

## Waves Summary Notes

### Transverse waves

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

Freq. of waves produced per second  
In time for 1 wave to pass a point



**Transverse waves:** The particles of the medium transmitting the wave travel at right angles to the direction of energy travel, e.g. EM waves

**Longitudinal waves:** 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



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

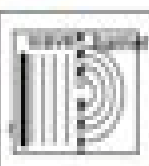
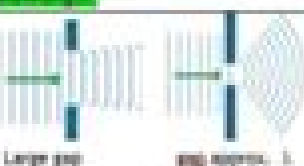
$$f\lambda = \frac{d}{t} \quad \frac{v}{t} = \frac{d}{t} \quad v = \frac{d}{t}$$



$$f = \frac{1}{T} \quad \text{frequency} = \frac{\text{no of waves}}{\text{time to pass a point}} \quad \lambda = \frac{d}{N} \quad \text{wavelength} = \frac{\text{distance}}{\text{no of waves}}$$

**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.

**When waves enter there is no change to the frequency**



When waves diffract through a large gap only the edges of the wave change. Bend through a narrow gap, smaller than  $\lambda$ , the waves emerge as semi-circles.



Long wavelengths short wavelength  
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  $3 \times 10^8 \text{ m s}^{-1}$  in a straight line in air.  
EM spectrum waves can be **radio waves**, **microwaves** and **infrared waves**.

Light colours, **red**, **orange**, **yellow**, **green**, **blue**, **indigo**, and **violet**

**red light long  $\lambda$  and low  $f$**  / **blue light short  $\lambda$  and high  $f$**

Type of EM Waves	Application	Detector	Source
Radio & TV	communication under the sea, in space, radio and TV programming, 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)	<b>Photodiode</b> , <b>thermocouple</b> , <b>thermistor</b> , heat sensitive paper, touch bulb thermometer	warm objects, sun
Visible	human vision, photography, laser surgery,	<b>Photodiode</b> / <b>photographic film</b> / <b>diode</b> / <b>CCD</b>	Stars, candles, light bulbs, electronic devices (eg LEDs), 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, sterilising instruments, detecting broken pipes underground	/ photographic film / Geiger Muller Tube and counter/ Photodiode	Radioactive nuclei, outer space (including neutron stars)

Low Energy  
Low frequency  
Long wavelength



High Energy  
High frequency  
Short wavelength



<https://www.youtube.com/watch?v=8u00N000Yr4> Calculate the wavelength of a 88 MHz radio **point, stop, point** for given the speed as you should know all these waves travel at  $3 \times 10^8 \text{ m s}^{-1}$

$$v = f\lambda \\ 3 \times 10^8 = 88 \times 10^6 \times \lambda \\ \lambda = 3.4 \text{ m}$$

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