The Refraction of Light

SPH4U

Light will travel more _____ in more _____ materials.

The _____ of the speed of light in a vacuum (or air) to the speed in the material

is the _____, _____.

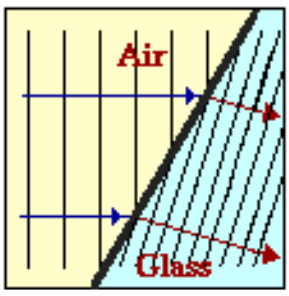
Example: For water, the index of refraction is 1.33.
The speed of light in water is therefore:

Frequency and Wavelength

Light with a wavelength of 6.0×10^{-7} m in air (i.e. with a frequency of 5.0×10^{14} Hz) travels into water. What is the frequency of the light in water?

The frequency is:

What is the wavelength of the light in water?



What happens when a wave meets a boundary between two media?

In 2D (with the boundary at an angle to the wave), the wave will _____

as those parts that enter the more-dense material first _____

first. (The black lines show the crests or "_____").

If the ray is _____ to the boundary, _____.

Snell's Law: The amount by which the wave is bent is given by Snell's Law (n_i and n_r are the refractive indices of the media).

Formula: Sketch:

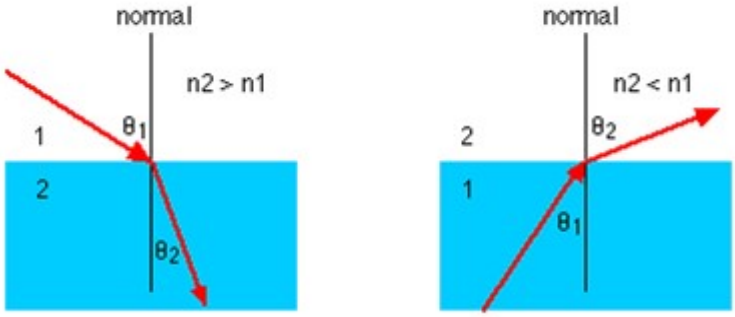
Note that a ray will bend _____ the normal when travelling into a _____ medium (and _____ the normal when travelling into a _____ medium).

Refraction effects produce a number of interesting observable phenomena. . . .

E.g. objects in water may appear to be _____:

If we look at an object in a different medium, we will see an _____ of the object along the _____ of the rays that are _____ to us.

But more interesting than the refraction of light rays is the _____ of light rays to refract. . . .



For the case of the ray travelling from the _____-dense material to the _____-dense material, there must exist some _____ incident angle _____ such that the ray will refract at _____ from the normal (along the boundary).

Sketch:

If the light is incident at an angle larger than this critical angle θ_c, _____ will occur.

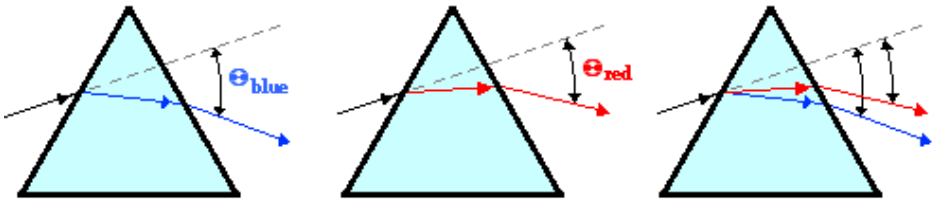
Example: When light is travelling through glass into air, the total internal reflection will occur at a critical angle of 42°. Find the index of refraction of the glass.

Applications:

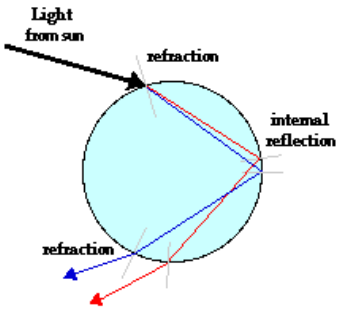
_____ are based on the principle of TIR. These are flexible strands of _____. With a straight or smoothly bending fibre, the light will hit the wall at an angle higher than the critical angle and will all be reflected back into the fibre so that no light will be lost.

Air of different _____ will have different *n*s and light rays can reflect within the air, resulting in _____ and _____.

Different frequencies (_____) of light actually refract at different _____. This is called _____ and is especially apparent when white light is passed through a _____.



Blue light refracts more than red light due to the difference in wavelength. This causes blue light to deviate from its original path by a greater angle than the red light.



Dispersion *and* _____ can occur in _____, which may result in _____.

More Practice: Snell's Law Lab