

3.1 Properties of Waves

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1. KEY VOCABULARY

TERM	MEANING
Amplitude	The maximum distance a particle moves from rest.
Wavelength	The distance between two matching points on a wave.
Frequency	The number of waves passing a point each second (Hz).
Transverse	Vibrations are at 90° to the direction of travel.
Longitudinal	Vibrations are along the direction of travel.

2. TRANSVERSE & LONGITUDINAL WAVES

TRANSVERSE WAVE

Vibrations are at 90° to the direction of travel.
e.g. light, all electromagnetic waves, water waves.

LONGITUDINAL WAVE

Vibrations are along the direction of travel.
e.g. sound waves, some seismic waves.

wave speed = frequency × wavelength ($v = f \times \lambda$)
 Frequency = waves per second (Hz). Amplitude = how far particles move from rest.
 Waves transfer ENERGY (and information) — not matter.

3. THE KEY EQUATIONS

wave speed = frequency × wavelength ($v = f \times \lambda$)
frequency = 1 ÷ time period
 Speed is in m/s, frequency in hertz (Hz), wavelength in metres.

4. TWO TYPES OF WAVE

Transverse: vibrations at right angles to travel — e.g. light and all EM waves, water waves.
Longitudinal: vibrations along the direction of travel, with compressions and rarefactions — e.g. sound.

5. WHAT A WAVE DOES

Waves transfer energy (and information) from one place to another.
They do NOT transfer matter — the particles just vibrate about a fixed position; they do not travel with the wave.

6. THE WHY

Why a wave carries energy but not matter: each particle pushes the next and then returns to rest — the disturbance moves along, but the particles stay put.
Why $v = f \times \lambda$: in one second, f whole waves pass, each of length λ — so the wave advances $f \times \lambda$ metres per second.

7. COMMON EXAM MISTAKES

- ✗ "Waves carry particles along with them."
- ✓ Waves transfer energy — the particles only vibrate in place.
- ✗ "Sound is a transverse wave."
- ✓ Sound is longitudinal; light is transverse.
- ✗ Measuring wavelength from a peak to the next trough.
- ✓ Wavelength is peak-to-peak (one full wave).

8. SELF-CHECK · cover & quiz

- Can you...*
1. Define amplitude, wavelength and frequency?
 2. Use $v = f \times \lambda$ in a calculation?
 3. Explain the difference between transverse and longitudinal?
 4. Give an example of each type of wave?
 5. Explain why waves transfer energy but not matter?