Waves - Light

IB Physics Content Guide

Big Ideas

- Light waves can be transformed through reflection, refraction, and diffraction
- Light travels at different speeds through different material

Content Objectives

1 – Light and the EM Spectrum

I can describe how the properties of electromagnetic waves change as frequency changes			
I can identify and use the speed of light to solve wave problems with the wave equations			
I can estimate the wavelength magnitude for the different EM waves			
I can provide real world examples for each of the electromagnetic waves			

2 – Reflection and Refraction

I can identify the angle of incidence and angle of reflection for a reflected wave ray			
I can use the law of reflection to predict the way light bounces off of a plane mirror			
I can relate the index of refraction of a material to the speed of light as it travels through			
I can qualitatively describe how light bends when transitioning between boundaries			
I can predict the direction that light will bend at a medium transition			

3 – Snell's Law and Critical Angle

I can mathematically relate the angles of refraction to the indices of refraction for the materials			
I can describe the phenomenon of Total Internal Reflection			
I can calculate the critical angle of incidence so that the light cannot escape the medium			
I can identify applications of total internal reflection and describe their importance			

4 – Diffraction

I can describe how light bends around a boundary			
I can describe the interference pattern formed by two coherent waves			
I can predict the resulting image from a double slit experiment			
I can calculate the spacing between bright spots for the double slit experiment			
I can conceptually relate band spacing with wavelength and gap distance			

5 – Polarization

I can describe the transformation that takes place when unpolarized light is polarized			
I can describe the interaction between two polarized filters at different orientations			
I can use Malus's Law to calculate the change in intensity when passing through polarized filters			

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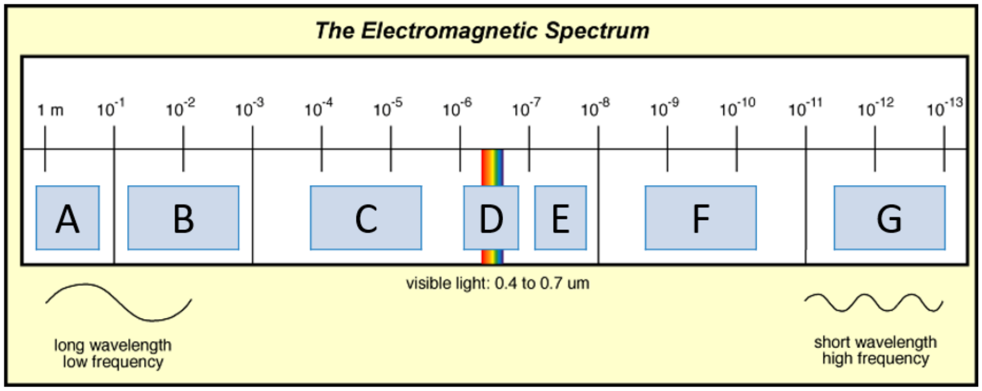
Shelving Guide

Electromagnetic Spectrum

A	Radiowaves
B	Microwaves
C	Infrared
D	Visible Light
E	Ultraviolet
F	X-Rays
G	Gamma Waves



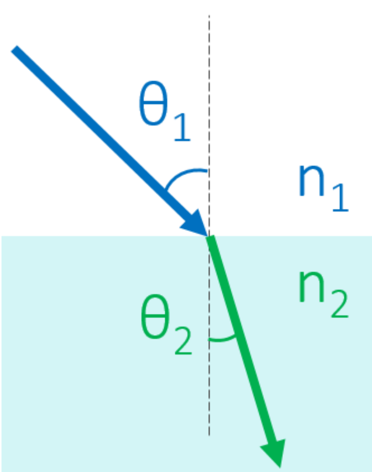
Index of Refraction

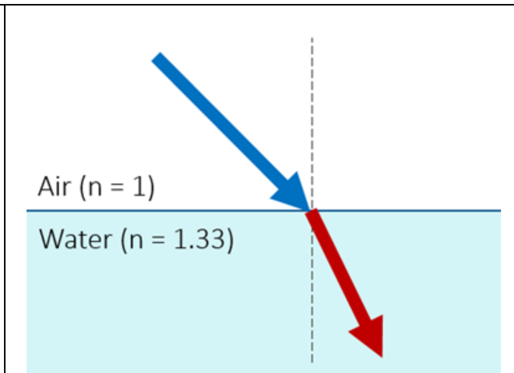
Medium	Wave Speed (v)	Index of Refraction (n)
Vacuum	3.00×10^8 m s^{-1}	1.0000
Air	2.999×10^8 m s^{-1}	1.0003
Water	2.256×10^8 m s^{-1}	1.33
Glass	1.974×10^8 m s^{-1}	1.52

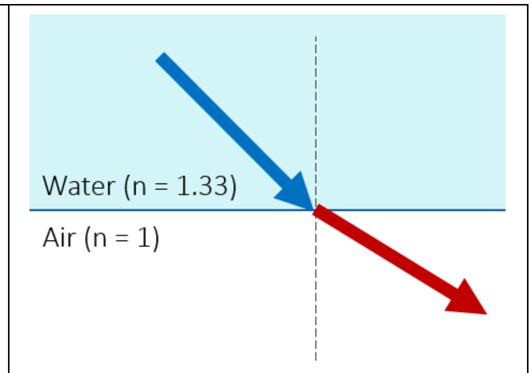
$$\frac{n_1}{n_2} = \frac{v_2}{v_1}$$

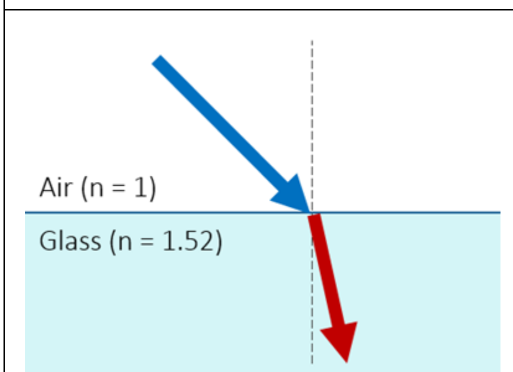
Refraction

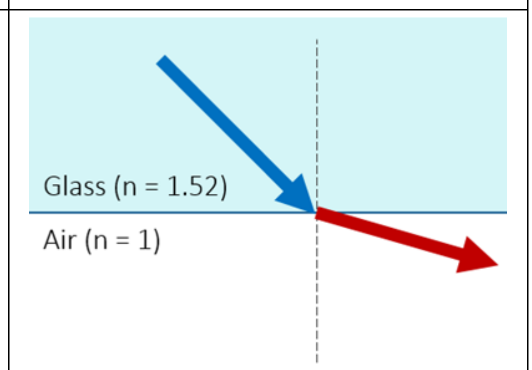
$$\frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1}$$





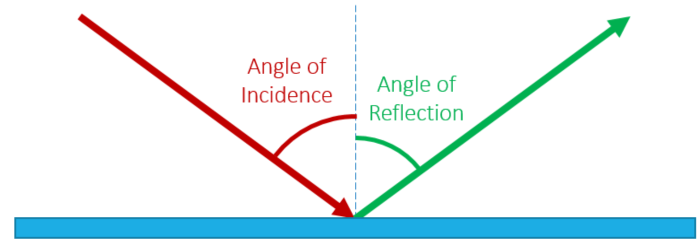




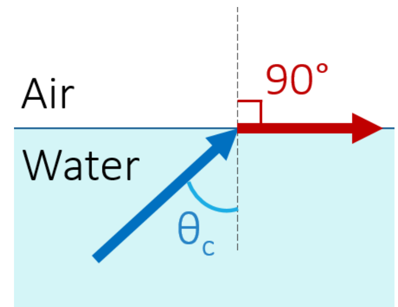


Reflection

Law of Reflection
Angle of Incidence = Angle of Reflection

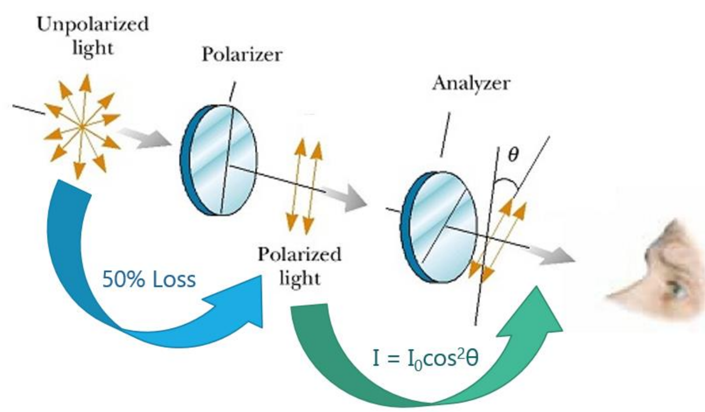


Critical Angle

When $\theta_1 = \theta_c$ $\theta_2 = 90°$	$\theta_c = sin^{-1}\left(\frac{n_2}{n_1}\right)$	

Polarized Light

$I = I_0 cos^2\theta$	
I	Intensity Observed
I_0	Original Intensity
θ	Difference in Angle



Double Slit Experiment

$s = \frac{\lambda D}{d}$	
s	Distance between fringes
λ	Wavelength
D	Distance to Screen
d	Distance between slits

Label this diagram: