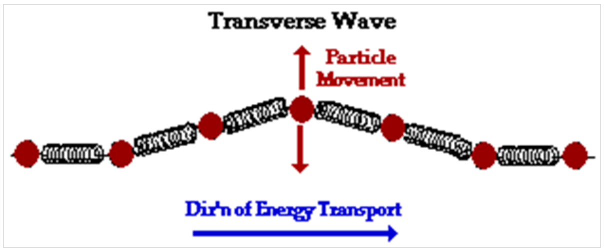
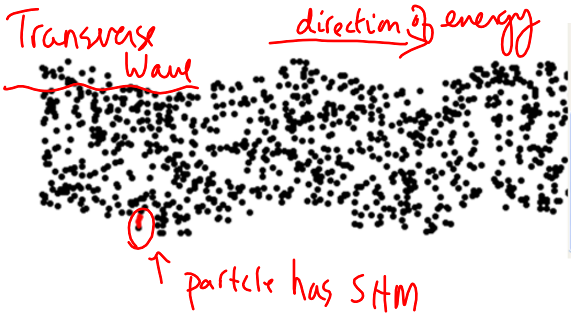
4.2 Travelling Waves

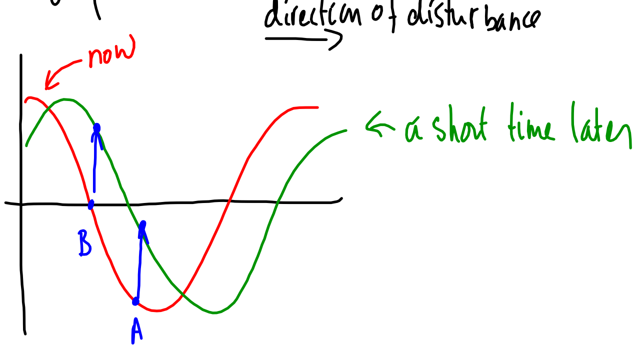
Particles undergo SHM.





In a transverse wave the particles vibrate perpendicular to the direction of the energy transport.

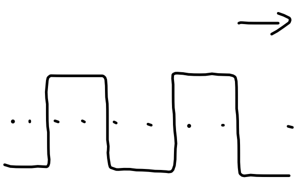
Phase relationship

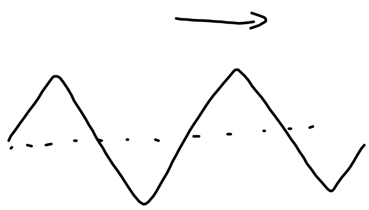


↑ this particle is behind in phase to the one preceding it (i.e. B)

- A wave is a Simple Harmonic wave if it is sinusoidal.
- There are other waves that are not harmonic:

Square Wave





Triangular wave.

Saw tooth wave.

Progressive (travelling) waves transfer energy.

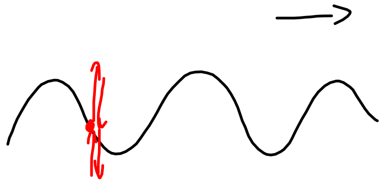
* It is the energy (or disturbance) that is transferred by a wave through a given medium.

Examples of waves:

- ocean waves
- sound waves
- earthquake waves
- light waves (electromagnetic waves)

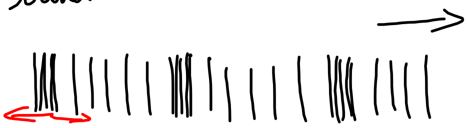
Transverse Waves

- light
- water ripples

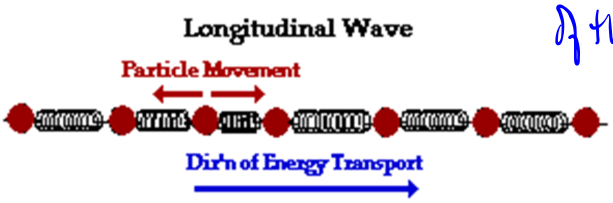


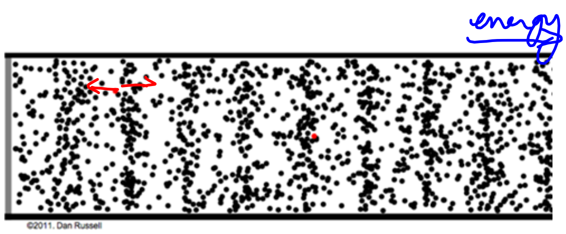
Longitudinal waves

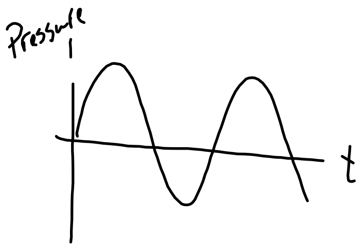
- sound waves



A longitudinal wave has the particles vibrating in the same direction of the energy transport





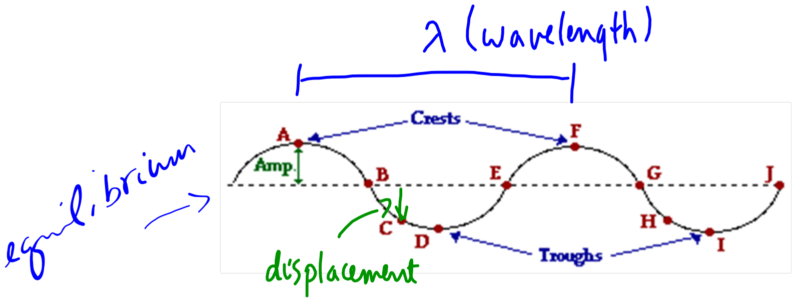


Propagation of Sound energy

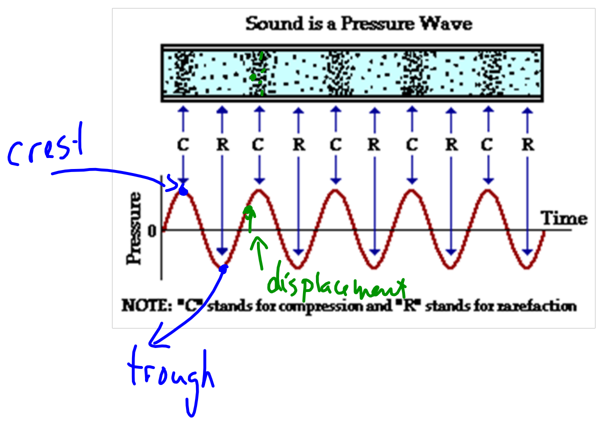
- sound is propagated via a longitudinal wave.
- areas of high pressure (compressions) and low pressure (rarefactions)
- areas of pressure fluctuations travel to your ear from the sound source → causes ear drum to vibrate at the same frequency as the sound source.

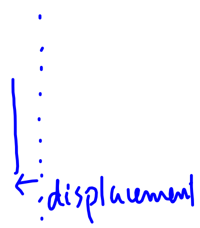
← sending electrical impulses to your brain. → we perceive this as sound.

Transverse Waves cannot be propagated in gases
- no mechanism in gases for driving the motion of the particles perpendicular to the propagation of the wave.

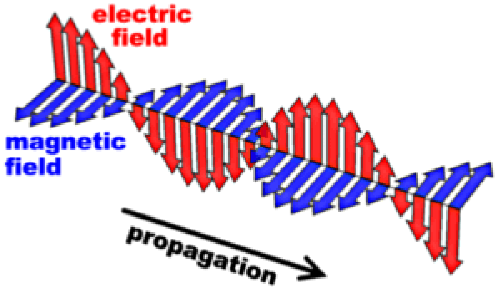


Lamda (λ)

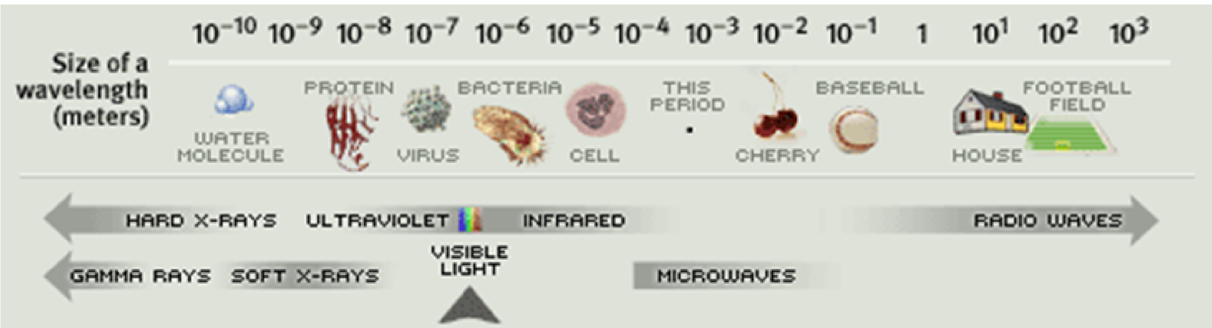


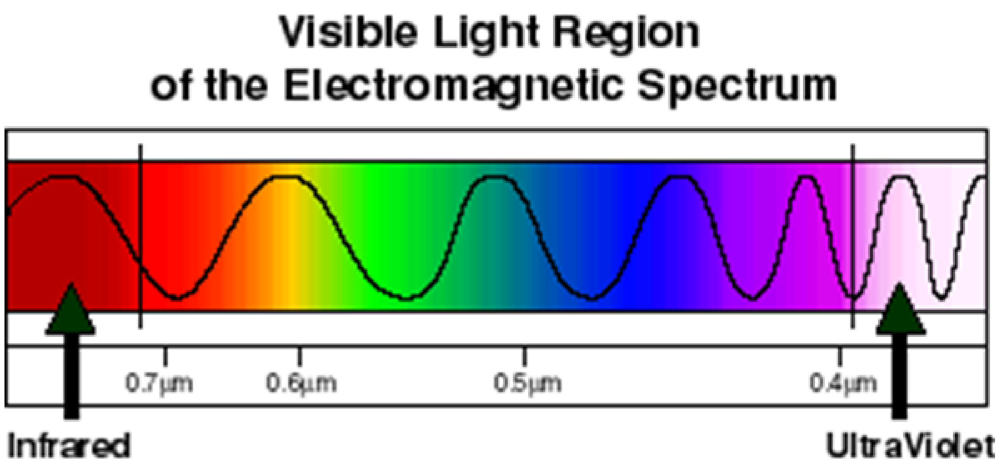


Propagation of Electromagnetic Radiation



no medium is required





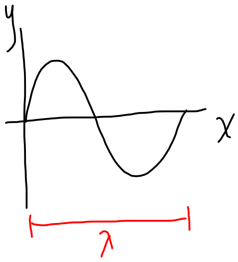
700nm (0.7µm)

400nm (0.4µm)

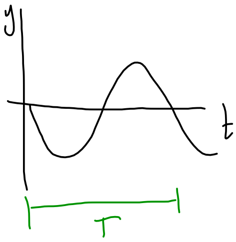
R O Y G B I V

Displacement-time graphs and displacement-position graphs for Transverse Waves

Displacement-position graph is like taking a picture of a wave at a given instant in time. At a later time, the waveform will have moved to the left (or right)



Displacement vs time graph is the graph of the displacement of point (or particle) on the wave versus time.



* Take note of the horizontal axis!!

Wave Equation

wave speed: $v = \frac{d}{t}$

for a wave to travel a special distance (λ) it would take 1 full period to travel

$v = \frac{\lambda}{T}$

In your data booklet: $c = \lambda f$ ← speed of light

$v = \lambda\left(\frac{1}{T}\right)$

$v = \lambda f$ ← universal wave equation.

Example:

FM radio station: $f = 103.9\ MHz$

The speed of radio waves: $3.00 \times 10^8\ ms^{-1}$

Find the wavelength and the period!

Electrons vibrate to create the radio waves

$c = \lambda f$

$\lambda = \frac{c}{f}$

$\lambda = \frac{3.00 \times 10^8\ ms^{-1}}{103.9 \times 10^6\ s^{-1}}$

$\lambda = 2.89\ m$

$T = \frac{1}{f}$

$T = \frac{1}{103.9 \times 10^6\ s^{-1}}$

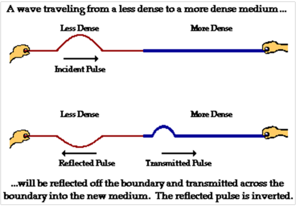
$T = 9.62 \times 10^{-9}\ s$

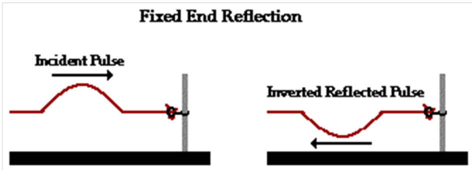
Waves at a Boundary

What happens to a wave when it encounters a boundary?

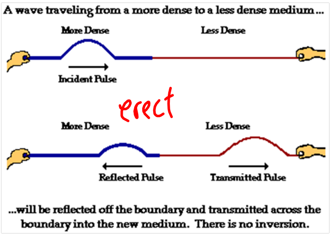
- the speed of the wave is dependent ONLY on the properties of the medium.
- the frequency of the wave remains the same when the wave enters a new medium.
- some energy will be reflected + some is transmitted
- If the wave is going from a less dense medium (fast) to a more dense medium (slow), then the reflected wave will be inverted.

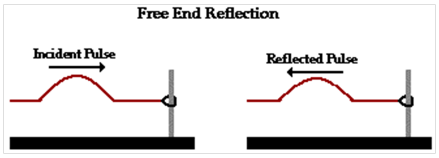
Waves encountering a boundary (1D)





Less dense → More Dense.
(fast) (slow)





More Dense → Less Dense
(slow) (fast)

TO DO (e-book)

4.1 Oscillations p144 - 149 (do any Exercises)

4.2 travelling waves

p151 to 156
p159 to 160 } do any Exercises