Answer on Question #74434, Physics / Optics

Question. A ray of light is incident at angle $60°$ on one face of a prism which has an apex angle of $30°$. The ray emerging out of the prism make an angel of $30°$ with the incident ray. The refractive index of the material of prism is

(1) $\sqrt{2}$;

(2) $\sqrt{3}$;

(3) 1.5;

(4) 1.6.

Given. $\theta = 60°; A = 30°; \delta = 30°.$

Find. $n-?$

Solution.

For a prism

$$\delta = \theta + \gamma - A,$$

where

$$\sin\gamma = n \cdot \sin\left(A - \arcsin\left(\frac{\sin\theta}{n}\right)\right)$$

So,

$$30° = 60° + \gamma - 30° \quad \rightarrow \quad \gamma = 0.$$

$$\sin 0° = n \cdot \sin\left(A - \arcsin\left(\frac{\sin 60°}{n}\right)\right) \quad \rightarrow \quad 0 = \sin\left(A - \arcsin\left(\frac{\sin 60°}{n}\right)\right) \rightarrow$$

$$A - \arcsin\left(\frac{\sin 60°}{n}\right) = 0 \quad \rightarrow \arcsin\left(\frac{\sin 60°}{n}\right) = 30° \quad \rightarrow$$

$$\frac{\sin 60°}{n} = \sin 30° \quad \rightarrow \quad \frac{\sqrt{3}}{2n} = \frac{1}{2} \quad \rightarrow \quad n = \sqrt{3}$$

Answer. $n = \sqrt{3}.$