1. A point source of light B is placed at a distance L in front of the centre of a mirror of width d hung vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance $2L$ from it as shown. The greatest distance over which he can see the image of the light source in the mirror is

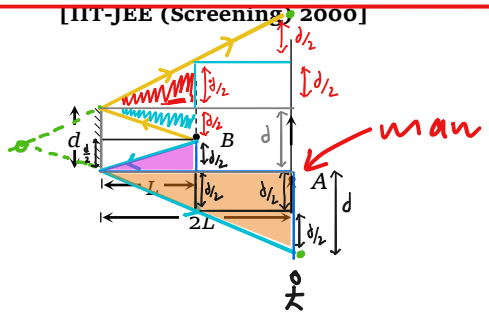
[IIT-JEE (Screening) 2000]

(a) $d/2$

(b) d

(c) $2d$

(d) $3d$



2. Two plane mirrors. A and B are aligned parallel to each other, as shown in the figure. A light ray is incident at an angle of $30°$ at a point just inside one end of A. The plane of incidence coincides with the plane of the figure. The maximum number of times the ray undergoes reflections (including the first one) before it emerges out is

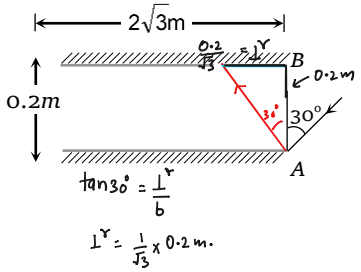
[IIT-JEE (Screening) 2002]

(a) 28

(b) 30

(c) 32

(d) 34



Distance travelled in one reflection = $\frac{0.2\text{m}}{\sqrt{3}}$

Supposed after x reflections light comes out

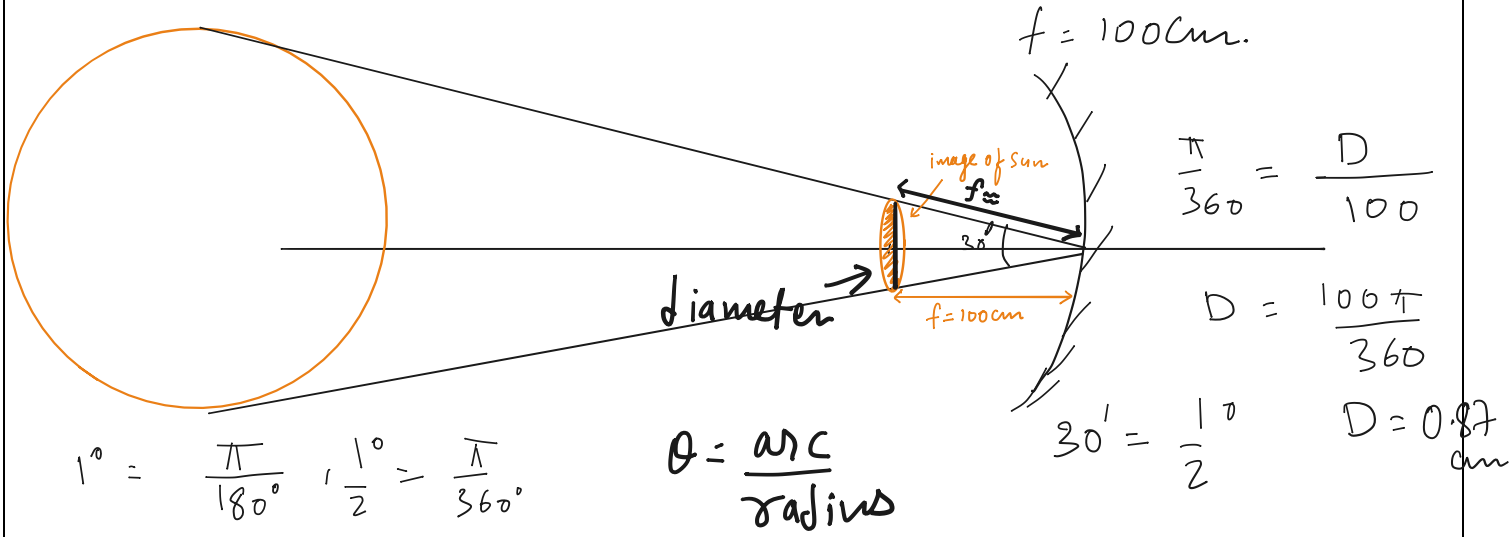
$$\frac{0.2}{\sqrt{3}}x = 2\sqrt{3}$$

$$x = 30$$

3. A concave mirror of focal length $100\,cm$ is used to obtain the image of the sun which subtends an angle of $30'$. The diameter of the image of the sun will be

(a) $1.74\,cm$ (b) $0.87\,cm$

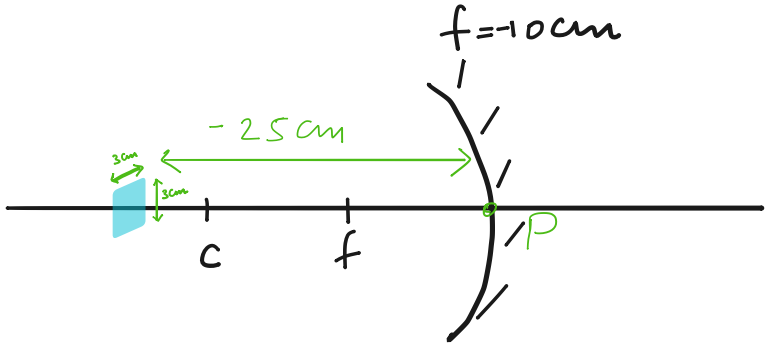
(c) $0.435\,cm$ (d) $100\,cm$



4. A square of side $3cm$ is placed at a distance of $25\,cm$ from a concave mirror of focal length $10\,cm$. The centre of the square is at the axis of the mirror and the plane is normal to the axis. The area enclosed by the image of the square is

(a) $4\,cm^2$ (b) $6\,cm^2$

(c) $16\,cm^2$ (d) $36\,cm^2$



$A_0 = 9\,cm^2$

$A_i = m^2 A_0$

$m = \frac{f}{f-u} = \frac{-10}{-10-(-25)}$

$= \frac{-10}{-10+25}$

$A_i = \frac{4}{9} \times 9 = 4\,cm^2$

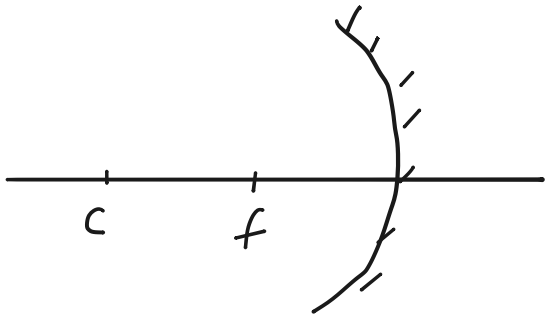
$m = \frac{-10}{15} = -\frac{2}{3}$

5. A short linear object of length l lies along the axis of a concave mirror of focal length f at a distance u from the pole of the mirror. The size of the image is approximately equal to **[IIT-JEE 1988; BHU 2003; CPMT 2004]**

(a) $l\left(\frac{u-f}{f}\right)^{1/2}$ (b) $l\left(\frac{u-f}{f}\right)^{2}$

(c) $l\left(\frac{f}{u-f}\right)^{1/2}$ (d) $l\left(\frac{f}{u-f}\right)^{2}$

$L_i = m^2 L_o$



$= \left(\frac{f}{f-u}\right)^2 L_o$

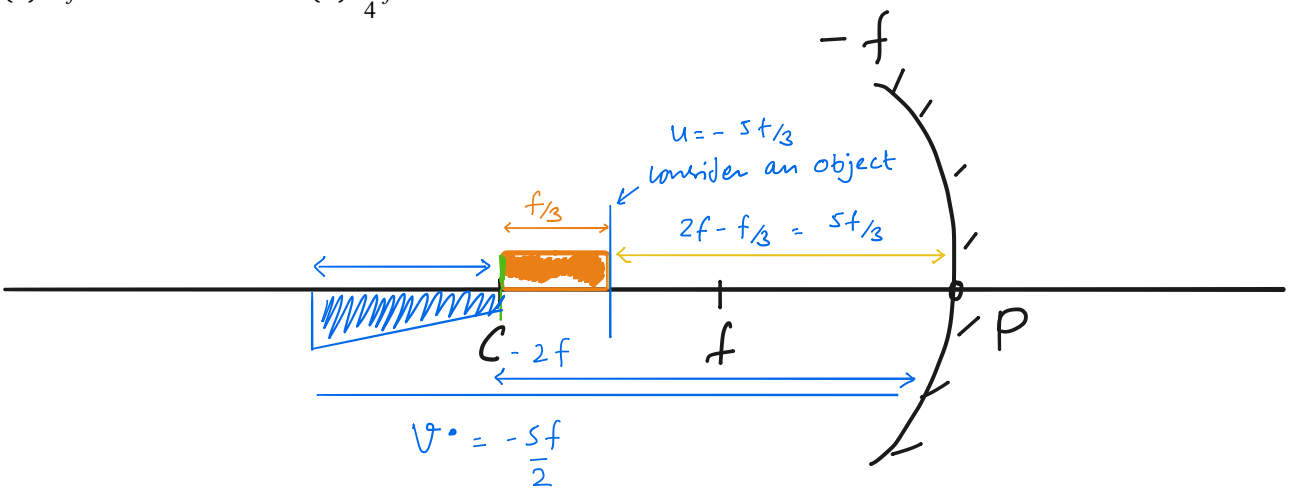
$L_i = \left(\frac{f}{f-u}\right)^2 l = \left(\frac{f}{u-f}\right)^2 l.$

6. A thin rod of length $f/3$ lies along the axis of a concave mirror of focal length f. One end of its magnified image touches an end of the rod. The length of the image is

[MP PET 1995]

(a) f (b) $\frac{1}{2}f$

(c) $2f$ (d) $\frac{1}{4}f$



$v = -\frac{5f}{2}$

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

$-\frac{1}{f} = \frac{1}{v} - \frac{3}{5f}$

$\frac{1}{v} = \frac{3}{5f} - \frac{1}{f} = \frac{1}{f}\left[\frac{3}{5} - 1\right]$

$\frac{1}{v} = \frac{1}{f}\left(-\frac{2}{5}\right)$

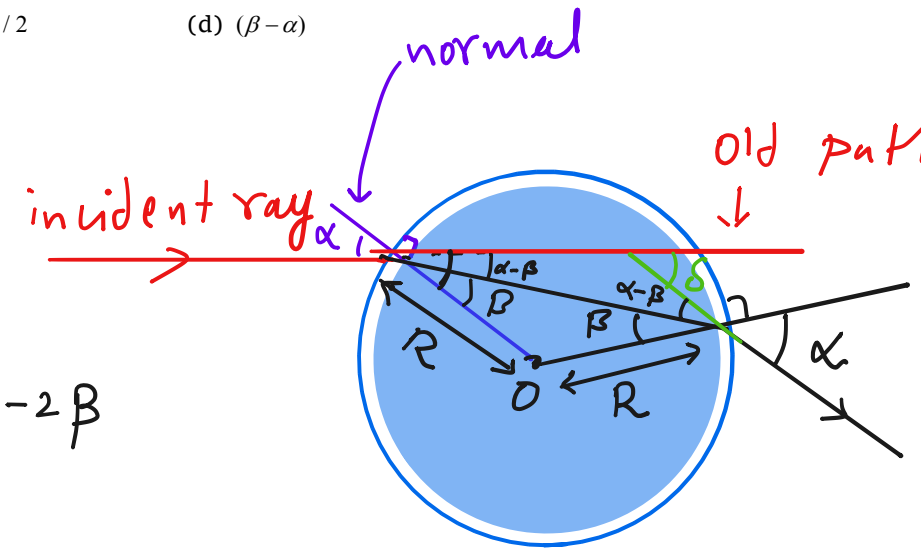
$V = -5f$

7. A ray of light falls on the surface of a spherical glass paper weight making an angle α with the normal and is refracted in the medium at an angle β. The angle of deviation of the emergent ray from the direction of the incident ray

[NCERT 1982]

(a) $(\alpha - \beta)$ (b) $2(\alpha - \beta)$

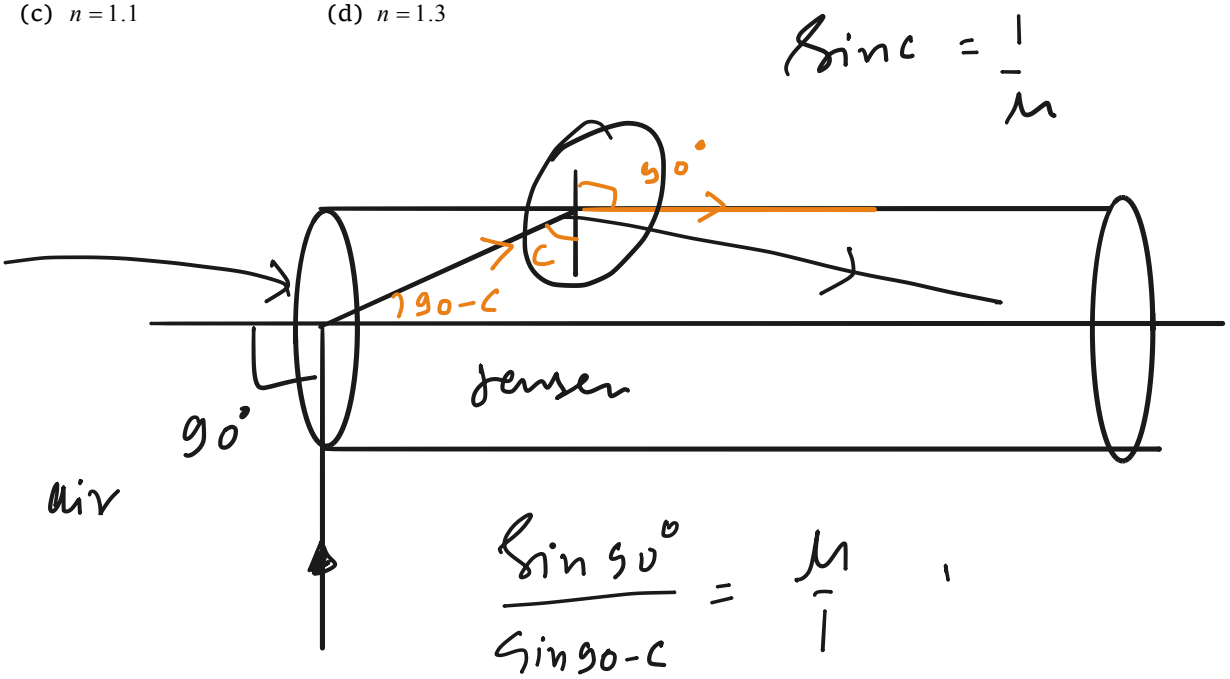
(c) $(\alpha - \beta)/2$ (d) $(\beta - \alpha)$



8. Light enters at an angle of incidence in a transparent rod of refractive index n. For what value of the refractive index of the material of the rod the light once entered into it will not leave it through its lateral face whatsoever be the value of angle of incidence **[CBSE PMT 1998]**

(a) $n > \sqrt{2}$ (b) $n = 1$

(c) $n = 1.1$ (d) $n = 1.3$

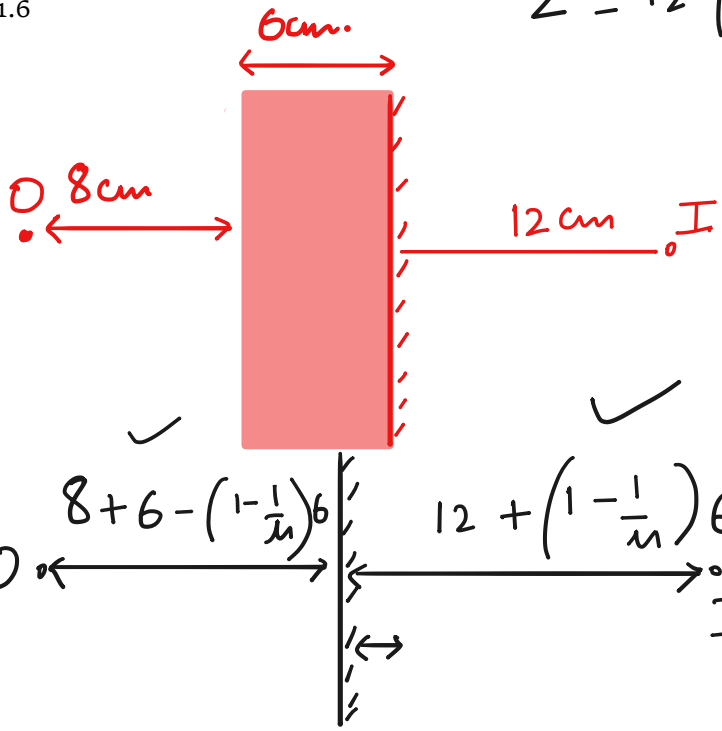


9. One face of a rectangular glass plate 6 *cm* thick is silvered. An object held 8 *cm* in front of the first face, forms an image 12 *cm* behind the silvered face. The refractive index of the glass is

[CPMT 1999]

(a) 0.4 (b) 0.8

(c) 1.2 (d) 1.6



$2 = 12\left(1-\frac{1}{\mu}\right)$

$\frac{1}{6} = 1-\frac{1}{\mu}$

$\frac{1}{\mu} = 1-\frac{1}{6}$

$\frac{1}{\mu} = \frac{5}{6}$

$\mu = \frac{6}{5} = 1.2$

$8+6-\left(1-\frac{1}{\mu}\right)6$

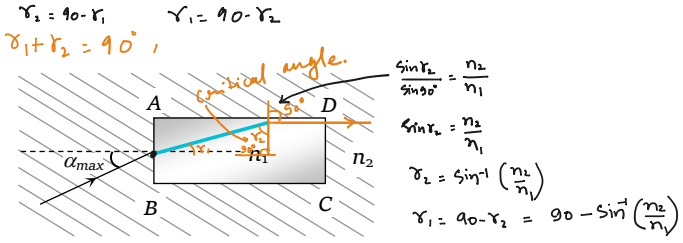
$= 12+\left(1-\frac{1}{\mu}\right)6$

$= \left(1-\frac{1}{\mu}\right)6$

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

10. A rectangular glass slab *ABCD*, of refractive index n_1, is immersed in water of refractive index n_2 $(n_1 > n_2)$. A ray of light in incident at the surface *AB* of the slab as shown. The maximum value of the angle of incidence α_{max}, such that the ray comes out only from the other surface *CD* is given by

[IIT-JEE (Screening) 2000]



(a) $\sin^{-1}\left[\frac{n_1}{n_2}\cos\left(\sin^{-1}\frac{n_2}{n_1}\right)\right]$ (b) $\sin^{-1}\left[n_1\cos\left(\sin^{-1}\frac{1}{n_2}\right)\right]$

(c) $\sin^{-1}\left(\frac{n_1}{n_2}\right)$ (d) $\sin^{-1}\left(\frac{n_2}{n_1}\right)$

$\frac{\sin\alpha_{max}}{\sin\gamma_1} = \frac{n_1}{n_2}$

$\frac{\sin\alpha_{max}}{\sin(90-\gamma_2)} = \frac{n_1}{n_2}$

$\sin\alpha_{max} = \frac{n_1\cos\gamma_2}{n_2}$

$\alpha_{max} = \sin^{-1}\left(\frac{n_1}{n_2}\cos\gamma_2\right)$

$\alpha_{max} = \sin^{-1}\left(\frac{n_1}{n_2}\cos\left(\sin^{-1}\frac{n_2}{n_1}\right)\right)$

11. A diverging beam of light from a point source S having divergence angle α, falls symmetrically on a glass slab as shown. The angles of incidence of the two extreme rays are equal. If the thickness of the glass slab is t and the refractive index n, then the divergence angle of the emergent beam is

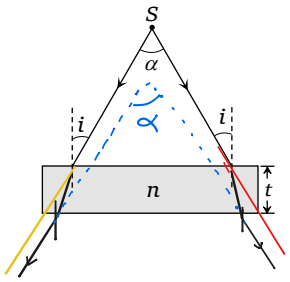
[IIT-JEE (Screening) 2000]

(a) Zero

(b) α

(c) $\sin^{-1}(1/n)$

(d) $2\sin^{-1}(1/n)$



12. A concave mirror is placed at the bottom of an empty tank with face upwards and axis vertical. When sunlight falls normally on the mirror, it is focussed at distance of 32 *cm* from the mirror. If the tank filled with water $\left(\mu = \frac{4}{3}\right)$ upto a height of 20 *cm*, then the sunlight will now get focussed at

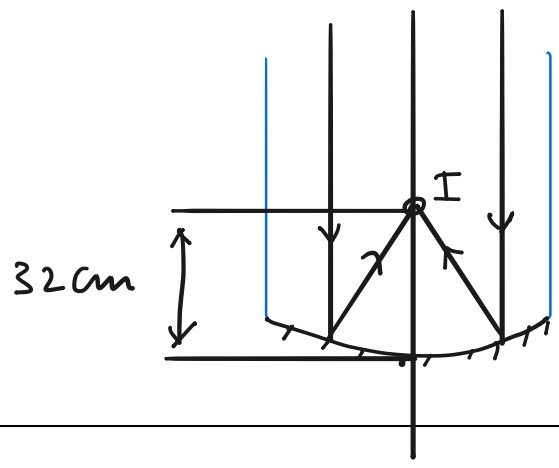
[UPSEAT 2002]

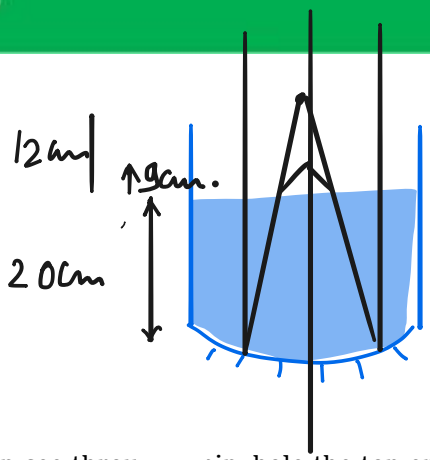
(a) 16 *cm* above water level

(b) 9 *cm* above water level

(c) 24 *cm* below water level

(d) 9 *cm* below water level



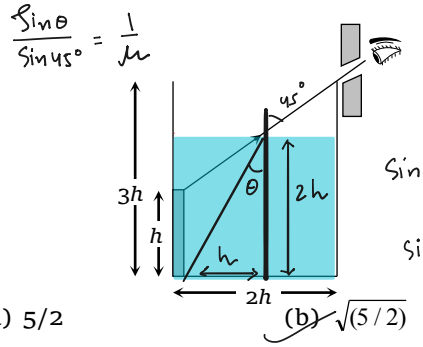


12cm. actual height.

$= \frac{12}{4/3} = \frac{36}{4} = 9\text{cm}.$

13. An observer can see throu ...in-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is $3h$ a... 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

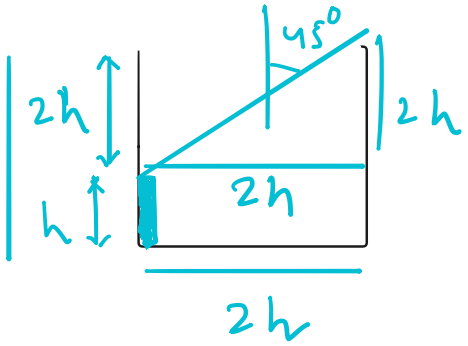
[IIT-JEE (Screening) 2002]



$\frac{\sin\theta}{\sin 45^\circ} = \frac{1}{\mu}$

$\sin\theta = \frac{h}{\sqrt{(2h)^2+(h)^2}}$

$\sin\theta = \frac{1}{\sqrt{5}}$



(a) 5/2 (b) $\sqrt{(5/2)}$

(c) $\sqrt{(3/2)}$ (d) 3/2

$$\frac{\frac{1}{\sqrt{5}}}{\frac{1}{\sqrt{2}}} = \frac{1}{\mu} \quad , \quad \mu = \sqrt{5/2}$$

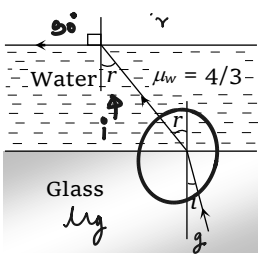
14. A ray of light is incident at the glass-water interface at an angle i, it emerges finally parallel to the surface of water, then the value of μ_g would be **[IIT-JEE (Screening) 2003]**

(a) (4/3) sin i

(b) 1/sin i

(c) 4/3

(d) 1



$\frac{\sin r}{\sin 90^\circ} = \frac{1}{\mu_w}$

$\sin r = \frac{3}{4}$

$\frac{\sin i}{\sin r} = \mu_w$, $\sin i = \frac{4}{3}$

15. A glass prism ($\mu = 1.5$) is dipped in water ($\mu = 4/3$) as shown in figure. A light ray is incident normally on the surface AB. It reaches the surface BC after totally reflected, if

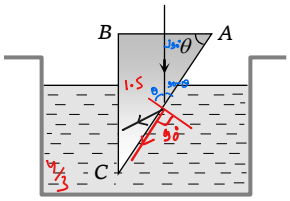
[IIT JEE 1981; MP PMT 1997]

(a) $\sin\theta \geq 8/9$

(b) $2/3 < \sin\theta < 8/9$

(c) $\sin\theta \leq 2/3$

(d) It is not possible



they want TIR at AC

$$\frac{\sin\theta}{\sin 90^\circ} = \frac{4/3}{1.5} = \frac{4/3}{3/2} = \frac{8}{9}$$

$$\sin\theta = \frac{8}{9}$$

$$\sin\theta > \frac{8}{9}$$

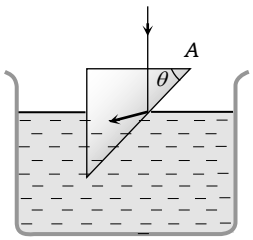
16. The refractive index of the material of the prism and liquid are 1.56 and 1.32 respectively. What will be the value of θ for the following refraction **[BHU 2003; CPMT 2004]**

(a) $\sin\theta \geq \frac{13}{11}$

(b) $\sin\theta \geq \frac{11}{13}$

(c) $\sin\theta \geq \frac{\sqrt{3}}{2}$

(d) $\sin\theta \geq \frac{1}{\sqrt{2}}$



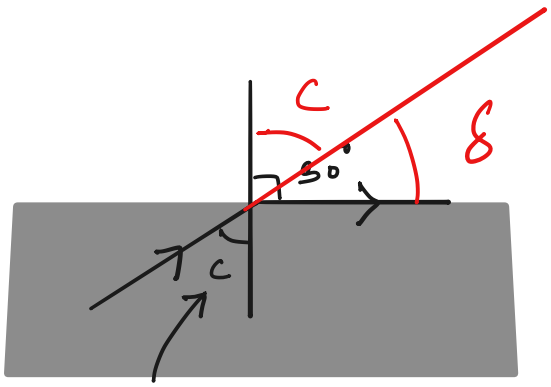
H.W.

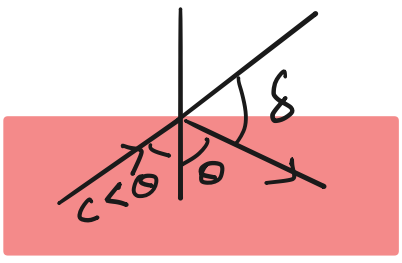
17. A ray of light travels from an optically denser to rarer medium. The critical angle for the two media is C. The maximum possible deviation of the ray will be

[KCET (Engg./Med.) 2002]

(a) $\left(\frac{\pi}{2} - C\right)$ (b) $2C$

(c) $\pi - 2C$ (d) $\pi - C$





$\delta = 90 - C = \frac{\pi}{2} - C$

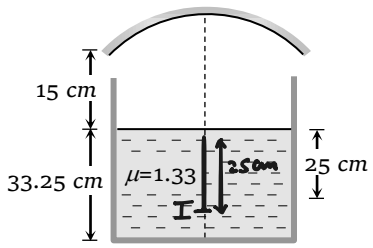
$\delta + 2\theta = 180^\circ$

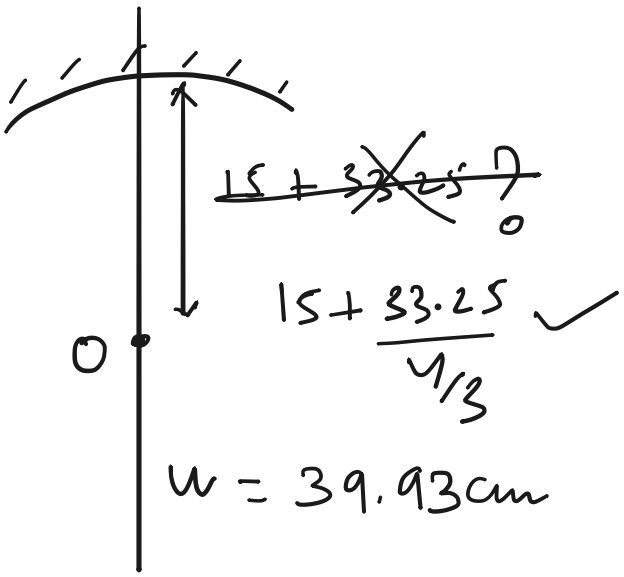
$\delta = \pi - 2\theta$?

$\delta = \pi - 2C$

18. A container is filled with water (μ = 1.33) upto a height of 33.25 *cm*. A concave mirror is placed 15 *cm* above the water level and the image of an object placed at the bottom is formed 25 *cm* below the water level. The focal length of the mirror is **[IIT-JEE (Screening) 2005]**

(a) 10
(b) 15
(c) 20
(d) 25





$V = 15 + \frac{25}{4/3}$

$V = 33.75\,cm.$

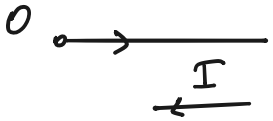
$u = 39.93\,cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = -\frac{1}{33.75} - \frac{1}{39.93}$

$f \simeq -18.3\,cm.$

19. A point object is moving on the principal axis of a concave mirror of focal length $24\,cm$ towards the mirror. When it is at a distance of $60\,cm$ from the mirror, its velocity is $9\,cm/sec$. What is the velocity of the image at that instant **[MP PMT 1997]**

(a) $5\,cm/sec$ towards the mirror
(b) $4\,cm/sec$ towards the mirror
(c) $4\,cm/sec$ away from the mirror
(d) $9\,cm/sec$ away from the mirror



$f = 24\,cm.$

$u = 60\,cm$

$u_0 = 9\,cm/sec.$

$m = \frac{f}{f-u}$

$V_i = -m^2 u_0$

$m = \frac{-24}{-24-(-60)}$

$V_i = -\left(\frac{2}{3}\right)^2 \times 9$

$m = \frac{-24}{-24+60}$

$V_i = -\frac{4}{9} \times 9$

$V_i = 4$ cm/sec

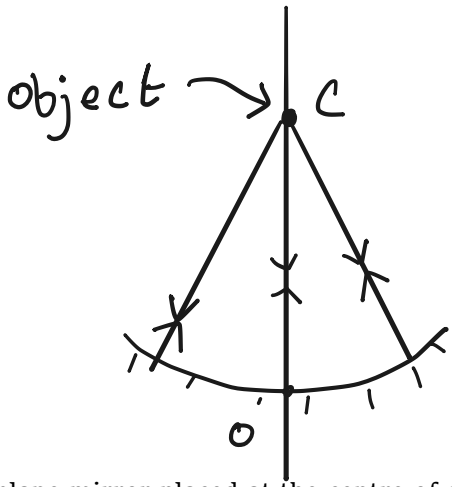
20. A concave mirror is placed on a horizontal table with its axis directed vertically upwards. Let O be the pole of the mirror and C its centre of curvature. A point object is placed at C. It has a real image, also located at C. If the mirror is now filled with water, the image will be **[IIT-JEE 1998]**

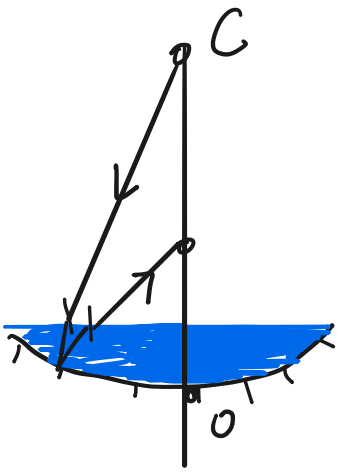
(a) Real, and will remain at C

(b) Real, and located at a point between C and ∞

(c) Virtual and located at a point between C and O

(d) Real, and located at a point between C and O

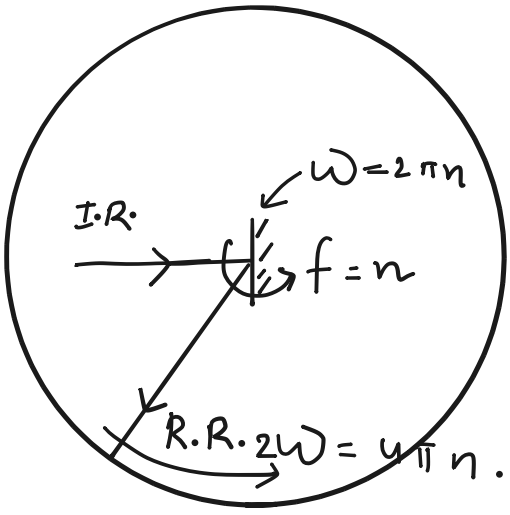




21. A small plane mirror placed at the centre of a spherical screen of radius R. A beam of light is falling on the mirror. If the mirror makes n revolution. per second, the speed of light on the screen after reflection from the mirror will be

(a) $4\pi nR$ (b) $2\pi nR$

(c) $\frac{nR}{2\pi}$ (d) $\frac{nR}{4\pi}$



$\frac{V}{R} = \omega$

$V = \omega R$

$V = 4\pi nR.$

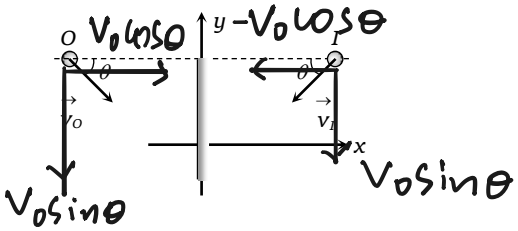
22. If an object moves towards a plane mirror with a speed v at an angle θ to the perpendicular to the plane of the mirror, find the relative velocity between the object and the image

(a) v

(b) $2v$

(c) $2v\cos\theta$

(d) $2v\sin\theta$



Q 12

Q 9

$$\vec{V}_0 = V_0\cos\theta\,\hat{i} - V_0\sin\theta\,\hat{j}$$

$$\vec{V}_I = -V_0\cos\theta\,\hat{i} - V_0\sin\theta\,\hat{j}$$

$$\vec{V}_{0/I} = \vec{V}_0 - \vec{V}_I = 2V_0\cos\theta$$

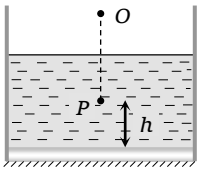
23. A plane mirror is placed at the bottom of the tank containing a liquid of refractive index μ. P is a small object at a height h above the mirror. An observer O-vertically above P outside the liquid see P and its image in the mirror. The apparent distance between these two will be

(a) $2\mu h$

(b) $\dfrac{2h}{\mu}$

(c) $\dfrac{2h}{\mu-1}$

(d) $h\left(1+\dfrac{1}{\mu}\right)$



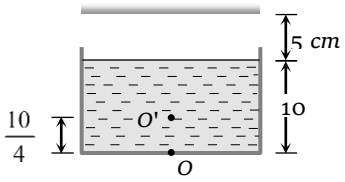
24. Consider the situation shown in figure. Water $\left(\mu_w = \frac{4}{3}\right)$ is filled in a breaker upto a height of 10 *cm*. A plane mirror fixed at a height of 5 *cm* from the surface of water. Distance of image from the mirror after reflection from it of an object *O* at the bottom of the beaker is

(a) 15 *cm*

(b) 12.5 *cm*

(c) 7.5 *cm*

(d) 10 *cm*



25. An object is placed infront of a convex mirror at a distance of 50 *cm*. A plane mirror is introduced covering the lower half of the convex mirror. If the distance between the object and plane mirror is 30 *cm,* it is found that there is no parallax between the images formed by two mirrors. Radius of curvature of mirror will be

(a) 12.5 *cm* (b) 25 *cm*

(c) $\frac{50}{3}$ *cm* (d) 18 *cm*

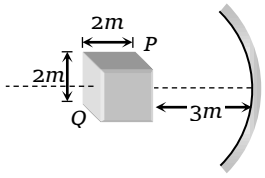
26. A cube of side 2 m is placed in front of a concave mirror focal length 1m with its face P at a distance of 3 m and face Q at a distance of 5 m from the mirror. The distance between the images of face P and Q and height of images of P and Q are

(a) 1 m, 0.5 m, 0.25 m

(b) 0.5 m, 1 m, 0.25 m

(c) 0.5 m, 0.25 m, 1m

(d) 0.25 m, 1m, 0.5 m



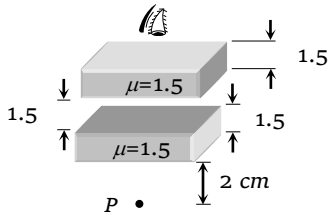
27. The image of point P when viewed from top of the slabs will be

(a) 2.0 cm above P

(b) 1.5 cm above P

(c) 2.0 cm below P

(d) 1 cm above P



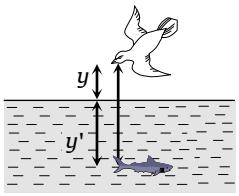
28. A fish rising vertically up towards the surface of water with speed 3 ms^{-1} observes a bird diving vertically down towards it with speed 9 ms^{-1}. The actual velocity of bird is

(a) 4.5 ms^{-1}

(b) 5. ms^{-1}

(c) 3.0 ms^{-1}

(d) 3.4 ms^{-1}



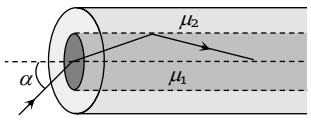
29. An optical fibre consists of core of μ_1 surrounded by a cladding of $\mu_2 < \mu_1$. A beam of light enters from air at an angle α with axis of fibre. The highest α for which ray can be travelled through fibre is

(a) $\cos^{-1}\sqrt{\mu_2^2-\mu_1^2}$

(b) $\sin^{-1}\sqrt{\mu_1^2-\mu_2^2}$

(c) $\tan^{-1}\sqrt{\mu_1^2-\mu_2^2}$

(d) $\sec^{-1}\sqrt{\mu_1^2-\mu_2^2}$



30. water tank of diameter $2R$ *cm* is reducing at the rate of x *cm*/minute when water is being drained out at a constant rate. The amount of water drained in *c.c.* per minute is (n_1 = refractive index of air, n_2 = refractive index of water) **[AIIMS 2005]**

(a) $x\,\pi R^2\,n_1/n_2$ (b) $x\,\pi R^2\,n_2/n_1$

(c) $2\,\pi R\,n_1/n_2$ (d) $\pi R^2\,x$