

## Worksheet 1. Index of Refraction & Snell's Law Questions

1. Calculate the speed of light for the following mediums:

a. Water ( $n=1.33$ )

$$n = \frac{c}{v} \quad v = \frac{c}{n} \quad v = \frac{3 \times 10^8}{1.33} \quad v = 2.26 \times 10^8 \text{ m/s}$$

b. Diamond ( $n=2.42$ )

$$v = \frac{c}{n} \quad v = \frac{3 \times 10^8}{2.42} \quad v = 1.24 \times 10^8 \text{ m/s}$$

c. Plexiglas ( $n=1.51$ )

$$v = \frac{c}{n} \quad v = \frac{3 \times 10^8}{1.51} \quad v = 1.99 \times 10^8 \text{ m/s}$$

2. Calculate the refractive index for a substance if the speed of light in that medium is

a.  $2.10 \times 10^8 \text{ m/s}$

$$n = \frac{c}{v} \quad n = \frac{3 \times 10^8}{2.1 \times 10^8} \quad n = 1.43$$

b.  $1.50 \times 10^8 \text{ m/s}$

$$n = \frac{c}{v} \quad n = \frac{3.0 \times 10^8}{1.5 \times 10^8} \quad n = 2.0$$

3. Calculate the speed of light in a hypothetical material you have discovered and named in honour of yourself. Its refractive index is 1.10.

$$v = \frac{c}{n} \quad v = \frac{3 \times 10^8}{1.1} \quad v = 2.73 \times 10^8 \text{ m/s}$$

4. Calculate the angle of refraction for light as it passes from air to each of the mediums;

a. Water ( $n=1.33$ )

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

$$n_1 = 1 \quad \theta_r = \sin^{-1} \left( \frac{\sin(25^\circ)}{1.33} \right)$$

$$\theta_r = 18.5^\circ$$

b. Diamond ( $n=2.42$ )

$$\theta_r = \sin^{-1} \left( \frac{\sin(25^\circ)}{2.42} \right) \quad \theta_r = 10.1^\circ$$

c. Plexiglas ( $n=1.51$ )

$$\theta_r = \sin^{-1} \left( \frac{\sin(25^\circ)}{1.51} \right) \quad \theta_r = 16.3^\circ$$

At an incidence angle of  $25.0^\circ$ .

5. Light travels 875 km in material "x" in 5.00 ms. Calculate the speed of light in the material and the material's index of refraction.

$$v = \frac{s}{t} \quad v = \frac{875000}{0.005} \quad v = 1.75 \times 10^8 \text{ m/s}$$

$$n = \frac{c}{v} \quad n = \frac{3 \times 10^8}{1.75 \times 10^8} \quad n = 1.71$$