CAMBRIDGE IGCSE™ PHYSICS 0625 | TOPICS 3.1 · 3.4

FREE SAMPLE

Waves & Sound

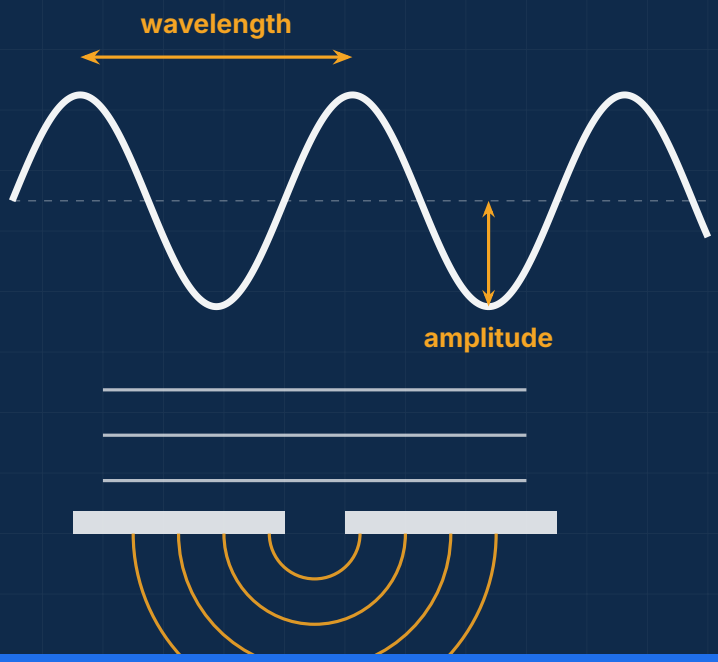
Free sample: knowledge organiser and Worksheet 1 with answers

Wave features | $v = f\lambda$ | Transverse & longitudinal | Ripple tank | Diffraction

Sound & echoes | Ultrasound | Exam-style questions

$$v = f\lambda$$

20 Hz – 20 kHz



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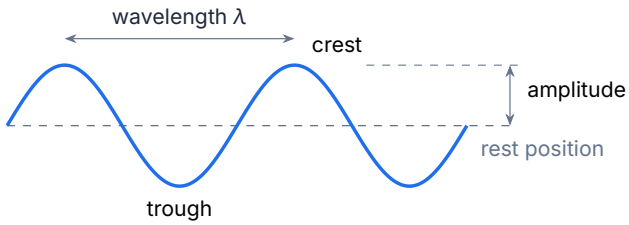
Physics that finally makes sense.

Free sample

Full pack: worksheets, exam paper, answers

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Describing a wave



Waves transfer **energy**, not matter.

Wavelength: crest to next crest.

Amplitude: rest position to crest.

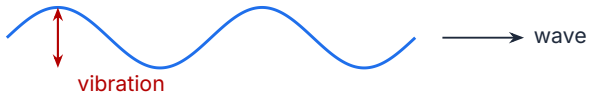
Frequency: waves per second (Hz).

Wavefront: line along one crest.

Wave speed $v = f\lambda$ (m/s = Hz × m)

Transverse and longitudinal waves

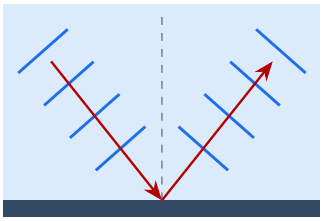
Transverse: vibrations at **right angles** to the direction the wave travels. Examples: light and all electromagnetic waves, water waves, seismic S-waves.



Longitudinal: vibrations **parallel** to the direction the wave travels. Examples: sound, seismic P-waves. SUPPLEMENT C compression, R rarefaction.

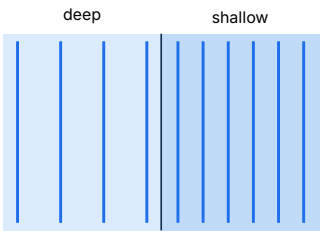


Ripple tank: reflection, refraction and diffraction



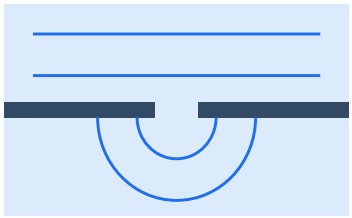
reflection

angle of incidence = angle of reflection



refraction

slower in shallow water: λ shorter, f the same



diffraction

SUPPLEMENT most spreading when the gap ≈ λ

Sound

Made by **vibrating** objects; sound is a **longitudinal** wave.

Needs a **medium**: it cannot travel through a vacuum.

Speed in air: about **330–350 m/s**.

Human hearing: **20 Hz to 20 000 Hz**.

Larger **amplitude** → louder. Higher **frequency** → higher pitch.

An **echo** is a reflected sound wave.

Ultrasound and speed of sound

Ultrasound: sound above **20 kHz**.

SUPPLEMENT Uses: checking materials for cracks (non-destructive testing), medical scanning of soft tissue, sonar.

SUPPLEMENT Echo distance: $d = \frac{v \times t}{2}$ (the pulse goes there **and back**).

SUPPLEMENT Sound is usually fastest in **solids**, slower in liquids, slowest in gases.

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Describing waves

WORKSHEET 1
CORE

You will: describe what waves transfer, name and measure the features of a wave, and use $v = f\lambda$ to calculate wave speed, frequency and wavelength.

1 CORE A cork floats on a pond. Water waves pass the cork from left to right.

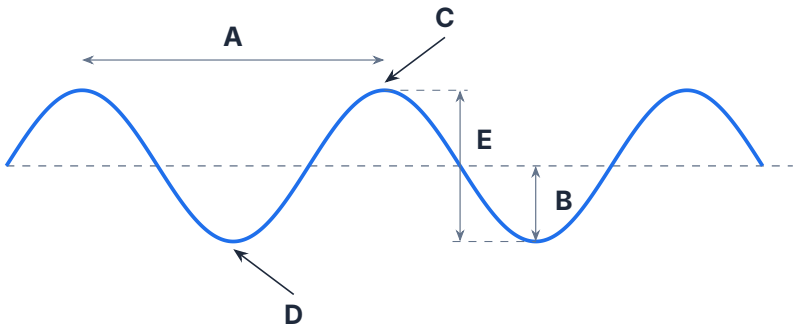
(a) Describe how the cork moves as the waves pass. [1]

.....

(b) The cork does not travel across the pond with the waves. State what the waves transfer across the pond. [1]

.....

2 CORE The diagram shows a wave on a rope at one instant.



(a) Name the features labelled A, B, C and D. [4]

A _____ B _____

C _____ D _____

(b) A student says that E is the amplitude of the wave. Explain why she is wrong. [1]

.....

3 CORE A student ties one end of a long rope to a post. She moves the other end up and down three times every second, making waves on the rope.

(a) State the frequency of the waves. [1]

frequency = _____

(b) She now moves her hand further up and down, at the same rate. State which feature of the waves changes. [1]

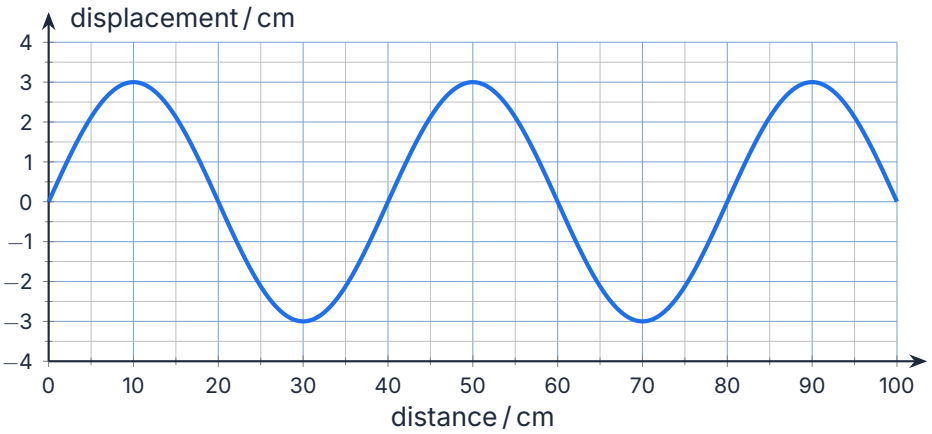
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(c) She now moves her hand up and down more quickly. The speed of the waves on the rope stays the same. State what happens to the wavelength. [1]

.....

4 CORE The graph shows the shape of a water wave at one instant. The frequency of the wave is 2.0 Hz.



(a) Use the graph to find the amplitude of the wave. [1]

amplitude = _____

(b) Use the graph to find the wavelength of the wave. [1]

wavelength = _____

(c) Calculate the speed of the wave in m/s. [2]

.....

speed = _____

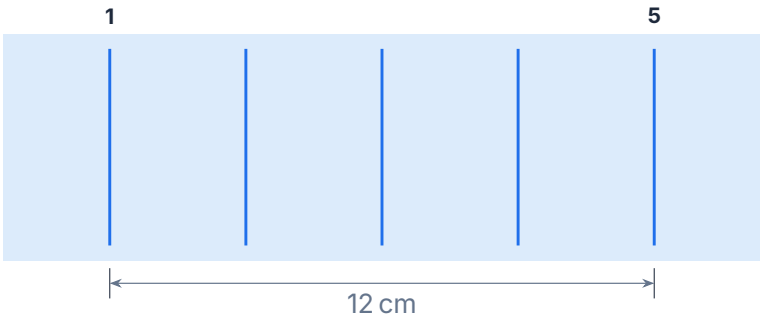
5 CORE Complete the table. Use $v = f\lambda$. [4]

Wave	Frequency	Wavelength	Speed
sound in air	170 Hz	2.0 m	_____
ripples on a pond	_____	0.060 m	0.30 m/s
seismic wave in rock	2.0 Hz	_____	6000 m/s
ultrasound in water	2.0 MHz	_____	1500 m/s

Exam tip Convert to base units before you use $v = f\lambda$: kHz → Hz (×1000), MHz → Hz ($\times 10^6$), cm → m (÷100). The answer is then in m/s, Hz or m.

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6 CORE The diagram shows straight wavefronts in a ripple tank, seen from above. The waves are moving to the right.



(a) State what is meant by a **wavefront**. [1]

.....

(b) The distance from wavefront 1 to wavefront 5 is 12 cm. Calculate the wavelength. [2]

.....

wavelength = _____

(c) The speed of the waves is 18 cm/s. Calculate the frequency of the waves. [2]

.....

frequency = _____

7 CORE A student counts 12 waves passing a post in 4.0 s. The distance from the first crest to the sixth crest is 15 m.

(a) Calculate the frequency of the waves. [1]

frequency = _____

(b) Calculate the wavelength of the waves. [2]

.....

wavelength = _____

(c) Calculate the speed of the waves. [1]

speed = _____

8 CORE The frequency of a wave is doubled. Its speed stays the same. State and explain what happens to its wavelength. [2]

.....

.....

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Answers: Worksheet 1

Mark codes: B1 independent mark C1 method mark, implied by a correct final answer A1 correct answer with unit. Accept answers that round correctly; allow error carried forward from earlier parts.

Worksheet 1 – Describing waves

1 **(a)** It moves up and down as each wave passes, but stays in about the same place. B1
(b) Energy. B1

2 **(a)** A wavelength B1; B amplitude B1; C crest (peak) B1; D trough B1
(b) E is the height from a trough to a crest, which is **twice** the amplitude. The amplitude is measured from the rest position to a crest (or trough). B1

3 **(a)** **3 Hz** B1
(b) The amplitude (it increases). B1
(c) The wavelength decreases (gets shorter). B1

4 **(a)** **3.0 cm** B1
(b) **40 cm** B1
(c) $v = f\lambda = 2.0 \times 0.40$ C1 $=$ **0.80 m/s** A1

5 Sound: $170 \times 2.0 =$ **340 m/s** B1
Ripples: $0.30 \div 0.060 =$ **5.0 Hz** B1
Seismic: $6000 \div 2.0 =$ **3000 m** B1
Ultrasound: $1500 \div (2.0 \times 10^{6}) =$ **7.5×10^{-4} m** (0.75 mm) B1

6 **(a)** A line joining points on the same crest (points that are in step). B1
(b) Wavefront 1 to wavefront 5 is 4 wavelengths: $12 \div 4$ C1 $=$ **3.0 cm** A1
(c) $f = v/\lambda = 18 \div 3.0$ C1 $=$ **6.0 Hz** A1

7 **(a)** $12 \div 4.0 =$ **3.0 Hz** B1
(b) First to sixth crest is 5 wavelengths C1;
$15 \div 5 =$ **3.0 m** A1
(c) $3.0 \times 3.0 =$ **9.0 m/s** B1

8 The wavelength halves B1; $v = f\lambda$ stays the same, so if f doubles λ must halve. B1

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Get the full pack

You have just used Worksheet 1. The full Waves & Sound pack contains:

- **Worksheet 1:** Describing waves
- **Worksheet 2:** Transverse and longitudinal waves
- **Worksheet 3:** Reflection, refraction and diffraction
- **Worksheet 4:** Sound
- **Multiple-choice practice:** 10 Paper 1/2-style questions
- **Practical skills:** an Alternative to Practical (Paper 6) question
- **Exam-style questions:** a 40-mark paper
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