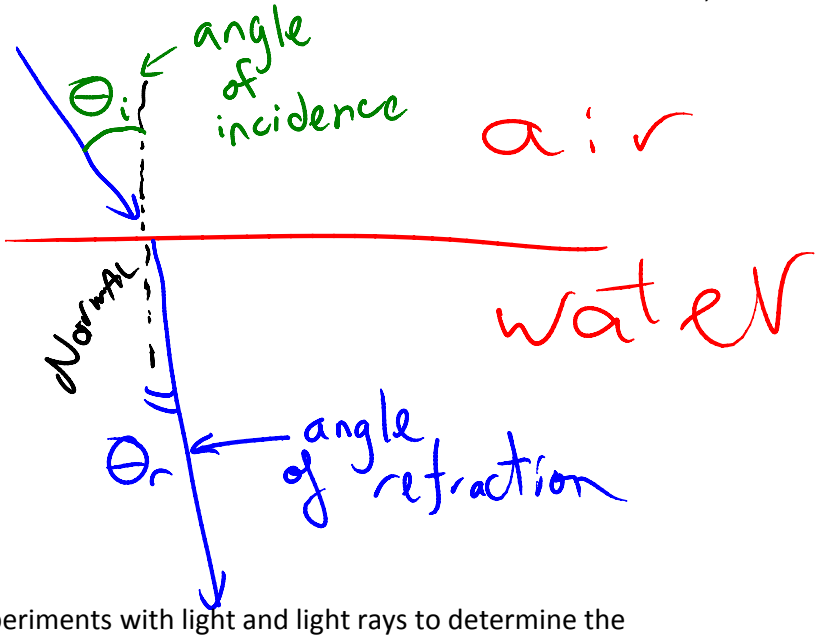
Refraction and Snell's Law

Wednesday, May 26, 2010
11:59 AM

When waves change media their speed changes. This causes a bending of the wave's path. Rays change their angles. ALL ANGLES MUST BE MEASURED FROM THE NORMAL. Snell,



Snell did repeated experiments with light and light rays to determine the relation between wave speed and θi and θr. He came up with the following:

Velocity of light in some medium = velocity of light in a vacuum / index of refraction

v = c /n

He also devise SNELL'S LAW:

$n_i \sin \theta_i = n_r \sin \theta_r$

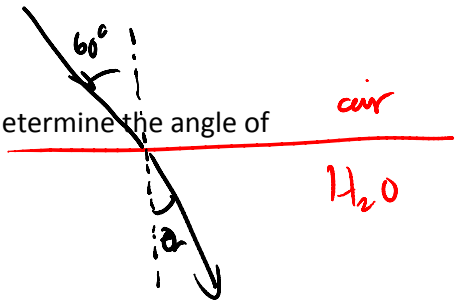
ni is the index of refraction of the incident (starting) medium
nr is index of refraction of the refracting (entered) medium
θi is angle of incidence
θr is the angle of refraction

Speed of light in a vacuum = 3.00 x 10 ^{8} m/s
Find the index of refraction of water if light travels at 2.25 x 10 ^{8} m/s in water.

$n = \frac{c}{v} = \frac{3 \times 10^8}{2.25 \times 10^8} = 1.33$

60° !

A light ray in air has angle of incidence 60° on water determine the angle of refraction.



$n_i \sin\theta_i = n_r \sin\theta_r$

air $= 1$

$\frac{\sin 60}{(.866)} = 1.33 \sin\theta_r$

$\theta_r = 41^\circ$

A light ray in apple juice (n = 1.4) is incident on air at 32°. Determine the angle of refraction. Then answer Allison's question.

$n_i \sin\theta_i = n_r \sin\theta_r$

high ← Low

$1.4 \sin 32 = 1 \sin\theta_r$

$.742 = \sin\theta_r \quad 48^\circ = \theta_r$

$n_r > n_i$ then θ_r will $< \theta_i$ (ray goes toward normal)

$n_r < n_i$ then $\theta_r > \theta_i$ (ray bends away from normal)

$V \propto f$

$\frac{c}{n} \propto f$

$n \propto \frac{1}{f}$

$f \propto \frac{1}{n}$

$n_i \sin\theta_i = n_r \sin\theta_r$ $\qquad n = \frac{c}{v}$

$n_i \sin\theta_i = n_r \sin\theta_r$ $\qquad n = \frac{c}{v}$

$\frac{c}{v_i} \sin\theta_i = \frac{c}{v_r} \sin\theta_r$

$\frac{v_2}{v_i} = \frac{\sin\theta_2}{\sin\theta_i}$

$\frac{4}{2} = \frac{6}{3}$

$\frac{2}{4} = \frac{3}{6}$