Refraction

As a wave enters a new medium, the wave changes speed. If it enters the new medium at a non-zero angle, this change in speed causes the light to bend.

Refraction – the bending of light as it moves into a new medium.

When a wave changes medium, it has a change in speed, direction, and wavelength. A wave's **frequency always remains constant**.

Three cases for refraction:

1. Less dense to more dense medium.

- refracted ray bends <u>towards</u> the normal

2. More dense to less dense medium.

- refracted ray bends <u>away</u> from the normal

3. Angle of incidence equals zero.

- partial transmission and partial reflection
- transmitted ray changes speed, but keeps going straight

How do we find the angle of refraction?

<u>Snell's Law</u>

where: n = index of refraction for each medium

n indicates the optical density of the medium, as n increases, the optical density increases, and the speed of light decreases.

<u>ex</u>.
Light travels from crown glass (n = 1.52) into water (n = 1.33). The angle of incidence in the glass is 40°.
   a.) Will the light bend towards or away from the normal?

   b.) What is the angle of refraction?

<u>Index of Refraction, n</u>

The index of refraction, n, is a measure of how much light will change speed, and therefore how much light will bend, as it enters a new medium.

The index of refraction for any substance is defined as the ratio of the speed of light in a vacuum to the speed of light in that medium.

where: c = speed of light in a vacuum (3 X 10^8 m/s)
          v = speed of light in medium

Note: n <u>cannot</u> be less than 1.

<u>ex</u>.
The index of refraction of quartz is 1.54. What is the speed of light in quartz?