# 3.1 Wave properties and the EM spectrum

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

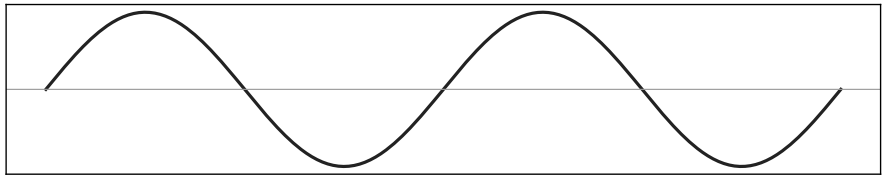
## Objective

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

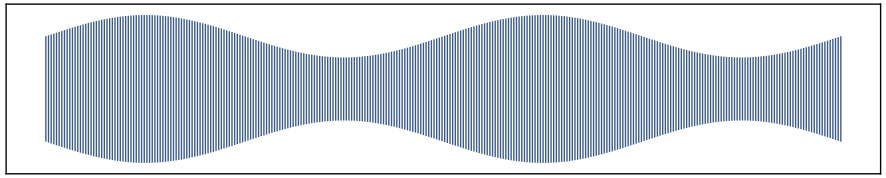
## 1 Key knowledge and worked examples

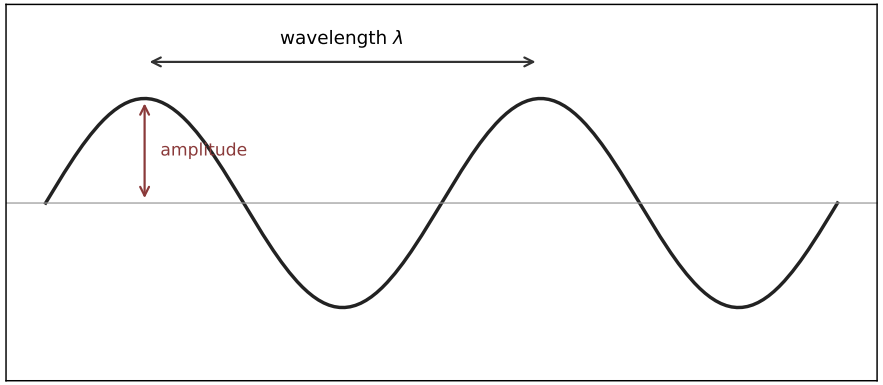
### ■ The vocabulary and the equation

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 → microwave → infrared → visible (red → violet) → ultraviolet → X-ray → 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 $3 \times 10^8$ 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** $v = 250 \times 1.2 = 300$ m/s.

**2.4** $T = 1/50 = 0.02$ 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** $\lambda = v/f = (3 \times 10^8)/(200 \times 10^6) = 1.5$ m.