

### Formulas

$$f=1/T \quad v=f\lambda$$

$$\lambda=c/f \quad v=\lambda T$$

constructive p.d (antinode) =  $n\lambda$

or  $n\lambda = |S_1X - S_2X|$

destructive p.d (node) =  $(n-0.5)\lambda$

or  $(n-0.5)\lambda = |S_1X - S_2X|$

one free end, one fixed (odd):  $\lambda=4L/n, f=nv/4L$

fixed ends:  $\lambda=2L/n, f=nv/2L$

fringe spacing:  $\Delta x = \lambda L / d$

bigger  $\Delta x$  gives more refraction, more spread out  
 $\Delta x$ =fringe spacing (m),  
 $\lambda$ =wavelength (m),  $L$ =distance from slits to screen (m),  $d$ =slit separation (m)

refraction & reflection:  $n=c/v$

where;  $n$ =speed of light in a vacuum/ speed of light medium  
 $n_1v_1=n_2v_2$

diffraction  $\approx \lambda/w$   $n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$

energy  $\propto$  fr- equency  $n_1 \sin(\theta_1) = n_2$

### Young's double slit experiment

Young's double slit experiment shows light exhibiting the wave properties of diffraction and interference.

Light can be polarised, observed as white light diffracts and colours are seen as a result. As only transverse waves can be polarised, the wave model of light is proven.

### Snell's Law

### Wave types

**Transverse waves:** particle moves along **vertical axis**

**Longitudinal waves:** particle moves along **horizontal axis**

**Coherent waves:** waves with the **same frequency**

Mechanical (sound, air, water) waves do not exist in a vacuum, they **require a medium to travel through**

Electromagnetic (light) waves can exist in a vacuum, **do not require a medium**

**Travelling wave:** a wave for which the crests and troughs travel in the direction of wave propagation.

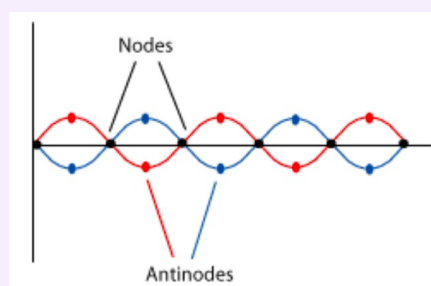
**Standing Waves:** when 2 wave trains with the same amplitude and wavelength move through each other, the resulting interfering pattern results in a standing wave. Consists of alternating nodes and antinodes that remain in a fixed position, wave appears to be stationary/'standing'

fundamental frequency:  $n=1$

*formation of standing waves on a string:*

1. waves **reflect** at both ends of string
2. reflections travel in opposite directions with the same frequency and amplitude
3. fixed ends are **nodes**, free ends are **antinodes**

### Nodes & Antinodes



**Constructive Interference:** When waves in the same phase overlap, their amplitudes add together

**Destructive Interference:** When waves of different phases overlap, their amplitudes cancel

**Nodes:** Points of complete destructive interference

**Antinodes:** Points of complete constructive interference, largest amplitude

### Wave resonance

Waves reflect at the end of a string and are **inverted** if end is fixed

An object or system will resonate if driven at its **natural frequency**

Resonance greatly increases magnitude of oscillation in an object/system

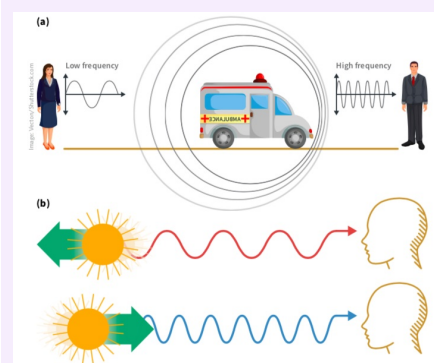
### Doppler effect

Doppler effect is the detected frequency change due to the relative motion between a wave source and detector.

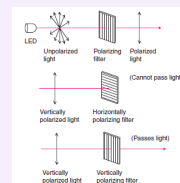
$f$  increases when source and detector move towards each other

$f$  decreases when source and detector move away from each other

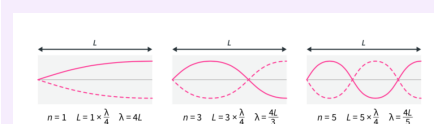
### Doppler effect:



### Polarising filters



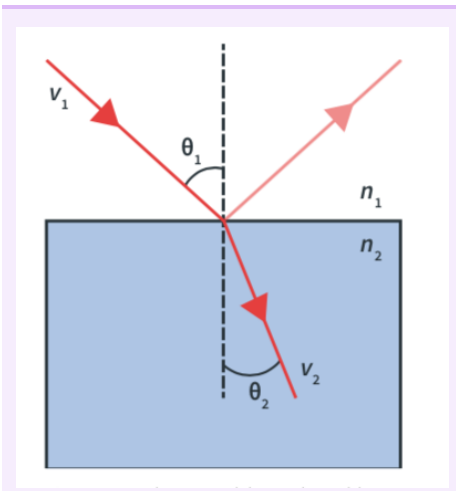
### Waves



### Variables

independent: variable that is being changed (x-axis)

dependent: variable that is being measured (y-axis)



$n_1$ =refractive index of first medium

$\theta_1$ =angle to the normal in first medium

$n_2$ =refractive index of second medium

$\theta_2$ =angle to the normal in second medium



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Published 5th August, 2021.

Last updated 5th August, 2021.

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