Index of refraction: Ratio of speed of light in a vacuum to speed of light in a substance.

Formula:

$$n = \frac{c}{v}$$

Variable:	n	$3.00 \times 10^8 \frac{m}{s}$ c	v
Quantity:	index of refraction (optical density)	speed of light in a vacuum	speed of light in medium
Units:	X	$\frac{m}{s}$	$\frac{m}{s}$
Type:	scalar	vector	vector

Examine the tables of **Absolute Indices of Refraction** in your Reference Tables. p. 486

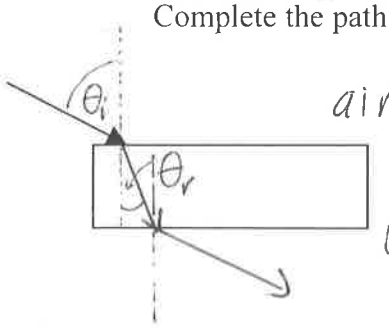
by TUES. 4/9

1. In which substance will light travel the fastest? What is its index of refraction?
   vacuum $n = 1.000$ air in comparison $n = 1.0003$
2. In which substance will light travel the slowest? What is its index of refraction?
   diamond $n = 2.42$
3. What is the relationship between the index of refraction of a substance and the speed of light in that substance?
   inverse relationship
4. Calculate the speed of light in water.
   Water $n = 1.33$

$$v = \frac{c}{n} \qquad v = \frac{3.0 \times 10^8 \text{ m/s}}{1.33} = 2.3 \times 10^8 \text{ m/s}$$

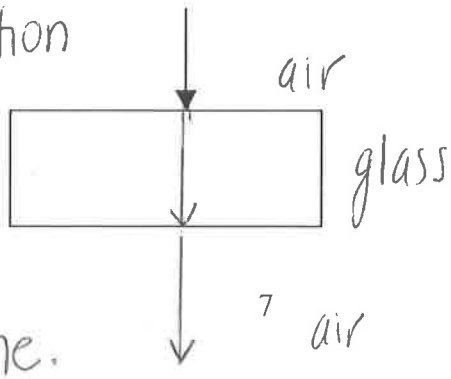
5. Will light slow down if it travels from corn oil to ~~glycerol~~ glass? Explain.
   No, because corn oil + glass have almost the same index of refraction.
6. If light crosses a boundary between two substances with very different indices of refraction . . .
   light will change speed (and therefore refract) a lot
7. If light crosses a boundary between two substances with very similar indices of refraction . .
   light will not change speed (or refract) very much at all
8. Why does the table indicate ($f = 5.09 \times 10^{14}$ Hz)?
   average frequency of visible light $c = \lambda f$

Complete the path of the light ray through the Glass block in each diagram below.



Rays in air are parallel to each other.

Rule for Refraction: No refraction if light crosses a boundary along the normal line.

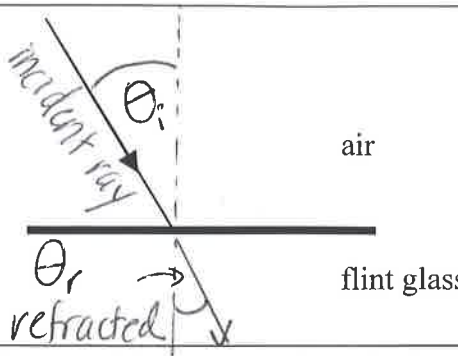


Snell's Law of Refraction

Snell's Law (Law of Refraction)

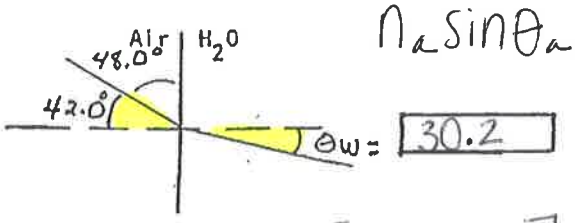
$n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\quad \frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1}$

Use Snell's law to construct the refracted ray on the diagram at right.



p.486 - has indices of refraction

Use a Snell's law to determine and draw the path light takes in the material as shown. *Note: Indices are in the text. Also, not all interfaces are horizontal. Dotted lines are the normal lines.*

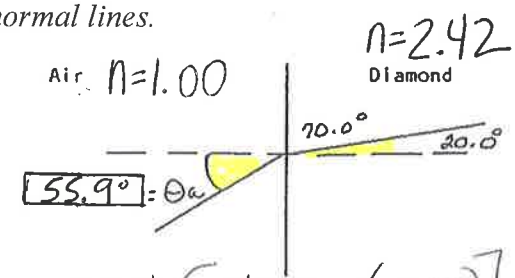


$n_a \sin\theta_a = n_w \sin\theta_w$

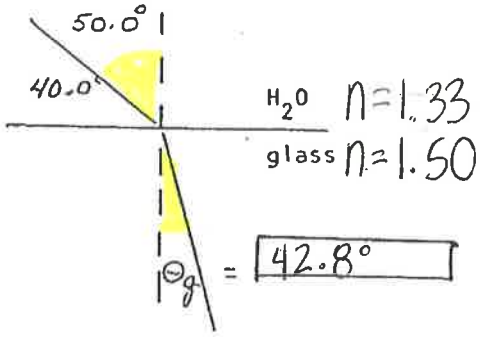
$n = 1.00$ air

$n = 1.33$ water

$\theta_w = \sin^{-1}\left[\frac{n_a \sin\theta_a}{n_w}\right]$

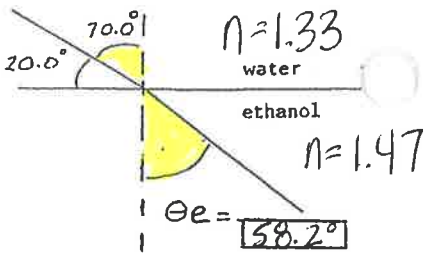


$\theta_a = \sin^{-1}\left[\frac{2.42 \sin(20.0°)}{1.00}\right]$



show all work on WS #6

$\theta_g = \sin^{-1}\left[\frac{n_w \sin\theta_w}{n_g}\right]$



problems are the same as WS #6

$\theta_e = \sin^{-1}\left[\frac{1.33(\sin 70.0°)}{1.47}\right]$

Refraction and Wavelength

Why does refraction occur?

As the wave enters a more optically dense medium . . .

Relationship: