

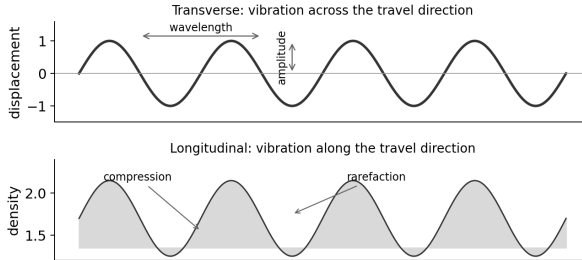
Topic 6: Waves

AQA GCSE Physics 8463 · spec 4.6 · sheets 6.1–6.5

Waves carry energy, not material

- Waves transfer energy from a source to an absorber.
- Physics-only strands are marked; sound and detection are HT.
- Ray diagrams are a required skill.

Two ways to vibrate



- Transverse: across the travel direction (ripples, EM).
- Longitudinal: along it, with compressions and rarefactions (sound).
- The ball on the ripple stays put: the wave travels, not the water.

The wave equation

- Amplitude, wavelength, frequency and period.
- $T = 1/f$ and $v = f\lambda$.
- Convert kHz, MHz and micrometres before substituting.

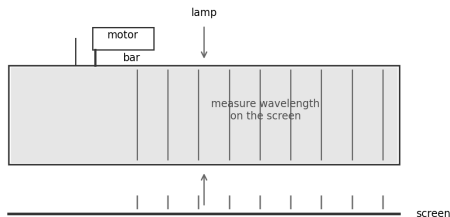
Your turn: sound wavelength

- Sound at 4.0 kHz travels at 330 m/s.
- Calculate the wavelength.

Sound wavelength worked

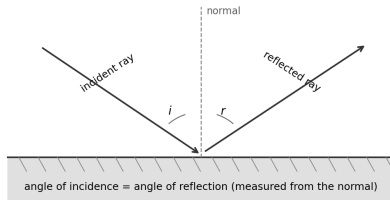
- 1 **Convert** $f = 4.0 \text{ kHz} = 4000 \text{ Hz}$.
- 2 **Equation** $\lambda = v/f = 330/4000$.
- 3 **Answer** $\lambda = 8.3 \times 10^{-2} \text{ m}$.

RP8: measuring wave speed



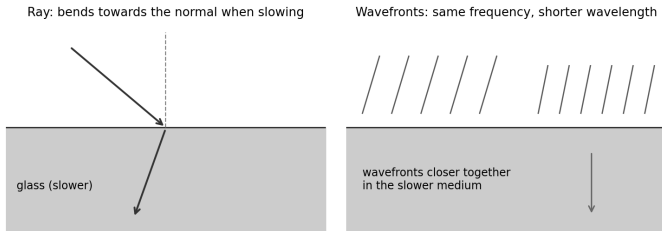
- Ripple tank: bar motor, lamp, screen.
- String: vibration generator, count loops.
- Speed of sound: clap and echo over a large distance.

Reflection with a normal



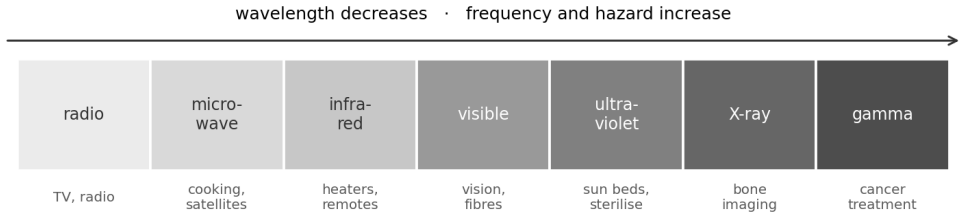
- Draw the normal at 90 degrees to the surface.
- Angle of incidence equals angle of reflection.
- Smooth: specular. Rough: diffuse.

Refraction: the bend at a boundary (HT)



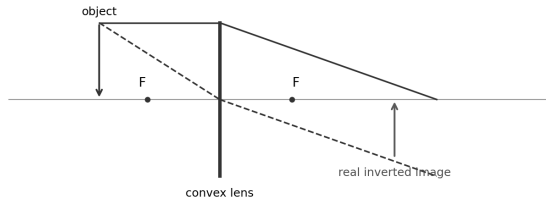
- Refraction: the ray bends towards the normal when slowing.
- Wavefronts bunch closer together in the slower medium.
- Frequency cannot change at the boundary.

The electromagnetic spectrum



- Radio to gamma; wavelength down, frequency up.
- All transverse; all at 3×10^8 m/s in air or vacuum.
- UV ages skin; X-rays and gamma are ionising.

Lenses form images by refraction



- Convex: parallel rays meet at the principal focus.
- Concave: always a virtual image.
- Magnification = image height over object height, no units.

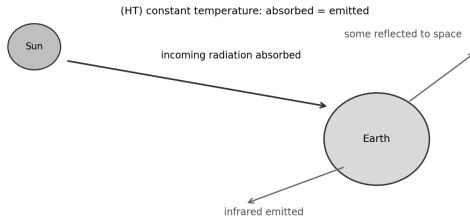
Colour is reflected wavelength

- An opaque object reflects some wavelengths, absorbs the rest.
- All reflected: white. All absorbed: black.
- Filters transmit their own colour and absorb the others.

Every body emits infrared

- All bodies emit and absorb infrared, at any temperature.
- Hotter: more radiation per second.
- A perfect black body: best absorber, so best emitter.

The Earth radiation balance (HT)



- Constant temperature: absorb rate equals emit rate.
- Absorb faster than emit: temperature rises.
- Ice, clouds and gases change the reflection.

Sound waves and hearing (physics only, HT)

- Sound waves and hearing (physics only, HT): vibrations in solids.
- The ear drum converts them; the range is 20 Hz to 20 kHz.
- Ultrasound is above 20 kHz.

Waves for detection (physics only, HT)

- Waves for detection (physics only, HT): ultrasound reflects at boundaries.
- Echo time gives the distance; halve a there-and-back path.
- P-waves pass liquid; S-waves do not.

Check yourself

- Checklist before you call this topic done.
- Definitions and the wave equation; RP8 method.
- EM order, uses and hazards; lens diagrams; black-body balance.