

Name: _____

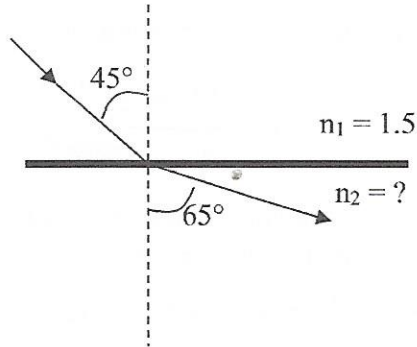
Snell's Law Practice Worksheet

1) For the drawing to the right, find n_2 .

$$n_1 \sin \theta_i = n_2 \sin \theta_r$$

$$1.5 \sin(45^\circ) = n_2 \sin(65^\circ)$$

$$n_2 = \frac{1.5 \sin(45^\circ)}{\sin(65^\circ)} \quad n_2 = 1.17$$



2) For the drawings below, state whether n_1 is bigger than n_2 , n_2 is bigger than n_1 , or n_1 is equal to n_2 .

a)

$n_2 < n_1$

b)

$n_2 > n_1$

c)

$n_2 = n_1$

Indexes of Refraction	
Air or vacuum: 1.00	Barium glass: 1.60
Water: 1.33	Flint glass: 1.70
CR39: 1.498	Polycarbonate: 1.586
Crown Glass: 1.523	Diamond: 2.45

1. A ray of light traveling from air into crown glass strikes the surface at an angle of 30 degrees. What will the angle of refraction be?

$$n_1 \sin \theta_i = n_2 \sin \theta_r \quad \sin \theta_r = \frac{n_1 \sin \theta_i}{n_2} \quad \theta_r = \sin^{-1} \left(\frac{n_1 \sin \theta_i}{n_2} \right) \quad \theta_r = \sin^{-1} \left(\frac{1 \times \sin 30^\circ}{1.523} \right)$$

$$\theta_r = 19.7^\circ$$

2. Light traveling through air encounters a second medium which slows the light to 2.7×10^8 m/s. What is the index of the second medium?

$$n = \frac{c}{v} \quad n = \frac{3 \times 10^8}{2.7 \times 10^8} \quad n = 1.11$$

3. Light travels through a substance at 1.97×10^8 m/s. What is the index of the liquid? What type of liquid is it?

$$n = \frac{c}{v} \quad n = \frac{3 \times 10^8}{1.97 \times 10^8} \quad n = 1.523$$

Crown glass

4. What is the index of refraction of a refractive medium if the angle of incidence in air is 30 degrees and the angle of refraction is 15 degrees?

$$1 \times \sin 30^\circ = n \sin 15^\circ \quad n = \frac{\sin 30^\circ}{\sin 15^\circ} \quad n = 1.93$$

5. If the angle of incidence of light traveling through air, striking water, is 30 degrees, what is the angle of refraction?

$$\theta_r = \sin^{-1} \left(\frac{\sin 30^\circ}{1.33} \right) \quad \theta_r = 22.1^\circ$$

6. If the index of refraction for a certain glass is 1.50, and the angle of refraction is 15 degrees for a ray of light traveling from air, what is the angle of incidence?

$$1 \times \sin \theta_i = 1.5 \sin 15^\circ \quad \theta_i = \sin^{-1} (1.5 \sin 15^\circ) \quad \theta_i = 22.8^\circ$$

7. What is the velocity of light in meters per second in a material with an index of 2.0?

$$v = \frac{c}{n} \quad v = \frac{3 \times 10^8}{2} \quad v = 1.5 \times 10^8 \text{ m/s}$$

8. A light ray moving through CR39 at an angle of 49 degrees exits into another medium at an angle of 27.48 degrees. What is the index of the second medium? What is this medium?

$$1.498 \sin(49^\circ) = n \sin(27.48^\circ) \quad n = \frac{1.498 \sin(49^\circ)}{\sin(27.48^\circ)} \quad n = 2.45 \text{ Diamond}$$

9. If the incoming angle from the air is 20° from the normal.

- a. What angle is light traveling through each of the mediums below:

- i. Flint glass:

$$\theta_r = \sin^{-1} \left(\frac{\sin 20^\circ}{1.61} \right) \quad \theta_r = 12.27^\circ$$

- ii. Water:

$$1.61 \sin(12.27^\circ) = 1.33 \sin \theta_r \quad \theta_r = \sin^{-1} \left(\frac{1.61 \sin 12.27^\circ}{1.33} \right) \quad \theta_r = 15.38^\circ$$

- iii. Diamond:

$$\theta_r = \sin^{-1} \left(\frac{1.33 \sin 15.38^\circ}{2.42} \right) \quad \theta_r = 8.38^\circ$$

- iv. Cubic Zirconium:

$$\theta_r = \sin^{-1} \left(\frac{2.42 \sin(8.38^\circ)}{2.17} \right) \quad \theta_r = 9.35^\circ$$

- v. Air:

$$\theta_r = \sin^{-1} \left(\frac{2.17 \sin 9.35^\circ}{1} \right) \quad \theta_r = 20.6^\circ$$

- b. How does the final angle of the light in air compare to the initial angle of light in air?

The same. Small difference due to roundings.

