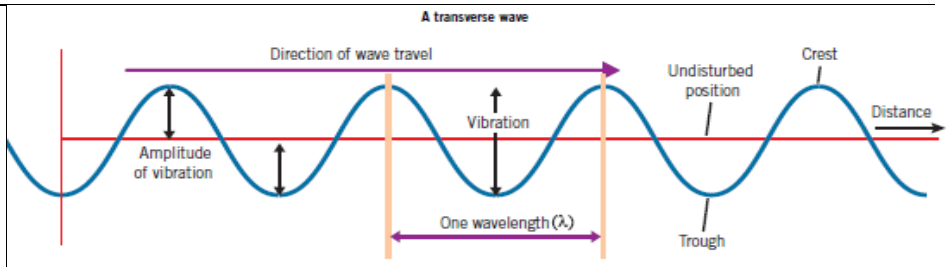
Waves Summary Notes

Waves transfer energy

The higher the amplitude the greater the energy of the wave.

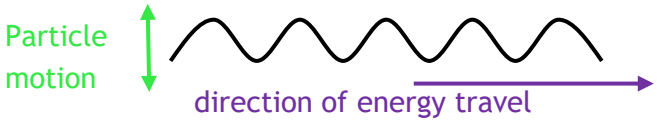
f=no. of waves produced per second

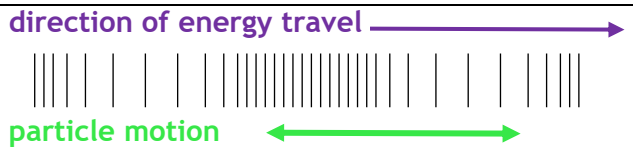
T= time for 1 wave to pass a point



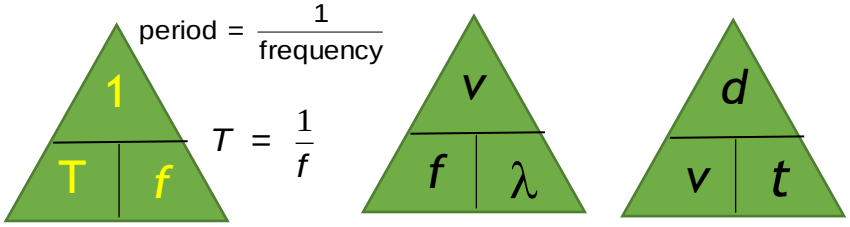
Transverse Wave: The particles of the medium transmitting the wave travel at right angles to the direction of energy travel. e.g. E.M. waves

Longitudinal Wave: The particles of the medium carrying the wave move parallel to the direction of energy travel. e.g. sound





Properties of waves = reflection, refraction, diffraction



$$\text{period} = \frac{1}{\text{frequency}} \qquad T = \frac{1}{f}$$

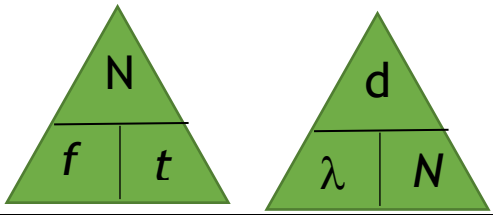
wave speed = frequency × wavelength

$$v = f\lambda \qquad v = \frac{d}{t}$$

$$\text{wave speed} = \frac{\text{distance wave travels}}{\text{time taken}}$$

Law of reflection, angle of incidence = angle of reflection where all angles are measured from the normal

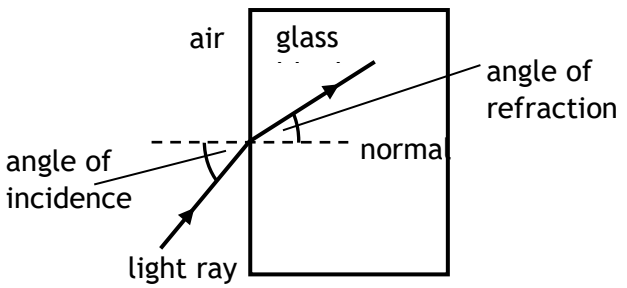
$$f\lambda = \frac{d}{N} \times \frac{N}{t} = \frac{d}{t}$$

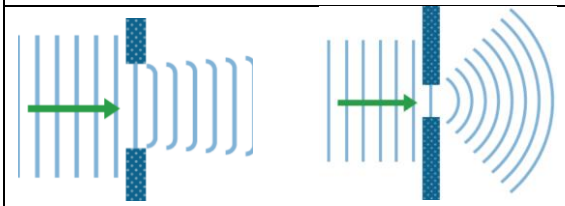


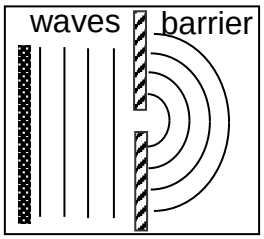
$$f = \frac{N}{t}, \qquad frequency = \frac{no\ of\ waves}{time\ to\ pass\ a\ point}$$

$$\lambda = \frac{d}{N}, \qquad wavelength = \frac{distance}{no.\ of\ waves}$$

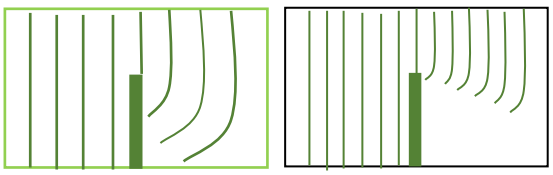
Refraction occurs when light enters a material which is more optically dense the wave speed and wavelength reduce but frequency remains the same. Usually this is accompanied by a change in direction of the wave. Diffraction –bending of waves passing through a gap or around a barrier, when waves diffract there is no change to the wavelength.







Long waves diffract more than short waves.



When waves diffract through a large gap only the edges of the waves change bend

Through a narrow gap, smaller than 1λ the waves emerge as semi-circles

Long waves diffract more than short waves which is why long wave radio signals can be detected at the bottom of a hill, but shorter wavelength signals cannot be detected.

All members of EM-spectrum are transverse waves and travel at 3×10^8 m s^{-1} in straight lines in air.
EM spectrum waves can be refracted, reflected and diffracted.

Light colours, red, orange, yellow, green, blue, indigo, and violet;
red light long λ and low *f* blue light short λ and high *f*.

Type of EM Waves	Application	Detector	Source
Radio & TV	communication (under the sea, in space, radio and TV)Watching TV programmes, films, listening to the news,	Aerial	transmitter, outer space, electronic circuits
Microwaves	Heating food through microwave ovens, communications	Aerial	electronic circuits magnetron, transmitters, outer space
Infra Red	detector in security lighting, remote controls (e.g. TV)	Photodiode,thermocouple, thermistor, heat-sensitive papers, black-bulb thermometer	warm objects, sun,
Visible	humans vision, photography, laser surgery,	Photodiode / photographic film/ diode/ CCD	Stars , candles, light bulbs, electronic devices (eg LED), sun
Ultra violet	detecting forged bank notes, causing white shirts to look cleaner? Sterilising medical instruments	Human skin / causes fluorescence (glowing) in some objects/ fluorescent materials	Fluorescent tubes, very hot objects, sun, gas discharge, lamps
X-Ray	detecting broken bones, checking suitcases at the airport,	Photodiode / photographic film	X-ray machines, stars, very fast electrons hitting a metal target
Gamma Rays	medical tracers to detect cancer, killing bacteria, sterilizing instruments, detecting broken pipes underground	/ photographic film / Geiger Muller Tube and counter/ Photodiode	Radioactive nuclei, outer space (colliding neutron stars)

https://www.youtube.com/watch?v=bjOGNVH3D4Y

Low Energy
Low frequency
Long wavelength

High Energy
High frequency
Short wavelength