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EDEXCEL COMBINED SCIENCE PHYSICS: QUESTIONS BY TOPIC

Waves (4)

Combined Science Physics (Higher) Topic 4

4 questions · 38 marks · Mark schemes included

Pearson Edexcel Combined Science (9-1) Physics 1SC0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.
Click any row below to jump straight to that question.
On every question page, click ANSWER in the top-right corner to jump to its mark scheme.
Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
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QUESTIONS

4 questions · 38 marks · lowest tariff first



9-MARK QUESTIONS

3 questions in this booklet



3 (a) Figure 5 shows a tuning fork.

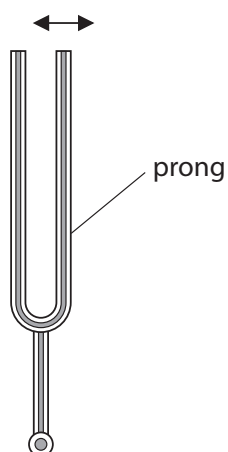


Figure 5

When the prongs of the tuning fork are struck, the prongs vibrate in the directions shown by the arrows on Figure 5.

Describe how the vibrating tuning fork causes a sound wave to travel through the air.

You may add to the diagram if it helps your answer.

(2)

- (b) The following descriptions describe waves from different parts of the electromagnetic spectrum.

Complete each description by adding the name of the wave.

Use the name of each wave only once. Each description refers to a different part of the electromagnetic spectrum.

(4)

Description 1

used in cooking

used in short-range communication

typical wavelength 900 nm

name of wave

Description 2

used in cooking

used in communication

typical wavelength 150 mm

name of wave

Description 3

used in communication

produced by oscillations in electrical circuits

typical wavelength 150 m

name of wave

Description 4

used in medical scanning

is emitted by the nucleus of an atom

typical wavelength 2.0×10^{-3} nm

name of wave



- (c) When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.

Explain, in terms of speed, why the light behaves like this.

(3)

(Total for Question 3 = 9 marks)



- 1 (a) Figure 1 shows part of a wave.

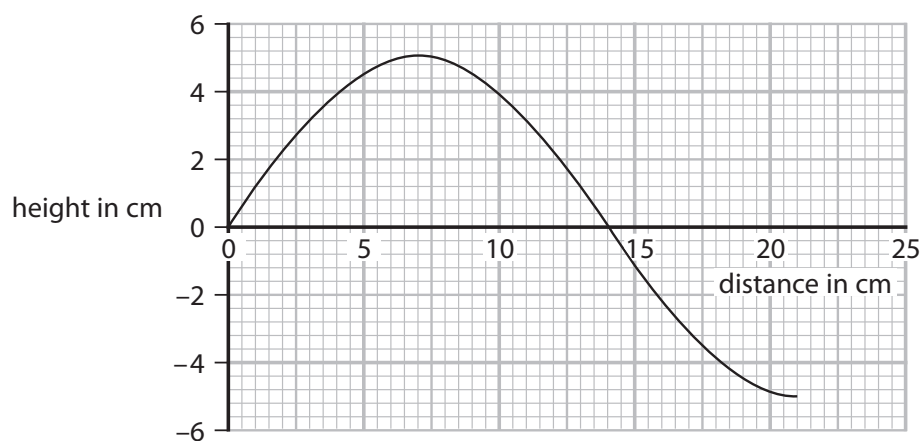


Figure 1

Use data from Figure 1 to calculate the wavelength of the wave.

(2)

wavelength = ... cm

- (b) (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.

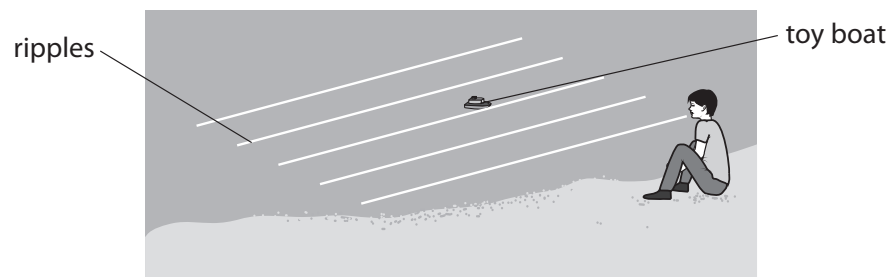


Figure 2

The student has a stopwatch.

Describe how the student could determine the frequency of the ripples on the lake.

(3)

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.....

- (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 1 = 9 marks)



- 2 (a) Figure 4 is a diagram of part of a water wave.

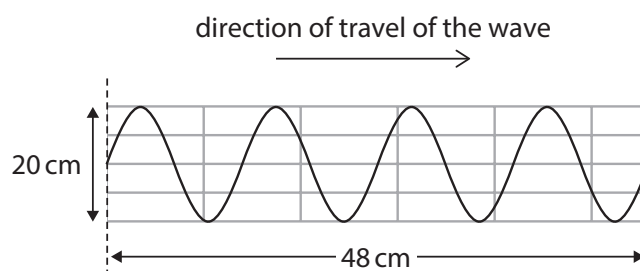


Figure 4

- (i) Use data from Figure 4 to determine the amplitude of the wave.

(1)

amplitude = ... cm

- (ii) Use data from Figure 4 to determine the wavelength of the wave.

(1)

wavelength = ... cm

- (iii) The water wave shown in Figure 4 is generated in a large tank.

A student observes the wave.

Describe how the student could determine the wave speed of the wave.

(2)

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- (b) When an earthquake happens, waves are transmitted through the Earth. Figure 5 is a diagram of a part of the Earth's crust.

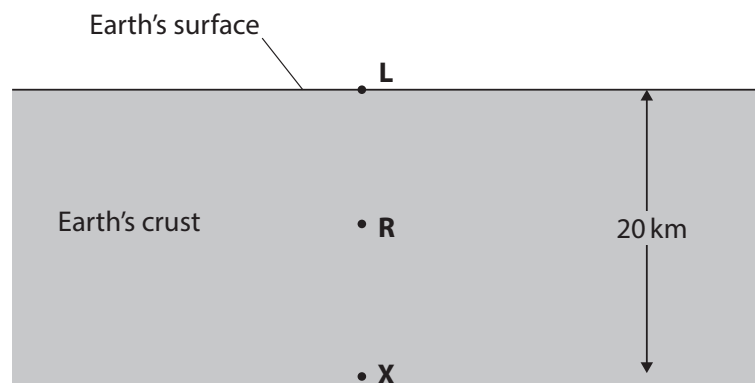


Figure 5

An earthquake happens at point **X**, 20 km below the Earth's surface.

An earthquake wave from **X** is detected at point **L**.

This earthquake wave is a transverse wave.

- (i) State **one** other example of a transverse wave.

(1)

- (ii) A point in the crust is labelled **R** in Figure 5.
There is a rock at point **R**.

Describe the effect that this earthquake wave has on the rock at **R** as the wave passes through the rock.

You may add to Figure 5 to help your answer.

(2)



(iii) The wave from **X** reaches **L** 3.8 seconds after it passes through **R**.

The speed of the wave is 4500 m/s.

Calculate the distance between **X** and **R**.

(2)

distance = ... m

(Total for Question 2 = 9 marks)



11-MARK QUESTIONS

1 question in this booklet



- 4 (a) Figure 6 shows two technicians, L and M, measuring the speed of sound in air.

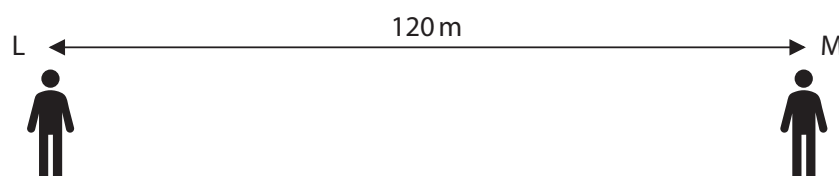


Figure 6

L fires a starting pistol.

M starts a stopwatch when first seeing the smoke from the starting pistol.

M stops the stopwatch when hearing the bang made by the starting pistol.

The distance between L and M is 120 m.

M's reaction time is 0.23 s.

The speed of sound in air is 330 m/s.

- (i) Calculate M's reaction time as a percentage of the time sound takes to travel from L to M.

(3)

.....%

- (ii) Which of these would improve the technicians' measurement of the speed of sound?

(1)

- ☐ **A** Use a firework 'banger' instead of the starting pistol.
- ☐ **B** Use a stop clock that measures time in minutes.
- ☐ **C** Increase the distance between **L** and **M**.
- ☐ **D** Decrease the distance between **L** and **M**.

- (b) Figure 7 shows the difference in refraction of sound waves and light waves when these waves travel from air into water.

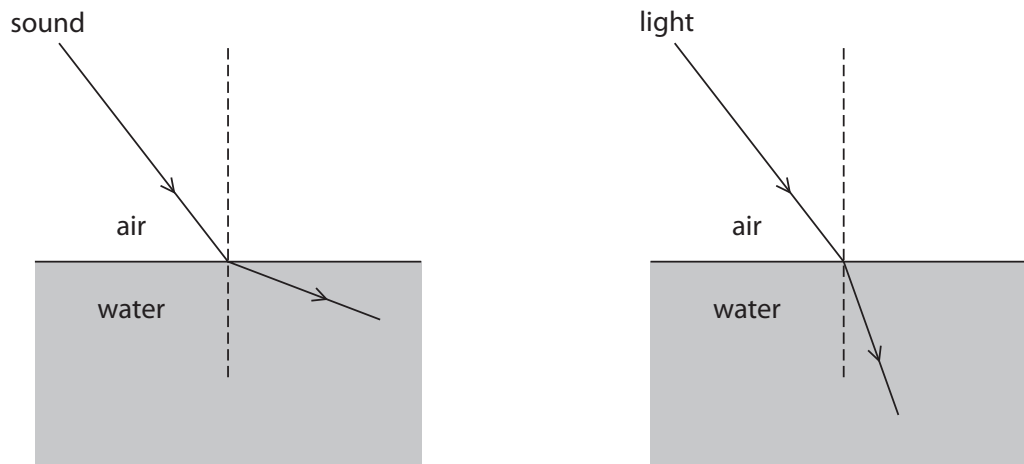


Figure 7

Explain why the refraction of the sound wave is different from the refraction of the light wave in Figure 7.

(3)

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(c) Light is one example of an electromagnetic wave.

Light can transfer energy from a lamp to the leaf of a plant, causing chemical reactions in the leaf.

Describe examples of **two** other electromagnetic waves transferring energy.

(4)

1

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2

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.....

.....

(Total for Question 4 = 11 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional guidance	Mark
3(a)	a description to include: (the prong makes the) air vibrate/oscillate (1) in the same direction as /parallel to the wave travels (1)	causes compressions and rarefactions in air transfers ke to air longitudinal credit can be given for a labelled diagram	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
3(b)	in this order infrared (wave) / IR (1) micro(wave) (1) radio (wave) (1) gamma (ray/wave)(1)	accept μ(wave) accept γ not X	(4) AO 1 1

Question Number	Answer	Additional guidance	Mark
3(c)	an explanation linking: (the colours have) different wavelengths (1) different wavelengths / colours travel at different speeds (1) so refract by different amounts (1)	allow the word frequencies for wavelengths for refract allow bend/change direction/follow different path	(3) AO 2 1

(Total for Question 3 = 9 marks)



Question number	Answer	Additional guidance	Mark
1(a)	uses data taken from x axis (1) 28(cm) (1)	award full marks for correct answer without working	(2) AO3

Question number	Answer	Additional guidance	Mark
1 b(i)	a description to include count the number of waves(1) (arriving/passing a point) in a specific time(1) use frequency = $\frac{\text{number of waves}}{\text{time}}$ (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
1 b(ii)	substitution (1) $1.5 = 0.7 \times \lambda$ rearrangement and evaluation $2.1(4) \text{ m}$	$\frac{1.5}{0.7}$ allow $\frac{0.7}{1.5}$ for 1 mark award full marks for correct answer without working. $\lambda = v/f$ scores 1 mark	(2) AO2

Question number	Answer	Additional guidance	Mark
1 b(iii)	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

Total marks for Question 1H = 9



Question number	Answer	Additional guidance	Mark
2(a)(i)	10(.0) (cm)		(1) AO1.1

Question number	Answer	Additional guidance	Mark
2(a)(ii)	12(.0) (cm)		(1) AO1.1

Question number	Answer	Additional guidance	Mark
2(a)(iii)	a description to include time a wave (crest) over a measured/fixed/known/stated distance (1) use (speed =) $\frac{\text{distance}}{\text{time}}$ (1) ALTERNATIVE METHOD (determine frequency by measuring) the time taken for a set number of waves to pass a point (1) use (speed =) $f \times \lambda$ (1)	measure how long it takes for a wave to travel a set distance measure distance travelled in a stated time (count) the number of waves in a specified time 'measure frequency' is not sufficient for this mark use (speed =) $f \times (0.)12$	(2) AO1.2

Question number	Answer	Additional guidance	Mark
2(b)(i)	any one from electromagnetic (wave) (1) ripples/water (waves) (1) (waves on a) string (1)	radio(waves) / microwaves / IR / infrared / visible / light / UV / ultraviolet / X(-ray) / gamma / γ allow sea / ocean / tidal wave ignore waves on a spring ignore earthquake or seismic P or S	(1) AO1.1

Question number	Answer	Additional guidance	Mark
2(b)(ii)	a description to include: (causes it to) vibrate/oscillate (1) perpendicular/at right angles to (the direction of travel of) the wave (1)	can be shown on diagram allow shake in this context allow double headed arrow(s) $\leftrightarrow$ or $\updownarrow$ centred on R on diagram (to show vibration) allow “up and down” or “forwards and backwards” for vibration perpendicular/at right angles to (direction of) energy transfer allow horizontal arrow(s) $\rightarrow$ or $\leftarrow$ centred on R on diagram (to show direction) allow side to side OR left to right OR in and out for perpendicular $\leftrightarrow$ centred on R scores 2 marks ignore possible eventual consequences e.g. rock breaks up / heats up	(2) AO2.1

Question number	Answer	Additional guidance	Mark
2(b)(iii)	calculation of distance from R to L (1) $(= 4500 \times 3.8)$ $= 17\,000 \text{ (m)}$ calculation of distance from X to R (1) $(= 20\,000 - 17\,000)$ $= 3000 \text{ (m)}$ ALTERNATIVE METHOD calculation of time X to L (1) $(20\,000 / 4500 =) 4.44$ calculation of distance from X to R (1) $(= (4.44 - 3.8) \times 4500)$ $= 3000 \text{ (m)}$	accept 17 100 allow ECF from MP1 accept numbers which round to 3000 e.g. 2900 accept numbers which round to 3000 e.g. 2900 award full marks for the correct answer without working	(2) AO2.1

Total for Question 2 = 9 marks



4(a)(i)	calculation of time of travel (1) $(120/330 =) 0.36(36)$ (s) substitution (1) $\frac{0.23 \times 100}{0.36(36)}$ evaluation (1) 63 (%)	ecf from MP1 for MP2&3 accept values that round to 64 or 63 accept values that round to 0.64 or 0.63 for 2 marks award full marks for the correct answer without working	(3) AO2
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	Answer	Mark
4(a)(ii)	C Increase the distance between L and M. A, B and D are incorrect as these would not improve the technicians' measurement	(1) AO3

	Answer	Additional guidance	Mark
4(b)	an explanation linking: (refraction caused by) change in speed (1) sound speeds up (when entering water) (1) light slows down (when entering water) (1)	allow 3 marks for sound speeds up and light slows down (when entering water) allow 2 marks for sound speeds up (when entering water) OR light slows down (when entering water) if no other marks scored allow 1 mark for description of any speed change (when entering water) if no other marks scored allow 1 mark for wavelength changes ignore references to transverse, longitudinal.	(3) AO1

	Answer	Additional guidance	Mark
4(c)	example 1 e-m wave (1) corresponding result of energy transfer (1) example 2 e-m wave (1) corresponding result of energy transfer (1)	e.g. radio waves: communication, oscillations (of electrons) in wires microwaves: cooking, communications and satellite transmissions, internal heating of body cells, increase KE/vibration of water molecules infrared: cooking, thermal imaging, optical fibres, television remote controls, skin burns ultraviolet: security marking, fluorescent lamps, detecting forged bank notes and disinfecting water, damage to surface cells and eyes, skin cancer x-rays: observing the internal structure of objects, airport security scanners and medical x-rays, mutation or damage to cells in the body, cancer gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment, mutation or damage to cells in the body, cancer additional effect for visible light scores 1 mark e.g. : including vision, photography and illumination	(4) AO1

Total for Question 4 = 11 marks.

	Answer	Mark
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