

3.1 Wave properties and the EM spectrum

Name: _____ Class: _____ Date: _____

Total: 21 marks

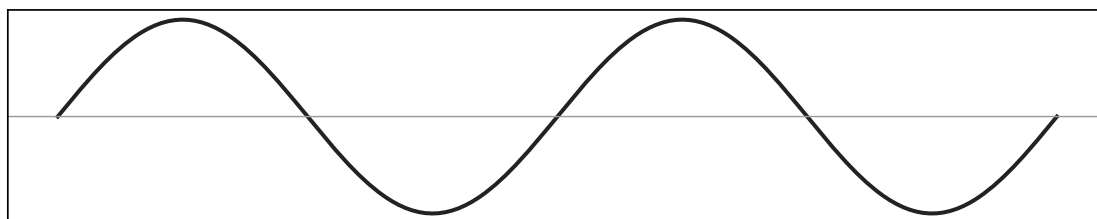
Objective

Cover wave properties and the electromagnetic spectrum (3.1–3.13): transverse and longitudinal waves, definitions, $v = f\lambda$, the Doppler effect, the spectrum's order, uses and dangers. Original IGCSE-level practice.

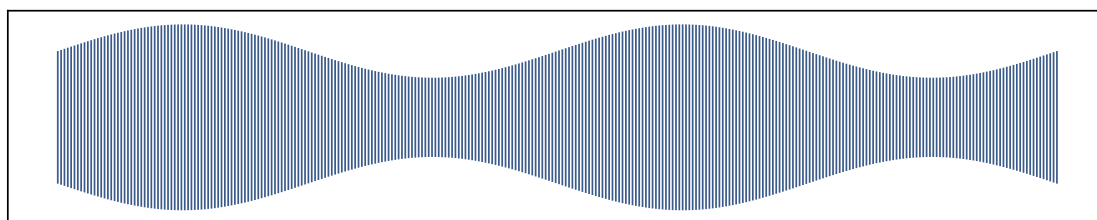
1 Key knowledge and worked examples

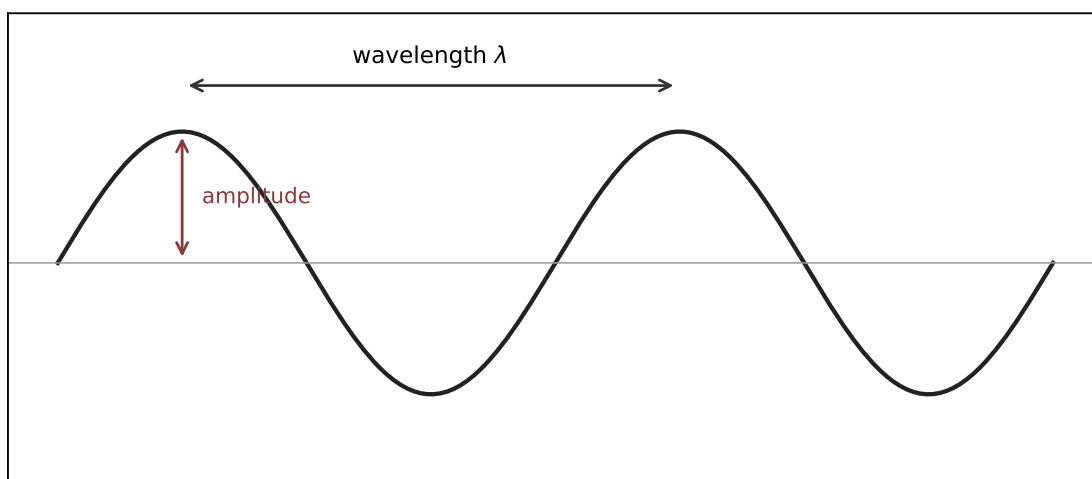
■ The vocabulary and the equation

transverse: oscillations perpendicular to travel (light, water)



longitudinal: oscillations parallel to travel (sound)





Worked check. Water waves of wavelength 2.0 m pass a post at 3 waves each second:
 $v = 3.0 \times 2.0 = 6.0$ m/s.

■ **The spectrum in order**

Radio $\rightarrow$ microwave $\rightarrow$ infrared $\rightarrow$ visible (red $\rightarrow$ violet) $\rightarrow$ ultraviolet $\rightarrow$ X-ray $\rightarrow$ gamma: wavelength falls, frequency rises, speed in free space the same for all.

2 Practice

2.1 State one difference between transverse and longitudinal waves, naming one example of each. [2]

2.2 Define frequency and period. [2]

2.3 A wave has frequency 250 Hz and wavelength 1.2 m. Calculate its speed. [2]

2.4 Calculate the period of a 50 Hz wave. [2]

2.5 List the electromagnetic spectrum in order of increasing frequency. [1]

3 Exam-style questions

3.1 Explain why a moving ambulance siren sounds higher-pitched as it approaches and lower as it recedes. [3]

3.2 Give one use and one danger for each of: microwaves, ultraviolet, gamma rays. [6]

3.3 A radio station broadcasts at 200 MHz. Calculate the wavelength (speed of radio waves 3×10^8 m/s). [3]

Solutions

2.1 Transverse oscillates perpendicular to the direction of travel (light); longitudinal oscillates parallel, as compressions and rarefactions (sound).

2.2 Frequency – the number of waves passing a point per second (Hz); period – the time for one wave, $T = 1/f$.

2.3 $v = 250 \times 1.2 = 300 \text{ m/s}$.

2.4 $T = 1/50 = 0.02 \text{ s}$.

2.5 Radio, microwave, infrared, visible, ultraviolet, X-ray, gamma.

3.1 As the siren approaches, each wavefront is emitted from closer to you; wavefronts bunch – shorter wavelength, higher observed frequency – higher pitch; receding stretches them – lower frequency and pitch.

3.2 Microwaves: cooking/satellite transmission; internal heating of body tissue. Ultraviolet: fluorescent lamps; damage to surface cells and blindness. Gamma: sterilising food and medical equipment; cancer and mutation.

3.3 $\lambda = v/f = (3 \times 10^8)/(200 \times 10^6) = 1.5 \text{ m}$.