For an isosceles prism of angle A and refractive index μ, it is found that the angle of minimum deviation $\delta_m = A$. Which of the following option(s) is/are correct?

This question has multiple correct options

A. At minimum deviation, the incident angle i_1 and the refracting angle r_1 at the first refracting surface are related by $r_1 = (i_1/2)$

B. For this prism the refractive index μ and the angle of prism A are related as $A = \frac{1}{2}\cos^{-1}\left(\frac{\mu}{2}\right)$

C. For this prism, the emergent ray at the second surface will be tangential to the surface when the angle of incidence at the first surface is $i_1 = \sin^{-1}\left[\sin A\sqrt{4\cos^2\frac{A}{2} - 1} - \cos A\right]$

D. For the angle of incidence $i_1 = A$, the ray inside the prism is parallel to the base of the prism

Solution

Correct options are A) , C) and D)

Option A

We know for minimum deviation, $i_1 = \frac{A + \delta_m}{2}$ (δ_m : angle of minimum deviation)

Given $\delta_m = A$

Hence $i_1 = A$

Now, for minimum deviation condition $r_1 = A/2$

Hence $r_1 = i_1/2$

Correct

Option B

$$\mu = \frac{\sin(i_1)}{\sin(r_1)}$$

$$\mu = \frac{\sin(\frac{A + \delta_m}{2})}{\text{Sin } (A/2)}$$

$$\mu = \frac{\sin A}{\sin A/2} = 2 \cos A/2$$

Incorrect

Option C

Emergence = 90^o

$\sin r_2 = \mu$

$r_2 = \text{Sin}^{-1} \mu$

Also $r_1 = A - r_2$

$\sin i_1 = \mu \sin r_1$

$\sin i_1 = \mu \sin(A - r_2)$

$\sin i_1 = \mu(\sin A \cos r_2 - \cos A \sin r_2)$

But $\mu \sin r_2 = 1$

$\sin i_1 = \mu \sin A \cos r_2 - \cos A = \sin A \sqrt{4\cos^2 A/2 - 1} - \cos A$

Correct