Question

A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is $\frac{3}{4}$th of the angle of prism. Calculate the speed of light in the prism.

Solution

Here, Angle of prism, $A = 60^o$

Angle of incidence, $i=\frac{3}{4} \times 60$

$i+e=A+\delta$

e is emergence angle

where δ is deviation angle

At minimum deviation $\delta = \delta_{min}$

$i=e$

$2i=A+\delta_{min}$

$2 \times 45 = 60 + \delta_{min}$

$\delta_{min} = 30$

By prism law,

$$\mu = \frac{\sin\frac{A + \delta_{min}}{2}}{\sin\frac{A}{2}}$$

$$\mu = \frac{\sin\frac{60 + 30}{2}}{\sin\frac{60}{2}} = \frac{2}{\sqrt{2}} = 1.41$$

Let v be velocity of light in prism

$$v = \frac{c}{\mu} = \frac{3 \times 10^8}{1.41} = 2 \times 10^8 \text{ m/s}$$