Earthquakes

1 (a) Seismic (earthquake) waves can be either P-waves or S-waves.

Which row of the table is correct for P-waves?

Put a cross (☒) in the box next to your answer.

(1)

	type of wave	can they be refracted?
☒ **A**	longitudinal	yes
☒ **B**	transverse	no
☒ **C**	longitudinal	no
☒ **D**	transverse	yes

(b) Explain why it is difficult to predict when an earthquake will happen.

(2)

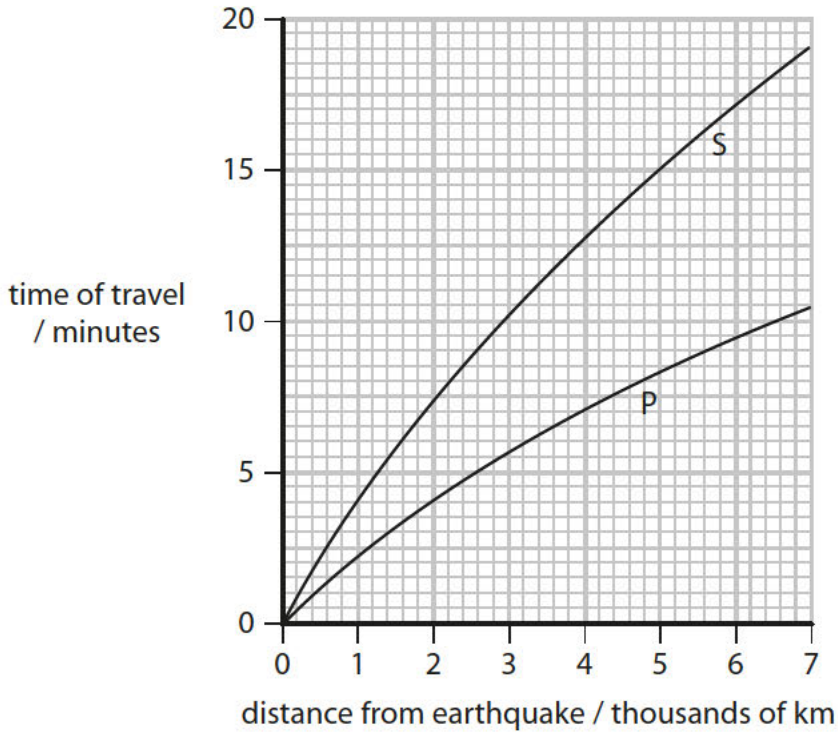
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(c) The graph shows how long it takes the P-waves and the S-waves from an earthquake to travel different distances.



The time difference between these waves arriving at a place allows scientists to find out how far away the earthquake was.

Use the graph to find the time difference between the P- and S-waves when the distance is 4800 km.

(3)

time for P-wave = ... minutes

time for S-wave = ... minutes

time difference = ... minutes

*(d) The map below shows the positions of some seismic earthquake stations in the UK.



At the seismic stations, scientists record the arrival of earthquake waves.
They use this data to locate where an earthquake happened.

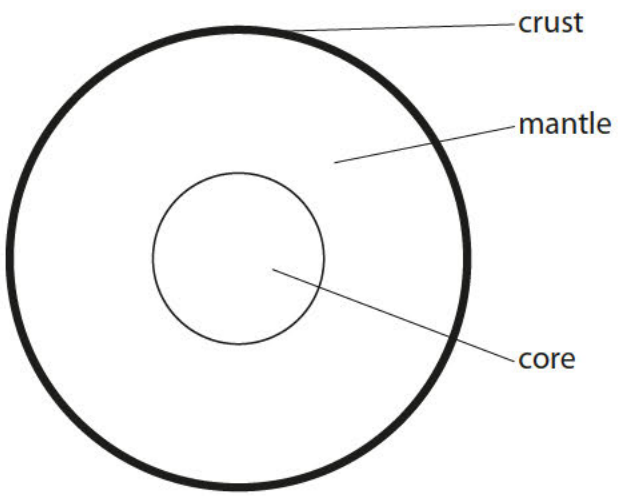
Describe how they use the data to find out where an earthquake happened.
You may add to the diagram above or draw your own diagram to help with your answer.

(6)

(Total for Question 6 = 12 marks)

Earthquakes

2 (a) The diagram shows a cross-section of the Earth.



The mantle is hotter near the core than near the crust.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

One reason for the mantle being hotter near the core is that

(1)

☐ **A** the Earth's crust is a solid

☐ **B** the Earth's core is a liquid

☐ **C** the Earth is radiating heat to space

☐ **D** the Earth is absorbing heat from space

(ii) Explain how this temperature difference causes the tectonic plates in the Earth's crust to move.

(2)

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(b) All earthquakes emit S-waves and P-waves.
Scientists determine the position of earthquakes by detecting these seismic waves.

(i) The S-waves and P-waves do not always travel in straight lines.

Explain why the S-waves and P-waves do not always travel in straight lines.

(2)

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(ii) S-waves and P-waves travel at different speeds.
The scientists use the (S–P) time to estimate how far away the earthquake is.

Suggest what is meant by (S–P) time.

(2)

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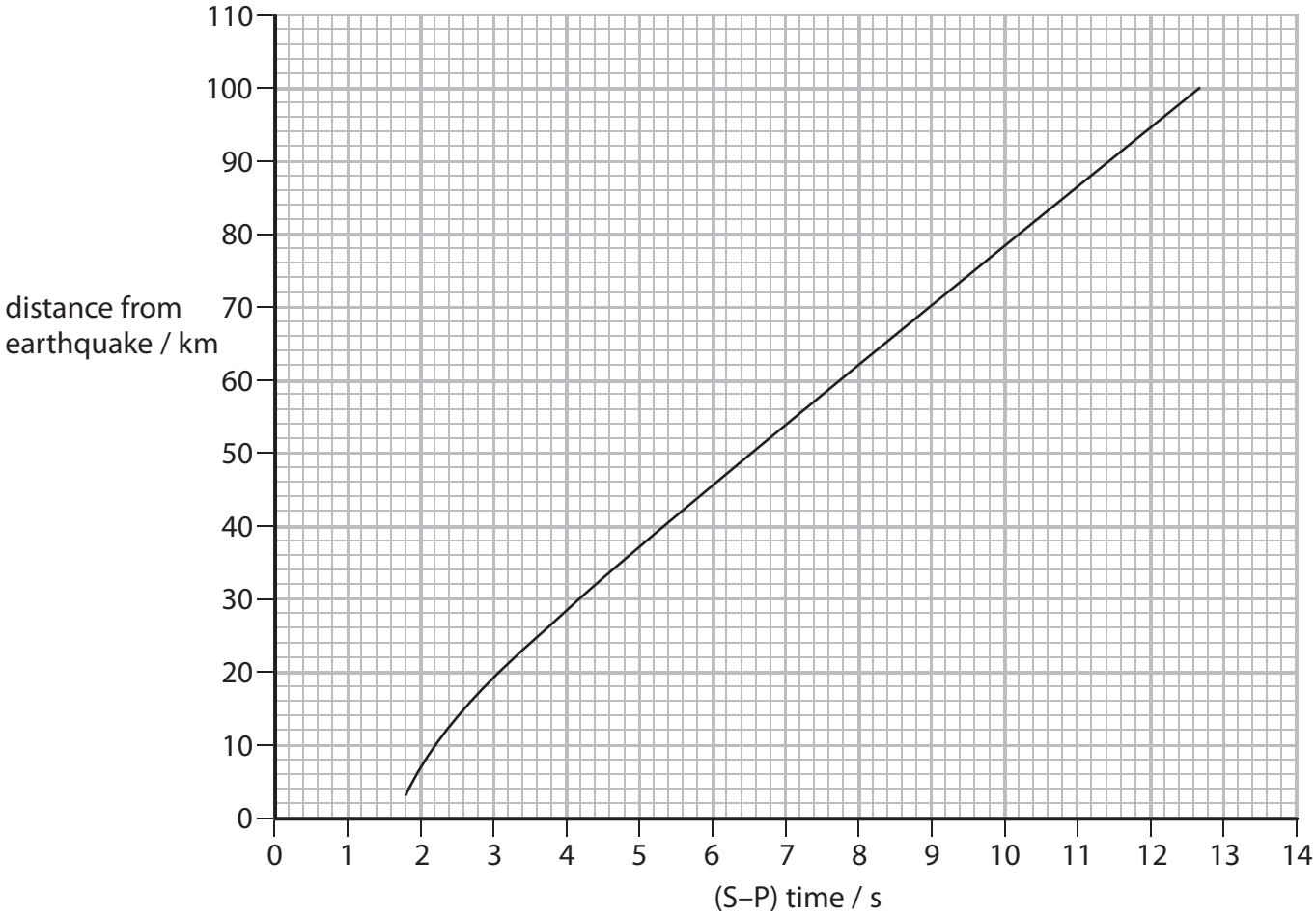
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(iii) Some scientists use the following equation to get a quick estimate of how far away an earthquake happened.

distance from earthquake in km = 8 × (S–P) time in seconds

The graph shows the relationship between the (S–P) time and the distance from the earthquake, measured along the Earth's surface.



Use values from the graph to evaluate the range of distances for which this estimate is reasonable.

(3)

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(Total for Question 3 = 10 marks)

Using electromagnetic radiation

3 (a) A specific electromagnetic wave has a frequency greater than visible light.
The wavelength of this wave is longer than that of X-rays.

Complete the sentence by putting a cross (☒) in the box next to your answer.

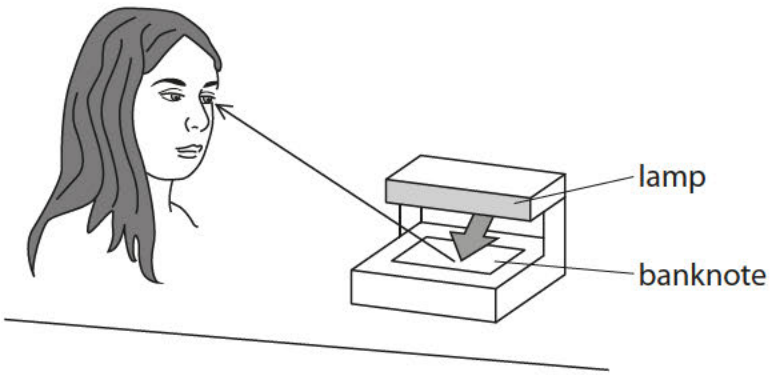
This electromagnetic wave is

(1)

- ☐ **A** a gamma wave
- ☐ **B** an infrared wave
- ☐ **C** a microwave
- ☐ **D** an ultraviolet wave

(b) The picture shows a woman checking that a banknote is genuine.

She is using a lamp which emits a radiation which is part of the electromagnetic spectrum.



Explain how **two** different electromagnetic radiations enable the woman to check the banknote.

(2)

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(c) A light wave from a star has a frequency of 6.67×10^{14} Hz and a wavelength of 4.50×10^{-7} m.

The star is 4.00×10^{16} m away from Earth.

Calculate the time it takes light from the star to reach the Earth.

(3)

time to reach Earth = ... s

*(d) Explain the differences between longitudinal and transverse waves.
Your explanation should refer to ultraviolet, ultrasound and seismic waves.

(6)

(Total for Question 5 = 12 marks)

Silent waves

4 (a) A man uses a dog whistle to call his dog.
The whistle uses ultrasound.

(i) The dog can hear the whistle but the man cannot.
Explain why the dog can hear the whistle but the man cannot hear the whistle.

(2)

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(ii) The dog is 140 m away from the man.
The ultrasound takes 0.42 s to travel from the man to the dog.
Calculate the speed of ultrasound.
State the unit.

(3)

speed of ultrasound = ... unit = ...

(b) (i) An earthquake P-wave has a frequency of 15 Hz.

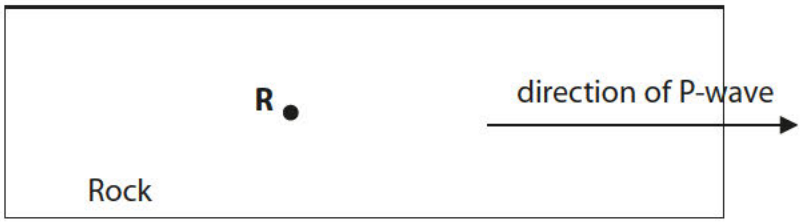
Complete the sentence by putting a cross (☒) in the box next to your answer.

The earthquake P-wave is

(1)

- ☐ **A** an infrasound wave
- ☐ **B** an ultrasound wave
- ☐ **C** an electromagnetic wave
- ☐ **D** a transverse wave

(ii) The diagram shows the direction of an earthquake P-wave in some rock.



Draw arrows on the diagram to show how the piece of rock, labelled **R**, moves.

(2)

(c) Earthquakes occur when two tectonic plates move against each other.
Explain what causes the tectonic plates to move.

You may draw a diagram if it helps your answer.

(2)

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(Total for Question 4 = 10 marks)