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Day 5
English notes

Topics 41-50

10 topics with the original lesson text, worked examples, revision points and source references.

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1,000 TOPICS IN 100 DAYS

Day 5
Complete bilingual reader

Topics 41–50 · English and Telugu

Answers immediately below every question

Revision Programme
9 October 2026

Topic 41 · Revolt of 1857: causes, centres and leaders

ENGLISH

1. Concept in one line

The Revolt of 1857 broke out as a mutiny of the East India Company's sepoys at Meerut on 10 May 1857 and grew into a wide rising in north and central India. The examination asks for its causes group by group, and for each centre its leader, the British officer who retook it and the dates.

2. Revision notes

2.1 Basics to keep in mind

- **Sepoy** means an Indian soldier in the East India Company's army. The Bengal Army had about 130,000 (1.3 lakh) Indian troops (Britannica). Most of its sepoys came from the villages of Awadh and eastern Uttar Pradesh, and many were Brahmins or men of other high castes. NCERT says that Awadh was therefore called the "nursery of the Bengal Army".
- **Dates:** the revolt is dated from 10 May 1857 (Meerut). Hostilities were formally declared ended on 8 July 1859 (Britannica).
- **Governor-General:** Lord Canning was Governor-General during the revolt. Lord Dalhousie held the office from 1848 to 1856, and Canning was Governor-General from 1856. In 1858 Canning became the first Viceroy.
- **Names:** Sepoy Mutiny, Indian Mutiny, Revolt of 1857, First War of Independence. The debate on its nature, the reasons for its failure and its results come on another day (Topic 152).

2.2 Causes

Group	Main points
Political	**Subsidiary alliance** (devised by Wellesley in 1798, imposed on Awadh in 1801): the ruler had to disband his army, keep British troops and follow the British Resident's advice. **Doctrine of Lapse:** devised by Dalhousie. If the ruler of a dependent Hindu state died without a natural heir, the Company could refuse to recognise an adopted son and annex the state. Annexed under it, in NCERT's list: Satara (1848), Sambalpur (1850), Udaipur (1852), Nagpur (1853) and Jhansi (1854). These are the dates in NCERT's annexation list. The Udaipur entry should not be confused with Udaipur (Mewar) in Rajasthan. **Awadh** was a different case. Nawab Wajid Ali Shah was deposed on the plea of misgovernment and sent to Calcutta, and Awadh was annexed in 1856. Awadh is not in the list of lapse annexations. **Pension and titles:** When Peshwa Baji Rao II died, Dalhousie refused to continue his pension to his adopted son Nana Sahib. In 1856 Canning decided that after the Mughal emperor Bahadur Shah II his descendants would be called princes, not kings.

Group	Main points
Administrative and economic	Land revenue was high and rigidly collected, and peasants in debt lost their land to moneylenders. In Awadh the Summary Settlement of 1856 treated the taluqdars (the big landholders) as interlopers: their share of the villages fell from 67 per cent to 38 per cent. British machine-made goods ruined weavers and other artisans. Indians were paid little and kept out of the higher posts. The rebels' Azamgarh Proclamation of 25 August 1857 sets out these complaints of zamindars, merchants, public servants and artisans. English replaced Persian in higher administration and courts; Indian vernacular languages were used in lower courts.
Social and religious	Reforms were read as attacks on religion: the abolition of sati (1829), the legalising of the remarriage of Hindu widows, the campaign against infanticide, and English education. After 1830 Christian missionaries could work freely and own land. A law of 1850 (Act XXI) let a convert to Christianity inherit ancestral property. So people feared that they would be converted. Rumours fed the fear: that the bone dust of cows and pigs was mixed in the flour, and that British rule would end on the centenary of the Battle of Plassey, 23 June 1857.
Military	Sepoys were paid less than British soldiers and could not rise above the rank of subedar. Crossing the sea was believed to cost a man his religion and caste; in 1824 sepoys who refused to go to Burma by sea were severely punished. The **General Service Enlistment Act** of 25 July 1856, passed under Canning, made every new recruit of the Bengal Army accept service overseas if ordered. Serving sepoys feared that it would be extended to them.
Immediate	The new Enfield rifle used a greased cartridge, which the sepoy had to bite open. In January 1857 a rumour that started at Dum Dum said that the grease was the fat of cows and pigs, which would defile Hindus and Muslims alike.

2.3 From Barrackpore to Delhi

- **Barrackpore, 29 March 1857:** Mangal Pandey, a sepoy of the 34th Bengal Native Infantry, attacked his officers at Barrackpore, near Calcutta. A court martial tried him on 6 April, and he was hanged on 8 April.
- **Meerut, 9 May 1857:** 85 men of the 3rd Bengal Light Cavalry had refused the new cartridges on 24 April. On 9 May they were dismissed and sentenced to ten years in jail (NCERT).
- **Meerut, 10 May 1857:** the sepoys rose, freed the prisoners, killed British officers and rode through the night towards Delhi, 40 miles (65 km) away.
- **Delhi, 11 May 1857:** the Meerut sepoys reached the Red Fort, and the Delhi garrison joined them. Bahadur Shah II (Zafar), the Mughal emperor, gave his blessing and accepted the nominal leadership. The revolt could now be carried on in the emperor's name, and this gave it legitimacy.
- **Spread:** between 20 and 27 May sepoys mutinied at Aligarh, Etawah, Mainpuri and Etah. Lucknow rose on 30 May, and Kanpur in June. In many places the sepoys and the people pressed the old ruling families to lead them: NCERT says this of Nana Sahib, Rani Lakshmi Bai and Kunwar Singh.

2.4 Centres, leaders and the British officers

Centre	Leaders	British officers and the retaking	What became of the leaders
Delhi	Bahadur Shah II (Zafar) was the nominal head. Bakht Khan, a soldier from Bareilly who brought a large force to Delhi, held the military command; the emperor named him commander-in-chief.	Attempts to retake Delhi began in early June 1857, mainly with forces from the Punjab. Archdale Wilson commanded, and John Nicholson brought the siege train. The assault began on 14 September, and Delhi was taken on 20 September 1857.	Bahadur Shah, who had fled to Humayun's Tomb, was arrested. Major William Hodson had two of his sons and a grandson shot. The emperor was tried, sentenced to life imprisonment and sent to Rangoon in October 1858. He died there in November 1862.
Kanpur	Nana Sahib, the adopted son of Peshwa Baji Rao II, proclaimed himself Peshwa. Tantia Tope was his general, and Azimullah Khan his adviser.	General Wheeler's entrenchment was besieged for about three weeks in June 1857. The garrison came out on 27 June under a promise of safe passage and was attacked at the Satichaura Ghat. Henry Havelock then defeated Nana Sahib, and Sir Colin Campbell defeated Tantia Tope at Kanpur on 6 December 1857.	Nana Sahib escaped to Nepal (at the end of 1858, according to NCERT) and is thought to have died there.
Lucknow (Awadh)	Birjis Qadr, the young son of the deposed Nawab Wajid Ali Shah, was proclaimed Nawab. His mother, Begum Hazrat Mahal, organised the rising.	Sir Henry Lawrence was defeated at Chinhat on 30 June 1857 and died on 4 July in the besieged Residency. Havelock and James Outram entered the Residency on 25 September 1857 and reinforced its garrison. Campbell brought the garrison out in November 1857 and captured Lucknow in March 1858.	Some taluqdars stayed with the Begum even in defeat. After the British defeated the rebels in Awadh, the Begum fled to Nepal, and she died there in exile (Britannica).
Jhansi and Gwalior	Rani Lakshmi Bai of Jhansi. The Company had refused to recognise her adopted son and had annexed Jhansi (1854, following NCERT). Tantia Tope fought beside her.	Sir Hugh Rose besieged Jhansi in March 1858. Tantia Tope came to relieve it and was defeated. The Rani escaped to Kalpi. On 1 June 1858 the rebels seized Gwalior. After Rose's victories the British recovered Gwalior on 20 June 1858.	The Rani was killed in battle at Kotah-ki-Serai, near Gwalior, on 17 or 18 June 1858. Tantia Tope fought on as a guerrilla. He was betrayed in April 1859, tried, and executed at Shivpuri on 18 April 1859.

Centre	Leaders	British officers and the retaking	What became of the leaders
Bareilly (Rohilkhand)	Khan Bahadur Khan, a grandson of Hafiz Rahmat Khan, who had once been Regent of Rohilkhand. He set up his own government at Bareilly.	After Lucknow, Campbell campaigned in Rohilkhand in 1858, and the British took Bareilly.	He escaped to Nepal, was handed over to the British, and was tried and hanged in 1860.
Bihar (Arrah and Jagdishpur)	Kunwar Singh, the zamindar of Jagdishpur, who was nearly eighty years old.	The sepoys of Danapur mutinied on 25 July 1857 and joined him, and Arrah was besieged. Major Vincent Eyre relieved Arrah on 3 August 1857 and destroyed Jagdishpur.	Kunwar Singh fought on. He defeated Captain Le Grande's force near Jagdishpur on 23 April 1858, and died in his village on 26 April 1858. His brother Amar Singh carried on the struggle.
Faizabad	Maulvi Ahmadullah Shah, also called Danka Shah. He was jailed at Faizabad in 1857. When he was freed, the mutinous 22nd Native Infantry chose him as its leader. He fought at Chinhat and at Lucknow.	After Lucknow was captured in March 1858 he moved to Shahjahanpur in Rohilkhand, and fought the British there in May 1858.	He was killed on 5 June 1858 at Powayan, north of Shahjahanpur, where the family of the local Raja turned on him.

2.5 Other centres

- **Barout** (a pargana in Uttar Pradesh): Shah Mal, a Jat cultivator, led 84 villages. He was killed in battle in July 1857.
- **Singhbhum** (Chotanagpur): Gonoo, a tribal cultivator, became a leader of the Kol tribals.
- **Ramgarh** (Mandla region): Rani Avantibai Lodhi raised an army of about 4,000. When the British surrounded her, she chose death.
- **Benares and Allahabad:** the sepoys rose when attempts to disarm them were bungled. Colonel James Neill carried out ruthless reprisals along the Grand Trunk Road in June 1857.
- The revolt in the Andhra region is a separate topic (Topic 951).

2.6 Who stayed out

- **Bengal, the south and the west:** the people of Bengal stayed quiet. The south gave the British virtually no anxiety, and the Madras Army had no mutiny. The west gave only a little: there were three mutinies among the 29 regiments of the Bombay Army.
- **The Punjab:** the Sikhs backed the British against a return of Mughal rule, and Sikh princes such as those of Patiala, Nabha and Kapurthala helped the British with soldiers.

- **Princes:** Hyderabad, Mysore, Travancore, Kashmir and the Rajputana states did not join the revolt. Sindhia (Scindia) of Gwalior supported the British, though a large part of his troops, the Gwalior contingent, mutinied. Canning likened such states to breakwaters in a storm.
- **Nepal:** Jung Bahadur brought a large Nepalese force to join Campbell at Lucknow in March 1858.
- **Classes:** the modern educated Indians and the middle and upper classes did not support the revolt.

2.7 How it ended

- With the recovery of Gwalior on 20 June 1858 the revolt was "virtually over" (Britannica). The capture of Tantia Tope in April 1859 ended the mopping-up, and hostilities were formally declared ended on 8 July 1859.
- The Government of India Act of August 1858 transferred the government of India from the Company to the Crown (Topic 12). The Queen's Proclamation of 1 November 1858 followed. The princes were assured that their states would not be annexed and that adopted heirs would be recognised.

3. Extra section: chronology from 1848 to 1862

Date	Event
1848 to 1854	Annexations under the Doctrine of Lapse, beginning with Satara (1848)
1856	Awadh annexed on the plea of misgovernment; in the same year Canning succeeds Dalhousie as Governor-General
25 July 1856	General Service Enlistment Act
January 1857	The rumour about the greased cartridges starts at Dum Dum
26 February 1857	Trouble over the cartridges in the 19th Bengal Native Infantry
29 March 1857	Mangal Pandey attacks his officers at Barrackpore
8 April 1857	Mangal Pandey is hanged
9 May 1857	The 85 men of the 3rd Bengal Light Cavalry are sentenced at Meerut
10 May 1857	The sepoys rise at Meerut
11 May 1857	The sepoys reach Delhi; Bahadur Shah accepts the nominal leadership
30 May 1857	Rising at Lucknow
27 June 1857	The Kanpur garrison is attacked at the Satichaura Ghat
30 June 1857	Battle of Chinhat: Sir Henry Lawrence is defeated

Date	Event
4 July 1857	Sir Henry Lawrence dies in the Lucknow Residency
25 July 1857	The Danapur sepoys mutiny and join Kunwar Singh
3 August 1857	Vincent Eyre relieves Arrah
25 August 1857	Azamgarh Proclamation
14 September 1857	The British assault on Delhi begins
20 September 1857	Delhi is taken
25 September 1857	Havelock and Outram enter the Lucknow Residency
November 1857	Campbell brings out the Residency garrison
6 December 1857	Campbell defeats Tantia Tope at Kanpur
March 1858	Campbell captures Lucknow; Rose besieges Jhansi
23 April 1858	Kunwar Singh's last victory, near Jagdishpur
26 April 1858	Kunwar Singh dies
1 June 1858	The rebels seize Gwalior
5 June 1858	Maulvi Ahmadullah Shah is killed at Powayan
17 or 18 June 1858	Rani Lakshmi Bai is killed at Kotah-ki-Serai
20 June 1858	The British recover Gwalior
August 1858	Government of India Act
1 November 1858	Queen's Proclamation
18 April 1859	Tantia Tope is executed at Shivpuri
8 July 1859	Hostilities are formally declared ended
1860	Khan Bahadur Khan is hanged
November 1862	Bahadur Shah dies in Rangoon

4. Three common exam traps

1. **Barrackpore is not the starting point, and 29 March is not the day of the hanging.** Mangal Pandey attacked his officers at Barrackpore on 29 March 1857 and was hanged on 8 April. The revolt itself is dated from Meerut, 10 May 1857, and the sepoys reached Delhi the next day, 11 May. Questions put Mangal Pandey at Meerut, or give 29 March as the day he was hanged.
2. **Dalhousie or Canning.** Dalhousie (1848 to 1856) made the annexations that angered the princes, but he had left office before the revolt. The Governor-General in 1857 was Canning, and it was Canning who became the first Viceroy in 1858. Questions name Dalhousie as the Governor-General during the revolt.
3. **Where each leader's story ended.** Bahadur Shah died in Rangoon in November 1862, not in Delhi. Rani Lakshmi Bai was killed at Kotah-ki-Serai, near Gwalior, not at Jhansi. Tantia Tope began at Kanpur, but he was executed at Shivpuri. Nana Sahib escaped to Nepal. Kunwar Singh was not captured or executed: he died in his own village three days after a victory.

5. MCQs with answers and explanations

Q1. Match List I (Centre of the revolt) with List II (Leader who directed the revolt there):

List I (Centre of the revolt)	List II (Leader who directed the revolt there)
A. Delhi	1. Maulvi Ahmadullah Shah
B. Bareilly	2. Bakht Khan
C. Lucknow	3. Begum Hazrat Mahal
D. Faizabad	4. Khan Bahadur Khan

- (1) A-4, B-2, C-3, D-1
- (2) A-2, B-4, C-3, D-1
- (3) A-2, B-4, C-1, D-3
- (4) A-4, B-2, C-1, D-3

Q1. Answer: (2) A-2, B-4, C-3, D-1

- Why it is correct: At Delhi, Bahadur Shah was the nominal head, and the military command lay with Bakht Khan, who had brought a large force to the city (A-2). At Bareilly, Khan Bahadur Khan set up his own government (B-4). At Lucknow, Begum Hazrat Mahal organised the rising, and her young son Birjis Qadr was proclaimed Nawab (C-3). Maulvi Ahmadullah Shah was the leader from Faizabad, where he had been jailed in 1857 (D-1).
- Why (1) is wrong: It exchanges Delhi and Bareilly. Bakht Khan was a soldier from Bareilly, but he led in Delhi. Khan Bahadur Khan led at Bareilly itself.
- Why (3) is wrong: It exchanges Lucknow and Faizabad. The Maulvi did fight at Lucknow, but Faizabad was his centre, and it was Begum Hazrat Mahal who organised the rising at Lucknow.

- Why (4) is wrong: It makes both exchanges, the one in (1) and the one in (3).

Q2. Consider the following statements about the Revolt of 1857:

1. Misgovernment was the ground given for the annexation of Awadh in 1856.
2. Under the General Service Enlistment Act of 1856, new recruits of the Bengal Army had to accept service overseas if ordered.
3. Sir Colin Campbell led the British force that besieged Jhansi in March 1858.
4. Sikh princes of the Punjab, such as the ruler of Patiala, helped the British with soldiers.

Which of the statements given above is/are correct?

- (1) 1 and 2 only
- (2) 2 and 4 only
- (3) 1, 3 and 4 only
- (4) 1, 2 and 4 only

Q2. Answer: (4) 1, 2 and 4 only

- Statement 1 is correct: Nawab Wajid Ali Shah was deposed on the plea of misgovernment, and Awadh was annexed in 1856. Awadh was not a case under the Doctrine of Lapse.
- Statement 2 is correct: The General Service Enlistment Act of 25 July 1856 made every new recruit of the Bengal Army accept service overseas if ordered. Serving sepoys feared that it would be extended to them.
- Statement 3 is wrong: It was Sir Hugh Rose who besieged Jhansi in March 1858. In that month Campbell captured Lucknow.
- Statement 4 is correct: The Sikhs backed the British, and Sikh princes such as those of Patiala, Nabha and Kapurthala helped the British with soldiers.
- Why the other options are wrong: (1) leaves out statement 4, which is correct. (2) leaves out statement 1, which is correct. (3) includes statement 3, which is wrong, and leaves out statement 2, which is correct.

6. Sources

6.1 Sources

No.: S1

Source: NCERT, Themes in Indian History, Part III (Class XII), theme "Rebels and the Raj: The Revolt of 1857 and its Representations", with its Timeline. https://ncert.nic.in/textbook/pdf/lehs302.pdf

Used for: Meerut on 10 May 1857 and Delhi on 11 May; Bahadur Shah's blessing, nominal leadership and the legitimacy it gave; leaders pressed to lead (Nana Sahib, Rani Lakshmi Bai, Kunwar Singh of Arrah); Birjis Qadr and Begum Hazrat Mahal; Shah Mal of pargana Barout (84 villages, killed in July 1857); Gonoo of Singhbhum; Maulvi Ahmadullah Shah (Danka Shah, jailed at Faizabad in 1857, 22nd Native Infantry, Chinhat); subsidiary alliance (Wellesley, 1798; Awadh, 1801); Wajid Ali Shah deposed on the plea of misgovernment and sent to Calcutta, 1856;

Summary Settlement of 1856 and the taluqdars (67 per cent to 38 per cent); "nursery of the Bengal Army"; the cartridge rumour of January 1857 (Dum Dum), bone dust in the flour, the Plassey prophecy of 23 June 1857; sati abolished in 1829; Azamgarh Proclamation of 25 August 1857; attempts to recover Delhi from early June 1857 and forces from the Punjab; Timeline entries (20 to 27 May, 30 May, 30 June, 25 September 1857; June 1858); Henry Lawrence, Havelock, Outram and Campbell at Lucknow; Nana Sahib's escape to Nepal at the end of 1858; Governor General Canning

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No.: S2

Source: NCERT, Our Pasts III (Class VIII), chapter "When People Revolt: 1857 and After", reprint 2024-25. https://ncert.nic.in/textbook/pdf/hess205.pdf

Used for: Residents and the loss of the rulers' power; Rani Lakshmibai's adopted son; Nana Saheb's pension; Awadh (1801, 1856, misgovernment); the Mughal title (Canning's decision of 1856); peasants, moneylenders and land revenue; sepoys and the sea (1824, Burma); the 1856 rule for new recruits; missionaries after 1830; the law of 1850 on converts' inheritance; Mangal Pandey hanged on 8 April 1857 for attacking his officers at Barrackpore; the 85 sepoys dismissed and sentenced to ten years on 9 May 1857; 10 May at Meerut; Nana Saheb proclaims himself Peshwa; Tantia Tope his general; Birjis Qadr proclaimed Nawab and Begum Hazrat Mahal; Rani Avantibai Lodhi of Ramgarh; Ahmadullah Shah of Faizabad; Bakht Khan, a soldier from Bareilly; Kunwar Singh; Delhi recaptured in September 1857; Bahadur Shah tried, sent to Rangoon in October 1858, died in November 1862; Lucknow taken in March 1858; Rani Lakshmibai killed in June 1858; Tantia Tope captured, tried and killed in April 1859; assurances to the rulers after 1858

No.: S3

Source: Encyclopaedia Britannica, "Indian Mutiny". https://www.britannica.com/event/Indian-Mutiny

Used for: Names of the event; sepoys as Indian troops in the Company's service; dates 10 May 1857 to 8 July 1859; Begum Hazrat Mahal's flight to Nepal and her death there in exile (section "Notable figures in the rebellion")

No.: S4

Source: Encyclopaedia Britannica, "India", history section "The mutiny and great revolt of 1857-59". https://www.britannica.com/place/India/The-mutiny-and-great-revolt-of-1857-59

Used for: Bengal Army of about 130,000 Indian troops; General Service Enlistment Act of 1856; Language-policy background; sati, infanticide and widow remarriage; Delhi 40 miles (65 km) from Meerut; Lawrence died on 4 July; Sikh support for the British in the Punjab; Nicholson's siege train; Delhi captured on 20 September; Havelock at the Residency on 25 September and relief in November; Campbell captured Lucknow in March 1858 and campaigned in Avadh and Rohilkhand; Sir Hugh Rose; Gwalior recovered on 20 June 1858, the revolt "virtually over"; Tantia Tope captured in April 1859; Bengal quiet, the south and the west; Canning the first viceroy (1858-62)

No.: S5

Source: Encyclopaedia Britannica, "doctrine of lapse". https://www.britannica.com/topic/doctrine-of-lapse

Used for: Definition; Dalhousie as governor-general (1848-56); dependent Hindu states; general annexation-policy background; the lesson’s dates follow NCERT S14

No.: S6

Source: Encyclopaedia Britannica, "Lakshmi Bai". https://www.britannica.com/biography/Lakshmi-Bai

Used for: Death on 17/18 June 1858 at Kotah-ki-Serai, near Gwalior; killed in combat

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No.: S7

Source: Encyclopaedia Britannica, "Tantia Tope". https://www.britannica.com/biography/Tantia-Tope

Used for: Service under Baji Rao and Nana Sahib; defeat by Sir Colin Campbell on 6 December 1857, after the fighting at Kanpur of 27 and 28 November; attempt to relieve Jhansi in March 1858; the Rani at Kalpi; Gwalior on 1 June 1858; guerrilla fighting; betrayal in April 1859; tried and executed at Shivpuri; died 18 April 1859

No.: S8

Source: Encyclopaedia Britannica, "Nana Sahib". https://www.britannica.com/biography/Nana-Sahib

Used for: Adopted by Baji Rao II; Dalhousie's refusal of the pension; Azimullah Khan; General Wheeler; 27 June 1857; defeats by Havelock and by Campbell (December 1857); driven into the Nepal hills in 1859, where he is thought to have died

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No.: S9

Source: National Institute of Open Schooling (NIOS), Secondary Social Science (213), Lesson 7, "Popular Resistance to the British Rule". https://digital.nios.ac.in/content/213en/Lesson-07.pdf

Used for: Grouping of the causes (political, economic, social and religious, discontent in the army, immediate); machine-made goods and the artisans; Act XXI of 1850; no rise above subedar and lower pay; Khan Bahadur Khan at Bareilly; Azimullah; the revolt largely confined to north and central India; educated Indians and the middle and upper classes; the Act of August 1858 and the Queen's proclamation of 1 November 1858; the date 8 July 1858 for the end of the revolt

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No.: S10

Source: Wikipedia, "Indian Rebellion of 1857" (citing, among others, Philip Mason; Bandyopadhyay 2004, pp. 172-173; Bose and Jalal 2004, pp. 72-73; Malleson; David 2003; Dalrymple 2006; Edwardes). https://en.wikipedia.org/wiki/Indian_Rebellion_of_1857

Used for: General Service Enlistment Act of 25 July 1856 under Canning, for new recruits; Jhansi background; 19th Bengal Native Infantry on 26 February 1857; Mangal Pandey of the 34th Bengal Native Infantry (29 March, court martial on 6 April, hanged two days later); Meerut on 24 April, 9 May and 10 May; Bakht Khan named commander-in-chief; assault on Delhi on 14 September, Archdale Wilson, Humayun's Tomb, Hodson; Wheeler's entrenchment and the Satichaura Ghat; relief of Lucknow, evacuation in November, capture in March 1858; Rose besieges Jhansi in March 1858; Gwalior on 1 June and the Rani's death on 17 June 1858; Danapur, Arrah and Vincent Eyre; Benares, Allahabad and Neill's reprisals; Madras and Bombay armies; Sikh princes and loyal states; Jung Bahadur; hostilities formally ended on 8 July 1859

No.: S11

Source: Wikipedia, "Kunwar Singh" (its references include Kalikinkar Datta, Biography of Kunwar Singh and Amar Singh, 1984, and K. Datta, Unrest Against British Rule in Bihar (1831-1859), 1957, pp. 51-55). https://en.wikipedia.org/wiki/Kunwar_Singh

Used for: Jagdishpur; nearly eighty; Amar Singh; Danapur on 25 July 1857; Eyre on 3 August 1857; victory of 23 April 1858 over Captain Le Grande; death on 26 April 1858

No.: S12

Source: Wikipedia, "Khan Bahadur Khan Rohilla" (citing "Khan Bahadur Khan Rohilla and the War of Independence", The News International, 13 June 2016). https://en.wikipedia.org/wiki/Khan_Bahadur_Khan_Rohilla

Used for: Grandson of Hafiz Rahmat Khan, Regent of Rohilkhand; government at Bareilly; Bareilly captured by the British; escape to Nepal; hanged in 1860

No.: S13

Source: Wikipedia, "Ahmadullah Shah" (citing G.B. Malleson, History of the Indian Mutiny, 1857-1858, and G.W. Forrest, A History of the Indian Mutiny, 1857-58). https://en.wikipedia.org/wiki/Ahmadullah_Shah

Used for: Move to Shahjahanpur after the fall of Lucknow; Campbell at Shahjahanpur and the fighting of May 1858; death on 5 June 1858 at Powayan, north of Shahjahanpur

No.: S14

Source: NCERT, Our Pasts III (Class VIII), chapter "From Trade to Territory: The Company Establishes Power", reprint 2024-25. https://ncert.nic.in/textbook/pdf/hess202.pdf

Used for: Dalhousie as Governor-General from 1848 to 1856; the Doctrine of Lapse and NCERT's list of annexations: Satara (1848), Sambalpur (1850), Udaipur (1852), Nagpur (1853) and Jhansi (1854); Awadh taken over in 1856 on the ground of misgovernment; terms of the subsidiary alliance

No.: S15

Source: The Encyclopaedia of Sikhism (Punjabi University, Patiala), online edition, entry "Narinder Singh, Maharaja (1824-1862)". https://eos.learnpunjabi.org/NARINDER%20SINGH%20MAHARAJA%20(1824-1862).html

Used for: The ruler of Patiala's support to the British in 1857 with guns, carriage, loans and troops

6.2 Additional verification sources · 9 October 2026

- **A1. NCERT via IIT Kanpur SATHEE: From Trade to Territory.** https://sathee.iitk.ac.in/mr/sathee-ssc/student-corner/ncert-books/class-08/social-science/history-our-past-3/chapter-02-from-trade-to-territory-the-company-establishes-power/
- Used for: NCERT annexation years; no unsupported Chota Udaipur identification
- **A2. Bhojpur district: Veer Kunwar Singh.** https://bhojpur.nic.in/tourist-place/veer-kunwar-singh-jayanti/
- Used for: 23 April 1858 victory and 26 April death
- **A3. Adam government education report,1838, reproduced scan.** https://en.wikisource.org/wiki/Page:Adam%27s_reports_on_vernacular_education_in_Bengal_and_Behar%2C_submitted_to_Government_in_1835%2C_1836_and_1838.djvu/365
- Used for: ActXXIX 1837 and replacement of Persian by vernacular languages in specified judicial/revenue proceedings

Topic 42 · Salient features of the Constitution

ENGLISH

1. Concept in one line

The salient features of the Constitution of India are the marks that set it apart, such as its length, a federal system with a strong Centre, the parliamentary form of government, an integrated judiciary, adult franchise and single citizenship; some of them were added by later amendments. The examination asks which Part or Article carries a feature, which amendment added it, and how the figures of 1950 differ from the figures of today.

2. Revision notes

2.1 The lengthiest written constitution: the figures

- The Constitution of India is the longest written national constitution in the world. The Draft Constitution itself had 315 Articles and 8 Schedules, and Dr B.R. Ambedkar said even then that the constitution of no country was so bulky.

Item	At commencement (26 January 1950)	As on 9 October 2026
Articles	395	The last Article is still numbered 395. The total is commonly described as about 470; counting conventions differ
Parts	22	25
Schedules	8	12
Amendment Acts	None	106. The last is the Constitution (One Hundred and Sixth Amendment) Act, 2023

- **Basis of the figures:** the Legislative Department's official Constitution, updated to 1 May 2026, incorporates amendments through the 106th Amendment Act, 2023. A Law Ministry parliamentary reply dated 25 July 2026 also lists the 106th as the latest enacted amendment. Amendment Bill numbers must not be counted as enacted Amendment Acts.
- **Why the last Article is still 395:** a new Article takes a letter after the number (21A, 51A, 243ZH), and an omitted Article leaves its number vacant. The last number is therefore not the total. A count must state whether it includes omitted entries and provisions printed in the official book but invalidated by a court.
- Articles 124A, 124B and 124C are still printed with an explanatory footnote, although the Supreme Court struck down the 99th Amendment that inserted them on 16 October 2015. Printed text and operative provisions are therefore not identical.

- **Parts:** the numbers still run from I to XXII. Four Parts with a letter were inserted (IVA, IXA, IXB and XIVA). Part VII, on the States in Part B of the First Schedule, was omitted when the 7th Amendment (1956) did away with that class of States. The same amendment also omitted the original Part IX. The present Part IX, on the Panchayats, is a new Part, which the 73rd Amendment inserted under the same number in 1993. So the count is: 22 - 2 (the original Parts VII and IX) + 1 (the present Part IX) + 4 (the Parts with a letter) = 25.
- **Schedules:** four were added later, the Ninth to the Twelfth (Topic 412).
- **In the examination:** for 1950 give a Preamble, 395 Articles, 22 Parts and 8 Schedules (Topic 32). For today give about 470 Articles, 25 Parts and 12 Schedules.
- **Why it is so long, and where it came from:** one document provides for the Union (Part V), the States (Part VI) and now the local bodies, with much administrative detail. It was drawn from several sources: mainly the Government of India Act 1935 (Topic 23), and also the constitutions of other countries (Topic 392).

2.2 What was added after 1950

What was added or changed	Amendment	In force from
The words "socialist" and "secular" in the Preamble, and the word "integrity" in "unity and integrity of the Nation"	42nd (Act of 1976)	3 January 1977
Part IVA, Fundamental Duties (Article 51A)	42nd (Act of 1976)	3 January 1977
Part XIVA, Tribunals (Articles 323A and 323B)	42nd (Act of 1976)	3 January 1977
The right to property taken out of Part III: Article 31 was omitted. The right now stands in Article 300A, in Part XII	44th (Act of 1978)	20 June 1979
The voting age in Article 326 lowered from 21 years to 18 years	61st (Act of 1988)	28 March 1989
Part IX, the Panchayats, and the Eleventh Schedule	73rd (Act of 1992)	24 April 1993
Part IXA, the Municipalities, and the Twelfth Schedule	74th (Act of 1992)	1 June 1993
The eleventh Fundamental Duty, clause (k) of Article 51A	86th (Act of 2002)	1 April 2010
Co-operative societies: words added to Article 19(1)(c), a new Article 43B, and Part IXB	97th (Act of 2011)	February 2012

- Before 3 January 1977 the Preamble read "SOVEREIGN DEMOCRATIC REPUBLIC" and "unity of the Nation".

2.3 How power is arranged

(a) A blend of rigidity and flexibility: Part XX, Article 368

- A rigid constitution can be changed only by a special procedure. A flexible constitution can be changed like an ordinary law. The Constitution of India uses both methods.
- Article 368 gives Parliament the power to amend the Constitution and lays down the procedure. An amendment needs a special majority in each House (Topic 104 gives the rule). An amendment that touches the federal scheme must, in addition, be ratified by the Legislatures of not less than one-half of the States.
- Some provisions can be changed by an ordinary law of Parliament, which is not treated as an amendment under Article 368. Topic 33 gave an example: a law extending Part IX to the Scheduled Areas.
- The power has a limit: an amendment cannot alter the basic structure of the Constitution (Topic 123).

(b) A federal system with a unitary bias

- Federalism accommodates two sets of polities, each with its own powers. Article 1 says: "India, that is Bharat, shall be a Union of States." NCERT points out that the Constitution does not even mention the word "federation". Why "Union" was chosen is taken up in Topic 512.

Federal features	Features that give the Centre the upper hand (the unitary bias)
Two sets of government: the Union (Part V) and the States (Part VI)	Article 1 speaks of a "Union of States"
A written Constitution that divides the subjects into three lists: Union, State and Concurrent (Article 246, Seventh Schedule)	Residuary powers, on matters found in none of the lists, belong to Parliament alone (Article 248)
An independent judiciary to settle disputes between the two	Single citizenship, and one system of courts for the whole country
An amendment touching the federal scheme needs ratification by at least half the States	Parliament can alter the boundary of any State, or even its name
The States have Legislatures and Ministries of their own	The Governor is appointed by the President (Article 155) and may reserve a State Bill for the President (Article 200). There are all-India services, and the States depend on grants from the Centre

- NCERT says the emergency provisions can turn the federal polity into a highly centralised system. In Dr Ambedkar's words, the Constitution "can be both unitary as well as federal according to the requirements of time and circumstances". Books call such a system "quasi-federal".

(c) The parliamentary form of government: Articles 74 and 75, 163 and 164

- Dr Ambedkar: "What the Draft Constitution proposes is the Parliamentary system." The President "occupies the same position as the King under the English Constitution".
- The President is the formal (constitutional) head of the Union executive, because Article 53 vests the executive power of the Union in the President. The real executive is the Council of Ministers, with the Prime Minister at its head. This is the sense of Dr Ambedkar's phrase that the President is "the head of the State but not of the Executive".
- A Council of Ministers aids and advises the President (Article 74) and, in a State, the Governor (Article 163). Articles 75 and 164 carry the other provisions as to Ministers. The real power lies with the Ministers, who answer to the legislature. The President and the Governor are formal heads (Topic 4).
- Dr Ambedkar said the Draft "preferred more responsibility to more stability". Topic 253 compares the parliamentary and presidential systems.

(d) Parliamentary sovereignty and judicial supremacy, brought together

- Guidebooks call this feature a synthesis of parliamentary sovereignty, which is the British idea, and judicial supremacy, which goes with the American idea of judicial review.
- The courts' side: a law that takes away or abridges a Fundamental Right is void to the extent of the contravention (Article 13). The Supreme Court (Article 32) and the High Courts (Article 226) can be moved against such a law.
- Parliament's side: it makes the laws, and it can amend the Constitution under Article 368.
- Neither is supreme. The exact name is constitutional supremacy, as against the parliamentary supremacy of the United Kingdom.

(e) An integrated and independent judiciary

- There is one system of courts: the Supreme Court at the top (Article 124), the High Courts below it (Article 214), and the district courts and other subordinate courts under the High Courts (Article 233 onwards).
- "Integrated" means that this one set of courts decides cases under Union laws and State laws alike. The federal system has two sets of government, but not two sets of courts.
- "Independent" means free from the control of the executive and the legislature. The independence of the judiciary has been held to be a basic feature of the Constitution. Topic 112 covers the courts.

2.4 The citizen and the State

- **Fundamental Rights: Part III, Articles 12 to 35.** They can be enforced in court, and Article 32 gives the remedy. The right to property was one of them until 20 June 1979.
- **Directive Principles of State Policy: Part IV, Articles 36 to 51.** They are aims for the State to follow in its laws and policies. They are non-justiciable, that is, a court cannot enforce them. An example is Article 40, on village panchayats (Topic 33).

- **Fundamental Duties: Part IVA, Article 51A.** They were not in the Constitution of 1950. Article 51A now lists eleven duties, in clauses (a) to (k). Ten came in 1977, and clause (k) was added by the 86th Amendment.
- **Secular State.** The word "secular" entered the Preamble only in 1977. The substance was there from 1950: the State has no religion of its own, and Part III gives the Right to Equality (Articles 14 to 18) and the Freedom of Religion (Articles 25 to 28).
- **Universal adult franchise: Article 326.** Elections to the Lok Sabha (House of the People) and to the Legislative Assemblies of the States are held on the basis of adult suffrage. The voting age was 21 years in 1950 and has been 18 years since 28 March 1989. Compare the 1935 Act, under which no more than 10 to 15 per cent of the adult population had the vote (Topic 23).
- **Single citizenship: Part II, Articles 5 to 11.** Dr Ambedkar called the Constitution "a dual polity with a single citizenship". There is no separate citizenship of a State, though some federal countries have dual citizenship. Parliament regulates citizenship by law (Article 11; Topic 542).

2.5 Independent bodies, emergencies, local government and co-operative societies

- **Independent bodies.** The Constitution itself sets up certain bodies, so that they do not depend on the government of the day.

Body	Article	Part
Election Commission	324	XV, Elections
Comptroller and Auditor-General of India (CAG)	148	V, The Union
Public Service Commissions for the Union and for the States	315	XIV, Services
Finance Commission	280	XII, Finance

- **Emergency provisions: Part XVIII, Articles 352 to 360.** The Part provides for a Proclamation of Emergency (Article 352), for the failure of constitutional machinery in a State (Article 356) and for a financial emergency (Article 360). Topic 373 covers them.
- **Three-tier government.** In 1950 the Constitution provided for two levels of government, the Union and the States. Village panchayats were only a Directive Principle (Article 40). The 73rd and 74th Amendments added a third level with constitutional status: the Panchayats for rural areas (Part IX) and the Municipalities for urban areas (Part IXA).
- **Co-operative societies: the 97th Amendment.** It did three things. (1) It added the words "or co-operative societies" to Article 19(1)(c), so that forming a co-operative society became part of a Fundamental Right. (2) It added a Directive Principle, Article 43B, on the promotion of co-operative societies. (3) It added Part IXB, "The Co-operative Societies", with 13 Articles (243ZH to 243ZT).
- **What the Supreme Court did to Part IXB.** In Union of India v. Rajendra N. Shah (20 July 2021) a Bench of three judges decided, by 2 to 1, as follows:
- Co-operative societies are a State subject (Entry 32 of the State List). Part IXB cut down the States' power over them.

- Such an amendment needs ratification by the Legislatures of not less than one-half of the States. The 97th Amendment had not been ratified.
- So Part IXB was struck down so far as it concerns co-operative societies that come under the States.
- Part IXB remains operative for multi-State co-operative societies, in the States and in the Union territories.
- The words added to Article 19(1)(c), and Article 43B, still stand in the official text.

3. Extra section: the Parts of the Constitution as on 9 October 2026

Part	Heading in the Constitution	Articles	What to remember
I	The Union and its Territory	1 to 4	"Union of States" (Article 1)
II	Citizenship	5 to 11	Single citizenship
III	Fundamental Rights	12 to 35	Articles 13 and 32
IV	Directive Principles of State Policy	36 to 51	Articles 40 and 43B
IVA	Fundamental Duties	51A	Inserted by the 42nd Amendment
V	The Union	52 to 151	President, Council of Ministers, Parliament, Supreme Court, CAG
VI	The States	152 to 237	Governor, Council of Ministers, State Legislature, High Courts, subordinate courts
VII	Omitted	238, also omitted	Omitted by the 7th Amendment, 1956
VIII	The Union Territories	239 to 242	Article 242 is omitted
IX	The Panchayats	243 to 243-O	Inserted by the 73rd Amendment
IXA	The Municipalities	243P to 243ZG	Inserted by the 74th Amendment
IXB	The Co-operative Societies	243ZH to 243ZT	Inserted by the 97th Amendment
X	The Scheduled and Tribal Areas	244 to 244A	Fifth and Sixth Schedules (Topic 933)
XI	Relations between the Union and the States	245 to 263	Three lists (Article 246); residuary powers (Article 248)

Part	Heading in the Constitution	Articles	What to remember
XII	Finance, Property, Contracts and Suits	264 to 300A	Finance Commission (Article 280); property (Article 300A)
XIII	Trade, Commerce and Intercourse within the Territory of India	301 to 307	Article 306 is omitted
XIV	Services under the Union and the States	308 to 323	Public Service Commissions (Article 315)
XIVA	Tribunals	323A and 323B	Inserted by the 42nd Amendment
XV	Elections	324 to 329A	Election Commission (Article 324); adult suffrage (Article 326); Article 329A was omitted by the 44th Amendment
XVI	Special Provisions relating to Certain Classes	330 to 342A	Reserved seats in the legislatures
XVII	Official Language	343 to 351	Topic 954
XVIII	Emergency Provisions	352 to 360	Articles 352, 356 and 360
XIX	Miscellaneous	361 to 367	Stands between Parts XVIII and XX
XX	Amendment of the Constitution	368	A Part with a single Article
XXI	Temporary, Transitional and Special Provisions	369 to 392	Articles 379 to 391 are omitted
XXII	Short Title, Commencement, Authoritative Text in Hindi and Repeals	393 to 395	Article 395 is the last Article

- Count the rows: there are 26. One of them, Part VII, is omitted. That leaves 25 Parts.
- The inserted Parts came in this order: Parts IVA and XIVA in 1977, the present Part IX and Part IXA in 1993, and Part IXB in 2012.

4. Three common exam traps

1. **"Union of States" is not "federation of States", and "federal" is not "unitary".** Article 1 calls India a "Union of States", and the Constitution does not even mention the word "federation". Yet the structure is federal: there are two sets of government and three lists of subjects. The safe description is "a federal system with a unitary bias". A statement that calls the Constitution purely federal, or purely unitary, is wrong. Remember also that the federal system here does not bring two citizenships or two sets of courts.

2. **The figures of 1950 are not today's figures, and the last number is not the count.** 395 Articles, 22 Parts and 8 Schedules describe the Constitution at its commencement. Today it has about 470 Articles, 25 Parts and 12 Schedules, although the last Article is still numbered 395 and the last Part is still Part XXII. In the same way, the words "socialist", "secular" and "integrity" were not in the Preamble of 1950: they came in on 3 January 1977. And the right to property has not vanished. It has only moved out of Part III, to Article 300A.
3. **The parliamentary form is not parliamentary sovereignty.** The Constitution follows the British parliamentary system, but not the British rule that Parliament is supreme. A law made by Parliament can be declared void under Article 13, and even an amendment made under Article 368 cannot alter the basic structure. The courts are not supreme either: the Constitution is. Note also that the President is the formal (constitutional) head of the Union executive, because Article 53 vests the executive power of the Union in the President. The real executive is the Council of Ministers headed by the Prime Minister. Dr Ambedkar's phrase "the head of the State but not of the Executive" means only this. So a statement that the President is the constitutional head of the executive is correct.

5. MCQs with answers and explanations

Q1. Consider the following statements about the features of the Constitution of India:

1. When the Constitution commenced, the voting age under Article 326 was 21 years.
2. Part IVA, on Fundamental Duties, was inserted by the 44th Amendment Act of 1978.
3. The Supreme Court has held that Part IXB is inoperative for multi-State co-operative societies.

Which of the statements given above is/are correct?

- (1) 1 only
- (2) 1 and 2 only
- (3) 1 and 3 only
- (4) 2 and 3 only

Q1. Answer: (1) 1 only

- Statement 1 is correct: Article 326 has provided for elections on the basis of adult suffrage since 1950, and the voting age then was 21 years. The 61st Amendment lowered it to 18 years with effect from 28 March 1989. That amendment did not bring in adult franchise. It only changed the age.
- Statement 2 is wrong: Part IVA was inserted by the 42nd Amendment Act of 1976, with effect from 3 January 1977. The 44th Amendment Act of 1978 is the one that omitted Article 31 and so took the right to property out of Part III.
- Statement 3 is wrong: It is the other way round. In Union of India v. Rajendra N. Shah (20 July 2021) the Supreme Court struck down Part IXB so far as it concerns co-operative societies that come under the States, because the 97th Amendment had not been ratified by the Legislatures of at least half the States. It held that Part IXB remains operative for multi-State co-operative societies.

- Why the other options are wrong: (2) includes statement 2, which is wrong. (3) includes statement 3, which is wrong. (4) includes statements 2 and 3, which are both wrong, and leaves out statement 1, which is correct.

Q2. Match List I (subjects dealt with in the Constitution) with List II (the Parts that deal with them):

List I	List II
A. Emergency Provisions	1. Part IXB
B. Amendment of the Constitution	2. Part XX
C. The Municipalities	3. Part XVIII
D. The Co-operative Societies	4. Part IXA

- (1) A-2, B-3, C-4, D-1
- (2) A-3, B-2, C-1, D-4
- (3) A-3, B-2, C-4, D-1
- (4) A-2, B-3, C-1, D-4

Q2. Answer: (3) A-3, B-2, C-4, D-1

- Why it is correct: Emergency Provisions form Part XVIII, Articles 352 to 360 (A-3). Amendment of the Constitution is Part XX, which has a single Article, 368 (B-2). The Municipalities are in Part IXA, inserted by the 74th Amendment (C-4). The Co-operative Societies are in Part IXB, inserted by the 97th Amendment (D-1).
- Why (1) is wrong: It exchanges Parts XVIII and XX. Part XX has only Article 368, on amendment. The emergency Articles, 352 to 360, are in Part XVIII. Part XIX, Miscellaneous, stands between the two.
- Why (2) is wrong: It exchanges Parts IXA and IXB. The letters follow the order in which the Parts were inserted: the Municipalities in 1993, the Co-operative Societies in 2012.
- Why (4) is wrong: It exchanges both Parts XVIII and XX and Parts IXA and IXB, so all four of its pairs are wrong.

6. Sources

6.1 Sources

No.: S1

Source: Government of India, Ministry of Law and Justice, Legislative Department, The Constitution of India [As on 1st May, 2024], official text with footnotes. https://cdnbbsr.s3waas.gov.in/s380537a945c7aaa788ccfcdf1b99b5d8f/uploads/2024/07/20240716890312078.pdf

Used for: Title page "[As on 1st May, 2024]"; Preface: text brought up to date "by incorporating therein all the amendments up to the Constitution (One Hundred and Sixth Amendment) Act, 2023". Contents: the list of Parts I to XXII with Parts IVA, IXA, IXB and XIVA, "[PART VII.-Omitted]", the heading of each Part and its first and last Article; Article numbering, omitted entries and explanatory footnotes (not a certified exact total); the twelve Schedules; Article 395 as the last Article; headings of Articles 1, 13, 32, 40, 43B, 51A, 74, 75, 124, 148, 163, 164, 214, 226, 233, 280, 300A, 315, 323A, 323B, 324, 326, 352, 356, 360 and 368; headings of Articles 9 and 11. Text and footnotes: Preamble words substituted by the Forty-second Amendment Act, 1976 with effect from 3 January 1977, for "SOVEREIGN DEMOCRATIC REPUBLIC" and "Unity of the Nation"; Article 1(1); Article 13(2); "or co-operative societies" in Article 19(1)(c), inserted by the Ninety-seventh Amendment Act, 2011, s. 2; clause (k) of Article 51A, inserted by the Eighty-sixth Amendment Act, 2002, s. 4, with effect from 1 April 2010; Article 31 omitted by the Forty-fourth Amendment Act, 1978, s. 6, with effect from 20 June 1979; Article 43B, on the promotion of co-operative societies, inserted by the Ninety-seventh Amendment Act, 2011, s. 3, with effect from 15 February 2012; Part IVA inserted by the Forty-second Amendment Act, 1976, s. 11, with effect from 3 January 1977; eleven duties in clauses (a) to (k) of Article 51A

No.: S2

Source: NCERT, Indian Constitution at Work (Class XI), Chapter 7, "Federalism", reprint 2026-27. https://ncert.nic.in/textbook/pdf/keps207.pdf

Used for: "India, that is Bharat, shall be a Union of States"; "the Constitution of India does not even mention the word federation"; federalism as "an institutional mechanism to accommodate two sets of polities"; the Union, State and Concurrent Lists and residuary powers with the Union Legislature alone; "an independent judiciary to settle disputes"; "India has only a single citizenship", and dual citizenship in some federal countries; Parliament can "alter the boundary of any State or even its name"; emergency provisions "which can turn our federal polity into a highly centralised system"; the States "mostly dependent on the grants and financial assistance from the centre"; the Governor's power to reserve a Bill for the President; all-India services

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No.: S3

Source: Constituent Assembly Debates, 4 November 1948 (Volume VII), Dr B.R. Ambedkar's speech on the Draft Constitution, paragraphs 7.48.193 to 7.48.213, Constitution of India project, Centre for Law and Policy Research. https://www.constitutionofindia.net/debates/04-nov-1948/

Used for: "It contains 315 Articles and 8 Schedules"; "the Constitution of no country could be found to be so bulky as the Draft Constitution"; "What the Draft Constitution proposes is the Parliamentary system"; "the President occupies the same position as the King under the English Constitution"; "He is the head of the State but not of the Executive"; "preferred more responsibility to more stability"; "a dual polity with a single citizenship"; "can be both unitary as well as federal according to the requirements of time and circumstances"

No.: S4

Source: SCC Online (Eastern Book Company), report of Union of India v. Rajendra N. Shah, 2021 SCC OnLine SC 474, decided on 20 July 2021. https://www.scconline.com/blog/post/2021/07/21/constitution-97th-amendment-act-2011/

Used for: Date; Bench of R.F. Nariman, B.R. Gavai and K.M. Joseph, JJ.; decided 2:1, with Joseph, J. partly dissenting; Part IXB held ultra vires in so far as it concerns co-operative societies, for want of ratification under the proviso to Article 368(2) by "the legislatures of not less than one-half of the States"; co-operative societies under Entry 32 of List II, which Part IXB curtails; "Part IX-B of the Constitution of India is operative insofar as Multi-State Cooperative Societies are concerned", in the States and in the Union territories; the Gujarat High Court's judgment under appeal

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No.: S5

Source: Wikipedia, "List of amendments of the Constitution of India" (a secondary source: a table of the amendment Acts, one row for each Act). https://en.wikipedia.org/wiki/List_of_amendments_of_the_Constitution_of_India

Used for: "As of March 2026, there have been 106" amendments; the last row is the 106th, enforced since 28 September 2023; 7th Amendment, 1 November 1956, abolishing the Class A, B, C and D States; 42nd Amendment imposing fundamental duties; 44th Amendment and the right to property; 61st Amendment amending Article 326, enforced since 28 March 1989, "Reduce age for voting rights from 21 to 18"; 73rd Amendment (Part IX and the Eleventh Schedule, 24 April 1993); 74th Amendment (Part IXA and the Twelfth Schedule, 1 June 1993); 97th Amendment (Article 19, Article 43B and Part IXB) and the Supreme Court's decision of July 2021; 99th Amendment inserting Articles 124A, 124B and 124C, struck down on 16 October 2015

No.: S6

Source: Wikipedia, "Constitution of India" (a secondary source, used for its summary figures and descriptions). https://en.wikipedia.org/wiki/Constitution_of_India

Used for: "the longest written national constitution in the world"; at enactment "395 articles in 22 parts and 8 schedules"; now "a preamble and 470 articles", "grouped into 25 parts", with 12 schedules; amended 106 times; "federal in nature, and unitary in spirit", "quasi-federal"; "single citizenship"; drawn "from a number of sources, mainly the Government of India Act 1935"; "espouses constitutional supremacy", not the parliamentary supremacy of the United Kingdom; judicial review adopted from the United States; an independent judiciary held to be a basic feature; an amendment cannot alter the basic structure; ratification of certain amendments by State legislatures; Part VII as the Part on the States in Part B of the First Schedule (repealed); "socialist", "secular" and "integrity" added in 1976 by the 42nd Amendment

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No.: S7

Source: Earlier topics of this programme, read for consistency: Topic 4, "Governor" (its sources include the official text of Parts V and VI hosted by the Ministry of External Affairs, https://www.mea.gov.in/Images/pdf1/Part5.pdf and https://www.mea.gov.in/Images/pdf1/Part6.pdf , and Shamsher Singh v. State of Punjab, https://indiankanoon.org/doc/1382698/); Topic 23, "Government of India Act 1935 and the Indian Independence Act 1947" (its sources include the text of Articles 163, 246 and 248, https://www.constitutionofindia.net/articles/article-248-residuary-powers-of-legislation/ , and NCERT, https://ncert.nic.in/textbook/pdf/lehs304.pdf); Topic 32, "Making of the Constitution" (NCERT, https://ncert.nic.in/textbook/pdf/keps201.pdf); Topic 33, "73rd Amendment and Panchayati Raj" (the Act, https://constitution.org/1-Constitution/cons/india/tamnd73.htm , NCERT, https://ncert.nic.in/textbook/pdf/keps208.pdf , and Article 243M, https://www.constitutionofindia.net/articles/article-243m-part-not-to-apply-to-certain-areas/)

Used for: Topic 4: the Governor appointed by the President (Article 155); reservation of a Bill for the President (Article 200); Articles 74 and 163; Shamsher Singh (1974), the Governor, like the President, a formal head. Topic 23: three lists (Article 246) and residuary powers with Parliament (Article 248); administrative detail taken from the 1935 Act; franchise under the 1935 Act, no more than 10 to 15 per cent of the adult population. Topic 32: a Preamble, 395 Articles in 22 Parts and 8 Schedules. Topic 33: Article 40 as a non-justiciable Directive Principle; the 73rd Amendment Act of 1992; Part IX and the Eleventh Schedule in force from 24 April 1993; Scheduled Areas and tribal areas under Article 244; a law under Article 243M not treated as an amendment under Article 368

No.: S8

Source: Supreme Court of India, judgment in Union of India v. Rajendra N. Shah, Civil Appeal Nos. 9108-9109 of 2014 with connected appeals, judgment of R.F. Nariman, J., judgment file dated 20 July 2021. https://api.sci.gov.in/supremecourt/2013/21321/21321_2013_32_1501_28728_Judgement_20-Jul-2021.pdf

Used for: The Constitution (Ninety-seventh Amendment) Act, 2011 came into force on 15 February 2012; the Gujarat High Court's judgment of 22 April 2013, which does not touch the amendment made in Article 19(1)(c) or the insertion of Article 43B (paragraph 2); co-operative societies under Entry 32 of List II, "entirely a matter for the States to legislate upon", and multi-State co-operative societies under Entry 44 of List I (paragraph 23); the proviso to Article 368(2), ratification by the Legislatures of "not less than one-half of the States" (paragraph 27); the Amendment "has not been

so ratified" (paragraph 32); Part IXB "would therefore require ratification" under sub-clauses (b) and (c) of the proviso (paragraph 67); Article 243ZH, definition of a multi-State co-operative society as one "with objects not confined to one State"

No.: S9

Source: Government of India, The Constitution of India, Part XV, "Elections" (official text with footnotes, copy hosted by the Ministry of External Affairs). https://www.mea.gov.in/Images/pdf1/Part15.pdf

Used for: Text of Article 326: elections to the House of the People and to the Legislative Assembly of every State "shall be on the basis of adult suffrage"; "eighteen years" substituted by the Constitution (Sixty-first Amendment) Act, 1988, s. 2, for "twenty-one years"; Part XV runs from Article 324 to Article 329A; Article 329A repealed by the Forty-fourth Amendment Act, 1978, s. 36, with effect from 20 June 1979

No.: S10

Source: PRS Legislative Research, "Session Wrap", Monsoon Session 2026 of Parliament (20 July to 13 August 2026). https://prsindia.org/sessiontrack/monsoon-session-2026/session-wrap

Used for: The twelve Government Bills passed by Parliament in the session include no Constitution (Amendment) Bill; the Constitution (129th Amendment) Bill, 2024 and the Constitution (130th Amendment) Bill, 2025 stand referred to Joint Committees. Used with S5 for the figure of 106 amendment Acts

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No.: S11

Source: Government of India, The Constitution of India, Part V, "The Union", and Part IX, "The Panchayats" (official text with footnotes, copies hosted by the Ministry of External Affairs). https://www.mea.gov.in/Images/pdf1/Part5.pdf and https://www.mea.gov.in/Images/pdf1/Part9.pdf

Used for: Article 53(1): "The executive power of the Union shall be vested in the President"; Article 74(1): a Council of Ministers "with the Prime Minister at the head"; footnote to the heading of Part IX: inserted by the Constitution (Seventy-third Amendment) Act, 1992, s. 2, with effect from 24 April 1993, and "Original Part IX was omitted by the Constitution (Seventh Amendment) Act, 1956, s. 29 and Sch."

No.: S12

Source: Text of the Constitution (Seventy-fourth Amendment) Act, 1992 (a private copy of the Act, on the site that Topic 33 used for the Seventy-third Amendment Act). https://constitution.org/1-Constitution/cons/india/tamnd74.htm

Used for: Title of the Act, "THE CONSTITUTION (SEVENTY-FOURTH AMENDMENT) ACT, 1992"; section 2, "Insertion of new Part IXA". Used for the year of the Act in the table in 2.2

6.2 Additional verification sources · 9 October 2026

- **A1. Legislative Department: Constitution as on 1 May 2026.** https://www.legislative.gov.in/static/uploads/2025/07/88cca69e868e50b217f855be2fb8bdba.pdf
- Used for: Current official edition, amendments through 106 th, inserted/omitted provisions and commencement footnotes
- **A2. Law Ministry parliamentary reply,25 July 2026.** https://www.pib.gov.in/PressReleasePage.aspx?PRID=2289474
- Used for: Enacted amendment series through 106 th
- **A3. Supreme Court: Union of India v Rajendra N Shah,20 July 2021.** https://api.sci.gov.in/supremecourt/2013/21321/21321_2013_32_1501_28728_Judgement_20-Jul-2021.pdf

- Used for: PartIXB decision, including paragraph 80; multi-State cooperative and Union Territory distinction

Topic 43 · RBI: functions and monetary policy tools

ENGLISH

1. Concept in one line

The Reserve Bank of India (RBI) is India's central bank: it issues bank notes, acts as banker to the Government and to banks, regulates the financial system and runs monetary policy. The examination asks about its history and organisation, its functions, and what a rise or a fall in each tool of monetary policy does.

2. Revision notes

2.1 How the RBI came to be

Date	Event
1926	The Royal Commission on Indian Currency and Finance, known as the Hilton Young Commission, recommended the setting up of a central bank. The RBI was set up on the basis of its recommendations
1934	The Reserve Bank of India Act, 1934 (Act II of 1934; here "the RBI Act") gave the Bank its statutory basis
1 April 1935	The RBI began work, as a shareholders' bank. Its first Governor was Sir Osborne Smith
1937	The Central Office, first set up in Kolkata (Calcutta), was moved permanently to Mumbai (Bombay)
1 January 1949	The RBI was nationalised. Since then it has been fully owned by the Government of India

- **The RBI Act:** its Preamble says the Bank was constituted to regulate the issue of bank notes and the keeping of reserves, with a view to securing monetary stability in India. The RBI is a body corporate (section 3), with a capital of Rs 5 crore (section 4).

2.2 Who runs the RBI

- **Section 7:** the Central Government may give the RBI such directions as it considers necessary in the public interest, after consultation with the Governor. Subject to such directions, the Central Board of Directors has the general superintendence and direction of the Bank's affairs.
- The Central Government appoints or nominates every member of the Central Board.

Part of the Central Board	Members	Number	Point to note
Official directors	The Governor and the Deputy Governors, all full-time	1 Governor and not more than 4 Deputy Governors	The Central Government appoints them for a term that it fixes, not exceeding five years; they can be reappointed
Non-official directors	Directors nominated from various fields	10	Their term is four years
Non-official directors	Government officials	2	They hold office at the pleasure of the Central Government
Non-official directors	One director from each of the four Local Boards	4	They too are nominated by the Central Government

- So the Central Board can have at most 21 members: 1 + 4 + 10 + 2 + 4.
- **Local Boards:** there are four, at Mumbai, Kolkata, Chennai and New Delhi. Each has five members, appointed by the Central Government for four years. A Local Board advises the Central Board on matters referred to it.
- **Office holders (the RBI's list of its Central Board, seen on 9 October 2026):** the Governor is Shri Sanjay Malhotra. The four Deputy Governors are Shri Swaminathan J, Dr Poonam Gupta, Shri Shirish Chandra Murmu and Shri Rohit Jain.

2.3 Functions, as the RBI itself lists them

The RBI lists six main functions and two "related functions".

Function	What the RBI does	Law or link to remember
Monetary authority	It formulates, implements and monitors monetary policy. The aim is price stability, keeping in mind the objective of growth	RBI Act, 1934, as amended in May 2016
Regulator and supervisor of the financial system	It lays down the broad parameters within which banks work, to protect depositors' interest and keep public confidence in the system	Banking Regulation Act, 1949 (Topic 34)
Manager of foreign exchange	It manages the Foreign Exchange Management Act, 1999 (FEMA), to facilitate external trade and payments	FEMA, 1999. NCERT also calls the central bank the custodian of the foreign exchange reserves
Issuer of currency	It issues, exchanges and destroys currency notes, and puts into circulation the coins minted by the Government	Section 22 of the RBI Act (see 2.4)

Function	What the RBI does	Law or link to remember
Developmental role	It performs promotional functions in support of national objectives	It helped to set up the National Bank for Agriculture and Rural Development (NABARD)
Regulator and supervisor of payment and settlement systems	It introduces and upgrades safe and efficient payment systems	Payment and Settlement Systems Act, 2007
Banker to the Government (related function)	It is banker and merchant banker to the Central and State Governments, and it manages the public debt	Central Government: sections 20 and 21 of the RBI Act. A State Government: by agreement, under section 21A
Banker to banks (related function)	It maintains the banking accounts of all scheduled banks	The balances that banks keep for the cash reserve ratio (CRR) lie in these accounts: the "bankers' deposits" of Topic 24

- **Lender of last resort:** the RBI can support a solvent bank facing temporary liquidity problems when other lenders are unwilling. This backstop protects depositors and helps prevent a banking problem from spreading; it is not an unconditional promise to rescue every insolvent bank.

2.4 Issuer of currency: who issues what

Item	Issued by	Law	Point to note
Bank notes	The RBI	Section 22 of the RBI Act: the RBI has the sole right to issue bank notes in India	No note can be of a value above Rs 10,000 (section 24). Every bank note is guaranteed by the Central Government (section 26)
One-rupee note	The Government of India	Coinage Act, 2011	It is legal tender
Coins	The Government of India, which designs and mints them	Coinage Act, 2011	Coins of up to Rs 1,000 can be issued under this Act. Coins are issued for circulation only through the RBI (section 38 of the RBI Act)

- Rs 2 and Rs 5 notes are no longer printed; existing notes remain legal tender, while these denominations are now issued as coins (the RBI's questions and answers on Indian currency, updated on 15 April 2025).

2.5 Monetary policy: target and two kinds of tools

- **Target:** inflation of 4 per cent by the Consumer Price Index (CPI), with a lower limit of 2 per cent and an upper limit of 6 per cent, retained up to 31 March 2031 (Topic 13). A Monetary Policy Committee (MPC) of six members, chaired by the Governor, decides the policy repo rate (Day 17).
- **How it works:** the RBI manages liquidity, that is, the funds available with banks from day to day, so that the weighted average call rate (WACR), its operating target, stays close to the policy repo rate.
- **Two kinds of tools (NCERT):** quantitative tools control the extent of money supply as a whole. Qualitative tools, also called selective credit controls, work on the lending decisions of banks, through persuasion and through rules for particular kinds of loans.
- **Two words:** "tightening" makes credit costlier or scarcer, to bring inflation down. "Easing" does the opposite, to support growth.

2.6 Quantitative tools

One basis point is one-hundredth of a percentage point.

Tool	What it is	Tightening move and its effect	Easing move and its effect
Cash reserve ratio (CRR)	The average daily balance that a bank must keep with the RBI, as a percentage of its net demand and time liabilities (NDTL); section 42(1) of the RBI Act	A rise: banks have less to lend, and the money multiplier falls (Topic 24)	A cut: banks have more to lend, and the money multiplier rises
Statutory liquidity ratio (SLR)	The share of its demand and time liabilities that a bank must hold in liquid assets: unencumbered government securities, cash and gold	A rise: less of a bank's funds is left for loans	A cut: more of a bank's funds can go into loans
Policy repo rate	The rate at which the RBI lends to banks under the liquidity adjustment facility (LAF), against the collateral of government and other approved securities	A rise: loans become costlier, and borrowing and spending slow down	A cut: loans become cheaper, and borrowing and spending pick up
Standing deposit facility (SDF) rate	The rate at which the RBI accepts overnight deposits from banks without giving any collateral; 25 basis points below the repo rate	It rises with the repo rate	It falls with the repo rate
Marginal standing facility (MSF) rate	A penal rate at which banks borrow overnight from the RBI by dipping into their SLR securities, up to a limit; 25 basis points above the repo rate	It rises with the repo rate	It falls with the repo rate

Tool	What it is	Tightening move and its effect	Easing move and its effect
Bank Rate	The rate at which the RBI is ready to buy or rediscount bills of exchange or other commercial paper (section 49 of the RBI Act). It is aligned with the MSF rate and is the reference rate for penal interest on CRR/SLR shortfalls; the applicable penalty adds a prescribed margin to the Bank Rate	It rises with the MSF rate. NCERT: a higher bank rate reduces money supply	It falls with the MSF rate. NCERT: a fall in the bank rate can increase money supply
Reverse repo rate	The rate at which the RBI absorbs liquidity from banks against government securities. Since the SDF came, fixed rate reverse repo operations are at the RBI's discretion	A rise: banks earn more interest on the funds that the RBI takes in from them under a reverse repo	A cut: banks earn less interest on the funds that the RBI takes in from them under a reverse repo
Open market operations (OMOs)	Outright purchase or sale of government securities by the RBI, to inject or absorb durable (long-lasting) liquidity	A sale: the reserves of banks and the money supply fall	A purchase: the reserves of banks and the money supply rise
Market Stabilisation Scheme (MSS)	The Government of India issues Treasury Bills and dated securities under a memorandum of understanding with the RBI, and the RBI auctions them. The money stays in a separate cash account with the RBI, used only to redeem or buy back these securities	An issue of MSS securities absorbs excess liquidity	On redemption the money goes back to the holders

- **LAF:** the RBI's operations to inject liquidity into the banking system or to absorb it: repos and reverse repos (overnight and term), the SDF and the MSF.
- **The current corridor:** the MSF rate is the ceiling, the SDF rate is the floor and the repo rate is in the middle, so the corridor is 50 basis points wide. The SDF came in April 2022 and replaced the fixed reverse repo rate as the floor.
- **Sterilisation:** capital flowing in from abroad adds to liquidity at home, and the RBI offsets this by absorbing liquidity. The MSS was made to help these operations.
- **Bank Rate and penalties, 7 October 2026:** Bank Rate is 5.75 per cent. RBI prescribed penal rates of Bank Rate plus 3 or 5 percentage points, depending on the duration of a reserve shortfall: 8.75 or 10.75 per cent.
- **CRR announcement, 9 October 2026:** the CRR ratio remains 3 per cent. The minimum maintained on each day of the reporting fortnight increases from 90 to 99 per cent of the required CRR only from the fortnight beginning 16 October 2026; the fortnightly average must still meet the full prescribed CRR. Do not confuse this daily-maintenance rule with a change in the CRR ratio.

2.7 Qualitative tools

Tool	What it means	Tightening move
Margin requirements	The margin is the part of the value of a security against which the bank does not lend. The RBI can fix minimum margins for loans against specific securities	A higher margin. With a margin of 30 per cent, a security worth Rs 100 gets a loan of Rs 70; with 50 per cent, only Rs 50
Credit rationing	A ceiling on the amount of credit for certain purposes	A lower ceiling
Moral suasion	Persuasion: the RBI persuades banks, for example through meetings, to lend more or to lend less. It is a request, not an order	Banks are asked to hold back their lending
Direct action	Action against a bank that does not keep to the RBI's requirements: for example, penal interest on a bank that falls short of its reserve requirements	Stricter penalties

2.8 The rates as on 9 October 2026

- The MPC held its 63rd meeting from 5 to 7 October 2026. On 7 October 2026 it raised the policy repo rate by 25 basis points to 5.50 per cent, by a unanimous vote, and changed its stance to "calibrated tightening". It projected CPI inflation of 5.2 per cent for 2026-27. Its resolution announced no change in the CRR or the SLR.
- The next meeting is fixed for 2 to 4 December 2026, so these rates can change before the examination. Check the "Current Rates" box on the RBI's website.

Rate or ratio	Level (per cent) in the "Current Rates" box on the RBI's home page, as seen on 9 October 2026
Policy repo rate	5.50
SDF rate	5.25
MSF rate	5.75
Bank Rate	5.75
Fixed reverse repo rate (no longer the floor of the corridor)	3.35
CRR (per cent of NDTL)	3.00
SLR (per cent of demand and time liabilities)	18.00

Covered on other days: the Monetary Policy Committee and inflation targeting in detail (Day 17); the money market, where the call rate and Treasury Bills belong (Day 65).

3. Extra section: a rate decision followed step by step, and the corridor worked out

A. From the MPC's decision to prices.

1. The MPC raises the policy repo rate. On 7 October 2026 it raised the rate by 25 basis points, to 5.50 per cent.
2. The corridor moves with it: the SDF rate, the MSF rate and the Bank Rate rise by the same 25 basis points.
3. Through the LAF, the RBI manages liquidity so that the WACR stays close to the new repo rate.
4. Funds cost banks more, so loan rates tend to rise.
5. Borrowing and spending slow down, so aggregate demand (the total demand in the economy) grows more slowly.
6. The pressure of demand on prices eases (the demand-pull inflation of Topic 13). A cut in the repo rate works the same way in reverse.

B. Working out the corridor. The first row is the actual position. The other two rows are invented repo rates, for practice only.

Policy repo rate	SDF rate (repo minus 0.25)	MSF rate (repo plus 0.25)	Bank Rate (same as MSF)	Width of the corridor
5.50 (actual, 7 October 2026)	5.25	5.75	5.75	0.50
6.00 (invented)	5.75	6.25	6.25	0.50
5.00 (invented)	4.75	5.25	5.25	0.50

C. Tightening and easing at a glance.

Tool	To bring inflation down (tightening)	To support growth (easing)
Policy repo rate	Raise it	Cut it
CRR	Raise it	Cut it
SLR	Raise it	Cut it
Open market operations	Sell government securities	Buy government securities
MSS	Issue securities under the scheme	Issue none, and redeem the old ones when they fall due
Margin requirements	Raise them	Lower them

Tool	To bring inflation down (tightening)	To support growth (easing)
Ceiling on credit for a purpose	Lower it	Raise it
Moral suasion	Ask banks to lend less	Ask banks to lend more

4. Three common exam traps

1. **"The RBI issues all the money in India."** Its sole right covers bank notes. The one-rupee note and all coins are issued by the Government of India under the Coinage Act, 2011; the RBI only puts the coins into circulation. And the larger part of the money supply is not currency at all: it is the deposits held with banks (Topic 24).
2. **The old corridor of the old books.** Many books still give the reverse repo rate as the floor of the corridor and the Bank Rate as the RBI's main lending rate. Since April 2022 the floor is the SDF rate and the ceiling is the MSF rate. The policy rate is the repo rate, and the Bank Rate simply follows the MSF rate. In a repo the RBI lends; in a reverse repo, as under the SDF, it takes funds in.
3. **Mixing up the two families of tools, and the direction of a margin.** A tool that changes the total amount or the cost of credit is quantitative; a tool that steers credit towards or away from a particular use is qualitative. A higher margin means a smaller loan, not a bigger one. Moral suasion is a request, not an order.

5. MCQs with answers and explanations

Q1. Consider the following statements about the Reserve Bank of India (RBI):

1. The RBI was nationalised on 1 January 1949.
2. The Governor of the RBI is appointed by its Central Board of Directors.
3. Under the Reserve Bank of India Act, 1934, the Central Government may give directions to the RBI after consultation with the Governor of the RBI.
4. The RBI is called the "lender of last resort" because it stands ready to lend to the Central Government at all times.

Which of the statements given above is/are correct?

- (1) 1 only
- (2) 2 and 3 only
- (3) 1 and 3 only
- (4) 1, 3 and 4 only

Q1. Answer: (3) 1 and 3 only

- Statement 1 is correct: the RBI began work on 1 April 1935 as a shareholders' bank. It was nationalised on 1 January 1949, and since then it has been fully owned by the Government of India.
- Statement 2 is wrong: the Governor and the Deputy Governors are appointed by the Central Government, for a term that it fixes, not exceeding five years. They are themselves members of the Central Board; the Board does not choose them.
- Statement 3 is correct: under section 7 of the RBI Act the Central Government may give the RBI such directions as it considers necessary in the public interest, after consultation with the Governor.
- Statement 4 is wrong: the role concerns emergency liquidity support to banks, with RBI describing a solvent bank facing temporary liquidity difficulties. Its work for the Government is a different function: banker to the Government.
- Why the other options are wrong: (1) leaves out statement 3, which is correct. (2) includes statement 2, which is wrong, and leaves out statement 1, which is correct. (4) includes statement 4, which is wrong.

Q2. Other things remaining the same, which one of the following follows when the RBI raises the cash reserve ratio (CRR)?

- (1) Banks have less to lend, and the money multiplier falls
- (2) Banks have less to lend, and the money multiplier rises
- (3) The SDF rate and the MSF rate rise, and the money multiplier falls
- (4) The SDF rate and the MSF rate rise, and the money multiplier rises

Q2. Answer: (1) Banks have less to lend, and the money multiplier falls

- Why it is correct: the CRR is the average daily balance that a bank must keep with the RBI, as a percentage of its net demand and time liabilities. When the RBI raises the ratio, a bank has to keep a larger balance with the RBI, so banks have less to lend. Banks now keep more reserves against their deposits, so the money multiplier falls.
- Why (2) is wrong: its first part is right, but the money multiplier does not rise; it falls. In Topic 24 the money multiplier is (1 + cdr) ÷ (cdr + rdr), where cdr is the currency-deposit ratio and rdr is the reserve-deposit ratio. A higher CRR raises rdr, so the multiplier falls. A cut in the CRR raises the multiplier.
- Why (3) is wrong: its second part is right, but its first part is not. The SDF rate is 25 basis points below the policy repo rate and the MSF rate is 25 basis points above it, so these two rates move with the repo rate, not with the CRR. The CRR is not a rate of interest; it is a share of a bank's liabilities.
- Why (4) is wrong: both its parts are wrong, for the reasons given under (2) and (3).

6. Sources

6.1 Sources

No.: S1

Source: Reserve Bank of India, "About Us" (page seen on 9 October 2026). https://www.rbi.org.in/Scripts/AboutusDisplay.aspx

Used for: Bank established on 1 April 1935 under the RBI Act, 1934; Central Office first in Kolkata, moved permanently to Mumbai in 1937; originally privately owned, fully owned by the Government of India since nationalisation in 1949; Preamble; Central Board appointed by the Government of India; official directors (Governor and not more than four Deputy Governors, full-time); non-official directors (ten nominated from various fields, two government officials, four from the four Local Boards); general superintendence and direction; list of Acts (FEMA, 1999; Payment and Settlement Systems Act, 2007; Banking Regulation Act, 1949; Coinage Act, 2011); the six main functions and the related functions (banker to the Government, banker to banks)

No.: S2

Source: Reserve Bank of India, "Brief History". https://www.rbi.org.in/Scripts/briefhistory.aspx

Used for: Bank set up on the basis of the recommendations of the Hilton Young Commission; RBI Act, 1934 (II of 1934); operations began on 1 April 1935; originally a shareholders' bank, nationalised in 1949; role in setting up institutions such as NABARD

No.: S3

Source: Reserve Bank of India, "Chronology of Events: The Early Years, 1935 to 1949"; and the index of the chronology. https://www.rbi.org.in/Scripts/chro_1935.aspx and https://www.rbi.org.in/Scripts/chronology.aspx

Used for: 1 April 1935: RBI commences operations, Sir Osborne Smith the first Governor, a shareholders' bank; 1 January 1949: "Reserve Bank of India nationalised"; the first period of the chronology is headed "The Beginnings: 1926 to 1935"

No.: S4

Source: Reserve Bank of India, list of the Central Board of Directors appointed or nominated under the RBI Act (page carries no date; seen on 9 October 2026). https://www.rbi.org.in/Content/Central.html

Used for: Governor Shri Sanjay Malhotra; Deputy Governors Shri Swaminathan J, Dr Poonam Gupta, Shri Shirish Chandra Murmu and Shri Rohit Jain; directors listed under section 8(1)(c) and section 8(1)(d)

No.: S5

Source: Reserve Bank of India Act, 1934, text as reproduced on B&B Associates LLP (bnblegal.com), a non-official compilation. https://bnblegal.com/bareact/reserve-bank-of-india-act-1934/

Used for: Preamble; section 3 (body corporate; management of the currency; business of banking); section 4 (capital of five crores of rupees); section 7 (directions by the Central Government after consultation with the Governor; general superintendence with the Central Board); section 8 (Governor and not more than four Deputy Governors appointed by the Central Government; four Directors from the Local Boards and ten Directors nominated by the Central Government; term not exceeding five years, eligible for re-appointment; four years for nominated Directors; pleasure of the Central Government); section 9 (four Local Boards for the areas in the First Schedule; five members appointed by the Central Government; four years; advice to the Central Board on matters referred); sections 20, 21 and 21A (Government business; State business by agreement); section 22 (sole right to issue bank notes); section 24 (denominations from two rupees to ten thousand rupees); section 26 (legal tender; guarantee by the Central Government); section 38 (rupee coin only through the Bank); section 42(1) (average daily balance of scheduled banks)

No.: S6

Source: Reserve Bank of India, Frequently Asked Questions, "Indian Currency" (updated on 15 April 2025). https://www.rbi.org.in/Scripts/FAQView.aspx?Id=136

Used for: Sole right to issue bank notes under section 22; Rs 2 and Rs 5 notes no longer printed and "coinised"; section 24 and the limit of Rs 10,000; one-rupee notes issued by the Government of India under the Coinage Act, 2011 and legal tender; Government of India responsible for designing and minting coins; coins issued for circulation only through the RBI (section 38); coins up to Rs 1,000 under the Coinage Act, 2011

No.: S7

Source: Reserve Bank of India, "Monetary Policy: Overview" (website last updated on 8 October 2026). https://www.rbi.org.in/Scripts/FS_Overview.aspx?fn=2752

Used for: Primary objective of monetary policy (price stability, keeping in mind growth); amendment of May 2016; inflation target of 4 per cent with limits of 2 and 6 per cent, retained on 25 March 2026 for 1 April 2026 to 31 March 2031; MPC of six members with the Governor as Chairperson; weighted average call rate as the operating target; transmission to aggregate demand; definitions of the repo rate, SDF rate (25 basis points below the repo rate; introduced in April 2022; floor of the corridor), MSF rate (25 basis points above the repo rate; penal rate; dipping into the SLR portfolio up to a limit), LAF, the corridor, reverse repo rate, Bank Rate (section49; aligned with MSF; the reference rate used to calculate reserve-shortfall penalties), CRR, SLR, open market operations; the MSS named among the tools of liquidity management

No.: S8

Source: Reserve Bank of India, home page, "Current Rates" box (seen on 9 October 2026; the policy rates and reserve ratios in the box carry no date of their own, and the page was last updated on 9 October 2026). https://www.rbi.org.in/

Used for: Policy repo rate 5.50 per cent; SDF rate 5.25 per cent; MSF rate 5.75 per cent; Bank Rate 5.75 per cent; fixed reverse repo rate 3.35 per cent; CRR 3.00 per cent; SLR 18.00 per cent

No.: S9

Source: Reserve Bank of India, press release 2026-2027/1264, "Monetary Policy Statement, 2026-27: Resolution of the Monetary Policy Committee, October 5 to 7, 2026" (7 October 2026). https://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=63742

Used for: 63rd meeting of the MPC; repo rate raised by 25 basis points to 5.50 per cent, unanimously; SDF rate 5.25 per cent, MSF rate and Bank Rate 5.75 per cent; stance changed to "calibrated tightening"; no decision on CRR or SLR in the resolution; CPI inflation projected at 5.2 per cent for 2026-27; next meeting on 2 to 4 December 2026

No.: S10

Source: NCERT, Introductory Macroeconomics (Class XII), Chapter 3 "Money and Banking", sections 3.2.2, 3.3.2 and 3.4, reprint 2026-27. https://ncert.nic.in/textbook/pdf/leec103.pdf

Used for: Central bank issues currency, is banker to the Government, custodian of foreign exchange reserves and bank to the banking system; school-level lender-of-last-resort concept (scope refined using RBI's banker-to-banks description); quantitative tools (CRR, bank rate, open market operations) and qualitative tools (persuasion, moral suasion, margin requirement); CRR as a percentage of deposits; SLR; effect of a higher reserve ratio; open market purchase raises and sale lowers reserves and money supply; repo rate and reverse repo rate; effect of a rise and of a fall in the bank rate; notes issued by the RBI and coins by the Government of India

No.: S11

Source: Arthapedia (Indian Economic Service), "Market Stabilization Scheme (MSS)", contributed by Rangeet Ghosh. https://ies.gov.in/arthapedia/concept/market-stabilization-scheme-mss

Used for: MSS: memorandum of understanding between the Government of India and the RBI; Treasury Bills and dated securities issued by the Government and auctioned by the RBI; primary aim of aiding the sterilisation operations of the RBI; absorbs excess liquidity; money kept in a separate cash account with the RBI and used only to redeem or buy back MSS securities; sterilisation as offsetting the liquidity effect of capital inflows by selling government securities

No.: S12

Source: Wikipedia, "Reserve Bank of India" (citing Reserve Bank of India, "Reserve Bank of India: Platinum Jubilee", 2012, for the Royal Commission of 1926, and the RBI's website for the nationalisation and the Central Board). https://en.wikipedia.org/wiki/Reserve_Bank_of_India

Used for: "The 1926 Royal Commission on Indian Currency and Finance"; nationalisation on 1 January 1949 (cross-check); Central Board of 21 members; Local Boards at Mumbai, Kolkata, Chennai and New Delhi, with five members each; minimum margins for lending against specific securities; a ceiling on the amounts of credit for certain purposes; persuasion of banks through meetings; coins minted by, and one-rupee notes issued by, the Government of India (cross-check)

No.: S13

Source: Reserve Bank of India, "The Reserve Bank of India Act, 1934 (As amended by the Finance Act, 2022)", text of the Act on the RBI's website (page dated 29 August 2022). https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=6449

Used for: Section 4 (capital of five crores of rupees); section 7(1) (directions by the Central Government after consultation with the Governor) and section 7(2) (general superintendence and direction with the Central Board); section 8(1)(a) to (d) (a Governor and not more than four Deputy Governors appointed by the Central Government; four Directors from the Local Boards, ten Directors and two Government officials, all nominated by the Central Government); section 8(4) (term not exceeding five years; four years for the ten nominated Directors); section 9 (a Local Board for each of the four areas; five members appointed by the Central Government; four years; advice to the Central Board); the headings of sections 20, 21, 21A, 22, 24, 26, 38, 42 and 49

No.: S14

Source: Reserve Bank of India, "Chronology of Events", period 1926 to 1935. https://www.rbi.org.in/Scripts/chro_1926.aspx

Used for: 1926: the Hilton Young Commission recommends the establishment of a central bank; 1934: the Reserve Bank of India Act, 1934 (II of 1934) as the statutory basis of the Bank

6.2 Additional verification sources · 9 October 2026

- **A1. RBI Monetary Policy Statement,7 October 2026.** https://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=63742
- Used for: Repo 5.50%, SDF 5.25%, MSF/Bank Rate 5.75%; current stance and meeting dates
- **A2. RBI: Central Board.** https://www.rbi.org.in/Content/Central.html
- Used for: Governor and four Deputy Governors checked 9 October 2026
- **A3. RBI: Bank Rate circular,7 October 2026.** https://www.rbi.org.in/scripts/NotificationUser.aspx?Id=13728&Mode=0
- Used for: Bank Rate 5.75%; applicable reserve-shortfall penal rates 8.75%/10.75%
- **A4. RBI: minimum daily CRR,9 October 2026.** https://www.rbi.org.in/scripts/NotificationUser.aspx?Id=13736&Mode=0
- Used for: 90% to 99% minimum daily maintenance only from fortnight beginning 16 October 2026; ratio 3% is a separate figure
- **A5. Gazette S.O.1580(E),25 March 2026.** https://egazette.gov.in/WriteReadData/2026/271285.pdf
- Used for: CPI inflation target 4%, tolerance 2–6%,1 April 2026 through 31 March 2031
- **A6. RBI: Banker to banks.** https://www.rbi.org.in/scripts/FS_Overview.aspx?fn=2758
- Used for: Lender-of-last-resort support to a solvent bank with temporary liquidity difficulty
- **A7. RBI: Indian currency FAQ.** https://www.rbi.org.in/Scripts/FAQView.aspx?Id=136
- Used for: Existing ₹2/₹5 notes remain legal tender although no longer printed; issuance distinctions

Topic 44 · Pressure belts and planetary winds

ENGLISH

1. Concept in one line

Atmospheric pressure, the weight of the air above a place, is arranged over the globe in belts of low and high pressure, and the planetary winds blow between these belts in directions turned by the rotation of the earth. The examination asks for the belts with their latitudes and causes, the forces that govern wind, and the three cells with their wind belts.

2. Revision notes

2.1 Atmospheric pressure: meaning, unit and instrument

- **Atmospheric pressure** is the force per unit area exerted by the air above the measuring point. At sea level, the column extends from mean sea level to the top of the atmosphere.
- **Unit:** it is expressed in millibar (mb). 1 mb = 1 hectopascal (hPa) = 100 pascal (Pa), so a figure reads the same in mb and in hPa (NOAA).
- **Instrument:** a mercury barometer or an aneroid barometer (NCERT).
- **Standard sea-level pressure:** NCERT's text gives the average as 1,013.2 mb. NCERT's table of standard values and NOAA give 1,013.25 mb, which is 29.92 inches of mercury (about 760 mm). Britannica rounds the mean to about 1,000 mb and adds that sea-level pressure varies by less than 5 per cent from it.

2.2 Pressure and height; isobars

- Pressure falls with height because the number of air molecules decreases (NOAA). In the lower atmosphere it decreases rapidly: by about 1 mb for each 10 m increase in elevation (NCERT).

Level	Standard pressure (NCERT)	Standard temperature (NCERT)
Sea level	1,013.25 mb	15.2°C
1 km	898.76 mb	8.7°C
5 km	540.48 mb	minus 17.3°C
10 km	265.00 mb	minus 49.7°C

- So at 5 km the pressure is a little more than half of the sea-level value, and at 10 km about a quarter. NOAA: one half of the air molecules lie within the first 5.6 km.
- **Why there are no strong upward winds:** the vertical pressure gradient force is much larger than the horizontal pressure gradient force, but it is generally balanced by a nearly equal and opposite gravitational force (NCERT).

- **Isobars** are lines connecting places having equal pressure. To remove the effect of altitude, the pressure measured at a place is first reduced to sea level and only then compared (NCERT).

2.3 The seven pressure belts

- A rule to carry through the topic (NCERT): over a low pressure area the air converges and rises. Over a high pressure area the air subsides from above and diverges at the surface.
- NCERT names an equatorial low, the subtropical highs along 30° N and 30° S, the sub-polar lows along 60° N and 60° S, and a polar high near the poles. Counting the two hemispheres separately, 1 + 2 + 2 + 2 makes 7 belts.
- By cause, the belts fall into two groups. **Thermally induced** belts are made directly by the heating or cooling of the air. **Dynamically induced** belts are made by the movement of the air: air that piles up and sinks, or air streams that meet and rise.

Belt	Where	How it forms	Group	Popular name
Equatorial low (1 belt)	Near the equator	High insolation causes convection, the air rises and a low is created. Winds from the two sides converge here, so it is the Inter-Tropical Convergence Zone (ITCZ)	Thermally induced	Doldrums: the very calm area within the ITCZ
Subtropical highs (2 belts)	Along 30° N and 30° S	The air that rose at the ITCZ moves towards the poles at a height, accumulates at about 30° and sinks. NCERT adds a second reason: the air has cooled by the time it reaches 30°	Dynamically induced	Horse latitudes
Sub-polar lows (2 belts)	Along 60° N and 60° S (NOAA: 50° to 60°)	Winds from the subtropical highs and from the polar highs meet, and the air rises	Dynamically induced	They have no popular name
Polar highs (2 belts)	Near the poles	Cold, dense air subsides	Thermally induced	They have no popular name

- The world's major deserts lie under the subtropical highs. These are the subtropical deserts of Day 3 (Topic 25), where cloudiness is the least.

2.4 The belts shift with the seasons

- The pressure belts are not permanent. They oscillate with the apparent movement of the sun: in the northern hemisphere they move southwards in winter and northwards in summer (NCERT).
- On a real map the belts are broken into separate centres of high and low pressure, largely because the surface is heated unequally (Britannica). In the southern hemisphere the sub-polar low is a continuous belt, because of the ocean. In the northern hemisphere it is split into the Icelandic Low and the Aleutian Low.

- In the northern summer the Siberian High, the Aleutian Low and the Icelandic Low virtually disappear as the continents warm, while the highs over the Pacific and the Atlantic strengthen and move northward (Britannica).

2.5 The forces that govern wind

Differences in atmospheric pressure set the air in motion, and air in motion is wind. Three forces then act on it. In addition, the gravitational force acts downward (NCERT).

Force	What it does	Points to remember (NCERT)
Pressure gradient force	It drives the air from high pressure towards low pressure	The pressure gradient is the rate of change of pressure with respect to distance. It is strong where the isobars are close to each other and weak where they are apart. The force is perpendicular to an isobar
Coriolis force	It deflects the wind: to the right in the northern hemisphere and to the left in the southern hemisphere	It comes from the rotation of the earth about its axis. For horizontal motion its magnitude is proportional to wind speed and the sine of latitude: maximum at the poles and zero at the equator for a given speed. It acts perpendicular to the wind velocity, not generally perpendicular to the pressure gradient force
Frictional force	It affects the speed of the wind	It is greatest at the surface, and its influence generally extends up to 1 to 3 km. Over the sea surface friction is minimal

- **Coriolis force:** named after Gustave-Gaspard Coriolis, who described it mathematically in 1835 (NOAA). For wind questions, the important facts are its direction, latitude dependence and dependence on wind speed.
- **Ferrel's law:** air or water moving horizontally is deflected to the right of its line of motion in the northern hemisphere, and to the left in the southern hemisphere. It is named after the American meteorologist William Ferrel (1817 to 1891), and it restates for the whole globe the action of the Coriolis force.

2.6 What the forces produce

- **Geostrophic wind:** 2 to 3 km above the surface the wind is free from friction. When the isobars are straight and there is no friction, the pressure gradient force is balanced by the Coriolis force, and the wind blows parallel to the isobars (NCERT).
- **At the equator:** the horizontal Coriolis effect is zero. In the simplified pressure-gradient model, air moves from high to low pressure across the isobars. Actual equatorial winds are also affected by friction, acceleration and convection, so perpendicular flow is not an unconditional rule for every wind. The weak Coriolis effect near the equator makes tropical-cyclone formation very difficult (Topic 125).
- **Around lows and highs:** the pressure gradient force, Coriolis force and, near the surface, friction together determine the wind. Curved flow also requires centripetal acceleration. Winds spiral inward around surface lows and outward around surface highs; aloft, flow is more nearly parallel to isobars. The circulation around a low is cyclonic, and around a high it is anticyclonic.

Pressure system	Pressure at the centre	Northern hemisphere	Southern hemisphere
Cyclone	Low	Anticlockwise	Clockwise
Anticyclone	High	Clockwise	Anticlockwise

2.7 The general circulation: three cells

- The pattern of the planetary winds is called the general circulation of the atmosphere. NCERT lists what it largely depends on: (i) the latitudinal variation of atmospheric heating; (ii) the emergence of pressure belts; (iii) the migration of the belts following the apparent path of the sun; (iv) the distribution of continents and oceans; (v) the rotation of the earth.
- Circulations from the surface upwards and back again are called **cells** (NCERT). Each hemisphere has three.

Cell	Where	How the air moves	Surface wind	Note
Hadley cell	The tropics	It rises at the ITCZ, moves towards the pole at a height, sinks at about 30° and returns to the equator along the surface	Trade winds (NCERT calls them the easterlies)	It is named after George Hadley, the English physicist and meteorologist, who proposed a single circulation for each hemisphere in 1735 (NOAA)
Ferrel cell	The middle latitudes	Near the surface the air flows poleward and eastward. Higher up it moves equatorward and westward (NOAA)	Westerlies	William Ferrel proposed it in 1856. It was the first to account for the westerly winds between 35° and 60° (NOAA)
Polar cell	The polar latitudes	The air rises at the higher latitudes, travels towards the pole and sinks over it. The cold, dense air then blows towards the middle latitudes along the surface	Polar easterlies	It is the smallest and weakest of the cells (NOAA)

- At the ITCZ, deep convection carries air towards the tropical upper troposphere. NCERT's circulation diagram uses about 14 km; its general description gives about 18 km for the equatorial tropopause. These are schematic values for different descriptions, not a single fixed height of all rising air.
- The transfer of heat energy from lower latitudes to higher latitudes maintains the general circulation (NCERT). This is the poleward movement of the tropical surplus of heat seen on Day 3 (Topic 25). The general circulation also sets the circulation of ocean water in motion.

2.8 The planetary winds

Wind	From where to where	Direction it blows from	Character
Trade winds	From the subtropical highs to the ITCZ	Mainly from the north-east in the northern hemisphere and from the south-east in the southern hemisphere	They are the most consistent winds
Westerlies	From the subtropical highs to the sub-polar lows	Mainly from the south-west in the northern hemisphere and from the north-west in the southern hemisphere	They are less consistent than the trade winds, because of landform barriers. They are strongest in winter. They are particularly strong in the southern hemisphere, where the middle latitudes have less land: the Roaring Forties lie between 40° and 50° S
Polar easterlies	From the polar highs to the sub-polar lows	From the east: from the north-east in the northern hemisphere and from the south-east in the southern hemisphere	They are dry and cold, and often weak and irregular

- Seasonal and local winds (Day 6, Topic 56), jet streams (Day 7, Topic 65) and El Nino (Day 37, Topic 365) are separate topics.

3. Extra section: how Ferrel's law gives each planetary wind its direction (worked examples)

The order of belts and winds from the equator to the pole is the same in both hemispheres: equatorial low, trade winds, subtropical high, westerlies, sub-polar low, polar easterlies, polar high. Low and high alternate, and so do rising air and sinking air.

The surface air starts from a high and heads for a low. Then apply the law: turn the air to the right in the northern hemisphere and to the left in the southern hemisphere. Face the way the air is heading, and then see which side is right and which is left.

Wind	It starts from	It heads for	Northern hemisphere	Southern hemisphere
Trade winds	Subtropical high (30°)	Equatorial low	The air heads south. Turned to the right, it swings towards the west. So it blows from the north-east	The air heads north. Turned to the left, it swings towards the west. So it blows from the south-east
Westerlies	Subtropical high (30°)	Sub-polar low (60°)	The air heads north. Turned to the right, it swings towards the east. So it blows from the south-west	The air heads south. Turned to the left, it swings towards the east. So it blows from the north-west

Wind	It starts from	It heads for	Northern hemisphere	Southern hemisphere
Polar easterlies	Polar high	Sub-polar low (60°)	The air heads south. Turned to the right, it swings towards the west. So it blows from the north-east	The air heads north. Turned to the left, it swings towards the west. So it blows from the south-east

Check with Britannica's summary: the trade winds blow westward and equatorward, the westerlies eastward and poleward, and the polar easterlies westward and equatorward.

4. Three common exam traps

1. **"Wind blows straight from high pressure to low pressure."** Only the pressure gradient force points that way. Away from the equator the Coriolis force turns the moving air, so the wind does not blow straight across the isobars; above the reach of friction it blows along them. Remember what the Coriolis force depends on: latitude (it is greatest at the poles) and wind velocity.
2. **"A westerly wind blows towards the west."** A wind is named after the direction it comes from. The trade winds come from the east and blow towards the west, and NCERT simply calls them the easterlies. Trade winds are tropical easterlies; polar easterlies are a different wind belt.
3. **"Low pressure means heat and high pressure means cold."** That is true only of the thermally induced belts, the equatorial low and the polar highs. The subtropical highs lie in hot latitudes and the sub-polar lows in cold latitudes, because sinking and rising air makes them. Remember also that no belt stays in one place: all of them shift with the apparent movement of the sun.

5. MCQs with answers and explanations

Q1. Match List I (Belt or wind) with List II (Description):

List I (Belt or wind)	List II (Description)
A. Doldrums	1. Lie in a belt of low pressure, where the air converges and rises
B. Horse latitudes	2. Blow mainly from the south-west
C. Westerlies of the northern hemisphere	3. Lie in a belt of high pressure, where the air subsides and diverges at the surface
D. Westerlies of the southern hemisphere	4. Blow mainly from the north-west

- (1) A-3, B-1, C-2, D-4
- (2) A-3, B-1, C-4, D-2
- (3) A-1, B-3, C-4, D-2
- (4) A-1, B-3, C-2, D-4

Q1. Answer: (4) A-1, B-3, C-2, D-4

- Why it is correct: The doldrums are the very calm area within the ITCZ, the zone of low pressure near the equator where the winds converge and the air rises (A-1). The horse latitudes are the subtropical high pressure belts near 30° N and 30° S, and over a high the air subsides from above and diverges at the surface (B-3). The westerlies start from the subtropical highs and head for the sub-polar lows. In the northern hemisphere they head north and are turned to the right, so they blow mainly from the south-west (C-2). In the southern hemisphere they head south and are turned to the left, so they blow mainly from the north-west (D-4). The Roaring Forties are these winds.
- Why (1) is wrong: It exchanges the doldrums and the horse latitudes. The doldrums belong to the equatorial low, where the air rises. The belt of high pressure with sinking air is the subtropical high, and its popular name is the horse latitudes.
- Why (2) is wrong: It exchanges the doldrums and the horse latitudes, and also the two directions of the westerlies. The doldrums belong to the low near the equator, and the westerlies of the northern hemisphere blow mainly from the south-west.
- Why (3) is wrong: It exchanges the two directions of the westerlies. A wind turned to the right while heading north comes from the south-west, and that happens in the northern hemisphere. The north-west direction belongs to the southern hemisphere.

Q2. Consider the following statements about atmospheric pressure and winds:

1. In the southern hemisphere, the wind blows anticlockwise around a centre of low pressure.
2. The horizontal Coriolis effect on moving air is zero at the equator.
3. The vertical pressure gradient force is much larger than the horizontal pressure gradient force.

Which of the statements given above is/are correct?

- (1) 2 only
- (2) 2 and 3 only
- (3) 3 only
- (4) 1, 2 and 3

Q2. Answer: (2) 2 and 3 only

- Statement 1 is wrong: The circulation around a low is cyclonic, and in the southern hemisphere a cyclonic circulation is clockwise. It is anticlockwise in the northern hemisphere.
- Statement 2 is correct: for horizontal motion the Coriolis effect is proportional to the sine of latitude, which is zero at the equator. This does not mean that every actual equatorial wind must always be perpendicular to isobars.
- Statement 3 is correct: NCERT says the vertical pressure gradient force is much larger than the horizontal one. We do not feel strong upward winds because it is generally balanced by a nearly equal and opposite gravitational force. Pressure falls by about 1 mb for each 10 m of height in the lower atmosphere.
- Why the other options are wrong: (1) leaves out statement 3, which is correct. (3) leaves out statement 2, which is correct. (4) includes statement 1, which is wrong.

6. Sources

6.1 Sources

No.: S1

Source: NCERT, Fundamentals of Physical Geography (Class XI), Chapter 9, "Atmospheric Circulation and Weather Systems", reprint 2026-27. https://ncert.nic.in/textbook/pdf/kegy209.pdf

Used for: Definition of atmospheric pressure; millibar; average sea-level pressure of 1,013.2 mb; mercury and aneroid barometers; fall of about 1 mb for each 10 m; vertical pressure gradient force balanced by gravity; the table of standard pressure and temperature at sea level, 1 km, 5 km and 10 km; isobars and reduction to sea level; equatorial low, subtropical highs along 30° N and 30° S, sub-polar lows along 60° N and 60° S, polar high; the belts not permanent and their movement in winter and summer; the forces acting on wind; pressure gradient and the spacing of isobars; friction (greatest at the surface, 1 to 3 km, minimal over the sea); general discussion of wind forces and idealised equatorial flow; tropical cyclones rarely forming near the equator (Coriolis vector direction and historical date in the lesson follow NOAA/FAA, A1–A2); geostrophic wind; cyclonic and anticyclonic circulation and the table of wind directions; convergence and rising air over a low, subsidence and divergence over a high; the five things on which the planetary winds depend; general circulation and ocean water circulation; the ITCZ, convection due to

high insolation, the altitude of 14 km, accumulation and sinking at about 30°, cooling as a second reason, the easterlies; cells, Hadley cell, Ferrel cell and westerlies, polar cell and polar easterlies; transfer of heat energy from lower to higher latitudes

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No.: S2

Source: NOAA, JetStream, "Air Pressure" (page updated 10 July 2026). https://www.noaa.gov/jetstream/atmosphere/air-pressure

Used for: Standard sea-level pressure of 1,013.25 mb, 1,013.25 hPa and 29.92 inches of mercury; 1 hPa = 100 Pa = 1 mb; pressure falling with height as the number of molecules decreases; one half of the air molecules within the first 5.6 km

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No.: S3

Source: NOAA, JetStream, "Global Atmospheric Circulations" (page updated 3 October 2023). https://www.noaa.gov/jetstream/global/global-atmospheric-circulations

Used for: Hadley cell and George Hadley, 1735; Ferrel cell, William Ferrel, 1856, westerly winds between 35° and 60°, air movement near the surface and higher up; polar cell, air rising at higher latitudes and sinking over the poles, polar highs, polar easterlies, the smallest and weakest cell; high pressure bands at about 30° and at each pole, low pressure bands at the equator and at 50° to 60°

No.: S4

Source: Encyclopaedia Britannica, "atmospheric circulation". https://www.britannica.com/science/atmospheric-circulation

Used for: Subtropical high pressure belts near 30° N and 30° S as the horse latitudes, with descending air; trade winds blowing westward and equatorward and merging and rising in the intertropical convergence zone near the Equator; midlatitude westerlies moving eastward and poleward; polar easterlies blowing westward and equatorward, poleward of 60°

No.: S5

Source: Encyclopaedia Britannica, "climate", section "Atmospheric pressure and wind". https://www.britannica.com/science/climate-meteorology/Atmospheric-pressure-and-wind

Used for: Mean sea-level pressure of about 1,000 mb, varying by less than 5 per cent; isobars as lines connecting points of equal pressure; closed centres of high and low pressure largely caused by differential surface heating; the Siberian High, Aleutian Low and Icelandic Low virtually disappearing in summer, and the Pacific and Atlantic highs amplifying and migrating northward

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No.: S6

Source: Sierra College (California), Department of Geography, physical geography lecture pages, "Atmospheric Pressure: Global Pressure and Wind Systems". https://geography.sierracollege.edu/Booth/Phy_lectures)/chp5_atm_pressure/atmpres4_global.htm

Used for: The ITCZ as a thermally induced trough of low pressure with the doldrums as the very calm area within it; the subtropical highs at about 30° as dynamically induced, formed by subsidence, linked with the horse latitudes and with the world's major deserts; the sub-polar lows at 60° as dynamically induced, a continuous belt in the southern hemisphere and the Icelandic Low and Aleutian Low in the northern; the polar highs as thermally induced, from cold sinking air; trade winds as the most consistent winds; westerlies less consistent because of landform barriers; polar easterlies between the polar highs and 60°

No.: S7

Source: Wikipedia, "Prevailing winds" (citing the American Meteorological Society, Glossary of Meteorology, 2009, entries "trade winds", "Westerlies" and "Polar easterlies"; Tarr, McMurry and Parkins, Advanced Geography, Macmillan, 1909; Halldor Bjornsson, "Global circulation", 2005; Stuart Walker, The Sailor's Wind, W. W. Norton, 1998, p. 91). https://en.wikipedia.org/wiki/Prevailing_winds

Used for: Trade winds blowing predominantly from the north-east in the northern hemisphere and from the south-east in the southern; westerlies blowing predominantly from the south-west in the northern hemisphere and from the north-west in the southern, strongest in winter, particularly strong in the southern hemisphere where there is less land in the middle latitudes; the Roaring Forties between 40° and 50° S; polar easterlies as dry, cold winds from the polar highs, blowing from the east, often weak and irregular

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No.: S8

Source: World of Earth Science, entry "Ferrel's Law", as reproduced on Encyclopedia.com. https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/ferrelslaw

Used for: Ferrel's law (deflection to the right of the line of motion in the northern hemisphere and to the left in the southern); the American meteorologist W. Ferrel, 1817 to 1891; the law as a restatement in global terms of the action of the Coriolis force

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No.: S9

Source: Encyclopaedia Britannica, "Coriolis force". https://www.britannica.com/science/Coriolis-force

Used for: The force described by the French engineer and mathematician Gustave-Gaspard Coriolis in 1835; air rotating counterclockwise around low-pressure systems and clockwise around high-pressure systems in the northern hemisphere, with the direction reversed in the southern hemisphere

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No.: S10

Source: Encyclopaedia Britannica, "doldrums". https://www.britannica.com/science/doldrums

Used for: The doldrums as equatorial regions of light winds within the intertropical convergence zone, a belt of converging winds and rising air near the Equator where the north-east and south-east trade winds meet; ships often becalmed there

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No.: S11

Source: Encyclopaedia Britannica, "horse latitude". https://www.britannica.com/science/horse-latitude

Used for: The horse latitudes as the two subtropical high-pressure belts around 30° to 35° N and S, with light winds, clear skies and dry subsiding air; arid climates below them, with the Sahara as the example; the more continuous belt in the southern hemisphere; the belts made up of several separate high-pressure centres

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No.: S12

Source: National Geographic Society, Education, encyclopedic entry "Wind" (page updated 24 July 2026). https://education.nationalgeographic.org/resource/wind/

Used for: Trade winds blowing from the north-east in the northern hemisphere and from the south-east in the southern, and very predictable; the low-pressure doldrums around the intertropical convergence zone, with very weak winds; the high-pressure horse latitudes and their deserts; westerlies blowing from the west in the middle latitudes, strongest in winter; the Roaring Forties between 40° and 50° S, with few landmasses to slow the winds; polar easterlies as dry, cold winds blowing from the east, from the polar highs to the sub-polar low-pressure areas

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No.: S13

Source: National Institute of Open Schooling (NIOS), Senior Secondary Geography (316), Learner Guide, Lesson 11, "Pressure and Winds". https://www.nios.ac.in/media/documents/316courseE/Learner_guide/LG_english/316_LG_E_L11.pdf

Used for: The equatorial low pressure belt called the doldrums, the zone of calm; the subtropical high pressure belts also called the horse latitudes; the pressure belts not permanent; deflection of winds to the right in the northern hemisphere and to the left in the southern hemisphere as Ferrel's law

6.2 Additional verification sources · 9 October 2026

- **A1. NOAA: Origin of Wind.** https://www.noaa.gov/jetstream/synoptic/origin-of-wind
- Used for: Pressure-gradient force, Coriolis direction, friction and 1835 historical date
- **A2. FAA Balloon Flying Handbook, Chapter 4.** https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/Balloon_Flying_Handbook_FAA-H-8083-11B/bfh_chapter_4.pdf
- Used for: Coriolis perpendicular to wind velocity; dependence on wind speed and latitude
- **A3. NOAA: Global Atmospheric Circulations.** https://www.noaa.gov/jetstream/global/global-atmospheric-circulations
- Used for: Hadley, Ferrel and polar cells and surface winds
- **A4. NOAA: Air Pressure.** https://www.noaa.gov/jetstream/atmosphere/air-pressure
- Used for: Pressure at measuring level and standard sea-level pressure
- **A5. NOAA AOML: Gradient Wind Balance.** https://www.aoml.noaa.gov/hrd/hrd_sub/gradbal.html
- Used for: Curved flow and inward centripetal acceleration

Topic 45 · Rivers of Andhra Pradesh: Godavari, Krishna, Penna and Vamsadhara

ENGLISH

1. Concept in one line

The Godavari, the Krishna, the Penna and the Vamsadhara all rise outside Andhra Pradesh and cross the State to reach the Bay of Bengal. The examination asks you to match each river with its source, tributaries, projects, districts and the place where it meets the sea.

2. Revision notes

2.1 The four rivers compared

Left and right banks are counted facing downstream. For the Godavari, the Krishna and the Penna, the lengths, basin areas and tributary lists below are those of India-WRIS (the Government of India's Water Resources Information System). So are the heights of the Godavari and Krishna sources.

Point	Godavari	Krishna	Penna (Pennar)	Vamsadhara
Source	Trimbakeshwar, Nashik district, Maharashtra, in the Western Ghats; height 1,067 m	Near Jor village, Satara district, Maharashtra, just north of Mahabaleshwar, in the Western Ghats; height 1,337 m	Chenna Kesava hill of the Nandi Hills (Nandidurg range), Chikkaballapura district, Karnataka	Near Lanjigarh, Kalahandi district, Odisha; height about 400 m
Length	1,465 km	1,400 km	597 km	About 254 km
Basin area	3,12,812 sq. km	2,58,948 sq. km	55,213 sq. km	About 10,830 sq. km
States on the main river	Maharashtra, Telangana, Andhra Pradesh	Maharashtra, Karnataka, Telangana, Andhra Pradesh	Karnataka, Andhra Pradesh	Odisha, Andhra Pradesh
Enters Andhra Pradesh	A little below Bhadrachalam (Telangana)	Where the Tungabhadra joins it, near Sangameswaram	Near Hindupur, in Sri Sathya Sai district	From Rayagada district of Odisha. It first touches the State at Bhamini mandal of Parvathipuram Manyam district, forms the border between Odisha and Andhra Pradesh for 29 km, and then flows inside Srikakulam district

Point	Godavari	Krishna	Penna (Pennar)	Vamsadhara
Main tributaries	Left bank: Purna, Pranhita, Indravati, Sabari. Right bank: Pravara, Manjira, Maner (Manair)	Left bank: Bhima, Musi, Munneru. Right bank: Ghataprabha, Malaprabha, Tungabhadra	Left bank: Jayamangali, Kunderu, Sagileru. Right bank: Chitravati, Papagni, Cheyyeru	Mahendratanaya
Meets the Bay of Bengal	Below Dowleswaram it divides into the Gautami and the Vasishta; the mouth usually named is Antarvedi, in Dr B.R. Ambedkar Konaseema district	Hamsaladeevi, Krishna district	Near Utukuru, Nellore district	Kalingapatnam, Srikakulam district
Main projects in Andhra Pradesh	Polavaram Project; Sir Arthur Cotton Barrage	Srisailam Dam; Nagarjuna Sagar Dam; Pulichintala Project; Prakasam Barrage	Somasila Dam; Mid Pennar, Gandikota and Mylavaram reservoirs	Gotta Barrage; Hiramandalam reservoir

- The Godavari is the longest of the four and has the largest basin. The Krishna basin is nearly 8 per cent of the area of India.
- **NCERT figure:** NCERT prints 1,401 km for the Krishna, against 1,400 km on India-WRIS; for the Godavari both give 1,465 km. In a question that follows NCERT, give 1,401 km.
- **Basin wider than the main river:** the Godavari basin also covers parts of Chhattisgarh and Odisha, and smaller parts of Madhya Pradesh, Karnataka and the Union Territory of Puducherry. India-WRIS describes these basins with undivided Andhra Pradesh, so it does not name Telangana separately.
- **Shares of the two smaller basins:** Penna, 6,937 sq. km in Karnataka and 48,276 sq. km in Andhra Pradesh. Vamsadhara, 8,015 sq. km in Odisha and 2,815 sq. km in Andhra Pradesh.
- **Vamsadhara figures:** India-WRIS does not treat this river as a separate basin. It places it in the group "East flowing rivers between Mahanadi and Pennar" (86,643 sq. km in Andhra Pradesh and Odisha). The length and basin figures given here are those of the Central Water Commission. The figures in this table consistently use the Central Water Commission's basin description.
- India-WRIS lists the Jayamangali as a left-bank tributary of the Penna.

2.2 The Godavari in Andhra Pradesh

- The Sabari is its last major tributary. It joins inside the State, on the left bank at Kunavaram.
- Below Kunavaram the river crosses the Papi hills of the Eastern Ghats in a narrow gorge and widens again at Polavaram.

- **Polavaram Project:** on the main river at Polavaram; reported as under construction in July 2026. Its right bank canal links the Godavari with the Krishna. Topic 14 (Day 2) gave its status as a national project under Section 90 of the Andhra Pradesh Reorganisation Act, 2014, and the Godavari River Management Board, with headquarters in Telangana.
- **Sir Arthur Cotton Barrage:** at Dowleswaram, by Rajamahendravaram, so it is also called the Dowleswaram Barrage. Sir Arthur Cotton built an anicut here in 1852. An anicut is a low dam that turns river water into canals. It was later rebuilt as a barrage with a road on it and named after him. It feeds the canals of the Godavari delta.
- **The delta:** below the barrage the river divides into the Gautami and the Vasishta. The Gautami, the largest branch, passes Yanam, an enclave of Puducherry, and reaches the sea at Point Godavari. The Vasishta divides again into the Vasishta and the Vainateya. The delta formed by these branches is Konaseema.
- Topic 16 (Day 2) gave NCERT's flow figures for the Godavari at Polavaram: the highest flow comes in July to August and the lowest in May.

2.3 The Krishna in Andhra Pradesh

- From the place where the Tungabhadra joins it, the Krishna has Andhra Pradesh on its right bank and Telangana on its left bank, down to the Pulichintala area. Below that, both banks are in Andhra Pradesh.
- **Tributaries:** the Tungabhadra is the main right-bank tributary and comes in through Andhra Pradesh. The Munneru joins on the left bank. Other left-bank tributaries in the lists are the Dindi and the Paleru. The Bhima (861 km) is the longest tributary of the Krishna.
- **Projects on the main river:** the Srisailam Dam at Srisailam, the Nagarjuna Sagar Dam at Vijayapuri South, the Pulichintala Project at Pulichintala village and the Prakasam Barrage at Vijayawada. Srisailam and Nagarjuna Sagar are also major hydropower stations.
- Topic 14 (Day 2) gave the Krishna River Management Board, with headquarters in Andhra Pradesh.

2.4 The Penna

- **Somasila Dam:** in Nellore district, where the river leaves the Velikonda range and enters the coastal plain. It is a major storage project in the Penna basin; the basin also has other major reservoirs.
- Higher up the river are the Mid Pennar reservoir, the Gandikota reservoir on the Penna near Gandikota and the Mylavaram reservoir.
- **Krishna water in the Penna basin:** the Telugu Ganga project draws water from the Srisailam reservoir on the Krishna. It carries the water to the Somasila reservoir in the Penna valley, then to the Kandaleru reservoir, and delivers it to the Poondi reservoir near Chennai, about 406 km in all. The Tungabhadra High Level Canal also irrigates a part of the Penna basin.

2.5 The Vamsadhara

- It flows through Kalahandi and Rayagada districts of Odisha. It first touches Andhra Pradesh at Bhamini mandal of Parvathipuram Manyam district and forms the border between the two States for 29 km. Below that it flows through Srikakulam district, past Hiramandalam and Mukhalingam, to the sea at Kalingapatnam.
- **Mahendratanaya:** its main tributary. It rises in Gajapati district of Odisha and joins the Vamsadhara in Andhra Pradesh, upstream of the Gotta Barrage.
- **Vamsadhara Project:** the Gotta Barrage, with a left main canal and a right main canal. The Hiramandalam reservoir has a planned storage capacity of about 19 TMC (19.05 TMC; thousand million cubic feet). Capacity is not the same as the amount actually stored on a particular date.
- The sharing of its water between Odisha and Andhra Pradesh belongs to the topic on river water disputes.

2.6 The Nagavali, the Tungabhadra and the small rivers

- **Nagavali:** it rises near Lakhbahal village in Kalahandi district of Odisha and is about 256 km long, 161 km of it in Odisha. Its catchment is 9,510 sq. km, of which 5,048 sq. km is in Andhra Pradesh. It passes Rayagada, has the Thotapalli Barrage (Parvathipuram Manyam district) and the Narayanapuram Anicut (Srikakulam district) on it, and meets the sea near Kallepalli, close to Srikakulam town.
- **Tungabhadra:** the Tunga and the Bhadra, which both rise at Gangamoola in the Western Ghats, meet at Koodli in Shivamogga district of Karnataka to form it. It is about 531 km long, passes Hampi, Mantralayam and Kurnool, and joins the Krishna on the right bank. The Tungabhadra Dam is at Hospet in Karnataka; the Sunkesula Barrage near Kurnool feeds the K.C. Canal.
- **Small rivers (names only):** the Bahuda, the Sarada, the Varaha and the Tandava, north of the Godavari; the Gundlakamma and the Manneru, between the Krishna and the Penna.
- **Three names that are easily mixed:** the Maner joins the Godavari, the Munneru joins the Krishna, and the Manneru is a small river between the Krishna and the Penna. Do not mix them up.

2.7 Districts along the rivers, as on 9 October 2026

- Andhra Pradesh went from 13 to 26 districts on 4 April 2022. It has 28 districts from 31 December 2025, when Markapuram district and Polavaram district (headquarters Rampachodavaram) were formed.

River	Main districts of Andhra Pradesh along it
Godavari	Polavaram and Eluru (the hill stretch from Kunavaram to the Polavaram Project); East Godavari (Rajamahendravaram, Dowleswaram); West Godavari and Dr B.R. Ambedkar Konaseema (the delta)
Krishna	Nandyal (Sangameswaram, Srisailam); Palnadu (Nagarjuna Sagar, Pulichintala); NTR (Vijayawada); Guntur; Krishna (Hamsaladeevi); Bapatla

River	Main districts of Andhra Pradesh along it
Penna	Sri Sathya Sai (Hindupur); Anantapur, officially Ananthapuramu (Tadipatri); YSR Kadapa (Gandikota, Kamalapuram, Sidhout); Sri Potti Sriramulu Nellore (Somasila, Nellore, Utukuru)
Vamsadhara	Parvathipuram Manyam (Bhamini mandal); Srikakulam
Nagavali	Parvathipuram Manyam, Vizianagaram, Srikakulam
Tungabhadra	Kurnool

- **Project and district:** the Polavaram Project stands at Polavaram in Eluru district. Polavaram district is the hill country upstream, with Kunavaram. That area was in Alluri Sitharama Raju district until 31 December 2025.
- Books and web pages written before these dates use the older district names, for example Kurnool district for Sangameswaram. Give the district as it stands on the date of the examination.

3. Extra section: each river inside Andhra Pradesh, from the border to the sea

Stage	Godavari	Krishna	Penna	Vamsadhara
Reaches Andhra Pradesh	A little below Bhadrachalam, after the Kinnerasani joins it in Telangana	At the Tungabhadra confluence, between Sangameswaram (Andhra Pradesh) and Gundimalla (Jogulamba Gadwal district, Telangana)	Near Hindupur. It then crosses a strip of Karnataka (Pavagada taluk) and returns in Anantapur district	From Rayagada district of Odisha, at Bhamini mandal; it then forms the border with Odisha for 29 km
Tributaries it meets in the State	Sabari, left bank, at Kunavaram	Tungabhadra, right bank; Munneru, left bank	Chitravati (right) at Gandalur near Gandikota; Papagni (right) and Kunderu (left) near Kamalapuram; Cheyyeru (right) near Sidhout	Mahendratanaya, upstream of the Gotta Barrage
Places on the way, in order	The Papi hills gorge, Polavaram, Rajamahendravaram, Dowleswaram	Srisailam, Vijayapuri South, Pulichintala, Vijayawada	Penna Ahobilam, where it turns east; Tadipatri; the Gandikota gorge; Sidhout; Nellore	Hiramandalam, Mukhalingam

Stage	Godavari	Krishna	Penna	Vamsadhara
Dams and barrages, in downstream order	Polavaram Project, then Sir Arthur Cotton Barrage	Srisailam Dam, Nagarjuna Sagar Dam, Pulichintala Project, Prakasam Barrage	Mid Pennar, Gandikota, Mylavaram, Somasila	Gotta Barrage
Reaches the sea	The Gautami at Point Godavari, after passing Yanam; Antarvedi is the mouth usually named for the river	Hamsaladeevi	Near Utukuru	Kalingapatnam

How to hold it in memory:

- **By State of origin:** two from Maharashtra (Godavari, Krishna), one from Karnataka (Penna) and two from Kalahandi district of Odisha (Vamsadhara, Nagavali). The Tungabhadra is also formed in Karnataka.
- **By length:** Godavari 1,465 km, Krishna 1,400 km, Penna 597 km, Tungabhadra about 531 km, Nagavali about 256 km, Vamsadhara about 254 km. The Tungabhadra, a tributary, is longer than the Vamsadhara and the Nagavali.
- **The last structure is a barrage:** the Sir Arthur Cotton Barrage at Dowleswaram on the Godavari, and the Prakasam Barrage at Vijayawada on the Krishna. The big storage dams stand higher up.

4. Three common exam traps

1. **Mixing up the places where the rivers meet the sea.** Kalingapatnam is the mouth of the Vamsadhara. Kallepalli, near Srikakulam town, is the mouth of the Nagavali. Both are in Srikakulam district and the names sound alike. Hamsaladeevi is the Krishna, Antarvedi the Godavari and Utukuru the Penna. Yanam, on the Gautami branch, belongs to Puducherry and not to Andhra Pradesh.
2. **Taking the water for the river.** A project belongs to the river it stands on, not to the river whose water it carries. Somasila stands on the Penna, although the Telugu Ganga brings Krishna water to it. The Sunkesula Barrage stands on the Tungabhadra, not on the Krishna. The right bank canal of Polavaram carries Godavari water towards the Krishna, yet Polavaram is a Godavari project.
3. **Main river against basin.** The main stream of the Godavari runs through three States only: Maharashtra, Telangana and Andhra Pradesh. Its basin is much wider and takes in parts of Chhattisgarh, Odisha, Madhya Pradesh and Karnataka. So "the Godavari flows through Odisha" is wrong, while "the Godavari basin extends into Odisha" is right. The main stream of the Krishna runs through four States.

5. MCQs with answers and explanations

Q1. Match List I (River) with List II (Its tributary, or a barrage built across it):

List I (River)	List II (Tributary or barrage)
A. Godavari	1. Munneru
B. Krishna	2. Gotta Barrage
C. Vamsadhara	3. Sabari
D. Nagavali	4. Thotapalli Barrage

- (1) A-3, B-1, C-2, D-4
- (2) A-1, B-3, C-2, D-4
- (3) A-3, B-1, C-4, D-2
- (4) A-1, B-3, C-4, D-2

Q1. Answer: (1) A-3, B-1, C-2, D-4

- Why it is correct: The Sabari is the last major tributary of the Godavari and joins it on the left bank at Kunavaram (A-3). The Munneru is a left-bank tributary of the Krishna (B-1). The Gotta Barrage is on the Vamsadhara and belongs to the Vamsadhara Project (C-2). The Thotapalli Barrage is on the Nagavali, in Parvathipuram Manyam district (D-4).
- Why (2) is wrong: It exchanges the two tributaries. The Munneru joins the Krishna, not the Godavari, and the Sabari joins the Godavari, not the Krishna.
- Why (3) is wrong: It exchanges the two barrages. The Vamsadhara and the Nagavali both rise in Kalahandi district of Odisha and both reach the sea in Srikakulam district, but Gotta is on the Vamsadhara and Thotapalli is on the Nagavali.
- Why (4) is wrong: It makes both exchanges, so none of its four pairs is right.

Q2. Consider the following statements about the rivers of Andhra Pradesh:

1. The whole of the Penna basin lies within Andhra Pradesh.
2. The Kunderu joins the Penna on its left bank.
3. The Tungabhadra joins the Krishna on its left bank.

Which of the statements given above is/are correct?

- (1) 1 only
- (2) 1 and 2 only
- (3) 2 only
- (4) 2 and 3 only

Q2. Answer: (3) 2 only

- Statement 1 is wrong: The Penna rises in Chikkaballapura district of Karnataka. Of its basin of 55,213 sq. km, 6,937 sq. km lies in Karnataka and 48,276 sq. km in Andhra Pradesh.
- Statement 2 is correct: The left-bank tributaries of the Penna are the Jayamangali, the Kunderu and the Sagileru. The Kunderu joins it near Kamalapuram.
- Statement 3 is wrong: The Tungabhadra joins the Krishna on its right bank, near Sangameswaram. The left-bank tributaries of the Krishna are the Bhima, the Musi and the Munneru.
- Why the other options are wrong: (1) takes statement 1 as correct and leaves out statement 2. (2) includes statement 1, which is wrong. (4) includes statement 3, which is wrong.

6. Sources

6.1 Sources

No.: S1

Source: India-WRIS (Water Resources Information System of India), wiki page "Godavari". https://indiawris.gov.in/wiki/doku.php?id=godavari

Used for: Source at Trimbakeshwar, Nashik district, at 1,067 m; length 1,465 km; basin area 3,12,812 sq. km; basin over Maharashtra, Andhra Pradesh, Chhattisgarh and Odisha, with smaller parts of Madhya Pradesh, Karnataka and Puducherry; left-bank tributaries Purna, Pranhita, Indravati, Sabari and right-bank tributaries Pravara, Manjira, Maner; the Godavari delta system and the Godavari barrage among the projects

No.: S2

Source: India-WRIS, wiki page "Krishna". https://indiawris.gov.in/wiki/doku.php?id=krishna

Used for: Source near Jor village, Satara district, at 1,337 m, just north of Mahabaleshwar, in the Western Ghats; length 1,400 km; basin area 2,58,948 sq. km, nearly 8 per cent of the country; right-bank tributaries Ghataprabha, Malaprabha, Tungabhadra and left-bank tributaries Bhima, Musi, Munneru; Nagarjuna Sagar and Telugu Ganga among the projects; Srisailam and Nagarjuna Sagar among the major hydropower stations

No.: S3

Source: India-WRIS, wiki page "Pennar". https://indiawris.gov.in/wiki/doku.php?id=pennar

Used for: Source in the Chenna Kesava hill of the Nandidurg range, Chikkaballapura district, Karnataka; length 597 km; basin area 55,213 sq. km, of which 48,276 sq. km in Andhra Pradesh; left-bank tributaries Jayamangali, Kunderu, Sagileru and right-bank tributaries Chitravati, Papagni, Cheyyeru; Somasila project background; the Tungabhadra High Level Canal irrigating a part of the basin

No.: S4

Source: India-WRIS, wiki page "East flowing rivers between Mahanadi and Pennar". https://indiawris.gov.in/wiki/doku.php?id=east_flowing_rivers_between_mahanadi_and_pennar

Used for: The Vamsadhara and the Nagavali placed in this composite basin of 86,643 sq. km in Andhra Pradesh and Odisha; the list of independent rivers from north to south (Bahuda, Vamsadhara, Nagavali, Sarada, Varaha, Tandava, Gundlakamma, Manneru among them)

No.: S5

Source: Wikipedia, "Godavari River". https://en.wikipedia.org/wiki/Godavari_River

Used for: Main river in Maharashtra, Telangana and Andhra Pradesh; Bhadrachalam and the Kinnerasani before the river leaves Telangana; the Sabari as the last major tributary, left bank, at Kunavaram; the Papi hills gorge and the widening at Polavaram; Polavaram in Eluru district; Rajamahendravaram and the barrage at Dowleswaram; anicut built by Sir Arthur Cotton in 1852, rebuilt as a barrage with a roadway and named after him; the Gautami and the Vasishta, the Vainateya, Konaseema, Yanam and Point Godavari; Antarvedi as the mouth; the Polavaram right bank canal linking the Godavari to the Krishna; districts named along the river

No.: S6

Source: Wikipedia, "Krishna River". https://en.wikipedia.org/wiki/Krishna_River

Used for: States on the main river; mouth at Hamsaladeevi, Krishna district; left-bank tributaries Dindi, Musi, Paleru, Munneru; the Bhima as the longest tributary, 861 km; the Tungabhadra, 531 km; the Prakasam Barrage near Vijayawada; NTR, Guntur and Kurnool districts named along the river

No.: S7

Source: Wikipedia, "Penna River" (citing S.K. Garg, International and Interstate River Water Disputes, Laxmi Publications, 1999, for the basin shares, and S.K. Jain, P.K. Agarwal and V.P. Singh, Hydrology and Water Resources of India, Springer, for the tributaries). https://en.wikipedia.org/wiki/Penna_River

Used for: Nandi Hills source; 6,937 sq. km of the basin in Karnataka; course through Hindupur (Sri Sathya Sai district), Pavagada taluk of Karnataka, Anantapur district, Penna Ahobilam, Tadipatri, Kadapa district, the Gandikota gorge, the Velikonda range, Somasila and Nellore; mouth near Utukuru; places where the Chitravati, the Papagni, the Kunderu and the Cheyyeru join; tributary background; bank classification in the lesson follows India-WRIS

No.: S8

Source: Wikipedia, "Vamsadhara River" (citing "Orissa Information: Mahendra Tanaya River of Odisha", 8 January 2013, and the reports of the Vamsadhara Water Disputes Tribunal, 2017 and June 2021). https://en.wikipedia.org/wiki/Vamsadhara_River

Used for: Source near Lanjigarh, Kalahandi district, at 400 m; the figure of 278 km that some web pages print for the length; Rayagada and Srikakulam districts; Hiramandalam, Mukhalingam and Kalingapatnam; the Mahendratanaya rising in Gajapati district and joining upstream of the Gotta Barrage; the two main canals of the Vamsadhara Project; the Hiramandalam reservoir of 19 TMC

No.: S9

Source: Wikipedia, "Nagavali River". https://en.wikipedia.org/wiki/Nagavali_River

Used for: Source near Lakhbahal village, Kalahandi district; length of about 256 km, 161 km in Odisha; catchment of 9,510 sq. km, 4,462 sq. km in Odisha and 5,048 sq. km in Andhra Pradesh; Rayagada; Vizianagaram and Srikakulam districts; the Thotapalli Barrage in Parvathipuram Manyam district; the Narayanapuram Anicut in Burja mandal of Srikakulam district; mouth near Kallepalli, near Srikakulam

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No.: S10

Source: Wikipedia, "Tungabhadra River". https://en.wikipedia.org/wiki/Tungabhadra_River

Used for: The Tunga and the Bhadra rising at Gangamoola and meeting at Koodli in Shivamogga district; length of about 531 km; Hampi, Mantralayam and Kurnool; the confluence with the Krishna at Sangameswaram in Andhra Pradesh, near Gundimalla in Jogulamba Gadwal district of Telangana; the Sangameswaram temple described as in Kurnool district; the Tungabhadra Dam at Hospet; the Sunkesula Barrage near Kurnool and the K.C. Canal

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No.: S11

Source: Wikipedia, "List of dams and reservoirs in Andhra Pradesh". https://en.wikipedia.org/wiki/List_of_dams_and_reservoirs_in_Andhra_Pradesh

Used for: The river and place of each project: Polavaram Project (Godavari, under construction), Dowleswaram Barrage (Godavari, Rajahmundry), Srisailam Dam, Nagarjuna Sagar Dam (Vijayapuri South), Pulichintala Project and Prakasam Barrage (Krishna), Somasila, Mid Pennar, Gandikota reservoir background and Mylavaram (Penna), Thotapalli Barrage (Nagavali), Sunkesula Barrage (Tungabhadra)

No.: S12

Source: Wikipedia, "Telugu Ganga project" (citing Vandana Shiva, Ecology and the Politics of Survival, 1991, and The Hindu, "Kandaleru water reaches Satyamurthi Sagar", 8 March 2004). https://en.wikipedia.org/wiki/Telugu_Ganga_project

Used for: Water drawn from the Srisailam reservoir; carried about 406 km through the Somasila reservoir in the Penna valley and the Kandaleru reservoir to the Poondi reservoir near Chennai

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No.: S13

Source: Wikipedia, "List of districts of Andhra Pradesh" (citing The Hindu, 26 January 2022 and 4 April 2022, and Eenadu, 30 December 2025). https://en.wikipedia.org/wiki/List_of_districts_of_Andhra_Pradesh

Used for: 13 districts became 26 with effect from 4 April 2022; Markapuram and Polavaram districts formed with effect from 31 December 2025, making 28; Polavaram district with headquarters at Rampachodavaram; the official names of the districts

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No.: S14

Source: Central Water Commission, Water Year Book (June 2017 to May 2018), Volume IV: Vamsadhara, Rushikulya, Nagavali and Sarada Basin, Hydrological Observation Circle, Bhubaneswar, September 2018. https://cwc.gov.in/sites/default/files/admin/7DWYB17-18.pdf

Used for: The Vamsadhara rising near Lanjigarh village, Kalahandi district; total length of about 254 km; meeting the Bay of Bengal at Kalingapatnam; catchment of 10,830 sq. km, 8,015 sq. km in Odisha and 2,815 sq. km in Andhra Pradesh; the Mahendratanaya among its tributaries; the Gotta Barrage as an existing project on the Vamsadhara

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No.: S15

Source: NCERT, India: Physical Environment (Class XI), Chapter 3 "Drainage System". https://ncert.nic.in/textbook/pdf/kegy103.pdf

Used for: The Godavari, 1,465 km, rising in Nasik district; the Krishna, 1,401 km, rising near Mahabaleshwar in the Sahyadri

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No.: S16

Source: Encyclopaedia Britannica, "Godavari River". https://www.britannica.com/place/Godavari-River

Used for: The Godavari rising in the Western Ghats in north-western Maharashtra; length of about 1,465 km; the river flowing mainly in Maharashtra, Telangana and Andhra Pradesh, with the basin reaching into Odisha and Chhattisgarh; the gorge through the Eastern Ghats; the Gautami and the Vasishta as its two mouths; the anicut just below Rajahmundry built in the middle of the nineteenth century by Arthur Cotton

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No.: S17

Source: Wikipedia, "Polavaram district" (citing Deccan Chronicle, "AP Issues GO Creating Polavaram District With Rampachodavaram as Headquarters", 30 December 2025; The New Indian Express, 30 December 2025; The Hindu, 29 December 2025). https://en.wikipedia.org/wiki/Polavaram_district

Used for: Polavaram district formed on 31 December 2025 out of Alluri Sitharama Raju district, with headquarters at Rampachodavaram; Kunavaram among its 12 mandals; Polavaram mandal not among them

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No.: S18

Source: Deccan Chronicle, "Polavaram works to be completed by March 2027, says CM", 14 July 2026. https://www.deccanchronicle.com/southern-states/andhra-pradesh/polavaram-works-to-be-completed-by-march-2027-says-cm-1970707

Used for: The Polavaram Project still under construction in July 2026, with completion promised by March 2027

No.: S19

Source: Supreme Court of India, State of Orissa v. Government of India and another, Writ Petition (Civil) No. 443 of 2006, judgment of 6 February 2009 (copy on the website of the Orissa High Court). https://orissahighcourt.nic.in/uploads/vernacular_judgements/sc_judgements/Writ%20Petition%20(C)_443_2006_e.pdf

Used for: The Vamsadhara rising south-west of Lanjigarh in Kalahandi district; its course lying first in Odisha, then for 29 km along the border between Odisha and Andhra Pradesh, then inside Andhra Pradesh; the Gotta Barrage on the Vamsadhara

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No.: S20

Source: Government of Andhra Pradesh, Parvathipuram Manyam district website, "About District". https://parvathipurammanyam.ap.gov.in/about-district/

Used for: The district formed on 4 April 2022; the Nagavali as its main river, entering through Komarada mandal and flowing through Garugubilli mandal towards Srikakulam district; the Vamsadhara reaching Andhra Pradesh at Bhamini mandal

No.: S21

Source: Government of Andhra Pradesh, Nandyal district website, "About District". https://nandyal.ap.gov.in/about-district/

Used for: The Krishna and the Kunderu as the principal rivers of Nandyal district; the Srisailam hydro-electric project across the Krishna, 3 km from the Srisailam temple; the district bounded on the north by the Krishna and by Telangana

No.: S22

Source: National Water Development Agency, Detailed Project Report of the link project from the Godavari (Janampet) to the Cauvery (Grand Anicut), Chapter 3 "Interstate Aspects". https://nwda.gov.in/upload/uploadfiles/files/Chapter%203%20Interstate%20aspects%204_4_2019.pdf

Used for: The Godavari flowing through the States of Maharashtra, Telangana and Andhra Pradesh; the Sabari as its last major tributary, joining about 100 km above Rajamahendravaram

No.: S23

Source: Central Water Commission, Godavari Circle, Hyderabad, Meteorological Year Book (June 2017 to May 2018): Godavari Basin, March 2019. https://cwc.gov.in/sites/default/files/admin/10BGBMYB17-18.pdf

Used for: The Godavari rising at 1,067 m and running 1,465 km; the Sabari as the last major tributary, joining in Andhra Pradesh; the barrage at Dowleswaram and the Cotton Barrage named as one structure

No.: S24

Source: Wikipedia, "Palakonda revenue division" (citing Sakshi, "Districts Reorganization", retrieved 1 May 2022). https://en.wikipedia.org/wiki/Palakonda_revenue_division

Used for: Bhamini among the seven mandals of the Palakonda revenue division of Parvathipuram Manyam district

6.2 Additional verification sources · 9 October 2026

- **A1. ASR district official history.** https://allurisitharamaraju.ap.gov.in/history/
- Used for: AP 26 to 28 districts from 31 December 2025; Polavaram HQ Rampachodavaram; remaining ASR HQ Paderu
- **A2. Markapuram district GazetteNo 230,30 December 2025.** https://cdn.s3waas.gov.in/s38f7d807e1f53eff5f9efbe5cb81090fb/uploads/2026/01/17678549325255.pdf
- Used for: G.O.Ms.No 524; new district effective 31 December 2025
- **A3. Parvathipuram Manyam: revenue divisions and mandals.** https://parvathipurammanyam.ap.gov.in/tehsil/
- Used for: Bhamini in Palakonda revenue division, Parvathipuram Manyam district
- **A4. Eluru: subdivisions and blocks.** https://eluru.ap.gov.in/subdivision-blocks/
- Used for: Polavaram mandal in Eluru district; distinguish it from the newly named district
- **A5. CWC: Vamsadhara and Nagavali basin yearbook.** https://cwc.gov.in/sites/default/files/admin/7DWYB17-18.pdf
- Used for: Vamsadhara 254 km/10830 km²; Nagavali 256 km/9510 km²; basin/state splits and origin descriptions

- **A6. SPS Nellore: Somasila Dam.** https://spsnellore.ap.gov.in/somasila-dam-nellore/
- Used for: Somasila on Penna; storage and inter-basin transfer context
- **A7. AP reservoir monitoring.** https://desweather.ap.gov.in/weather/Realtime/Reservoir.jsp
- Used for: Multiple major Penna reservoirs; Somasila is not the basin's only major project
- **A8. AP Budget 2016–17, VolumeVII/1.** https://s3.ap-south-1.amazonaws.com/apfinance.gov.in/uploads/budget-volumes/2016-17/Volume-VII-1.pdf
- Used for: Hiramandalam planned capacity 19.05 TMC; capacity is distinct from actual storage
- **A9. APSAC Kadapa district survey report.** https://apsac.ap.gov.in/wp-content/uploads/2025/09/DSR-Reports/kadapa.pdf
- Used for: Penna/Chitravati geography and Gandikota context
- **A10. Government environmental-clearance repository: Gandikota project report.** https://environmentclearance.nic.in/writereaddata/Online/TOR/26_Oct_2021_164603717718534 49GandikotaPFRforFORM1.pdf
- Used for: Gandikota reservoir on Penna; avoid equating dam location with tributary confluence

Topic 46 · India's Advanced Computing Push: PARAM Rudra and Amaravati Quantum Valley

ENGLISH

1. Concept in one line

India's advanced-computing push combines operational classical supercomputing, emerging quantum research and skills development; PARAM Rudra at IIT Bombay and Amaravati Quantum Valley show why an installed machine, cloud access and a future installation plan must be read separately.

2. Revision notes

2.1 Why this is in the news

Dated development	What the source establishes	Correct status to remember
8 January 2026: PARAM Rudra inaugurated at IIT Bombay; PIB report published on 9 January	A 3 PetaFLOPS high-performance computing facility developed under the National Supercomputing Mission	An inaugurated classical HPC facility [S2]
February 2026: Amaravati Quantum Valley construction and foundation-related announcements	IBM's 7 February account records construction and member access to its quantum computers through TCS; PIB's 8 February report records the foundation plaque, quantum cloud services and an IBM–TCS Quantum Innovation Centre	Construction and cloud-service milestones; these reports do not certify a completed on-site IBM installation [S3–S4]
20 February 2026: NIELIT–Andhra Pradesh MoU; PIB report published on 21 February	A proposed Quantum and AI university campus in Amaravati, with planned fields including HPC	A signed agreement and proposed education/ research facility [S5]
4 October 2026: PIB review of India's supercomputing ecosystem	It distinguishes deployed NSM capacity, reported for September 2026, from further expansion plans	A dated national progress update [S6]

Read the verb: inaugurated, accessible, under construction, proposed and planned describe different stages. Also distinguish an event date from the date its report was published.

2.2 How a classical supercomputer gets useful work done

A **supercomputer** is a high-performance computing system used for demanding calculations, simulations and data analysis. Classical HPC can distribute suitable work across many processors. It is incorrect to assume that classical computing always completes only one task at a time. [S7, S15]

Simplified teaching flow:

Input data + scientific model → divide suitable work → processors calculate in parallel → exchange and combine results → analyse the output.

For example, a weather model can divide a region into a grid. Calculations for different parts of the grid can be distributed, while processors exchange information because nearby regions influence one another. This is an illustrative explanation of parallel modelling, not a description of a particular IIT Bombay project. [S15]

A useful HPC system needs more than fast processors:

- **Memory and storage** supply and retain the data
- **Interconnects** move information between computing nodes
- **Software** organises jobs and makes the model run on the hardware
- **Power and cooling** keep the system operating within its required conditions

The IIT Bombay PARAM Rudra facility uses C-DAC's Rudra servers and system software, together with **Direct Contact Liquid Cooling**. Cooling removes heat generated by computation. It supports dependable operation; it does not change classical bits into qubits. [S2, S7–S8]

PetaFLOPS: FLOPS means floating-point operations per second. One petaFLOPS represents 10^{15} such operations per second. This expresses a computing-performance rate, not storage capacity, internet speed or a qubit count. A headline rate alone does not tell us how quickly every real application will finish. [S6–S7]

2.3 PARAM Rudra: link the machine to its purpose

The IIT Bombay announcement identifies research opportunities in **artificial intelligence, biotechnology and advanced manufacturing**. These are areas the facility can support; inauguration itself is not proof of a new drug, a finished product or a scientific breakthrough. [S2]

The wider NSM application portfolio shows why HPC matters: [S9]

Application	What computation helps researchers do
Weather and climate	Run models of atmospheric behaviour and climate processes
Computational biology and chemistry	Study biological systems and molecular behaviour
Engineering simulation	Examine physical behaviour, such as fluid flow, before or alongside experiments
Seismic imaging	Process measurements to investigate structures below the ground
Disaster management	Support modelling and analysis relevant to hazards
Astrophysics	Analyse astronomical data and simulate physical processes

These applications still depend on observations, appropriate models, skilled users and validation. More computing capacity cannot automatically repair poor input data or an unsuitable scientific assumption.

National context: NSM is jointly steered by **MeitY and DST**, with **C-DAC and IISc Bengaluru** implementing it. Its work includes infrastructure, applications, R&D and training. The 4 October 2026 PIB backgrounder reports **40 deployed systems with a combined 68 PF as of September 2026**. Retain the reference date: aggregate capacity is not the speed of one machine, and a future expansion target must be read separately. [S2, S6]

2.4 Amaravati Quantum Valley: distinguish the parts of the initiative

Amaravati provides the **Andhra Pradesh current-affairs connection**. The collaboration involves the state government, IBM and TCS, with research, training and industrial applications among its purposes. TCS's original announcement identified applied-research opportunities in life sciences, materials, supply chains, energy and manufacturing. These are intended use cases, not a list of already achieved quantum breakthroughs. [S14]

The verified February accounts identify several different components:

1. **Physical infrastructure:** the Quantum Valley Tech Park was entering construction
2. **Access and collaboration:** IBM and TCS were providing a route to quantum cloud resources; PIB also reported an IBM–TCS Quantum Innovation Centre
3. **People and applications:** training, research and industry collaboration form part of the initiative
4. **Planned on-site hardware:** IBM described an **IBM Quantum System Two** as a future installation at the park [S3–S4]

Read the milestones separately: the February announcements describe cloud access and a planned local installation. Documented cloud access does not itself prove on-site installation. A proposed specification must not be silently relabelled as an achieved installation.

Amaravati's initiative also connects with the **National Quantum Mission (NQM)**, the DST-led effort to build Indian capabilities in quantum technologies. This links the state's infrastructure and talent plans with wider national research priorities. [S4, S16]

The separate **NIELIT–Andhra Pradesh MoU of 20 February 2026** concerns a proposed Quantum and AI university campus. Planned subjects include quantum algorithms, AI, quantum hardware, communication/cybersecurity and HPC. NIELIT is under MeitY. A signed MoU supports the existence of an agreement; it does not establish that the proposed campus is already admitting students or operating all its laboratories. [S5]

2.5 Cloud access and hybrid computing: two different ideas

Cloud access describes how a user reaches a computing service. A researcher can submit a job remotely and receive results without the processor being physically located in the researcher's city. IBM's February account confirms that Amaravati tech-park members could work with TCS to use IBM quantum computers through the cloud. [S3]

Hybrid quantum–classical computing describes how work is shared between different kinds of processors. Classical computers can prepare inputs, organise a workflow and analyse outputs while a quantum processor runs a suitable quantum part. The quantum component may be nearby or accessed remotely. [S10]

Illustrative hybrid workflow:

Classical preparation → selected quantum circuit → measurement results → classical analysis and checking.

This is a teaching example, not a claim that this exact workflow has already delivered a named commercial result in Amaravati.

Keep three questions separate:

- **Access:** can an authorised user run a job?
- **Location:** where is the physical machine installed?
- **Usefulness:** does this method improve the chosen task after accuracy, time and cost are considered?

An affirmative answer to one question does not automatically settle the others.

2.6 Enough quantum science to read the news correctly

A classical **bit** has a value of 0 or 1. A **qubit** can be prepared in a quantum superposition of the two basis states. Quantum operations use features such as superposition, entanglement and interference. These are different from simply adding more classical processors. [S11–S12]

For a qubit measured in the usual computational basis, a single measurement gives **0 or 1**. It does not display both values or reveal every possible answer. Repeated runs can be used to estimate the distribution of measurement results. Useful quantum algorithms must arrange the computation so those results reveal useful information. [S11–S12]

Two cautions matter when reading announcements:

- **Advantage is task-specific:** quantum computing offers possible advantages for selected problems, including some quantum simulations. It does not promise to accelerate every calculation or replace every supercomputer [S11]
- **Quality matters as well as quantity:** qubits are affected by noise and errors. Error correction protects logical quantum information using multiple physical qubits. A hardware qubit count alone does not establish an equal number of reliable, error-corrected logical qubits [S13]

2.7 What benefits are plausible, and what must still be demonstrated?

The two case studies illustrate complementary priorities: make powerful computing accessible now, develop new hardware and methods, train people, and connect research with useful applications.

For a **classical HPC application**, examine the model, data, execution time and validation against observations or experiments. For a **quantum application**, additionally examine the algorithm, noise, reliability and comparison with a suitable classical method. A promising laboratory or cloud demonstration is not automatically a cost-effective service ready for widespread use.

The same discipline applies to policy: an announcement indicates intent; an agreement establishes a commitment between parties; commissioning establishes a particular facility milestone; repeated useful operation needs evidence of its own.

Revision focus: connect the 2026 developments to ICT applications, research capacity, skills and indigenous capability. The detailed theory and full NSM/NQM mission surveys belong to the later dedicated lessons.

3. Quick comparison and value addition

Feature	Classical HPC, including PARAM Rudra	Quantum computing
Information unit	Bits	Qubits
Basic approach	Large-scale classical calculation, often using many processors in parallel	Controlled quantum operations followed by measurement
Useful role	Established simulation and data-analysis workloads	Selected algorithms and research applications with problem-dependent potential
Key constraint	Data movement, memory, power, cooling and suitability of the program	Noise, errors, controllability, suitable algorithms and supporting classical work
Headline number	A FLOPS rate describes floating-point performance	A qubit count describes a resource; it is not a FLOPS score
Relationship	Can prepare, support and analyse quantum workloads	Can form part of a hybrid workflow with classical resources

Two distinctions to remember: supercomputing and superconducting are different terms; a quantum processor using superconducting qubits does not make every supercomputer a quantum computer. Cloud describes a service-access arrangement and does not by itself identify either the processor type or its location. [S7, S10–S13]

4. Common exam traps

1. **“PARAM Rudra is a quantum computer because it is extremely fast.”** Speed alone does not change its classical HPC architecture
2. **“Classical supercomputers cannot process work in parallel.”** Parallel processing is central to many HPC workloads
3. **“Amaravati cloud access proves the planned machine is already installed there.”** Remote access and local commissioning need different evidence
4. **“A foundation plaque or an MoU proves a completed operational facility.”** These are earlier or different project milestones
5. **“A qubit measurement reveals all answers at once.”** Measurement returns an outcome; algorithms must make that outcome informative

6. **“More physical qubits automatically mean the same number of reliable logical qubits.”** Error protection requires additional resources and suitable hardware quality
7. **“A mission target is the latest achieved total.”** Keep targets, reported achievements and reference dates separate
8. **“Indigenous system development proves every component was fabricated in India.”** Check the precise component or capability claimed

5. MCQs with answers and explanations

Q1. With reference to the PARAM Rudra facility inaugurated at IIT Bombay in January 2026, consider the following statements:

1. It is a classical high-performance computing facility that can use parallel processing.
2. Its reported 3 PetaFLOPS capacity means that it contains 3 quadrillion qubits.
3. Liquid cooling helps remove heat generated during computation.

Which of the statements given above are correct?

(1) 1 only

(2) 1 and 3 only

(3) 2 and 3 only

(4) 1, 2 and 3

Q1. Answer: (2)

1 and 3 only.

- **Statement 1 is correct:** PARAM Rudra is a classical HPC system. Classical processors can share appropriate workloads and calculate in parallel; parallelism is not exclusive to quantum computers
- **Statement 2 is incorrect:** petaFLOPS expresses a rate of floating-point operations. Qubits are quantum-information units. The two quantities are not interchangeable
- **Statement 3 is correct:** cooling carries away computational heat. The IIT Bombay announcement specifically records Direct Contact Liquid Cooling [S2, S6–S8]

Q2. With reference to the verified February 2026 announcements concerning Amaravati's quantum initiatives, consider the following statements:

1. Access to IBM quantum computers through the cloud and the proposed installation of a machine at Amaravati represent distinct milestones.
2. Unveiling a foundation plaque by itself establishes that a quantum processor has been installed, tested and commissioned on the site.
3. The NIELIT–Andhra Pradesh MoU concerns a proposed Quantum and AI campus whose planned subject areas include high-performance computing.

Which of the statements given above are correct?

(1) 1 only

(2) 2 and 3 only

(3) 1 and 3 only

(4) 1, 2 and 3

Q2. Answer: (3)

1 and 3 only.

- **Statement 1 is correct:** a user can access remote hardware through a cloud service. A proposed installation in Amaravati needs separate evidence of on-site completion [S3]
- **Statement 2 is incorrect:** a foundation-stage event does not by itself establish installation, testing or commissioning. The February PIB account must be read according to the milestones it actually reports [S4]
- **Statement 3 is correct:** the MoU concerns a proposed Quantum and AI campus, and the official announcement includes HPC among its planned fields. The statement preserves the proposal status rather than assuming completed operation [S5]

6. Sources and verification

Primary sources checked on **9 October 2026**. Dated reports support the stated event or announcement, not an unstated later completion. Explanatory examples and the workflow arrows are teaching illustrations.

ID: S1

Source: APPSC, Group-I Prelims Syllabus (2018), p6, Item 19; APPSC content supplied via NDLI. https://ndl.iitkgp.ac.in/cd_document/appsc/appsc/group_i_services_prelims_syll

Use in this lesson: Local six-page PDF checked; broad ICT mapping, with the version limitation stated

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ID: S2

Source: PIB/MeitY, PARAM Rudra Supercomputer inaugurated at IIT Bombay, 9 January 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2212879&lang=2&reg=48

Use in this lesson: 8 January inauguration, 3 PF facility, servers/software/cooling, research areas and NSM responsibilities

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ID: S3

Source: IBM, Breaking ground on India's quantum future, 7 February 2026. https://www.ibm.com/quantum/blog/quantum-education-india

Use in this lesson: Construction, cloud access through TCS and future-tense local System Two plan; no claim of local commissioning

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ID: S4

Source: PIB/DST, Amaravati foundation ceremony report, 8 February 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2225097

Use in this lesson: Foundation plaque, cloud-service launch and IBM–TCS Quantum Innovation Centre

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ID: S5

Source: PIB/MeitY, NIELIT Quantum and AI campus announcement, 21 February 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2231125

Use in this lesson: MoU signed on 20 February; proposed campus and subject areas including HPC

ID: S6

Source: PIB, India's Rising Supercomputing Ecosystem, 4 October 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2318908&lang=1&reg=3

Use in this lesson: Date-labelled deployed capacity versus plan; FLOPS terminology and national context

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ID: S7

Source: IBM, What is high-performance computing? https://www.ibm.com/think/topics/hpc

Use in this lesson: Classical parallel processing, nodes, data movement and software; no rankings adopted

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ID: S8

Source: HPE, Direct liquid cooling solutions. https://www.hpe.com/us/en/solutions/direct-liquid-cooling.html

Use in this lesson: General heat-removal explanation only; no claim HPE supplied the IIT Bombay system

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ID: S9

Source: National Supercomputing Mission, HPC Applications of National Relevance. https://nsmindia.in/applications/

Use in this lesson: Official application areas

ID: S10

Source: IBM, What is quantum-centric supercomputing?, updated 14 April 2026. https://www.ibm.com/think/topics/quantum-centric-supercomputing

Use in this lesson: Complementary quantum/classical workflows; conceptual support, not proof of local deployment

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ID: S11

Source: NIST, Quantum Computing Explained. https://www.nist.gov/quantum-information-science/quantum-computing-explained

Use in this lesson: Measurement limits, selected potential uses and complementary role; no current-ranking claims

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ID: S12

Source: IBM Quantum Learning, Build and run your first quantum program. https://quantum.cloud.ibm.com/learning/en/courses/use-a-qc-today/build-and-run-your-first-quantum-program

Use in this lesson: Computational-basis measurement and repeated runs

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ID: S13

Source: IBM, What is fault-tolerant quantum computing?, 30 May 2025. https://www.ibm.com/quantum/blog/what-is-ftqc

Use in this lesson: Noise, errors and physical/logical qubit distinction; no future roadmap treated as achieved

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ID: S14

Source: TCS, Andhra Pradesh–IBM–TCS Quantum Valley announcement, 2 May 2025. https://www.tcs.com/who-we-are/newsroom/press-release/ibm-tata-consultancy-services-government-andhra-pradesh-deploy-indias-largest-quantum-computer-countrys-first-quantum-valley-tech-park

Use in this lesson: Partners and intended applied-research areas; no proposed processor specification treated as an installed system

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ID: S15

Source: Lawrence Livermore National Laboratory, Introduction to Parallel Computing Tutorial. https://hpc.llnl.gov/documentation/tutorials/introduction-parallel-computing-tutorial

Use in this lesson: Parallel work, data decomposition, inter-process communication and performance limits

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ID: S16

Source: PIB/DST, National Quantum Mission ecosystem update, 30 September 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2317241&lang=1&reg=48

Use in this lesson: Brief national programme context only; no additional targets or volatile totals used

Topic 47 · Nuclear fission, fusion and reactor types

ENGLISH

1. Concept in one line

Nuclear fission splits a heavy nucleus and nuclear fusion joins light nuclei; both release energy because the products are more tightly bound than the nuclei that went in. The examination asks for the terms, the job and material of each part of a reactor, the reactor types with their Indian examples, and the facts of ITER.

2. Revision notes

2.1 The nucleus, mass defect and binding energy

- A nucleus is made of protons and neutrons, together called **nucleons**. The mass number A is the number of nucleons.
- **Mass defect (ΔM):** the mass of a nucleus is less than the total mass of its protons and neutrons taken separately. This difference in mass is the mass defect (NCERT).
- **Binding energy (Eb):** the energy that corresponds to the mass defect, Eb = ΔMc^2. It is the energy that must be supplied to separate the nucleus into its nucleons. One atomic mass unit (u) corresponds to 931.5 MeV.
- **Binding energy per nucleon** (Eb divided by A) shows how tightly a nucleus is held. NCERT's curve has a maximum of about 8.75 MeV at A = 56 and falls to 7.6 MeV at A = 238. It is low for the very light nuclei too.
- So energy is released when a very heavy nucleus splits into middle-weight nuclei (fission), and also when very light nuclei join (fusion).

2.2 Fission and the chain reaction

- **Fission:** a heavy nucleus splits into lighter fragments and releases energy. In neutron-induced fission, as in the uranium-235 example below, absorption of a neutron triggers the splitting and further neutrons are released.
- **NCERT's example:** neutron + uranium-235 → barium-144 + krypton-89 + 3 neutrons. The same nucleus can split in other ways; NCERT also gives xenon-140 + strontium-94 + 2 neutrons. Fission does not give one fixed pair of fragments.
- **Energy:** of the order of 200 MeV for each nucleus that undergoes fission (NCERT). NCERT's estimate from the binding energy curve, for a nucleus with A = 240, is a gain of about 0.9 MeV per nucleon: 240 × 0.9 is about 216 MeV.
- The fragments are radioactive. They emit beta particles one after another until they become stable. This is why the waste of fission is radioactive and has to be stored.

- **Chain reaction:** each fission of uranium-235 gives two or three neutrons, about 2.5 on average, according to the lesson of the National Institute of Open Schooling (NIOS). If these neutrons cause more fissions, the reaction feeds itself. It is self-sustained when neutrons are produced as fast as they are lost.
- A reactor that has reached this self-sustaining state is said to be **critical**. "First criticality" is the first time a new reactor reaches it.
- **Critical mass:** the least amount of fissile material (material that can sustain a chain reaction, such as uranium-235) in which a chain reaction can keep itself going. In a smaller piece too many neutrons leak out through the surface.
- In a reactor the chain reaction is kept under control. In an atom bomb the fission is uncontrolled (NCERT).

2.3 Fissile and fertile materials, and enrichment

Kind of material	What it means	Nuclides
Fissile	It can undergo fission after absorbing a low-energy (thermal) neutron and can support a fission chain reaction	Uranium-233, uranium-235 and plutonium-239
Fertile	It is not itself fissile, but can be converted into a fissile nuclide by neutron absorption, with subsequent radioactive decay where required	Uranium-238, which changes into plutonium-239; thorium-232, which changes into uranium-233

- **Natural uranium** has 0.7 per cent uranium-235 and over 99.2 per cent uranium-238 (World Nuclear Association).
- **Enrichment** means raising the share of uranium-235. Fuel for light water (ordinary water) reactors is commonly enriched to 3.5 to 5 per cent uranium-235. The pressurised heavy water reactor uses natural uranium, with no enrichment.
- India has large deposits of thorium but limited reserves of uranium (Bhabha Atomic Research Centre, BARC). India's three-stage programme, a separate topic, is built on this.

2.4 The parts of a reactor

"Light water" means ordinary water.

Part	What it does	Materials and form
Fuel	Undergoes fission and gives out the heat	Usually pellets of uranium oxide (UO_2) packed in tubes of zirconium alloy, which form the fuel rods
Moderator	Slows down the fast neutrons from fission, so that they cause more fission	Light water, heavy water or graphite
Coolant	Carries the heat away from the core (the part of the reactor that holds the fuel)	Water, heavy water, carbon dioxide, helium or liquid sodium

Part	What it does	Materials and form
Control rods	Absorb neutrons. Pushed in or pulled out, they set the rate of the reaction or stop it	Cadmium, hafnium or boron
Reflector	Scatters escaping neutrons back into the core, reducing neutron leakage	A layer around the core; common materials include graphite and beryllium
Shielding	Protects the people working at the plant from radiation	A thick concrete wall. The outer containment is a structure of concrete and steel, typically a metre thick

- In light water reactors the same water is both moderator and coolant.
- **Thermal and fast reactors:** a thermal reactor works with slowed (thermal) neutrons and needs a moderator. A fast reactor works with fast neutrons and has no moderator.

2.5 Reactor types by moderator and coolant

MWe means megawatts of electrical output.

Reactor type	Fuel	Moderator	Coolant	How it works	Indian example
Pressurised heavy water reactor (PHWR)	Natural uranium oxide	Heavy water	Heavy water	The fuel sits in pressure tubes. The reactor can be refuelled without shutting it down	Kakrapar-3, Gujarat: 700 MWe, the first 700 MWe unit of Indian design; commercial operation on 30 June 2023
Boiling water reactor (BWR)	Enriched uranium oxide	Light water	Light water	A single circuit, at about 75 times atmospheric pressure. The water boils in the core at about 285°C and the steam goes to the turbine	Tarapur 1 and 2, Maharashtra: 160 MWe each, built by GE (General Electric); commercial operation on 28 October 1969
Pressurised water reactor (PWR); the Russian design is called VVER	Enriched uranium oxide	Light water	Light water	Two circuits. Water in the core, at about 325°C, is kept at about 150 times atmospheric pressure so that it does not boil. In a steam generator (a large heat exchanger) it gives its heat to the second circuit, where the steam is raised	Kudankulam 1 and 2, Tamil Nadu: 1,000 MWe each, VVER-1000 reactors supplied by Russia; commercial operation on 31 December 2014 (unit 1) and 31 March 2017 (unit 2)

Reactor type	Fuel	Moderator	Coolant	How it works	Indian example
Fast breeder reactor (FBR)	Oxides of plutonium and uranium (mixed oxide, MOX)	None	Liquid sodium	Fast neutrons cause the fission. A blanket of uranium-238 round the core changes into plutonium-239, so the reactor makes more fuel than it uses	Prototype Fast Breeder Reactor (PFBR), Kalpakkam, Tamil Nadu: 500 MWe; first criticality at 8.25 pm on 6 April 2026

- **Advanced Heavy Water Reactor (AHWR):** a 300 MWe design of BARC, of the vertical pressure tube type, moderated by heavy water and cooled by boiling light water, with thorium-based fuel. It is still a design: in a list updated in July 2026 the World Nuclear Association shows it as "proposed".
- **Small modular reactors (SMRs):** advanced reactors with electrical capacity up to 300 MWe per unit, whose systems and components can be factory-made and assembled at the site. The Union Budget 2025–26 announced a Nuclear Energy Mission with ₹20,000 crore for SMR research and development, aiming for at least five indigenous SMRs to operate by 2033. A DAE parliamentary answer of 5 August 2026 lists three designs: the 220 MWe Bharat Small Modular Reactor (BSMR-200), the 55 MWe SMR-55, and a high-temperature gas-cooled reactor of up to 5 MWth for hydrogen production. MWe measures electrical output; MWth measures thermal output.
- The website of the Nuclear Power Corporation of India Limited (NPCIL), seen on 9 October 2026, lists 24 units with a total of 8,780 MWe: 20 PHWRs, 2 BWRs and 2 PWRs. The PFBR is not in that list: it was built by Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI), to a design of the Indira Gandhi Centre for Atomic Research (IGCAR). The list of power plants is a separate topic.

2.6 Fusion

- **Fusion:** two light nuclei combine to form a heavier nucleus, and energy is released. NCERT's example: two nuclei of deuterium (hydrogen-2) give helium-3 and a neutron, with 3.27 MeV.
- **Why great heat is needed:** nuclei carry positive charge and repel each other, and the nuclear force acts only over a few femtometres. Heating gives the nuclei the energy to come that close. Fusion brought about by raising the temperature is called **thermonuclear fusion**.
- **The deuterium-tritium (D-T) reaction:** ITER is designed to use a 50-50 mixture of deuterium (hydrogen-2) and tritium (hydrogen-3), two isotopes of hydrogen. One deuterium nucleus and one tritium nucleus produce a helium-4 nucleus (an alpha particle) and a neutron, releasing about 17.6 MeV: about 3.5 MeV is carried by the alpha particle and 14.1 MeV by the neutron.
- **Conditions:** NCERT says the fuel must be heated to about 10^8 K, that is, 100 million K (10 crore K). ITER, the international fusion experiment described in 2.7, gives a figure of the order of 150 million °C. At such temperatures the fuel is a **plasma**, a mixture of positive ions and electrons.
- **Why it is hard to hold:** no container can stand such a temperature (NCERT), so the plasma has to be kept away from the walls. Machines such as the tokamak (see 2.7) do this with magnetic fields. The plasma is also unstable: in a "disruption" the confinement is lost within milliseconds.

- **Fusion in the Sun:** hydrogen is fused into helium by the proton-proton cycle. In effect four hydrogen nuclei make one helium-4 nucleus, and 26.7 MeV is released. The temperature at the Sun's core is 1.5×10^7 K, that is, 15 million K (1.5 crore K). This is lower than the 100 million K that a fusion reactor needs.

2.7 Tokamaks, ITER and India

- **Tokamak:** a machine that confines plasma in a torus-shaped chamber (a ring) using magnetic fields produced by external coils and an electric current in the plasma. The word comes from a Russian acronym; one expansion is "toroidal chamber with magnetic coils". The idea came from the Soviet physicists Andrei Sakharov and Igor Tamm.

Point	ITER
Name	"The Way" in Latin
What it is	An experimental fusion project that is building the world's largest tokamak
Place	Saint Paul-lez-Durance, in southern France
Members	Seven: China, the European Union (through Euratom), India, Japan, the Republic of Korea (South Korea), Russia and the United States
Agreement	The ITER Agreement was concluded in 2006
Goal	Q = 10: 500 MW of fusion power from 50 MW of external heating supplied to the plasma. This is plasma energy gain; Q = 1 is scientific breakeven. It is not whole-plant electrical gain, and ITER will not generate electricity
Schedule on the ITER website (page updated on 20 April 2026)	Planned start of research operation in 2034; planned start of deuterium-tritium operation in 2039
Share of construction cost	Europe 45.6 per cent; each of the other six members 9.1 per cent (rounded figures)

- **India in ITER:** India joined the project in 2005. ITER-India is the Indian Domestic Agency and a project under the Institute for Plasma Research (IPR) in Gujarat. Its website lists nine major packages for India. The ITER website speaks of India's 14 procurement packages and calls the **cryostat** the largest of them. The cryostat weighs 3,850 tonnes and was completed in 2022. India has also supplied the in-wall shielding of the vacuum vessel and parts of the cooling water and cryogenic systems.
- **India's own tokamaks:** ADITYA, India's first tokamak, began operation at IPR in Gujarat in 1989. It was upgraded to ADITYA-U, which achieved first plasma in December 2016. IPR also operates the Steady State Superconducting Tokamak-1 (SST-1), developed to study steady-state plasma operation.

2.8 Fission and fusion compared

Point	Fission	Fusion
What happens	A heavy nucleus splits into two middle-weight nuclei	Light nuclei join to form a heavier nucleus
Usual fuel	Uranium-235 or plutonium-239	Isotopes of hydrogen: deuterium and tritium
Energy for one event	Of the order of 200 MeV for one fission	26.7 MeV when four hydrogen nuclei make one helium nucleus in the Sun
Energy for each nucleon taking part	Less than 1 MeV (200 ÷ 236 is about 0.85)	About 6.7 MeV (26.7 ÷ 4)
Chain reaction	Yes, carried by neutrons and held in check by control rods	No chain of neutrons; the fuel has to be kept hot and confined
Products	Radioactive fragments, which have to be stored	Helium; the D-T reaction also gives neutrons
Use for electricity, as on 9 October 2026	The source of energy in the nuclear reactors that produce electricity	Still at the stage of experiment: ITER is under construction
Weapon	Atom bomb	Hydrogen bomb

3. Extra section: milestones in order of date

Date	Milestone
1942	Enrico Fermi's team achieves the first self-sustained chain reaction at the University of Chicago
1958	T-1, sometimes considered the first tokamak, begins to work in the Soviet Union
28 October 1969	Tarapur 1 and 2, boiling water reactors, begin commercial operation
1989	Aditya, India's first tokamak, begins to work at IPR
2005	India joins the ITER project
2006	The ITER Agreement is concluded
31 December 2014	Kudankulam-1, a VVER-1000, begins commercial operation
2022	The ITER cryostat, India's largest package, is completed
30 June 2023	Kakrapar-3, a 700 MWe PHWR, begins commercial operation

Date	Milestone
February 2025	The Union Budget announces the Nuclear Energy Mission: ₹20,000 crore, at least five SMRs by 2033
6 April 2026	The PFBR at Kalpakkam attains first criticality
2034 and 2039 (planned)	ITER is to start research operation in 2034 and deuterium-tritium operation in 2039

How to read the table:

- The four reactor dates give one Indian example for each type in the table of 2.5: BWR (1969), PWR of the VVER design (2014), PHWR of 700 MWe (2023) and FBR (2026).
- Three of them are dates of commercial operation. The PFBR date is the date of first criticality only.
- The fusion dates run on a separate line: 1958, 1989, 2005, 2006, 2022, and then the planned 2034 and 2039.

4. Three common exam traps

1. **Taking a fertile material for a fuel.** Uranium-238 and thorium-232 are fertile, not fissile: they have to be changed first, into plutonium-239 and uranium-233. Plutonium-239 and uranium-233 are not mined; they are made in reactors. Natural uranium is almost all uranium-238. Enrichment only raises the share of uranium-235 to a few per cent; it does not make the uranium pure uranium-235.
2. **Mixing up the jobs of the parts.** The moderator slows neutrons down; it is not there to stop the reaction. The control rods absorb neutrons, and they are the part that sets the rate or shuts the reactor down. The coolant only carries heat. The reflector saves neutrons for the reaction, while the shielding protects people. "Critical" is not a word for an accident: a reactor is critical when its chain reaction sustains itself.
3. **Taking ITER for an Indian machine or for a power station.** ITER is in France, and India is one of its seven members, not its host. It is an experiment that is still being built, and its deuterium-tritium operation is planned only for 2039. India's own tokamaks include ADITYA-U and SST-1 at IPR in Gujarat. Every nuclear power station that produces electricity runs on fission.

5. MCQs with answers and explanations

Q1. Match List I (Reactor type) with List II (Moderator, coolant and circuits):

List I (Reactor type)	List II (Moderator, coolant and circuits)
A. Boiling water reactor	1. Heavy water is the moderator and light water is the coolant
B. Pressurised water reactor	2. Light water is both moderator and coolant; steam is raised in a second circuit
C. Pressurised heavy water reactor	3. Heavy water is both the moderator and the coolant
D. Advanced heavy water reactor	4. Light water is both moderator and coolant; there is only a single circuit

- (1) A-2, B-4, C-3, D-1
- (2) A-4, B-2, C-1, D-3
- (3) A-4, B-2, C-3, D-1
- (4) A-2, B-4, C-1, D-3

Q1. Answer: (3) A-4, B-2, C-3, D-1

- Why it is correct: in the boiling water reactor light water is both moderator and coolant, and there is a single circuit, because the water boils in the core and the steam goes to the turbine (A-4). In the pressurised water reactor light water again does both jobs, but it is kept from boiling by high pressure and gives its heat to a second circuit in a steam generator (B-2). In the pressurised heavy water reactor heavy water is both moderator and coolant (C-3). The Advanced Heavy Water Reactor is moderated by heavy water but cooled by boiling light water (D-1).
- Why (1) is wrong: it exchanges the two light water reactors. The single circuit belongs to the boiling water reactor and the second circuit to the pressurised water reactor.
- Why (2) is wrong: it exchanges the two heavy water reactors. The pressurised heavy water reactor uses heavy water as coolant too; it is the Advanced Heavy Water Reactor that is cooled by light water.
- Why (4) is wrong: it makes both exchanges, so all four of its pairs are wrong.

Q2. Consider the following statements about fission and fusion:

1. A fast breeder reactor works without a moderator.
2. For each nucleon taking part, the fission of uranium-235 releases more energy than the fusion of hydrogen into helium in the Sun.
3. The temperature at the core of the Sun is higher than the plasma temperature planned for ITER.
4. The cryostat of ITER is among the components supplied by India.

Which of the statements given above is/are correct?

- (1) 1 and 4 only
- (2) 1 only
- (3) 1, 3 and 4 only
- (4) 2 and 4 only

Q2. Answer: (1) 1 and 4 only

- Statement 1 is correct: a fast reactor works with fast neutrons, so it has no moderator. The Indian PFBR uses liquid sodium as coolant.
- Statement 2 is wrong: one fission releases about 200 MeV, but about 236 nucleons take part, so the energy for each nucleon is less than 1 MeV. In the Sun 26.7 MeV is released when four hydrogen nuclei make one helium nucleus, which is about 6.7 MeV for each nucleon. Fusion gives more for each nucleon.
- Statement 3 is wrong: the Sun's core is at about 1.5×10^7 K (15 million K). ITER requires plasma temperatures of the order of 150 million °C. ITER's plasma must therefore be much hotter than the Sun's core.
- Statement 4 is correct: the cryostat is the largest of India's packages for ITER. It weighs 3,850 tonnes and was completed in 2022.
- Why the other options are wrong: (2) leaves out statement 4, which is correct. (3) includes statement 3, which is wrong. (4) includes statement 2, which is wrong, and leaves out statement 1, which is correct.

6. Sources

6.1 Sources

No.: S1

Source: NCERT, Physics, Part II (Class XII), Chapter 13, "Nuclei", reprint 2026-27. https://ncert.nic.in/textbook/pdf/leph205.pdf

Used for: Nucleons; mass defect; binding energy, Eb = ΔMc^2; 1 u = 931.5 MeV; binding energy per nucleon, about 8.75 MeV at A = 56 and 7.6 MeV at A = 238; two fission reactions of uranium-235; energy of the order of 200 MeV per fission and the estimate 240 × 0.9 = 216 MeV; radioactive fragments and beta emission; fission as the source of energy in reactors that produce electricity, and uncontrolled fission in the atom bomb; fusion of two deuterium nuclei

with 3.27 MeV; short range of the nuclear force; thermonuclear fusion; proton-proton cycle and 26.7 MeV; Sun's core at 1.5×10^7 K; controlled thermonuclear fusion at about 10^8 K, plasma, "no container can stand such a high temperature"

No.: S2

Source: National Institute of Open Schooling (NIOS), Senior Secondary Physics (312), Lesson 27, "Nuclear Fission and Fusion". https://www.nios.ac.in/media/documents/SrSec312NEW/312_Physics_Eng/312_Physics_Eng_Lesson27.pdf

Used for: Chain reaction; two or three neutrons per fission, about 2.5 on average; self-sustained reaction when production of neutrons equals loss; uranium-233, uranium-235 and plutonium-239 as fissile; parts of a reactor: core, moderator, coolant, control rods of cadmium or boron, reflector to reduce neutron leakage, pressure vessel, thick concrete shielding, heat exchanger; thermal and fast reactors; Fermi and the first self-sustained chain reaction, 1942, University of Chicago; definition of fusion; energy for each nucleon in fission and in fusion; radioactive waste of fission to be stored; atom bomb and hydrogen bomb

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No.: S3

Source: World Nuclear Association, "Nuclear Power Reactors" (updated 5 August 2026). https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/nuclear-power-reactors

Used for: Fuel as uranium oxide pellets in zirconium alloy tubes; jobs and materials of moderator, control rods, coolant, pressure vessel or pressure tubes, steam generator and containment; natural uranium 0.7 per cent uranium-235 and over 99.2 per cent uranium-238; enrichment commonly to 3.5 to 5 per cent; table of reactor types with fuel, coolant and moderator (PWR, BWR, PHWR, fast neutron reactor); PWR at about 325°C and about 150 times atmospheric pressure with two circuits, called VVER in Russia; BWR with a single circuit at about 75 times atmospheric pressure, boiling at about 285°C; PHWR with natural uranium, pressure tubes and refuelling without shutdown; fast reactors without a moderator, making plutonium from uranium-238; breeder reactors

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No.: S4

Source: Nuclear Power Corporation of India Limited (NPCIL), "Plants Under Operation". https://www.npcil.nic.in/content/302_1_AllPlants.aspx

Used for: The 24 units with reactor type, capacity and date of commercial operation: Tarapur 1 and 2 (BWR, 160 MWe each, 28 October 1969); Kakrapar-3 (PHWR, 700 MWe, 30 June 2023); Kudankulam 1 and 2 (PWR, 1,000 MWe each, 31 December 2014 and 31 March 2017); total installed capacity 8,780 MWe; count of 20 PHWRs, 2 BWRs and 2 PWRs

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No.: S5

Source: Department of Atomic Energy, "Prototype Fast Breeder Reactor at Kalpakkam, Tamil Nadu attains first criticality" (published 7 April 2026). https://dae.gov.in/prototype-fast-breeder-reactor-at-kalpakkam-tamil-nadu-attains-first-criticality

Used for: PFBR of 500 MWe; first criticality at 8.25 pm on 6 April 2026; design by IGCAR; built by BHAVINI; uranium-plutonium mixed oxide fuel; liquid sodium coolant; blanket of uranium-238 and later thorium-232; fertile uranium-238 changing into fissile plutonium-239; thorium-232 changing into uranium-233; the reactor producing more fuel than it consumes

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No.: S6

Source: World Nuclear Association, "Nuclear Power in India" (updated 15 July 2026). https://world-nuclear.org/information-library/country-profiles/countries-g-n/india

Used for: Tarapur 1 and 2 built by GE; Kudankulam 1 and 2 as VVER-1000 reactors supplied by Russia; Kakrapar-3 as the first 700 MWe unit of Indian design; PFBR as a sodium-cooled reactor with mixed oxide fuel; AHWR of 300 MWe listed as "proposed"; Nuclear Energy Mission of February 2025 with ₹20,000 crore and at least five Indian-designed SMRs operational by 2033

No.: S7

Source: Bhabha Atomic Research Centre, "Advanced Heavy Water Reactor (AHWR)". https://www.barc.gov.in/randd/ahwr.html

Used for: AHWR as a 300 MWe, vertical pressure tube type, boiling light water cooled and heavy water moderated reactor; thorium-based fuel; demonstration of large-scale use of thorium; India's large thorium deposits and limited uranium reserves

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No.: S8

Source: International Atomic Energy Agency, “What are small modular reactors (SMRs)?” https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs

Used for: Up to 300 MWe per unit; modular factory manufacture and site assembly

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No.: S9

Source: News On AIR (Akashvani), "India to make five small nuclear power reactors operational by 2033" (23 July 2026). https://newsonair.gov.in/india-to-make-five-small-nuclear-power-reactors-operational-by-2033/

Used for: Written reply in the Lok Sabha; at least five indigenous small modular reactors by 2033; BARC developing three designs, among them a Bharat Small Modular Reactor; installed capacity of 8.78 gigawatts

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No.: S10

Source: ITER Organization, "In a few lines" (page updated 20 April 2026). https://www.iter.org/few-lines

Used for: ITER as "The Way" in Latin; the world's largest tokamak; Saint Paul-lez-Durance, southern France; the seven members; agreement concluded in 2006; Q = 10, 500 MW from 50 MW; temperature of the order of 150,000,000 °C; deuterium and tritium; start of research operation in 2034 and of deuterium-tritium operation in 2039; Europe 45.6 per cent and the other members 9.1 per cent each

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No.: S11

Source: ITER Organization, "India's contributions to ITER" (17 February 2025). https://www.iter.org/node/30333

Used for: India joined in 2005; Indian Domestic Agency and the Institute for Plasma Research in Gujarat; 14 procurement packages; cryostat of 3,850 tonnes completed in 2022; in-wall shielding, cooling water and cryogenic systems; Aditya, India's first tokamak, at IPR since 1989

No.: S12

Source: Wikipedia, "Tokamak". https://en.wikipedia.org/wiki/Tokamak

Used for: Definition of a tokamak; the Russian acronym; Sakharov and Tamm (the article cites Shafranov, 2001, for their proposal of 1950); T-1 of 1958 (the article cites Smirnov, 2009); 50-50 mix of deuterium and tritium, alpha particles and high-energy neutrons; temperature over 100 million °C; disruptions and loss of confinement in milliseconds; Q and breakeven; Aditya, 1989, at IPR in Gujarat

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No.: S13

Source: Encyclopaedia Britannica, "nuclear fusion" (Robert W. Conn; updated 17 September 2026). https://www.britannica.com/science/nuclear-fusion

Used for: Fusion as the forming of heavier elements from light elements; the energy of fusion first exploited in thermonuclear weapons

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No.: S14

Source: NASA, National Space Science Data Center, "Sun Fact Sheet" (David R. Williams; last updated 9 May 2024). https://nssdc.gsfc.nasa.gov/planetary/factsheet/sunfact.html

Used for: Central temperature of the Sun, 1.571×10^7 K, which agrees with NCERT's 1.5×10^7 K for the Sun's interior

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No.: S15

Source: Department of Atomic Energy, parliamentary reply, 5 August 2026, PIB Release ID 2294814. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2294814

Used for: Nuclear Energy Mission; ₹20,000 crore; at least five indigenous SMRs by 2033; 220 MWe BSMR-200 (PWR), 55 MWe SMR-55 (PWR), and HTGCR up to 5 MWth

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No.: S16

Source: ITER-India, "India's contribution to ITER" (seen on 9 October 2026). https://www.iterindia.in/indias-contribution-iter

Used for: ITER-India as a project under the Institute for Plasma Research; nine major packages for India: cryostat, in-wall shielding, cooling water system, cryogenic system, ion cyclotron and electron cyclotron radio-frequency heating systems, diagnostic neutral beam system, power supplies and selected diagnostics

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No.: S17

Source: Institute for Plasma Research. https://online.ipr.res.in/documents/aditya_u.html ; https://online.ipr.res.in/documents/sst-1.html

Used for: ADITYA-U first plasma in December 2016; SST-1

No.: S18

Source: US Nuclear Regulatory Commission, glossary. https://www.nrc.gov/education-regulatory-research/glossary/full-text ; Idaho National Laboratory. https://inldigitallibrary.inl.gov/content/uploads/50/2026/04/Sort_72216.pdf

Used for: Fissile, fertile, critical mass and reflector definitions; graphite and beryllium reflector materials

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No.: S19

Source: ITER Organization and CEA. https://www.iter.org/node/20687/magic-cocktail-deuterium-and-tritium ; https://www.iter.org/mag/4/t-time-jet ; https://www.iter.org/node/20687/us-deliver-tough-electronics-iter ; https://irfm.cea.fr/2026/03/comment-les-reactions-de-fusion-font-elles-battre-le-coeur-du-plasma/ ; https://www.iter.org/fusion-glossary

Used for: D–T fuel and 17.6 MeV total energy, split 3.5/14.1 MeV; tokamak fields

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No.: S20

Source: ITER-India, About. https://www.iterindia.in/about-us

Used for: ITER-India is the Indian Domestic Agency

Topic 48 · Calendar: leap years and century rules

ENGLISH

1. Concept in one line

In the Gregorian calendar a year divisible by 4 is a leap year of 366 days, except that a century year is a leap year only when it is divisible by 400. The exam asks you to test years, to count leap years and days in a span of years, and to work with dates around 29 February.

2. Revision notes

2.1 Ordinary year and leap year

Point	Ordinary year	Leap year
Number of days	365	366
Days in February	28	29
In weeks	52 weeks and 1 day (365 = 52 × 7 + 1)	52 weeks and 2 days (366 = 52 × 7 + 2)
Odd days	1	2

- An ordinary year is also called a common year.
- The one extra day of a leap year is 29 February, the leap day. Every other month has the same length in both kinds of year.
- The days left over after the complete weeks are taken out are called odd days. That is all this topic needs of them; using odd days to find the day of the week is Topic 58.

2.2 The leap year rule

"Divisible" here means divisible exactly, with no remainder. A century year is a year that ends in 00, that is, a year divisible by 100 (1900, 2000).

- **Rule 1.** A year that is not a century year is a leap year if it is divisible by 4.
- **Rule 2.** A century year is a leap year only if it is divisible by 400.
- So 1600, 2000 and 2400 are leap years. 1700, 1800, 1900, 2100, 2200 and 2300 are not, although each of them is divisible by 4.
- Out of every four century years, three are ordinary years and one is a leap year.
- Leap years normally come 4 years apart. Across a century year that is not a leap year the gap is 8 years: after 1896 the next leap year is 1904.

2.3 Why the rule exists: the solar year and the correction of 1582

- The seasons repeat after one tropical year (also called the solar year), which is approximately 365.2422 days, that is, about 365 days, 5 hours and 49 minutes. In round figures, the Earth takes about 365 days and 6 hours to go once round the Sun.
- A year of 365 days is therefore short by almost 6 hours. Four such years are short by almost one day, so one day is added in every fourth year.
- Julius Caesar ordered the Julian reform in 46 BC; the reformed calendar began in 45 BC and used this principle. Every fourth year was a leap year, and the average year was 365.25 days.
- But 365.25 days is more than 365.2422 days by 0.0078 day, about 11 minutes a year. This adds up to about one day in 128 years, so the calendar slowly moved out of step with the seasons.
- **The Gregorian correction.** Pope Gregory XIII ordered it by the papal bull Inter gravissimas, dated 24 February 1582. It did two things. First, in the countries adopting it immediately, Thursday 4 October 1582 was followed by Friday 15 October 1582: 10 dates were omitted without breaking the weekday sequence. Other countries adopted the Gregorian calendar later. Second, the century rule was brought in, which gives 97 leap years in 400 years in place of 100.
- The average Gregorian year is 365 + 97/400 = 365.2425 days. It is longer than the tropical year by only 0.0003 day, about 26 seconds a year. The US Naval Observatory puts the time needed for this to add up to one day at about 3,300 years.
- In exam questions, apply the Gregorian rule to every year unless the question says otherwise.

Point	Julian calendar	Gregorian calendar
Introduced	Reform ordered in 46 BC; calendar began in 45 BC, under Julius Caesar	1582, by Pope Gregory XIII
Leap year rule	Every fourth year	Every fourth year, but a century year only if divisible by 400
Leap years in 400 years	100	97
Average length of the year	365.25 days	365.2425 days
Longer than the tropical year by	About 11 minutes a year	About 26 seconds a year

2.4 Testing a year quickly

- **Not a century year:** divide only the last two digits by 4. This works because 100 is divisible by 4, so the hundreds do not change the remainder.
- **Century year:** drop the two zeros and divide what is left by 4. This is the same as dividing the year by 400.

Year	Test	Result
1996	96 ÷ 4 = 24, no remainder	Leap year
2026	26 ÷ 4 leaves remainder 2	Ordinary year
2028	28 ÷ 4 = 7, no remainder	Leap year
1900	Century year: 19 ÷ 4 leaves remainder 3	Ordinary year
2000	Century year: 20 ÷ 4 = 5, no remainder	Leap year
2200	Century year: 22 ÷ 4 leaves remainder 2	Ordinary year
2400	Century year: 24 ÷ 4 = 6, no remainder	Leap year

- An odd-numbered year is never a leap year. An even-numbered year need not be one: 2026 and 2030 are even but ordinary.

2.5 Counting leap years in a span of years

Count both end years unless the question says otherwise.

1. Count the multiples of 4 in the span: (last multiple - first multiple) ÷ 4 + 1.
2. List the century years in the span and pick out those that are not divisible by 400.
3. Leap years = the count in step 1 - the number of years picked out in step 2.

The standard results. Books give them for "100, 200, 300 and 400 years". They hold for a block of years that begins in the year just after a leap century year, such as 2001 (or 1601).

Block of years	Multiples of 4	Century years that are not leap years	Leap years	Ordinary years	Days
100 years (2001 to 2100)	25	1 (2100)	25 - 1 = 24	76	36,524
200 years (2001 to 2200)	50	2 (2100, 2200)	50 - 2 = 48	152	73,048
300 years (2001 to 2300)	75	3 (2100, 2200, 2300)	75 - 3 = 72	228	109,572
400 years (2001 to 2400)	100	3 (2100, 2200, 2300); 2400 is a leap year	100 - 3 = 97	303	146,097

- Days = 365 × the number of years + the number of leap years. For 100 years: 36,500 + 24 = 36,524.
- Any 400 consecutive years have exactly 97 leap years and 146,097 days, because the pattern of leap years repeats every 400 years.

- Shorter blocks depend on where they begin. Any 100 consecutive years hold exactly one century year, so they have 24 leap years, or 25 if that century year is a leap year: 1901 to 2000 has 25. In the same way, any 200 consecutive years have 48 or 49 leap years, and any 300 consecutive years have 72 or 73.

2.6 Days in the months and in the two halves of the year

Months	Days in each
January, March, May, July, August, October, December (7 months)	31
April, June, September, November (4 months)	30
February	28 in an ordinary year, 29 in a leap year

- Check: 7 × 31 + 4 × 30 + 28 = 217 + 120 + 28 = 365.

Part of the year	Ordinary year	Leap year
January to March	90	91
April to June	91	91
July to September	92	92
October to December	92	92
First half: 1 January to 30 June	181	182
Second half: 1 July to 31 December	184	184

- Only the first half changes in a leap year. The second half has 184 days in every year.
- 1 March is the 60th day of an ordinary year and the 61st day of a leap year. From 1 March onwards, every date comes one place later in a leap year.

2.7 Counting days between two dates across a February

- Split the period into three parts: the days left in the first month, the whole months in between, and the days of the last month up to the end date.
- "From A to B" counts the days you move forward from A to reach B. If both dates are to be counted, add 1.
- Then ask one question: does a 29 February lie inside the period?
- Example: 15 January to 15 March. The days left in January are 31 - 15 = 16. In 2027 the count is 16 + 28 + 15 = 59 days. In 2028 it is 16 + 29 + 15 = 60 days.
- From a date to the same date one year later there are 365 days, or 366 days if a 29 February lies in between. It does not matter whether the starting year is a leap year.

From	To	Is a 29 February in between?	Days
1 January 2027	1 January 2028	No	365
1 March 2027	1 March 2028	Yes, 29 February 2028	366
1 January 2028	1 January 2029	Yes, 29 February 2028	366
1 March 2028	1 March 2029	No	365

- A period of 12 months that does not begin on 1 January follows the same test. 1 April 2027 to 31 March 2028, counting both dates, has 366 days, because 29 February 2028 is inside it. 1 April 2028 to 31 March 2029, counted the same way, has 365 days.

2.8 People born on 29 February

- 29 February comes only in leap years. A person born on that date is called a "leapling" or a "leaper". In ordinary years such people celebrate their birthdays on 28 February or 1 March.
- Their age still goes up by one every year, but the date of birth itself normally returns only once in 4 years. A person born on 29 February 2000 completes 26 years in 2026, yet the date has returned only 6 times by then: in 2004, 2008, 2012, 2016, 2020 and 2024.
- Across a century year that is not a leap year, the wait is 8 years. For a person born on 29 February 1896, the date first returned on 29 February 1904, at the age of 8, because 1900 had no 29 February.

Other days cover finding the day of the week with odd days (Topic 58), calendars that repeat (Topic 448) and finding a date from a given day (Topic 688).

3. Extra section: worked examples

A. Testing a year

1. **2076 and 1974.** Neither is a century year, so use the last two digits. 76 ÷ 4 = 19 with no remainder, so 2076 is a leap year. 74 ÷ 4 leaves remainder 2, so 1974 is an ordinary year.
2. **2300 and 1600.** Both are century years, so drop the two zeros. 23 ÷ 4 leaves remainder 3, so 2300 is an ordinary year. 16 ÷ 4 = 4 with no remainder, so 1600 is a leap year.

B. Counting leap years and days in a span

1. **Leap years from 1947 to 2026, both included.** The first multiple of 4 is 1948 and the last is 2024: (2024 - 1948) ÷ 4 + 1 = 19 + 1 = 20. The only century year in the span is 2000, and it is a leap year, so nothing is taken out. Answer: 20 leap years. Days from 1 January 1947 to 31 December 2026, counting both dates: 80 × 365 + 20 = 29,220.
2. **Leap years from 1895 to 1905, both included.** The multiples of 4 are 1896, 1900 and 1904: three. But 1900 is a century year not divisible by 400. Answer: 3 - 1 = 2 leap years.

3. **Days from 1 January 1901 to 31 December 2000, counting both dates.** These are 100 years. The multiples of 4 run from 1904 to 2000: (2000 - 1904) ÷ 4 + 1 = 25. The one century year, 2000, is a leap year. So there are 25 leap years and 36,500 + 25 = 36,525 days, one more than the standard figure for 100 years.

C. Days between two dates

1. **From 20 December 2027 to 10 March 2028.** Days left in December: 31 - 20 = 11. January: 31. February 2028: 29. March: 10. Total: 11 + 31 + 29 + 10 = 81 days. A year earlier, from 20 December 2026 to 10 March 2027, February has 28 days and the total is 80.
2. **From 10 February 2028 to 5 April 2028.** Days left in February: 29 - 10 = 19. March: 31. April: 5. Total: 19 + 31 + 5 = 55 days.
3. **From 26 January 2028 to 15 August 2028, counting both dates.** Days left in January: 5. Then 29 + 31 + 30 + 31 + 30 + 31 for February to July, and 15 in August: 5 + 182 + 15 = 202. Counting both dates: 202 + 1 = 203 days. In 2027 February has 28 days, so the count with both dates is 5 + 181 + 15 + 1 = 202 days.

D. A birthday on 29 February

1. **A man was born on 29 February 1888. How many times did the date 29 February return up to the end of 1912?** Every fourth year after 1888: 1892, 1896, 1900, 1904, 1908, 1912. Of these, 1900 is a century year not divisible by 400, so it had no 29 February. The date returned 5 times, not 6, although the man completed 24 years on 29 February 1912.

4. Three common exam traps

1. **Half the rule.** "Divisible by 4" settles only the years that are not century years. 1700, 1800 and 1900 are all divisible by 4 and all are ordinary years. The opposite slip is just as common: "a century year is never a leap year" is wrong, because 1600 and 2000 are leap years. Test a century year by 400.
2. **Standard counts used outside the standard block.** 400 years have 97 leap years, not 100. The standard figure for 100 years also fails when the block holds a leap century year: 1701 to 1800 has 24 leap years, but 2301 to 2400 has 25. Always look at which century years lie inside the span.
3. **Giving the extra day to the wrong period.** A period gets the extra day only if 29 February lies inside it. From 1 March of a leap year to 1 March of the next year there are only 365 days. In the same way, a leap year adds a day to the first half of the year only (181 becomes 182); the second half stays at 184. And "from A to B" is one day less than the count that includes both dates.

5. MCQs with answers and explanations

Q1. A child is born on 29 February 2088. After the day of the child's birth, in which year will the date 29 February return for the third time?

- (1) 2091
- (2) 2096
- (3) 2100
- (4) 2104

Q1. Answer: (4) 2104

- Worked solution: 29 February comes only in leap years, so test every fourth year after 2088.
- 2092: 92 ÷ 4 = 23, no remainder. It is a leap year: the first return.
- 2096: 96 ÷ 4 = 24, no remainder. It is a leap year: the second return.
- 2100: a century year. 21 ÷ 4 leaves remainder 1, so 2100 is not divisible by 400. It is an ordinary year and has no 29 February.
- 2104: 04 ÷ 4 = 1, no remainder. It is a leap year: the third return. The gap from 2096 to 2104 is 8 years.
- Why (1) is wrong: 2091 = 2088 + 3 is the year in which the child completes 3 years. But 2089, 2090 and 2091 are ordinary years, and none of them has a 29 February.
- Why (2) is wrong: 2096 comes from counting the day of birth in 2088 as the first time. The question counts only the returns after the day of birth.
- Why (3) is wrong: 2100 comes from taking every fourth year as a leap year: 2092, 2096, 2100. It leaves out the rule for century years.

Q2. How many leap years are there from the year 1801 to the year 2100, both years included?

- (1) 72
- (2) 73
- (3) 74
- (4) 75

Q2. Answer: (2) 73

- Worked solution, step 1: the first multiple of 4 in the span is 1804 and the last is 2100. Their number is (2100 - 1804) ÷ 4 + 1 = 74 + 1 = 75.
- Step 2: the century years in the span are 1900, 2000 and 2100. 2000 is divisible by 400 and is a leap year. 1900 and 2100 are not divisible by 400.
- Step 3: leap years = 75 - 2 = 73.
- Check, century by century: 1801 to 1900 has 24, 1901 to 2000 has 25, and 2001 to 2100 has 24. Total: 24 + 25 + 24 = 73.

- Why (1) is wrong: 72 is the standard figure for 300 years. It holds only for a block in which no century year is a leap year. Here 2000 is a leap year, and taking it out as well gives 75 - 3 = 72.
- Why (3) is wrong: 74 comes from taking out only one century year. It removes 1900 but forgets that the last year of the span, 2100, is also a century year that is not a leap year.
- Why (4) is wrong: 75 is the number of multiples of 4. It treats every fourth year as a leap year and leaves out the rule for century years.

6. Sources

6.1 Sources

No.: S1

Source: United States Naval Observatory, Astronomical Applications Department, "Leap Years" (frequently asked questions). https://aa.usno.navy.mil/faq/leap_years

Used for: The rule (years divisible by 4 are leap years, except century years not divisible by 400); 1700, 1800, 1900 and 2100 are not leap years, 1600, 2000 and 2400 are; the tropical year is approximately 365.2422 days; the Julian calendar, introduced by Julius Caesar in 46 BC, with an average year of 365.25 days; Pope Gregory XIII and the Gregorian calendar of 1582; 97 leap days in 400 years; the average Gregorian year of 365.2425 days, within half a minute of the tropical year; about 3,300 years before the calendar is one day out of step with the seasons

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No.: S2

Source: Encyclopaedia Britannica, "leap year". https://www.britannica.com/science/leap-year-calendar

Used for: A leap year has a 29th day of February in place of the standard 28; the year is about 365.242 days, or 365.25 days to a first approximation; an extra day every four years, first done in 46 BC; in the Gregorian calendar the extra day is added only to century years exactly divisible by 400 (1600, 2000)

No.: S3

Source: Wikipedia, "Gregorian calendar" (its references include Dershowitz and Reingold, Calendrical Calculations, 3rd edition, 2008, p. 45; Coyne, Hoskin and Pedersen (eds.), Gregorian Reform of the Calendar, 1983; Ziggelaar, "The Papal Bull of 1582 Promulgating a Reform of the Calendar", 1983). https://en.wikipedia.org/wiki/Gregorian_calendar

Used for: The papal bull Inter gravissimas dated 24 February 1582; Thursday 4 October 1582 followed by Friday 15 October 1582, with the weekday cycle unaffected; 1800 and 1900 not leap years, 1600 and 2000 leap years; the 400-year cycle of 146,097 days with 97 leap years; the lengths of the twelve months; the Julian calendar's error of 1 day in 128 years

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No.: S4

Source: Wikipedia, "Leap year" (its references include Richards, "Calendars", in Explanatory Supplement to the Astronomical Almanac, 3rd edition, 2013, p. 598; Richards, Mapping Time: The Calendar and its History, 1998; Meeus, Astronomical Algorithms, 2nd edition, 1998). https://en.wikipedia.org/wiki/Leap_year

Used for: A leap year has one day more than a common year; 365 and 366 days; 1600, 2000 and 2400 are leap years, but 1700, 1800, 1900, 2100, 2200 and 2300 are not; a 365-day year is shorter than the tropical year by almost six hours; a person born on 29 February is called a "leapling" or a "leaper" and celebrates on 28 February or 1 March in common years; 1900 was not a leap year (the example of a birthday on 29 February)

No.: S5

Source: NASA Space Place, "What Is a Leap Year?". https://spaceplace.nasa.gov/leap-year/en/

Used for: The Earth takes approximately 365 days and 6 hours to orbit the Sun; approximately every four years February has 29 days in place of 28, and the year has 366 days

No.: S6

Source: Telugu Wikipedia, "లీపు సంవత్సరం". https://te.wikipedia.org/wiki/లీపు_సంవత్సరం

Used for: Telugu terms: లీపు సంవత్సరం, సాధారణ సంవత్సరం, శతాబ్ది సంవత్సరం, నిశ్శేషంగా

No.: S7

Source: SATHEE (IIT Kanpur), Railway Exams, quick revision page on calendar problems. https://sathee.iitk.ac.in/sathee-railway-exams/student-corner/quick-revision/reasoning/reasoning-calendar-problems

Used for: The term "odd days": an ordinary year of 365 days has 1 odd day and a leap year of 366 days has 2 odd days; a block of 100 years has 76 ordinary years and 24 leap years

6.2 Additional verification sources · 9 October 2026

- **A1. US Naval Observatory: Leap Years.** https://aa.usno.navy.mil/faq/leap_years
- Used for: Gregorian divisibility-by 4/100/400 rule and 400-year cycle
- **A2. US Naval Observatory: Introduction to Calendars.** https://aa.usno.navy.mil/faq/calendars
- Used for: Julian reform ordered 46 BC, calendar begins 45 BC; Gregorian adoption is not simultaneous worldwide

Topic 49 · Divisibility rules

ENGLISH

1. Concept in one line

A divisibility rule is a quick test on the digits of a number that tells, without doing the division, whether a given divisor divides it exactly. The exam asks you to apply the rules for the divisors 2 to 13, to combine them correctly for a composite divisor such as 12, and to use them to find a missing digit, or the largest or smallest number of a given number of digits that a divisor divides exactly.

2. Revision notes

2.1 What "divisible" means

- A number is divisible by 6 when 6 divides it exactly, that is, leaves no remainder. Then 6 is a factor of the number, and the number is a multiple of 6: 48 = 6 × 8, so 48 is divisible by 6. The number we divide by is the divisor.
- 0 divided by any non-zero integer divisor leaves no remainder (0 ÷ 11 = 0). So whenever a test gives the result 0, the test is passed.
- Places are counted from the right: ones, tens, hundreds, thousands. The "last digit" is the digit in the ones place.
- Every rule in 2.2 and 2.3 works both ways: the number is divisible if the condition holds, and not divisible if it does not.

2.2 The rules for 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12

Divisor	The number is divisible when	Why the rule works	Example
2	the last digit is 0, 2, 4, 6 or 8	Every place value except the ones is a multiple of 10, and 10 = 2 × 5. So the last digit alone decides	7,138 is divisible. 7,183 is not
5	the last digit is 0 or 5	The same reason as for 2	6,205 is divisible. 6,502 is not
10	the last digit is 0	Every place value except the ones is a multiple of 10	7,010 is divisible. 7,001 is not
4	the number formed by the last two digits is divisible by 4	100 = 4 × 25, so the hundreds and all higher places are multiples of 4	9,532: 32 = 4 × 8, so it is divisible. 9,542: 42 is not divisible by 4, so it is not

Divisor	The number is divisible when	Why the rule works	Example
8	the number formed by the last three digits is divisible by 8	1,000 = 8 × 125, so the thousands and all higher places are multiples of 8	73,512: 512 = 8 × 64, so it is divisible. 73,412: 412 = 8 × 51 + 4, so it is not
3	the sum of the digits is divisible by 3	10 = 9 + 1, 100 = 99 + 1, 1,000 = 999 + 1: every place value is 1 more than a multiple of 9. So the number is a multiple of 9 plus the sum of its digits; and 9 = 3 × 3	7,221: 7 + 2 + 2 + 1 = 12, so it is divisible
9	the sum of the digits is divisible by 9	The same reason as for 3	5,283: 5 + 2 + 8 + 3 = 18, so it is divisible. 7,221: the sum is 12, so it is not
11	the difference between the sum of the digits in the odd places and the sum of the digits in the even places, counted from the right, is 0 or divisible by 11	10 = 11 - 1, 100 = 99 + 1, 1,000 = 1,001 - 1: the place values are by turns 1 less and 1 more than a multiple of 11	61,809: (9 + 8 + 6) - (0 + 1) = 22, so it is divisible. 5,081: (1 + 0) and (8 + 5) differ by 12, so it is not
6	it is divisible by both 2 and 3	2 and 3 are co-prime numbers, and 2 × 3 = 6 (see 2.4)	4,356: last digit 6, sum of the digits 18, so it is divisible
12	it is divisible by both 3 and 4	3 and 4 are co-prime numbers, and 3 × 4 = 12 (see 2.4)	7,536: sum of the digits 21, last two digits 36, so it is divisible

- **Three kinds of rule.** Last digits: 2, 5 and 10 (one digit), 4 (two digits), 8 (three digits). Sum of the digits: 3 and 9. Alternate digits: 11.
- A test on the last digit alone works only for 2, 5 and 10. 12 and 22 end in the same digit, but only 12 is divisible by 4.
- A number ending in 00 is divisible by 4, and a number ending in 000 is divisible by 8. In 5,016 the last three digits are 016, that is, 16; 16 = 8 × 2, so 5,016 is divisible by 8.
- Every number divisible by 9 is divisible by 3. The reverse is false: 15, 33 and 87 are divisible by 3 but not by 9.

2.3 Rules for 7 and 13

Take the last digit separately, and call the number formed by the remaining digits "the rest". In 2,961 the last digit is 1 and the rest is 296.

Divisor	What to do	The number is divisible when	Example
7	Subtract twice the last digit from the rest	the result is 0 or a multiple of 7	2,961: 296 - 2 = 294; 294: 29 - 8 = 21 = 7 × 3. So it is divisible
13	Add four times the last digit to the rest	the result is a multiple of 13	2,197: 219 + 28 = 247; 247: 24 + 28 = 52 = 13 × 4. So it is divisible

- Repeat the step until the result is small enough to recognise. If the result of the test for 7 is negative, ignore the sign: for 49 it is 4 - 18 = -14.
- An example that fails: 2,468 gives 246 - 16 = 230, and then 23 - 0 = 23, which is not a multiple of 7. So 2,468 is not divisible by 7.
- **Why they work.** Write the number as 10a + b, where b is the last digit and a is the rest. Then 10a + b = 10(a - 2b) + 21b, and 21b is a multiple of 7. Also 10a + b = 10(a + 4b) - 39b, and 39b is a multiple of 13. 10 is co-prime with 7 and with 13. So the number is divisible by 7 if a - 2b is, and not otherwise; it is divisible by 13 if a + 4b is, and not otherwise.
- These two tests say only whether the number is divisible or not. The result of a step is neither the quotient (the answer of the division) nor the remainder.
- 1,001 = 7 × 11 × 13 passes all three tests: 100 - 2 = 98 = 7 × 14; (1 + 0) - (0 + 1) = 0; 100 + 4 = 104 = 13 × 8.

2.4 Composite divisors: test with co-prime factors

- Co-prime numbers are two numbers that have no common factor other than 1 (Topic 39). The NCERT rule: a number divisible by two co-prime numbers is divisible by their product also.
- So write the divisor as a product of two co-prime factors and apply both tests: 6 = 2 × 3, 12 = 3 × 4, 15 = 3 × 5, 45 = 5 × 9.
- **Why 12 needs 3 and 4, not 2 and 6.** 2 and 6 are not co-prime: they have the common factor 2. Every number divisible by 6 is already divisible by 2. So the pair "2 and 6" proves only that the number is divisible by 6. 18, 30 and 42 are divisible by 2 and by 6, but not by 12.
- In the same way the pair "2 and 4" does not settle 8: 12 is divisible by 2 and by 4, but not by 8.
- **A split that never fails.** Write the prime factorisation of the divisor (Topic 39) and take each prime with its full power: 12 = $2^2 \times 3$ gives 4 and 3; 72 = $2^3 \times 3^2$ gives 8 and 9.

Divisor	Co-prime pair to test with	A pair that is not enough	A number that passes the pair that is not enough, but is not divisible by the divisor
12	3 and 4	2 and 6	18
18	2 and 9	3 and 6	12
24	3 and 8	4 and 6	12
36	4 and 9	3 and 12	12

Divisor	Co-prime pair to test with	A pair that is not enough	A number that passes the pair that is not enough, but is not divisible by the divisor
72	8 and 9	6 and 12	12

- **Downwards always, upwards not always.** A number divisible by 12 is divisible by every factor of 12, that is, by 1, 2, 3, 4, 6 and 12. But 20 is divisible by 4 and not by 8.

2.5 Sums and differences

- NCERT gives two rules for Class VI. If two numbers are divisible by a number, their sum is also divisible by that number; and their difference is also divisible by that number.
- Example: 35 and 49 are divisible by 7. So are 35 + 49 = 84 and 49 - 35 = 14.
- In symbols: if a divides b and c exactly, a divides b + c and b - c exactly.
- **Use.** Break a number into parts that are easy to recognise as multiples: 9,163 = 9,100 + 63, and both parts are multiples of 7. 1,287 = 1,300 - 13, and both are multiples of 13.
- **The reverse is false.** 7 divides 5 + 9 = 14 exactly, but it divides neither 5 nor 9 exactly.
- If a divides only one of two numbers exactly, it divides neither their sum nor their difference exactly: 7 divides 70 exactly but not 4, so it divides neither 74 nor 66 exactly.

2.6 Finding a missing digit

Write the missing digit as *, write down the condition of the rule, and see which of the digits from 0 to 9 satisfy it. For a composite divisor, keep only the digits that pass both tests.

Divisor	Number	Condition	Missing digit
9	4,5*6	4 + 5 + 6 = 15, so 15 + * must be a multiple of 9	3
3	4,5*6	15 + * must be a multiple of 3	0, 3, 6 or 9
4	7,3*6	The two-digit number *6 must be divisible by 4: it must be 16, 36, 56, 76 or 96	1, 3, 5, 7 or 9
8	5,1*2	The three-digit number 1*2 must be divisible by 8: it must be 112, 152 or 192	1, 5 or 9
11	7,*39	(9 + *) - (3 + 7) = * - 1 must be 0 or a multiple of 11	1
12	7,1*2	Test for 3: 10 + * must be a multiple of 3, so * is 2, 5 or 8. Test for 4: *2 must be divisible by 4, so * is 1, 3, 5, 7 or 9	5

- A question may have more than one answer (rows 2, 3 and 4 of the table). So see whether it asks for "the digit", "the smallest digit" or "how many digits".
- With 9, if the known digits already add up to a multiple of 9, the missing digit may be 0 or 9: 8,*46 gives both 8,046 and 8,946. But if * is the first digit from the left, it cannot be 0.

2.7 Largest and smallest numbers of a given number of digits

The smallest numbers of 1, 2, 3, 4 and 5 digits are 1, 10, 100, 1,000 and 10,000. The largest are 9, 99, 999, 9,999 and 99,999.

Step	Largest n-digit number divisible by d	Smallest n-digit number divisible by d
Start	Take the largest n-digit number	Take the smallest n-digit number
Divide by d	Note the remainder r	Note the remainder r
Then	Subtract r	If r = 0, that number is the answer; if not, add d - r
Example with three digits and d = 7	999 = 7 × 142 + 5, so 999 - 5 = 994	100 = 7 × 14 + 2, so 100 + (7 - 2) = 105

- If r is not 0, subtracting r from the smallest n-digit number also gives a multiple of d, but that multiple has one digit fewer: 100 - 2 = 98.
- To count the n-digit multiples of d: (largest multiple - smallest multiple) ÷ d + 1. For three digits and 7: (994 - 105) ÷ 7 + 1 = 128.

Other days cover remainders, unit digits, the number of factors, and the highest common factor (HCF) and the least common multiple (LCM).

3. Extra section: worked examples

A. One number, all the tests

1. **30,756.** The last digit is 6: divisible by 2, not by 5 or 10. Sum of the digits: 3 + 0 + 7 + 5 + 6 = 21: divisible by 3, not by 9. Last two digits: 56 = 4 × 14: divisible by 4. Last three digits: 756 = 8 × 94 + 4: not divisible by 8. Odd places from the right: 6 + 7 + 3 = 16; even places: 5 + 0 = 5; the difference is 11: divisible by 11. So 30,756 is also divisible by 6 (2 and 3) and by 12 (3 and 4).

B. The tests for 7 and 13

1. **Is 3,451 divisible by 7?** 345 - 2 = 343; 34 - 6 = 28 = 7 × 4. Yes.
2. **Is 3,458 divisible by 13?** 345 + 32 = 377; 37 + 28 = 65 = 13 × 5. Yes. It is also divisible by 7: 345 - 16 = 329; 32 - 18 = 14. As 7 and 13 are co-prime, 3,458 is divisible by 7 × 13 = 91.

C. Composite divisors

1. **Is 4,518 divisible by 18?** Use 2 and 9. The last digit is 8, and the sum of the digits is 18. Both tests are passed, so 4,518 is divisible by 18.
2. **Is 2,154 divisible by 12?** It is even and the sum of its digits is 12, so it is divisible by 2, 3 and 6. But 54 is not divisible by 4. So 2,154 is not divisible by 12.

D. Missing digits

1. **4*,618 is divisible by 11.** The digits from the right are 8, 1, 6, * and 4. Odd places: 8 + 6 + 4 = 18. Even places: 1 + *. The difference is 17 - *. No digit makes it 0, but * = 6 makes it 11. The number is 46,618 = 11 × 4,238.
2. **3*,756 is divisible by 36.** Use 4 and 9. The last two digits form 56, which is divisible by 4 whatever * is. The sum of the digits is 21 + *, which must be a multiple of 9, so * = 6. The number is 36,756.

E. Largest and smallest numbers

1. **Four-digit numbers divisible by 12.** 9,999 = 12 × 833 + 3, so the largest is 9,999 - 3 = 9,996. 1,000 = 12 × 83 + 4, so the smallest is 1,000 + (12 - 4) = 1,008. Check with 3 and 4: for 9,996 the sum of the digits is 33 and the last two digits form 96; for 1,008 the sum is 9 and the last two digits form 08. How many are there? (9,996 - 1,008) ÷ 12 + 1 = 750.

F. Sums and differences

1. **Is 6,993 divisible by 7? Is 7,013?** 6,993 = 7,000 - 7, and both are multiples of 7, so 6,993 is divisible by 7. 7,013 = 7,000 + 13; 7 divides 7,000 exactly but not 13, so 7,013 is not divisible by 7.

4. Three common exam traps

1. **Splitting a composite divisor into factors that are not co-prime.** "Divisible by 2 and by 6" proves only "divisible by 6", not "divisible by 12": 18 passes both tests and is not divisible by 12. In the same way "divisible by 3 and by 6" does not prove "divisible by 18". The two numbers you test with must have no common factor other than 1: test 12 with 3 and 4, and 18 with 2 and 9.
2. **Using the test of one divisor for another.** The sum of the digits is for 3 and 9 only, and a sum divisible by 3 does not make the number divisible by 9 (7,221). The last digit alone is for 2, 5 and 10 only: 14 ends in 4 but is not divisible by 4, and 18 ends in 8 but is not divisible by 8. For 4 look at the last two digits, and for 8 at the last three.
3. **The rule for 11, and rules read backwards.** For 11, subtract one alternate sum from the other; do not add all the digits. 137 has the digit sum 11 but is not divisible by 11. The difference need not be 0: a difference of 11 or 22 also passes (61,809). And the rule for sums cannot be reversed: 7 divides 5 + 9 exactly, but neither 5 nor 9.

5. MCQs with answers and explanations

Q1. The five-digit number 53,1*6 is divisible by 24. Which digit does * stand for?

- (1) 0
- (2) 3
- (3) 7
- (4) 9

Q1. Answer: (2) 3

- Worked solution: 24 = 3 × 8, and 3 and 8 are co-prime. So the number must pass the test for 3 and the test for 8.
- Test for 8: the last three digits form 1*6, which must be divisible by 8. Of 106, 116, 126, 136, 146, 156, 166, 176, 186 and 196, only 136 = 8 × 17 and 176 = 8 × 22 are. So * is 3 or 7.
- Test for 3: 5 + 3 + 1 + 6 = 15, so 15 + * must be a multiple of 3. So * is 0, 3, 6 or 9.
- Only 3 passes both tests. Check: 53,136 = 24 × 2,214.
- Why (1) is wrong: 0 passes only the test for 3 (the sum of the digits is 15). It is the answer of a candidate who stops after the sum of the digits. But 106 = 8 × 13 + 2, so 53,106 is not divisible by 8.
- Why (3) is wrong: 7 passes only the test for 8 (176 = 8 × 22). The sum of the digits of 53,176 is 22, which is not a multiple of 3.
- Why (4) is wrong: 9 comes from splitting 24 into 4 and 6. 53,196 is divisible by 4 (96 = 4 × 24) and by 6 (it is even, and the sum of its digits is 24). But 4 and 6 are not co-prime. 196 = 8 × 24 + 4, so 53,196 is not divisible by 8, and so not by 24.

Q2. What is the smallest five-digit number that is divisible by 13?

- (1) 9,997
- (2) 10,003
- (3) 10,010
- (4) 10,013

Q2. Answer: (3) 10,010

- Worked solution: the smallest five-digit number is 10,000. Divide it by 13: 10,000 = 13 × 769 + 3. The remainder is 3.
- The remainder is not 0, so add 13 - 3 = 10. The answer is 10,000 + 10 = 10,010 = 13 × 770.
- Check with the test for 13: 1,001 + 0 = 1,001; 100 + 4 = 104; 10 + 16 = 26 = 13 × 2.
- Why (1) is wrong: 9,997 = 10,000 - 3. It subtracts the remainder. 9,997 = 13 × 769 is divisible by 13, but it has only four digits; it is the largest four-digit number divisible by 13.
- Why (2) is wrong: 10,003 = 10,000 + 3. It adds the remainder itself, not 13 - 3. 10,003 = 13 × 769 + 6, so it is not divisible by 13.

- Why (4) is wrong: 10,013 = 10,000 + 13. It adds the divisor, as if 10,000 were itself a multiple of 13. 10,013 = 13 × 770 + 3, so it is not divisible by 13.

6. Sources

6.1 Sources

No.: S1

Source: NCERT, Mathematics, Class VI, Chapter 3 "Playing with Numbers" (the textbook used before Ganita Prakash), read on the SATHEE portal of IIT Kanpur. Sections 3.2 (Factors and Multiples), 3.4 (Tests for Divisibility of Numbers), 3.5 (Common Factors and Common Multiples) and "What have we discussed?". https://sathee.iitk.ac.in/ncert-books/class-06/mathematics/chapter-03-playing-with-numbers/

Used for: A factor as an exact divisor; the tests for 10, 5, 2, 3, 6, 4, 8, 9 and 11 as worded there (0 in the ones place; 0 or 5 in the ones place; 0, 2, 4, 6 or 8 in the ones place; the sum of the digits a multiple of 3; divisible by 2 and 3 both; the number formed by the last two digits; the number formed by the last three digits; the sum of the digits divisible by 9; the difference between the sums of the digits at odd and even places from the right is 0 or divisible by 11); the example numbers 6205, 7010, 4356, 9532, 73512, 7221, 5283, 61809 and 5081; co-prime numbers as two numbers with only 1 as a common factor; "A number divisible by two co-prime numbers is divisible by their product also"

No.: S2

Source: NCERT, Exemplar Problems: Mathematics, Class VI, Unit 1 "Number System", the list of main concepts under "Playing with Numbers" ("More divisibility rules"), Example 13 and Questions 79 to 85. https://ncert.nic.in/pdf/publication/exemplarproblem/classVI/Mathematics/feep101.pdf

Used for: "If two given numbers are divisible by a number, then their sum is also divisible by that number", and the same for their difference; "If a number is divisible by another number, then it is divisible by each of the factors of that number"; a number divisible by two co-prime numbers is divisible by their product; Example 13: divisible by 2 and 4 does not mean divisible by 8, because 2 and 4 are not co-prime; the true-or-false items 80, 81, 84 and 85, which raise the points on the reverse of the sum rule, on 2 and 3 against 12, on the digit sum for 3 against 9, and on 4 against 8

No.: S3

Source: NCERT, Ganita Prakash, Grade 8 (reprint 2026-27), Chapter 5 "Number Play", Sections 5.1 "Is This a Multiple Of?" and 5.2 "Checking Divisibility Quickly". https://ncert.nic.in/textbook/pdf/hegp105.pdf

Used for: Every place value except the units place is a multiple of 10; a number is divisible by 9 if and only if the sum of its digits is divisible by 9; 10 = 9 + 1, 100 = 99 + 1, 1000 = 999 + 1; 15, 33 and 87 as multiples of 3 that are not multiples of 9; the alternating pattern of place values for 11; checking 24 with 4 and 6 does not work (12 is divisible by both), and 3 and 8 are used instead; "if a divides M and a divides N, then a divides M + N and a divides M - N"; a number divisible by 12 is divisible by all the factors of 12

No.: S4

Source: NCERT, Ganita Prakash, Grade 6 (reprint 2026-27), Chapter 5 "Prime Time", Section 5.5 "Divisibility Tests". https://ncert.nic.in/textbook/pdf/fegp105.pdf

Used for: The tests for 10, 5 and 2 by the last digit; only the last two digits matter for 4 and only the last three for 8, and both tests work in both directions; 12 and 22 have the same last digit but only 12 is a multiple of 4

No.: S5

Source: Wikipedia, "Divisibility rule" (citing Gardner, "Mathematical Games", Scientific American, September 1962; Wells 1997, The Penguin Dictionary of Curious and Interesting Numbers, p. 51; Dunkels 2000, Mathematical Gazette 84, pp. 79-81; Kisačanin 1998, Mathematical Problems and Proofs). https://en.wikipedia.org/wiki/Divisibility_rule

Used for: The test for 7 (subtracting twice the last digit from the rest gives a multiple of 7) and the reason for it; the test for 13 (add 4 times the last digit to the rest); 100 is divisible by 4, so hundreds and higher places do not affect the test for 4; a number is divisible by a divisor if it is divisible by the highest power of each of its prime factors; 36 is tested with 4 and 9, and checking 3 and 12, or 2 and 18, is not sufficient

6.2 Additional verification sources · 9 October 2026

- **A1. NCERT: Playing with Numbers.** https://ncert.nic.in/textbook/pdf/hegp105.pdf
- Used for: Elementary divisibility rules and positional-value reasoning
- **A2. Independent arithmetic verification.**
- Used for: All worked numerical examples recomputed; divisibility rules 2–13 tested against integer division for every integer 0–99,999. The rules for 7 and 13 follow modular arithmetic:10 a+b is divisible by 7 iff a−2 b is; by 13 iff a+4 b is.

Topic 50 · Current affairs: WHO Global Tuberculosis Report 2025

ENGLISH

1. Concept in one line

The Global Tuberculosis Report is the World Health Organization's yearly account of tuberculosis (TB) in the world; its 2025 edition, released on 12 November 2025, carries data for 2024. The examination asks about its main figures for the world and for India, the End TB Strategy targets against which it measures progress, and India's TB programme and schemes.

2. Revision notes

2.1 TB and the report at a glance

- **TB:** An infectious disease caused by the bacterium Mycobacterium tuberculosis. It most often affects the lungs and spreads through the air when people with TB cough, sneeze or spit. It can be prevented and cured.
- **Infection and disease:** About a quarter of the world's population is estimated to have been infected with TB bacteria. Only about 5 to 10 per cent of them will go on to develop TB disease.
- **Incidence:** The number of people who newly fall ill with TB in a year. The incidence rate is that number for every 100,000 (one lakh) people.

Point	Detail
Name	Global Tuberculosis Report 2025
Published by	World Health Organization (WHO)
How often	Every year; WHO's website lists editions from 1997 to 2025
Released on	12 November 2025
Year of data	2024
Where the data come from	National health ministries report to WHO every year; 184 countries and areas, with more than 99 per cent of the world's population and TB cases, reported for this edition
What it measures progress against	The milestones and targets of WHO's End TB Strategy, and the targets set by the United Nations (UN) high-level meeting on TB of 2023
Position on 9 October 2026	The 2025 edition is the most recent one on WHO's website. When the next edition comes, it will replace these figures

2.2 The global picture in the 2025 report (2024 unless stated)

Indicator	Figure in the 2025 report (2024 unless stated)
People who fell ill with TB	10.7 million (1.07 crore): 5.8 million men, 3.7 million women and 1.2 million children
Incidence rate	131 per 100,000 (one lakh) population
Trend in the rate	Down 1.7 per cent from 2023; down 12 per cent from 2015
Deaths from TB	1.23 million (12.3 lakh): 1.08 million among HIV-negative people and 150,000 among people with HIV
Trend in deaths	Down 3 per cent from 2023; down 29 per cent from 2015
Diagnosed and put on treatment	8.3 million (83 lakh) people, about 78 per cent of those who fell ill
Treatment success	88 per cent for drug-susceptible TB (patients enrolled in 2023); 71 per cent for MDR/RR-TB (patients enrolled in 2022)
MDR/RR-TB	An estimated 390,000 (3.9 lakh) people developed multidrug-resistant or rifampicin-resistant TB
Funding	5.9 billion US dollars were available, against a target of 22 billion US dollars a year by 2027

- **Reading the trend:** The number of people who fell ill also came down from 2023, for the first time since the COVID-19 pandemic. WHO's news release rounds the 1.7 per cent fall in the rate to "nearly 2 per cent".
- **Regions, share of the world's cases:** South-East Asia 34 per cent, Western Pacific 27 per cent, Africa 25 per cent, Eastern Mediterranean 8.6 per cent, the Americas 3.3 per cent, Europe 1.9 per cent. This edition counts Indonesia in the Western Pacific Region.
- **Regions, trend in the rate since 2015:** It fell in Europe (39 per cent), Africa (28), South-East Asia (16) and the Eastern Mediterranean (5.9). It rose in the Americas (13 per cent; 2024 was the fourth yearly rise in a row) and in the Western Pacific (1.7 per cent).
- **Countries:** The 30 high TB burden countries had 87 per cent of the cases. Eight of them had 67 per cent, about two thirds: India (25 per cent), Indonesia (10), the Philippines (6.8), China (6.5), Pakistan (6.3), Nigeria (4.8), the Democratic Republic of the Congo (3.9) and Bangladesh (3.6).
- **Drug-resistant TB:** Multidrug-resistant TB (MDR-TB) is TB that resists both rifampicin and isoniazid. Rifampicin-resistant TB (RR-TB) resists rifampicin. The report counts them together as MDR/RR-TB. The yearly number has been falling since 2015. Shares in 2024: India 32 per cent, China 7.1, the Philippines 7.1, the Russian Federation 6.7; these four had more than half. Only about 2 in 5 people with MDR/RR-TB received treatment in 2024. Drug resistance in general is covered in Topic 20.

- **Funding:** Stagnant since 2020. Of the 5.9 billion US dollars, 4.8 billion came from countries' own sources and 1.1 billion from international donors. Donor funding has been cut from 2025; modelling shows that long-term cuts could cause 10 million more cases and up to 2 million more deaths between 2025 and 2035.
- **Gain:** Timely treatment has saved about 83 million lives since 2000.

2.3 India in the 2025 report

The last column shows where each figure is taken from: the WHO report itself, or the Health Ministry's press release on the report, issued on 12 November 2025.

Point	Figure	Taken from
Share of the world's TB cases, 2024	25 per cent, the largest of any country	WHO report
Share of the world's MDR/RR-TB cases, 2024	32 per cent, the largest of any country	WHO report
Incidence rate	237 per lakh population in 2015; 187 per lakh in 2024; a fall of 21 per cent, against 12 per cent for the world	Health Ministry's press release, citing the WHO report
TB mortality rate	28 per lakh population in 2015; 21 per lakh in 2024, a reduction of 25 per cent	Health Ministry's press release and Annual Report 2025–26
Treatment coverage	53 per cent in 2015; over 92 per cent in 2024	Health Ministry's press release
Case detection	The ministry reports a substantial reduction in undetected cases; use the separately reported treatment-coverage indicator above for revision	Health Ministry’s press release
Treatment success rate	90 per cent, against 88 per cent for the world	Health Ministry's press release

- **Two terms:** Treatment coverage is the share of the people estimated to have fallen ill in a year who were diagnosed and put on treatment. Treatment success rate is the share of treated people whose treatment succeeded.
- **Deaths, in per cent:** India’s TB mortality rate fell by 25 per cent between 2015 and 2024, from 28 to 21 per lakh population. The Ministry of Health and Family Welfare’s Annual Report 2025–26 explicitly reports this 25 per cent reduction.
- **Treatment coverage:** use the explicitly reported indicator, over 92 per cent in 2024. It is a programme indicator, not a success rate among patients who completed treatment.
- **India and the world:** India's rate in 2024 (187 per lakh) is higher than the world's (131 per lakh), though it has fallen faster since 2015.

2.4 The End TB Strategy and the Sustainable Development Goal

- **End TB Strategy:** Adopted by the World Health Assembly in May 2014, for the years after 2015. Its vision is "A world free of TB": zero deaths, disease and suffering due to TB. Its goal is to end the global TB epidemic.
- **Three pillars:** (1) integrated, patient-centred care and prevention; (2) bold policies and supportive systems; (3) intensified research and innovation.

Indicator (compared with 2015)	Milestone for 2020	Milestone for 2025	Target for 2030	Target for 2035
Reduction in the number of TB deaths	35 per cent	75 per cent	90 per cent	95 per cent
Reduction in the TB incidence rate	20 per cent	50 per cent	80 per cent	90 per cent
TB-affected families facing catastrophic costs	0 per cent	0 per cent	0 per cent	0 per cent

- **Catastrophic costs:** Total TB-related costs, including medical expenses, non-medical expenses and income losses, exceeding 20 per cent of annual household income.
- **Where the world stood in 2024:** Deaths down 29 per cent (the 2025 milestone is 75) and the rate down 12 per cent (the 2025 milestone is 50). The report calls this far from the milestones.
- **Sustainable Development Goals (SDGs):** Target 3.3 under Goal 3 includes ending the TB epidemic by 2030. The 2030 column of the table holds the targets for the SDG year.
- **UN high-level meeting on TB, 2023:** It set global targets for 2027; 22 billion US dollars a year is the funding needed to meet them.

2.5 India's response: the programme and its schemes

- **National TB Elimination Programme (NTEP):** India's TB programme, of the Union Ministry of Health and Family Welfare, under the National Health Mission. The National Tuberculosis Programme (NTP) began in 1962. A revised strategy was piloted in 1993, and the Revised National Tuberculosis Control Programme (RNTCP) began as a full programme in 1997, using the DOTS (Directly Observed Treatment, Short-course) strategy. Until 2020 the programme was called RNTCP. It was renamed in 2020 to stress the aim of eliminating TB.
- **India's target year:** 2025, five years ahead of the global year 2030. The Prime Minister gave this call at the Delhi End TB Summit in March 2018. The targets, compared with 2015: 80 per cent reduction in the incidence rate, 90 per cent reduction in deaths, and no TB-affected household facing catastrophic costs.
- **Where India stands:** By 2024 the incidence rate had fallen 21 per cent, well short of 80 per cent. The Government note of 24 March 2026 speaks of eliminating TB before the global target year of 2030.
- **National Strategic Plan (2017 to 2025):** Four pillars: Detect, Treat, Prevent, Build.

- **Ni-kshay:** The programme's digital platform. Money under Ni-kshay Poshan Yojana reaches patients through it by direct benefit transfer (DBT).

Measure	Date	What it is
Ni-kshay Poshan Yojana	April 2018	Money for nutrition, sent by DBT to every notified TB patient for every month of treatment. It began at Rs 500 a month. The raise to Rs 1,000 a month was announced on 7 October 2024. The Rs 1,000 monthly rate took effect on 1 November 2024 and applies throughout treatment
Pradhan Mantri TB Mukt Bharat Abhiyaan (PMTBMBA)	9 September 2022	Launched by the President of India, Smt. Droupadi Murmu, as an additional part of NTEP. It brings extra support for patients from the community and from corporate social responsibility (CSR) funds
Ni-kshay Mitra	Under PMTBMBA	An individual or organisation that adopts TB patients and supports them, for example with food baskets. 6,77,541 individuals and organisations had enrolled as Ni-kshay Mitras by 12 November 2025. In October 2024 the Ministry allowed them to adopt patients' household contacts as well
100-day campaign	7 December 2024	Launched at Panchkula, Haryana, by the Union Health Minister, Shri J P Nadda, in 347 districts of 33 States and Union Territories, as a drive to screen vulnerable people for TB. Later extended to all districts. Since December 2024, as reported by the Health Ministry on 24 March 2026: over 20 crore vulnerable people screened and 32.65 lakh TB patients diagnosed, including nearly 10.9 lakh without symptoms
TB-free gram panchayats	For 2024	More than 46,000 gram panchayats were given TB-free certification

2.6 Vaccine, newer tools and World TB Day

- **BCG (Bacille Calmette-Guérin) vaccine:** Given to babies or small children in some countries. It prevents TB deaths and protects children from serious forms of TB.
- **New vaccines:** In August 2025, 18 vaccine candidates were in clinical trials, 6 of them in Phase 3.
- **BPaLM regimen:** Bedaquiline, pretomanid, linezolid and moxifloxacin: a 6-month regimen for eligible patients with MDR/RR-TB. India has introduced it under NTEP.
- **TB preventive treatment (TPT):** Given to household contacts, people living with HIV and other eligible people, so that infection does not turn into disease.
- **World TB Day:** 24 March. It marks the day in 1882 when Dr Robert Koch announced that he had discovered the bacterium that causes TB. Theme for 2026: "Yes! We can end TB!", with the line "Led by countries. Powered by people."

3. Extra section: chronology, 2014 to 2035, and the position on 9 October 2026

Date	What happened or is due
May 2014	The World Health Assembly adopts the End TB Strategy
2015	The year with which all End TB milestones and targets are compared
March 2018	Delhi End TB Summit: the Prime Minister calls for ending TB in India by 2025
April 2018	Ni-kshay Poshan Yojana begins, at Rs 500 a month
2020	RNTCP is renamed NTEP; first milestone year of the End TB Strategy
9 September 2022	The President of India launches PMTBMBA
2023	UN high-level meeting on TB sets global targets for 2027
7 October 2024	Raise of Ni-kshay Poshan Yojana support to Rs 1,000 a month announced
7 December 2024	100-day campaign launched at Panchkula, in 347 districts
2025	Second milestone year of the End TB Strategy; India's own target year
12 November 2025	WHO releases the Global Tuberculosis Report 2025; the Health Ministry issues its press release the same day
24 March 2026	World TB Day; theme "Yes! We can end TB!"
2027	Year for the targets of the UN high-level meeting of 2023
2030	SDG year: 90 per cent fewer deaths and an 80 per cent lower incidence rate than in 2015
2035	End TB targets: 95 per cent fewer deaths and a 90 per cent lower incidence rate than in 2015

Position on 9 October 2026:

- The 2025 edition (data for 2024) is the most recent Global Tuberculosis Report on WHO's website.
- A newer edition updates the figures and may revise estimates for earlier years. In the examination, use the edition and data year named in the question; do not mix estimates from different editions.
- The End TB milestones and targets, the dates of India's schemes and World TB Day do not change with a new edition.

4. Three common exam traps

1. **Edition year and data year.** The report named "2025" was released in November 2025, but its figures are for 2024. A question that says "in 2025, so many people fell ill" is using the wrong year. A newer edition brings new figures, so the edition must always be read.
2. **Number, rate, fall and coverage.** 10.7 million is a number of people; 131 per lakh is a rate. India's 21 per cent is the fall in its rate since 2015, not its share of the world's cases. The world's falls since 2015 are 12 per cent in the rate and 29 per cent in deaths; questions exchange them. Treatment coverage (people found and treated out of those who fell ill) is not the treatment success rate (people whose treatment succeeded out of those treated).
3. **Milestone, target and year.** The End TB Strategy has milestones for 2020 and 2025 and targets for 2030 and 2035, all compared with 2015. The cut asked for in deaths is always larger than the cut asked for in the incidence rate. 2030 is the SDG year, 2035 is the year of the End TB targets, and 2025 was the year India set for itself.

5. MCQs with answers and explanations

Q1. Consider the following statements about the Global Tuberculosis Report 2025 of the World Health Organization (WHO):

1. According to it, eight countries together had about two thirds of the world's TB cases in 2024.
2. It counts Indonesia in the WHO Western Pacific Region.
3. In it, India's share of the world's cases of drug-resistant TB (MDR/RR-TB) is larger than India's share of all TB cases.

Which of the statements given above is/are correct?

- (1) 1, 2 and 3
- (2) 1 and 2 only
- (3) 2 and 3 only
- (4) 1 and 3 only

Q1. Answer: (1) 1, 2 and 3

- Statement 1 is correct: In the 2025 report, eight countries (India, Indonesia, the Philippines, China, Pakistan, Nigeria, the Democratic Republic of the Congo and Bangladesh) had 67 per cent of the world's cases in 2024, which is about two thirds. The figure of 87 per cent belongs to the 30 high TB burden countries.
- Statement 2 is correct: This edition counts Indonesia in the Western Pacific Region. With that, the regional shares are South-East Asia 34 per cent, Western Pacific 27 per cent and Africa 25 per cent.
- Statement 3 is correct: In the 2025 report India has 32 per cent of the world's MDR/RR-TB cases and 25 per cent of all TB cases.

- Why the other options are wrong: (2) leaves out statement 3, (3) leaves out statement 1 and (4) leaves out statement 2. All three statements are correct.

Q2. Match List I (measures against TB) with List II (a feature of each):

List I	List II
A. Ni-kshay Poshan Yojana	1. Began in September 2022: individuals and organisations adopt TB patients and give them extra support, such as food baskets
B. Pradhan Mantri TB Mukt Bharat Abhiyaan	2. Has three pillars, the first of which is integrated, patient-centred care and prevention
C. National Strategic Plan (2017 to 2025) of India's TB programme	3. Began in April 2018: money is sent by direct benefit transfer (DBT) to the TB patient for every month of treatment
D. End TB Strategy of WHO	4. Has four pillars: Detect, Treat, Prevent and Build

- (1) A-1, B-3, C-4, D-2
- (2) A-3, B-1, C-2, D-4
- (3) A-1, B-3, C-2, D-4
- (4) A-3, B-1, C-4, D-2

Q2. Answer: (4) A-3, B-1, C-4, D-2

- Why it is correct: Ni-kshay Poshan Yojana began in April 2018 and sends money for nutrition to the TB patient by direct benefit transfer for every month of treatment (A-3). Pradhan Mantri TB Mukt Bharat Abhiyaan was launched on 9 September 2022; under it Ni-kshay Mitras, who are individuals and organisations, adopt TB patients and support them, for example with food baskets (B-1). The National Strategic Plan (2017 to 2025) has four pillars: Detect, Treat, Prevent, Build (C-4). The End TB Strategy of WHO has three pillars: integrated, patient-centred care and prevention; bold policies and supportive systems; intensified research and innovation (D-2).
- Why (1) is wrong: It exchanges the two schemes. The money for nutrition is the Yojana of April 2018; adoption of patients by the community belongs to the Abhiyaan of September 2022.
- Why (2) is wrong: It exchanges the two sets of pillars. Detect, Treat, Prevent, Build are the four pillars of India's plan; the three pillars are those of WHO's strategy.
- Why (3) is wrong: It makes both exchanges.

6. Sources

6.1 Sources

No.: S1

Source: World Health Organization, "Global tuberculosis report 2025" (report home page), 12 November 2025. https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025

Used for: Name, publisher and release date of the report; data reported by 184 countries and areas with more than 99 per cent of the world's population and TB cases

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No.: S2

Source: World Health Organization, Global tuberculosis report 2025, section 1.1 "TB incidence". https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-disease-burden/1-1-tb-incidence

Used for: 10.7 million people fell ill in 2024; rate 131 per 100,000; fall of 1.7 per cent from 2023 and of 12.3 per cent from 2015; first yearly fall in the number since the COVID-19 pandemic; men, women and children; shares of the six WHO regions; Indonesia counted in the Western Pacific Region; regional trends since 2015; shares of the eight countries (India 25 per cent); the 2025 milestone of a 50 per cent reduction

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No.: S3

Source: World Health Organization, Global tuberculosis report 2025, section 1.2 "TB mortality". https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-disease-burden/1-2-tb-mortality

Used for: 1.23 million deaths in 2024 (1.08 million among HIV-negative people, 150,000 among people with HIV); fall of 3 per cent from 2023 and of 29 per cent from 2015; milestones of 35 per cent (2020) and 75 per cent (2025)

No.: S4

Source: World Health Organization, Global tuberculosis report 2025, section 1.3 "Drug-resistant TB". https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-disease-burden/1-3-drug-resistant-tb

Used for: 390,000 people developed MDR/RR-TB in 2024; falling trend since 2015; shares of India (32 per cent), China, the Philippines and the Russian Federation; meaning of MDR-TB and RR-TB

No.: S5

Source: World Health Organization, Global tuberculosis report 2025, section 1 "TB disease burden". https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2025/tb-disease-burden

Used for: Net reductions of 12 per cent (incidence rate) and 29 per cent (deaths) from 2015 to 2024, described as far from the End TB milestones

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No.: S6

Source: World Health Organization, news release "Global gains in tuberculosis response endangered by funding challenges", 12 November 2025. https://www.who.int/news-room/releases/12-11-2025-global-gains-in-tuberculosis-response-endangered-by-funding-challenges

Used for: Release date; "nearly 2 per cent" and 3 per cent falls from 2023; 30 countries with 87 per cent and eight with 67 per cent of cases; 8.3 million diagnosed and treated (78 per cent); treatment success of 88 and 71 per cent; 83 million lives saved since 2000; funding of 5.9 billion against 22 billion US dollars; donor cuts and the modelling for 2025 to 2035; 18 vaccine candidates, 6 in Phase 3; TB preventable and curable

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No.: S7

Source: World Health Organization, fact sheet "Tuberculosis", updated 24 March 2026. https://www.who.int/news-room/fact-sheets/detail/tuberculosis

Used for: What TB is and how it spreads; a quarter of the world's population infected, 5 to 10 per cent develop disease; BCG vaccine; about 2 in 5 people with MDR-TB treated in 2024; 4.8 billion US dollars from domestic sources and 1.1 billion from donors; 22 billion US dollars needed yearly for the 2027 targets of the UN high-level meeting of 2023; catastrophic costs as more than 20 per cent of household income

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No.: S8

Source: World Health Organization, "Global tuberculosis reports" (list of editions), read on 9 October 2026. https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports

Used for: Yearly updating of the report; editions from 1997 to 2025; the 2025 edition as the most recent one

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No.: S9

Source: World Health Organization, "The End TB Strategy" (web page). https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/the-end-tb-strategy

Used for: Adoption by the World Health Assembly in May 2014; vision and goal; the three pillars

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No.: S10

Source: World Health Organization, "The End TB Strategy" (brochure). https://cdn.who.int/media/docs/default-source/documents/tuberculosis/end-tb-brochure22cf78c9-ddf7-47df-9261-b999e8df83ba.pdf

Used for: Milestones for 2020 and 2025 and targets for 2030 and 2035, compared with 2015; the three pillars; ending the TB epidemic by 2030 under Goal 3 of the SDGs

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No.: S11

Source: World Health Organization, campaign page "World TB Day 2026". https://www.who.int/campaigns/world-tb-day/2026

Used for: Date of World TB Day; the theme for 2026 and the line that goes with it ("Led by countries. Powered by people.")

No.: S12

Source: Press Information Bureau (Ministry of Health and Family Welfare), "TB incidence in India drops by 21% from 237 per lakh population in 2015 to 187 per lakh population in 2024", 12 November 2025, Release ID 2189415. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2189415

Used for: India's incidence rate and deaths per lakh in 2015 and 2024; treatment coverage; 26.18 lakh diagnosed against an estimated 27 lakh; "missing" cases; treatment success rate of 90 per cent; Ni-kshay Poshan Yojana raised from Rs 500 to Rs 1,000 a month; 6,77,541 Ni-kshay Mitras

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No.: S13

Source: Press Information Bureau, explainer "India Speeding Towards TB Elimination", 24 March 2026. https://www.pib.gov.in/PressNoteDetails.aspx?id=157923&NoteId=157923&ModuleId=3

Used for: RNTCP renamed NTEP in 2020; aim of eliminating TB before 2030; Ni-kshay as the digital platform for direct benefit transfer; Ni-kshay Poshan Yojana since April 2018 at Rs 1,000 a month per notified patient; PMTBMBA launched on 9 September 2022 as an additional component of NTEP; 100-day campaign of 7 December 2024 in 347 districts and its extension; gram panchayats certified for 2024; BPaLM; TB preventive treatment; World TB Day and Dr Robert Koch

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No.: S14

Source: Press Information Bureau (Ministry of Health and Family Welfare), "India's 100-Day TB Elimination Campaign", 6 December 2024, Release ID 2081662. https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2081662

Used for: Launch of the 100-day campaign on 7 December 2024 at Panchkula, Haryana, by the Union Health Minister in 347 districts of 33 States and Union Territories; NTEP under the National Health Mission; National Strategic Plan 2017 to 2025; India's pledge of 2018 to end TB by 2025, five years before the SDG year ; post-launch confirmation: https://www.pib.gov.in/PressReleasePage.aspx?PRID=2081931

No.: S15

Source: Press Information Bureau (Ministry of Health and Family Welfare), "Union Health Minister Unveils Key Initiatives to boost Nutrition Support for TB Patients and their Families", 7 October 2024, Release ID 2062928. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2062928

Used for: Announcement of the raise of Ni-kshay Poshan Yojana support from Rs 500 to Rs 1,000 a month for the whole treatment; Ni-kshay Mitras allowed to adopt household contacts of patients

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No.: S16

Source: Directorate General of Health Services, Ministry of Health and Family Welfare, "National Tuberculosis Elimination Programme" (web page). https://dghs.mohfw.gov.in/national-tuberculosis-elimination-programme.php

Used for: Renaming of RNTCP as NTEP in 2020 and the reason; target year 2025 and the Prime Minister's call at the Delhi End TB Summit of March 2018; India's targets compared with 2015; the four pillars of the National Strategic Plan 2017 to 2025; Ni-kshay Poshan Yojana from April 2018 at Rs 500 a month; PMTBMBA launched by the President of India on 9 September 2022; Ni-kshay Mitras

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No.: S17

Source: The institute's current affairs file: Insights "Current Affairs 30", November 2025, "Global TB Report 2025", page 28

Used for: Selection of the item only. The facts in the notes are taken from the official sources listed in this table

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No.: S18

Source: WHO, Global TB Report 2025 factsheet and slide set. https://cdn.who.int/media/docs/default-source/global-tuberculosis-report-2025/global-tb-report-2025_factsheet.pdf ; https://cdn.who.int/media/docs/default-source/global-tuberculosis-report-2025/globaltbreport2025_slideset_forweb.pdf?sfvrsn=b3f8fc1e_1

Used for: MDR/RR-TB labels; treatment-success cohorts; August 2025 vaccine pipeline; catastrophic-cost definition

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No.: S19

Source: MoHFW Annual Report 2025–26, p. 113; World TB Day release, 24 March 2026. https://notto.mohfw.gov.in/WriteReadData/Portal/News/951_1_Annual_Report_of_the_MoH_FW__2025_-_2026.pdf ; https://www.pib.gov.in/PressReleasePage.aspx?PRID=2244703

Used for: India’s 25 per cent mortality-rate reduction; dated campaign totals

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No.: S20

Source: MoHFW, parliamentary reply, PIB Release ID 2200795. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2200795

Used for: NPY ₹1,000 monthly rate effective 1 November 2024

No.: S21

Source: National Strategic Plan for Tuberculosis Elimination 2017–2025. https://nti.gov.in/?p=12493

Used for: NTP 1962; RNTCP pilot 1993 and full launch 1997; DOTS; Detect–Treat–Prevent–Build

No.: S22

Source: MoHFW, PMTBMBA launch release, 9 September 2022. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1858006

Used for: Launch by President Droupadi Murmu

No.: S23

Source: United Nations, Goal 3. https://sdgs.un.org/goals/goal3

Used for: SDG target 3.3

No.: S24

Source: WHO, treatment using six-month regimens. https://tbksp.who.int/en/node/3033

Used for: BPaLM for eligible MDR/RR-TB patients

6. ఆధారాలు

6.1 ఆధారాలు

ఆధారాల పట్టిక, లింకులు ఇంగ్లిష్ వెర్షన్‌లోని 7.1 విభాగంలో ఉన్నవే (S1 నుంచి S24). రెండు వెర్షన్లకూ అవే ఆధారాలు.

Day 5 | Answer key at a glance

Topic no.	Q1	Q2
41	(2)	(4)
42	(1)	(3)
43	(3)	(1)
44	(4)	(2)
45	(1)	(3)
46	(2)	(3)
47	(3)	(1)
48	(4)	(2)
49	(2)	(3)
50	(1)	(4)

Spread of correct options across the 20 questions: option (1) 5 times, option (2) 5 times, option (3) 6 times, option (4) 4 times. The keys are the same in the English and Telugu versions.