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APPSC GROUP 1 | 1,000 TOPICS IN 100 DAYS

Day 1
English notes

Topics 1-10

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

Use the PDF bookmarks to jump to each topic. Original printed page numbers are retained and refer to the combined edition. Shared original cover and answer-key pages, where present, are retained for completeness. Full bibliography tables referenced in Telugu remain in the English companion and the original combined download. The 54 original English infographic pages are included only in the English notes, under English visual revision bookmarks.

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10 TOPICS · COMPLETE BILINGUAL NOTES

Day 1 Study Pack

Choose a topic, language or visual section below. Each topic includes the full English and Telugu lessons, followed by its approved visual revision pages. All 54 visuals appear at full-page size. Sources for both languages follow each English topic. The 20 practice questions and explanations remain in the separate quiz booklet.

No.	Topic	English	తెలుగు	Visuals
1	Indus Valley sites and what each is known for	Page 2	పేజీ 6	Page 10
2	Kakatiyas: Ganapatideva, Rudramadevi and Prataparudra	Page 16	పేజీ 20	Page 24
3	Historical background: Regulating Act 1773 to Charter Act 1853	Page 30	పేజీ 34	Page 39
4	Governor: appointment, powers and discretion	Page 44	పేజీ 49	Page 54
5	National income concepts: GDP, GNP, NNP and GVA	Page 61	పేజీ 66	Page 71
6	Interior of the Earth: crust, mantle, core and discontinuities	Page 76	పేజీ 82	Page 88
7	Orbits: LEO, MEO, GEO, polar and sun-synchronous	Page 93	పేజీ 98	Page 103
8	Venn diagrams: showing relations between groups	Page 109	పేజీ 114	Page 119
9	Types of numbers: natural, whole, integers, rational and irrational	Page 124	పేజీ 129	Page 134
10	PM-KISAN and Direct Benefit Transfer	Page 138	పేజీ 140	Page 142

TOPIC 1 · ENGLISH

Indus Valley sites and what each is known for

Concept in one line

The Harappan (Indus Valley) Civilisation is known through its excavated sites, and each major site is remembered for one or two finds or features that the examination asks you to match with it.

Revision notes

2.1 Basics to keep in mind

- The civilisation is called "Harappan" after Harappa, where it was first identified.
- Excavations began at Harappa in 1921 and at Mohenjo-daro in 1922. In 1924 John Marshall, Director-General of the Archaeological Survey of India (ASI), announced the discovery of a new civilisation to the world.
- Most Harappan towns have two parts: a smaller, higher **Citadel** and a larger, lower **Lower Town**.
- Sites lie in three present-day countries: Pakistan, India and Afghanistan.

2.2 Major sites and what each is known for

Harappa

Present location: Sahiwal district, Punjab, Pakistan; old course of the River Ravi
Known for: Name-giving site; excavations began in 1921 under Daya Ram Sahni; badly damaged when its bricks were taken for the Lahore-Multan railway; Cemetery H (a Late Harappan burial area)

Mohenjo-daro

Present location: Larkana district, Sindh, Pakistan; right bank of the River Indus
Known for: Great Bath; about 700 wells; bronze "Dancing Girl"; stone "Priest-King" statue; steatite "Pashupati" seal; UNESCO World Heritage Site since 1980

Chanhudaro

Present location: Sindh, Pakistan
Known for: A tiny settlement (less than 7 hectares) almost wholly given to craft production: bead-making, shell-cutting, metal-working, seal-making and weight-making

Lothal

Present location: Ahmedabad district, Gujarat; on the Bhogava, a tributary of the Sabarmati
Known for: Basin commonly identified as a tidal dockyard; bead-making factory; warehouse; fire altars; seals linked to the Persian Gulf; excavated by S.R. Rao from 1955

Kalibangan

Present location: Hanumangarh district, Rajasthan; bank of the Ghaggar
Known for: Ploughed field of the Early Harappan level, with two sets of furrows at right angles; fire altars; name means "black bangles"; excavated by B.B. Lal and B.K. Thapar from 1960

Dholavira

Present location: Khadir island, Kachchh (Kutch) district, Gujarat
Known for: City in three parts (citadel, middle town, lower town); large stone water reservoirs; signboard with ten large signs; UNESCO World Heritage Site since 2021; excavated by R.S. Bisht

Banawali

Present location: Fatehabad district, Haryana
Known for: Terracotta model of a plough; fortified town; excavated by R.S. Bisht

Rakhigarhi

Present location: Hansi district, Haryana (formerly in Hisar district; Hansi district was created on 22 December 2025)
Known for: Among the largest Harappan sites; excavated by Amarendra Nath from 1997; DNA (archaeogenetic) research by Vasant Shinde from 2013

Surkotada

Present location: Kachchh (Kutch) district, Gujarat
Known for: Bones reported by the excavators as those of the horse (identification disputed)

Nageshwar and Balakot

Present location: Gujarat coast; Balochistan coast
Known for: Specialised centres for making shell objects

Shortughai

Present location: Afghanistan, on the Oxus
Known for: Traces of canals; located near the source of lapis lazuli

"Priest-King" and "Pashupati" are conventional names for finds; their identities and functions are not established facts.

2.3 Limits of the civilisation

Direction	Site	Present location
West	Sutkagan Dor (Sutkagendor)	Balochistan, Pakistan; near the Dasht river, close to the Iran border
East	Alamgirpur	Meerut district, Uttar Pradesh
North	Manda	Jammu; right bank of the Chenab
South	Daimabad	Ahilyanagar (formerly Ahmednagar) district, Maharashtra; on the Pravara, a tributary of the Godavari

These limits combine sites associated with different Harappan phases. Daimabad is associated with the Late Harappan phase; the table does not show the extent of one uniformly occupied Mature Harappan territory.

Note: Shortughai in Afghanistan lies further north than Manda. Manda is the northernmost site within India.

2.4 Distinctions worth remembering

Often confused	The difference
Ploughed field and plough model	The actual ploughed field is at Kalibangan. The terracotta models of the plough are from Banawali (and from sites in Cholistan).

Often confused	The difference
Great Bath and dockyard	The Great Bath is at Mohenjo-daro. The dockyard is at Lothal.
Two Gujarat sites	Lothal is the port town with the dockyard. Dholavira is the city of reservoirs on Khadir island.
Citadel layout	Usually the Citadel is walled and separate. At Lothal the Citadel was not walled off but built at a height. At Dholavira and Lothal the entire settlement was fortified.
Sites by country	Harappa, Mohenjo-daro, Chanhudaro, Sutkagan Dor and Balakot are in Pakistan. Shortughai is in Afghanistan. The other sites in this note are in India.

Extra section: who dug what, and when

Year	Development
1875	Alexander Cunningham's report on a Harappan seal
1921	Daya Ram Sahni begins excavations at Harappa
1922	Excavations begin at Mohenjo-daro (R.D. Banerji found Harappa-type seals there)
1924	John Marshall announces the discovery of a new civilisation
1946	R.E.M. Wheeler excavates at Harappa
1955	S.R. Rao begins excavations at Lothal
1960	B.B. Lal and B.K. Thapar begin excavations at Kalibangan
1990	R.S. Bisht begins excavations at Dholavira (the first field season was 1989-90)
1997	Amarendra Nath starts excavations at Rakhigarhi
2013	Vasant Shinde begins archaeogenetic research at Rakhigarhi
2021	Dholavira inscribed on the UNESCO World Heritage List

The years from 1875 to 2013 are from the NCERT textbook: its timeline of Harappan archaeology and, for 1924, its text.

Three common exam traps

1. **Ploughed field or plough model?** Kalibangan has the ploughed field. Banawali has the terracotta plough model. Questions swap the two.
2. **Which site is "northernmost"?** Manda in Jammu is the northernmost site in India, but Shortughai in Afghanistan lies further north. Read whether the question says "in India". Daimabad, not Lothal, is the southern limit.
3. **Harappa first, Mohenjo-daro more famous.** Systematic excavations at Harappa began in 1921; excavations at Mohenjo-daro followed in 1922. The Great Bath, the Dancing Girl and the Pashupati seal all belong to Mohenjo-daro, not Harappa.

Sources

1. NCERT, Themes in Indian History, Part I (Class XII), Theme One "Bricks, Beads and Bones: The Harappan Civilisation",...; 2. UNESCO World Heritage Centre, "Dholavira: a Harappan City"; 3. UNESCO World Heritage Centre, "Archaeological Ruins at Moenjodaro"; 4. UNESCO World Heritage Centre, Tentative List, "Archaeological remains of a Harappa Port-Town, Lothal"; 5. Wikipedia, "Kalibangan"; 6. Wikipedia, "Dholavira"; 7. Wikipedia, "Banawali"; 8. Wikipedia, "Rakhigarhi"; 9. Wikipedia, "Surkotada"; 10. Wikipedia, "Sutkagan Dor"; 11. Wikipedia, "Alamgirpur"; 12. Wikipedia, "Manda, Jammu"; 13. Wikipedia, "Indus Valley Civilisation" [link 2]; 14. Wikipedia, "Mohenjo-daro", "Pashupati seal", "Harappa" and "Cemetery H

culture" [link 2] [link 3] [link 4]; 15. UNESCO World Heritage Centre, ICOMOS evaluation of "Dholavira: a Harappan City" (2021); 16. R.S. Bisht, Archaeological Survey of India report on the Dholavira excavations of 1989 to 2005, dated 2015 (copy…; 17. ASI, Indian Archaeology 1958-59: A Review; 18. ASI, Indian Archaeology 1960-61: A Review; 19. ASI, Indian Archaeology 1971-72: A Review; 20. ASI, Indian Archaeology 1976-77: A Review; 21. ASI, Indian Archaeology 1989-90: A Review; 22. ASI, Indian Archaeology 1997-98: A Review; 23. B.K. Thapar, article on Kalibangan in Expedition (Penn Museum), vol. 17, no. 2, 1975; 24. G.F. Dales, "A Search for Ancient Seaports", Expedition, vol. 4, no. 2, 1962 [link 2]; 25. Harappa.com (specialist website on the Indus civilisation, with material by J.M. Kenoyer, A. Parpola, J. McIntosh… [link 2] [link 3] [link 4] [link 5] [link 6] [link 7] [link 8] [link 9] [link 10] [link 11] [link 12]; 26. Encyclopaedia Britannica: "Harappa" [link 2] [link 3] [link 4] [link 5]; 27. National Virtual Library of India (Government of India), National Museum objects: "Dancing Girl" [link 2] [link 3]; 28. Haryana Tourism (Government of Haryana), "Ancient Site of Banawali"; 29. Indira Gandhi National Centre for the Arts, documentation form RJ/HNG-023, "Archaeological Museum, Kalibanga"; 30. Pakistan Bureau of Statistics, Statistical Year Book 2014, tables 19.10 and 19.11 (data of the Department of… [link 2]; 31. Hisar district website, [link 2] [link 3] [link 4] [link 5]; 32. ASI Aurangabad Circle, "Ancient Site and Remains at Daimabad" [link 2] [link 3] [link 4]; 33. Jammu district website, page on Akhnoor Fort and Jia Pota Ghat; 34. National Institute of Open Schooling, Senior Secondary History (315), Lesson 3; 35. Haryana Development and Panchayats Department, current Hansi district panchayat list; Hansi district administration;… [link 2] [link 3];

Bath or basin?

Two water structures. Two different Harappan sites.

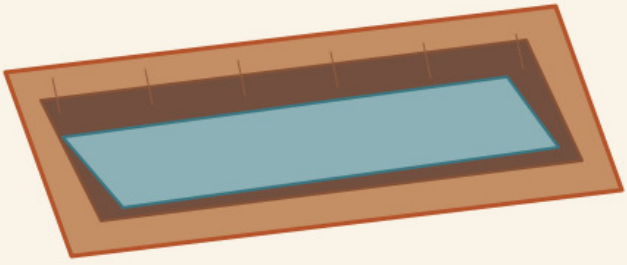
MOHENJO-DARO



THE GREAT BATH

Stepped tank in the Citadel.
Watertight brick construction.
Sindh, Pakistan.

LOTHAL



Basin: structural sketch

THE DOCKYARD BASIN

Commonly identified
as a tidal dockyard.
Gujarat, India.

Keep the site attached to the evidence

Great Bath → Mohenjo-daro

Basin → Lothal

Explanatory reconstructions, not photographs or measured replicas.

References: Source Index

Where the sites are

Present-day countries orient you; the numbered clues identify sites.



01 Harappa
Name-giving site

02 Mohenjo-daro
Great Bath

03 Chanhudaro
Craft production

04 Kalibangan
Ploughed field

05 Banawali
Plough model

06 Rakhigarhi
Large site; Hansi, Haryana

07 Dholavira
Reservoirs

08 Lothal
Dockyard interpretation

09 Surkotada
Disputed horse-bone claim

10 Shortughai
Canals; lapis-lazuli link

11 Nageshwar
Shell objects

12 Balakot
Shell objects

Sites span different Harappan phases; the dots do not mark one empire.

Coast and rivers: Natural Earth (public domain)

Field or model?

Both teach agriculture; they are different kinds of evidence.

KALIBANGAN

Actual ploughed field

BANAWALI

Terracotta plough model



Field: two sets of furrows cross at right angles.

Model: a miniature implement, not the field itself.

Explanatory field and model reconstructions; not excavation photographs.

References: Source Index

Water, crafts and resources

Remember the site by what people built or made there.

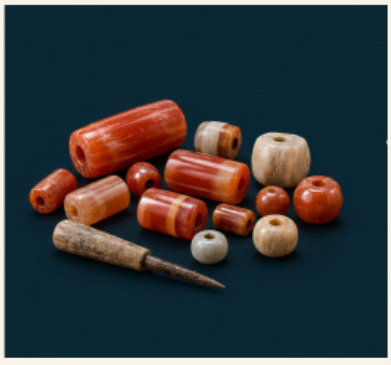
DHOLAVIRA · KHADIR ISLAND, GUJARAT



Reservoirs stored water

UNESCO World Heritage inscription: 2021

Organisation schematic, not a scaled city plan



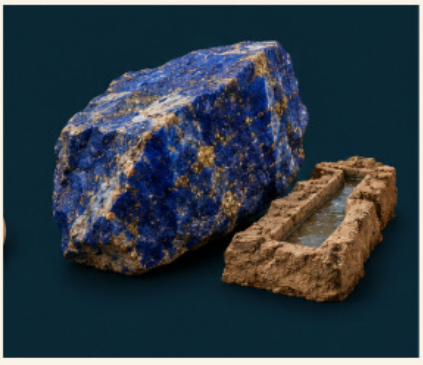
CHANHUDARO

Beads and specialised crafts



NAGESHWAR + BALAKOT

Shell objects



SHORTUGHAI

Near lapis source; traces of canals

References: Source Index

How the sites were studied

Separate discovery, excavation and heritage recognition.

1875	Cunningham reports a Harappan seal
1921	**Daya Ram Sahni begins at Harappa**
1922	**Excavations begin at Mohenjo-daro**
1924	John Marshall announces the civilisation
1946	R.E.M. Wheeler excavates at Harappa
1955	S.R. Rao begins at Lothal
1960	B.B. Lal + B.K. Thapar: Kalibangan
1990	R.S. Bisht begins at Dholavira
1997	Amarendra Nath begins at Rakhigarhi
2013	Vasant Shinde: Rakhigarhi genetics
2021	**Dholavira enters UNESCO World Heritage**

Harappa: 1921 first. Mohenjo-daro: 1922 next.

References: Source Index

Limits: read the scope

The traditional limits combine sites from different Harappan phases.

FARTHER NORTH: SHORTUGHAI

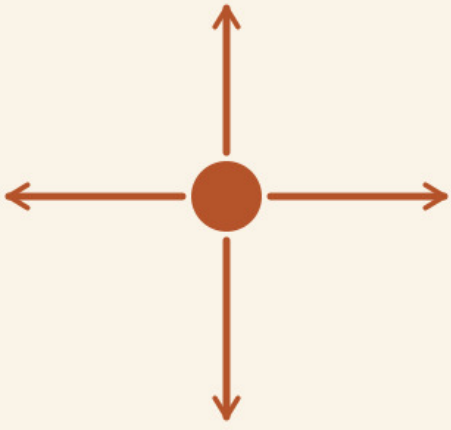
Afghanistan

N · MANDA

Jammu · northernmost within India

W · SUTKAGAN DOR

Balochistan, Pakistan



E · ALAMGIRPUR

Uttar Pradesh

S · DAIMABAD

Maharashtra · Late Harappan

Alamgirpur is EAST, not west.
Manda is northernmost only when the scope is India.
These are not the borders of one Mature Harappan state.

Compass is a memory diagram, not a map

TOPIC 2 · ENGLISH

Kakatiyas: Ganapatideva, Rudramadevi and Prataparudra

Concept in one line

The Kakatiyas rose from feudatory chiefs to rulers of most of the Telugu country from Orugallu (Warangal), and their rule ended with the Delhi Sultanate's capture of Warangal in 1323. The examination asks you to link each ruler with the right inscription, traveller, enemy and invasion.

Revision notes

2.1 Rise of the dynasty (brief)

- The Kakatiyas were a Telugu dynasty of the eastern Deccan. Their kingdom covered much of present-day Telangana and Andhra Pradesh.
- For over two centuries the early chiefs were feudatories, first of the Rashtrakutas and then of the Western Chalukyas of Kalyani. From the Kalyani Chalukyas they received Anumakonda (Hanamkonda) as a fief, and it became their first capital.
- Prola II (c. 1116 to 1157) was still a Kalyani Chalukya vassal.
- His son **Rudradeva** (c. 1158 to 1195, shown as Prataparudra I in some lists) proclaimed sovereignty. The Anumakonda inscription of 1163, in the Thousand Pillar Temple, records Rudradeva's achievements and the dedication of the Rudresvara temple.
- Rudradeva began shifting the capital from Anumakonda to Orugallu (Warangal) and started a fort there.
- Rudradeva died childless. His younger brother **Mahadeva** (c. 1196 to 1199) died fighting the Yadavas (Seunas) of Devagiri under their king Jaitugi. Mahadeva's son Ganapati was taken captive by the Yadavas.

2.2 Ganapatideva (c. 1199 to 1262)

- Son of Mahadeva. Jaitugi released him and sent him back to rule. During his captivity the commander **Recherla Rudra** held the kingdom together.
- His reign of about 63 years is the longest in the dynasty.
- **Expansion to the coast:** his forces were in the Krishna delta by 1201, annexed Velanadu and Kammanadu by 1209, subdued the chiefs of Divi island and placed Tikka on the throne of Nellore (some time after 1207-08). Campaigns in Kalinga had mixed results, and lasting control stayed south of the Godavari.
- **Why it matters:** the Telangana uplands and the coastal Andhra lowlands came under one rule. Scholars call this unification of upland and lowland the most significant political achievement of the Kakatiyas.
- He completed the move of the capital to Orugallu and gave the city a stone wall and a moat.
- **Motupalli (one line):** his pillar inscription of 1244-45 at the port of Motupalli is an abhaya-sasana, an edict assuring safety to foreign sea traders. Before it, the whole cargo of a ship wrecked on the coast was forfeited to the state; the edict ended this and allowed only the customary duties to be taken. The port and its trade are covered on another day.
- In his last years the Pandyas under Jatavarman Sundara Pandya I pushed north into the Nellore region.

- He had no son. His daughters were Rudrama, married to the Chalukya prince Virabhadra of Nidadavolu, and Ganapamba, married to Beta of the Kota family. Around 1259-60 he made Rudrama co-regent under the male name **Rudradeva Maharaja**.

2.3 Rudramadevi (c. 1262 to 1289)

- She was co-regent from about 1259-60 and sole ruler from the early 1260s. She is one of the few women in Indian history who ruled in their own right.
- Contemporary inscriptions show her as Ganapati's daughter. She ruled under the male name Rudradeva Maharaja. The NCERT textbook says she "changed her name on her inscriptions and pretended she was a man".
- **Opposition she faced:** an invasion by the Yadava king Mahadeva of Devagiri; an invasion of Vengi by the forces of Bhanudeva I, the Eastern Ganga king of Kalinga (about 1274), which her generals repulsed; Pandya pressure in the far south; and the revolt of the **Kayastha chief Ambadeva**. A later chronicle also tells of a revolt by two relatives, Harihara and Murarideva, but no other source supports it.
- She relied more on appointed officers than on hereditary chiefs (the nayankara system is covered on another day).
- She is credited with strengthening the Warangal fort: a higher stone wall, and an outer earthen wall with a moat. Older works credit both walls to Ganapatideva.
- **Marco Polo:** the Venetian traveller described the kingdom of "Mutfili" (Motupalli) as ruled by a queen who was "a lover of justice, of equity, and of peace". He also praised its diamonds and its very fine cloth. He wrongly called her the widow of the former king.
- **Her death:** the **Chandupatla inscription** (Nalgonda district, Telangana), dated November 1289, records a gift of land so that Rudramadevi and her general Mallikarjuna Nayaka might attain Shiva-loka, which means that both had died. So she was dead by the end of November 1289. The inscription does not say how she died.
- **Heir:** she had no son. She adopted Prataparudra, the son of her daughter Mummadamma, as her heir.

2.4 Prataparudra (c. 1289 to 1323)

- Daughter's son of Rudramadevi, also called Prataparudra II. He was the last Kakatiya ruler.
- **Early successes:** his forces defeated Ambadeva (about 1291), fought the Yadavas and the Pandyas, campaigned in Nellore and reached Kanchi.
- **Delhi Sultanate:** after Malik Kafur's siege of 1310 Prataparudra agreed to pay tribute to Alauddin Khalji. After the Khaljis fell in 1320 he again stopped paying. All five expeditions are in Section 3.
- **Fall of Warangal, 1323:** Ghiyasuddin Tughluq sent his son Ulugh Khan (later Muhammad bin Tughluq). The first siege failed. The second siege, of about five months, forced Prataparudra to surrender in 1323. Warangal was renamed Sultanpur.
- **His end:** he was sent towards Delhi as a captive and died on the way. The Vilasa grant of Musunuri Prolaya Nayaka (about 1330) says he died on the banks of the Narmada. A Reddi inscription of 1423 says he departed "by his own desire". Historians therefore think he probably killed himself.
- **Afterwards (one line):** Telugu chiefs such as the Musunuri Nayakas recovered Warangal, and Reddi and Velama families took over much of the Kakatiya lands. These are covered on other days.

2.5 The three rulers compared

Reign (approximate)

Ganapatideva: c. 1199 to 1262
Rudramadevi: c. 1262 to 1289
Prataparudra: c. 1289 to 1323

Came to the throne as

Ganapatideva: Son of Mahadeva; became king after his release from captivity under the Yadavas
Rudramadevi: Daughter of Ganapati; co-regent from about 1259-60
Prataparudra: Daughter's son of Rudramadevi; adopted heir

Point to remember

Ganapatideva: Longest reign, about 63 years
Rudramadevi: Ruled as "Rudradeva Maharaja"
Prataparudra: Also called Prataparudra II; last ruler

Main work

Ganapatideva: Brought the Telangana uplands and coastal Andhra under one rule
Rudramadevi: Held the kingdom against revolts and invasions; strengthened Warangal fort
Prataparudra: Recovered lost ground at first; then resisted Delhi for two decades

Main opponents

Ganapatideva: Yadavas; Velanadu and Nellore chiefs; Kalinga; Pandyas
Rudramadevi: Yadava Mahadeva; Ambadeva; Pandyas
Prataparudra: Ambadeva; Pandyas; Khalji and Tughluq armies

Key source

Ganapatideva: Motupalli pillar inscription, 1244-45
Rudramadevi: Chandupatla inscription, November 1289; Marco Polo's account
Prataparudra: Vilasa grant, about 1330; Delhi chroniclers such as Amir Khusrau and Barani

End

Ganapatideva: Handed power to Rudrama in his old age
Rudramadevi: Dead by the end of November 1289
Prataparudra: Surrendered in 1323; died on the way to Delhi

Extra section: the Delhi Sultanate's expeditions against Warangal

1302-03

Sultan of Delhi: Alauddin Khalji
Commander: Malik Juna and Malik Chajju
What happened: The expedition failed. The sources disagree on why.

1309-10

Sultan of Delhi: Alauddin Khalji
Commander: Malik Kafur
What happened: Ordered in October 1309. The siege of Warangal began on 19 January 1310. The outer mud fort fell in mid-February (12 or 16 February in different accounts). The inner stone fort was not taken, but Prataparudra made peace, gave up great wealth and promised an annual tribute. Kafur left Warangal on 20 March 1310.

1318

Sultan of Delhi: Mubarak Shah Khalji
Commander: Khusrau Khan
What happened: The tribute had lapsed. Prataparudra submitted again and the tribute was fixed at 100 elephants and 12,000 horses.

Early 1320s (first Tughluq siege)

Sultan of Delhi: Ghiyasuddin Tughluq
Commander: Ulugh Khan
What happened: A long siege failed after a false rumour that the Sultan had died caused panic in the Delhi army. Ulugh Khan retreated towards Devagiri.

1323

Sultan of Delhi: Ghiyasuddin Tughluq
Commander: Ulugh Khan
What happened: He returned with reinforcements. After a siege of about five months Prataparudra surrendered. Kakatiya rule ended and Warangal was renamed Sultanpur.

Points to remember from the table:

- Two dynasties of Delhi were involved: the Khaljis (1302-03, 1309-10, 1318) and the Tughluqs (early 1320s, 1323).
- The Khalji expeditions of 1310 and 1318 ended in tribute. Only the Tughluq expedition of 1323 annexed the kingdom.
- Ghiyasuddin Tughluq became Sultan in September 1320. Ulugh Khan was his son and later ruled as Muhammad bin Tughluq.

Three common exam traps

1. **Same names, different people.** Rudradeva (c. 1158 to 1195) is the king of the 1163 inscription. "Rudradeva Maharaja" is the male name used by Rudramadevi. Mahadeva the Kakatiya king was Ganapati's father, but Mahadeva the Yadava king invaded in Rudramadevi's time. The last ruler is Prataparudra II if Rudradeva is counted as Prataparudra I.
2. **Motupalli inscription or Marco Polo?** The Motupalli abhaya-sasana (1244-45) belongs to Ganapatideva. Marco Polo's account of "Mutfili" describes the rule of a queen, that is, Rudramadevi. Polo called her the former king's widow, but inscriptions show her as Ganapati's daughter.
3. **Malik Kafur did not end the dynasty.** Malik Kafur (1310, for Alauddin Khalji) only made Prataparudra a tributary. Khusrau Khan came in 1318. The dynasty ended in 1323 at the hands of Ulugh Khan, son of Ghiyasuddin Tughluq.

Sources

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Kakatiyas: three rulers

Expansion → defence → recovery, then the loss of sovereignty



Orugallu (Warangal)

Kakatiya capital · pictured: temple gateway

Ganapatideva — EXPAND
c. 1199–1262

Rudramadevi — DEFEND
c. 1262–1289

Prataparudra II — RECOVER → FALL
c. 1289–1323

Father → daughter → her grandson

Gateway study after the district photograph · ornamental detail simplified

Sources: Epigraphia Telanganica II–III; Telangana: Land & People

Ganapatideva: expansion

c. 1199–1262 · linked the Telangana uplands and Andhra coast

A KINGDOM PRESERVED

Ganapatideva held captive by the Yadavas → **Recherla Rudra held the kingdom together**

A KINGDOM EXPANDED



TELANGANA UPLANDS



COASTAL ANDHRA

Brought under one rule

Coastal gains included Divi and Velanadu.

Completed the capital shift to Orugallu.



Motupalli · 1244–45

Safety for sea traders.

Customary duties only;

no total cargo seizure.



Illustrative terrain and source objects; no territorial boundary is implied.

Sources: Epigraphia Telanganica II, pp. 149, 227–230; Telangana history, pp. 218–220

Rudramadevi: defence

c. 1262–1289 · Ganapatideva’s daughter, a ruler in her own right

REGNAL NAME

“Rudradeva Maharaja”

Co-regent from c. 1259–60; then sovereign ruler.

CHALLENGES TO HER RULE

YADAVA MAHADEVA
External invasion

AMBADEVA
Kayastha chief’s revolt



ORUGALLU

Defended the kingdom against external invasions. Credited with strengthening Warangal’s defences.

Chandupatla, Nov 1289: she had died.
The record does not state how.

Sources: Epigraphia Telanganica III; Telangana: Land & People, pp. 220–222

Prataparudra II: recovery

c. 1289–1323 · Rudramadevi’s grandson through Mummadamma

EARLY REIGN · c. 1291

Ambadeva defeated → **Southern territory recovered**

1310 MALIK KAFUR

For Alauddin Khalji

ANNUAL TRIBUTE → **Delhi**

Prataparudra remains ruler but agrees to pay tribute.

1323 ULUGH KHAN

Son of Ghiyasuddin Tughluq

Warangal falls → **Kakatiya rule ends**

Tribute = continued rule under an obligation.
Conquest = the end of Kakatiya sovereignty.

Source: Telangana: Land & People, pp. 223–230; Epigraphia Telanganica III

Five Delhi campaigns

Supporting chronology: follow the commander and the outcome.

● KHALJI ● TUGHLUQ

1. **1302–03** — FAILED
   Malik Juna + Malik Chajju
   For Alauddin Khalji
2. **1309–10** — TRIBUTE
   Malik Kafur
   For Alauddin Khalji
3. **1318** — TRIBUTE
   Khusrau Khan
   For Mubarak Shah Khalji
4. **Early 1320s** — FAILED
   Ulugh Khan · first siege
   For Ghiyasuddin Tughluq
5. **1323** — CONQUEST
   Ulugh Khan · return
   For Ghiyasuddin Tughluq

1310: tribute ≠ 1323: end of the dynasty

Source: Telangana: Land & People, pp. 226–230

Evidence and direction

Keep the inscription, policy and capital shift attached to the ruler.

1 1163 · ANUMAKONDA INSCRIPTION

Rudradeva, the earlier king.
Records his achievements and
dedication of the Rudresvara temple.

2 1244–45 · MOTUPALLI EDICT



Ganapatideva's protection for foreign sea traders

~~Whole wrecked cargo seized~~ → **Customary duties only**

3 CAPITAL SHIFT: KEEP THE DIRECTION

Anumakonda → **Orugallu**

Rudradeva began the move.
Ganapatideva completed it.

Sources: Epigraphia Telanganica II; Telangana: Land & People, pp. 218–220

TOPIC 3 · ENGLISH

Historical background: Regulating Act 1773 to Charter Act 1853

Concept in one line

Between 1773 and 1853 the British Parliament passed a series of Acts that brought the East India Company's rule in India under government control and created the first central institutions: a Governor-General with a council, a Supreme Court, a law-making council and a civil service chosen by competition. The examination asks which Act introduced which feature, and which came first.

Revision notes

2.1 Basics to keep in mind

- The Regulating Act of 1773 was the first step by the British Parliament to regulate the Company's government in India. Britannica calls it "the first intervention by the British government in the company's territorial affairs".
- From 1784 two bodies in London ran Indian affairs: the Company's own Court of Directors and the Crown's Board of Control. This is called "double government". It lasted until 1858.
- Parliament renewed the Company's charter for 20 years at a time, in 1793, 1813 and 1833. The Act of 1853 fixed no term.
- Two things happen across these Acts: government control over the Company grows, and the Company's trading rights shrink.
- The Government of India Act 1858 and the later Acts are covered on other days.

2.2 The seven Acts compared

Regulating Act, 1773

Main provisions: A Governor-General and four counsellors for the Presidency of Fort William in Bengal, named in the Act for five years: Warren Hastings, with Clavering, Monson, Barwell and Francis. The majority decided; the Governor-General had only a casting vote on a tie. Bengal was to superintend and control Madras, Bombay and Bencoolen (in Sumatra), which could not make war or treaties without its consent. The Crown could set up a Supreme Court at Fort William with a Chief Justice and three other judges. The Governor-General, counsellors and judges could not take presents or trade. Directors had to send copies of Indian correspondence to the Treasury and a Secretary of State.
Remember it for: First step by Parliament to regulate the Company's government; first Governor-General; Supreme Court at Calcutta

Amending Act, 1781 (also called the Act of Settlement)

Main provisions: Passed to explain and amend the Regulating Act after disputes between the council and the Supreme Court. The Governor-General and council were not answerable to the Supreme Court for official acts. The Court lost jurisdiction in revenue matters. It kept jurisdiction over all inhabitants of Calcutta, but had to apply Muslim law to Muslims and Hindu law to Hindus in inheritance, succession and contract. The Governor-General and council could frame regulations for the provincial courts.
Remember it for: Limits on the Supreme Court; personal laws recognised in a British statute

Pitt's India Act, 1784

Main provisions: A Board of Control of six commissioners: the Chancellor of the Exchequer, a Secretary of State and four Privy Councillors. It could "superintend, direct and control" the civil and military government and the revenues. The Court of Directors kept patronage and commerce. A secret committee of not more than three Directors passed on the Board's secret orders. The Governor-General's council was cut to three, one of them the Commander-in-Chief. Bengal's control over Madras and Bombay was widened to war, peace and relations with Indian states.

Remember it for: Board of Control; double government; the long title speaks of the "British Possessions in India"

Charter Act, 1793

Main provisions: Exclusive trade continued for 20 years. Mainly a consolidating Act. The Governor-General's power to override his council (first given by an Act of 1786) was continued and extended to the Governors of Madras and Bombay. The two junior members of the Board of Control no longer had to be Privy Councillors, and the Board's members and staff were to be paid from Indian revenues.

Remember it for: 20-year renewal; overriding power of the Governor-General and Governors

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Charter Act, 1813

Main provisions: Charter renewed for 20 years; the preamble kept the Crown's "undoubted sovereignty" over the territories. Trade with India was thrown open to other British traders, subject to conditions. The Company kept the China trade and the tea trade. A sum of not less than one lakh rupees a year was to be set apart for literature, learned Indians and the sciences. A Bishop of Calcutta with three archdeacons. Persons wishing to go to India to promote useful knowledge and religious and moral improvement (missionaries) could go under licence.

Remember it for: End of the monopoly of Indian trade; one lakh rupees for education; entry of missionaries under licence

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Charter Act, 1833

Main provisions: Charter renewed for 20 years; the territories were held "in trust for" the Crown. The monopoly of the China trade and the tea trade was abolished, and the Company had to close its commercial business. The Governor-General of Bengal became the Governor-General of India, and the Governor-General of India in Council controlled the whole civil and military government. Law-making for British India was vested in the Governor-General in Council alone; Madras and Bombay lost their law-making powers. A fourth member, not a Company servant, was added to the council for law-making only (the Law Member); Macaulay was the first. An Indian Law Commission was to be appointed. No Indian was to be barred from office under the Company by reason of religion, place of birth, descent or colour.

Remember it for: Governor-General of India; Law Member; Law Commission; Company ceases to be a trader

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Charter Act, 1853

Main provisions: No fixed term: Company rule to continue until Parliament provided otherwise. Directors reduced from 24 to 18, six of them appointed by the Crown. The Law Member became a full member of the council. For law-making, six "legislative members" were added: the Chief Justice of Bengal, one other Supreme Court judge, and four Company servants representing Bengal, Madras, Bombay and the North-Western Provinces (Agra). This made a legislative council of twelve. The Directors lost their patronage, and the covenanted civil service was thrown open to competition; the first rules were framed in 1854 by a committee under Macaulay.

Remember it for: Last Charter Act; legislative work separated from executive work; first local representation; open competition

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2.3 How the Governor-General's council changed

Act	Change
1773	Governor-General and four counsellors. Bound by the majority decision; casting vote in a tie, with no power to override the majority.
1784	Three counsellors, one of them the Commander-in-Chief.
1786	Governor-General may override the majority in special cases, on his own responsibility.
1793	Overriding power continued, and extended to the Governors of Madras and Bombay.
1833	Fourth member (Law Member) added, for law-making only.
1853	Law Member becomes a full member. Six legislative members added. Twelve members for law-making.

The 1853 Act enabled competitive recruitment. Macaulay's committee reported in 1854; the first competitive examination was held in 1855.

2.4 Distinctions worth remembering

Often confused	The difference
End of the trade monopoly: 1813 or 1833?	1813 opened the trade with India but kept the China trade and the tea trade with the Company. 1833 ended the Company's monopoly of those too and told the Company to close its commercial business.
Supreme Court: 1773 or 1774?	The Act of 1773 provided for it. The charter setting it up is dated 26 March 1774, and the judges reached Calcutta in October 1774. Sir Elijah Impey was the first Chief Justice.
Macaulay appears twice	Under the 1833 Act he was the first Law Member and the chairman of the first Law Commission. Under the 1853 Act he headed the 1854 committee on competition for the civil service.

Extra section: chronology of "firsts"

Year	What came first
1773	Regulating Act: first Governor-General of Bengal (Warren Hastings) and a council of four; Parliament's first step to regulate the Company's government
1774	Charter of 26 March 1774 sets up the Supreme Court at Calcutta; Sir Elijah Impey is the first Chief Justice; Hastings is Governor-General from 1774
1781	Amending Act: first express recognition in a British statute that Hindus and Muslims are governed by their own laws in matters such as inheritance
1784	Pitt's India Act: Board of Control set up; double government begins
1786	An Act first lets the Governor-General override the majority of his council in special cases
1793	Charter renewed for 20 years; from this year the Board of Control has a permanent, salaried President (before this, the senior Privy Councillor on the Board presided)
1813	Trade with India thrown open; one lakh rupees a year set apart for education; Bishop of Calcutta

Year	What came first
1833	Governor-General of India; fourth (Law) member; Indian Law Commission; end of the China trade and tea monopoly
1834	The 1833 Act comes into force on 22 April 1834; first Law Commission, with Macaulay
1853	Last Charter Act: legislative council of twelve; first local representation; Directors lose patronage
1854	Committee under Macaulay frames the first rules for competition for the civil service

Three common exam traps

1. **The trade monopoly ended in two steps, not one.** The 1813 Act ended the monopoly of trade with India but kept the China trade and the tea trade with the Company. The 1833 Act ended the monopoly of those too and closed the Company's commercial business. Questions swap the two years.
2. **Which Act changed the council, and how.** Four counsellors in 1773, three in 1784, a fourth member for law-making only in 1833, and six legislative members (twelve in all for law-making) in 1853. In 1773 the Governor-General was bound by the council's majority decision and had a casting vote in a tie; the power to override his council came from an Act of 1786.
3. **Law Member and Law Commission are 1833; open competition is 1853.** Macaulay is linked with both Acts, so questions mix them up. The Board of Control (1784) and the Supreme Court (Act of 1773, charter of 1774) are also swapped.

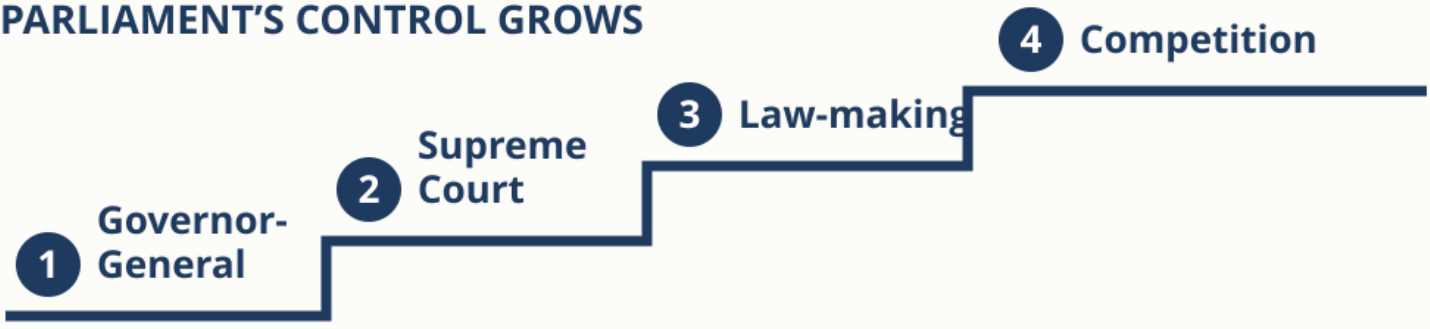
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Seven Acts. One direction.

Regulating Act 1773 → Charter Act 1853

PARLIAMENT'S CONTROL GROWS



Central institutions take shape; the Company loses its commercial role.

FROM 1784: "DOUBLE GOVERNMENT"

BOARD OF CONTROL		COURT OF DIRECTORS
Civil and military government; revenues	London →	Company commerce and patronage

CHARTER RENEWALS

1793 · 1813 · 1833
20 years each

1853
No fixed term

Sources: Ilbert, Historical Introduction; UK Parliament; CBC

The seven-act time path

Attach a contribution to each date

1773 — **REGULATING ACT**
Governor-General of Bengal; Supreme Court at Calcutta provided for.

1781 — **AMENDING ACT / SETTLEMENT**
Limits Court jurisdiction; recognises Hindu and Muslim personal law.

1784 — **PITT'S INDIA ACT**
Board of Control begins double government.

1793 — **CHARTER ACT**
20-year renewal; council override continued and extended.

1813 — **CHARTER ACT**
India trade opens; at least ₹1 lakh yearly for education.

1833 — **CHARTER ACT**
Governor-General of India; Law Member; Law Commission.

1853 — **CHARTER ACT**
Legislative separation; local representation; open competition.

Sources: Ilbert; Acts of 1773–1853; Law Commission of India

Count the council seats

GG = Governor-General; count members and powers

1773

GG



+ four counsellors

Majority binds; GG breaks a tie only.

1784

GG



+ three counsellors

One counsellor is the Commander-in-Chief.

1833

GG



+ fourth: the Law Member

Macaulay: law-making only.

1853



12 for law-making = 6 existing + 6 added

Added: 2 judges + 4 local representatives.
Law Member becomes a full member.

Existing: GG + four members + Commander-in-Chief

Override begins in 1786. The 1793 Act continues it and extends it to Madras and Bombay Governors.

Sources: Acts; Ilbert; Keith; Charter Act 1853, ss. 21–22; Wood speech (1853)

The Company stops trading

Two steps end the monopoly; keep the dates apart

COMPANY MONOPOLY	1813		1833
India trade	**ENDED**	→	**Already ended**
China trade	**KEPT**	→	**ENDED**
Tea trade	**KEPT**	→	**ENDED**

1833: commercial business closes. The Company remains an administrative body.

ACT → INSTITUTION / IMPLEMENTATION

1773 → 1774
Court provided for → charter, 26 March
First Chief Justice: Sir Elijah Impey

1833 → 1834
Law Commission enabled → constituted
Macaulay: first Law Member and chairman

1853 → 1854 → 1855
Competition enabled → rules → first exam
Directors lose civil-service patronage

Sources: Ilbert; Law Commission; UPSC/PIB, 30 September 2026

Three exam traps

Read the change, the date and the council's role

1 1813 ≠ 1833

1813 opens trade with India. China and tea monopolies remain until 1833.

2 A SEAT COUNT IS NOT A POWER

1773: four counsellors, majority rule. 1786 first allows override; 1793 continues it. 1833's Law Member is legislative only.

3 1833 ≠ 1853

1833: Law Member and Law Commission. 1853: civil-service competition. Court: Act 1773; Board of Control: 1784.

Practise with this topic's MCQs

References: Source Index

TOPIC 4 · ENGLISH

Governor: appointment, powers and discretion

Concept in one line

The Governor is the constitutional head of a State, appointed by the President and not elected. The exam tests the text of Articles 153 to 163, 200, 201 and 361, and the Supreme Court rulings on how far the Governor can act on his own, especially on assent to Bills.

Revision notes

2.1 The office: what each Article says

Article	What it says
153	There shall be a Governor for each State. A proviso added by the Constitution (Seventh Amendment) Act, 1956 allows the same person to be Governor for two or more States.
154 and 162	The executive power of the State is vested in the Governor, who uses it directly or through officers subordinate to him. It extends to the matters on which the State Legislature can make laws.
155	The Governor is appointed by the President by warrant under his hand and seal.
156	Holds office during the pleasure of the President. Resigns by writing to the President. Term is five years from the date of entering office, and he continues until his successor enters office.
157	Only two qualifications: citizen of India, and completed 35 years of age.
158	Not a member of Parliament or of a State Legislature (a member who is appointed Governor vacates the seat on the date of entering office). No other office of profit. Rent-free official residence. Emoluments are fixed by Parliament by law and cannot be reduced during the term. If one person is Governor of two or more States, the President decides how the States share the emoluments (clause 3A, also added in 1956).
159	Oath is taken before the Chief Justice of the High Court of the State or, in his absence, the senior-most Judge of that Court available. The oath is to "preserve, protect and defend the Constitution and the law".
160	The President may provide for the discharge of the Governor's functions in any contingency not provided for in this Chapter of the Constitution (the Chapter on the State Executive).
161	Power to grant pardons and to suspend, remit or commute sentences for offences against laws on matters within the State's executive power (details on another day).
361	Not answerable to any court for the exercise of the powers and duties of the office. No criminal proceedings and no arrest during the term. A civil case for a personal act needs two months' written notice.

2.2 Governor compared with the President

Point	President	Governor
How chosen	Elected by an electoral college (Article 54)	Appointed by the President (Article 155)
Qualifications	Citizen, 35 years, and qualified for election to the Lok Sabha (Article 58)	Citizen and 35 years only (Article 157)
Term	Five years (Article 56)	Five years, but subject to the pleasure of the President (Article 156)
Removal	By impeachment for violation of the Constitution (Articles 56 and 61)	No impeachment. The President can withdraw his pleasure at any time, and the Constitution lists no grounds
Resignation addressed to	Vice-President	President
Oath before	Chief Justice of India (Article 60)	Chief Justice of the High Court (Article 159)
Ministers' advice	Article 74 does not mention discretion. The President acts on advice and can ask for reconsideration once	Article 163 itself excepts functions that the Constitution requires the Governor to exercise "in his discretion"
Options on a Bill	Assent, withhold assent, or return a non-Money Bill (Article 111)	Assent; withhold and return a non-Money Bill; or reserve the Bill for the President (Article 200)

2.3 Powers in outline

- **Executive:** All executive action of the State is taken in the Governor's name (Article 166). He appoints the Chief Minister and, on the Chief Minister's advice, the other Ministers, who hold office during his pleasure (Article 164). He appoints the Advocate-General (Article 165) and the State Election Commissioner (Article 243K). He appoints the Chairman and members of the State Public Service Commission (Article 316), but only the President can remove them (Article 317). The Chief Minister must send him all decisions of the Council of Ministers and any information he asks for (Article 167).
- **Legislative:** Summons and prorogues the House or Houses; dissolves only the Legislative Assembly (Article 174). Addresses the first session after each general election and the first session of each year (Article 176). Decides disqualification questions under Article 191(1), according to the Election Commission's opinion (Article 192). Defection cases under the Tenth Schedule go to the Speaker or Chairman. Gives assent to Bills (Article 200). May promulgate Ordinances when immediate action is necessary (Article 213; details on another day). In a State with only an Assembly, he cannot do so while the Assembly is in session. In a State that also has a Legislative Council, he is barred only while both Houses are in session, so an Ordinance is possible when either House is not sitting.
- **Financial:** He causes the annual financial statement (Budget) to be laid before the Legislature (Article 202). Bills on Money Bill matters can be introduced only on his recommendation (Article 207). He constitutes the State Finance Commission every fifth year (Article 243-I).
- **Judicial:** Pardoning power (Article 161, covered on another day). Appoints district judges in consultation with the High Court (Article 233).

2.4 Assent to Bills: Articles 200 and 201, and the position on time limits as on 8 October 2026

- **Article 200:** When a Bill is presented, the Governor declares that he assents, or withholds assent, or reserves the Bill for the President. He may return a Bill that is not a Money Bill "as soon as possible" with a message. If the House passes it again, with or without amendment, he "shall not withhold assent". He must reserve a Bill which, in his opinion, would endanger the position of the High Court (second proviso).

- **Article 201:** The President either assents or withholds assent to a reserved Bill. For a Bill that is not a Money Bill he can direct the Governor to return it to the Legislature, which must reconsider it within six months. If passed again, it is presented again to the President.
- **The Constitution fixes no number of days** for the Governor or the President to decide.
- **8 April 2025, State of Tamil Nadu v. Governor of Tamil Nadu (two judges):** The Court fixed time limits (one month or three months, depending on the situation, for the Governor; three months for the President) and used Article 142 to treat 10 Tamil Nadu Bills as having received assent.
- **13 May 2025:** The President referred 14 questions to the Supreme Court under Article 143.
- **20 November 2025, opinion of a five-judge Constitution Bench (2025 INSC 1333). This is the present position:**
- Courts cannot fix timelines for the Governor or the President, and there is no "deemed assent". Article 142 cannot be used for this.
- For a non-Money Bill, the Governor may assent, reserve it for the President, or withhold assent and return it with comments. Withholding-and-return is not available for a Money Bill, so for a Money Bill he has two options: assent, or reserve it for the President. He cannot keep a Bill pending indefinitely.
- After reconsideration and re-passage, the Governor may assent or reserve the Bill for the President, whether the Bill is amended or unamended (paragraphs 99-101).
- In choosing among the three options he has discretion and is not bound by the advice of the Council of Ministers.
- Courts cannot examine the merits of his decision. But if his inaction is prolonged, unexplained and indefinite, a court can issue a limited direction (mandamus) to decide within a reasonable time, without telling him what to decide.
- Article 361 protects the Governor personally. It does not stop this limited review.
- A Bill cannot be challenged in court before it becomes law.
- The opinion said the Reference did not seek to disturb the final relief already given in the Tamil Nadu case.

2.5 Discretion: when the Governor need not follow the Council of Ministers

Article 163(1) says the Council of Ministers aids and advises the Governor, except where the Constitution requires him to act in his discretion. Under Article 163(2), if a question arises whether a matter is one for his discretion, his own decision is final.

Type	Situation	Basis
Written in the Constitution	Reserving a Bill that, in his opinion, endangers the position of the High Court	Article 200, second proviso
Written in the Constitution	Acting as administrator of an adjoining Union Territory, independently of his Council of Ministers	Article 239(2)
Written in the Constitution	Special responsibility for law and order in Nagaland and in Arunachal Pradesh, using his "individual judgment" after consulting the Ministers	Articles 371A(1)(b) and 371H(a)
Written in the Constitution	Deciding a dispute about the share of mineral royalties payable to a District Council	Sixth Schedule, paragraph 9(2)
Situational	Choosing the Chief Minister, who must be a person able to command a majority in the House (the choice is real when no party has a clear majority, a hung Assembly)	Shamsher Singh (1974), opinion of Justice Krishna Iyer
Situational	Dismissing a Ministry that has lost its majority but refuses to resign	Shamsher Singh (1974), opinion of Justice Krishna Iyer

Type	Situation	Basis
Situational	Dissolving the Assembly when an appeal to the people is necessary	Shamsher Singh (1974), opinion of Justice Krishna Iyer
Situational	Reporting to the President under Article 356, even against the Ministers' advice	Shamsher Singh (1974)
Situational	Choosing among assent, return and reservation of a Bill	Opinion of 20 November 2025

Ordinarily, summoning the Assembly under Article 174 is on ministerial advice while the Ministry enjoys the House's confidence. If there are grounds to doubt its majority, the Governor may require a floor test (Nabam Rebia, 2016, paragraphs 150-154). Commissions on Centre-State relations (Sarkaria, Punchhi) are covered on another day.

Extra section: leading Supreme Court cases in date order

23 August 1974

Case and Bench: Shamsher Singh v. State of Punjab (7 judges)
The one point it stands for: The Governor, like the President, is a formal head who acts on the aid and advice of the Council of Ministers, except where the Constitution requires him to use his discretion

11 March 1994

Case and Bench: S.R. Bommai v. Union of India (9 judges)
The one point it stands for: A proclamation under Article 356 is open to judicial review. A Ministry's majority must be tested on the floor of the House. The Assembly should not be dissolved before Parliament approves the proclamation

24 January 2006

Case and Bench: Rameshwar Prasad v. Union of India (5 judges, decided 3:2)
The one point it stands for: The dissolution of the Bihar Assembly in May 2005, on the report of Governor Buta Singh, was unconstitutional. Under Article 361 the Governor cannot be called to court, but an action taken in bad faith can still be reviewed

7 May 2010

Case and Bench: B.P. Singhal v. Union of India (5 judges)
The one point it stands for: The President can remove a Governor without notice and without giving reasons, but not arbitrarily. A Governor cannot be removed merely because he is out of sync with the Union Government's policies or has lost its confidence

13 July 2016

Case and Bench: Nabam Rebia v. Deputy Speaker (5 judges)
The one point it stands for: The Governor's discretion is limited. While the Ministry enjoys the confidence of the House, he cannot ordinarily summon or advance a session on his own without ministerial advice. The Nabam Tuki government in Arunachal Pradesh was restored

10 November 2023

Case and Bench: State of Punjab v. Principal Secretary to the Governor of Punjab (3 judges)
The one point it stands for: A Governor who withholds assent must return the Bill to the House. As an unelected head of the State he cannot use this power to block the normal course of law-making

8 April 2025

Case and Bench: State of Tamil Nadu v. Governor of Tamil Nadu (2 judges)
The one point it stands for: Fixed time limits for the Governor and the President, and treated 10 Bills as assented under Article 142

20 November 2025

Case and Bench: Presidential Reference on assent to Bills, Special Reference No. 1 of 2025 (5 judges)
The one point it stands for: Courts cannot fix time limits and cannot deem assent. Only a limited direction to decide can be given when the inaction is prolonged, unexplained and indefinite

Three common exam traps

1. **"Five-year term" does not mean a secure tenure.** The Governor is appointed, not elected. He holds office during the pleasure of the President, he is not impeached, he resigns to the President, and his oath is before the Chief Justice of the High Court, not the Chief Justice of India. He needs only two qualifications, unlike the President.
2. **Time limits for assent: April 2025 or November 2025?** The time limits and "deemed assent" came from the two-judge judgment of 8 April 2025. The five-judge opinion of 20 November 2025 said courts cannot fix time limits or deem assent. But the Governor still cannot sit on a Bill indefinitely, and a court can direct him to decide.
3. **Discretion is not a general power.** Article 163 mentions discretion and Article 74 does not, but the Governor cannot act on his own wherever he likes. Ordinarily, summoning the Assembly is on ministerial advice while the Ministry has majority support; a floor test may be required when that support is in doubt (Nabam Rebia). A disqualification question under Article 191(1) is decided under Article 192 according to the Election Commission's opinion. And "appoints" does not mean "removes": State Public Service Commission members are appointed by the Governor but removed only by the President.

Sources

1. Constitution of India, Part VI (official text hosted by the Ministry of External Affairs); 2. Constitution of India, article-by-article text (Centre for Law and Policy Research). Index: [link 2] [link 3]; 3. Same site, Part V pages opened: Articles 54, 56, 58, 60, 72, 74 and 111, for example [link 2]; 4. Supreme Court of India, In re: Assent, Withholding or Reservation of Bills by the Governor and the President of...; 5. Supreme Court Observer, case page "Presidential Reference on Powers of the Governor and President"; 6. Citizens for Justice and Peace, "A Constitutional Reset on Governor Assent" (analysis of the opinion, question by...; 7. News reports of the opinion: The News Minute, [link 2] [link 3] [link 4]; 8. Supreme Court Observer, Pranav Verma, "The Supreme Court's retreat from holding Governors accountable", 26 November 2025; 9. Supreme Court Observer, judgment summary of State of Tamil Nadu v. Governor of Tamil Nadu, [link 2]; 10. LiveLaw, "Governor must return Bill to Assembly on withholding assent: Supreme Court" (report of State of Punjab v....; 11. Shamsher Singh v. State of Punjab, judgment text on Indian Kanoon, [link 2]; 12. Wikipedia, "S. R. Bommai v. Union of India"; 13. The Tribune, 25 January 2006, report of the Bihar dissolution judgment, [link 2]; 14. B.P. Singhal v. Union of India, judgment text on Indian Kanoon, [link 2]; 15. Supreme Court Observer, "President's Rule: Judgment Summary" (Nabam Rebia); 16. Wikipedia, "Governor (India)" [link 2]; 17. Constitution of India, official text hosted by the Ministry of External Affairs, other Parts: Part V [link 2] [link 3] [link 4] [link 5]; 18. Supreme Court of India, Record of Proceedings dated 20 November 2025 in Special Reference No. 1 of 2025, which...; 19. Text of the same opinion as reproduced by Eastern Book Company (Supreme Court Cases), read for paragraphs 81 to 106; 20. SCC Online, report of the opinion dated 20 November 2025, [link 2]; 21. Judgment texts on Indian Kanoon: State of Punjab v. Principal Secretary to the Governor of Punjab, 2023 INSC 1017, [link 2] [link 3] [link 4] [link 5] [link 6]; 22. Tangkham M. Sangma v. State of Meghalaya, High Court of Meghalaya, 30 June 2015, which reproduces paragraph 9 of the...; 23. Constitution of India, official text (Legislative Department, Ministry of Law and Justice); 24. Nabam Rebia and Bamang Felix v. Deputy Speaker, Arunachal Pradesh Legislative Assembly (2016), judgment text hosted...;

Governor: the constitutional office

State constitutional head · appointed by the President

CONSTITUTIONAL

155 **APPOINTED BY**

The President, by warrant under his hand and seal.

157 **QUALIFICATIONS**

Indian citizen; completed 35 years. No Lok Sabha eligibility requirement (unlike the President).

156 **TERM, PLEASURE AND RESIGNATION**

Five years, subject to the President's pleasure. Continues until successor enters office. Resigns to the President.

159 **OATH BEFORE**

High Court Chief Justice; in their absence, the senior-most available Judge of that Court.

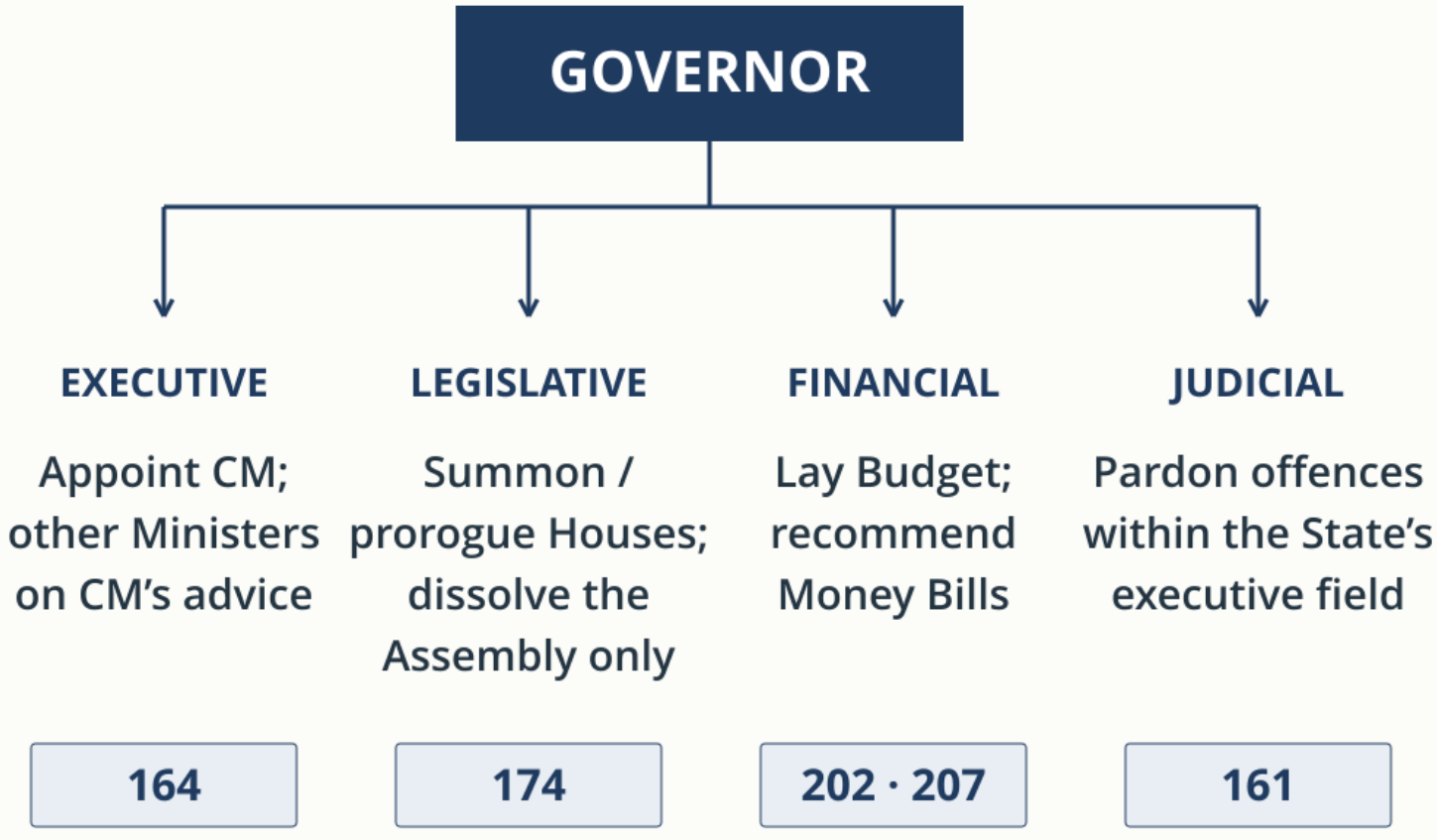
153 **ONE PERSON, TWO OR MORE STATES**

The proviso allowing this was added by the Seventh Amendment, 1956.

Source: Constitution of India, Articles 153, 155–159; Seventh Amendment, 1956

Four kinds of power

Actor → action → constitutional Article



Article 163: aid and advice is the general rule

STATE PSC: APPOINTMENT AND REMOVAL

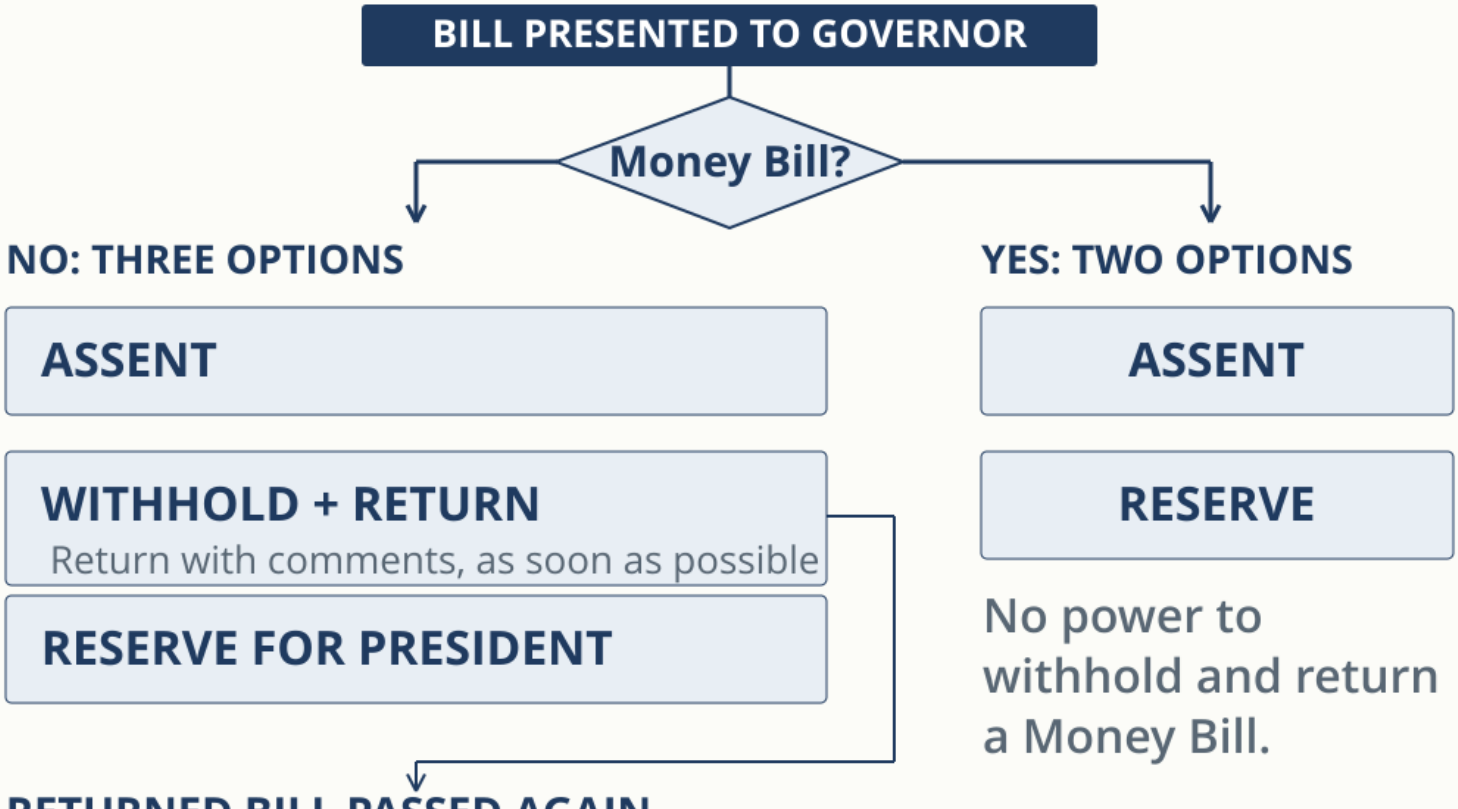


Source: Constitution, Articles shown · PSC: State Public Service Commission

As on 8 October 2026

Article 200: follow the Bill

Current position under the opinion of 20 November 2025



Must reserve if, in the Governor's opinion, the Bill endangers the High Court's position.

ARTICLE 201: AFTER RESERVATION

President assents or withholds. For a non-Money Bill, may direct return; the Legislature reconsiders within six months. If re-passed, it goes back to the President.

Sources: Constitution, Articles 200–201; 2025 INSC 1333, paragraphs 45–50, 99–101, 165

Advice or discretion?

Start with the rule; identify the precise exception

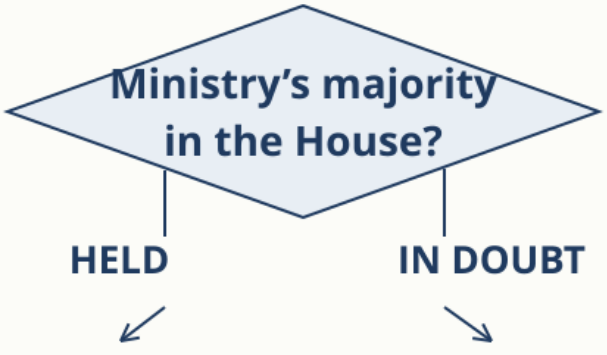
ADVICE · DEFAULT

Council of Ministers

↓

Governor acts on advice
Article 163

SUMMONING THE HOUSE · 174



Ordinarily summon on advice

Grounds may justify a floor test

Shamsher Singh: advice rule.
Nabam Rebia: sessions and the majority boundary.

DISCRETION · EXCEPTION

Requires a specific constitutional basis or defined situation.

ARTICLE 200 · CURRENT RULE

Non-Money Bill: choose assent, withhold + return, or reservation.

Money Bill: assent or reservation only.

↓

Not bound by Ministers' advice in choosing these options.

OTHER DEFINED BASES

239(2): adjoining UT.
371A / 371H: law and order after consulting Ministers.
Sixth Schedule 9(2): royalties.

Sources: Constitution; Shamsher Singh (1974); Nabam Rebia (2016); 2025 INSC 1333

Six cases, six boundaries

The case name must stay attached to its holding

1974 · 7 judges
Shamsher Singh
Formal head: acts on ministerial advice, except where the Constitution requires discretion.

1994 · 9 judges
S.R. Bommai
Article 356: reviewable; majority: floor test. No Assembly dissolution before Parliament's approval.

2006 · 5 · 3:2
Rameshwar Prasad
Bihar dissolution unconstitutional. Personal immunity does not shield bad-faith action from review.

2010 · 5 judges
B.P. Singhal
No removal merely for policy differences with the Union Government or loss of its confidence.

2016 · 5 judges
Nabam Rebia
While Ministry has majority support, ordinarily no summoning or advancing sessions without advice.

2023 · 3 judges
State of Punjab
Withholding requires return of the Bill; the Governor cannot block normal law-making.

References: Source Index

As on 8 October 2026

Assent: read the later position

8 April → 20 November 2025

8 APRIL 2025

TAMIL NADU CASE

2 judges

Set time limits for Governor / President. Used Article 142 to deem assent to 10 Bills.

→

20 NOVEMBER 2025

PRESIDENTIAL REFERENCE

5 judges · PRESENT POSITION

No court-fixed timelines. No deemed assent. Article 142 cannot substitute for assent.

INACTION STILL HAS A LIMIT

Prolonged + unexplained + indefinite inaction

↓

A court may direct a decision within a reasonable time. It cannot direct which decision to make.

Article 361 protects the Governor personally; this limited review remains possible. No merits review of the decision, or challenge to a Bill before it becomes law.

The April case's final relief was not disturbed by the Reference.

Source: 2025 INSC 1333, paragraphs 26 and 165; court Record of Proceedings, 20 November 2025

Three exam traps

Office rules, current law and bounded discretion

1 FIVE YEARS ≠ SECURE TENURE

Governor: appointed; President's pleasure; no impeachment. Resigns to President; oath before HC Chief Justice.

President: elected; impeachment; resigns to Vice-President; oath before Chief Justice of India.

2 APRIL 2025 ≠ CURRENT RULE

November 2025: no court-fixed deadline or deemed assent. Indefinite inaction can still trigger a limited direction to decide.

3 DISCRETION IS NOT A GENERAL POWER

Ordinary summoning needs advice while majority is held. Article 192 follows the ECI's opinion. PSC appointment ≠ removal.

Practise with this topic's MCQs

Sources: Constitution; Shamsher Singh; Nabam Rebia; 2025 INSC 1333

TOPIC 5 · ENGLISH

National income concepts: GDP, GNP, NNP and GVA

Concept in one line

National income accounting uses a family of aggregates (GDP, GNP, NDP, NNP and GVA) that differ on only three points: where or by whom the output is produced, whether depreciation is deducted, and which taxes and subsidies are included in the valuation. The exam tests the formulas that link them and the aggregates India actually reports.

Revision notes

2.1 Reading "GDP" word by word

Gross Domestic Product (GDP) at market prices is the market value of all final goods and services produced within the domestic territory of a country in a year.

Word	What it means
Gross	Depreciation has not been deducted. "Net" means it has been deducted.
Domestic	Produced inside the country's domestic territory, whoever owns the producer. The profits of the Korean-owned Hyundai car factory in India are part of India's GDP.
Final goods	Goods that will not pass through any more stages of production. Intermediate goods (raw materials and inputs) are left out, because their value is already inside the value of the final good. Counting wheat and also the bread made from it would be double counting.
Market prices	Valued at the prices buyers pay, so taxes on products are included and subsidies on products are netted out.

2.2 The three adjustments

Domestic to National

What you do: Add net factor income from abroad (NFIA)
Key term: NFIA = factor income earned by domestic factors of production employed in the rest of the world, minus factor income earned by the rest of the world's factors employed in the domestic economy. It can be negative.

Gross to Net

What you do: Subtract depreciation
Key term: Depreciation is the annual allowance for wear and tear of capital goods. It is also called consumption of fixed capital (CFC).

Market prices to Factor cost

What you do: Subtract net indirect taxes (indirect taxes minus subsidies)
Key term: Factor cost includes only the payments to factors of production. It does not include any tax.

Gross National Product (GNP) is therefore the output produced by a country's normal residents, whether they are located inside the country or abroad. In the UN System of National Accounts (SNA) the same aggregate is called Gross National Income (GNI).

2.3 The aggregates and their formulas

MP = market prices, FC = factor cost.

Aggregate	Formula
GDP at MP	Sum of GVA at basic prices + taxes on products - subsidies on products
NDP at MP	GDP at MP - depreciation
GNP at MP	GDP at MP + NFIA
NNP at MP	GNP at MP - depreciation (also NDP at MP + NFIA)
GDP at FC	GDP at MP - net indirect taxes
NDP at FC	NDP at MP - net indirect taxes
GNP at FC	GNP at MP - net indirect taxes
NNP at FC (National Income)	NNP at MP - net indirect taxes (also NDP at FC + NFIA)
GVA at basic prices	GDP at MP - net product taxes
GVA at factor cost	GVA at basic prices - net production taxes

Net indirect taxes = net product taxes + net production taxes. "Net" here means taxes minus subsidies.

2.4 Factor cost, basic prices and market prices

Gross Value Added (GVA) is the value of output minus the value of intermediate consumption. It can be valued at three levels, and the difference lies in two kinds of taxes and subsidies.

Point	Production taxes and subsidies	Product taxes and subsidies
Basis	Paid or received in relation to production; independent of the volume produced	Paid or received per unit of the product
Tax examples	Land revenue, stamp and registration fees, professional tax	Goods and Services Tax (GST), excise duty, sales tax, service tax, export and import duties
Subsidy examples	Subsidies to the railways, subsidies to village and small industries	Electricity, petroleum and fertiliser subsidies
Included in GVA at basic prices?	Yes (taxes added, subsidies deducted)	No

- The subsidy examples are from the list given by the Ministry of Statistics and Programme Implementation (MoSPI) for the national accounts series with base year 2022-23. Older books also give the food subsidy as a product subsidy; in the 2022-23 series, Government financing of the Food Corporation of India is treated as a social transfer in kind, not as a product subsidy.
- GVA at factor cost + net production taxes = GVA at basic prices.
- GVA at basic prices + net product taxes = GDP at market prices.
- The SNA 2008 defines the basic price as the amount receivable by the producer from the purchaser for a unit of output, minus any tax payable on the product and plus any subsidy receivable on it.

2.5 Which aggregate is "National Income"?

- In the NCERT textbook, **NNP at factor cost is National Income (NI)**: the income earned by a country's factors of production.

- India's official tables use SNA labels instead. The National Statistics Office reports Gross National Income (GNI) and Net National Income (NNI). Here GNI = GDP + primary income receivable from the rest of the world (net), and NNI = GNI - consumption of fixed capital. "Per Capita Income" in its press notes means per capita NNI. Because this GDP is at market prices, the official NNI is also at market prices: it corresponds to the textbook NNP at market prices, not to NNP at factor cost.

2.6 India's present practice

- **Who compiles:** the National Accounts Division of the National Statistics Office (NSO), Ministry of Statistics and Programme Implementation (MoSPI). Until May 2019 this division was part of the Central Statistics Office (CSO). In May 2019 the CSO and the National Sample Survey Office (NSSO) were merged to form the NSO.
- **The January 2015 change:** with the new series released on 30 January 2015 (base year changed from 2004-05 to 2011-12), sector-wise estimates began to be given as GVA at basic prices instead of at factor cost. "GDP at market prices" began to be called simply GDP, and GDP at factor cost was dropped from the press releases. The series followed the recommendations of the SNA 2008.
- **Headline figure:** growth is measured by GDP at constant market prices. Sectoral output (agriculture, industry, services) is reported as GVA at basic prices.
- **Current base year:** 2022-23. NSO released the new series on 27 February 2026, replacing the 2011-12 base, and the quarterly GDP press note of 31 August 2026 uses the same base.

Covered on other days: the three methods of measurement, nominal and real GDP and the deflator, per capita, personal and disposable income, advance and revised estimates, and the limits of GDP as a welfare measure.

Extra section: worked example, moving from one aggregate to another

This is an illustration with invented round numbers. It is not real data for any country or year. All figures refer to one year, are at current prices, and are in Rs crore.

Given: GVA at basic prices 900; taxes on products 150; subsidies on products 50; production taxes 30; production subsidies 10; consumption of fixed capital 70; factor income received from abroad 10; factor income paid abroad 30.

1

What we find: Net product taxes
Working: 150 - 50
Result: 100

2

What we find: GDP at market prices
Working: 900 + 100
Result: 1,000

3

What we find: Net production taxes
Working: 30 - 10
Result: 20

4

What we find: GVA at factor cost
Working: 900 - 20
Result: 880

5

What we find: NDP at market prices
Working: 1,000 - 70
Result: 930

6

What we find: NFIA
Working: 10 - 30
Result: minus 20

7

What we find: GNP at market prices
Working: 1,000 + (minus 20)
Result: 980

8

What we find: NNP at market prices
Working: 980 - 70
Result: 910

9

What we find: Net indirect taxes
Working: 100 + 20
Result: 120

10

What we find: NNP at factor cost (National Income)
Working: 910 - 120
Result: 790

Cross-check: NDP at factor cost = 930 - 120 = 810, and 810 + (minus 20) = 790. Both routes give the same National Income. Note also that GNP (980) is smaller than GDP (1,000) here, because NFIA is negative.

Three common exam traps

1. **"Domestic" is about place, "National" is about residents.** GDP counts what is produced inside the territory, even by foreign-owned units. GNP adds NFIA. Since NFIA can be negative, GNP can be smaller than GDP. Do not assume that GNP is always the bigger figure.
2. **Production taxes and product taxes are not the same thing.** GVA at basic prices already includes net production taxes (such as land revenue and stamp duty) but excludes net product taxes (such as excise and import duties). Add net product taxes to GVA at basic prices and you get GDP at market prices. Subtract net production taxes and you get GVA at factor cost.
3. **"National Income" is not GDP.** In the textbook it is NNP at factor cost, reached from GDP at market prices by three steps: subtract depreciation, add NFIA, subtract net indirect taxes. Questions change one sign (adding depreciation, or adding net indirect taxes) to produce the wrong options. Also remember that the unqualified word "GDP" in India's official statistics has meant GDP at market prices since January 2015.

Sources

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Accounts 1993, entry "Gross national income (GNI)"; 8. National Statistics Office, MoSPI, "Press Note on New Series of Gross Domestic Product (GDP) Estimates with Base…; 9. MoSPI, press note on the release of the report of the committee on constant price estimates, 20 February 2026; 10. National Statistics Office, MoSPI, press note "Quarterly Estimates of Gross Domestic Product for the First Quarter…; 11. The Quint, "Statistics Ministry Orders Revamp; Merges NSSO and CSO Into NSO", 26 May 2019; 12. United Nations Statistical Commission, 39th session (26 to 29 February 2008), background document "Updated System of…; 13. United Nations Statistical Commission, same series, "Updated System of National Accounts (SNA): Chapter 7: The…; 14. United Nations Statistical Commission, same series, "Updated System of National Accounts (SNA): Chapter 16:…; 15. National Statistics Office, MoSPI, Sources and Methods for Compilation of National Accounts Statistics (base year…; 16. MoSPI, second discussion paper on the base year revision, "Methodological Improvements in compilation of GDP from…; 17. Press Information Bureau and MoSPI, press note "Advance Estimates of National Income, 2012-13", 7 February 2013; 18. MoSPI, National Accounts Statistics 2018, Highlights; 19. National Statistics Office, MoSPI, press note "First Advance Estimates of Gross Domestic Product, 2024-25", 7…; 20. MoSPI, press release "National Accounts Statistics - 2026 publication", 31 August 2026; 21. Press Information Bureau (Ministry of Statistics and Programme Implementation), "Additional Information related to…;

National income concepts

GDP · GNP · NDP · NNP · GVA

READ "GDP" WORD BY WORD

GROSS Wear and tear of capital is not yet deducted.

DOMESTIC Production inside the territory, whoever owns it.

PRODUCT Final goods and services produced in a year.

COUNT THE FINAL GOOD ONCE



WHEAT FLOUR BREAD

Wheat and flour used to make bread are intermediate inputs. Their value is already inside the bread.

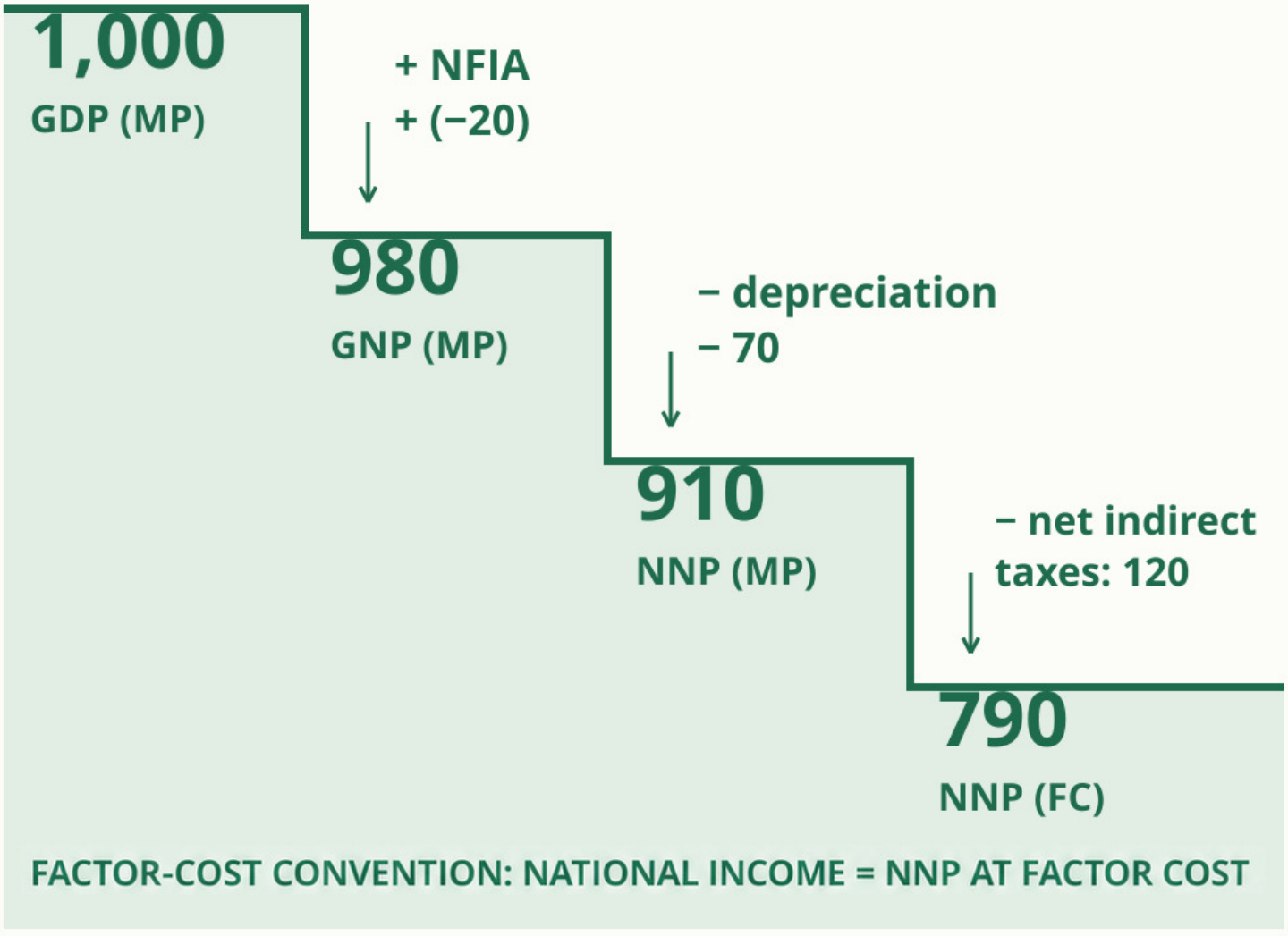
Market prices: what buyers pay, with net product taxes.

References: Source Index

Three adjustments to income

Illustrative worked example · ₹ crore

National: normal residents, at home and abroad.



NFIA = received 10 − paid 30 = −20

Cross-check: NDP (MP) = 1,000 − 70 = 930

NDP (FC) = 930 − 120 = 810; 810 − 20 = 790

MP: market prices; FC: factor cost

Three prices. Two tax steps.

Illustrative worked example · ₹ crore

GVA = output − intermediate consumption

VALUE COMPONENTS

GVA at factor cost



880

+ net production taxes: 30 − 10 = 20

GVA at basic prices



900

+ net product taxes: 150 − 50 = 100

GVA at market prices



1,000

PRODUCTION TAXES

Related to production, independent of volume. Land revenue; stamp fees.

PRODUCT TAXES

Per unit of product. GST, excise and import duties.

Net indirect taxes = 20 + 100 = 120

Basic prices include production taxes; exclude product taxes.

Net = taxes − subsidies

As on 8 October 2026

What India reports

Income measures use different valuation conventions

30 JANUARY 2015: THE VALUATION SWITCH

SECTORS ⟶ **GVA at basic prices**

HEADLINE ⟶ **GDP at market prices**

The official word "GDP" means GDP at market prices. Headline growth uses constant prices.

KEEP THESE TWO CONVENTIONS SEPARATE

Factor-cost convention

National Income = NNP (FC)

Official SNA labels

GNI = GDP + net primary income from abroad

NNI = GNI − consumption of fixed capital

Official NNI is at market prices. "Per Capita Income" in NSO press notes is per capita NNI.

CURRENT BASE YEAR: 2022–23

Released 27 Feb 2026; retained 31 Aug 2026.
Compiler: NSO, MoSPI · NSO formed May 2019

Sources: MoSPI, 30 January 2015; PIB 2233518 and 2305896, 2026

Three exam traps

Keep the boundary, tax layer and signs correct

1 DOMESTIC = PLACE

National = normal residents. GNP = GDP + NFIA. Negative NFIA can make GNP smaller than GDP.

2 BASIC PRICES: CHECK THE TAX LAYER

Net production taxes are already included. Add net product taxes to reach GDP at market prices.

3 NATIONAL INCOME: CHECK ALL SIGNS

GDP (MP) − depreciation + NFIA − net indirect taxes = NNP (FC). Subtracting a negative NFIA is a sign error.

Practise with this topic's MCQs

References: Source Index

TOPIC 6 · ENGLISH

Interior of the Earth: crust, mantle, core and discontinuities

Concept in one line

The Earth is made of three main layers, the crust, the mantle and the core, which differ in thickness, state, composition and density and are separated by boundaries called discontinuities. The examination asks you to match each layer and each discontinuity with its figures and features.

Revision notes

2.1 How we know about the interior

The Earth's radius is about 6,378 km at the equator (the figure in the current NCERT text); its mean radius is 6,371 km. The deepest hole ever drilled is only about 12 km deep. So most of what we know comes from indirect evidence.

Type	Source	What it tells us
Direct	Mining	Rocks from shallow depths. Gold mines in South Africa are 3 to 4 km deep; below that it is too hot to work.
Direct	Deep drilling	The Deep Ocean Drilling Project and the Integrated Ocean Drilling Project; the deepest drill, at Kola, reached about 12 km.
Direct	Volcanic eruptions	Magma thrown out can be studied in the laboratory, but the depth it came from is hard to fix.
Indirect	Rise of temperature, pressure and density with depth	Values at different depths can be estimated.
Indirect	Meteorites	They are not from the Earth's interior, but they are made of material the same as, or similar to, the Earth's.
Indirect	Gravitation	Gravity is greater near the poles and less at the equator. Gravity anomalies show how mass is distributed in the crust.
Indirect	Magnetic field	Magnetic surveys show how magnetic materials are distributed in the crust.
Indirect	Seismic activity	The most important source. The behaviour of earthquake waves gives the layered picture of the interior.

2.2 The layers at a glance

Crust

Depth from the surface: 0 to about 5 km under oceans and about 30 km under continents (NCERT mean figures)
State: Solid, brittle
Composition: Oceanic: basaltic (mafic) rocks. Continental: granitic (felsic) rocks
Density (g/cm³): 2.6 to 2.9

Mantle

Depth from the surface: From the Moho to 2,900 km
State: Solid; its upper part, the asthenosphere, is weak and flows slowly
Composition: Silicate rocks with more iron and magnesium than the crust; the upper mantle is mainly peridotite
Density (g/cm³): 3.4 to 5.6

Outer core

Depth from the surface: 2,900 km to about 5,150 km
State: Liquid
Composition: Mainly iron and nickel
Density (g/cm³): 9.9 to 12.2

Inner core

Depth from the surface: About 5,150 km to the centre
State: Solid
Composition: Iron with some nickel
Density (g/cm³): 12.8 to 13.1

- By volume, the crust is about 1 per cent of the Earth, the mantle about 84 per cent and the core about 15 per cent.
- The density figures in the table are from the Preliminary Reference Earth Model (PREM, 1981), the standard seismological model of the Earth. Other books give slightly different figures, so the densities in 2.3 and 2.6, which are from other sources, do not match these exactly. What matters is the order: sima is denser than sial, the mantle is denser than the crust, and the core is the densest.
- The Earth's average density is about 5.5 g/cm³ (5.513 on NASA's Earth Fact Sheet), about twice that of surface rocks. This alone shows that the interior is much denser than the crust.

2.3 The crust

The crust is the outermost solid layer and is brittle. It is thinner under the oceans than under the continents.

Feature	Oceanic crust	Continental crust
Mean thickness (NCERT)	5 km	About 30 km; as much as 70 km in the Himalayan region
Other figures in use	About 6 to 7 km (Britannica)	About 35 to 40 km on average (Britannica); up to about 100 km under large mountain ranges (USGS)
Main rocks	Basalt and gabbro (mafic)	Granite-type (felsic) rocks
Density	Denser: about 2.9 to 3.0 g/cm³ (Britannica)	Lighter: about 2.7 g/cm³ (Britannica)
Older name	Sima	Sial

2.4 The mantle

- The mantle extends from the Moho to a depth of 2,900 km (NCERT).
- **Lithosphere:** the rigid crust plus the uppermost mantle, broken into plates. An illustrative thickness range is 10–200 km; thickness varies by region (plate tectonics is covered on another day).
- **Asthenosphere:** the weak upper mantle below the lithosphere. "Astheno" means weak. The illustrative model here extends it to about 400 km depth; its boundaries vary by region. It is an important source region for magma.
- The asthenosphere is not liquid. It is predominantly solid rock that deforms and flows slowly over geological time; small amounts of partial melt may be present, and S-waves can pass through it.
- **Lower mantle:** lies beyond the asthenosphere and is solid (NCERT). Modern geophysics places the boundary of the upper and lower mantle at a depth of 660 to 670 km.

2.5 The core

- The core begins at 2,900 km. The outer core is liquid and the inner core is solid.
- It is made of very heavy material, mostly nickel and iron, so it is called the **nife** layer.
- The outer core is about 2,200 to 2,260 km thick. The inner core has a radius of about 1,220 km.
- **Evidence for a liquid outer core:** S-waves travel only through solids. NCERT says that seismographs beyond about 105° from an earthquake record no S-waves, and that P-waves are missing between about 105° and 145°. These "shadow zones" show that the outer core is liquid. (Earthquakes and seismic waves are covered in detail on another day.)
- R.D. Oldham discovered the core in 1906 from earthquake records. Inge Lehmann discovered the inner core in 1936.
- The flow of liquid iron and nickel in the outer core produces the Earth's magnetic field.

2.6 The older names: sial, sima and nife

Sial

Stands for: Silica + alumina
Layer: Upper, lighter layer of the crust; thick over the continents, thin or absent on the ocean floor
Density (g/cm³): About 2.7 to 2.8

Sima

Stands for: Silica + magnesia
Layer: Lower, denser layer of the crust; forms most of the ocean floor
Density (g/cm³): About 2.9 to 3.3

Nife

Stands for: Nickel (Ni) + iron (Fe)
Layer: Core
Density (g/cm³): 9.9 to 13.1

These names are credited to the geologist Eduard Suess. Sial is lighter and was described as "floating" on sima. Geologists now treat sial and sima as outdated terms, but examinations still use them.

2.7 Temperature, pressure and density with depth

- All three increase with depth (NCERT).
- **Temperature:** in the upper 100 km it rises by about 15 to 30°C per km. Through most of the mantle the rise is much slower. Estimates for the centre range from about 5,000°C to more than 6,000°C.
- **Pressure:** about 136 GPa (about 1.3 million atmospheres) at the base of the mantle and about 364 GPa at the centre (PREM).
- **Density:** it rises gradually through the mantle and then jumps sharply at the mantle-core boundary, from about 5.6 to about 9.9 g/cm³.

2.8 Discontinuities

A discontinuity is a boundary inside the Earth where the speed of seismic waves changes suddenly.

Conrad

What it separates: Upper crust (sial) and lower crust (sima), within the continental crust
Depth: About 15 to 20 km in most accounts; A Dictionary of Earth Sciences gives 10 to 12 km
Named after: Victor Conrad
How firmly established: Weak. Not found in oceanic crust, absent in some continental regions, and its meaning is still unclear

Mohorovicic (Moho)

What it separates: Crust and mantle
Depth: At the base of the crust: on NCERT's mean figures, about 5 km below the ocean floor and about 30 km below the continental surface (Britannica gives about 7 km and about 35 km)
Named after: Andrija Mohorovicic, who identified it in 1909
How firmly established: Firm. The only discontinuity named in the NCERT chapter

Repetti

What it separates: Upper mantle and lower mantle (as used in exam books)
Depth: Not fixed. The geophysics writing that uses the name places it near 900 to 1,000 km
Named after: Repetti
How firmly established: Weak. The name is rare in modern geophysics, which usually places the boundary of the upper and lower mantle at the "660 km discontinuity"

Gutenberg

What it separates: Mantle and outer core
Depth: 2,900 km
Named after: Beno Gutenberg (1913)
How firmly established: Firm. P-waves slow down sharply and S-waves stop here

Lehmann

What it separates: Outer core and inner core
Depth: About 5,150 km (Britannica: roughly 5,100 km)
Named after: Inge Lehmann (1936)
How firmly established: Firm. The same name is also used for a second boundary in the upper mantle, at about 200 to 220 km

Order from the surface downwards: Conrad, Moho, Repetti, Gutenberg, Lehmann.

Extra section: a journey to the centre of the Earth, depth by depth

Depth	What you meet
3 to 4 km	The deepest gold mines of South Africa
About 5 to 7 km	Base of the oceanic crust (the Moho under the oceans)
About 12 km	Bottom of the Kola Superdeep Borehole in Russia: 12,262 m, reached in 1989. Still only about one-third of the way through the continental crust there
15 to 20 km	Conrad discontinuity, where it is present
About 30 to 35 km	Base of the continental crust (the Moho under the continents)
About 70 km	Base of the crust under the Himalayan region
10–200 km	Illustrative range; varies by region. Base of the lithosphere and transition to the asthenosphere.
About 400 km	Lower extent in this illustrative model; not a fixed global boundary of the asthenosphere.

Depth	What you meet
660 to 670 km	Boundary of the upper and lower mantle in modern geophysics
2,900 km	Gutenberg discontinuity: the solid mantle ends and the liquid outer core begins
About 5,150 km	The liquid outer core ends and the solid inner core begins
About 6,371 km (mean radius)	Centre of the Earth: temperature estimated at about 5,000°C to more than 6,000°C; pressure about 364 GPa

Deep drilling at a glance:

- **Kola Superdeep Borehole (Kola Peninsula, Murmansk Oblast, Russia):** drilling began on 24 May 1970; deepest point 12,262 m in 1989; drilling ended in 1992. The temperature at the bottom was about 180°C, far higher than expected. The basalt layer expected at about 7 km was never found.
- **Shenditake 1 (Tarim Basin, Xinjiang, China):** 10,910 m; completion announced by CNPC on 20 February 2025; reported as Asia's deepest and the world's second-deepest vertical well.
- **Bertha Rogers well (Oklahoma, USA):** 9,583 m, reached in 1974; the depth record before Kola overtook it in 1979.
- **KTB borehole (Germany, 1987 to 1995):** 9,101 m, reached in 1994, with a temperature of about 265°C at the bottom.
- **Project Mohole (USA):** an attempt in the early 1960s to drill through the ocean floor to the Moho; cancelled in 1966.

No borehole has yet drilled through the full thickness of the crust to the Moho. What lies below the crust is known mainly from indirect evidence.

Three common exam traps

1. **"The asthenosphere is liquid" and "the lithosphere is the crust".** Both are wrong. The asthenosphere is a weak, slowly flowing part of the solid mantle. The only liquid layer is the outer core. The lithosphere is the crust plus the uppermost mantle, so it is thicker than the crust.
2. **Mixing up the discontinuities.** Moho separates the crust and the mantle. Gutenberg separates the mantle and the core. Lehmann separates the outer core and the inner core. Conrad lies inside the crust, between sial and sima, not between the crust and the mantle.
3. **"Thicker means denser".** The oceanic crust is thinner (about 5 km) but denser, and is basaltic (sima). The continental crust is thicker (about 30 km) but lighter, and is granitic (sial). Sial takes its name from silica and alumina; sima from silica and magnesia.

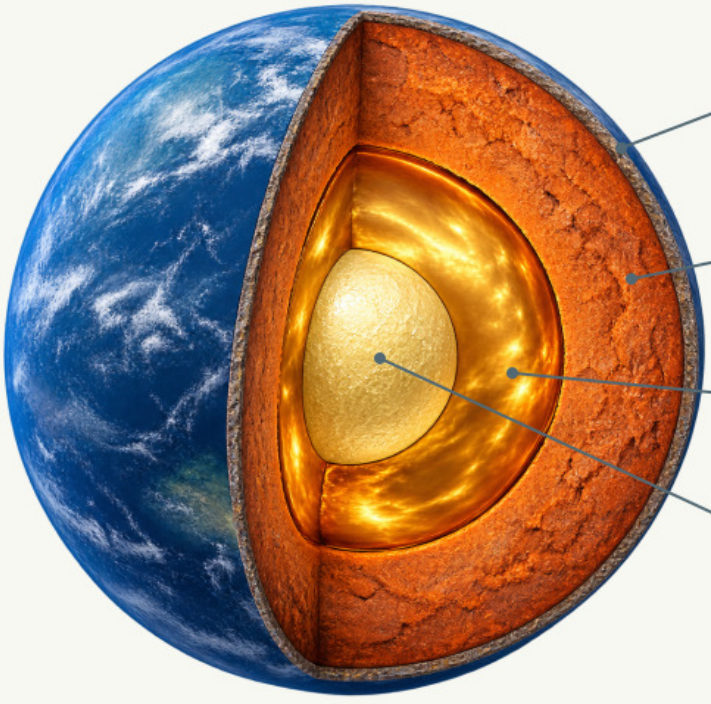
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Inside the Earth

Layer • physical state • boundary



BOUNDARIES TO REMEMBER

MOHO	Crust ↔ mantle
GUTENBERG	Mantle ↔ outer core • about 2,900 km
INNER-CORE BOUNDARY	Outer ↔ inner core • about 5,150 km

MATERIAL LAYERS ≠ MECHANICAL LAYERS

Crust

Rigid uppermost mantle

Weaker asthenosphere below

Lithosphere = both together

EXAM CLUE

S-waves do not pass through the liquid outer core.

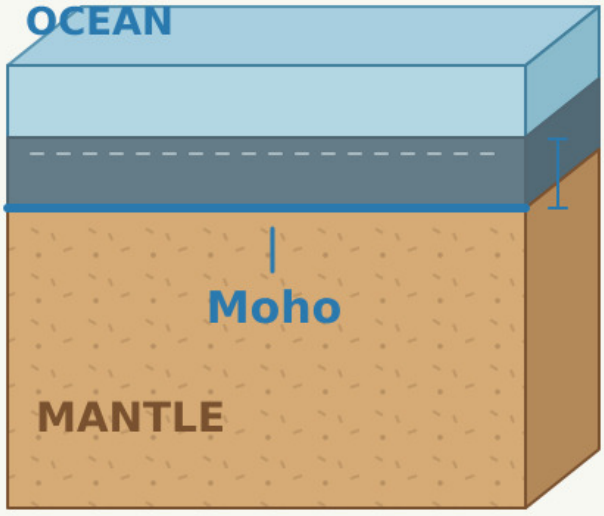
References: Source Index

Depths approximate; layer proportions in the illustration are not to scale

The crust has two very different faces

The Moho is deeper beneath continents

OCEANIC CRUST

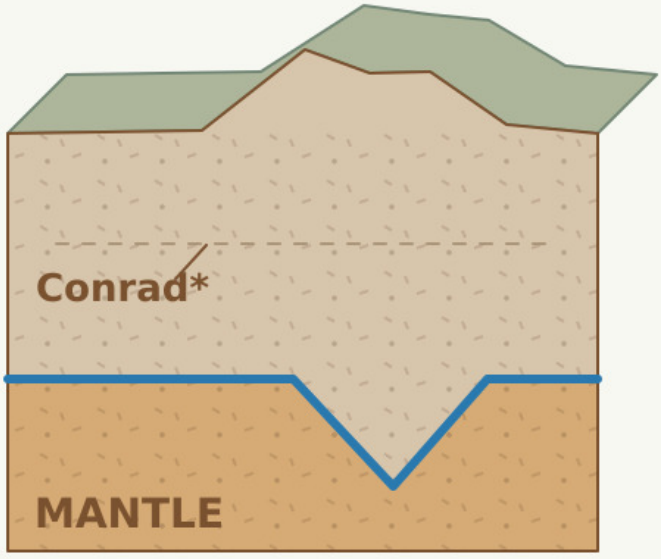


5 km mean

Basalt + gabbro

Thinner, but denser

CONTINENTAL CRUST



≈30 km mean

Granite-type rocks

Thicker, but lighter

Himalayan crust: up to 70 km

SIMA

Silica + magnesia

Older exam term

SIAL

Silica + alumina

Older exam term

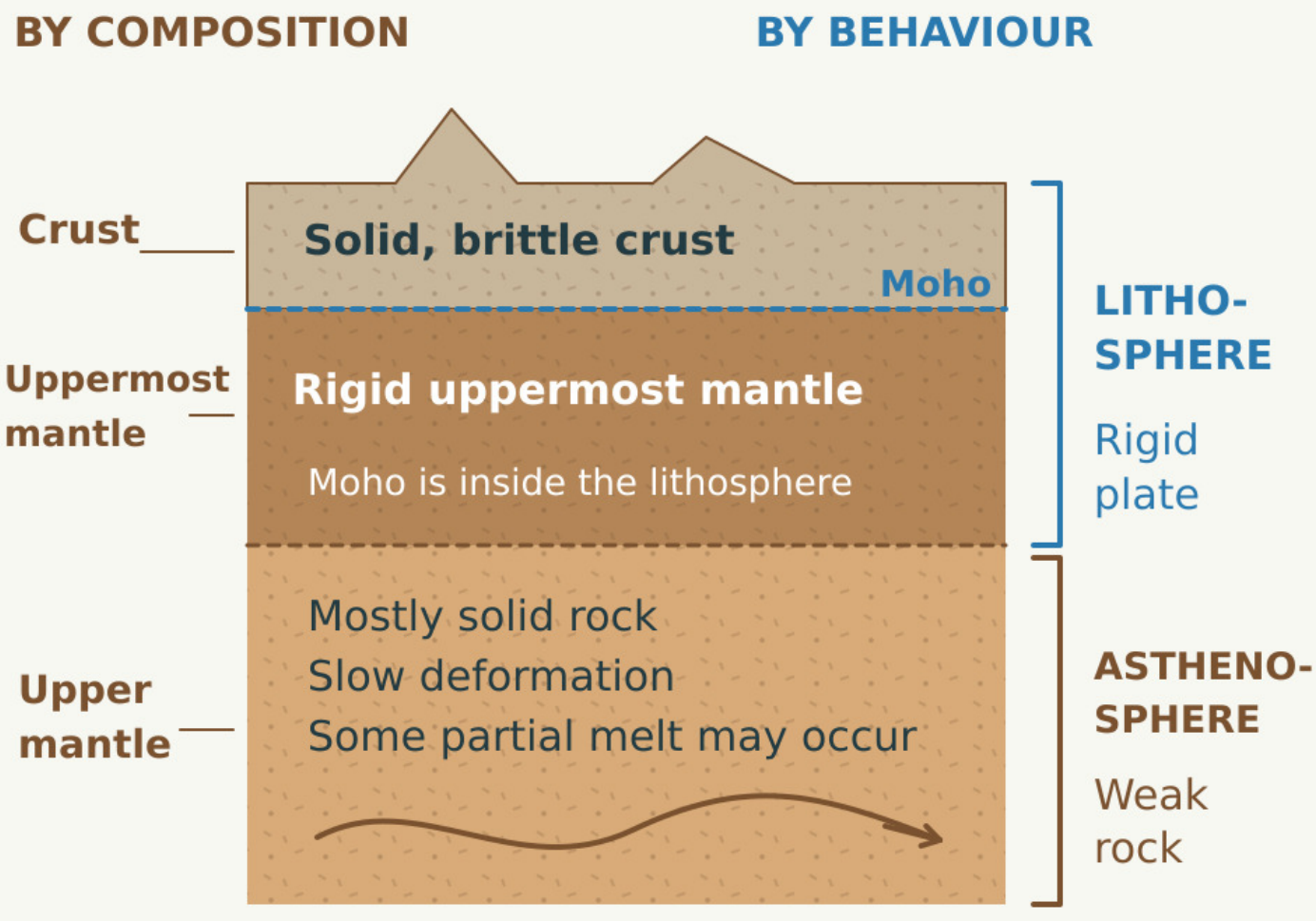
*Variable boundary within continental crust; absent in some regions.

References: Source Index

Physical cross-sections are schematic, not to scale

Two ways to divide the same Earth

Composition tells you what; mechanics tells you how



Lithosphere = crust + uppermost mantle

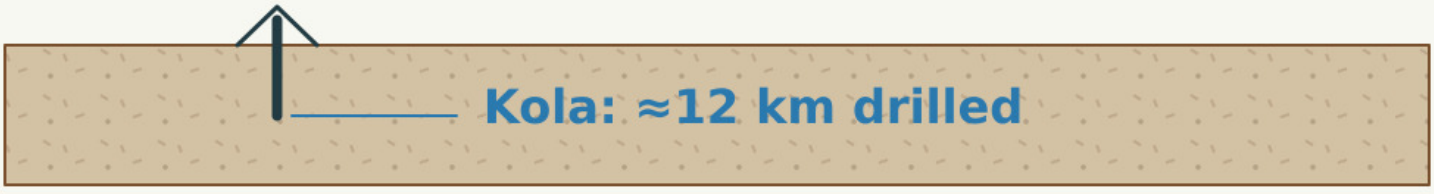
Asthenosphere supplies magma; it is not a liquid sea.

Lithosphere thickness varies with age and tectonic setting.
The asthenosphere is the weaker upper mantle beneath it.

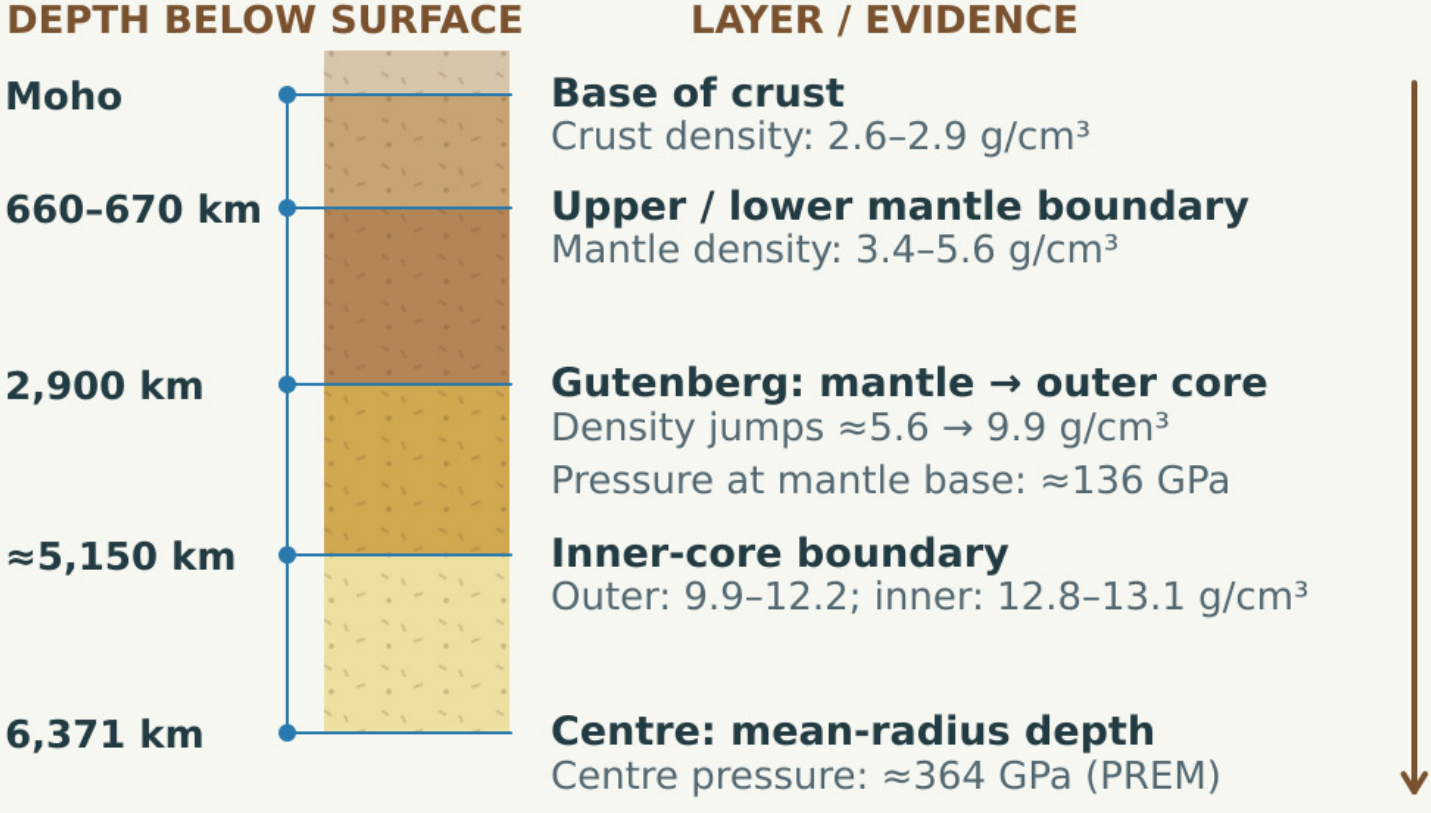
References: Source Index
Depths vary by region; cross-section not to scale

Our samples barely scratch the crust

Most of the deep interior is inferred from evidence



Mines: 3–4 km • magma: source depth uncertain

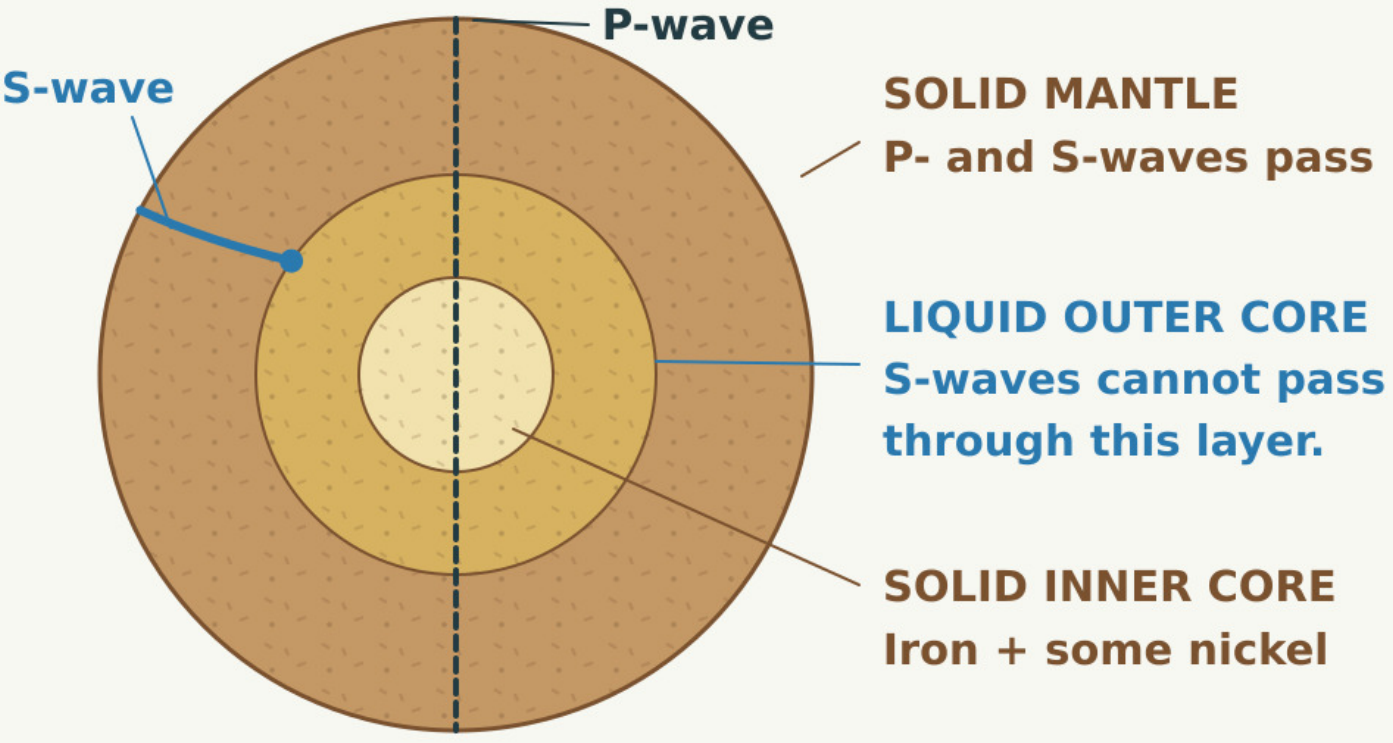


Temperature, pressure and density generally rise with depth.
Equatorial radius ≈6,378 km; mean radius ≈6,371 km.
Indirect: seismic waves, gravity, magnetism and meteorites.

References: Source Index
Depth ladder is schematic, not to scale

Waves reveal the liquid outer core

P-waves can pass through solid and liquid layers



THREE BOUNDARY / STATE TRAPS

01 Weak asthenosphere ≠ liquid outer core

02 Moho = crust / mantle; Gutenberg = mantle / core

03 Conrad lies within continental crust; it is not universal

Upper/lower mantle boundary: ≈660 km in modern geophysics.
“Repetti” is an older, rarely used name for a deeper boundary.
“Lehmann” is ambiguous: say inner-core boundary here.

References: Source Index
Radial P path (normal incidence); layers not to scale

TOPIC 7 · ENGLISH

Orbits: LEO, MEO, GEO, polar and sun-synchronous

Concept in one line

A satellite's orbit is chosen to suit its job: low orbits for close imaging, medium orbits for navigation, and the geostationary orbit for communication and weather watching. The examination asks you to match each orbit with its altitude, its special feature, its use and the Indian satellites and launch vehicles linked to it.

Revision notes

2.1 What decides an orbit

- **Altitude** (height above the Earth's surface): the closer a satellite is to the Earth, the stronger the pull of gravity and the faster the satellite moves.
- **Period** (time for one round): about 90 minutes in Low Earth Orbit, 12 hours for GPS satellites, and 23 hours 56 minutes 4 seconds at geostationary height.
- **Inclination** (angle between the orbit and the equator): 0 degrees means an orbit over the equator; 90 degrees means an orbit from pole to pole.
- **Shape** (eccentricity): 0 is a circle; a value close to 1 is a long ellipse. In an elliptical orbit the farthest point from the Earth is the **apogee** and the closest point is the **perigee**.
- Agencies do not define LEO and MEO in the same way. This note follows the European Space Agency (ESA): LEO is below 2,000 km, and MEO is the wide band between LEO and the geostationary orbit.

2.2 The orbits compared

Low Earth Orbit (LEO)

Altitude: Below 2,000 km; satellites generally do not fly below 180 km because of atmospheric drag
Period: About 90 minutes
Key feature: Closest to the Earth; speed about 7.8 km per second; the orbit can be tilted at any angle
Uses: High-resolution imaging; space stations; satellite constellations
Examples: International Space Station; Astrosat; EOS-08

Medium Earth Orbit (MEO)

Altitude: Between LEO and GEO; GPS at about 20,200 km
Period: 12 hours for GPS (two rounds a day)
Key feature: A constellation of satellites covers large areas at the same time; NASA calls the 12-hour orbit "semi-synchronous"
Uses: Navigation, mainly
Examples: GPS (United States); Galileo (Europe)

Geostationary Orbit (GEO)

Altitude: 35,786 km, above the equator
Period: 23 hours 56 minutes 4 seconds (one sidereal day, loosely "24 hours")
Key feature: Moves west to east at the Earth's own rate, so it appears fixed over one spot; speed about 3 km per second; three evenly spaced satellites give near-global coverage
Uses: Telecommunication and broadcasting (ground antennas stay fixed); weather monitoring
Examples: INSAT and GSAT series; INSAT-3D, INSAT-3DR, INSAT-3DS

Polar orbit

Altitude: Often in LEO, typically 200 to 1,000 km for Earth observation; polar orbits are not restricted to LEO
Period: About 99 minutes (NASA's example)
Key feature: Travels roughly from pole to pole; up to 10 degrees away from the poles still counts; the Earth turns underneath, so the whole globe is covered
Uses: Global mapping and Earth observation
Examples: OneWeb satellites launched by LVM3 (87.4 degrees)

Sun-synchronous orbit (SSO)

Altitude: Usually 600 to 800 km; ISRO satellites from 509 km to 817 km
Period: Same range as other polar orbits
Key feature: A near-polar Earth-observation orbit in which successive equator crossings in the same direction occur at approximately the same local solar time
Uses: Remote sensing, because images of the same place on different days can be compared
Examples: IRS series: Cartosat, Resourcesat, Oceansat; NISAR

Geostationary Transfer Orbit (GTO)

Altitude: Elliptical: low perigee; apogee at about 35,786 km in the standard case (some launches use a lower apogee)
Period: Depends on the size of the transfer ellipse
Key feature: The satellite performs orbit-raising manoeuvres to reach GEO; in a standard GTO, circularization occurs near apogee
Uses: A stepping stone to GEO
Examples: INSAT-3DS (GSLV-F14); CMS-03 (LVM3-M5)

Highly elliptical (eccentric) orbit

Altitude: Distance from the Earth changes greatly
Period: 12 hours for the Molniya orbit
Key feature: Molniya orbit: inclination 63.4 degrees; the satellite spends about two-thirds of its time over one hemisphere
Uses: Communication at high latitudes; long observation from great height
Examples: Proba-3 of ESA, launched by PSLV-C59

Halo orbit around Sun-Earth Lagrange point L1

Altitude: About 1.5 million km from the Earth, towards the Sun
Period: About 178 days for Aditya-L1's halo orbit
Key feature: At L1, the combined gravitational pull permits a spacecraft to orbit the Sun with the Earth's orbital period; Aditya-L1's halo orbit provides a continuous, unobstructed view of the Sun
Uses: Solar observation
Examples: Aditya-L1

2.3 Distinctions worth remembering

Often confused	The difference
Geosynchronous and geostationary	A geosynchronous orbit has the same period as the Earth's rotation (semimajor axis about 42,164 km; a circular orbit has an altitude of about 35,786 km). An inclined or eccentric geosynchronous satellite generally moves north-south and/or east-west in the sky, repeating its ground track once per sidereal day. A geostationary orbit is the special case: circular and exactly over the equator (zero inclination), so the satellite stays over one spot.
Polar and sun-synchronous	Polar describes the path (over or near the poles). Sun-synchronous adds a time rule: successive equator crossings in the same direction occur at approximately the same local solar time. ISRO's sun-synchronous satellites are inclined a little more than 90 degrees (Cartosat-3: 97.5 degrees; NISAR: 98.405 degrees).
GTO and GEO	GTO is elliptical and temporary. GEO is circular and is the working orbit. ESA expands GTO as "geostationary transfer orbit"; ISRO writes "Geosynchronous Transfer Orbit".
GPS and NavIC	GPS satellites are in MEO. NavIC is designed with 3 satellites in geostationary orbit and 4 in geosynchronous orbit inclined at 29 degrees.

2.4 Which Indian launch vehicle for which orbit

- **PSLV:** ISRO's "workhorse", four stages; up to 1,750 kg to a sun-synchronous polar orbit of 600 km, particularly the IRS series. It has also launched the IRNSS satellites, Chandrayaan-1 (2008), the Mars Orbiter (2013) and Aditya-L1 (2023).
- **GSLV (Mark II):** 2,250 kg to GTO; its main payloads are INSAT-class communication satellites; third stage is cryogenic. GSLV-F16 (NISAR) was the first GSLV mission to a sun-synchronous polar orbit.
- **LVM3:** three stages; 4,000 kg to GTO (the 4-tonne class GSAT series) and 8,000 kg to LEO; chosen for Gaganyaan.
- **SSLV:** three solid stages; one satellite of up to 500 kg to a 500 km planar orbit.

Extra section: which satellite is where

Satellite or system	Orbit	Details
International Space Station	LEO	Average altitude about 250 miles (about 400 km); one round about every 90 minutes; 16 rounds in 24 hours
Gaganyaan (planned)	LEO	Crew of 3 to an orbit of 400 km for 3 days; launch vehicle LVM3
Astrosat	LEO, near the equator	650 km, inclination 6 degrees; PSLV-C30, 28 September 2015; India's first space observatory
EOS-08	LEO	475 km circular orbit, inclination 37.4 degrees; SSLV-D3, 16 August 2024
OneWeb (36 satellites)	LEO, near-polar	Placed at launch in a 450 km circular orbit, inclination 87.4 degrees; LVM3-M3, 26 March 2023; the working altitude of the OneWeb constellation is about 1,200 km
Cartosat-3	Sun-synchronous polar orbit	509 km, inclination 97.5 degrees; PSLV-C47, 27 November 2019
Resourcesat-2 A	Sun-synchronous polar orbit	817 km; PSLV-C36, 7 December 2016

Satellite or system	Orbit	Details
EOS-06 (Oceansat series)	Sun-synchronous polar orbit	PSLV-C54, 26 November 2022; ocean colour, sea surface temperature, wind
NISAR (NASA and ISRO)	Sun-synchronous polar orbit	747 km circular orbit, inclination 98.405 degrees; GSLV-F16, 30 July 2025
GPS constellation	MEO	About 20,200 km; each satellite circles the Earth twice a day; six orbital planes
INSAT-3DS	GTO first, then geostationary orbit	GSLV-F14, 17 February 2024; meteorological satellite
CMS-03	GTO at launch	LVM3-M5, 2 November 2025; about 4,400 kg; GTO with perigee about 170 km and apogee about 29,970 km
NavIC (as designed)	Geostationary and inclined geosynchronous orbits	7 satellites: 3 geostationary and 4 geosynchronous at 29 degrees inclination
Proba-3 (ESA)	Highly elliptical orbit	PSLV-C59, 5 December 2024
Aditya-L1	Halo orbit around Sun-Earth L1	About 1.5 million km from the Earth; launched by PSLV-C57 on 2 September 2023; halo orbit insertion on 6 January 2024

Note: The Indian remote sensing series began with IRS-1A in 1988. The INSAT system in geostationary orbit was established in 1983 with the commissioning of INSAT-1B. This table gives orbits and launch dates only; it does not say which satellites are working today.

Three common exam traps

1. **Geosynchronous is not the same as geostationary.** Both have a period of one sidereal day. Only the circular orbit exactly over the equator is geostationary. An inclined geosynchronous satellite, like four of the seven in the NavIC design, moves north and south of the equator.
2. **"Sun-synchronous" is about time, not position.** The satellite does not stay over one place; that is the geostationary orbit. Its successive equator crossings in the same direction occur at approximately the same local solar time. Every sun-synchronous orbit is a polar-type orbit, but a polar orbit need not be sun-synchronous.
3. **Navigation does not always mean MEO, and GTO is not a working orbit.** GPS and Galileo are in MEO, but NavIC uses geostationary and geosynchronous orbits. GTO is only the elliptical path a satellite takes on its way to GEO.

Sources

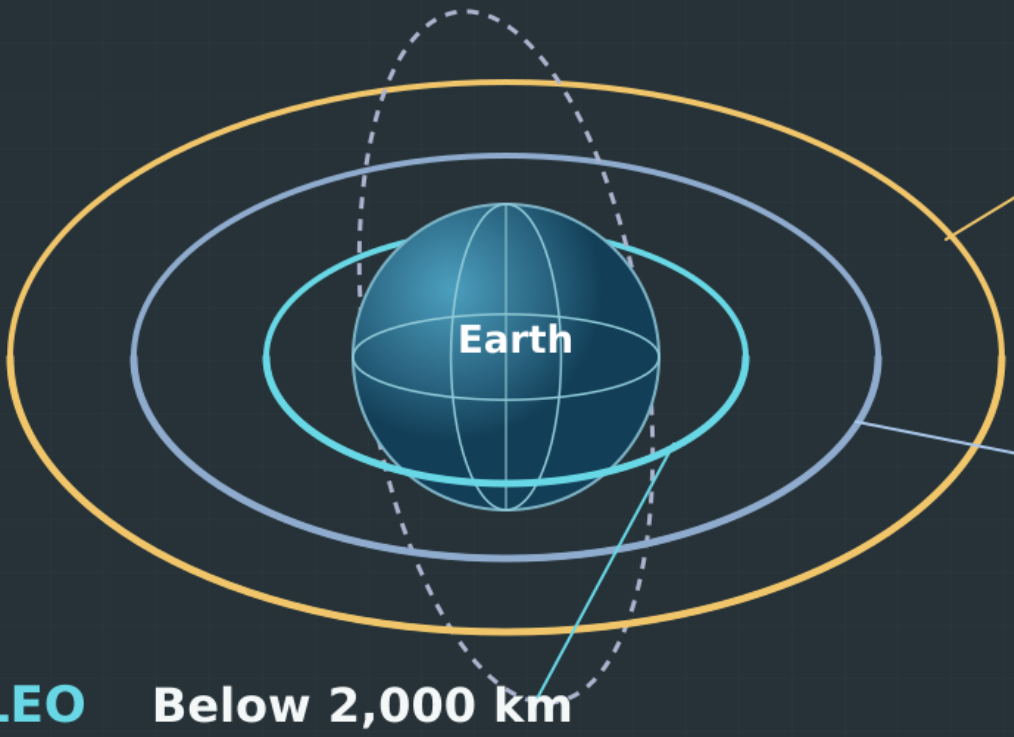
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Choose the orbit for the job

Altitude, tilt and shape describe different things

ALTITUDE = HEIGHT ABOVE THE SURFACE



GEO
35,786 km
Comms / weather
1 sidereal day

MEO
Above LEO,
below GEO
GPS: ≈12 h

LEO **Below 2,000 km**
Close imaging, crewed stations
ISS example: ≈400 km; ≈90 min



TILT / ORIENTATION
Polar: near the poles
Can also be in LEO



SHAPE
Circle or
ellipse

Sources: ESA orbit definitions; NASA orbit catalogue
Every orbit drawing is schematic, not to scale

Same period. Different ground motion.

Geostationary is a special case of geosynchronous

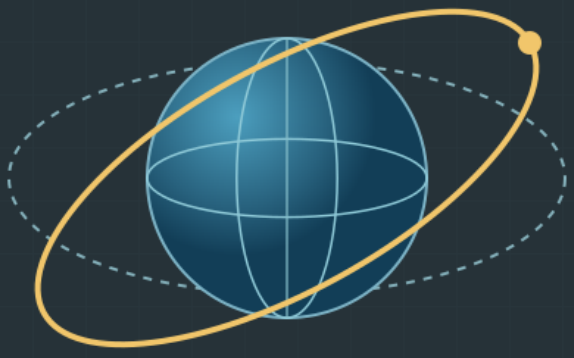
GEOSTATIONARY



Circular · equatorial · prograde

One fixed ground point

INCLINED GEOSYNCHRONOUS



Same period, tilted plane

Ground position changes

Both: 23 h 56 min 4 s = one sidereal day



GPS → MEO

≈20,200 km · navigation

NavIC (as designed)

3 geostationary satellites
+ 4 geosynchronous
at 29° inclination

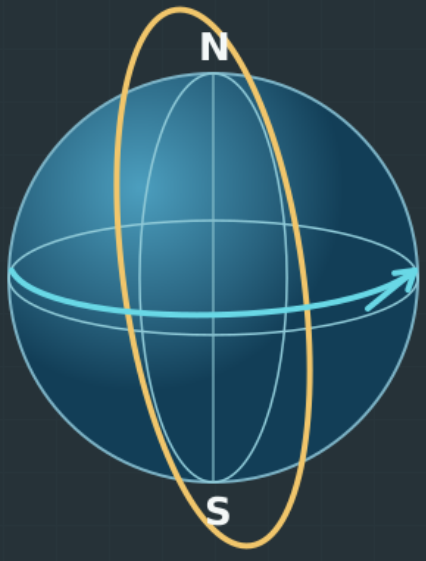
Navigation need not mean MEO

Sources: ESA / NASA; GPS.gov; ISRO NavIC design
GPS reference illustration: NASA · Geometry not to scale

Polar is a path. SSO adds a time rule.

Repeated lighting makes Earth images comparable

01 POLAR COVERAGE



Near-polar passes cross many latitudes. Earth turns beneath the orbit.

Ideal polar tilt: 90°
SSO: usually slightly retrograde (>90°)

PSLV-C36 → Resourcesat-2A → polar SSO (2016)

02 SUN-SYNCHRONOUS TIMING



Same-direction equator crossings at nearly the same local solar time. Clocks illustrate equal solar time.

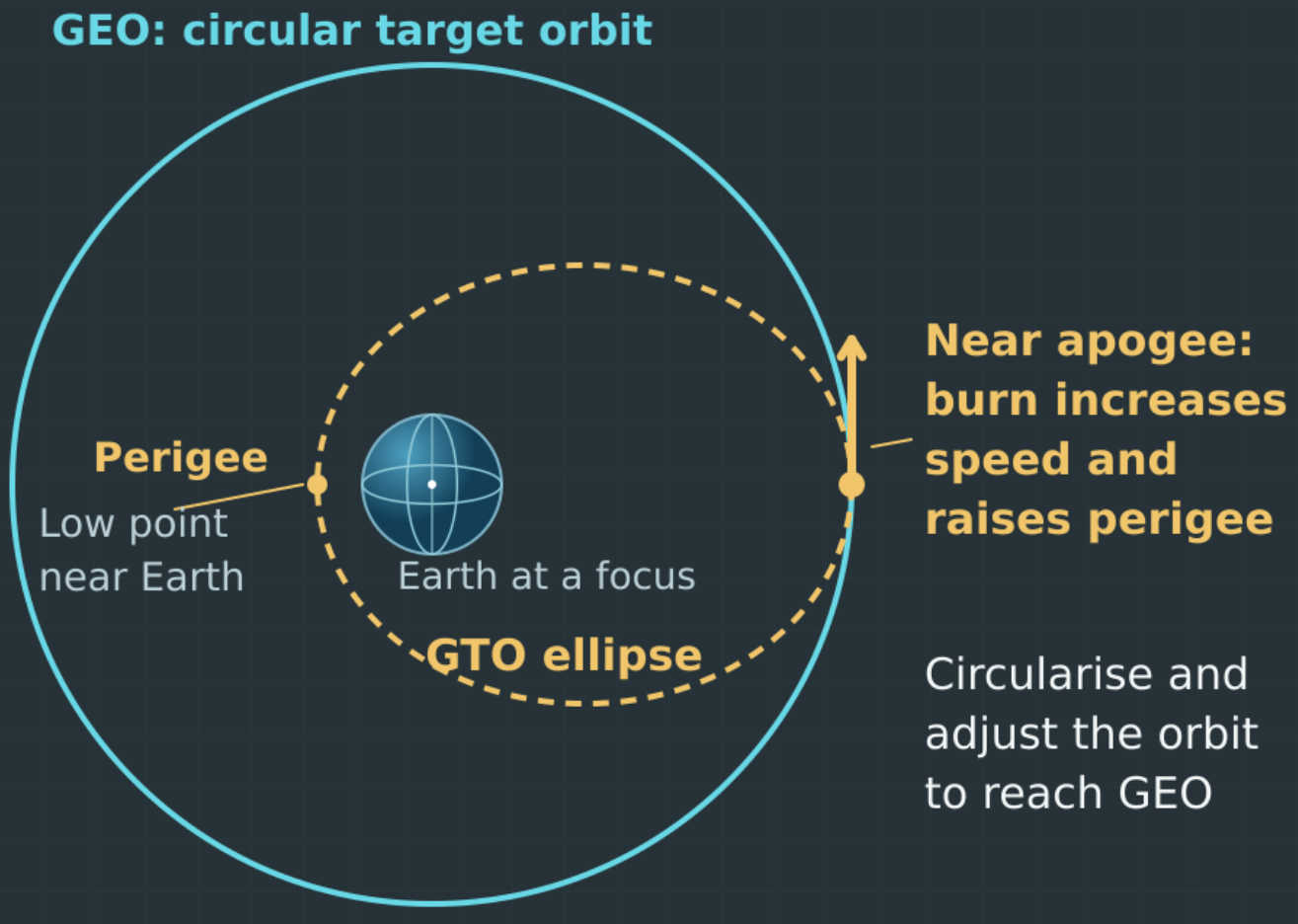


Resourcesat-2A · 817 km

Sources: ESA / NASA; ISRO PSLV-C36 mission
Resourcesat-2A photograph: ISRO · Not to scale

GTO is the transfer. GEO is the goal.

The satellite changes its orbit after launch





INSAT-3DS: weather observations

GSLV-F14 → GTO → orbit raising → GEO

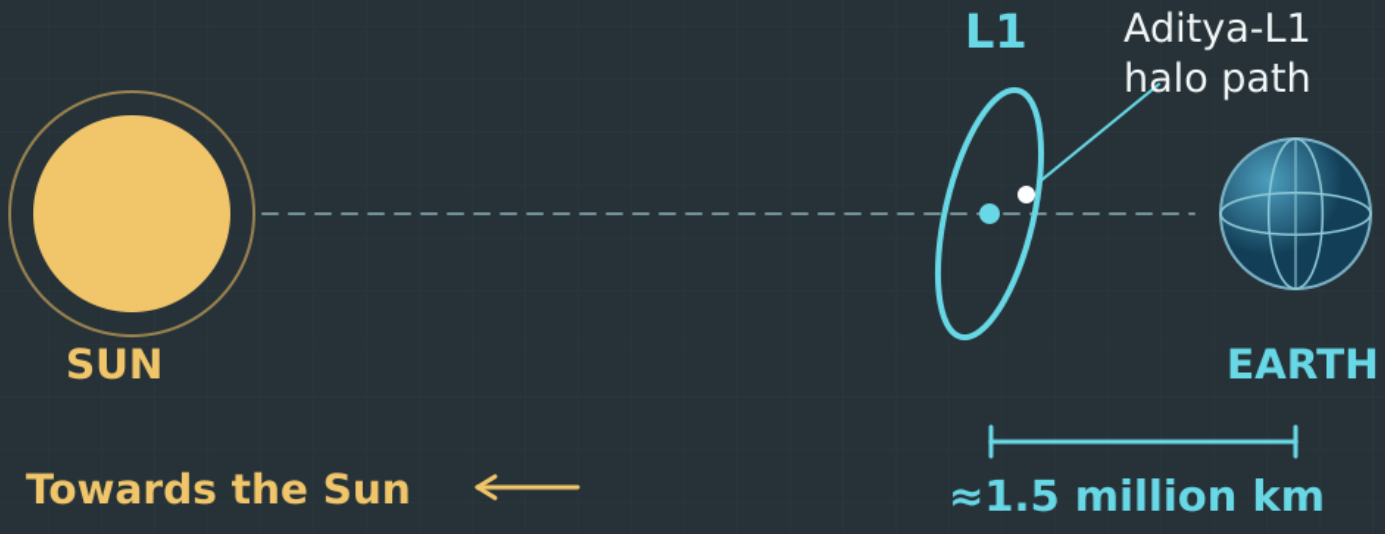
Launched 17 February 2024; GEO slot 28 February.

Transfer period depends on the ellipse.

Sources: ESA; ISRO GSLV-F14 / INSAT-3DS mission
INSAT-3DS photograph: ISRO · Geometry not to scale

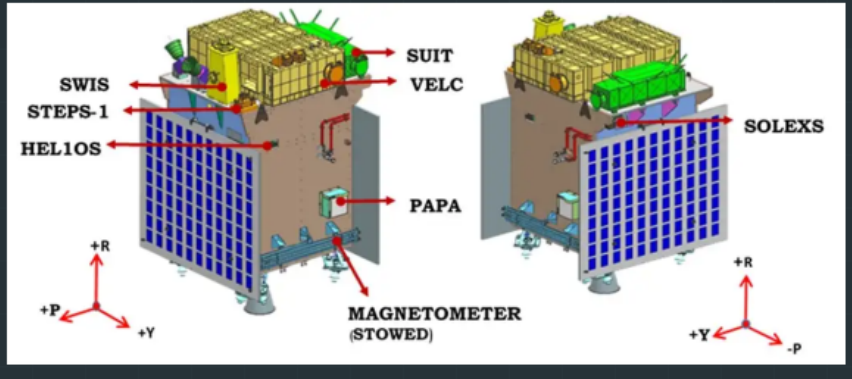
Aditya-L1 watches the Sun from a halo

L1 is part of the Sun–Earth orbital system



Combined gravity and orbital motion let the spacecraft travel around the Sun with Earth's one-year period.

The halo loops around L1; L1 itself is not a solid object.



PSLV-C57
Launch: 2 Sep 2023
Halo insertion:
6 Jan 2024

Continuous view of the Sun • Halo period ≈178 days

Sun, Earth, distance and halo size are not to scale.

Sources: NASA Lagrange points; ISRO Aditya-L1
Original spacecraft reference drawing: ISRO

Follow the launcher to the destination

A launch vehicle can serve more than one orbit

PSLV ⟶ **Resourcesat-2A → SSO**
Proba-3 → highly elliptical orbit



GSLV Mk II ⟶ **INSAT-3DS → GTO → GEO**
GSLV-F16 also launched NISAR to SSO



LVM3 ⟶ **OneWeb: 450 km injection**
Raised to ≈1,200 km working LEO



SSLV ⟶ **EOS-08 → circular LEO**
475 km; SSLV-D3 (2024)



KEEP THE THREE TRAPS STRAIGHT

01 Polar / SSO describe orientation, not a separate height band.

02 GTO is a temporary ellipse; GEO is circular and equatorial.

03 At L1, gravity does not simply cancel to zero.

Geostationary ⇒ geosynchronous; the reverse is not always true.

Sources: ISRO launcher and mission pages; ESA
Orbit sketches not to scale · Mission designs, not live status

TOPIC 8 · ENGLISH

Venn diagrams: showing relations between groups

Concept in one line

A Venn diagram uses closed curves, usually circles, to show how groups of things are related: one inside another, partly overlapping, or wholly separate. The examination gives two or three groups and asks you to pick the diagram that fits them.

Revision notes

2.1 What a Venn diagram is

- A Venn diagram is a diagram that shows the relationships between sets, that is, between groups of things. It is made of closed curves, usually circles.
- It is named after the English logician John Venn, who introduced it in 1880.
- In set theory the universal set (the set of everything under discussion) is drawn as a rectangle, and its subsets as circles inside it. In reasoning questions the rectangle is usually left out and only the circles are shown.
- Each circle stands for one group. Whatever lies inside a circle belongs to that group.
- Only the position of the circles matters: inside, overlapping or apart. A circle is drawn larger only so that another circle can fit inside it. Its size does not show how many members the group has.
- Standard question: "Which diagram best represents the relation among Doctors, Women and Mothers?"
- Not covered here, because other days cover them: reading the numbered regions of a given diagram, numerical Venn diagrams with formulas, and syllogisms.
- For the human-group examples, use the conventional categories intended by these questions: treat Mothers as a subset of Women, Fathers and Brothers as subsets of Males, and Fathers/Mothers and Boys/Girls as disjoint pairs. Girls and Boys refer to children; adult singers can lie outside both groups.

2.2 Four basic relations between two groups

Proper subset (all in one direction only)

Test in words: Every member of the first group belongs to the second group, but the second group has other members too
Diagram in words: A small circle lying wholly inside a larger circle
Examples: Cows and Mammals; Guntur district and Andhra Pradesh

Partial overlap

Test in words: Some members are common, and each group also has members that are not in the other
Diagram in words: Two circles that partly overlap; the common part holds the members of both groups
Examples: Women and Doctors; Teachers and Singers

Separate (answer: "none")

Test in words: No member is common
Diagram in words: Two circles that do not touch each other
Examples: Cows and Crows; Fathers and Mothers

Equal sets (all in both directions)

Test in words: Every member of each group belongs to the other
Diagram in words: One circle carrying both labels
Examples: Positive even integers and positive integer multiples of 2

- In logic, "some" means "at least one" and does not rule out "all". Draw a partial overlap only when there is a common member, a member belonging only to the first group, and a member belonging only to the second group.
- A subset may equal its containing set. If every A is B and every B is A, the sets are equal; if B has additional members, A is a proper subset of B. Separate sets are disjoint.

2.3 Ten standard patterns for three groups

Call the three groups A, B and C. In each example the groups are listed in the order A, B, C.

1

Short name: Nested
Diagram in words: Three circles one inside another: C wholly inside B, and B wholly inside A
Pair answers: All B are A; all C are B
Examples (A, B, C): India, Andhra Pradesh, Guntur district. Animals, Mammals, Cows

---

2

Short name: Two apart inside one
Diagram in words: One large circle A with two small circles B and C inside it; B and C do not touch each other
Pair answers: All B are A; all C are A; no B is C
Examples (A, B, C): Animals, Cows, Crows. Human beings, Fathers, Mothers

---

3

Short name: One inside, one apart
Diagram in words: Circle B wholly inside circle A; circle C lies outside and touches neither
Pair answers: All B are A; no C is A; no C is B
Examples (A, B, C): Mammals, Cows, Crows. Fruits, Mangoes, Chairs

---

4

Short name: Overlapping pair inside one
Diagram in words: One large circle A with two circles B and C inside it; B and C partly overlap each other
Pair answers: All B are A; all C are A; B and C partially overlap
Examples (A, B, C): Human beings, Women, Doctors. Human beings, Teachers, Singers

---

5

Short name: Overlapping pair, one apart
Diagram in words: Circles A and B partly overlap; circle C lies outside and touches neither
Pair answers: A and B partially overlap; C is disjoint from both
Examples (A, B, C): Women, Doctors, Crows. Teachers, Singers, Chairs

---

6

Short name: Chain
Diagram in words: Circles A and B do not touch each other; circle C partly overlaps A and partly overlaps B; no part is common to all three
Pair answers: A and B are disjoint; C partially overlaps each and has members outside both
Examples (A, B, C): Fathers, Mothers, Doctors. Boys, Girls, Students

---

7

Short name: Three-way overlap
Diagram in words: Three circles, each partly overlapping the other two, with a small part in the middle common to all three
Pair answers: Each pair overlaps; at least one member belongs to all three; check the other regions separately
Examples (A, B, C): Women, Doctors, Singers. Indians, Teachers, Cricket players

---

8

Short name: One inside, third cuts both
Diagram in words: Circle B wholly inside circle A; circle C partly overlaps B and A, and a part of C lies outside A
Pair answers: B is inside A; C overlaps B and the part of A outside B, and extends outside A
Examples (A, B, C): Women, Mothers, Doctors. People living in India, People living in Andhra Pradesh, Engineers

---

9

Short name: One inside, third cuts only the outer
Diagram in words: Circle B wholly inside circle A; circle C partly overlaps A but does not touch B, and a part of C lies outside A
Pair answers: B is inside A; C partially overlaps A and is disjoint from B
Examples (A, B, C): Mammals, Cows, Animals that can fly. Even numbers, Multiples of 4, Prime numbers

---

10

Short name: All apart
Diagram in words: Three circles, none touching any other
Pair answers: No A is B; no B is C; no A is C
Examples (A, B, C): Cows, Crows, Chairs. Mangoes, Pens, Dogs

Facts used in the examples: cows and bats are mammals; crows are birds, not mammals; bats can fly and cows cannot. 2 is the only even prime number, so no multiple of 4 is prime. Guntur district is in Andhra Pradesh.

2.4 Method: two at a time, "all, some or none?"

1. Name the three groups A, B and C.
2. Take them two at a time: A with B, B with C, A with C.
3. For each pair ask "all, some or none?". Ask "all" in both directions: is every A a B, and is every B an A?
4. Use all the given information: a proper subset goes inside the larger set; equal sets share one circle; disjoint sets are separate. "Some" alone establishes a non-empty intersection, but does not determine whether one set is contained in the other.
5. Draw the widest group first, then place the other two.
6. Check every part of your picture with one real member. If a part has no possible member, or a real member has no place, the picture is wrong.
7. Check the three-way intersection separately. For example, A={1,2}, B={2,3}, C={1,3} overlap pairwise but have no member common to all three.

Extra section: worked examples

Doctors, Women, Mothers

Pair 1: Mothers and Women: all mothers are women, so Mothers is inside Women
Pair 2: Doctors and Women: some doctors are women, some are men, and some women are not doctors, so they overlap
Pair 3: Doctors and Mothers: some mothers are doctors, some mothers are not doctors, and some doctors are not mothers, so they partially overlap
Diagram: Pattern 8. Mothers circle inside Women circle; Doctors circle cuts across both and also extends outside the Women circle

India, Andhra Pradesh, Guntur district

Pair 1: Andhra Pradesh and India: all of Andhra Pradesh is in India
Pair 2: Guntur district and Andhra Pradesh: all of Guntur district is in Andhra Pradesh
Pair 3: Guntur district and India: all, which follows from the first two
Diagram: Pattern 1. Three circles one inside another: India outermost, Guntur district innermost

Mammals, Cows, Crows

Pair 1: Cows and Mammals: all cows are mammals
Pair 2: Crows and Mammals: none, because crows are birds
Pair 3: Crows and Cows: none
Diagram: Pattern 3. Cows circle inside Mammals circle; Crows circle separate from both

Fathers, Mothers, Doctors

Pair 1: Fathers and Mothers: none under the stated categories
Pair 2: Doctors and Fathers: partial overlap
Pair 3: Doctors and Mothers: partial overlap; some doctors are neither fathers nor mothers
Diagram: Pattern 6. Fathers and Mothers circles separate; Doctors circle overlaps each of them

Even numbers, Multiples of 4, Prime numbers

Pair 1: Multiples of 4 and Even numbers: all multiples of 4 are even
Pair 2: Prime numbers and Even numbers: some, because 2 is prime and even, while 3, 5 and 7 are prime but odd, and 4 is even but not prime
Pair 3: Prime numbers and Multiples of 4: none
Diagram: Pattern 9. Multiples of 4 circle inside Even numbers circle; Prime numbers circle overlaps the Even numbers circle only, and also extends outside it

Check for the first example: a woman doctor who is a mother, a woman doctor who is not a mother, a male doctor, a mother who is not a doctor and a woman who is neither all find a place in the picture.

Three common exam traps

1. **Inside or only overlapping?** A circle goes inside another only when the answer is "all". All mothers are women, so Mothers goes inside Women, never the other way round. There are women doctors, male doctors, and women who are not doctors, so Doctors and Women partially overlap. Drawing Doctors inside Women is the usual mistake.
2. **Does the third circle stay inside the big one or stick out?** Human beings, Women, Doctors is pattern 4, because every doctor is a human being. Women, Mothers, Doctors is pattern 8, because some doctors are men, so the Doctors circle must extend outside the Women circle. In the same way, Human beings, Fathers, Mothers is pattern 2, but Fathers, Mothers, Doctors is pattern 6, because not all fathers and mothers are doctors.
3. **A slip in a simple fact changes the diagram.** Bats are mammals, not birds. 2 is a prime number and it is even, so the Prime numbers circle can never lie wholly inside the Odd numbers circle. Decide the facts first, then choose between patterns that look alike, such as 8 and 9.

Sources

1. NCERT, Mathematics textbook for Class XI, Chapter 1 "Sets": Section 1.6 (definition of subset), Section 1.7…; 2. Wikipedia, "Venn diagram"; 3. Wikipedia, "Euler diagram"; 4. Wikipedia, "Cattle" [link 2]; 5. Wikipedia, "Bat"; 6. Wikipedia, "Prime number" (reference list includes Dudley 1978, Elementary Number Theory; Sierpinski 1988,…; 7. Wikipedia, "Guntur district" [link 2]; 8. SUNY Geneseo, A Concise Introduction to Logic, Chapter 12;

DAY 01 / TOPIC 08

WORKED NOTES 1/3

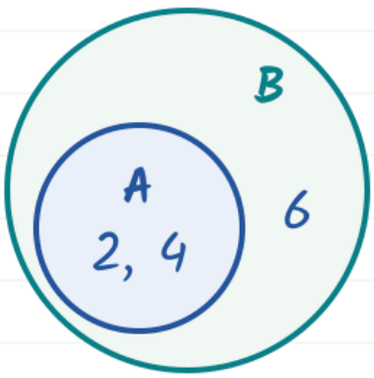
Build two-set diagrams

Read the members. Draw the relation. Check it.

01 Subset or equality?

B has an extra member

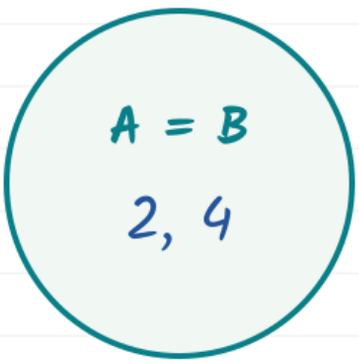
A = {2, 4}; B = {2, 4, 6}



Draw B; put all of A inside

Same members in both

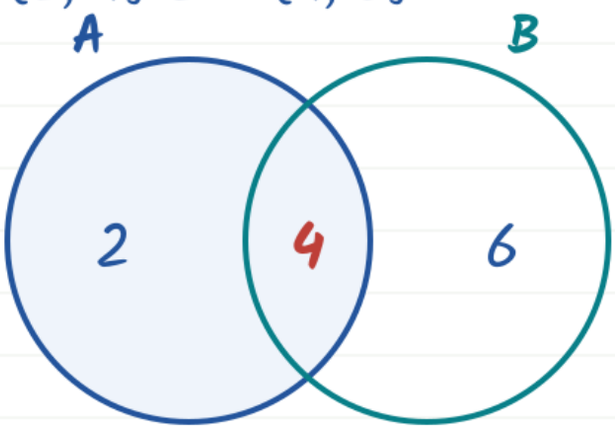
A = B = {2, 4}



Use one curve with both labels

02 Prove a partial overlap

A = {2, 4} B = {4, 6}



1. *Put 4 in both.*
2. *Put 2 in A only.*
3. *Put 6 in B only.*

Common + A-only + B-only: partial overlap

> *"Some" means at least one common member.*
> *It can still be all. Check the exclusive parts.*

DAY 01 / TOPIC 08

WORKED NOTES 2/3

Build three-set diagrams

Place each member once, in its correct region.

03 Separate means disjoint

$A = \{1, 3\}$ $B = \{2, 4\}$



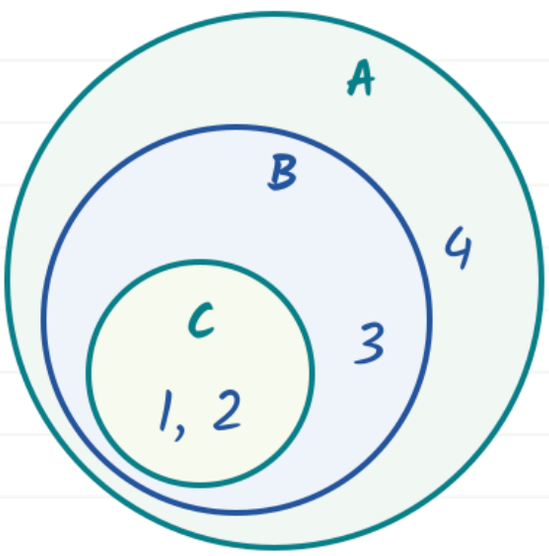
1. Compare the lists.
2. Nothing repeats.

Draw circles apart.

No shared member: A and B are disjoint

04 Build containment from the outside

$A = \{1, 2, 3, 4\}$; $B = \{1, 2, 3\}$; $C = \{1, 2\}$



1. Draw the outer set A.
2. Put all of B inside A.
3. Put all of C inside B.

Check: 1 and 2 belong to all three sets.

Read each number through every enclosing curve

> Outside C but inside B? That is 3.
> Outside B but inside A? That is 4.

DAY 01 / TOPIC 08

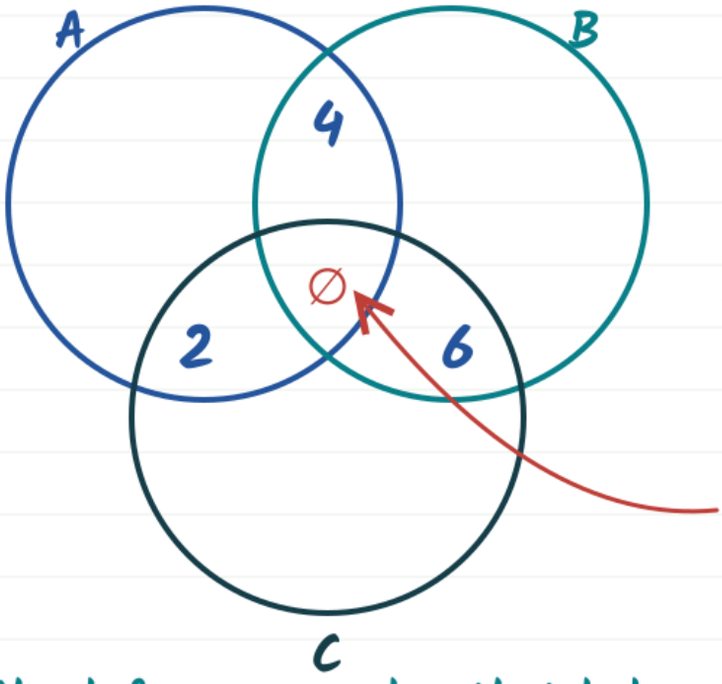
WORKED NOTES 3/3

Check the middle last

Every pair can overlap while the centre is empty.

05 Pairwise does not mean triple

$A = \{2, 4\}$ $B = \{4, 6\}$ $C = \{2, 6\}$



1. A with B: shared 4
2. A with C: shared 2
3. B with C: shared 6
4. All three: no member

∅ means empty

Check for one member that belongs to all three

06 A quick all / some / no check

ALL — Check both directions. Equality is allowed.

SOME — At least one common member. It could be all; do not assume partial overlap.

NO — No common member. Keep the curves apart.

> "All A are B" alone does not prove any A exists.
> Final check: every pair, then all three together.

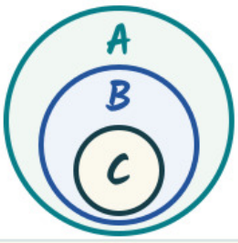
DAY 01 / TOPIC 08

PATTERN GALLERY 1/2

Ten three-group patterns: 1–5

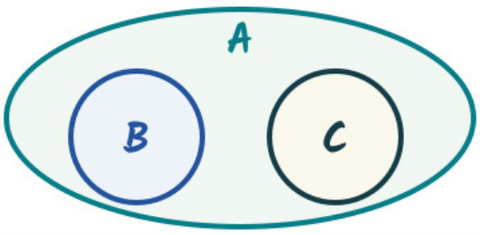
Read A, B and C beside each diagram; size does not mean count.

01 Nested



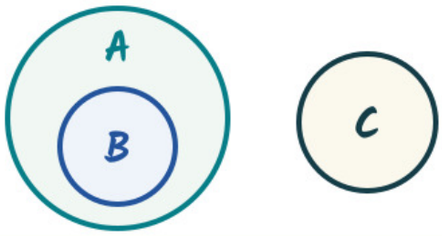
A Animals; B Mammals
C Cows
Every C is B; every B is A.
C lies inside both B and A.

02 Two apart inside one



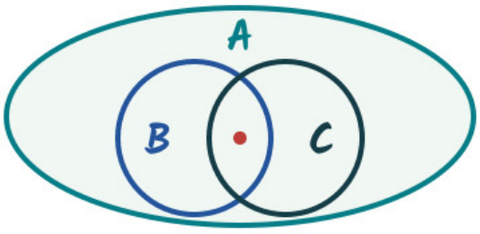
A Mammals
B Bats; C Cows
All bats and cows are mammals.
No bat is a cow.

03 One inside, one apart



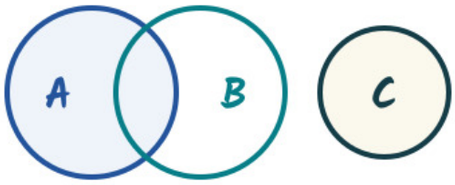
A Mammals; B Cows
C Crows
All B are A.
C lies apart from both.

04 Overlapping pair inside one



A Males; B Fathers; C Brothers
Both: a father with a sibling
B, not C: a father, an only child
C, not B: a boy with a sister

05 Overlapping pair, one apart



A Women; B Doctors
C Crows
A and B partially overlap.
C lies apart from both.

Read these examples under the supplied exam conventions

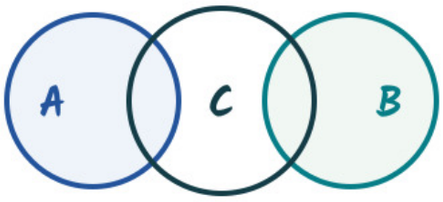
Fathers and Brothers are inside Males; neither contains the other.
A father with a sibling establishes their common region.
"Some" means at least one, possibly all; it is not "only some".
Equal sets share one curve when "all" holds in both directions.

References: Source Index

Ten three-group patterns: 6–10

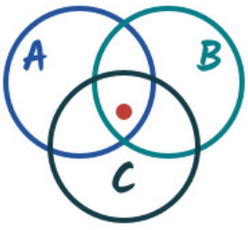
Check the third set: inside, crossing both, or crossing only one.

06 Chain



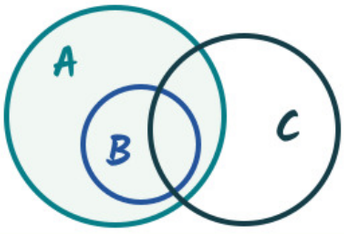
A Girls; B Boys; C Singers
A and B mean children here.
C overlaps each; adults in C
can lie outside both A and B.

07 Three-way overlap



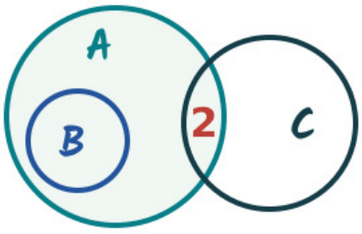
A Women; B Doctors; C Singers
The marked member is a woman
doctor who sings: in all three.
Check the other regions too.

08 One inside, third cuts both



A Women; B Mothers; C Doctors
B lies wholly inside A.
C cuts B and A outside B;
part of C also lies outside A.

09 One inside, third cuts only the outer



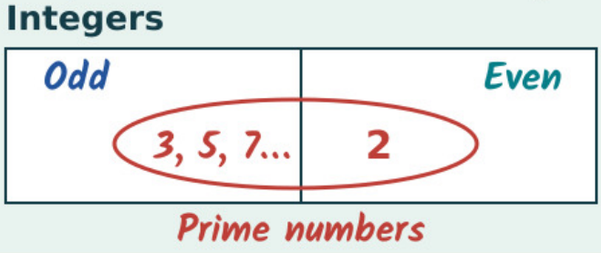
A Even; B Multiples of 4
C Prime numbers
C meets A at 2; it misses B.
3, 5, 7... in C lie outside A.

10 All apart



A Cows; B Crows; C Chairs
No A is B; no B is C; no A is C.
No member belongs to
more than one of these sets.

Odd, Even and Prime: 2 changes the picture



2 is the only even prime.
All other primes are odd.
No prime lies outside both.
Primes cannot lie inside Odd.

References: Source Index. People labels use the stated exam conventions.

TOPIC 9 · ENGLISH

Types of numbers: natural, whole, integers, rational and irrational

Concept in one line

The number sets are related by N ⊂ W ⊂ Z ⊂ Q ⊂ R. Irrational numbers are the real numbers outside Q; rational and irrational numbers are disjoint and together form R. The exam tests whether you can place a given number in the right family and whether you know how these families behave when added or multiplied.

Revision notes

2.1 The number sets and their relationships

Natural numbers

Symbol: N
What it contains: Counting numbers: 1, 2, 3, ...
Examples: 1, 7, 100
Not in this set: 0, -3, 1/2

Whole numbers

Symbol: W
What it contains: Natural numbers together with zero: 0, 1, 2, 3, ...
Examples: 0, 7, 100
Not in this set: -3, 1/2

Integers

Symbol: Z
What it contains: Whole numbers and the negatives of the natural numbers: ..., -2, -1, 0, 1, 2, ...
Examples: -5, 0, 12
Not in this set: 1/2, √2

Rational numbers

Symbol: Q
What it contains: Numbers that can be written as p/q, where p and q are integers and q is not 0
Examples: 3/4, -7/2, 5 (= 5/1), 0.25, 0.333...
Not in this set: √2, π

Irrational numbers

Symbol: No agreed single letter; they are the real numbers outside Q
What it contains: Numbers on the number line that cannot be written as p/q
Examples: √2, √3, π, 0.1010010001...
Not in this set: 22/7, √49

Real numbers

Symbol: R
What it contains: All rational and all irrational numbers together
Examples: Every number above
Not in this set: √(-1), which is not on the number line

- The nested chain is N ⊂ W ⊂ Z ⊂ Q ⊂ R; the irrational numbers form the subset R \ Q (read "R minus Q": the real numbers that are not in Q), disjoint from Q.
- So every natural number is a whole number, every whole number is an integer, every integer n is rational (n = n/1), and every rational number is real. None of these statements can be reversed.
- A real number is either rational or irrational, never both.
- Z comes from the German word Zahlen (numbers). Q stands for quotient.
- Every real number has exactly one point on the number line.

2.2 Where zero belongs

- Zero is not a natural number in the NCERT convention used in Indian exams. The smallest natural number is 1. The smallest whole number is 0.
- Zero is a whole number, an integer, a rational number (0 = 0/1) and a real number.
- Zero is neither positive nor negative.
- Zero is even, because 0 = 2 × 0.

2.3 The decimal expansion test

Decimal expansion	Type of number	Examples
Terminating (it stops)	Rational	3/8 = 0.375; 0.25 = 1/4
Non-terminating recurring (after a possible non-repeating beginning, a fixed block repeats indefinitely)	Rational	1/3 = 0.333...; 5/11 = 0.4545...; 22/7 = 3.142857142857...
Non-terminating non-recurring (never stops, and no fixed block repeats periodically forever from any point onward)	Irrational	√2 = 1.41421356...; π = 3.14159265...; 0.1010010001...

The test works both ways: a decimal that stops or repeats is always rational, and a rational number always gives a decimal that stops or repeats. (A fraction in lowest terms gives a terminating decimal exactly when its denominator has no prime factor other than 2 and 5; this is taken up on the fractions and decimals day.)

2.4 How to recognise rational and irrational numbers

- **22/7 and π.** 22/7 is a ratio of two integers, so it is rational. π is irrational. 22/7 is only an approximate value of π: 22/7 = 3.1428..., while π = 3.1415.... The value 3.14 (= 157/50) is also rational.
- **Square roots.** If a natural number is a perfect square, its square root is rational (√49 = 7). If it is not a perfect square, its square root is irrational (√2, √3, √50).
- **A rounded value is rational.** 1.732 = 1732/1000 is rational, but √3 = 1.7320508... is irrational.
- **A pattern need not be periodic.** In 0.1010010001..., the gaps between successive 1s contain one, then two, then three, and so on zeros. This rule continues indefinitely, so no fixed block repeats periodically forever; the number is irrational.
- **Simplify before you decide.** √2 × √8 = √16 = 4, which is rational.

2.5 Adding and multiplying rational and irrational numbers

Operation	Result	Example
Rational + rational, rational × rational	Always rational	1/2 + 1/3 = 5/6; 2/3 × 3/4 = 1/2
Rational + irrational, rational - irrational	Always irrational	2 + √3; 5 - √3
Non-zero rational × irrational	Always irrational	3√2
Zero × irrational	Zero, which is rational	0 × √2 = 0
Irrational + irrational	May be rational or irrational	√2 + (-√2) = 0 is rational; √2 + √3 is irrational
Irrational × irrational	May be rational or irrational	√2 × √2 = 2 is rational; √2 × √3 = √6 is irrational

2.6 Rational numbers between two rational numbers

- Between any two distinct rational numbers there is another rational number: their average. Repeating this step never ends, so there are infinitely many rational numbers between any two distinct rational numbers.
- Example: between 1/3 and 1/2 lies (1/3 + 1/2) ÷ 2 = 5/12.
- Integers do not behave like this: there is no integer between 2 and 3.

2.7 Even and odd; positive and negative

- An even number is an integer that is divisible by 2 (form 2k). An odd number is an integer that is not (form 2k + 1). Examples: -4, 0 and 82 are even; -7, 5 and 23 are odd.
- Even and odd apply only to integers. 1/2 is neither even nor odd.
- Even + even = even; odd + odd = even; even + odd = odd. Even × any integer = even; odd × odd = odd.
- Positive integers are 1, 2, 3, ... (the natural numbers). Negative integers are -1, -2, -3, ... Zero is neither.
- On the number line, negative numbers lie to the left of zero, and the smaller of two numbers lies to the left. So -5 is less than -2.

Other days cover prime and composite numbers, comparing fractions and decimals, divisibility rules, place value, unit digits and remainders, surds, and order of magnitude.

Extra section: worked examples

A. Classifying given numbers

-7

Work it out: Already an integer
Smallest of the listed number sets containing it: Integers (Z)
Rational or irrational: Rational

0

Work it out: 0 = 0/1
Smallest of the listed number sets containing it: Whole numbers (W)
Rational or irrational: Rational

12/4

Work it out: 12 ÷ 4 = 3
Smallest of the listed number sets containing it: Natural numbers (N)
Rational or irrational: Rational

-3/5

Work it out: Ratio of two integers, not an integer
Smallest of the listed number sets containing it: Rational numbers (Q)
Rational or irrational: Rational

√49

Work it out: 7 × 7 = 49, so √49 = 7
Smallest of the listed number sets containing it: Natural numbers (N)
Rational or irrational: Rational

√50

Work it out: 50 is not a perfect square; √50 = 5√2
Smallest of the listed number sets containing it: Irrational numbers (R \ Q)
Rational or irrational: Irrational

0.1666...

Work it out: Recurring decimal; equals 1/6
Smallest of the listed number sets containing it: Rational numbers (Q)
Rational or irrational: Rational

3.14

Work it out: Terminating decimal; 314/100 = 157/50
Smallest of the listed number sets containing it: Rational numbers (Q)
Rational or irrational: Rational

π

Work it out: Decimal never stops and never repeats
Smallest of the listed number sets containing it: Irrational numbers (R \ Q)
Rational or irrational: Irrational

22/7

Work it out: Ratio of two integers; 3.142857142857...
Smallest of the listed number sets containing it: Rational numbers (Q)
Rational or irrational: Rational

√3 × √12

Work it out: √36 = 6
Smallest of the listed number sets containing it: Natural numbers (N)
Rational or irrational: Rational

---

2 + √5

Work it out: Rational + irrational
Smallest of the listed number sets containing it: Irrational numbers (R \ Q)
Rational or irrational: Irrational

B. Converting a recurring decimal into a fraction

Method: call the number x, multiply by a power of 10 so that the repeating blocks line up, and subtract.

1. **0.777...** Let x = 0.777.... Then 10x = 7.777.... Subtract: 9x = 7, so x = 7/9.

2. **0.363636...** Let x = 0.363636.... The block has two digits, so multiply by 100: 100x = 36.3636.... Subtract: 99x = 36, so x = 36/99 = 4/11.
3. **0.2444...** Let x = 0.2444.... Then 10x = 2.444... and 100x = 24.444.... Subtract: 90x = 22, so x = 22/90 = 11/45.

C. Finding rational numbers between two rational numbers

Between 1/3 and 1/2: the average is (1/3 + 1/2) ÷ 2 = (5/6) ÷ 2 = 5/12. Between 1/3 and 5/12: the average is (4/12 + 5/12) ÷ 2 = 9/24 = 3/8. So 1/3 < 3/8 < 5/12 < 1/2. The same step can be repeated without end.

Three common exam traps

1. **"Non-terminating" does not mean "irrational".** 0.333... and 22/7 = 3.142857142857... never stop, but they repeat, so they are rational. Only a decimal that never stops and never repeats is irrational. In the same way, 22/7 and 3.14 are rational, but π is irrational.
2. **Two irrational numbers do not always give an irrational answer.** √2 + (-√2) = 0 and √2 × √8 = 4 are rational. Only "rational + irrational" and "non-zero rational × irrational" are always irrational. Watch the word "non-zero": 0 × √2 = 0.
3. **The direction of "every".** Every natural number is a whole number, but 0 is a whole number that is not a natural number. Every integer is rational, but 1/2 is rational and not an integer. Zero is an integer and a rational number, and it is neither positive nor negative.

Sources

1. NCERT, Ganita Manjari, Grade 9, Part I, Chapter 3 "The World of Numbers" (the Class IX textbook now on the NCERT...; 2. NCERT, Mathematics, Class X, Chapter 1 "Real Numbers", Section 1.3 "Revisiting Irrational Numbers" (Theorem 1.3 and...; 3. NCERT, Exemplar Problems: Mathematics, Class IX, Chapter 1 "Number Systems", part (A) "Main Concepts and Results",...; 4. NCERT, Mathematics, Class IX, Chapter 1 "Number Systems" (the textbook used before Ganita Manjari), read through... [link 2] [link 3]; 5. National Institute of Open Schooling (NIOS), Secondary Course Mathematics (211), Lesson 1 "Number Systems", Sections...; 6. NCERT, Ganita Prakash, Grade 6, Chapter 10 "The Other Side of Zero", Section 10.1 and the chapter summary; 7. SATHEE (IIT Kanpur), solutions to Exercise 1.1 of the earlier NCERT Class IX chapter "Number Systems"; 8. Wikipedia, "Natural number"; 9. Wikipedia, "Parity (mathematics)" [link 2]; 10. Wikipedia, "Sign (mathematics)"; 11. Wikipedia, "Irrational number"; 12. Wikipedia, "Pi"; 13. Telugu Wikipedia, "సంఖ్య";

Types of numbers

Families, definitions and first checks

1 Place each number in its family

$$\mathbb{N} \subset \mathbb{W} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R}$$

Natural → Whole → Integers → Rational → Real

N Counting numbers: 1, 2, 3, ...

W Natural numbers together with zero: 0, 1, 2, 3, ...

Z Whole numbers and the negatives of the natural numbers: ..., −2, −1, 0, 1, 2, ...

Q Numbers that can be written as p/q, where p and q are integers and q is not 0

$-7 = -7/1 \in \mathbb{Q}$ | $0 = 0/1 \in \mathbb{Q}$ | $12/4 = 3 \in \mathbb{N}$

> Zero: whole, integer, rational and real; not natural
> Neither positive nor negative; even because $0 = 2 \times 0$

2 Split the reals, then simplify

R: All rational and all irrational numbers together



Irrational: Numbers on the number line that cannot be written as p/q

$\sqrt{49} = 7 \rightarrow$ rational

$\sqrt{50} = \sqrt{(25 \times 2)} = 5\sqrt{2} \rightarrow$ irrational

π is irrational; $22/7$ is rational

$2 + \sqrt{5} \rightarrow$ irrational (rational + irrational)

> Shortcut: simplify first, then name the smallest set
> A real number is rational or irrational, never both

Types of numbers

IAS WITH DR RAVI
AIM. PREPARE. ACHIEVE

Read decimals, then turn repetition into a fraction

3 Read the decimal behaviour

STOPS

$3/8 = 0.375$

Terminating → rational

REPEATS

$5/11 = 0.454545...$

Non-terminating recurring → rational

NEVER REPEATS

$\sqrt{2} = 1.41421356...$

Non-terminating non-recurring → irrational

Recurring means a fixed block repeats forever, after any non-repeating beginning

Shortcut for a fraction in lowest terms ($q > 0$):

No prime factors in q other than 2 and 5 → it stops

Any other prime factor in q → it recurs

4 Turn 0.363636... into a fraction

The repeating block has 2 digits, so use ×100

Let $x = 0.363636...$

$$\begin{array}{rrl} & 100x = & 36.363636... \\ - & x = & 0.363636... \\ \hline & 99x = 36 & x = 36/99 = 4/11 \end{array}$$

Identical decimal tails cancel when we subtract

Shortcut, after the working:

Put the block over 9 (1 digit) or 99 (2 digits)

Use only when repetition starts at the decimal point

Types of numbers

Test the operation, then find numbers in between

5 Two irrationals: test the result

Both inputs below are irrational. Watch the answer.

$\sqrt{2} + (-\sqrt{2}) = 0$	→ rational
$\sqrt{2} + \sqrt{3}$	→ irrational
$\sqrt{2} \times \sqrt{2} = 2$	→ rational
$\sqrt{2} \times \sqrt{3} = \sqrt{6}$	→ irrational

Two irrational inputs can give either kind of result

Now keep these always-rules:

Rational + rational; rational × rational → rational

Rational + or − irrational → irrational

Non-zero rational × irrational → irrational

> *The zero exception: $0 \times \sqrt{2} = 0$, which is rational*

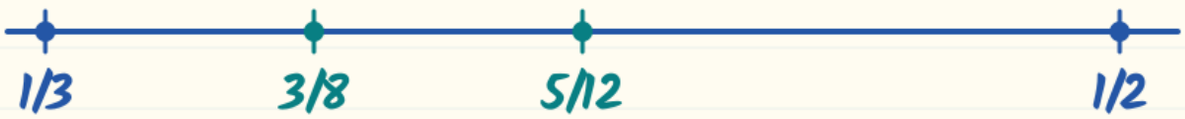
6 Find two rationals in between

Between 1/3 and 1/2, use the average:

1. $(1/3 + 1/2) \div 2 = (5/6) \div 2 = 5/12$

Now average 1/3 and the new number 5/12:

2. $(4/12 + 5/12) \div 2 = 9/24 = 3/8$



$1/3 < 3/8 < 5/12 < 1/2$

Shortcut: for distinct rationals $a < b$, $(a + b)/2$ lies between them. Repeat: there are infinitely many.

Types of numbers

IAS WITH DR RAVI
AIM. PREPARE. ACHIEVE

Mixed repetition: align the tails, then subtract

1 Separate the start from the repeating block

Let $x = 0.2\overline{36} = 0.2363636...$

The first digit 2 does not repeat; the block 36 repeats.
One starting digit → ×10. Two repeating digits → ×100.

2 Line up the identical decimal tails

$10x = 2.363636...$ — move past the first 2

$1000x = 236.363636...$ — then multiply by 100

$$\begin{array}{rrl} 1000x &= 236.363636... & \\ -\quad 10x &= 2.363636... & \\ \hline 990x &= 234 & \text{tails cancel} \end{array}$$

3 Reduce to lowest terms

$$x = \frac{234}{990} = \frac{234 \div 18}{990 \div 18} = \frac{13}{55}$$

13 and 55 = 5 × 11 have no common factor other than 1.

LOWEST TERMS

$$x = \frac{13}{55} \qquad p + q = 13 + 55 = 68$$

Check: $13 \div 55 = 0.2363636...$

Trap: 236 over 999 repeats the whole block 236

$\frac{236}{999} = 0.236236236...$ That is a different number. Here, only 36 repeats.

Also reduce first: 234 + 990 = 1224 is not p + q in lowest terms.

References: Source Index

TOPIC 10 · ENGLISH

PM-KISAN and Direct Benefit Transfer

Concept in one line

PM-KISAN is a fully Union-funded income-support scheme that transfers ₹6,000 a year directly into the bank accounts of eligible landholding farmer families.

Revision notes

2.1 Why this was in the news

The 21st PM-KISAN instalment was released at Coimbatore on 19 November 2025. Use this event to revise how government income support reaches a farmer's family. [S1]

2.2 The core scheme

What to understand	PM-KISAN
Full name	Pradhan Mantri Kisan Samman Nidhi
Purpose	Supplement eligible farmer families' financial needs
Ministry	Ministry of Agriculture and Farmers Welfare
Scheme type	Central Sector Scheme
Funding	100% by the Government of India
Annual support	₹6,000 per eligible family
Instalments	Three equal payments of ₹2,000
Delivery	Direct credit to the beneficiary's bank account through DBT

Sources: S2, S3 and S4.

2.3 Eligibility and the family unit

- Cultivable landholding is the primary eligibility criterion; specified exclusions also apply [S4]
- The scheme's family unit consists of a husband, wife and minor children [S3]
- Landholding size alone does not restrict coverage to families owning up to two hectares; that was the original scope, subsequently expanded [S5]
- Exclusions include institutional landholders and families with a member who paid income tax in the preceding assessment year; other notified exclusions also apply [S3, S6]

2.4 Who does what

1. States and Union Territories identify eligible farmer families under the scheme guidelines [S3]
2. The November 2025 release describes three requirements for receiving benefits: land details entered in the PM-KISAN portal, an Aadhaar-seeded bank account and completed e-KYC [S7]
3. The Union government funds the benefit, which reaches the beneficiary's bank account directly [S2, S3]

Administrative participation by a State does not make PM-KISAN a Centre–State cost-sharing scheme.

Extra section: Andhra Pradesh connection

The Andhra Pradesh Agriculture Department's Tirupati district page describes annual assistance of ₹20,000 under Annadata Sukhibhava–PM-KISAN, including the ₹6,000 PM-KISAN benefit. The 2025–26 State Budget also proposed ₹20,000 annual support under Annadata Sukhibhava. [S8, S9]

For a family eligible for both components, the useful distinction is:

₹14,000 State component + ₹6,000 PM-KISAN component = ₹20,000 annual total

The ₹6,000 central component is already included in ₹20,000. This combined State support does not change the nationwide PM-KISAN entitlement. Eligibility for the two components must be considered separately.

Three common exam traps

1. **Family versus individual:** ₹6,000 is the annual benefit for an eligible family; it is not a separate annual benefit for every adult member [S3]
2. **Funding versus identification:** States identify beneficiaries, while PM-KISAN is fully Union-funded [S2, S3]
3. **Income support versus other instruments:** PM-KISAN is direct income support. Procurement pays for produce bought; a crop loan must be repaid; crop insurance covers specified insured risks [S4, S10, S11]

Sources

[S1] Ministry of Agriculture and Farmers Welfare, 19 November 2025; [S2] PIB PM-KISAN backgrounder, 1 August 2025 [link 2]; [S3] Official PM-KISAN portal; [S4] Ministry eligibility reply, 22 July 2025; [S5] Ministry scheme review, 17 March 2020; [S6] Ministry eligibility reply, 25 June 2019; [S7] Ministry pre-release note, 14 November 2025; [S8] Agriculture Department, Tirupati district, Government of Andhra Pradesh; [S9] Andhra Pradesh Budget 2025–26, Minorities Component, section 1.6, printed page 5; [S10] Ministry reply on PM-KISAN, PMFBY and KCC, 1 August 2025; [S11] PIB MSP backgrounder, 10 October 2025;

Snapshot: 8 October 2026

Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)

₹6,000

PER YEAR · PER ELIGIBLE FAMILY

₹2,000 instalment 1 + **₹2,000** instalment 2 + **₹2,000** instalment 3



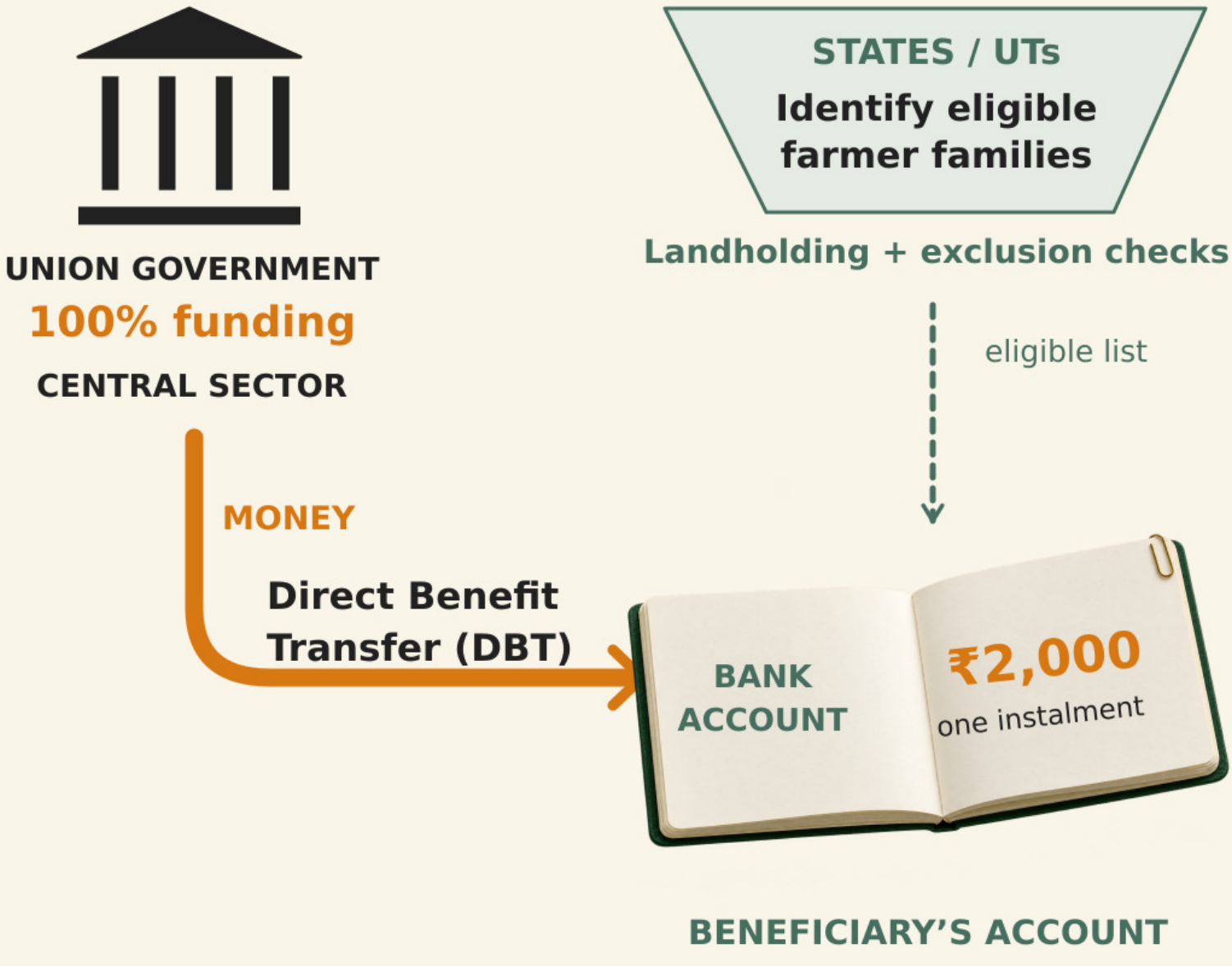
Cultivable landholding + eligibility rules + exclusions

News anchor: 19 Nov 2025, Coimbatore · 21st-instalment event · Source: PIB 2191922

Snapshot: 8 October 2026

Follow the money

The Centre funds it; States and UTs identify eligible families



Payment readiness

Land details · Aadhaar-seeded bank account · completed e-KYC

Sources: PM-KISAN portal; PIB 2190074 · Generic passbook illustration

Snapshot: 8 October 2026

Why is the money paid?

Income support, a purchase, a loan and insurance work differently

PM-KISAN · INCOME SUPPORT



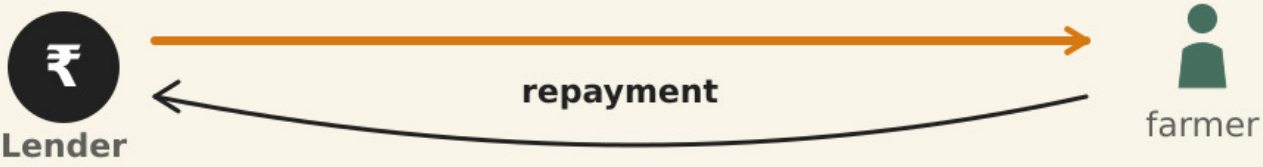
Scheme benefit; no produce sale or repayment

PROCUREMENT



Money in exchange for produce bought

CROP LOAN



Credit creates a repayment obligation

CROP INSURANCE



An insured event and policy terms govern the claim

Static link: identify the instrument behind the payment.

Sources: PIB 2151345 and PIB 2177219 · Arrow direction carries the meaning

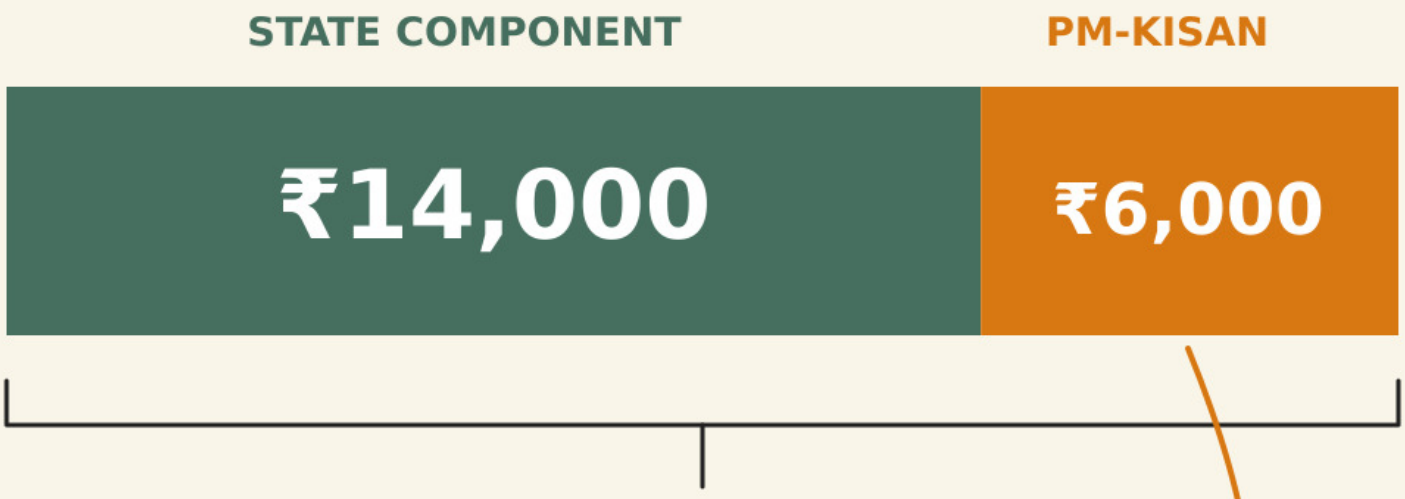
Snapshot: 8 October 2026

AP: read the whole package

AP

Annadata Sukhibhava–PM-KISAN · annual policy components

For a family eligible for both components



₹20,000

ANNUAL TOTAL

The ₹6,000 central component is already inside the ₹20,000 total.

Eligibility for the two components is assessed separately.

Source: AP Agriculture Department, Tirupati · ₹14,000 = ₹20,000 − ₹6,000

Snapshot: 8 October 2026

Three exam traps

Check the benefit unit, the funder and the payment type

1 FAMILY ≠ EACH ADULT



ONE family unit

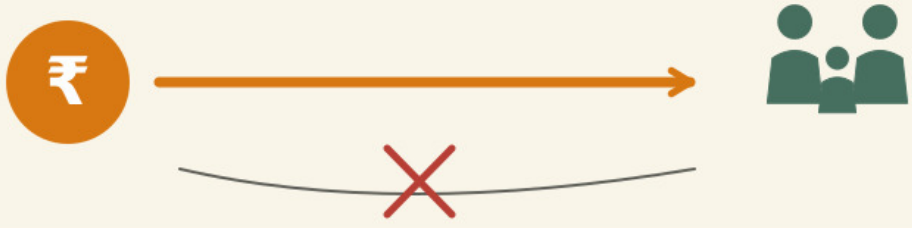
₹6,000 a year for an eligible family. Husband, wife and minor children form the scheme's family unit.

2 IDENTIFICATION ≠ FUNDING

CENTRE → funds PM-KISAN → **100%**

STATES / UTs --- identify beneficiaries

3 INCOME SUPPORT ≠ A CROP LOAN



No loan repayment obligation

Exclusions include institutional landholders and families with a member who paid income tax in the preceding assessment year.

Sources: PM-KISAN eligibility; PIB 190752, 2146932 and 2151345