajgir, fourth under Kanishka; Mahavira died at Pavapuri; Megasthenes (Indica) under Chandragupta Maurya; Kalinga war in Rock Edict XIII, Ashoka named in Maski edict; Harisena's Prayag Prashasti on Samudragupta; Fa-Hien under Chandragupta II, Hiuen Tsang under Harsha; Iltutmish tanka-jital, Alauddin market control, M.b. Tughlaq token currency; Vijayanagara 1336, Talikota 1565; Panipat 1526 Babur, 1556 Akbar, 1761 Abdali; Aurangzeb jizya 1679. |
| **Prehistoric India and the Indus Valley (Harappan) Civilisation** | Foote found first Palaeolithic tool at Pallavaram 1863; Bhimbetka paintings found by Wakankar 1957; microliths mark the Mesolithic; Mehrgarh earliest farming; Burzahom pit dwellings; Harappa 1921 (Sahni), Mohenjo-daro 1922 (Banerji), Marshall 1924; mature phase 2600-1900 BC; Great Bath at Mohenjo-daro, dockyard at Lothal, ploughed field at Kalibangan, signboard at Dholavira; bricks 1:2:4; weights on 16; unicorn seals; script undeciphered; no iron; gradual decline. |
| **The Vedic Age: Rigvedic and Later Vedic Periods** | Rigvedic age 1500-1000 BC in Sapta Sindhu, Later Vedic 1000-600 BC in the Ganga plains; Rigveda 10 mandalas, 1028 hymns; Gayatri Mantra in mandala 3, Purusha Sukta in mandala 10; Indus most mentioned river, Saraswati most revered, Ganga once; Dasarajna on the Parushni won by Sudas; Sabha, Samiti, Vidatha; bali voluntary then compulsory; Indra 250 hymns, Agni 200; iron around 1000 BC; Videgha Madhava to Videha; Jabala Upanishad names four ashramas. |
| **Mahajanapadas, the Rise of Magadha, Buddhism and Jainism** | Sixteen Mahajanapadas in Anguttara Nikaya; Vajji and Malla republics; Magadha rose through iron, elephants, fertile land; Bimbisara annexed Anga; Ajatashatru used mahashilakantaka; Udayin to Pataliputra; Mahapadma Nanda Ekarat; Buddha 563-483 BC, Lumbini-Bodh Gaya-Sarnath-Kushinagar; Four Noble Truths, Eightfold Path; councils Rajgir, Vaishali, Pataliputra, Kashmir; Mahavira 24th tirthankara, kaivalya at 42, died at Pavapuri; Svetambara and Digambara; Jain councils Pataliputra and Vallabhi. |
| **The Mauryan Empire: Chandragupta, Bindusara and Ashoka** | Mauryas about 321-185 BC; Kautilya's Arthashastra (15 books, saptanga); Chandragupta defeated Seleucus, got Kabul-Kandahar for 500 elephants; Megasthenes' Indica (570 towers, 64 gates, committees of five); Chandragupta died at Shravanabelagola (Jain tradition); Bindusara Amitraghata; Kalinga about 261 BC in Rock Edict XIII; Dhamma Mahamattas in Rock Edict V; 14 rock edicts, 7 pillar edicts (Delhi-Topra); Brahmi, Kharoshthi, Greek, Aramaic; Prinsep 1837; Sarnath capital emblem 26 January 1950; Brihadratha killed by Pushyamitra. |
| **Post-Mauryan Kingdoms and the Sangam Age** | Shungas from about 185 BC (Pushyamitra, two Ashvamedhas); Heliodorus' Garuda pillar at Besnagar; Menander and Nagasena (Milindapanho); Indo-Greek gold coins; Rudradaman's Junagadh inscription AD 150; Kanishka, Saka era AD 78, fourth council, Ashvaghosha; Gandhara, Mathura, Amaravati art; Gautamiputra Satakarni, Nasik inscription, first land grants; Sangam Tolkappiyam, Silappadikaram; Chera bow, Chola tiger, Pandya fish; Karikala's Kallanai; Arikamedu and Roman trade. |
| **The Gupta Empire and the Age of Harsha** | Gupta era 319-320 AD; Chandragupta I married Kumaradevi; Samudragupta's Prayag Prashasti by Harisena, Napoleon of India; Chandragupta II Vikramaditya ended Shaka rule, Fa-Hien 399-414 AD, Mehrauli iron pillar; Kumaragupta founded Nalanda; Skandagupta repelled Hunas; Eran 510 AD sati; Aryabhatiya 499 AD; Kalidasa; Deogarh temple; Harsha 606-647 AD, Kannauj, Pulakeshin II, Ratnavali; Banabhatta; Hiuen Tsang at Nalanda under Shilabhadra. |
| **Early Medieval Kingdoms: Tripartite Struggle, Rajputs, Chalukyas, Pallavas and Cholas** | Tripartite struggle for Kannauj: Palas, Pratiharas, Rashtrakutas; Gopala ended matsyanyaya; Dharmapala founded Vikramashila; Mihira Bhoja greatest Pratihara; Krishna I built Kailasa at Ellora; Agnikula clans; Khajuraho by Chandelas; Aihole inscription 634 AD; Vatapi taken 642 AD; Shore Temple by Rajasimha; Rajaraja I Brihadeshwara; Rajendra I Gangaikonda Cholapuram, Srivijaya; Uttaramerur 919 and 921 AD, kudavolai; Mahmud 17 raids, Somnath 1025; Tarain 1191 and 1192. |

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| **The Delhi Sultanate (1206-1526): Dynasties, Reforms and Architecture** | Mamluk, Khalji, Tughlaq, Sayyid, Lodi (1206-1526); Aibak began Qutub Minar; Iltutmish iqta, tanka, jital, Chahalgani; Razia only woman ruler; Balban Zil-i-Ilahi, sijda, paibos; Alauddin dagh, chehra, market control, half-produce land tax; Malik Kafur in the south; Muhammad bin Tughlaq Daulatabad 1327, token currency; Ibn Battuta 1333; Firoz canals, jizya on Brahmins; Timur 1398; Agra 1504; Sultan Ghari first tomb; Alai Darwaza 1311 first true dome. |
| **Vijayanagara, the Bahmani Kingdom and the Bhakti-Sufi Movements** | Vijayanagara 1336 (Harihara, Bukka), four dynasties; Abdur Razzaq 1443; Krishnadeva Raya 1509-1529, Amuktamalyada, Ashtadiggajas; nayankara and ayagar systems; Talikota 23 January 1565; Bahmani 1347 Gulbarga then Bidar; Mahmud Gawan; five Deccan Sultanates; Gol Gumbaz, Charminar; 63 Nayanars, 12 Alvars; Ramanuja Vishishtadvaita; Basavanna Lingayat; Jnaneshwar, Tukaram; Kabir, Nanak, Tulsidas, Mirabai, Chaitanya; Chishti at Ajmer, Suhrawardi at Multan, Naqshbandi orthodox. |
| **The Mughal Empire from Babur to Aurangzeb and the Rise of the Marathas** | Panipat I 1526, Khanwa 1527; Sher Shah rupiya, one-third revenue; Panipat II 1556; Akbar abolished jizya 1564, Ibadat Khana 1575, Din-i-Ilahi 1582; mansab 10 to 10,000, zat and sawar; dahsala 1580; Hawkins 1608, Roe 1615; Taj Mahal by Shah Jahan; Aurangzeb jizya 1679, Bijapur 1686, Golconda 1687, died 1707; Shivaji crowned 1674, Purandar 1665, Ashtapradhan, chauth and sardeshmukhi; Balaji Vishwanath 1719; Panipat III 14 January 1761. |
| **Environment and Ecology** | Ecology term: Haeckel 1866; ecosystem: Tansley 1935; 10 percent law: Lindeman; energy pyramid always upright; Project Tiger 1973, Project Elephant 1992; first national park Jim Corbett 1936; first biosphere reserve Nilgiri 1986; Ramsar 1971 (Iran); hotspot concept Norman Myers, India in 4 hotspots, 17 megadiverse nations; Minamata = mercury, itai-itai = cadmium; Bhopal 1984 = methyl isocyanate; Montreal 1987 ozone, Kyoto 1997, Paris 2015 (well below 2 C); IPCC 1988; EPA 1986; NGT 2010; Brundtland 1987; 17 SDGs 2015; World Environment Day 5 June, Ozone Day 16 September. |
| **Ecosystems: Food Chains, Trophic Levels, Ecological Pyramids and Nutrient Cycles** | Ecosystem term: Tansley 1935; producers, consumers, decomposers; grazing vs detritus food chain; 10 per cent law: Lindeman 1942; Eltonian pyramids: Elton 1927; energy pyramid always upright, biomass inverted in sea, numbers inverted in parasitic chain; succession: lichens pioneer on rock, climax community last; carbon and nitrogen gaseous cycles, phosphorus sedimentary; Nitrosomonas to nitrite, Nitrobacter to nitrate, Pseudomonas denitrifies. |
| **Biodiversity: Levels, Hotspots, Megadiverse Countries and Conservation Methods** | Biodiversity term popularised by E.O. Wilson; genetic, species and ecosystem diversity; India 2.4 per cent of land, about 8.1 per cent of species (NCERT); hotspot concept Norman Myers 1988 (1,500 endemic plants, 70 per cent habitat lost); India in 4 hotspots; 17 megadiverse countries (1998); evil quartet; in-situ: parks, sanctuaries, sacred groves; ex-situ: zoos, seed banks, cryopreservation at minus 196 C; Svalbard vault 2008. |
| **Protected Areas of India: National Parks, Sanctuaries, Reserves and Biosphere Reserves** | First national park Hailey 1936 (now Jim Corbett, Uttarakhand); WPA 1972 gives sanctuaries and national parks, 2002 amendment adds conservation and community reserves; biosphere reserves from UNESCO MAB 1971: core, buffer, transition; first Nilgiri 1986, on UNESCO network 2000; Gulf of Mannar first marine BR 1989; Kaziranga rhino, Gir lion, Dachigam hangul, Hemis snow leopard, Keibul Lamjao sangai, Kanha barasingha, Chambal gharial. |
| **Wildlife Conservation in India: Project Tiger, Project Elephant, IUCN Red List and CITES** | Project Tiger 1 April 1973 (9 reserves); tiger national animal 1973; NTCA by 2006 amendment; Project Elephant 1992; crocodile project 1975; snow leopard project 2009; IUCN 1948, Gland, Red List 1964, 9 categories, CR-EN-VU are threatened; GIB, gharial, three vultures CR; CITES 3 March 1973, India 1976, Appendix I to III; WPA six schedules cut to four in 2022; WII Dehradun 1982; NBWL chaired by PM. |
| **Wetlands, Mangroves and Coral Reefs of India** | Ramsar Convention 2 February 1971, Iran, in force 1975; India party 1982; first Indian sites Chilika and Keoladeo 1981; Montreux Record 1990, Chilika removed 2002; Chilika largest brackish lagoon in Asia; Sambhar largest inland salt lake; Loktak phumdis; mangroves: pneumatophores, vivipary; Sundarbans largest mangrove forest, WHS 1987; Bhitarkanika second; corals with zooxanthellae; reefs: Gulf of Mannar, Gulf of Kutch, Lakshadweep atolls, Andaman and Nicobar; CRZ 1991. |

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| **Pollution: Air, Water, Soil, Noise, Radioactive and Solid Waste** | Primary vs secondary pollutants; PM10, PM2.5; AQI six bands, 0-500; London smog 1952 sulphurous; photochemical smog gives ozone and PAN; normal rain pH 5.6; BOD over 5 days at 20 C; eutrophication by nitrates and phosphates; noise rules 2000, silence zone 50/40 dB; SWM Rules 2016; microplastics below 5 mm; Bhopal 1984 MIC; Minamata mercury; itai-itai cadmium; Chernobyl 1986. |
| **Climate Change, the Greenhouse Effect and Ozone Depletion** | Natural greenhouse effect keeps Earth at about 15 C instead of minus 18 C; Arrhenius 1896; Keeling curve from 1958, pre-industrial CO2 280 ppm; Kyoto's original six gases; NCERT shares CO2 60, CH4 20, CFCs 14, N2O 6 per cent; ozone in stratosphere 15-35 km, Dobson Units, hole below 220 DU; CFC chlorine, halon bromine; ozone hole reported 1985; Nobel 1995; carbon credit = 1 tonne CO2e; CDM gives CERs. |
| **International Environmental Conventions: From Stockholm 1972 to the Paris Agreement** | Stockholm 1972 (UNEP, 5 June); Brundtland 1987; Rio 1992: Rio Declaration, Agenda 21, UNFCCC, CBD; UNCCD 1994; UNFCCC in force 1994, Bonn; Kyoto 1997 (COP3), in force 2005, 5.2 per cent cut; Paris 2015 (COP21), in force 2016, well below 2 C; Vienna 1985; Montreal 1987; Kigali 2016 (HFCs); Basel 1989, Rotterdam 1998, Stockholm 2001; Cartagena 2000; Nagoya 2010; IPCC 1988 (WMO, UNEP). |
| **Environmental Laws and Movements in India: Constitution, Acts, NGT and Chipko** | Articles 48A and 51A(g) by 42nd Amendment 1976; Article 21 covers healthy environment; WPA 1972; Water Act 1974 (Article 252, CPCB); Forest Conservation Act 1980; Air Act 1981 (noise 1987); EPA 1986 after Bhopal; PLI Act 1991; Biological Diversity Act 2002 (NBA Chennai); FRA 2006 (4 ha, 13 Dec 2005); NGT 2010 (New Delhi, 6 months); Khejarli 1730; Chipko 1973; Appiko 1983; Silent Valley NP 1984; NBA Medha Patkar. |
| **Energy Resources and Sustainable Development: Renewables, Nuclear Power and the SDGs** | NAPCC 2008, eight missions; Solar Mission 2010; ISA 2015, Gurugram; wind needs over 15 km/h; small hydro up to 25 MW; biogas up to 75 per cent methane; Puga geothermal; La Rance 1966 tidal; AEC 1948, Apsara 1956, Tarapur 1969, FBTR 1985; three stages ending in thorium; BEE 2002; UJALA 2015; SDGs 25 September 2015, 17 goals, 169 targets, 2030; Tamil Nadu first to mandate rooftop harvesting. |
| **General Science (Physics, Chemistry, Biology)** | Pressure unit pascal; 1 kWh = 3.6 x 10^6 J; escape velocity 11.2 km/s; weight on Moon one-sixth; water densest at 4 C; -40 same on C and F; sound fastest in solids, none in vacuum; sky blue by scattering; myopia concave, hypermetropia convex; fuse low melting point; transformer only AC; neutron Chadwick, nucleus Rutherford; periodic law atomic number; baking soda NaHCO3; bleaching powder CaOCl2; Haber ammonia, Contact H2SO4; galvanisation zinc; brass Cu+Zn; 206 bones; 46 chromosomes; O negative universal donor; insulin pancreas; vitamin C scurvy, D rickets; malaria protozoan, Anopheles. |
| **Physical Quantities, Units and Motion (Newton's Laws, Momentum, Friction)** | SI (1960) has 7 base units: m, kg, s, A, K, mol, cd; newton, joule, watt, pascal are derived; light year measures distance; current is a scalar; displacement can be zero; 1 km/h = 5/18 m/s; v = u + at, s = ut + 1/2 at^2, v^2 = u^2 + 2as; g about 9.8 m/s^2; first law is inertia; F = ma; action and reaction act on different bodies; p = mv is conserved; static > sliding > rolling friction. |
| **Work, Energy, Power, Gravitation and Pressure** | W = Fs cos θ (joule); KE = 1/2 mv^2, PE = mgh; energy is conserved; P = W/t (watt); 1 hp = 746 W; kWh is energy; F = Gm1m2/r^2, G = 6.67 x 10^-11 (Cavendish); g = 9.8 m/s^2, more at poles, zero at centre; weight = mg changes, mass does not; escape velocity 11.2 km/s, orbital 7.9 km/s; geostationary 36,000 km, 24 h; pressure = F/A (pascal); Pascal's law: hydraulic brakes; Archimedes: upthrust = weight of fluid displaced. |
| **Heat, Temperature and Thermodynamics** | Heat in joule, temperature in kelvin; 1 cal = 4.186 J; C/5 = (F-32)/9 = (K-273)/5; -40 C = -40 F; absolute zero -273.15 C; 37 C = 98.6 F; clinical thermometer 35-42 C; β = 2α, γ = 3α; water densest at 4 C; latent heat ice 80 cal/g, steam 540 cal/g; pressure cooker raises boiling point; silver and copper best conductors; sea breeze by day; radiation needs no medium; evaporation cools; no engine is 100% efficient. |
| **Light: Mirrors, Lenses, Refraction and the Human Eye** | c = 3 x 10^8 m/s; angle of incidence = angle of reflection; plane mirror image laterally inverted; concave mirror in headlights and shaving, convex as rear-view; n = c/v, water 1.33, diamond 2.42; P = 1/f in dioptre; total internal reflection in diamond, optical fibre, mirage; VIBGYOR, red least deviated; blue sky by scattering; Raman effect 1928; myopia concave, hypermetropia convex, presbyopia bifocal, astigmatism cylindrical; near point 25 cm. |

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| **Sound, Waves and the Electromagnetic Spectrum** | Transverse: crests and troughs, light; longitudinal: compressions and rarefactions, sound; v = f λ; pitch = frequency, loudness = amplitude (dB); audible 20 Hz-20 kHz; infrasonic below, ultrasonic above (bats, SONAR, ultrasonography); echo needs 17.2 m; sound fastest in solids, none in vacuum, 331 m/s in air at 0 C; Doppler 1842; EM order: gamma, X, UV, visible, IR, microwave, radio; X-rays Roentgen 1895. |
| **Electricity and Magnetism: From Ohm's Law to Household Wiring** | Electron charge 1.6 x 10^-19 C; ampere = coulomb per second; V = IR (Ohm, 1827); R = ρL/A; nichrome heaters, tungsten filament; series resistances add, parallel reciprocals add; houses wired in parallel; P = VI; 1 kWh = 3.6 x 10^6 J; Oersted 1820, Faraday 1831; left-hand rule motor, right-hand rule generator; transformer works only on AC; India 50 Hz AC; fuse in live wire, low melting point; earth wire against shocks. |
| **Matter, Atomic Structure and the Periodic Table** | Plasma is the 4th state, Bose-Einstein condensate the 5th; camphor sublimes; compound has a fixed ratio, mixture any ratio; centrifugation for cream, chromatography for dyes, fractional distillation for petroleum; electron Thomson 1897, nucleus Rutherford 1911, Bohr shells 1913, neutron Chadwick 1932; Z = protons, A = protons + neutrons; isotopes same Z, isobars same A; heavy water moderator; Mendeleev 1869 by atomic mass; modern law by atomic number; 18 groups, 7 periods; 17 halogens, 18 noble gases. |
| **Chemical Reactions, Acids, Bases and Salts** | Combination, decomposition, displacement, double displacement; electrolysis of water gives H2 and O2 in 2:1; respiration exothermic, photosynthesis endothermic; oxidation = gain of oxygen or loss of electrons; rust is hydrated iron oxide; nitrogen in chips packets stops rancidity; alkalis are soluble bases; tomato oxalic, curd lactic, ant sting formic; phenolphthalein pink in base; pH 7 neutral, blood 7.4, acid rain below 5.6; aqua regia 3 HCl : 1 HNO3; baking soda NaHCO3; bleaching powder CaOCl2; POP from gypsum at 373 K. |
| **Metals, Non-metals and Everyday Chemistry** | Gold most ductile; silver best conductor; mercury liquid metal, bromine liquid non-metal; Na and K kept in kerosene; reactivity K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Hg > Ag > Au; bauxite Al, haematite Fe, cinnabar Hg, galena Pb; thermit welds rails; ornaments 22 carat; solder Pb + Sn; diamond 4 bonds, graphite 3 bonds and conducts; C-60 found 1985; alkane CnH2n+2; vinegar 5-8% acetic acid; soap fails in hard water; bakelite thermosetting; hydrogen highest calorific value, 150000 kJ/kg. |
| **The Cell, Tissues and Classification of Living Things** | Hooke 1665 named cell; Leeuwenhoek 1674; Brown nucleus 1831; Schleiden and Schwann cell theory; Virchow 1855; prokaryotes lack nuclear membrane; mitochondria powerhouse; lysosome suicide bag; ribosome makes protein; plant cell wall cellulose, fungal wall chitin; mitosis 2 identical cells, meiosis 4 cells with half chromosomes; 46 chromosomes; tendon muscle-bone, ligament bone-bone; Whittaker 1969 five kingdoms; bryophytes amphibians of plants; Homo sapiens; virus TMV Ivanovsky 1892. |
| **The Human Body: Organ Systems, Glands and Bones** | 32 adult teeth; enamel hardest; ptyalin starch, pepsin protein, bile emulsifies fat; liver largest gland; villi absorb; alveoli exchange gases; breathing 15-18 per minute; heart 4 chambers, 72 beats per minute, BP 120/80; RBC 120 days, spleen graveyard; Landsteiner ABO 1900; O universal donor, AB universal recipient; nephron unit of kidney; 12 cranial, 31 spinal nerve pairs; cerebellum balance, medulla heartbeat; pituitary master gland; insulin 1921; 206 bones; femur longest, stapes smallest. |
| **Nutrition, Diseases, Vaccines, Plants and Heredity** | Fat 9 kcal/g, carbohydrate and protein 4; kwashiorkor protein deficiency; A, D, E, K fat-soluble; B1 beri-beri, C scurvy, D rickets, K clotting, B12 has cobalt; TB Koch 1882; typhoid Widal; HIV ELISA; malaria Plasmodium (Laveran 1880), female Anopheles (Ross 1897); smallpox eradicated 1980; Jenner 1796, Pasteur rabies 1885, Fleming penicillin 1928; oxygen of photosynthesis from water; ethylene ripens fruit; ovule becomes seed; Mendel 1866, 3:1 and 9:3:3:1; DNA double helix 1953; XY male. |

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| **Indian Art and Culture** | 8 classical dances (SNA): Bharatanatyam-TN, Kathak-North, Kathakali and Mohiniyattam-Kerala, Kuchipudi-AP, Odissi-Odisha, Manipuri, Sattriya-Assam; Carnatic trinity: Tyagaraja, Dikshitar, Syama Sastri; Kailasa (Ellora)-Rashtrakuta Krishna I; Brihadeeswara-Rajaraja I; Khajuraho-Chandela; Konark-Narasimhadeva I (Eastern Ganga); Humayun's Tomb-first charbagh tomb; Gandhara grey schist, Mathura red sandstone, Amaravati marble; Bani Thani-Kishangarh; UNESCO 1983: Ajanta, Ellora, Agra Fort, Taj; Kumbh: Prayagraj, Haridwar, Ujjain, Nashik; first Jnanpith 1965 G. Sankara Kurup. |
| **Ancient Indian Architecture: Harappan Cities, Stupas, Rock-cut Caves and Temple Styles** | Harappa: grid, citadel, 1:2:4 bricks, Great Bath (Mohenjo-daro), dockyard (Lothal); Sarnath capital = National Emblem 26 Jan 1950; Sanchi: Ashoka brick, Shunga stone, toranas 1st century BCE; Barabar caves for Ajivikas; Karle chaitya; Ajanta ~30 Buddhist caves; Ellora 34 caves, Kailasa by Krishna I; Nagara (shikhara, amalaka): Konark, Khajuraho, Lingaraja; Dravida (vimana, gopuram): Brihadeeswara 1010; Vesara: Aihole, Pattadakal, Belur, Halebidu. |
| **Indo-Islamic and Later Architecture: Sultanate, Mughal, Rajput and Colonial Buildings** | Arcuate (arch, dome, mortar) replaced trabeate; Qutub Minar: Aibak c.1199, Iltutmish, Firoz Tughlaq; Balban's tomb first true arch; Alai Darwaza 1311 first true dome; Atala Masjid (Jaunpur); Gol Gumbaz (Bijapur); Charminar 1591; Humayun's Tomb 1570 (Bega Begum, Mirak Mirza Ghiyas); Buland Darwaza (Gujarat victory); Itimad-ud-Daulah first all-marble; Taj (Ustad Ahmad Lahori); Red Fort 1639; Vijay Stambha (Rana Kumbha); CST (Stevens); Victoria Memorial (Emerson). |
| **Indian Sculpture and Painting: From Mauryan Polish to Pahari Miniatures** | Mauryan: Chunar polish, Didarganj Yakshi (Patna, 1917, usually called Mauryan); early Buddhist art aniconic; Kushana: Gandhara (schist, Greco-Roman) and Mathura (red sandstone, Indian, Kanishka statue); Amaravati white limestone; Gupta Sarnath Buddha (dharmachakra mudra); Chola Nataraja by lost-wax (Swamimalai); Ajanta Padmapani (Cave 1); Bagh; Mughal: Mir Sayyid Ali, Abdus Samad, Ustad Mansur; Bani Thani (Nihal Chand, Kishangarh); Basohli, Kangra (Sansar Chand). |
| **Folk Paintings, Textiles and Crafts of the Indian States** | Madhubani-Bihar (women, double borders, Kohbar); Warli-Maharashtra (rice paste, geometry); Pattachitra-Odisha (Raghurajpur); Kalighat-Kolkata; Phad-Bhilwara (Pabuji); Pichwai-Nathdwara; Gond-MP; Kalamkari-Andhra (Srikalahasti pen, Machilipatnam block); Tanjore gold foil; Banarasi, Kanjeevaram, Patola double ikat, Paithani, Muga; Chikankari-Lucknow; Bandhani; Pashmina-Changthangi goat; Bidriware-Bidar; Dhokra lost-wax; GI Act 1999, first GI Darjeeling tea. |
| **Classical Dances of India: The Eight Forms, Their Texts and Exponents** | Natya Shastra (Bharata): nritta, nritya, natya; 4 abhinayas; 8 rasas; SNA (1953) recognises 8 classical dances (Ministry of Culture list adds Chhau); Bharatanatyam-TN (Sadir, Tanjore Quartet, Rukmini Devi, Kalakshetra 1936); Kuchipudi-AP (Siddhendra Yogi, tarangam); Kathakali-Kerala (pacha, Kalamandalam 1930); Mohiniyattam-Kerala; Kathak (tatkar, chakkar, Lucknow-Jaipur-Banaras); Odissi (tribhanga, chowk); Manipuri (Ras Lila, kumil); Sattriya-Assam (Sankardeva, 2000). |
| **Folk Dances, Folk Theatre and Puppetry of India by State** | Bhangra-Giddha (Punjab); Rouf (Kashmir); Chholiya (Uttarakhand); Ghoomar, Kalbelia, Chari, Terah Taali (Rajasthan); Garba, Tippani (Gujarat); Lavani (Maharashtra); Cheraw (Mizoram); Hojagiri (Tripura); Wangala (Meghalaya); Theyyam (Kerala); Karagattam (TN); Dollu Kunitha (Karnataka); Panthi (Chhattisgarh); theatre: Yakshagana, Koodiyattam, Jatra, Nautanki, Tamasha, Bhavai, Bidesia; puppets: Kathputli string, Tholu Bommalata shadow, Putul Nach rod, Pavakoothu glove. |
| **Indian Classical Music: Hindustani and Carnatic Traditions, Ragas, Gharanas and Instruments** | Sangita Ratnakara (13th century) last shared text; 7 swaras, 22 shrutis; raga = aroha, avaroha, vadi, samvadi; Teentaal 16, Jhaptaal 10, Ektaal 12, Rupak 7; 10 thaats (Bhatkhande), 72 melakartas (Venkatamakhin); dhrupad oldest (pakhawaj, Dagar); khayal (Sadarang); thumri (Lucknow); Gwalior oldest khayal gharana; Purandara Dasa Pitamaha; trinity: Tyagaraja, Dikshitar, Syama Sastri; tata, sushira, avanaddha, ghana; MS Subbulakshmi Bharat Ratna 1998. |
| **Indian Languages, Scripts and Literature: Eighth Schedule, Brahmi and the Classics** | Part XVII, Articles 343-351; Hindi Diwas 14 Sept (1949); Eighth Schedule 14 (1950), Sindhi 21st Amdt 1967, Konkani-Manipuri-Nepali 71st 1992, Bodo-Dogri-Maithili-Santhali 92nd 2003 = 22; classical languages from 2004, Tamil first; Brahmi left-right, Prinsep 1837; Kharosthi right-left; Rigveda 10 mandalas 1,028 hymns; Kalidasa; Rajatarangini (Kalhana); Tirukkural 1,330 couplets; Khusrau Tuti-i-Hind; Baburnama Turki; Ramcharitmanas Awadhi. |

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| **Indian Philosophy, Religious Texts, Fairs, Festivals and the National Calendar** | Astika darshanas: Nyaya-Gautama, Vaisheshika-Kanada, Samkhya-Kapila, Yoga-Patanjali, Mimamsa-Jaimini, Vedanta-Badarayana; Advaita-Shankara, Vishishtadvaita-Ramanuja, Dvaita-Madhva; Tripitaka in Pali (Vinaya, Sutta, Abhidhamma); Jain Agamas Ardha-Magadhi, Vallabhi; Pongal, Lohri, Bihu; Onam (Mahabali); Kumbh: Haridwar, Prayagraj, Ujjain (Shipra), Nashik (Godavari); Pushkar, Sonepur at Kartik Purnima; Saka calendar from 22 March 1957, era 78 CE. |
| **India on the UNESCO Lists: World Heritage Sites and Intangible Cultural Heritage** | Convention 1972, India ratified 1977; 1983: Ajanta, Ellora, Agra Fort, Taj; 1984: Konark, Mahabalipuram; 1986: Goa churches, Khajuraho, Hampi, Fatehpur Sikri; 1987: Pattadakal, Elephanta, Thanjavur, Sundarbans; 1985: Kaziranga, Manas, Keoladeo; DHR 1999; Mahabodhi 2002; Bhimbetka 2003; Red Fort 2007; Rajasthan hill forts 2013; Khangchendzonga mixed 2016; Ahmedabad 2017; Dholavira, Ramappa 2021; Santiniketan, Hoysalas 2023; Moidams 2024; Maratha forts 2025; Sarnath 2026; ICH: Kutiyattam 2001, Vedic chanting 2003, Ramlila 2005, Yoga 2016, Kumbh 2017, Durga Puja 2021, Garba 2023. |
| **Indian Economy** | National Income = NNP at factor cost; GNP = GDP + net factor income from abroad; Planning Commission 1950, NITI Aayog 1 Jan 2015; First Plan Harrod-Domar, Second Plan Mahalanobis, plan holiday 1966-69; RBI 1 April 1935, nationalised 1949; bank nationalisation 1969 (14) and 1980 (6); NABARD 1982, RRBs 1975; NPA = overdue above 90 days; WPI by DPIIT, CPI by NSO; Budget Art 112, Finance Commission Art 280, GST 1 July 2017 (101st Amendment); fiscal deficit = expenditure - non-debt receipts; HDI by UNDP; SEBI statutory 1992, BSE 1875; WTO 1995; MGNREGA 2005, PMJDY 2014, PM-KISAN 2019. |
| **National Income: GDP, GNP, NNP and the Three Sectors of the Economy** | National Income = NNP at factor cost; GNP = GDP + NFIA; net = gross - depreciation; factor cost = market price - indirect taxes + subsidies; GDP deflator = nominal / real x 100; methods: production, income, expenditure (India mainly production + income); Naoroji 1867-68, V.K.R.V. Rao 1931-32, Mahalanobis committee 1949; CSO 1951 + NSSO (NSS from 1950) = NSO 2019 (MoSPI); 2015 series: base 2011-12, GVA at basic prices; services lead GDP, agriculture leads jobs. |
| **Five-Year Plans, the Planning Commission and NITI Aayog** | Planning Commission 15 March 1950 (Cabinet resolution, PM chairman, Nanda first Deputy Chairman); NDC 1952; Plan 1 Harrod-Domar (agriculture), Plan 2 Mahalanobis (heavy industry), Plan 3 failed (wars, drought); plan holidays 1966-69 and 1990-92; Rolling Plan 1978-80; Plan 8 human development; Plan 12 (2012-17) last; NITI Aayog 1 Jan 2015: PM chairs, Governing Council, CEO, think tank, cooperative federalism, no fund allocation; Atal Innovation Mission 2016. |
| **Money, Money Supply, Inflation and Price Indices (CPI and WPI)** | Money: medium of exchange, measure of value, store of value, deferred payments; notes by RBI (Sec 22), coins and Re 1 note by GoI; Minimum Reserve System 1957 (Rs 200 crore, gold Rs 115 crore); M0 reserve money, M1 narrow, M3 broad (measures from 1977); demand-pull vs cost-push; stagflation, deflation, disinflation; WPI by OEA (DPIIT), goods only; CPI by NSO, CPI-IW by Labour Bureau; CPI (Combined) headline since 2014; Phillips curve 1958. |
| **RBI and Monetary Policy: CRR, SLR, Repo, MSF and the MPC** | RBI Act 1934, began 1 April 1935, nationalised 1949; flexible inflation targeting via Finance Act 2016 (Urjit Patel Committee 2014), target on CPI (Combined) every 5 years, first 4% (2-6%); MPC 6 members, Governor casting vote, quorum 4; CRR with RBI (Sec 42), SLR with bank (BR Act Sec 24); repo = policy rate under LAF; SDF floor (2022), MSF ceiling (2011), bank rate = MSF; OMO, MSS 2004; qualitative: margins, moral suasion; MCLR 2016, external benchmark 1 Oct 2019. |
| **Union Budget, Deficits, Taxes, GST and the Finance Commission** | Budget = Annual Financial Statement, Art 112; Art 114 Appropriation Bill, 265 no tax without law, 266 Consolidated Fund, 267 Contingency Fund; revenue vs capital (capital receipts create liability or reduce assets); fiscal deficit = borrowing; primary = fiscal - interest; GST: 101st Amendment 2016, from 1 July 2017, Council Art 279A (Centre 1/3, states 2/3, 3/4 majority); Finance Commission Art 280, every 5 years, first K.C. Neogy; FRBM Act 2003. |
| **Poverty Lines, Types of Unemployment and Welfare Schemes** | Poverty line = consumption spending per person; Alagh 1979 calories (2400 rural, 2100 urban); Lakdawala 1993 state lines; Tendulkar 2009 basket with health and education (Rs 27/33 a day, 2011-12); Rangarajan 2014 (Rs 32/47); Global MPI 2010 UNDP-OPHI, 3 dimensions, 10 indicators; disguised, seasonal, frictional, structural, cyclical unemployment; PLFS 2017; ICDS 1975, IRDP 1980, JRY 1989, NSAP 1995, NRLM 2011; MGNREGA 2005/2006, 100 days; VB-G RAM G Act 2025 enacted to replace it (125 days). |

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| **Agriculture, MSP, Public Distribution and Food Security** | Land reforms: intermediaries abolished, tenancy reform, ceilings, consolidation; Ninth Schedule 1951; Bhoodan 1951; Operation Barga 1978; Green Revolution mid-1960s (Swaminathan, HYV wheat); MSP by CACP (1965), 22 crops, at least 1.5 x A2+FL since 2018-19; FCI 1965; TPDS 1997, AAY 2000; NFSA 2013 (75% rural, 50% urban, 5 kg); PMFBY 2016 (2/1.5/5%); KCC 1998; PM-KISAN 2019 Rs 6,000; e-NAM 2016. |
| **Industrial Policy, the 1991 LPG Reforms and Public Sector Enterprises** | IPR 1948 (mixed economy, 3 Central monopolies); IDRA 1951 licensing; IPR 1956: 17 Schedule A, 12 Schedule B, economic constitution; MRTP 1969, FERA 1973; 1991 BoP crisis, gold pledged, rupee devalued July 1991, New Industrial Policy 24 July 1991; public sector reservation 17 to 8; Competition Act 2002; Department of Disinvestment 1999, DIPAM 2016; Navratna/Miniratna 1997, Maharatna 2009; MSMED Act 2006, revised 2020; Make in India 25 Sept 2014. |
| **Balance of Payments, Exchange Rates, FDI, FEMA and the WTO** | BoP: current account (goods, services, income, remittances) + capital account (FDI, FPI, ECB, NRI deposits); reserves = FCA, gold, SDR, IMF reserve tranche; rupee devalued 1949, 1966, 1991; LERMS 1992, unified rate 1993; current account convertible Aug 1994; Tarapore 1997, 2006; FDI = 10% or more; FEMA 1999 (from 1 June 2000) replaced FERA 1973; GATT 1947, WTO 1 Jan 1995 Geneva; IMF and World Bank from Bretton Woods 1944; WB group: IBRD, IDA, IFC, MIGA, ICSID. |
| **Financial Markets: Money Market, Capital Market, SEBI, Insurance and Pensions** | Money market up to 1 year (RBI): call, notice, T-bills 91/182/364 days, CD 1989, CP 1990; capital market long-term (SEBI): primary (IPO, FPO) and secondary; SEBI 1988, statutory 30 Jan 1992, HQ Mumbai, FMC merged 2015; BSE 1875, NSE 1992; Sensex 30 (base 1978-79 = 100), Nifty 50 (base 1000, 1995); UTI 1963; NSDL 1996, CDSL 1999; LIC 1956, IRDA Act 1999 (Hyderabad); PFRDA 2003/2013, NPS 2004; FSDC 2010. |
| **Indian Geography: Physical, Economic and Human** | Standard Meridian 82.5 E (Mirzapur); Tropic of Cancer crosses 8 states; longest border Bangladesh; Kangchenjunga highest peak in India, Anamudi highest in Western Ghats; Ganga = Bhagirathi + Alaknanda at Devprayag; Kosi Sorrow of Bihar; Hirakud on Mahanadi, Bhakra on Sutlej, Sardar Sarovar on Narmada; Wular largest freshwater lake, Chilika largest lagoon; Mawsynram wettest; black regur soil from basalt; Corbett first NP (1936), Project Tiger 1973, Nilgiri first biosphere reserve; Jharia coal and Koderma mica in Jharkhand; Census 2011: UP most populous, Bihar densest, Kerala most literate. |
| **India's Location, Extent, Neighbours and Boundary Lines** | Mainland 8°4'N-37°6'N and 68°7'E-97°25'E; area 32,87,263 sq km, 7th largest, 2.4% of world land; Tropic of Cancer crosses 8 states; Standard Meridian 82°30'E at Mirzapur, IST = GMT + 5:30; land border about 15,200 km with 7 countries, longest with Bangladesh, shortest with Afghanistan; coastline 7,516.6 km (11,098.81 km in the re-measurement adopted in 2025), Gujarat longest; Radcliffe 1947, McMahon 1913-14, Durand 1893; Palk Strait to Sri Lanka; Ten Degree Channel splits Andaman and Nicobar. |
| **The Himalayas and the Northern Plains: Ranges, Peaks, Passes and Plain Belts** | Himalayas: young fold mountains, about 2,400 km; Himadri averages 6,000 m with Kangchenjunga (8,586 m) and Nanda Devi (7,816 m); Himachal has Pir Panjal and Dhauladhar; Shiwalik has duns like Dehradun; divisions Punjab, Kumaon, Nepal, Assam; passes Zoji La, Banihal, Shipki La, Rohtang, Lipulekh, Nathu La, Bomdi La; Meghalaya hills are peninsular; plain belts Bhabar, Terai, Bhangar, Khadar; Punjab, Ganga and Brahmaputra plains; Majuli largest inhabited river island. |
| **The Peninsular Plateau, Western and Eastern Ghats, Coasts, Islands and the Thar** | Peninsular Plateau: oldest, Gondwana, slopes east; Central Highlands (Malwa, Bundelkhand, Baghelkhand, Chotanagpur) and Deccan; Guru Shikhar 1,722 m (Aravalli), Dhupgarh 1,350 m (Satpura); Western Ghats continuous, Anamudi 2,695 m; Eastern Ghats broken, Mahendragiri 1,501 m; Konkan, Kanara, Malabar on the west, Northern Circars and Coromandel on the east; Barren Island active volcano; Lakshadweep 36 coral islands; Thar under 150 mm rain, Luni into the Rann of Kachchh. |
| **Himalayan River Systems: Indus, Ganga and Brahmaputra with Their Tributaries** | Himalayan rivers perennial; Indus about 2,880 km (1,114 km in India), Leh on it, Panjnad joins at Mithankot; Chenab largest tributary (Chandra + Bhaga); Indus Waters Treaty 19 September 1960: Ravi, Beas, Sutlej to India; Ganga about 2,525 km, Bhagirathi + Alaknanda at Devprayag, National River 2008; Yamuna longest tributary; Kosi Sorrow of Bihar, Damodar Sorrow of Bengal; Brahmaputra = Tsangpo, Siang, Jamuna; Subansiri largest tributary. |

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| **Peninsular Rivers, Lakes, Waterfalls and Multipurpose River Projects** | Peninsular rivers old, rain-fed, fixed courses; east-flowing Mahanadi, Godavari (largest, about 1,465 km, Dakshin Ganga), Krishna, Kaveri form deltas; west-flowing Narmada and Tapi flow in rift valleys and form estuaries; Wular largest freshwater lake, Chilika largest lagoon, Sambhar salt lake, Loktak phumdis; Jog on Sharavathi, Chitrakote on Indravati; DVC 1948 first multipurpose project; Bhakra-Sutlej, Hirakud-Mahanadi, Tehri tallest dam. |
| **Climate of India and the Monsoon Mechanism: Seasons, Local Winds and Rainfall** | Tropical monsoon climate; monsoon from Arabic mausim; IMD set up 1875; seasons: Dec-Feb cold, Mar-May hot, Jun-Sep SW monsoon, Oct-Nov retreat; western disturbances from the Mediterranean bring winter rain for wheat; loo, Kalbaisakhi (Bardoli Chheerha), mango showers; ITCZ, Coriolis, Tibetan heating, Tropical Easterly Jet; El Nino weakens monsoon; onset Kerala about 1 June; Tamil Nadu rain Oct-Dec; average rain about 125 cm; Mawsynram wettest; Ladakh and western Rajasthan driest. |
| **Soils of India and Natural Vegetation: Soil Types, Forest Types and Conservation** | ICAR (1929): 8 soil groups; alluvial most widespread (about 40%), rich in potash; black regur from Deccan basalt, self-ploughing, cotton; red from iron; laterite from leaching, tea, coffee, cashew; saline (usar, reh) treated with gypsum; contour ploughing, terracing, shelter belts check erosion; evergreen forests over 200 cm, deciduous most widespread (teak, sal), thorn below 70 cm; conifers 1,500-3,000 m; Sundarbans mangroves; Forest Policy 1988 aims at 33%. |
| **Agriculture in India: Kharif, Rabi and Zaid Crops, Leading States and Farm Revolutions** | Kharif June-October (rice, cotton, jute, groundnut), rabi October-June (wheat, gram, mustard), zaid summer (melons); aus, aman, boro paddy; West Bengal rice and jute, UP wheat and sugarcane, Rajasthan bajra, Karnataka coffee and ragi, Assam tea, Kerala rubber; Green Revolution mid-1960s, Swaminathan and Borlaug; Operation Flood 1970, Kurien; Yellow Revolution, oilseeds, 1986; wells and tube-wells lead irrigation; Indira Gandhi Canal longest. |
| **Minerals, Energy Resources and Industries: Mines, Power Plants and Steel Centres** | Chotanagpur and Odisha richest mineral belt; Odisha leads iron ore; Bailadila, Keonjhar, Noamundi, Kudremukh; bauxite Koraput; copper Khetri, Malanjkhand; mica Koderma; Jharia coking coal, Raniganj 1774, Neyveli lignite; Digboi 1889 oil, refinery 1901; Mumbai High 1974; Tarapur first nuclear plant 1969; TISCO 1907; Bhilai and Bokaro USSR, Rourkela West Germany, Durgapur UK; first cotton mill Mumbai 1854; first jute mill Rishra 1855. |
| **Transport and Population: Highways, Railways, Ports, Waterways and Census 2011** | Golden Quadrilateral 5,846 km; NS-EW corridors cross at Jhansi; NH 44 longest; first train 16 April 1853, Mumbai-Thane, 34 km; broad gauge 1.676 m; Kandla tidal, JNPT container, Mormugao iron ore, Visakhapatnam deepest landlocked, Kolkata riverine; NW 1 Haldia-Prayagraj 1,620 km; Census 2011: 121.09 crore, growth 17.7%, density 382, sex ratio 943, literacy 74.04%; UP most populous, Bihar densest, Kerala highest sex ratio and literacy, Haryana lowest sex ratio. |
| **Indian Polity and Constitution** | Constituent Assembly first met 9 Dec 1946; Constitution adopted 26 Nov 1949, in force 26 Jan 1950; 42nd Amendment (1976) added Socialist, Secular, Integrity; Fundamental Rights Articles 12-35, Article 32 writs; DPSP Part IV not enforceable (Art 37); Fundamental Duties Art 51A, 11 duties; Money bill Art 110, Rajya Sabha 14 days; Ordinance Art 123 lapses 6 weeks after reassembly; Emergency Arts 352, 356, 360; 73rd/74th Amendments 1992, Eleventh (29) and Twelfth (18) Schedules; Kesavananda Bharati 1973 basic structure; S.R. Bommai 1994 on Art 356. |
| **Making of the Constitution: Constituent Assembly, Committees and Sources** | Idea: M.N. Roy 1934; Cabinet Mission 1946, 389 seats; first met 9 Dec 1946; Rajendra Prasad President; Objectives Resolution 13 Dec 1946; Drafting Committee 29 Aug 1947 under Ambedkar; 11 sessions; adopted 26 Nov 1949, in force 26 Jan 1950; originally 395 Articles, 22 Parts, 8 Schedules; GoI Act 1935 largest source; Fundamental Rights USA, Directive Principles Ireland, Concurrent List Australia, residuary powers Canada. |
| **Preamble, Union and Its Territory (Articles 1-4) and Citizenship (Articles 5-11)** | Preamble: Sovereign Socialist Secular Democratic Republic; justice, liberty, equality, fraternity; 42nd Amendment 1976 its only amendment; Kesavananda 1973: part of Constitution; Art 1 Union of States; Art 3 new states by simple majority, Art 4 not an Art 368 amendment; Andhra 1953 first linguistic state; SRC Fazl Ali 1953-55; 14 states and 6 UTs on 1 Nov 1956; Arts 5-11 citizenship; 1955 Act: 5 ways to acquire, 3 to lose. |
| **Fundamental Rights (Articles 12-35), Reasonable Restrictions and Writs** | Part III Arts 12-35; Art 12 defines State, Art 13 basis of judicial review; equality 14-18, freedom 19-22, against exploitation 23-24, religion 25-28, cultural and educational 29-30, remedies 32; property removed by 44th Amendment 1978 (now Art 300A); Art 21A by 86th Amendment 2002; Maneka Gandhi 1978; Puttaswamy 2017 privacy; writs: habeas corpus, mandamus, prohibition, certiorari, quo warranto; Art 226 wider; Arts 20 and 21 never suspended. |

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| **Directive Principles of State Policy and Fundamental Duties** | DPSP Part IV Arts 36-51, Irish source, Art 37 not justiciable; socialistic (38, 39, 39A, 41, 42, 43, 43A, 47), Gandhian (40, 43, 43B, 46, 47, 48), liberal (44, 45, 48, 48A, 49, 50, 51); 42nd Amendment added 39(f), 39A, 43A, 48A; Champakam 1951, Golaknath 1967, Kesavananda 1973, Minerva Mills 1980; Fundamental Duties Art 51A, Swaran Singh Committee 1976, 11th duty by 86th Amendment 2002. |
| **The President and the Vice-President of India** | Arts 52-62 President, 63-71 Vice-President; President elected by elected MPs and MLAs (incl. Delhi, Puducherry) by single transferable vote; age 35; 5-year term; oath by CJI; impeachment Art 61 for violation of Constitution, two-thirds of total membership; ordinance Art 123; pardon Art 72; absolute, suspensive and pocket veto; VP ex officio Rajya Sabha Chairman, elected by all MPs, removed under Art 67(b); election disputes to Supreme Court (Art 71). |
| **Prime Minister, Council of Ministers and the Attorney General** | Arts 74-78: PM heads Council of Ministers, appointed by President; collective responsibility to Lok Sabha (75(3)); non-member may serve 6 months; 91st Amendment 2003: 15% cap, state minimum 12; Cabinet ministers, Ministers of State, Deputy Ministers; word cabinet only in Art 352; cabinet committees under 1961 Rules; Attorney General Art 76, audience in all courts, speaks in Parliament without vote (Art 88); Advocate General Art 165. |
| **Parliament: Lok Sabha, Rajya Sabha, Bills, Budget and Committees** | Art 79 Parliament = President + Rajya Sabha + Lok Sabha; RS max 250, LS max 550 elected; ages 30 and 25; Speaker Arts 93-94, casting vote; max 6-month gap between sessions (Art 85); question hour, zero hour 1962; adjournment and no-confidence motions need 50 members; money bill Art 110, RS 14 days; amendment Art 368 special majority; joint sitting Art 108 (1961, 1978, 2002); budget Art 112; PAC 22, Estimates 30, COPU 22. |
| **The Judiciary: Supreme Court, High Courts, Subordinate Courts and Tribunals** | Integrated judiciary from GoI Act 1935; SC inaugurated 28 Jan 1950; Arts 124-147; collegium from Second Judges case 1993; NJAC struck down 2015; SC judges retire at 65, HC at 62; removal Art 124(4) and Judges (Inquiry) Act 1968; jurisdiction: original 131, writ 32, appellate 132-134 and 136, advisory 143; HCs Arts 214-231, writs Art 226; district judges Art 233; tribunals 323A, 323B; Lok Adalats under 1987 Act. |
| **Centre-State Relations, the Governor and Emergency Provisions** | Arts 245-263 Centre-state; Seventh Schedule lists originally 97/66/47; residuary Art 248; Arts 249, 250, 252, 253 let Parliament legislate on State List; Art 254 repugnancy; Art 312 All-India Services; Art 262 water disputes; Art 263 Inter-State Council 1990; Finance Commission Art 280; GST Council Art 279A; Governor Arts 153-161; Legislative Council Arts 169, 171; emergencies Arts 352, 356, 360; 44th Amendment: armed rebellion; Bommai 1994. |
| **Panchayats, Municipalities and Constitutional and Non-Constitutional Bodies** | 73rd Amendment 1992 (in force 24 Apr 1993): Part IX, Arts 243-243O, Eleventh Schedule 29 subjects; 74th (1 Jun 1993): Part IXA, Arts 243P-243ZG, Twelfth Schedule 18; women one-third; SEC 243K, SFC 243I; Election Commission Art 324; UPSC Arts 315-323; CAG Arts 148-151; NCSC 338, NCST 338A; NHRC 1993, CVC 1964 (statutory 2003), CBI 1963, Lokpal 2013 Act. |
| **Modern Indian History and the Freedom Struggle** | Vasco da Gama 1498; EIC charter 1600; Plassey 1757, Buxar 1764, Diwani 1765; Regulating Act 1773, Pitt's Act 1784; Permanent Settlement 1793 (Cornwallis); Subsidiary Alliance (Wellesley); Doctrine of Lapse (Dalhousie); Sati banned 1829 (Bentinck); 1857 began at Meerut 10 May; Queen's Proclamation 1 Nov 1858; INC 1885 (Bonnerjee); Bengal partition 1905; Muslim League 1906 Dhaka; Lucknow Pact 1916; Jallianwala Bagh 13 Apr 1919; Chauri Chaura 1922; Purna Swaraj Lahore 1929; Dandi 1930; Poona Pact 1932; Quit India 8 Aug 1942; Cabinet Mission 1946; Independence Act 18 Jul 1947 |
| **The Europeans Arrive and the British Win Bengal (1498-1772)** | Vasco da Gama at Calicut 1498; Albuquerque took Goa 1510; Dutch company 1602, Masulipatnam 1605; English charter 31 Dec 1600, Surat 1613, Madras 1639, Bombay 1668, Calcutta 1690; Danes 1616; French 1664, Pondicherry 1674; farman of 1717; Aix-la-Chapelle 1748, Wandiwash 1760, Paris 1763; Plassey 23 Jun 1757; Buxar Oct 1764; Treaty of Allahabad 1765 (Diwani); dual government 1765-72, ended by Hastings |
| **British Expansion: Mysore, Maratha and Sikh Wars, Subsidiary Alliance and Lapse** | Mysore: Madras 1769, Mangalore 1784, Seringapatam 1792, Tipu killed 1799; Maratha: Surat 1775, Salbai 1782, Bassein 31 Dec 1802, Assaye 1803, Peshwaship ended 1818; Sikh: Amritsar 1809, Lahore 1846, Punjab annexed 1849; Subsidiary Alliance by Wellesley, Nizam first 1798; Doctrine of Lapse by Dalhousie, Satara 1848 to Nagpur 1854; Awadh annexed 1856 for misgovernment |

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| **Land Revenue Systems, Drain of Wealth and Early Peasant and Tribal Revolts** | Permanent Settlement 1793 (Cornwallis, zamindars, Bengal, Sunset Law); Ryotwari - Read 1792, Munro in Madras 1820; Mahalwari - Holt Mackenzie 1822, Bird and Thomason 1833; drain theory - Naoroji, per capita income 20 rupees; Charter Act 1813 opened India to British goods; Sanyasi revolt (Anandamath); Paika 1817; Kol 1831-32; Santhal 1855-56; Indigo 1859-60 (Neel Darpan); Deccan riots 1875; Munda Ulgulan 1899-1900 |
| **The Revolt of 1857: Causes, Centres, Failure and the Act of 1858** | Causes: Lapse, Awadh 1856, General Service Enlistment Act 1856, greased Enfield cartridges; Mangal Pandey at Barrackpore 29 Mar 1857; Meerut 10 May; Delhi 11 May, Bahadur Shah II; Kanpur - Nana Sahib, Lucknow - Hazrat Mahal, Jhansi - Lakshmibai, Arrah - Kunwar Singh; Tantia Tope hanged 1859; failed - limited spread, loyal princes, no common plan; Act of 1858 - Crown rule, Secretary of State; Queen's Proclamation 1 Nov 1858 |
| **Socio-Religious Reform Movements and Social Reform Laws** | Brahmo Samaj 1828 (Rammohan Roy); sati banned 1829 (Bentinck); Young Bengal (Derozio); Tattvabodhini Sabha 1839; Widow Remarriage Act 1856 (Vidyasagar); Prarthana Samaj 1867; Satyashodhak Samaj 1873 (Phule); Arya Samaj 1875 (Dayananda); Theosophical Society 1875, Adyar 1882; MAO College Aligarh 1875 (Sir Syed); Deoband 1866; Ramakrishna Mission 1897 (Vivekananda); Age of Consent Act 1891; Sarda Act 1929 |
| **Rise of Nationalism: Early Congress to the Morley-Minto Reforms (1885-1914)** | Landholders' Society 1838; Indian Association 1876; INC 28 Dec 1885, Bombay, 72 delegates, W.C. Bonnerjee; Tyabji 1887; Moderates - prayer, petition, protest; Extremists - Lal-Bal-Pal; Bengal partition 16 Oct 1905 (Curzon); Swadeshi proclaimed 7 Aug 1905; Muslim League Dacca 30 Dec 1906; Surat split 1907; Morley-Minto 1909 separate electorates; partition annulled 1911; Ghadar Party 1913 |
| **From Home Rule to Non-Cooperation (1914-1922)** | Home Rule Leagues 1916 (Tilak - April, Besant - September); Lucknow Pact Dec 1916; August Declaration 1917; Gandhi back 9 Jan 1915; Champaran 1917, Ahmedabad and Kheda 1918; Rowlatt Act Mar 1919; Jallianwala Bagh 13 Apr 1919 (Dyer); Act of 1919 - dyarchy; Khilafat; Non-Cooperation 1 Aug 1920, Nagpur Dec 1920; Chauri Chaura 5 Feb 1922; withdrawn at Bardoli |
| **From the Swaraj Party to Provincial Ministries (1922-1939)** | Swaraj Party 1 Jan 1923 (Das, Motilal); Simon Commission Nov 1927, reached India 1928; Nehru Report Aug 1928; Lahore Dec 1929 Purna Swaraj; 26 Jan 1930 Independence Day; Dandi 12 Mar - 6 Apr 1930; Gandhi-Irwin Pact 5 Mar 1931; Round Tables 1930, 1931, 1932; Communal Award 16 Aug 1932; Poona Pact 24 Sep 1932; Act of 1935; Congress ministries 1937-39; Kakori 1925; HSRA 1928; Bhagat Singh hanged 23 Mar 1931 |
| **From the Second World War to Independence and Integration (1939-1947)** | India declared at war Sept 1939; Lahore Resolution 23 Mar 1940; August Offer 8 Aug 1940; Individual Satyagraha 17 Oct 1940 (Vinoba first); Cripps Mar 1942; Quit India 8 Aug 1942, Do or Die; Azad Hind govt 21 Oct 1943; INA trials 1945; naval mutiny 18 Feb 1946; Cabinet Mission plan 16 May 1946; Direct Action 16 Aug 1946; Mountbatten Plan 3 Jun 1947; Independence Act 18 Jul 1947; Patel integrated the states |
| **Constitutional Development (1773-1935) and the Governors-General** | Regulating Act 1773 (Hastings, Supreme Court 1774); Pitt's India Act 1784 (Board of Control); Charter Acts 1813 (monopoly ended), 1833 (Governor-General of India, Bentinck), 1853 (open civil service); Act of 1858; Councils Acts 1861, 1892, 1909; Act of 1919 - dyarchy; Act of 1935 - provincial autonomy; key rulers - Cornwallis, Wellesley, Bentinck, Dalhousie, Canning, Mayo, Lytton, Ripon, Curzon, Linlithgow, Mountbatten |
| **Physical and World Geography** | Planets: Mercury-Venus-Earth-Mars-Jupiter-Saturn-Uranus-Neptune; axis tilt 23.5 degrees; 21 June summer solstice; 1 degree longitude = 4 min, IST = GMT+5:30; Moho crust/mantle, Gutenberg mantle/core; S-waves stop at outer core; Richter magnitude, Mercalli intensity; nitrogen 78%, ozone in stratosphere; Chinook Rockies, Foehn Alps, Mistral France; hurricane Atlantic, typhoon W Pacific, willy-willy Australia; Labrador, Benguela, Peru cold currents; Nile longest, Amazon largest, Baikal deepest, Sahara largest hot desert; Suez Med-Red Sea, Panama Atlantic-Pacific; Kazakhstan largest landlocked. |
| **The Universe and the Solar System: Galaxies, the Sun, Planets, Moons and Eclipses** | Big Bang about 13.8 billion years ago; Milky Way a barred spiral galaxy, Andromeda the nearest large galaxy; light year about 9.46 trillion km; Proxima Centauri nearest star after the Sun; Sun holds 99.8% of mass, core about 15 million C, corona seen in total eclipse, sunspot cycle 11 years; Mercury smallest, Venus hottest and spins backwards, Jupiter largest, Saturn least dense, Uranus on its side; Ganymede largest moon; Pluto a dwarf planet since 2006; Halley every 76 years; Moon's orbit tilted 5 degrees. |

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| **The Earth's Motions, Seasons, Latitudes, Longitudes and Time Zones** | Earth an oblate spheroid (geoid), equatorial diameter about 12,756 km; rotates west to east in 23 h 56 min 4 s; revolves in about 365 days 6 hours; perihelion 3 January, aphelion 4 July; axis tilted 23.5 degrees, parallelism causes seasons; solstices 21 June and 22 December, equinoxes 21 March and 23 September; 1 degree of latitude about 111 km; Prime Meridian at Greenwich, 1884; 1 degree of longitude = 4 minutes; IST on 82.5 E near Mirzapur, GMT+5:30; Date Line about 180 degrees. |
| **The Earth's Interior, Rocks, Continental Drift and Plate Tectonics** | Earth's radius about 6,371 km; crust under 1% of volume, oceanic about 5 km, continental about 30 km; SIAL over SIMA with Conrad between; Moho (1909) crust-mantle; mantle to 2,900 km, about 84% of volume; asthenosphere up to about 400 km, source of magma; Gutenberg at 2,900 km; outer core liquid, inner core solid (found by Lehmann, 1936); NIFE core; shadow zone 105-145 degrees; granite intrusive, basalt extrusive; Wegener 1912 Pangaea; Hess sea-floor spreading; plate tectonics 1967; seven major plates; San Andreas transform fault. |
| **Landforms and Their Makers: Volcanoes, Earthquakes, Mountains, Rivers, Glaciers, Wind and Waves** | Endogenic forces build, exogenic forces wear down; exfoliation in deserts, carbonation dissolves limestone; magma underground, lava at the surface; shield (Mauna Loa), composite (Fuji), caldera; Ring of Fire around the Pacific; Barren Island active, Narcondam dormant; focus below, epicentre above; P fastest, S solids only, surface waves most destructive; Richter 1935 magnitude, Mercalli intensity; Chile 1960 9.5; horst and graben; V-valley, meander, ox-bow lake, delta; cirque, U-valley, fjord, moraine; barchan, loess; stack, spit, lagoon. |
| **The Atmosphere: Composition, Layers, Insolation, Heat Budget and Temperature Inversion** | Nitrogen 78%, oxygen 21%, argon 0.93%, CO2 about 0.04%; 99% of mass within 32 km; troposphere 8 km at poles, 18 km at Equator, lapse rate 6.5 C per km; stratosphere to 50 km with ozone; mesosphere 50-80 km, coldest, meteors burn; ionosphere 80-400 km reflects radio waves; ozone hole 1985, Montreal Protocol 1987; insolation highest over subtropical deserts; albedo 35 units; inversion on clear calm winter nights; greenhouse effect keeps Earth at 15 C. |
| **Pressure Belts, Planetary and Local Winds, Jet Streams, Cyclones and Rainfall** | Sea-level pressure 1013.25 mb; air moves from high to low; doldrums near the Equator, horse latitudes at 30 degrees, subpolar lows at 60 degrees; trades NE and SE, westerlies SW and NW, polar easterlies; Coriolis zero at Equator; Roaring Forties; Chinook, Foehn, Zonda, Santa Ana warm; Mistral, Bora, Pampero cold; Sirocco, Khamsin, Harmattan hot; jet streams steer western disturbances; tropical cyclones need sea above 27 C; temperate cyclones form on fronts; cirrus high, cumulonimbus hail; convectional, orographic, cyclonic rain. |
| **The Oceans: Sea-Floor Relief, Trenches, Currents, Tides, Salinity and Coral Reefs** | 71% of the surface is water, 97% of water is in the oceans; Pacific largest and deepest; continental shelf usually under 200 m, abyssal plain 3,000-6,000 m; Mariana Trench nearly 11,000 m; Puerto Rico Trench deepest in the Atlantic, Java Trench in the Indian Ocean; gyres clockwise in the north; Gulf Stream, Kuroshio, Brazil, Agulhas warm; Labrador, Canary, Benguela, Peru, California cold; spring tides at new and full moon; Bay of Fundy highest tides, Khambhat in India; salinity 35 per thousand; Great Barrier Reef largest. |
| **Climates and Natural Regions of the World: Koppen's Scheme, Vegetation and Peoples** | Koppen: groups A, B, C, D, E plus H; letters f, m, w, s; Af equatorial, 27 C, over 200 cm, selvas, Pygmies; Am monsoon forests of teak and sal; Aw savanna, llanos, campos, Maasai; BWh hot deserts on western margins at 15-30 degrees, Bedouin, Tuareg, Bushmen; Cs Mediterranean winter rain, orchard lands; steppes, prairies, pampas, veld, downs; taiga conifers only in the north; tundra mosses and permafrost, Inuit, Sami; shifting cultivation roca, milpa, ladang, jhum. |
| **The Continents: Highest Peaks, Longest Rivers, Largest Lakes, Deserts and World Records** | Asia largest continent, Australia smallest; Everest 8,849 m, K2 8,611 m, Aconcagua 6,961 m, Denali, Kilimanjaro 5,895 m, Elbrus 5,642 m, Vinson 4,892 m, Kosciuszko 2,228 m; Nile longest, Amazon largest by volume, Yangtze longest in Asia, Volga in Europe; Caspian largest lake, Superior largest freshwater lake, Baikal deepest, Titicaca highest navigable; Sahara largest hot desert, Atacama driest outside the poles; Andes longest range on land; Angel Falls highest waterfall; Dead Sea lowest land; Greenland largest island. |

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| **The World Map: Straits, Canals, Boundary Lines, Capitals, Landlocked and Island Countries** | Malacca: Andaman Sea to South China Sea; Hormuz: Persian Gulf to Gulf of Oman; Bab-el-Mandeb: Red Sea to Gulf of Aden; Gibraltar: Mediterranean to Atlantic; Bosphorus and Dardanelles divide Europe and Asia; Bering: Russia and Alaska; Suez 1869 without locks; Panama 1914 with locks; Kiel: North Sea to Baltic; Radcliffe 1947, Durand 1893, McMahon 1914, 38th parallel Korea, 49th parallel USA-Canada; Danube capitals Vienna, Bratislava, Budapest, Belgrade; Kazakhstan largest landlocked; Uzbekistan and Liechtenstein doubly landlocked; Indonesia largest archipelagic country. |
| **Static General Knowledge: Symbols, Firsts, Awards, Sports and Organisations** | Anthem: Tagore, adopted 24 Jan 1950; song: Vande Mataram (Anandamath); emblem: Sarnath Lion Capital, Satyameva Jayate (Mundaka Upanishad); flag 2:3, 24 spokes, Pingali Venkayya; first Bharat Ratna 1954 (Rajaji, Radhakrishnan, Raman); first PVC Major Somnath Sharma; Jnanpith 1965 G. Sankara Kurup; Phalke 1969 Devika Rani; UN 24 Oct 1945, UNSC 15 members; SAARC HQ Kathmandu; Hirakud longest, Tehri highest dam; NH 44 Srinagar to Kanyakumari; first hockey gold 1928; World Cups 1983, 2011; Aryabhata 1975, SLV-3 1980, Chandrayaan-1 2008, MOM 2013; IGMDP: Prithvi, Agni, Trishul, Akash, Nag; 22 Eighth Schedule languages. |
| **National Symbols of India: Flag, Emblem, Anthem, Song, Calendar and More** | Flag adopted 22 July 1947, ratio 2:3, navy blue chakra with 24 spokes, Pingali Venkayya's design, Flag Code 2002; emblem from Sarnath Lion Capital, adopted 26 Jan 1950, Satyameva Jayate (Mundaka Upanishad); anthem by Tagore, first sung 27 Dec 1911, adopted 24 Jan 1950, 52 seconds; Vande Mataram from Anandamath (1882); Saka calendar 22 March 1957, first month Chaitra; tiger, peacock, lotus, banyan, mango; Ganga 2008, dolphin 2009, elephant 2010. |
| **Firsts and Superlatives of India: First Office-Holders, First Women, Largest and Longest** | First President Rajendra Prasad, PM Nehru, CJI H.J. Kania, Speaker Mavalankar, CEC Sukumar Sen; only Indian Governor-General Rajagopalachari; women: Governor Sarojini Naidu 1947, CM Sucheta Kripalani 1963, PM Indira Gandhi 1966, SC judge Fathima Beevi 1989, President Pratibha Patil 2007; Rakesh Sharma 1984; Everest 29 May 1953; largest state Rajasthan, smallest Goa; UP most populous (2011); Ganga longest, Godavari Dakshin Ganga; Wular, Chilika, Sambhar, Majuli; Hirakud longest, Tehri highest dam. |
| **Important Days: National and International Days Month by Month** | 9 Jan Pravasi Bharatiya Divas; 12 Jan Youth Day; 15 Jan Army Day; 25 Jan Voters' Day; 28 Feb Science Day (Raman Effect); 24 Mar TB Day; 7 Apr Health Day; 24 Apr Panchayati Raj Day; 11 May Technology Day (Pokhran-II); 5 Jun Environment Day; 21 Jun Yoga Day; 11 Jul Population Day; 26 Jul Kargil Vijay Diwas; 29 Aug Sports Day; 5 Sep Teachers' Day; 14 Sep Hindi Diwas; 15 Sep Engineers' Day; 8 Oct Air Force Day; 31 Oct Ekta Diwas; 26 Nov Constitution Day; 4 Dec Navy Day; 16 Dec Vijay Diwas. |
| **Books and Authors: Ancient Classics to Modern Indian and World Writers** | Arthashastra Kautilya; Indica Megasthenes; Ashtadhyayi Panini; Kalidasa: Shakuntalam, Meghaduta; Harshacharita Banabhatta; Rajatarangini Kalhana; Kitab-ul-Hind Al-Biruni; Baburnama in Turki; Akbarnama Abul Fazl; Ramcharitmanas Tulsidas; Hind Swaraj Gandhi 1909; Discovery of India Nehru (written 1944); India Wins Freedom Azad; Gita Rahasya Tilak; Gulamgiri Phule; Godan Premchand; Kamayani Prasad; Midnight's Children 1981; The God of Small Things 1997; Wealth of Nations 1776. |
| **Sports GK: Players per Side, Terms, Trophies, Olympics and National Sports Awards** | Players: cricket, football, hockey 11, kho-kho 9, kabaddi 7, volleyball 6, basketball 5, polo 4; Thomas, Uber = badminton; Davis = tennis; Swaythling = table tennis; Ryder = golf; Durand, Santosh = football; Ranji = cricket; Beighton = hockey; IOC 1894 Lausanne, Athens 1896; first hockey gold 1928, 8 golds; K.D. Jadhav 1952; Malleswari 2000; Bindra 2008; Arjuna 1961, Dronacharya 1985, Khel Ratna 1991-92 (Anand); Asian Games 1951 Delhi. |
| **Awards and Honours: Bharat Ratna, Gallantry, Literary, Film and International Prizes** | Bharat Ratna and Padma awards 1954; first Bharat Ratna Rajaji, Radhakrishnan, Raman; first posthumous Shastri 1966; PVC, MVC, VrC (wartime, 1950); Ashoka, Kirti, Shaurya Chakra (peacetime, 1952, renamed 1967); first PVC Major Somnath Sharma; Jnanpith 1965 G. Sankara Kurup; Sahitya Akademi 1954, 24 languages; Phalke Award 1969 Devika Rani; Nobel 1901, Economics 1969, 10 December; Magsaysay 1957, Vinoba Bhave 1958; Booker 1969; Gandhi Peace Prize 1995 Nyerere. |

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| **International Organisations: UN Organs, Agencies, Headquarters and Regional Groupings** | UN Charter 26 June 1945 San Francisco, in force 24 Oct 1945, HQ New York, 6 languages; UNSC 15 (5 permanent, 10 for 2 years); ICJ The Hague, 15 judges, 9 years; Trusteeship Council suspended 1994; ILO 1919 Geneva; FAO Rome; UNESCO Paris; WHO 1948 Geneva; IMF and World Bank Washington; UNEP Nairobi; IAEA Vienna; WTO 1995 Geneva; SAARC 1985 Kathmandu; ASEAN 1967 Jakarta; BIMSTEC 1997 Dhaka; SCO 2001 Beijing, India 2017; G20 1999; BRICS NDB Shanghai; NAM Belgrade 1961. |
| **States and Union Territories: Formation, Capitals, High Courts and Borders** | Art 1 Union of States, Art 3 new states by ordinary law; Andhra State 1 Oct 1953; SRC Fazl Ali; 1 Nov 1956: 14 states, 6 UTs; Maharashtra, Gujarat 1960; Nagaland 1963; Haryana 1966; HP 1971; Manipur, Tripura, Meghalaya 1972; Sikkim 1975; Mizoram, Arunachal, Goa 1987; Chhattisgarh, Uttarakhand, Jharkhand 2000; Telangana 2 June 2014; J&K and Ladakh UTs 31 Oct 2019; Calcutta HC 1862 oldest; UP borders 8 states; Tropic of Cancer 8 states. |
| **Banking and Financial Awareness — Fundamentals** | RBI is the central bank (est. 1935, nationalised 1949, HQ Mumbai); its Monetary Policy Committee decides only the policy repo rate, while RBI itself sets the other instruments - reverse repo rate, CRR and SLR; know your payment-system abbreviations (NEFT/RTGS/IMPS/UPI) and regulators (SEBI-securities [1992], IRDAI-insurance [1999], NABARD-agri/rural credit [1982]). Banking history: Bank of Hindustan (1770, first bank) → three Presidency banks merge into Imperial Bank of India (1921) → becomes SBI (1955). |
| **Indian Banking System: History, Nationalisation and Structure** | Bank of Hindustan 1770; Presidency banks 1806, 1840, 1843 merged into Imperial Bank 1921, which became SBI on 1 July 1955 (Gorwala committee); PNB 1894 Lahore; nationalisation 19 July 1969 (14 banks) and 15 April 1980 (6 banks); scheduled bank = Second Schedule of RBI Act 1934; first RRB Prathama Bank 2 October 1975, RRB Act 1976, capital 50:35:15; SFB and payments bank guidelines November 2014 (payments banks proposed by Nachiket Mor); BR Act 1949, renamed 1966. |
| **Reserve Bank of India: Origin, Organisation, Functions and Subsidiaries** | Hilton Young Commission 1926; RBI Act 1934; RBI from 1 April 1935 with Rs 5 crore private capital; HQ to Bombay 1937; nationalised 1 January 1949; first Governor Osborne Smith, first Indian C.D. Deshmukh; Central Board under section 8; sole note issuer (section 22), Re 1 note and coins by government; Minimum Reserve System Rs 200 crore incl. Rs 115 crore gold; banker to government and banks, lender of last resort, regulator, forex manager (FEMA 1999); subsidiaries DICGC, BRBNMPL, ReBIT. |
| **Monetary Policy Tools: CRR, SLR, Repo, SDF, MSF and the MPC** | CRR (section 42 RBI Act, cash with RBI, no interest); SLR (section 24 BR Act, cash, gold, G-secs, ceiling 40%); repo = RBI lends, reverse repo = RBI borrows; SDF absorbs without collateral (Urjit Patel Committee 2014, amendment 2018); MSF 2011 = corridor ceiling, bank rate aligned with it; LAF June 2000; OMO buy injects, sell absorbs; MSS 2004; MPC under section 45ZB, 6 members, quorum 4, sets only the repo rate; first CPI target 4% (2-6%). |
| **Bank Accounts, NRI Deposits, Cheques, Loans and Deposit Insurance** | Demand deposits (savings, current) vs time deposits (FD, RD); savings rate deregulated 2011; NRE (repatriable, tax-free) vs NRO (Indian income) vs FCNR(B) (foreign currency); KYC under PMLA 2002; cheque = section 6 NI Act 1881, valid three months, dishonour = section 138; CTS from NCR 2008; nomination sections 45ZA-45ZF BR Act; BPLR 2003, base rate 2010, MCLR 2016, external benchmark 1 October 2019; CICRA 2005, CIBIL 300-900; DICGC insures deposits, insurance since 1962. |
| **Payment and Settlement Systems: NEFT, RTGS, IMPS, UPI and NPCI** | PSS Act 2007 (in force August 2008), RBI authorises payment systems via BPSS; RTGS March 2004, gross and real time, minimum Rs 2 lakh; NEFT November 2005, half-hourly deferred net batches; both run by RBI, 24x7 from 2019 (NEFT) and 2020 (RTGS); NPCI December 2008 by RBI and IBA, HQ Mumbai; IMPS 2010; UPI 2016, BHIM December 2016; NACH replaced ECS; AePS via Aadhaar and fingerprint; BBPS for bills; RuPay 2012; first ATM HSBC Mumbai 1987. |
| **NPAs, Debt Recovery Laws, IBC and Basel Capital Norms** | NPA = overdue more than 90 days (from March 2004, earlier 180); SMA-0/1/2 = up to 30/31-60/61-90 days; sub-standard up to 12 months, doubtful after 12 months, loss = uncollectible; SARFAESI 2002 (section 13(2) notice, 60 days, no court; ARCs under section 3); DRT Act 1993; Lok Adalat 1987; IBC 2016 (NCLT, CoC 66%, 180+90, 330 days; IBBI 1 October 2016); Basel Committee 1974; Basel I 1988 (8%), II 2004 (three pillars), III 2010 (buffers, LCR, NSFR); India CRAR 9%; PCA 2002. |

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| **Financial Inclusion: Lead Bank Scheme, Priority Sector and Jan Dhan to MUDRA** | Rangarajan Committee 2008; Lead Bank Scheme 1969 (Gadgil, Nariman); priority sector 40% of ANBC, PSLCs; KCC 1998; BCs 2006; PMJDY 28 August 2014 (Mera Khata, Bhagya Vidhata); PMJJBY Rs 2 lakh life (18-50), PMSBY Rs 2 lakh accident (18-70), APY Rs 1,000-5,000 pension (18-40, PFRDA), all 9 May 2015; MUDRA 8 April 2015 (Shishu, Kishore, Tarun; SIDBI subsidiary); Stand-Up India 5 April 2016; Sukanya Samriddhi 22 January 2015. |
| **Development Banks, NBFCs and Financial Regulators (NABARD, SIDBI, SEBI, IRDAI, PFRDA)** | IFCI 1948 first DFI, ICICI 1955, IDBI 1964; NABARD 12 July 1982 (Act 1981, CRAFICARD, Mumbai); SIDBI 2 April 1990 (Lucknow); EXIM Bank 1982 (Act 1981, Mumbai); NHB 9 July 1988 (New Delhi), HFC regulation to RBI 2019; NBFCs register under section 45-IA, no demand deposits, no cheques, no DICGC cover; SEBI 1988, statutory 1992, FMC merged 2015; IRDAI Act 1999, Hyderabad; PFRDA 2003, Act 2013; IFSCA 2020 Gandhinagar; FSDC 2010. |
| **Money Market and Capital Market: Instruments, IPOs, Exchanges and Mutual Funds** | Money market up to 1 year (RBI), capital market over 1 year (SEBI); Vaghul Group 1987; call 1 day, notice 2-14 days, term 15 days-1 year; T-bills 91/182/364 days at discount; CP 1990, CD 1989; CCIL 2001, TREPS replaced CBLO 2018; equity vs preference shares, debentures, G-secs (gilt-edged), masala bonds; IPO, FPO, rights, bonus, ASBA; BSE 1875 (SENSEX 30), NSE 1992 (NIFTY 50); Depositories Act 1996, NSDL 1996, CDSL 1999; UTI first mutual fund, SEBI MF Regulations 1996. |
| **Banking Terms, Bank Codes (IFSC, MICR, SWIFT) and International Financial Institutions** | NDTL, CASA, CRAR, NIM, bancassurance; inoperative after two years, unclaimed 10 years to DEAF (2014); hypothecation vs pledge vs mortgage vs lien; LC, bank guarantee, factoring, forfaiting; IFSC 11 characters (5th is 0), MICR 9 digits (city-bank-branch), SWIFT/BIC 8 or 11, SWIFT 1973 Belgium, PAN 10; Bretton Woods July 1944: IMF (operations 1 March 1947, SDR 1969) and IBRD, Washington; IDA 1960, IFC 1956, MIGA 1988, ICSID 1966; BIS 1930 Basel; ADB 1966 Manila; AIIB 2016 Beijing; NDB 2014 Shanghai; FATF 1989. |

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