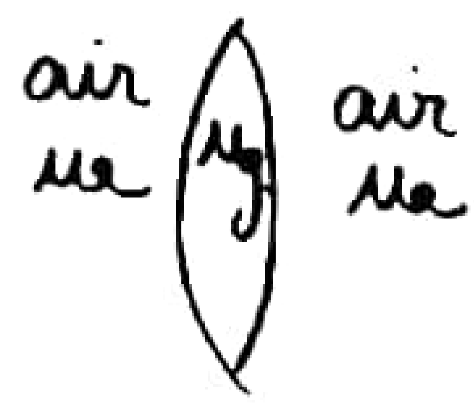
1.
A thin lens of refractive index 1.5 has a focal length of 15 cm in air. When lens is placed in a medium of refractive index (4/3), focal length will be now

(1) 30 cm (2*) 60 cm (3) – 60 cm (4) – 30 cm

Sol

$$f_{air} = \frac{R}{2[{}_a\mu_g - 1]}$$



$$f_{liq} = \frac{R}{2[{}_l\mu_g - 1]}$$

$$\frac{f_l}{f_{air}} = \frac{({}_a\mu_g - 1)}{({}_l\mu_g - 1)}$$

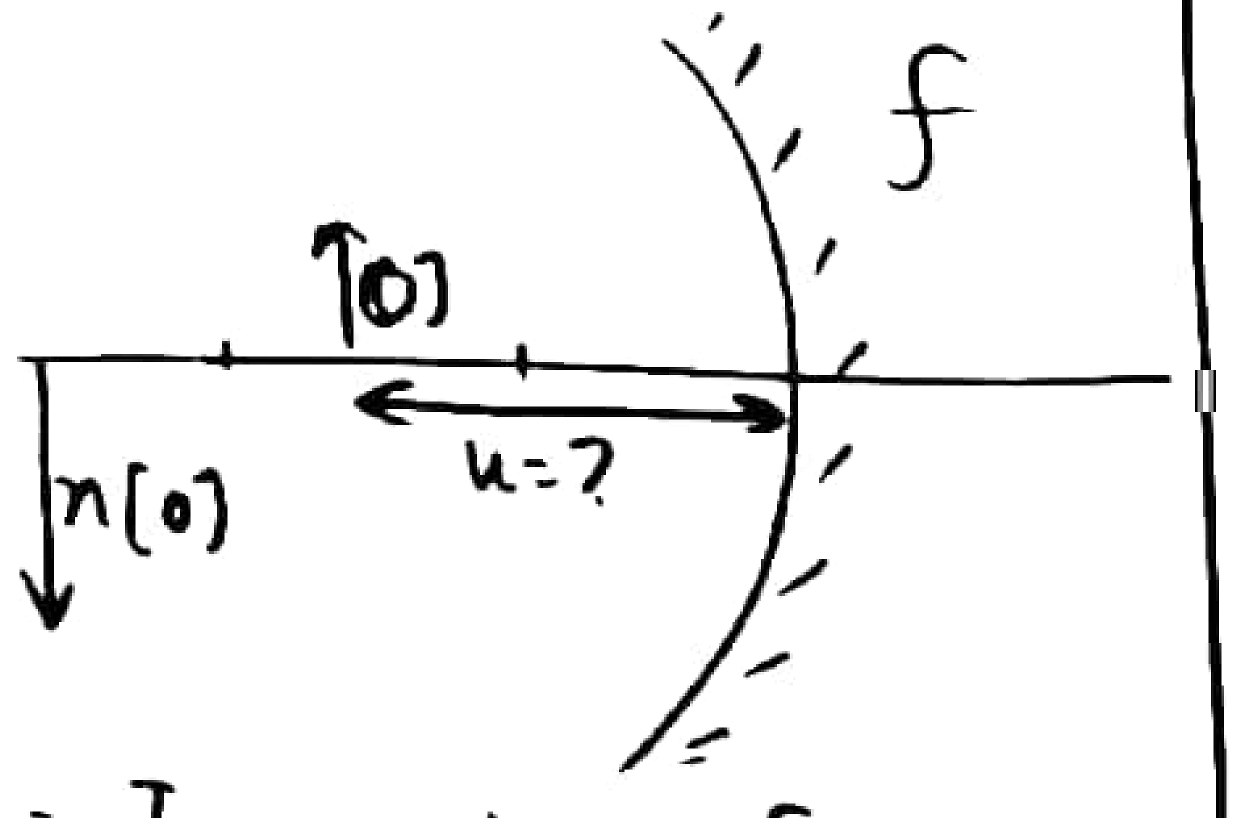
$$\frac{f_l}{15\text{cm}} = \frac{(1.5 - 1)}{\left[\frac{3}{2}\cdot\frac{3}{4} - 1\right]} = \frac{\frac{1}{2}}{\frac{1}{8}} = 4$$

$$f_l = 4 f_{air} = 60\text{cm}$$

2.
A concave mirror of focal length f produces an image n times the size of the object. If the image is real then the distance of the object from the mirror is

(1) $(n-1)f$ (2) $\frac{(n-1)}{n}f$ (3*) $\frac{(n+1)}{n}f$ (4) $(n+1)f$

Sol



$$m_T = \frac{I}{O} = -\frac{v}{u} = \frac{f}{f-u}$$

$$-n = \frac{-f}{-f+u}$$

$$-f+u = \frac{f}{n}$$

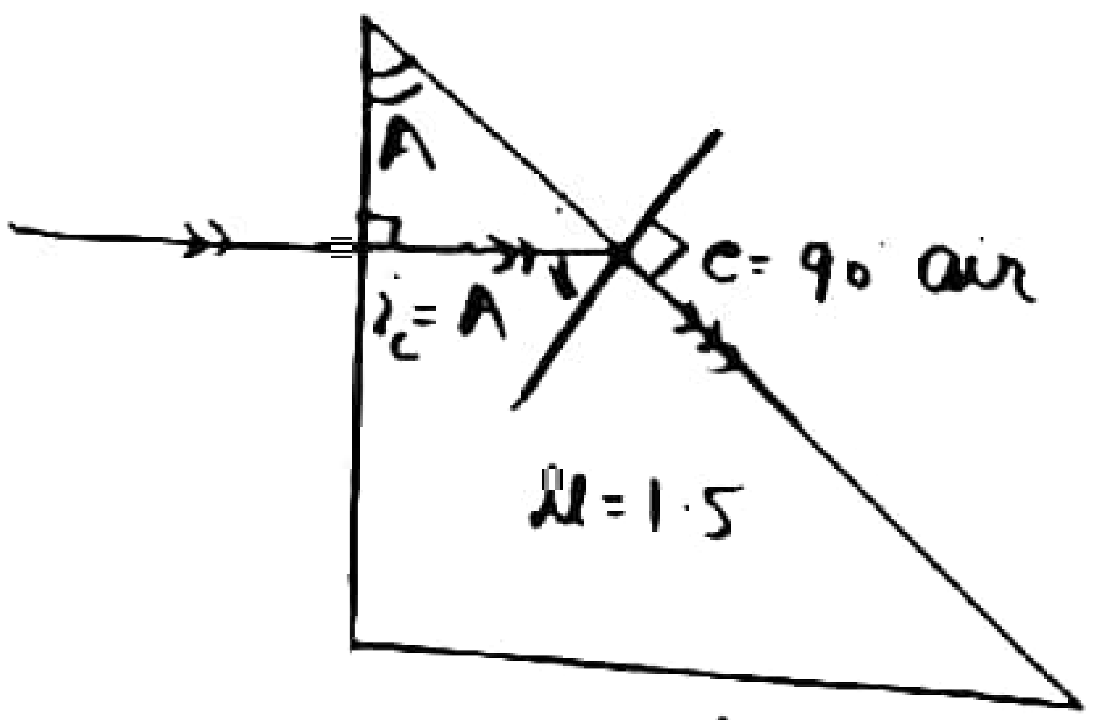
$$u = f\left[1+\frac{1}{n}\right]$$

$$u = f\left(\frac{n+1}{n}\right)$$

3.

A ray of light falls normally on a refracting face of a prism of refractive index 1.5. If the ray just fails to emerge from the prism. Then the angle of prism is

(1) $\sin^{-1}\left(\frac{2}{3}\right)$ (2) $\cos^{-1}\left(\frac{2}{3}\right)$ (3) $\sin^{-1}\left(\frac{1}{2}\right)$ (4) $\sin^{-1}\left(\frac{1}{3}\right)$



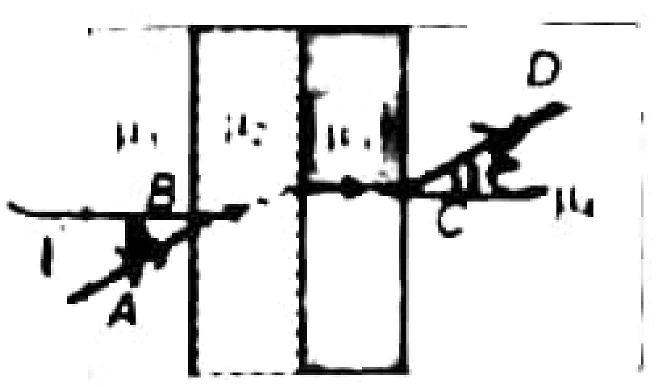
$1.5 \sin A = 1 \sin 90°$

$\sin A = \frac{2}{3}$

$A = \sin^{-1}\frac{2}{3}$

4.

A ray of light passes through four transparent media with refractive indices μ_1, μ_2, μ_3 and μ_4 as shown in the figure. The surface of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, then



(1) $\mu_1 = \mu_2$ (2) $\mu_2 = \mu_3$ (3) $\mu_3 = \mu_4$ (4) $\mu_4 = \mu_1$

$\mu_1 \sin i = \mu_4 \sin e$

$i = e$

$\mu_1 = \mu_4$

5.

An object 1 cm tall is placed in front of a mirror at a distance of 4 cm. In order to produce an upright image of 3cm height one needs a

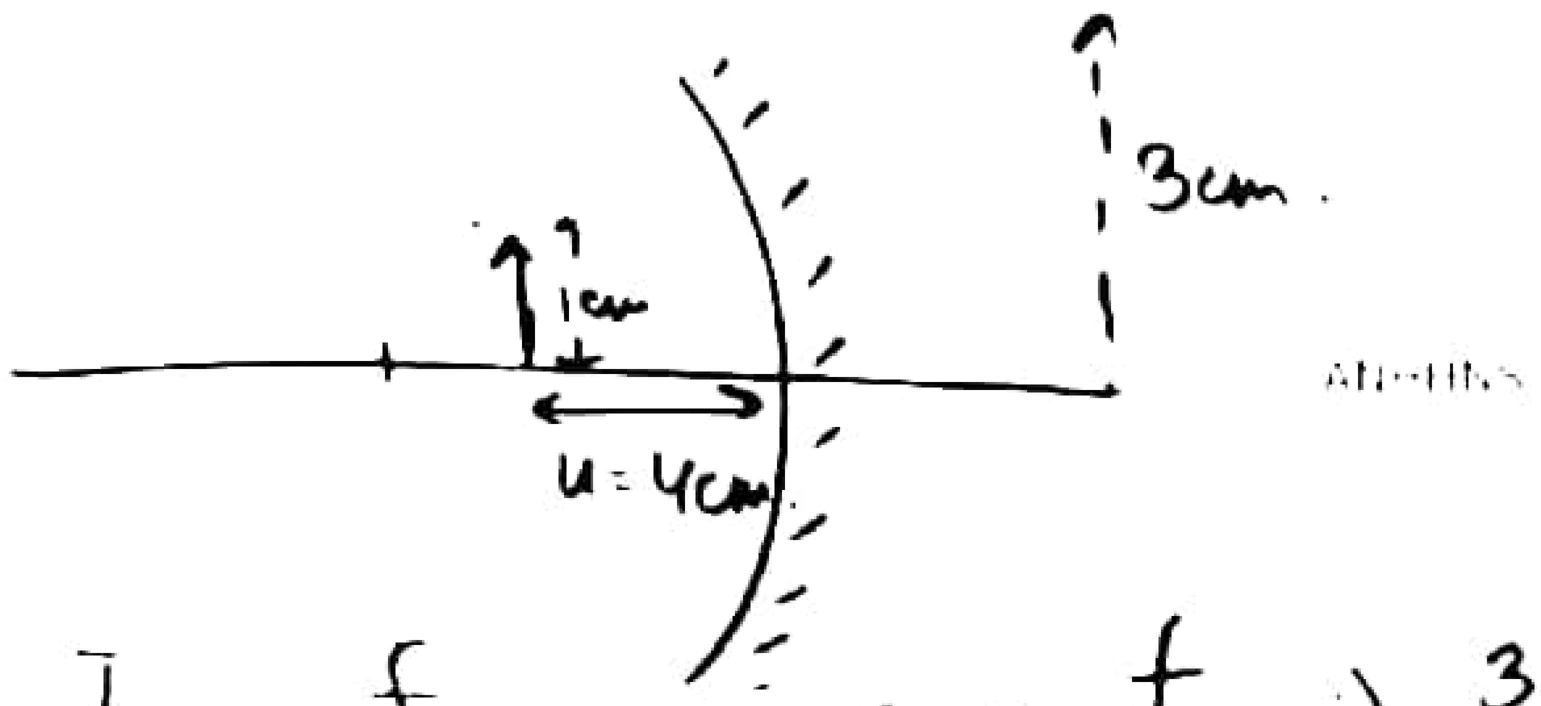
(1) Convex mirror of radius of curvature 12 cm

(2) Concave mirror of radius of curvature 12 cm ✓

(3) Concave mirror of radius of curvature 4 cm

(4) Plane mirror of height 12 cm

Sol



$m = \frac{I}{O} = \frac{f}{f-u} \Rightarrow \frac{3}{1} = \frac{f}{f-(-4)} \Rightarrow 3 = \frac{f}{f+4}$

$3f + 12 = f$

$2f = -12$

$f = -6cm$

$R = 2f = 12cm$

Mirror = Concave

6.

An optically active compound

(1) rotates the plane polarized light ✓

(2) Changes the direction of polarized light

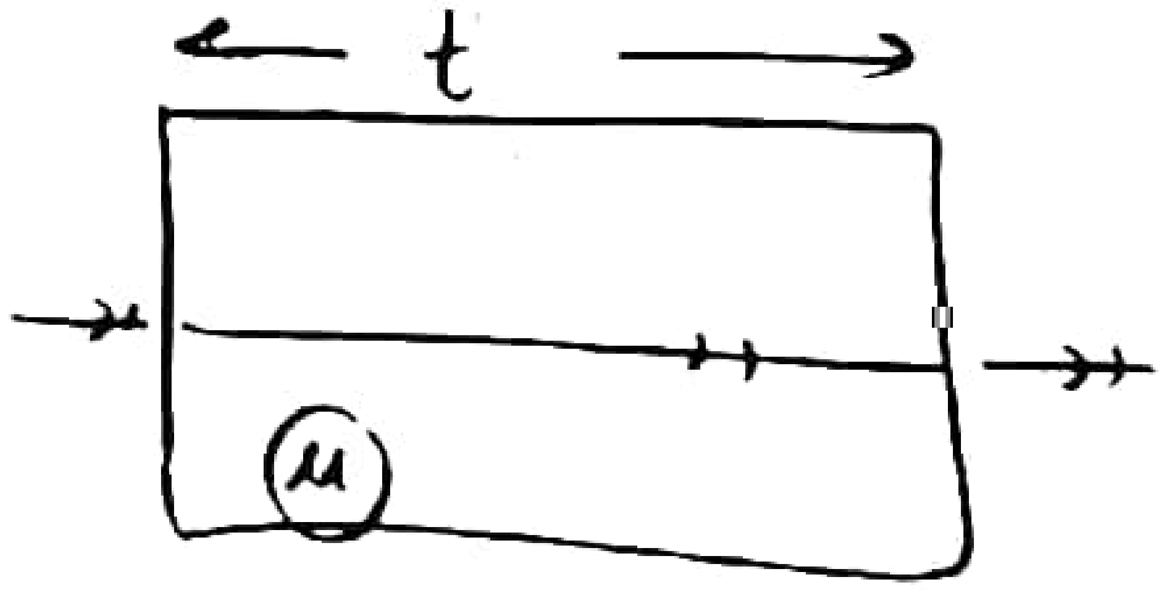
(3) Do not allow plane polarized light to pass through

(4) None of the above

7.

Light travels through a glass plate of thickness t and having refractive index μ. If c be the velocity of light in vacuum, the time taken by the light to travel this thickness of glass is

(1) $\frac{t}{\mu c}$ (2) $t\mu c$ (3*) $\frac{\mu t}{c}$ (4) $\frac{tc}{\mu}$



$$\text{time} = \frac{d}{v} = \frac{t}{\frac{c}{\mu}} = \frac{\mu t}{c}$$

8.

If ε_0 and μ_0 represent the permittivity and permeability of vacuum, ε and μ represent the permittivity and permeability of medium, then refractive index of the medium is given by

(1) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$ (2*) $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$ (3) $\sqrt{\frac{\varepsilon}{\mu_0\varepsilon_0}}$ (4) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu}}$

Sol

$$\mu = \frac{c}{v_{med}} \Rightarrow \mu = \sqrt{\frac{\mu\epsilon}{\mu_0\epsilon_0}}$$

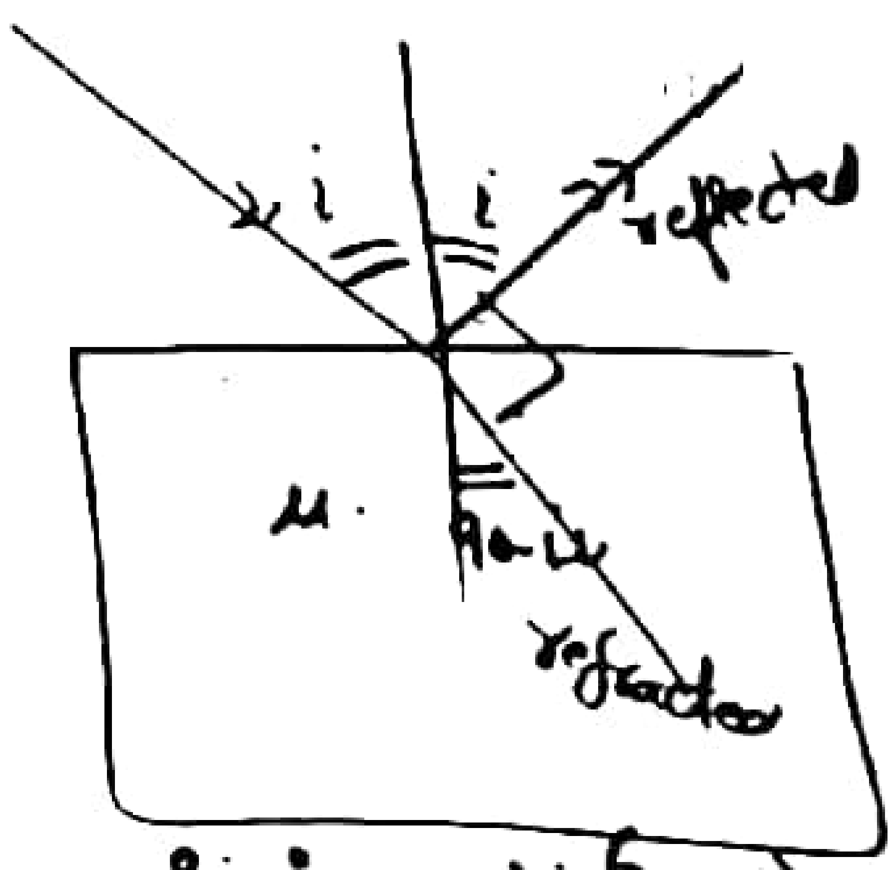
$$c = \frac{1}{\sqrt{\mu_0\epsilon_0}}$$

$$v_{med} = \frac{1}{\sqrt{\mu\epsilon}}$$

9.

A ray of light strikes a glass plate at an angle of 60° with the vertical. If the reflected and refracted rays are perpendicular to each other, the refractive index of glass is

(1) $\frac{\sqrt{3}}{2}$ (2) $\frac{3}{2}$ (3) $\frac{1}{2}$ (4*) $\sqrt{3}$



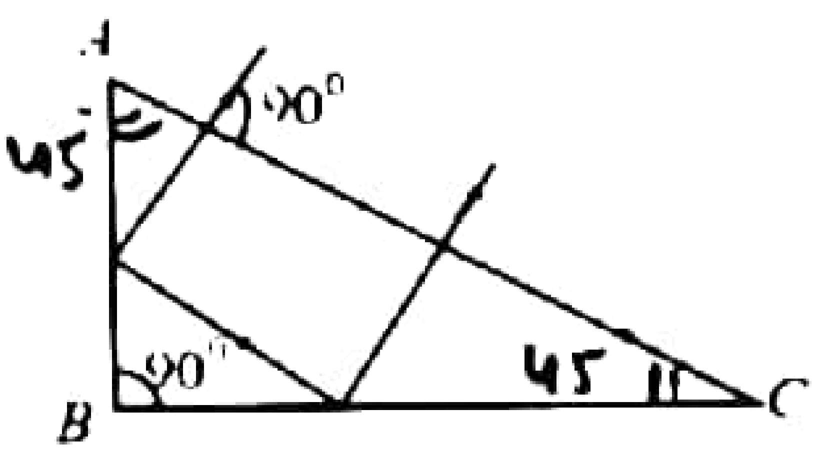
$\sin i = \mu \sin(90 - i)$

$\tan i = \mu$

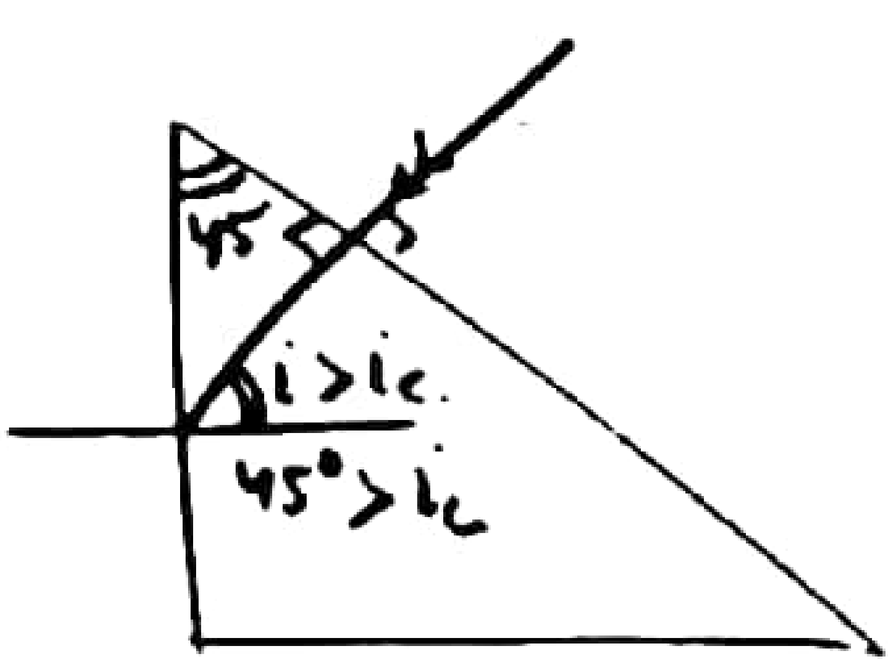
$\mu = \tan 60 = \sqrt{3}$

10.

A ray of light falls on a prism ABC ($AB = BC$) and travels as shown in figure. The refractive index of the prism material should be greater than



(1) $4/3$ (2*) $\sqrt{2}$ (3) 1.5 (4) $\sqrt{3}$



$45° > i_c$

$\sin 45° > \sin i_c$

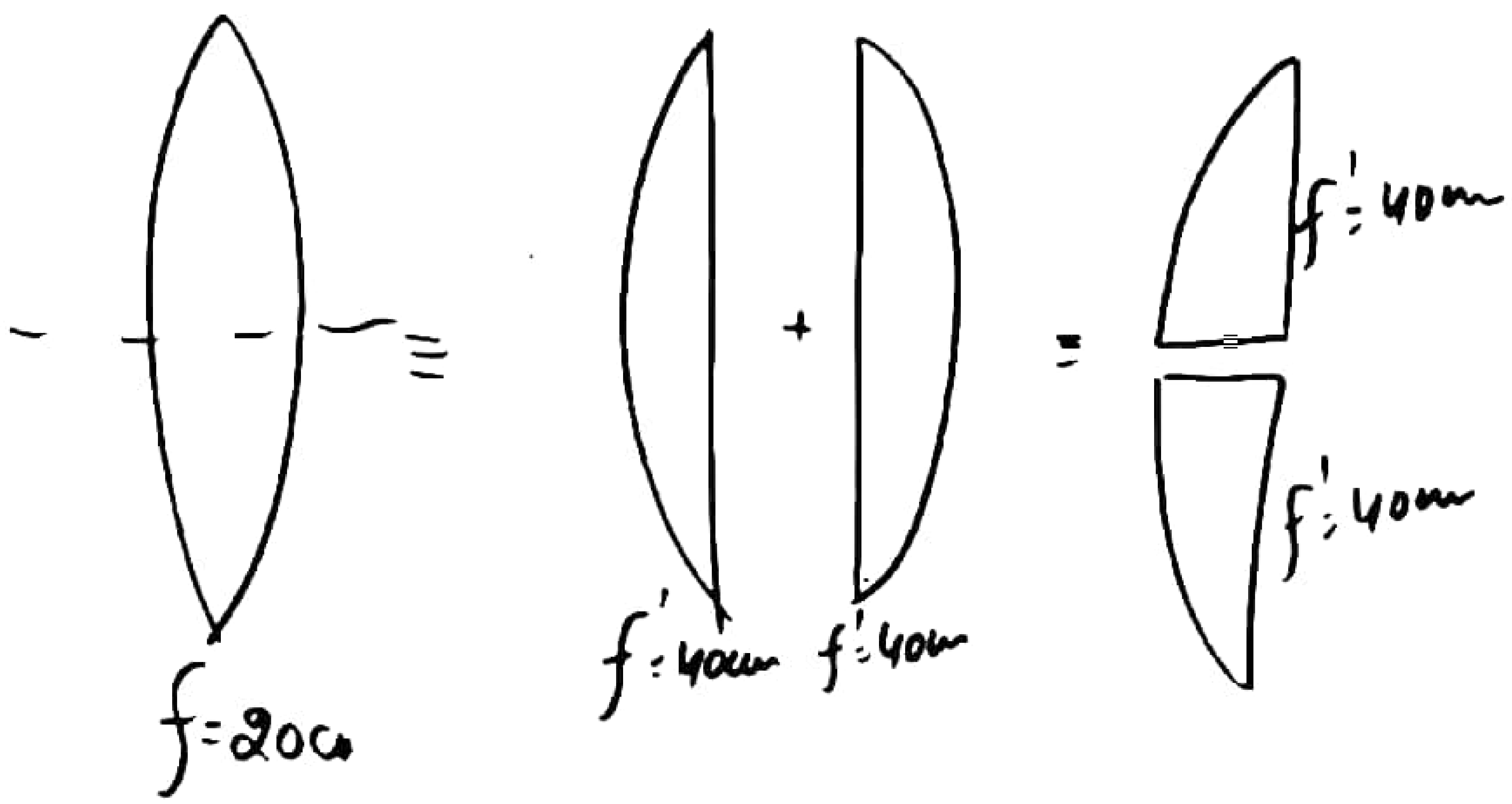
$\frac{1}{\sqrt{2}} > \frac{1}{\mu}$

$\mu > \sqrt{2}$

11.

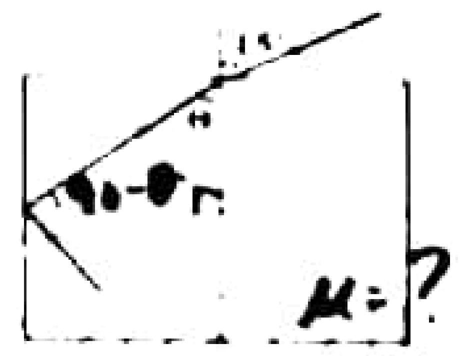
Focal length of an equiconvex lens is 20 cm. If we cut it once perpendicular to principle axis, and then along principle axis. Then focal length of each part will be

(1) 20 cm (2) 10 cm (3*) 40 cm (4) 5 cm



12.

A light ray falls on a square slab at an angle 45°. What must be the minimum index of refraction of glass, if total internal reflection takes place at the vertical face?



(1) $\frac{\sqrt{3}}{2}$ (2*) $\sqrt{\frac{3}{2}}$ (3) $\frac{3}{2}$ (4) $\frac{3}{\sqrt{2}}$

Sol–

$90-\theta \geq i_c$

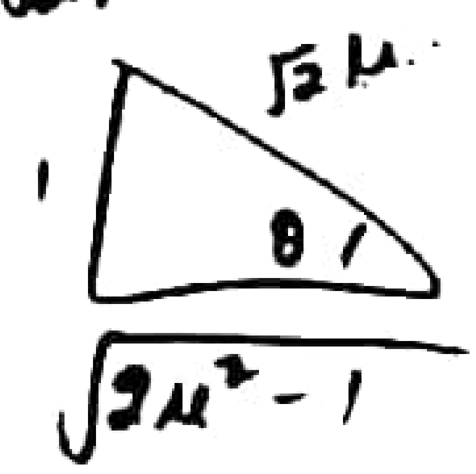
$\sin(90-\theta) \geq \frac{1}{\mu}$

$\cos\theta \geq \frac{1}{\mu}$

Snell's law:

$\sin 45° = \mu \sin\theta$

$\frac{1}{\sqrt{2}\mu} = \sin\theta$



$\cos\theta \geq \frac{1}{\mu}$

$\frac{\sqrt{2\mu^2-1}}{\sqrt{2}\mu} \geq \frac{1}{\mu}$

$\sqrt{2\mu^2-1} \geq \sqrt{2}$

$2\mu^2-1 \geq 2$

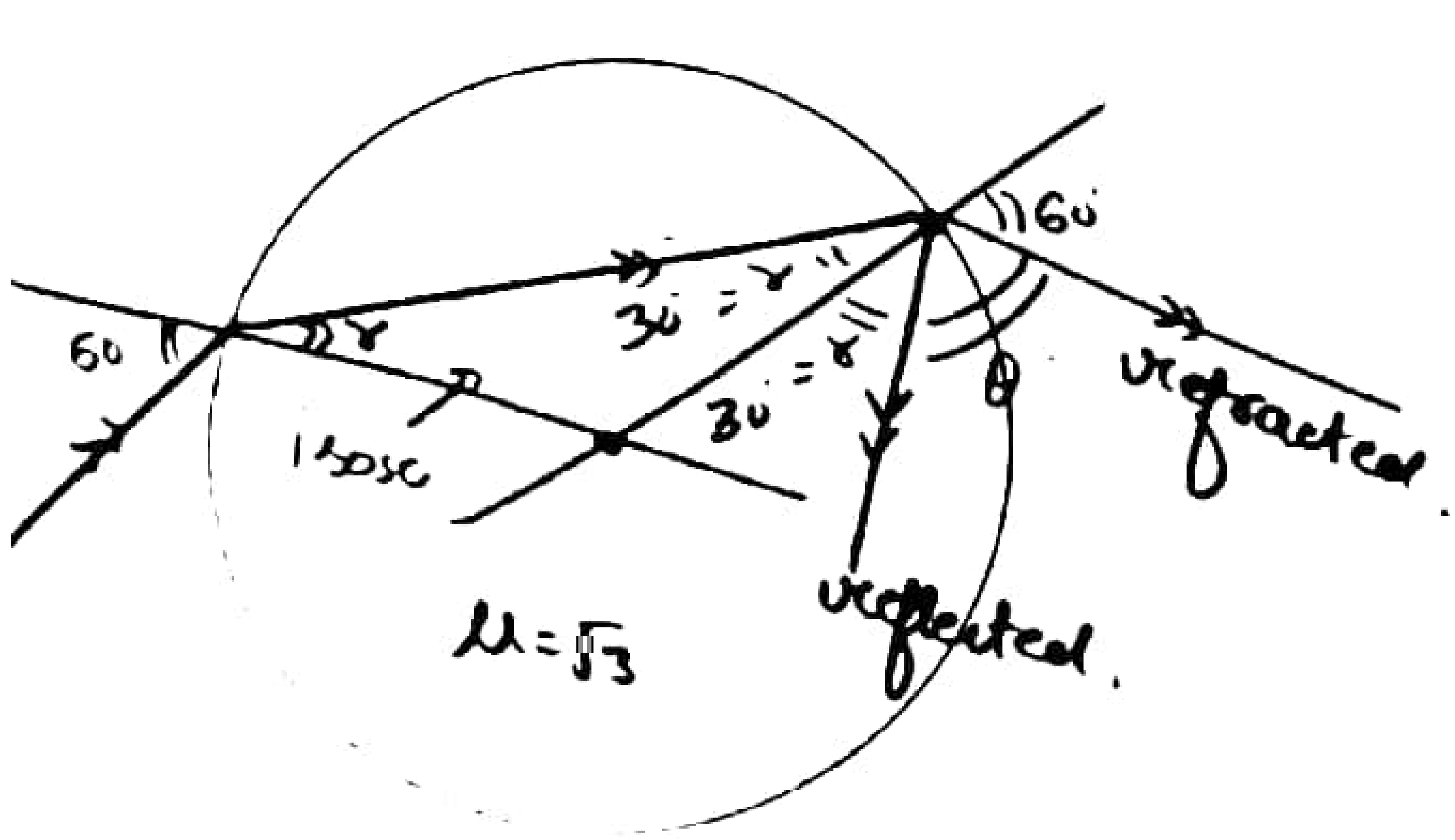
$\mu^2 \geq \frac{3}{2}$

$\mu \geq \sqrt{\frac{3}{2}}$

$\mu_{min} = \sqrt{\frac{3}{2}}$

13.
A ray incident at a point at an angle of incidence of 60^0 enters a glass sphere of R.I $n = \sqrt{3}$ and gets reflected and refracted at the farther surface of the sphere. The angle between the reflected and refracted rays at this surface is

(1) 50^0 (2) 60^0 (3*) 90^0 (4) 40^0



$\sin 60 = \mu \sin r$

$\frac{\sqrt{3}}{2} = \sqrt{3} \sin r$

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

$r = 30$

$\theta = 90$

14.
A microscope has an objective of focal length 1.5 cm and an eye - piece of focal length 2.5 cm. If the distance between objective and eye-piece is 25 cm. what is the approximate value of magnification produced for relaxed eye?

(1) 75 (2) 110 (3*) 140 (4) 25

Sol→ $f_0 = 1.5$ cm $f_e = 2.5$ cm

$L = V_0 + U_e = 25$ cm

Relaxed state $V_e = \infty$

$U_e = f_e$

$V_0 + f_e = 25$ cm

$V_0 = 25 - 2.5$

$V_0 = 22.5$ cm

$m = \frac{V_0}{U_0} \times \frac{D}{f_e}$

$\frac{1}{f_0} = \frac{1}{V_0} - \frac{1}{-U_0}$

$U_0 = \frac{V_0 f_0}{V_0 - f_0}$

$m = \frac{(V_0 - f_0)}{f_0} \times \frac{D}{f_e}$

$m = \frac{22.5 - 1.5}{1.5} \times \frac{25}{2.5}$

$= \frac{21}{1.5} \times 10$

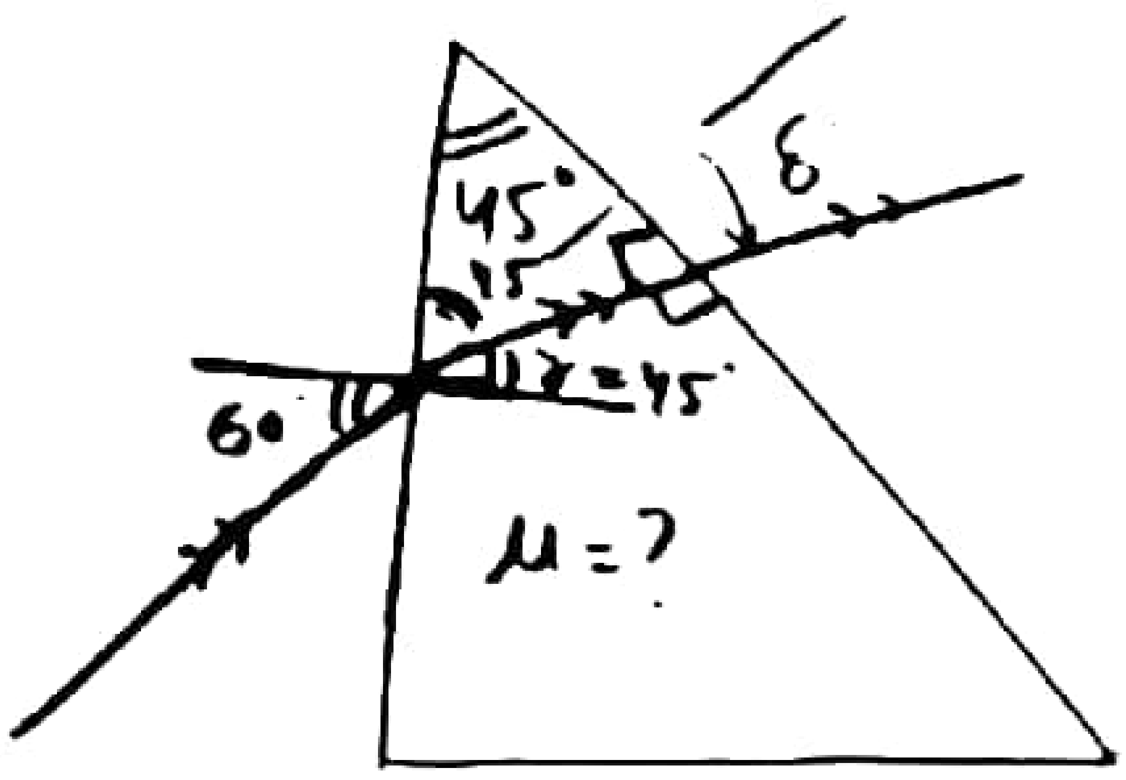
$m = 140$

15.

The light ray is incident at angle of 60° on a prism of angle 45°. When the light ray falls on the other surface at 90°, the refractive index of the material of prism μ and the angle of deviation δ are given by ?

(1) $\mu = \sqrt{\frac{3}{2}}, \delta = 30°$ (2) $\mu = 1.5, \delta = 15°$

(3) $\mu = \frac{\sqrt{3}}{2}, \delta = 30°$ (4*) $\mu = \sqrt{\frac{3}{2}}, \delta = 15°$



$\delta = i + e - A$

$= 60 + 0 - 45°$

$= 15°$

$\sin 60 = \mu \sin 45°$

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

16.

The refractive index of water is 4/3 and that of glass is 5/3. Then the critical angle for a ray of light entering in water from glass will be

(1*) $\sin^{-1}\left(\frac{4}{5}\right)$ (2) $\sin^{-1}\left(\frac{5}{4}\right)$ (3) $\sin^{-1}\left(\frac{20}{9}\right)$ (4) $\sin^{-1}\left(\frac{9}{20}\right)$

Solⁿ Water → Glass

$\sin i_c = \frac{\mu_R}{\mu_D} = \frac{1}{{}_R\mu_D}$

$= \frac{\mu_w}{\mu_g} = \frac{4 \times 3}{3 \times 5}$

$i_c = \sin^{-1}\frac{4}{5}$

17.

A simple telescope, consisting of an objective of focal length 30 cm and a single eye lens of focal length 6 cm. Eye observes final image in relaxed condition. If the angle subtended on objective is 1.5° then image will subtend angle of

(1) 6.5° (2) 7.5° (3) 0.3° (4) 2.5°

Sol –

$f_o = 30\text{cm}$

$f_e = 6\text{cm}$

$V_e = \infty \quad u_e = f_e = 6\text{cm}$

$\theta_o = 1.5° \quad \theta_{Image}$

$m = \frac{\theta_I}{\theta_o} = f_o/f_e$

$\theta_I = \frac{f_o}{f_e} \times \theta_o$

$= \frac{30 \times 1.5}{6}$

$= 7.5°$

18.

A thin converging lens of refractive index 1.5 has power of +5D. When this lens is immersed in a liquid, it acts as a diverging lens of focal length 100 cm. The refractive index of the liquid is

(1) 2 (2) $\frac{15}{11}$ (3) $\frac{4}{3}$ (4) $\frac{5}{3}$

Sol

$P = 5D \quad f_{air} = \frac{100}{P} = \frac{100}{5}\text{cm} = 20\text{cm} \quad \mu_g = 1.5$

$f_{liq} = -100\text{cm} \quad \mu_l = ?$

$f_l = \frac{R}{2(\frac{\mu_g}{\mu_l} - 1)} \Rightarrow \frac{f_l}{f_{air}} = \frac{(\mu_g - 1)}{(\frac{\mu_g}{\mu_l} - 1)}$

$-\frac{100}{20} = \frac{\frac{3}{2} - 1}{(\frac{3}{2\mu} - 1)}$

$\frac{3}{2\mu} - 1 = \frac{1}{-10}$

$\frac{3}{2\mu} = \frac{9}{10}$

$\mu = \frac{5}{3}$

19.

In an astronomical telescope, the focal length of objective lens and eye-piece are 150 cm and 6cm respectively. In case when final image is formed at least distance of clear vision (D = 25 cm). The magnifying power is ?

(1) 29 (2) 30 (3) 31 (4) 32

Sol $f_o = 150$ cm $f_e = 6$ cm

$V_e = D$ $u_e = \frac{Df_e}{D + f_e}$.

$m = \frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right)$

$= \left(\frac{150}{6}\right)\left(1 + \frac{6}{25}\right)$

$m = 25 \times \frac{31}{25}$

$= 31$

20.

A telescope of diameter 2m uses light of wavelength 5000 Å for viewing stars. The minimum angular separation between two stars whose image is just resolved by this telescope is ?

(1) 4 10^{-4} rad (2) 0.25 10^{-6} rad

(3) 0.31 10^{-6} rad (4) 5.0 10^{-3} rad

Sol $\theta = \frac{1.22\lambda}{a}$

$\theta = \frac{1.22 \times 5000 \times 10^{-10}}{2}$

$\theta = 0.31 \times 10^{-6}$ rad

21.
A microscope is focused on a needle lying in an empty tank. Now, the tank is filled with benzene to a height 120 mm. The microscope is moved 40 mm to focus the needle again. The refractive index of benzene is ?

(1) 1.5 ✓ (2) 2.5 (3) 3.0 (4) 4.5

$$S = t\left(1 - \frac{1}{\mu}\right)$$

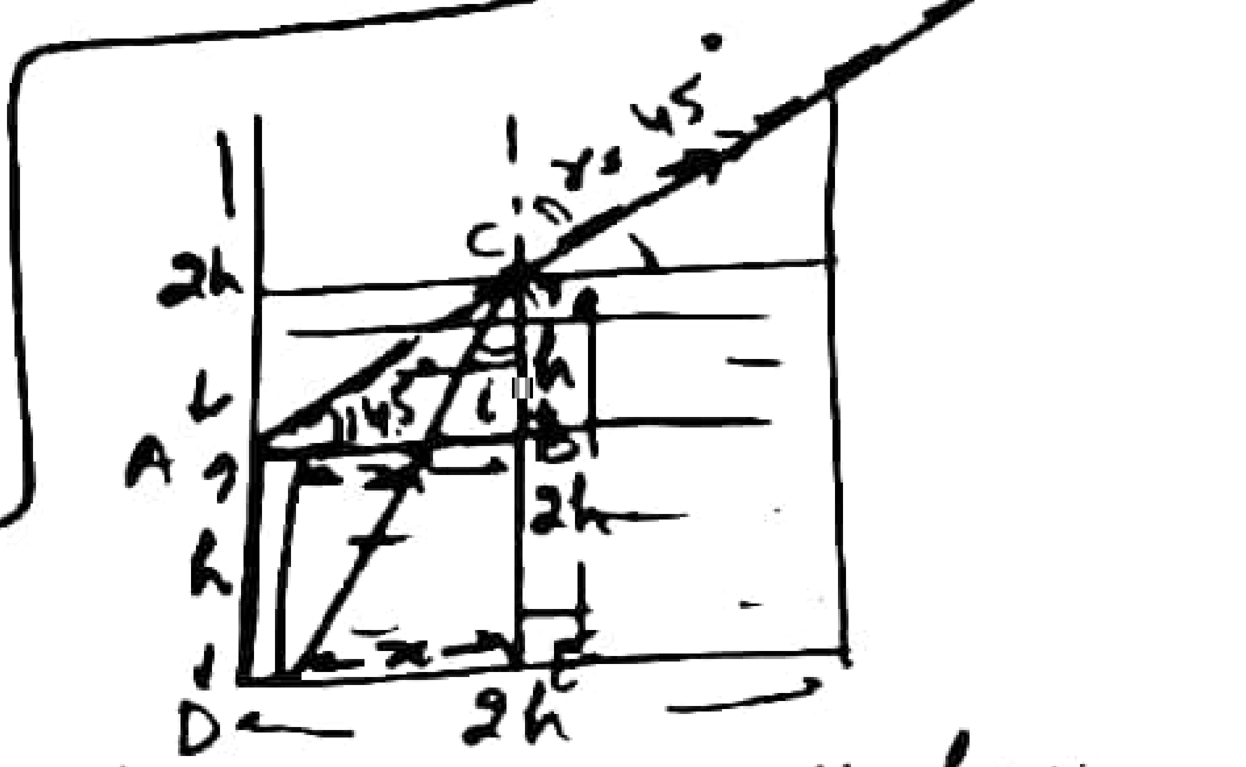
$$40 = 120\left(1 - \frac{1}{\mu}\right)$$

$$\frac{1}{3} = 1 - \frac{1}{\mu}$$

$$\frac{1}{\mu} = \frac{2}{3} \qquad \mu = \frac{3}{2}$$

22.
An observer can see through a pinhole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is $3h$ and its radius h. When the beaker is filled with a liquid up to a height $2h$, he can see the lower end of the rod. Then the refractive index of the liquid is ?

(1) 5/2 (2) $\sqrt{5/2}$ ✓ (3) $\sqrt{3/2}$ (4) 3/2

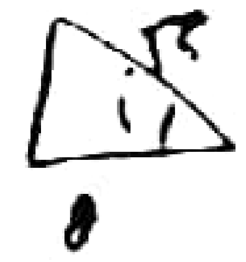


Sol →

$\tan\theta = 1$
$\theta = 45^\circ$

$\triangle ABC$
$\tan 45^\circ = \frac{h}{x}$
$x = h$

$\triangle DEC$
$\tan i = \frac{x}{2h} = \frac{h}{2h}$
$\tan i = \frac{1}{2}$



Snell's law
$\mu \sin i = \sin 45^\circ$
$\mu \times \frac{1}{\sqrt{5}} = \frac{1}{\sqrt{2}}$
$\mu = \sqrt{\frac{5}{2}}$

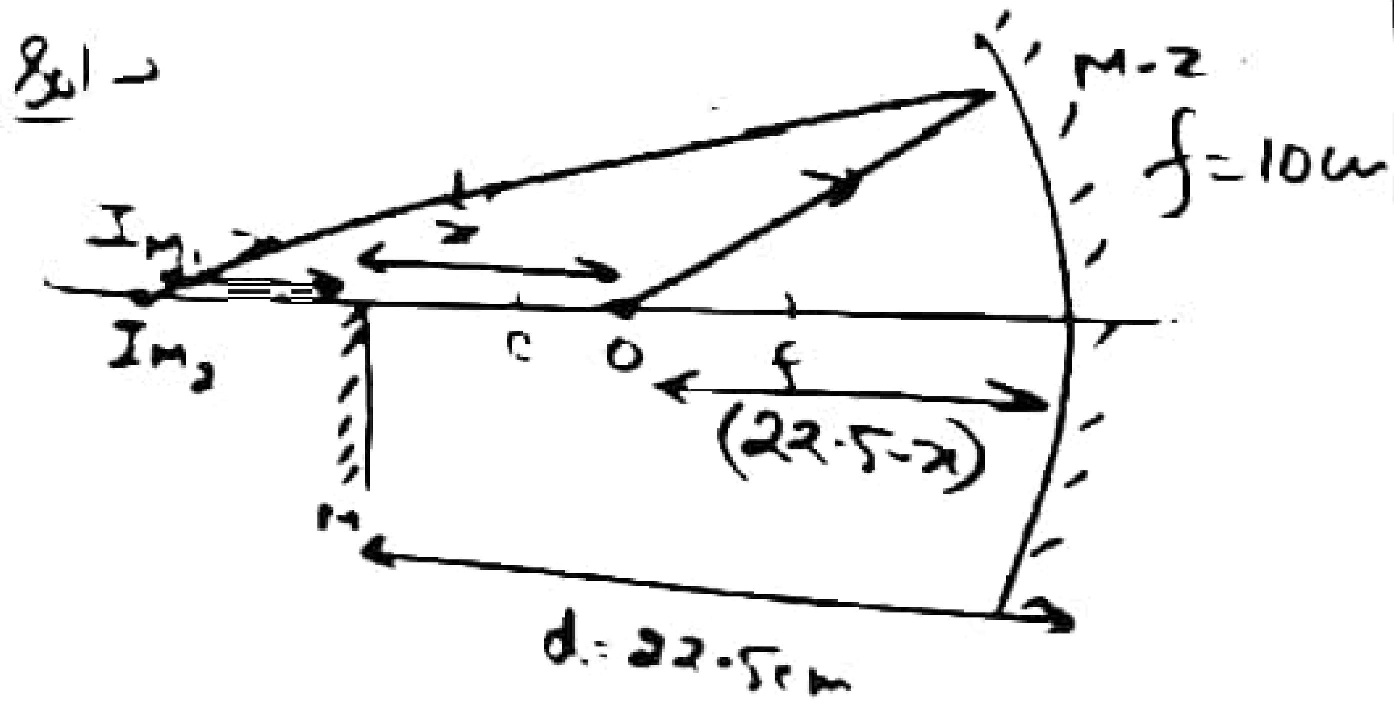
23.

A plane mirror is placed 22.5 cm in front of a concave mirror of focal length 10 cm. Find where an object can be placed between the two mirrors, so that the first image in both the mirrors coincides ?

(1) 15 cm from concave mirror (2) 15 cm from plane mirror

(3) 7.5 cm from concave mirror (4) 12.5 cm from plane mirror

Sol →



$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$u = -(22.5 - x)$

$v = -(22.5 + x)$

$f = -10$ cm

$$\frac{1}{-10} = \frac{1}{-(22.5+x)} + \frac{1}{-(22.5-x)}$$

$$\frac{1}{10} = \frac{45}{(22.5+x)(22.5-x)}$$

$$\left(\frac{45}{2}\right)^2 - x^2 = 45 \times 10$$

$$x^2 = \frac{(45)^2}{4} - 45 \times 10$$

$$x^2 = 45 \times \left[\frac{45}{4} - 10\right]$$

$$x^2 = \frac{45 \times 5}{4}$$

$$x^2 = \frac{225}{4}$$

$$x = \frac{15}{2} = 7.5 \text{ cm}$$

$M_1 \rightarrow 7.5$ cm

$M_2 \rightarrow 22.5 - 7.5 = 15$ cm

24.

A ray of light is incident on a plane mirror along a vector $\hat{i} + \hat{j} - \hat{k}$ and the normal on the incidence point is along vector $\hat{i} + \hat{j}$, then find the equation of reflected ray -

(1) $\hat{i} + \hat{j} - \hat{k}$ (2) $-\hat{i} + \hat{j} - \hat{k}$ (3) $-\hat{i} - \hat{j} - \hat{k}$ (4) $\hat{i} + \hat{j} + \hat{k}$

$$\hat{r} = \hat{e} - 2(\hat{e}\cdot\hat{n})\hat{n}$$

$\hat{e}$ = Unit vector along incident ray

$$\hat{e} = \frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}$$

$$\hat{n} = \frac{\hat{i} + \hat{j}}{\sqrt{2}}$$

$$\hat{e}\cdot\hat{n} = \frac{1+1}{\sqrt{6}} = \frac{\sqrt{2}}{\sqrt{3}}$$

$$\hat{r} = \left(\frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}\right) - 2\left(\frac{\sqrt{2}}{\sqrt{3}}\right)\left(\frac{\hat{i} + \hat{j}}{\sqrt{2}}\right)$$

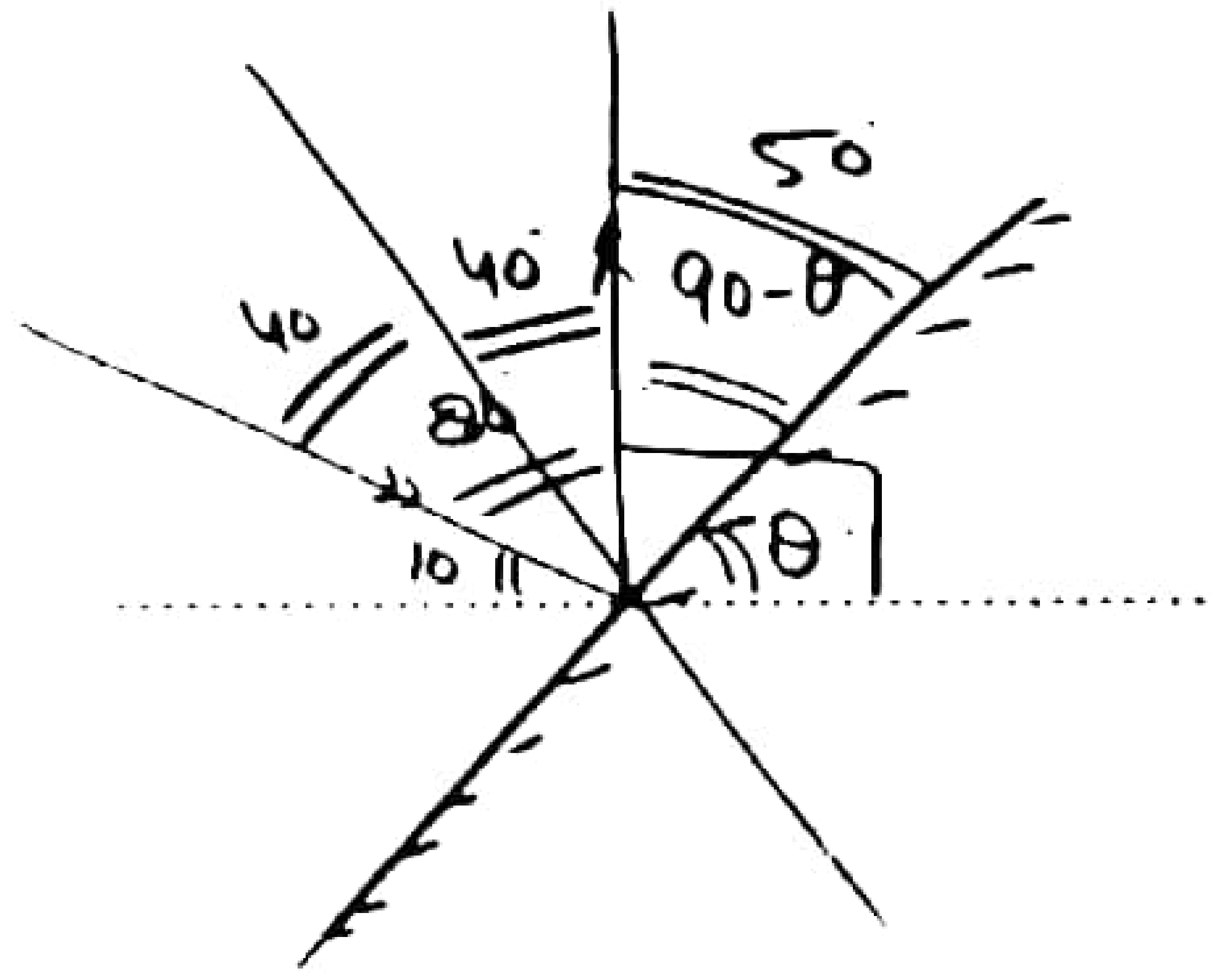
$$= \frac{\hat{i} + \hat{j} - \hat{k} - 2\hat{i} - 2\hat{j}}{\sqrt{3}}$$

$$\boxed{\hat{r} = \frac{-\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}}}$$

25.

A ray of light makes an angle of 10° with the horizontal above it and strikes a plane mirror which is inclined at an angle θ to the horizontal. The angle θ for which the reflected ray becomes vertical is -

(1*) 40° (2) 50° (3) 80° (4) 100°

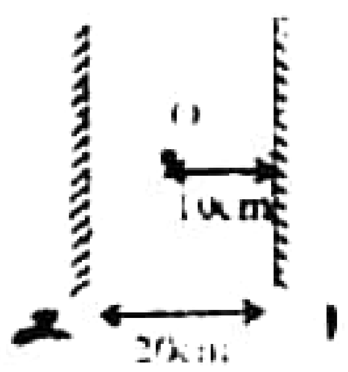


$90 - \theta = 50$

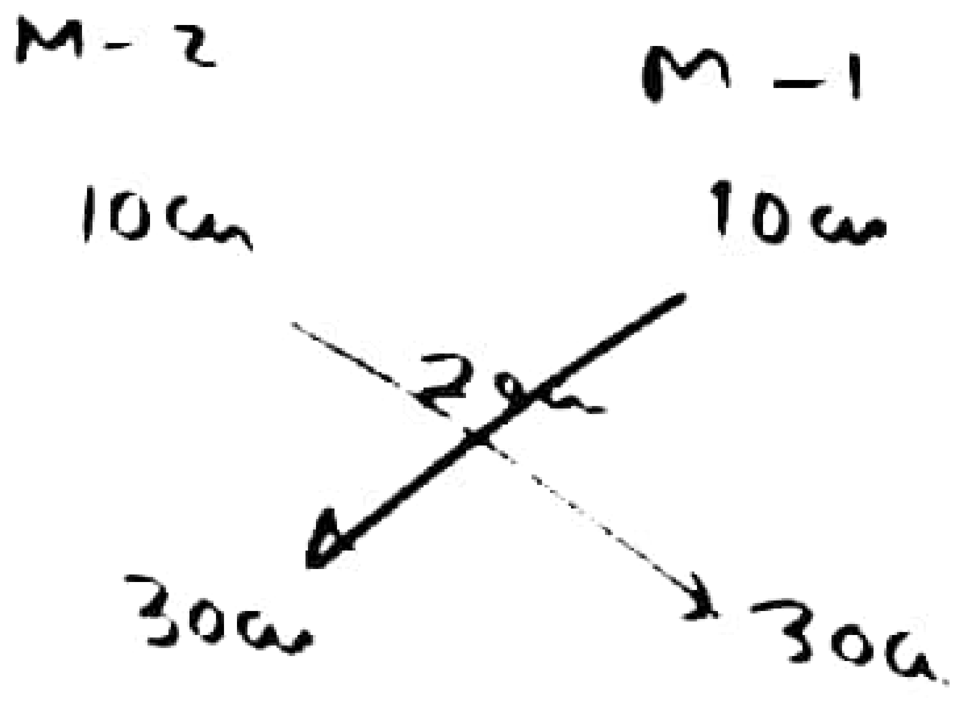
$\theta = 40$

26.

Two plane mirrors kept parallel at 20 cm from each other. A point object is placed exactly in between them. Calculate distance between second images formed by two mirrors



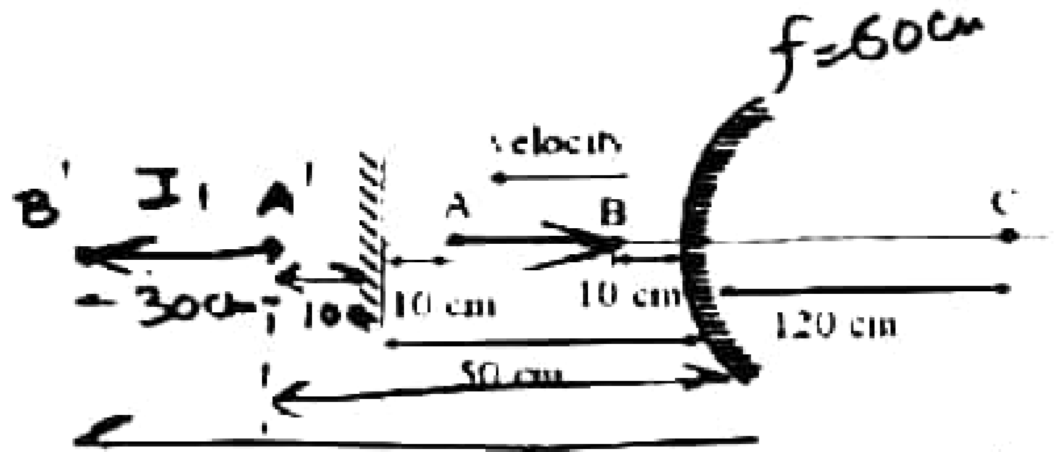
(1*) 80 cm (2) 60 cm (3) 40 cm (4) 10 cm



D = 30 + 20 + 30 = 80 cm.

27.

In the figure shown consider the first reflection at the plane mirror and second at the convex mirror. AB is object.



(1) the second image is real, inverted of 1/5th magnification

(2) the second image is virtual and erect with magnification 1/5

(3) the second image is virtual and erect with magnification 5

(4) none

I_1 act as Real object

I_2 = Virtual

$m_{AB} = m_{TA'} \times m_{TB'}$

$m_{TA'} = \frac{f}{f-u} = \frac{+60cm}{+60-(-60)} = \frac{1}{2}$

$m_{TB'} = \frac{f}{f-u} = \frac{60}{60-(-90)} = \frac{6}{15} = \frac{2}{5}$

$m_{AB} = \frac{1}{2} \times \frac{2}{5} = \frac{1}{5}$

28.

Which statement is correct ?

(1) When light proceeds from denser to rarer medium and the angle of incidence is greater than critical angle total internal reflection of light takes place correct

(2) When light proceeds from rarer to denser medium total internal reflection of light takes place ✗

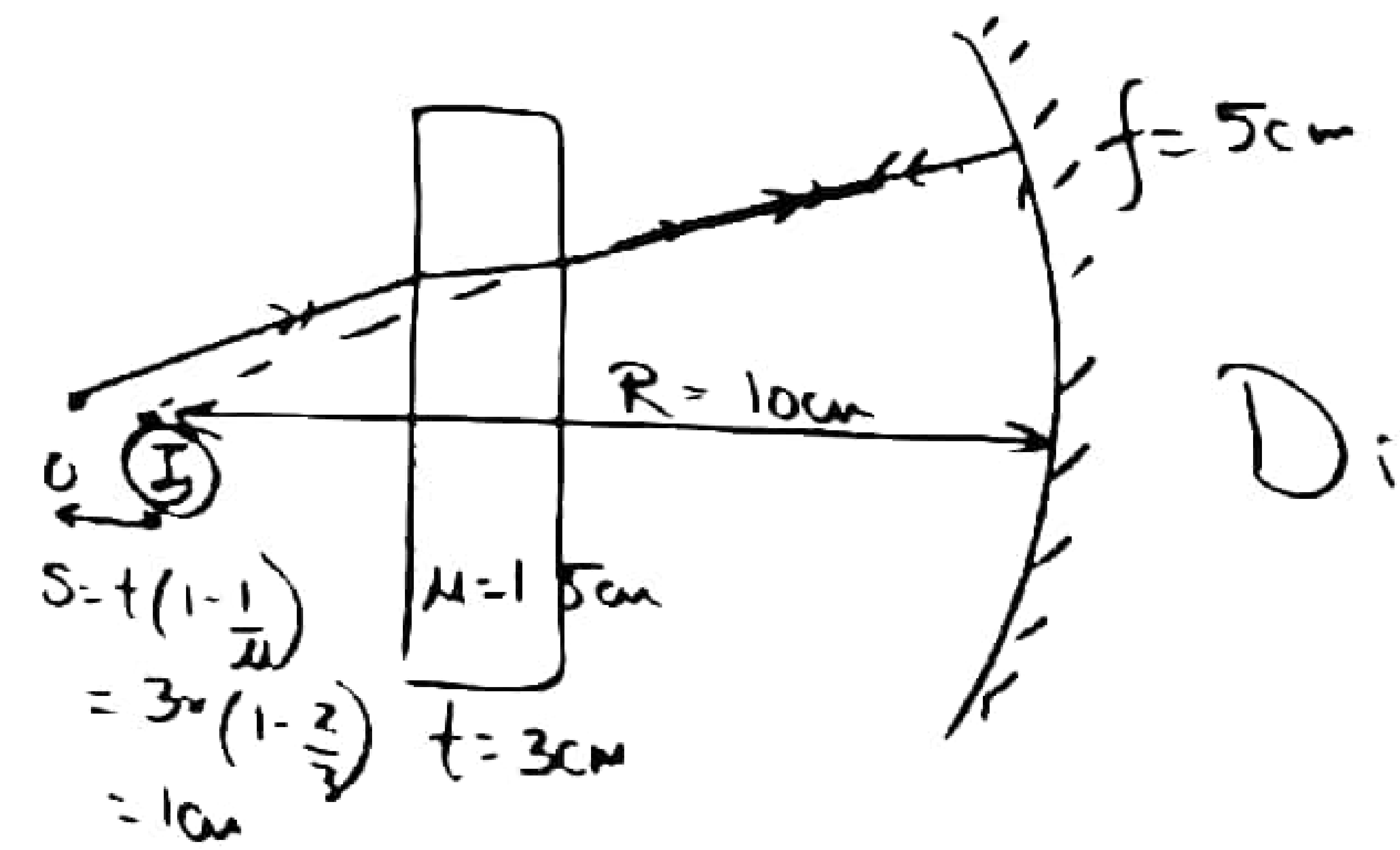
(3) When light proceeds from denser to rarer medium, total internal reflection always takes place ✗

(4) None of the above

29.

A slab of glass of refractive index 1.5 and thickness 3cm is placed with the faces perpendicular to the principal axes of a concave mirror. If the radius of curvature of the mirror is 10 cm, the distance at which an object must be placed from the mirror so that image coincides with the object is -

(1) 9 cm (2) 10 cm (3*) 11cm (4) 12 cm



Distance of O = R + S
= 10 + 1
= 11cm

30.

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)

(1) 62° (2) 41° (3*) 82° (4) 31°

Sol

$\mu = 1.5$ $\delta_{min} = A$

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

$2i = 2A$

$i = A$

$\sin i = \mu \sin \frac{A}{2}$

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

$2 \sin \frac{A}{2} \cos \frac{A}{2} = 1.5 \sin \frac{A}{2}$

$\cos A/2 = 0.75$

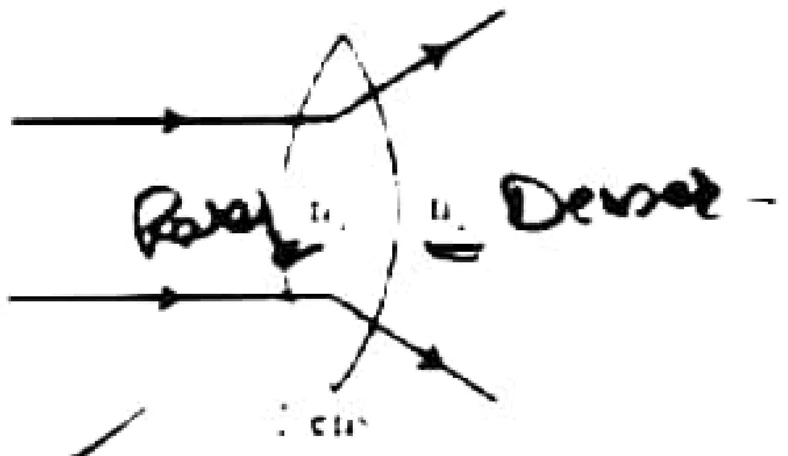
$\cos A/2 = \cos 41$

$\frac{A}{2} = 41$

$A = 82$

31.

The relation between n_1 and n_2 if the behaviour of light ray is as shown in the fig. is -

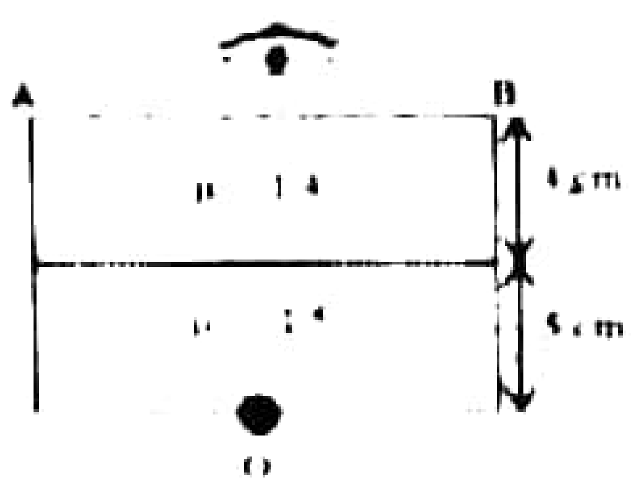


(1) n_2 n (2) n_1 n_2 (3) n_1 n_2 (4) n_1 n_2

$n_2 > n_1$

32.

The apparent depth of object O from AB is



(1) 4.29 cm (2) 5.43 cm (3) 6.19 cm (4) 5.99 cm

App depth = $\mu_{obs} \sum \frac{x}{\mu}$

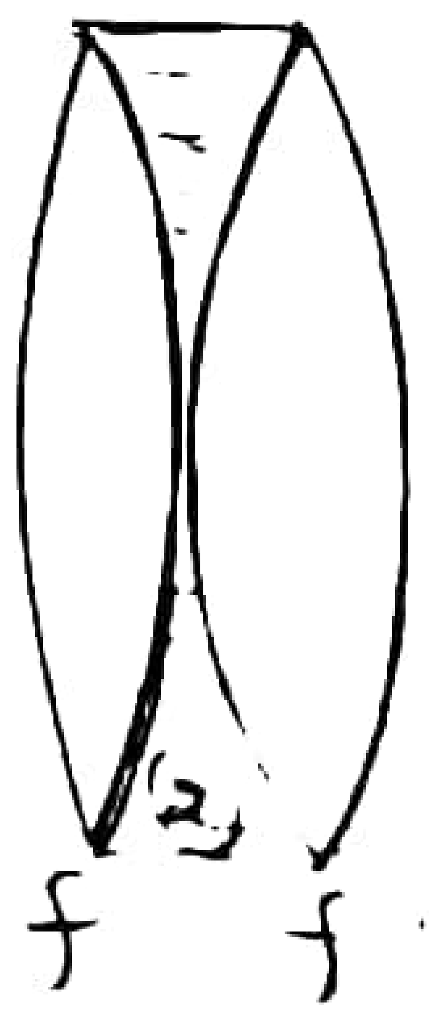
$= 1\left(\frac{4}{1.4} + \frac{5}{1.5}\right)$

$= 6.19\text{cm}$

33.

Two identical glass (μ_g = 3/2) equiconvex lenses of focal length f are kept in contact. The space between the two lenses is filled with water (μ_w = 4/3). The focal length of the combination is -

(1) f (2) $\frac{f}{2}$ (3) $\frac{4f}{3}$ ✓(4) $\frac{3f}{4}$



$f = \frac{R}{2(\mu_g - 1)} = \frac{R}{2\left(\frac{3}{2}-1\right)} = R$

$\boxed{f = R}$

$f_2 = \frac{-R}{2(\mu_w - 1)} = \frac{-f}{2\left(\frac{4}{3}-1\right)} = -\frac{3f}{2}$

$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} = \frac{2}{f} - \frac{2}{3f} = \frac{4}{3f}$

$f_{eq} = 3f/4$

34.

Choose the incorrect statement :

(1) A convex mirror can form a virtual image of a virtual object. Correct

(2) A convex mirror can form a real image of a virtual object correct

✓(3) A concave mirror can form a virtual image of a virtual object ✗

(4) A concave mirror can form a real image of a virtual object corr

Concave Mirror does not form Virtual object ki Virt. Image

Convex . . . . Real . . . Real . .

35.

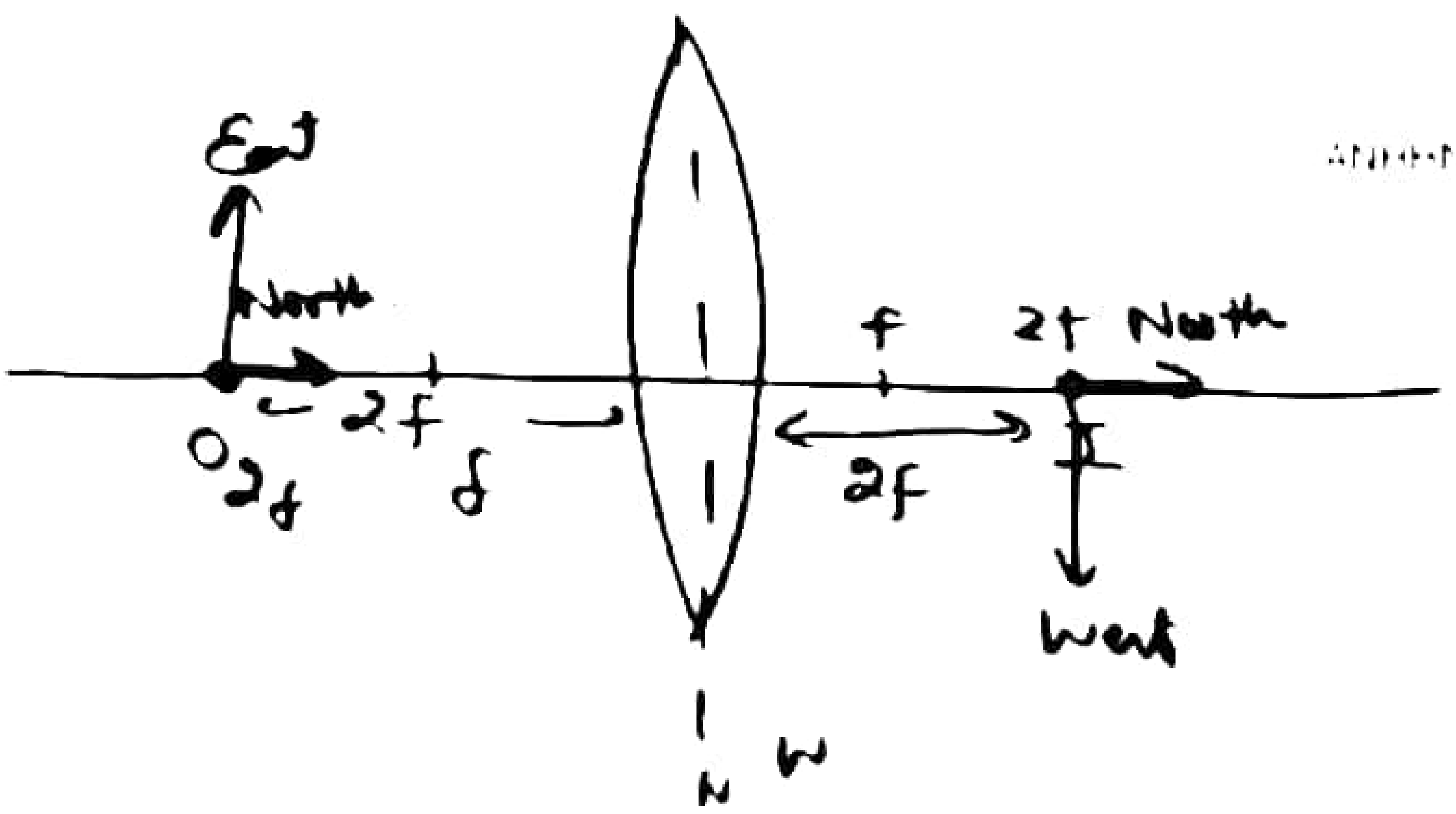
A point source is moving along principal axis of a convex lens. If distance of object from lens is twice the focal length of lens at some instant. Then which of the following is incorrect (wrong) -

(1) ratio of velocity of image to object is unity (1) Correct

(2) ratio of size of image to object is unity (1) Correct

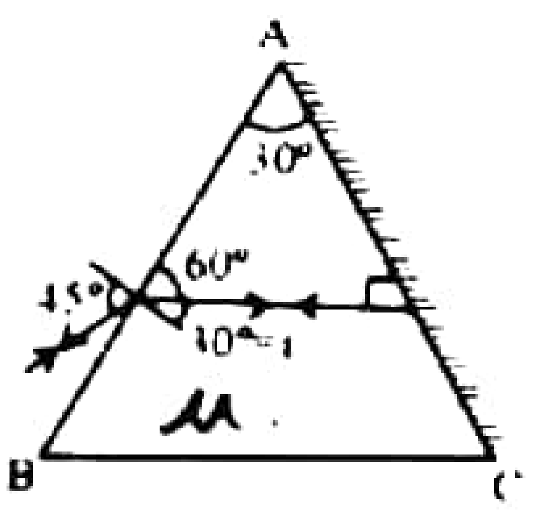
(3) if image is moving towards north the object moves towards south Incorrect

(4) if principle axis is along north south line and object moves towards east image moves west Correct



36.

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) $\frac{4}{3}$

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

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

$\mu = \sqrt{2}$

37.

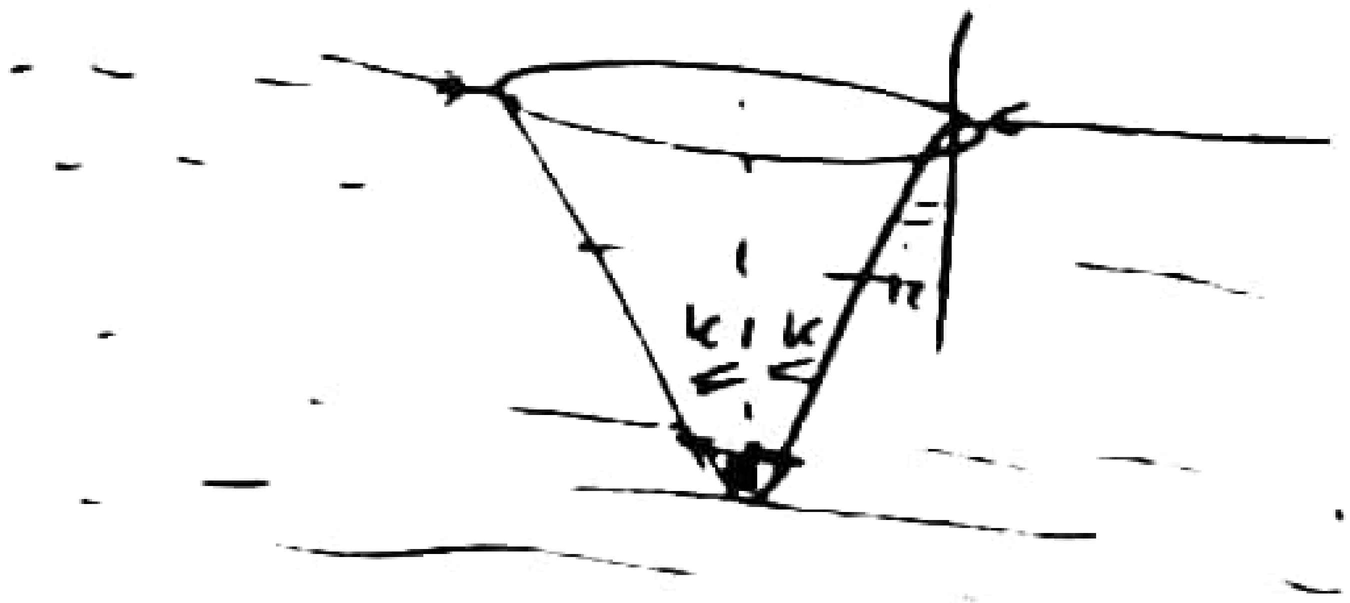
A swimmer is swimming inside a tank of water. He looks up at the sky through the water surface. The surface is calm and sky is bright due to day-light. He can see -

(1*) a small illuminated patch directly above his head whose angular size is independent of his depth ✓

(2) a small illuminated patch above his head whose angular size depends upon the depth of the swimmer ✗

(3) nothing but darkness outside the tank ✗

(4) the entire top surface of the water ✗



$\sin i_c = \frac{1}{\mu}$

$2i_c$ = angular range = $2\sin^{-1}\frac{1}{\mu}$

38.

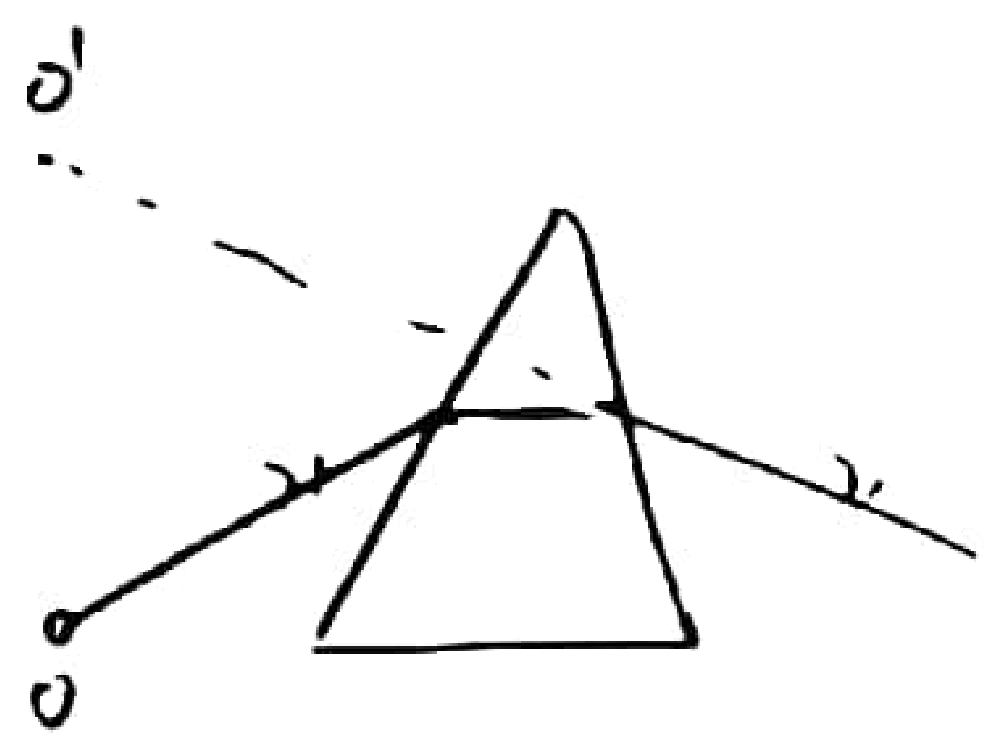
Which of the following is correct -

(1) refractive index of all media increases with increase in wavelength of light ✓

(2*) critical angle for red color is more than critical angle for violet ✓

(3) color of light changes in refraction ✗

(4) image by thin prism is always real ✗



$\sin i_c = \frac{1}{\mu}$

λ_R = Max →

μ_R = Min

i_{cR} = Max →

39.

In a microscope the focal lengths of two lenses are 1.5 cm and 6.25 cm. If an object is placed at 2 cm from objective and final image is formed at 25 cm from eye – lens, the distance between two lenses is -

(1) 6 cm (2) 7.75 cm (3) 9.25 cm (4*) 11 cm

Sol

$f_0 = 1.5 cm$

$f_e = 6.25 cm$

$u_0 = 2 cm$

$V_e = D$

$L = V_0 + \frac{Df_e}{D+f_e}$

$\frac{1}{f_0} = \frac{1}{V_0} - \frac{1}{u_0}$

$\frac{1}{1.5} = \frac{1}{V_0} + \frac{1}{2}$

$V_0 = \frac{2 \times 1.5}{2 - 1.5}$

$V_0 = 6 cm$

$L = 6 + \frac{25 \times \frac{25}{4}}{25 + \frac{25}{4}}$

$L = 6 + \frac{\frac{25}{4}}{\frac{5}{4}}$

$= 11 cm$

40.

The magnification produced by an astronomical telescope for normal adjustment is 10 and the length of telescope is 1.1m. The magnification when image is formed at least distance of distinct vision (D = 25 cm) is -

(1*) 14 (2) 6 (3) 16 (4) 18

Sol

$m_{NA} = 10 = \frac{f_0}{f_e}$

$L = 1.1 = f_0 + f_e$

$1.1 = 11 f_e$

$f_e = 0.1 m = 10 cm$

$f_0 = 100 cm$

$m_{ST} = \frac{f_0}{f_e}\left(1 + \frac{f_e}{D}\right)$

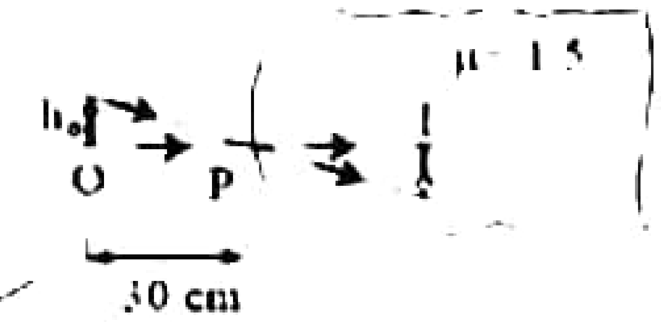
$= m_{NA}\left(1 + \frac{10}{25}\right)$

$= 10 \times \left[\frac{35}{25}\right]$

$m_{ST} = 14$

41.

The image formed by refraction in the situation shown in figure (Given R=300/11 cm)



(A*) 100 cm left of P (B) 50 cm left of P

(C) 100 cm right of P (D) 50 cm right of P

$V = -100 cm$

$\mu_2 = 1.5$ $\mu_1 = 1$

$u = -30 cm$ $v = ?$

$R = +\frac{300}{11} cm$

$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\frac{1.5}{v} + \frac{1}{30} = \frac{0.5 \times 11}{300}$

$\frac{1.5}{v} = \frac{5.5}{300} - \frac{10}{300}$

$\frac{1.5}{v} = \frac{-4.5}{300}$ -3

42.

Magnification of a compound microscope is 30. Focal length of eye - piece is 5 cm and image is formed at a distance of 25 cm from eye - piece. The magnification of objective lens is -

(1) 6 (2*) 5 (3) 7.5 (4) 10

Sol. $m = 30$ $f_e = 5 cm$

$V_e = D$

$m = m_o \times m_e$

$30 = m_o \times \frac{D(D+f_e)}{D f_e}$

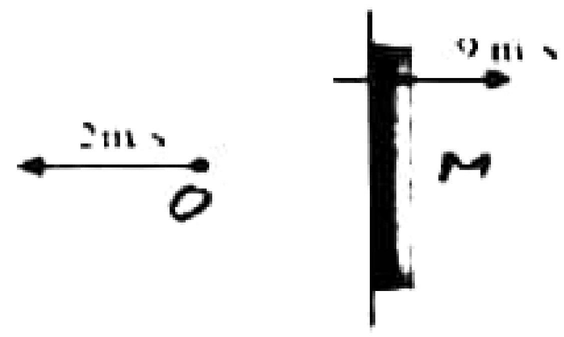
$30 = m_o \times \left(\frac{25+5}{5}\right)$

$m_o = 5$

43.

43 Match the entries of column I and column II

An object is moving in front of mirror as shown in figure



$V_O = -2 m/s$ $V_M = +9 m/s$

(1) $V_{O/M} = V_O - V_M = -11 m/s$

(2) $V_{I/M} = -V_{O/M} = +11 m/s$

(3) $V_{I/M} = V_I - V_M$
$V_I = V_{I/M} + V_M = 11 + 9 = 20 m/s$

(4) $V_{I/O} = V_I - V_O = 20 - (-2) = 22 m/s$

	Column – I		Column – II
Q ←	(i) Velocity of image	(P)	2 m/s
R ←	(ii) Velocity of image with respect to mirror	(Q)	20 m/s
S ←	(iii) Velocity of image with respect to object	(R)	11 m/s
P ←	(iv) Velocity of image if mirror is stopped	(S)	22 m/s

(1*) i → Q, ii → R, iii → S, iv → P ✓ (2) i → R, ii → S, iii → Q, iv → P

(3) i → Q, ii → S, iii → R, iv → P (4) i → S, ii → Q, iii → P, iv → R

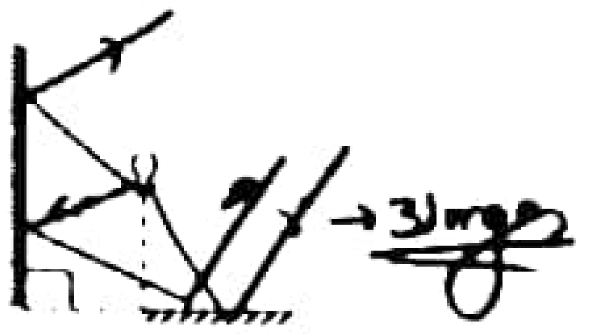
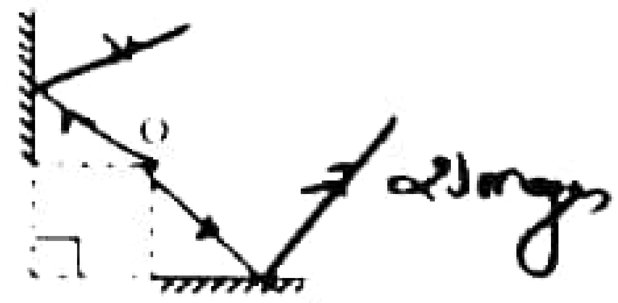
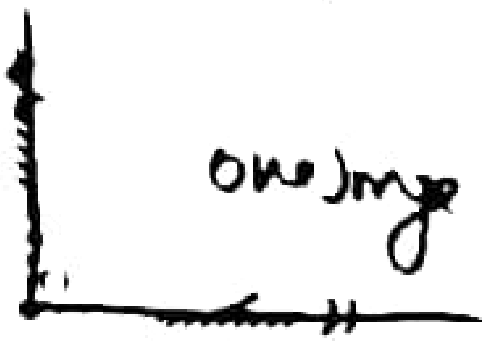
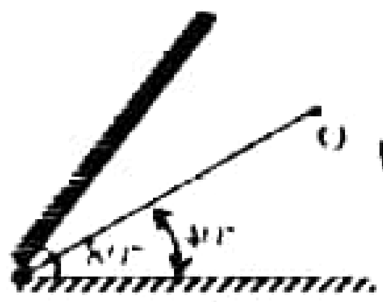
44.

A clock hung on a wall has marks instead of numerals on its dial. On the adjoining wall, there is a plane mirror and the image of the clock in the mirror indicates the time 7.10. Then the time on the clock is-

(1) 7.10 ✓(2*) 4.50 (3) 5.40 (4) 10.7

11 : 60
− 7 : 10
4 : 50

45.

Column-I	Column-II
(i)  R — 3 Images	(P) 2
(ii)  P — 2 Images	(Q) 4
(iii)  S — one Image	(R) 3
(iv)  Q — 4 Images	(S) 1

(1*) (i) → R, (ii) → P, (iii) → S, (iv) → Q

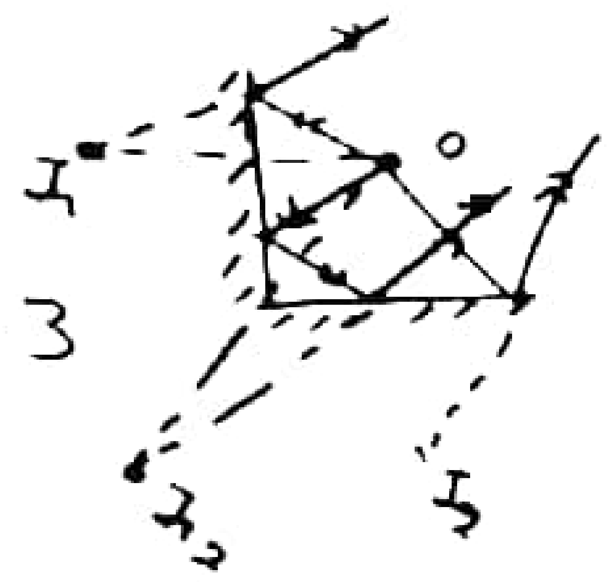
(2) (i) → P, (ii) → S, (iii) → R, (iv) → S

(3) (i) → S, (ii) → R, (iii) → Q, (iv) → P

(4) (i) → Q, (ii) → P, (iii) → R, (iv) → S

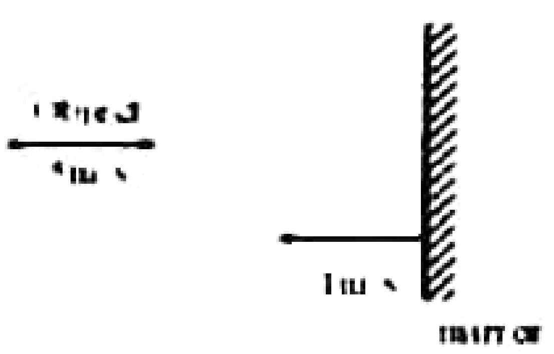
$n = \frac{360}{90} = 4$

no of Images $= n - 1 = 3$



46.

An object moves with 5m/s towards right while the mirror moves with 1m/s towards the left as shown, then velocity of image



An object moves with 5m/s towards right while

(1) 6m/s toward left
(2) 4m/s toward left
(3) 7m/s toward right
(4*) 7m/s toward left

$V_0 = 5 m/s \quad V_M = -1$

① $V_{O/M} = V_O - V_M = 6 m/s$

② $V_{I/M} = -6 m/s$

③ $V_I = V_{I/M} + V_M = -6 + (-1) = -7 m/s$ (Ans)

47.
All of the following statements are correct except -

(1) The magnification produced by a convex mirror is always less than one ✓ $m_T < 1$

(2) A virtual, erect, same-sized image can be obtained using a plane mirror ✓

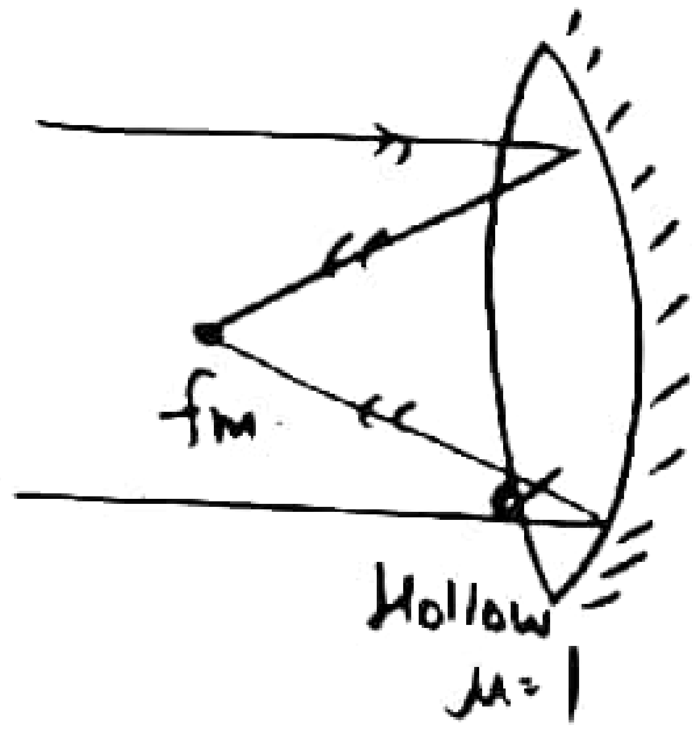
(3) A virtual, erect, magnified image can be formed using a concave mirror ✓

(4) A real, inverted, same-sized image can be formed using a convex mirror ✗

48.
A thin hollow equi-convex lens, silvered at the back, converges a parallel beam of light at a distance of 0.2 m in front of it. where will it converge the same light if filled with water having μ = 4 / 3 ?

(A) 10 cm (B) 22 cm

(C) 12 cm (D) 14



$$f_m = \frac{-R}{2(2\mu-1)} = -0.2$$

$$\frac{R}{2(2-1)} = 0.2$$

$$R = 0.4\,m$$

$$f_m' = \frac{-0.4}{2\left(2\times\frac{4}{3}-1\right)} = \frac{-0.4}{2\left(\frac{5}{3}\right)} = -\frac{1.2}{10} = -0.12\,m = -12\,cm$$

49.
In a compound microscope, if the objective produces an image I_o and the eye piece produces an image I_e, then -

(1) I_o is virtual but I_e is real

(2) I_o is real but I_e is virtual

(3) I_o and I_e are both real

(4) I_o and I_e are both virtual

50.

Which of the following statements is correct?

(1) When a lens is dipped in water, magnitude of its focal length increases.

(2) When a lens is dipped in water, magnitude of its focal length decreases.

(3) When a spherical mirror is dipped in water, magnitude of its focal length increases.

(4) None of these.

$f_w = 4 f_{air}$.