Properties of Waves

Total marks:20

Q1.

A water wave has a wavelength of 0.25 m and a frequency of 1.5 Hz.

Calculate the wave speed.

(2)

wave speed = ... m/s

(Total for question = 2 marks)

Q2.

A radio station transmits on 97.4 MHz.

To receive the waves an aerial needs a length equal to half the wavelength of the radio waves being transmitted.

Calculate the length of the aerial needed.

The speed of the radio waves is 3.00×10^8 m / s.

(3)

length of aerial = ... m

(Total for question = 3 marks)

Q3.

(i) Figure 2 shows a student sitting on the shore of a lake watching ripples on the surface of the water moving past a toy boat.

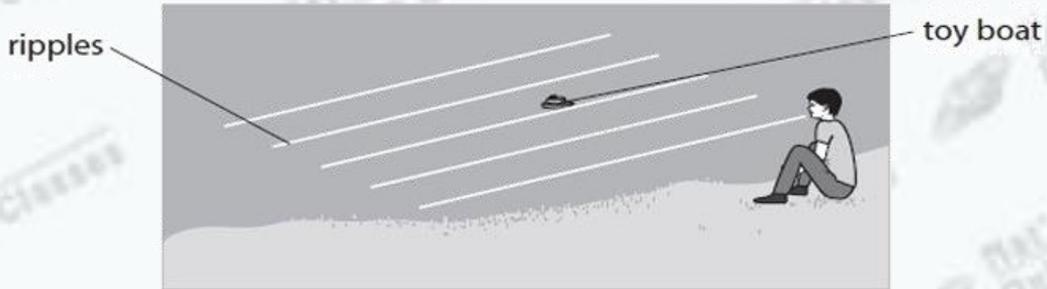**Figure 2**

The student has a stopwatch.
Describe how the student could determine the frequency of the ripples on the lake.

(3)

....

....

....

....

(ii) The speed of a water wave is 1.5 m/s.

The frequency of the wave is 0.70 Hz.
Calculate the wavelength of this wave.
Use the equation

$$v = f \times \lambda$$

(2)

wavelength = ... m

(iii) Water waves are transverse waves.

Describe the difference between transverse waves and longitudinal waves.

(2)

....

....

....

....
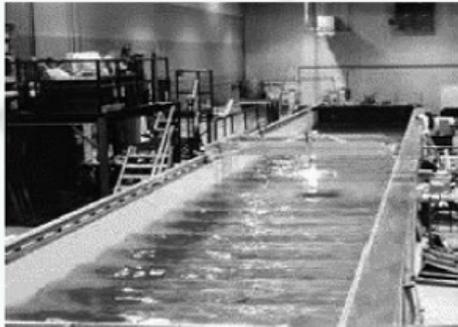
(Total for question = 7 marks)

Q4.

Figure 11 shows a large tank of water.

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Figure 11

The tank of water is used to study water waves.

(i) Water waves are transverse waves.

Give another example of a transverse wave.

(1)

....

(ii) Figure 12 shows a side view of part of the tank.

L

M

32 m
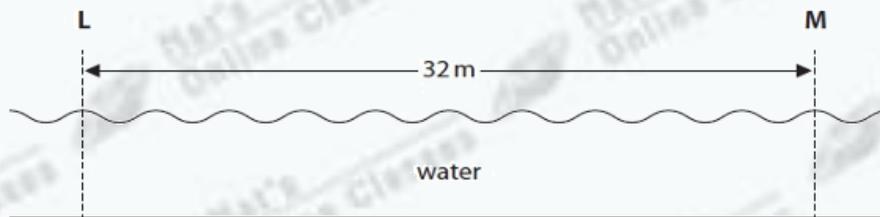
water

Figure 12

A water wave is moving from **L** to **M**.
Calculate the wavelength of the wave.

(2)

wavelength = ... m

(iii) A technician stands at the side of the tank.

He counts the peaks of the waves as they pass him.
12 peaks pass the technician in a time of 15 s.
Calculate the frequency of the wave.

(2)

frequency = ... Hz

(Total for question = 5 marks)

Q5.

Sound travels slower in cold air than it does in warm air.

The equation relating the speed of sound in air to the density of the air is

$$\text{speed of sound} = \frac{K}{\sqrt{(\text{density})}} \qquad \text{where K is a constant.}$$

The table in Figure 10 gives some data about the speed of sound in air and the density of air.

	speed of sound in m/s	density of air in kg / m³
in cold air	331	1.29
in warm air		1.16

Figure 10

Use the equation and the data in the table in Figure 10 to calculate the speed of sound in warm air.

Give your answer to an appropriate number of significant figures.

(3)

speed of sound in warm air = ... m/s

(Total for question = 3 marks)

Mark scheme:

Q1.

Question Number:	Answer	Additional guidance	Mark
	recall and substitution (1) (v =) 0.25 x 1.5 evaluation (1) 0.38 (m/s)	 accept 0.375 or 0.37 (m/s) accept 37.5, 37 or 38 for 1 mark only award full marks for the correct answer without working	**(2)**

Q2.

Question number	Answer	Additional guidance	Mark
	recall **and** rearrangement (1) $\lambda = \dfrac{v}{f}$ evaluation (1) 3.08 (m)	$\dfrac{3.0\ (\times 10^8)}{97.4\ (\times 10^6)}$ accept 3.1 (m) award 1 mark for wavelength that rounds to 3.1 to any other power of 10	(3)
	(so) length of aerial = 1.54 m (1) check working $\dfrac{3\times10^8}{2} = 1.5 \times 10^8$ gets only 1 mark for ecf	independent mark. allow ECF from candidate's wavelength accept 1.5 (m) award 2 marks for 1.5 to any other power of 10 award full marks for the correct answer without working Allow 1.46 rounded to 1.5 for 1 mark only if it is ecf from mp2	

Q3.

Question number	Answer	Additional guidance	Mark
(i) CS1	a description to include count the number of waves(1) (arriving/passing a point) in a specific time(1) use frequency = $\dfrac{\text{number of waves}}{\text{time}}$ (1)	ignore in one second count the number of waves in one second scores 2 marks (MP1 and MP3) find the time between one wave and the next scores 2 marks (MP1 and MP2)	(3) AO1

Question number	Answer	Additional guidance	Mark
(ii) CS1	substitution (1) 1.5 = 0.7 x λ rearrangement and evaluation 2.1(4) m	$\dfrac{1.5}{0.7}$ allow $\dfrac{0.7}{1.5}$ for 1 mark award full marks for correct answer without working. λ = v/f scores 1 mark	(2) AO2

Question number	Answer	Additional guidance	Mark
(iii) CS1	A description to include: mention of oscillations/vibrations (1) EITHER transverse – (oscillations) perpendicular to direction of wave (travel) (1) OR longitudinal - (oscillations) in same direction as wave (travel) (1)	up and down OR side to side (movements) OR back and forth transverse movement up and down but longitudinal is side to side (1 mark only)	(2) AO1

Q4.

Question number	Answer	Additional guidance	Mark
(i)	**one** from: radio(wave) (1) micro(wave) (1) infrared (1) visible (light) (1) ultraviolet (1) X(-ray) (1) gamma (rays) (1) electromagnetic/em wave(s) seismic **S**(-wave)	Do not credit if sound waves also mentioned γ earthquake **S**(-wave)	(1)

Question number	Answer	Additional guidance	Mark
(ii)	$$\frac{32}{\text{number of wavelengths}}\quad(1)$$ $\frac{32}{10}$ evaluation (1) 3.2 (m)	accept 9 or 11 for 10 no ecf from mp1 3.6 (3.5r) or 2.9(1) award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
(iii)	substitution (1) $\frac{12}{15}$ evaluation (1) 0.8(0) (Hz)	award full marks for the correct answer without working	(2)

Q5.

Question Number	Answer	Additional guidance	Mark
	using cold row: evaluate (K=)376 (1) using warm row: substitute K and ρ $\frac{376}{\sqrt{1.16}}$ OR 349.10.... (1) 349 (m/s) to 3 sig figs (1)	$\frac{\text{other K from earlier calculation}}{\sqrt{1.16}}$ any answer to 3 sig figs 349.10... scores MP1 and MP2 award full marks for the correct answer without working	(3)