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APPSC GROUP 1 | 1,000 TOPICS IN 100 DAYS

Day 2
English notes

Topics 11-20

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

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DAY 2 · TOPIC 11

Badami Chalukyas: Pulakesin II and political history

1. Concept in one line

The Chalukyas of Badami (Vatapi) ruled the Deccan from the middle of the 6th century to the middle of the 8th century; their greatest king, Pulakesin II, stopped Harsha at the Narmada but lost his capital to the Pallavas in 642. The examination asks you to link each ruler with the right inscription, enemy, title and event.

2. Revision notes

2.1 Who they were and how we know

- They are also called the Chalukyas of Vatapi or the Early Western Chalukyas. Their capital was Vatapi, the modern Badami in Karnataka.
- They held large parts of the Deccan for about two centuries. About the middle of the 8th century their power passed to the Rashtrakutas.
- **Origin:** most probably a family native to the Kannada country that claimed Kshatriya status (*The Classical Age*, edited by R.C. Majumdar).
- They called themselves Haritiputras of the Manavya gotra, as the Kadambas of Banavasi had done before them. Their crest was the boar (varaha) and their family god was Vishnu, but they also supported Jains and Saivas.
- **Later legends:** court poets of the later Chalukyas of Kalyani said that the first Chalukya was born from the *chuluka* (hollowed palm) of Brahma, or that the family came from Ayodhya. The Badami records do not have these stories, and historians treat them as later inventions.
- **Main sources:** the Badami rock inscription of 543; the Mahakuta pillar inscription of Mangalesa; the Aihole inscription of 634-35; the account of the Chinese pilgrim Xuanzang (Hiuen Tsang); Pallava copper-plate grants; the Persian historian Tabari.
- **Capital:** standard histories give Vatapi as the capital from the time of Pulakesin I. The older NCERT Class VI textbook calls Aihole "the capital of the Chalukyas" and describes it as a trading centre with many temples.
- Dates in this topic follow K.A. Nilakanta Sastri's *A History of South India*. Other books differ, so treat every regnal date as approximate. The conventional 543 date for Pulakesin I is given as 543–44 by Sastri (Saka 465).

2.2 The early rulers

Ruler	Dates (about)	What to remember
Jayasimha and Ranaraga	Before 543	The earliest known names of the family: the grandfather and father of Pulakesin I. Little is known of them.
Pulakesin I	Known date 543; ruled to about 566	First independent king and real founder of the line. Turned the hill of Vatapi into a fortress in 543 (Badami inscription, Saka 465). Performed the asvamedha (horse sacrifice). Titles: Satyasraya, Rana-vikrama, Sri-prithivi-vallabha.

Ruler	Dates (about)	What to remember
Kirtivarman I	566-67 to 597-98	Son of Pulakesin I. The Aihole inscription calls him the "night of doom" to the Nalas, the Mauryas (of the Konkan) and the Kadambas (of Banavasi). Father of Pulakesin II and Kubja Vishnuvardhana.
Mangalesa	597-98 to 609-10	Younger brother of Kirtivarman I; ruled because Kirtivarman's sons were too young. Defeated the Kalachuri king Buddharaja and took the island of Revatidvipa on the Konkan coast. His Mahakuta pillar inscription credits Kirtivarman I with a long list of conquests, which historians treat as exaggerated. Tried to keep the throne for his own son and was killed in a civil war with Pulakesin II.

2.3 Pulakesin II (609-10 to 642): accession and titles

- Son of Kirtivarman I and nephew of Mangalesa. He left the court, made war on his uncle, killed him in battle and became king in 609-10 (610-11 in some books).
- The civil war shook the kingdom. Feudatories broke away and enemies appeared on all sides.
- His first success came north of the river Bhima (Bhimarathi): he defeated Appayika and won over Govinda.
- **Titles:** Satyasraya (his best-known title; Pulakesin I also bore it), Sri-prithivi-vallabha or Vallabha, and Paramesvara. Records of his successors say that he won the name Paramesvara by defeating Harshavardhana, "the warlike lord of all the region of the north".
- The Lohner grant of 630 calls him a Parama-bhagavata, a devotee of Vishnu. His court poet Ravikirti was a Jain.
- The name is also spelt Pulakeshin (NCERT), Pulikesin and Polekesin.

2.4 The Aihole inscription of Ravikirti

Point	Detail
Where	On the east wall of the Meguti Jain temple at Aihole, Bagalkot district, Karnataka
Date	Saka 556, that is, 634-35 CE; the inscription also counts 3,735 years from the Bharata war
Composer	Ravikirti, a Jain poet, who built this temple of Jinendra in the reign of his patron Pulakesin II
Language and form	Sanskrit; a *prasasti* (poem of praise) of 37 verses
What it gives	The family line from Jayasimha to Pulakesin II, and the conquests of Pulakesin II
Literary point	Ravikirti claims the fame of Kalidasa and Bharavi, so both poets were already famous by 634-35
Edited by	J.F. Fleet in the *Indian Antiquary*; F. Kielhorn in *Epigraphia Indica*, volume VI

Three lines from it that examiners use:

- Harsha's "mirth (harsha) melted away by fear" when his elephants fell in battle.
- The "lord of the Pallavas" was made "to vanish behind the walls of Kanchipura".

- Pulakesin won sovereignty over the "three Maharashtrakas with their nine and ninety thousand villages" (99,000 villages).

The poem lists the conquests region by region, not in order of time. It is dated 634-35, so it says nothing about the fall of Vatapi in 642.

2.5 Conquests of Pulakesin II

- **South and west:** he besieged and took Banavasi, the Kadamba capital. The Alupas and the Gangas accepted his overlordship; the Ganga king gave him a daughter in marriage, and she became the mother of Vikramaditya I. His ships attacked and took Puri, the capital of the Mauryas of the Konkan. This Puri was on the Konkan (west) coast; it is not the Puri of Odisha.
- **North:** the Latas, the Malavas and the Gurjaras submitted to him. Sastri describes the resulting northern frontier as reaching the river Mahi; the line given for his boundary with Harsha, however, is the Narmada (see 2.6).
- **East:** Kosala and Kalinga submitted. He captured Pishtapura (Pithapuram) and won a hard battle at the Kunala lake (Kolleru), which broke the power of the Vishnukundins.
- **Vengi:** he placed his younger brother Kubja Vishnuvardhana in charge of the conquered Andhra country (about 621 according to Nilakanta Sastri; about 624 according to Britannica). Vishnuvardhana founded the Eastern Chalukya line of Vengi, which is covered on another day. The Kopparam plates of 631 confirm Pulakesin's hold over the Andhra coast.
- **Far south:** he crossed the Kaveri and made friends with the Cholas, the Keralas and the Pandyas against the Pallavas.
- **Abroad:** the Persian historian Tabari records that in 625-26 an Indian king, usually identified with Pulakesin II, sent an embassy with letters and presents to Khusru II of Persia. The older view that a painting in Ajanta Cave 1 shows a Persian embassy at his court is no longer accepted.

2.6 Pulakesin II and Harsha

- Harsha of Kanauj "tried to cross the Narmada to march into the Deccan, but was stopped" by Pulakesin II (NCERT).
- **Evidence:** verse 23 of the Aihole inscription; Xuanzang, who says that Siladitya (Harsha) had conquered the nations from east to west but had "not yet conquered" the people of Maharashtra; and later Chalukya and Rashtrakuta records.
- Bana's *Harshacharita*, written at Harsha's court, is silent on this defeat.
- The Narmada became the boundary between the two powers (Britannica).
- **Date:** disputed. Nilakanta Sastri places it in the first three or four years of the reign (by about 612). A recent study of Pulakesin's copper plates dated 4 April 619 places it in the winter of 618-19. The chapter on the Chalukyas in *The Classical Age* places it between about 630 and 634. All agree that it was before 634-35, the date of the Aihole inscription.

2.7 The two Pallava wars and the fall of Vatapi

Point	First war	Second war
Pallava king	Mahendravarman I (about 600 to 630)	Narasimhavarman I Mahamalla (about 630 to 668), son of Mahendravarman I
What happened	Pulakesin's army pushed deep into the Pallava country and reached Pullalur, about 15 miles from Kanchi	Pulakesin overran the Banas, who were Pallava feudatories in Rayalaseema, and again threatened Kanchi. He was defeated at Manimangala, about 20 miles

Point	First war	Second war
		east of Kanchi, and, according to Pallava grants, at Pariyala and Suramara
Sources	Aihole inscription: the Pallava lord vanished "behind the walls of Kanchipura". The Pallava Kasakudi plates claim that Mahendravarman defeated his chief enemies at Pullalur	Pallava copper-plate grants; a rock inscription of Narasimhavarman's 13th year at Badami itself
Result	Mahendravarman saved his capital but lost his northern provinces	Narasimhavarman invaded the Chalukya country and captured Vatapi in 642. Pulakesin II probably died in the fighting. Narasimhavarman took the title Vatapikonda

- Narasimhavarman was helped by Manavarma, a prince of Ceylon. Tamil tradition (the *Periya Puranam*) links the capture of Vatapi with the Pallava general Siruttondar, also called Paranjoti.
- These wars began a Chalukya-Pallava conflict that went on for more than a century.

2.8 Xuanzang's visit (about 641)

- He calls the country Mo-ho-la-ch'a (Maharashtra) and the king Pu-lo-ki-she, "of the Kshattriya caste".
- **The people:** tall, stern and vindictive, but grateful to those who help them; they warn an enemy before attacking him. Warriors and war elephants were given wine before a battle.
- He counted about 100 Buddhist monasteries with about 5,000 monks, and about 100 Deva temples.
- The capital he describes, with a great river to its west, does not fit Badami. Some scholars think he saw the king at Nasik.
- He also travelled through the Pallava kingdom, shortly before Narasimhavarman's attack on Badami.

2.9 The later rulers

Ruler	Dates (about)	What to remember
No settled king	642 to 654-55	The Pallavas held Badami for some years. Feudatories and viceroys acted on their own, and more than one son of Pulakesin II claimed the throne.
Vikramaditya I	654-55 to 681	Son of Pulakesin II. Drove the Pallavas out of Vatapi with Ganga help and restored the kingdom. Fought three Pallava kings in turn: Narasimhavarman I, Mahendravarman II and Paramesvaravarman I. Advanced to Kanchi and camped at Uraiyur on the Kaveri on 25 April 674 (Gadval grant). Pallava records say that Paramesvaravarman I defeated his army at Peruvalanallur. Made his younger brother Jayasimhavarman viceroy of Lata (south Gujarat).
Vinayaditya	681 to 696	Son of Vikramaditya I. A generally peaceful reign; he led an expedition into north India.
Vijayaditya	696 to 733	The longest reign of the Badami line; peaceful and prosperous, with much temple building.
Vikramaditya II	733 to 744-45	Said to have overrun Kanchi three times. About 740 he defeated

Ruler	Dates (about)	What to remember
		Nandivarman II Pallavamalla and occupied Kanchi. He did no damage to the city, returned the gold of the Kailasanatha temple and left a Kannada inscription on a pillar there. An Arab invasion from Sind was stopped (about 739) by Pulakesin, the Chalukya viceroy of Lata, who was given the title Avanijanasraya.
Kirtivarman II	744-45 to about 757	Son of Vikramaditya II and last king of the line. Defeated by the Pandya king Rajasimha I at Venbai. Lost his provinces to Dantidurga.

2.10 The end: Dantidurga and the Rashtrakutas

- The Rashtrakutas were at first subordinate to the Chalukyas (NCERT). In the first half of the 8th century they grew strong in the northern Deccan.
- **Dantidurga:** in his Ellora grant of 742 he still uses a feudatory title, but names no overlord. He took the outlying provinces of the empire one by one and made an ally of the Pallava king Nandivarman II, to whom he gave his daughter in marriage.
- About 752-53 he made his final attack on Kirtivarman II and proclaimed himself the sovereign power in the Deccan. His Samangad grant of 754 gives him imperial titles for defeating "Vallabha", that is, Kirtivarman II.
- NCERT says that Dantidurga "overthrew his Chalukya overlord" and performed the *hiranya-garbha* ("golden womb") ritual, which was thought to give the sacrificer a "rebirth" as a Kshatriya.
- Kirtivarman II lingered on: his Vakkaleri grant is dated 2 September 757. Soon after, Krishna I, the uncle and successor of Dantidurga, completed the overthrow.
- **Why the line fell:** the long wars with the Pallavas drained its strength and loosened its hold on the north, where the viceroys became half independent.
- **Neighbouring topics (other days):** the temples of Aihole, Badami and Pattadakal (Pattadakal was inscribed as a UNESCO World Heritage Site in 1987); the Eastern Chalukyas of Vengi, who lasted until 1070; and the later Chalukyas of Kalyani, founded by Taila about 973 to 975.

3. Chronology of the Badami Chalukyas

Year	Event
543	Pulakesin I turns the hill of Vatapi into a fortress (Badami inscription, Saka 465)
566-67	Kirtivarman I becomes king
597-98	Kirtivarman I dies; his brother Mangalesa rules
609-10	Pulakesin II kills Mangalesa and becomes king
About 621	Kubja Vishnuvardhana is sent to rule the Andhra country (Nilakanta Sastri; about 624 in Britannica)
625-26	Embassy to Khusru II of Persia from an Indian king, usually identified with Pulakesin II
634-35	Aihole inscription of Ravikirti (Saka 556)
About 641	Xuanzang in Maharashtra
642	Narasimhavarman I captures Vatapi; Pulakesin II probably dies in the fighting
654-55	Vikramaditya I proclaims himself king of the restored kingdom
674	Vikramaditya I camps at Uraiyur on the Kaveri

Year	Event
681	Vinayaditya becomes king
696	Vijayaditya becomes king
733	Vikramaditya II becomes king
About 739	The Arab invasion is stopped by Pulakesin, viceroy of Lata
About 740	Vikramaditya II occupies Kanchi
742	Ellora grant of Dantidurga, still a feudatory in title
744-45	Kirtivarman II becomes king
About 752-53	Dantidurga's final attack on Kirtivarman II
757	Vakkaleri grant of Kirtivarman II (2 September); Krishna I ends the line soon after

The five phases at a glance:

- **Rise, 543 to 609-10:** Pulakesin I, Kirtivarman I and Mangalesa.
- **Peak, 609-10 to 642:** Pulakesin II.
- **Crisis, 642 to 654-55:** Vatapi lost; no settled king.
- **Recovery, 654-55 to 744-45:** Vikramaditya I, Vinayaditya, Vijayaditya and Vikramaditya II.
- **Fall, 744-45 to 757:** Kirtivarman II, Dantidurga and Krishna I.

4. Three common exam traps

1. **Three men named Pulakesin, two named Vikramaditya.** Pulakesin I turned Vatapi into a fortress in 543 and performed the asvamedha. Pulakesin II (609-10 to 642) is the king of the Aihole inscription who checked Harsha. A third man named Pulakesin, the viceroy of Lata with the title Avanijanasraya, stopped the Arabs in the time of Vikramaditya II. In the same way, Vikramaditya I recovered Vatapi from the Pallavas, while Vikramaditya II occupied Kanchi about 740.
2. **Two Pallava kings, two results.** Mahendravarman I is the "lord of the Pallavas" who was pushed back behind the walls of Kanchi. His son Narasimhavarman I defeated Pulakesin II, captured Vatapi in 642 and is called Vatapikonda. The Aihole inscription is dated 634-35, so it cannot mention the events of 642.
3. **The fall of Vatapi in 642 did not end the dynasty.** Vikramaditya I restored the kingdom in 654-55 and the line ruled for another century. It was ended by the Rashtrakutas, Dantidurga and then Krishna I, about 752 to 757, not by the Pallavas. Do not mix this line with the Eastern Chalukyas of Vengi or the later Chalukyas of Kalyani.

Practice and explanations

Q1. Consider the following statements about Pulakesin II:

1. He was the Chalukya king who turned the hill of Vatapi into a fortress in 543.
2. He placed his younger brother Kubja Vishnuvardhana in charge of the Andhra country that he had conquered.
3. The Pallava king who captured his capital, Vatapi, was Mahendravarman I.

Which of the statements given above is/are correct?

- (1) 2 only

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

Q1. Answer: (1) 2 only

- Statement 1 is wrong: The hill of Vatapi was turned into a fortress in 543 by Pulakesin I, the grandfather of Pulakesin II. Pulakesin II became king only in 609-10.
- Statement 2 is correct: After his eastern campaign Pulakesin II placed his younger brother Kubja Vishnuvardhana in charge of the conquered Andhra country. Vishnuvardhana founded the Eastern Chalukya line of Vengi.
- Statement 3 is wrong: Vatapi was captured in 642 by Narasimhavarman I, who took the title Vatapikonda. Mahendravarman I was his father, the earlier Pallava king who was pushed back behind the walls of Kanchi.
- Why the other options are wrong: (2) includes statement 1, which is wrong. (3) includes statement 3, which is wrong. (4) includes both wrong statements and leaves out statement 2, the only correct one.

Q2. Match List I (Ruler) with List II (Event):

List I (Ruler)	List II (Event)
A. Mangalesa	1. Drove the Pallavas out of Vatapi and restored the kingdom
B. Vikramaditya I	2. Lost his throne and his life in a civil war with his nephew
C. Vikramaditya II	3. Lost his provinces to Dantidurga and was the last king of the line
D. Kirtivarman II	4. Occupied Kanchi and left a Kannada inscription in the Kailasanatha temple

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

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

- Why it is correct: Mangalesa tried to keep the throne for his own son and lost his throne and his life in the civil war with his nephew Pulakesin II (A-2). Vikramaditya I, son of Pulakesin II, drove the Pallavas out of Vatapi and restored the kingdom in 654-55 (B-1). Vikramaditya II occupied Kanchi about 740 and left a Kannada inscription on a pillar of the Kailasanatha temple (C-4). Kirtivarman II lost his provinces to Dantidurga and was the last king of the line (D-3).
- Why (1) is wrong: It swaps the two Vikramadityas. Vikramaditya I recovered Vatapi; the Kannada inscription at Kanchi belongs to Vikramaditya II.
- Why (2) is wrong: It swaps Mangalesa and Vikramaditya I. Mangalesa ruled before the Pallavas ever took Vatapi; the king who died fighting his nephew was Mangalesa, not Vikramaditya I.
- Why (4) is wrong: It makes Vikramaditya I the king of the Kanchi inscription, Vikramaditya II the last king and Kirtivarman II the restorer of the kingdom. The last king was Kirtivarman II, and the kingdom was restored a century earlier by Vikramaditya I.

7. Sources

7.1 Sources

No.	Source	Used for
S1	K.A. Nilakanta Sastri, *A History of South India*, 2nd edition (Oxford University Press, 1958), chapter VIII, "Conflict of Three Empires", pp. 142 to 151. Internet Archive scan: [source link]	The regnal dates used in the notes; Pulakesin I's fortress and horse sacrifice; Kirtivarman I's wars; Mangalesa, Buddharaja and Revatidvipa; the civil war and accession of 609-10; Appayika and Govinda; Banavasi, Alupas, Gangas and the Ganga marriage; Puri; Latas, Malavas, Gurjaras and the Mahi frontier; Harsha checked on the Narmada in the first three or four years; Kosala, Kalinga, Pishtapura and the Kunala battle; Vishnuvardhana sent to the Andhra country in 621; the embassy of 625-26; Mahendravarman I and Pullalur; Narasimhavarman I, the Banas, Manimangala, Manavarma, the capture of Badami in 642 and the title Vatapikonda; the crisis and Vikramaditya I's accession in 654-55; Jayasimhavarman in Lata; Uraiyur and Peruvalanallur; Vinayaditya and Vijayaditya; Vikramaditya II, Kanchi, the Kailasanatha inscription and the Arabs; Kirtivarman II, Venbai, Dantidurga's attack of 752 or 753 and Krishna I
S2	R.C. Majumdar (editor), *The Classical Age* (The History and Culture of the Indian People, volume III, Bharatiya Vidya Bhavan), chapter XII, "The Chalukyas", pp. 227 to 249. Internet Archive scan: [source link]	Rule of about two centuries; origin as a local Kannada family claiming Kshatriya status; Haritiputra and Manavya gotra; boar crest and Vishnu; the chuluka and Ayodhya legends; Jayasimha and Ranaraga; Pulakesin I as first independent king, Badami inscription of Saka 465 and his titles; Mahakuta pillar inscription and its exaggerated list; variant dates (610-11; 733-34 to 744-45; 744-45 to 757); titles of Pulakesin II and the name Paramesvara; Lohner grant of 630; the Harsha war dated between 629-30 and 634-35; Kubja Vishnuvardhana and the Eastern Chalukyas to 1070; Kasakudi plates and Pullalur; Tabari and the embassy of 625-26; the Ajanta painting view doubted; Pariyala, Manimangala and Suramara; Badami rock inscription; Xuanzang's visit about 641 and the Nasik suggestion; the vacancy of 642 to 655; three Pallava kings fought by Vikramaditya I; Uragapura on 25 April 674; Vikramaditya II and Nandivarman II; Avanijanasraya Pulakesin; Ellora grant of 742; Samangad grant of 754; Vakkaleri grant of 2 September 757; Krishna I; reasons for the fall. The section on the Pallavas in the same volume: Narasimhavarman I about 630 to 668, Vatapi captured in 642, the title Vatapikonda, Vikramaditya II at Kanchi about 740, Dantidurga's daughter married to Nandivarman II
S3	F. Kielhorn, "Aihole Inscription of Pulikesin II; Saka-Samvat 556", *Epigraphia Indica*, volume VI (1901), No. 1. Internet Archive scan: [source link]	Place of the stone (east side-wall of the Meguti temple); date Saka 556, the year 3735 from the Bharata war, 634-35 CE; Ravikirti and the Jinendra temple; 37 verses; the verses on Kirtivarman I, Mangalesa, Harsha, the three Maharashtrakas, the Pallava lord and Kanchipura; Kalidasa and Bharavi; Kunala identified with the Kolleru lake; Fleet's earlier editions
S4	Samuel Beal (translator), *Si-Yu-Ki: Buddhist Records of the Western World*, volume II, Book XI, account of Mo-ho-la-	Xuanzang's own words on the country, the capital and its river, the people, the champions and elephants, King Pu-lo-ki-she "of the Kshattriya caste", Siladitya's failure to

No.	Source	Used for
	ch'a, pp. 255 to 257. Internet Archive scan: [source link]	conquer the country, and about 100 monasteries, 5,000 monks and 100 Deva temples
S5	NCERT, *Our Pasts II* (Class VII history), chapter 2, "Kings and Kingdoms". [source link]	Rashtrakutas at first subordinate to the Chalukyas of Karnataka; Dantidurga overthrew his Chalukya overlord in the mid-eighth century; the hiranya-garbha ritual
S6	NCERT, *Our Pasts I* (Class VI history), chapter 9, "New Empires and Kingdoms", as reproduced on SATHEE (IIT Kanpur and Ministry of Education). [source link]	Harsha stopped at the Narmada by Pulakeshin II; Ravikirti's prashasti; the Pallava king behind the walls of Kanchipuram; the sentence calling Aihole the capital and a trading centre with temples; the spelling Pulakeshin
S7	Encyclopaedia Britannica, "Chalukya dynasty". [source link]	Vatapi as modern Badami; Narmada as the boundary with Harsha; Vengi given to Kubja Vishnuvardhana about 624; Eastern Chalukyas to about 1070; Taila and Kalyani about 975; variant dates (543 to 757; Vikramaditya I 655 to 680; Vikramaditya II 733 to 746)
S8	Encyclopaedia Britannica, "Pulakeshin II". [source link]	Reign given as 610 to 642; civil war at the start of the reign
S9	e-PG Pathshala (INFLIBNET), subject Indian Culture, paper Indian Epigraphy, module 35, "Aihole Inscription of Pulakesin II". [source link]	Aihole in Hungund taluk, Bagalkot district, Karnataka; Sanskrit verse; conquests arranged by region and not by time; editions by Fleet and Kielhorn; Lohner plates and Parama-bhagavata
S10	UNESCO World Heritage Centre, "Group of Monuments at Pattadakal". [source link]	Pattadakal inscribed in 1987; Chalukya art of the 7th and 8th centuries
S11	Wikipedia, "Pulakeshin II" (citing D.P. Dikshit, *Political History of the Chalukyas of Badami*, 1980; K.A. Nilakanta Sastri in G. Yazdani, editor, *The Early History of the Deccan*, 1960; P.S. Sohoni and S.L. Bapat, 2017; W.M. Spink, 2005). [source link]	The 618-19 date for the Harsha war from the copper plates of 4 April 619; Bana's silence; Kopparam plates of 631; the Ajanta painting view no longer accepted; spellings of the name; variant accession dates
S12	Wikipedia, "Aihole inscription" (citing Kielhorn 1901; Fleet 1876 and 1879; Upinder Singh, *A History of Ancient and Early Medieval India*). [source link]	Cross-check of the date, the composer, the language and the editions
S13	Wikipedia, "Chalukya dynasty" (citing S.U. Kamath, *A Concise History of Karnataka*, 2001; K.V. Ramesh, *Chalukyas of Vatapi*, 1984). [source link]	Cross-check of the origin theories and the three Chalukya lines; Tailapa II in 973
S14	Wikipedia, "Pulakeshin I", "Kirttivarman I" and "Mangalesha" (all citing Dikshit 1980 and Ramesh 1984). [source link] ; [source link] ; [source link]	Variant dates for the early rulers; sons of Kirtivarman I; Revatidvipa identified with Redi; the Badami rock inscription of Pulakesin I dated 543 (Saka 465)
S15	Wikipedia, "Vikramaditya I", "Vikramaditya II", "Kirtivarman II" and "Dantidurga" (citing Dikshit 1980; Ramesh 1984; Kamath 2001; Sastri 1955; R.C. Majumdar, *Ancient India*). [source link] ; [source link] ; [source link] ; [source link]	The date of about 739 for the Arab defeat (Navsari grant); cross-check of the later rulers; variant dates; Jayasimhavarman as the younger brother of Vikramaditya I
S16	Wikipedia, "Battle of Vatapi" and	The general Paranjoti (Siruttondar) in Tamil tradition;

No.	Source	Used for
	"Narasimhavarman I" (citing Dikshit 1980; H. Heras, *Studies in Pallava History*, 1933; Sastri; the *Periya Puranam*). [source link] ; [source link]	cross-check of 642 and Vatapikonda
S17	Wikipedia, "Kubja Vishnuvardhana" and "Harsha" (citing D.C. Ganguly, *The Eastern Chalukyas*, 1937; Sastri 1955; R.C. Majumdar, *Ancient India*). [source link] ; [source link]	Variant dates for Vishnuvardhana; cross-check of the Harsha war
S18	E. Hultzsch, "Kanchi Inscription of Vikramaditya", *Epigraphia Indica*, volume III (1894-95), No. 48. Text reproduced at [source link]	The Kanarese (Kannada) inscription on the back of a pillar of the mandapa in front of the Rajasimhesvara shrine in the Kailasanatha temple at Kanchi; the conqueror of Kanchi returned the property of the temple; the record is undated and is assigned to Vikramaditya II
S19	Encyclopaedia Britannica, "Pallava dynasty". [source link]	Mahendravarman I, about 600 to 630, and his battles with Pulakeshin II; Narasimhavarman I as his successor

Additional sources for the reviewed edition

- K.A. Nilakanta Sastri, A History of South India, 1958, printed pp. 142–150; official IGNCA scan. [source link] — Direct reading of the source-specific chronology, Mahi frontier (p. 144), c. 621 appointment (p. 145), Pallava wars and later rulers; 543–44 on p. 142
- DHARMA, Aihole inscription, edition and Kielhorn translation. [source link] — Inscription, genealogy, conquests and Saka 556 date

DAY 2 · TOPIC 12

Historical background: Acts of 1858, 1861, 1892, 1909 and 1919

1. Concept in one line

From 1858 the British Crown governed India directly, and five Acts of Parliament (1858, 1861, 1892, 1909 and 1919) step by step enlarged the legislative councils, brought in elected Indian members and, in 1919, placed some provincial subjects under Indian ministers. The examination asks which Act introduced which feature, and it swaps features between the Acts.

2. Revision notes

2.1 Basics to keep in mind

- The Government of India Act 1858 took the government of India from the East India Company and gave it to the Crown. It mainly changed the machinery in London; the system of government in India stayed much the same.
- The three Indian Councils Acts (1861, 1892 and 1909) dealt mainly with the legislative councils: how many members they had, how the members were chosen and what they could discuss.
- The Government of India Act 1919 followed two steps: the declaration of 20 August 1917 and the Montagu-Chelmsford Report of 1918. Its preamble set the aim as the "progressive realization of responsible government in British India as an integral part of the empire".
- Two sets of reforms are named after two persons each. Morley-Minto reforms, 1909: John Morley was Secretary of State for India and Lord Minto was Viceroy. Montagu-Chelmsford reforms, 1919: Edwin Montagu was Secretary of State and Lord Chelmsford was Viceroy.
- The Acts from 1773 to 1853, the Government of India Act 1935 and the Indian Independence Act 1947 are covered on other days.

2.2 The five Acts compared

Act	Main provisions	Remember it for
Government of India Act, 1858	Passed on 2 August 1858 as "An Act for the better government of India". India was to be "governed by and in the name of Her Majesty". The powers of the Court of Directors and the Board of Control passed to a Secretary of State for India, a member of the British cabinet. A Council of India of fifteen members assisted him: eight appointed by the Crown and seven elected by the Directors of the Company. The majority of them had to be persons who had served or lived in India for at least ten years. The Council was advisory. The Secretary of State	Crown rule begins; Secretary of State and the fifteen-member Council of India; end of double government

Act	Main provisions	Remember it for
	presided over it and could overrule it, except in some matters such as the spending of Indian revenues. Lord Stanley, who piloted the Bill in Parliament, became the first Secretary of State for India.	
Indian Councils Act, 1861	The Governor-General's executive council got a fifth ordinary member. The Governor-General could make rules for the conduct of business in his council; this gave recognition to the portfolio system begun under Lord Canning, in which each member took charge of a department. For law-making, the council was enlarged by six to twelve additional members, nominated by the Governor-General for two years. At least half of them had to be non-officials. Canning nominated three Indians: the Raja of Benares, the Maharaja of Patiala and Sir Dinkar Rao. The enlarged council could take up only Bills and its own rules of business. Madras and Bombay got back the law-making power they had lost in 1833. Legislative councils could be set up in other provinces: Bengal got one in 1862, the North-Western Provinces and Oudh in 1886 and the Punjab in 1897. In an emergency the Governor-General could issue an ordinance without his council; it stayed in force for not more than six months.	Indians enter the legislative council by nomination; portfolio system; ordinances; law-making power back to Madras and Bombay
Indian Councils Act, 1892	The number of additional members rose: ten to sixteen in the Governor-General's council, and eight to twenty each in Madras and Bombay. At least half still had to be non-officials. In law every member was still nominated. But under the regulations some non-official seats were filled on the recommendation of bodies. For the Governor-General's council these were the non-official members of the provincial councils and the Calcutta Chamber of Commerce. For the provincial councils they were bodies such as municipalities, district boards,	Budget discussion and questions; nomination on recommendation (indirect election)

Act	Main provisions	Remember it for
	universities, landholders and trade associations. Books call this indirect election. Rules could now allow members to discuss the annual financial statement (the budget) and to ask questions. No member could move a resolution or ask for a vote on either.	
Indian Councils Act, 1909 (Morley-Minto reforms)	The Act itself said that the additional members would include elected members as well as nominated ones. The maximum number rose to 60 in the Governor-General's council; 50 each in Madras, Bombay, Bengal, the United Provinces and Eastern Bengal and Assam; and 30 each in the Punjab and Burma. Officials kept their majority in the Governor-General's council. The provincial councils no longer needed an official majority. The regulations made under the Act gave Muslims separate electorates: the members for the seats kept for Muslims were chosen only by Muslim voters. Members could discuss the financial statement and any matter of general public interest, move resolutions (which were only recommendations) and ask supplementary questions. Outside the Act, Satyendra P. Sinha became the first Indian member of the Viceroy's Executive Council in 1909, as Law Member. Earlier, in 1907, Morley had appointed two Indians, K.G. Gupta and Sayyid Husain Bilgrami, to the Council of India in London.	Elected members named in the Act; separate electorates for Muslims; resolutions and supplementary questions; first Indian in the Viceroy's Executive Council
Government of India Act, 1919 (Montagu-Chelmsford reforms)	It received the royal assent on 23 December 1919, and the first elections under it were held in 1920. Rules made under the Act separated central subjects from provincial subjects. Provincial subjects were divided into reserved subjects and transferred subjects: this is dyarchy (see 2.4). The Act named eight Governors' provinces: Bengal, Madras, Bombay, the United Provinces, the Punjab, Bihar and Orissa, the	Dyarchy in the provinces; two chambers at the centre; direct elections; review commission after ten years

Act	Main provisions	Remember it for
	Central Provinces and Assam. In each provincial council at least 70 per cent of the members were elected and not more than 20 per cent were officials. At the centre there was no dyarchy. But the central legislature got two chambers, the Council of State and the Legislative Assembly, and elected members were chosen by direct election. Separate electorates stayed for Muslims and were extended: to Sikhs in the Punjab, and to Indian Christians, Anglo-Indians and Europeans in some provinces. In London, the Secretary of State's salary was now to be paid from money voted by the British Parliament, the Council of India was to have eight to twelve members, and a High Commissioner for India could be appointed. The Act provided for a Public Service Commission. It also provided for a commission after ten years to review the reforms; this was the Simon Commission, which was appointed in November 1927, two years before the ten years were over.	

2.3 How the central legislature grew

Act	Size and make-up	What members could do
1861	Six to twelve additional members, all nominated; at least half non-officials	Law-making only: Bills and the rules of business
1892	Ten to sixteen additional members, all nominated, some on recommendation; at least half non-officials	Discuss the annual financial statement and ask questions. No resolutions, no voting, no supplementary questions
1909	Up to 60 additional members, nominated and elected; official majority kept	Discuss the financial statement and matters of general public interest; move resolutions, which were only recommendations; ask supplementary questions
1919	Two chambers. Council of State: not more than 60 members, not more than 20 of them officials; life of five years. Legislative Assembly: 140 members in the Act, 100 elected and 40 not elected, 26 of	The Assembly voted on demands for grants and could refuse or reduce them. Some heads, such as defence and interest on debt, were not put to the vote. The Governor-General could certify a Bill as

Act	Size and make-up	What members could do
	the 40 being officials; life of three years. Rules could raise the Assembly's number, and under the rules it had 145 members, 104 of them elected	essential and enact it over a refusal

2.4 Dyarchy in the provinces under the 1919 Act

Dyarchy means dual rule. The executive government of a province was split into two parts.

Point	Reserved subjects	Transferred subjects
Who was in charge	The Governor with his executive council, whose members were appointed by the Crown	The Governor acting with ministers
Link with the provincial legislative council	The councillors were answerable to the Secretary of State, not to the provincial council	The ministers came from the elected members of the provincial council
Examples	Justice, police, land revenue, irrigation, finance	Local self-government, education, public health, public works, agriculture

- A minister held office during the Governor's pleasure. A minister who was not an elected member of the provincial council had to become one within six months.
- In transferred subjects the Governor was to be guided by the advice of his ministers, unless he saw sufficient cause to dissent.
- The lists of reserved and transferred subjects were in the rules made under the Act, not in the Act itself.
- Dyarchy in the provinces ended with the Government of India Act 1935.

2.5 Distinctions worth remembering

Often confused	The difference
"Viceroy" and the Act of 1858	The Act of 1858 does not use the word "Viceroy". The Governor-General was styled Viceroy as the Crown's representative. The Queen's Proclamation, which Lord Canning announced on 1 November 1858, named him "first Viceroy and Governor-General". Many textbooks simply say that the designation changed in 1858.
Law-making power of Madras and Bombay	Taken away by the Charter Act of 1833; given back by the Indian Councils Act of 1861.
Official majority after 1909	Kept in the Governor-General's legislative council. No longer required in the provincial legislative councils.
How members came into the councils	1861: nomination only. 1892: nomination, partly on the recommendation of bodies. 1909: the Act speaks of elected members, and Muslims get separate electorates. 1919: direct election, and wider communal electorates.
Dyarchy in 1919	In the provinces only. The centre got two chambers,

Often confused	The difference
	but no dyarchy.
"Double government" and "dyarchy"	The double government that ended in 1858 sat in London (the Court of Directors and the Board of Control). The dyarchy of 1919 was in the provinces. Question papers in Telugu may use one term for both, so look at the year.

3. Extra section: chronology from 1858 to 1927

Date	Event
2 August 1858	Government of India Act passed: Crown rule, Secretary of State for India, Council of India of fifteen
1 November 1858	Lord Canning announces the Queen's Proclamation; he is the first Viceroy
1861	Indian Councils Act: nominated additional members, portfolio system, ordinances. The Indian High Courts Act and the Indian Civil Service Act were passed in the same year
18 January 1862	Legislative council for Bengal set up by proclamation
26 November 1886	Legislative council for the North-Western Provinces and Oudh
1892	Indian Councils Act: discussion of the budget, questions, nomination on recommendation
9 April 1897	Legislative councils for the Punjab and Burma
1909	Indian Councils Act (Morley-Minto reforms); S.P. Sinha joins the Viceroy's Executive Council
20 August 1917	Montagu's declaration in the House of Commons: responsible government is the goal
1918	Montagu-Chelmsford Report
23 December 1919	Government of India Act 1919 receives the royal assent
1920	First elections under the Act of 1919
November 1927	Simon Commission appointed to review the working of the Act of 1919

4. Three common exam traps

1. **The four steps in what members could do.** 1861: only law-making. 1892: discuss the budget and ask questions, but no resolutions and no supplementary questions. 1909: resolutions and supplementary questions. 1919: voting on demands for grants. Questions give the 1909 powers to 1892, or the 1892 powers to 1861.
2. **Centre against province.** In 1909 the official majority stayed at the centre but was given up in the provinces. In 1919 dyarchy came to the provinces only; the centre got two chambers, not dyarchy. Questions swap the two levels.
3. **What is in the Act and what is outside it.** The word "Viceroy" is not in the Act of 1858. Separate electorates for Muslims came through the regulations made under the Act of 1909. The lists of reserved and transferred subjects were in the rules made under the Act of 1919. Sinha was appointed to the Viceroy's Executive Council in 1909, but this was not a provision of the Act of 1909.

Practice and explanations

Q1. Match List I (Act) with List II (What members of the legislature could do under it):

List I (Act)	List II (What members of the legislature could do under it)
A. Indian Councils Act, 1861	1. Move resolutions on matters of general public interest and ask supplementary questions
B. Indian Councils Act, 1892	2. Vote on demands for grants, with power to refuse or reduce a demand
C. Indian Councils Act, 1909	3. Take up nothing except Bills and the rules of business
D. Government of India Act, 1919	4. Discuss the annual financial statement and ask questions, without moving any resolution

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

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

- Why it is correct: Under the Act of 1861 the enlarged council could take up only Bills and its own rules of business (A-3). The Act of 1892 let members discuss the annual financial statement and ask questions, but no member could move a resolution or ask for a vote (B-4). After the Act of 1909 members could move resolutions on matters of general public interest and ask supplementary questions (C-1). Under the Act of 1919 the Legislative Assembly voted on demands for grants and could refuse or reduce them (D-2).
- Why (1) is wrong: It makes two swaps: 1861 with 1892, and 1909 with 1919. The council of 1861 could not discuss the financial statement, and voting on demands for grants came only in 1919.
- Why (2) is wrong: It swaps 1861 and 1892. Discussion of the financial statement came in 1892; in 1861 the council was confined to law-making.
- Why (3) is wrong: It swaps 1909 and 1919. Resolutions and supplementary questions came in 1909; voting on demands for grants came only in 1919.

Q2. Consider the following statements about the Acts passed between 1858 and 1919:

1. The Government of India Act, 1858 set up a Council of India of fifteen members to assist the Secretary of State for India.
2. The Indian Councils Act, 1861 took away the law-making powers of the Governments of Madras and Bombay.
3. Under the Morley-Minto reforms of 1909, officials kept their majority in the Governor-General's legislative council.
4. The Government of India Act, 1919 introduced dyarchy in the central government.

Which of the statements given above is/are correct?

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

- (4) 1 and 3 only

Q2. Answer: (4) 1 and 3 only

- Statement 1 is correct: The Act of 1858 gave the Secretary of State for India a Council of India of fifteen members, eight appointed by the Crown and seven elected by the Directors.
- Statement 2 is wrong: It was the Charter Act of 1833 that took away the law-making powers of Madras and Bombay. The Act of 1861 gave them back.
- Statement 3 is correct: In 1909 the official majority was kept in the Governor-General's legislative council. Only the provincial legislative councils no longer needed one.
- Statement 4 is wrong: The Act of 1919 introduced dyarchy in the provinces. At the centre it set up two chambers, the Council of State and the Legislative Assembly, but no dyarchy.
- Why the other options are wrong: (1) includes statement 2, which is wrong, and leaves out statement 3. (2) has both the wrong statements. (3) includes statement 4, which is wrong, and leaves out statement 1.

7. Sources

7.1 Sources

No.	Source	Used for
S1	Arthur Berriedale Keith, *A Constitutional History of India 1600-1935*, Methuen, London, 1936, Chapter VI "The Direct Rule of the Queen Empress", Chapter VII "Political Unrest, the Minto-Morley Reforms, and the New Delhi" and Chapter VIII "The War and Constitutional Reform; the Montagu-Chelmsford Scheme". Internet Archive scan: [source link]	1858: Secretary of State takes over the powers of the Court of Directors and the Board of Control; council of fifteen, eight appointed by the Crown and seven by the Directors; ten years' service or residence in India for the majority; council advisory, Secretary of State presides and can overrule it except in matters such as the appropriation of revenues; the Governor-General styled "viceroy" though not by statute. 1861: fifth member; portfolio system under Canning; Madras and Bombay regain legislative power, with the advocate-general and four to eight members; councils for Bengal (1862), the North-Western Provinces (1886), Burma and the Punjab (1897). 1892: additional members raised to sixteen; regulations for indirect election, the Governor-General nominating persons chosen in various ways; discussion of the budget and questions. 1909: maximum of 60, 50 and 30; official majority needed in the Indian legislature but not in the provincial councils; elected members up from 39 to 135; separate representation for Muslims, chosen only by Muslim voters; resolutions as recommendations; supplementary questions as an innovation; two Indians admitted to the Secretary of State's council in 1907. 1917: declaration of 20 August 1917. 1919: not more than 20 per cent officials and at least 70 per cent elected in provincial councils; communal electorates kept for Muslims and extended to Europeans, Anglo-Indians and Indian Christians in some provinces; twelve Sikh seats in the Punjab; at least five-sevenths of the Legislative Assembly elected
S2	Courtenay Ilbert, *The Government of India: Being a Digest of the Statute Law Relating Thereto, with Historical Introduction and Explanatory Matter*, 2nd edition, Clarendon	1858: the Act (21 & 22 Vict. c. 106) placed British India under direct Crown government; called the "Act for the better government of India"; Lord Stanley took charge of the Bill; Lord Canning the first viceroy. 1861: Indian

No.	Source	Used for
	Press, Oxford, 1907, Chapter I "Historical Introduction", Table of Dates and the Digest. Internet Archive scan: [source link]	Councils Act (24 & 25 Vict. c. 67), passed in the same year as the Indian Civil Service Act and the Indian High Courts Act; fifth ordinary member; six to twelve additional members, nominated for two years, at least half non-official; councils could consider only measures introduced for enactment and changes to their rules of business; legislative power restored to Madras and Bombay after its removal in 1833; ordinances in emergencies for not more than six months; Bengal council by proclamation of 18 January 1862, North-Western Provinces and Oudh on 26 November 1886, Punjab and Burma on 9 April 1897. 1892: Indian Councils Act (55 & 56 Vict. c. 14); ten to sixteen additional members at the centre, eight to twenty in Madras and Bombay, at least half non-official; nomination on the recommendation of the non-official members of provincial councils, the Calcutta Chamber of Commerce, and (in Bombay) the corporation, the university, municipal and district bodies, landholders and trade associations; discussion of the annual financial statement and asking of questions; no member may move a resolution or divide the council
S3	Panchanandas Mukherji (ed.), *Indian Constitutional Documents (1773-1915)*, Thacker, Spink & Co., Calcutta, 1915, which reprints the text of the Government of India Act 1858 and the Queen's Proclamation of 1858. Internet Archive scan: [source link]	Words of the Act of 1858: "governed by and in the name of Her Majesty"; the Council of India to "consist of fifteen members". Words of the Queen's Proclamation appointing Canning "first Viceroy and Governor-General". Editor's Introduction: royal assent to the Act of 1858 on 2 August 1858; Council of India originally fifteen; Canning first styled "Viceroy" in the Proclamation; Charter Act of 1833 withdrew the legislative functions of Madras and Bombay and the Act of 1861 restored them; 1861: six to twelve members nominated for two years, not less than half non-official; ordinances in force for six months. Text of the Indian Councils Act 1861: no business other than "the consideration and enactment of measures". Text of the Indian Councils Act 1892: additional members "not less than eight nor more than twenty" in Madras and Bombay; no member may "submit or propose any resolution" or "divide the Council". Introduction on 1909: members may propose resolutions and divide the Council on them
S4	Government of India Act, 1919 (9 & 10 Geo. 5, c. 101), text reproduced by the Centre for Law and Policy Research on constitutionofindia.net. [source link]	Preamble ("progressive realization of responsible government in British India as an integral part of the empire"); section 1 (rules classifying central and provincial subjects; transferred and reserved subjects); the eight Governors' provinces; ministers hold office during the Governor's pleasure, six-month rule, Governor guided by ministers' advice unless he sees sufficient cause to dissent; provincial councils at least 70 per cent elected and not more than 20 per cent official; Council of State of not more than 60 members with not more than 20 officials, five years; Legislative Assembly of 140 members, 100 elected, 40 non-elected of whom 26 official, three years, rules may increase the number; demands for grants and non-voted heads; the Governor-General's power to certify a Bill; Secretary of State's salary; Council of India of

No.	Source	Used for
		eight to twelve members; High Commissioner for India; Public Service Commission; commission after ten years
S5	Indian Councils Act, 1909 (9 Edw. 7, c. 4), text and commentary on constitutionofindia.net. [source link]	Section 1 (nominated and elected additional members); First Schedule (maximum numbers 60, 50 and 30, council by council); section 5 (discussion of the annual financial statement and of any matter of general public interest, and the asking of questions); the Act's text does not mention separate electorates, which came through the regulations
S6	Encyclopaedia Britannica, "Government of India Acts". [source link]	1858: transfer of the Company's powers to the Crown. 1919: central and provincial subjects, dyarchy in the provinces, bicameral central legislature, direct elections. 1935: end of provincial dyarchy (one line)
S7	Encyclopaedia Britannica, "India", history sections "Government of India Act of 1858", "Reforms of the British Liberals" and "Constitutional reforms". [source link] ; [source link] ; [source link]	Act passed on 2 August 1858; Secretary of State a member of the British cabinet; Council of India of 15, seven from the Company's Court of Directors and eight appointed by the Crown; Canning announced the Queen's Proclamation on 1 November 1858; 1861 Act and the portfolio system; six to twelve additional members, at least half non-official; 1892 maximum of 16. 1909: Sinha the first Indian member of the Viceroy's Executive Council, as law member; Gupta and Bilgrami; supplementary questions. 1919: elections held in 1920; Legislative Assembly of 145 members with 104 elected; transferred and reserved departments; separate electorates extended to other minorities
S8	Encyclopaedia Britannica, "Indian Councils Act of 1909". [source link]	Morley (Secretary of State 1905-10) and Minto (Viceroy 1905-10); elective principle; maximum additional membership raised from 16 to 60; 50 in the larger provincial councils; official majorities abolished in the provincial legislatures; Sinha, Gupta and Bilgrami
S9	Encyclopaedia Britannica, "dyarchy". [source link]	Montagu (Secretary of State 1917-22) and Chelmsford (Viceroy 1916-21); executive councillors appointed by the Crown and ministers chosen from the elected members of the provincial legislature; examples of reserved subjects (justice, police, land revenue, irrigation) and transferred subjects (local self-government, education, public health, public works, agriculture); dyarchy ended with provincial autonomy in 1935
S10	Encyclopaedia Britannica, "Montagu-Chelmsford Report". [source link]	Montagu's statement in the House of Commons in August 1917; the Report of 1918 as the basis of the Act of 1919
S11	Encyclopaedia Britannica, "Simon Commission". [source link]	Commission appointed in November 1927 under the ten-year review provision of the Act of 1919
S12	Encyclopaedia Britannica, "Charles John Canning, Earl Canning". [source link]	Canning as Governor-General from 1856 and first Viceroy from 1858
S13	House of Lords Library, "Lord Sinha of Raipur and the Government of India Act 1919", 2019. [source link]	Royal assent on 23 December 1919; Montagu's declaration of 20 August 1917; reserved subjects under councillors answerable to the Secretary of State and transferred subjects under ministers from the elected council; at least 70 per cent of provincial council members

No.	Source	Used for
		elected; no dyarchy at the centre; bicameral central legislature; commission after ten years
S14	UK Parliament, Living Heritage, "The Raj and independence 1914-47". [source link]	Government of India Act dated December 1919; power shared between officials and elected Indians in the central and provincial councils
S15	Pages titled "The Crown Rule (1858-1947)" hosted on the Government of India domain cbc.gov.in (Capacity Building Commission). Act of 1858: [source link] ; Act of 1861: [source link] ; Act of 1892: [source link] ; Act of 1909: [source link] ; Act of 1919: [source link]	1858: machinery in England changed more than the system of government in India; Board of Control and Court of Directors abolished, ending double government; 15-member council. 1861: Canning's three Indian nominees (Raja of Benares, Maharaja of Patiala, Sir Dinkar Rao); recognition of the portfolio system; ordinances for six months. 1892: budget discussion and questions; nomination on the recommendation of bodies. 1909: 16 to 60; supplementary questions and resolutions; separate electorates for Muslims; Sinha as law member. 1919: declaration of 20 August 1917; bicameralism and direct elections; dyarchy in the provinces; Public Service Commission; wider separate electorates
S16	legislation.gov.uk, entries for the Government of India Act 1858 (21 & 22 Vict. c. 106), the Indian Councils Act 1909 (9 Edw. 7 c. 4) and the Government of India Act 1919 (9 & 10 Geo. 5 c. 101). [source link] ; [source link] ; [source link]	Titles, years and chapter numbers of the three Acts
S17	Wikipedia: "Government of India Act 1858" (citing Klein, *Modern Asian Studies*, 2000, and legislation.gov.uk) [source link] ; "Edward Stanley, 15th Earl of Derby" (citing Grant Duff in the *Encyclopaedia Britannica*, 11th edition, 1911, vol. 8, p. 68) [source link] ; "Indian Councils Act 1861" (citing the *Encyclopaedia Britannica*, 11th edition, and Ilbert) [source link] ; "Indian Councils Act 1892" (citing Ilbert, *The Government of India*, 1911, pp. 246-254) [source link] ; "Indian Councils Act 1909" (citing Britannica and Kulke and Rothermund, 2004) [source link] ; "Government of India Act 1919" (citing U.B. Singh, *Administrative System in India*, p. 204) [source link]	Lord Stanley as the first Secretary of State for India; no right to ask supplementary questions under the Act of 1892; cross-checks of the main features of each Act
S18	President of India, speech of Shri Pranab Mukherjee at the valedictory ceremony of the Platinum Jubilee Celebrations of the West Bengal Legislative Assembly, Kolkata, 6 December 2013. [source link]	1862: Lord Canning appointed three Indians (the Maharaja of Patiala, the Raja of Benares and Sir Dinkar Rao) to the new legislative council; legislative council for Bengal set up on 18 January 1862. 1892: additional members "not less than ten nor more than sixteen"; discussion of the budget and the asking of questions. 1909: 16 to 60; members given the power to move resolutions; communal representation. 1919: dyarchy in eight Governors' provinces; bicameral central legislature

Additional sources for the reviewed edition

- UK Parliament, historical record of the office Secretary of State for India. [source link] — Edward Stanley, first holder in the office record, 1858–1859

DAY 2 · TOPIC 13

Inflation: types, causes and measurement by CPI and WPI

1. Concept in one line

Inflation is a sustained rise in the general level of prices, which India measures mainly through two index numbers, the Consumer Price Index (CPI) and the Wholesale Price Index (WPI). The exam asks about the types and causes of inflation, who compiles each index and what it covers, and how the inflation rate is worked out from index numbers.

2. Revision notes

2.1 What inflation is

- Inflation is a sustained rise in the general level of prices of goods and services. The inflation rate is the percentage rise in a price index over a period, usually one year.
- It is about prices as a whole. A rise in the price of tomatoes alone is not inflation.
- When prices rise, each rupee buys less: the purchasing power of money falls.
- The NCERT textbook names three price indices: the CPI, the WPI and the GDP deflator. The GDP deflator is the ratio of nominal GDP to real GDP and covers everything produced in the country (covered on another day).

2.2 Types by cause

Point	Demand-pull inflation	Cost-push inflation
What happens	Total demand in the economy (aggregate demand) grows faster than the economy can produce	The cost of producing goods rises, or supply is disrupted
Typical triggers	More spending by consumers, businesses or the government; lower interest rates; a rise in net exports	Costlier inputs such as crude oil and raw materials; wages rising faster than productivity; a fall in the value of the currency, which makes imports costlier; bad weather or a natural disaster

- **Money supply:** long-lasting high inflation often comes from loose monetary policy. If the money supply grows too fast compared with the size of the economy, the purchasing power of the currency falls (the quantity theory of money).
- **Expectations:** if people and firms expect prices to rise, they build this into wages and prices, so the expectation partly comes true and inflation persists.

2.3 Types by speed

Type	How it is usually described (rough figures only)
Creeping (mild) inflation	Prices rise very slowly. Often put at less than about 3 per cent a year
Walking (trotting) inflation	Prices rise moderately, in a single digit. Often put at

Type	How it is usually described (rough figures only)
	about 3 per cent to below 10 per cent a year
Running inflation	Prices rise rapidly. Often put at about 10 to 20 per cent a year
Galloping inflation	Prices rise very rapidly, in double or triple digits. Often put at more than about 20 per cent a year
Hyperinflation	Prices out of control. The most widely used definition (Phillip Cagan, 1956) is a rise of more than 50 per cent in a month. Examples: Germany in 1921 to 1923, Hungary in 1945 to 1946, Zimbabwe in 2007 to 2009

These figures are rough conventions, not official definitions or exact limits, and books differ on them: walking inflation is given as 3 to 4, 3 to 6 or 3 to 10 per cent, and some books treat galloping inflation and hyperinflation as one stage. The order is what matters: creeping, walking, running, galloping, hyperinflation.

2.4 Headline and core inflation, and four related terms

Term	Meaning
Headline inflation	The change in the whole basket, including food and fuel. In India it is the year-on-year change in the All India CPI (Combined)
Core inflation	Inflation after leaving out items whose prices swing sharply, notably food and energy. In India it is usually taken as CPI inflation excluding food and fuel. It shows the underlying trend
Deflation	A fall in the general price level. The inflation rate is negative
Disinflation	A fall in the rate of inflation. Prices still rise, but more slowly than before
Stagflation	High inflation together with stagnant output and high unemployment. The best-known case is the 1970s, after the oil price shocks. The word was used by the British politician Iain Macleod in the House of Commons in 1965
Reflation	A deliberate attempt, after a slump or deflation, to raise demand and bring prices back up to a desirable level

2.5 Consumer Price Index (CPI)

- **What it measures:** the change over time in the general level of retail prices of selected goods and services that households buy for consumption.
- **Who compiles it:** the National Statistics Office (NSO), Ministry of Statistics and Programme Implementation (MoSPI). Older books name the Central Statistics Office (CSO), which compiled it earlier.

- **Release:** on the 12th of every month for the previous month (on the next working day if the 12th is a holiday), separately for Rural, Urban and Combined. The first figure for a month is provisional.
- Items that households get free (free social transfers) are left out. The CPI covers only what households actually pay for.
- NSO also releases the Consumer Food Price Index (CFPI), published since May 2014, which tracks food items only.

The base year changed in February 2026. Question banks still carry the old figures, so learn both, with the series each belongs to.

Point	Old series: base 2012 = 100	New series: base 2024 = 100
First release	12 February 2015, with the index for January 2015 (it replaced base 2010 = 100)	12 February 2026, with the index for January 2026
Weights taken from	Consumer Expenditure Survey 2011-12 (NSS 68th round)	Household Consumption Expenditure Survey (HCES) 2023-24
Classification	6 groups	12 divisions and 43 groups, on the international COICOP 2018 classification
Weighted items (All India)	299	358 (308 goods and 50 services)
Published food and beverages weight, Combined (different category structures; see the like-for-like comparison below)	45.86	36.753
Weight of food and beverages, Rural and Urban	54.18 and 36.29	41.983 and 30.251
Housing	10.07 in Combined, from urban areas only (urban weight 21.67); no rural housing index. Fuel and light was a separate group: 6.84	"Housing, water, electricity, gas and other fuels": 17.665 in Combined (rural 11.764, urban 25.000). Rural house rent is included for the first time
Prices collected from	1,181 villages and 310 towns	1,465 villages, 1,395 urban markets in 434 towns, and 12 online markets

- **Old series, six groups (Combined weights):** food and beverages 45.86; pan, tobacco and intoxicants 2.38; clothing and footwear 6.53; housing 10.07; fuel and light 6.84; miscellaneous 28.32.
- **New series, 12 divisions (Combined weights):**

No.	Division	Weight (Combined)
1	Food and beverages	36.753
2	Paan, tobacco and intoxicants	2.989
3	Clothing and footwear	6.383
4	Housing, water, electricity, gas and other fuels	17.665
5	Furnishings, household equipment and	4.469

No.	Division	Weight (Combined)
	routine household maintenance	
6	Health	6.100
7	Transport	8.796
8	Information and communication	3.609
9	Recreation, sport and culture	1.516
10	Education services	3.333
11	Restaurants and accommodation services	3.348
12	Personal care, social protection and miscellaneous goods and services	5.038

In both series food and beverages is the largest component. Do not compare the published 45.86 and 36.753 weights as a like-for-like fall: the category classification changed. With both baskets mapped to the new COICOP 2018 structure, MoSPI gives Combined food and beverages weights of 42.617 for the 2012 basket and 36.753 for the 2024 basket. Under the old structure, the corresponding pair is 45.863 and 40.104.

Why the CPI is the headline measure:

- It records the retail prices that households actually pay, and it includes services.
- Earlier the WPI was treated as the headline measure. Since April 2014 the Reserve Bank of India (RBI) has used CPI (Combined) inflation as the anchor of its monetary policy.
- The inflation target under the RBI Act, 1934 is fixed in terms of the CPI: 4 per cent, with a lower limit of 2 per cent and an upper limit of 6 per cent. On 25 March 2026 it was retained for 1 April 2026 to 31 March 2031. (Inflation targeting, the Monetary Policy Committee and the RBI's tools of control are covered on other days.)

Other CPIs: the Labour Bureau (Ministry of Labour and Employment) compiles the CPI for Industrial Workers (CPI-IW, base 2016 = 100), which is used to fix dearness allowance, and the CPIs for Agricultural Labourers and Rural Labourers (CPI-AL and CPI-RL, base 2019 = 100).

2.6 Wholesale Price Index (WPI)

- **What it measures:** the average change in wholesale prices, that is, the prices of goods sold in bulk at the first stage of sale.
- **Who compiles it:** the Office of the Economic Adviser (OEA), Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry.
- **Release:** on the 14th of every month for the previous month (on the next working day if the 14th is a holiday). The first figure is provisional and is finalised later.
- **Prices used:** ex-factory prices for manufactured products, ex-mine prices for minerals and mandi prices for agricultural products.
- **Three major groups:** Primary Articles, Fuel and Power, and Manufactured Products. Manufactured Products is the largest, with about 63 to 64 per cent of the weight in both series.

The base year changed in June 2026. Again, learn both series.

Point	Old series: base 2011-12 = 100	New series: base 2022-23 = 100
Released	12 May 2017 (it replaced base 2004-05)	15 June 2026, with the index for May

Point	Old series: base 2011-12 = 100	New series: base 2022-23 = 100
		2026
Items	697	957
Price quotations	8,331	15,254
Primary Articles	22.62 (117 items)	22.76 (129 items)
Fuel and Power	13.15 (16 items)	14.11 (25 items)
Manufactured Products	64.23 (564 items)	63.13 (803 items)
WPI Food Index (food articles plus manufactured food products)	About 24.4	24.99
Weights based on	Net traded value: output plus imports minus exports	Gross value of output

- In the new series crude petroleum and natural gas moved from Primary Articles to Fuel and Power.
- The new series follows the report (April 2026) of a Working Group that was set up on 30 December 2024 under the chairmanship of Prof. Ramesh Chand, who was a Member of NITI Aayog at that time.

What the WPI leaves out:

- **Services.** It covers goods only: no house rent, education, health care or transport fares.
- **Taxes and margins.** It uses the basic price, which leaves out taxes and trade and transport margins. Indirect taxes have been left out since the 2011-12 series.

Other points:

- With the new series the OEA also began to publish Producer Price Indices (PPI): an Output PPI, a trial Input PPI for manufacturing and Service PPIs for seven services. Its press release of 15 June 2026 says the WPI will be released for five years from that release, along with the PPI, and will be discontinued thereafter.
- History: the first WPI was computed from the week commencing 10 January 1942, with the week ended 19 August 1939 as its base. The base years since then: 1952-53, 1961-62, 1970-71, 1981-82, 1993-94, 2004-05, 2011-12 and 2022-23.

2.7 CPI against WPI

Point	CPI	WPI
Compiled by	NSO, Ministry of Statistics and Programme Implementation	Office of the Economic Adviser, DPIIT, Ministry of Commerce and Industry
Prices	Retail prices paid by households	Bulk prices at the first stage of sale (ex-factory, ex-mine, mandi), without taxes and trade margins
Coverage	Goods and services	Goods only
Weights come from	A household consumption expenditure survey	The value of output (the production side)
Base year in October	2024, a calendar year (2012 in the old	2022-23, a financial year (2011-12 in the

Point	CPI	WPI
2026	series)	old series)
Largest component	Food and beverages: 36.753 (old native-series weight 45.86; category structures differ)	Manufactured Products: 63.13 (old series 64.23)
Release date	12th of every month	14th of every month
Main use	Headline inflation; the RBI's inflation target; dearness allowance (CPI-IW)	Deflator in estimating GDP and the Index of Industrial Production; price escalation clauses in business contracts

Both indices are Laspeyres-type: the weights stay fixed at the base period until the base is revised. Food has a much smaller weight in the WPI (Food Index 24.99 in the 2022-23 series) than in the CPI (food and beverages 36.753 in the 2024 series), and the WPI has no services, so the two rates can move apart for months.

2.8 Working out the inflation rate from index numbers

India reports inflation on a year-on-year basis, also called point-to-point: the index for a month is compared with the index for the same month of the previous year.

Inflation rate (per cent) = (index of the month - index of the same month a year earlier) ÷ index of the same month a year earlier × 100

- Divide by the earlier index, not by 100 and not by the newer index.
- A rise of 9 index points is not a rise of 9 per cent, unless the earlier index was exactly 100.
- The level of the index (say 148) shows the rise since the base year, not the rise over one year.

3. Extra section: worked examples, from prices to an index and from an index to the inflation rate

A. From a basket to an index (the NCERT example)

A representative consumer buys 90 kg of rice and 5 pieces of cloth in a year.

Item	Quantity	Base year price (Rs)	Base year cost (Rs)	Current year price (Rs)	Current year cost (Rs)
Rice	90 kg	10	900	15	1,350
Cloth	5 pieces	100	500	120	600
Whole basket	Same in both years	Not applicable	1,400	Not applicable	1,950

CPI of the current year = 1,950 ÷ 1,400 × 100 = 139.29 (approximately). The same basket costs about 39 per cent more than in the base year.

B. The year-on-year rate from two index numbers (actual data)

All India CPI (Combined), base 2024 = 100: August 2025 = 103.74; August 2026 = 108.74 (provisional; released on Monday, 14 September 2026, the next working day, because 12 September 2026 was a Saturday).

Inflation rate = (108.74 - 103.74) ÷ 103.74 × 100 = 5.00 ÷ 103.74 × 100 = 4.82 per cent. This is the rate NSO published for August 2026.

C. Inflation, disinflation and deflation in one series (invented figures)

Year	Price index	Change over the previous year	What it is called
1	100	Not applicable	Starting point
2	120	20 ÷ 100 × 100 = 20.0 per cent	Inflation
3	132	12 ÷ 120 × 100 = 10.0 per cent	Disinflation: prices still rise, but the rate has fallen
4	125.4	minus 6.6 ÷ 132 × 100 = minus 5.0 per cent	Deflation: the price level itself has fallen

D. The base effect (invented figures)

Year	Index for the same month	Rise in index points	Year-on-year rate
1	100	Not applicable	Not applicable
2	120	20	20 ÷ 100 × 100 = 20.00 per cent
3	140	20	20 ÷ 120 × 100 = 16.67 per cent
4	160	20	20 ÷ 140 × 100 = 14.29 per cent

The index rises by the same 20 points every year, yet the rate keeps falling, because each year the rise is measured on a bigger base. This is the base effect: a high index a year ago pulls this year's rate down, and a low index a year ago pushes it up.

4. Three common exam traps

1. **Disinflation is not deflation.** In disinflation the rate of inflation falls (say from 8 per cent to 5 per cent) but prices still rise. In deflation the price level itself falls and the inflation rate is negative. Stagflation is something else again: high inflation together with stagnant output and high unemployment.
2. **Who compiles which index, and what it covers.** The CPI is compiled by the NSO (Ministry of Statistics and Programme Implementation), uses retail prices and covers goods and services. The WPI is compiled by the Office of the Economic Adviser (DPIIT, Ministry of Commerce and Industry) and covers goods only: no services and no taxes. The RBI compiles neither. CPI-IW, CPI-AL and CPI-RL come from the Labour Bureau.
3. **Old and new base years, and calendar year against financial year.** The CPI base is a calendar year: 2012 in the old series and 2024 from February 2026. The WPI base is a financial year: 2011-12 in the old series and 2022-23 from June 2026. Older books give food and beverages 45.86 per cent of the CPI; in the 2024 series it is 36.753 per cent. Those published headings use

different classifications; for a like-for-like comparison under the new structure, use 42.617 and 36.753. Check which series a question is about, and do not attach 2022-23 to the CPI.

Practice and explanations

Q1. Consider the following statements about inflation and its measurement in India:

1. During disinflation, the general price level continues to rise, but more slowly than before.
2. The Wholesale Price Index is compiled by the National Statistics Office of the Ministry of Statistics and Programme Implementation.
3. The Wholesale Price Index does not cover the prices of services.

Which of the statements given above is/are correct?

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

Q1. Answer: (2) 1 and 3 only

- Statement 1 is correct: disinflation is a fall in the rate of inflation. Prices are still rising, only more slowly. A fall in the price level itself is deflation.
- Statement 2 is wrong: the WPI is compiled by the Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry. The National Statistics Office compiles the CPI.
- Statement 3 is correct: the WPI covers goods only, in three major groups (Primary Articles, Fuel and Power, Manufactured Products). Services such as house rent, education and health care are covered by the CPI, not by the WPI.
- Why the other options are wrong: (1) leaves out statement 3, which is correct. (3) leaves out statement 1, which is correct. (4) includes statement 2, which is wrong.

Q2. The price index of a country (base year = 100) stood at 125 in September 2024, at 150 in September 2025 and at 162 in September 2026. What was the year-on-year rate of inflation in September 2026?

- (1) 8.0 per cent
- (2) 12.0 per cent
- (3) 20.0 per cent
- (4) 62.0 per cent

Q2. Answer: (1) 8.0 per cent

- Worked solution: the year-on-year rate for September 2026 compares the index for September 2026 with the index for September 2025. Rate = (162 - 150) ÷ 150 × 100 = 12 ÷ 150 × 100 = 8.0 per cent. The September 2024 figure is not needed.
- Why (2) is wrong: 12.0 is the rise in index points (162 - 150 = 12) read as a percentage. That would be right only if the earlier index were exactly 100. The rise has to be divided by 150.
- Why (3) is wrong: 20.0 per cent is the rate for September 2025 over September 2024: (150 - 125) ÷ 125 × 100. It belongs to the previous year, not to September 2026.
- Why (4) is wrong: 62.0 per cent is the rise since the base year (162 against 100). It is not the rise over one year.

7. Sources

7.1 Sources

No.	Source	Used for
S1	NCERT, *Introductory Macroeconomics* (Class XII), Chapter 2 "National Income Accounting", Section 2.4 "Nominal and Real GDP". [source link]	GDP deflator as the ratio of nominal to real GDP; CPI as the index of prices of a given basket bought by the representative consumer; the rice and cloth example (1,400, 1,950, CPI 139.29); retail and wholesale prices; WPI, called Producer Price Index in countries like the USA; the three price indices (GDP deflator, CPI, WPI); CPI weights are constant; GDP deflator covers all goods and services produced
S2	National Statistics Office, MoSPI, "First Press Release of Consumer Price Index on Base 2024=100", 12 February 2026, with its technical note and FAQs (PIB document). [source link]	Base changed from 2012 = 100 to 2024 = 100; first release on 12 February 2026 with the January 2026 index; weights from HCES 2023-24; COICOP 2018, 12 divisions, 43 groups, 358 items (308 goods, 50 services) against 299 in the old series; division weights for Rural, Urban and Combined; the six old groups and their weights (FAQ 39); published food and beverages weights 45.86 and 36.753 use different category structures; same-structure comparison is 42.617 to 36.753 (FAQ 40); rural house rent included for the first time; 1,465 villages, 1,395 urban markets in 434 towns, 12 online markets; free social transfers excluded; definition of the CPI (FAQ 1); year-on-year inflation formula (FAQ 2); release on the 12th of the month; Young or Modified Laspeyres formula for higher-level indices
S3	National Statistics Office, MoSPI, "Press Release of Consumer Price Index on Base 2024=100 for August, 2026", 14 September 2026. [source link]	Position close to October 2026: base 2024 = 100 still in use; All India CPI (Combined) 103.74 in August 2025 and 108.74 in August 2026 (provisional); year-on-year inflation 4.82 per cent (provisional); CFPI still released; 12 divisions; next release on 12 October 2026
S4	National Statistics Office, MoSPI, "Press Release of Consumer Price Index on Base 2024=100 for July, 2026", 12 August 2026. [source link]	Monthly series of the Combined index from January 2025 (cross-check of 103.74 for August 2025); release schedule
S5	Central Statistics Office, MoSPI, press release on the revision of the base year of the CPI from 2010=100 to 2012=100, 12 February 2015. [source link]	Old series: base revised from 2010 = 100 to 2012 = 100 with the January 2015 index, released on 12 February 2015; compiled by the CSO; weights from the Consumer Expenditure Survey 2011-12 (NSS 68th round); six groups and their Rural, Urban and Combined weights; rural housing not compiled; inflation calculated "on point to point basis", January 2015 over January 2014
S6	MoSPI, "Consumer Price Index: Changes in the Revised Series (Base Year 2012 = 100)". [source link]	Old series: group weights (cross-check); 1,181 villages and 310 towns; Laspeyres formula with expenditure weights for higher-level indices
S7	Office of the Economic Adviser, DPIIT, "Press Release on New Series of Wholesale Price Index, and Producer Price Indices with Base Year 2022-23", 15 June 2026. [source link]	New WPI series with base 2022-23 released on 15 June 2026 with the index for May 2026, replacing base 2011-12; items up from 697 to 957; weights 22.75730, 14.11433 and 63.12837; WPI Food Index weight 24.99 and its composition; basic price, which excludes net tax and trade and transport margin; weights from gross value of

No.	Source	Used for
		output; crude petroleum and natural gas shifted to Fuel and Power; Output PPI, trial Input PPI and Service PPIs for seven services; WPI to be released for five years from the release, along with PPI, and discontinued thereafter
S8	Office of the Economic Adviser, DPIIT, press release on the WPI, Output PPI and trial Input PPI for August 2026, 14 September 2026. [source link]	Position close to October 2026: base 2022-23 in use; weights of the three major groups and of the Food Index; inflation reported on a year-on-year basis; provisional figures released on the 14th and finalised later; next release on 14 October 2026
S9	Office of the Economic Adviser, FAQs on the new series (2022-23) and FAQs on WPI and PPI (2022-23). [source link] and [source link]	Working Group chaired by Prof. Ramesh Chand, constituted on 30 December 2024, report in April 2026; items 697 and 957; quotations 8,331 and 15,254; weights of the major groups in both series; WPI covers goods only; basic price excludes tax and margins; ex-factory, ex-mine and mandi prices; weights from gross value of output against net traded value in 2011-12; list of the base years from 1952-53 to 2022-23; comparison of the WPI with the CPI; uses of the WPI
S10	Office of the Economic Adviser, "Brief Note on Methodology for WPI and PPI" (2022-23 series). [source link]	Item counts of the major groups in the 2022-23 series (129, 25, 803); Laspeyres formula; OEA as the compiler; Output PPI, Input PPI and Service PPI described
S11	Office of the Economic Adviser, "Note for WPI Users", 1 June 2026; and website home page. [source link] and [source link]	Base year revision from 2011-12 to 2022-23 completed, new indices to be released on 15 June 2026; Working Group dates; the home page heading "Wholesale Price Index (WPI) (Base Year = 2022-23)"
S12	Office of the Economic Adviser, "Metadata WPI and PPIs" (2022-23 series). [source link]	WPI released on the 14th of every month; 957 items and 15,254 quotations; item counts 129, 25 and 803; ex-factory, ex-mine and mandi prices; Laspeyres formula with fixed base-year weights; provisional figures finalised later
S13	Office of the Economic Adviser, press release "Revision of base year of All-India Wholesale Price Index (WPI) from 2004-05 to 2011-12", 12 May 2017. [source link]	Old WPI series released on 12 May 2017; weights 22.62, 13.15 and 64.23; "seventh revision"
S14	Office of the Economic Adviser, "FAQs on WPI" (2011-12 series). [source link]	Old WPI series: items 117, 16 and 564 (total 697); quotations 8,331; indirect taxes excluded; services not covered; food weight of 24.4 per cent; earlier base years; uses of the WPI
S15	Office of the Economic Adviser, *WPI Manual* (2011-12 series). [source link]	First index computed from the week commencing 10 January 1942 with the week ended 19 August 1939 as base; Laspeyres-type aggregation
S16	Reserve Bank of India, "Monetary Policy: Overview". [source link]	Inflation target of 4 per cent CPI inflation with limits of 2 and 6 per cent; retained on 25 March 2026 for 1 April 2026 to 31 March 2031; RBI Act, 1934 amended in May 2016
S17	Arthapedia (Indian Economic Service), "Inflation Targeting in India", "Headline inflation" and "Core inflation". [source link] ; [source link] ; [source link]	RBI has used headline CPI (Combined) inflation as the nominal anchor since April 2014; target fixed in terms of the CPI under section 45ZA; WPI earlier treated as the headline measure; year-on-year also called point-to-point; core inflation excludes food and energy

No.	Source	Used for
S18	Arthapedia, "Consumer Price Index", "Consumer Food Price Index (CFPI)", "Consumer Price Index for Industrial Workers", "Wholesale Price Index (WPI)" and "Base Effect". [source link] ; [source link] ; [source link] ; [source link] ; [source link]	CPI as a measure of retail prices; Labour Bureau compiles CPI-IW, CPI-AL and CPI-RL; dearness allowance based on the CPI-IW; CFPI released since May 2014; WPI definition, compiler, prices used and uses; year-on-year formula and the base effect example (100, 120, 140, 160)
S19	Labour Bureau, Ministry of Labour and Employment, website home page; and its press release "Consumer Price Index for Industrial Workers (2016=100): August, 2026", 30 September 2026 (copy hosted by a news site). [source link] and [source link]	CPI-IW base 2016 = 100; CPI-AL and CPI-RL base 2019 = 100; Labour Bureau as an attached office of the Ministry of Labour and Employment
S20	Reserve Bank of India, *Handbook of Statistics on Indian Economy*, Table 236 "Consumer Price Index (Average of Months): Annual Variation", 31 July 2026. [source link]	Cross-check of base years: CPI-IW 2016 = 100; CPI-AL 2019 = 100; All India CPI on base 2012 = 100 up to December 2025 and on base 2024 = 100 from January 2026
S21	Government of India, *Economic Survey 2025-26*, Chapter 5 "Inflation: Tamed and Anchored". [source link]	Retail inflation measured by the CPI; core inflation as inflation excluding volatile components such as food and fuel
S22	Ceyda Oner, "Inflation: Prices on the Rise", IMF *Finance and Development*, Back to Basics. [source link]	Inflation as the rate of increase in prices over a period; a broad measure of prices; demand-pull and cost-push; lower interest rates and higher government spending as expansionary policies that raise demand; loose monetary policy and the quantity theory; expectations; core inflation
S23	Reserve Bank of Australia, Explainers: "Causes of Inflation" and "Inflation and its Measurement". [source link] and [source link]	Triggers of demand-pull inflation (spending by consumers, businesses or government; net exports) and of cost-push inflation (input prices, wages rising faster than productivity, depreciation, weather and natural disasters); inflation expectations; deflation as falling prices; headline and underlying inflation
S24	Encyclopaedia Britannica (Britannica Money), "Hyperinflation", "What is stagflation?" and "Inflation". [source link] ; [source link] ; [source link]	Hyperinflation frequently defined as more than 50 per cent a month (Phillip Cagan, 1956); Germany 1921 to 1923, Hungary 1945 to 1946, Zimbabwe 2007 to 2009; stagflation as stagnation with high inflation and high unemployment, the 1970s and the oil price shocks
S25	Wikipedia, "Stagflation" (citing Hansard, House of Commons, 17 November 1965), "Disinflation", "Reflation" and "Inflation". [source link] ; [source link] ; [source link] ; [source link]	Iain Macleod's use of "stagflation" in 1965; disinflation as a decrease in the rate of inflation, distinct from deflation; reflation as an attempt to raise prices to counter deflationary pressures
S26	Merriam-Webster Dictionary, "reflation" and "disinflation". [source link] and [source link]	Reflation as the "restoration of deflated prices to a desirable level"
S27	University course notes on the types of inflation: Jayoti Vidyapeeth Women's University, Jaipur, "Inflation: Meaning and	Creeping, walking, running and galloping inflation and the ranges usually given for each; the different ranges for walking inflation; galloping inflation as "double or triple

No.	Source	Used for
	Types I" (BA Hons Economics); T.R. College study material, "Inflation"; CSJM University, Kanpur, "Types of Inflation, Effects of Inflation". [source link] ; [source link] ; [source link]	digit" inflation; galloping and hyperinflation treated as one stage in some notes
S28	Hansard, House of Commons Debates, 17 November 1965, "Economic Affairs", vol. 720, cols 1165 and 1167 (speech of Mr Iain Macleod). [source link]	Iain Macleod's use of the word "stagflation" in the House of Commons on 17 November 1965
S29	Mary Clare Peate, "The Inflation Rate Is Falling, but Prices Are Not", *Page One Economics*, Federal Reserve Bank of St. Louis, 1 March 2024. [source link]	Inflation as a general, sustained upward movement of prices; disinflation as a decrease in the inflation rate, with the price level still rising at a slower rate; deflation as a general, sustained downward movement of prices

Additional sources for the reviewed edition

- MoSPI, First CPI 2024-base release, 12 February 2026, FAQ 39–40. [source link] — Native classification versus like-for-like weights, including 42.617 and 36.753 under the new structure

DAY 2 · TOPIC 14

AP Reorganisation Act 2014: key economic provisions

1. Concept in one line

The Andhra Pradesh Reorganisation Act, 2014 (Act 6 of 2014) divided the existing State of Andhra Pradesh into Telangana and Andhra Pradesh and laid down how revenues, assets, debts, companies, river waters, power and central support were to be shared between them. The examination asks you to match each economic provision with its exact section or schedule and its figures.

2. Revision notes

2.1 The Act at a glance

Point	What the Act says
Name and size	The Andhra Pradesh Reorganisation Act, 2014 (Act 6 of 2014): 12 Parts, 108 sections, 13 Schedules
President's assent	1 March 2014
Appointed day	2 June 2014, fixed by a Central Government notification dated 4 March 2014
New State	Telangana, formed under Section 3. The Act calls undivided Andhra Pradesh the "existing State" and the two States after the division the "successor States"
Common capital, Section 5	Hyderabad, including the Greater Hyderabad Municipal Corporation area, for a period "not exceeding ten years"; after that it is the capital of Telangana alone. Hyderabad ceased to be the common capital on 2 June 2024
Capital of Andhra Pradesh	Section 6: an expert committee to report within six months of the Act. Section 5 at first said only "a new capital"; the Amendment Act of 2026 (assent 6 April 2026) names Amaravati, with effect from 2 June 2024
Population ratio, Section 2(h)	Andhra Pradesh 58.32 : Telangana 41.68, as per the 2011 Census

2.2 Where the economic provisions sit

Part	Sections	Subject	Linked Schedule
Part V	44 to 46	Authorisation of expenditure and distribution of revenues	None
Part VI	47 to 67	Apportionment of assets and liabilities	Seventh (list of funds), Eighth (pensions)
Part VII	68 to 75	Provisions as to certain	Ninth (Government

Part	Sections	Subject	Linked Schedule
		corporations	companies and corporations), Tenth (training institutions)
Part IX	84 to 91	Management and development of water resources	Eleventh (principles for the River Management Boards)
Part X	92 to 94	Infrastructure and special economic measures	Twelfth (coal, oil and gas, power), Thirteenth (education and infrastructure)

Part VIII (services) and Part XI (Section 95: existing admission quotas in higher education to continue for ten years) are outside this topic.

2.3 Revenues: Section 46

- **Section 46(1):** the Thirteenth Finance Commission's award to the existing State is apportioned between the two States by the Central Government "on the basis of population ratio and other parameters". On the appointed day the President was to make a reference to the Fourteenth Finance Commission to make separate awards for each State.
- **Section 46(2):** the Central Government "may", having regard to the resources available to Andhra Pradesh, make appropriate grants and also ensure that adequate benefits and incentives, in the form of a special development package, are given to the backward areas of that State.
- **Section 46(3):** while considering the special development package, the Central Government "shall" provide adequate incentives, in particular for Rayalaseema and the north coastal regions.
- The Act does not use the words "Special Category Status" anywhere. Special Category Status, the special assistance measure and the revenue deficit grant are separate topics on other days.

2.4 Apportionment of assets and liabilities: Part VI

General rule (Section 47): the apportionment must be "just, reasonable and equitable". A dispute on financial assets and liabilities is settled by mutual agreement, failing which by an order of the Central Government on the advice of the Comptroller and Auditor-General of India (CAG).

Item	Section	Basis of apportionment
Land and goods	48	The State in which they lie. Property outside the existing State: population ratio
Treasury and bank balances	49	Population ratio, by adjusting the two States' balances in the books of the Reserve Bank of India
Investments from the funds listed in the Seventh Schedule	52	Population ratio. Exception: securities held in investments from the Calamity Relief Fund are divided in the ratio of the area of the two States
Commercial or industrial undertakings of the State	53	Assets and liabilities pass to the State where the undertaking is located, regardless of headquarters location. If

Item	Section	Basis of apportionment
		operations become inter-State: operational-unit assets and liabilities by location; headquarters assets and liabilities by population ratio
Public debt and public account liabilities	54	Population ratio, unless the Act provides a different mode
Pensions	59 and the Eighth Schedule	Each State pays from its treasuries; the liability of the existing State is then shared in the population ratio
Anything not covered elsewhere	64	Passes to Andhra Pradesh in the first instance, subject to financial adjustment

Section 65 lets the two States agree on a different apportionment. Section 66 lets either State refer a matter to the Central Government within three years of the appointed day.

2.5 Companies, corporations and institutions: Part VII

- **Ninth Schedule (Sections 68 and 71):** "List of Government Companies and Corporations", with 89 entries in the Act as passed, among them APGENCO, APTRANSCO, Singareni Collieries Company Ltd and APSRTC. They continue to function in the areas where they were working, and their assets, rights and liabilities are apportioned in the manner provided in Section 53. Under Section 71 the Central Government may direct how the State's shares are divided and how each Board is reconstituted.
- **Tenth Schedule (Section 75):** "List of Training Institutions/Centres", with 107 entries in the Act as passed, such as the Dr MCR Human Resource Development Institute, Hyderabad. The State in which an institution is located must go on providing its facilities to the people of the other State, on terms not less favourable than before. The terms were to be agreed within one year of the appointed day, failing which the Central Government fixes them.

2.6 Water resources: Part IX

Body	Section	Who sits on it, or where it sits	Main work
Apex Council	84	Union Minister of Water Resources as Chairperson; the Chief Ministers of Andhra Pradesh and Telangana as members	Supervises the two Boards; approves new projects on the Godavari or Krishna after appraisal by the Boards; resolves water-sharing disputes through negotiation; refers disputes not covered by the Krishna Water Disputes Tribunal to a tribunal under the Inter-State River Water Disputes Act, 1956
Godavari River Management Board	85	Headquarters in Telangana	Administers, regulates, maintains and operates

Body	Section	Who sits on it, or where it sits	Main work
			the projects notified by the Central Government; regulates the supply of water and power from them; gives technical clearance to new projects
Krishna River Management Board	85	Headquarters in Andhra Pradesh	The same work, for the Krishna

- Both Boards were to be constituted by the Central Government within sixty days of the appointed day. They are autonomous bodies under the administrative control of the Central Government. Each has a Chairperson of the rank of Secretary or Additional Secretary to the Government of India, two members nominated by each State and one expert nominated by the Centre.
- **Section 89:** the term of the Krishna Water Disputes Tribunal is extended, to make project-wise allocations where these have not been made and to fix an operational protocol for releasing water when flows are deficit.
- **Section 90:** the Polavaram Irrigation Project is declared a national project. The Union takes its regulation and development under its control, Telangana's consent is deemed to have been given, and the Central Government shall execute the project and obtain all clearances. (Polavaram is covered in detail on another day.)
- **Eleventh Schedule:** principles for the Boards. Drinking water comes before irrigation, and irrigation before power. No new project on the Godavari or Krishna without the sanction of the Apex Council.

2.7 Coal, oil and gas, power: Section 92 and the Twelfth Schedule

Section 92 says that the successor States shall implement the Central Government's principles, guidelines, directions and orders on these matters, as enumerated in the Twelfth Schedule.

Sector	What the Twelfth Schedule lays down
Coal	Equity of Singareni Collieries Company Ltd (SCCL): 51% with the Government of Telangana and 49% with the Government of India. Existing coal linkages continue
Oil and gas	Royalty on domestic onshore production of oil and gas accrues to the State in which the production takes place. Natural gas is allocated as per Government of India policy
Power: generation	Units of APGENCO are divided on the basis of the geographical location of the power plants. Existing power purchase agreements continue
Power: sharing	Power of central generating stations is allotted on the actual energy consumption of the last 5 years. For ten years the State with a deficit has the first right of refusal to buy the other State's surplus power. Anantapur and Kurnool districts move from the AP Central Power Distribution Company Ltd to the AP South Power Distribution Company Ltd

2.8 Institutions and infrastructure: Section 93 and the Thirteenth Schedule

Section 93: the Central Government shall take all necessary measures enumerated in the Thirteenth Schedule for the progress and sustainable development of the successor States within ten years from the appointed day.

Head	For Andhra Pradesh	For Telangana
Education	In the 12th and 13th Plan periods, one each of IIT, NIT, IIM, IISER, Central University, Petroleum University, Agricultural University and IIIT. One AIIMS-type super-speciality hospital-cum-teaching institution. A Tribal University. The National Institute of Disaster Management	A Tribal University. A Horticulture University
Port, industry and power	A new major port at Duggirajupatnam, with Phase I by the end of 2018. An integrated steel plant in YSR District (SAIL to examine). A greenfield crude oil refinery and petrochemical complex (IOC or HPCL to examine). A Vizag-Chennai industrial corridor	An integrated steel plant in Khammam district (SAIL to examine). A 4,000 MW power facility by NTPC
Transport	A new railway zone (Indian Railways to examine). Visakhapatnam, Vijayawada and Tirupati airports to international standards. Metro Rail in Visakhapatnam and in the Vijayawada-Guntur-Tenali area. Rapid rail and road links from the new capital to Hyderabad	A Rail Coach Factory (Indian Railways to examine). Better road connectivity in backward regions (NHAI)

For the steel plants, the refinery, the corridor, the airports, the railway zone and the coach factory the Schedule asks only for an examination within six months from the appointed day. For all of these except the two steel plants it adds that an expeditious decision is to be taken. For Metro Rail the feasibility is to be examined within one year. It does not say "shall establish" for any of them. For other items its words are firm: "shall establish" for the AIIMS-type institution, the Tribal Universities, the National Institute of Disaster Management and the NTPC power facility; "shall be established" for the Horticulture University; "shall develop" for the port at Duggirajupatnam; and "shall take steps to establish" for the eight institutions from IIT to IIIT.

2.9 Fiscal measures: Section 94

Sub-section	The Central Government shall
94(1)	Take appropriate fiscal measures, including offer of tax incentives, to promote industrialisation and economic growth in both States
94(2)	Support programmes for the development of backward areas in the successor States, including

Sub-section	The Central Government shall
	expansion of physical and social infrastructure
94(3)	Provide special financial support for essential facilities in the new capital of Andhra Pradesh, including the Raj Bhawan, High Court, Government Secretariat, Legislative Assembly and Legislative Council
94(4)	Facilitate the creation of the new capital, if considered necessary, by denotifying degraded forest land

Sub-sections (1) and (2) cover both States; (3) and (4) concern Andhra Pradesh alone. Section 46(2) uses "may"; every sub-section of Section 94 uses "shall".

3. Extra section: the Act in dates and time limits

Date	Event
1 March 2014	The President gives assent to the Act
4 March 2014	Notification fixing 2 June 2014 as the appointed day
29 May 2014	Ordinance amending Section 3, later replaced by the Amendment Act of 2014 (Act 19 of 2014; assent 17 July 2014): seven mandals of Khammam district, two of them only in part, are kept out of Telangana and stay in Andhra Pradesh, for rehabilitation and resettlement under the Polavaram project
2 June 2014	Appointed day: Telangana is formed
2 June 2024	Hyderabad ceases to be the common capital
6 April 2026	Amendment Act of 2026 (Act 7 of 2026): Section 5 now says "Amaravati shall be the new capital"; deemed in force from 2 June 2024

Time limit in the Act	What it applies to
Sixty days from the appointed day	Constitution of the two River Management Boards (Section 85)
Six months from the date of enactment of the Act	Report of the expert committee on the new capital (Section 6)
Not more than six months (starting date not stated in the Schedule)	The existing Electricity Regulatory Commission as a joint body (Twelfth Schedule)
Six months from the appointed day	The examinations asked for in the Thirteenth Schedule, except Metro Rail, which has one year
One year from the appointed day	Agreement on the Tenth Schedule institutions (Section 75); feasibility of Metro Rail
Two years	The existing State Load Despatch Centre serving both States, at most (Twelfth Schedule)
Three years from the appointed day	Reference to the Centre on allocation or adjustment of assets and liabilities (Section 66)
Ten years	Common capital (Section 5); Thirteenth Schedule measures (Section 93); admission quotas (Section 95); first right of refusal on surplus power (Twelfth

Time limit in the Act	What it applies to
	Schedule)
End of 2018	Phase I of the port at Duggirajupatnam

4. Three common exam traps

1. **"Everything was divided in the ratio 58.32 : 41.68."** The population ratio (Andhra Pradesh first, Telangana second) applies to cash balances, public debt and the assets and liabilities of inter-State undertakings' headquarters. Land, operational units and APGENCO plants go by location. Calamity Relief Fund securities go by area. Power from central stations goes by the consumption of the last 5 years.
2. **Swapping the pairs.** The Godavari Board has its headquarters in Telangana and the Krishna Board in Andhra Pradesh. The Apex Council is chaired by the Union Minister of Water Resources, not by the Prime Minister or a Chief Minister. The 51 : 49 split in Singareni is between Telangana and the Government of India, not between the two States.
3. **Mixing up the sections, and reading more into the Act than it says.** Section 46 is revenue and the special development package, Section 90 is Polavaram, Section 92 goes with the Twelfth Schedule, Section 93 with the Thirteenth Schedule, and Section 94 is fiscal measures. The Act does not contain the words "Special Category Status", and many Thirteenth Schedule items only say "examine the feasibility".

Practice and explanations

Q1. Consider the following statements about the apportionment of assets and liabilities under the Andhra Pradesh Reorganisation Act, 2014:

1. The Act defines the population ratio of Andhra Pradesh to Telangana as 58.32 : 41.68.
2. When a commercial or industrial undertaking of the existing State becomes inter-State because of the division, the assets and liabilities of its headquarters are apportioned on the basis of the population ratio.
3. Securities held in investments made from the Calamity Relief Fund are divided in the ratio of the area of the two successor States.

Which of the statements given above is/are correct?

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

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

- Statement 1 is correct: Section 2(h) defines the population ratio of Andhra Pradesh and Telangana as 58.32 : 41.68, as per the 2011 Census.
- Statement 2 is correct: Section 53 concerns the assets and liabilities of commercial or industrial undertakings. If an undertaking becomes inter-State because of the division, the assets and liabilities of its operational units are apportioned on location basis, and those of its headquarters on the basis of the population ratio.

- Statement 3 is correct: Under Section 52, investments from the funds listed in the Seventh Schedule are apportioned in the population ratio, but securities held in investments from the Calamity Relief Fund are divided in the ratio of the area of the two States.
- Why the other options are wrong: (1) leaves out statement 3, (2) leaves out statement 1 and (4) leaves out statement 2. All three statements are correct.

Q2. Match List I (Section of the Andhra Pradesh Reorganisation Act, 2014) with List II (Subject):

List I (Section)	List II (Subject)
A. Section 46	1. Declaration of the Polavaram Irrigation Project as a national project
B. Section 90	2. Offer of tax incentives to promote industrialisation in both States
C. Section 93	3. Measures for the institutions and infrastructure of the Thirteenth Schedule, within ten years
D. Section 94	4. Apportionment of the Thirteenth Finance Commission's award between the two States

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

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

- Why it is correct: Section 46 deals with the distribution of revenue, starting with the apportionment of the Thirteenth Finance Commission's award (A-4). Section 90 declares the Polavaram Irrigation Project a national project (B-1). Section 93 requires the Central Government to take the measures listed in the Thirteenth Schedule within ten years (C-3). Section 94 provides for fiscal measures, including offer of tax incentives (D-2).
- Why (1) is wrong: It swaps Section 46 and Section 94. Tax incentives are in Section 94; the Finance Commission award is in Section 46.
- Why (3) is wrong: It swaps Section 90 and Section 93. Polavaram is in Section 90, in the Part on water resources; the Thirteenth Schedule measures come under Section 93.
- Why (4) is wrong: It makes both of these swaps, so none of its four pairs is right.

7. Sources

7.1 Sources

No.	Source	Used for
S1	The Andhra Pradesh Reorganisation Act, 2014 (No. 6 of 2014), text as published, copy on the Ministry of Home Affairs website. [source link]	Act number and long title; assent on 1 March 2014; Section 2 definitions (appointed day, existing State, population ratio 58.32 : 41.68 as per 2011 Census, successor State); Sections 5 and 6; Sections 44 to 46; Sections 47 to 67 (headings and the rules in Sections 47, 48, 49, 52, 53, 54, 59, 64, 65, 66); Sections 68 to 75; Sections 84 to 91; Sections 92 to 95; absence of the words "special category" in the sections
S2	The Andhra Pradesh Reorganisation Act,	Arrangement of sections: 12 Parts, 108 sections, 13

No.	Source	Used for
	2014, updated text with amendment footnotes, Legislative Department, Ministry of Law and Justice. [source link]	Schedules, and the headings of the Parts and sections; footnote to Section 2(a): appointed day 2 June 2014, notification S.O. 655(E) dated 4 March 2014; Section 3 as amended by Act 19 of 2014 (the seven mandals of Khammam district and the villages left out of the exclusion); the schedule each section refers to
S3	The Andhra Pradesh Reorganisation Act, 2014, Schedules, as reproduced on AdvocateKhoj (bare acts library). [source link] ; [source link] ; [source link] ; [source link] ; [source link] ; [source link] ; [source link]	Seventh Schedule (list of funds); Eighth Schedule (apportionment of pension liability); Ninth Schedule (list of Government companies and corporations, 89 entries, and the examples named); Tenth Schedule (list of training institutions and centres, 107 entries, and the examples named); Eleventh Schedule (principles for the River Management Boards); Twelfth Schedule (coal, oil and gas, power: all items and figures); Thirteenth Schedule (education and infrastructure: all items, places and time limits)
S4	The Andhra Pradesh Reorganisation Act, 2014, Schedules IX to XIII, as reproduced on Tilak Marg. [source link]	Second copy used to cross-check the Ninth to Thirteenth Schedules: headings and section references, 89 and 107 entries, and every item of the Eleventh, Twelfth and Thirteenth Schedules
S5	The Andhra Pradesh Reorganisation (Amendment) Act, 2014 (No. 19 of 2014), and the Bill with its Statement of Objects and Reasons, copies on PRS Legislative Research. [source link] and [source link]	Assent on 17 July 2014; deemed in force from 29 May 2014; amendment of Section 3; repeal of Ordinance 4 of 2014, promulgated on 29 May 2014; purpose: rehabilitation and resettlement under the Polavaram project; transfer to Andhra Pradesh
S6	The Andhra Pradesh Reorganisation (Amendment) Act, 2026 (No. 7 of 2026), Gazette of India, Extraordinary, Part II, Section 1, 6 April 2026; and the Bill as introduced, Gazette of 1 April 2026. [source link] and [source link]	Assent on 6 April 2026; Section 5(2) amended to read "and Amaravati shall be the new capital"; deemed in force from 2 June 2024
S7	Lok Sabha, Starred Question No. 35, answered on 19 November 2019 by the Ministry of Home Affairs. [source link]	Official reading of Sections 46(2), 46(3), 90(1), 94(2), 94(3) and 94(4); the ten-year period for institutions and infrastructure; the steel plant in YSR District and the port at Duggirajupatnam as items of the Act
S8	Press Trust of India report carried by Deccan Herald, "Hyderabad ceases to be common capital of Telangana, Andhra Pradesh", 2 June 2024. [source link]	Hyderabad ceased to be the common capital on 2 June 2024, ten years after the appointed day
S9	Explanatory Statement on the Andhra Pradesh Reorganisation (Amendment) Ordinance, 2014 (No. 4 of 2014), laid on the Table by the Minister of Home Affairs, Parliament Digital Library. [source link]	Ordinance promulgated on 29 May 2014; amendment of Section 3; whole mandals of Khammam district placed in Andhra Pradesh for rehabilitation under the Polavaram project, leaving out Bhadrachalam town and 12 revenue villages of Bhurgampadu mandal
S10	Central Electricity Regulatory Commission, order dated 24 March 2025 in Petition No. 129/MP/2024. [source link]	Official statement of the Twelfth Schedule rule that power of the central generating stations was allotted on the actual energy consumption of the last 5 years of the distribution companies concerned
S11	Lok Sabha, Unstarred Question No. 505, answered on 6 February 2019 by the	Singareni Collieries Company Ltd as an institution listed in the Ninth Schedule

No.	Source	Used for
	Ministry of Coal, copy on the Ministry of Coal website. [source link]	

Additional sources for the reviewed edition

- Official republication of Amendment Act 7 of 2026 in the Gazette of DNH and DD, 3 June 2026, pages 2–3. [source link] — Visually verified Presidential assent on 6 April 2026, deemed commencement on 2 June 2024 and the Amaravati amendment
- Ministry of Home Affairs, full Gazette text of Act 6 of 2014, including all schedules. [source link] — Direct verification of Schedules VII–XIII, including 89 Ninth Schedule entries, 107 Tenth Schedule entries and the exact obligation language of Schedule XIII

DAY 2 · TOPIC 15

Atmosphere: structure and composition

1. Concept in one line

The atmosphere is the envelope of gases, water vapour and dust particles around the Earth, and it is divided by temperature into five layers. The examination asks you to match each gas with its share and role, and each layer with its height, temperature trend and special feature.

2. Revision notes

2.1 The three ingredients

- The atmosphere is a mixture of gases, water vapour and dust particles (NCERT).
- Air is densest near the surface and thins out quickly with height. 99 per cent of the total mass of the atmosphere lies within 32 km of the surface (NCERT).
- **Permanent gases** keep a nearly constant share: nitrogen, oxygen, argon and the rare gases such as neon and helium.
- **Variable gases** change with place and time: water vapour, carbon dioxide, methane and ozone.
- NCERT gives the textbook statements that oxygen is negligible at 120 km and carbon dioxide and water vapour occur only up to about 90 km. Read these as simplified textbook descriptions, not sharp physical cut-offs. In particular, atomic oxygen (O) is an important constituent of the thermosphere, distinct from molecular oxygen (O_2).

2.2 The gases of dry air

Gas	Share of dry air by volume	What to remember
Nitrogen (N_2)	78.08 per cent	The most plentiful gas. Plants need it but cannot take it straight from the air; bacteria in the soil and in the roots of some plants change it into a form that plants can use
Oxygen (O_2)	20.95 per cent	The second most plentiful gas. People and animals breathe it in; green plants give it out in photosynthesis
Argon (Ar)	0.93 per cent	The third most plentiful gas. An inert (noble) gas
Carbon dioxide (CO_2)	About 0.042 per cent (about 420 ppm), and rising	The fourth. A greenhouse gas. Plants use it to make food
Neon, helium, methane, krypton, hydrogen, xenon	Traces: neon 18.18 ppm, helium 5.24 ppm, methane about 1.9 ppm, krypton 1.14 ppm, hydrogen 0.55 ppm, xenon 0.09 ppm	Together less than 0.003 per cent

- ppm means parts per million. 10,000 ppm make 1 per cent.
- Nitrogen and oxygen together make up about 99 per cent of dry air. With argon the total is about 99.96 per cent.

2.3 Carbon dioxide, ozone, water vapour and dust

Constituent	Where and how much	What it does
Carbon dioxide	Monthly mean at Mauna Loa, Hawaii: 427.55 ppm in August 2026, against 425.48 ppm in August 2025 (NOAA, preliminary figures). Its volume has been rising in the past few decades, mainly because of the burning of fossil fuels	Largely transparent to visible sunlight, but absorbs particular wavelengths of outgoing infrared radiation. The atmosphere emits infrared radiation in all directions, including back towards the surface. This absorption and re-emission contributes to the greenhouse effect; it is not mirror-like reflection. Water vapour is the most abundant greenhouse gas (NASA)
Ozone	Found between 10 and 50 km above the surface (NCERT). The ozone layer proper lies roughly between 15 and 35 km (Britannica). About 90 per cent of the ozone of the atmosphere is in the stratosphere	Absorbs most UV-B radiation; together with oxygen, it prevents virtually all UV-C from reaching the surface. Much UV-A still reaches the ground
Water vapour	Decreases with height, and from the equator towards the poles. Up to 4 per cent of the air by volume in the warm and wet tropics; less than 1 per cent in the dry and cold areas of deserts and polar regions. About 99 per cent of it is in the troposphere (NASA)	Absorbs a part of the incoming solar radiation and holds in the heat radiated by the Earth. It acts like a blanket, so that the Earth becomes neither too cold nor too hot
Dust particles	Sea salt, fine soil, smoke and soot, ash, pollen and disintegrated particles of meteors. Concentrated in the lower layers, though convection currents can carry them to great heights. More in subtropical and temperate regions, because of dry winds, than in equatorial and polar regions	Dust and salt particles act as hygroscopic nuclei: water vapour condenses around them to form clouds

2.4 The five layers by temperature

NCERT divides the column of the atmosphere into five layers according to temperature: troposphere, stratosphere, mesosphere, thermosphere and exosphere.

Layer	Extent (NCERT figure first)	Temperature as you go up	Known for
Troposphere	From the surface to 13 km on average: about 8 km near the poles and about 18 km at the equator	Falls	Almost all weather, such as rain, fog and hailstorms. It contains dust particles and almost all the water vapour of the atmosphere, and is the most important layer

Layer	Extent (NCERT figure first)	Temperature as you go up	Known for
			for all biological activity. It has about 75 to 80 per cent of the mass of the atmosphere (UCAR)
Stratosphere	From the tropopause up to 50 km	Nearly constant in the lower part, then rises, because ozone absorbs ultraviolet radiation	The ozone layer. Very dry and almost free of clouds. Jet aircraft fly in its lower part
Mesosphere	From 50 km up to 80 km (about 85 km in NOAA and UCAR)	Falls, to about minus 100°C at 80 km (NCERT); about minus 85°C to minus 90°C in NASA and UCAR	The coldest part of the atmosphere is near its top. Most meteors burn up here
Thermosphere	From 80 km upwards. NCERT describes its ionosphere as lying between 80 and 400 km. The top shifts with solar activity: about 500 to 1,000 km (UCAR); NOAA uses about 600 km	Rises sharply: about 500°C to 2,000°C or more in the upper part	Holds most of the ionosphere, which reflects radio waves. Auroras occur mainly here. The International Space Station orbits here
Exosphere	The outermost layer, above the thermosphere. NOAA and NASA take it up to about 10,000 km	The air is extremely rarefied and no longer behaves like an ordinary gas	Very little is known about it (NCERT). Light gases such as hydrogen and helium float off into space. It merges gradually with outer space

- The pattern of temperature with height: falls, rises, falls, rises.
- **The pauses** are the boundaries between the layers: the tropopause (troposphere and stratosphere), the stratopause (at about 50 km), the mesopause (at about 80 km) and the thermopause (thermosphere and exosphere).
- Thermospheric temperature describes the high energy of individual particles. The gas is so sparse that it does not transfer heat like dense hot air; an object’s temperature also depends on radiation absorbed and emitted.

2.5 The troposphere and the normal lapse rate

- The troposphere is thickest at the equator because heat is carried to great heights there by strong convection currents (NCERT). Its top is also higher in summer than in winter.
- Other figures in use for its top: about 6 to 7 km at the poles and 18 to 20 km at the equator (NOAA, UCAR); Britannica gives 10 to 18 km.
- **Normal lapse rate:** the rate at which temperature falls with height in the troposphere. NCERT gives two figures: 1°C for every 165 m of height (in the chapter on the atmosphere) and 6.5°C per 1,000 m (in the chapter on temperature). Britannica also gives an average of about 6.5°C per km. Learn both figures. They do not convert exactly (1°C for every 165 m comes to about 6.06°C per 1,000 m), so use the one the question gives.

- Temperature falls with height because the atmosphere is heated from below, by terrestrial radiation (insolation and the heat budget come on Day 3, Topic 25).
- **Tropopause:** the temperature here is nearly constant. It is about minus 80°C over the equator and about minus 45°C over the poles (NCERT). So the tropopause is colder over the equator than over the poles, although the surface is warmer at the equator.
- When temperature rises with height instead of falling, it is called an inversion of temperature (covered with temperature distribution on another day).

2.6 The ionosphere, radio waves and auroras

- The ionosphere is not a separate temperature layer. It is the zone where X-rays and ultraviolet light from the Sun knock electrons off atoms and molecules, leaving electrically charged particles called ions.
- NCERT places it between 80 and 400 km, above the mesopause. UCAR's figures start lower: its lowest region, the D region, begins at about 60 km, in the upper mesosphere. On either figure, most of the ionosphere lies in the thermosphere.
- The ionosphere can return radio waves of suitable frequencies towards Earth, enabling long-distance communication. The result depends on frequency, ionisation, time of day and solar activity; not every radio wave is reflected.

Region	Height	Points
D	About 60 to 90 km	The lowest region, usually in the upper mesosphere. It almost disappears at night
E	About 90 to 150 km (Britannica: 90 to 160 km)	Also called the Kennelly-Heaviside layer. Much weaker at night
F	Above about 150 km (Britannica: above 160 km)	Has the highest concentration of free electrons. Splits into F1 and F2 by day and lasts through the night. Its F2 layer is also called the Appleton layer

- **Auroras:** electrons guided towards the poles by the magnetic field of the Earth strike oxygen and nitrogen atoms and molecules, which then give out light. Auroras typically form 80 to 500 km above the surface. They are the aurora borealis (northern lights) in the north and the aurora australis (southern lights) in the south, and are seen best between about 60° and 75° of latitude.

2.7 Homosphere and heterosphere: the division by composition

Feature	Homosphere	Heterosphere
Extent	From the surface to about 80 to 100 km	Above about 80 to 100 km
Composition	The gases are thoroughly mixed by turbulence, so the make-up of dry air is nearly the same throughout	The gases separate out by molecular mass: heavier gases stay lower and lighter gases lie higher. Above about 1,000 km helium and hydrogen are the main gases
Temperature layers inside it	Troposphere, stratosphere and mesosphere, with the lowest part of the thermosphere	Most of the thermosphere, and the exosphere

The boundary between the two is the turbopause, at around 100 km.

3. Extra section: a climb from the ground to space, height by height

Height above the surface	What you meet
Surface	The densest air; the average temperature is about 15°C (NASA)
About 8 km	The tropopause near the poles (NCERT)
13 km	The average height of the troposphere (NCERT)
About 18 km	The tropopause at the equator (NCERT), at about minus 80°C
15 to 25 km	Polar stratospheric (nacreous) clouds, which form near the poles in winter, and only when the temperature is below minus 78°C
15 to 35 km	The ozone layer (Britannica); NCERT places ozone between 10 and 50 km
32 km	99 per cent of the mass of the atmosphere lies below this height (NCERT)
50 km	The stratopause: the top of the stratosphere
60 to 90 km	The D region, the lowest part of the ionosphere
80 km	The mesopause (NCERT): about minus 100°C, the coldest level. Noctilucent clouds, the highest clouds of the Earth, form in the upper mesosphere
About 90 km	NCERT textbook reference for carbon dioxide and water vapour; not a strict absence boundary
80 to 100 km	The homosphere ends; the turbopause is at around 100 km
100 km	The Karman line, commonly used as the boundary with space; 99.99997 per cent of the atmosphere lies below it (NASA)
120 km	NCERT's simplified molecular-oxygen statement; atomic oxygen remains important in the thermosphere
80 to 500 km	The range in which auroras typically form
400 km	The upper limit of the ionosphere in NCERT
500 to 1,000 km	The thermopause: the thermosphere ends and the exosphere begins
About 10,000 km	The upper limit used for the exosphere by NOAA and NASA; there is no sharp boundary with space

4. Three common exam traps

1. **"Carbon dioxide is the third most abundant gas."** It is not. The order in dry air is nitrogen (78.08 per cent), oxygen (20.95 per cent), argon (0.93 per cent) and only then carbon dioxide

(about 0.04 per cent). Carbon dioxide matters because of what it does to terrestrial radiation, not because of its quantity.

2. **"Temperature keeps falling as we go up."** It falls only in the troposphere and the mesosphere. It rises in the stratosphere (ozone) and in the thermosphere. The coldest level is the mesopause, not the exosphere. And at the tropopause it is colder over the equator (about minus 80°C) than over the poles (about minus 45°C).
3. **Putting a feature in the wrong layer.** Weather belongs to the troposphere, the ozone layer to the stratosphere, burning meteors to the mesosphere, and radio-wave reflection and auroras to the thermosphere. The ionosphere is not a sixth layer: NCERT lists five layers, and the ionosphere lies mostly inside the thermosphere. The troposphere is thicker at the equator (about 18 km), not at the poles (about 8 km).

Practice and explanations

Q1. Match List I (Layer of the atmosphere) with List II (Feature):

List I (Layer of the atmosphere)	List II (Feature)
A. Troposphere	1. Temperature falls with height and reaches the lowest values found in the atmosphere at its upper limit
B. Stratosphere	2. Temperature rises with height because ozone absorbs ultraviolet radiation
C. Mesosphere	3. Its upper limit is at about 8 km near the poles and about 18 km at the equator
D. Thermosphere	4. Temperature rises with height; much of the ionosphere lies here, helping return radio waves of suitable frequencies to Earth

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

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

- Why it is correct: The top of the troposphere is at about 8 km near the poles and about 18 km at the equator (A-3). In the stratosphere temperature rises with height because ozone absorbs ultraviolet radiation (B-2). In the mesosphere temperature falls with height, to about minus 100°C at its upper limit, the coldest level of the atmosphere (C-1). In the thermosphere temperature rises with height. Much of the ionosphere overlaps this layer; its ionised regions can return suitable radio frequencies to Earth. The ionosphere also extends into adjacent layers and is not identical to the thermosphere (D-4).
- Why (2) is wrong: It swaps the stratosphere and the thermosphere. Temperature rises in both, but the cause in the stratosphere is ozone; the ionosphere, which reflects radio waves, lies mostly in the thermosphere.
- Why (3) is wrong: It swaps the troposphere and the mesosphere. Temperature falls with height in both, but the heights of 8 km and 18 km are those of the top of the troposphere, and the lowest temperatures of the atmosphere are at the top of the mesosphere.

- Why (4) is wrong: It swaps the troposphere and the mesosphere, and also the stratosphere and the thermosphere. The heights of 8 km and 18 km are those of the top of the troposphere, and the cause of the rise of temperature in the stratosphere is ozone.

Q2. Consider the following statements about the composition of the atmosphere:

1. In dry air, carbon dioxide is the third most abundant gas by volume.
2. Water vapour forms a larger share of the air over the polar regions than over the warm and wet tropics.
3. Dust and salt particles in the air act as hygroscopic nuclei around which water vapour condenses to form clouds.

Which of the statements given above is/are correct?

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

Q2. Answer: (4) 3 only

- Statement 1 is wrong: The third most abundant gas in dry air is argon (0.93 per cent). Carbon dioxide (about 0.04 per cent) comes fourth.
- Statement 2 is wrong: Water vapour decreases from the equator towards the poles. It can be up to 4 per cent of the air in the warm and wet tropics, but less than 1 per cent in polar regions and deserts.
- Statement 3 is correct: Dust and salt particles act as hygroscopic nuclei; water vapour condenses around them to form clouds (NCERT).
- Why the other options are wrong: (1) and (2) include statement 1, which is wrong. (2) and (3) include statement 2, which is wrong.

7. Sources

7.1 Sources

No.	Source	Used for
S1	NCERT, *Fundamentals of Physical Geography* (Class XI), chapter 7, "Composition and Structure of Atmosphere", reprint 2026-27. [source link]	Atmosphere as a mixture of gases, water vapour and dust particles; 99 per cent of the mass within 32 km; oxygen almost negligible at 120 km; carbon dioxide and water vapour only up to 90 km; carbon dioxide transparent to incoming solar radiation and opaque to outgoing terrestrial radiation, greenhouse effect, rise due to fossil fuels; ozone between 10 and 50 km as a filter of ultraviolet rays; water vapour decreasing with altitude and from the equator to the poles, 4 per cent in warm and wet tropics, less than 1 per cent in deserts and polar regions, the blanket effect; kinds of dust particles, their concentration, hygroscopic nuclei; the five layers; troposphere 13 km on average, 8 km near the poles, 18 km at the equator, convection currents; 1°C for every 165 m; tropopause about minus 80°C over the equator and minus 45°C over the poles; stratosphere to 50 km with the ozone layer; mesosphere to 80 km and minus 100°C;

No.	Source	Used for
		ionosphere between 80 and 400 km, ions, reflection of radio waves, temperature rising with height; exosphere
S2	NCERT, *Fundamentals of Physical Geography* (Class XI), chapter "Solar Radiation, Heat Balance and Temperature", reprint 2026-27. [source link]	Normal lapse rate of 6.5°C per 1,000 m; the atmosphere heated from below by terrestrial radiation; inversion as the reversal of the normal lapse rate
S3	NCERT, *Our Environment* (Class VII Geography), chapter 4, "Air", reprint 2024-25. [source link]	Nitrogen the most plentiful gas, plants and nitrogen-fixing bacteria; oxygen the second most plentiful, breathing and photosynthesis; carbon dioxide used by plants and a greenhouse gas; rainfall, fog and hailstorm as weather of the troposphere; meteorites burning up in the mesosphere; the ionosphere as a part of the thermosphere, 80 to 400 km; helium and hydrogen floating into space from the exosphere; stratosphere almost free of clouds
S4	NOAA, JetStream, "The Atmosphere" (page updated 2 July 2024). [source link]	Composition of dry air: nitrogen 78.084 per cent, oxygen 20.946 per cent, argon 0.934 per cent, carbon dioxide 0.042 per cent, neon 18.182 ppm, helium 5.24 ppm, methane 1.92 ppm, krypton 1.14 ppm, hydrogen 0.55 ppm, xenon 0.09 ppm; water vapour up to about 4 per cent and its effect on the shares of the other gases
S5	NOAA, JetStream, "Layers of the Atmosphere". [source link]	The four pauses; troposphere 18 to 20 km at the equator and just under 6 km at the poles; stratosphere to about 50 km; mesosphere to about 85 km, meteors; thermosphere from about 85 km to about 600 km, up to 2,000°C, feeling cold to the skin; exosphere from about 600 km to 10,000 km
S6	NOAA Global Monitoring Laboratory, "Trends in Atmospheric Carbon Dioxide", Mauna Loa (page last updated 5 September 2026). [source link]	Monthly mean carbon dioxide at Mauna Loa: 427.55 ppm in August 2026 and 425.48 ppm in August 2025; the most recent data are preliminary
S7	NASA, Earth Fact Sheet (NSSDCA, D.R. Williams, updated 15 November 2024). [source link]	Nitrogen 78.08 per cent, oxygen 20.95 per cent, argon 9,340 ppm, carbon dioxide 420 ppm, neon 18.18 ppm, helium 5.24 ppm, methane 1.94 ppm, krypton 1.14 ppm, hydrogen 0.55 ppm; average temperature 288 K (15°C)
S8	NASA, "Earth's Atmosphere: A Multi-layered Cake". [source link]	About 99 per cent of water vapour in the troposphere; top of the mesosphere the coldest place, about minus 85°C; noctilucent clouds as the highest clouds; meteors; thermosphere about 80 to 700 km with auroras and the International Space Station; exosphere about 700 to 10,000 km, gas too sparse to behave like a gas; 99.99997 per cent of the atmosphere below the 100 km Karman line
S9	UCAR Center for Science Education, "Layers of Earth's Atmosphere", with the pages "The Troposphere", "The Stratosphere", "The Mesosphere", "The Thermosphere" and "The Exosphere". [source link] ; [source link] ; [source link] ; [source link] ; [source link] ;	Troposphere with about 75 to 80 per cent of the mass, top as low as 7 km at the poles in winter and as high as 20 km at the equator, higher in summer; ozone heating the stratosphere, its dryness, jets in the lower stratosphere, polar stratospheric clouds at 15 to 25 km below minus 78°C; mesosphere 50 to 85 km, about minus 90°C near the top, meteors, gases mixed by turbulence up to the mesopause; thermosphere temperatures of 500°C to

No.	Source	Used for
	[source link]	2,000°C or more, thermopause at 500 to 1,000 km, auroras, the International Space Station; exosphere
S10	UCAR Center for Science Education, "The Ionosphere". [source link]	Ionisation by X-rays and ultraviolet light; D, E and F regions and their heights; behaviour by day and by night; the regions inside the mesosphere and the thermosphere; reflection of radio waves and long-distance radio
S11	Encyclopaedia Britannica, "lapse rate". [source link]	Average lapse rate of about 6.5°C per km in the troposphere
S12	Encyclopaedia Britannica, "troposphere", "stratosphere", "mesosphere" and "thermosphere". [source link] ; [source link] ; [source link] ; [source link]	Troposphere about 10 to 18 km; lower stratosphere nearly isothermal, stratopause at about 50 km; mesosphere about 50 to 80 km; thermosphere from about 80 km
S13	Encyclopaedia Britannica, "E region" and "F region". [source link] ; [source link]	E region from 90 km to about 160 km, also called the Kennelly-Heaviside layer, weaker at night; D region at about 70 to 90 km, not lasting through the night; F region above 160 km, highest concentration of free electrons, F1 and F2 by day, the F2 layer also called the Appleton layer
S14	Encyclopaedia Britannica, "ozone layer". [source link]	Ozone layer between roughly 15 and 35 km; about 90 per cent of the ozone of the atmosphere between 10 to 18 km and about 50 km
S15	Encyclopaedia Britannica, "heterosphere". [source link]	Heterosphere above about 100 km, gases separating by molecular mass, helium and hydrogen the main gases above about 1,000 km; homosphere well mixed; turbopause at around 100 km
S16	American Meteorological Society, Glossary of Meteorology, "homosphere" and "heterosphere". [source link] ; [source link]	Homosphere from the surface to about 80 to 100 km with no gross change in composition; heterosphere above it
S17	Wikipedia, "Atmosphere of Earth" (citing Schlatter 2009 for the turbopause, and UCAR). [source link]	Homosphere made of the troposphere, stratosphere, mesosphere and the lowest part of the thermosphere; heterosphere made of most of the thermosphere and the exosphere; turbopause at about 100 km
S18	NOAA Space Weather Prediction Center, "Aurora". [source link]	Cause of auroras; height of 80 to 500 km; aurora borealis and aurora australis; best seen between about 60 and 75 degrees of latitude
S19	University of Leeds, School of Earth and Environment, "Enviroweb", atmosphere module, page on the composition of the atmosphere. [source link]	The grouping into permanent gases and variable gases; nitrogen and oxygen together just over 99 per cent of dry air
S20	Encyclopaedia Britannica, "argon". [source link]	Argon as an inert (noble) gas
S21	Encyclopaedia Britannica, "atmosphere", section "Stratosphere and mesosphere". [source link]	Lower stratosphere isothermal and temperature rising above it; stratopause at 45 to 50 km; noctilucent clouds in the upper mesosphere; thermosphere temperatures of about 500 K to 2,000 K; ionosphere within the thermosphere; exosphere above about 500 km
S22	NASA Science, "Steamy Relationships:	Water vapour as the most abundant greenhouse gas of

No.	Source	Used for
	How Atmospheric Water Vapor Amplifies Earth's Greenhouse Effect" (published 8 February 2022, updated 23 October 2024). [source link]	the Earth

Additional sources for the reviewed edition

- NASA ozone assessment and atmospheric layers. [source link] — UV-B and UV-C protection; UV-A reaching the surface
- NASA atomic oxygen technical reference. [source link] — Atomic oxygen remains important in the thermosphere; textbook heights are not strict absence boundaries
- NASA, The Carbon Cycle. [source link] — Greenhouse gases absorb and re-emit infrared radiation
- NOAA, Mauna Loa monthly CO2 data, retrieved 9 October 2026. [source link] — August 2026 preliminary 427.55 ppm and August 2025 425.48 ppm

DAY 2 · TOPIC 16

Drainage patterns and river regimes

1. Concept in one line

A drainage pattern is the design that a river and its tributaries make on the ground, fixed mainly by slope and rock structure, and a river regime is the pattern of a river's flow over a year. The examination asks you to match each pattern and drainage type with its description and example, and to compare the regimes of the Himalayan and the Peninsular rivers.

2. Revision notes

2.1 The basic terms

Term	Meaning (NCERT)	Remember
Drainage	The flow of water through well-defined channels	The Class IX book uses the word for the river system of an area
Drainage system	The network of such channels	A river along with its tributaries is called a river system
Catchment area	The specific area from which a river collects its water	The catchments of small rivulets and rills are often called watersheds
Drainage basin	The area drained by a river and its tributaries	The catchments of large rivers are called river basins
Watershed	The boundary line that separates one drainage basin from another	The Class IX book calls the upland that separates two drainage basins a water divide

- So NCERT uses "watershed" in two ways: as the boundary line between two basins, and as a small catchment. In its words, watersheds are small in area while basins cover larger areas.
- The United States Geological Survey (USGS) uses "watershed" for the area itself: an area of land that drains all its streams and rainfall to a common outlet. It calls the boundary a drainage divide.
- Ambala lies on the water divide between the Indus and the Ganga river systems (NCERT Class IX).
- By size of watershed (here the word means the catchment area), NCERT groups the drainage basins of India into three: major (catchment of more than 20,000 sq. km; 14 basins), medium (2,000 to 20,000 sq. km; 44 basins) and minor (less than 2,000 sq. km).

2.2 Drainage patterns

NCERT says the drainage pattern of an area is the outcome of the geological time period, the nature and structure of the rocks, topography, slope, the amount of water flowing and the periodicity of the flow.

Pattern	What it looks like	Where it develops	Example
Dendritic	Like the branches of a tree	Where rock structure exercises no control: rocks of equal resistance, such as flat-lying	The rivers of the northern plain (NCERT)

Pattern	What it looks like	Where it develops	Example
		sedimentary beds without faults or strong joints	
Trellis	Primary tributaries flow parallel to each other; secondary tributaries join them at right angles	Folded country with alternating bands of hard and soft rock. Main streams follow the weak rock; short feeders run down the ridges of strong rock	Appalachian Mountains, USA
Rectangular	The streams themselves make right-angled bends, and tributaries join at right angles	Rock of uniform resistance cut by faults and joints that meet at about right angles	The Norwegian coast; parts of the Adirondack Mountains, USA
Radial	Rivers rise on a hill and flow away from it in all directions	Volcanic cones, domes and isolated hills	The rivers rising in the Amarkantak range (NCERT); the Narmada and the Son both rise on the Amarkantak plateau
Centripetal	Rivers from all directions discharge their waters into a lake or a depression	Craters, basins and enclosed desert depressions	NCERT names no example
Parallel	Streams run side by side in the same direction	Moderate to steep slopes; tilted rock beds	Between long, straight ridges of sand or loess (a setting, not a named place)
Annular	Streams follow ring-shaped paths	Eroded domes or basins with concentric bands of hard and soft rock. The streams keep to the weak bands	Red Valley, which nearly encircles the Black Hills dome, USA
Deranged	No regular pattern; channels are interrupted by lakes and swamps	Land recently cleared of an ice sheet	The Canadian Shield

- NCERT Class XI describes four of these: dendritic, radial, trellis and centripetal.
- A.D. Howard (1967) listed the basic patterns as dendritic, parallel, trellis, rectangular, radial, annular, multibasinal and contorted. He treated centripetal as a modified form of radial.
- Radial and centripetal are opposites: outward from a high point, inward to a low point.
- Trellis and rectangular both show right angles. Trellis comes from folded beds of hard and soft rock. Rectangular comes from joints and faults in rock of uniform resistance.

2.3 Drainage types by relation to structure

A drainage that fits the structure and relief of the land is called accordant. A drainage that cuts across the structure is called discordant.

Type	Meaning	Indian example in standard texts
Consequent	The stream follows the initial slope of a newly formed land surface	The upper Chambal on the Deccan lavas of Malwa, described as "more nearly consequent" (Spate and Learmonth)
Subsequent	The stream develops later, along a belt of weak rock or a line of geological weakness. It grows headwards and may capture other streams	NCERT names no example. A subsequent stream that follows the strike of the rock beds is called a strike stream, and its valley a strike valley. Spate and Learmonth say the lower Chambal "may be regarded as occupying a strike valley" in the Vindhyan scarplands
Antecedent	The river is older than the uplift. As the land rises across its path, it keeps its course by cutting down, and leaves a deep gorge	The Satluj, the Kosi and the Subansiri (NCERT). D.N. Wadia calls the Himalayan drainage as a whole antecedent, with the Indus gorge in Gilgit as his most striking example
Superimposed (superposed)	The river formed on a cover of younger rocks. It cut down through that cover into older rocks of a different structure and kept its course	The Chambal above Kota, "probably superimposed, cutting across the strike" (Spate and Learmonth)

- Consequent and subsequent streams fit the structure. Antecedent and superimposed streams cut across it, so they are the two discordant types.
- The Chambal stands in three rows of the table because Spate and Learmonth describe three different stretches of the one river: its upper reaches on the Deccan lavas of Malwa, the stretch above Kota, and its lower course in the Vindhyan scarplands.
- Three more names from W.M. Davis: obsequent (flows opposite to the original consequent), resequent (flows in the same direction as the consequent but at a lower level) and insequent (shows no apparent control by structure).
- Wadia's point about the Himalaya: it is "not a consequent drainage". The watershed lies north of the highest peaks, and the main rivers, which existed before the mountains rose, cross the ranges in transverse gorges.
- NCERT's comparison table (in the 2020-21 reprint) sums up the two systems. Himalayan rivers: "antecedent and consequent leading to dendritic pattern in plains". Peninsular rivers: "super imposed, rejuvenated resulting in trellis, radial and rectangular patterns".
- How to read Wadia and NCERT together: both call the Himalayan rivers antecedent. They differ only on the word "consequent". Wadia rules it out for the Himalayan drainage, whose main rivers cut across the ranges. NCERT's table adds it, in the same line that speaks of the dendritic pattern in the plains. In a question based on NCERT, follow the NCERT table: Himalayan rivers are "antecedent and consequent".
- The Himalayan river systems, the east-flowing and west-flowing Peninsular rivers, the rivers of Andhra Pradesh and the landforms made by rivers are separate topics on other days.

2.4 River regime: meaning and controls

- **Regime:** the pattern of flow of water in a river channel over a year (NCERT). Britannica puts it as the seasonal variation in discharge.
- **Discharge:** the volume of water flowing in a river measured over time. It is measured in cusecs (cubic feet per second) or cumecs (cubic metres per second).
- NCERT's Class XI book dealt with this in a section called "River Regimes". The section is in the 2020-21 reprint. NCERT dropped it when it rationalised its textbooks in 2022, so the 2026-27 reprint does not carry it.
- **What controls a regime:**
- The source of water: rain, snowmelt or glacier melt. Regimes of hot climates follow the seasonal rain. Regimes of cold climates follow the seasonal release of meltwater.
- Geology: where the bedrock is impermeable, a long drought can stop the flow.
- River size, climate, topography, and land use and land cover.
- **Pardé's classification:** a simple regime has one maximum and one minimum in a year, and is glacial (glacier melt), nival (snowmelt) or pluvial (rain) by its source of water. A mixed regime has two maxima and two minima. A complex regime has several, and is typical of large rivers fed by many tributaries.

2.5 Himalayan and Peninsular regimes compared

Point	Himalayan rivers	Peninsular rivers
Place of origin	Himalayan mountains covered with glaciers	Peninsular plateau and central highland
Source of water	Glaciers, through snowmelt, and rainfall in the rainy season	Monsoon rainfall; they do not originate from glaciers
Nature of flow	Perennial	Seasonal (non-perennial)
What controls the regime	Snowmelt in summer and then the monsoon rains	Rainfall, which varies from one part of the Peninsular plateau to another
Type of drainage (NCERT table)	Antecedent and consequent, leading to a dendritic pattern in the plains	Superimposed and rejuvenated, resulting in trellis, radial and rectangular patterns
NCERT example	The Ganga	The Narmada and the Godavari

- An exception among Peninsular rivers: the Kaveri carries water throughout the year with comparatively less fluctuation than the other Peninsular rivers. Its upper catchment gets rain in the southwest monsoon season and its lower part in the northeast monsoon season (NCERT).

2.6 The three NCERT examples: the figures

River	Recording station	Highest flow (cusecs, as NCERT prints)	Lowest flow (cusecs, as NCERT prints)	Highest to lowest
Ganga	Farakka	About 55,000 (mean maximum)	1,300 (mean minimum)	About 42 to 1
Narmada	Garudeshwar	Of the order of 2,300 (maximum)	15 (minimum)	About 153 to 1
Godavari	Polavaram	3,200 (mean	50 (mean	64 to 1

River	Recording station	Highest flow (cusecs, as NCERT prints)	Lowest flow (cusecs, as NCERT prints)	Highest to lowest
		maximum)	minimum)	

- NCERT prints all these figures in cusecs. Learn them with their stations, as printed.
- Do not use them to judge the real size of the rivers. In the India-Bangladesh treaty of 12 December 1996 on sharing the Ganga waters at Farakka, the 1949 to 1988 average flow at Farakka is 60,992 cusecs even in the leanest ten-day period of its January to May schedule (21 to 30 April).
- The ratios show the point of the table: the perennial Ganga also swings widely between seasons, and the Narmada swings the most of the three.

3. Extra section: the year of the three rivers, stage by stage

Stage of the year	Ganga at Farakka	Narmada at Garudeshwar	Godavari at Polavaram
Low-flow period	January to June	January to July: a very low volume of discharge	The minimum comes in May
Before the monsoon	A sizeable flow is kept up in the early part of summer by snowmelt	No such support: the river does not originate from glaciers	No such support: the river does not originate from glaciers
Peak	August or September	August, after a sudden rise	July to August
After the peak	A steady fall after September	A fall in October as spectacular as the rise in August	A sharp fall after August, but October and November still carry more water than any month from January to May
What to note	NCERT calls it "a monsoon regime during the rainy season"	A sudden rise and an equally spectacular fall	The earliest peak of the three

How to hold it in memory:

- **Order of the peaks:** Godavari (July to August), Narmada (August), Ganga (August or September).
- **Order of the swing between highest and lowest flow:** Narmada (about 153 to 1), Godavari (64 to 1), Ganga (about 42 to 1).
- **Snowmelt is not the peak.** Snowmelt explains why the Ganga does not run very low in early summer. The peak comes later, with the monsoon rains.
- **Within the Ganga basin:** NCERT notes striking differences between the regimes of the eastern and the western parts of the basin.

4. Three common exam traps

1. **"Watershed" can mean a line or an area.** In NCERT it is the boundary line between two drainage basins, and it is also the name for a small catchment. In USGS usage it is the drained area itself. The drainage basin is always the area, never the line. Read the statement to see which sense is meant.

2. **Look-alike pairs.** Radial flows outward from a hill; centripetal flows inward to a lake or depression. Trellis and rectangular both have right-angled junctions; trellis belongs to folded beds of hard and soft rock, rectangular to joints and faults. Antecedent and superimposed rivers both cut across the structure; the antecedent river is older than the uplift, while the superimposed river was let down from a cover of younger rocks.
3. **"Perennial means steady" and "snowmelt gives the peak".** Both are wrong. The Ganga is perennial, yet its mean maximum at Farakka is about 42 times its mean minimum. Its minimum flow is in the January to June period and its maximum in August or September, with the monsoon, not in early summer. Also keep the months apart: the Godavari has its minimum in May, and the Narmada peaks in August.

Practice and explanations

Q1. Match List I (Drainage pattern) with List II (Description):

List I (Drainage pattern)	List II (Description)
A. Trellis	1. Rivers from all directions discharge their waters into a lake or a depression
B. Radial	2. Streams follow faults and joints that meet at about right angles in rock of uniform resistance, and make sharp bends
C. Centripetal	3. Rivers rise on a hill and flow away from it in all directions, as in the Amarkantak range
D. Rectangular	4. Primary tributaries flow parallel to each other in folded belts of hard and soft rock, and secondary tributaries join them at right angles

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

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

- Why it is correct: In a trellis pattern the primary tributaries flow parallel to each other and the secondary tributaries join them at right angles; it belongs to folded country with alternating hard and soft rock (A-4). In a radial pattern the rivers rise on a hill and flow in all directions; NCERT's example is the Amarkantak range (B-3). In a centripetal pattern the rivers discharge their waters from all directions into a lake or depression (C-1). A rectangular pattern follows faults and joints that meet at about right angles (D-2).
- Why (1) is wrong: It swaps trellis and rectangular. Both show right angles, but joints and faults in uniform rock give the rectangular pattern, and folded hard and soft beds give the trellis pattern.
- Why (3) is wrong: It swaps radial and centripetal. Radial is outward from a hill; centripetal is inward to a lake or depression.
- Why (4) is wrong: It makes both swaps, so all four pairs are wrong.

Q2. Consider the following statements about the regimes of Indian rivers:

1. The Ganga keeps a sizeable flow in the early part of summer, before the monsoon rains begin, because of snowmelt.

2. The Ganga at Farakka attains its maximum flow in June.
3. The Kaveri carries water throughout the year, with comparatively less fluctuation than the other Peninsular rivers.

Which of the statements given above is/are correct?

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

Q2. Answer: (2) 1 and 3 only

- Statement 1 is correct: Himalayan rivers are fed by melting snow as well as by rain. Snowmelt keeps up a sizeable flow in the Ganga in the early part of summer, before the monsoon rains begin.
- Statement 2 is wrong: The Ganga has its minimum flow during the January to June period. Its maximum is attained in August or in September, with the monsoon rains, and the flow falls steadily after September.
- Statement 3 is correct: The upper catchment of the Kaveri gets rain in the southwest monsoon season and its lower part in the northeast monsoon season. So the river carries water throughout the year, with comparatively less fluctuation than the other Peninsular rivers (NCERT).
- Why the other options are wrong: (1) leaves out statement 3, which is correct. (3) and (4) both include statement 2, which is wrong, and (3) also leaves out statement 1.

7. Sources

7.1 Sources

No.	Source	Used for
S1	NCERT, *India: Physical Environment* (Class XI), Chapter 3 "Drainage System", reprint 2026-27. [source link]	Definitions of drainage, drainage system, catchment area, drainage basin and watershed; river basins and watersheds, "watersheds are small in area while the basins cover larger areas"; the sentence on what a drainage pattern is the outcome of; the four patterns (dendritic, radial, trellis, centripetal) with the northern plain and the Amarkantak range as examples; three size classes of basins (more than 20,000 sq. km with 14 basins, 2,000 to 20,000 sq. km with 44 basins, less than 2,000 sq. km); the Satluj, the Kosi and the Subansiri as antecedent rivers; the Narmada and the Son rising on the Amarkantak plateau; Himalayan rivers perennial, fed by melting snow and precipitation; Peninsular rivers with non-perennial flow; the Kaveri carrying water throughout the year with comparatively less fluctuation than the other Peninsular rivers, its upper catchment getting rain in the southwest monsoon season and its lower part in the northeast monsoon season; no "River Regimes" section and no table in this reprint
S2	NCERT, *India: Physical Environment* (Class XI), Chapter 3 "Drainage System", reprint 2020-21, copy on the Internet Archive (item "ncert-kegy1", uploaded 27 June	The section "River Regimes": definitions of regime and discharge, cusecs and cumecs; Himalayan rivers fed by glaciers through snowmelt and by rain; rivers of South India not originating from glaciers, regime controlled by

No.	Source	Used for
	2021). [source link]	rainfall; the Ganga (minimum flow January to June, maximum in August or September, steady fall after September, "monsoon regime", sizeable flow in early summer from snowmelt, differences between eastern and western parts of the basin, about 55,000 and 1,300 cusecs at Farakka); the Narmada (very low January to July, sudden rise in August, fall in October, 2,300 and 15 cusecs at Garudeshwar); the Godavari (minimum in May, maximum in July to August, October and November higher than January to May, 3,200 and 50 cusecs at Polavaram); Table 3.1, "Comparison between the Himalayan and the Peninsular River" (place of origin, nature of flow, type of drainage)
S3	NCERT, *List of Rationalised Content in Textbooks for Class XI* (May 2022). [source link]	"River Regimes" and Table 3.1 listed among the content dropped from Chapter 3 "Drainage System"
S4	NCERT, *Contemporary India I* (Class IX), Chapter 3 "Drainage", reprint 2020-21, copy on the Internet Archive (item "ncert-iess1"). [source link]	"Drainage" as the river system of an area; drainage basin as the area drained by a single river system; water divide; river system; Ambala on the water divide between the Indus and the Ganga river systems; Himalayan rivers perennial and many Peninsular rivers seasonal
S5	Encyclopaedia Britannica, "river", section "Drainage patterns". [source link]	Dendritic pattern where there is no structural control (flat-lying sedimentary rocks without faults and strong joints); trellis in tightly folded country with main streams on weak rocks; rectangular on faults and joints meeting at about right angles; radial on volcanic cones; centripetal in craters and enclosed desert depressions; annular on structural domes; deranged patterns interrupted by lakes and swamps on land recently cleared of ice; subparallel streams on tilted strata; antecedent and superposed streams
S6	Encyclopaedia Britannica, "river", section "Variation of stream regime". [source link]	"Seasonal variation in discharge defines river regime"; regimes controlled by seasonal rain and by seasonal release of meltwater; impermeable bedrock and the halting of flow in long droughts
S7	e-PG Pathshala (UGC and INFLIBNET), e-book *Geomorphology*, module 20 "Drainage Pattern", by Dr Anshu. [source link]	Howard's (1967) list of basic patterns and centripetal as a modified form of radial; controls of dendritic, parallel, trellis, rectangular, radial and annular patterns; examples (Appalachian Mountains, Norwegian coast and Adirondack Mountains, Red Valley around the Black Hills, loess and sand ridges); accordant and discordant drainage; W.M. Davis's consequent, subsequent, obsequent, resequent and insequent streams; antecedent and superimposed drainage
S8	e-PG Pathshala (UGC and INFLIBNET), e-book *Geography of Water Resources*, module 8 "River Regimes and Channel Flows", by Dr Ajay Kumar. [source link]	Regimes determined by river size, climate, geology, topography and land use and land cover; Pardé's (1955) simple, mixed and complex regimes; glacial, nival and pluvial types
S9	Ailsa Allaby and Michael Allaby, *A Dictionary of Earth Sciences*, entries "consequent stream" and "subsequent	Consequent stream: course consequent upon the shape of a newly emerged land surface; subsequent stream: follows a line of geological weakness, extends headwards

No.	Source	Used for
	stream", as given on Encyclopedia.com. [source link] and [source link]	and may gain tributaries by river capture; called a strike stream when it follows the geological strike, and its valley a strike valley
S10	D.N. Wadia, *Geology of India for Students* (Macmillan, London; first edition 1919, revised edition 1926), Chapter I "Physical Features", full text of the 1926 edition on the Internet Archive. [source link]	Himalayan drainage "not a consequent drainage" but an antecedent drainage; main rivers older than the mountains; watershed north of the highest peaks; transverse gorges, with the Indus gorge in Gilgit as the most striking
S11	O.H.K. Spate and A.T.A. Learmonth, *India and Pakistan: Land, People and Economy*, 3rd edition (Methuen, London, 1967), Chapter 1 "Structure and Relief", full text on the Internet Archive. [source link]	The Chambal: lower course in a strike valley in the Vindhyan scarplands; above Kota "probably superimposed, cutting across the strike"; upper reaches "more nearly consequent on the Deccan Lavas of Malwa"
S12	Wikipedia, "Drainage system (geomorphology)" (citing M.E. Ritter, *The Physical Environment*, 2006; M. Pidwirny, *Fundamentals of Physical Geography*, 2006; D.J. Easterbrook, *Principles of Geomorphology*, 1969). [source link]	Accordant and discordant patterns; rectangular streams with right-angle bends on two sets of joints; trellis in the Appalachian Mountains; Red Valley nearly encircling the Black Hills dome; deranged drainage of the Canadian Shield; superimposed drainage formed on a cover of younger rock
S13	Wikipedia, "Antecedent drainage stream" (citing J. Grotzinger and T.H. Jordan, *Understanding Earth*, 5th edition, 2006). [source link]	Antecedent stream keeps its course by cutting a gorge through a slowly rising ridge; superimposed stream formed on horizontal beds lying over older folded rock
S14	United States Geological Survey, Water Science School, "Watersheds and Drainage Basins". [source link]	Watershed as an area of land that drains all the streams and rainfall to a common outlet; the term used interchangeably with drainage basin or catchment; drainage divide as the boundary
S15	Treaty between the Government of the Republic of India and the Government of the People's Republic of Bangladesh on Sharing of the Ganga/Ganges Waters at Farakka, signed at New Delhi on 12 December 1996, copy on the Asian Development Bank's Law and Policy Reform site. [source link]	Annexure II: average total flow at Farakka, 1949 to 1988, by ten-day period; lowest figure 60,992 cusecs for 21 to 30 April
S16	UGC MOOCs (INFLIBNET), e-text script "Drainage System of India" (Geography). [source link]	Second copy of the NCERT wording on regime, discharge and the figures for the Ganga at Farakka, the Narmada at Garudeshwar and the Godavari at Polavaram
S17	Encyclopaedia Britannica, "Ganges River", section "Climate and hydrology". [source link]	The water supply of the Ganga depends partly on the rains of the southwesterly monsoon from July to October and partly on the flow from melting Himalayan snows in the hot season from April to June

Additional sources for the reviewed edition

- NCERT, India Physical Environment, 2020–21 original PDF preserved by Internet Archive. [source link] — Directly checked the historical River Regimes text and its cusec figures; these are textbook figures as printed, not current discharge observations

DAY 2 · TOPIC 17

ISRO launch vehicles: PSLV, GSLV, LVM3 and SSLV

1. Concept in one line

A launch vehicle is the rocket that carries a satellite from the ground into orbit, and ISRO's present family has four of them: PSLV, GSLV, LVM3 and SSLV. The examination asks you to tell them apart by their stages, propellants, engines, payload capacity and landmark missions.

2. Revision notes

2.1 What a launch vehicle is

- ISRO's definition: launchers, or launch vehicles, are used to carry spacecraft to space. What they carry is called the **payload**.
- **Stages:** most of a rocket's weight at lift-off is propellant. A launch vehicle drops its empty parts during flight (staging), so the part that remains is lighter and can reach orbital speed. Stages stacked one above the other burn one after the other. **Strap-on** boosters are fixed to the side of the core and are dropped when they are empty.
- **Solid propellant:** fuel and oxidiser are mixed and packed as a solid. Once lit, it burns until it is used up. It is easy to handle and store. ISRO's solid motors use HTPB-based propellant.
- **Liquid propellant:** fuel and oxidiser are stored separately as liquids. The thrust can be stopped by cutting off the flow, but the pumps and tanks make the stage more complex. ISRO's main liquid engine is the **Vikas**; PSLV, GSLV and LVM3 all use it.
- **Cryogenic stage:** a liquid stage that burns liquid hydrogen (LH2) with liquid oxygen (LOX). GSLV and LVM3 use one as the upper stage. Cryogenic engines are covered in detail on another day.
- Payload capacity is always stated with the orbit, because the same vehicle carries less to a higher orbit: LVM3 carries 8,000 kg to Low Earth Orbit (LEO) but 4,000 kg to Geostationary Transfer Orbit (GTO). ISRO writes GTO as "Geosynchronous Transfer Orbit". Orbits were covered in Topic 7.

2.2 The earlier vehicles: SLV-3 and ASLV

- **SLV-3 (Satellite Launch Vehicle-3):** India's first experimental satellite launch vehicle. Four stages, all solid; 22 m tall; 17 tonnes; 40 kg class payloads to LEO. Its first flight, in August 1979, was only partially successful. On 18 July 1980 it placed the Rohini satellite RS-1 in orbit from Sriharikota.
- **ASLV (Augmented Satellite Launch Vehicle):** five stages, all solid; 24 m tall; 40 tonnes; 150 kg class satellites to a 400 km circular orbit. Its development programme (1987–1994) proved strap-on technology, inertial navigation and closed-loop guidance for the vehicles that followed.

ISRO lists both as retired.

2.3 The four vehicles side by side

Feature	PSLV	GSLV	LVM3	SSLV
Full name	Polar Satellite Launch Vehicle	Geosynchronous Satellite Launch	LVM3; earlier called GSLV Mk III	Small Satellite Launch Vehicle

Feature	PSLV	GSLV	LVM3	SSLV
		Vehicle Mark II		
Number of stages	4	3	3	3, with a small liquid module on top
Strap-ons	Solid: 6, 4, 2 or none, by variant	4 liquid strap-ons (L40H), each with one Vikas engine	2 solid strap-on boosters, named S200; with the core and the upper stage they make up the three stages	None
Stage 1	Solid: S139 motor (HTPB)	Solid: S139 motor (HTPB)	The two solid S200 boosters (HTPB)	Solid: SS1 (HTPB)
Stage 2	Liquid: Vikas engine (UDMH + N2O4)	Liquid: Vikas engine (UH25 + N2O4)	Liquid core stage L110: two Vikas engines (UH25 + N2O4)	Solid: SS2 (HTPB)
Stage 3	Solid (HTPB)	Cryogenic upper stage: CE-7.5 engine (LOX + LH2)	Cryogenic stage C25: CE-20 engine (LOX + LH2)	Solid: SS3 (HTPB)
Stage 4 or top module	Liquid: two engines (MMH + MON)	None	None	Velocity Trimming Module (VTM): liquid (MMH + MON-3)
Height	44 m	51.73 m	43.5 m	34 m
Lift-off mass	320 tonnes (XL variant)	420 tonnes	640 tonnes	About 120 tonnes
Payload capacity	1,750 kg to a sun-synchronous polar orbit of 600 km; 1,425 kg to sub-GTO	2,250 kg to GTO; 6,000 kg to LEO	4,000 kg to GTO; 8,000 kg to LEO	One satellite of up to 500 kg, or several of 10 to 300 kg each, to a 500 km planar orbit
First flight	20 September 1993 (PSLV-D1, unsuccessful); first success on 15 October 1994 (PSLV-D2)	18 April 2001 (GSLV-D1); first success with the Indian cryogenic stage on 5 January 2014 (GSLV-D5)	18 December 2014 (experimental flight with a passive cryogenic stage); first developmental flight on 5 June 2017 (LVM3-D1)	7 August 2022 (SSLV-D1, satellites not placed in their intended orbits); first success on 10 February 2023 (SSLV-D2)

Place in the programme	**"Workhorse of ISRO": remote sensing satellites to polar orbits; also navigation satellites and the Moon, Mars and Sun missions**	**2-tonne class communication, weather and navigation satellites to GTO**	**The heaviest lifter: 4-tonne class satellites to GTO, Chandrayaan-2 and Chandrayaan-3, commercial launches to LEO; its human-rated version is chosen for Gaganyaan**	**Small satellites on demand, at low cost and with a short turnaround time**

- The pairs in brackets are the propellants as ISRO lists them. LOX + LH2 (liquid oxygen and liquid hydrogen) marks a cryogenic stage. ISRO calls the liquid engines of PSLV's second and fourth stages "Earth storable".
- The GSLV design details in this table refer to Mk II, which uses the Indian cryogenic upper stage. Early GSLV missions used Russian-supplied cryogenic stages; that earlier configuration is commonly called Mk I.
- A sub-GTO is a transfer orbit whose apogee is lower than that of a standard GTO. For GSLV-F17, for example, the planned sub-GTO for EOS-05 had a perigee of 170 km and an apogee of 28,934 km.

2.4 Points to remember on each vehicle

PSLV

- It was the first Indian launch vehicle to have liquid stages. Its stages alternate: solid, liquid, solid, liquid.
- Variants differ in the number of solid strap-ons: XL (6), QL (4), DL (2) and CA, the Core Alone version (none). ISRO's launch list also uses the label PSLV-G: for the flights from PSLV-D1 (1993) to PSLV-C7 (2007), and for PSLV-C16 (2011).
- Besides remote sensing satellites, it has launched the IRNSS navigation satellites, Chandrayaan-1, the Mars Orbiter Mission, 104 satellites in a single flight (PSLV-C37) and Aditya-L1. The dates are in Section 3.
- Recent flights: PSLV-C61 (18 May 2025) could not be accomplished because of an observation in the third stage. PSLV-C62 (12 January 2026) met an anomaly at the end of the third stage. ISRO said on 25 February 2026 that a national-level expert committee was reviewing the reason for the anomaly in the PSLV vehicle.

GSLV (Mk II)

- A solid core with four liquid strap-ons at the bottom and a cryogenic stage on top. The CE-7.5 is India's first cryogenic engine.
- The first flights used cryogenic stages supplied by Russia. The Indian cryogenic upper stage was unsuccessful on its first flight test (GSLV-D3, 15 April 2010) and succeeded on GSLV-D5 (5 January 2014).
- Recent payloads: INSAT-3DS (GSLV-F14, 17 February 2024); the navigation satellite NVS-02 (GSLV-F15, 29 January 2025); NISAR (GSLV-F16), the first GSLV mission to a sun-synchronous polar orbit; EOS-05 (GSLV-F17, 4 September 2026), an Earth observation satellite placed in a sub-GTO. ISRO's mission page calls EOS-05 "India's first ever imaging satellite from Geosynchronous orbit". The

phrase is ISRO's, for an Earth observation satellite; do not stretch it to all satellites, because INSAT-3DS, a weather satellite for geostationary orbit, also carries an imager.

LVM3

- It lifts off on the two S200 solid boosters alone. The liquid core stage L110 is ignited nearly two minutes into the flight (at about 113 seconds on ISRO's LVM3 page; at about 106 seconds in the LVM3-M6 mission brochure). ISRO calls the CE-20 India's largest cryogenic engine.
- Learn 4,000 kg to GTO and 8,000 kg to LEO, the figures on ISRO's LVM3 page. The LVM3-M6 mission page (December 2025) gives 4,200 kg to GTO, and other ISRO pages speak of "10 tonne class" payloads to LEO. One payload has gone above both GTO figures: ISRO's LVM3-M5 mission page gives CMS-03 as about 4,400 kg, launched to GTO.
- Payloads so far include GSAT-19, Chandrayaan-2 and Chandrayaan-3. LVM3-M2, with 36 OneWeb satellites weighing 5,796 kg in all, was its first commercial mission and its first launch to LEO. CMS-03 (LVM3-M5) is the heaviest communication satellite launched to GTO from Indian soil. BlueBird Block-2 (LVM3-M6) is the heaviest payload LVM3 has carried to LEO.

SSLV

- Three solid stages do the lifting. The small liquid Velocity Trimming Module on top corrects the final velocity and places the satellites in orbit.
- SSLV-D2 (10 February 2023) placed EOS-07 and two small satellites in a 450 km orbit. SSLV-D3 (16 August 2024) placed EOS-08 in a 475 km orbit and completed the development project.

2.5 Launch sites

Site	Status	Used for
First Launch Pad (FLP), Sriharikota	First launch on 20 September 1993 (PSLV-D1)	Built for PSLV; supports PSLV and SSLV
Second Launch Pad (SLP), Sriharikota	Operational since 2005; first launch on 5 May 2005 (PSLV-C6 with Cartosat-1)	Mainly GSLV and LVM3; standby for PSLV. Chandrayaan-3 was launched from here
Third Launch Pad (TLP), Sriharikota	Approved by the Union Cabinet on 16 January 2025; cost Rs 3,984.86 crore; to be completed in 48 months	Next Generation Launch Vehicle (NGLV) and LVM3 with a semicryogenic stage; standby for the SLP
SSLV Launch Complex, Kulasekarapattinam, Thoothukudi (Tuticorin) district, Tamil Nadu	Foundation stone laid by the Prime Minister on 28 February 2024; construction of facilities began on 5 March 2025; foundation stone of the launch pad laid on 27 August 2025. ISRO said in August 2025 that the complex was targeted for completion by the end of 2026.	Mainly polar launches of SSLV; also launches by non-governmental enterprises

- All four vehicles fly from the Satish Dhawan Space Centre (SDSC) SHAR at Sriharikota, India's spaceport. Sriharikota is an island between Pulicat Lake and the Bay of Bengal. It has been in Tirupati district of Andhra Pradesh since the districts were reorganised on 4 April 2022; before that it was in SPSR Nellore district. The centre was renamed after Prof. Satish Dhawan on 5 September 2002.

2.6 Production, and what comes next

- **NewSpace India Limited (NSIL)**, a company under the Department of Space and the commercial arm of ISRO, is the nodal agency for producing PSLV through a consortium of Indian industry and is responsible for SSLV manufacture through industry. It also sells commercial launches on ISRO's vehicles. The agreement to transfer SSLV technology to Hindustan Aeronautics Limited (HAL) was signed by ISRO, NSIL, IN-SPACe and HAL on 10 September 2025.
- **Covered on other days:** the Reusable Launch Vehicle and other new technologies; Gaganyaan; and the Next Generation Launch Vehicle, which the Union Cabinet approved on 18 September 2024 (up to 30 tonnes to LEO, with a reusable first stage).

3. Extra section: landmark flights in date order

Date	Flight	Why it matters
18 July 1980	SLV-3	Rohini satellite RS-1 placed in orbit from Sriharikota
20 May 1992	ASLV-D3	SROSS-C (106 kg) placed in orbit
20 September 1993	PSLV-D1	First flight of PSLV; IRS-1E could not be placed in orbit
15 October 1994	PSLV-D2	First successful flight of PSLV; IRS-P2
18 April 2001	GSLV-D1	First flight of GSLV; GSAT-1
5 May 2005	PSLV-C6	First launch from the Second Launch Pad; Cartosat-1
22 October 2008	PSLV-C11	Chandrayaan-1
5 November 2013	PSLV-C25	Mars Orbiter Mission
5 January 2014	GSLV-D5	First success of the Indian cryogenic upper stage; GSAT-14
18 December 2014	LVM3 experimental flight	Carried the crew module experiment CARE; the cryogenic stage was passive
15 February 2017	PSLV-C37	104 satellites in a single flight, to a 505 km sun-synchronous orbit
5 June 2017	LVM3-D1	First developmental flight; GSAT-19 (3,136 kg) to GTO
22 July 2019	LVM3-M1	Chandrayaan-2
7 August 2022	SSLV-D1	First flight of SSLV; the satellites were not placed in their intended orbits
23 October 2022	LVM3-M2	36 OneWeb satellites; first commercial mission of LVM3
10 February 2023	SSLV-D2	First successful flight of SSLV; EOS-07
14 July 2023	LVM3-M4	Chandrayaan-3
2 September 2023	PSLV-C57	Aditya-L1
16 August 2024	SSLV-D3	EOS-08; SSLV development

Date	Flight	Why it matters
		completed
30 July 2025	GSLV-F16	NISAR; first GSLV mission to a sun-synchronous polar orbit
2 November 2025	LVM3-M5	CMS-03, about 4,400 kg, to GTO
24 December 2025	LVM3-M6	BlueBird Block-2, about 6,100 kg, to LEO
12 January 2026	PSLV-C62	Anomaly at the end of the third stage
4 September 2026	GSLV-F17	EOS-05 placed in a sub-GTO

4. Three common exam traps

1. **Mixing up GSLV and LVM3.** GSLV has a solid core, four liquid strap-ons and the CE-7.5 cryogenic engine. LVM3 has two solid strap-ons, a liquid core with two Vikas engines and the CE-20 cryogenic engine. LVM3 is the vehicle earlier called GSLV Mk III. It is heavier at lift-off (640 tonnes against 420 tonnes) and carries more, but it is shorter (43.5 m against 51.73 m).
2. **Reading the name as a limit.** "Polar" and "Geosynchronous" tell you what each vehicle was designed for, not all that it does. PSLV launched Chandrayaan-1, the Mars Orbiter Mission and Aditya-L1. GSLV-F16 took NISAR to a sun-synchronous polar orbit. LVM3 has taken OneWeb and BlueBird satellites to LEO.
3. **Counting stages and "firsts" loosely.** PSLV has four stages; its strap-ons are not counted as a stage. LVM3 is the exception: its two S200 strap-ons are counted as its first stage. SSLV has three solid stages, and its liquid Velocity Trimming Module is a top module, so SSLV is not the same as the all-solid, four-stage SLV-3. A first flight is not always a first success: PSLV first flew in 1993 but first succeeded in 1994, and SSLV first flew in 2022 but first succeeded in 2023.

Practice and explanations

Q1. Consider the following statements about India's launch vehicles:

1. SLV-3, India's first experimental satellite launch vehicle, had four stages, all using solid propellant.
2. PSLV can carry up to 1,750 kg to a sun-synchronous polar orbit of 600 km altitude.
3. GSLV Mk II can carry a heavier satellite to Geostationary Transfer Orbit (GTO) than LVM3 can.
4. GSLV Mk II is taller than LVM3.

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

Q1. Answer: (4) 1, 2 and 4 only

- Statement 1 is correct: ISRO describes SLV-3 as India's first experimental satellite launch vehicle and as an all-solid, four-stage vehicle. The five-stage vehicle was ASLV.

- Statement 2 is correct: PSLV can take up to 1,750 kg to a sun-synchronous polar orbit of 600 km altitude. Its other figure is 1,425 kg to sub-GTO.
- Statement 3 is wrong: ISRO lists GSLV Mk II at 2,250 kg to GTO. Its general LVM3 page gives 4,000 kg, while the LVM3-M6 mission page gives 4,200 kg. In either comparison LVM3 has the greater GTO payload capability.
- Statement 4 is correct: GSLV Mk II is 51.73 m tall and LVM3 is 43.5 m tall. LVM3 is shorter but much heavier at lift-off, 640 tonnes against 420 tonnes.
- 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.

Q2. Match List I (Launch vehicle) with List II (Distinguishing feature of its design):

List I (Launch vehicle)	List II (Distinguishing feature)
A. PSLV	1. Three solid stages with a liquid Velocity Trimming Module on top
B. GSLV Mk II	2. Two solid strap-on boosters and the CE-20 cryogenic engine
C. LVM3	3. Four stages in which solid and liquid stages alternate
D. SSLV	4. Four liquid strap-on motors and the CE-7.5 cryogenic engine

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

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

- Why it is correct: PSLV has four stages that alternate between solid and liquid: solid, liquid, solid, liquid (A-3). GSLV Mk II has four liquid strap-on motors around a solid core, and its upper stage uses the CE-7.5 cryogenic engine (B-4). LVM3 has two solid S200 strap-on boosters, and its C25 upper stage uses the CE-20 cryogenic engine (C-2). SSLV has three solid stages and a liquid Velocity Trimming Module on top (D-1).
- Why (2) is wrong: It swaps GSLV Mk II and LVM3. The solid strap-ons and the CE-20 belong to LVM3; the liquid strap-ons and the CE-7.5 belong to GSLV Mk II.
- Why (3) is wrong: It swaps PSLV and SSLV. PSLV has four stages, two of them liquid; the vehicle with three solid stages and a Velocity Trimming Module is SSLV.
- Why (4) is wrong: It makes both swaps, so all four pairs are wrong.

7. Sources

7.1 Sources

No.	Source	Used for
S1	ISRO, "Launchers". [source link]	Definition of launchers; PSLV, GSLV and LVM3 as operational vehicles; SLV-3 and ASLV listed as retired; PSLV variants with 6, 4, 2 strap-ons and core alone; "work

No.	Source	Used for
		horse of ISRO"; GSLV for 2 tonne class communication satellites; LVM3 for 4 tonne class satellites and "10 tonne class" payloads to LEO; human-rated LVM3 identified for Gaganyaan; SSLV for small satellites on demand; SDSC SHAR as the spaceport
S2	ISRO, "SLV". [source link]	SLV-3: first experimental satellite launch vehicle, all solid, four stages, 22 m, 17 tonnes, 40 kg class to LEO; August 1979 flight partially successful; 18 July 1980, Rohini RS-1
S3	ISRO, "ASLV". [source link]	ASLV: five stages, all solid, 24 m, 40 tonnes, 150 kg class to 400 km circular orbits; technologies proved; developmental flights from 24 March 1987 to 4 May 1994; ASLV-D3 on 20 May 1992 with SROSS-C (106 kg)
S4	ISRO, "PSLV". [source link]	Height 44 m; lift-off mass 320 tonnes (XL); four stages; S139 solid first stage (HTPB); solid strap-ons, 6 in XL, 4 in QL, 2 in DL, none in CA; second stage Vikas engine (UDMH + N2O4); solid third stage (HTPB); fourth stage with two liquid engines (MMH + MON); "Earth storable" liquid engines in the second and fourth stages; 1,750 kg to sun-synchronous polar orbit of 600 km; 1,425 kg to sub-GTO; first Indian launch vehicle with liquid stages; "Workhorse of ISRO"; first flight 20 September 1993 and first successful launch in October 1994; Chandrayaan-1 (2008), Mars Orbiter (2013), IRNSS satellites
S5	ISRO, "Geosynchronous Satellite Launch Vehicle Mark II". [source link]	Three stages; height 51.73 m with ogive fairing; lift-off mass 420 tonnes; 2,250 kg to GTO; 6,000 kg to LEO; S139 solid first stage (HTPB); four liquid strap-ons, each with one Vikas engine; second stage Vikas engine (UH25 + N2O4); cryogenic upper stage with CE-7.5 (LOX + LH2), "India's first cryogenic engine"; Russian-supplied cryogenic stages used initially; first flight 18 April 2001; first flight with indigenous cryogenic stage given as 5 January 2014
S6	ISRO, "LVM3 (Geosynchronous Satellite Launch Vehicle Mk III)". [source link]	Earlier name; three stages: two S200 solid strap-ons (HTPB), L110 liquid core with two Vikas engines, C25 cryogenic stage with CE-20 (LOX/LH2), "India's largest cryogenic engine"; height 43.5 m; lift-off mass 640 tonnes; 4,000 kg to GTO; 8,000 kg to LEO; lift-off on the two S200 boosters and ignition of L110 at about 113 seconds
S7	ISRO, "SSLV". [source link]	Three solid stages (HTPB) and a liquid Velocity Trimming Module (MMH + MON-3) as terminal stage; length 34 m; diameter 2 m; lift-off mass about 120 tonnes; single satellite up to 500 kg or multiple satellites of 10 to 300 kg to a 500 km planar orbit; key features
S8	ISRO, "List of PSLV Launches". [source link]	Mission dates from PSLV-D1 (20 September 1993) to PSLV-C62 (12 January 2026); dates of PSLV-D2, PSLV-C6, PSLV-C11, PSLV-C25, PSLV-C37, PSLV-C57, PSLV-C61; variant labels; the label PSLV-G against missions from PSLV-D1 to PSLV-C7 (10 January 2007) and against PSLV-C16 (20 April 2011)
S9	ISRO, "List of GSLV Launches". [source	Mission dates from GSLV-D1 (18 April 2001) to GSLV-F17

No.	Source	Used for
	link]	(4 September 2026); GSLV-F14/INSAT-3DS (17 February 2024); GSLV-F15/NVS-02 (29 January 2025); GSLV-F16/NISAR (30 July 2025)
S10	ISRO, "List of LVM3 Launches". [source link]	Mission dates from the LVM-3/CARE mission (18 December 2014) to LVM3-M6 (24 December 2025); dates of D1, M1, M2, M4, M5
S11	ISRO, "List of SSLV Launches". [source link]	Mission dates: SSLV-D1 (7 August 2022), SSLV-D2 (10 February 2023), SSLV-D3 (16 August 2024)
S12	ISRO, "Launch Missions" and ISRO home page. [source link] and [source link]	Historical launch dates, vehicle labels, payloads and mission outcomes; supplementary cross-check for the landmark-mission chronology
S13	ISRO, "PSLV-D1" and "PSLV-D2". [source link] and [source link]	PSLV-D1 on 20 September 1993, IRS-1E could not be placed in orbit; PSLV-D2 successfully launched IRS-P2 on 15 October 1994
S14	ISRO, "PSLV-C11", "PSLV-C25" and "PSLV-C37". [source link] , [source link] and [source link]	Chandrayaan-1 on 22 October 2008; Mars Orbiter Mission spacecraft on 5 November 2013; 104 satellites on 15 February 2017 into a 505 km polar sun-synchronous orbit; Second Launch Pad used for Cartosat-1 in 2005
S15	ISRO, "PSLV-C61/EOS-09 Mission". [source link]	18 May 2025; observation in the third stage, mission could not be accomplished
S16	ISRO, "PSLV-C62 / EOS-N1 Mission" and "PSLV Update" (25 February 2026). [source link] and [source link]	12 January 2026; anomaly at the end of the PS3 stage; NSIL commercial mission; national-level expert committee reviewing the anomaly
S17	ISRO, "Aditya-L1". [source link]	Aditya-L1 launched by PSLV-C57 on 2 September 2023
S18	ISRO, "GSLV-D3 / GSAT-4" and "GSLV-D5/GSAT-14". [source link] and [source link]	GSLV-D3 on 15 April 2010: maiden flight test of the indigenous cryogenic upper stage, which uses liquid hydrogen and liquid oxygen, unsuccessful; GSLV-D5 on 5 January 2014: indigenous cryogenic stage validated, GSAT-14
S19	ISRO, GSLV-F16/NISAR press note and launch brochure. [source link] and [source link]	NISAR launched on 30 July 2025; first mission with GSLV to sun-synchronous polar orbit; GSLV height 51.70 m and lift-off mass 420.5 tonnes; stage propellants
S20	ISRO, "GSLV-F17/EOS-05 Mission" and mission brochure. [source link] and [source link]	EOS-05 placed in the intended sub-GTO; EOS-05 described as an Earth observation spacecraft and as "India's first ever imaging satellite from Geosynchronous orbit"; sub-GTO with a nominal perigee of 170 km and apogee of 28,934 km; launch from the Second Launch Pad; first stage shown as S139 with four L40H strap-ons; vehicle height 51.7 m and lift-off mass 420.5 tonnes
S21	ISRO, "LVM-3/CARE Mission" and "LVM3-D1/GSAT-19 Mission". [source link] and [source link]	Experimental flight of 18 December 2014 with the CARE crew module and a passive cryogenic stage; first developmental flight on 5 June 2017 with GSAT-19 (3,136 kg) to GTO
S22	ISRO, "LVM3-M1 / Chandrayaan-2 Mission" and "Chandrayaan-3". [source link] and [source link]	Chandrayaan-2 launched on 22 July 2019; Chandrayaan-3 launched by LVM3-M4 on 14 July 2023 from the Second Launch Pad
S23	ISRO, "LVM3 M2 / OneWeb India-1	36 OneWeb satellites, 5,796 kg; first commercial mission

No.	Source	Used for
	Mission". [source link]	of LVM3; first launch of LVM3 to LEO
S24	ISRO, "LVM3-M5/CMS-03 Mission". [source link]	CMS-03, about 4,400 kg, heaviest communication satellite launched to GTO from Indian soil; 2 November 2025
S25	ISRO, "LVM3-M6 / BlueBird Block-2 Mission" and mission brochure. [source link] and [source link]	BlueBird Block-2, about 6,100 kg, heaviest payload to LEO in LVM3's launch history; payload capability of 4,200 kg to GTO; L110 propellant UH25 + N2O4; height 43.5 m and lift-off mass 640 tonnes; L110 ignition at 105.98 seconds in the flight profile
S26	ISRO, SSLV-D1, SSLV-D2 and SSLV-D3 mission pages and the SSLV-D3 brochure. [source link] , [source link] , [source link] and [source link]	SSLV-D1 fell short of placing the satellites in their intended orbits; SSLV-D2 the first SSLV to launch satellites successfully, EOS-07, Janus-1 and AzaadiSAT-2 to a 450 km circular orbit; SSLV-D3 placed EOS-08 in a 475 km circular orbit and completed the development project; launches from the First Launch Pad; role of the Velocity Trimming Module
S27	ISRO, "Technology Transfer Agreement of SSLV" (11 September 2025). [source link]	Agreement signed on 10 September 2025 by NSIL, ISRO, IN-SPACe and HAL; Sriharikota for inclined launches and Kulasekarapattinam for polar launches
S28	ISRO, "Cabinet approves Third Launch Pad". [source link]	Approval on 16 January 2025; Rs 3,984.86 crore; 48 months; for NGLV and LVM3 with semicryogenic stage; standby for the Second Launch Pad; First Launch Pad built for PSLV and supporting PSLV and SSLV; Second Launch Pad mainly for GSLV and LVM3 and standby for PSLV
S29	ISRO, "SSLV Launch Complex, Kulasekarapattinam" (March 2025) and "Foundation Stone Laid for Launch Pad at SSLV Launch Complex" (29 August 2025). [source link] and [source link]	Foundation stone by the Prime Minister on 28 February 2024; construction of facilities began on 5 March 2025; launch pad foundation stone on 27 August 2025; Tuticorin district, Tamil Nadu; targeted for completion by the end of 2026; meant for polar launches of SSLV and launches by non-governmental enterprises
S30	SDSC SHAR: ISRO centre page, the centre's own "About" page, and a tender notice of the centre dated 14 August 2025. [source link] , [source link] and [source link]	Spaceport of India; island between Pulicat Lake and the Bay of Bengal; address given as SPSR Nellore district on the older pages and as "Tirupati District (A.P)" in the 2025 notice; renamed Satish Dhawan Space Centre SHAR on 5 September 2002
S31	Wikipedia, "Tirupati district" (citing The Hindu, 30 March 2022, "New districts to come into force on April 4", and The Hans India, 4 April 2022). [source link]	Tirupati district came into existence on 4 April 2022; Sullurupeta revenue division came to it from Nellore district; the district is home to the Satish Dhawan Space Centre; on 31 December 2025 only Gudur, Kota and Chillakur mandals went back to Nellore district (the article cites Eenadu, 30 December 2025)
S32	NewSpace India Limited: home page, "PSLV production", "SSLV manufacturing" and "Launch services". [source link] , [source link] , [source link] and [source link]	NSIL as a company under the Department of Space and the commercial arm of ISRO; nodal agency for PSLV production through an industry consortium; responsibility for SSLV manufacture through industry; launch services; First Launch Pad's first launch on 20 September 1993; Second Launch Pad operational in 2005 with first launch on 5 May 2005
S33	Press Information Bureau, Cabinet release of 18 September 2024 on the Next	NGLV approved on 18 September 2024; maximum payload of 30 tonnes to LEO; reusable first stage

No.	Source	Used for
	Generation Launch Vehicle (Release ID 2055994), as reproduced by GlobalSecurity.org. [source link]	
S34	NASA Glenn Research Center, "Rocket Staging" and "Rocket Propulsion". [source link] and [source link]	Why launchers are staged; serial and parallel staging; strap-ons; solid and liquid propellants compared
S35	Wikipedia, "SSLV Launch Complex" (citing Indian news reports of 2024 and 2025). [source link]	Present name of the district, Thoothukudi; no SSLV launch from the complex so far
S36	Government of Andhra Pradesh, Tirupati district website, "About District". [source link]	Tirupati district has three revenue divisions, with headquarters at Tirupati, Srikalahasti and Sullurpet, and 36 revenue mandals, as the page read on 8 October 2026; so Sullurupeta (Sullurpet) revenue division is in Tirupati district
S37	ISRO, "GSLV-F14/INSAT-3DS Mission". [source link]	INSAT-3DS as a meteorological satellite for geostationary orbit, launched on 17 February 2024 into a geosynchronous transfer orbit; its payloads include a 6 channel Imager
S38	Wikipedia, "Geosynchronous Satellite Launch Vehicle". [source link]	The name GSLV Mk I for the flights that used the Russian cryogenic stage, and GSLV Mk II for the version with the Indian cryogenic upper stage

DAY 2 · TOPIC 18

Syllogisms solved with Venn diagrams

1. Concept in one line

A syllogism question gives two or three statements about groups, to be taken as true, and asks which conclusions must then be true. You draw a Venn diagram, with one circle for each group, and accept a conclusion only if it holds in every diagram that fits the statements.

2. Revision notes

2.1 What a syllogism question is

- A syllogism is deductive reasoning in which a conclusion is drawn from two statements that are taken to be true. It has three terms, that is, three groups. The group named in both statements is the middle term; it links the other two. An exam question gives two or three statements; when there are three, you still work with two statements at a time (see 2.4).
- Exam format: two or three statements, then conclusions numbered I and II. You decide which conclusions follow.
- Take every statement as true, even if it clashes with real life. From "All cats are birds" and "All birds are fish", the conclusion "All cats are fish" follows. The question tests the reasoning, not the facts.
- A conclusion follows only if it must be true whenever the statements are true. In diagram terms: it is true in every diagram that fits the statements.
- A diagram that fits the statements but makes the conclusion false is a counter-example. One counter-example is enough to reject a conclusion.
- From Day 1: "some" means "at least one" and does not rule out "all". "All A are B" does not by itself show that B has members outside A.
- Convention for this topic: every group named in the statements has at least one member, so no group is empty. In another test, follow its stated convention; universal statements alone do not establish existence in modern set-based logic.
- Not covered here: "possibility" conclusions and "either-or" (complementary pair) answers, which are a separate topic on another day.

2.2 The four standard statements and the diagrams each allows

Two groups A and B, neither of them empty, can be related in exactly five ways, so there are exactly five diagrams. What is counted is how the two circles lie with respect to each other, not their size or their place on the page. These are the four relations of Day 1, with "proper subset" counted once for each direction.

Diagram	Picture in words
1	One circle carrying both labels: A and B are equal sets
2	Circle A wholly inside a larger circle B: A is a proper subset of B
3	Circle B wholly inside a larger circle A: B is a proper

Diagram	Picture in words
	subset of A
4	Two circles that partly overlap: some members are common, and each group also has members of its own
5	Two circles that do not touch: no member is common

Statement	What it says	Diagrams it allows	Diagrams it rules out
All A are B	Every member of A is in B	1, 2	3, 4, 5
No A is B	A and B have no common member	5	1, 2, 3, 4
Some A are B	At least one member of A is in B	1, 2, 3, 4	5
Some A are not B	At least one member of A is outside B	3, 4, 5	1, 2

- Only "No A is B" fixes a single diagram. Each of the other statements leaves two or more diagrams open, so one drawing can mislead.

2.3 Inferences from a single statement (conversion)

Conversion means swapping the two groups: from a statement about "A ... B" you move to a statement about "B ... A".

Given statement	Definitely follows	Does not follow (diagram where it fails)
All A are B	Some B are A; Some A are B	All B are A (fails in diagram 2); Some B are not A (fails in diagram 1)
No A is B	No B is A; Some A are not B; Some B are not A	Some A are B; Some B are A (both fail in diagram 5)
Some A are B	Some B are A	All A are B (fails in diagrams 3 and 4); Some A are not B (fails in diagrams 1 and 2)
Some A are not B	Nothing about "B ... A"	Some B are not A (fails in diagram 3); Some B are A (fails in diagram 5); No B is A (fails in diagrams 3 and 4)

- "No" and "Some ... are" convert as they stand. "All" converts only to "Some". "Some ... are not" does not convert at all.
- The "some" inferences drawn from "All A are B" and from "No A is B" rest on the assumption that no group is empty.

2.4 Method for two or three statements

1. Mark the groups. For each pair of statements, find the middle term.

2. Draw the statements one at a time, each in the simplest way it allows.
3. Test each conclusion on this diagram. If it is false here, it does not follow: this diagram is your counter-example.
4. If it is true here, try to break it. Redraw the circles in every other way the statements allow (use the table in 2.2). If the conclusion is false in any one of these diagrams, it does not follow.
5. If the statements block every such attempt, the conclusion follows. A quick way to see this: a "some" statement gives you one definite member. Follow that member. "All" carries it into the larger group; "No" keeps it out of the other group.
6. With three statements, work link by link: take what definitely follows from the first two, then bring in the third.

Three quick rules for a pair of statements with middle term B:

- At least one statement must speak about every B: "All B are X", "No B is X", "No X is B" or "Some X are not B". If B appears only as "All X are B", "Some B are X", "Some X are B" or "Some B are not X", no conclusion links the other two groups.
- Two "some" statements give no conclusion that links the other two groups.
- Two negative statements ("No" or "Some ... are not") give no conclusion that links the other two groups.

2.5 Common two-statement combinations (B is the middle term)

No.	Statements	Definitely follows about A and C	Tempting, but does not follow
1	All A are B; All B are C	All A are C; Some A are C; Some C are A	All C are A (C may be the larger circle)
2	All A are B; No B is C	No A is C; No C is A; Some A are not C; Some C are not A	Some A are C
3	Some A are B; All B are C	Some A are C; Some C are A	All A are C (part of A may lie outside C)
4	Some A are B; No B is C	Some A are not C	Some C are not A; No A is C (C may lie wholly inside A, clear of B)
5	No A is B; All B are C	Some C are not A	No A is C; Some A are not C (A may lie wholly inside C, clear of B)
6	No A is B; Some B are C	Some C are not A	Some A are not C (A may lie wholly inside C)
7	All A are B; Some B are C	Nothing	Some A are C (C may cut only the part of B outside A)
8	Some A are B; Some B are C	Nothing	Some A are C (A and C may be separate)
9	No A is B; No B is C	Nothing	No A is C (A and C may be the same group)
10	All A are B; All C are B	Nothing	Some A are C (A and C may be separate circles

No.	Statements	Definitely follows about A and C	Tempting, but does not follow
			inside B)

- The "some" conclusions in rows 1 and 2, and the conclusion in row 5, rest on the assumption that no group is empty. Rows 3, 4 and 6 do not need it.

3. Extra section: worked examples

A. Two statements: one conclusion follows, one does not

Statements: All doors are windows. Some windows are walls.

Conclusions: I. Some doors are walls. II. Some windows are doors.

- Middle term: Windows. The first statement has Windows at the end of an "All" statement, and the second speaks of only some windows. So no statement covers every window.
- Simplest diagram: the Doors circle inside the Windows circle; the Walls circle partly overlapping Windows.
- Conclusion I: draw the Walls circle so that it cuts only the part of Windows that lies outside Doors. Both statements are still true, but no door is a wall. Conclusion I does not follow.
- Conclusion II: this is the conversion of "All doors are windows". The Doors group is not empty (the usual exam assumption). Wherever the Doors circle is drawn, every door is a window, so at least one window is a door. Conclusion II follows.
- Answer: only conclusion II follows.

B. Two "some" statements: the end groups are not linked

Statements: Some buses are trains. Some trains are boats.

Conclusions: I. Some buses are boats. II. All trains are buses.

- Counter-example for I: the Buses and Boats circles do not touch each other, and the Trains circle partly overlaps each of them (the chain pattern of Day 1). Both statements are true, but no bus is a boat.
- Counter-example for II: the same diagram. The trains that are boats are not buses.
- Answer: neither conclusion I nor II follows. What does follow, by conversion: "Some trains are buses" and "Some boats are trains".

C. Three statements: work link by link

Statements: All tigers are lions. No lion is a horse. Some horses are goats.

Conclusions: I. No tiger is a horse. II. Some goats are not lions.

- First two statements: Tigers lies inside Lions (or they are one circle), and the Horses circle is separate from Lions. So Tigers and Horses can never touch. Conclusion I holds in every diagram.
- Bring in the third statement: at least one horse is a goat. Call it x. x is a horse, and no lion is a horse, so x is not a lion. So x is a goat that is not a lion. Conclusion II holds in every diagram.
- Do not overreach. x is not a lion, and all tigers are lions, so x is not a tiger either. So "Some goats are not tigers" follows. But "No goat is a tiger" does not follow, because the Goats circle may stretch across and overlap Lions and Tigers.

- Answer: both conclusions I and II follow.

4. Three common exam traps

1. **"All" with "Some" does not always make a chain.** "All A are B; Some B are C" gives nothing about A and C, because the C that are B may lie outside A. But "All B are C; Some A are B" does give "Some A are C". Check whether the "All" statement begins with the middle term. Two "some" statements never link the end groups.
2. **Turning a statement round wrongly.** "All A are B" gives "Some B are A" (because no group is empty), never "All B are A". "Some A are not B" gives nothing about "B ... A": if B lies wholly inside A, every B is an A. And "Some A are B" does not give "Some A are not B", because "some" does not rule out "all".
3. **"True in my diagram" or "true in real life" is not "follows".** The usual sketch of "Some A are B", two overlapping circles, also shows a part of A outside B, but that part is not given. A conclusion must hold in every diagram the statements allow, and one counter-example rejects it. In the same way, a conclusion that matches real life does not follow unless the statements force it, and a conclusion that sounds absurd follows if they do.

Practice and explanations

Q1. Two statements are given below, followed by two conclusions numbered I and II. Take the statements to be true even if they seem to differ from commonly known facts, and decide which of the conclusions logically follow(s) from the statements. For these questions, assume every named group is non-empty.

Statements:

- All books are bags.
- Some pens are books.

Conclusions:

- I. Some bags are pens.
- II. Some books are pens.
- (1) Only conclusion I follows
- (2) Only conclusion II follows
- (3) Both conclusions I and II follow
- (4) Neither conclusion I nor II follows

Q1. Answer: (3) Both conclusions I and II follow

- Groups: Books, Bags, Pens. Middle term: Books. "All books are bags" speaks about every book, so the link through Books can work.
- Diagrams that fit the first statement: the Books circle wholly inside a larger Bags circle, or one circle for both.
- Diagrams that fit the second statement: the Pens circle shares at least one member with Books. Pens may (a) partly overlap Books, with the rest of Pens inside Bags, outside Bags, or both; (b) lie wholly inside Books; (c) wholly contain Books, and then it may stay inside Bags, be the same circle as Bags, stick out of Bags or contain Bags; (d) be the same circle as Books.
- In every one of these diagrams there is at least one thing, call it x, that is both a pen and a book.

- Conclusion I, "Some bags are pens": x is a book, and all books are bags, so x is a bag. x is also a pen. So a bag that is a pen exists in every diagram. To break the conclusion you would have to pull the Pens circle clear of Bags; but then it could not touch Books, which lie inside Bags, and the second statement would be false. Conclusion I follows.
- Conclusion II, "Some books are pens": x is a book and a pen. This is the conversion of the second statement, and it holds in every diagram. Conclusion II follows.
- Why (1) is wrong: it rejects conclusion II, as if "Some pens are books" could not be turned round. A "Some ... are" statement always converts.
- Why (2) is wrong: it rejects conclusion I by applying "All with Some gives nothing". That is true of "All A are B; Some B are C", where no statement covers the whole middle term. Here the "All" statement begins with the middle term, Books.
- Why (4) is wrong: it makes both of these mistakes.

Q2. Three statements are given below, followed by two conclusions numbered I and II. Take the statements to be true even if they seem to differ from commonly known facts, and decide which of the conclusions logically follow(s) from the statements. For these questions, assume every named group is non-empty.

Statements:

- All cups are plates.
- Some plates are spoons.
- No spoon is a knife.

Conclusions:

- I. Some cups are spoons.
- II. Some knives are not plates.
- (1) Only conclusion I follows
- (2) Only conclusion II follows
- (3) Both conclusions I and II follow
- (4) Neither conclusion I nor II follows

Q2. Answer: (4) Neither conclusion I nor II follows

- Groups: Cups, Plates, Spoons, Knives.
- First statement: the Cups circle lies wholly inside the Plates circle, or the two are one circle.
- Second statement: the Spoons circle shares at least one member with Plates. It may (a) overlap only the part of Plates that is outside Cups; (b) overlap Cups as well; (c) lie wholly inside Plates, either clear of Cups or touching Cups; (d) wholly contain Plates, or be the same circle as Plates, so that every cup is also a spoon.
- Third statement: the Knives circle never touches Spoons. Otherwise it is free. It may lie wholly outside Plates, partly inside Plates, or wholly inside Plates (even inside Cups), wherever Plates has room that is free of Spoons.
- Conclusion I, "Some cups are spoons": it is true in (b) but false in (a). Counter-example: a small Cups circle inside Plates; the Spoons circle overlapping Plates on the other side, clear of Cups; the Knives circle apart from all of them. In sets: Plates = {p, q}, Cups = {p}, Spoons = {q, s}, Knives = {k}. All three statements are true, and no cup is a spoon. Conclusion I does not follow.

- Conclusion II, "Some knives are not plates": it is true when the Knives circle lies outside Plates, but false when it lies wholly inside. Counter-example: keep the diagram above, but put the Knives circle wholly inside Plates, in the part that is free of Spoons. In sets: Plates = {p, q}, Cups = {p}, Spoons = {q, s}, Knives = {p}. The three statements are still true, and every knife is a plate. Conclusion II does not follow.
- What does follow: "Some plates are not knives", because the plate that is a spoon cannot be a knife. This cannot be turned round into conclusion II: a "Some ... are not" statement does not convert.
- Why (1) is wrong: it treats "All cups are plates; Some plates are spoons" as a chain. No statement covers every plate, so the plates that are spoons need not be cups.
- Why (2) is wrong: it converts "Some plates are not knives" into "Some knives are not plates".
- Why (3) is wrong: it makes both of these mistakes.

7. Sources

7.1 Sources

No.	Source	Used for
S1	NCERT, *Mathematics* textbook for Class XI, Chapter 1 "Sets": Section 1.3 (empty set), Section 1.6 (subset), Section 1.8 "Venn Diagrams" and Section 1.9.2 (intersection and disjoint sets), reprint 2026-27. [source link]	Set terms used in the diagrams: empty set, subset, intersection, disjoint sets; Venn diagrams named after John Venn
S2	Matthew Knachel, *Fundamental Methods of Logic* (open textbook hosted on Humanities LibreTexts; CC BY 4.0), Section 3.2 "Classes and Categorical Propositions". [source link]	The four standard statements (All S are P; No S are P; Some S are P; Some S are not P) and what each says about the two classes; "some" means "there is at least one" and does not imply that some are not
S3	Knachel, *Fundamental Methods of Logic*, Section 3.4 "Operations on Categorical Sentences". [source link]	Conversion: the converses of "No S are P" and "Some S are P" are equivalent to the originals; the converses of "All S are P" and "Some S are not P" are not
S4	Knachel, *Fundamental Methods of Logic*, Section 3.5 "Problems with the Square of Opposition". [source link]	The assumption that the classes named are not empty (existential import); on that assumption a universal statement implies the matching "some" statement; the inference fails if empty classes are allowed
S5	Knachel, *Fundamental Methods of Logic*, Section 3.6 "Categorical Syllogisms". [source link]	A categorical syllogism has two premises and a conclusion; the middle term appears in both premises; diagram test: draw the premises and ask whether the picture forces the conclusion; an argument is valid when true premises guarantee the conclusion
S6	Wikipedia, "Categorical proposition" (reference list includes Copi and Cohen, *Introduction to Logic*, 11th ed., 2002; Churchill, *Logic: An Introduction*, 2nd ed., 1990; Hausman, Kahane and Tidman, *Logic and Philosophy*, 11th ed., 2010). [source link]	"Some" means "one or more" and is consistent with "all"; converses of the E and I forms are valid; "All S are P" gives "Some P are S" if S has members; which terms a statement covers in full (distribution)
S7	Wikipedia, "Converse (logic)", part on conversion in traditional logic (citing Parry	Simple conversion is valid only for "No S is P" and "Some S is P"; "All S are P" converts only to "Some P is S"; the

No.	Source	Used for
	and Hacker, *Aristotelian Logic*, SUNY Press, 1991, p. 207; Hyslop, *The Elements of Logic*, 1892, p. 156). [source link]	simple converse of "Some S is not P" is not valid
S8	Wikipedia, "Syllogism" (citing Aristotle, *Prior Analytics*; Copi, *Introduction to Logic*, 1969; Khemlani and Johnson-Laird, "Theories of the syllogism: A meta-analysis", 2012). [source link]	A syllogism draws a conclusion from two propositions assumed to be true; three terms and the middle term; the valid forms behind rows 1 to 6 of the table in 2.5 (Barbara, Celarent, Darii, Ferio, Fesapo, Fresison); the fallacies of the undistributed middle and of two negative premises; "some A are B, some B are C" does not give "some A are C"
S9	Wikipedia, "Validity (logic)" (citing the Internet Encyclopedia of Philosophy, "Validity and Soundness"; Beall and Restall, "Logical Consequence", *Stanford Encyclopedia of Philosophy*). [source link]	An argument is valid when it is impossible for the premises to be true and the conclusion false; the premises need not be actually true
S10	Terence Parsons, "The Traditional Square of Opposition", *Stanford Encyclopedia of Philosophy*, Sections 1, 1.1 and 1.2. [source link]	The four forms A, E, I and O; the E and I forms convert simply; if "Every S is P" is taken to require that there are S's, the matching "some" statement follows
S11	Wikipedia, "Euler diagram" (citing Moktefi and Shin, "A History of Logic Diagrams", 2012; Venn, *Symbolic Logic*, 1881). [source link]	Circles drawn inside, overlapping or apart to show the relations of classes; such diagrams were first developed for syllogisms; one drawing can stand for more than one statement
S12	Testbook, "సిలాజిజం MCQ Quiz in తెలుగు" (a Telugu-language practice page). [source link]	Telugu wording in use for syllogism questions: ప్రకటనలు, తీర్మానాలు, అనుసరిస్తుంది, "ఏ ... కూడా ... కాదు"

DAY 2 · TOPIC 19

Fractions and decimals: comparing and ordering

1. Concept in one line

Fractions, decimals and percentages are compared by bringing them to one common form (the same denominator, the same numerator, decimals or percentages) or, for two fractions, by cross-multiplying. The exam asks for the greatest or the smallest of a set, or for its ascending or descending order, and the skill lies in choosing the quickest method that is safe.

2. Revision notes

2.1 Kinds of fractions

In a fraction a/b, a is the numerator and b is the denominator (b is not 0). In this table the numerators and denominators are positive.

Kind	Meaning	Example
Proper fraction	Numerator less than the denominator; value less than 1	3/8
Improper fraction	Numerator equal to or greater than the denominator; value 1 or more	11/4, 5/5
Mixed fraction	A whole number together with a proper fraction	2 3/4, that is, 2 + 3/4 = 11/4
Like fractions	Fractions with the same denominator	3/11, 7/11
Unlike fractions	Fractions with different denominators	3/4, 5/6
Equivalent fractions	Fractions with the same value; multiply or divide the numerator and the denominator by the same non-zero number	2/3 = 4/6 = 10/15

- A fraction is in lowest terms when its numerator and denominator have no common factor other than 1: 16/20 = 4/5.
- To compare positive mixed fractions, compare the whole-number parts first. If they are equal, compare the fractional parts. 2 3/4 > 2 5/7, because 3/4 > 5/7 (3 × 7 = 21, 4 × 5 = 20).

2.2 Comparing two fractions: the basic rules

1. **Same denominator** (the denominator is positive): the fraction with the greater numerator is the greater. 7/11 > 5/11.
2. **Same numerator** (numerators and denominators are positive): the fraction with the smaller denominator is the greater, because each part is bigger. 4/7 > 4/9.

3. **Cross-multiplication.** For a/b and c/d in which b and d are positive: if a × d > b × c, then a/b > c/d; if a × d < b × c, then a/b < c/d; if the two products are equal, the fractions are equal. 5/8 and 7/11: 5 × 11 = 55 and 8 × 7 = 56; 55 < 56, so 5/8 < 7/11. Remember that the product which starts with the numerator of the first fraction belongs to the first fraction.
4. **Equal denominators through the LCM.** 5/6 and 7/9: the LCM of 6 and 9 is 18. 5/6 = 15/18 and 7/9 = 14/18. So 5/6 > 7/9.
5. **Converting to decimals.** Divide the numerator by the denominator. 3/8 = 0.375 and 2/5 = 0.4. So 3/8 < 2/5. First check equality by simplifying or cross-multiplying. If the values are unequal, continue the division until the first differing decimal digit; treat an endless tail of 9s by the rule in 2.7.
6. **Comparing with 1/2 or with 1 (a benchmark).** Take a fraction whose numerator and denominator are positive. If twice the numerator is more than the denominator, the fraction is greater than 1/2; if it is less, the fraction is smaller than 1/2. In 5/9, 10 > 9, so it is greater than 1/2. In 6/13, 12 < 13, so it is smaller than 1/2. Hence 5/9 > 6/13. In the same way, any improper fraction greater than 1 is greater than every proper fraction.

2.3 Which method is quickest, and when

Method	Quickest when	Example
Compare the numerators	The denominators are already equal	5/11 < 7/11
Compare the denominators	The numerators are equal, or one numerator is a multiple of the other	3/7, 6/11: 6/14 < 6/11
Cross-multiplication	There are only two fractions	5/8 < 7/11, because 55 < 56
Equal denominators through the LCM	There are three or more fractions and the LCM of the denominators is small	5/6, 7/8, 11/12: LCM 24
Converting to decimals	The LCM is large, or the list also has decimals or percentages	5/8 = 0.625, 7/11 = 0.6363...
Comparing with 1/2 or with 1	The fractions lie on opposite sides of 1/2 or of 1	6/13 < 1/2 < 5/9
Gap from 1	All the fractions are close to 1	7/9 < 11/13 < 15/17

2.4 Shortcuts, and exactly when they hold

In this sub-section every numerator and denominator is positive.

Gap from 1.

- Of two numbers below 1, the one with the smaller gap from 1 is the greater. This is always true. It saves time when the fractions are close to 1, because the gaps (1 minus the fraction) then have small numerators.
- Special case: among positive proper fractions in which "denominator minus numerator" is the same number, the fraction with the bigger denominator is the greater. 7/9, 11/13, 15/17: the gaps are 2/9 > 2/13 > 2/17. So 7/9 < 11/13 < 15/17.

- Among positive fractions greater than 1 in which "numerator minus denominator" is the same number, the rule turns round: the fraction with the bigger denominator is the smaller. 9/7 > 13/11 > 17/15, because 1 + 2/7 > 1 + 2/11 > 1 + 2/15.
- If those differences are not the same number, compare the gaps themselves. 5/7 and 8/11: the gaps are 2/7 and 3/11. 2 × 11 = 22 and 7 × 3 = 21; 22 > 21, so 2/7 > 3/11. Therefore 5/7 < 8/11.

Adding the same number to the numerator and the denominator.

- Let a/b be a positive fraction and k a positive number. If a/b is a proper fraction, (a + k)/(b + k) is greater than a/b. If a/b is greater than 1, (a + k)/(b + k) is smaller than a/b. If a/b = 1, nothing changes. When a/b is not 1, the new fraction is closer to 1 and stays on the same side of 1.
- Reason: (a + k)/(b + k) - a/b = k(b - a)/(b(b + k)). This is positive when a < b and negative when a > b.
- Add 1 to the numerator and to the denominator. 3/5 becomes 4/6 = 2/3, which is greater. 7/4 = 1.75 becomes 8/5 = 1.6, which is smaller.
- Subtracting the same positive number does the opposite, as long as the numerator and the denominator stay positive: when 2 is subtracted from each, 5/7 becomes 3/5, which is smaller.

2.5 Negative fractions

- First move the minus sign to the numerator, so that the denominator is positive: 3/(-5) = -3/5.
- Every negative fraction is less than 0. So it is less than every positive fraction.
- To compare two negative fractions, compare them without their signs and then reverse the result: 2/3 < 3/4, so -2/3 > -3/4. On the number line, -3/4 lies to the left of -2/3.
- Cross-multiplication works here too, if the sign stays with the numerator: (-2) × 4 = -8 and 3 × (-3) = -9; -8 > -9, so -2/3 > -3/4.
- When the numerator is negative, rule 2 of 2.2 turns round: -4/7 < -4/9.

2.6 Putting three or more fractions in order

1. Write every fraction with a positive denominator. Change mixed fractions into improper fractions; if they are positive, you may compare their whole-number parts first instead.
2. First separate the boundary values 0, 1/2 and 1, if present. Sort the remaining fractions into four groups: negative, strictly between 0 and 1/2, strictly between 1/2 and 1, and greater than 1. Insert the boundary values in their correct positions. The order across these groups is then settled.
3. Use one method for all the fractions of a group: the LCM method if the LCM is small, decimals otherwise.
4. Look at the direction asked. Ascending order means the smallest first and the greatest last. Descending order means the greatest first and the smallest last.

2.7 Comparing decimals

- For positive decimals, compare the whole-number parts first. If they are equal, compare the digits in the tenths place, then in the hundredths place, then in the thousandths place, and so on. The first place in which the digits differ settles the result. 4.382 < 4.39 (in the hundredths place, 8 < 9).
- If the numbers of decimal places (the digits after the decimal point) differ, add zeros at the end to make them equal. This does not change the value: 0.5 = 0.50 = 0.500. So 0.5 > 0.459. A decimal is not greater merely because it has more digits.

- A zero put in just after the decimal point does change the value: 0.5, 0.05 and 0.005 are different numbers.
- To compare recurring decimals, write out the repeating block a few times and compare place by place. Take 0.58, 0.555..., 0.5858... and 0.5888.... Written to four decimal places they are 0.5800, 0.5555, 0.5858 and 0.5888. So 0.555... < 0.58 < 0.5858... < 0.5888....
- One exception: decimals in which 9 repeats without end. 0.999... = 1 and 0.4999... = 0.5. (By the Day 1 method: if x = 0.999..., then 10x - x = 9, so x = 1.) Here a place-by-place comparison can give a wrong answer: it makes 0.4999... look smaller than 0.5, though the two are equal. So first replace such a decimal by its equal form (0.4999... by 0.5).
- For negative decimals the order turns round: 0.75 > 0.7, so -0.75 < -0.7.

2.8 Fractions, decimals and percentages in one list

- Bring them all to one form. Decimals are usually the easiest.
- To change a fraction into a decimal, divide the numerator by the denominator. To change a decimal into a percentage, multiply by 100 (move the decimal point two places to the right). To change a percentage into a decimal, divide by 100 (move the point two places to the left). 62% = 0.62; 3/8 = 0.375 = 37.5%.

Fraction	Decimal	Percentage
1/2	0.5	50%
1/3	0.333...	33.33...%
1/4	0.25	25%
1/5	0.2	20%
1/6	0.1666...	16.66...%
1/7	0.142857...	14.28...%
1/8	0.125	12.5%
1/9	0.111...	11.11...%
1/11	0.0909...	9.09...%
1/12	0.0833...	8.33...%

- Multiples of these values give the others: 5/8 = 5 × 0.125 = 0.625; 4/7 = 4 × 0.142857... = 0.5714....

2.9 Finding a fraction between two fractions

- **Average.** The average of two different numbers always lies between them. Between 2/5 and 3/7: (14/35 + 15/35) ÷ 2 = 29/70.
- **Add the numerators and add the denominators.** If a, b, c and d are positive and a/b and c/d are different fractions, (a + c)/(b + d) lies strictly between them. Between 2/5 and 3/7: 5/12 (0.4 < 0.4166... < 0.4285...). This is not the sum of the two fractions (2/5 + 3/7 = 29/35). It is the exact midpoint only when the two denominators are equal.
- **Common denominator.** 2/5 = 28/70 and 3/7 = 30/70. So 29/70 lies between them. A still bigger common denominator gives more fractions in between.

Other days cover the four operations and simplification with fractions and decimals, and the HCF and LCM of fractions. Changing a recurring decimal into a fraction was done on Day 1 (Topic 9).

3. Extra section: worked examples, one for each method

1. **Cross-multiplication.** Compare 9/14 and 16/25. 9 × 25 = 225 and 14 × 16 = 224. 225 > 224, so 9/14 > 16/25. Check: 9/14 = 0.6428... and 16/25 = 0.64.
2. **LCM.** Arrange 5/6, 7/8 and 11/12 in ascending order. The LCM of 6, 8 and 12 is 24: 20/24, 21/24, 22/24. So 5/6 < 7/8 < 11/12. Check by gaps from 1: 1/6 > 1/8 > 1/12.
3. **Making the numerators equal.** Arrange 3/7, 6/11 and 2/5 in descending order. Make every numerator 6: 6/14, 6/11, 6/15. The fraction with the smallest denominator is the greatest. So 6/11 > 3/7 > 2/5. Check: 0.5454..., 0.4285..., 0.4.
4. **Comparing with 1/2.** Compare 4/9 and 7/13. 2 × 4 = 8 < 9, so 4/9 < 1/2. 2 × 7 = 14 > 13, so 7/13 > 1/2. Hence 7/13 > 4/9. Check: 4 × 13 = 52 < 9 × 7 = 63.
5. **Gap from 1.** Arrange 13/15, 17/19 and 23/25 in ascending order. In each fraction the denominator is 2 more than the numerator. The gaps from 1 are 2/15 > 2/19 > 2/25. So 13/15 < 17/19 < 23/25. Check: 0.8666..., 0.8947..., 0.92.
6. **Negative fractions.** Arrange -5/6, -3/4 and -7/9 in ascending order. Without the signs, and with the LCM 36: 30/36, 27/36, 28/36. That is, 3/4 < 7/9 < 5/6. For the negative fractions the order turns round: -5/6 < -7/9 < -3/4. Check: -0.8333..., -0.7777..., -0.75.
7. **Decimals with different numbers of digits.** Arrange 0.7, 0.07, 0.707, 0.77 and 0.0777 in descending order. Write them all to four decimal places: 0.7000, 0.0700, 0.7070, 0.7700, 0.0777. So 0.77 > 0.707 > 0.7 > 0.0777 > 0.07. Check: multiplying each by 10,000 gives 7700 > 7070 > 7000 > 777 > 700.
8. **Recurring decimals.** Arrange 0.36, 0.3636..., 0.3666... and 0.333... in ascending order. To four decimal places: 0.3600, 0.3636, 0.3666, 0.3333. So 0.333... < 0.36 < 0.3636... < 0.3666.... Check as fractions: 1/3 < 9/25 < 4/11 < 11/30 (cross products 25 < 27; 99 < 100; 120 < 121).
9. **Fractions, decimals and percentages together.** Arrange 5/8, 0.6, 62%, 0.666... and 7/11 in ascending order. As decimals: 0.625, 0.6, 0.62, 0.666..., 0.6363.... So 0.6 < 62% < 5/8 < 7/11 < 0.666.... Check as percentages: 60 < 62 < 62.5 < 63.63... < 66.66....
10. **A fraction in between.** Find a fraction between 3/5 and 2/3. Adding the numerators and adding the denominators gives 5/8. The average gives (9/15 + 10/15) ÷ 2 = 19/30. Check: 0.6 < 0.625 < 0.6333... < 0.666....

4. Three common exam traps

1. **What looks bigger is not always bigger.** For positive fractions with equal numerators and positive denominators, the fraction with the bigger denominator is the smaller (4/9 < 4/7). For equal negative numerators, the order reverses (-4/9 > -4/7). A decimal is not greater merely because it has more digits (0.459 < 0.5; 0.0777 < 0.7). A fraction need not be greater even when both its numerator and its denominator are bigger: 11/20 < 3/5 (0.55 < 0.6).
2. **Sign and direction.** For negative numbers the order turns round: 5/6 > 3/4, yet -5/6 < -3/4. Ascending order means the smallest first; descending order means the greatest first. If every comparison is right but the order is written in the wrong direction, the answer is still wrong. Examiners often give the correct order reversed as one of the options.
3. **A shortcut used where its condition does not hold.** "Same difference between numerator and denominator, so the fraction with the bigger terms is greater" is true only for proper fractions; for fractions greater than 1 it turns round (9/7 > 13/11). Adding the same positive number to a positive numerator and denominator generally changes the value (3/5 is not equal to 4/6); the exception is a fraction equal to 1. Multiplying or dividing both by the same non-zero number

preserves the value. A recurring decimal is not the same as its cut-off form: 0.6363... > 0.63, and 3/7 = 0.4285... > 0.428.

Practice and explanations

Q1. Which one of the following shows the fractions 5/8, 7/12, 11/18 and 13/24 in ascending order?

- (1) 5/8 < 7/12 < 11/18 < 13/24
- (2) 13/24 < 7/12 < 11/18 < 5/8
- (3) 13/24 < 11/18 < 7/12 < 5/8
- (4) 5/8 < 11/18 < 7/12 < 13/24

Q1. Answer: (2) 13/24 < 7/12 < 11/18 < 5/8

- Worked solution: the LCM of 8, 12, 18 and 24 is 72. 5/8 = 45/72, 7/12 = 42/72, 11/18 = 44/72 and 13/24 = 39/72. As 39 < 42 < 44 < 45, the ascending order is 13/24 < 7/12 < 11/18 < 5/8.
- Check by decimals: 13/24 = 0.5416..., 7/12 = 0.5833..., 11/18 = 0.6111..., 5/8 = 0.625.
- Check, by cross-multiplication, of the pair on which options (2) and (3) differ: 7 × 18 = 126 and 12 × 11 = 132; 126 < 132, so 7/12 < 11/18.
- Why (1) is wrong: it arranges the fractions by the size of their numerators (5, 7, 11, 13). A bigger numerator means a greater fraction only when the denominators are equal.
- Why (3) is wrong: it looks at the denominators alone (24, 18, 12, 8) and takes a bigger denominator to mean a smaller fraction. That is true only when the numerators are equal. Here 7/12 is less than 11/18.
- Why (4) is wrong: it is the correct order reversed, that is, the descending order written with "<" signs.

Q2. Consider the following five numbers:

0.571, 5/9, 0.5757... (the block 57 repeats without end), 57.2% and 7/12

How many of these numbers are greater than 4/7?

- (1) One
- (2) Two
- (3) Three
- (4) Four

Q2. Answer: (3) Three

- Worked solution: 4/7 = 4 × 0.142857... = 0.571428.... Compare each number with it place by place.
- 0.571 = 0.5710. The first three decimal places are the same (5, 7, 1); in the fourth place 0 < 4. So 0.571 is smaller than 4/7.
- 5/9 = 0.555.... In the hundredths place 5 < 7. So 5/9 is smaller than 4/7.
- 0.5757... has 5 in the thousandths place, and 5 > 1. So it is greater than 4/7.
- 57.2% = 0.572. In the thousandths place 2 > 1. So it is greater than 4/7.
- 7/12 = 0.5833.... In the hundredths place 8 > 7. So it is greater than 4/7.
- Three numbers are greater than 4/7: 0.5757..., 57.2% and 7/12.

- Check by cross-multiplication with 4/7: 0.571 = 571/1000, and 571 × 7 = 3997 < 4000. For 5/9, 5 × 7 = 35 < 36. 0.5757... = 57/99 = 19/33, and 19 × 7 = 133 > 132. 57.2% = 572/1000, and 572 × 7 = 4004 > 4000. For 7/12, 7 × 7 = 49 > 48.
- Why (1) is wrong: "One" comes from cutting every listed number down to two decimal places (0.57, 0.55, 0.57, 0.57, 0.58). Then only 7/12 appears to be greater than 0.5714....
- Why (2) is wrong: "Two" comes from dropping the repeating block and reading 0.5757... as 0.57, which is less than 0.5714.... Then only 57.2% and 7/12 are counted.
- Why (4) is wrong: "Four" comes from cutting 4/7 down to 0.57. Then 0.571 also appears to be greater.

7. Sources

7.1 Sources

No.	Source	Used for
S1	NCERT, *Ganita Prakash*, Grade 6, Chapter 7 "Fractions", Sections 7.5 (Mixed Fractions), 7.6 (Equivalent Fractions), 7.7 (Comparing Fractions) and the chapter summary. [source link]	Numerator and denominator; mixed fractions and their conversion; equivalent fractions; lowest terms (simplest form); with the same numerator the bigger denominator gives the smaller share; comparing by changing to equivalent fractions with the same denominator; comparing a fraction with 1/2 and with 1
S2	NCERT, *Ganita Prakash*, Grade 7, Chapter 3 "A Peek Beyond the Point", Sections 3.4 (Decimal Place Value), 3.6 (Locating and Comparing Decimals) and 3.8 (More on the Decimal System). [source link]	Tenths, hundredths and thousandths; comparing decimals from the highest place value and moving to the next place when the digits are the same; 0.2 = 0.20 = 0.200, but 0.02 and 0.002 are different; a decimal with more digits is not always greater
S3	NCERT, *Exemplar Problems: Mathematics*, Class VI, Unit 4 "Fractions and Decimals", part (A) "Main Concepts and Results", Example 6 and Example 12. [source link]	Definitions of proper, improper, mixed, equivalent, like and unlike fractions and of simplest form; comparing fractions by changing them to like fractions; comparing decimals by place value; arranging in ascending or descending order; comparison of two fractions by cross products
S4	NCERT, *Exemplar Problems: Mathematics*, Class VII, Unit 8 "Rational Numbers", part (A) "Main Concepts and Results", Example 10 and Questions 44, 67, 72 and 90. [source link]	Positive and negative rational numbers; standard form with a positive denominator; rewriting a fraction with a positive denominator; for standard forms, p/q < r/s when p × s < r × q; finding rational numbers between two fractions through a common denominator
S5	National Institute of Open Schooling (NIOS), Secondary Course Mathematics (211), Lesson 1 "Number Systems", Sections 1.3.1, 1.3.2, 1.4, 1.6, 1.8 and 1.9. [source link]	A rational number is negative when numerator and denominator have different signs; equivalent forms and lowest form; comparing rational numbers with the same positive denominator, with different denominators through a common denominator, and on the number line (the number to the right is greater); terminating and repeating decimals; a rational number between two rational numbers by the average and by a common denominator
S6	National Institute of Open Schooling (NIOS), Secondary Course Mathematics, Lesson 8 "Percentage and Its Applications", Sections 8.1 to 8.3. [source link]	Per cent as a fraction with denominator 100; changing a fraction or a decimal into a percentage and a percentage into a fraction or a decimal (moving the decimal point two places)

No.	Source	Used for
S7	NCERT, *Ganita Prakash*, Grade 6, Chapter 10 "The Other Side of Zero", Section 10.1 and the chapter summary. [source link]	Smaller numbers lie to the left on the number line; all negative numbers are less than 0; the order of two negative numbers
S8	NCERT, *Ganita Manjari*, Grade 9, Part I, Chapter 3 "The World of Numbers", Sections 3.4, 3.4.2, 3.6.1, 3.6.2 and Exercise Set 3.5. [source link]	Two rational numbers a/b and c/d are equal if ad = bc; the average of two rational numbers lies between them; 3/8 = 0.375; 1/7 = 0.142857...; repeating decimals; 0.999... = 1 by the "multiply by 10 and subtract" method
S9	NCERT, *Mathematics*, Class VIII, Chapter 1 "Rational Numbers", the summary "What Have We Discussed?". [source link]	Between any two rational numbers there are countless rational numbers; the mean helps to find them
S10	Wikipedia, "Fraction" (citing Perry and Perry 1981, *Mathematics I*; Greer 1986, *New Comprehensive Mathematics for 'O' Level*). [source link]	Proper and improper fractions; mixed numbers; with the same positive denominator the numerators decide; of two positive fractions with the same numerator the one with the smaller denominator is larger; comparing a/b and c/d through the common denominator bd, that is, comparing ad and bc; any negative fraction is less than any positive fraction; fraction to decimal by long division; per cent as denominator 100
S11	Wikipedia, "Mediant (mathematics)" (citing Bensimhoun 2013, "A note on the mediant inequality"; MathPages, "The Mediant"). [source link]	The fraction (a + c)/(b + d) formed from a/b and c/d with positive terms lies strictly between them; it is not the sum of the fractions; it depends on the form in which the fractions are written
S12	Wikipedia, "Inequality (mathematics)" (reference list includes Polyanin and Manzhirov 2006, *Handbook of Mathematics for Engineers and Scientists*). [source link]	If a ≤ b, then -a ≥ -b; multiplying both sides by a positive number keeps the order and by a negative number reverses it
S13	Wikipedia, "0.999..." (citing Stillwell 1994; Apostol 1974; Petkovšek 1990). [source link].	0.999... represents the number 1; every non-zero terminating decimal has an equal form that ends in repeating 9s
S14	Telugu Wikipedia, "సంఖ్య". [source link]	Telugu terms: భిన్నం, లవం, హారం, దశాంశ భిన్నం, దశాంశ బిందువు

DAY 2 · TOPIC 20

Current affairs: National Action Plan on Antimicrobial Resistance 2.0

1. Concept in one line

NAP-AMR 2.0 is India's second national plan to contain antimicrobial resistance, for 2025 to 2029, launched by the Union Health Minister on 18 November 2025 and built on the One Health approach. The examination asks about its date, period and six strategic objectives, how it differs from the first plan of 2017, and the Indian and global measures linked with it.

2. Revision notes

2.1 Understanding antimicrobial resistance

2.1.1 What becomes resistant

Antimicrobial resistance (AMR) means that a disease-causing microbe can withstand a medicine that should control it. Treatment may then become harder, longer or, in some cases, impossible. The resistance belongs to the microbe. A person's body does not become “antibiotic-resistant”. WHO AMR fact sheet, CDC explanation

“Antimicrobial” is the wider term:

Medicine group	Main target
Antibiotics	Bacteria
Antivirals	Viruses
Antifungals	Fungi
Antiparasitic medicines	Parasites

Antibiotic resistance is therefore one part of AMR. An antibiotic does not treat the viruses that cause colds or influenza. A clinician may still prescribe an antibiotic for a separate bacterial infection when it is needed. WHO AMR fact sheet, CDC antibiotic use

2.1.2 How selection increases resistant bacteria

Use bacteria as a simple example:

1. **Variation exists.** Some bacteria may carry resistance because of genetic changes or resistance genes acquired from other bacteria.
2. **An antibiotic creates selection pressure.** Susceptible bacteria are killed or their growth is suppressed. Bacteria that can withstand that antibiotic have a survival advantage.
3. **Survivors multiply.** Resistant bacteria can become a larger share of the bacterial population.
4. **Resistance spreads.** Resistant bacteria can pass to other people, animals or environments. Some resistance genes can also move between bacteria.

The antibiotic does not make every bacterium resistant at once. It can favour the survival and multiplication of resistant bacteria. Unnecessary exposure gives this selection more opportunities. WHO AMR fact sheet, CDC microbial ecology, CDC resistance mechanisms

2.1.3 How a resistant microbe can defeat a medicine

Different microbes use different mechanisms. A bacterium may destroy the drug with an enzyme, change the target the drug normally attacks, reduce entry of the drug, or pump it out. Resistance to 1 medicine does not automatically mean resistance to every medicine. Laboratory tests help identify which treatments may still work. CDC resistance mechanisms

2.1.4 Why misuse matters

Misuse includes taking an antibiotic for a viral cold, sharing leftover tablets, taking someone else's prescription, or using a medicine in a way that does not match the professional advice. The wrong medicine or an unnecessarily long treatment can expose microbes without helping the patient. CDC antibiotic use, WHO antibiotic guidance

Needed treatment must remain available. Patients should use antibiotics as prescribed and ask the prescriber about any change, side effect or uncertainty. They should not independently stop, extend or replace treatment. Appropriate use means effective treatment when needed and avoiding unnecessary exposure. CDC antibiotic use

2.1.5 Why One Health is necessary

Human health is connected to the health of animals, plants and the environment. **One Health** means these sectors work together rather than treating AMR as a hospital problem alone. WHO One Health

For example, resistant bacteria in animal waste can contaminate water, soil or food and reach people. Human sewage and pharmaceutical waste can also release resistant microbes or antimicrobial residues. These are possible pathways; they do not mean every farm, food item or water source is contaminated. Safe food, sanitation, veterinary care and waste management therefore belong in the same response. CDC environment and food

2.1.6 What surveillance tells us

Surveillance is repeated, organised collection and analysis of information so that action can follow. A laboratory identifies the microbe and tests its susceptibility to medicines. Combined with clinical and other relevant data, the results show where resistance is appearing or changing. WHO GLASS

Resistance surveillance and monitoring antibiotic use answer different questions: “Which medicines are failing against tested microbes?” and “Which medicines are being used, and how much?” Reliable data can guide treatment policies, outbreak responses and evaluation. A hospital's test results should not automatically be treated as the resistance rate of the entire population. WHO GLASS, WHO surveillance indicator limitations

2.1.7 How infection prevention reduces AMR

Preventing infection reduces both the spread of resistant microbes and the need for antimicrobial treatment. Hand hygiene, clean water, sanitation, vaccination, clean healthcare equipment and appropriate infection-control practices all help. This is why AMR policy must support prevention as well as new medicines. WHO infection prevention

A simple cause-and-effect chain is: **fewer infections → less need for treatment → fewer opportunities for unnecessary antimicrobial use**. Prevention does not remove the need to treat an infection that has already occurred. WHO infection prevention

2.1.8 What stewardship means

Antimicrobial stewardship is organised work to improve medicine use while protecting patients. The care team asks: Is an antimicrobial needed? Which medicine fits the infection? What dose and

route are appropriate? How long is treatment needed? Should the plan change after test results or clinical review? WHO AWaRe antibiotic book, WHO antibiotic guidance

For example, a hospital can review antibiotic prescriptions and give feedback to prescribers. Stewardship should improve treatment, not deny an effective medicine to a patient who needs it. WHO stewardship interventions

Remember the distinction: surveillance finds and tracks the problem; infection prevention reduces infections and spread; stewardship improves the use of medicines. They support one another.

2.1.9 Why this matters for public health

Effective infection treatment helps make surgery, cancer care and organ transplantation safer. AMR threatens that protection. A global study estimated that **4.71 million (47.1 lakh)** deaths in **2021** were associated with bacterial AMR, including **1.14 million (11.4 lakh)** attributable to resistance. These are different measures, not 2 totals to add together. Government launch release, IHME research summary

The supply of new antibacterial treatments is also insufficient. Research is needed, alongside prevention, reliable access and better use of existing medicines. WHO antibacterial pipeline assessment

2.2 The first plan (2017 to 2021) and the Delhi Declaration

- **Before the plan:** A National Task Force on AMR Containment was set up in 2010. A national policy on AMR containment followed in 2011.
- **The first NAP-AMR:** Released by the Union Health Minister on 19 April 2017, for 2017 to 2021. It was aligned with the Global Action Plan on AMR of the World Health Organization (WHO) and had six strategic priorities.
- **Delhi Declaration on AMR:** An inter-ministerial consensus signed on the same day, 19 April 2017, by Union ministers, including those of Health, Consumer Affairs and Environment. It is the Government's high-level commitment to contain AMR with a One Health approach.
- **Gains:** Stronger AMR surveillance at national and state levels; state action plans launched in 7 states (the count as of November 2025, given in NAP-AMR 2.0).
- **Gaps:** Sectors other than human health took limited ownership. The National Authority for Containment of AMR (NACA), which was to run the work across sectors, was not constituted.

2.3 NAP-AMR 2.0 at a glance

Point	Detail
Full name	National Action Plan on Antimicrobial Resistance (NAP-AMR) (2025-2029), Version 2.0
Launched by	Union Minister of Health and Family Welfare, Shri J P Nadda
Date and place	18 November 2025, New Delhi
Occasion	First day of World AMR Awareness Week (18 to 24 November)
Period	2025 to 2029
Approach	One Health; "whole of government", with sustained funding within each sector

Point	Detail
How it was prepared	Work began in 2022 with stakeholder consultations. NITI Aayog then held high-level meetings with 20 ministries, departments and organisations (the press release says "more than 20")
Main heads	Six strategic objectives
What it contains	The action plan of each key stakeholder ministry and department, with timelines and budget; mechanisms for coordination within and across sectors
How it addresses the gaps of the first plan	More ownership of AMR work; stronger inter-sectoral coordination; stronger engagement with the private sector

2.4 The 6 objectives of India's NAP-AMR 2.0

India launched NAP-AMR 2.0 on **18 November 2025**, for **2025–2029**. Its One Health approach requires coordinated action across departments. Government launch release

The official plan's 6 objectives can be understood as follows. NAP-AMR 2.0, Executive Summary, printed page 6

1. **Build understanding.** Improve AMR awareness through communication, education and training.
2. **Strengthen laboratories and surveillance.** Detect and track resistance, and monitor antibiotic residues through targeted testing.
3. **Prevent infections.** Reduce infection through effective prevention and control.
4. **Use medicines well and keep them available.** Support uninterrupted access and judicious use in humans, animals and food.
5. **Advance research and innovation.** Identify priorities for basic and operational research relevant to AMR.
6. **Coordinate the response.** Improve governance and cooperation within sectors and between sectors.

Connect the objectives to the concepts above: learning helps people avoid misuse; laboratory evidence guides action; prevention reduces treatment demand; stewardship improves use; research develops better answers; coordination assigns responsibility and keeps sectors working together.

Illustrative actions include explaining why antibiotics do not cure viral colds, testing bacterial samples, improving hand hygiene, reviewing prescriptions, evaluating a new diagnostic tool, and arranging joint reviews by health, animal-health and environmental departments. The plan includes ministry action plans, budgets and timelines so that implementation can be monitored. Government launch release, WHO GLASS, WHO stewardship interventions

2.5 The first plan and NAP-AMR 2.0 compared

Point	First NAP-AMR	NAP-AMR 2.0
Period	2017 to 2021	2025 to 2029
Date	Released on 19 April 2017	Launched on 18 November 2025
Main heads	Six strategic priorities	Six strategic objectives
Second head	Strengthen knowledge and evidence	Strengthen laboratory capacity for AMR

Point	First NAP-AMR	NAP-AMR 2.0
	through surveillance	detection and surveillance, including antibiotic residues
Fifth head	Promote investments for AMR activities, research and innovations	Promote research and innovation
Sixth head	Strengthen India's leadership on AMR through international, national and sub-national collaborations	Strengthen governance and coordination within and between sectors
Ownership by ministries	Sectors other than human health took limited ownership	Each key ministry and department has its own action plan, with timelines and budget
Coordination across sectors	Left to NACA, which was not constituted	Coordination mechanisms are written into the plan

The first, third and fourth heads (awareness, infection prevention and control, optimal use of antimicrobials) are common to both plans.

2.6 Ministries and sectors covered

- The plan annexes the action plans of the Ministries of Health and Family Welfare; Fisheries, Animal Husbandry and Dairying; Agriculture and Farmers Welfare; Environment, Forest and Climate Change; Science and Technology; and Chemicals and Fertilizers, and of other ministries and departments.
- Officials of the Ministries of AYUSH, Jal Shakti, Information and Broadcasting, and Education were also present at the launch.
- Sectors covered: human health, animals and fisheries, agriculture and food, the environment, and research.

2.7 Measures India already has

Measure	Since	What it is
National Programme on AMR Containment	2013, during the Twelfth Five Year Plan	Programme of the Health Ministry, coordinated by the National Centre for Disease Control (NCDC)
NARS-Net	Under the NCDC programme	The National AMR Surveillance Network; 50 state medical colleges in 33 States and Union Territories, as given in the plan of November 2025
AMRSN	2013	Network of the Indian Council of Medical Research (ICMR) that collects AMR data from tertiary care hospitals; seven nodal centres and 20 regional laboratories, as given in the plan
INFAAR	2017	Network of 21 veterinary and fisheries laboratories, started by the Indian Council of Agricultural Research (ICAR) with support from the Food and Agriculture

Measure	Since	What it is
		Organization (FAO)
Schedule H1	March 2014	A schedule of the Drugs Rules, 1945. The antibiotics listed in it can be sold only on a doctor's prescription, and the chemist must keep a record of the sale
Red Line campaign	February 2016	Awareness campaign: medicines whose pack carries a red vertical line are not to be used without a doctor's prescription
Ban on colistin in animal farming	July 2019	Manufacture, sale and distribution of colistin prohibited for food-producing animals, poultry, aqua farming and animal feed supplements
State action plans	7 states, as given in the plan of November 2025	The plan names Kerala, Madhya Pradesh, Delhi, Andhra Pradesh, Sikkim, Gujarat and Rajasthan (Delhi, a Union Territory, is counted among the seven). Kerala's plan is the Kerala Antimicrobial Resistance Strategic Action Plan (KARSAP)

2.8 The global frame

- **Global Action Plan on AMR, 2015:** Adopted by the 68th World Health Assembly in May 2015. It has five objectives: awareness; surveillance and research; infection prevention; optimal use of antimicrobials; and sustainable investment in new medicines, diagnostic tools and vaccines. National action plans follow from it.
- **UN political declaration, 2024:** Approved on 26 September 2024 at the second high-level meeting on AMR, during the 79th session of the UN General Assembly. Its main target is to reduce deaths associated with bacterial AMR by 10 per cent by 2030, against the 2019 baseline of an estimated 4.95 million (49.5 lakh) deaths. The 4.71 million in 2.1 is the later estimate, for 2021. Other targets: at least 60 per cent of countries to have funded national action plans by 2030; at least 70 per cent of antibiotics used in human health to come from the WHO Access group; catalytic funding of 100 million US dollars.
- **Updated Global Action Plan, 2026 to 2036:** Adopted by the 79th World Health Assembly in May 2026, as the 2024 declaration had asked. It has six strategic objectives.
- **Quadripartite:** FAO, the UN Environment Programme (UNEP), WHO and the World Organisation for Animal Health (WOAH) work together on One Health.
- **World AMR Awareness Week:** 18 to 24 November every year. Theme for 2025: "Act Now: Protect Our Present, Secure Our Future". Theme for 2026: "One Health, One Action: Prevent AMR Now".

3. Extra section: chronology of action on AMR, India and the world, 2010 to 2026

Date	What happened
2010	India sets up the National Task Force on AMR Containment
2011	India's national policy on AMR containment
2013	National Programme on AMR Containment begins under NCDC, during the Twelfth Five Year Plan; ICMR starts the AMRSN
March 2014	Schedule H1 of the Drugs Rules comes into use
May 2015	68th World Health Assembly adopts the Global Action Plan on AMR
February 2016	Red Line campaign launched in New Delhi
September 2016	First high-level meeting on AMR at the UN General Assembly
19 April 2017	First NAP-AMR (2017 to 2021) released; Delhi Declaration on AMR signed
July 2019	Colistin prohibited for food-producing animals, poultry, aqua farming and feed supplements
2022	Work on NAP-AMR 2.0 begins with stakeholder consultations
26 September 2024	UN General Assembly's second high-level meeting on AMR approves the political declaration
18 November 2025	NAP-AMR 2.0 (2025 to 2029) launched
January 2026	Health Ministry's draft notification G.S.R. 51(E) proposes a blue vertical strip on the label of antimicrobial medicines
May 2026	79th World Health Assembly adopts the updated Global Action Plan on AMR (2026 to 2036)
18 to 24 November 2026	World AMR Awareness Week 2026

Position in early October 2026:

- NAP-AMR 2.0 is the plan in force; its period runs up to 2029.
- G.S.R. 51(E) of 21 January 2026 was issued as a draft proposal. Publication of that draft must not be treated as proof that the blue-strip requirement is in force.
- The blue strip is separate from the Red Line campaign and from Schedule H1. If notified, it will be a new label mark for antimicrobials.

4. Three common exam traps

1. **Five or six?** WHO's Global Action Plan of 2015 has five objectives. India's first plan had six strategic priorities, and NAP-AMR 2.0 has six strategic objectives. The updated global plan of 2026 also has six. Questions put "five" against India's plans.
2. **Which plan, which date, who launched it?** The first plan was released on 19 April 2017 for 2017 to 2021. NAP-AMR 2.0 was launched on 18 November 2025 for 2025 to 2029, by the Union Health Minister. NITI Aayog only held the consultations; it did not launch the plan. The Delhi Declaration belongs to 2017, not to 2025.
3. **Look-alike measures.** NARS-Net is NCDC's network in state medical colleges; AMRSN is ICMR's network in tertiary care hospitals. Schedule H1 is a legal rule on sale; the Red Line is an awareness

campaign. The Delhi Declaration (2017) is Indian; the political declaration (2024) is of the UN General Assembly, with the target of 10 per cent fewer deaths by 2030.

Practice and explanations

Q1. Consider the following statements about the National Action Plan on Antimicrobial Resistance 2.0 (NAP-AMR 2.0):

1. It has five strategic objectives.
2. It was launched on the first day of World AMR Awareness Week 2025.
3. It includes the action plans of the key stakeholder ministries and departments, with timelines and budget.

Which of the statements given above is/are correct?

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

Q1. Answer: (1) 2 and 3 only

- Statement 1 is wrong: NAP-AMR 2.0 has six strategic objectives: awareness; laboratory capacity and surveillance; infection prevention and control; optimal use of antimicrobials; research and innovation; and governance and coordination. Five is the number of objectives in WHO's Global Action Plan of 2015.
- Statement 2 is correct: The plan was launched on 18 November 2025. World AMR Awareness Week runs from 18 to 24 November every year, so the launch fell on its first day.
- Statement 3 is correct: The plan includes the action plan of each key stakeholder ministry and department, with timelines and budget. This is the main change from the first plan.
- Why the other options are wrong: (2) leaves out statement 3, which is correct. (3) leaves out statement 2, which is correct. (4) includes statement 1, which is wrong.

Q2. Match List I (measures linked with the containment of antimicrobial resistance in India) with List II (what each is):

List I	List II
A. NARS-Net	1. Dates from March 2014: the antibiotics it covers are sold only on a doctor's prescription, and the chemist records the sale
B. AMRSN	2. ICMR's network that collects resistance data from tertiary care hospitals
C. Red Line campaign	3. NCDC's network of laboratories in state medical colleges
D. Schedule H1	4. Dates from February 2016: asks people not to use certain medicines without a doctor's prescription

- (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: NARS-Net, the National AMR Surveillance Network, is NCDC's network of laboratories in state medical colleges (A-3). AMRSN is ICMR's network, started in 2013, that collects AMR data from tertiary care hospitals (B-2). The Red Line campaign, launched in February 2016, asks people not to use certain medicines, those marked with a red vertical line, without a doctor's prescription (C-4). Schedule H1, in use since March 2014, is a schedule of the Drugs Rules, 1945: the antibiotics in it are sold only on prescription and the chemist keeps a record (D-1).
- Why (1) is wrong: It swaps the two networks. NARS-Net belongs to NCDC and AMRSN to ICMR.
- Why (2) is wrong: It swaps the Red Line campaign and Schedule H1. The campaign, launched in February 2016, is an awareness drive about the use of medicines; Schedule H1, in use since March 2014, is the legal rule on sale, and the chemist's record belongs to it.
- Why (4) is wrong: It makes both swaps.

7. Sources

7.1 Sources

No.	Source	Used for
S1	Press Information Bureau (Ministry of Health and Family Welfare), "Union Health Minister Shri J P Nadda Launches National Action Plan on Antimicrobial Resistance 2.0", 18 November 2025, Release ID 2191165. [source link]	Who launched the plan and when; period 2025-29; first day of World AMR Awareness Week (18 to 24 November); work began in 2022; NITI Aayog meetings with more than 20 ministries and departments; action plans of each key ministry with timelines and budget; mechanisms for coordination and collaboration within and across sectors; gaps addressed (ownership, inter-sectoral coordination, private sector); One Health; National Task Force 2010 and national policy 2011; first plan launched in April 2017 for 2017-2021; ministries present at the launch; risk to surgery, cancer treatment and organ transplants
S2	Government of India, "National Action Plan on Antimicrobial Resistance (NAP-AMR) (2025-2029)", One Health Approach, Version 2.0, November 2025, on the website of the National Centre for Disease Control. [source link] (the same document on the website of the Directorate General of Health Services: [source link])	Contents page and Executive Summary: the six strategic objectives of NAP-AMR 2.0 (chapter "Six Strategic Objectives"; the Executive Summary describes the first to the sixth one by one), the "whole of government" approach, gains and gaps of the first plan (7 state action plans; NACA not constituted); Introduction: what AMR is, drivers, 4.71 million and 1.14 million deaths in 2021, Global Action Plan of May 2015, UN high-level meetings of 2016 and 2024, six strategic priorities of the first plan, Delhi Declaration; National Response section: release of the first plan on 19 April 2017, National Programme on AMR Containment (2013), NARS-Net (50 state medical colleges in 33 States and Union Territories), AMRSN (2013; seven nodal centres, 20 regional laboratories), INFAAR (2017; 21 laboratories), colistin prohibition of July 2019, the seven states with action plans; NITI Aayog consultations with 20 ministries, departments and organisations; list of annexed ministry action plans
S3	WHO India, "National action plan on antimicrobial resistance (NAP-AMR) 2017 -	Date of the first plan; wording of its six strategic priorities; Schedule H1 in use since March 2014, sale only on

No.	Source	Used for
	2021", 19 April 2017, with the plan document. [source link] ; plan PDF: [source link]	prescription, register kept by the pharmacist; Red Line campaign launched in New Delhi in February 2016; national policy of 2011 and Task Force of 2010
S4	WHO India, "Delhi Declaration on Antimicrobial Resistance", 19 April 2017. [source link]	Date of the Delhi Declaration; signed at the Inter-Ministerial Consultation on AMR by the Ministers for Health and Family Welfare, Consumer Affairs and Environment; high-level commitment to contain AMR with a One Health approach
S5	World Health Organization, fact sheet "Antimicrobial resistance", updated 16 July 2026. [source link]	What AMR is; drivers; more than 4.7 million deaths in 2021; the Quadripartite (FAO, UNEP, WHO, WOAH); the updated Global Action Plan (2026-2036) and its six strategic objectives; the 2024 UN General Assembly target of a 10 per cent reduction in deaths by 2030; the 70 per cent Access group target
S6	World Health Organization, "Global action plan on antimicrobial resistance" (publication page). [source link]	Adoption by the World Health Assembly in May 2015; the five objectives of the 2015 plan
S7	World Health Organization, news release "World leaders commit to decisive action on antimicrobial resistance", 26 September 2024. [source link]	Political declaration approved at the high-level meeting on AMR of the 79th UN General Assembly; 4.95 million deaths a year and the 10 per cent reduction by 2030; 60 per cent of countries with funded national action plans by 2030; 70 per cent of human antibiotic use from the WHO Access group; 100 million US dollars of catalytic funding; request to update the Global Action Plan by 2026
S8	World Health Organization, news release "The World Health Assembly adopts updated Global Action Plan on Antimicrobial Resistance (2026-2036)", 25 May 2026. [source link]	Adoption of the updated plan by the 79th World Health Assembly in May 2026; prepared through the Quadripartite; follows from the 2024 political declaration
S9	World Health Organization, campaign page "World AMR Awareness Week". [source link]	Dates of the Week, 18 to 24 November every year; themes for 2025 and 2026; the 68th World Health Assembly of May 2015
S10	Press Information Bureau research document "Nafithromycin: Country's First Indigenous Antibiotic", 3 December 2024. [source link]	What the Red Line campaign asks people to do; antibiotics under Schedule H and H1 of the Drugs Rules, 1945 need a prescription; record-keeping for Schedule H1 drugs
S11	National Centre for Disease Control, page "National Action Plan on AMR (NAP-AMR)". [source link]	The name "Kerala Antimicrobial Resistance Strategic Action Plan (KARSAP)"; listing of the first plan, the Delhi Declaration and the state action plans of Kerala, Madhya Pradesh and Delhi
S12	Central Drugs Standard Control Organisation, "Gazette Notifications" list. [source link] ; draft notification entry: [source link]	Draft notification G.S.R. 51(E) of January 2026 on a blue line on the label of antimicrobials; no final notification on it in the list up to September 2026
S13	Business Standard, "Centre mandates blue chip on all antimicrobial brand labels to counter AMR", 23 January 2026. [source link] ; CliniExperts regulatory update on	Secondary reports of the draft notification: a blue vertical strip on the label of antimicrobial drugs; draft status

No.	Source	Used for
	G.S.R. 51(E): [source link]	
S14	Indian Council of Medical Research, website of the Antimicrobial Resistance Surveillance and Research Network (AMRSN). [source link]	AMRSN was initiated by ICMR in 2013 and covers hospitals across India
S15	WHO India, health topic page "Antimicrobial resistance". [source link]	Overuse and misuse of antimicrobials in humans, animals and agriculture as the driver; cross-check of the Delhi Declaration date and of World AMR Awareness Week, 18 to 24 November
S16	Akashvani News (News On AIR), "Health Minister J P Nadda launches National Action Plan on Antimicrobial Resistance 2.0", 18 November 2025. [source link]	Launch in New Delhi on 18 November 2025; cross-check of the period 2025-29
S17	The institute's current affairs file: Insights "Current Affairs 30", November 2025, "India launches National Action Plan on Antimicrobial Resistance 2.0 (NAP-AMR 2.0)", page 164	Selection of the item only. The facts in the notes are taken from the official sources listed in this table
S18	The Gazette of India, Extraordinary, Part II, Section 3(i), Ministry of Health and Family Welfare, draft notification G.S.R. 51(E), dated 21 January 2026 (copy of the gazette hosted by Simpliance). [source link]	Text of the draft rules: a blue vertical strip on the label of antimicrobial drugs and their preparations, proposed as a new clause in rule 96 of the Drugs Rules, 1945; draft published for objections and suggestions
S19	The Pioneer (PTI), "Govt proposes blue-strip labelling for antimicrobial medicines to curb misuse", 4 August 2026. [source link]	Report of the written reply in the Rajya Sabha on 4 August 2026 by the Minister of State for Health: the blue strip was a draft notification issued on 21 January 2026
S20	United Nations, Office of the President of the General Assembly, "Political Declaration of the High-level Meeting on Antimicrobial Resistance", text circulated in August 2024 and approved at the high-level meeting of 26 September 2024. [source link]	The 10 per cent reduction in deaths by 2030 is measured against the 2019 baseline of 4.95 million deaths

Additional sources for the reviewed edition

- WHO, 79th World Health Assembly daily update, 23 May 2026. [source link] — Adoption of the updated Global Action Plan 2026–2036
- CDSCO, Gazette Notifications list, checked 9 October 2026. [source link] — G.S.R. 51(E), 21 January 2026, is listed as a draft notification regarding a blue line on antimicrobial labels