

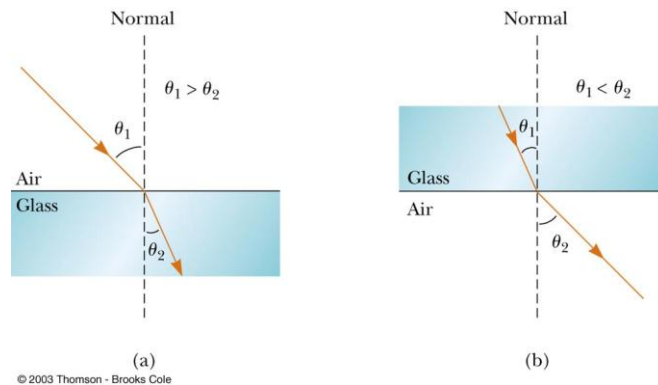
Chapter 22

Reflection and Refraction

$E=hf$ E is energy in Joules, h is Planck's constant $6.63 \times 10^{-34} \text{ J}\cdot\text{s}$ and f is frequency in Hertz

Light travels in a straight line path until it encounters a boundary between 2 different materials, (called an interface).

Refraction-when light enters a different medium is it bent. If the medium is more optically dense, the light bends toward the normal, and the opposite is true, bends away from normal when less optically dense.



As light travels from one medium to another it's frequency does not change.

Index of refraction (n) is the physics property of a pure substance that is the ration of the speed of light in a vacuum to the speed of light in that pure substance.

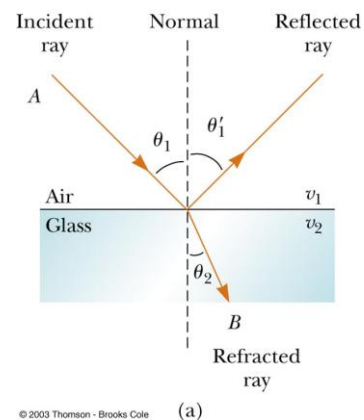
$n = \text{speed of light in a vacuum} / \text{speed of light in a medium}$ $n = c/v$ no unit

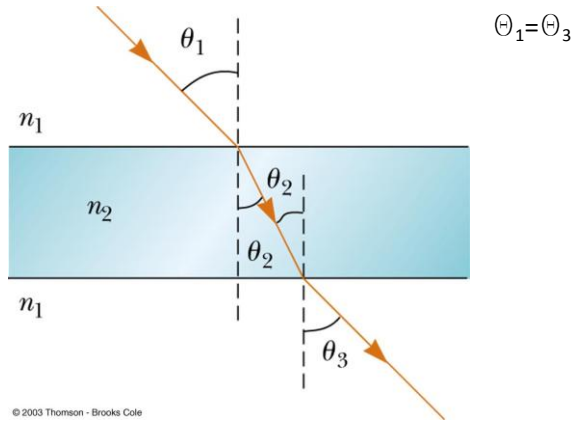
speed of light in a vacuum (c) is a constant = $3 \times 10^8 \text{ m/s}$

$v = f\lambda$ v in m/s, f is frequency is Hertz (1/s), λ (lambda) is wavelenth in m

$\lambda_1 / \lambda_2 = v_1 / v_2 = n_2 / n_1$

Snell's Law of refraction $n_1 \sin \theta_1 = n_2 \sin \theta_2$



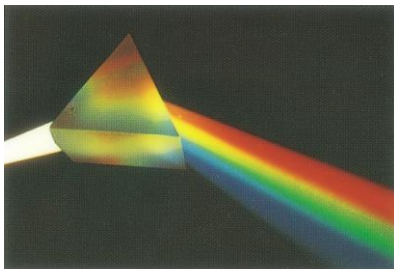


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Dispersion of light-index of refraction depends on wavelength; index of refraction usually decreases with increasing wavelength. Blue light gets bent more than red light.

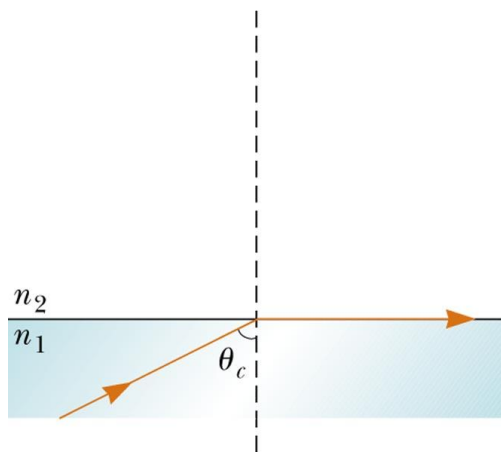
Visible light ROYGBIV-red (400 nm), orange, yellow, green, blue, indigo, violet (700 nm)

A prism breaks up a light ray into its colors. Light of different wavelength refract at different angles. A **continuous spectrum** shows all the colors. (Like a rainbow; water droplets act as a prism and bend the sunlight resulting in a continuous spectrum)



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Normal



Total internal reflection-application, fiber optics; has a critical angle θ_c

The light ray gets bent and moves parallel to the interface boundary. Using Snell's Law,

$$n_1 \sin \theta_c = n_2 \sin 90^\circ$$

This occurs only when light attempts to move from a medium of high index of refraction to a medium of lower index of refraction. $n_1 > n_2$

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(b)