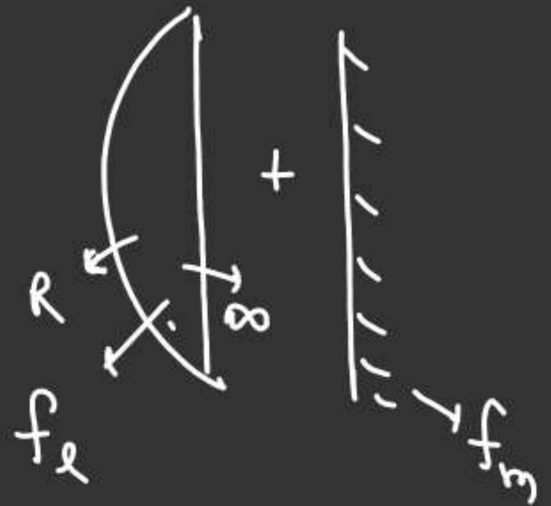
Nishant Jindal

AA. H-W ✓



Find

$\Downarrow$

f_1

$$\frac{f_1}{f_2} = ??$$

$$\frac{1}{f_\ell} = (\mu-1)\left[\frac{1}{+R} - \frac{1}{\infty}\right]$$

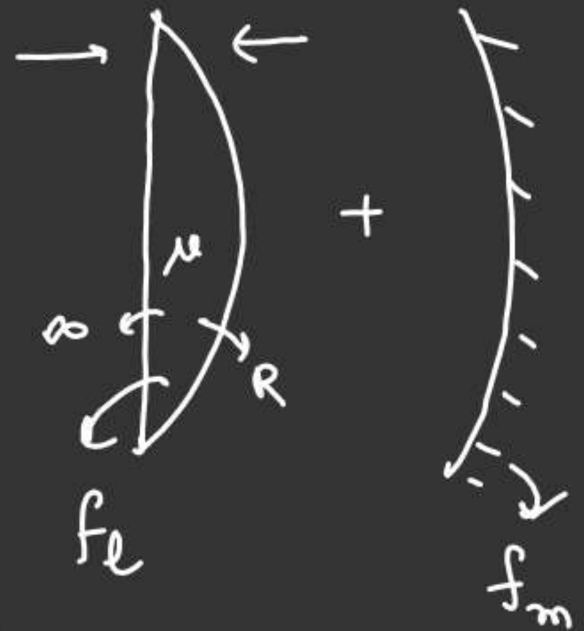
$$\frac{1}{f_\ell} = \frac{(\mu-1)}{R}$$

$f_m \to \infty$, $R_{\text{plane Mirror}} = \infty$

$$\frac{1}{f_1} = -\left[\frac{n}{f_\ell} - \frac{m}{f_m}\right] = -\left[\frac{2\times(\mu-1)}{R} - \frac{1}{\infty}\right]$$

$$f_1 = \ominus\frac{R}{2(\mu-1)}$$

Behave as Concave Mirror.



$\Downarrow$

f_2

$$\frac{1}{f_\ell} = (\mu-1)\left[\frac{1}{\infty} - \frac{1}{(-R)}\right]$$

$$\frac{1}{f_\ell} = \frac{(\mu-1)}{R}.$$

$$f_m = \left(-R/2\right)$$

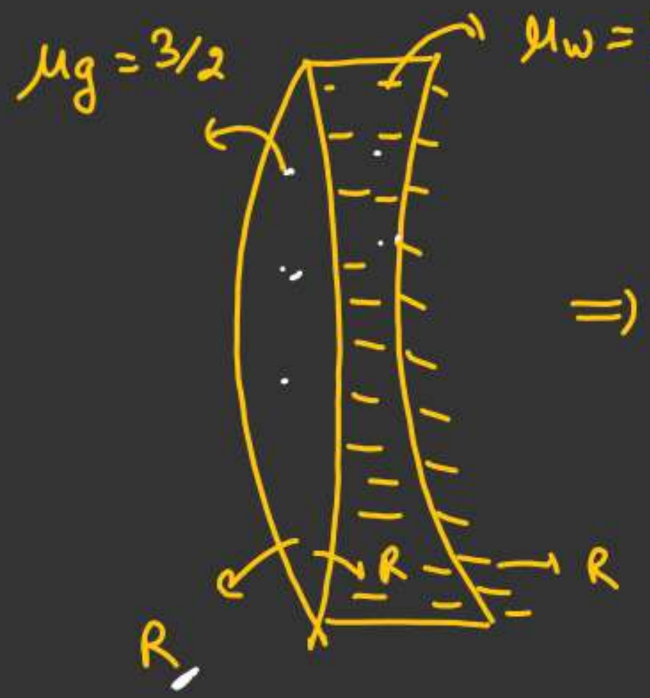
$$\frac{1}{f_2} = -\left[\frac{2(\mu-1)}{R} - \frac{1\times 2}{(-R)}\right]$$

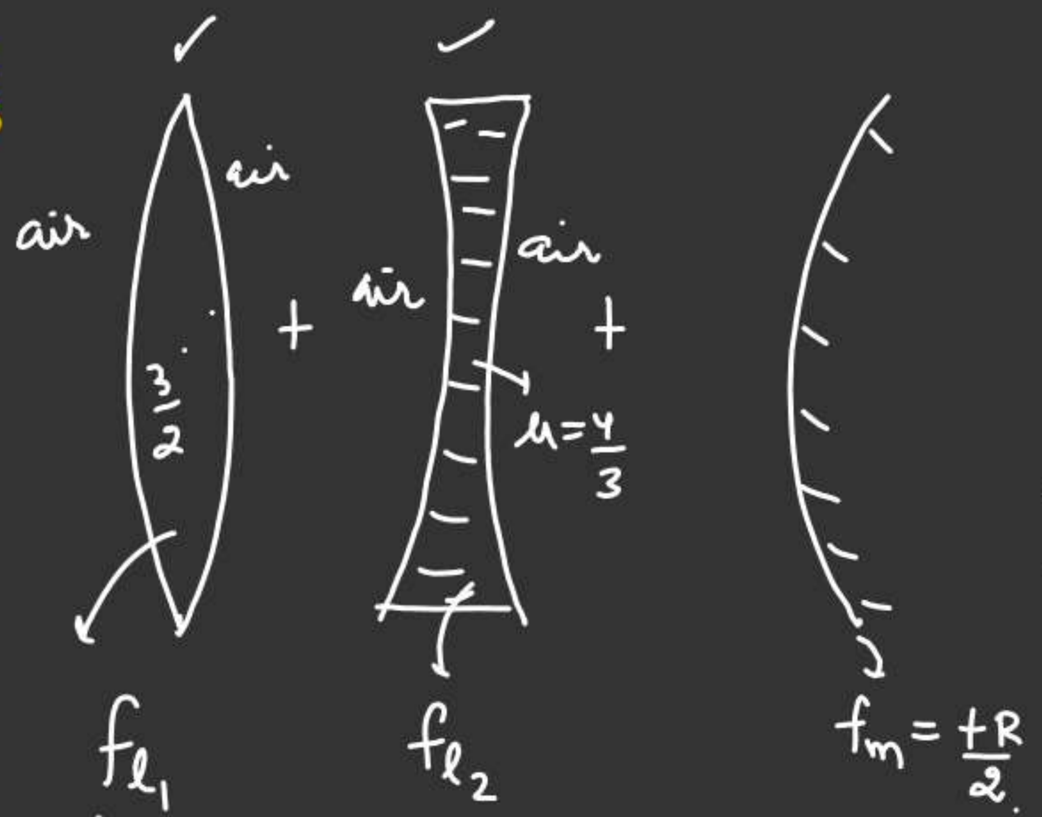
$$\frac{1}{f_2} = -\left[\frac{2\mu}{R}\right] \Rightarrow f_2 = \ominus\left(\frac{R}{2\mu}\right)$$

Acts as a Concave Mirror.

Nishant Jindal

H.W

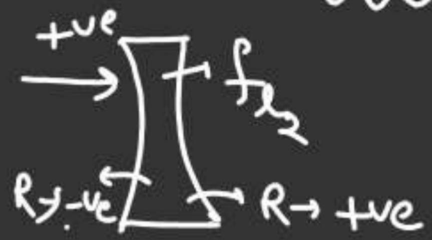




$$\frac{1}{f_{l_1}} = \left[\left(\frac{3}{2}-1\right)\left[\frac{1}{R} - \frac{1}{(-R)}\right]\right]$$

$$\frac{1}{f_{l_1}} = \frac{1}{2} \times \frac{2}{R}$$

$$\frac{1}{f_l} = \frac{1}{R}.$$



$$\frac{1}{f_{l_2}} = \left(\frac{4}{3}-1\right)\left[\frac{1}{(-R)} - \frac{1}{R}\right]$$

$$\frac{1}{f_{l_2}} = \frac{1}{3}\left(-\frac{2}{R}\right) = \left(\frac{-2}{3R}\right)$$

$$\frac{1}{f_l} = \frac{1}{f_{l_1}} + \frac{1}{f_{l_2}}$$

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

$$\frac{1}{f_l} = \frac{1}{3R}$$

$$\frac{1}{f} = -\left[\frac{n}{f_l} - \frac{m}{f_m}\right]$$

n → 2; m → Always 1.

$$\frac{1}{f} = -\left[2 \times \frac{1}{3R} - \frac{2}{R}\right]$$

$$\frac{1}{f} = -\left[\frac{2}{3R} - \frac{2}{R}\right]$$

$$\frac{1}{f} = -\left[\frac{-4}{3R}\right]$$

$$\frac{1}{f} = \frac{+4}{3R}$$

$$f = +\frac{3R}{4}$$ ⇒ overall behave as convex Mirror

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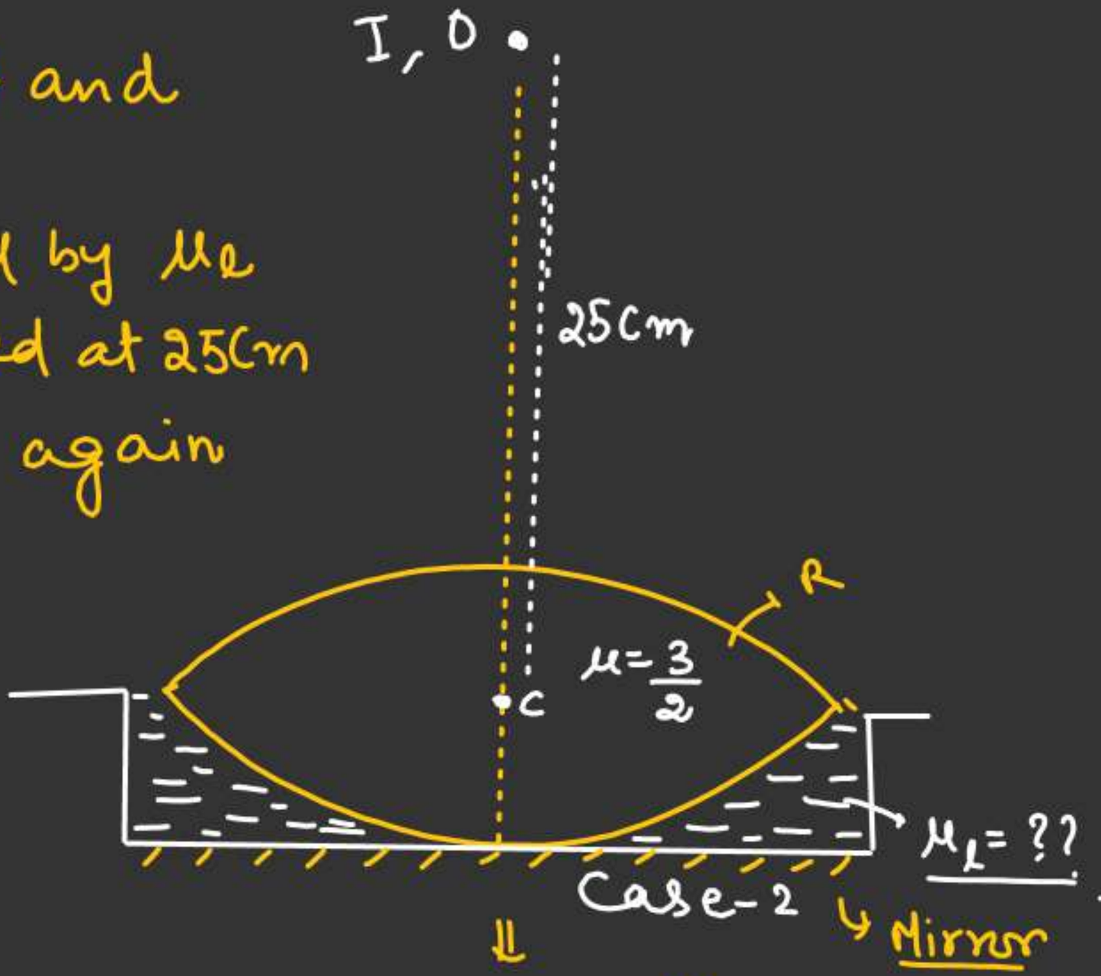
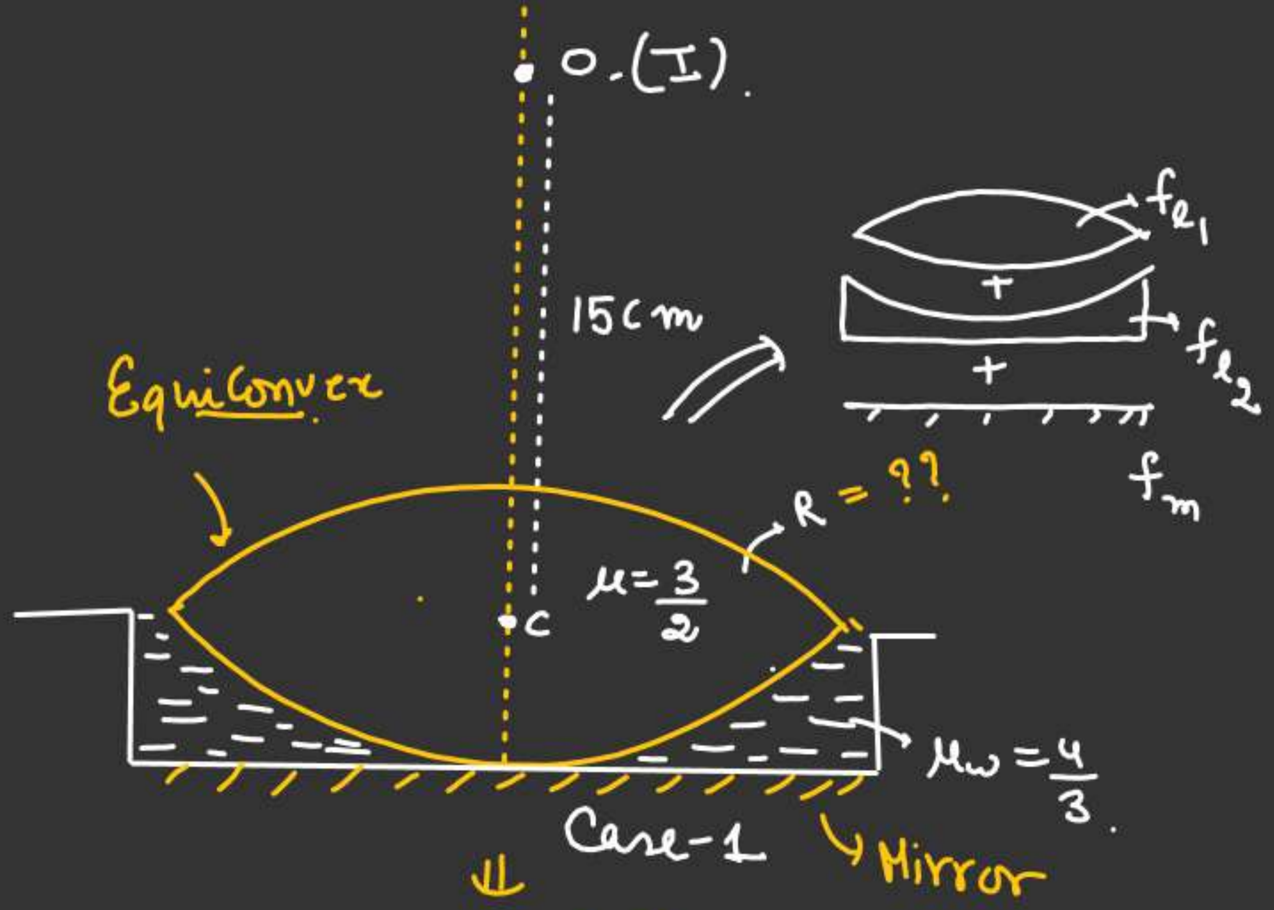
\# In 1st Case object and image concide.
If μ_w is replaced by μ_ℓ and object is placed at 25cm from lens then again image is concide with object. then find $\mu_\ell = ??$





For Case-1

$$\frac{1}{f_\ell} = \frac{1}{f_{\ell_1}} + \frac{1}{f_{\ell_2}}$$

$$\frac{1}{f_{\ell_1}} = \left(\frac{3}{2}-1\right)\left[\frac{1}{R} - \frac{1}{(-R)}\right] = \frac{1}{R}$$

$$\frac{1}{f_{\ell_2}} = \left(\frac{4}{3}-1\right)\left[\frac{1}{(-R)} - \frac{1}{\infty}\right] = \left(\frac{-1}{3R}\right)$$

$$\frac{1}{f_\ell} = \frac{1}{R} - \frac{1}{3R} = \left(\frac{2}{3R}\right)$$

$$\frac{1}{f} = -\left[2\times\frac{2}{3R} - \frac{1}{\infty}\right]$$

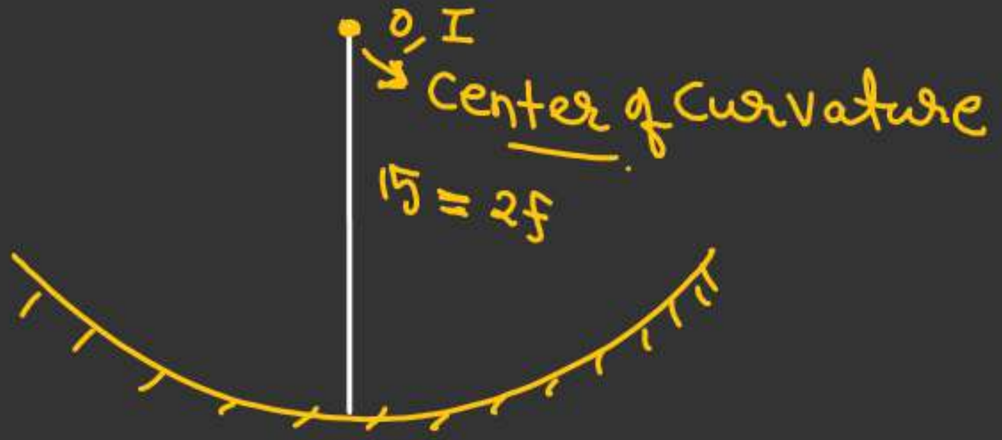
$$\frac{1}{f} = \left(-\frac{4}{3R}\right) \Rightarrow 15 = 2\times\frac{3R}{4}$$

$$f = \left(\frac{3R}{4}\right)$$

$$R = \frac{15\times 4}{2\times 3}$$

$$R = 5\times 2 = 10\,\text{Cm}$$

$25 = 2f'$



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#

For Case-2

$$\frac{1}{f_{\ell_1}} = \frac{1}{R}$$

$$\frac{1}{f_{\ell_2}} = (\mu_\ell - 1)\left[\frac{1}{-R} - \frac{1}{\infty}\right]$$

$$\frac{1}{f_{\ell_1}} = -\frac{(\mu_\ell - 1)}{R}$$

$$\frac{1}{f_\ell'} = \left(\frac{1}{f_{\ell_1}} + \frac{1}{f_{\ell_2}}\right)$$

$$\frac{1}{f_\ell'} = \left[\frac{1}{R} - \frac{(\mu_\ell - 1)}{R}\right]$$

$$\frac{1}{f_\ell'} = \frac{(2 - \mu_\ell)}{R}$$

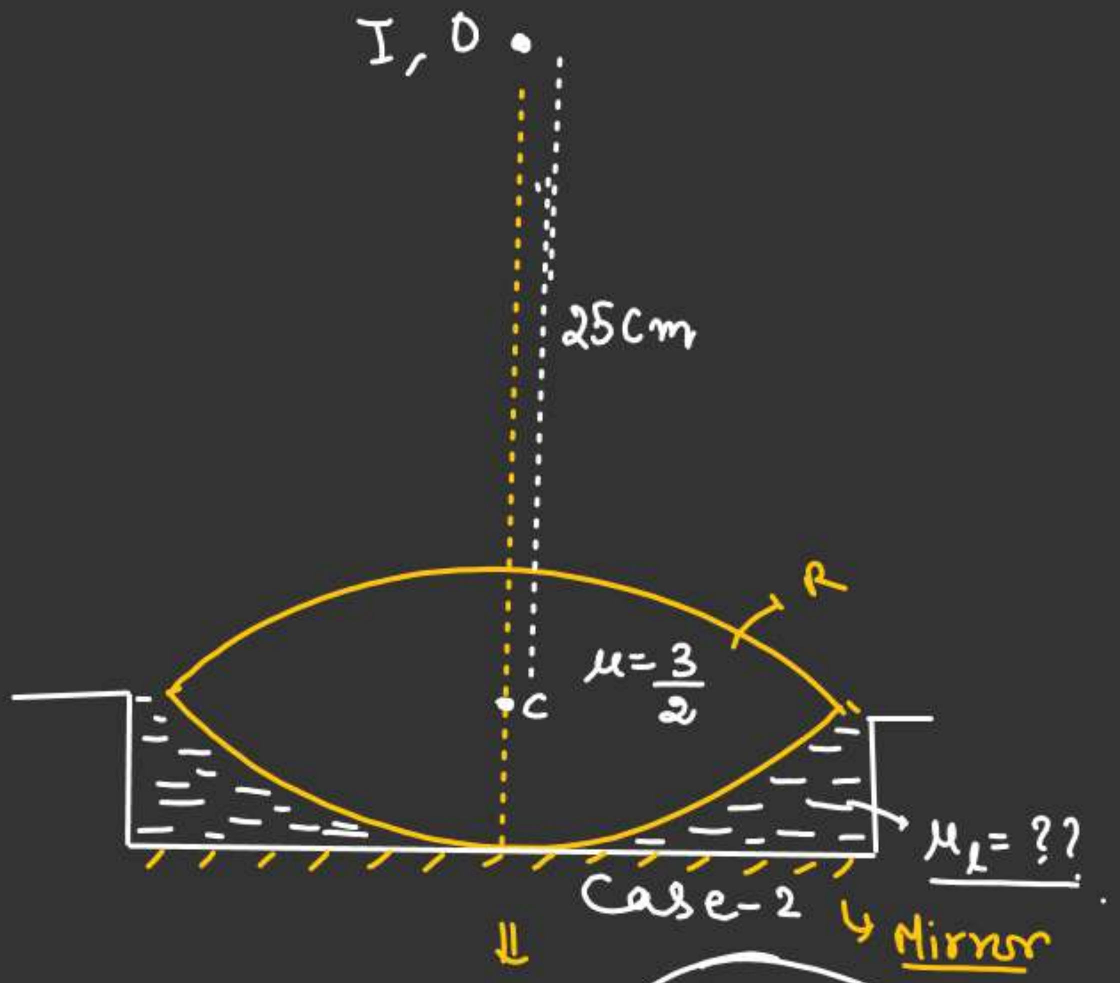
$$\frac{1}{f'} = -\left[\frac{2}{f_\ell'} - \frac{1}{\infty}\right]$$

$$\frac{1}{f'} = -\left(\frac{2}{f_\ell'}\right)$$

$$f' = -\left(\frac{f_\ell'}{2}\right) = \ominus \frac{R}{2(2-\mu_\ell)}$$

$$(2-\mu_\ell) = \frac{R}{2f'} = \frac{10}{25} = \frac{2}{5}$$

$$\mu_\ell = 2 - \frac{2}{5} = \left(\frac{8}{5}\right) \text{ Ans}$$



$25 = 2f'$

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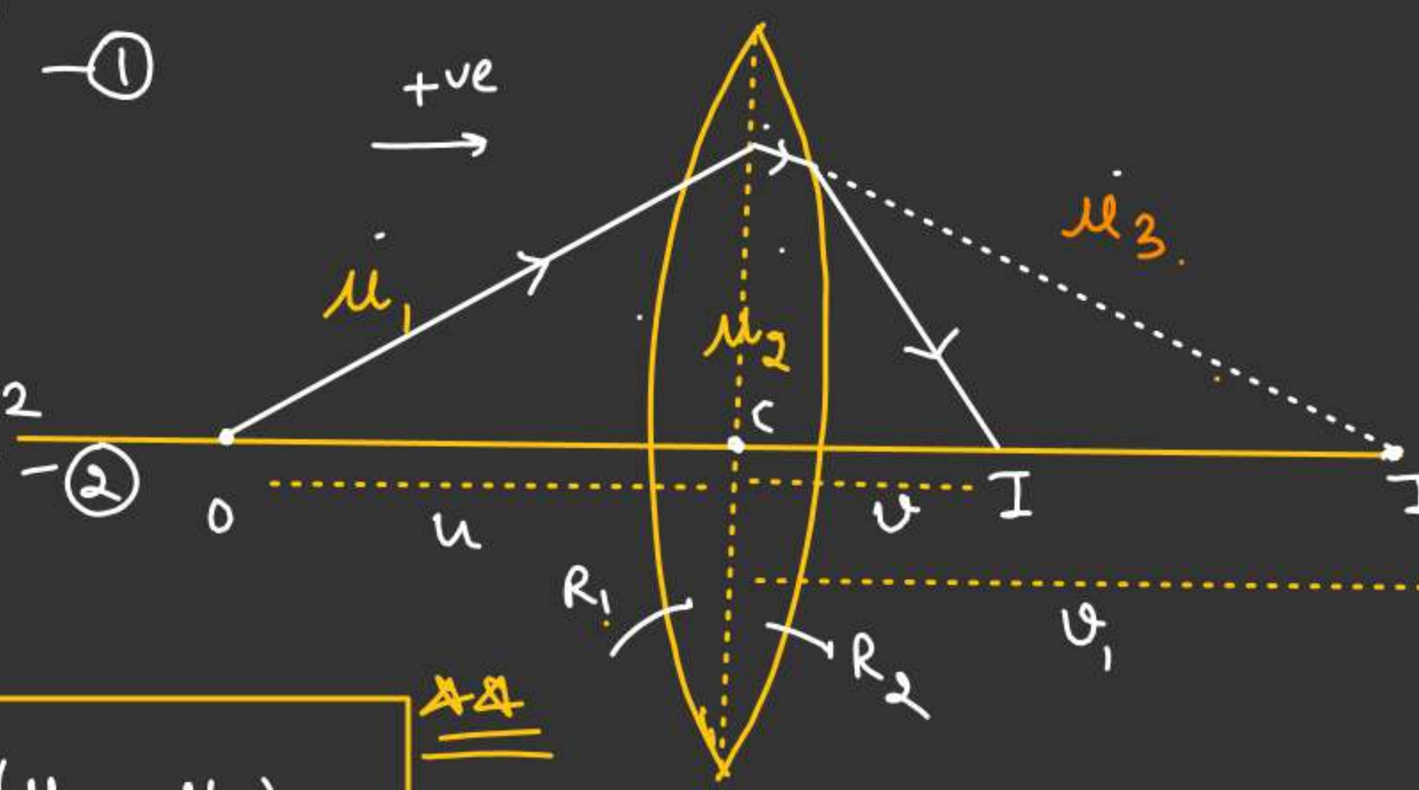
LEN'S MAKER FORMULA IN NON-HOMOGENIOUS MEDIUM

(without Sign)

$$\frac{\mu_2}{v_1} - \frac{\mu_1}{u} = \frac{(\mu_2-\mu_1)}{R_1} \quad -(1)$$



Acts as a virtual object I_1 for 2nd refraction

For 2nd Refraction

$$\frac{\mu_3}{v} - \frac{\mu_2}{v_1} = \frac{\mu_3-\mu_2}{R_2} \quad -(2)$$

Adding (1) + (2)

$$\boxed{\frac{\mu_3}{v} - \frac{\mu_1}{u} = \frac{(\mu_2-\mu_1)}{R_1} + \frac{(\mu_3-\mu_2)}{R_2}}$$

Q. Find No of images formed. also find the distance of the images relative to lens.

2 – Images.

For upper half

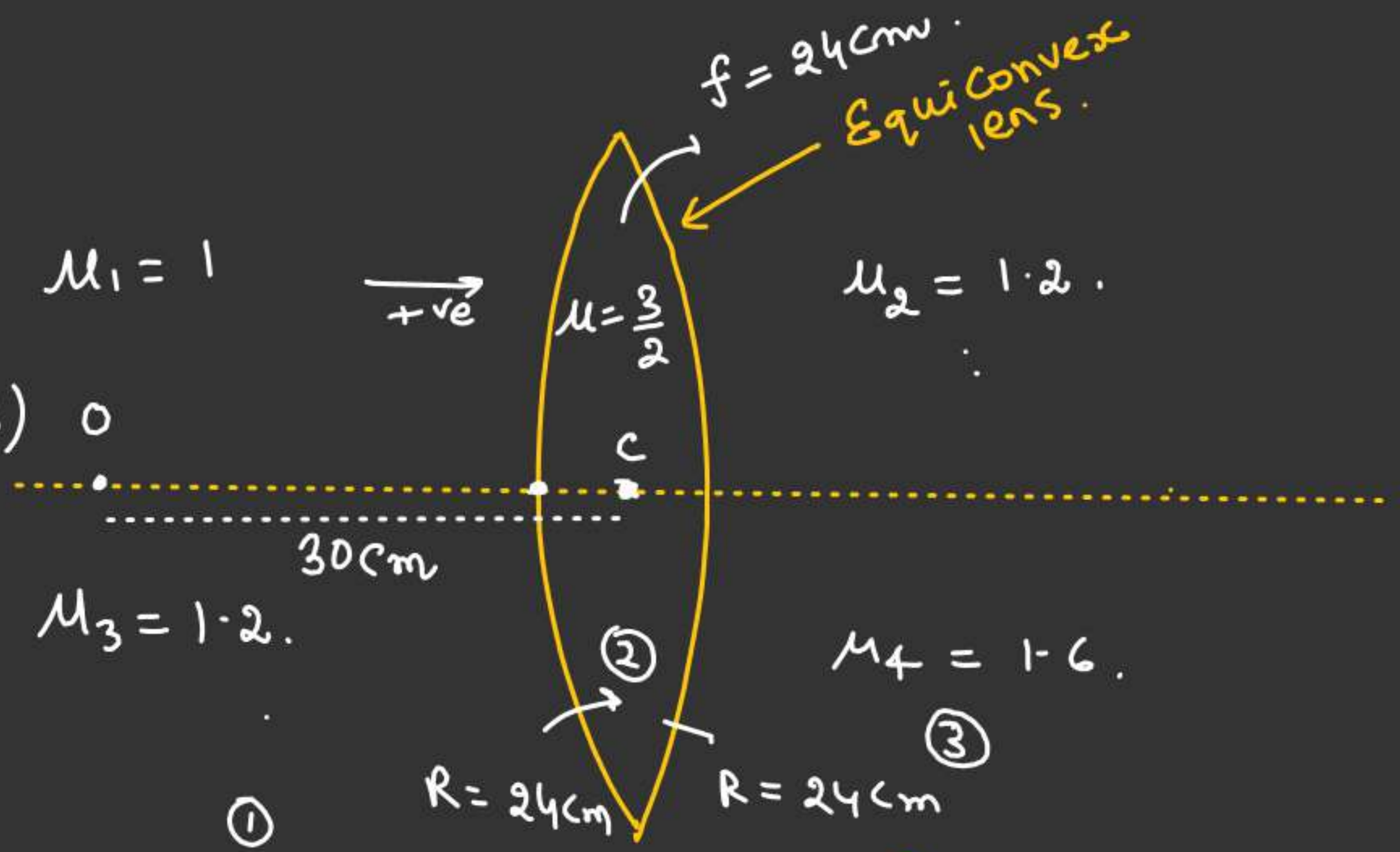
$$\frac{1.2}{v_1} - \frac{1}{(-30)} = \frac{\left(\frac{3}{2}-1\right)}{+24} + \frac{(1.2-1.5)}{(-24)}$$

$v_1 = \infty$

For Lower half

$$\frac{1.6}{v_2} - \frac{1.2}{(-30)} = \frac{(1.5-1.2)}{+24} + \frac{(1.6-1.5)}{(-24)}$$

$$v_2 = \frac{960}{19}\ cm$$



Equiconvex lens

$$\frac{1}{f} = (\mu-1)\left[\frac{1}{R} - \frac{1}{(-R)}\right]$$

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

$f = R = 24cm$

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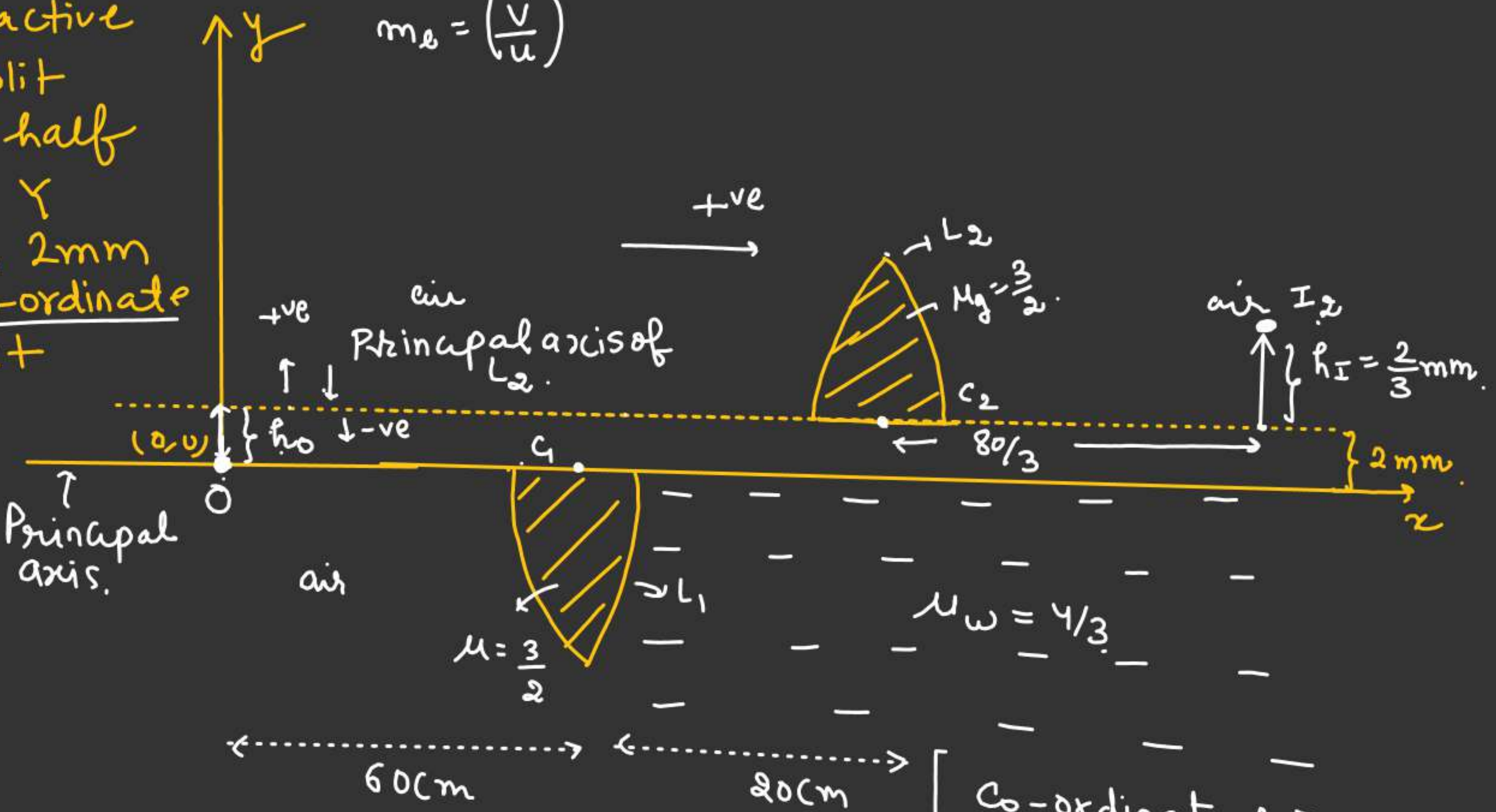
A lens having refractive index $\mu = 3/2$ is split in two half. Other half is shifted along x & Y direction by 20 cm and 2 mm respectively. Find co-ordinate of image of the object placed at origin.
Equiconvex lens having focal length 20 cm.

$(f = R = 20\,cm)$



For L_2

$$\frac{1}{v_2} - \frac{1}{(-80)} = \frac{1}{+20}$$

$$v_2 = +\frac{80}{3}\,cm$$

$$m = \left(\frac{v_2}{u_2}\right) = m = \left(\frac{+80/3}{(-80)}\right)$$

$m = -ve$.
h_I & h_o of opposite sign.

$$h_I = \frac{2}{3}\,mm$$

Co-ordinate of I_2

$$x = \left(80 + \frac{80}{3}\right) cm = \frac{320}{3}\,cm$$

$$y = \left(2 + \frac{2}{3}\right) mm = \frac{8}{3}\,mm$$

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For lower half ie for L_1

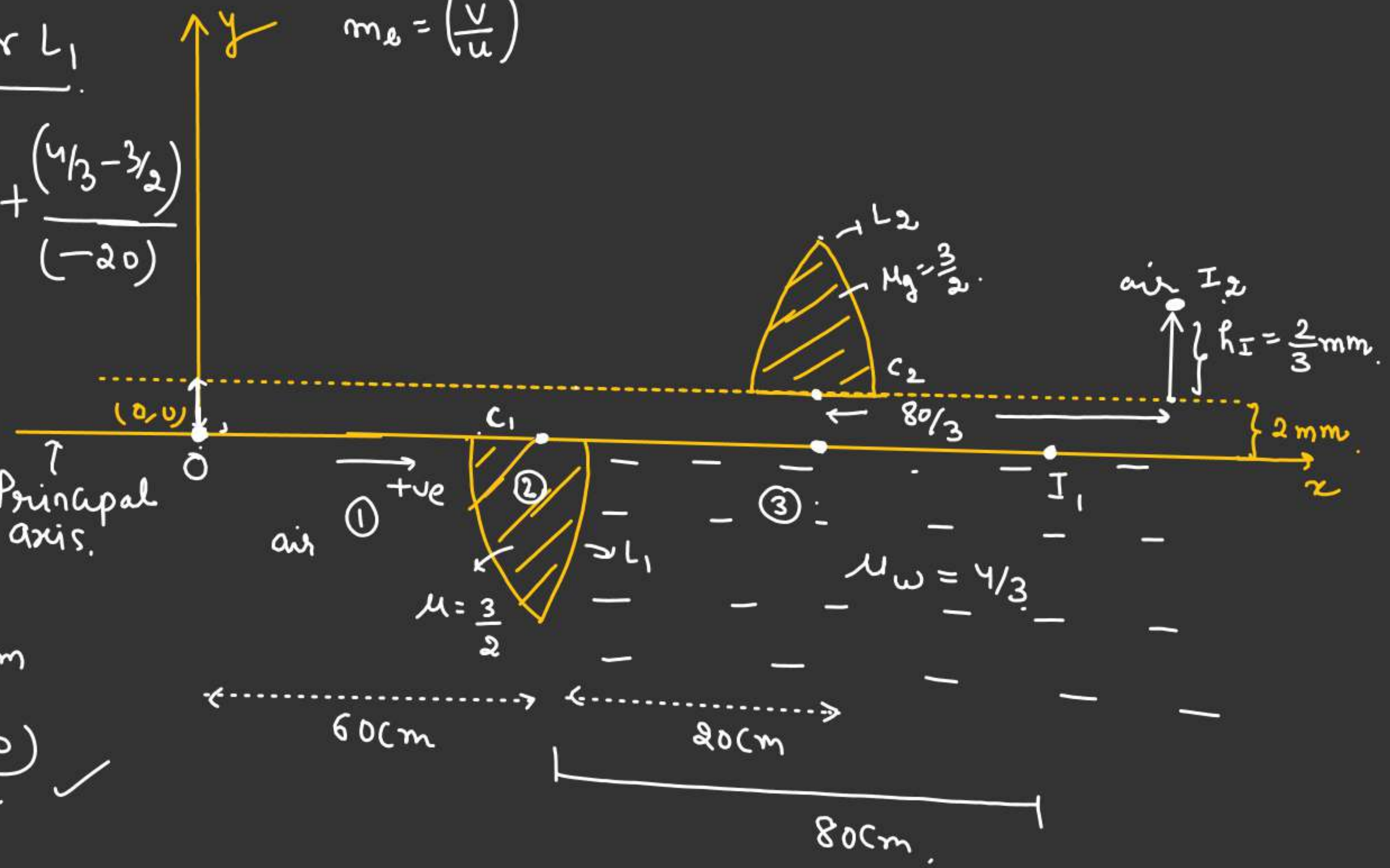
$$\frac{4/3}{v_1} - \frac{1}{(-60)} = \frac{(3/2 - 1)}{+20} + \frac{(4/3 - 3/2)}{(-20)}$$

$$v_1 = -80\ \text{cm}$$

Co-ordinate of I_1

$$= (80+60)\ \text{cm}$$

$$= (140\ \text{cm}, 0)$$



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There is no parallex b/w silvered lens and plane Mirror.
Height of final image formed by Silvered lens is twice the hight of image due to plane Mirror.
Find. a & b = ??

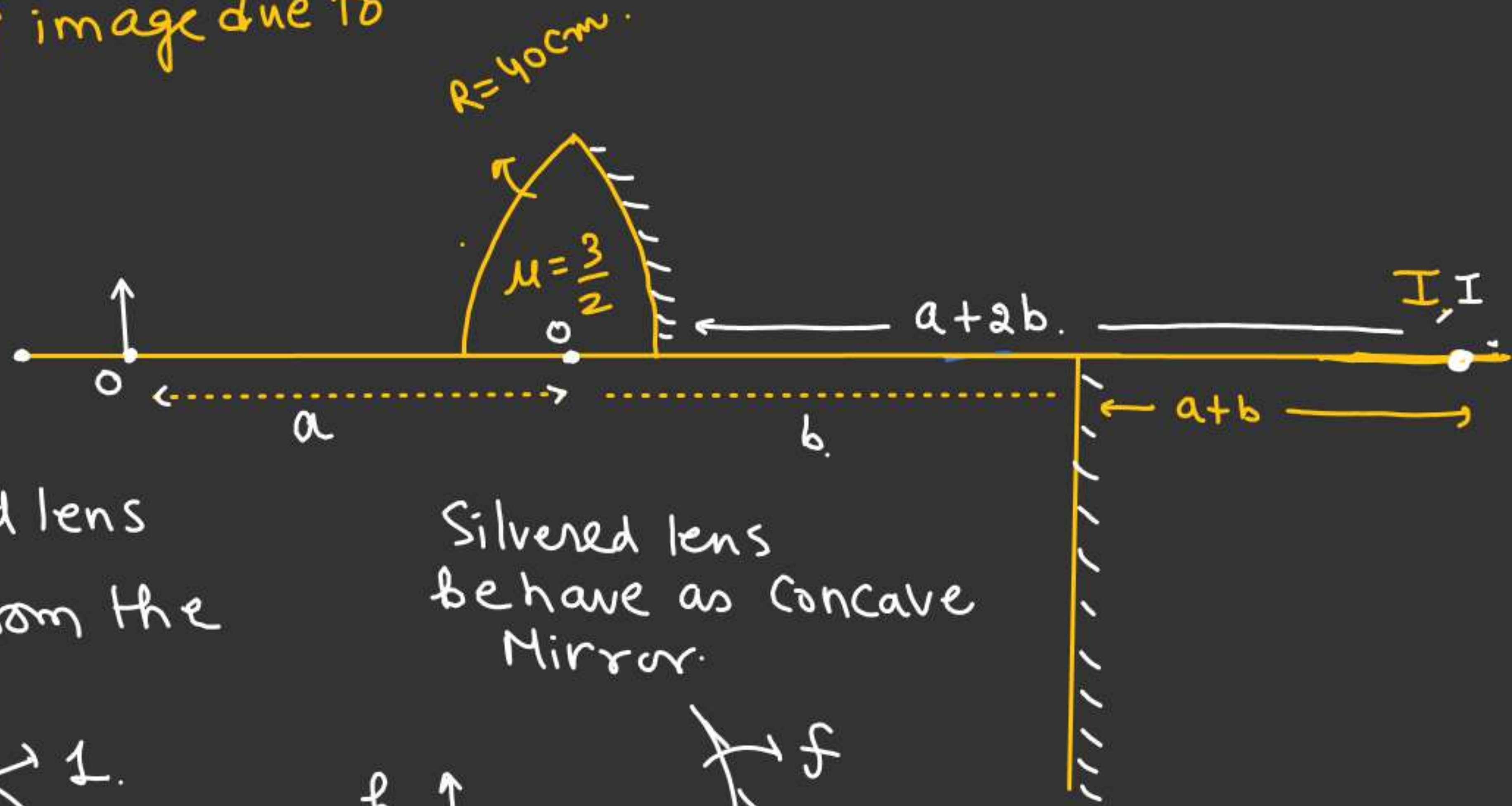
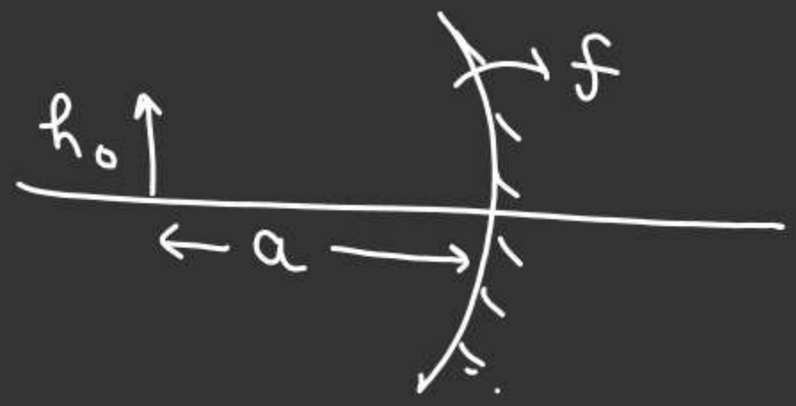


Image formed by plane Mirror at a distance (a+b) from the Mirror.
For No-parallex, image of Silvered lens also at a distance (a+2b) from the optical center.

Silvered lens behave as Concave Mirror.



$$m_{\text{silvered lens}} = 2\left(m_{\text{plane Mirror}}\right) \quad \to 1.$$

$$= 2$$

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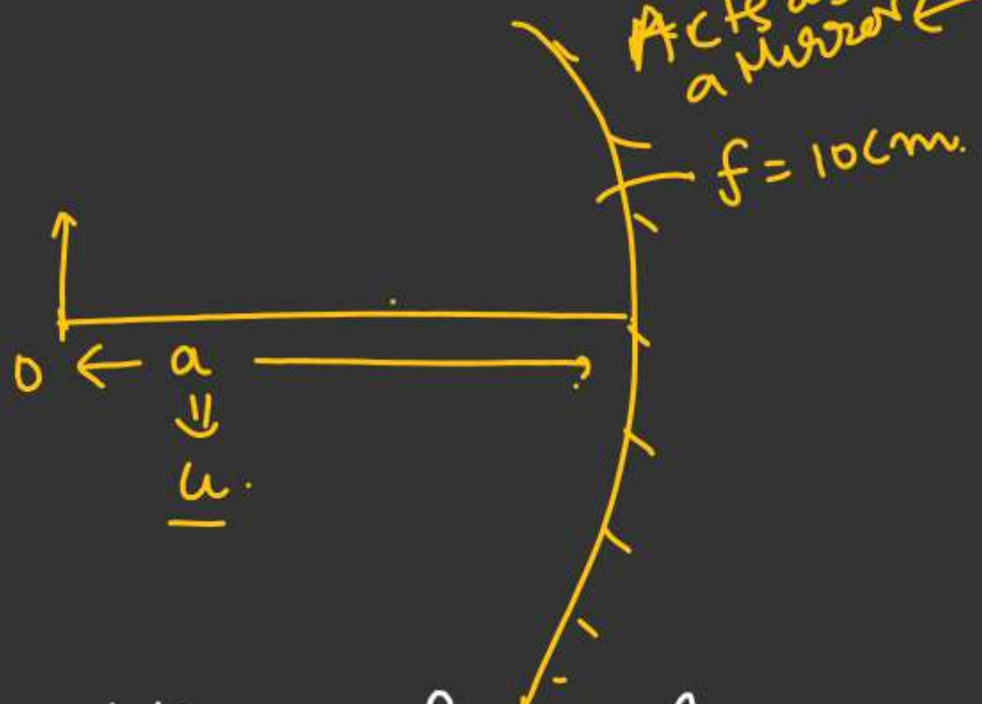

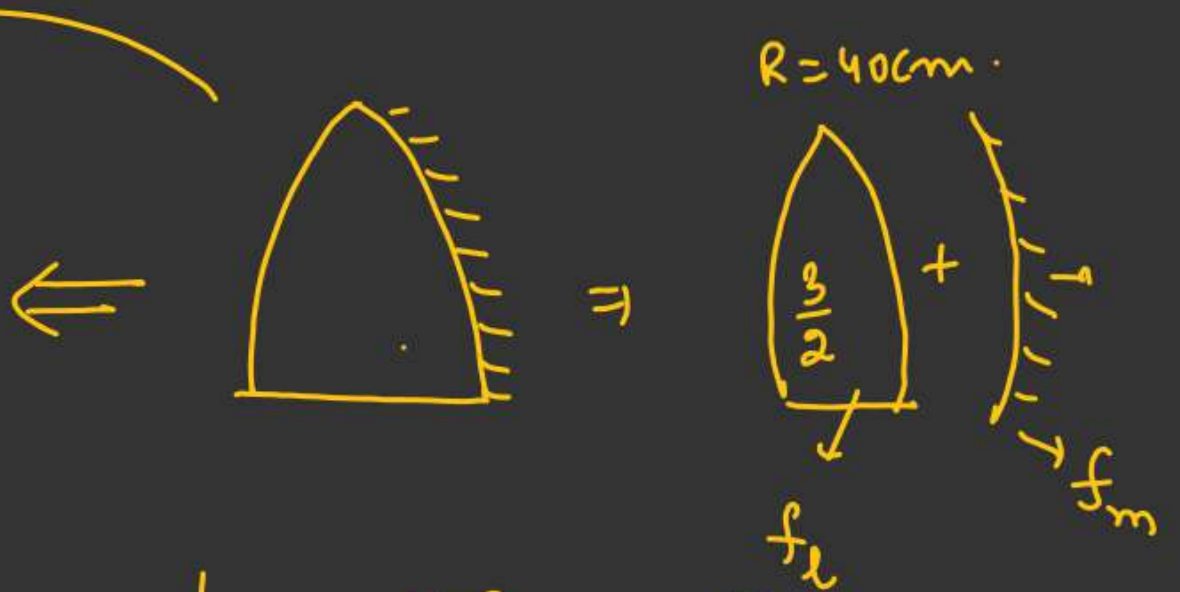

given

$m = 2$

$-\frac{v}{u} = 2$. $v = ??$

$\frac{-v}{(-a)} = 2$.

$\underline{v = +2a}$ ✓

Image Concide.

$v = a + 2b$

$\underline{2a} = \underline{a+2b}$

$a = 2b$

$b = a/2 = \frac{5}{2} = 2.5\,cm$

Mirror formula

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

$$\frac{1}{+2a} + \frac{1}{(-a)} = \frac{1}{(-10)}$$

$$\frac{1}{2a} - \frac{1}{a} = \frac{-1}{10}$$

$$-\frac{1}{2a} = \frac{-1}{10}$$

$\underline{a = 5cm}$ Ans

$$\frac{1}{f} = -\left[\frac{2}{f_l} - \frac{1}{f_m}\right]$$

$f_m = -20cm$

$$\frac{1}{f_l} = \left(\frac{1}{40}\right) \qquad \frac{1}{f_m} = \left(\frac{-1}{20}\right)$$

$$\frac{1}{f} = -\left[\frac{2}{40} + \frac{1}{20}\right] = -\frac{1}{10}$$

$\underline{f = 10cm}$ ✓