PRAYAS

JEE 2025

Lecture - 12

Physics

Ray Optics

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Topics to be covered

1. Ques Practise
2.
3.
4.

ATDB.uno

QUESTION

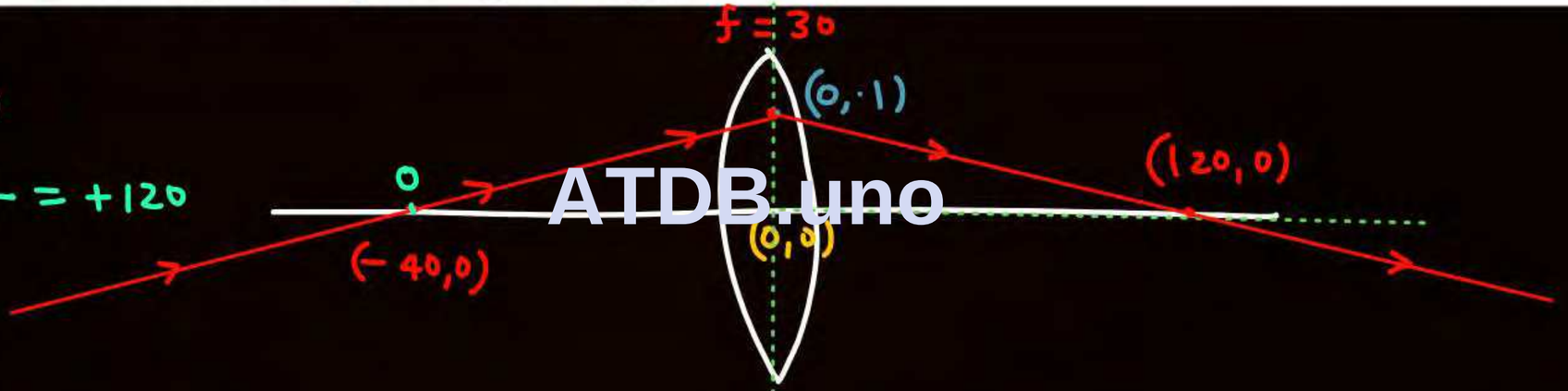
A lens is placed at origin, with x-axis as its principal axis. A ray of light is incident on it from the –ve side of x-axis along the line $y = \frac{x}{400} + 0.1$, where x, y are in cm. Focal length of lens is 30 cm.

Find the equation of the ray after passing through the lens.

$u = -40$

$f = +30$

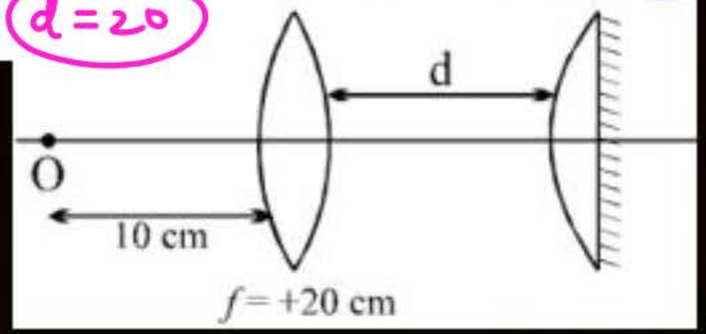
$v = \frac{-1200}{-10} = +120$

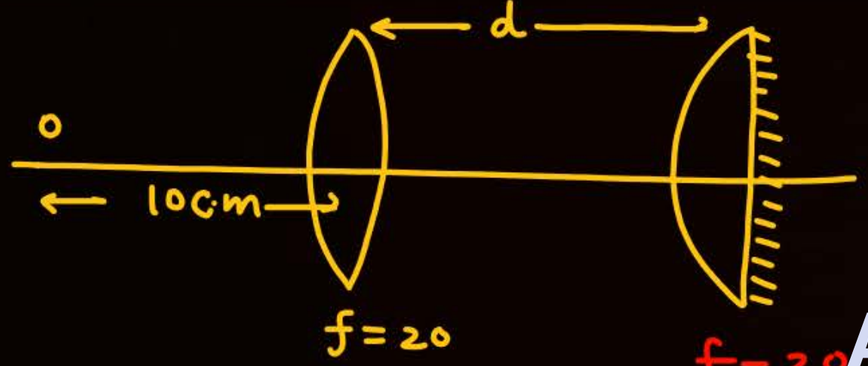


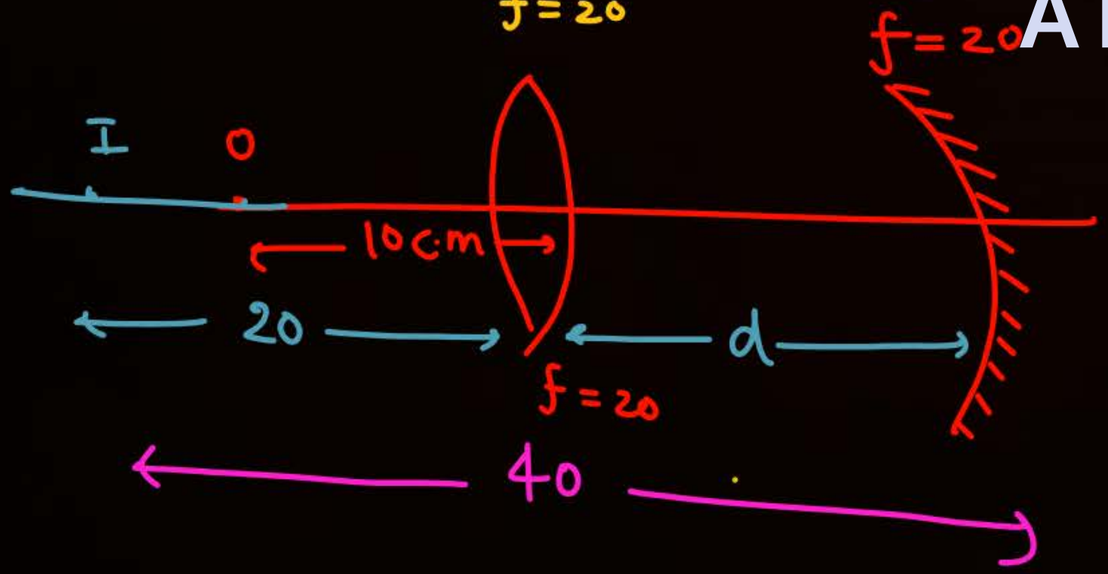
Ans. $y = -\frac{x}{1200} + 0.1$

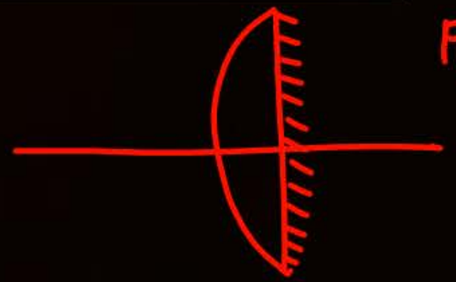
QUESTION

A convex lens of focal length 20 cm and another plano convex lens of focal length 40 cm are placed co-axially (see fig.). The plano convex lens is silvered on plane surface. What should be the (in m) so that final image of the object 'O' is formed on O itself.









$P_{net} = 2P_L + P_m$

$= 2\frac{1}{f_L} + \frac{1}{-f_m}$

$P_{net} = \frac{2}{40} + \frac{1}{\infty}$

$= \frac{1}{20} = \frac{-1}{f}$

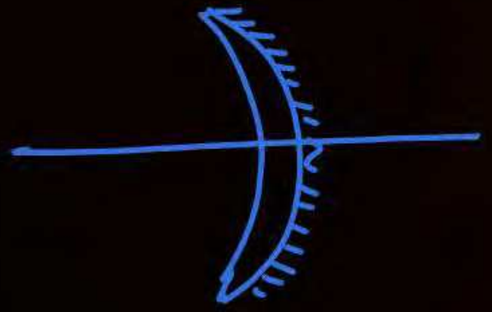
$f = -20$

Ans : 1

QUESTION

Radii of curvature of a concavo-convex lens (refractive index = 1.5) are 40 cm and 20 cm as shown. The convex side is silvered. The distance x (in cm) on the principal axis where an object is placed so that its image is created on the object itself, is given as 4β. Find the value of β.

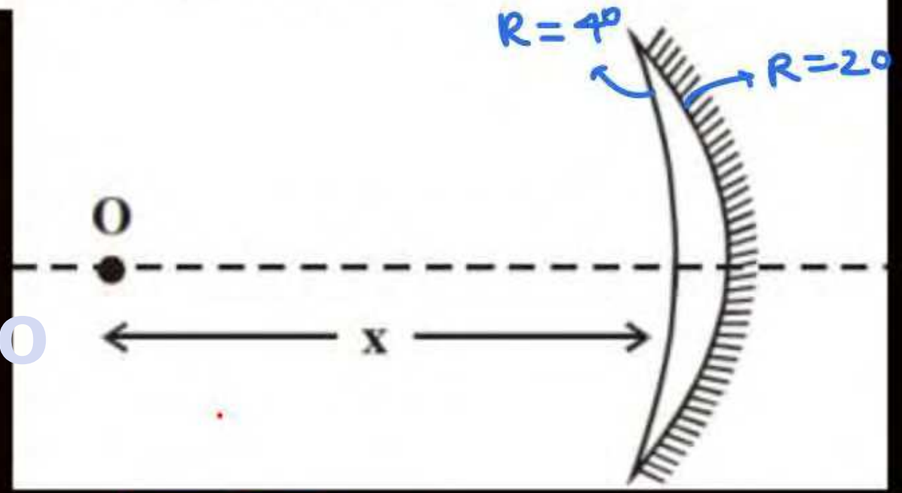
$x = 4\beta$ find β.



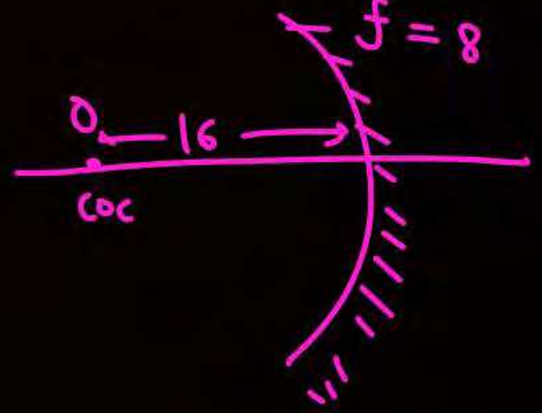
$\Rightarrow P_{net} = 2P_L + P_m$

$P_{net} = 2(1.5-1)\left(\frac{1}{-40} - \frac{1}{-20}\right) - \frac{1}{-20/2}$

$= \frac{1}{40} + \frac{2}{20} = \frac{5}{40} = -\frac{1}{f_{eq}}$



$f_{eq} = -8$



Ans : 4

QUESTION

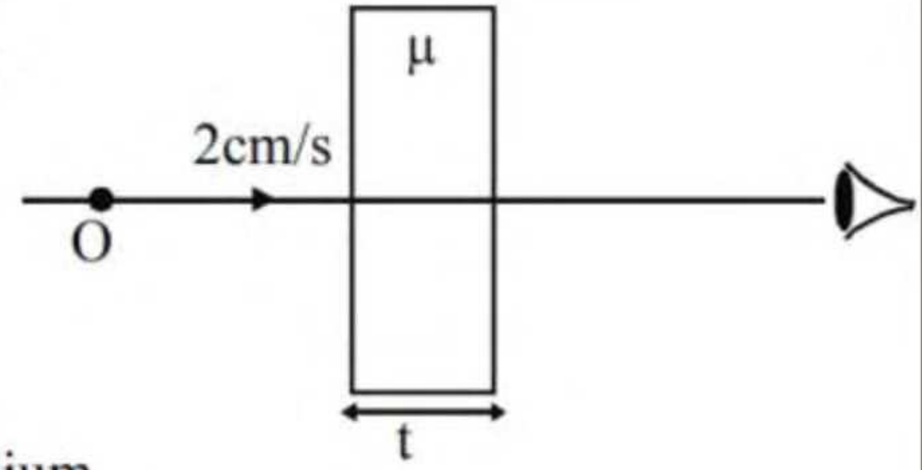
A glass slab of width 't', refractive index 'μ' is placed as shown in the figure. If the point object, moves with a speed 2 cm/s towards the slab the speed observered will be

(A) 2 cm/s

(B) less than 2 cm/s

(C) greater than 2 cm/s

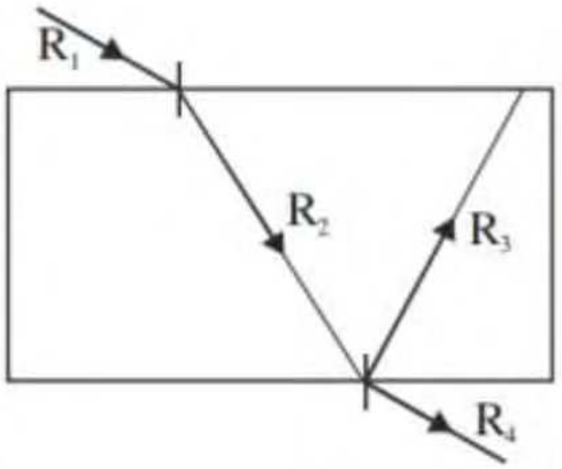
(D) dependent on the refractive index of surrounding medium



Ans : (A)

QUESTION

A ray R_1 is incident on the plane surface of the glass slab (kept in air) of refractive index $\sqrt{2}$ at an angle of incidence equal to the critical angle for this air glass system. The refracted ray R_2 undergoes partial reflection and refraction at the other surface. The angle between reflected ray R_3 and the refracted ray R_4 at that surface is :



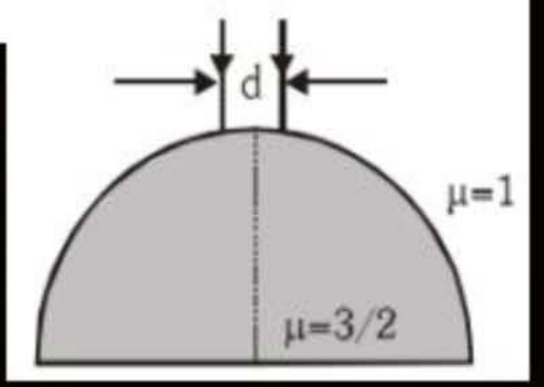
(A) 45°
(B) 135°
(C) 105°
(D) 75°

Ans : (C)

QUESTION

A beam of diameter 'd' is incident on a glass hemisphere as shown. If the radius of curvature of the hemisphere is very large in comparison to d, then the diameter of the beam at the base of the hemisphere will be :-

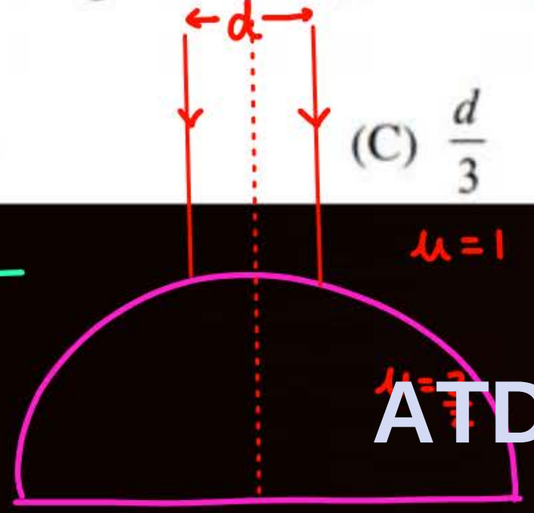
(A) $\frac{3}{4}$d (B) d (C) $\frac{d}{3}$ (D) $\frac{2}{3}d$

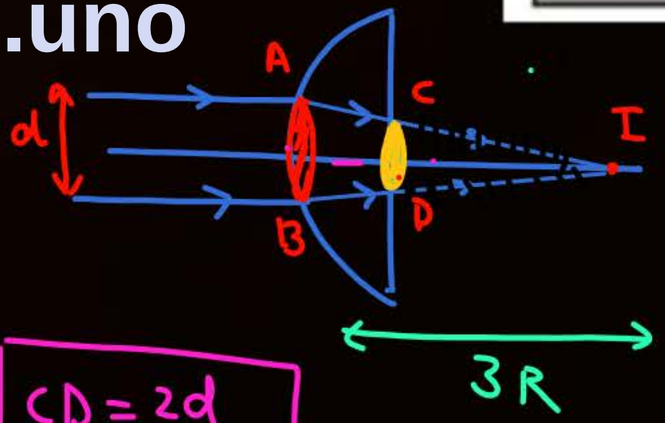


$\frac{3/2}{v} - \frac{1}{\infty} = \frac{3/2 - 1}{R}$

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

$V = 3R$





$\frac{AB}{CD} = \frac{3R}{2R}$

$\frac{d}{CD} = \frac{3}{2}$

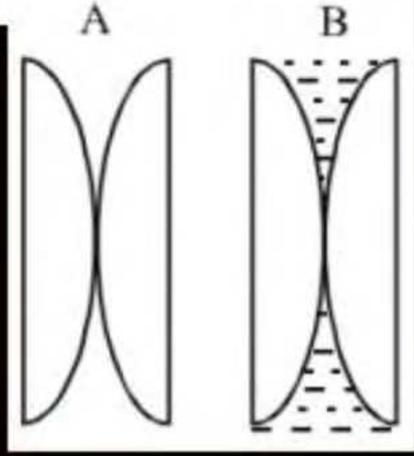
$CD = \frac{2d}{3}$

Ans : (D)

QUESTION

Figure A shows two identical plano-convex lenses in contact as shown. The combination has focal length 24 cm. Figure B shows the same with a liquid introduced between them. If refractive index of glass of the lenses is 1.50 and that of the liquid is 1.60, the focal length of the system in figure B will be :-

(A*) –120 cm (B) 120 cm (C) –24 cm (D) 24 cm



Ans : (A)

QUESTION

A beaker contains water up to a height h_1 and kerosene of height h_2 above watger so that the total height of (water + kerosene) is $(h_1 + h_2)$. Refractive index of water is μ_1 and that of kerosene is μ_2. The apparent shift in the position of the bottom of the beaker when viewed from above is :-

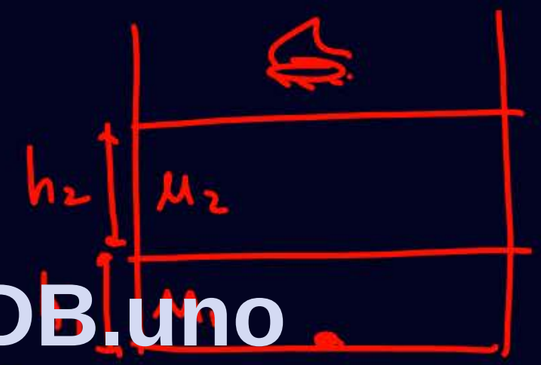
[AIEEE- 2011]

(1) $\left(1-\frac{1}{\mu_1}\right)h_2+\left(1-\frac{1}{\mu_2}\right)h_1$

(2) $\left(1+\frac{1}{\mu_1}\right)h_1-\left(1+\frac{1}{\mu_2}\right)h_2$

(3) $\left(1-\frac{1}{\mu_1}\right)h_1+\left(1-\frac{1}{\mu_2}\right)h_2$

(4) $\left(1+\frac{1}{\mu_1}\right)h_2-\left(1+\frac{1}{\mu_2}\right)h_1$



$h_{app} = 1\left(\frac{h_2}{\mu_2}+\frac{h_1}{\mu_1}\right)$

$h_{act} = h_1 + h_2$

$\text{Shift} = (h_1+h_2)-\left(\frac{h_2}{\mu_2}+\frac{h_1}{\mu_2}\right)$

$(\text{shift})_{net} = (\text{shift})_1 + (\text{shift})_2$

$= h_1\left(1-\frac{1}{\mu_1}\right)+h_2\left(1-\frac{1}{\mu_2}\right)$

Ans : (3)

QUESTION

Copy

Diameter of a plano-convex lens is 6cm and thickness at the centre is 3 mm. If speed of light in material of lens is 2×10^8 m/s, the focal length of the lens is : [JEE-Main- 2013]

(1) 15 cm (2) 20 cm (3) 30 cm (4) 10 cm

(कामचलाऊ)

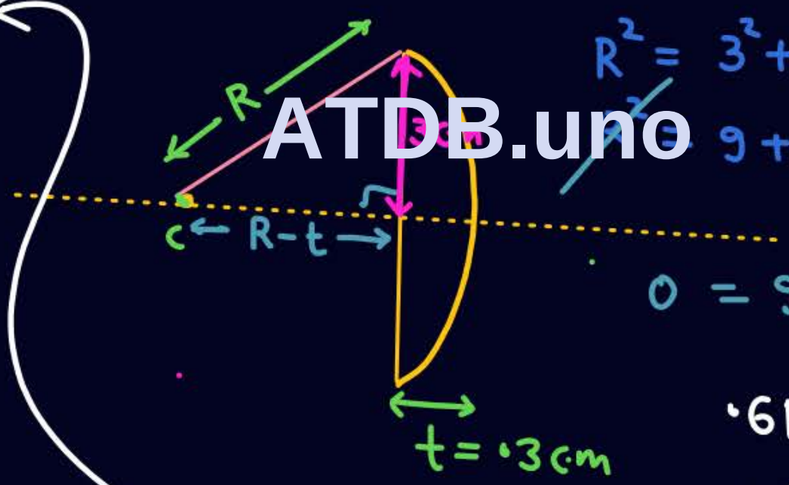
$\mu = \frac{3\times10^8}{2\times10^8} = \frac{3}{2}$

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

$\frac{1}{f} = \frac{1}{2}\left(\frac{1}{15}\right)$

$f = 30$

$\frac{1}{f} = \left(\frac{3}{2}-1\right)\left(\frac{1}{3}-\frac{1}{\infty}\right)$ $f = 6$



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

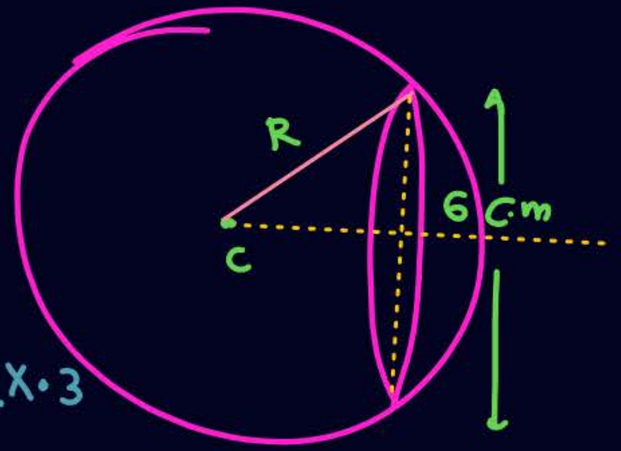
$= 9 + R^2 + t^2 - 2Rt$

$0 = 9 + (\cdot3)^2 - 2R\times\cdot3$

$\cdot6R = 9 + \cdot09$

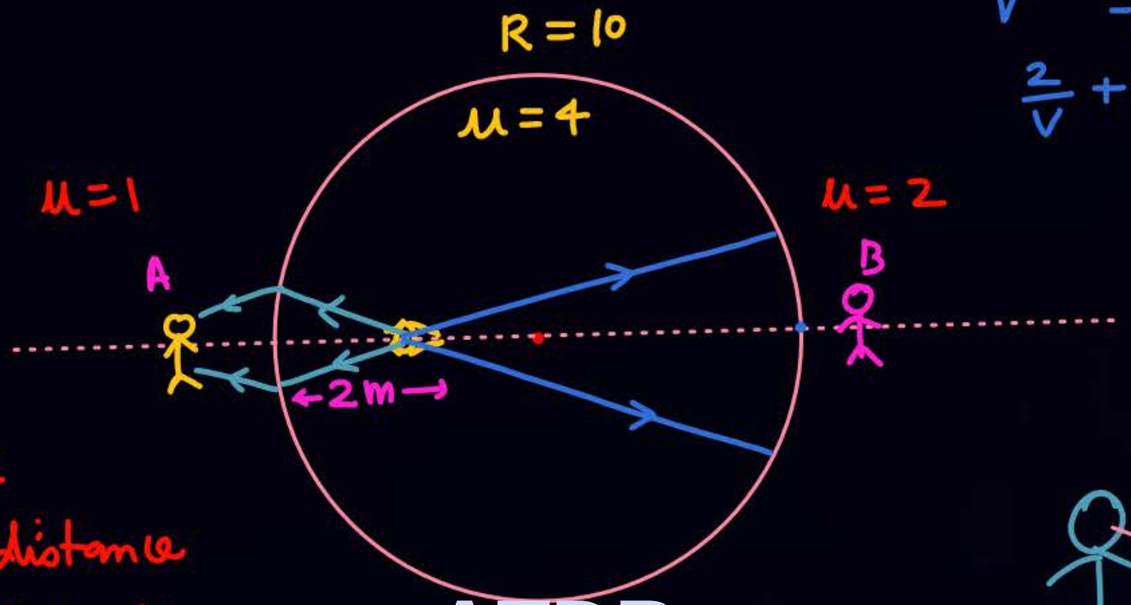
$\cdot6R = 9$

$R = 15$



Ans : (3)

Q



find the difference in the apparent distance of man A & B if they see fish.

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

$$\frac{1}{V} + 2 = \frac{3}{10}$$

$$\frac{1}{V} = \frac{3}{10} - 2 = \frac{-17}{10}$$

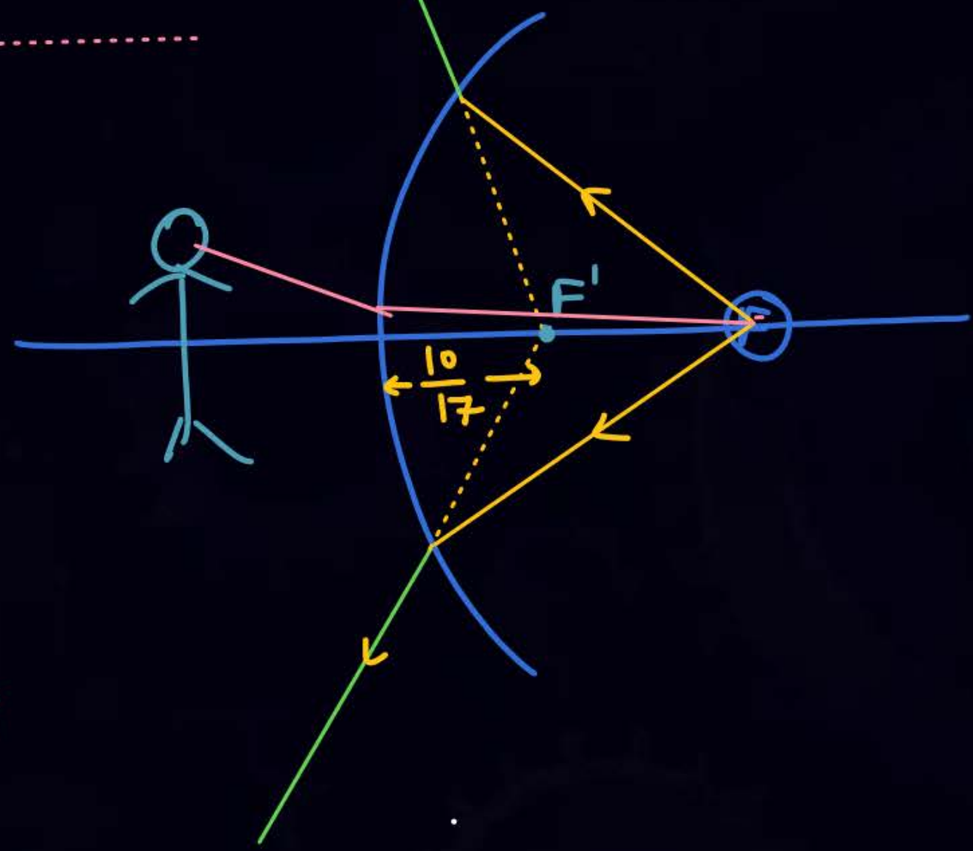
$$V = -\frac{10}{17}$$

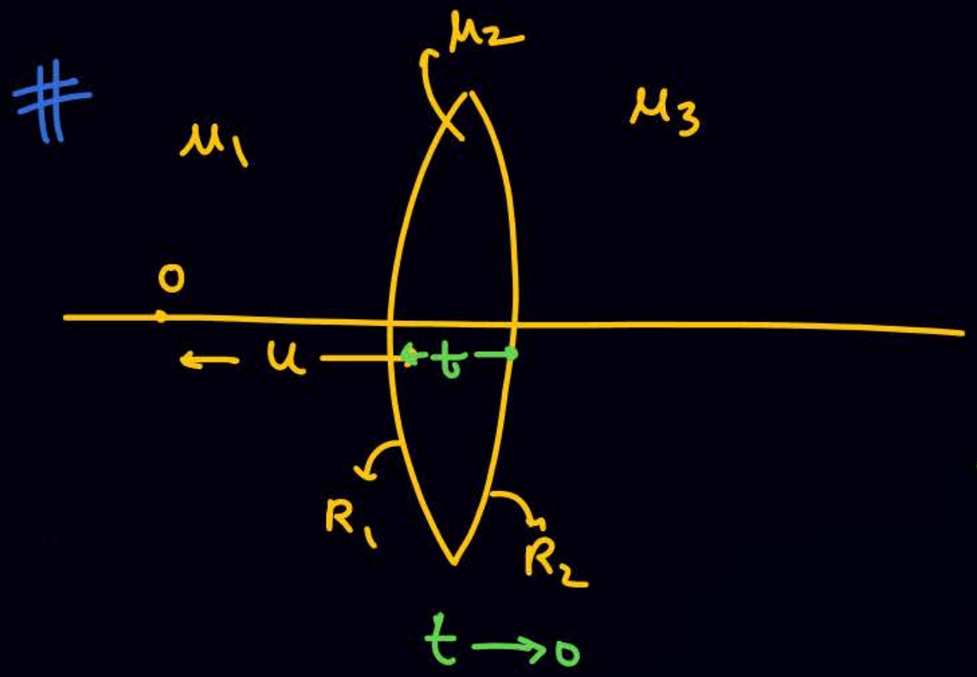
$$\frac{1}{V} - \frac{1}{-18} = \frac{1}{-10}$$

$$\frac{2}{V} + \frac{2}{9} = \frac{2}{10}$$

$$\frac{1}{V} = \frac{1}{10} - \frac{1}{9}$$

$$V = -90$$





$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R_1} \quad \text{——— (1)}$$

$$\frac{\mu_3}{v_f} - \frac{\mu_2}{v} = \frac{\mu_3 - \mu_2}{R_2} \quad \text{——— (2)}$$

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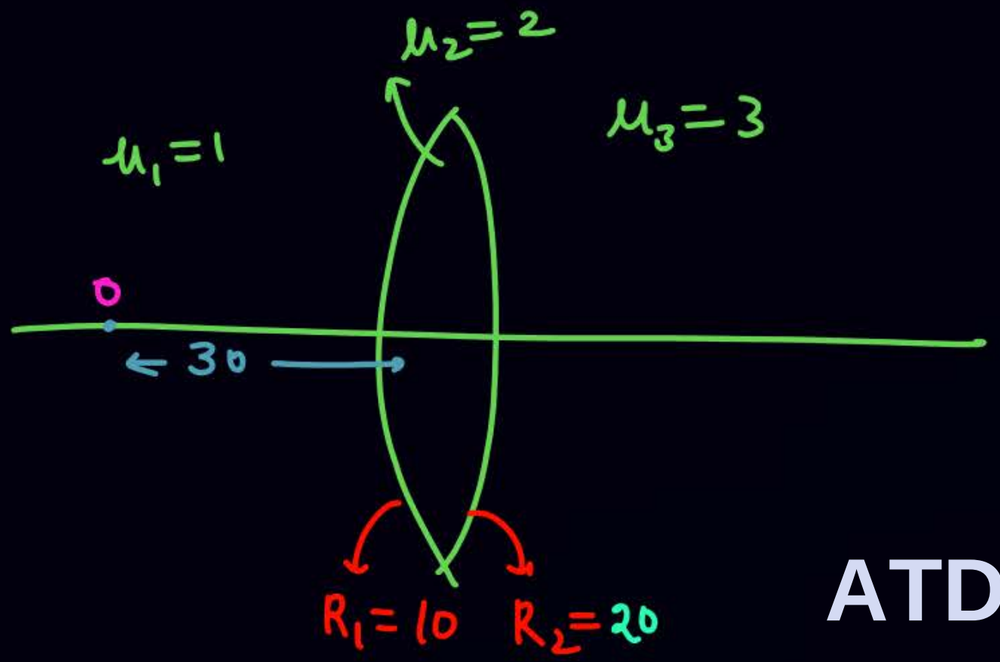
Q



$$\frac{2}{V} - \frac{1}{-30} = \frac{2-1}{+10}$$

$$\frac{2}{V} + \frac{1}{30} = \frac{1}{10}$$

$$\frac{2}{V} = \frac{1}{10} - \frac{1}{30} = \frac{3-1}{30} = \frac{1}{15}$$

$$V = +30$$

$$\frac{1}{15} - \frac{1}{20} = \frac{4-3}{60} = \frac{1}{\square}$$

For 2nd refraction

$u = +30$

$$\frac{3}{V_f} - \frac{2}{+30} = \frac{3-2}{-20}$$

$$\frac{3}{V_f} - \frac{1}{15} = -\frac{1}{20}$$

$$V_f = +180$$

Q