

3.1 General properties of waves

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS wave • transverse wave • longitudinal wave • wavelength • amplitude

Objective

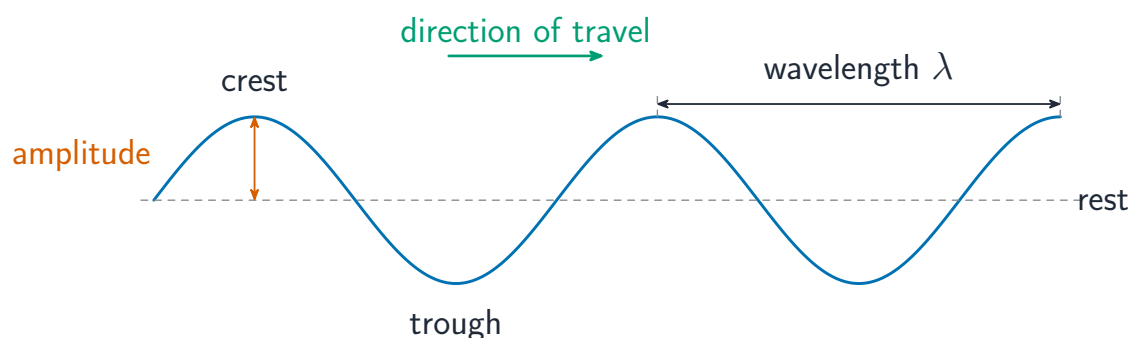
Build the skills to answer exam questions on the **general properties of waves** — the wave terms, the **wave equation** $v = f\lambda$, transverse vs longitudinal, and reflection/refraction/**diffraction**.

You must be able to:

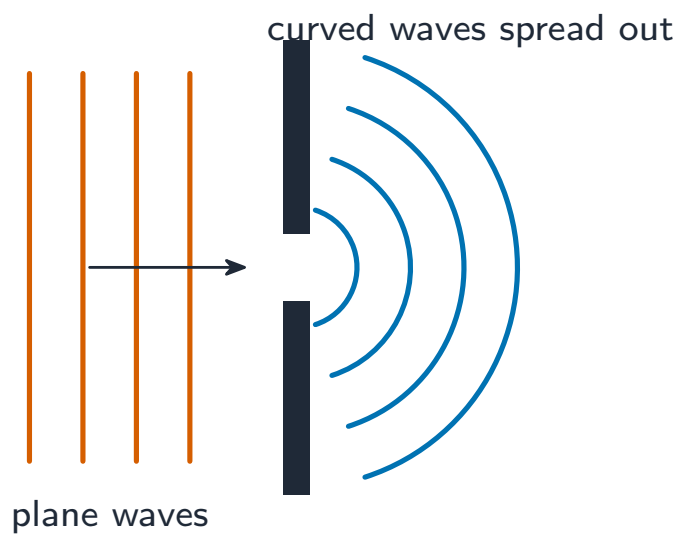
- use $v = f\lambda$ and define wavelength, frequency, amplitude
- distinguish transverse and longitudinal waves
- describe reflection, refraction and diffraction

1 Key knowledge and worked examples

■ The wave equation



Wavelength = crest-to-crest distance; amplitude = rest-to-crest height; $v = f\lambda$



Diffraction is strongest when the gap is about one wavelength wide

Sound $v = 340 \frac{\text{m}}{\text{s}}$, $f = 170 \text{ Hz}$: $\lambda = \frac{v}{f} = \frac{340}{170} = 2.0 \text{ m}$.

2 Practice

2.1 A wave has frequency 50 Hz and wavelength 0.40 m. Find its speed. [2]

2.2 State the difference between a transverse and a longitudinal wave. [1]

3 Exam-style questions

3.1 The number of complete waves passing a point each second is the: [1]

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- A wavelength
- B amplitude
- C frequency
- D wave speed

3.2 Water waves of wavelength 0.020 m travel at $0.30 \frac{\text{m}}{\text{s}}$.

(a) Find their frequency. [2]

(b) State and explain what happens to the waves as they pass through a gap about 0.02 m wide. [2]

3.3 A radio wave has a speed of $3.0 \times 10^8 \frac{\text{m}}{\text{s}}$ and a frequency of 1.0×10^8 Hz. Find its wavelength. [2]

Solutions

Each answer shows the steps, then the **result**.

2.1

- $v = f\lambda$

$$v = f\lambda = (50 \text{ Hz})(0.40 \text{ m}) = \mathbf{20 \frac{m}{s}}$$

2.2

- in a transverse wave the particles vibrate at right angles to the travel direction; in a longitudinal wave they vibrate along it

3.1 C

- frequency is the number of waves per second

3.2

- (a) $f = v/\lambda$

$$f = \frac{v}{\lambda} = \frac{0.30 \frac{\text{m}}{\text{s}}}{0.020 \text{ m}} = \mathbf{15 \text{ Hz}}$$

- (b) the waves spread out (diffract)

- because the gap is about the same size as the wavelength

3.3

- $\lambda = v/f$

$$\lambda = \frac{3.0 \times 10^8 \frac{\text{m}}{\text{s}}}{1.0 \times 10^8 \text{ Hz}} = \mathbf{3.0 \text{ m}}$$