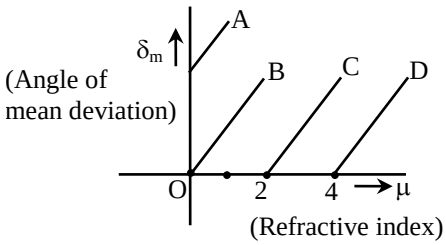
PHYSICS

Q.1 A student gets four different graphs when he does experiment with the prism at different value of angle of incidence. Which is correct –



(A) A , B, C (B) B, C, D

(C) C, B (D) only C **[D]**

Sol. A, B is not possible similarly for D μ is more than 4, which is not possible

Q.2 For a prism, its refractive index is cot A/2. Then minimum angle of deviation is -

(A) 180° – A (B) 180° – 2A

(C) 90° – A (D) A/2 **[B]**

Sol. $\cot A/2 = \dfrac{\sin\left(\dfrac{A+\delta_m}{2}\right)}{\sin A/2}$

$\dfrac{\cos A/2}{\sin A/2} = \dfrac{\sin\left(\dfrac{A+\delta_m}{2}\right)}{\sin A/2}$

$\sin(90 - A/2) = \sin\left(\dfrac{A+\delta_m}{2}\right)$

so $\delta_m = 180° - 2A$

Q.3 A glass prism has μ = 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 of this prism

[D]

Q.4 The cross-section of a prism (μ = 1.5) in an equilateral triangle. A ray of light is incident perpendicular on one of the faces. The angle of deviation of the ray is –

(A) 60º (B) 120º

(C) 90º (D) none of these

[A]

Q.5 A prism has a refracting angle of 60°, any ray falling on one face of the prism will not emerge from the other face if its refractive index exceeds :

(A) 1.414 (B) 1.500

(C) 1.732 (D) 2.000 **[C]**

Q.6 If the refracting angle of a prism is 60º and minimum deviation is 30º, the angle of incidence is -

(A) 30º (B) 45º (C) 60º (D) 90º

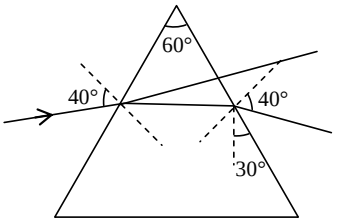
Sol. **[B]** $i = \dfrac{\delta_m + A}{2} = \dfrac{30º+60º}{2} = 45º$

Q.7 A ray of light is incident on a face of equilateral triangular prism at an incident angle 40°. At this angle, minimum deviation occurs. The value of this deviation is –

(A) 60° (B) 10°

(C) 20° (D) 40° **[C]**

Sol.



At δ_{min}

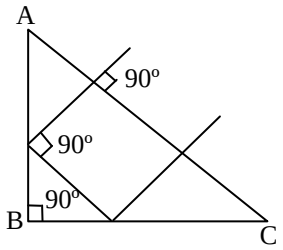
$i = e$

$\delta_{min} = i + e - A$

$= 40 + 40 - 60$

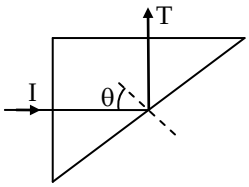
$= 20°$

Q.8 A ray of light is incident on a prism ABC(AB = BC) and travels as shown in figure. The refractive index of the prism material should be at least-



(A) 4/3 (B) √2 (C) 1.5 (D) √3 **[B]**

Q.9 A triangular prism of glass is shown in figure. A ray incident normal to one face is totally reflected.If θ is 45°, then index of refraction of the glass is-



(A) less than 1.41 (B) equal to 1.41

(C) greater then 1.41 (D) None of these **[C]**

Q.10 Find the angle of a prism of dispersive power 0.021 and refractive index 1.52 to form an achromatic combination with a prism of angle 4.2° and dispersive power 0.045 having refractive index 1.65.

(A) 11.25° (B) 12° (C) 11° (D) 11.5°

[A]

Q.11 The dispersive powers of flint glass and crown glass are 0.053 and 0.034 respectively and their mean refractive indices are 1.68 and 1.53 for white light. Calculate the angle of the flint glass prism required to form an achromatic combination with a crown glass prism of refracting angle 4°

(A) 2° (B) 4° (C) 5° (D) 6°

[A]

Q.12 Calculate the dispersive power for crown glass from the given data $\mu_v = .5230$, $\mu_r = 1.5145$

(A) 2° (B) 3°

(C) 0.0163° (D) 2.5° **[C]**

Q.13 Angle of minimum deviation for a prism of refractive index 1.5 is equal to the angle of prism. The angle of prism is - (cos 41° = 0.75)

(A) 62° (B) 41° (C) 82° (D) 31°

Sol. [C] $\mu = 1.5$, $\delta_m = A$, Given cos 41° = 0.75

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}} = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\frac{A}{2}}$$

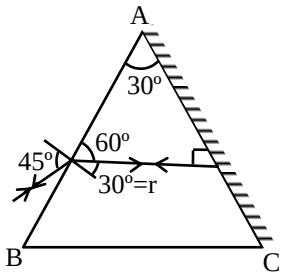
$$= \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}}$$

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

$$\frac{3}{2} = 2\cos\frac{A}{2} \Rightarrow \cos\frac{A}{2} = 0.75 = \cos 41^\circ$$

$$\frac{A}{2} = 41^\circ \ \therefore \ \boxed{A = 82^\circ}$$

Q.14 The face AC of a prism ABC of refracting angle 30° is silvered. A ray is incident on face AB at an angle of 45° as shown in figure. The refracted ray undergoes reflection at face AC and retraces its path. The refractive index of the prism is-



(A) $\sqrt{2}$ (B) $\sqrt{\frac{3}{2}}$

(C) $\frac{3}{2}$ (D) $\frac{4}{3}$ **[A]**

Q.15 In a thin prism of glass (refractive index 1.5), which of the following relations between the angle of minimum deviations δ_m and angle of refraction r will be correct ?

(A) $\delta_m = r$ (B) $\delta_m = 1.5r$

(C) $\delta_m = 2r$ (D) $\delta_m = \frac{r}{2}$ **[A]**

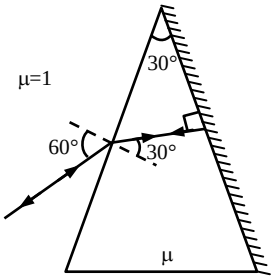
Sol. For minimum deviation $r = \frac{A}{2} \Rightarrow A = 2r$

$\delta_m = (\mu - 1)A = (1.5 - 1) \times 2r \ \therefore \boxed{\delta_m = r}$

Q.16 One of the refracting surfaces of a prism of angle 30° is silvered. A ray of light incident at an angle of 60° retraces its path . The refractive index of the material of the prism is -

(A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) 3/2 (D) 2 **[B]**

Sol.



$1 \sin 60° = \mu \sin 30°$

$\therefore \mu = \sqrt{3}$

Q.17 A parallel beam of monochromatic light is incident on one face of an equilateral prism, the angle of incidence being 55°. The angle of emergence of the beam from the other face is 46° .The angle of minimum deviation is -

(A) less than 41º

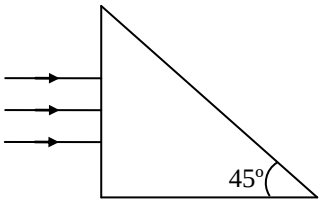
(B) equal to 41º

(C) greater than 41º

(D) greater than of equal to41º

[A]

Q.18 A beam of light consisting of red, green and blue colours is incident on an isosceles right angled prism as shown in the figure .The refractive indices of the material of the prism for red, green and blue colours are 1.39,1.43 and 1.47 respectively. The prism will –



A) separate red colour from green and blue colours.

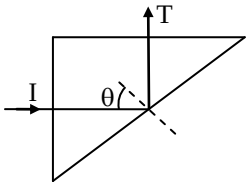
(B) separate blue colour from red and green colours

(C) separate green colour from, red and blue colours.

(D) separate all the three colours from one another

[A]

Q.19 A triangular prism of glass is shown in figure. A ray incident normal to one face is totally reflected.If θ is 45°, then index of refraction of the glass is-



(A) less than 1.41 (B) equal to 1.41

(C) greater then 1.41 (D) None of these

[C]

Q.20 The critical angle of a prism is 36º. The maximum angle of prism for which an emergent ray is possible is-

(A) 72º (B) 54º (C) 36º (D) 16º

Sol. **[A]**

For an emergent ray, $A \le 2\, i_c$

$\therefore A \le 2 \times 36º$

$\therefore A \le 72º$

Q.21 If the refracting angle of a prism is 60º and minimum deviation 30º, the angle of incidence will be :

(A) 30º (B) 45º

(C) 60º (D) 90º **[B]**

Q.22 A ray of light passes through an equilateral glass prism in such a manner that the angle of incidence is equal to the angle of emergence and each of these angles is equal to (3/4) of the angle of prism .The angle of deviation is :

(A) 40º (B) 70º

(C) 39º (D) 30º **[D]**

Q.23 When a beam of white light passes through a prism it splits up into different colours, violet is bent most because :

(A) μ of glass for violet rays is smaller than for other rays

(B) μ of glass for violet rays is greater than for other rays

(C) μ is same for all colours but violet rays have smaller wavelength

(D) μ is same for all colours but violet rays have longer wavelength **[B]**

Q.24 The deviation produced by a prism is :

(A) Same for all wavelengths

(B) Greatest for red and least for violet

(C) Greatest for violet and least for red

(D) The prism produces no deviation **[C]**

Q.25 Yellow light is refracted through a prism producing minimum deviation. If i_1 and i_2 denote the angle of incidence and emergence for the light then :

(A) $i_1 = i_2$ (B) $i_1 > i_2$

(C) $i_1 < i_2$ (D) $i_1 + i_2 = 90°$ **[A]**

Q.26 A small angle prism has a prism angle |A| = 4° and refractive index = 1.5.It is placed with its base horizontal in front of a vertical mirror. A horizontal ray of light passes through the prism and is reflected back from the mirror. By what angle the mirror should be rotated so that the reflected ray becomes horizontal ?

(A) 1º (B) 3º (C) 6º (D) 9º

[A]

Q.27 A ray is incident at an angle of incidence i on one face of a prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, the angle of incidence i is nearly equal to :

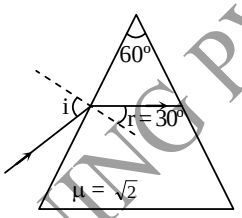
(A) A/μ (B) A/2μ (C) μA D)μA/2

[C]

Q.28 Refractive index of prism material is $\sqrt{2}$ and angle of prism is 60º. The angle of incidence for minimum deviation is -

(A) 30º (B) 45º (C) 60º (D) 90º

Sol.[B]

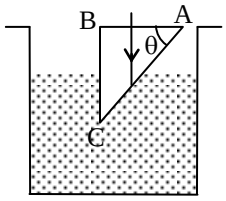


$r = \frac{A}{2} = 30º$

$\sin i = \sqrt{2} \sin 30º$

$\therefore \quad i = 45º$

Q.29 A glass prism of refractive index 1.5 is immersed in water (μ = 4/3). Light beam incident normally on the face AB is totally reflected to reach the face BC if :



(A) $\sin\theta > 8/9$ (B) $2/3 < \sin\theta < 8/9$

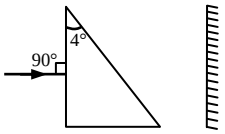
(C) $\sin\theta \le 2/3$ (D) $\cos\theta \ge 8/9$ **[A]**

Q.30 Deviation δ produced by a prism of refractive index μ and small angle A is given by :

(A) $\delta = (\mu - 1) A$ (B) $\delta = (\mu + 1) A$

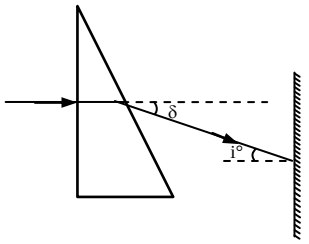
(C) $\delta = (A - 1) \mu$ (D) $\delta = (A + 1) \mu$ **[A]**

Q.31 A prism having an apex angle 4° and refractive index 1.5 is located in front of a vertical plane mirror as shown in figure. Through what total angle is the ray deviated after reflection from the mirror ?



(A) 176° (B) 4° (C) 178° (D) 2° **[C]**

Sol.



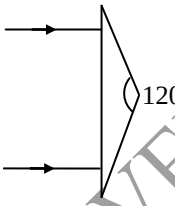
$\delta = (\mu - 1)\, A = (1.5 - 1)\, 4 = 2°$

Deviation by mirror = $180 - \angle i = 176°$

$\therefore$ Total deviation = 2 + 176

= 178°

Q.32 An isosceles prism of prism angle 120º has a refractive index of 1.44. Two parallel monochromatic rays enter the prism parallel to each other in air as shown in figure. The rays emerging from the opposite face **[IIT-JEE 95]**



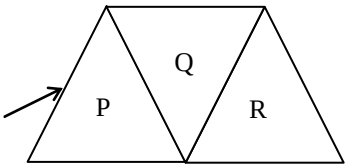
(A) Are parallel to each other

(B) Are diverging

(C) Make an angle $2 \sin^{-1}(0.72)$ with each other

(D) Make an angle $2[\sin^{-1}(0.72) - 30º]$ with each other **[D]**

Q.33 A given ray of light suffers minimum deviation in an equilateral prism P. Additional prisms Q and R of identical shape and of the same material as P are now added as shown in the figure. The ray will now suffer **[IIT-JEE 2001]**



(A) greater deviation

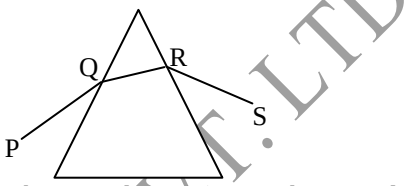
(B) no deviation

(C) same deviation as before

(D) total internal reflection **[C]**

Q.34 A light ray PQRS is passed through an equilateral prism then in case of minimum deviation.

[IIT Scr. - 2004]



(A) PQ is horizontal (B) QR is horizontal

(C) RS is horizontal (D) none of these **[B]**

Q.35 Two beams of red and violet colours are made to pass separately through a prism (angle of the prism is 60°). In the position of minimum deviation, the angle of refraction will be –

[IIT-JEE 2008]

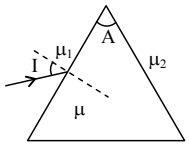
(A) 30° for both the colours

(B) greater for the violet colour

(C) greater for the red colour

(D) equal but not 30° for both the colours **[A]**

Q.36 A thin prism has different medium on its either side. A light ray is incident almost normally on the first face. What is the angle of deviation if all the angles are very small –



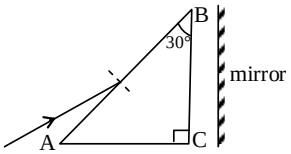
(A) $I\left(1-\frac{\mu_1}{\mu_2}\right)-A\left(1-\frac{\mu}{\mu_2}\right)$

(B) $I\left(1-\frac{\mu_1}{\mu_2}\right)+A\left(1-\frac{\mu}{\mu_2}\right)$

(C) $I\left(1+\frac{\mu_1}{\mu_2}\right)-A\left(1-\frac{\mu}{\mu_2}\right)$

(D) None of these **[C]**

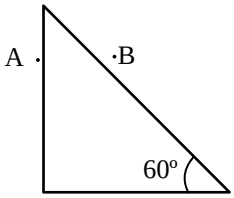
Q.37 Figure shows a right angled prism with refractive index $\frac{2}{\sqrt{3}}$. A light ray is incident at almost 90° on the inclined face. Find the deviation suffered by after it passes through prisms for the second time.



(A) 60° (B) 30°

(C) 90° (D) 180° **[C]**

Q.38 A right angled prism is placed on a printed page as shown in figure. observer A look through the vertical face while the observer B looks through the inclined face. Identify the correct statement.



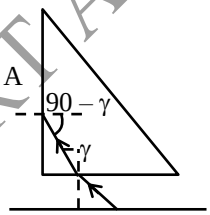
(A) If A is able to see the letters on the page then B will also see the letter

(B) If B is able to see the letters then A will also see letter.

(C) Both can see if the prism is made of glass $\mu = 1.5$

(D) Both can see whatever the refractive index of prism is

Sol. **[A]**



A can not see if ray will go for total internal reflection at vertical face.

$\therefore (90 - \gamma)_{minmum} > \theta_c$

$(90 - \gamma)_{min}$: $90 - \gamma_{max}$

$90 - \gamma_{max} > \theta_c$

$90 - \theta_c > \theta_c$

$45 > \theta_c$

$\text{Sin } 45 > \text{Sin } \theta_c = \mu > \sqrt{2}$

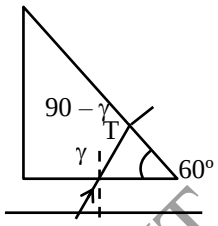
A can not see if $\mu > \sqrt{2}$

For B if he can not see then $60 - \gamma_{max} > \theta_c$

$60 - \theta_c > \theta_c$

$30 > \theta_c$

$\frac{1}{2} > \frac{1}{\mu}$



$\mu > 2$

B can not see if $\mu > 2$

Q.39 A beam of white light after passing through a prism produces a spectrum with seven colours. This is because:

(A) the prism converts white light into the light of seven colours

(B) the prism disperses white light into constituent components

(C) the colours are produced by the screen

(D) none of these **[B]**

Q.40 Minimum deviation suffered by red, yellow and violet beams passing through an equilateral transparent prism are 38.4°, 38.7° and 39.2° respectively. Calculate the dispersive power of the medium.

(A) 0.0206 (B) 0.00765

(C) 0.0130 (D) 0.206

Sol. **[A]**

$$\omega = \frac{\delta_V - \delta_R}{\delta_Y} = \frac{39.2° - 38.4°}{38.7°} = 0.0206$$

Q.41 In the position of minimum deviation, angle of emergence is:

(A) equal to the angle of incidence

(B) lesser than the angle of incidence

(C) greater than the angle of incidence

(D) equal to the angle of prism and the angle of incidence **[A]**

Q.42 If the refracting angle of a prism is 60° and minimum deviation 30°, the angle of incidence will be:

(A) 30° (B) 45°

(C) 60° (D) 90° **[B]**

Q.43 For a prism having prism angle 60° and $\mu = \sqrt{2}$, the angle of minimum deviation is:

(A) 30° (B) 45°

(C) 60° (D) 90° **[A]**

Q.44 A beam of monochromatic light is incident on one face of an equilateral prism, the angle of incidence being 55º. If the angle of emergence is 46º then the angle of minimum deviation is –

(A) 41° (B) < 41º (C) > 41º (D) ≥ 41º

Sol. **[B]**

$A = 60^\circ$; $i = 55^\circ$; $e = 46^\circ$

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

$55^\circ + 46^\circ = 60^\circ + \delta$

$\Rightarrow \quad \delta = 41^\circ \qquad \delta_{min} < \delta$

Q.45 A ray is incident at an angle of incidence i on one face of a prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, the angle of incidence i is nearly equal to:

(A) A/μ (B) A/2μ

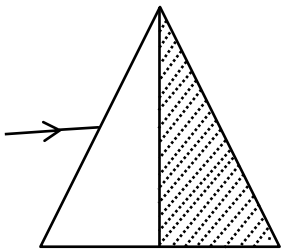
(C) μA (D) μA/2 **[C]**

Q.46 Angle of a prism is A and its one surface is silvered. Light rays falling at an angle of incidence 2A on the first surface return back through the same path after suffering reflection at the second silvered surface. Refractive index of the material is:

(A) 2 sin A (B) 2 cos A

(C) (1/2) cosA (D) tanA **[B]**

Q.47 A ray of light when incident upon a prism suffers a minimum deviation of 39°. If the shaded half portion of the prism is removed, then the same ray will -



(A) suffer a deviation of 19.5°

(B) suffer a deviation of 39°

(C) not suffer any deviation

(D) will be totally internally reflected **[A]**

Sol. $\delta = (\mu - 1)\, A$

$\delta \propto A$

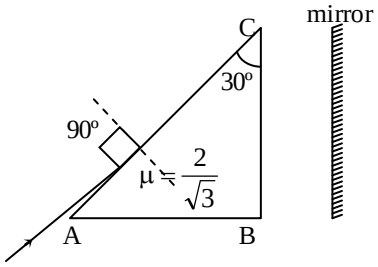
$\therefore \quad \dfrac{\delta_2}{\delta_1} = \dfrac{A_2}{A_1}$

$\therefore \quad \dfrac{\delta_2}{\delta_1} = \dfrac{A/2}{A} = \dfrac{1}{2}$

$\therefore \delta_2 = \dfrac{\delta_1}{2}$

$\delta_2 = \dfrac{39}{2} = 19.5^\circ$

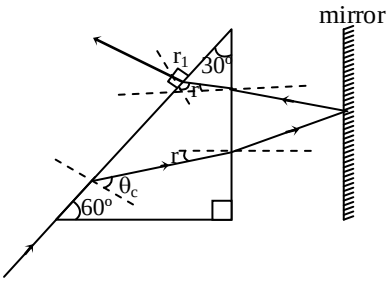
Q.48 A light ray is incident at almost 90º on the inclined face. Find the deviation suffered by after it passes through prisms for second time –



(A) 60º (B) 30º

(C) 90º (D) 180º **[C]**

Sol.



$$\sin 90^o = \frac{2}{\sqrt{3}} \sin \theta_c$$

$$\sin \theta_c = \frac{\sqrt{3}}{2} \quad \Rightarrow \ \theta_c = 60^o$$

$$30^o + 90^o - \theta_c + 90^o + r = 180^o$$

$$r = \theta_c - 30^o = 30^o$$

$$\therefore r_1 = 30^o - r = 0^o$$

so light will emerge out normally

Q.49 A crown glass prism of refracting angle 6º is to be used for deviation without dispersion with a flint glass of angle of prism α. Given: for crown glass μ_r = 1.513 and μ_v = 1.523, for flint glass μ_r = 1.645 and μ_v = 1.665. Find α.

(A) 3º (B) 4º

(C) 4.5º (D) 5º **[A]**

Sol. $(\mu_{V_1} - \mu_{r_1})\,\alpha_1 = (\mu_{v_2} - \mu_{r_2})\,\alpha_2$

$$\text{or } \alpha_2 = \frac{(1.523 - 1.513)}{(1.665 - 1.645)}\, 6^o = 3^o.$$

Q.50 A horizontal ray of light passes through a prism of index 1.50 and apex angle 4º and then strikes a vertical mirror, as shown in the figure (a). Through what angle must the mirror be rotated if after reflection the ray is to be horizontal?

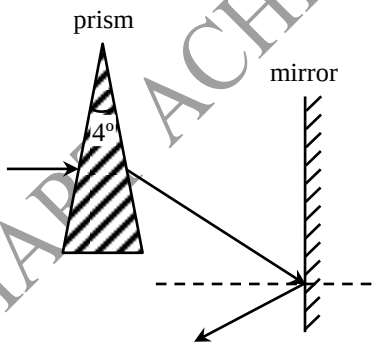


Fig. (a)

(A) 1º (B) 2º

(C) 2.5º (D) 1.5º **[A]**

Sol. As the apex angle is very small (α = 4º), the angle of deviation & can be obtained approximately:

$\delta = (n - 1)\alpha = (1.5 - 1) \times 4^o = 2^o$.

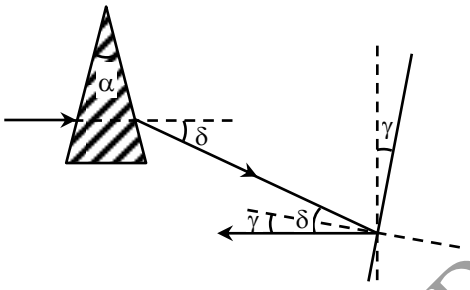


Fig. (b)

From Fig. (b) we see that if the reflected ray is to be horizontal, the mirror must be rotated clockwise through an angle γ given by

$$\gamma = \frac{\delta}{2} = 1^o$$