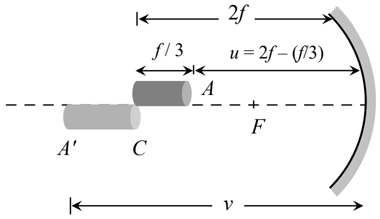
**6.** (b) If end $A$ of rod acts an object for mirror then it's image will be $A'$ and if

$u = 2f - \frac{f}{3} = \frac{5f}{3}$ so by using $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

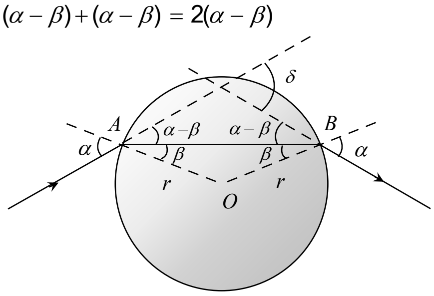



$\Rightarrow \frac{1}{-f} = \frac{1}{v} + \frac{1}{\frac{-5f}{3}} \Rightarrow v = -\frac{5}{2}f$

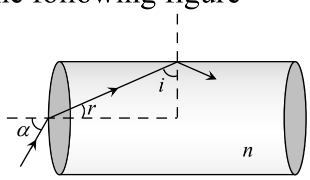
$\therefore$ Length of image $= \frac{5}{2}f - 2f = \frac{f}{2}$

**7.** (b) From the following ray diagram it is clear that

$\delta = (\alpha - \beta) + (\alpha - \beta) = 2(\alpha - \beta)$




**8.** (a) From the following figure




$r + i = 90^0 \Rightarrow i = 90^0 - r$

For ray not to emerge from curved surface $i > C$

$\Rightarrow \sin i > \sin C \Rightarrow \sin(90^o - r) > \sin C \Rightarrow \cos r > \sin C$

$\Rightarrow \sqrt{1 - \sin^2 r} > \frac{1}{n}$

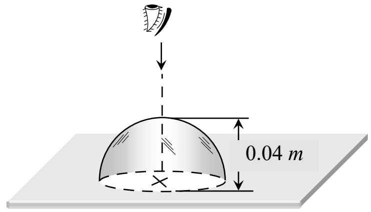
$\left\{\because \sin C = \frac{1}{n}\right\}$

$\Rightarrow 1 - \frac{\sin^2\alpha}{n^2} > \frac{1}{n^2} \Rightarrow 1 > \frac{1}{n^2}(1 + \sin^2\alpha)$

$\Rightarrow n^2 > 1 + \sin^2\alpha \Rightarrow n > \sqrt{2}$ $\{\sin i \to 1\}$

$\Rightarrow$ Least value $= \sqrt{2}$

**9.** (b) **Case (i)** When flat face is in contact with paper.




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

$\mu_2$ = *R. I.* of medium in which light rays are going = 1

$\mu_1$ = *R. I.* of medium from which light rays are coming = 1.6

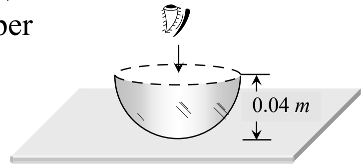
$u$ = distance of object from curved surface = – 0.04 $m$

$R$ = – 0.04 $m$.

$\therefore \frac{1}{v} - \frac{1.6}{(-0.04)} = \frac{1 - 1.6}{(-0.04)} \Rightarrow v = -0.04\, m$

*i.e.* the image will be formed at the same position of cross.

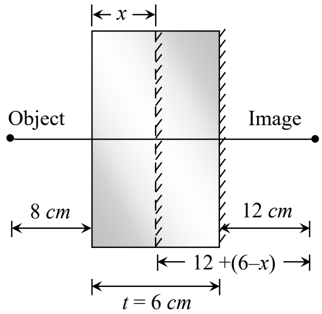
**Case (ii)** When curved face is in contact with paper




$\mu = \frac{\text{Real depth } (h)}{\text{Apparent depth } (h')}$

$\Rightarrow 1.6 = \frac{0.04}{h'} \Rightarrow h' = 0.025\, m$ (Below the flat face)

**10.** (c) Let $x$ be the apparent position of the silvered surface.

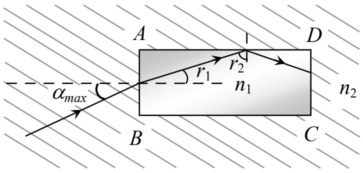


According to property of plane mirror

$x + 8 = 12 + 6 - x \;\Rightarrow x = 5\ cm$

Also $\mu = \dfrac{t}{x} \Rightarrow \mu = \dfrac{6}{5} = 1.2$

11. (a) Ray comes out from *CD*, means rays after refraction from *AB* get, total internally reflected at *AD*




$\dfrac{n_1}{n_2} = \dfrac{\sin\alpha_{\max}}{\sin r_1} \Rightarrow \alpha_{\max} = \sin^{-1}\left[\dfrac{n_1}{n_2}\sin r_1\right]$

…(i)

Also $r_1 + r_2 = 90^o \Rightarrow r_1 = 90 - r_2 = 90 - C$

$\Rightarrow r_1 = 90 - \sin^{-1}\left(\dfrac{1}{{}_2\mu_1}\right) \Rightarrow r_1 = 90 - \sin^{-1}\left(\dfrac{n_2}{n_1}\right)$

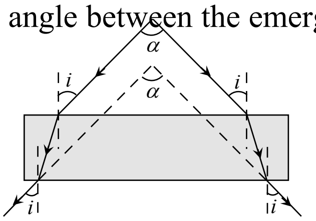
...(ii)

Hence from equation (i) and (ii)

$\alpha_{\max} = \sin^{-1}\left[\dfrac{n_1}{n_2}\sin\left\{90 - \sin^{-1}\dfrac{n_2}{n_1}\right\}\right]$

$= \sin^{-1}\left[\dfrac{n_1}{n_2}\cos\left(\sin^{-1}\dfrac{n_2}{n_1}\right)\right]$

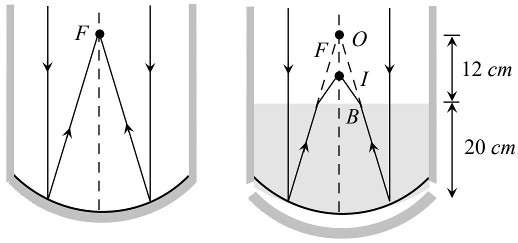
12. (b) Since rays after passing through the glass slab just suffer lateral displacement hence we have angle between the emergent rays as $\alpha$.




13. (b) Sun is at infinity *i.e.* $u = \infty$ so from mirror formula we have $\dfrac{1}{f} = \dfrac{1}{-32} + \dfrac{1}{(-\infty)} \Rightarrow f = -32\ cm.$

When water is filled in the tank upto a height of 20 *cm*, the image formed by the mirror will act as virtual object for water surface. Which will form it's image at $I$ such that $\dfrac{\text{Actual height}}{\text{Apperant height}} = \dfrac{\mu_w}{\mu_a}$ *i.e.* $\dfrac{BO}{BI} = \dfrac{4/3}{1}$

$\Rightarrow BI = BO \times \dfrac{3}{4} = 12 \times \dfrac{3}{4} = 9\ cm.$



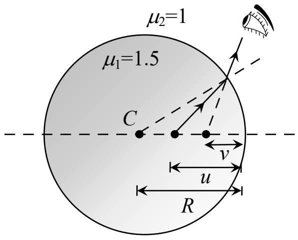

14. (a) $v = 1\ cm$, $R = 2\ cm$

By using

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

$\dfrac{1}{-1} - \dfrac{1.5}{u} = \dfrac{1 - 1.5}{-2}$

$\Rightarrow u = -1.2\ cm$

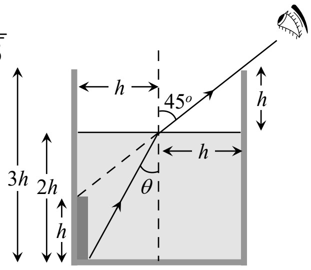



15. (b) The line of sight of the observer remains constant, making an angle of 45° with the normal.

$\sin\theta = \dfrac{h}{\sqrt{h^2 + (2h)^2}} = \dfrac{1}{\sqrt{5}}$

$\mu = \dfrac{\sin 45^o}{\sin\theta}$

$= \dfrac{1/\sqrt{2}}{1/\sqrt{5}} = \sqrt{\left(\dfrac{5}{2}\right)}$




16. (b) For *glass-water* interface ${}_g\mu_w = \dfrac{\sin i}{\sin r}$ …(i)

For *water-air* interface ${}_w\mu_a = \dfrac{\sin r}{\sin 90^o}$ …(ii)

$\Rightarrow {}_g\mu_w \times {}_w\mu_a = \dfrac{\sin i}{\sin r} \times \dfrac{\sin r}{\sin 90^o} = \sin i$

$\Rightarrow \dfrac{\mu_w}{\mu_g} \times \dfrac{\mu_a}{\mu_w} = \sin i \Rightarrow \mu_g = \dfrac{1}{\sin i}$

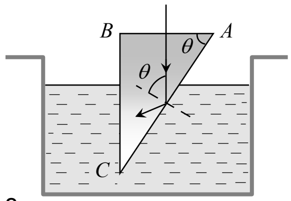
17. (a) For TIR at *AC*

$\theta > C$

$\Rightarrow \sin\theta \geq \sin C$

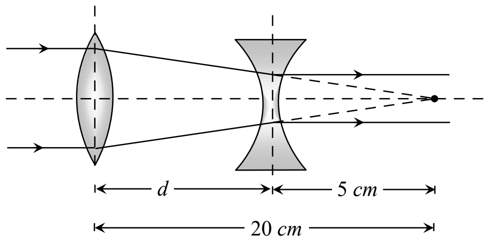
$\Rightarrow \sin\theta \geq \dfrac{1}{{}_w\mu_g}$

$\Rightarrow \sin\theta \geq \dfrac{\mu_w}{\mu_g} \Rightarrow \sin\theta \geq \dfrac{8}{9}$




18. (b) From figure it is clear that separation between lenses

$d = 20 - 5 = 15\,cm$



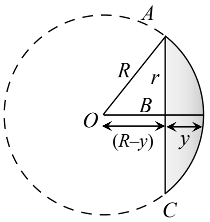

**19.** (c) According to lens formula $\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

The lens is plano-convex *i.e.*, $R_1 = R$ and $R_2 = \infty$

Hence $\frac{1}{f} = \frac{\mu - 1}{R} \Rightarrow f = \frac{R}{\mu - 1}$

Speed of light in medium of lens $v = 2 \times 10^8$ $m/s$

$\Rightarrow \mu = \frac{c}{v} = \frac{3 \times 10^8}{2 \times 10^8} = \frac{3}{2} = 1.5$



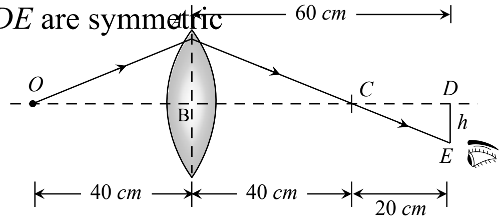

If $r$ is the radius and $y$ is the thickness of lens (at the centre), the radius of curvature $R$ of its curved surface in accordance with the figure is given by

$R^2 = r^2 + (R - y)^2 \Rightarrow r^2 + y^2 - 2Ry = 0$

Neglecting $y^2$; we get $R = \frac{r^2}{2y} = \frac{(6/2)^2}{2 \times 0.3} = 15$ $cm$

Hence $f = \frac{15}{1.5 - 1} = 30\ cm$

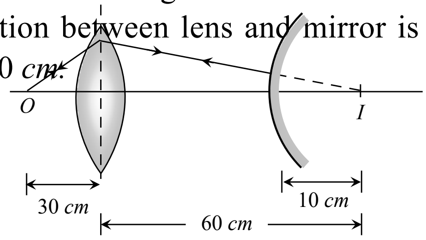
**20.** (c) In the following ray diagram $\Delta's$, $ABC$ and $CDE$ are symmetric



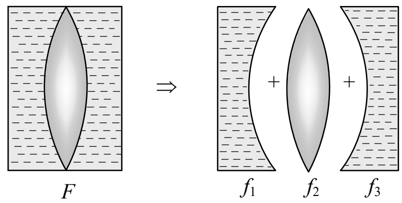

So, $\frac{AB}{BC} = \frac{DE}{CD} \Rightarrow \frac{5}{40} = \frac{h}{20} \Rightarrow h = 2.5\ cm$

**21.** (c) For lens $u = 30\,cm$, $f = 20\,cm$, hence by using $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{+20} = \frac{1}{v} - \frac{1}{-30} \Rightarrow v = 60\,cm$

The final image will coincide the object, if light ray falls normally on convex mirror as shown. From figure it is seen clear that separation between lens and mirror is 60 – 10 = 50 *cm*.




**22.** (d) $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$



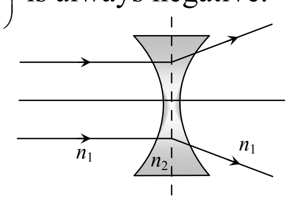

$\frac{1}{f_1} = (1.6 - 1)\left(\frac{1}{\infty} - \frac{1}{20}\right) = -\frac{0.6}{20} = -\frac{3}{100}$ …(i)

$\frac{1}{f_2} = (1.5 - 1)\left(\frac{1}{20} - \frac{1}{-20}\right) = \frac{1}{20}$ …(ii)

$\frac{1}{f_3} = (1.6 - 1)\left(\frac{1}{-20} - \frac{1}{\infty}\right) = -\frac{3}{100}$ …(iii)

$\Rightarrow \frac{1}{F} = -\frac{3}{100} + \frac{1}{20} - \frac{3}{100} \Rightarrow F = -100\ cm$

**23.** (d) $\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ where $n_2$ and $n_1$ are the refractive indices of the material of the lens and of the surroundings respectively. For a double concave lens, $\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ is always negative.




Hence $f$ is negative only when $n_2 > n_1$

**24.** (a, d) For a lens $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{u} + \frac{1}{f}$ .....(i)

Also $m = \frac{f-v}{f} = 1 - \frac{v}{f} \Rightarrow m = \left(-\frac{1}{f}\right)v + 1$

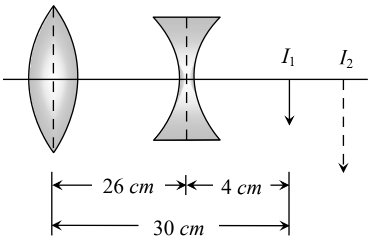
....(ii)

On comparing equations (i) and (ii) with $y = mx + c$.

It is clear that relationship between $\frac{1}{v}$ *vs* $\frac{1}{u}$ and $m$ *vs* $v$ is linear.

**25.** (c) The dispersion produced by a spherical surface depends on it's radius of curvature. Hence, a lens will not exhibit dispersion only if it's two surfaces have equal radii, with one being convex and the other concave.

**26.** (b) Convex lens will form image $I_1$ at it's focus which acts like a virtual object for concave lens.




Hence for concave lens $u = +4\ cm$, $f = 20\ cm$.

So by lens formula $\frac{1}{-20} = \frac{1}{v} - \frac{1}{4} \Rightarrow v = 5\,cm$ *i.e.* distance of final image $(I_2)$ from concave lens $v = 5\,cm$ by using $\frac{v}{u} = \frac{I}{O} \Rightarrow \frac{5}{4} = \frac{I}{2} \Rightarrow (I_2) = 2.5\,cm$

**27.** (d) For achromatic combination $\omega_C = -\omega_F$

$[(\mu_v - \mu_r)A]_C = -[(\mu_v - \mu_r)A]_F$

$\Rightarrow [\mu_r A]_C + [\mu_r A]_F = [\mu_v A]_C + [\mu_v A]_F$

$= 1.5 \times 19 + 6 \times 1.66 = 38.5$

Resultant $\delta = [(\mu_r - 1)A]_C + [(\mu_r - 1)A]_F$

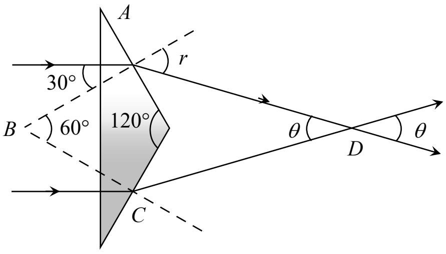
$= [\mu_r A]_C + [\mu_r A]_F - (A_C + A_F) = 38.5 - (19+6) = 13.5^o$

**28.** (d) By using $\mu = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}} \Rightarrow \cot\frac{A}{2} = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$

$\Rightarrow \frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$

$\Rightarrow \sin\left(90^\circ - \frac{A}{2}\right) = \sin\left(\frac{A+\delta_m}{2}\right) \Rightarrow \delta_m = 180 - 2A$

**29.** (d) At point A. $\frac{\sin 30^o}{\sin r} = \frac{1}{1.44}$



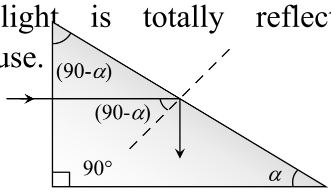

$\Rightarrow r = \sin^{-1}(0.72)$ also $\angle BAD = 180^o - \angle r$

In rectangle *ABCD*, $\angle A + \angle B + \angle C + \angle D = 360°$

$\Rightarrow (180° - r) + 60° + (180° - r) + \theta = 360°$

$\Rightarrow \theta = 2[\sin^{-1}(0.72) - 30^o]$

**30.** (d) If $\alpha$ = maximum value of base angle for which light is totally reflected form hypotenuse.




$(90° - \alpha) = C$ = minimum value of angle of incidence at hypotenuse for total internal reflection

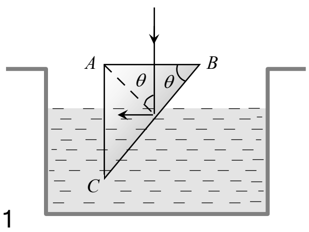
$\sin(90° - \alpha) = \sin C = \frac{1}{\mu} \Rightarrow \cos\alpha = \frac{1}{\mu} \Rightarrow \alpha = \cos^{-1}\left(\frac{1}{\mu}\right)$

**31.** (b) For total internal reflection from surface $BC$

$\theta \ge C \Rightarrow \sin\theta \ge \sin C$

$\Rightarrow \sin\theta \ge \left(\frac{1}{{}_l\mu_g}\right)$

$\Rightarrow \sin\theta \ge \left(\frac{\mu_{\text{Liquid}}}{\mu_{\text{Prism}}}\right)$




$\sin\theta \ge \left(\frac{1.32}{1.56}\right) \Rightarrow \sin\theta \ge \frac{11}{13}$

**32.** (a) $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{1.5}{+OQ} - \frac{1}{(-OP)} = \frac{(1.5-1)}{+R}$

On putting $OQ = OP$, $OP = 5R$

**33.** (d) Here $\frac{1}{F}=\frac{2}{f}+\frac{1}{f_m}$

Plano-convex lens silvered on plane side has $f_m=\infty$.

$\therefore \frac{1}{F}=\frac{2}{f}+\frac{1}{\infty} \Rightarrow \frac{1}{30}=\frac{2}{f} \Rightarrow f=60\ cm$

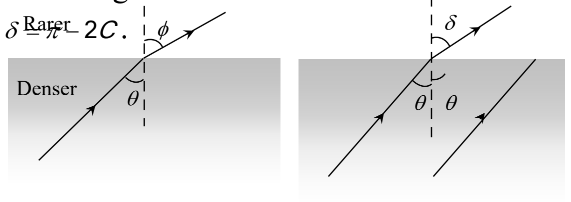
Plano-convex lens silvered on convex side has $f_m=\frac{R}{2}$

$\therefore \frac{1}{F}=\frac{2}{f}+\frac{2}{R} \Rightarrow \frac{1}{10}=\frac{2}{60}+\frac{2}{R} \Rightarrow R=30\ cm$

Now using $\frac{1}{f}=(\mu-1)\left(\frac{1}{R}\right)$, we get $\mu=1.5$

**34.** (c) When the ray passes into the rarer medium, the deviation is $\delta=\phi-0$. This can have a maximum value of $\left(\frac{\pi}{2}-C\right)$ for $\theta=C$ and $\phi=\frac{\pi}{2}$.

When total internal reflection occurs, the deviation is $\delta=\pi-2$, the minimum value of $\theta$ being $C$. The maximum value of $\delta=\pi-2C$.




**35.** (c) $\frac{x}{r}=\frac{1.22\,\lambda}{d} \Rightarrow x=\frac{1.22\,\lambda r}{d}$

$=\frac{1.22\times 500\times 10^{-9}\times 400\times 10^{3}}{5\times 10^{-3}}=50\ m$

**36.** (d) Resolving power $=\frac{1.22\,\lambda}{a}=\frac{1.22\times 6000\times 10^{-10}}{5}$

Also resolving power $=\frac{d}{D}=\frac{d}{38.6\times 10^{7}}$

$\therefore \frac{1.22\times 6\times 10^{-7}}{5}=\frac{d}{38.6\times 10^{7}}$

$\Rightarrow d=\frac{1.22\times 6\times 10^{-7}\times 38.6\times 10^{7}}{5}m=56.51\ m$

**37.** (a) As limit of resolution $\Delta\theta=\frac{1}{\text{ResolvingPower(RP)}}$; and if $x$ is the distance between points on the surface of moon which is at a distance $r$ from the telescope.

$\Delta\theta=\frac{x}{r}$

So $\Delta\theta=\frac{1}{RP}=\frac{x}{r}$ *i.e.* $x=\frac{r}{RP}=\frac{r}{d/1.22\,\lambda} \Rightarrow x=\frac{1.22\,\lambda r}{d}$

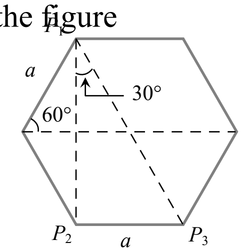
$=\frac{1.22\times 5500\times 10^{-10}\times(3.8\times 10^{8})}{500\times 10^{-2}}=51\ m$

**38.** (b) $I_{\text{edge}}=\frac{L\cos\theta}{(h^2+r^2)}=\frac{Lh}{(h^2+r^2)^{3/2}}$

For maximum extensity $\frac{dI}{dh}=0$

Applying this condition have get $h=\frac{r}{\sqrt{2}}$

**39.** (a) From the geometry of the figure




$p_1p_2=2a\sin 60^o$

so, $I_{P_2}=\frac{L}{p_1p_2^2}$

$=\frac{L}{(2a\sin 60^o)^2}=\frac{L}{3a^2}$

and $I_{P_3}=\frac{L}{(P_1P_2^2+a^2)}\cos 30^o$

$=\frac{L}{[(2a\sin 60^o)^2+a^2]}\frac{\sqrt{3}}{2}=\frac{\sqrt{3}\,L}{8\,a^2}$

$\Rightarrow I_{P_3}=\frac{3\sqrt{3}}{8}I_{P_2}=\frac{3\sqrt{3}}{8}I_0$

All options are wrong.

**40.** (c) Distance of object from mirror

$=15+\frac{33.25}{4}\times 3=39.93\ cm$

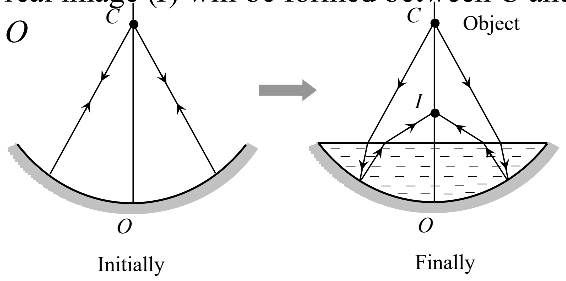
Distance of image from mirror $=15+\frac{25}{4}\times 3=33.75$

For mirror, $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\Rightarrow \frac{1}{-33.75}-\frac{1}{39.93}=\frac{1}{f} \Rightarrow f\approx -18.3\ cm.$

**41.** (c) $v_i=-\left(\frac{f}{f-u}\right)^2.v_o=-\left(\frac{-24}{-24-(-60)}\right)^2\times 9=4$ *cm/sec*.

**42.** (d) From the following figures it is clear that real image ($I$) will be formed between $C$ and $O$



43. (b) $|m| = \frac{f_o}{f_e} = \frac{400}{10} = 40$

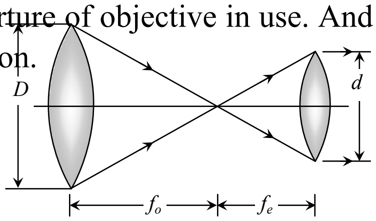
Angle subtented by moon on the objective of telescope $\propto = \frac{3.5 \times 10^3}{3.8 \times 10^3} = \frac{3.5}{3.8} \times 10^{-2} \, rad$

Also $|m| = \frac{\beta}{\alpha} \Rightarrow$ Angular size of final image

$\beta = |m| \times \alpha = 40 \times \frac{3.5}{3.8} \times 10^{-2} = 0.36 \, rad$

$= 0.3 \times \frac{180}{\pi} \approx 21^o$

44. (a) Full use of resolving power means whole aperture of objective in use. And for relaxed vision.




$\frac{f_o}{f_e} = \frac{D}{d} \Rightarrow \frac{300}{f_e} = \frac{15}{0.3} \Rightarrow f_e = 6 \, cm$

45. (b) Wave length of the electron wave be $10 \times 10^{-12} \, m$,

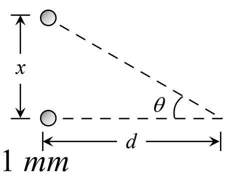
Using $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow E = \frac{h^2}{\lambda^2 \times 2m}$

$= \frac{(6.63 \times 10^{-34})^2}{(10 \times 10^{-12})^2 \times 2 \times 9.1 \times 10^{-31}} \, Joule$

$= \frac{(6.63 \times 10^{-34})^2}{(10 \times 10^{-12})^2 \times 2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19}} \, eV$

$= 15.1 \, KeV$.

46. (c) $\theta = \frac{x}{d} = \frac{1.22\lambda}{a}$




$\Rightarrow x = \frac{1.22 \times d}{a}$

$= \frac{1.22 \times 5000 \times 10^{-10} \times 10^3}{10 \times 10^{-2}} = 6.1 \, mm$

*i.e.* order will be 5 *mm*.

47. (c) $\frac{1.22\lambda}{a} = \frac{x}{d} \Rightarrow d = \frac{x \times a}{1.22\lambda} = \frac{1 \times 10^{-3} \times 3 \times 10^{-3}}{1.22 \times 500 \times 10^{-9}} = 5m$

48. (c) Let distance between lenses be $x$. As per the given condition, combination behaves as a plane glass plate, having focal length $\infty$.

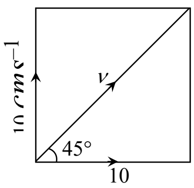
So by using $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 f_2}$

$\Rightarrow \frac{1}{\infty} = \frac{1}{+30} + \frac{1}{-10} - \frac{x}{(+30)(-10)} \Rightarrow x = 20 \, cm$

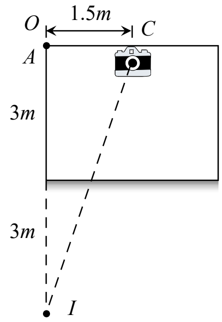
49. (a) When plane mirror rotates through an angle $\theta$, the reflected ray rotates through an angle $2\theta$. So spot on the screen will make $2n$ revolution per second.

50. (d) $v \cos 45° = 10 \quad v = 10\sqrt{2} \, cms^{-1}$

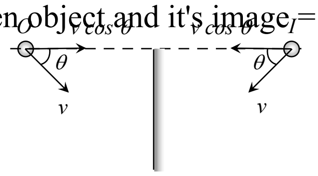
In the ceiling mirror the original velocity will be seen.




51. (d) According to the following figure distance of image $I$ from camera $= \sqrt{(6)^2 + (1.5)^2} = 6.18 \, m$




52. (c) From figure it is clear that relative velocity between object and it's image $= 2v \cos\theta$




53. (b) Image formation by a mirror (either plane or spherical) does not depend on the medium.

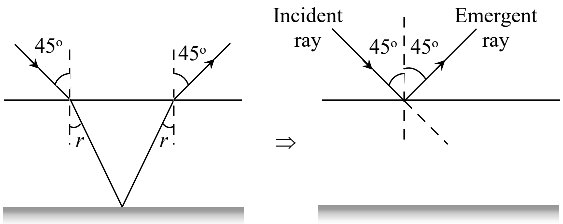
The image of $P$ will be formed at a distance $h$ below the mirror. If $d$ = depth of liquid in the tank.

Apparent depth of $P = x_1 = \frac{d-h}{\mu}$

Apparent depth of the image of $P = x_2 = \frac{d+h}{\mu}$

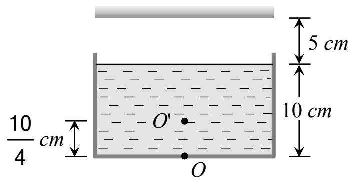
$\therefore$ Apparent distance between $P$ and it's image $= x_2 - x_1 = \frac{2h}{\mu}$

**54.** (a) From the figure it is clear that the angle between incident ray and the emergent ray is 90°.




**55.** (b) From figure it is clear that object appears to be raised by $\frac{10}{4} cm (2.5\, cm)$

Hence distance between mirror and $O = 5 + 7.5 = 12.5\, cm$




So final image will be formed at 12.5 *cm* behind the plane mirror.

**56.** (d) Velocity of approach of man towards the bicycle $= (u - v)$

Hence velocity of approach of image towards man is $2(u - v)$.

**57.** (c) For $A$

Total number of waves $= \frac{(1.5)t}{\lambda}$ ....(i)

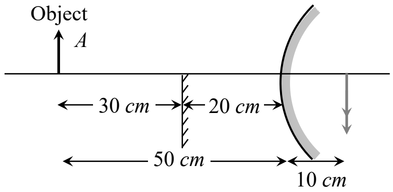
$\because \begin{pmatrix}\text{Total number}\\ \text{of waves}\end{pmatrix} = \left(\frac{\text{optical path length}}{\text{wavelength}}\right)$

For $B$ and $C$

Total number of waves $= \frac{n_B\left(\frac{t}{3}\right)}{\lambda} + \frac{(1.6)\left(\frac{2t}{3}\right)}{\lambda}$ ....(ii)

Equating (i) and (ii) $n_B = 1.3$

**58.** (b) Since there is no parallex, it means that both images (By plane mirror and convex mirror) coinciding each other.




According to property of plane mirror it will form image at a distance of 30 *cm* behind it. Hence for convex mirror $u = -50\ cm$, $v = +10\ cm$

By using $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{+10} + \frac{1}{-50} = \frac{4}{50}$

$\Rightarrow f = \frac{25}{2} cm \quad \Rightarrow R = 2f = 25 cm$

**59.** (d) For surface $P$, $\frac{1}{v_1} = \frac{1}{f} - \frac{1}{u} = 1 - \frac{1}{3} = \frac{2}{3} \Rightarrow v_1 = \frac{3}{2} m$

For surface $Q$, $\frac{1}{v_2} = \frac{1}{f} - \frac{1}{u} = 1 - \frac{1}{5} = \frac{4}{5} \Rightarrow$ $v_2 = \frac{5}{4} m$

$\therefore v_1 - v_2 = 0.25 m$

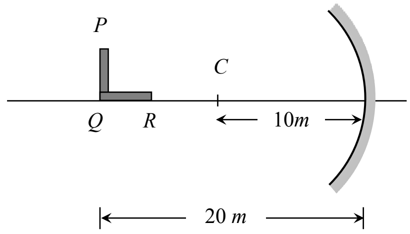
Magnification of $P = \frac{v_1}{u} = \frac{3/2}{3} = \frac{1}{2}$

$\therefore$ Height of $P = \frac{1}{2} \times 2 = 1 m$

Magnification of $Q = \frac{v_2}{u} = \frac{5/4}{5} = \frac{1}{4}$

$\therefore$ Height of $Q = \frac{1}{4} \times 2 = 0.5 m$

**60.** (b) Focal length of mirror $f = \frac{R}{2} = \frac{10}{2} = 5 cm$




For part $PQ$ : transverse magnification

length of image $L_1 = \left(\frac{f}{f-u}\right) \times L_0$

$= \left(\frac{-5}{-5-(-20)}\right) \times L_0 = \frac{-L_0}{3}$

For part $QR$ : longitudinal magnification

Length of image $L_2 = \left(\frac{f}{f-u}\right)^2 L_0$

$= \left(\frac{-5}{-5-(-20)}\right)^2 \times L_0 = \frac{L_0}{9} \Rightarrow \frac{L_1}{L_2} = \frac{3}{1}$

**61.** (d) The two slabs will shift the image a distance

$d = 2\left(1 - \frac{1}{\mu}\right)t = 2\left(1 - \frac{1}{1.5}\right)(1.5) = 1\,cm$

Therefore, final image will be 1 $cm$ above point $P$.

**62.** (a) Here optical distance between fish and the bird is

$s = y' + \mu y$

Differentiating $w.r.t$ $t$ we get $\frac{ds}{dt} = \frac{dy'}{dt} + \frac{\mu dy}{dt}$

$\Rightarrow 9 = 3 + \frac{4}{3}\frac{dy}{dt} \Rightarrow \frac{dy}{dt} = 4.5\,m/\text{sec}$

**63.** (a) The real depth $= \mu$ ( apparent depth)

$\Rightarrow$ In first case, the real depth $h_1 = \mu(b-a)$

Similarly in the second case, the real depth $h_2 = \mu(d-c)$

Since $h_2 > h_1$, the difference of real depths $= h_2 - h_1 = \mu(d-c-b+a)$

Since the liquid is added in second case, $h_2 - h_1 = (d-b) \Rightarrow \mu = \frac{(d-b)}{(d-c-b+a)}$

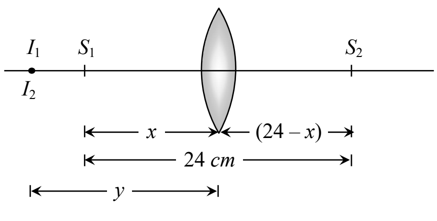
**64.** (a) The given condition will be satisfied only if one source ($S_1$) placed on one side such that $u < f$ (*i.e.* it lies under the focus). The other source ($S_2$) is placed on the other side of the lens such that $u > f$ (*i.e.* it lies beyond the focus).

If $S_1$ is the object for lens then $\frac{1}{f} = \frac{1}{-y} - \frac{1}{-x}$

$\Rightarrow \frac{1}{y} = \frac{1}{x} - \frac{1}{f}$ .....(i)

If $S_2$ is the object for lens then

$\frac{1}{f} = \frac{1}{+y} - \frac{1}{-(24-x)} \Rightarrow \frac{1}{y} = \frac{1}{f} - \frac{1}{(24-x)}$ .....(ii)




From equation (i) and (ii)

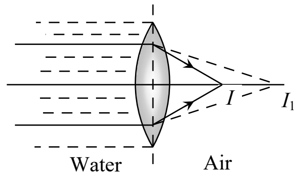
$\frac{1}{x} - \frac{1}{f} = \frac{1}{f} - \frac{1}{(24-x)} \Rightarrow \frac{1}{x} + \frac{1}{(24-x)} = \frac{2}{f} = \frac{2}{9}$

$\Rightarrow x^2 - 24x + 108 = 0$. After solving the equation $x = 18\,cm$, 6 $cm$.

**65.** (c) Consider the refraction of the first surface *i.e.* refraction from rarer medium to denser medium

$\frac{\mu_2 - \mu_1}{R} = \frac{\mu_1}{-u} + \frac{\mu_2}{v_1} \Rightarrow \frac{\left(\frac{3}{2}\right) - \left(\frac{4}{3}\right)}{R} = \frac{\frac{4}{3}}{\infty} + \frac{\frac{3}{2}}{v_1} \Rightarrow v_1 = 9R$

Now consider the refraction at the second surface of the lens *i.e.* refraction from denser medium to rarer medium




$\frac{1 - \frac{3}{2}}{-R} = -\frac{\frac{3}{2}}{9R} + \frac{1}{v_2} \Rightarrow v_2 = \left(\frac{3}{2}\right)R$

The image will be formed at a distance of $\frac{3}{2}R$. This is equal to the focal length of the lens.

**66.** (c) $\delta_{Prism} = (\mu - 1)A = (1.5-1)4^o = 2^o$

$\therefore \delta_{Total} = \delta_{Prism} + \delta_{Mirror}$

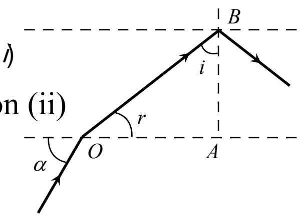
$= (\mu-1)A + (180-2i) = 2^o + (180 - 2\times 2) = 178^o$

**67.** (b) Here the requirement is that $i > c$

$\Rightarrow \sin i > \sin c \Rightarrow \sin i > \frac{\mu_2}{\mu_1}$ .....(i)

From Snell's law $\mu_1 = \frac{\sin\alpha}{\sin r}$ ....(ii)

Also in $\Delta OBA$




$r + i = 90^o \Rightarrow r = (90 - i)$

Hence from equation (ii)

$\sin\alpha = \mu_1 \sin(90 - i)$

$\Rightarrow \cos i = \frac{\sin\alpha}{\mu_1}$

$\sin i = \sqrt{1 - \cos^2 i} = \sqrt{1 - \left(\frac{\sin\alpha}{\mu_1}\right)^2}$ ....(iii)

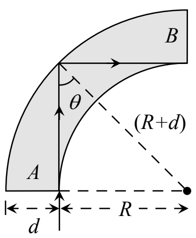
From equation (i) and (iii) $\sqrt{1-\left(\frac{\sin\alpha}{\mu_1}\right)^2} > \frac{\mu_2}{\mu_1}$

$\Rightarrow \sin^2\alpha < (\mu_1^2 - \mu_2^2) \Rightarrow \sin\alpha < \sqrt{\mu_1^2 - \mu_2^2}$

$\alpha_{max} = \sin^{-1}\sqrt{\mu_1^2 - \mu_2^2}$

**68.** (b) Consider the figure if smallest angle of incidence $\theta$ is greater than critical angle then all light will emerge out of $B$

$\Rightarrow \theta \ge \sin^{-1}\left(\frac{1}{\mu}\right) \Rightarrow \sin\theta \ge \frac{1}{\mu}$



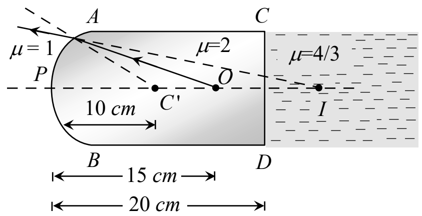

from figure $\sin\theta = \frac{R}{R+d}$

$\Rightarrow \frac{R}{R+d} \ge \frac{1}{\mu} \Rightarrow \left(1+\frac{d}{R}\right) \le \mu$

$\Rightarrow \frac{d}{R} \le \mu - 1 \Rightarrow \left(\frac{d}{R}\right)_{max} = 0.5$

**69.** (b) In case of refraction from a curved surface, we have

$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{1}{v} - \frac{2}{(-15)} = \frac{(1-2)}{-10} \Rightarrow v = -30$ *cm*.

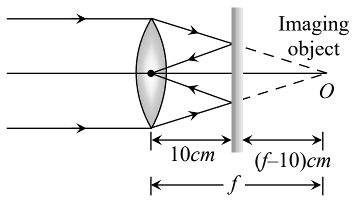



*i.e.* the curved surface will form virtual image $I$ at distance of 30 *cm* from $P$. Since the image is virtual there will be no refraction at the plane surface $CD$ (as the rays are not actually passing through the boundary), the distance of final image $I$ from $P$ will remain 30 *cm*.

**70.** (d) As $\mu_2 > \mu_1$, the upper half of the lens will become diverging.

As $\mu_1 > \mu_3$, the lower half of the lens will become converging

**71.** (b)




From the figure,

Using property of plane mirror

Image distance = Object distance

$f - 10 = 10 \Rightarrow f = 20\ cm$

**72.** (d) If initially the objective (focal length $F_o$) forms the image at distance $v_o$ then

$v_o = \frac{u_o f_o}{u_o - f_o} = \frac{3\times 2}{3-2} = 6\ cm$

Now as in case of lenses in contact

$\frac{1}{F_o} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + ..... = \frac{1}{f_1} + \frac{1}{F_o'}$

$\left\{\text{where} \frac{1}{F_o'} = \frac{1}{f_2} + \frac{1}{f_3} + .....\right\}$

So if one of the lens is removed, the focal length of the remaining lens system

$\frac{1}{F_o'} = \frac{1}{F_0} - \frac{1}{f_1} = \frac{1}{2} - \frac{1}{10} \Rightarrow F_o' = 2.5\ cm$

This lens will form the image of same object at a distance $v_o'$ such that

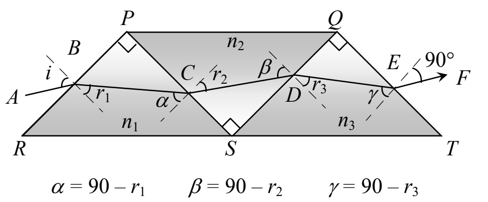
$v_o' = \frac{u_o F_o'}{u_o - F_o'} = \frac{3\times 2.5}{(3-2.5)} = 15\ cm$

So to refocus the image, eye-piece must be moved by the same distance through which the image formed by the objective has shifted *i.e.* 15 – 6 = 9 *cm*.

**73.** (b) By using $m_\infty = \frac{(L_\infty - f_o - f_e)D}{f_o f_e}$

$= \frac{(16 - 0.4 - 2.5)\times 25}{0.4\times 2.5} = 327.5$

**74.** (d)




$\alpha = 90 - r_1 \qquad \beta = 90 - r_2 \qquad \gamma = 90 - r_3$

At $B$

$\sin i = n_1 \sin r_1 \Rightarrow \sin^2 i = n_1^2 \sin^2 r_1$ .... (i)

At $C$

$n_1 \sin(90 - r_1) = n_2 \sin r_2 \Rightarrow n_2^2 \sin^2 r_2 = n_1^2 \cos^2 r_1$ ....(ii)

At $D$

$n_2 \sin(90 - r_2) = n_3 \sin r_3 \Rightarrow n_2^2 \cos^2 r_2 = n_3^2 \sin^2 r_3$ ....(iii)

At $E$

$n_3 \sin(90 - r_3) = (1)\sin(90 - 1) \Rightarrow \cos^2 i = n_3^2 \cos^2 r_3$ ....(iv)

Adding (i), (ii), (iii) and (iv) we get $1 + n_2^2 = n_1^2 + n_3^2$

75. (a) $L_D = v_o + u_e$ and for objective lens $\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$

Putting the values with proper sign convention.

$\frac{1}{+2.5} = \frac{1}{v_o} - \frac{1}{(-3.75)} \Rightarrow v_o = 7.5\ cm$

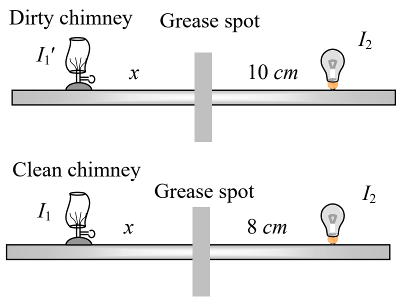
For eye lens $\frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e}$

$\Rightarrow \frac{1}{+5} = \frac{1}{(-25)} - \frac{1}{u_e} \Rightarrow u_e = -4.16\ cm$

$\Rightarrow |u_e| = 4.16\ cm$

Hence $L_D = 7.5 + 4.16 = 11.67\ cm$

76. (c) The actual luminous intensity of the lamp is $I_1$ whereas the intensity is $I_1'$ in the dirty state.

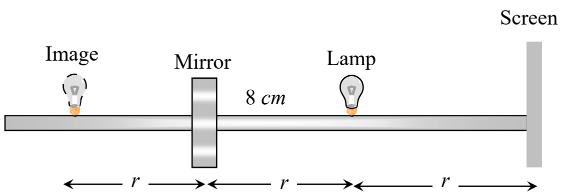



I position, $\frac{I_1'}{I_2} = \left(\frac{x}{10}\right)^2$

II position, $\frac{I_1}{I_2} = \left(\frac{x}{8}\right)^2 \Rightarrow \frac{I_1'}{I_1} = 0.64$

$\Rightarrow I_1' = 0.64\, I_1$. Thus, % of light absorbed = 36%.

77. (c) The illuminance on the screen without mirror is $I_1 = \frac{L}{r^2}$

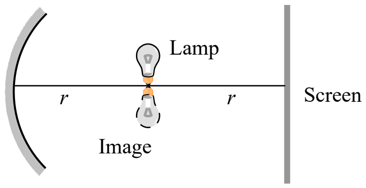



The illuminance on the screen with mirror is

$I_2 = \frac{L}{r^2} + \frac{L}{(3r)^2} = \frac{10}{9} \times \frac{L}{r^2}$

$\therefore \frac{I_2}{I_1} = \frac{10}{9} = 10 : 9$

78. (b) Illuminance on the screen without mirror is $I_1 = \frac{L}{r^2}$




Illuminance on the screen with mirror

$I_2 = \frac{L}{r^2} + \frac{L}{r^2} = \frac{2L}{r^2} \Rightarrow \frac{I_2}{I_1} = 2 : 1$

79. (b) Apparent depth $h' = \frac{h}{_{air}\mu_{liquid}}$

$\Rightarrow \frac{dh'}{dt} = \frac{1}{_a\mu_w} = \frac{1}{_a\mu_w}\frac{dh}{dt} \Rightarrow x = \frac{1}{_a\mu_w}\frac{dh}{dt} \Rightarrow \frac{dh}{dt} = {_a\mu_w}\, x$

Now volume of water $V = \pi R^2 h$

$\Rightarrow \frac{dV}{dt} = \pi R^2 \frac{dh}{dt} = \pi R^2 . {_a\mu_w}\, x$

$= {_a\mu_w}\pi R^2 x = \frac{\mu_w}{\mu_a}\pi R^2 x = \left(\frac{n_2}{n_1}\right)\pi R^2 x$

## Graphical Questions

1. (c) As $u \to f,\ v \to \infty$; $u \to \infty,\ v \to f$

2. (a) At $u = f$, $v = \infty$

At $u = 0$, $v = 0$ (*i.e.* object and image both lies at pole)

Satisfying these two conditions, only option (a) is correct.

3. (b, c) From graph $\tan 30^o = \frac{\sin r}{\sin i} = \frac{1}{_1\mu_2}$

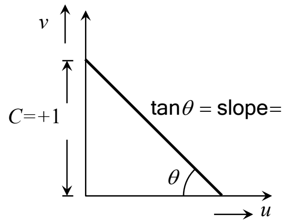
$\Rightarrow {_1\mu_2} = \sqrt{3} \Rightarrow \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2} = 1.73 \Rightarrow v_1 = 1.73\, v_2$

Also from $\mu = \frac{1}{\sin C} \Rightarrow \sin C = \frac{1}{_{Rarer}\mu_{Denser}}$

$\Rightarrow \sin C = \frac{1}{{}_1\mu_2} = \frac{1}{\sqrt{3}}$.

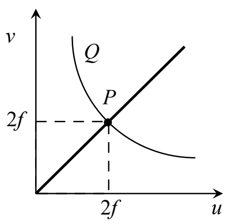
**4.** (c) For a lens $m = \frac{f-v}{f} \Rightarrow m = \left(-\frac{1}{f}\right)v + 1$

Comparing this equation with $y = mx + c$ (equation of straight line)




**5.** (c) At $P$, $u = v$ which happened only when $u = 2f$

At another point $Q$ on the graph (above $P$) $v > 2f$




**6.** (d) For a lens $m = \frac{f-v}{f} = -\frac{1}{f}v + 1$

Comparing it with $y = mx + c$

Slope $= m = -\frac{1}{f}$

From graph, slope of the line $= \frac{b}{c}$

Hence $-\frac{1}{f} = \frac{b}{c} \Rightarrow |f| = \frac{c}{b}$

**7.** (a) $\mu = A + \frac{B}{\lambda^2}$

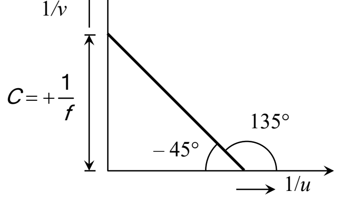
**8.** (a) Since $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{v} = -\frac{1}{u} + \frac{1}{f}$

Putting the sign convention properly

$\frac{1}{(-v)} = \frac{-1}{(-u)} + \frac{1}{(-f)} \Rightarrow \frac{1}{v} = -\frac{1}{u} + \frac{1}{f}$

Comparing this equation with $y = mx + c$

Slope $= m = \tan\theta = -1 \Rightarrow \theta = 135°$ or $-45°$ and intercept $C = +\frac{1}{f}$




**9.** (a) As $u$ goes from 0 to $-\infty$, $v$ goes from $+0$ to $+f$

**10.** (a) For convex lens (for real image) $u + v \geq 4f$

For $u = 2f$, $v$ is also equal to $2f$

Hence $u + v = 4f$

**11.** (d) For concave mirror $m = \frac{f}{f-u}$

For real image $m = -\frac{f}{(u-f)} = -\frac{f}{x}$

$= -\frac{f}{(\text{Distance of object from focus})} \Rightarrow m \propto \frac{1}{x}$.

**12.** (a) For a prism, as the angle of incidence increases, the angle of deviation first decreases, goes to a minimum value and then increases.

**13.** (b) From Newton's formula $xy = f^2$. This is the equation of a rectangular hyperbola.

**14.** (a, c) At $P$, $\delta = 0 = A(\mu - 1) \Rightarrow \mu = 1$.

Also $\delta_m = (\mu - 1)A = A\mu_m - A$

Comparing it with $y = mx + c$

Slope of the line $= m = A$

**15.** (b) From graph, slope $= \tan\left(\frac{2\pi}{10}\right) = \frac{\sin r}{\sin i}$

Also ${}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r} = \frac{1}{\tan\left(\frac{2\pi}{10}\right)} = \frac{4}{3} \Rightarrow \mu_2 > \mu_1$

It means that medium 2 is denser medium. So total internal reflection cannot occur.

**16.** (d) From graph it is clear that $\tan 30^o = \frac{\sin r}{\sin i}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{\sin r}{\sin i} = \frac{1}{\mu} \Rightarrow \mu = \sqrt{3}$

Also $v = \frac{c}{\mu} = nc \Rightarrow n = \frac{1}{\mu} = \frac{1}{\sqrt{3}} = (3)^{-1/2}$

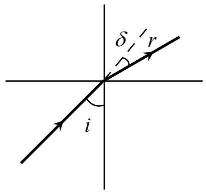
**17.** (b) In concave mirror, if virtual images are formed, $u$ can have values zero and $f$

At $u = 0$, $m = \frac{f}{f-u} = \frac{f}{f} = 1$

At $u = f$, $m = \frac{f}{f-u} = -\frac{f}{-f-(-f)} = \infty$

**18.** (a) The ray of light is refracted at the plane surface. However, since the ray is travelling from a denser to a rarer medium, for an angle of incidence (i) greater then the critical angle (c) the ray will be totally internally reflected.

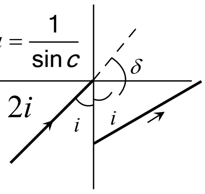
For $i < c$; deviation $\delta = r - i$ with $\frac{1}{\mu} = \frac{\sin i}{\sin r}$




Hence $\delta = \sin^{-1}(\mu \sin i) - i$

This is a non-linear relation. The maximum value of $\delta$ is

$\delta_1 = \frac{\pi}{2} - c$; where $i = c$ and $\mu = \frac{1}{\sin c}$




For $i > c$, deviation $\delta = \pi - 2i$

$\delta$ decreases linearly with $i$

$\delta_2 = \pi - 2c = 2\delta_1$

**19.** (d) For a lens $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

If $u = \infty$ , $v = f$ and if $u = f$, $v = \infty$

**20.** (d)

## Assertion and Reason

**1.** (b)

**2.** (b) The stars twinkle while the planets do not. It is due to variation in density of atmospheric layer. As the stars are very far and giving light continuously to us. So, the light coming from stars is found to change their intensity continuously. Hence they are seen twinkling. Also stars are much bigger in size than planets but it has nothing to deal with twinkling phenomenon.

**3.** (c) Owls can move freely during night, because they have large number of cones on their retina which help them to see in night.

**4.** (c) Shining of air bubble in water is on account of total internal reflection.

**5.** (c) After the removal of stimulus the image formed on retina is sustained up to 1/6 second.

**6.** (a) Because of smallest wavelength of blue colour it is scattered to large extent than other colours, so the sky appears blue.

**7.** (e) For total internal reflection the angle of incidence should be greater than the critical angle. As critical angle is approximately 35°. Therefore, total internal reflection is not possible. So, assertion is not true but reason is true.

**8.** (c) The sun and its surroundings appears red during sunset or sunrise because of scattering of light. The amount of scattered light is inversely proportional to the fourth power of wavelength of light *i.e.* $I \propto \frac{1}{\lambda^4}$

**9.** (a) Focal length of lens immersed in water is four times the focal length of lens in air. It means

$f_w = 4 f_a = 4 \times 10 = 40\ cm$

**10.** (e) The velocity of light of different colours (all wavelengths) is same in vacuum and $\mu \propto \frac{1}{\lambda}$.

**11.** (a) The red glass absorbs the radiations emitted by green flowers; so flower appears black.

**12.** (a) Magnification produced by mirror $m = \frac{I}{O} = \frac{f}{f-u} = \frac{f}{x}$

$x$ is distance from focus.

**13.** (e) Apparent shift for different coloured letter is $d = h\left(1 - \frac{1}{\mu}\right) \Rightarrow \lambda_R > \lambda_V$ so $\mu_R < \mu_V$

Hence $d_R < d_V$ *i.e.* red coloured letter raised least.

**14.** (a) The efficiency of fluorescent tube is about 50 *lumen/watt*, whereas efficiency of electric bulb is about 12 *lumen/watt*. Thus for same amount of electric energy consumed, the tube gives nearly 4 times more light than the filament bulb.

**15.** (c) Polar caps receives almost the same amount of radiation as the equatorial plane. For the polar caps angle between sun rays and normal (to polar caps) tends to 90°. As per Lambert's cosine law, $E \propto \cos\theta$, therefore $E$ is zero. For the equatorial plane, $\theta = 0°$, therefore $E$ is maximum. Hence polar caps of earth are so cold. (where $E$ is radiation received).

**16.** (b) At noon, rays of sun light fall normally on earth. Therefore $\theta$ = 0°. According to Lambert's cosine law, $E \propto \cos\theta$, when $\theta$ = 0°, cos $\theta$ = cos 0° = 1 = max. Therefore, $E$ is maximum.

**17.** (d) When an object is placed between two plane parallel mirrors, then infinite number of images are formed. Images are formed due to multiple reflections. At each reflection, a part of light energy is absorbed. Therefore, distant images get fainter.

**18.** (c) In search lights, we need an intense parallel beam of light. If a source is placed at the focus of a concave spherical mirror, only paraxial rays are rendered parallel. Due to large aperture of mirror, marginal rays give a divergent beam.

But in case of parabolic mirror, when source is at the focus, beam of light produced over the entire cross-section of the mirror is a parallel beam.

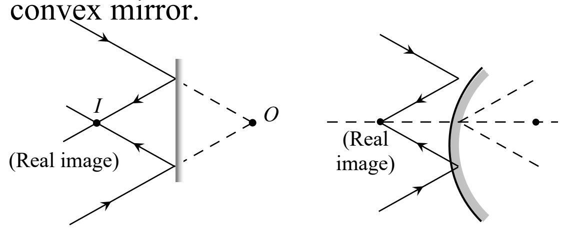
**19.** (d) The size of the mirror does not affect the nature of the image except that a bigger mirror forms a brighter image.

**20.** (a) When the sun is close to setting, refraction will effect the top part of the sun differently from the bottom half. The top half will radiate its image truly, while the bottom portion will send an apparent image. Since the bottom portion of sun is being seen through thicker, more dense atmosphere. The bottom image is being bent intensely and gives the impression of being squashed or "flattened" or elliptical shape.

**21.** (c) $\mu \propto \frac{1}{\lambda} \propto \frac{1}{C}$. $\lambda_V$ is least so $C_V$ is also least.

Also the greatest wavelength is for red colour.

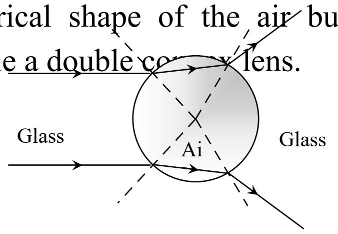
**22.** (e) We can produce a real image by plane or convex mirror.




Focal length of convex mirror is taken positive.

**23.** (d) The colour of glowing red glass in dark will be green as red and green are complimentary colours.

**24.** (d) The air bubble would behave as a diverging lens, because refractive index of air is less than refractive index of glass. However, the geometrical shape of the air bubble shall resemble a double convex lens.




**25.** (a) In total internal reflection, 100% of incident light is reflected back into the same medium, and there is no loss of intensity, while in reflection from mirrors and refraction from lenses, there is always some loss of intensity. Therefore images formed by total internal reflection are much brighter than those formed by mirrors or lenses.

**26.** (d) Focal length of the lens depends upon it's refractive index as $\frac{1}{f} \propto (\mu - 1)$. Since $\mu_b > \mu_r$

so $f_b < f_r$

Therefore, the focal length of a lens

decreases when red light is replaced by blue light.

27. (b) After refraction at two parallel faces of a glass slab, a ray of light emerges in a direction parallel to the direction of incidence of white light on the slab. As rays of all colours emerge in the same direction (of incidence of white light), hence there is no dispersion, but only lateral displacement.

28. (d) It is not necessary for a material to have same colour in reflected and transmitted light. A material may reflect one colour strongly and transmit some other colour. For example, some lubricating oils reflect green colour and transmit red. Therefore, in reflected light, they will appear green and in transmitted light, they will appear red.

29. (d) Dispersion of light cannot occur on passing through air contained in a hollow prism. Dispersion take place because the refractive index of medium for different colour is different. Therefore when white light travels from air to air, refractive index remains same and no dispersion occurs.

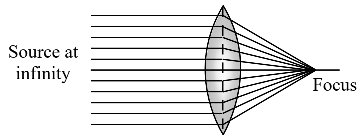
30. (b) The light gathering power (or brightness) of a telescope $\propto$ (diameter)$^2$. So by increasing the objective diameter even far off stars may produce images of optimum brightness.

31. (c) Very large apertures gives blurred images because of aberrations. By reducing the aperture the clear image is obtained and thus the sensitivity of camera increases.

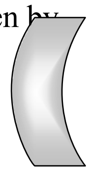
Also the focussing of object at different distance is achieved by slightly altering the separation of the lens from the film.

32. (d) We cannot interchange the objective and eye lens of a microscope to make a telescope. The reason is that the focal length of lenses in microscope are very small, of the order of *mm* or a few *cm* and the difference $(f_o - f_e)$ is very small, while the telescope objective have a very large focal length as compared to eye lens of microscope.

33. (a) Image formed by convex lens




34. (a) The focal length of a lens is given by



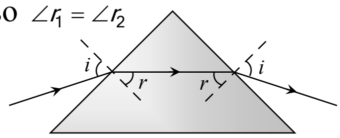
$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

For, goggle, $R_1 = R_2$

$\therefore \quad \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = 0$. Therefore, $P = \frac{1}{f} = 0$

35. (c) The wavelength of wave associated with electrons (de Broglie waves) is less than that of visible light. We know that resolving power is inversely proportional to wavelength of wave used in microscope. Therefore the resolving power of an electron microscope is higher than that of an optical microscope.

36. (a) In case of minimum deviation of a prism $\angle i = \angle e$ so $\angle r_1 = \angle r_2$




37. (b) The velocity of light in a material medium depends upon it's colour (wavelength). If a ray of white light incident on a prism, then on emerging, the different colours are deviated through different angles.

Also dispersive power $\omega = \frac{(\mu_V - \mu_R)}{(\mu_Y - 1)}$

*i.e.* $\omega$ depends upon only $\mu$.

**38.** (c) The ray of light incident on the water air interface suffers total internal reflections, in that case the angle of incidence is greater than the critical angle. Therefore, if the tube is viewed from suitable direction (so that the angle of incidence is greater than the critical angle), the rays of light incident on the tube undergoes total internal reflection. As a result, the test tube appears as highly polished *i.e.* silvery.

**39.** (a) In wide beam of light, the light rays of light which travel close to the principal axis are called paraxial rays, while the rays which travel quite away from the principal axis is called marginal rays. In case of lens having large aperture, the behaviour of the paraxial and marginal rays are markedly different from each other. The two types of rays come to focus at different points on the principal axis of the lens, thus the spherical aberration occur. However in case of a lens with small aperture, the two types of rays come to focus quite close to each other.

**40.** (e)

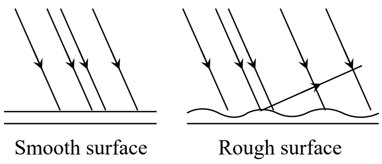
**41.** (b)

**42.** (b)

**43.** (c)

**44.** (a) Resolving power $= \frac{a}{1.22\lambda}$.

**45.** (c) When glass surface is made rough then the light falling on it is scattered in different direction due to which its transparency decreases.




**46.** (b) Diamond glitters brilliantly because light enters in diamond suffers total internal reflection. All the light entering in it comes out of diamond after number of reflections and no light is absorb by it.

**47.** (c) The clouds consist of dust particles and water droplets. Their size is very large as compared to the wavelength of the incident light from the sun. So there is very little scattering of light. Hence the light which we receive through the clouds has all the colours of light. As a result of this, we receive almost white light. Therefore, the cloud are generally white.