Wavelength affects the index of refraction

Note that the indices of refraction listed in **Table 1** are only valid for light that has a wavelength of 589 nm in a vacuum. The reason is that the amount that light bends when entering a different medium depends on the wavelength of the light as well as the speed. Thus, a spectrum is produced when white light passes through a prism. Each color of light has a different wavelength. Therefore, each color of the spectrum is refracted by a different amount.

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Code: HF61404

Snell's law determines the angle of refraction

The index of refraction of a material can be used to figure out how much a ray of light will be refracted as it passes from one medium to another. As mentioned, the greater the index of refraction, the more refraction occurs. But how can the angle of refraction be found?

In 1621, Willebrord Snell experimented with light passing through different media. He developed a relationship called Snell's law, which can be used to find the angle of refraction for light traveling between any two media.

SNELL'S LAW

$$n_i \sin \theta_i = n_r \sin \theta_r$$

index of refraction of first medium × sine of the angle of incidence = index of refraction of second medium × sine of the angle of refraction

SAMPLE PROBLEM A

Snell's Law

PROBLEM

A light ray of wavelength 589 nm (produced by a sodium lamp) traveling through air strikes a smooth, flat slab of crown glass at an angle of 30.0° to the normal. Find the angle of refraction, θ_r.

SOLUTION

Given: $\theta_i = 30.0°$ $\quad n_i = 1.00$ $\quad n_r = 1.52$

Unknown: $\theta_r = ?$

Use the equation for Snell's law.

$$n_i \sin \theta_i = n_r \sin \theta_r$$

$$\theta_r = \sin^{-1}\left[\frac{n_i}{n_r}(\sin \theta_i)\right] = \sin^{-1}\left[\frac{1.00}{1.52}(\sin 30.0°)\right]$$

$$\boxed{\theta_r = 19.2°}$$