



DPP – 10 (Geometrical Optics)

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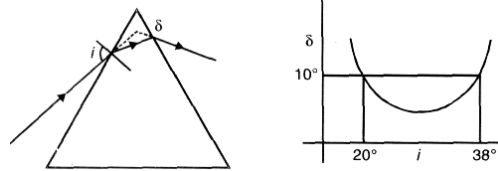
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- Q 1. A beam of monochromatic light is incident at $i = 50^\circ$ on one face of an equilateral prism, the angle of emergence is 40° , then the angle of minimum deviation is:
(a) 30° (b) $< 30^\circ$ (c) $\leq 30^\circ$ (d) $\geq 30^\circ$

- Q 2. A ray is incident on prism at an angle i with normal, when it comes out of prism its angular deviation is δ . Graph between δ and i is given. Prism angle is



- (a) 68° (b) 60° (c) 48° (d) 29°
- Q 3. What is the minimum value of refractive index for an equilateral prism so that rays do not emerge from opposite side?
(a) $\mu = 1.15$ (b) $\mu = 2$ (c) $\mu = 1.33$ (d) $\mu = 1.6$
- Q 4. The angle of incidence for an equilateral prism is 45° , what should be the refractive index of prism material so that the ray is parallel to the base inside prism
(a) 1.3 (b) 1.4 (c) 1.5 (d) 1.6
- Q 5. The limiting angle of incidence of a ray that can be transmitted by an equilateral prism of $\mu = \sqrt{\frac{7}{3}}$ is
(a) $\pi/6$ (b) $\pi/3$ (c) $\pi/4$ (d) $\pi/5$
- Q 6. A glass prism has $\mu = 1.5$ and the refracting angle is 90° . If a ray falls on it at angle of incidence of 30° then what will be the angle of emergence:
(a) 60°
(b) 30°
(c) 45°
(d) The ray will not come out from opposite surface of prism
- Q 7. If the refracting angle of a prism or prism angle is 60° and minimum deviation 30° , the angle of incidence will be:
(a) 30° (b) 45° (c) 60° (d) 90°

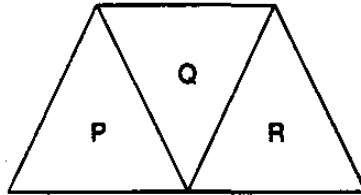
Q 8. The maximum value of index of refraction of a material of a prism which allows the passage of light through it when the refracting angle of the prism is A is

- (a) $\sqrt{1 + \sin^2\left(\frac{A}{2}\right)}$ (b) $\sqrt{1 + \cos^2\left(\frac{A}{2}\right)}$
 (c) $\sqrt{1 + \tan^2\left(\frac{A}{2}\right)}$ (d) $\sqrt{1 + \cot^2\left(\frac{A}{2}\right)}$

Q 9. The refractive index of a prism is 2. For no total internal reflection of any ray by prism, it can have a maximum refracting angle of:

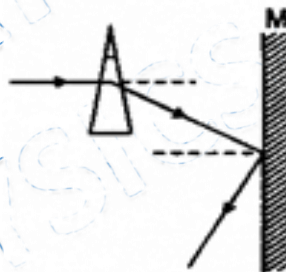
- (a) 90° (b) 60° (c) 45° (d) 30°

Q 10. A given ray of light suffers minimum deviation in an equilateral prism P. Additional prism Q and R of identical shape and of the same material as P are now added as shown in the figure. The ray will suffer:



- (a) greater deviation (b) no deviation
 (c) same deviation as before (d) total internal reflection

Q 11. A horizontal ray of light passes through a prism of $\mu = 1.5$ whose apex angle is 4° and then strikes a vertical mirror M as shown. The ray after reflections to become horizontal the mirror must be rotated through an angle of



- (a) 2° (b) 3° (c) 4° (d) 1°

Q 12. For an equilateral prism, it is observed that when a ray strikes grazingly at one face it emerges grazingly at the other. Its refractive index will be:

- (a) $\frac{\sqrt{3}}{2}$ (b) $\frac{2}{\sqrt{3}}$
 (c) 2 (d) data not sufficient

Q 13. For a ray passing through a prism, values of i and e are 36° and 42° respectively. Then angle of incidence for minimum deviation cannot be

- (a) 37° (b) 38° (c) 39° (d) 40°



Answer Key

Q.1 b	Q.2 c	Q.3 b	Q.4 b	Q.5 a
Q.6 d	Q.7 b	Q.8 d	Q.9 d	Q.10 c
Q.11 d	Q.12 c	Q.13 c, d		

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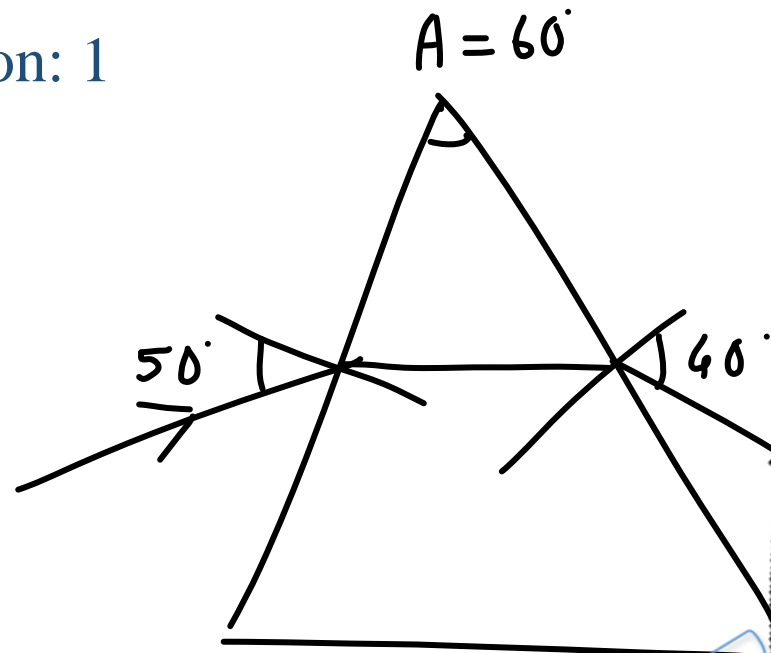


Written Solution

DPP- 10 : Geometrical optics - Prism

By Physicsaholics Team

Solution: 1



$$i + e = A + \delta$$

$$\delta = i + e - A$$

$$= 50 + 40 - 60$$

$$= 30$$

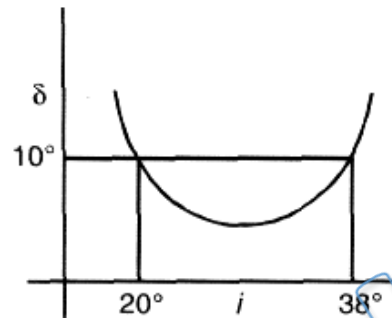
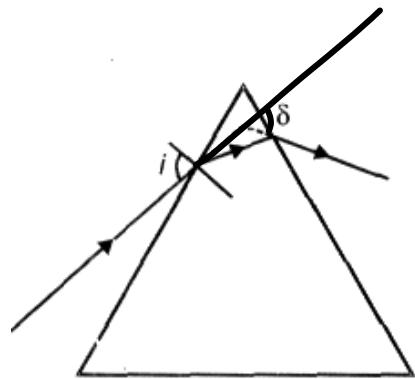
This δ is not δ_{\min} since $i \neq e$.

\Rightarrow

$$\delta_{\min} < 30$$

ANS(b)

Solution: 2



from graph →

$$i = 20 \Rightarrow e = 38^\circ \text{ and } \delta = 10^\circ$$

$$i + e = A + \delta$$

$$\Rightarrow A = i + e - \delta = 20 + 38 - 10 \\ = 48^\circ$$

Ans(c)

Solution: 3

for no emergence from opposite face

$$A > 2i_c \Rightarrow \sin A/2 > \sin i_c$$

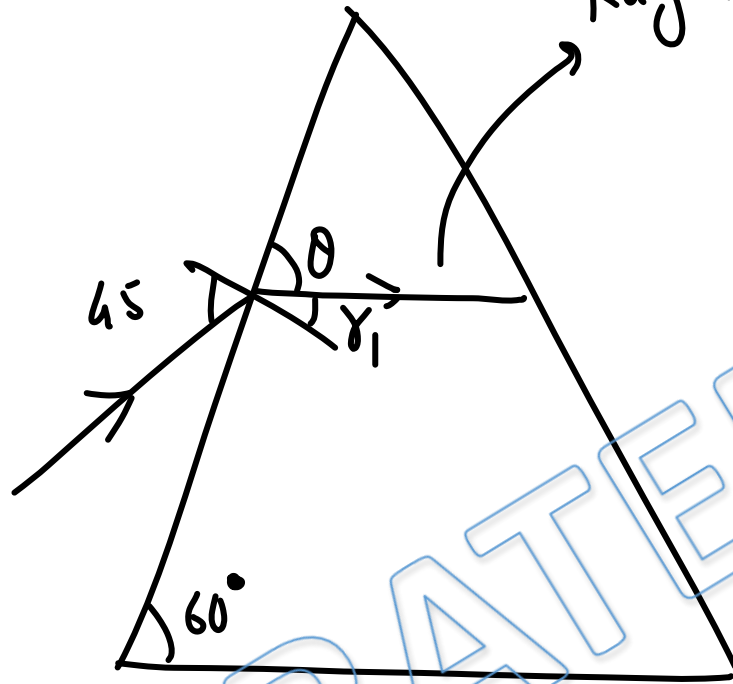
$$\Rightarrow \mu > \frac{1}{\sin(A/2)}$$

$$\Rightarrow \mu > \frac{1}{\sin 30^\circ}$$

$$\Rightarrow \mu > 2$$

ANS(b)

Solution: 4



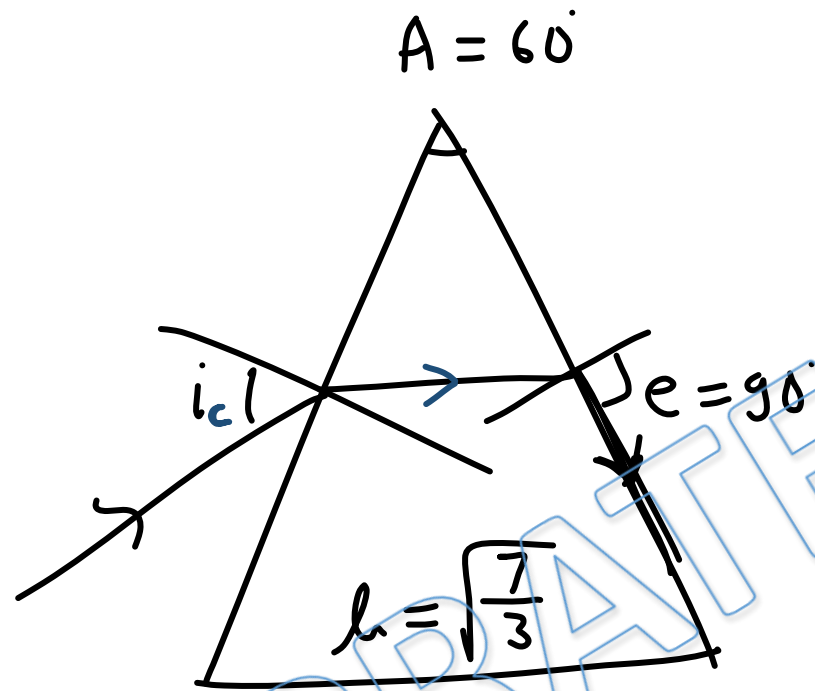
$$1 \sin 45^\circ = \mu \sin 30^\circ$$

$$\Rightarrow \frac{1}{\sqrt{2}} = \mu \times \frac{1}{2}$$

$$\Rightarrow \mu = \sqrt{2}$$

Ans (b)

Solution: 5

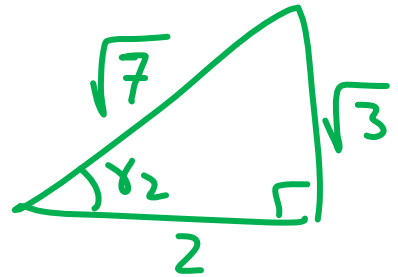


for limiting angle of incidence, $e = 90^\circ$.

Using Snell's law at second surface

$$\sqrt{\frac{7}{3}} \sin \gamma_2 = 1 \sin 90^\circ$$

$$\Rightarrow \sin \gamma_2 = \sqrt{\frac{3}{7}}$$



$$\gamma_1 = 60^\circ - \gamma_2$$

$$\Rightarrow \sin \gamma_1 = \sin 60^\circ \cos \gamma_2 - \cos 60^\circ \sin \gamma_2$$

$$\Rightarrow = \frac{\sqrt{3}}{2} \times \frac{2}{\sqrt{7}} - \frac{1}{2} \times \frac{\sqrt{3}}{\sqrt{7}}$$

$$= \frac{\sqrt{3}}{2\sqrt{7}}$$

Using Snell's law at first surface

$$1 \times \sin i_c = \sqrt{\frac{7}{3}} \sin r_1$$

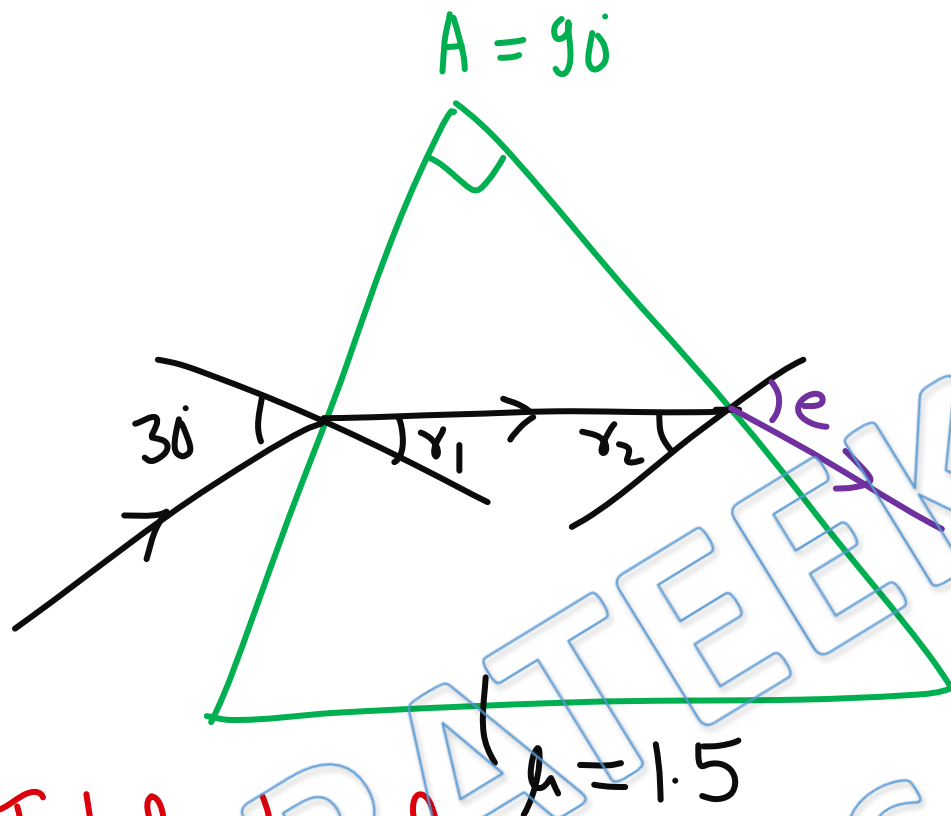
$$= \sqrt{\frac{7}{3}} \times \frac{\sqrt{3}}{2\sqrt{7}}$$

$$= \frac{1}{2}$$

$$\Rightarrow i_c = 30^\circ$$

Ans(a)

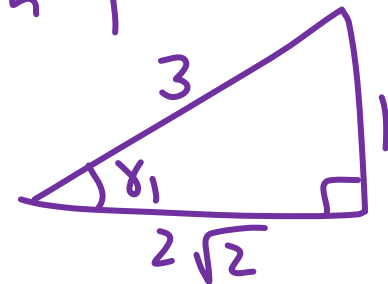
Solution: 6



Using Snell's law at first surface

$$1 \times \sin 30^\circ = \frac{3}{2} \sin r_1$$

$$\sin r_1 = \frac{1}{3}$$



$$r_2 = 90^\circ - r_1$$

$$\sin r_2 = \sin(90^\circ - r_1) = \cos r_1 = \frac{2\sqrt{2}}{3}$$

T.I.R. → Total internal reflection.

Using Snell's law at second surface →

$$\frac{3}{2} \times \frac{2\sqrt{2}}{3} = 1 \times \sin e$$

$$\Rightarrow \sin e = \sqrt{2}, \text{ not possible.}$$

⇒ T.I.R. at second surface. **Ans(d)**

Solution: 7

for minimum deviation angle of incidence

$$i = \frac{A + \delta_{\min}}{2} = \frac{60^\circ + 30^\circ}{2} = 45^\circ$$

Ans(6)

Solution: 8

for passage of rays through prism

$$A < 2i_c \Rightarrow \sin A/2 < \sin i_c$$

$$\Rightarrow \frac{1}{\mu} > \sin A/2 \Rightarrow \mu < \frac{1}{\sin A/2}$$

$$\Rightarrow \mu < \operatorname{cosec} A/2$$

$$\Rightarrow \mu < \sqrt{1 + \cot^2(A/2)}$$

Ans(d)

Solution: 9

FOR No total internal reflection by prism

$$A < i_c$$

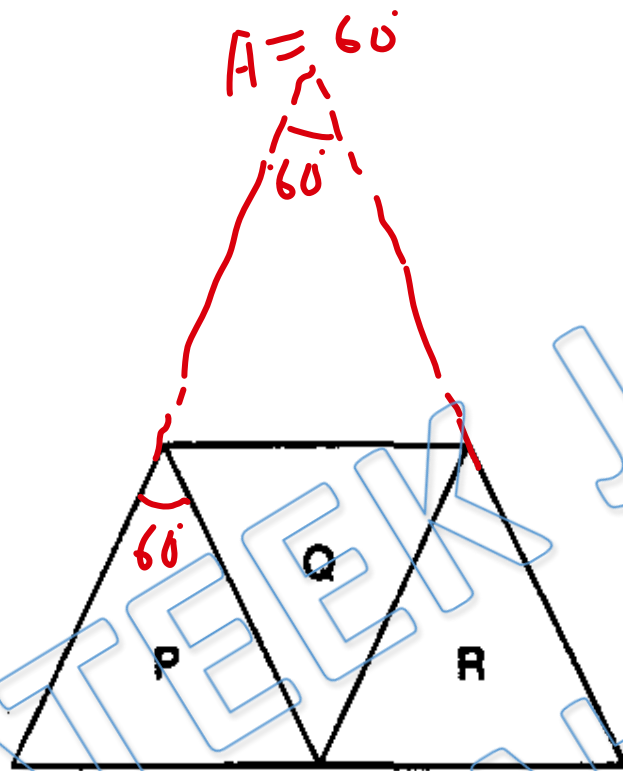
$$\Rightarrow A < \sin^{-1}\left(\frac{1}{\mu}\right)$$

$$\Rightarrow A < \sin^{-1}\left(\frac{1}{2}\right)$$

$$\Rightarrow A < 30^\circ$$

Ans(d)

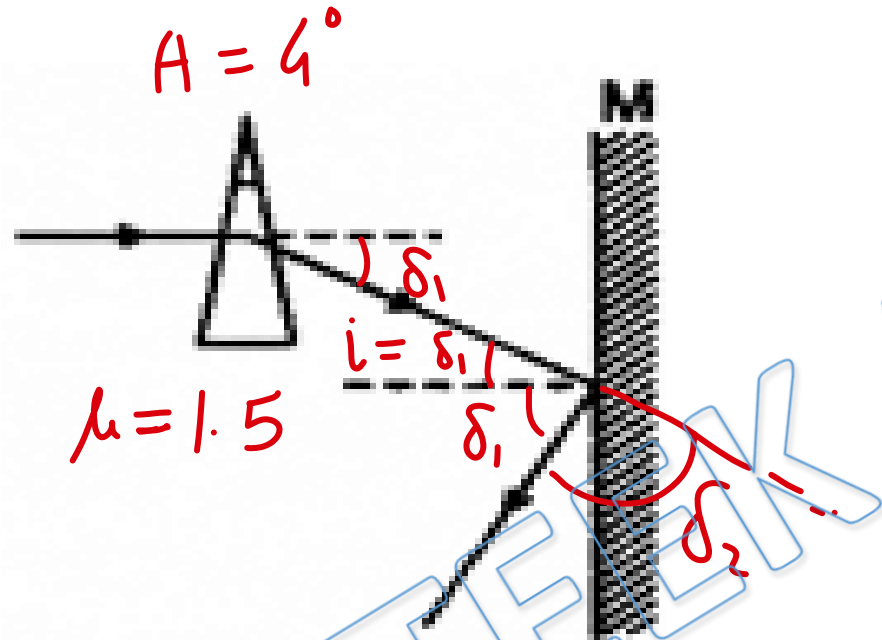
Solution: 10



Since A is not changing on adding Q & R .
 δ will remain same.

ANS (c)

Solution: 11



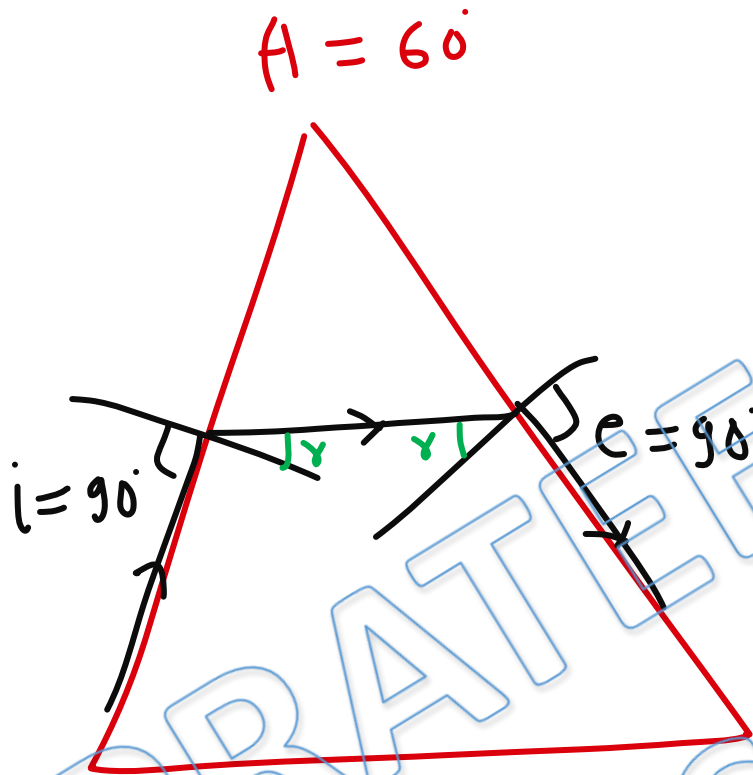
deviation by prism $\delta_1 = A(\mu - 1) = 4^\circ(1.5 - 1) = 2^\circ$

Here final ray is at 2° down to horizontal. To make it

horizontal we should rotate it by 1° clockwise.

Ans(d)

Solution: 12



Here $i = e \Rightarrow r_1 = r_2 = r = A/2$

$$r = 30^\circ$$

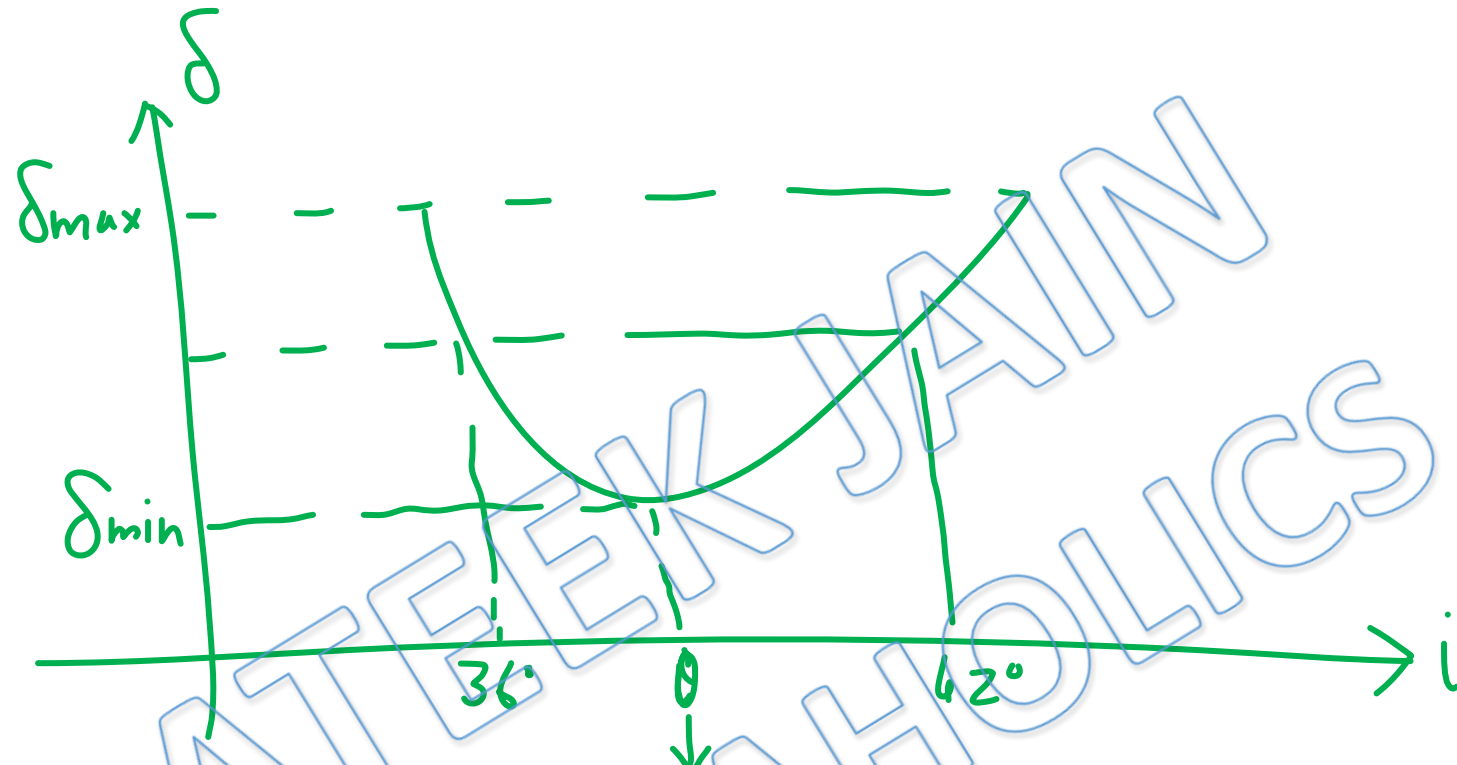
Using Snell's law at first surface

$$1 \times \sin 90^\circ = \mu \sin 30^\circ$$

$$\Rightarrow \mu = 2$$

Ans (c)

Solution: 13



δ vs i graph is not symmetric. θ is closer to 36° .
angle of incidence for minimum deviation.

$$\Rightarrow \theta < \frac{36^\circ + 42^\circ}{2} \Rightarrow \theta < 39^\circ$$

Ans (c, d)

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