

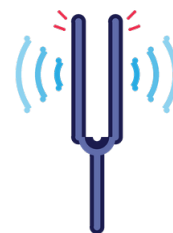
GCSE PHYSICS

Sound and Seismic Waves

AQA-style Topic Practice

Based on AQA GCSE Physics (8463)

Tier: Higher



Name _____

Date _____

Instructions

- Use black ink or black ball-point pen.
- Answer all questions in the spaces provided.
- Do all rough work in this booklet.
- In all calculations, show clearly how you work out your answer.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 54.
- You are expected to use a calculator where appropriate.
- Write clearly, use scientific terms correctly and organise your answers logically.

For marking

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

These are original practice questions written in the style of AQA GCSE Physics (8463). They are not official AQA examination questions and are not endorsed by AQA.

Q1.

This question is about sound waves and seismic waves.

- (a) What type of wave is a sound wave travelling through air?

Tick (✓) **one** box.

Electromagnetic

☐

Longitudinal

☐

Transverse

☐

(1)

- (b) What is the normal range of human hearing?

Tick (✓) **one** box.

2 Hz to 2 kHz

☐

20 Hz to 20 kHz

☐

200 Hz to 200 kHz

☐

20 kHz to 200 kHz

☐

(1)

- (c) Draw **one** line from each type of wave to its description.

Type of wave	Description
	A longitudinal seismic wave that can travel through solids and liquids
Ultrasound	A transverse wave that can travel through a vacuum
P-wave	A transverse seismic wave that cannot travel through liquids
S-wave	A sound wave with a frequency above the upper limit of human hearing

(2)

- (d) Describe how the particles of air move when a sound wave travels through the air.

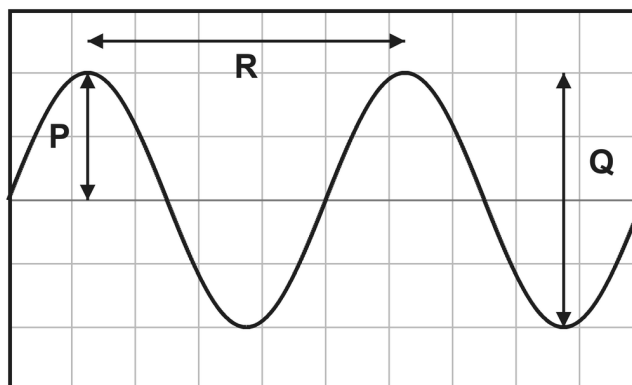
(2)

Q2.

A microphone is connected to an oscilloscope.

Figure 1 shows the trace on the oscilloscope when a sound is detected by the microphone.

Figure 1



- (a) Which arrow shows the amplitude of the wave?

Tick (✓) **one** box.

P ☐

Q ☐

R ☐

(1)

- (b) Each horizontal square on the screen represents 0.2 ms.

Determine the period of the wave.

Use Figure 1.

Period = _____ ms

(1)

- (c) Calculate the frequency of the sound.

Use the Physics Equations Sheet.

Frequency = _____ Hz

(3)

- (d) The sound is made louder. The frequency of the sound does not change.

Describe how the trace in Figure 1 would change.

(2)

Q3.

This question is about wave speed, frequency and wavelength.

- (a) Dolphins communicate using sound waves that travel through sea water.

A dolphin produces a sound with a frequency of 12 kHz.

The speed of sound in sea water is 1500 m/s.

Calculate the wavelength of the sound in sea water.

Use the Physics Equations Sheet.

Wavelength = _____ m

(3)

- (b) Some of the sound passes from the sea water into the air.

The speed of sound in air is 340 m/s.

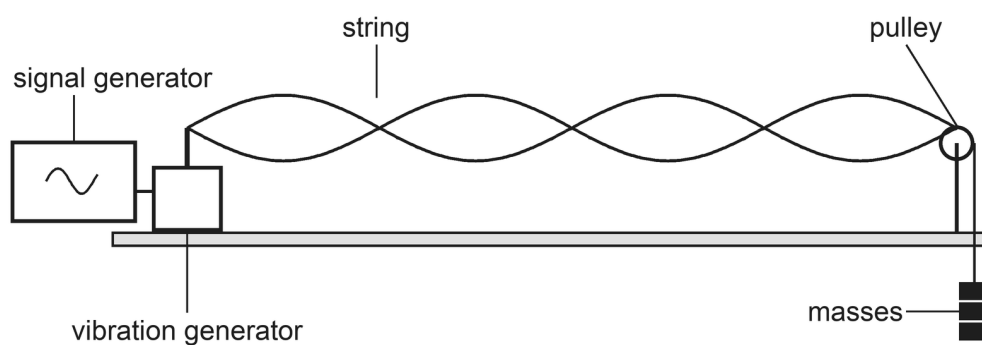
Explain what happens to the wavelength of the sound when it passes into the air.

(2)

- (c) A student investigated waves on a stretched string.

Figure 2 shows the equipment.

Figure 2



The frequency of the signal generator was 60 Hz.

Each loop on the string is half a wavelength long.

The student measured the total length of the four loops. The total length was 1.20 m.

Determine the wavelength of the waves on the string.

Wavelength = _____ m

(1)

- (d) Calculate the speed of the waves on the string.

Use the Physics Equations Sheet.

Wave speed = _____ m/s

(2)

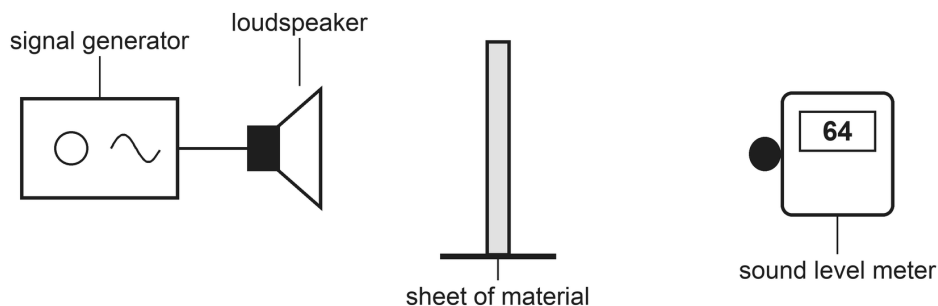
- (e) Give **one** reason why the student measured the total length of four loops, rather than the length of one loop.

(1)

Q4.

A student investigated how well different materials reduce the sound that passes through them.

Figure 3 shows the equipment.

Figure 3

The student placed a sheet of each material between the loudspeaker and the sound level meter.

The student recorded the reading on the sound level meter three times for each material.

Table 1 shows the results.

Table 1

Material	Reading 1 in dB	Reading 2 in dB	Reading 3 in dB	Mean in dB
No material	72	71	73	72
Cardboard	64	65	63	64
Wood	57	59	58	58
Foam	51	60	52	X

(a) What was the independent variable in this investigation?

Tick (✓) **one** box.

The number of readings taken ☐

The reading on the sound level meter ☐

The type of material ☐

(1)

- (b) Give **two** variables the student should have kept the same.

1 _____

2 _____

(2)

- (c) One of the readings for foam is anomalous.

Calculate the mean reading X for foam.

Do not include the anomalous reading in your calculation.

$X =$ _____ dB

(2)

- (d) Explain why the reading with the sheet of foam is lower than the reading with no material.

(2)

- (e) The student concluded:

'Foam is the best of these materials for reducing sound.'

Give **one** reason why this conclusion may not be valid.

(1)

Q5.

The human ear detects sound waves.

- (a) Describe how sound waves in the air cause the sensation of sound.

(3)

- (b) A bat produces sound waves with a frequency of 50 kHz.

Explain why a human cannot hear the sound produced by the bat.

(2)

- (c) Sound waves can travel through solids.

Give **one** example, other than the ear, of sound waves causing vibrations in a solid.

(1)

Q6.

Ultrasound is used to check steel castings for hidden flaws.

A transducer on the surface of a steel casting sends a pulse of ultrasound into the steel. The transducer also detects any reflected pulses.

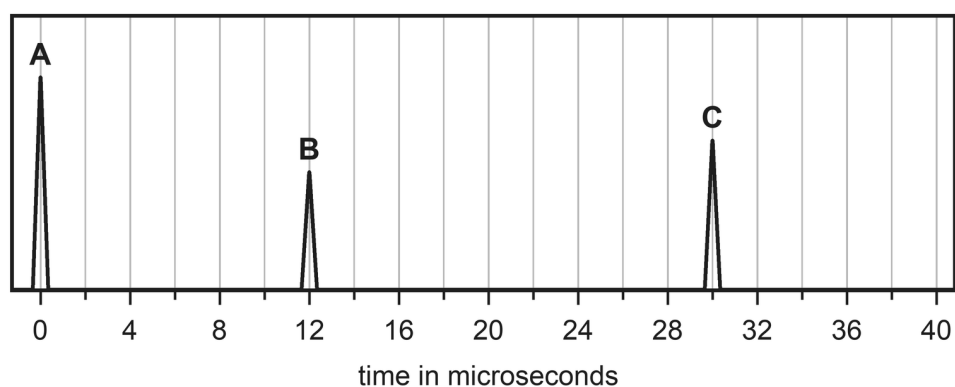
Figure 4 shows the pulses detected by the transducer.

Pulse A is the pulse sent into the steel.

Pulse B is reflected from a flaw.

Pulse C is reflected from the far side of the casting.

Figure 4



- (a) Explain why part of the ultrasound pulse is reflected at the flaw.

(2)

- (b) Determine the time between pulse A being sent and pulse B being detected.

Use Figure 4.

Time = _____ microseconds

(1)

- (c) The speed of ultrasound in steel is 6000 m/s.

Calculate the depth of the flaw below the surface of the casting.

Depth = _____ m

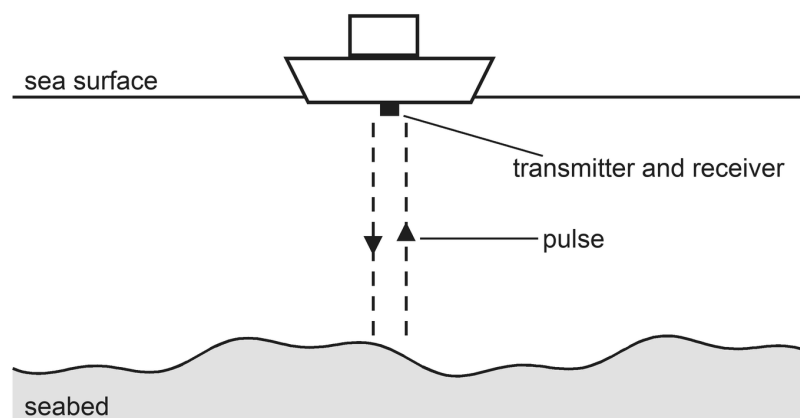
(3)

Q7.

A ship uses echo sounding to measure the depth of the sea.

Figure 5 shows a pulse of sound travelling from the ship to the seabed and back.

Figure 5



- (a) The depth of the sea below the ship is 450 m.

The speed of sound in sea water is 1500 m/s.

Calculate the time between the pulse being sent and the echo being detected.

Time = _____ s

(3)

- (b) The ship sails over a shoal of fish.

Explain how the time taken for the echo to be detected changes.

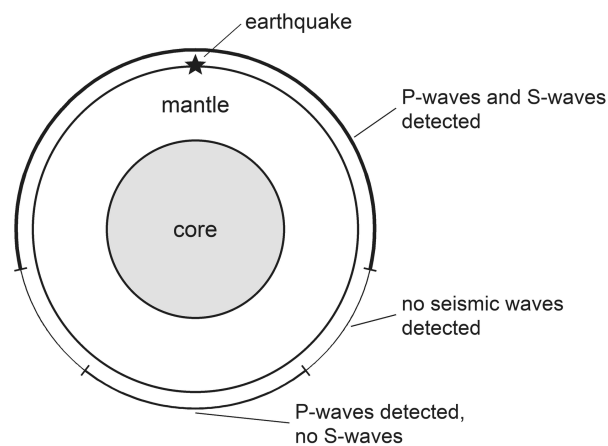
(2)

Q8.

Earthquakes produce seismic waves. P-waves and S-waves are two types of seismic wave.

Figure 6 shows where the P-waves and S-waves from one earthquake are detected at the Earth's surface. The pattern is the same on both sides of the Earth.

Figure 6



- (a) Give **one** difference between P-waves and S-waves.

(1)

- (b) Explain how the pattern shown in Figure 6 provides evidence about the structure of the Earth's core.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(6)

END OF QUESTIONS

Mark scheme

General marking guidance: credit any answer that is scientifically correct and conveys the same meaning as the answer given, unless the extra information says otherwise. Words in brackets are not needed to gain the mark.

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
1(a)	Longitudinal	if more than one box is ticked, award no mark	1	AO1 (1) 4.6.1.1
1(b)	20 Hz to 20 kHz	if more than one box is ticked, award no mark	1	AO1 (1) 4.6.1.4
1(c)	Ultrasound → a sound wave with a frequency above the upper limit of human hearing P-wave → a longitudinal seismic wave that can travel through solids and liquids S-wave → a transverse seismic wave that cannot travel through liquids	award 2 marks for three correct lines award 1 mark for one or two correct lines if more than one line is drawn from a type of wave, none of those lines score	2	AO1 (2) 4.6.1.5
1(d)	the particles vibrate / move backwards and forwards (about a fixed position) parallel to the direction the wave travels / the direction of energy transfer	allow "the particles do not travel with the wave (from the source to the listener)" for the first marking point allow "the particles form compressions and rarefactions" for the first marking point do not accept "the particles move up and down"	2	AO1 (2) 4.6.1.1
Total			6	

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
2(a)	P	if more than one box is ticked, award no mark	1	AO1 (1) 4.6.1.2
2(b)	1.0 (ms)	one complete wave covers 5 squares: $5 \times 0.2 = 1.0$ ms allow 1 (ms) allow 0.001 s if the unit is changed	1	AO2 (1) 4.6.1.2 · WS 3.5
2(c)	1.0 ms = 0.0010 s frequency = $1 / 0.0010$ frequency = 1000 (Hz)	the equation period = $1 /$ frequency is selected from the Physics Equations Sheet and rearranged award 3 marks for a correct answer with no working allow ecf from 2(b) award 2 marks for 1 (Hz), from using the period in ms allow 1 kHz	3	AO2 (3) 4.6.1.2 · WS 3.3
2(d)	the waves would be taller / the amplitude would be greater the number of waves on the screen would not change / the period (or the spacing of the waves) would stay the same	allow "the peaks would be higher and the troughs lower" for the first marking point do not accept "the waves would be longer"	2	AO1 (1) AO2 (1) 4.6.1.2
Total			7	

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
3(a)	$1500 = 12\,000 \times \lambda$ $\lambda = 1500 / 12\,000$ $\lambda = 0.125 \text{ (m)}$	the first marking point is for selecting wave speed = frequency $\times$ wavelength and substituting award 3 marks for a correct answer with no working allow 0.13 (m) award 2 marks for 125 (m), from using 12 for the frequency	3	AO2 (3) 4.6.1.2 · WS 3.3
3(b)	the frequency of the sound stays the same (the speed decreases) so the wavelength decreases	the second marking point requires a decrease in wavelength allow the wavelength becomes shorter allow a calculated wavelength in air of about 0.028 m for the second marking point	2	AO1 (1) AO2 (1) 4.6.1.2
3(c)	0.60 (m)	one loop = $1.20 / 4 = 0.30 \text{ m}$, so wavelength = $2 \times 0.30 \text{ m}$ allow 0.6 (m)	1	AO2 (1) 4.6.1.2 · RPA 8
3(d)	wave speed = 60×0.60 wave speed = 36 (m/s)	award 2 marks for a correct answer with no working allow ecf from 3(c) award 1 mark for 18 (m/s), from using one loop as the wavelength	2	AO2 (2) 4.6.1.2 · RPA 8 · WS 3.3
3(e)	measuring a longer length gives a smaller (percentage) uncertainty (in the wavelength)	allow "one loop is too short to measure accurately" allow "any error in measuring is shared between four loops" ignore "to make it more accurate" without a reason	1	AO3 (1) RPA 8 · WS 2.7
Total			9	

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
4(a)	The type of material	if more than one box is ticked, award no mark	1	AO2 (1) WS 2.2
4(b)	any two from: - the distance between the loudspeaker and the sound level meter - the thickness of each sheet (of material) - the size / area of each sheet - the frequency / volume (setting) of the sound from the loudspeaker - the position of the sheet between the loudspeaker and the meter	ignore "the type of material" ignore "the same equipment"	2	AO2 (2) WS 2.2
4(c)	60 (dB) not included $(51 + 52) / 2 = 51.5$ (dB)	award 2 marks for 51.5 with no working allow 52 dB if the answer is rounded to the nearest whole decibel award 1 mark for 54.3 (dB), from including the anomalous reading	2	AO2 (1) AO3 (1) WS 3.3
4(d)	the foam absorbs (some of the energy of) the sound waves so less sound is transmitted (through the sheet) to the sound level meter	allow the foam reflects some of the sound for the first marking point do not accept "the foam blocks the sound" alone	2	AO1 (1) AO2 (1) 4.6.1.3
4(e)	any one from: - the sheets may not have been the same thickness - only one frequency of sound was tested - the readings for foam were less consistent / one reading was anomalous	allow the sheets may not have been the same size ignore "the student should repeat the investigation" without a reason	1	AO3 (1) WS 2.7
Total			8	

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
5(a)	the sound waves make the ear drum vibrate the vibrations are passed on to other parts of the ear (the small bones and the cochlea) the vibration of these parts causes the sensation of sound / electrical signals sent to the brain	allow ossicles / hammer, anvil and stirrup for the small bones the marking points must be in a sensible sequence	3	AO1 (3) 4.6.1.4
5(b)	50 kHz is above 20 kHz (the upper limit of human hearing) / it is ultrasound the conversion of sound waves into vibrations of solids in the ear only works over a limited range of frequencies	allow "the ear drum and other parts of the ear do not respond to frequencies this high" for the second marking point do not accept "the sound is too quiet"	2	AO1 (2) 4.6.1.4
5(c)	any one from: • sound making a window / wall / door vibrate • sound making the diaphragm of a microphone vibrate • sound making a table / desk vibrate	allow any correct example of sound waves causing a solid object to vibrate ignore examples of sound travelling through a liquid or gas only	1	AO2 (1) 4.6.1.4
Total			6	

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
6(a)	the flaw is a boundary between two different media / materials ultrasound is partially reflected at a boundary between two different media	allow "the flaw contains air, which is different from steel" for the first marking point do not accept "the flaw blocks the ultrasound"	2	AO1 (2) 4.6.1.5
6(b)	12 (microseconds)	allow 1.2×10^{-5} s if the unit is changed	1	AO3 (1) 4.6.1.5 · WS 3.5
6(c)	distance travelled = $6000 \times 0.000\ 012$ distance travelled = 0.072 (m) depth = $0.072 / 2 = 0.036$ (m)	award 3 marks for a correct answer with no working allow ecf from 6(b) award 2 marks for 0.072 (m), from not halving allow 36 mm if the unit is changed	3	AO2 (3) 4.6.1.5 · WS 3.3
Total			6	

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
7(a)	distance travelled = $2 \times 450 = 900$ (m) $900 = 1500 \times \text{time}$ time = 0.60 (s)	award 3 marks for a correct answer with no working allow 0.6 (s) award 2 marks for 0.30 (s), from not doubling the depth	3	AO2 (3) 4.6.1.5 · WS 3.3
7(b)	the time decreases because the pulse is reflected from the fish, which are closer to the ship than the seabed / the pulse travels a shorter distance	do not award the second marking point without the first	2	AO2 (1) AO3 (1) 4.6.1.5 · WS 3.5
Total			5	

Question 8(b) is marked by levels of response. Decide which level best describes the answer, then award a mark within the level.

Level	Marks	Description
Level 3	5–6	A detailed and coherent explanation. The absence of S-waves on the far side of the Earth is linked to S-waves not travelling through liquids, giving a liquid outer core, and the region with no P-waves is linked to P-waves being refracted where they enter and leave the core.
Level 2	3–4	One of the two patterns is explained in terms of the properties of the waves, or both patterns are described with only partial explanation. Some points may be missing or not linked.
Level 1	1–2	Simple statements about P-waves, S-waves or the core, with little or no link to the pattern in Figure 6.
	0	No relevant content.

Qu.	Answers	Extra information	Mark	AO / Spec. ref.
8(a)	any one from: - P-waves are longitudinal and S-waves are transverse - P-waves can travel through liquids but S-waves cannot	allow P-waves travel faster than S-waves the answer must compare both types of wave	1	AO1 (1) 4.6.1.5
8(b)	Indicative content: - P-waves are longitudinal; S-waves are transverse - P-waves can travel through solids and liquids - S-waves can travel through solids but not through liquids - near the earthquake, both types of wave travel through the (solid) mantle only, so both are detected - no S-waves are detected on the far side of the Earth, because their paths to it pass through the core - so part of the core (the outer core) must be liquid - P-waves are detected on the far side, so they can travel through the core - P-waves change speed at the boundary of the core, so they are refracted (change direction) - this leaves a region where no P-waves are detected (a shadow zone) - where each region starts and ends can be used to work out the size of the core - this is evidence about a part of the Earth that cannot be observed directly	the indicative content is not a checklist; other scientifically correct points can receive credit to reach Level 3, both the S-wave pattern (liquid outer core) and the P-wave pattern (refraction at the core boundary) must be explained	6	AO1 (2) AO3 (4) 4.6.1.5 · WS 1.1
Total			7	

Assessment objectives in this paper

Assessment objective	Marks
AO1 knowledge and understanding	20 (37%)
AO2 applying knowledge and understanding	25 (46%)
AO3 analysing, interpreting and evaluating	9 (17%)
Total	54