ANSWER KEY & MARKING SCHEME · CBSE CLASS 11

Interior of the Earth

Geography · Chapter 3 · Use this with the Board Paper · Companion to Quick Drill

HOW TO USE

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

MODEL ANSWERS · BOARD PAPER

Section A — Very Short Answer (1 mark each, 4 Qs)

Q1. What is the epicentre of an earthquake? [1 mark]

Ans: The epicentre is the point on the earth's surface directly above the focus (the point inside the earth where the earthquake's energy is released).

Q2. Name the seismic wave that cannot pass through liquids. [1 mark]

Ans: The S-wave (Secondary wave).

Q3. What is the name of the discontinuity between the crust and the mantle? [1 mark]

Ans: The Mohorovicic (Moho) discontinuity.

Q4. Of what materials is the earth's core mainly composed? [1 mark]

Ans: Mainly iron and nickel (collectively abbreviated NIFE).

Section B — Short Answer I (2 marks each, 3 Qs)

Q5. Distinguish between the focus and the epicentre of an earthquake. [2 marks]

Ans: The FOCUS (or hypocentre) is the point INSIDE the earth where the earthquake's energy is first released. The EPICENTRE is the point on the SURFACE directly above the focus. Seismic waves spread out from the focus, and damage is usually greatest at the epicentre because it is nearest the source.

Q6. Name any two direct and two indirect sources of information about the earth's interior. [2 marks]

Ans: Direct sources (any two): deep mining; deep drilling (e.g. the Kola Superdeep Borehole); volcanic eruptions. Indirect sources (any two): seismic waves; the increase of temperature, pressure and density with depth; meteorites; the earth's gravity and magnetic field. Direct sources reach only the crust; the deep interior is known indirectly, chiefly from seismic waves.

Q7. Differentiate between intrusive and extrusive volcanic landforms with one example each. [2 marks]

Ans: Intrusive landforms form when magma solidifies BELOW the surface and cool slowly into coarse-grained rock — e.g. a batholith (or sill / dyke / laccolith). Extrusive landforms form when lava solidifies ON the surface and cool quickly into fine-grained rock — e.g. a lava flow / lava plateau such as the Deccan Traps, or a volcanic cone.

Section C — Short Answer II (3 marks each, 3 Qs)

Q8. Distinguish between P-waves and S-waves on the basis of speed, type of motion and the media through which they travel. [3 marks]

Ans: P-waves (Primary) are the fastest and arrive first; they are longitudinal (push-pull) waves and travel through solids, liquids and gases. S-waves (Secondary) are slower and arrive second; they are transverse waves and travel ONLY through solids, not through liquids or gases. In short: P = fast, longitudinal, all media; S = slower, transverse, solids only. This medium difference is why S-waves stop at the liquid outer core.

Q9. Describe the structure of the earth's core, naming the two discontinuities associated with it. [3 marks]

> **Ans:** The core lies below about 2,900 km and is made mainly of iron and nickel (NIFE). It has two parts: the OUTER core, which is LIQUID (S-waves cannot pass through it), and the INNER core, which is SOLID despite being the hottest region, because the immense pressure keeps it solid. The mantle-core boundary is the GUTENBERG discontinuity, and the boundary between the liquid outer core and solid inner core is the LEHMANN discontinuity. The motion of the liquid outer core generates the earth's magnetic field.

Q10. Explain the difference between the asthenosphere and the lithosphere, and state why the asthenosphere is important. [3 marks]

> **Ans:** The LITHOSPHERE is the rigid outer shell of the earth — the crust plus the uppermost solid mantle — broken into plates. The ASTHENOSPHERE is the soft, PLASTIC layer of the upper mantle (roughly 80-200 km deep) lying just beneath it. The asthenosphere is important because it is the chief source region of MAGMA, and because, being able to flow very slowly, it is the layer over which the rigid lithospheric plates move — making it the driver of plate tectonics, earthquakes and volcanoes.

Section D — Long / Source-Based (5 + 6 marks, 2 Qs)

Q11. Explain how seismic waves and their shadow zones have helped scientists determine the layered structure and physical state of the earth's interior. [5 marks]

> **Ans:** Seismic waves from earthquakes act like an X-ray of the planet. (1) There are two body waves: P-waves (fast, longitudinal, travel through solids, liquids and gases) and S-waves (slower, transverse, travel only through solids). (2) As these waves cross layers of differing density and state they speed up, slow down and bend (refract), and the timing of their arrival at worldwide stations reveals the boundaries between layers — the discontinuities (Moho, Gutenberg, Lehmann). (3) The S-wave SHADOW ZONE — the complete absence of S-waves beyond about 105 degrees from the epicentre — proves that the OUTER CORE is LIQUID, because S-waves cannot travel through liquid. (4) The P-wave SHADOW ZONE — a ring between about 105 and 145 degrees where P-waves are missing because the liquid core refracts them — confirms the size of the core; P-waves speeding up through the very centre further indicate a SOLID inner core. (5) Thus, without any drilling, the behaviour of seismic waves alone established a solid crust and mantle, a liquid outer core and a solid inner core. Conclusion: the interior is mapped indirectly, and seismic waves are the chief evidence.

Q12. Read the passage and answer: 'After a major earthquake, recording stations around the world report their data. Stations up to about 105 degrees from the epicentre record both P-waves and S-waves. Beyond 105 degrees, no station records any S-waves at all. In addition, stations in a belt between about 105 and 145 degrees record no P-waves, but stations beyond 145 degrees record P-waves once more.' (a) What is the name for the belts where particular waves fail to arrive? (b) Why do no S-waves arrive beyond 105 degrees, and what does this prove about the interior? (c) Why do P-waves disappear only in the 105-145 degree belt and then return? (d) Which property of S-waves is responsible for their behaviour? (e) Name the discontinuity at the boundary where S-waves are stopped. [6 marks]

> **Ans:** (a) They are called SHADOW ZONES (the S-wave shadow zone and the P-wave shadow zone). (b) No S-waves arrive beyond 105 degrees because the OUTER CORE is LIQUID and S-waves cannot travel through liquid; their total disappearance proves the outer core is liquid. (c) P-waves disappear only in the 105-145 degree belt because the liquid core REFRACTS (bends) them away from that band; they are not stopped, so they re-emerge beyond 145 degrees — making the P-shadow a narrow ring, not the whole far side. (d) S-waves are TRANSVERSE waves, which require a solid medium that can resist shearing; liquids cannot, so S-waves are stopped at the liquid outer core. (e) The discontinuity at the mantle-core boundary, where S-waves are stopped, is the GUTENBERG discontinuity.

★ TOPPER ANSWER TEMPLATES — 3 TEMPLATES · MEMORISE THE FORMAT

★ TOPPER TEMPLATE — 5-mark question: 'Distinguish between P-waves and S-waves and explain how they produce the shadow zones.'

CBSE SQP 2020, 2022; School Annual recurrently

Step 1 [1 mark]	**Define both waves with their key property**	Open: 'P-waves (Primary) are the fastest body waves; they are longitudinal (push-pull) and travel through solids, liquids and gases. S-waves (Secondary) are slower transverse waves that travel ONLY through solids and cannot pass through liquids.' State the medium difference first — it is the whole answer.
Step 2 [1 mark]	**Note speed / order of arrival**	Add that P-waves arrive first on the seismograph and S-waves second (hence Primary and Secondary), and that both are BODY waves travelling through the interior, unlike the slower, surface-confined surface waves that cause most damage.
Step 3 [1.5 marks]	**Explain the S-wave shadow zone**	'Beyond about 105 degrees from the epicentre, NO S-waves are recorded — the S-wave shadow zone covers the entire far side. Because S-waves cannot travel through liquid, their complete disappearance proves that the OUTER CORE is liquid.' Tie the observation to the conclusion.
Step 4 [1.5 marks]	**Explain the P-wave shadow zone + conclude**	'P-waves are recorded everywhere EXCEPT a ring between about 105 and 145 degrees — the P-wave shadow zone — because the liquid core REFRACTS (bends) them away from this band; they reappear beyond 145 degrees. Thus the shadow zones reveal both the existence and the liquid nature of the core.' A clear cause-to-conclusion close earns full marks.

COMMON LOSS OF MARKS:

- Saying S-waves are faster than P-waves (they are slower).
- Stating the P-shadow zone is 'everywhere past 105 degrees' — that is the S-shadow; the P-shadow is only the 105-145 degree ring.
- Describing the waves but never linking the shadow zones to the conclusion that the outer core is liquid.

★ TOPPER TEMPLATE — 3-mark question: 'Explain the direct and indirect sources of information about the interior of the earth.'

CBSE SQP 2019, 2021; School Annual 2021, 2022

Step 1 [1 mark]	**Direct sources**	'DIRECT sources come from material we can physically reach: deep mining, deep drilling projects such as the Kola Superdeep Borehole (about 12 km) and ocean-drilling, and the molten material thrown out by VOLCANIC ERUPTIONS, which brings up samples from depth.' Direct sources reach only the shallow crust.
Step 2 [1 mark]	**Indirect sources (non-seismic)**	'INDIRECT sources include the increase of TEMPERATURE, PRESSURE and DENSITY with depth; the study of METEORITES (similar in make-up to the earth's deep material); and the earth's GRAVITY and MAGNETIC FIELD, whose variations reveal the distribution of mass inside.'
Step 3 [1 mark]	**Seismic waves — the chief indirect source**	'The most important indirect source is SEISMIC WAVES from earthquakes: their changing speed and bending as they cross different layers, and the shadow zones, reveal the boundaries and physical state (solid/liquid) of the crust, mantle and core.' Naming seismic waves as the chief source secures the mark.

COMMON LOSS OF MARKS:

- Putting seismic waves under 'direct' sources — they are INDIRECT.
- Forgetting volcanic eruptions as a direct source.
- Listing sources without saying direct sources reach only the crust while the deep interior is known indirectly.

★ TOPPER TEMPLATE — 5-mark question: 'Describe the layered structure of the earth's interior and the discontinuities between the layers.'

CBSE SQP 2022; common at school level

Step 1 [1.5 marks]	**The crust**	'The CRUST is the thin, outermost solid shell — continental crust about 30 km (up to 70 km under mountains), made of lighter silica-alumina (SIAL, granitic); oceanic crust about 5 km, denser silica-magnesia (SIMA, basaltic). The crust-mantle boundary is the Mohorovicic (Moho) discontinuity.'
Step 2 [1.5 marks]	**The mantle**	'The MANTLE extends from the Moho to about 2,900 km and forms the bulk of the earth's volume. It is solid rock, but its upper part contains the ASTHENOSPHERE — a soft, plastic layer that is the source of magma and over which the lithospheric plates move.'
Step 3 [1.5 marks]	**The core**	'The CORE, mainly iron and nickel (NIFE), lies below about 2,900 km. The OUTER core is liquid (S-waves stop here — the Gutenberg discontinuity marks the mantle-core boundary); the INNER core is solid despite extreme heat, kept solid by immense pressure (the Lehmann discontinuity separates outer from inner core).'
Step 4 [0.5 mark]	**Conclude**	Close: 'These layers — distinguished by density and physical state and separated by seismic discontinuities — were mapped almost entirely from the behaviour of seismic waves.' Naming Moho, Gutenberg and Lehmann earns the discontinuity marks.

COMMON LOSS OF MARKS:

- Calling the whole mantle molten — only the asthenosphere is plastic; the mantle is mostly solid.
- Saying the inner core is liquid — it is SOLID (pressure keeps it so); the OUTER core is liquid.
- Omitting the discontinuities (Moho, Gutenberg, Lehmann) when the question asks for them.

MARKING SCHEME — GENERAL NOTES

- For P-vs-S questions, the medium difference (S = solids only) and the order of arrival both carry marks; reversing the speeds loses them.
- For the shadow zones, both the OBSERVATION and the CONCLUSION ('S-waves absent, therefore outer core liquid') are needed for full marks.
- For the layers, name the layer + its physical state + the bounding discontinuity; state alone without the discontinuity caps the mark.
- For focus vs epicentre, correctly placing focus INSIDE and epicentre on the SURFACE is essential.
- Source-based answers must use the passage's figures (105 / 145 degrees); generic answers that ignore the data are penalised.