

Answer on Question #55301, Physics / Optics

The angle of minimum deviation for a 75° prism of dense glass is found to be 45° when in air and 15° when immersed in certain liquid. The refractive index of the liquid is

Solution:

The minimum deviation D in a prism occurs when the entering angle and the exiting angle are the same, a particularly symmetrical configuration. Applying Snell's Law at the interfaces you can derive the following relationship:

$$\frac{n}{n_0} = \frac{\sin \frac{D_1 + A}{2}}{\sin \frac{A}{2}}$$

where n is the refractive index of glass, $n_0 = 1$ is the refractive index of air, D_1 is the angle of minimum deviation, and A is the internal angle of the prism.

Thus,

$$n = \frac{\sin \frac{45^\circ + 75^\circ}{2}}{\sin \frac{75^\circ}{2}} = 1.423$$

Equation for liquid is

$$\frac{n}{n_L} = \frac{\sin \frac{D_2 + A}{2}}{\sin \frac{A}{2}}$$

Thus,

$$n_L = n \frac{\sin \frac{A}{2}}{\sin \frac{D_2 + A}{2}} = 1.423 \cdot \frac{\sin \frac{75^\circ}{2}}{\sin \frac{75^\circ + 15^\circ}{2}} = 1.225$$

Answer: $n_L = 1.225$