

Practice Problems

18.1 Refraction of Light
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1. A laser beam in air is incident upon ethanol at an angle of incidence of 37.0° . What is the angle of refraction?

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

$$\begin{aligned}\theta_2 &= \sin^{-1}\left(\frac{n_1 \sin \theta_1}{n_2}\right) \\ &= \sin^{-1}\left(\frac{(1.00)(\sin 37.0^\circ)}{1.36}\right) \\ &= 26.3^\circ\end{aligned}$$

2. Light in air is incident upon a piece of crown glass at an angle of incidence of 45.0° . What is the angle of refraction?

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

$$\begin{aligned}\theta_2 &= \sin^{-1}\left(\frac{n_1 \sin \theta_1}{n_2}\right) \\ &= \sin^{-1}\left(\frac{(1.00)(\sin 45.0^\circ)}{1.52}\right) \\ &= 27.7^\circ\end{aligned}$$

3. Light passes from air into water at 30.0° to the normal. Find the angle of refraction.

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

$$\begin{aligned}\theta_2 &= \sin^{-1}\left(\frac{n_1 \sin \theta_1}{n_2}\right) \\ &= \sin^{-1}\left(\frac{(1.00)(\sin 30.0^\circ)}{1.33}\right) \\ &= 22.1^\circ\end{aligned}$$

4. Light is incident upon a diamond facet at 45.0° . What is the angle of refraction?

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

$$\begin{aligned}\theta_2 &= \sin^{-1}\left(\frac{n_1 \sin \theta_1}{n_2}\right) \\ &= \sin^{-1}\left(\frac{(1.00)(\sin 45.0^\circ)}{2.42}\right) = 17.0^\circ\end{aligned}$$

5. A block of unknown material is submerged in water. Light in the water is incident on the block at an angle of incidence of 31° . The angle of refraction of the light in the block is 27° . What is the index of refraction of the material of the block?

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

$$\begin{aligned}n_2 &= \frac{n_1 \sin \theta_1}{\sin \theta_2} \\ &= \frac{(1.33)(\sin 31^\circ)}{\sin 27^\circ} \\ &= 1.5\end{aligned}$$

Section Review

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6. **Index of Refraction** You notice that when a light ray enters a certain liquid from water, it is bent toward the normal, but when it enters the same liquid from crown glass, it is bent away from the normal. What can you conclude about the liquid's index of refraction?

$n_{\text{water}} < n_{\text{liquid}} < n_{\text{crown glass}}$, therefore, n_{liquid} must be between 1.33 and 1.52.

7. **Index of Refraction** A ray of light has an angle of incidence of 30.0° on a block of unknown material and an angle of refraction of 20.0° . What is the index of refraction of the material?

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

$$\begin{aligned}n_2 &= \frac{n_1 \sin \theta_1}{\sin \theta_2} \\ &= \frac{(1.00)(\sin 30.0^\circ)}{\sin 20.0^\circ} \\ &= 1.46\end{aligned}$$

Study Guide Refraction And Lenses Answers

Bo Lou



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