

# PRAYAS

## JEE 2025

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Lecture - 12

Physics

### Ray Optics

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# Topics *to be covered*

1

*Ques Practise*

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2

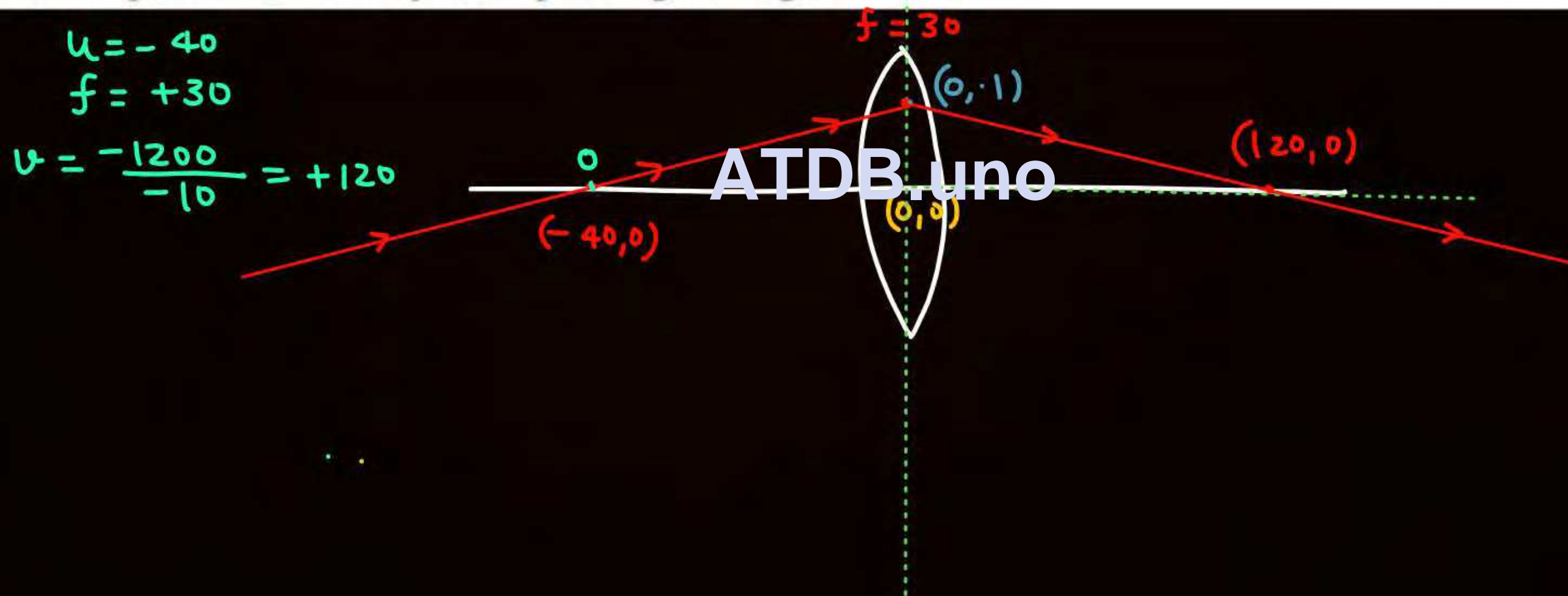
3

4

## 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.



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

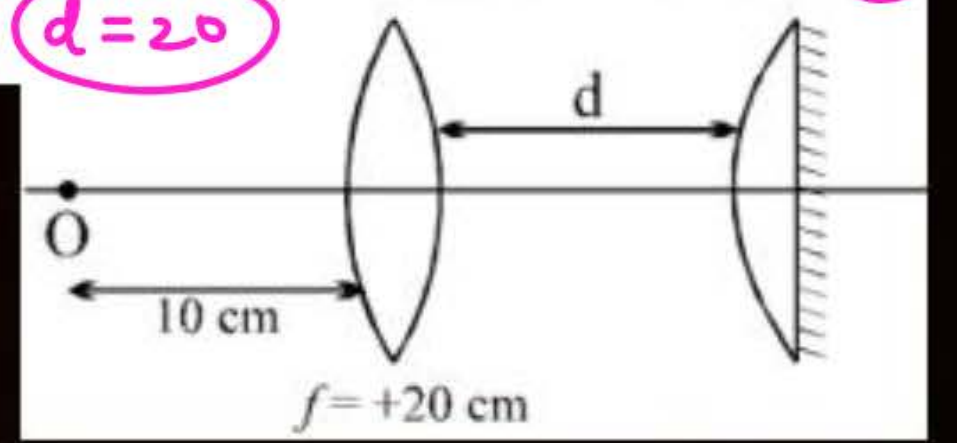
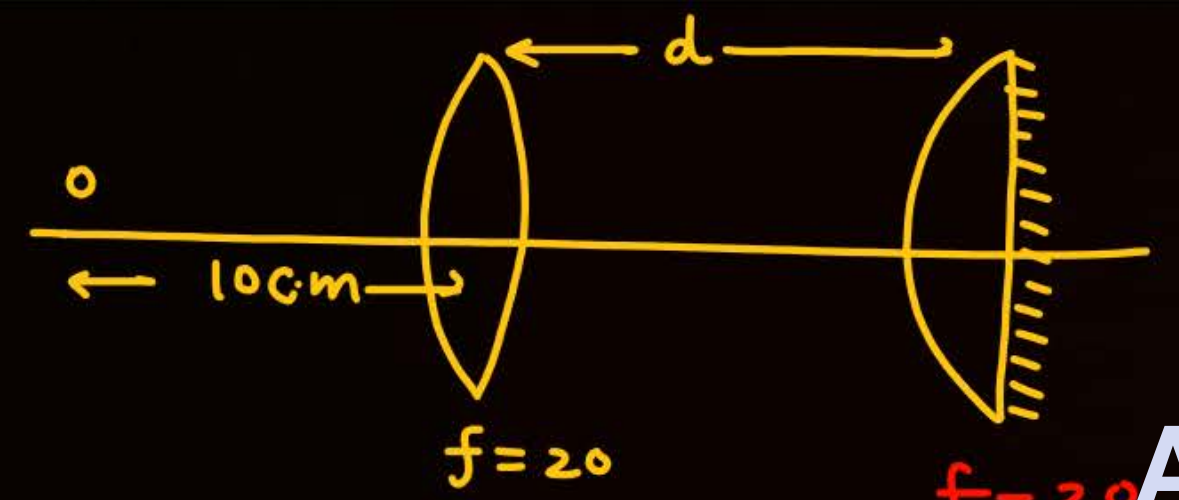
**QUESTION**

Lens  $\equiv v = -10 + 20$

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



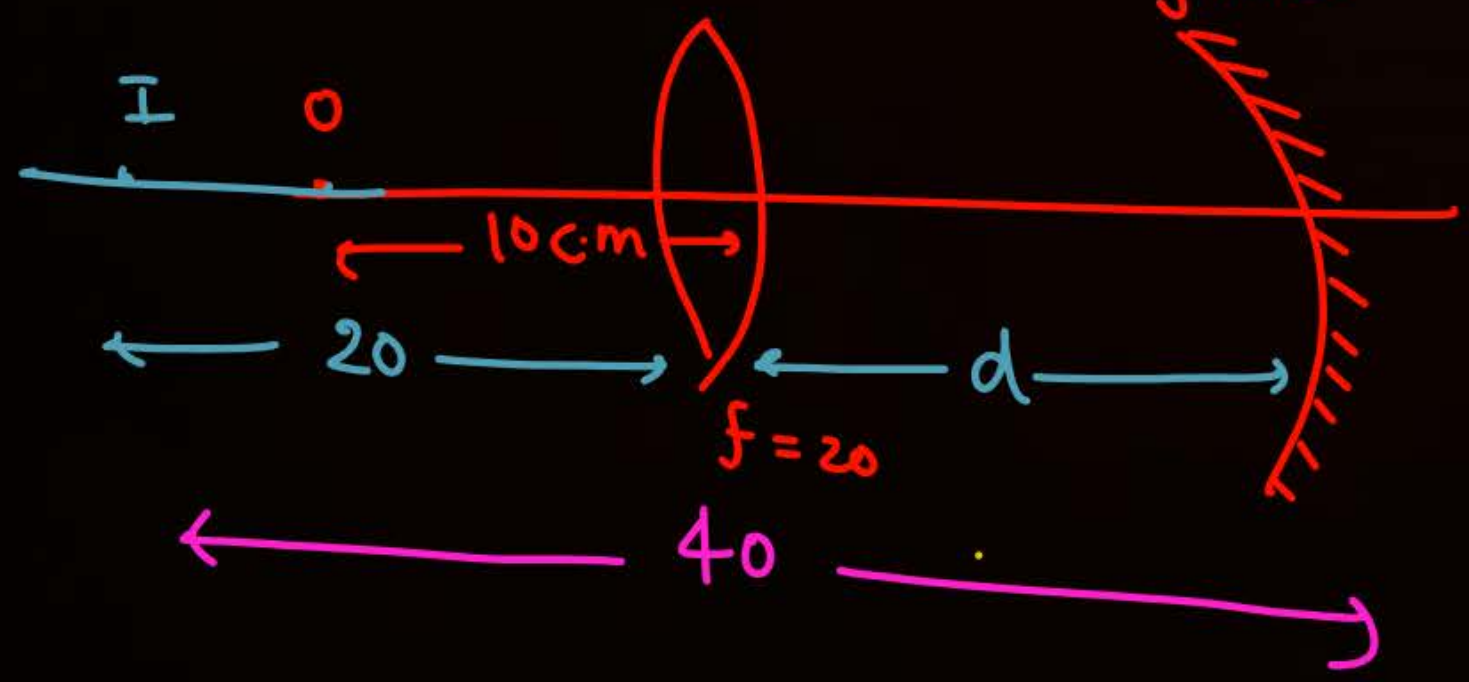
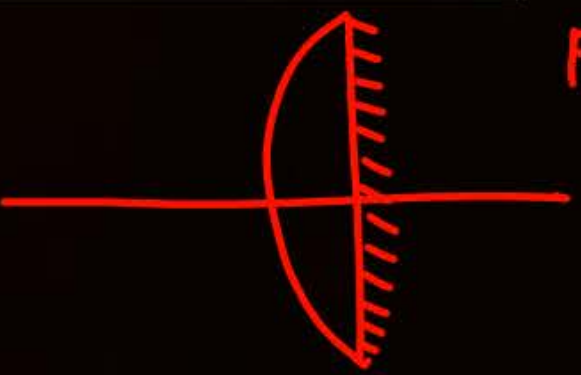
A convex lens of focal length 20 cm and another plano convex lens of focal length 40 cm are placed co-axially (see fig.). The plano convex lens is silvered on plane surface. What should be the 5d (in m) so that final image of the object 'O' is formed on O itself.  $d = 20$



$P_{net} = 2P_L + P_m$   
 $= 2 \frac{1}{f_L} + \frac{1}{-f_m}$

$P_{net} = \frac{2}{40} + \frac{1}{\infty}$   
 $= \frac{1}{20} = -\frac{1}{f}$

$f = -20$



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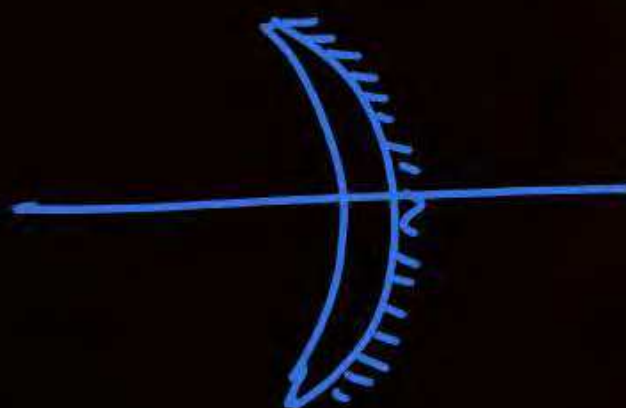
Ans : 1

## 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  $4\beta$ . Find the value of  $\beta$ .

$$x = 4\beta \quad \text{find } \beta.$$

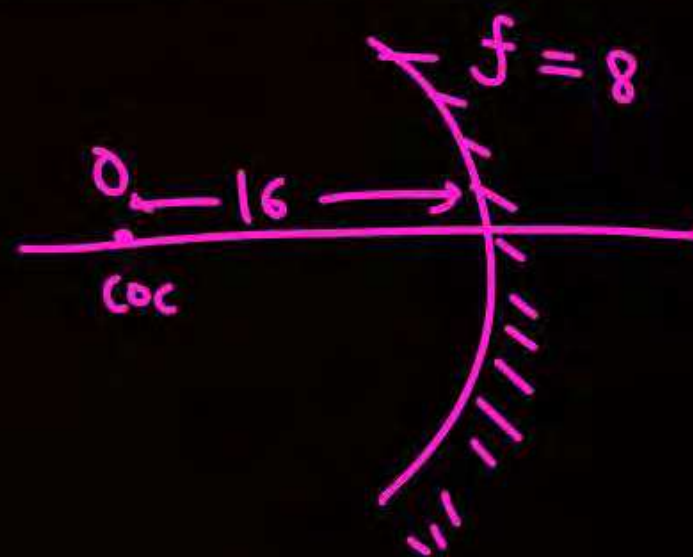
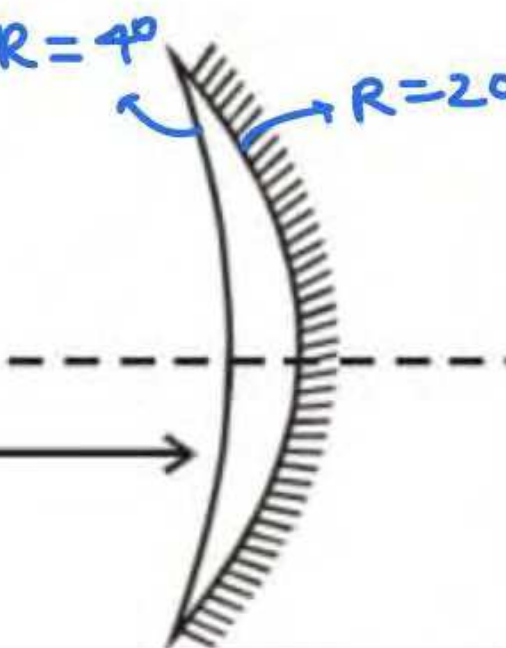


$$\Rightarrow P_{\text{net}} = 2P_L + P_m$$

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

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

$$f_{\text{eq}} = -8$$



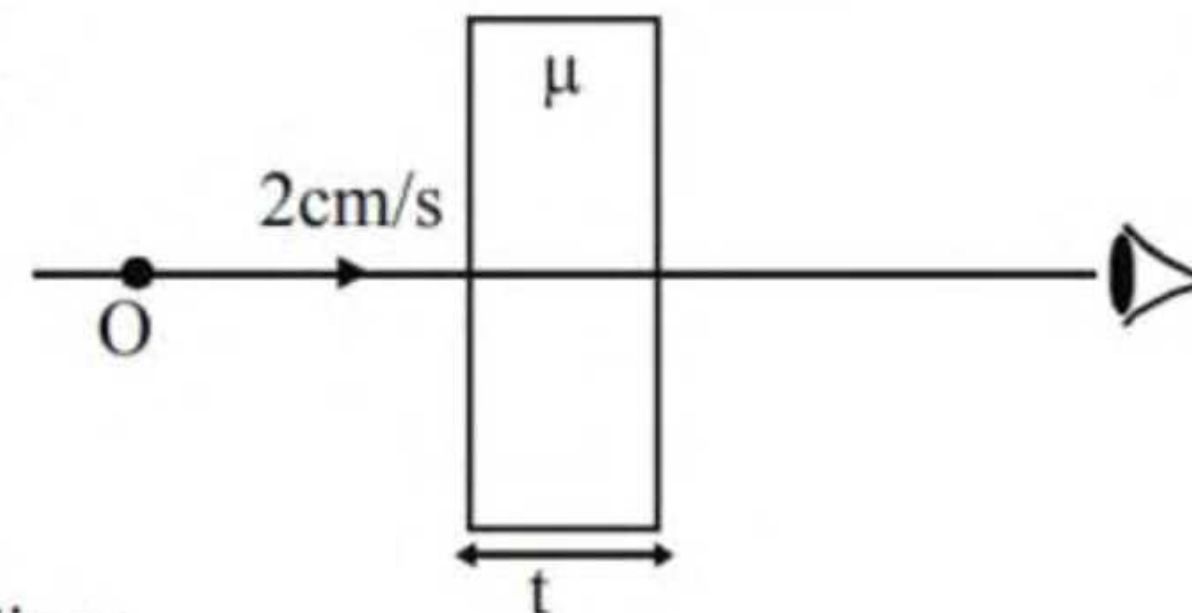
Ans : 4

## QUESTION



A glass slab of width ' $t$ ', refractive index ' $\mu$ ' is placed as shown in the figure. If the point object, moves with a speed  $2 \text{ cm/s}$  towards the slab the speed observed will be

- (A)  $2 \text{ cm/s}$
- (B) less than  $2 \text{ cm/s}$
- (C) greater than  $2 \text{ cm/s}$
- (D) dependent on the refractive index of surrounding medium



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Ans : (A)

## QUESTION



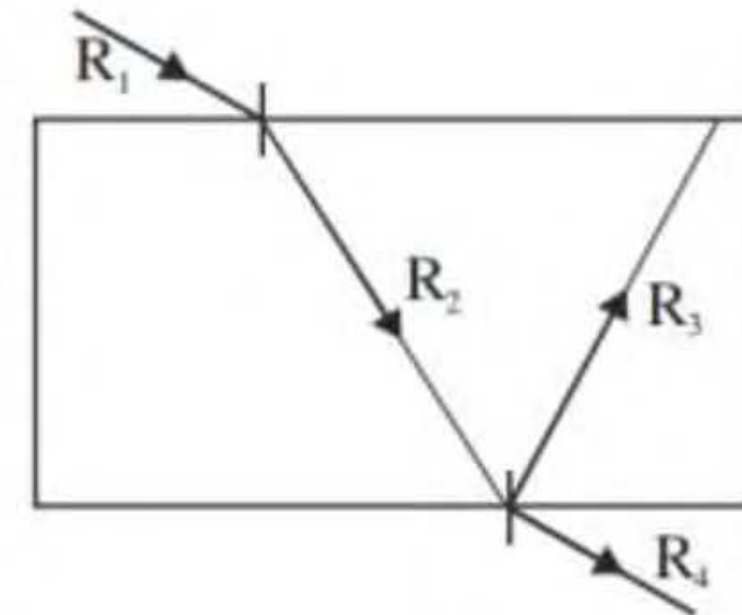
A ray  $R_1$  is incident on the plane surface of the glass slab (kept in air) of refractive index  $\sqrt{2}$  at an angle of incidence equal to the critical angle for this air glass system. The refracted ray  $R_2$  undergoes partial reflection and refraction at the other surface. The angle between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

(A)  $45^\circ$

(B)  $135^\circ$

(C)  $105^\circ$

(D)  $75^\circ$



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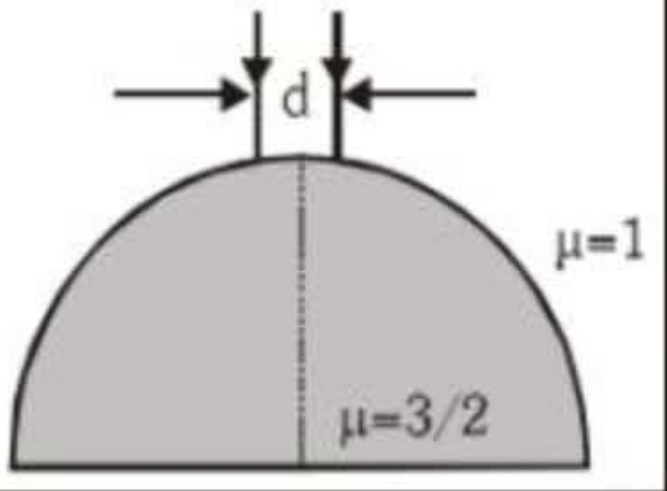
Ans: (C)

# 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 :-

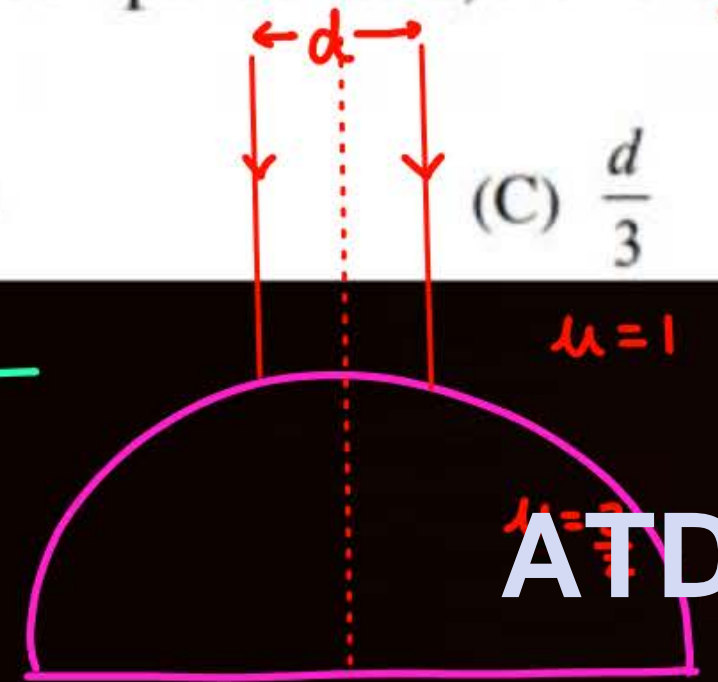
- (A)  $\frac{3}{4}d$
- (B) d
- (C)  $\frac{d}{3}$
- (D)  $\frac{2}{3}d$



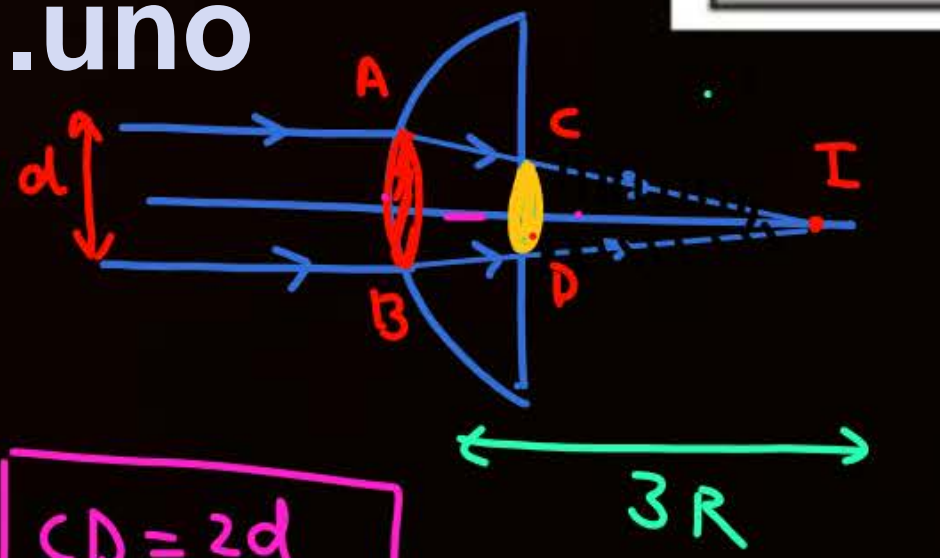
$$\frac{3/2}{v} - \frac{1}{\infty} = \frac{3/2 - 1}{R}$$

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

$$\boxed{v = 3R}$$



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

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

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

Ans: (D)

## QUESTION



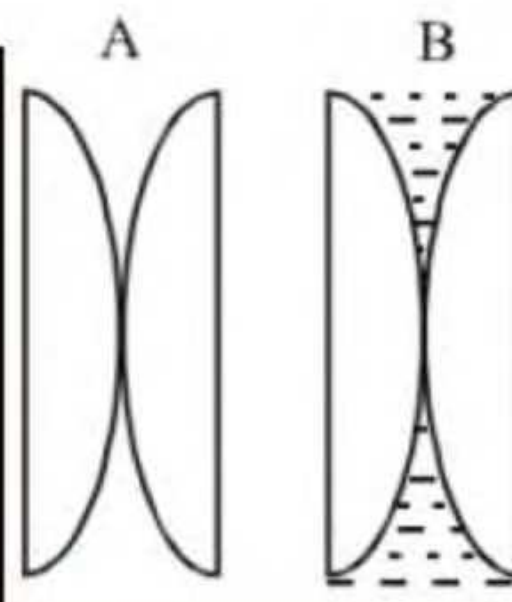
Figure A shows two identical plano-convex lenses in contact as shown. The combination has focal length 24 cm. Figure B shows the same with a liquid introduced between them. If refractive index of glass of the lenses is 1.50 and that of the liquid is 1.60, the focal length of the system in figure B will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

(A\*) -120 cm

(B) 120 cm

(C) -24 cm

(D) 24 cm



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Ans : (A)

## QUESTION



A beaker contains water up to a height  $h_1$  and kerosene of height  $h_2$  above water so that the total height of (water + kerosene) is  $(h_1 + h_2)$ . Refractive index of water is  $\mu_1$  and that of kerosene is  $\mu_2$ . The apparent shift in the position of the bottom of the beaker when viewed from above is :-

[AIEEE- 2011]

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

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

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

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



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

$$h_{act} = h_1 + h_2$$

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

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

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

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  $2 \times 10^8$  m/s, the focal length of the lens is : [JEE-Main-2013]

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

(chintita)

$$\mu = \frac{3 \times 10^8}{2 \times 10^8} = \frac{3}{2}$$

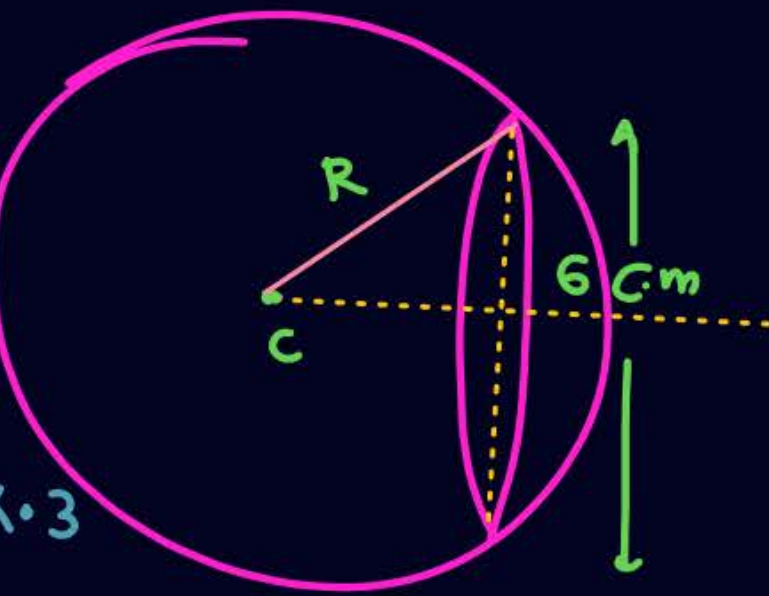
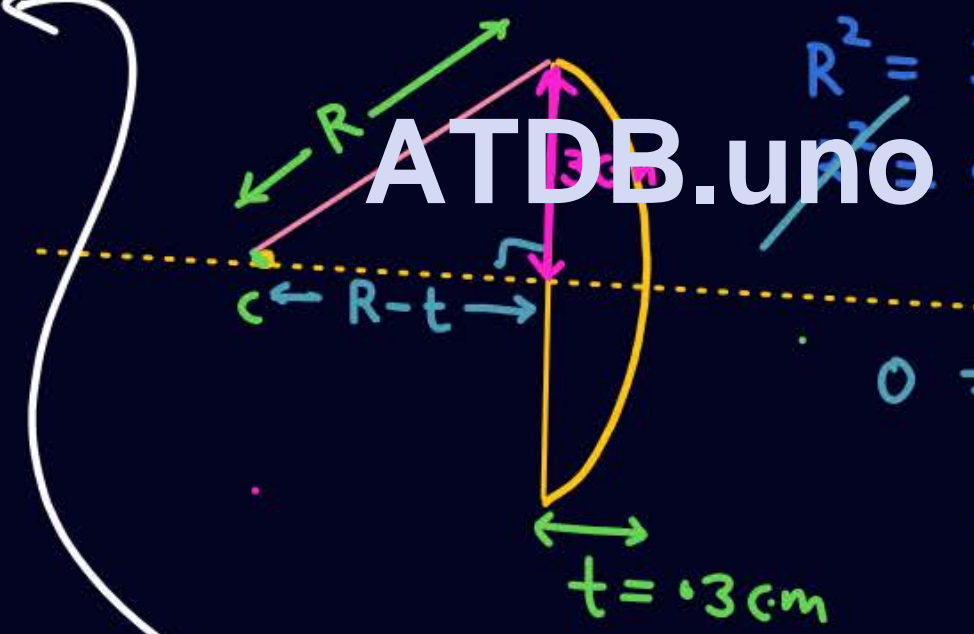
$$\frac{1}{f} = \left(\frac{3}{2} - 1\right) \left(\frac{1}{\infty} - \frac{1}{-R}\right)$$

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

$$f = 30$$

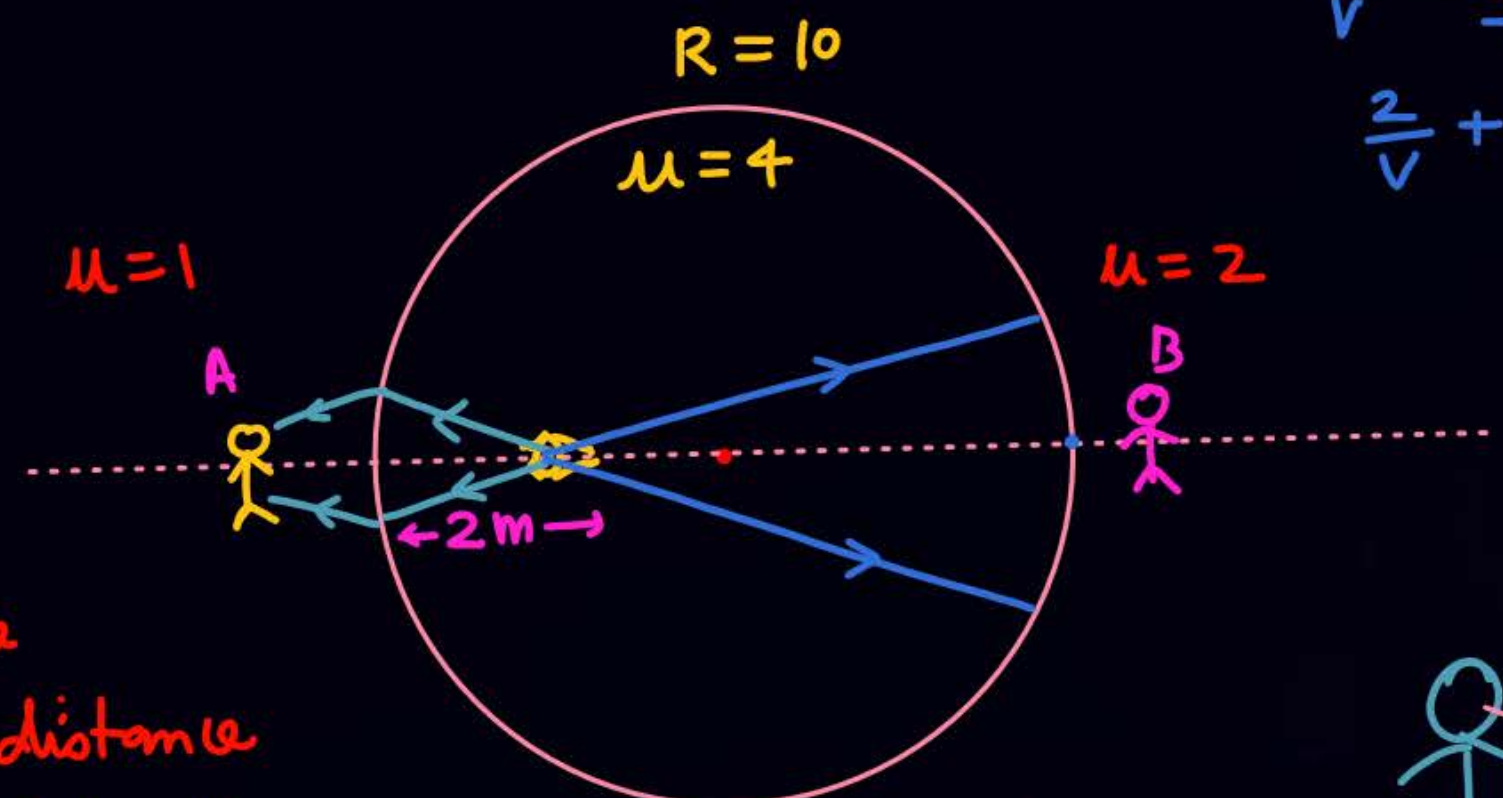
~~$$\frac{1}{f} = \left(\frac{3}{2} - 1\right) \left(\frac{1}{3} - \frac{1}{\infty}\right)$$

$$f = 6$$~~



Ans : (3)

Q



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

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$$\frac{1}{v} - \frac{1}{-2} = \frac{1-4}{-10}$$

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

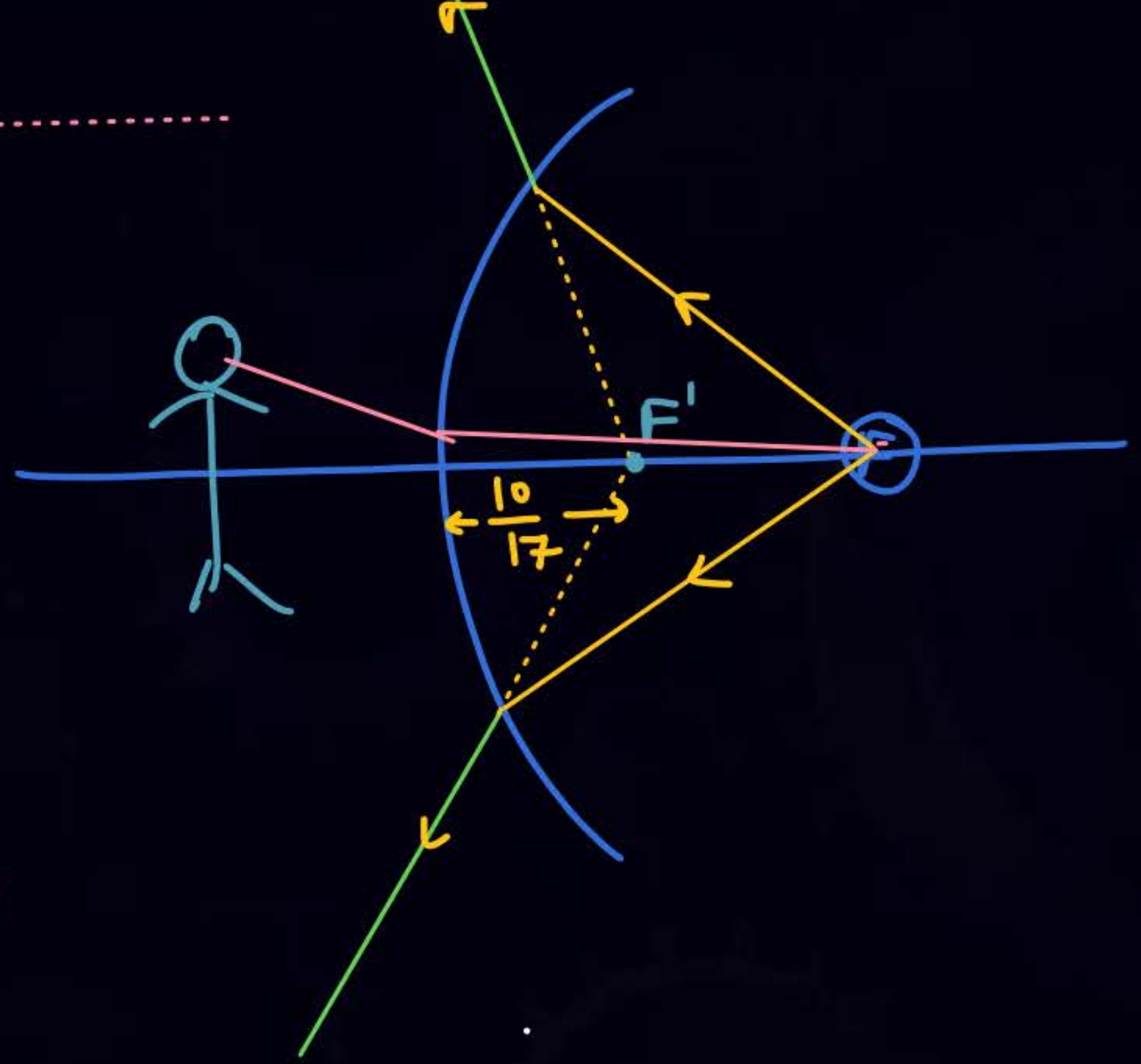
$$\frac{1}{v} = \frac{3}{10} - 2 = -\frac{17}{10}$$

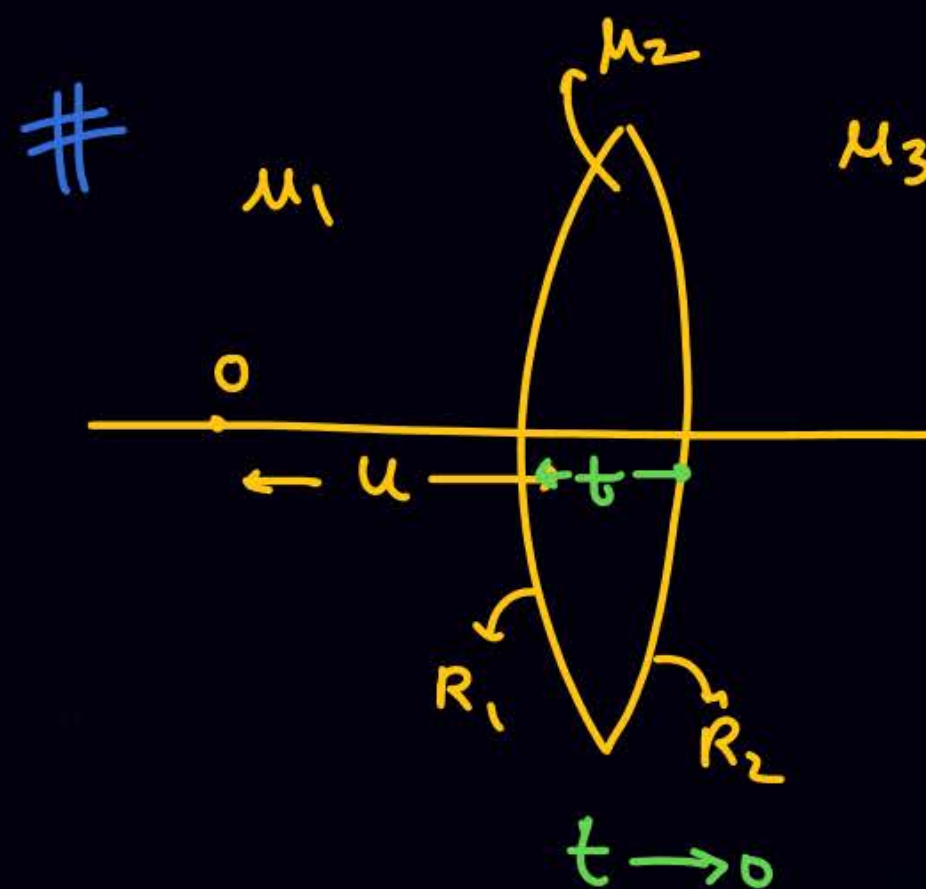
$$v = -\frac{10}{17}$$

$$\frac{2}{v} - \frac{2}{-18} = \frac{2-4}{-10}$$

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

$$v = -90$$

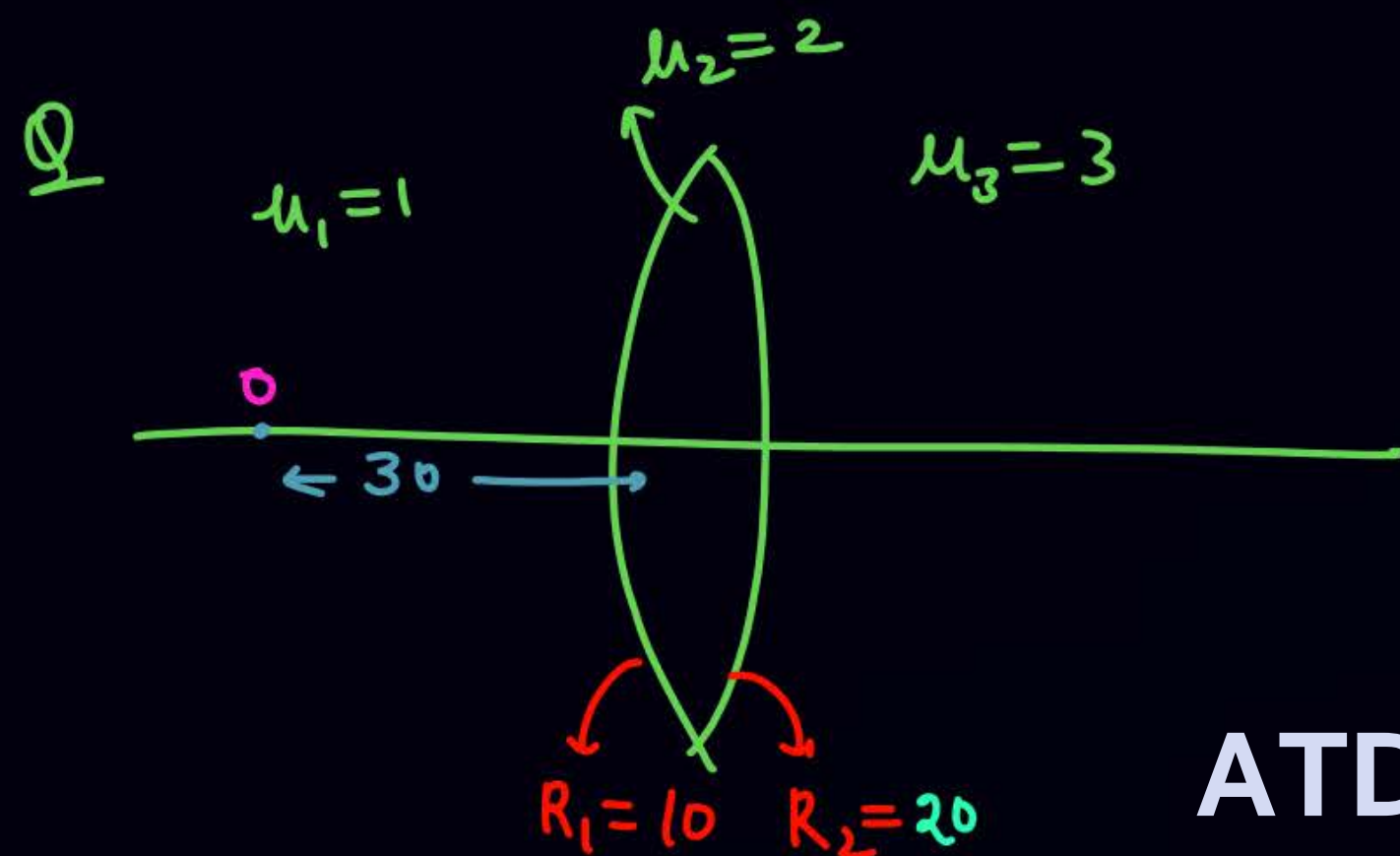




$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R_1} \quad \text{--- (1)}$$

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

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

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

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

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

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$$v = +30$$

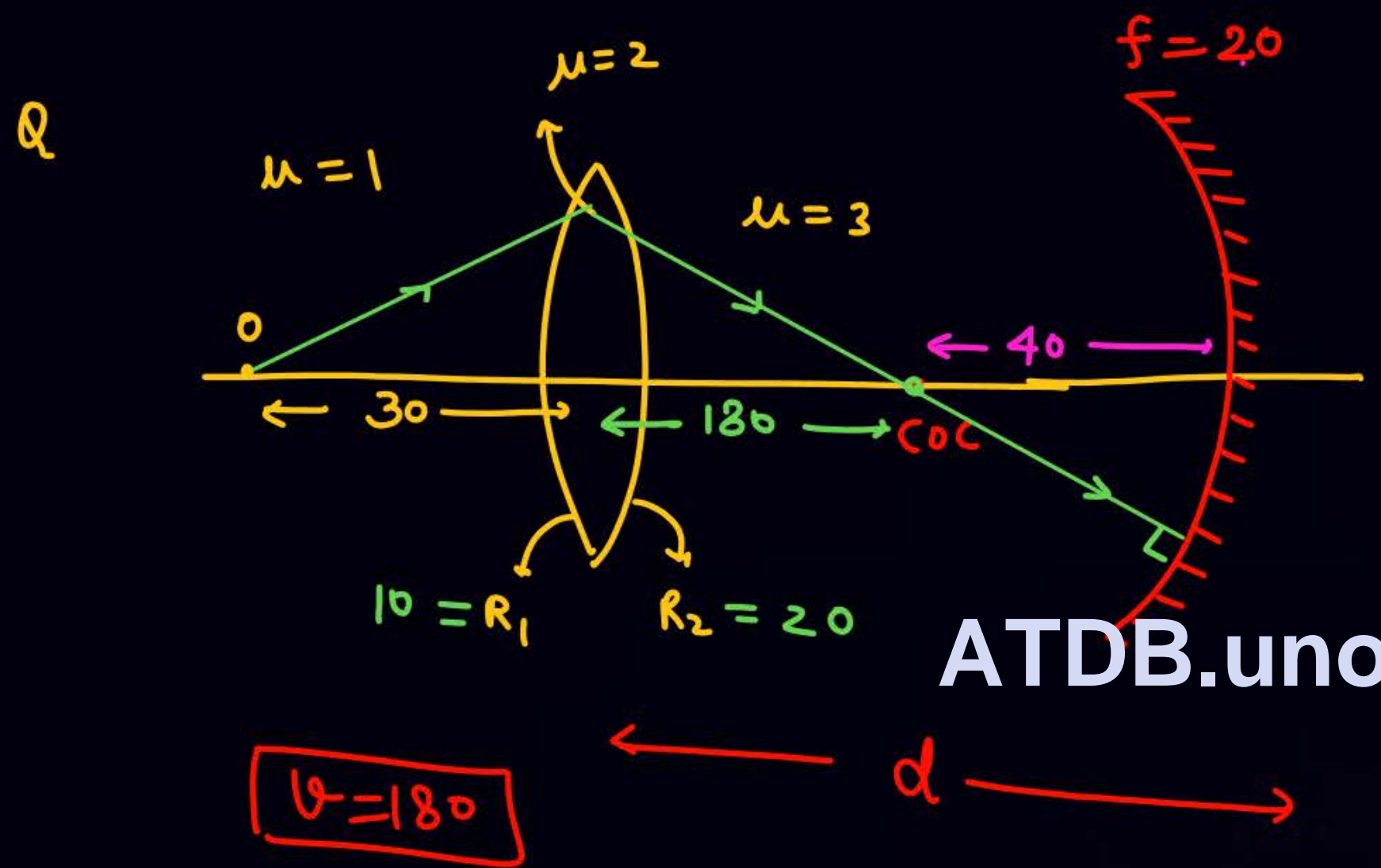
For 2<sup>nd</sup> refraction

$$u = +30$$

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

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

$$v_f = +180$$



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# THANK YOU

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