1 A point object O is placed in front of a glass rod having spherical end of radius of curvature 30 cm. The image would be formed at

[IIT- **JEE 2002**]

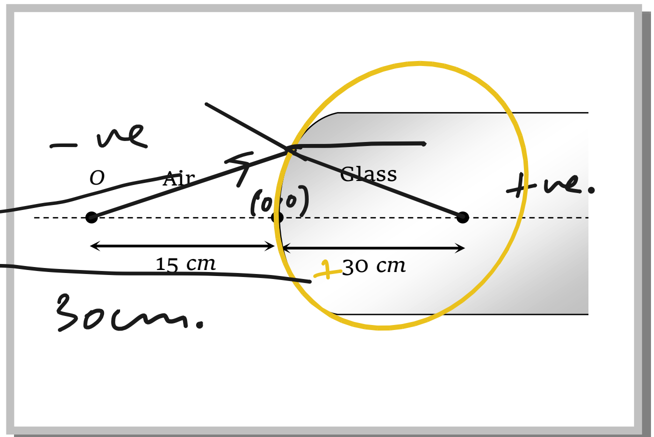
(a) 30 cm left
(b) Infinity
(c) 1 cm to the right
(d) 18 cm to the left

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

$\mu_1 = 1, \mu_2 = 1.5$

$v = ?\ ,\ u = -15cm$

$R = 30cm.$



$\frac{1.5}{v} - \frac{1}{-15} = \frac{1.5-1}{30}$, $\frac{3}{2v} = \frac{0.5}{30} - \frac{1}{15}$

$\frac{3}{2v} = \frac{1}{60} - \frac{1}{15}$

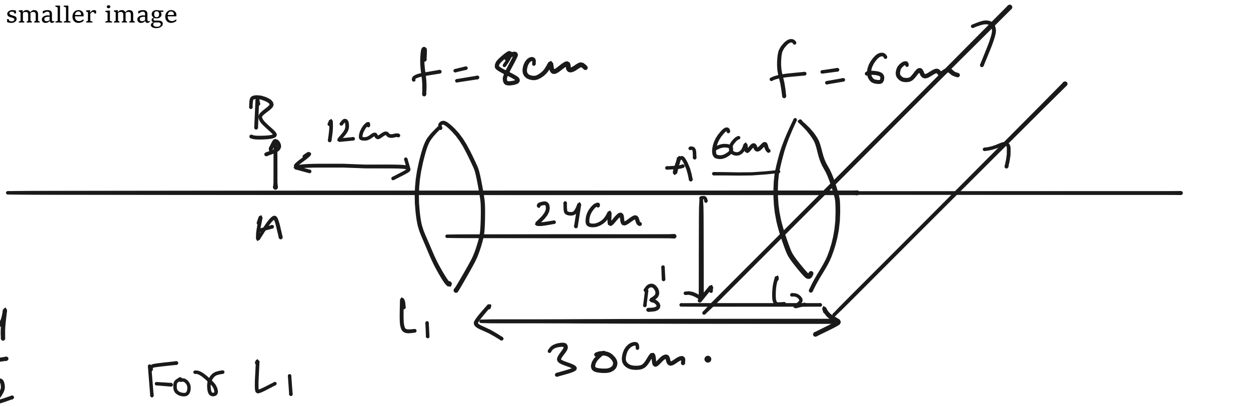
$\frac{3}{2v} = \frac{1-4}{60}$

$\frac{\cancel{3}}{2v} = -\frac{\cancel{3}}{60}$

$\boxed{v = -30cm}$

2 An object is placed 12 cm to the left of a converging lens of focal length 8 cm. Another converging lens of 6 cm focal length is placed at a distance of 30 cm to the right of the first lens. The second lens will produce

(a) No image (b) A virtual enlarged image (c) A real enlarged image (d) A real smaller image



$m = \frac{v}{u} = \frac{24}{-12}$

$m = -2$

For L_1

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

$\frac{1}{8} = \frac{1}{v} + \frac{1}{12}$

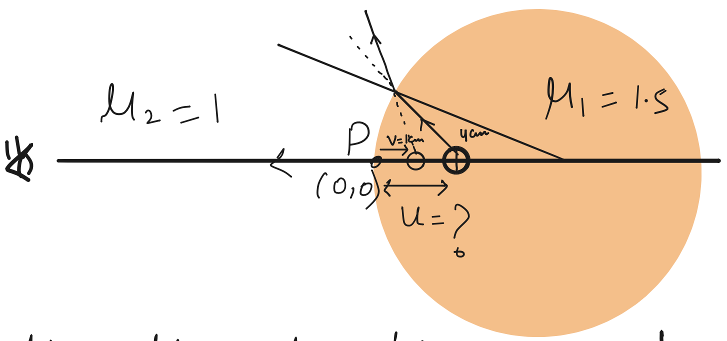
$\frac{1}{v} = \frac{1}{8} - \frac{1}{12} = \frac{3-2}{24}$

$v = +24$

For Sphere

3 An air bubble in sphere having 4 cm diameter appears 1 cm from surface nearest to eye when looked along diameter. If ${}_a\mu_g = 1.5$, the distance of bubble from refracting surface is

(a) 1.2 cm (b) 3.2 cm (c) 2.8 cm (d) 1.6 cm



$$1 - \frac{3}{2u} = \frac{-1}{4}$$

$$\frac{5}{2 \cdot 4} = \frac{3}{2u}$$

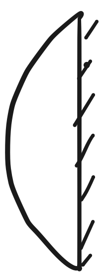
$$u = \frac{6}{5} = 1.2$$

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{2}$$

$$\frac{1}{+1} - \frac{1.5}{u} = \frac{-0.5}{2}$$

4 A plano-convex lens (f = 20 cm) is silvered at plane surface. Now it's focal length will be

(a) 20 cm (b) 40 cm (c) 30 cm (d) 10 cm



$$f_m = \infty$$

$$\frac{1}{f_{eq}} = \frac{2}{f_L} + \frac{1}{f_m}, \quad \frac{1}{f_{eq}} = \frac{2}{20}$$

$$f_{eq} = 10cm$$

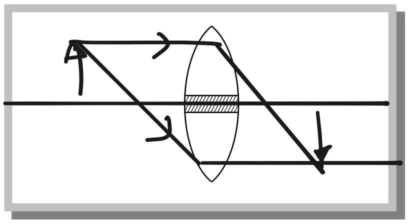
5 If the central portion of a convex lens is wrapped in black paper as shown in the figure

(a) No image will be formed by the remaining portion of the lens

(b) The full image will be formed but it will be less bright

(c) The central portion of the image will be missing

(d) There will be two images each produced by one of the exposed portions of the lens



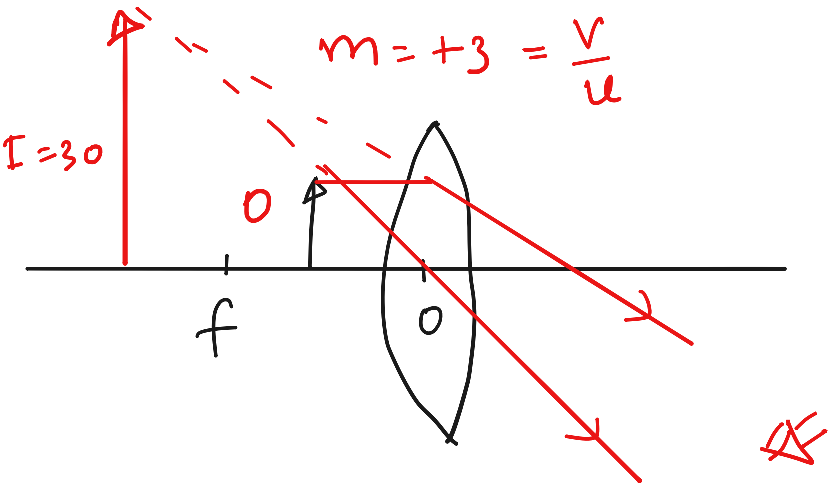
6 An object has image thrice of its original size when kept at 8 *cm* and 16 *cm* from a convex lens. Focal length of the lens is

(a) 8 *cm* (b) 16 *cm*

(c) Between 8 *cm* and 16 *cm* (d) Less then 8 *cm*

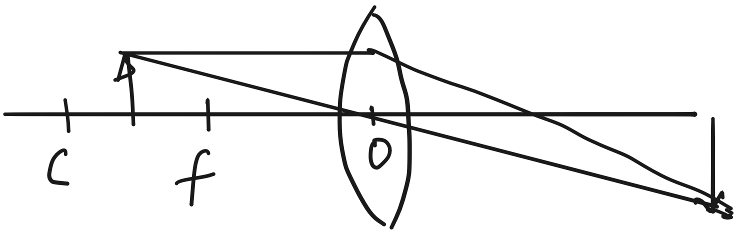
$m = \frac{I}{O} = 3$

$m = -3$



$m = +3 = \frac{v}{u}$

Case-1



$\frac{v}{u} = -3$

$\frac{\cancel{f}}{f-8} = -\frac{\cancel{f}}{f-16}$

$f - 16 = -f + 8$

$2f = 24,\ f = 12\,cm$

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

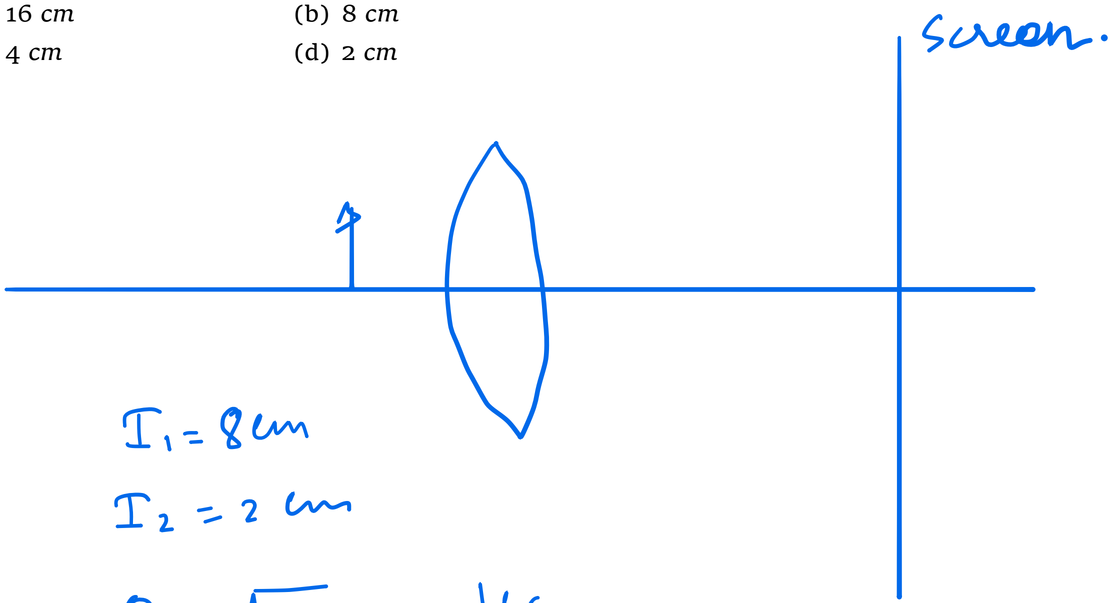
$+3 = \frac{f}{f-8}$

$-3 = \frac{f}{f-16}$

7 A convex lens forms a real image of an object for its two different positions on a screen. If height of the image in both the cases be 8 *cm* and 2 *cm*, then height of the object is **[KCET (Engg./Med.) 200**

(a) 16 *cm* (b) 8 *cm*

(c) 4 *cm* (d) 2 *cm*



$I_1 = 8\,cm$

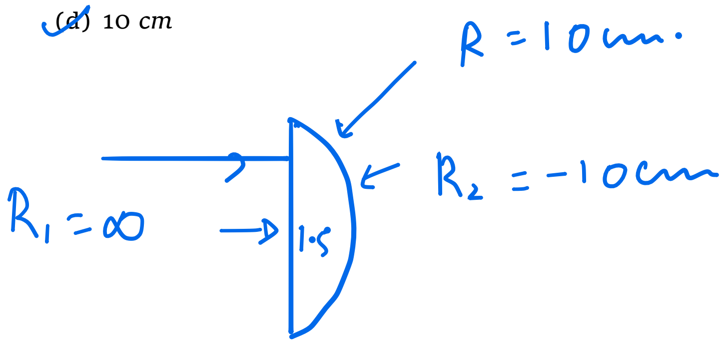
$I_2 = 2\,cm$

$O = \sqrt{I_1 I_2} = 4\,cm.$

8 The radius curvature of a thin plano-convex lens is 10 *cm* (of curved surface) and the refractive index is 1.5. If the plane surface is silvered, then the focal length will be **[CBSE PMT 20**

(a) 15 *cm* (b) 20 *cm*

(c) 5 *cm* (d) 10 *cm*



$\frac{1}{f_{eq}} = \frac{2}{f_l} + \frac{1}{f_m}$

$= \frac{2}{20}$

$f_{eq} = 10\,cm$

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

$\frac{1}{f_l} = (1.5-1)\left(\frac{1}{\infty} - \frac{1}{-10}\right)$

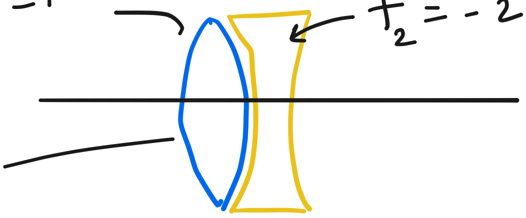
$\boxed{f_l = 20\,cm.}$

9 A convex lens of focal length 40 *cm* is an contact with a concave lens of focal length 25 *cm*. The power of combination is

[IIT-JEE 1982;]

(a) – 1.5 *D* (b) – 6.5 *D*
(c) + 6.5 *D* (d) + 6.67 *D*

$f_1 = +40 cm$ $f_2 = -25 cm$



$\frac{1}{f} = P$

$P_1 = \frac{10\cancel{0}}{4\cancel{0} cm}$

$P_2 = \frac{100}{-25}$

$P = P_1 + P_2$

$P_1 = 2.5$ Diopter

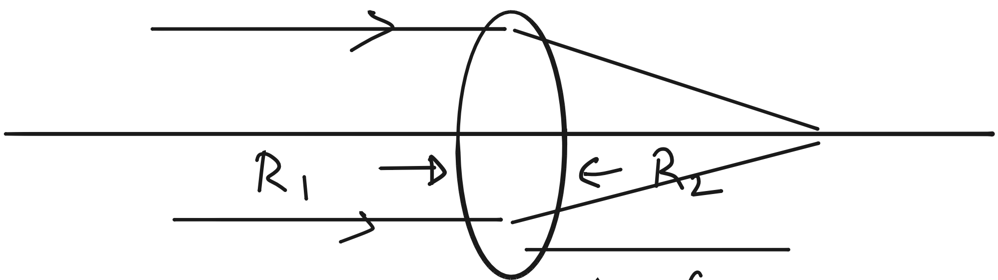
$P_2 = -4D$

$= 2.5 - 4 = -1.5D$

10 A double convex thin lens made of glass (refractive index $\mu = 1.5$) has both radii of curvature of magnitude 20 *cm*. Incident light rays parallel to the axis of the lens will converge at a distance *L* such that

(a) *L* = 20 (b) *L* = 10
(c) *L* = 40 (d) *L* = 20/3

$R_1 = R_2 = 20 cm.$



$L = f = 20 cm.$

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = (1.5 - 1)\left(\frac{1}{20} + \frac{1}{20}\right)$

$\frac{1}{f} = \frac{1}{2}\left(\frac{1}{10}\right)$, $f = 20 cm$

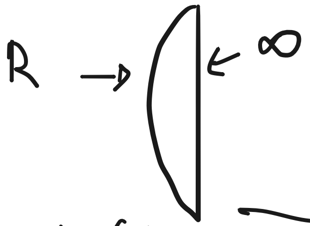
11 A thin plano-convex lens acts like a concave mirror of focal length 0.2 m when silvered form its plane surface. The refractive index of the material of the lens is 1.5. The radius of curvature of the convex surface of the lens will be

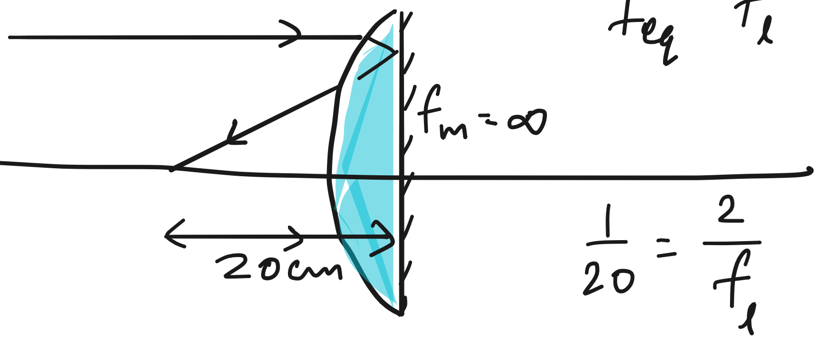
(a) 0.4 m (b) 0.2 m

(c) 0.1 m (d) 0.75 m

$f_{eq} = 20cm$

$\frac{1}{f_{eq}} = \frac{2}{f_l} + \frac{1}{f_m}$

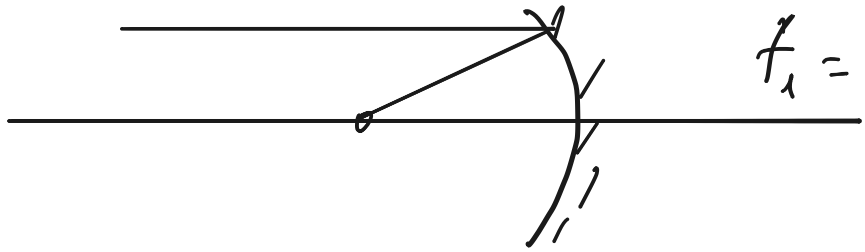




$\frac{1}{f_l} = (\mu-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{20} = \frac{2}{f_l}$

$\frac{1}{40} = (1.5-1)\left(\frac{1}{R}\right)$



$f_l = 40cm.$

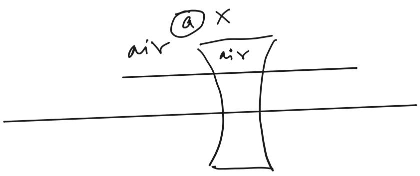
$R = 20cm$

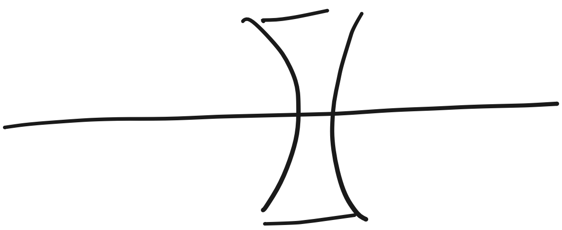
12 A hollow double concave lens is made of very thin transparent material. It can be filled with air or either of two liquids L_1 and L_2 having refractive indices n_1 and n_2 respectively $(n_2 > n_1 > 1)$. The lens will diverge a parallel beam of light if it is filled with

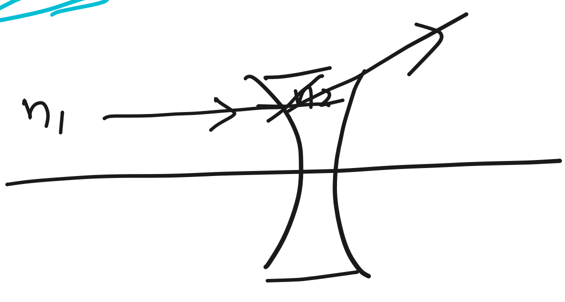
[IIT-JEE (Screening) 20

(a) Air and placed in air (b) Air and immersed in L_1

(c) L_1 and immersed in L_2 (d) L_2 and immersed in L_1







13 Two lenses, one convex and the other concave of same power are placed such that their principal axes coincide. If the separation between the lenses is x, then **[Roorkee 1999]**

(a) Real image is formed for x = 0 only

(b) Real image is formed for all values of x

(c) Virtual image is formed for all value of x other than zero

(d) System will behave like a glass plate for x = 0

$f_{eq} = \infty$ $\frac{1}{f_{eq}} = 0$

$x = 0$

$\frac{1}{f_{eq}} = -\frac{1}{f} + \frac{1}{f}$

14 The focal length of a convex lens of R.I. 1.5 is f when it is placed in air. When it is immersed in a liquid it behaves as a converging lens its focal length becomes xf (x > 1). The refractive index of the liquid **[Roorkee 1999]**

(a) > 3/2

(b) < (3/2) and > 1

(c) < 3/2

(d) All of these

15 A concave lens of glass, refractive index 1.5, has both surfaces of same radius of curvature R. On immersion in a medium of refractive index 1.75 it will behave as a **[IIT-JEE 1999]**

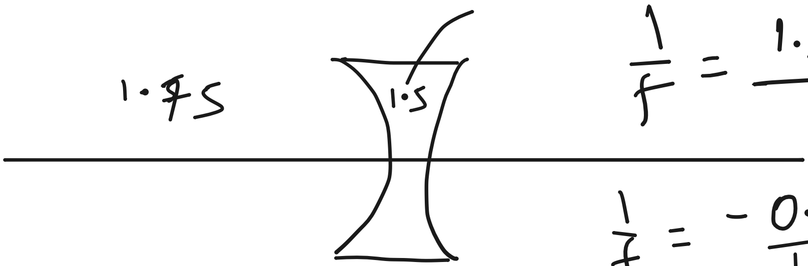
(a) Convergent lens of focal length 3.5 R ✓

(b) Convergent lens of focal length 3.0 R

(c) Divergent lens of focal length 3.5 R

(d) Divergent lens of focal length 3.0 R

$$\frac{1}{f} = \frac{\mu_l - \mu_{air}}{\mu_{air}}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$



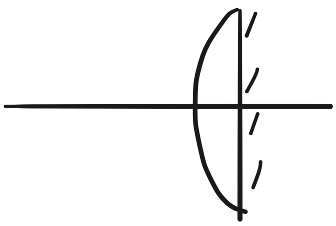
$$\frac{1}{f} = \frac{1.5 - 1.75}{1.75}\left(\frac{-1}{R} - \frac{1}{R}\right)$$

$$\frac{1}{f} = \frac{-0.25}{1.75}\left(-\frac{2}{R}\right)$$

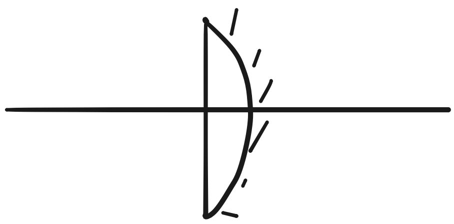
16 IIT main

A plano-convex lens when silvered in the plane side behaves like a concave mirror of focal length 30 *cm*. However, when silvered on the convex side it behaves like concave mirror of focal length 10 *cm*. Then the refractive index of its material will be

(a) 3.0 (b) 2.0 (c) 2.5 (d) 1.5 ✓



$f = R/2$



$f_{eq} = 30\,cm.$

$$\frac{1}{f_{eq}} = \frac{2}{f_l} + \frac{1}{f_m}$$

$$\frac{1}{f_{eq}} = \frac{2}{f_l} + \frac{1}{f_m} \qquad f_m = \infty$$

$$\frac{1}{10} = \frac{\cancel{2}}{\cancel{30}} + \frac{1}{R/2}$$

$$\frac{1}{30} = \frac{2}{f_l}, \quad f_l = 60\,cm \text{ - A}$$

$$\frac{1}{10} - \frac{1}{30} = \frac{2}{R}$$

$$\frac{3-1}{30} = \frac{2}{R}$$

R = 30

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

$\frac{1}{60} = (\mu - 1)\left(\frac{1}{30} - \frac{1}{\infty}\right)$

$\frac{1}{6\cancel{0}} = \frac{(\mu-1)}{3\cancel{0}}$

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

$\mu = 1.5$

17 Diameter of a plano-convex lens is 6 *cm* and thickness at the centre is 3 *mm*. If the speed of light in the material of the lens is $2 \times 10^8 \, m/\sec$ the focal length of the lens is [CPMT 19

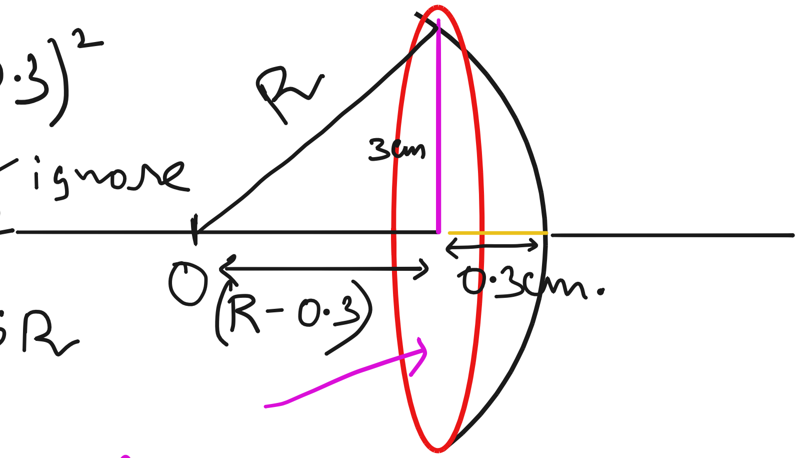
(a) 15 *cm* (b) 20 *cm*

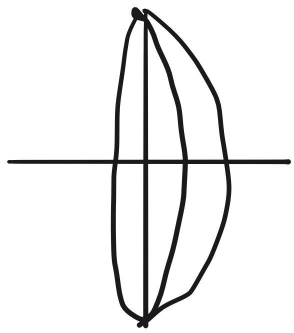
✓(c) 30 *cm* (d) 10 *cm*

$\mu = \frac{c}{v} = 1.5$

$R^2 = 3^2 + (R - 0.3)^2$

$\cancel{R^2} = 9 + \cancel{R^2} + (0.3)^2 - 0.6R$ ← ignore





$0.6R = 9$

$R = \frac{9}{0.6}$

$R = \frac{90}{6}$

$R = \frac{30}{2} = 15\,cm$

$R_1 = \infty$

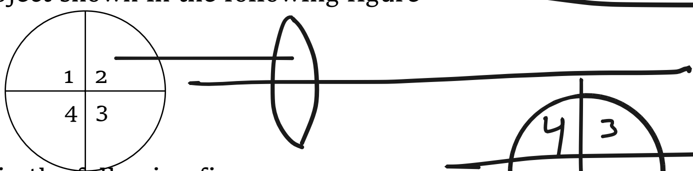
$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

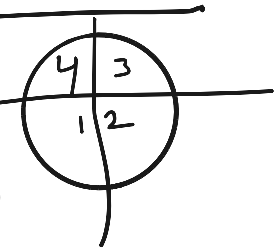
$\frac{1}{f} = (1.5 - 1)\left(\frac{1}{R}\right)$

$\frac{1}{f} = 0.5 \times \frac{1}{15}$

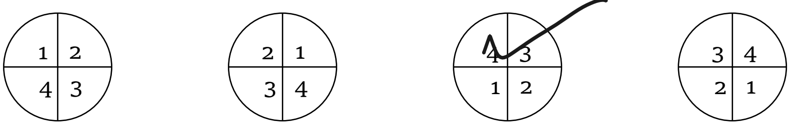
$f = 30\,cm$

18 A convex lens is used a real image of the object shown in the following figure





Then the real inverted images is as shown in the following figure



(a) a (b) b (c) c (d) d

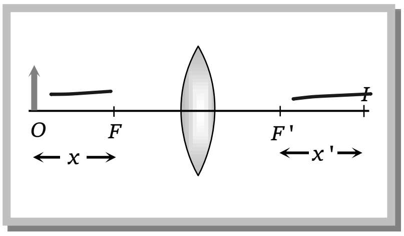
19 An object is placed at a point distant x from the focus of a convex lens and its image is formed at I as shown in the figure. The distances x, x' satisfy the relation

(a) $\frac{x+x'}{2}=f$

(b) $f=xx'$

(c) $x+x'\leq 2f$

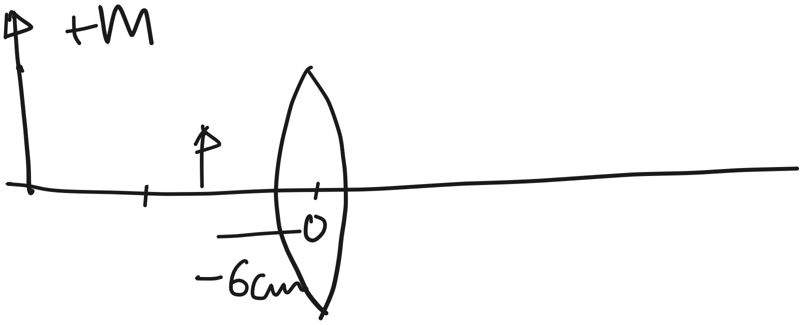
(d) $x+x'\geq 2f$

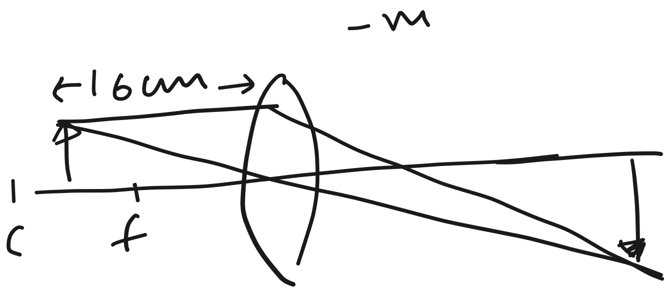


20 An object is kept at a distance of 16 *cm* from a thin and the image formed is real. If the object is kept at a distance of 6 *cm* from the same lens the image formed is virtual. If the size of the images formed are equal, the focal length of the lens will be

(a) 15 *cm* (b) 17 *cm*

(c) 21 *cm* (d) 11 *cm*





$$m = \frac{f}{f+u} \qquad -m = \frac{f}{f-16}$$

$$m = \frac{f}{f-6} \qquad \frac{\cancel{f}}{f-6} = -\frac{\cancel{f}}{f-16}$$

$$f-16 = -f+6$$

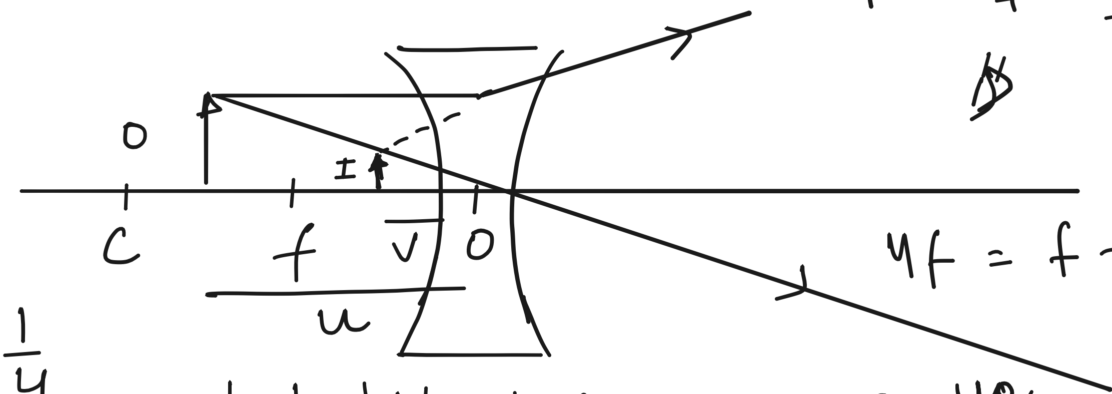
21 A concave lens forms the image of an object such that the distance between the object and image is 10 *cm* and the magnification produced is 1/4. The focal length of the lens will be

(a) 8.6 *cm* (b) 6.2 *cm*

(c) 10 *cm* (d) 4.4 *cm*

$$m = \frac{f}{f+u} \qquad \frac{1}{4} = \frac{f}{f+u}$$

$$\frac{1}{4} = \frac{f}{f - \frac{40}{3}}$$



$$4f = f - \frac{40}{3}$$

$$m = \frac{V}{u} = \frac{1}{4}$$

$$|u| - |V| = 10\,cm, \qquad 3f = 40/3 \qquad f = \frac{40}{9}$$

22 A plano convex lens fits exactly into a plano concave lens. Their plane surface are parallel to each other. If the lenses are made of different materials of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then focal length of the combination is

$u = V+10$, $u = \frac{40}{3}cm$

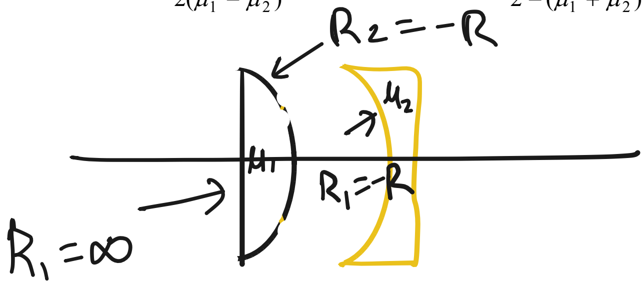
$\frac{1}{4} = \frac{V}{V+10}$, $V+10 = 4V$

$10 = 3V$

$V = \frac{10}{3} cm.$

(a) $\frac{R}{\mu_1-\mu_2}$ (b) $\frac{2R}{\mu_1-\mu_2}$

(c) $\frac{R}{2(\mu_1-\mu_2)}$ (d) $\frac{R}{2-(\mu_1+\mu_2)}$



$$\frac{1}{f_2}=(\mu_2-1)\left(\frac{1}{-R}-\frac{1}{\infty}\right)$$

$$\frac{1}{f_2}=\frac{-(\mu_2-1)}{R}$$

$$\frac{1}{f}=(\mu_1-1)\left(\frac{1}{\infty}-\frac{1}{-R}\right)$$

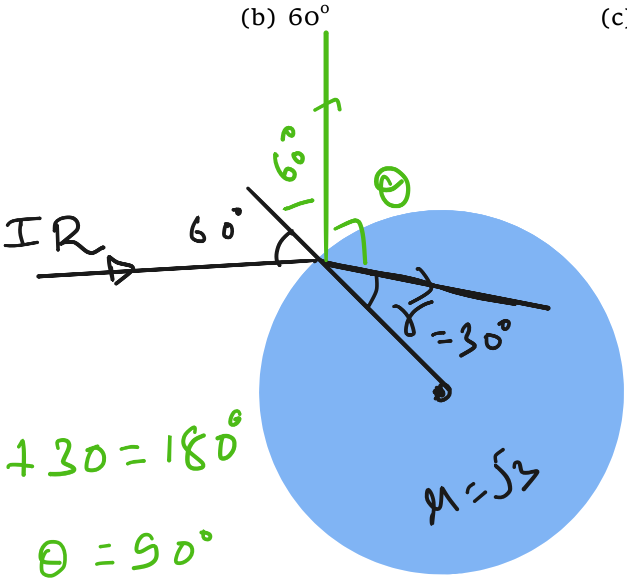
$$\frac{1}{f_1}=\frac{(\mu_1-1)}{R} \quad - A$$

$$f_{eq}=\frac{R}{\mu_1-\mu_2}$$

$$\frac{1}{f_{eq}}=\frac{1}{f_1}+\frac{1}{f_2}=\left(\frac{\mu_1-1}{R}\right)-\left(\frac{\mu_2-1}{R}\right)=\frac{\mu_1-\mu_2}{R}$$

23 A ray incident at an angle of incidence 60° enters a glass sphere of refractive index $\mu=\sqrt{3}$. This ray is reflected and refracted at the further surface of the sphere. The angle between reflected and refracted rays at this surface is

(a) 90° (b) 60° (c) 70° (d) 40°



$$\theta+60^\circ+30=180^\circ$$

$$\theta=90^\circ$$

$$\frac{\sin i}{\sin r}=\mu$$

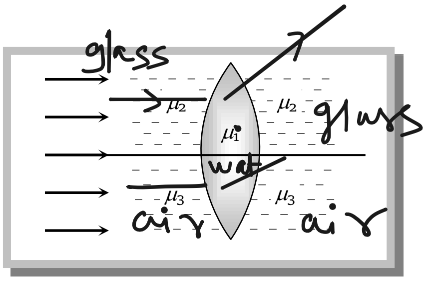
$$\frac{\sin 60^\circ}{\sin r}=\sqrt{3}$$

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

$$r=30$$

24 A double convex lens, lens made of a material of refractive index μ_1, is placed inside two liquids or refractive indices μ_2 and μ_3, as shown. $\mu_2 > \mu_1 > \mu_3$. A wide, parallel beam of light is incident on the lens from the left. The lens will give rise to

(a) A single convergent beam
(b) Two different convergent beams
(c) Two different divergent beams
(d) A convergent and a divergent beam



25 The magnification produced by the objective lens and the eye lens of a compound microscope are 25 and 6 respectively. The magnifying power of this microscope is**[Manipal MEE 1995; DPMT 2**

(a) 19 (b) 31
(c) 150 (d) $\sqrt{150}$

$m = m_1 \times m_2 = 25 \times 6 = 150$

26 The magnifying power of a simple microscope is 6. The focal length of its lens in *metres* will be, if least distance of distinct vision is 25 *cm* **[MP PMT 20**

(a) 0.05 (b) 0.06 (c) 0.25 (d) 0.12

$$m = 1 + \frac{D}{f}$$

$$6 = 1 + \frac{D}{f}$$

$$5 = \frac{25}{f}$$

$$f = 5\,cm = 0.05\,m.$$

27 The length of the tube of a microscope is 10 *cm*. The focal lengths of the objective and eye lenses are 0.5 *cm* and 1.0 *cm*. The magnifying power of the microscope is about

(a) 5 (b) 23 (c) 166 (d) 500

$L = 10\,cm.$

$f_o = 5\,cm,\ f = 1\,cm$

$L = V_o + u_e$

$u_e <<< V_o$

$L \cong V_o$

$$m = m_1 \times m_2 = \frac{V_o}{u_o}\left(1 + \frac{D}{f_e}\right) = \frac{L}{f_o}\left(1 + \frac{D}{f_e}\right)$$

$u_o \cong f_o$

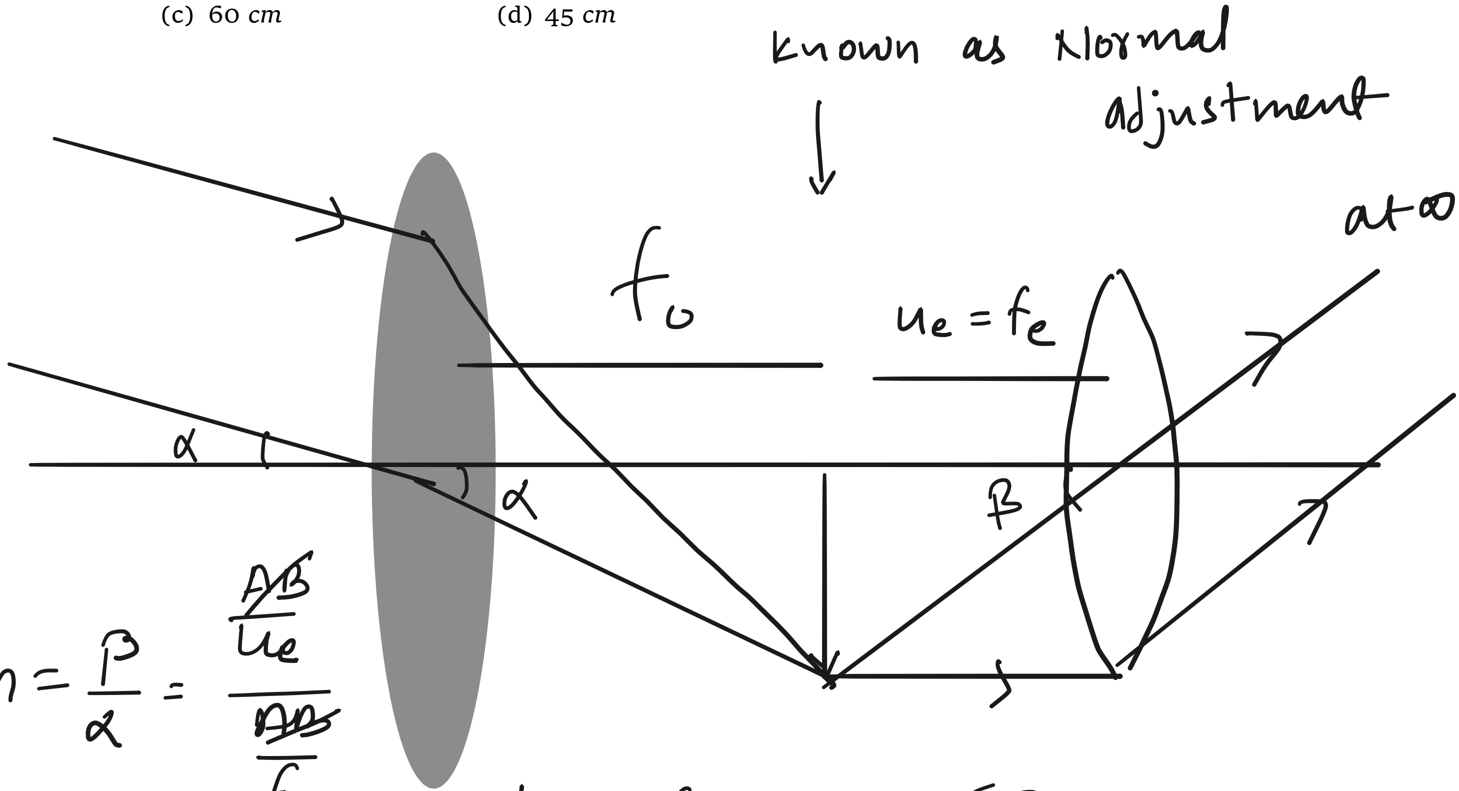
$$= \frac{10}{0.5}\left(1 + \frac{25}{1}\right)$$

$$= 20(26) = 520$$

28 The focal length of the objective and eyepiece of an astronomical telescope for normal adjustments are 50 *cm* and 5 *cm*. The length of the telescope should be

(a) 50 *cm* (b) 55 *cm*

(c) 60 *cm* (d) 45 *cm*



$$m = \frac{\beta}{\alpha} = \frac{\frac{\cancel{AB}}{u_e}}{\frac{\cancel{AB}}{f_o}}$$

$$m = \frac{f_o}{u_e} = \frac{f_o}{f_e} = 10$$

$$l = f_o + f_e = 55\,cm.$$