Geo. 347k
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SNELLS LAW AND THE CRITICAL ANGLE

Snells Law states

$$n_r/n_i = \sin i/\sin r$$

Where

- n_r = the refractive index of the medium that light is passing into.
- n_i = the refractive index of the medium that light is passing out of.
- i = the angle that the incident light ray makes with the normal.
- r = the angle the light ray is refracted to relative to the normal.

Air has a refractive index of 1.0003, which we will round off to 1. Thus, for light passing from air into a gem (Fig. 1) n_i is 1 and Snells Law simplifies to:

$$n_r = \sin i/\sin r$$

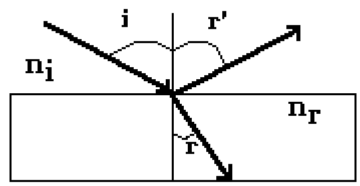

Figure 1

For light passing from a gem into air (Fig. 2) the incident ray is within the gem and the medium that light is passing into is air. Thus n_r is 1 and Snells Law is:

$$1/n_i = \sin i/\sin r \quad \text{or} \quad n_i = \sin r/\sin i$$

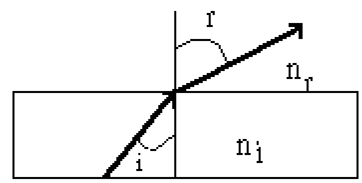

Figure 2

We define a special angle, the **Critical Angle** (**CA**), as the angle of incidence within a gem for which light is refracted parallel to the surface it is incident upon (Fig. 3). By this definition, the angle of refraction (r) at the critical angle is 90^o. Plugging this special relationship into Snells Law yields the following:

$$1/n_i = \sin CA/ \sin 90^o$$

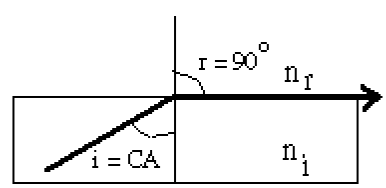

Figure 3

The sine of 90^o equals 1, which reduces the equation to:

$$1/n_i = \sin CA$$

This equation simply states that high refractive index materials have small critical angles and vise versa.