

PhyzGuide: Refraction Diagrams

Index of refraction, Snell's law

Angle of refraction is related to angle of incidence by the index of refraction of a specific material.

Index of refraction is a unitless number that refers to refraction of a wave when the wave passes from medium 1 to medium 2.

Index of refraction, n , for various media can be found experimentally with an arrangement such as that shown to the right. A beam of light is incident at an angle θ_i on the surface of a semicircular dish of liquid. Some of the light is reflected, the rest is refracted at an angle θ_2 into the material. Because of the shape of the dish, the refracted ray will hit the second boundary (liquid to air) at 90° and is therefore not refracted further, so θ_2 can easily be measured.

The index of refraction of the liquid is given by **Snell's law** (after seventeenth-century Dutch astronomer Willebrord Snell).

$$n = \sin\theta_1 / \sin\theta_2$$

Notice what happens to the wavelength λ of the wave as it is refracted. Two rays are shown to the right. The lines perpendicular to those rays represent wavefronts or wavecrests, so the distance between them is λ .

Because the waves travel more slowly in the second medium, $\lambda_2 < \lambda_1$. (Recall the conveyor belt analogy—if boxes go from a fast moving conveyor belt to a slow one, the distance between the boxes becomes smaller.)

The mathematical relation is

$$\lambda_1/\lambda_2 = v_1/v_2 = n_2/n_1$$

