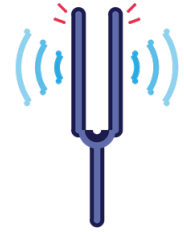


GCSE (9–1) PHYSICS

Sound and Seismic Waves

Pearson Edexcel-style Topic Practice

Based on Pearson Edexcel GCSE Physics (1PH0)



Name _____

Date _____

Instructions

- Answer all questions.
- Write your answers in the spaces provided.
- Show all working in calculations. A calculator may be used.
- For multiple-choice questions, put a cross in the box next to your answer.

Information

- The marks for each question are shown in brackets.
- The total mark for this paper is 50.

These are original practice questions written in the style of Pearson Edexcel GCSE Physics. They are not official Pearson examination questions.

Total marks

50

1 Sound is a type of wave.

(a) Which of these is the range of frequencies that a person with normal hearing can hear?

- A ☐ 2 Hz to 2000 Hz
- B ☐ 20 Hz to 2000 Hz
- C ☐ 20 Hz to 20 000 Hz
- D ☐ 200 Hz to 200 000 Hz

(1)

(b) Which of these frequencies is an example of infrasound?

- A ☐ 5 Hz
- B ☐ 50 Hz
- C ☐ 5000 Hz
- D ☐ 50 000 Hz

(1)

(c) Which of these uses infrasound?

- A ☐ exploring the structure of the Earth's core
- B ☐ producing an image of a fetus in the womb
- C ☐ measuring the depth of the sea from a ship
- D ☐ measuring the speed of sound in air using echoes

(1)

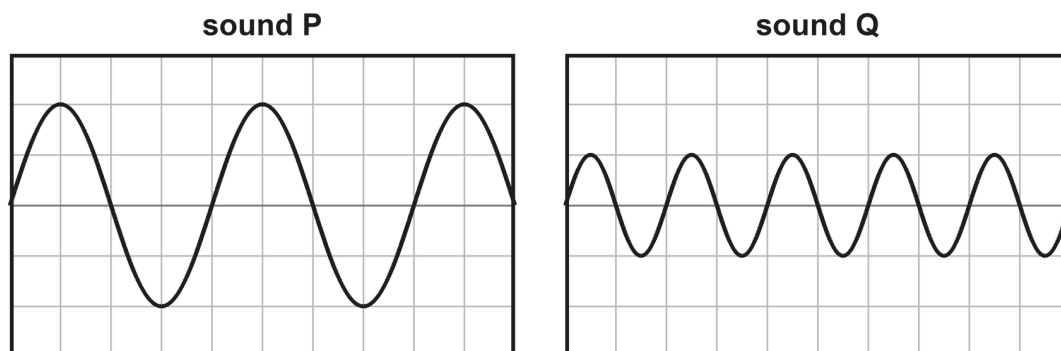
(d) Which statement about sound waves is correct?

- A ☐ Sound waves can travel through a vacuum.
- B ☐ Sound waves are longitudinal waves.
- C ☐ The air particles move from the source of a sound to the listener.
- D ☐ Sound waves travel faster in air than in water.

(1)

(Total for Question 1 = 4 marks)

- 2 A microphone is connected to an oscilloscope. The diagram shows the traces produced by two sounds, P and Q. The oscilloscope settings are the same for both sounds.



Oscilloscope traces of sound P and sound Q.

- (a) State which sound, P or Q, is louder. Give a reason for your answer.

.....
.....

(2)

- (b) Compare the pitch of sound Q with the pitch of sound P. Give a reason for your answer.

.....
.....

(2)

- (c) Each horizontal square on the oscilloscope represents 0.5 ms. 1 ms = 0.001 s.

Calculate the frequency of sound P. Use the equation

frequency = $1 \div \text{time period}$

Answer Hz

(3)

(Total for Question 2 = 7 marks)

- 3 A ship's engine makes a sound of frequency 400 Hz. The sound travels through the air and through the sea water.

speed of sound in air = 340 m/s

speed of sound in sea water = 1500 m/s

- (a) Calculate the wavelength of the sound in air.

Answer m

(2)

- (b) State the frequency of the sound when it travels through the sea water.

.....

(1)

- (c) Calculate the wavelength of the sound in the sea water.

Answer m

(2)

(Total for Question 3 = 5 marks)

- 4 A music practice room is next to a school corridor.

- (a) The walls of the practice room are covered with soft foam panels.

Explain how the foam panels reduce the echoes heard in the practice room.

.....

.....

(2)

- (b) Music from the practice room can be heard in the corridor, even when the wooden door is closed.

Describe how the sound passes through the closed door into the corridor.

.....

.....

.....

.....

.....

(3)

(Total for Question 4 = 5 marks)

- 5** The human ear converts sound waves into electrical signals.

- (a) Describe how sound waves arriving at the ear lead to electrical signals being sent to the brain.

.....

.....

.....

.....

.....

.....

.....

(4)

- (b) A dog whistle produces a sound of frequency 25 000 Hz. A dog can hear the whistle but a person cannot.

Explain why the person cannot hear the whistle.

.....

.....

(2)

- (c) Suggest why an older adult may not hear a high-pitched sound that a teenager can hear.

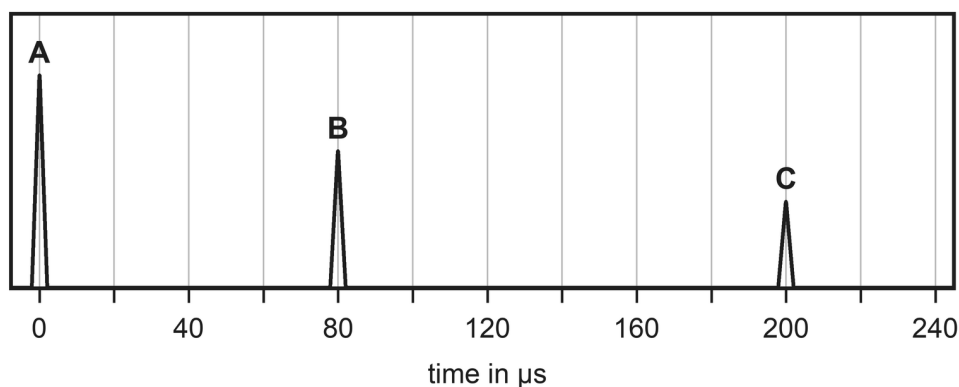
.....

(1)

(Total for Question 5 = 7 marks)

- 6 Ultrasound is used to produce images of a fetus in the womb. A transducer sends a pulse of ultrasound into the body and detects the pulses that are reflected back.

The diagram shows the pulses on a screen. Pulse A is the pulse sent into the body. Pulse B is reflected from the front of the fetus's head. Pulse C is reflected from the back of the fetus's head.



The pulses shown on the screen.

- (a) Explain why some of the ultrasound is reflected at the front of the fetus's head.

.....

.....

(2)

- (b) Use the diagram to find the time between pulse A being sent and pulse B being detected.

Answer μs

(1)

- (c) The speed of ultrasound in soft tissue is 1500 m/s.

Calculate the distance from the transducer to the front of the fetus's head. $1 \mu\text{s} = 0.000\,001 \text{ s}$.

Answer m

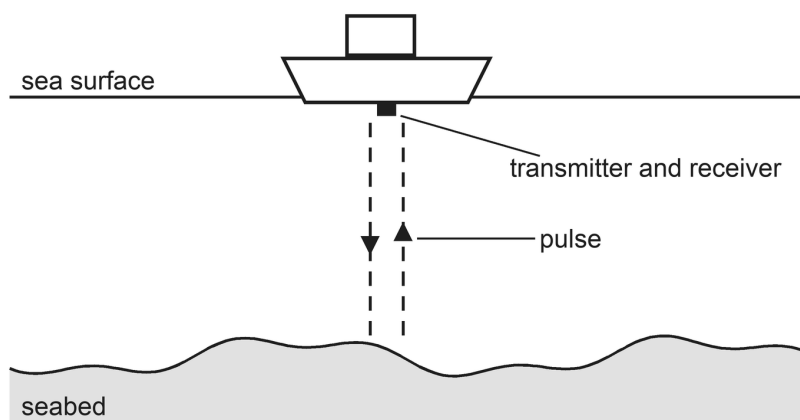
(3)

- (d) Give one reason why ultrasound is used to scan a fetus instead of X-rays.

(1)

(Total for Question 6 = 7 marks)

- 7 A ship uses echo sounding to measure the depth of the sea. The diagram shows a pulse of sound travelling from the ship to the seabed and back.



A ship using echo sounding.

- (a) The pulse is detected 0.36 s after it is sent. The speed of sound in sea water is 1500 m/s. Calculate the depth of the sea below the ship.

Answer m

(3)

- (b) The ship moves on. For a short time, the pulses are detected 0.12 s after they are sent. The time then returns to about 0.36 s.

Suggest an explanation for this change.

(2)

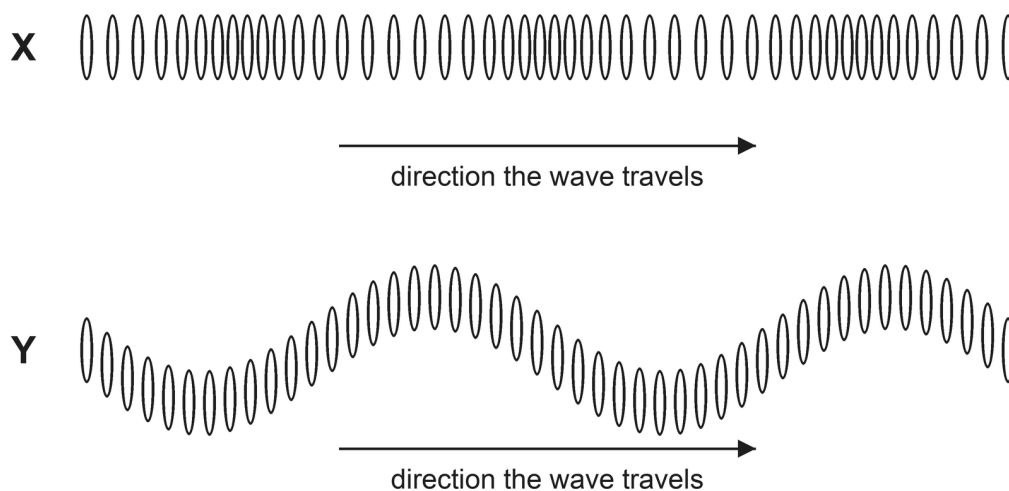
- (c) Explain why the depth of the sea is half of the distance calculated from the speed of the pulse and the time taken.

(1)

(Total for Question 7 = 6 marks)

- 8 Earthquakes produce seismic waves. Some seismic waves are longitudinal and some are transverse.

A student uses a long spring to model two seismic waves, X and Y.



A long spring showing two waves, X and Y.

- (a) State which wave, X or Y, is longitudinal.

(1)

- (b) Describe how the coils of the spring move in a longitudinal wave, compared with the direction the wave travels.

(1)

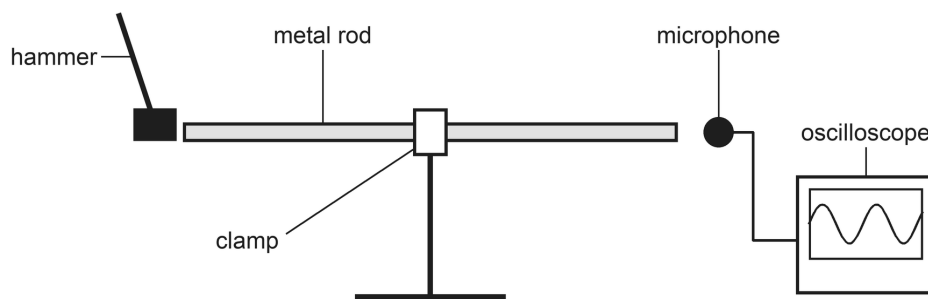
- (c) Describe how the coils of the spring move in a transverse wave, compared with the direction the wave travels.

(1)

(Total for Question 8 = 3 marks)

- 9 A student investigates the speed of sound in a metal rod.

The rod is held by a clamp at its centre. The student strikes one end of the rod with a hammer. A microphone connected to an oscilloscope is used to measure the frequency of the sound produced.



Apparatus used to investigate the speed of sound in a metal rod.

- (a) The wavelength of the sound in the rod is twice the length of the rod.

State the other measurement the student must make to find the wavelength of the sound.

(1)

- (b) The student strikes the rod three times. The table shows the frequency measured each time.

	Reading 1	Reading 2	Reading 3
Frequency in Hz	2510	2490	2530

Calculate the mean frequency.

Answer Hz

(1)

- (c) The rod is 1.00 m long.

Calculate the speed of sound in the rod.

Answer m/s

(2)

- (d) Another student suggests finding the frequency by listening to the sound instead of using the microphone and oscilloscope.

Explain why the microphone and oscilloscope are more suitable.

.....

.....

(2)

(Total for Question 9 = 6 marks)

TOTAL FOR PAPER = 50 MARKS

Mark scheme

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

Question number	Answer	Additional guidance	Mark
1(a)	C 20 Hz to 20 000 Hz	The only correct answer is C. A and B are not correct because the upper limit of normal hearing is 20 000 Hz, not 2000 Hz. D is not correct because the lower limit is 20 Hz and sounds above 20 000 Hz are ultrasound.	(1)
1(b)	A 5 Hz	The only correct answer is A. B and C are not correct because they are within the range of human hearing. D is not correct because it is above 20 000 Hz, so it is ultrasound.	(1)
1(c)	A exploring the structure of the Earth's core	The only correct answer is A. B and C are not correct because foetal scanning and sonar use ultrasound. D is not correct because the echoes used are sounds in the range of human hearing.	(1)
1(d)	B Sound waves are longitudinal waves.	The only correct answer is B. A is not correct because sound needs a medium; there are no particles in a vacuum to pass on the vibrations. C is not correct because the particles vibrate about fixed positions; only the wave (energy) travels. D is not correct because sound usually travels more slowly in air than in water.	(1)

(Total for Question 1 = 4 marks)

Question number	Answer	Additional guidance	Mark
2(a)	• P (1) • (the trace of P has a) larger amplitude / taller waves (1)	Do not award the second marking point without the first. Accept "the peaks of P are higher". Do not accept "P has more waves" or "P has longer waves".	(2)

Question number	Answer	Additional guidance	Mark
2(b)	- Q has a higher pitch (than P) (1) (because) Q has a higher frequency / more waves on the screen / a shorter time period (1)	Accept the converse for P. Do not award the second marking point without the first. Ignore references to amplitude.	(2)
2(c)	- time period = $4 \times 0.5 = 2$ (ms) (1) $2 \text{ ms} = 0.002$ (s) (1) - frequency = $1 \div 0.002 = 500$ (Hz) (1)	Award full marks for a correct answer with no working. One complete wave of P covers 4 squares. ECF: award the third marking point for $1 \div$ their time period in seconds. Award 2 marks for 0.5 (Hz), from using the time period in ms.	(3)

(Total for Question 2 = 7 marks)

Question number	Answer	Additional guidance	Mark
3(a)	- wavelength = speed $\div$ frequency / $340 \div 400$ (1) 0.85 (m) (1)	Award full marks for a correct answer with no working. Accept $340 = 400 \times \lambda$ for the first marking point.	(2)
3(b)	400 Hz	Accept "the same as in air" / "it does not change".	(1)
3(c)	$1500 \div 400$ (1) 3.75 (m) (1)	Award full marks for a correct answer with no working. Accept 3.8 (m). ECF: use their frequency from (b).	(2)

(Total for Question 3 = 5 marks)

Question number	Answer	Additional guidance	Mark
4(a)	An explanation linking: - the foam absorbs (the energy of the) sound (1) - so less sound is reflected (from the walls) (1)	Accept "the soft surface does not reflect sound well" for the second marking point. Do not accept "the foam blocks the sound" alone.	(2)
4(b)	A description including: - the sound waves / vibrations in the air make the door vibrate (1) - the vibrations are transmitted / pass through the (solid) door (1) - the door makes the air in the corridor vibrate, producing sound waves (1)	Accept "the particles of the door vibrate" for the first or second marking point. Do not accept "the air travels through the door".	(3)

(Total for Question 4 = 5 marks)

Question number	Answer	Additional guidance	Mark
5(a)	A description including four from: - the sound waves make the ear drum vibrate (1) - the (three) small bones pass the vibrations on (to the inner ear) (1) - the vibrations pass into the liquid in the cochlea (1) (the vibrations move) the hair cells (in the cochlea) (1) (the hair cells produce) electrical signals, which travel along the (auditory) nerve to the brain (1)	The marking points may be given in any order, but the sequence must not be wrong. Accept ossicles / hammer, anvil and stirrup for the small bones. Accept "the sound is collected by the outer ear and passes down the ear canal" as one of the four marking points.	(4)
5(b)	An explanation linking: 25 000 Hz is above the upper limit of normal human hearing / above 20 000 Hz / it is ultrasound (1) - the ear only responds to a limited range of frequencies / the processes that convert sound waves into vibrations and then into electrical signals only work over a limited frequency range (1)	Accept "the parts of the ear do not respond to frequencies this high" for the second marking point. Do not accept "the sound is too quiet" for either marking point. Do not accept "the brain cannot process the frequency".	(2)
5(c)	The upper frequency limit of hearing (generally) decreases with age	Accept "the range of hearing gets narrower with age". Accept a correct reference to damage to the ear (for example to hair cells in the cochlea), but it is not needed for the mark.	(1)

(Total for Question 5 = 7 marks)

Question number	Answer	Additional guidance	Mark
6(a)	An explanation linking: - there is a boundary between two different (types of) tissue / media (1) (ultrasound is) partially reflected at a boundary / the rest is transmitted (1)	Accept "the ultrasound passes from one material into another". Do not accept "the fetus's head blocks the ultrasound".	(2)
6(b)	80 (μ s)	Accept 8.0×10^{-5} s.	(1)
6(c)	$80 \mu\text{s} = 0.000\ 08\ \text{s} / 8.0 \times 10^{-5}\ \text{s}$ (1) - distance travelled = $1500 \times 0.000\ 08 = 0.12\ (\text{m})$ (1) - distance to the head = $0.12 \div 2 = 0.06\ (\text{m})$ (1)	Award full marks for a correct answer with no working. ECF: use their time from (b). Award 2 marks for 0.12 (m), from not halving. Accept 6 cm if the unit is changed.	(3)

Question number	Answer	Additional guidance	Mark
6(d)	Ultrasound is non-ionising / does not damage cells or DNA / is safe (for the mother and fetus)	Accept "X-rays are ionising / can damage cells". Accept "ultrasound can show soft tissue". Ignore "ultrasound is cheaper".	(1)

(Total for Question 6 = 7 marks)

Question number	Answer	Additional guidance	Mark
7(a)	- distance travelled = 1500×0.36 (1) = 540 (m) (1) - depth = $540 \div 2 = 270$ (m) (1)	Award full marks for a correct answer with no working. Award 2 marks for 540 (m), from not halving. Accept $\frac{1}{2} \times 1500 \times 0.36$ for the first marking point.	(3)
7(b)	A suggestion linking: - the pulses were reflected from an object above the seabed / a shoal of fish / a shipwreck / a submarine (1) - the object is closer to the ship (than the seabed), so the echo returns sooner / the pulse travels a shorter distance (1)	Accept the object is 90 m below the ship for the second marking point. Accept "the seabed is shallower here" for the first marking point only if linked to a shorter distance.	(2)
7(c)	The pulse travels to the seabed and back (so the distance travelled is twice the depth)	Accept "the pulse travels the depth twice".	(1)

(Total for Question 7 = 6 marks)

Question number	Answer	Additional guidance	Mark
8(a)	X	The coils of X are bunched together and spread out along the direction the wave travels (compressions and rarefactions).	(1)
8(b)	(The coils move) backwards and forwards parallel to the direction the wave travels	Accept "in the same direction as / along the direction the wave travels". Do not accept "the coils move along with the wave".	(1)
8(c)	(The coils move) at right angles / perpendicular to the direction the wave travels	Accept "up and down (or side to side) while the wave travels along the spring".	(1)

(Total for Question 8 = 3 marks)

Question number	Answer	Additional guidance	Mark
9(a)	The length of the rod	Accept "measure the rod with a metre rule / tape measure". Ignore references to measuring the frequency.	(1)
9(b)	2510 (Hz)	$(2510 + 2490 + 2530) \div 3 = 2510$ Do not accept an answer that is not a mean of all three readings.	(1)
9(c)	- wavelength = $2 \times 1.00 = 2.00$ (m) (1) - speed = $2510 \times 2.00 = 5020$ (m/s) (1)	Award full marks for a correct answer with no working. ECF: use their mean frequency from (b). Accept 5000 (m/s) (2 significant figures). Award 1 mark for 2510 (m/s), from using the length of the rod as the wavelength.	(2)
9(d)	An explanation linking: - the ear cannot measure a frequency / the frequency is too high to count the vibrations (1) - the oscilloscope shows the waveform, so the time period can be measured and the frequency calculated / gives a value that can be read accurately (1)	Accept "listening only tells you the pitch, not a value of frequency" for the first marking point. Accept "the sound only lasts a short time" for the first marking point. Ignore "the oscilloscope is more accurate" without a reason.	(2)

(Total for Question 9 = 6 marks)