Using Waves

Questions

Q1.

A transducer can transmit and detect ultrasonic waves.

Figure 15 shows ultrasonic waves transmitted by the transducer on the bottom of a ship.

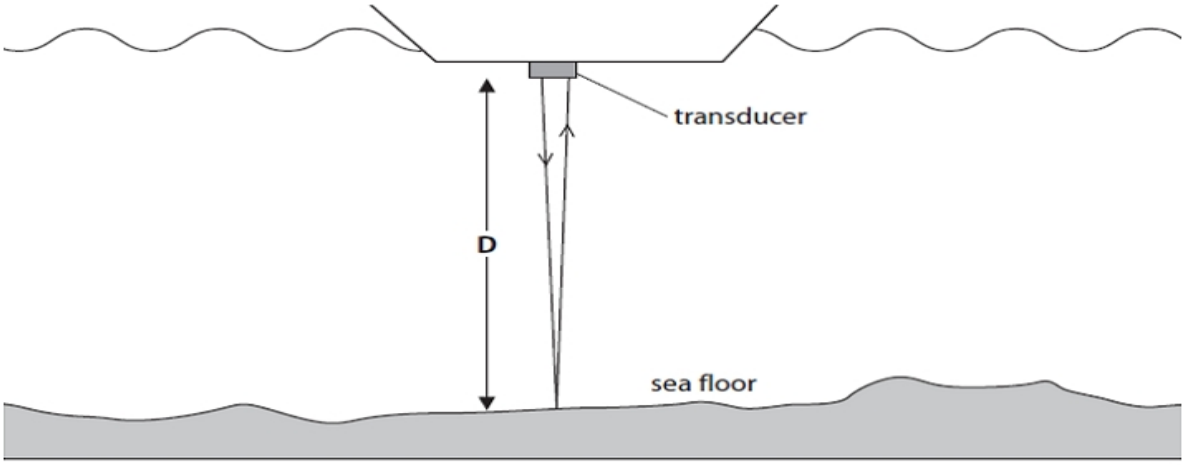

Figure 15

The waves reflect off the sea floor and are received back at the transducer.

The waves travel at 1500 m / s.

The time between transmission and reception is 48 milliseconds.

Calculate the depth of water, D, shown in Figure 15.

(2)

depth of water, D = ... m

(Total for question = 2 marks)

Q2.

Describe the difference between 'infrasound' and 'ultrasound'.

(2)

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(Total for question = 2 marks)

Q3.

Explain how vibrations from earthquakes may be used to study the core of the Earth.

(4)

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(Total for question = 4 marks)

Q4.

This question is about ultrasound.

Which of these is a frequency of ultrasound?

(1)

- ☒ **A** 2.3 Hz
- ☒ **B** 23 Hz
- ☒ **C** 2.3 kHz
- ☒ **D** 23 kHz

(Total for question = 1 mark)

Q5.

Figure 13 shows part of the inside of the Earth below the surface.

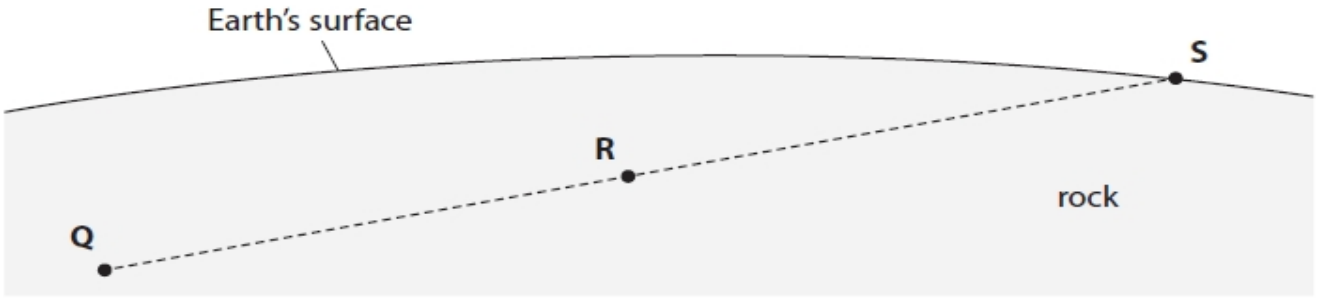

Figure 13

An earthquake starts at **Q**.

A seismic wave travels from **Q** to **S**.

The seismic wave is a longitudinal wave.

(i) Draw arrows on Figure 13 to show how the rock at **R** moves when the seismic wave passes through **R**.

(2)

(ii) The frequency of the seismic wave is 12 Hz.

The wave speed of the seismic wave is 7 km / s.
Calculate the wavelength of the seismic wave, in metres.
Use the equation

$$\text{wavelength} = \frac{\text{wave speed}}{\text{frequency}}$$

(3)

wavelength = ... m

(Total for question = 5 marks)

Q6.

Sonar is an example of a use of ultrasound.

Figure 1 shows the depth of the sea, measured using sonar, at different distances from the shore.

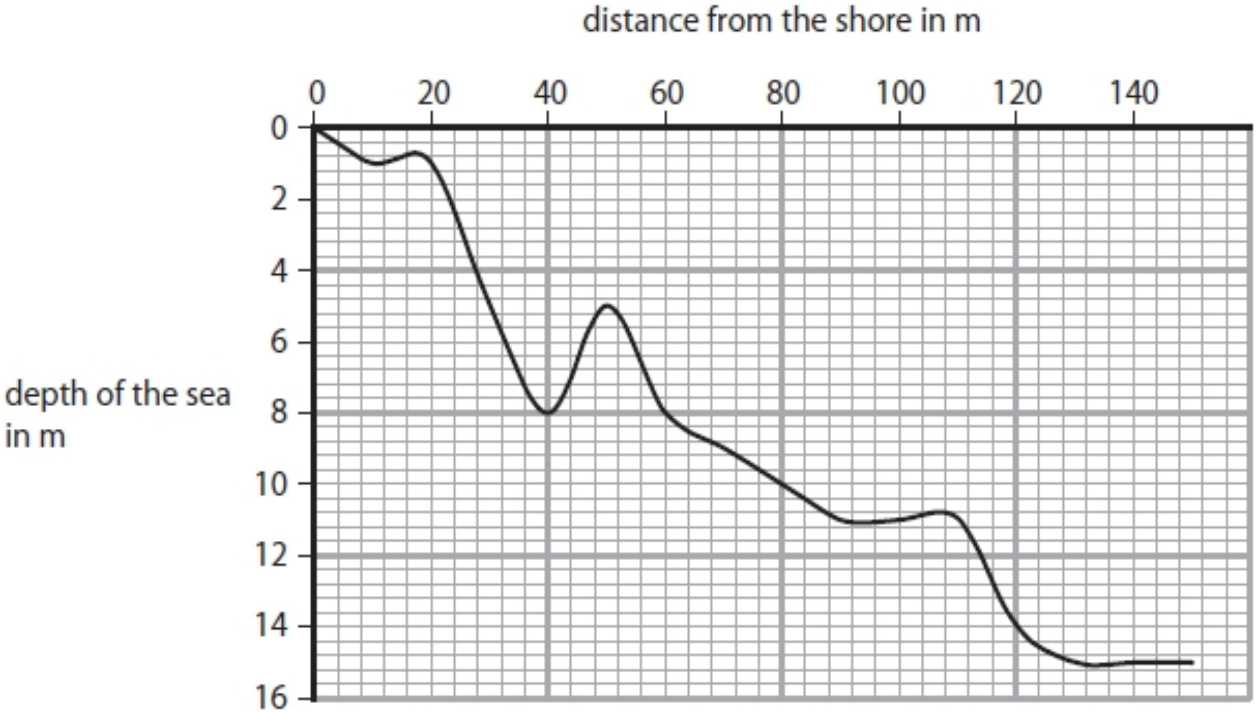

Figure 1

A technician on a boat uses sonar pulses to measure the depth of the sea when the boat is 120 m from the shore.

Calculate the **total** time of travel for the sonar pulse used to make this measurement.

The speed of the sonar pulse in seawater is 1600 m/s.

(4)

time of travel = ... s

(Total for question = 4 marks)

Q7.

This question is about ultrasound.

Ultrasound has many uses.

(i) One device called a pest repeller emits ultrasound.

The ultrasound keeps mice out of the garden.
Explain why the device affects mice but does not affect humans.

(2)

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(ii) A technician has a different ultrasound device.

This device can emit and detect short pulses of ultrasound.
The device can also measure the time, in ms, from emitting a pulse to detecting the same pulse.
Describe how the technician can use this device to determine the speed of ultrasound in air.

(3)

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(Total for question = 5 marks)

Q8.

Sonar is an example of a use of ultrasound.

State an example of a use of infrasound.

(1)

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(Total for question = 1 mark)

Q9.

Sonar is an example of a use of ultrasound.

State **one** other example of a use of ultrasound.

(1)

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(Total for question = 1 mark)

Mark Scheme – Using Waves

Q1.

Question number	Answer	Additional guidance	Mark
	recall and substitution (1) D = ½ v x t = ½1500 x 0.048 evaluation (1) 36 (m)	 award full marks for the correct answer without working award 1 mark only for 72 m (i.e. ½ ignored)	**(2) grad**

Q2.

Question number	Answer	Additional guidance	Mark
	description including: infrasound < 20 Hz (1) ultrasound > 20 000 Hz (1)	 award 1 mark for infrasound lower frequency than ultrasound OR reverse argument	**(2) grad**

Q3.

Question number	Answer	Additional guidance	Mark
	An explanation linking any four from use of seismometers (1) waves can be refracted in the interior of the earth (1) (showing) different densities (1) some seismic waves are longitudinal and some transverse (1) S/transverse waves cannot pass through liquid (1) S wave / transverse wave shadow zone shows part of the earth must be liquid (1) P / longitudinal waves can go through the core/liquid (1) mention S and P waves (1)	 S/transverse waves can only pass through solids	**(4) exp**

Q4.

Question number	Answer	Mark
	D 23 kHz A,B and C are not correct because they are all below 20 kHz	**(1)** **AO2**

Q5.

Question number	Answer	Additional guidance	Mark
(i)	at least one arrow in the direction QS (1) two arrows in opposite directions (1)	allow arrows parallel to QS independent mark  scores 2 marks two arrows in opposite directions but perpendicular to QS scores 1 mark maximum	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	converts 7 km/s to 7000 m/s (1) substitution (1) $\frac{7(\times 10^3)}{12}$ evaluation (1) 580 (m)	7000 seen (1) allow numbers that round down to 580 such as 583.33.... 5.8 to any incorrect power of ten scores 2 marks award full marks for the correct answer without working	**(3)**

Q6.

Question Number	Answer	Additional guidance	Mark
	recall (1) $v = \frac{x}{t}$ rearrangement (1) $t = \frac{x}{v}$ substitution (1) $\frac{14 \times 2}{1600}$ evaluation (1) 0.018 (s)	substitution and rearrangement in either order max 3 marks if 14 used as distance accept numbers that round to 0.018 e.g. 0.0175 (s) award full marks for the correct answer with no working	**(4)** AO 1 1 AO 2 1

Q7.

Question number	Answer	Additional guidance	Mark
i	An explanation linking: frequency (1) in mouse hearing range but not in human hearing range (1)	accept wavelength relevant frequency value with unit eg > 20 kHz	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
ii	A description to include: send pulse to a wall/reflecting surface OR detect the echo (1) measure distance (to wall and time to echo) (1) use speed = 2 x $\frac{\text{distance}}{\text{time}}$ (1)	accept measure time to receive echo OR reflection back OR record time to echo/return	**(3)** **AO3**

Q8.

Question Number	Answer	Additional Guidance	Mark
	studying the Earth's structure (1)	accept other examples e.g. detect meteor(ites) seismic activity named animals communicating e.g. elephants giraffes whales	**(1)** AO 1 1

Q9.

Question Number	Answer	Additional Guidance	Mark
	foetal scanning (1)	ignore sonar ACCEPT echo location accept other examples e.g. dog whistle cat scarer bat detector kidney stones cleaning jewellery baby scanner pregnancy scanner faults in structures	**(1)** AO 1 1