

Sound Waves *(Physics only)*

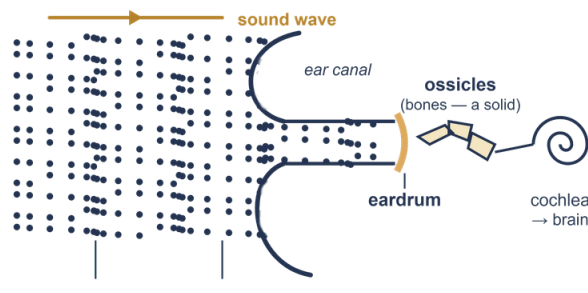
Sound is a longitudinal wave

Sound is a _____ wave: the particles vibrate _____ to the direction of energy transfer. It is a series of _____ and _____.

THE RANGE OF HUMAN HEARING



How we hear a sound



DESCRIBE HOW WE HEAR A SOUND

1

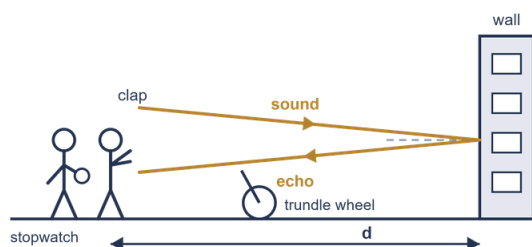
2

3

4

- ☐ sound wave ☐ compression ☐ rarefaction ☐ force
☐ eardrum ☐ vibrations ☐ solids

Measuring the speed of sound in air — the echo method



$$\text{speed} = (\text{distance} \times 2) \div \text{time}$$

Why $\times 2$? The sound goes to the wall and back.

METHOD

- 1 Measure the distance from the person to the wall with a _____.
- 2 One person makes a loud sound, e.g. a clap. It _____ off the wall and returns.
- 3 Another person measures the _____ from the clap to the echo with a stopwatch. Repeat and find the mean.

time for echo (ms)	trial 1	trial 2	trial 3	mean
d = 85 m	490	515	495	

Mean time in seconds = _____ s Distance there and back = _____ m

Speed of sound = _____ m/s

Exam-style question

Two students want to measure the speed of sound in air. They stand in front of a tall building.

- (a) Describe how they could use an echo to measure the speed of sound. Include the measurements they take and the equipment they use. [4]
- (b) They stand **99 m** from the building. The echo returns **600 ms** after the clap. Calculate the speed of sound. [3]
- (c) Explain why humans cannot hear sounds with a frequency above 20 000 Hz. [2]

[Total: 9 marks]

ANSWER

Ultrasound *(Physics only · Higher)*

What is ultrasound?

Definition

KEY WORDS TO USE

☐ frequency ☐ higher than ☐ upper limit ☐ human hearing ☐ 20 000 Hz

FILL IN THE LIMITS OF HUMAN HEARING



How does an ultrasound device work?

3 marks

1

2

3

KEY WORDS TO USE

☐ pulse
☐ emitted
☐ reflected
☐ boundary
☐ different densities
☐ time
☐ speed

Distance to the boundary

In words

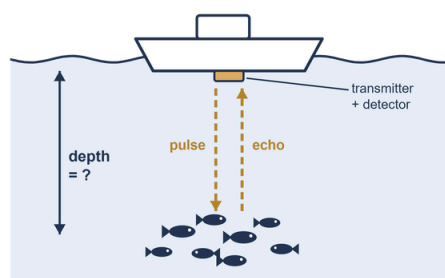
 ÷ 2

In symbols

 ÷ 2

Why ÷ 2?

Example — how deep is the shoal of fish?



A boat sends a pulse of ultrasound down into the sea. The pulse reflects off a shoal of fish and is detected **400 ms** after it was sent. The speed of ultrasound in water is **1500 m/s**. Calculate how deep the shoal of fish is.

Careful: change ms to s first. 400 ms is the time **down to the fish and back up**.

1 Time in seconds =

 s 2 Speed =

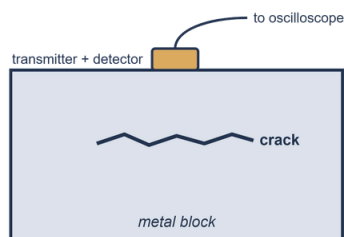
 m/s

3 $s = v \times t \div 2 =$

 4 Depth =

 m

Exam-style question — finding a crack in a metal block

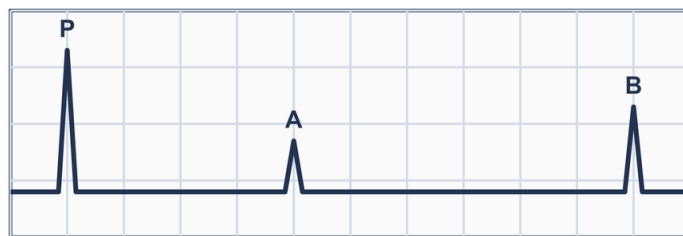


Ultrasound is used to check a metal block for cracks. The oscilloscope trace shows three pulses, **P**, **A** and **B**. The speed of ultrasound in the metal is **5000 m/s**.

- (a) Identify each pulse P, A and B. Give a reason for each. [3]
 (b) Explain how the pulses are used to find the distance to the crack. [3]
 (c) Calculate the distance from the top of the block to the crack, in metres. [3]

[Total: 9 marks]

time-base: 1 division = 10 μ s



ANSWER
