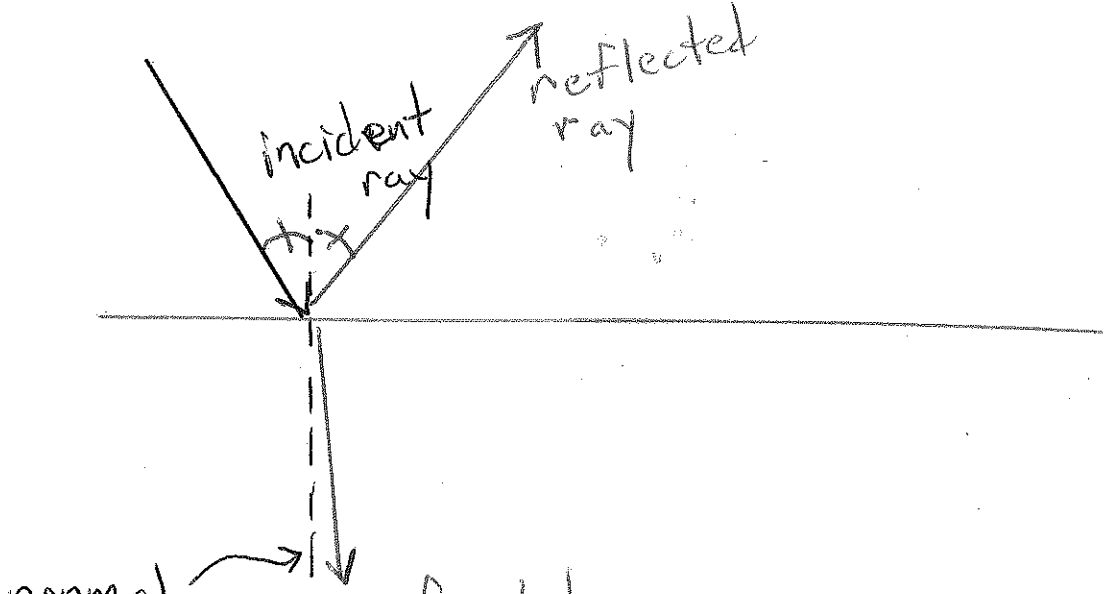
Refraction & Reflection Practice

(1)

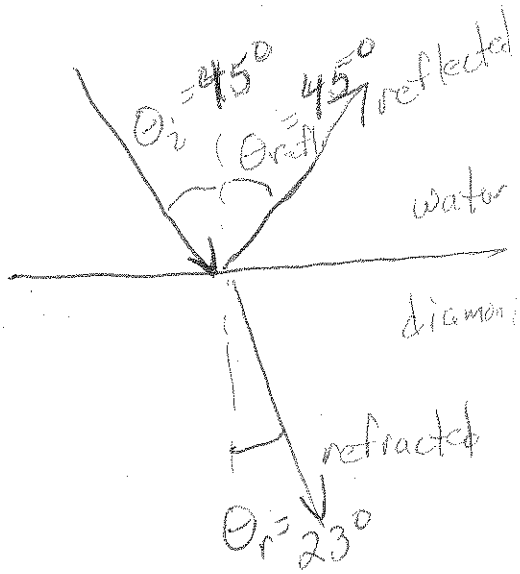
a)



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

$1.33 \sin 45^\circ = 2.40 \sin\theta_r$

$.39 = \sin\theta_r \Rightarrow \boxed{\theta_r = 23^\circ}$ (i)



(ii) $\theta_i = \theta_r$ for reflection

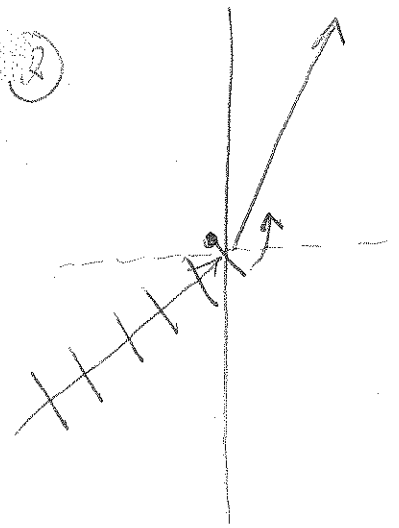
$\boxed{45^\circ = \theta_{reflected}}$

(iii) $n = \frac{c}{v} \Rightarrow v = \frac{c}{n} = \frac{3 \times 10^8 \text{ m/s}}{1.33}$

$\boxed{v_{H_2O} = 2.26 \times 10^8 \text{ m/s}}$

Refract. & Refl. Pract.

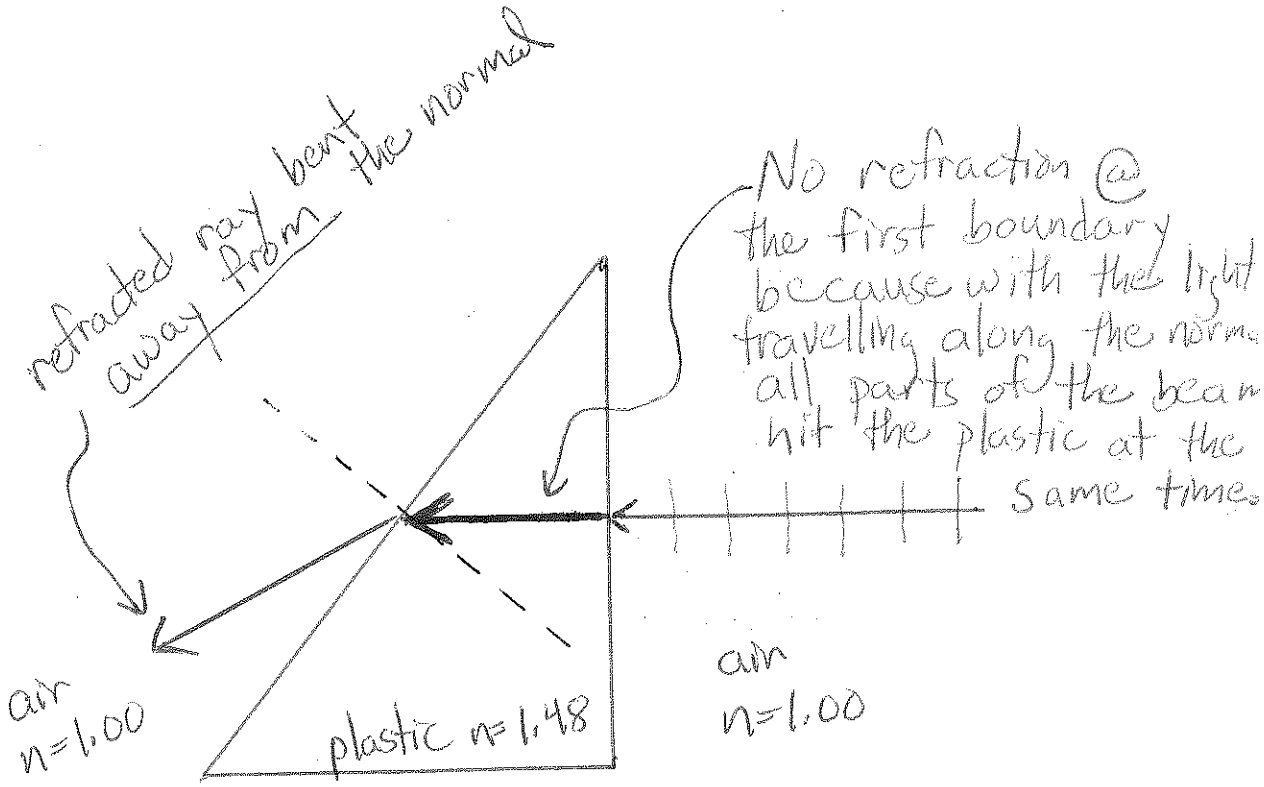
(2)



rotating away from the normal
⇒ speeding up in new medium
⇒ Light travels faster in material Y.

(3)

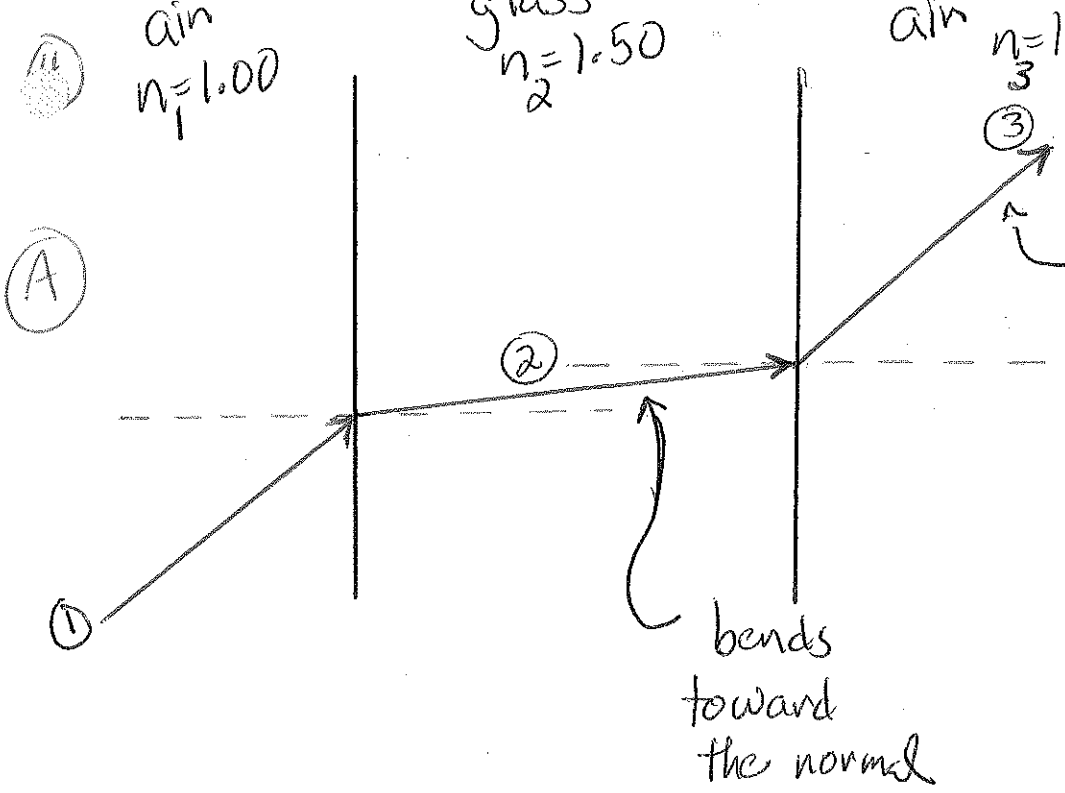
a)



b) $n = \frac{c}{v} \Rightarrow v = \frac{c}{n} = \frac{3 \times 10^8 \text{ m/s}}{1.48} = \boxed{2.0 \times 10^8 \frac{\text{m}}{\text{s}}}$

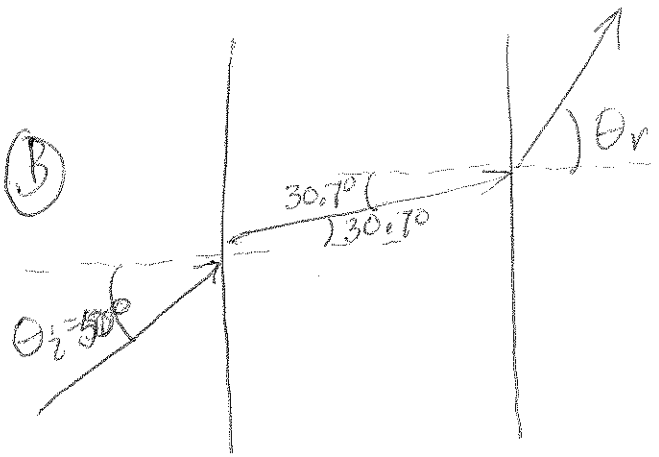
Refr. & Refl. Pract.

(11)



Note: Ray 1 & Ray 3 are parallel as long as the two boundaries are parallel & the materials have the same indices of refraction @ the start & finish ($n_1 = n_3$).

File for Away future use



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

$1.00 \sin 50° = 1.50 \sin\theta_r$

$\theta_r = 30.7°$

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

$1.50 \sin 30.7° = 1.00 \sin\theta_r$

$\theta_r = 50°$

Refr. & Refl. Practice

(5)

A) Glasses' higher index of refraction means that light travels more slowly in glass than in water. When the light goes from glass to air there is a bigger change in speed and more bending than when light goes from water to air.

B) water-air

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

$1.33 \sin 40^\circ = 1.00 \sin\theta_r$

$\theta_r = 58.7^\circ$

This one bent 18.7° away from its original direction of travel.

glass-air

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

$1.50 \sin 40^\circ = 1.00 \sin\theta_r$

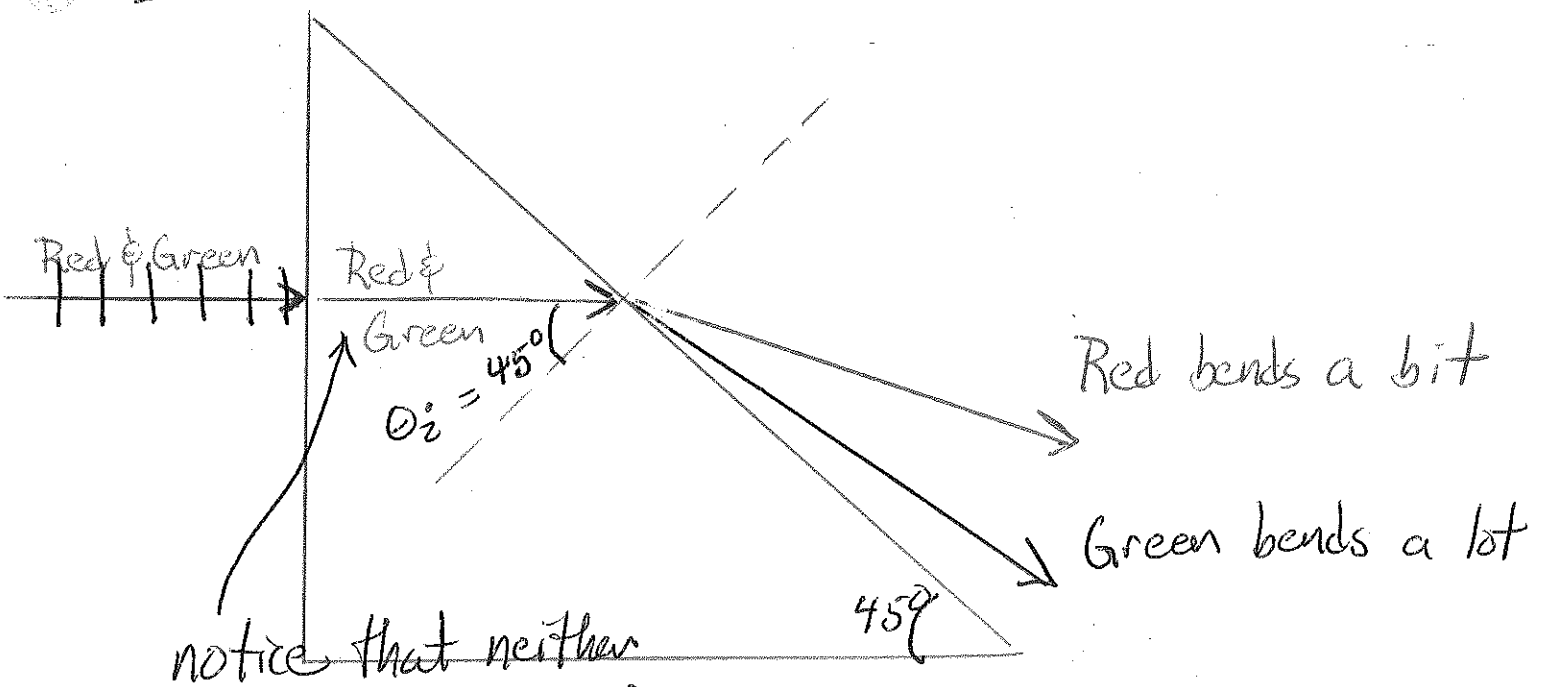
$\theta_r = 74.6^\circ$

This one bent 34.6° away from its original direction of travel

So we see that there is more bending at the glass-air boundary than @ the water-air boundary

(6)

A & B



notice that neither red nor green refracts @ the first boundary because all parts of the wave front reach the boundary @ the same time

c) green

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

$1.30 \sin 45° = 1.00 \sin\theta_r$

$\theta_r = 66.7°$

red

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

$1.10 \sin 45° = 1.00 \sin\theta_r$

$\theta_r = 51.0°$

D) Since all colors have a slightly different index of refraction in a given crystal, then a beam of white light containing all the colors of the rainbow will have each color bent different amounts as the colors exit the crystal. This differential bending spreads the colors out.