Unit 15 · Geology

HARDER PRACTICE QUESTIONS

Full marks 43

Write your answers on separate paper. Show your working. 1 km = 100,000 cm. Take the speed of P waves as 6 km/s and of S waves as 3.5 km/s.

1 Spot the error [3]

Find the mistake in the working and correct it.

At a station, the S waves of an earthquake arrive 12 s after the P waves. Dipesh wrote: "The waves differ in speed by $6 - 3.5 = 2.5$ km/s, so in 12 s the gap is $2.5 \times 12 = 30$ km. **The focus is 30 km away.**"

2 How far, how long? [4]

i. The Indian plate moves north at about 4.5 cm a year. At that speed, how long would it take to move 2,000 km?

ii. The Atlantic widens by about 2.5 cm a year. How many million years would it take to widen by 5,000 km?

iii. Which of the two is the faster plate motion, and by how many times?

3 What if? [3]

Suppose the sea floor of the Tethys had never sunk under Asia, and India had stayed far to the south. What would be different (a) about Nepal's mountains, (b) about the shaligrams of the Kali Gandaki, and (c) about Nepal's earthquakes? Give a reason for each.

4 Check the claim [4]

Anjali found these records of earthquakes in the unit:

Earthquake	Magnitude	Deaths
Bihar–Nepal, 1934	8.0	8,519 in Nepal
Udayapur, 1988	6.9	more than 700 in Nepal
Gorkha, 2015	7.8	nearly 9,000
Jajarkot, 2023	5.7	about 150

She concluded: "The bigger the magnitude, the more people die."

i. Which pair of rows supports her claim?

ii. Which pair shows that magnitude is not the whole story? Explain.

iii. Name two other things that decide how many die.

5 Design a fair test [4]

Roshan wants to test, with a shaking table, whether a model house with a band of wood tied round its walls stands longer than one without. Plan a fair test.

i. What will he change, and what will he measure?

ii. Name three things to keep the same.

iii. How can he make his results reliable?

iv. What result would support the idea?

6 Correct the misconceptions [3]

The paragraph has three mistakes. Write each mistake and correct it.

> Fatima wrote: "The Tatopani hot springs show that there is a volcano under Nepal. An earthquake of magnitude 8 releases twice as much energy as one of magnitude 4. The epicenter is the point deep underground where the rock slips."

7 Which explanation fits? [3]

Two students explain why runny lava builds broad, gentle shield volcanoes while sticky lava builds steep cones.

Ujjwal: "Runny lava is cooler, so it doesn't explode."

Rojina: "Runny lava flows far before it hardens, and lets its gas escape; sticky lava piles up near the vent and traps its gas until it bursts out."

Which explanation fits the unit? Use the shapes and the eruptions to decide.

8 Predict, then explain [3]

Write your prediction first, then explain it.

> An earthquake strikes 84 km from a city. A phone alert system detects the P waves the moment they arrive at the city. How many seconds of warning does the city get before the S waves arrive? Would a city 10 km from the epicenter get more or less warning?

9 Work backwards [4]

i. A layer of rock was shortened by 25% by folding, and its ends are now 36 km apart. How long was it before it was folded?

ii. The squeeze took 600,000 years. At how many cm a year was it shortened?

10 Show that [3]

Show that, with P waves at 6 km/s and S waves at 3.5 km/s, every second of gap between them means a distance of 8.4 km. Then use it to find how far away an earthquake is when the gap is 30 s.

11 Estimate it [3]

About 2 cm a year of India's motion builds up as slip on the stuck fault under Nepal. Estimate how much slip had built up between the earthquakes of 1934 and 2015. A great earthquake slips the fault several meters at once. What does your answer suggest about how often great earthquakes come?

12 Make your own [2]

Make up two earthquakes whose magnitudes differ so that the larger releases exactly 1,000 times the energy of the smaller. Show that your pair works.

13 Think [4]

The Gorkha earthquake of 2015 broke only the deeper part of the stuck fault; the shallow part, between Kathmandu and the Terai, still holds its strain. Dawa says, "After such a big earthquake, Kathmandu is safe for centuries."

i. Is he right? Give a reason from the unit.

ii. Western Nepal hasn't had a great earthquake for over 500 years. How much slip may be stored there?

iii. Since earthquakes can't be predicted, what is the best thing towns there can do?