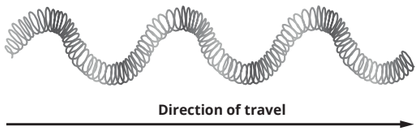
GCE Physics Unit 2.4 The Nature of Waves

Progressive waves:

Progressive waves transfer **energy** without any transfer of matter. They can be transverse or longitudinal.

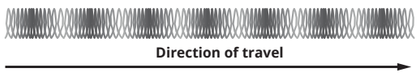
Transverse:

A transverse wave has **oscillations** at right angles to the direction of travel.



Longitudinal:

A longitudinal wave has **oscillations** parallel to the direction of travel.



Phase:

A complete cycle of a wave is equivalent to 2π or 360°.

On the diagram above;

- Points A and E are **in phase** (phase difference = 2π) as they are at the **same point in their cycle at the same time**. Other pairs in phase include B and F, A and I, G and K...
- Points A and C are in **antiphase** (phase difference = π) as they are at **opposite points in their cycle at the same time**. Other pairs in antiphase include B and D, E and G...

The phase difference is normally expressed as fractions of π. For example, the phase difference between A and I is 4π and between E and F is ½π.

Key definitions:

Wavelength (λ); the minimum distance between 2 points oscillating in phase.

Displacement; measured from the equilibrium position.

Amplitude (A); maximum value of displacement.

Frequency (f); the number of cycles per second.

Period (T); the time taken for 1 complete cycle.

Frequency and period are linked by this equation:

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

Wavespeed (c); can be calculated using this equation:

$$c = f\lambda$$

Speed can also be calculated using this equation:

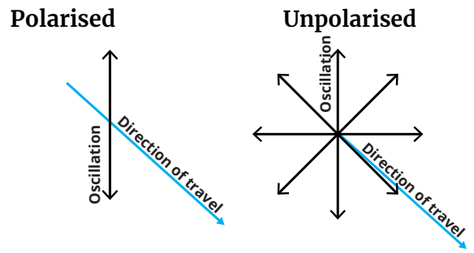
$$v = \frac{x}{t}$$

You will need to be able to use both and at times calculate the speed with one equation to use in the other.

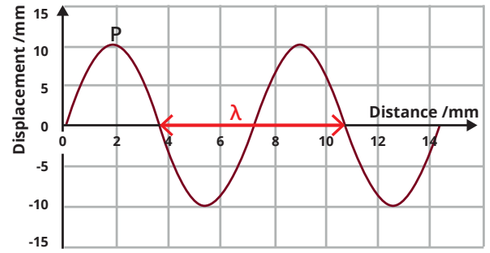
Polarisation:

A polarised wave is a transverse wave where the oscillations are all in the same direction.

A polaroid **allows oscillations in only one direction** to pass through, the other directions are absorbed. The light that has passed through is now polarised and if directed through another, rotating polaroid the intensity that passes through the second would vary between maximum, when the polaroids are parallel, and 0, when the polaroids are perpendicular.

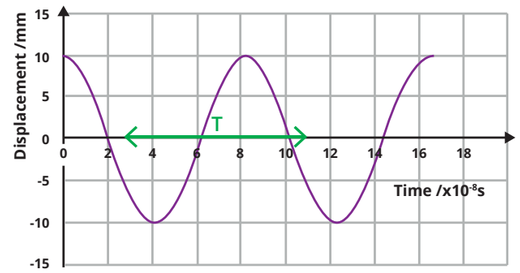


Displacement-position graph:



This graph shows a section of the wave at a particular time.

Displacement-time graph:



This graph shows how the **displacement of a specific point** varies with time. This example is for the point labelled P on the wave as above.

Both graphs can be used to measure features of waves and together can be used to make wave speed calculations.

c = wave speed in ms^{-1} f = frequency in Hz λ = wavelength in m T = wave period in s