



GuideMyGrades

— YOUR GOALS. OUR EXPERTISE. —

EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Waves (4)

GCSE Physics (Foundation) Topic 4

8 questions · 84 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Foundation Tier, June 2018 - June 2025

 guidemygrades.com

 [@Guidemygrades](https://www.instagram.com/Guidemygrades)

 [@Guidemygrades](https://twitter.com/Guidemygrades)

 [@Guidemygrades](https://www.youtube.com/Guidemygrades)

 info@guidemygrades.com

 Piccadilly Business Centre, Unit C, Aldow Enterprise Park
Blackett Street, Manchester, M12 6AE

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
1. Q2	Paper 1 June 2018	8	4
2. Q2	Paper 1 June 2022	9	7
3. Q5	Paper 1 June 2023	10	10
4. Q5	Paper 1 June 2024	10	13
5. Q8	Paper 1 November 2021	11	17
6. Q10 <i>also Topic 7</i>	Paper 1 June 2023	11	20
7. Q6	Paper 1 November 2020	12	24
8. Q9	Paper 1 June 2025	13	28



QUESTIONS

8 questions · 84 marks · lowest tariff first



8-MARK QUESTIONS

1 question in this booklet



2 (a) A sound wave in air travels a distance of 220 m in a time of 0.70 s.

(i) State the equation linking speed, distance and time.

(1)

(ii) Calculate the speed of the sound wave in air.

(2)

wave speed = ... m/s

(b) Figure 2 shows water waves spreading out from a source.

A student measures the wavelength of the waves.

He uses a ruler to measure the distance from one crest to the next crest.

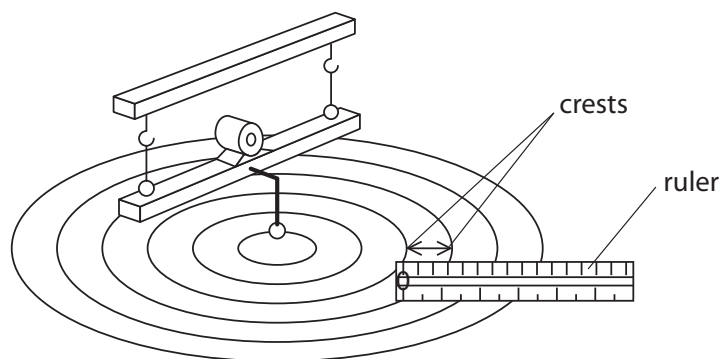


Figure 2

Explain how to improve the student's method for measuring the wavelength.

(2)

.....

.....

.....

.....

(c) Sound waves are longitudinal waves.

Water waves are transverse waves.

Describe the difference between longitudinal waves and transverse waves.

(3)

(Total for Question 2 = 8 marks)



9-MARK QUESTIONS

1 question in this booklet



2 This question is about waves.

(a) Figure 3 is a diagram of a **water wave** in a ripple tank.

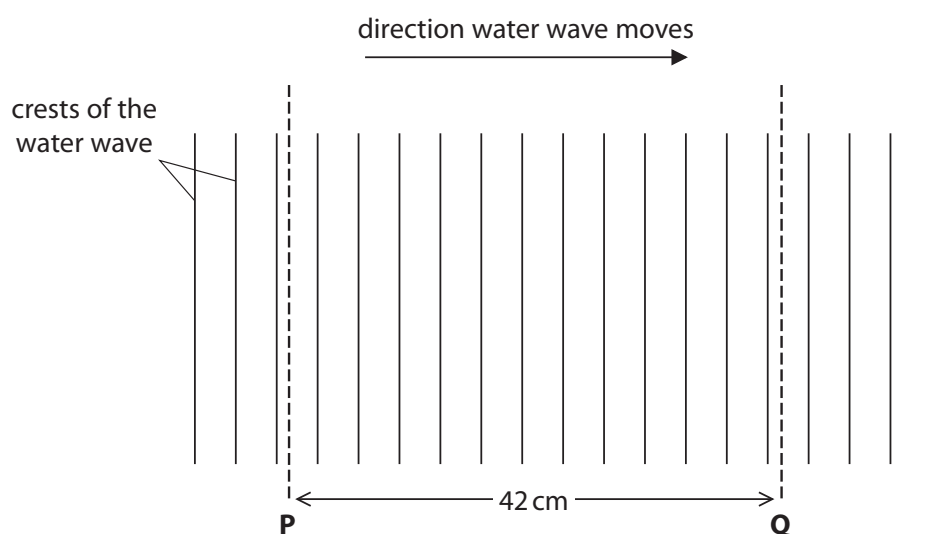


Figure 3

(i) State the number of crests of the wave between **P** and **Q**.

(1)

number of crests = ...

(ii) The distance between **P** and **Q** is 42 cm.

Calculate the wavelength of the water wave in Figure 3.

(2)

wavelength = ... cm

(iii) Describe how a student could determine the wave speed of the water wave in Figure 3.

(3)

.....

.....

.....

.....

.....

.....

(b) (i) Which row of the table is correct for **sound waves**?

(1)

	sound waves are	can sound waves transfer energy?
☐ A	longitudinal	yes
☐ B	longitudinal	no
☐ C	transverse	yes
☐ D	transverse	no

(ii) A sound wave has a frequency of 440 Hz and a wavelength of 0.75 m.

Calculate the wave speed of the sound wave.

(2)

wave speed = ... m/s

(Total for Question 2 = 9 marks)



10-MARK QUESTIONS

2 questions in this booklet



5 (a) Figure 7 shows a wave on the surface of water.

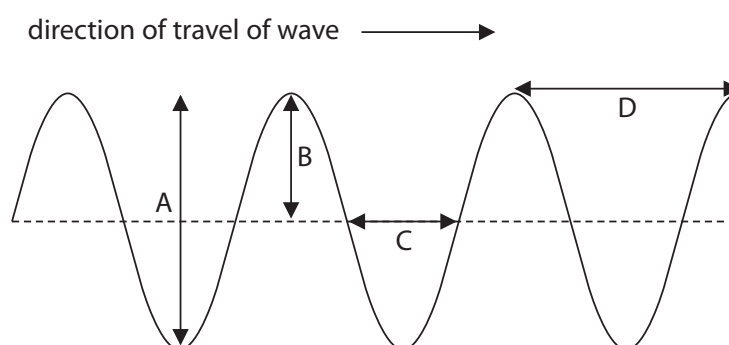


Figure 7

(i) Which of the arrowed lines shows the amplitude of the wave?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(ii) Explain why the wave shown in Figure 7 is a transverse wave.

(2)

.....

.....

.....

.....

(b) Figure 8 shows a ripple tank.

A screen is placed below the ripple tank.

The wave pattern produced by the ripples can be seen on the screen.

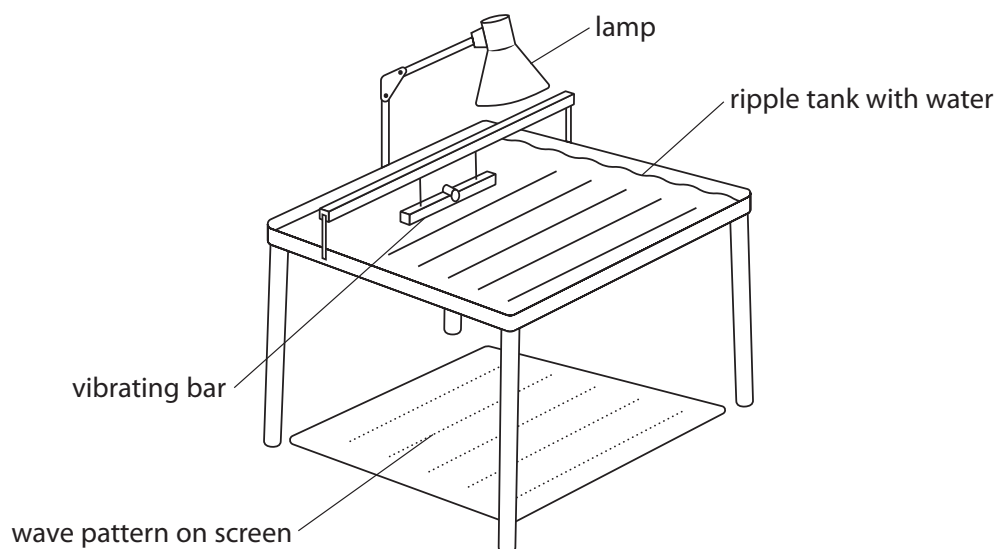


Figure 8

A student has a stop clock and a ruler.

(i) Describe how the student could measure the frequency of the ripples.

(2)

.....

.....

.....

.....

(ii) Describe how the student could measure the wavelength of the ripples.

(2)

.....

.....

.....

.....

- (c) In a swimming pool, a wave is produced with a wavelength of 4.0 m and a velocity of 0.8 m/s.

Calculate the frequency of the wave.

State the unit of frequency.

(3)

Use the equation

$$v = f \times \lambda$$

frequency of wave unit

(Total for Question 5 = 10 marks)



- 5 (a) A sound wave can transfer information across a room.

Which row of the table shows what else a sound wave can transfer?

(1)

	can transfer energy	can transfer air
☐ A	yes	yes
☐ B	yes	no
☐ C	no	yes
☐ D	no	no

- (b) Which of these always increases as a sound gets louder?

(1)

- ☐ **A** amplitude
☐ **B** frequency
☐ **C** speed
☐ **D** wavelength

- (c) The speed of a sound wave in air is 330 m/s.

The wavelength of this wave is 0.75 m.

Calculate the frequency of this wave.

Use the equation

$$v = f \times \lambda$$

(3)

frequency = ... Hz



(d) Figure 10 shows a water wave.

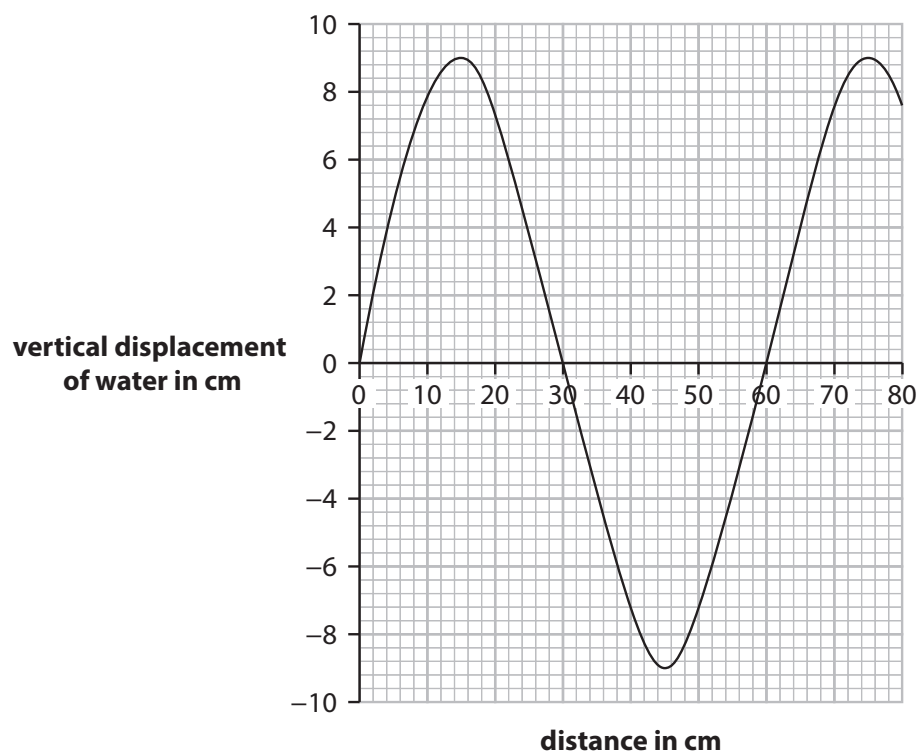


Figure 10

Which of these is the amplitude of the wave shown in Figure 10?

(1)

- ☐ A 9 cm
- ☐ B 18 cm
- ☐ C 30 cm
- ☐ D 60 cm

(e) Ripples travel out from the centre of a small circular pond to its edge.

(i) Describe how a student could determine the wave speed of the ripples.

(3)

(ii) Figure 11 shows a duck floating on the pond.

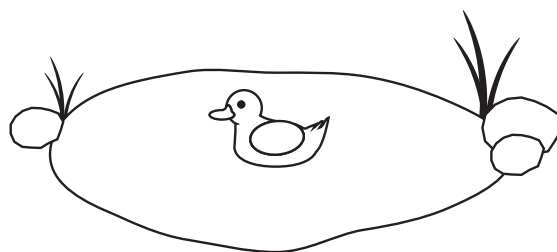


Figure 11

The ripples cause the duck to move.

Draw arrows on Figure 11 to show how the duck moves due to the ripples.

(1)

(Total for Question 5 = 10 marks)

11-MARK QUESTIONS

2 questions in this booklet



8 (a) Figure 12 shows part of a wave.

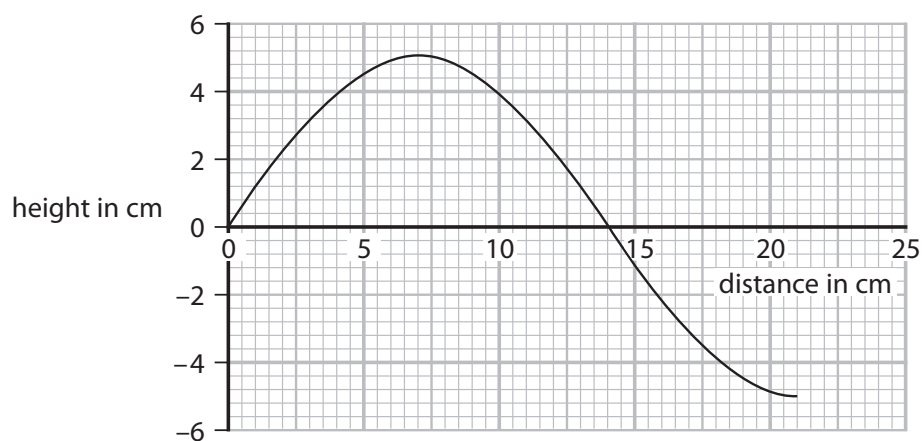


Figure 12

Use data from Figure 12 to calculate the wavelength of the wave.

(2)

wavelength = ... cm

- (b) (i) Figure 13 shows a student sitting on the shore of a lake watching ripples on the surface of the water moving past a toy boat.

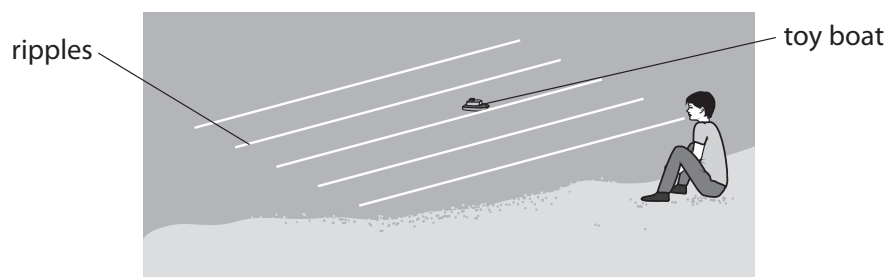


Figure 13

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)

(c) Sound waves travel at 330 m/s in air.

A student sees a flash of lightning.

The student hears the sound of thunder 4.0 s later.

Calculate the distance from the student to the flash of lightning.

Use the equation

$$x = v \times t$$

(2)

distance = ... m

(Total for Question 8 = 11 marks)



10 (a) Figure 19 shows two objects, **E** and **D**.

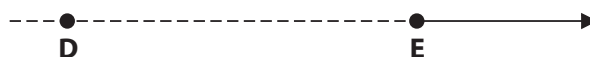


Figure 19

E emits a sound.

D detects the sound.

E is moving in the direction shown by the arrow, but **D** is not moving.

E emits a sound of wavelength 1.86 m.

D measures the wavelength of this sound as 1.98 m.

- (i) Calculate the difference between the wavelength that **E** emits and the wavelength that **D** detects.

(1)

difference in wavelength = ... m

- (ii) The velocity of sound is 330 m/s.

Calculate the velocity of **E**.

(2)

Use the equation

$$\text{velocity of E} = \frac{\text{velocity of sound} \times \text{difference in wavelength}}{\text{wavelength E emits}}$$

velocity of **E** = ... m/s



(b) The wavelength of light emitted from distant galaxies is different when the light is detected on Earth.

Explain how this difference in wavelength shows that the Universe is expanding. (2)

(c) CMB radiation provides evidence that the Universe had a definite beginning.

Use the table in Figure 20 to give a typical value for the wavelength of CMB radiation.

type of radiation	typical wavelength
gamma rays	$1.0 \times 10^{-12} \text{ m}$
X-rays	$3.0 \times 10^{-11} \text{ m}$
ultraviolet	200 nm
visible	600 nm
infrared	$4.0 \mu\text{m}$
microwaves	1.0 mm
radio waves	50 m

Figure 20 (2)

wavelength = ...

(d) During the evolution of a star, the nebula collapses and becomes a main sequence star.

(i) State what causes the nebula to collapse. (1)

(ii) Explain why the nebula stops collapsing as it becomes a main sequence star.

(3)

.....

.....

.....

.....

.....

.....

.....

(Total for Question 10 = 11 marks)

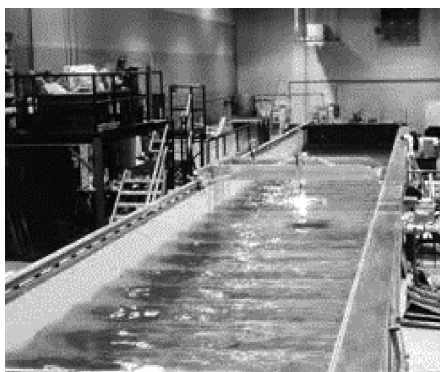


12-MARK QUESTIONS

1 question in this booklet



- 6 (a) Figure 11 shows a large tank of water.



© NOAA

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.

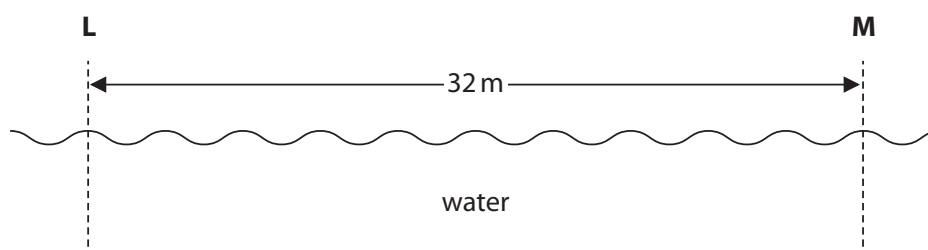


Figure 12

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

(b) Figure 13 shows part of the inside of the Earth below the surface.

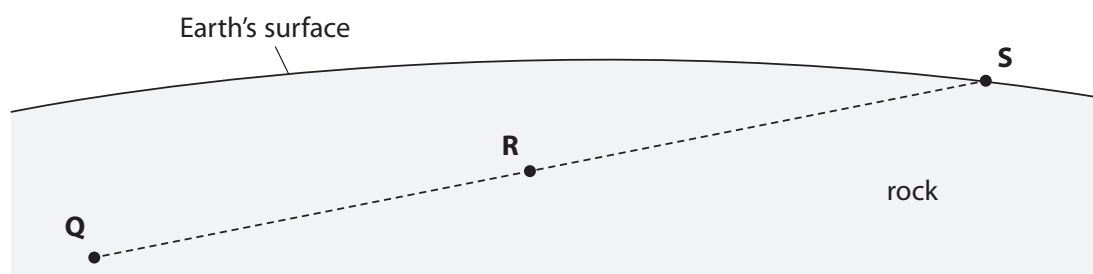


Figure 13

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

(c) A technician measured the frequency of the water wave in part (a) by counting how many waves passed him in 15 s.

Explain why this would **not** be a suitable method for measuring the frequency of the seismic wave in part (b)(ii).

(2)

.....

.....

.....

.....

(Total for Question 6 = 12 marks)



13-MARK QUESTIONS

1 question in this booklet



- 9 (a) Figure 16 is a diagram of part of a water wave.

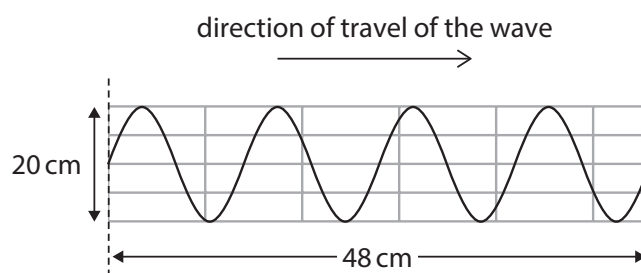


Figure 16

- (i) Use data from Figure 16 to determine the amplitude of the wave.

(1)

amplitude = ... cm

- (ii) Use data from Figure 16 to determine the wavelength of the wave.

(1)

wavelength = ... cm

- (iii) The water wave shown in Figure 16 is generated in a large tank.

A student observes the wave.

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

(2)

.....

.....

.....

.....

- (b) When an earthquake happens, waves are transmitted through the Earth. Figure 17 is a diagram of a part of the Earth's crust.

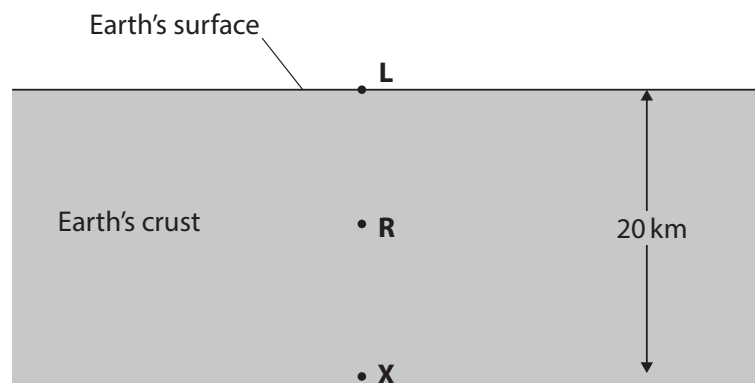


Figure 17

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 17. 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 17 to help your answer.

(2)

*(c) A scientist investigates a sample of an unknown radioactive material.

The scientist finds that the sample does **not** emit beta radiation.

The scientist sets up the experiment shown in Figure 18 and uses different absorbers to investigate alpha and gamma radiation.

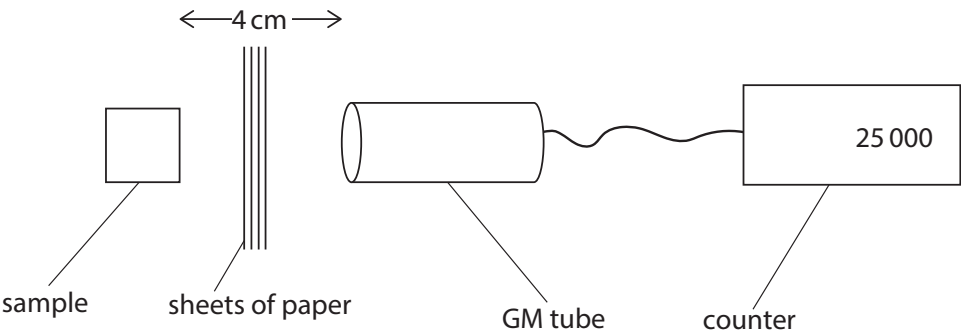


Figure 18

The results are shown in Figure 19.

The count rates are rounded to two significant figures.

The background radiation was 18 counts per minute (cpm).

absorber	count rate / cpm
none	33 000
4 sheets of paper	25 000
3 cm of lead	4 000

Figure 19

Discuss whether the sample emits alpha or gamma radiation or both.

Your answer should refer to

- the data shown in Figure 19
- how the data gives evidence for particular radiations.

(6)

Handwriting practice area with 20 horizontal dotted lines.

(Total for Question 9 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional guidance	Mark
2(a)(i)	recall speed = $\frac{\text{distance}}{\text{time}}$	accept any correct rearrangement or use of s, d and t may use v for speed and x for distance ignore use of triangles	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
2(a)(ii)	substitution (1) (speed) = $\frac{220}{0.7(0)}$ evaluation (1) 310 (m/s)	allow ecf from part (i) for this mark only allow any numbers that round to 310 e.g. 314 award full marks for the correct answer without working	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
2(b)	an explanation linking: • measure across more than one (wavelength) (1) • divide by the number of wavelengths (1)	use a more accurate device (finer divisions) use a camera / picture/strobe(light) (so the waves are not moving) count the number of wavelengths must be talking about measuring, NOT changing the wavelength etc.	(2) AO 3 3b

Question Number	Answer	Additional guidance	Mark
2(c)	a description to include: • longitudinal – (vibrations) parallel to (direction of travel) (1) • transverse – (vibrations) at right angles to (direction of travel) (1) • (connection between) direction of travel with (direction of) vibrations (1)	back and forth (oscillations)/ compressions or rarefactions up and down (oscillations)	(3) AO 1 1

(Total for Question 2 = 8 marks)



2(a)(i)	12		(1) AO1
---------	----	--	------------

	Answer	Additional guidance	Mark
2(a)(ii)	$\frac{42}{12}$ (1) 3.5 (cm) (1)	ecf from 2ai allow 0.035 for 1 mark award full marks for the correct answer without working	(2) AO1

	Answer	Additional guidance	Mark
2(a)(iii)	A description to include: either time a crest/ripple/wavefront (1) (moving) between P and Q (1) use (wave speed =) $\frac{\text{distance}}{\text{time}}$ (1) or count number of crests /ripples /wavefronts passing (eg P) (1) in a given time (to find f) (1) use $v = f \lambda$ (1)	allow 'how long it takes' allow 'wave' for crest allow – over the 42 cm over a (set) distance allow waves if no other mark scored measure frequency for 1 mark	(3) AO1

Question Number	Answer	Mark
2(b)(i)	A longitudinal yes B is not correct because sound waves can transfer energy C is not correct because sound waves are longitudinal D is not correct because sound waves are longitudinal and sound waves can transfer energy	(1) AO1

	Answer	Additional guidance	Mark
2(b)(ii)	select wave equation (1) $(v =) f \times \lambda$ evaluation (1) (speed =) 330 (m/s)	(speed =) freq(uency) × wavelength (speed =) 440 × 0.75 award full marks for the correct answer without working.	(2) AO2

(Total for Question 2 = 9 marks)

	Answer	Additional guidance	Mark
--	--------	---------------------	------

Question Number	Answer	Mark
5 (a)(i)	B the line shows the amplitude A is incorrect the line shows twice the amplitude C is incorrect the line shows half the wavelength D is incorrect the line shows the wavelength	(1) AO1

Question Number	Answer	Additional guidance	Mark
5 (a)(ii)	an explanation linking vibration/oscillation (1) perpendicular / at right angles / 90° (to the direction of travel of the wave/direction of energy transfer) (1)	accept up and down	(2) AO1

Question Number	Answer	Additional guidance	Mark
5 (b)(i)	a description including count the number of waves/ripples (1) (that pass a point) in a certain time (1) OR measure the time for a certain number of waves/ripples (1) use of $f = 1/T$ (1)	accept use of numerical values calculate the number of waves that pass the point in a second scores 2 marks	(2) AO1

Question Number	Answer	Additional guidance	Mark
5 (b)(ii)	a description including any two from the waves/ripples are made to look stationary (1) measure the distance across a number of waves/wave fronts/ripples (1) calculate the wavelength from the measurements (1)	using camera, video, strobe light, stroboscope, mobile, phone, photo(graph) accept measure the distance across a number of lines divide distance by the number of waves/ripples accept the idea of measuring the distance between one wave/ripple/line and another (successive) wave/ripple/line for 2 marks	(2) AO1

Question Number	Answer	Additional guidance	Mark
5 (c)	substitution (1) $0.8 = f \times 4.0$ rearrangement and evaluation (1) 0.2 (Hz) unit (1) Hz / s⁻¹ / per sec	(f =) $\frac{0.8}{4.0}$ allow correct substitution into seen incorrect rearrangement award 2 marks for the correct answer with no working accept hz or hertz independent mark accept recognisable spelling	(3) AO2

Total for question 5 = 10marks



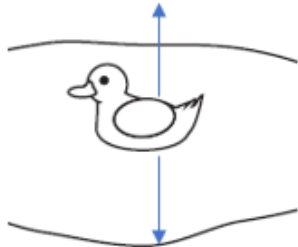
Question number	Answer	Additional guidance	Mark
5(a)	B A, C and D are incorrect because energy is transferred but air is not transferred		1 AO1.1

Question number	Answer	Additional guidance	Mark
5(b)	A amplitude B, C and D are incorrect because they are independent of intensity		1 AO1.1

Question number	Answer	Additional guidance	Mark
5(c)	substitution (1) $330 = f \times 0.75$ rearrangement (1) $(f =) \frac{330}{0.75}$ evaluation (1) $(f =) 440 \text{ (Hz)}$	substitution and rearrangement may be in either order. $f = \frac{v}{\lambda}$ if no other marks scored then award 1 mark for an answer that rounds to 0.0023 or 250 award full marks for the correct answer without working	3 AO2.1

Question number	Answer	Additional guidance	Mark
5(d)	A 9cm B is incorrect because amplitude is measured from zero to the peak displacement C is incorrect because this is half the wavelength D is incorrect because this is the wavelength.		1 AO2.1

Question number	Answer	Additional guidance	Mark
5(e)(i)	a description to include: use (wave) speed = $\frac{\text{distance}}{\text{time}}$ (1) find relevant time (1) measure specified distance (1)	use $v = f \times \lambda$ count number of waves in specified time width / radius / circumference of pond do not accept wavelength	3 AO2.2

Question number	Answer	Additional guidance	Mark
5(e)(ii)	arrow(s) up and/or down (1) 	judge by eye need not be on duck do not credit answers that imply duck (also) moves horizontally	1 AO1.1

Total for question 5 = 10 marks

Question number	Answer	Additional guidance	Mark
8(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
8 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
8 b(ii)	substitution (1) $1.5 = 0.7 \times \lambda$ rearrangement and evaluation 2.1(4) 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
8 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

Question number	Answer	Additional guidance	Mark
8 (c)	substitution $(x) = 330 \times 4.0$ evaluation 1300 (m)	accept 1320 (m) award full marks for correct answer without working.	(2) AO2

Total marks for Question 8 = 11



10 (a)(i)	$(1.98-1.86) = (+/-) 0.12$		(1) AO2
------------------	----------------------------	--	--------------------------

	Answer	Additional guidance	Mark
10(a)(ii)	$(\text{velocity}) = \frac{330 \times 0.12}{1.86} \quad (1)$ $(+/-) 21.3 \text{ (m/s)} \quad (1)$	ecf from 10ai accept numbers that round to 21 (m/s) award 1,2 marks for (i) and (ii) for the correct answer for (ii) even without working	(2) AO2

	Answer	Additional guidance	Mark
10(b)	(there is) an increase in wavelength (of light) (1) shows <u>galaxies</u> are moving away (from Earth) (1)	allow wavelength stretches allow red shift ignore shift to red end of spectrum ignore objects / stars / planets	(2) AO1

	Answer	Additional guidance	Mark
10(c)	$1(.0) \quad (1)$ mm (1)	Allow values between 1.0 and 1.9 allow $1 \times 10^{-3} \text{ m}$ or 0.001 m for 2 marks if nothing in answer line, credit answer indicated in table	(2) AO3

	Answer	Additional guidance	Mark
10 d(i)	gravitational attraction / gravitational force (causing collapse) (1)	allow gravity ignore weight ignore gpe ignore gravitational energy	(1) AO1

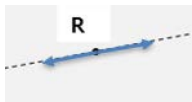
	Answer	Additional guidance	Mark
10 d(ii)	An explanation linking: (gravity causing) increase in temperature (1) (until hot enough for) fusion (1) (until) balance (between gravity and fusion/thermal) (1)	 allow increase in pressure/density hydrogen to form helium allow nuclear reactions ignore fission allow equilibrium / counteracts	(3) AO1

Total for Question 10 = 11 marks.

Question number	Answer	Additional guidance	Mark
6(a)(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
6(a)(ii)	<u>32</u> (1) number of wavelengths <u>32</u> 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
6(a)(iii)	substitution (1) <u>12</u> 15 evaluation (1) 0.8(0) (Hz)	award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
6(b)(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
6(b)(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)

Question number	Answer	Additional guidance	Mark
6(c)	an explanation to include two from: waves cannot be seen (on arrival) (1) person will need another way of detecting the waves (1) (as) a person cannot count to 12 in one second / at a rate of 12 per second (1) <u>frequency</u> too high (1)	idea of coming too fast to count / easy to lose count	(2)

(Total for Question 6 = 12 marks)

9(a)(i)	10(.0) (cm)		(1) AO1.1
----------------	-------------	--	----------------------------

	Answer	Additional guidance	Mark
9(a)(ii)	12(.0) (cm)		(1) AO1.1

	Answer	Additional guidance	Mark
9(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

	Answer	Additional guidance	Mark
9(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

	Answer	Additional guidance	Mark
9(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	Indicative content	Mark
*9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • count rate goes down when you put paper in the way (data processed) • indicates alpha being absorbed • alpha not very penetrating • count rate goes down (a lot) when the lead is in the way (data processed) • indicates gamma being absorbed • count rate above background • so some gamma still getting through (data processed) • overall conclusion alpha and gamma radiation emitters present	(6) AO2

AO targeting: 6 marks AO2 strand 2

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)



Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> Isolated facts (uses limited observational evidence from the table)	<u>Possible candidate responses</u> alpha stopped by paper count rate goes down, with paper
Level 2	3–4	<u>Additional guidance</u> uses limited observational evidence from the table AND links to some scientific knowledge about the radiations	<u>Possible candidate responses</u> count rate goes down, with paper AND links to alpha being absorbed OR count rate goes down with lead AND links to gamma being absorbed
Level 3	5–6	<u>Additional guidance</u> uses extensive observational evidence from the table AND links to detailed scientific knowledge about the radiations WITH some synthesis / making logical connections between observations argued from the table.	<u>Possible candidate responses</u> count rate goes down, with paper linked to alpha being absorbed AND count rate goes down (a lot) when the lead is in the way, linked to gamma being absorbed

Total for Question 9 = 13 marks

