

Indexes of Refraction

Air or vacuum: 1.00

Water: 1.33

Maple Syrup 1.46

CR39 (Eyeglass Plastic): 1.498

Crown Glass: 1.523

Barium glass: 1.60

Rubbing Alcohol 1.38

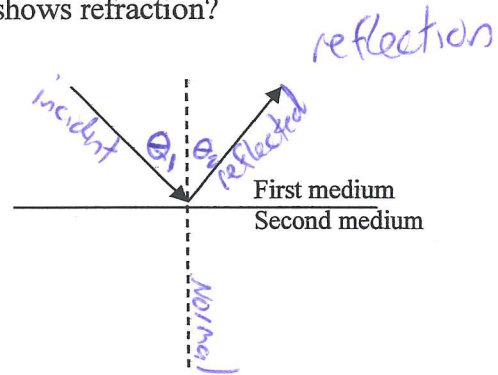
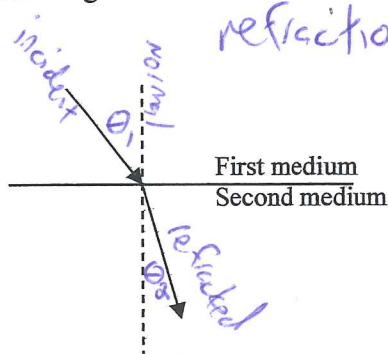
Flint glass: 1.70

Polycarbonate: 1.586

Diamond: 2.45

 $c = \text{speed of light} = 3 \times 10^8 \text{ m/s}$ Index of refraction, $n = c / (\text{light velocity in substance})$ Snell's Law: $n_1 \sin \theta_1 = n_2 \sin \theta_2$

1. Which diagram below shows reflection and which shows refraction?



2. In the diagram above that shows reflection, label the incident ray, the reflected ray, the normal, the angle of incidence (θ_1), and the angle of reflection (θ_2).
3. In the diagram above that shows refraction, label the incident ray, the refracted ray, the normal, the angle of incidence (θ_1), and the angle of refraction (θ_2).
4. Using Snell's Law, calculate the angle of refraction when a light wave travels from air ($n = 1$) into water ($n = 1.33$) at an incident angle of 35 degrees.
5. A ray of light traveling from air into water strikes the surface at an angle of 60 degrees. What will the angle of refraction be?

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$1 \sin 35 = 1.33 \sin \theta_2$$

$$.57358 = 1.33 \sin \theta_2$$

$$.43126 = \sin \theta_2$$

$$\sin^{-1}(.43126) = \theta_2$$

$$\theta_2 = 25.55^\circ$$

$$\theta_2 = 40.63^\circ$$

6. 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?

$$\theta_2 = 19.17^\circ$$

7. You buy a small patch of land in Africa. You happen to notice a strange crystal is found all over your land. To determine what it is, you pass a beam of light through it. You observe that the light enters the crystal at a 30-degree angle from the normal and is bent 11.776 degrees from the normal. What is the strange crystal?

$$n_2 = 2.45$$

Diamond!!

NAME: Key

Snells Law Worksheet

8. After your discovery in question 5, you set up a small mining operation. A worker (that does not know physics) brings you some crystals from his daily dig. Not trusting him, you pass a beam of light through one of the crystals. You observe that the light enters the crystal at a 30-degree angle from the normal and is bent 19.47 degrees from the normal. What has he brought you? $n_2 = 1.5$ Eyeglass Plastic
9. Light travels through a liquid at 2.2531×10^8 m/s. What is the liquid? $n = 1.33$ Water
10. Light travels through a liquid at 2.0548×10^8 m/s. What is the liquid? (mmm, tasty) $n = 1.46$ Maple syrup!!
11. Light traveling through air encounters a second medium which slows the light to 1.61×10^8 m/s. What is the index of the second medium? $n = 1.8634$
12. 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? $n = 1.932$
13. What is the index of refraction of a refractive medium if the angle of incidence in air is 40 degrees and the angle of refraction is 29 degrees? $n = 1.326$
14. What is the index of refraction of a liquid if the angle of incidence in air is 35 degrees and the angle of refraction is 14 degrees? $n = 2.371$
15. If the angle of incidence of light traveling through air, striking water, is 30 degrees, what is the angle of refraction? $\theta_2 = 22.1^\circ$
16. 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? $\theta_1 = 22.84$
17. What is the velocity of light in a material with an index of 2.0? $1.5 \times 10^8 \text{ m/s}$
18. A light ray moving through CR39 at an angle of 49 degrees exits into another medium at an angle of 41 degrees. What is the index of the second medium? $n_2 = 1.723$
19. What is the angle of incidence for a light ray traveling from water into flint glass, if the angle of refraction is 30 degrees? $\theta_1 = 39.72$