Waves

A wave is a means of transferring energy and momentum from one point to another without there being any transfer of matter between the two points.

They can be mechanical/electromagnetic, progressive/stationary and longitudinal/transverse

Types of waves

Mechanical waves are made up of vibrating particles. They require a substance for transmission, so can't travel through a vacuum. *eg* sound (air molecules), water (water molecules)	Electromagnetic waves are made up of oscillating electric and magnetic fields. They don't require a substance for transmission, so can travel through a vacuum. *eg* light and radio
Progressive waves are when there is a net transfer of energy and momentum from one point to another *eg* sound from a person speaking, light from a lamp	Stationary waves are when there is NO net transfer of energy and momentum from one point to another. *eg* the wave on a guitar string
Longitudinal waves are when the direction of vibration of the particles is parallel to the direction of travel *eg* sound	Transverse waves are when the direction of vibration of the particles is perpendicular to the direction of travel *eg* water and electromagnetic waves

Measuring Waves

Displacement, x: the distance of an oscillating particle from its undisturbed/equilibrium position

Amplitude, a: the maximum displacement from an oscillating particle from its equilibrium position
It is equal to the height of a peak or depth of a trough

Wavelength, λ: the distance between two consecutive particles at the same phase, measured in metres/m
Example: peak to peak

Period, T: the time taken for one complete oscillation of a particle in a waves, measured in seconds/s

Frequency, f: the number of complete oscillations in one second performed by a particle in a wave
note: f =1/ T

Phase, φ: the point that a particle is at within an oscillation
It can be expressed in terms of an angle up to 360°

Phase difference, Δφ: the fraction of a cycle between two particles within one or two waves
Example:the top of a peak has a phase difference of half of one cycle compared with the bottom of a trough.

Phase difference is often expressed as an angle difference. So in the above case the phase difference is 180°. Also with phase difference, angles are usually measured in radians.

Wave equation

For all waves:

c = f λ OR speed = frequency x wavelength

(where speed is in ms^-1 provided frequency is in hertz and wavelength in metres)

Polarisation

Only TRANSVERSE waves undergo polarisation (where they all travel at the same speed in a vacuum)

The oscillations within a transverse wave and the direction of travel of the wave define a plane.

If the wave only occupies one plane the wave is said to be plane polarised.

Light from a lamp is unpolarised.
However, with a polarising filter it can be plane polarised.

If two ‘crossed’ filters are used then no light will be transmitted.

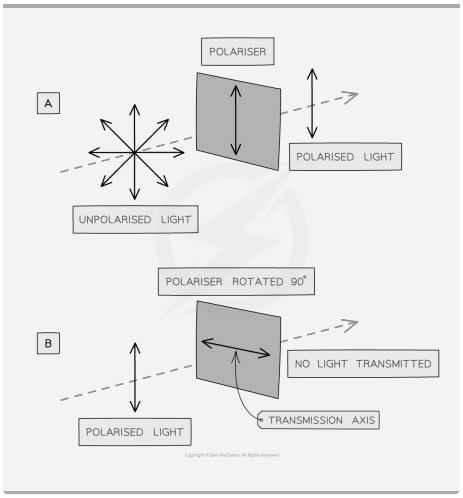
Applications of polarisation

Polarised sunglasses: these contain lenses with polarising filters that only transmit vertically polarised light.
When light is reflected from a reflective surface with water, it undergoes partial plane polarisation (a proportion of the reflected light will oscillate more in the horizontal plane than the vertical plane).

Polaroid photography: work in a similar way to polarised sunglasses.
They are useful for capturing intensified colour and reducing glare on bright days. They also enable photographers to take photos of objects underwater.

Polarisation of Radio & Microwaves Signals: Radio and television services are broadcast either horizontally- or vertically-polarised. Therefore, the reception aerial needs to be mounted horizontal or vertical, where its orientation will depend on the transmitter it is pointing towards and the polarity of the services being broadcast.

Polarisation of light



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