



PRAYAS

JEE 2025

ATDB.uno

Lecture- 03

Physics

Ray optics



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Topics *to be covered*

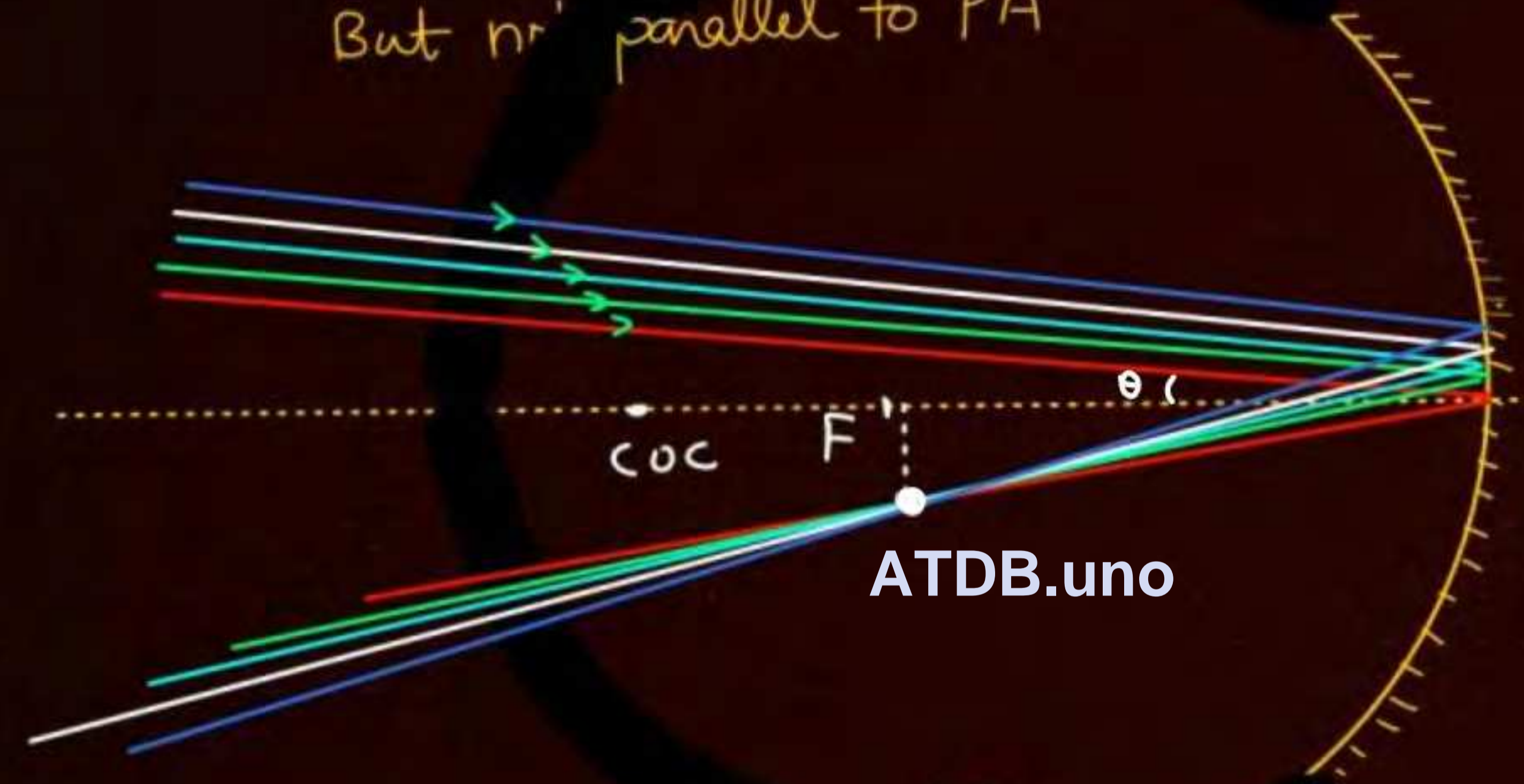
1 Mirror Formula

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Home # 4



paraxial ($i \rightarrow 0$)
& parallel to each other
But $n r'$ parallel to PA



$$\tan \theta = \frac{h}{R/2} \approx \theta$$

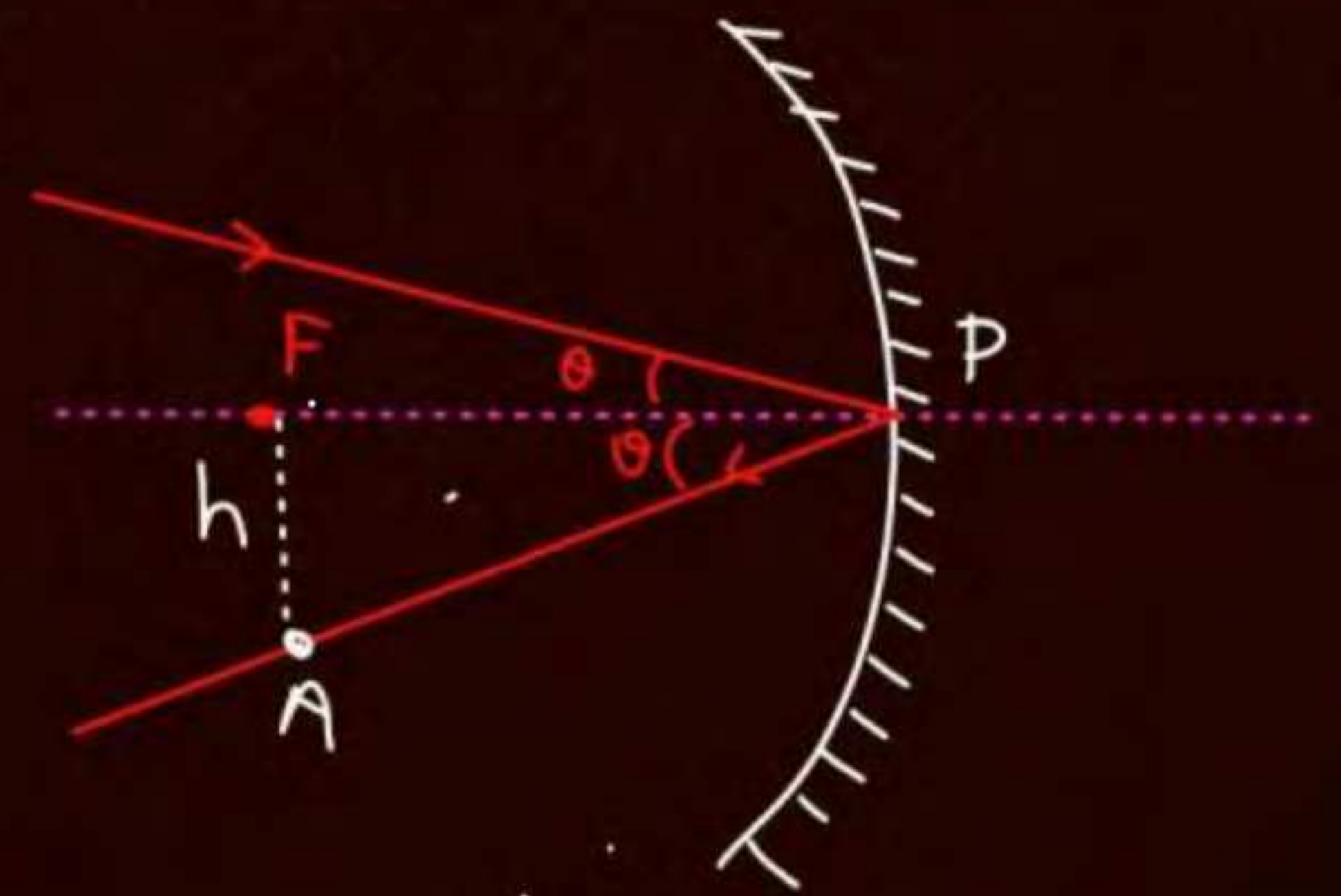
$$h = \frac{R\theta}{2}$$

$$\tan \theta = \frac{AF}{FP}$$

(paraxial rays)

$$\theta = \frac{h}{R/2}$$

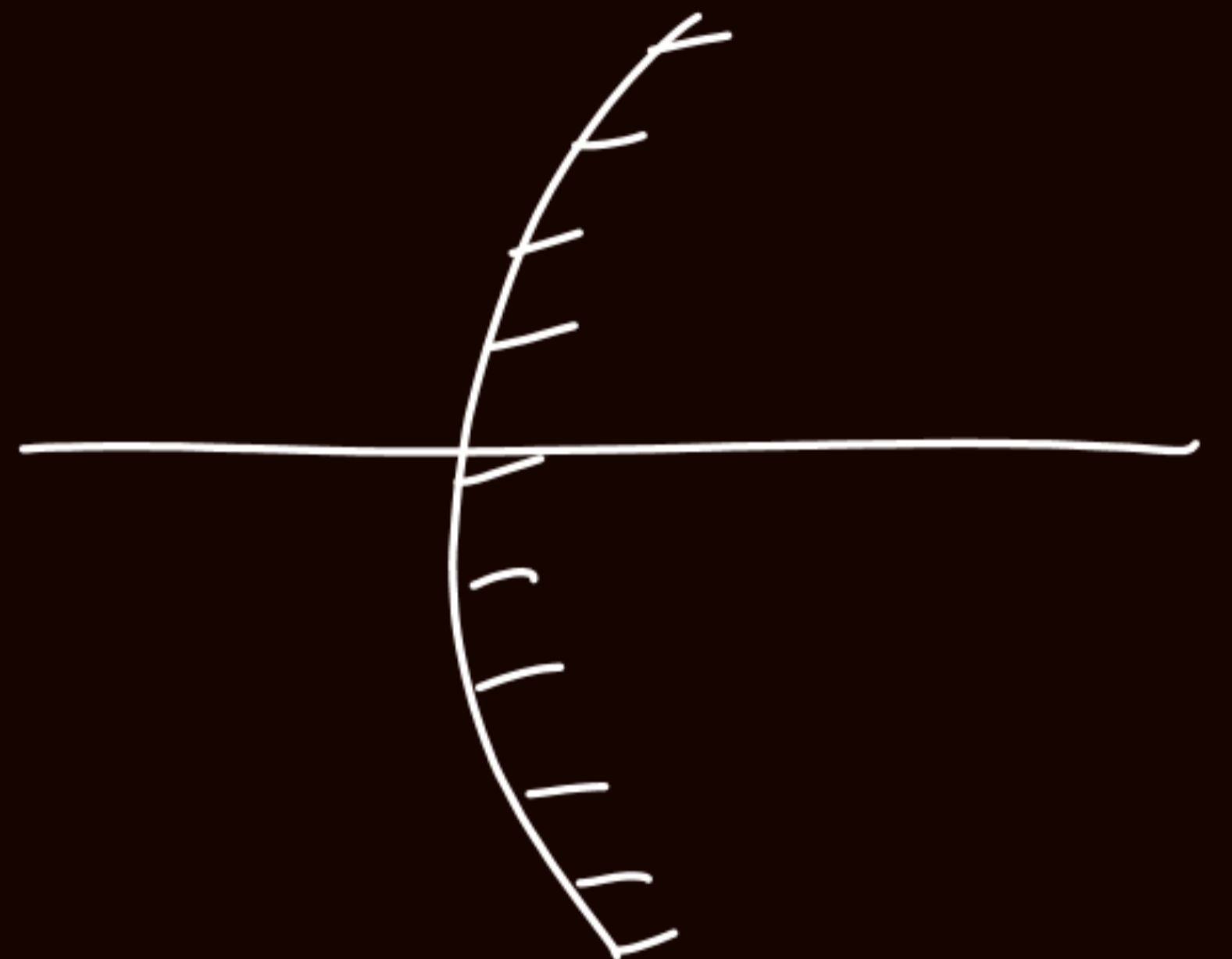
$$h \approx \theta \cdot R/2$$



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

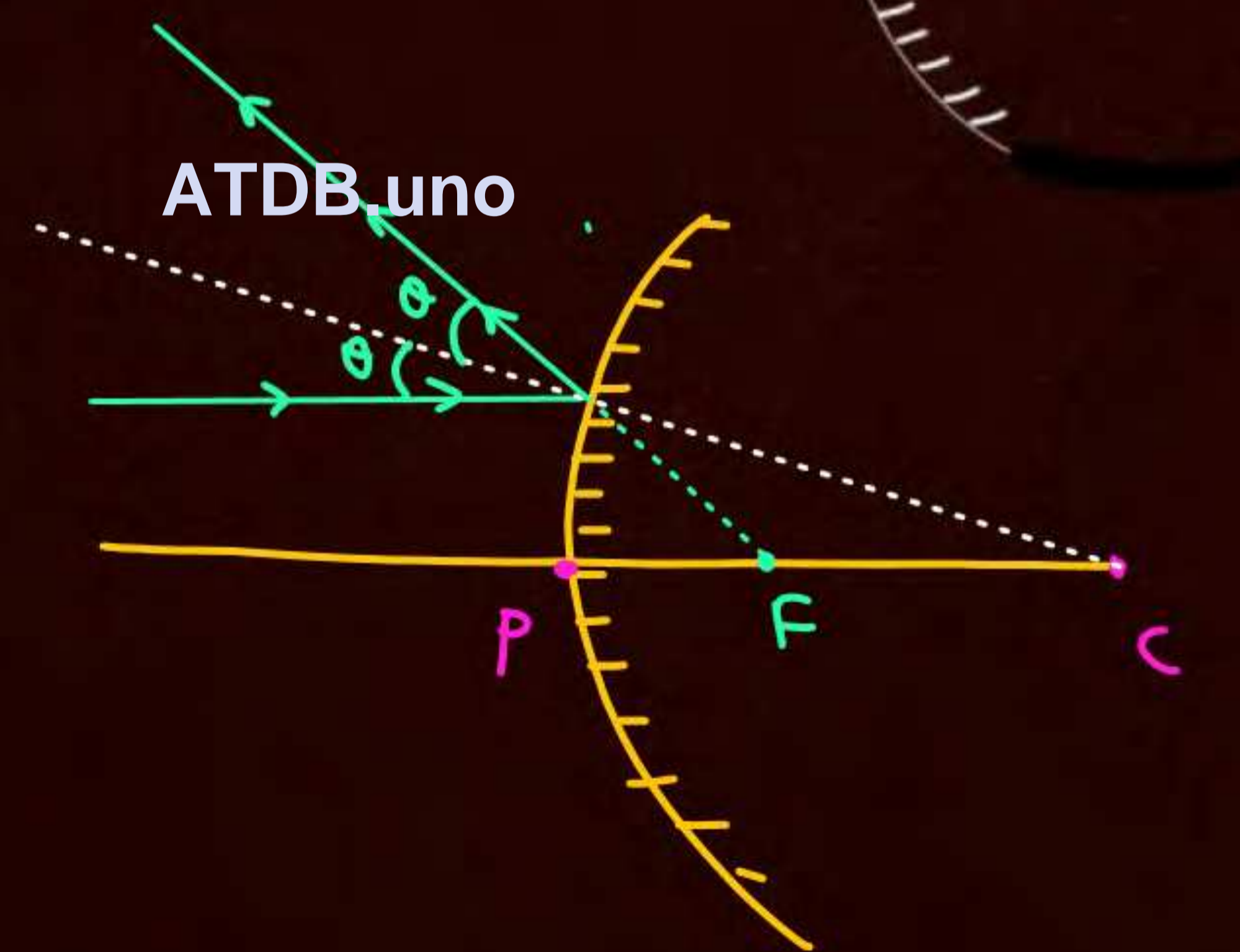
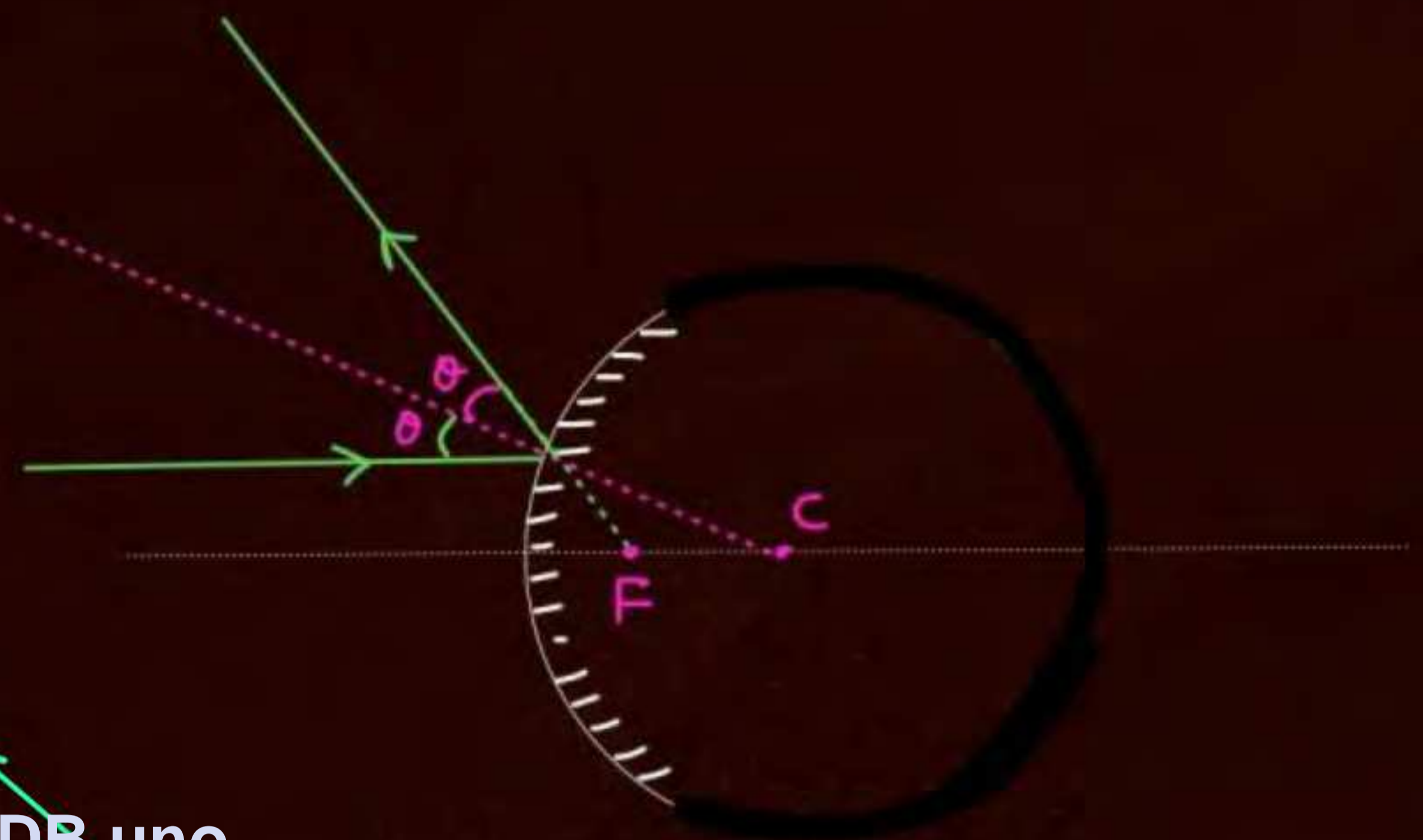
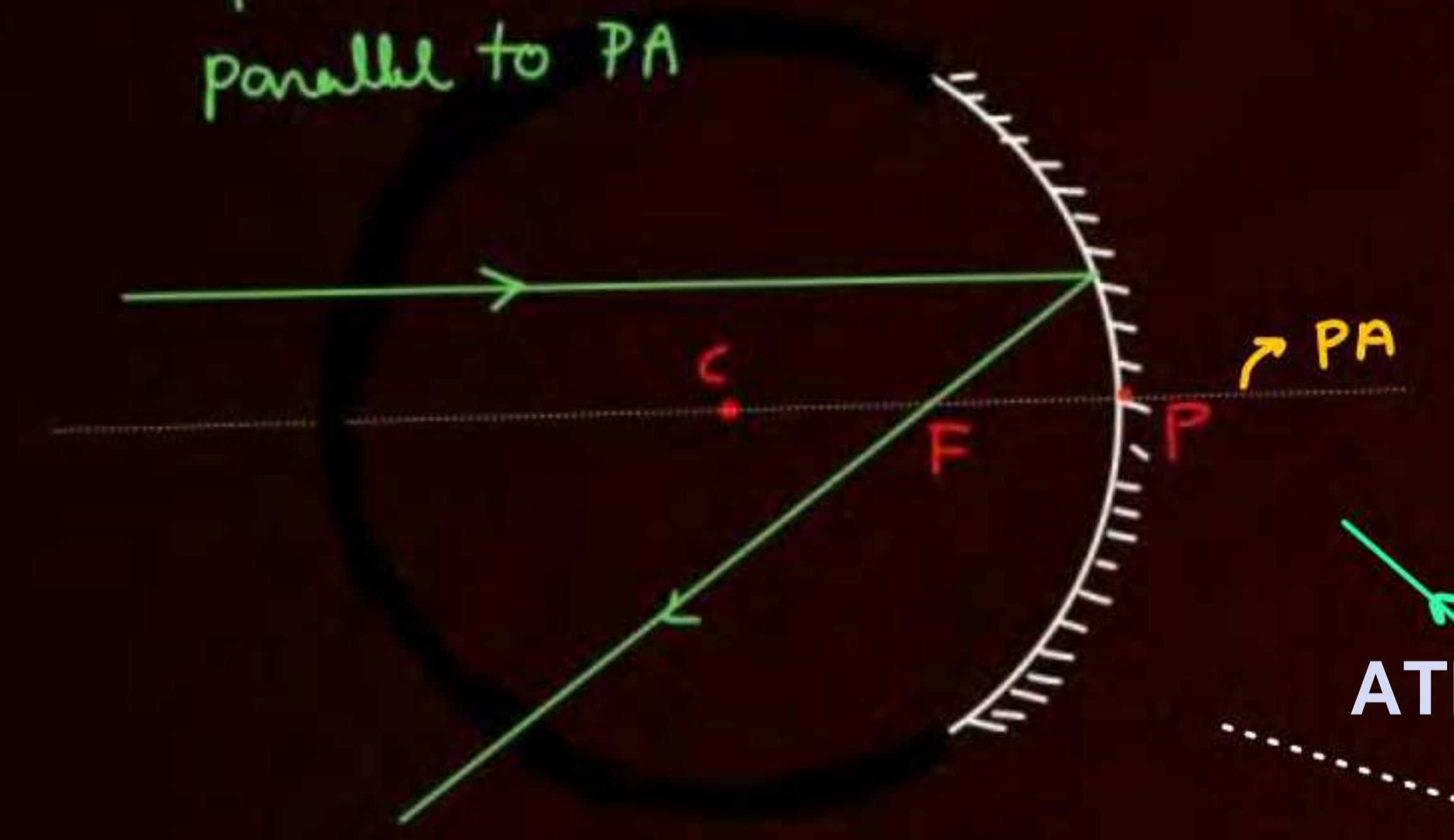


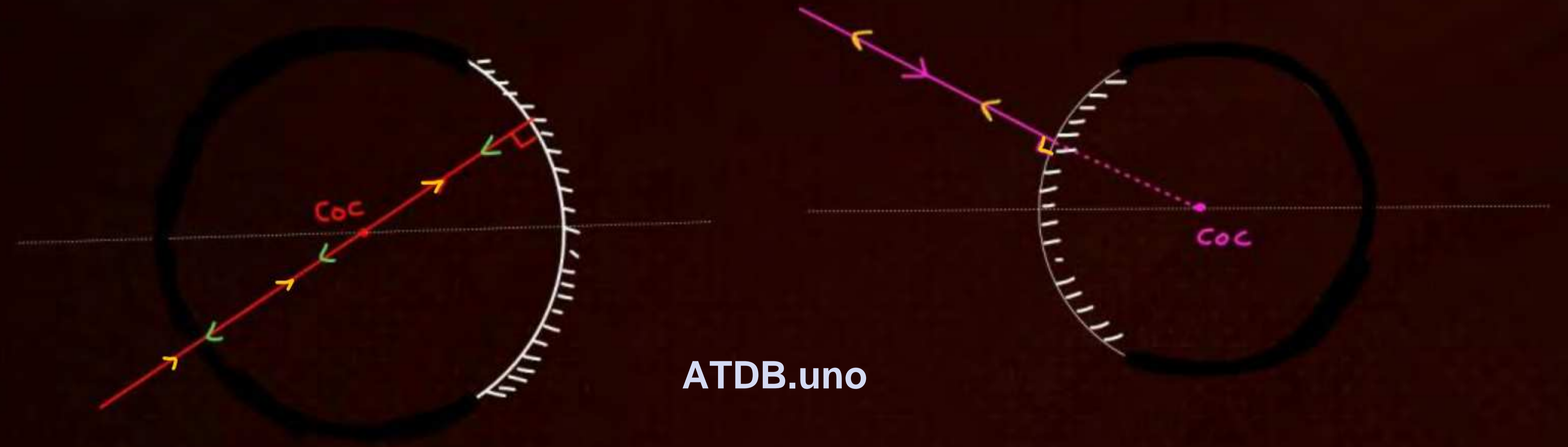
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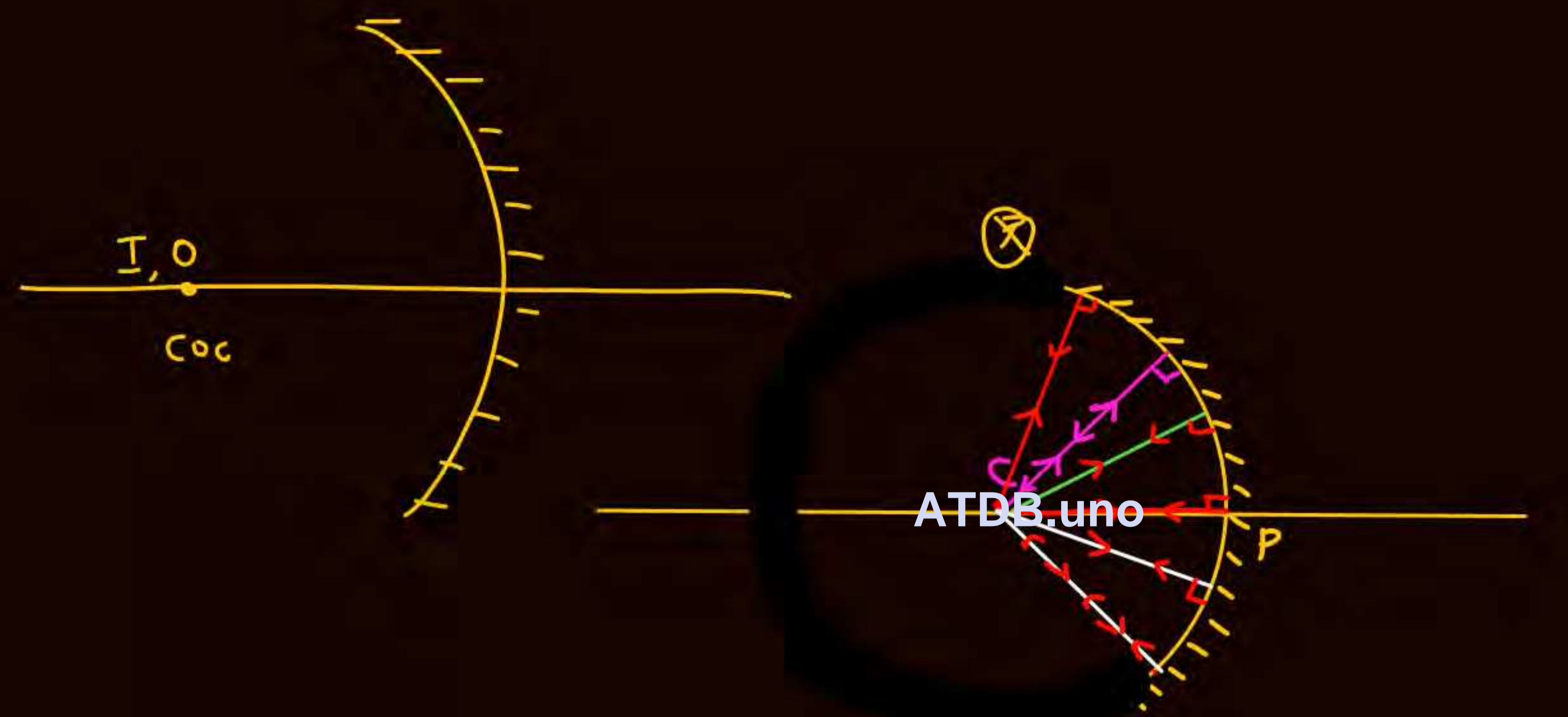


paraxial
parallel to PA





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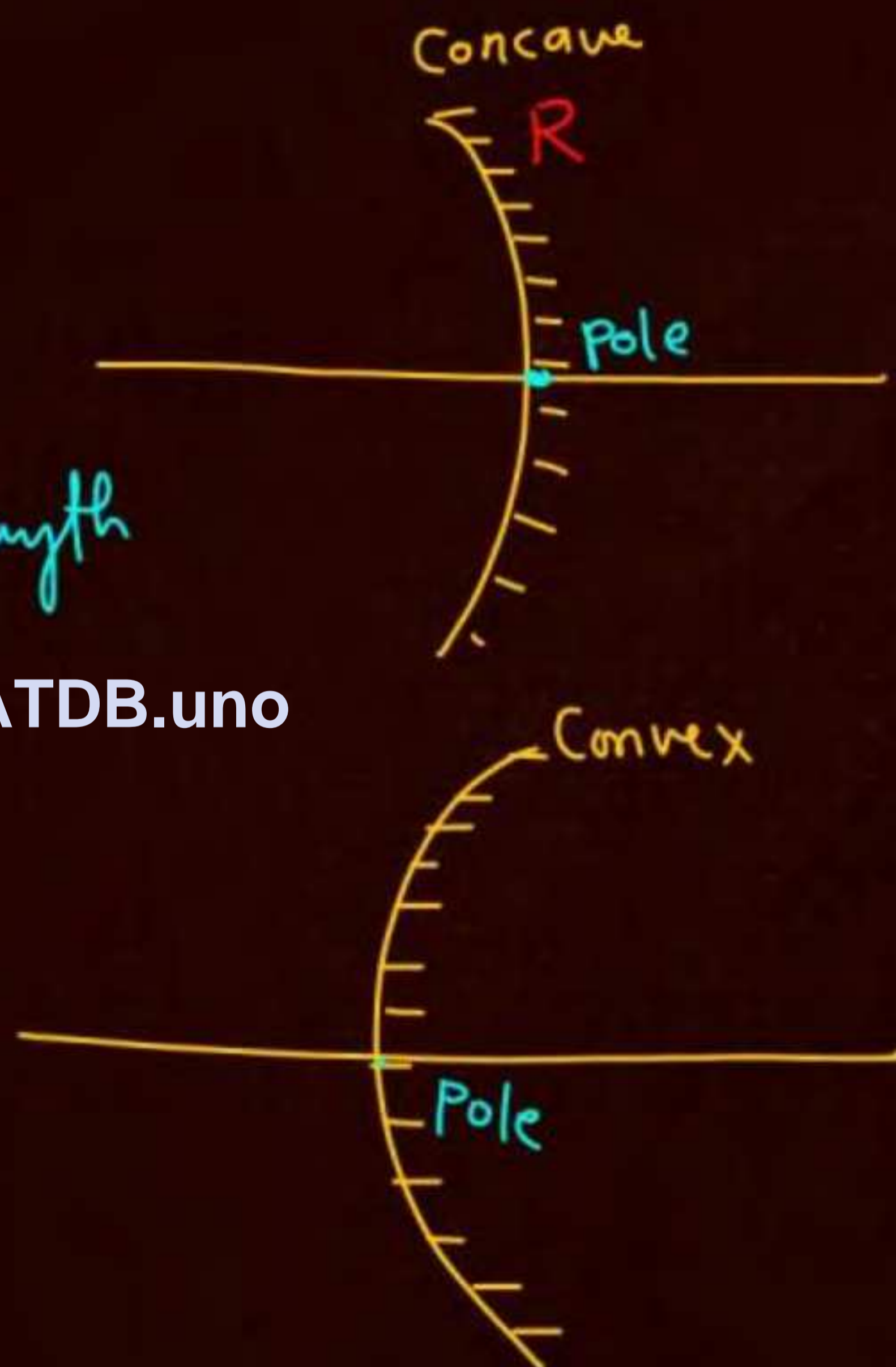




Mirror formula

- Valid for paraxial rays only
- $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ \rightarrow focal length
- $u, v, f \equiv$ with sign

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mirror formula

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

$$* \quad \text{magnification} = m = \frac{h_I}{h_o} = -\frac{v}{u}$$

$u \rightarrow$ distance of obj from pole along P.A

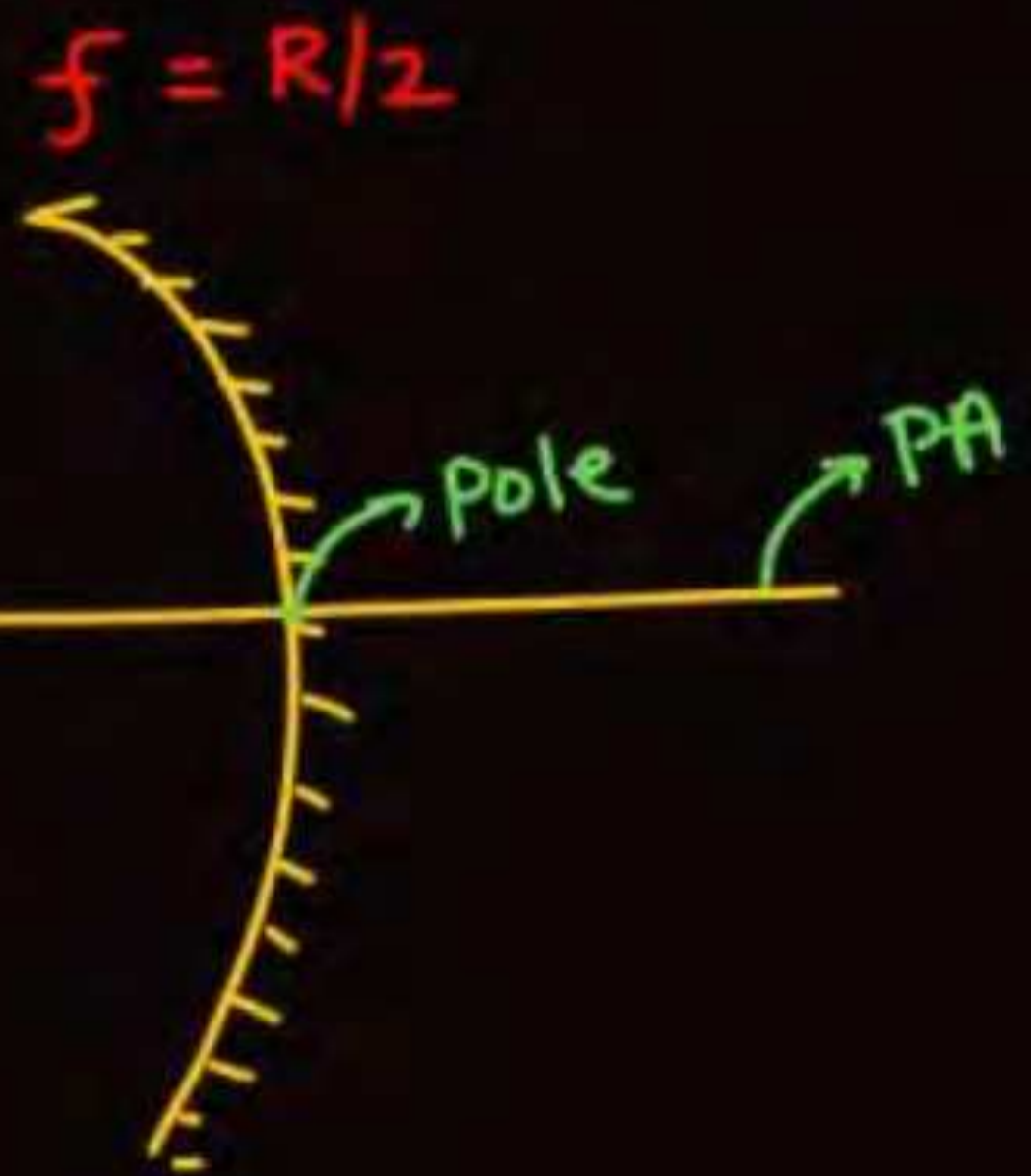
$v \rightarrow$ distance of image from pole along P.A

$f \rightarrow$ focal length. $f = R/2$ (magnitude)

• Valid for paraxial rays.

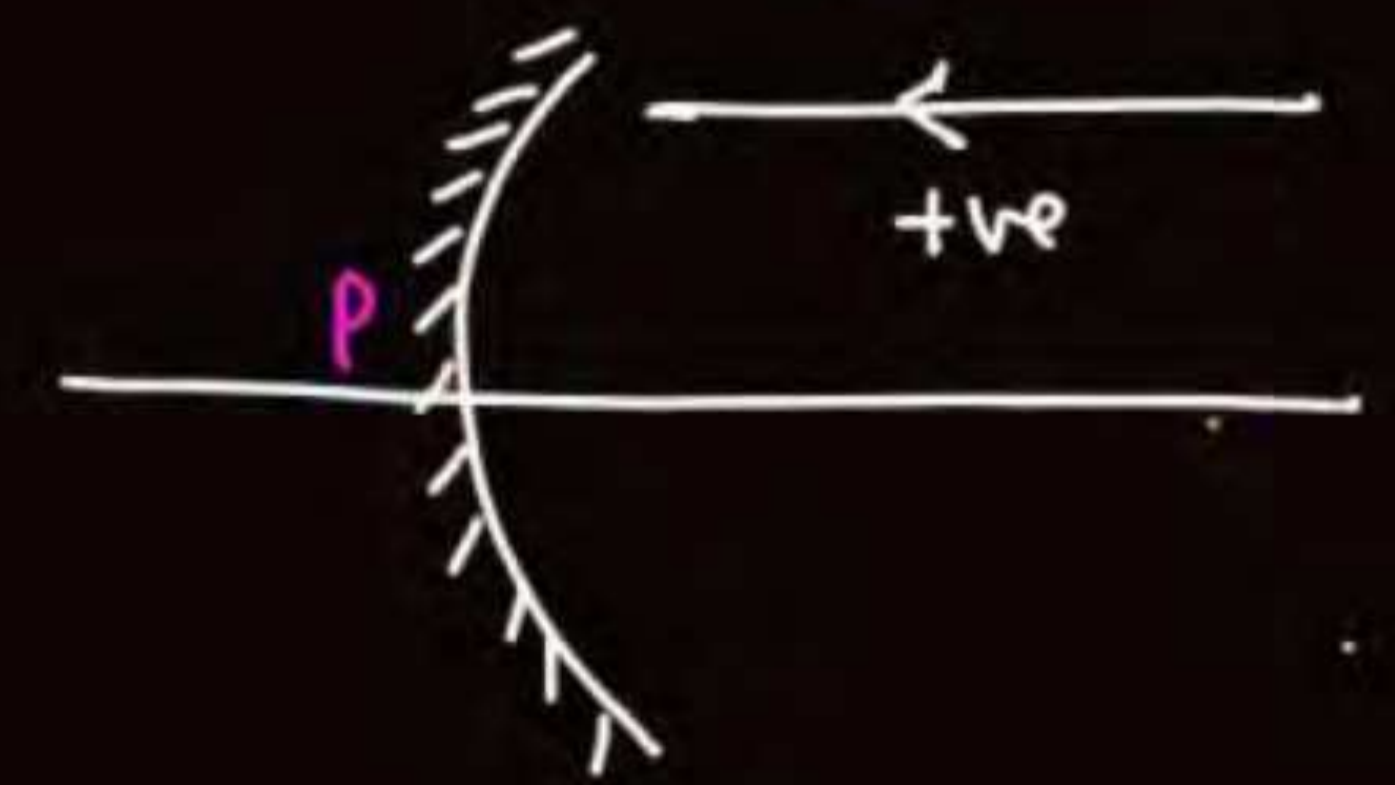
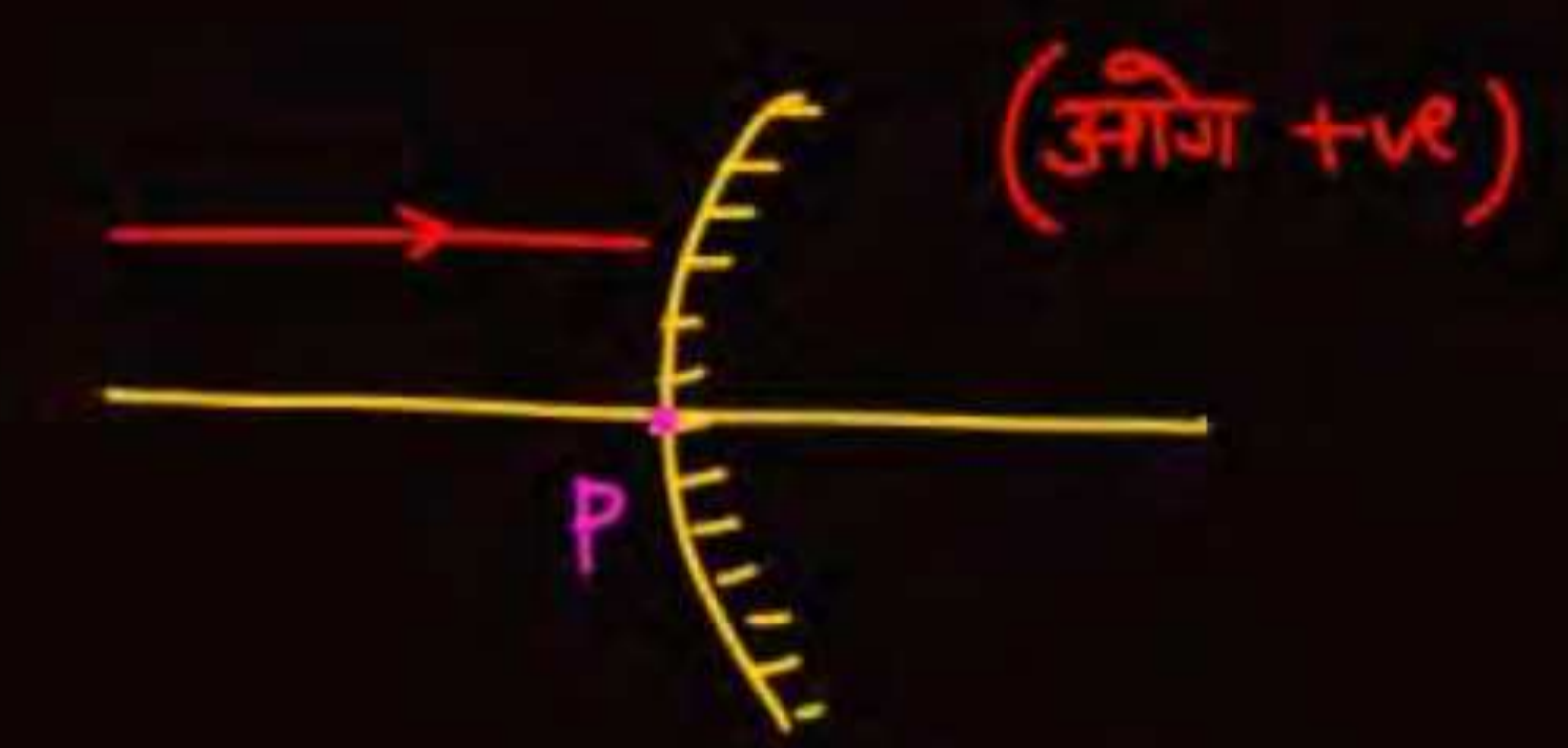
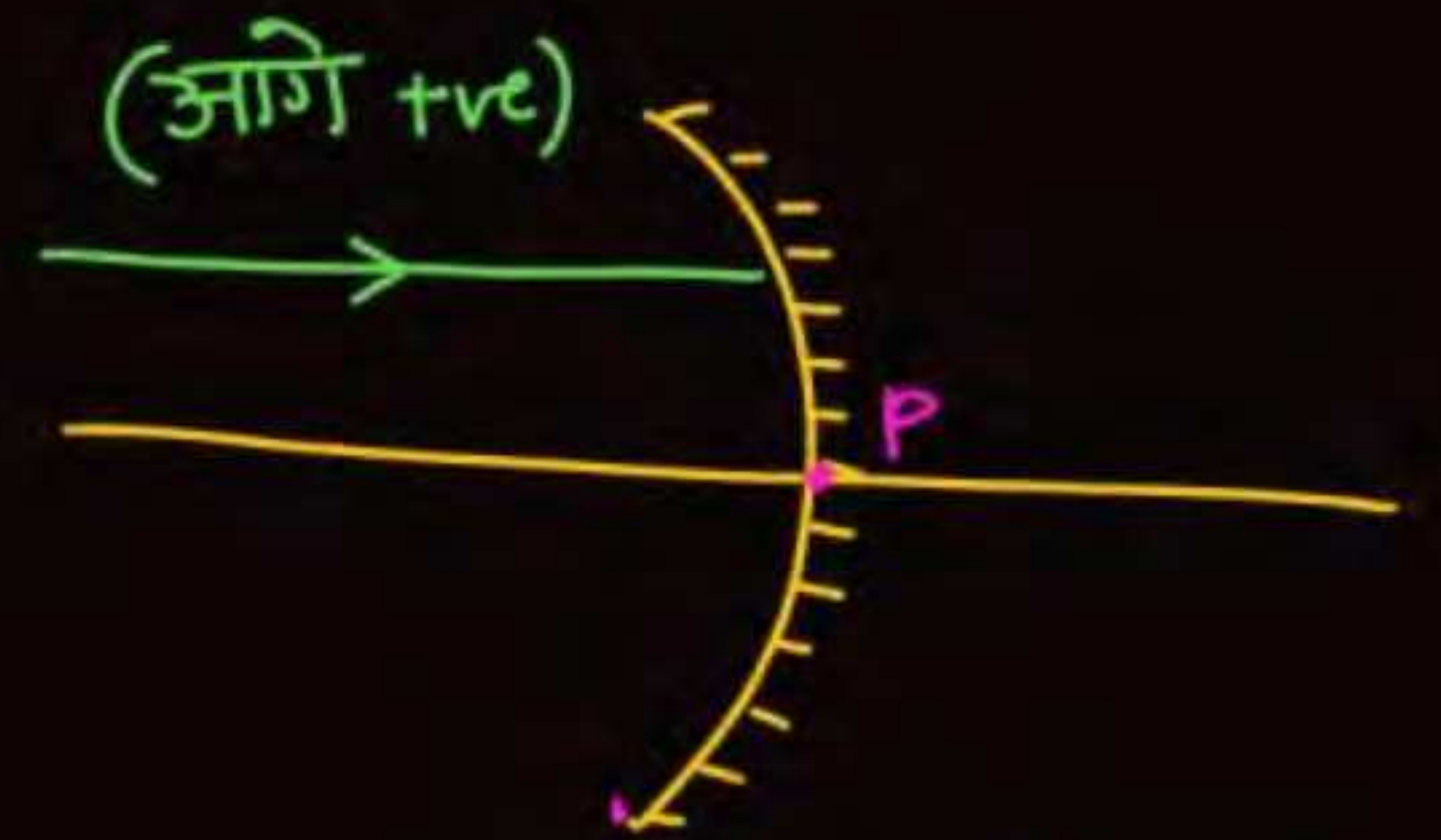
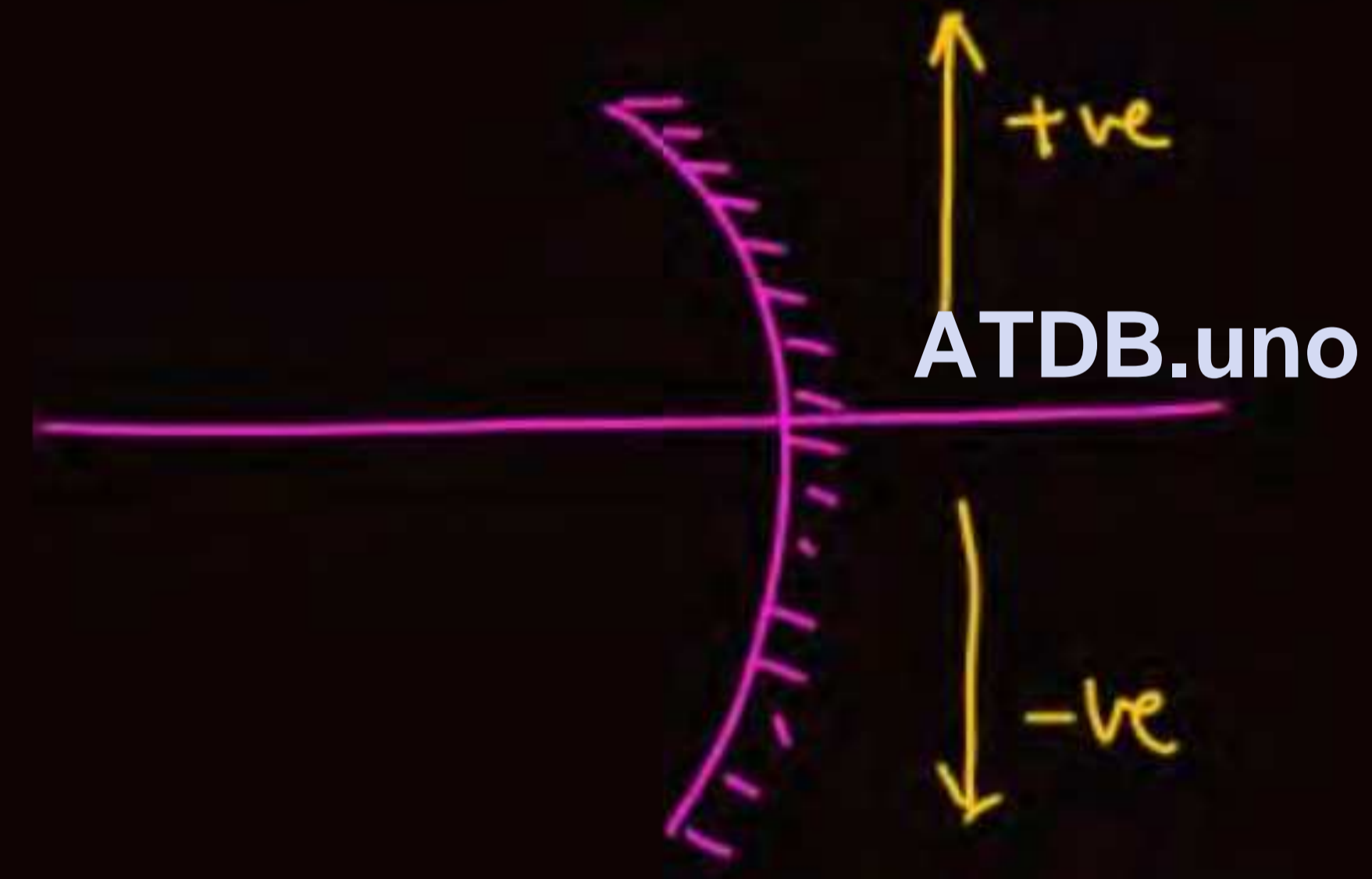
* $u, v, f \rightarrow$ with sign

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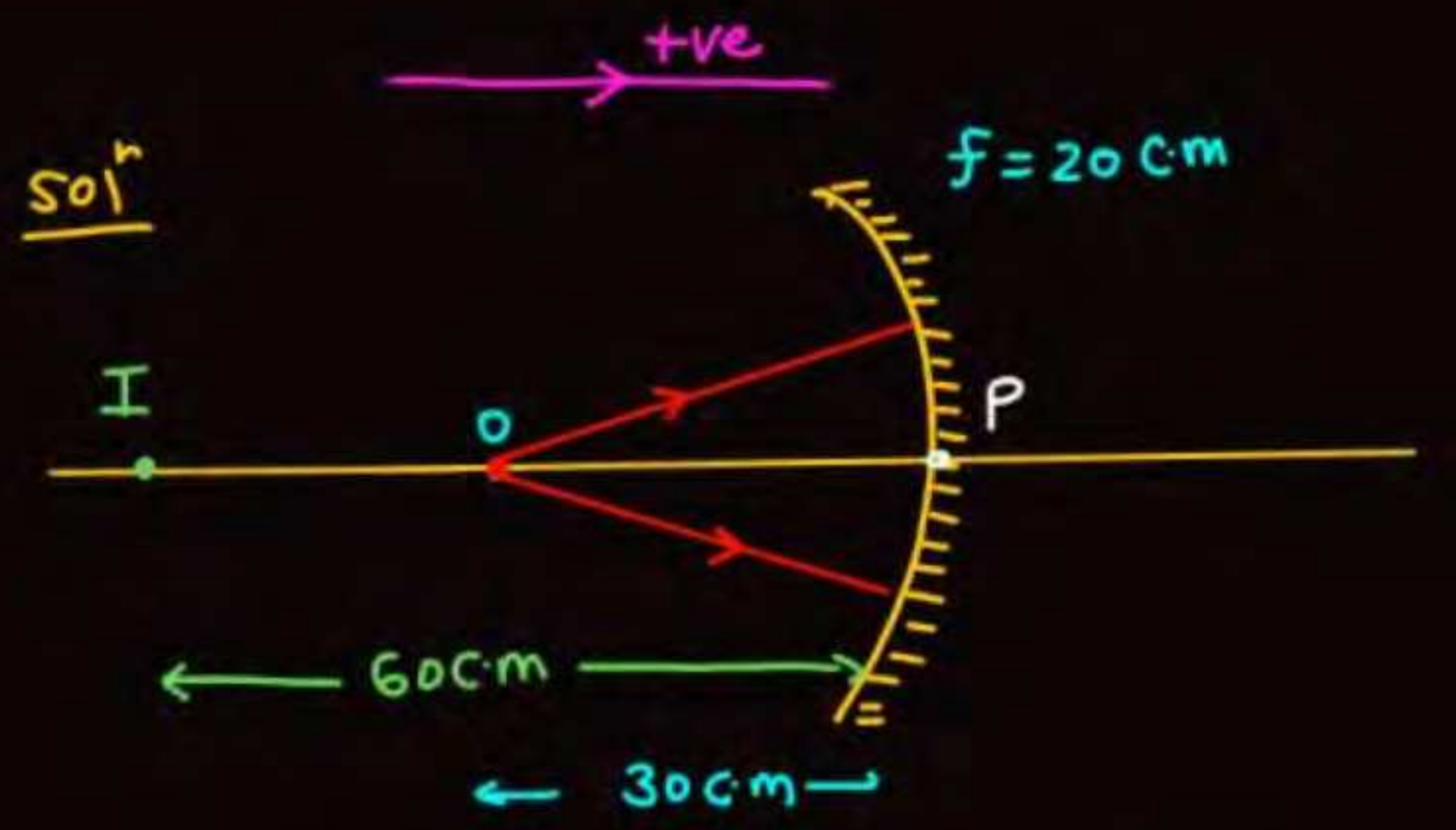
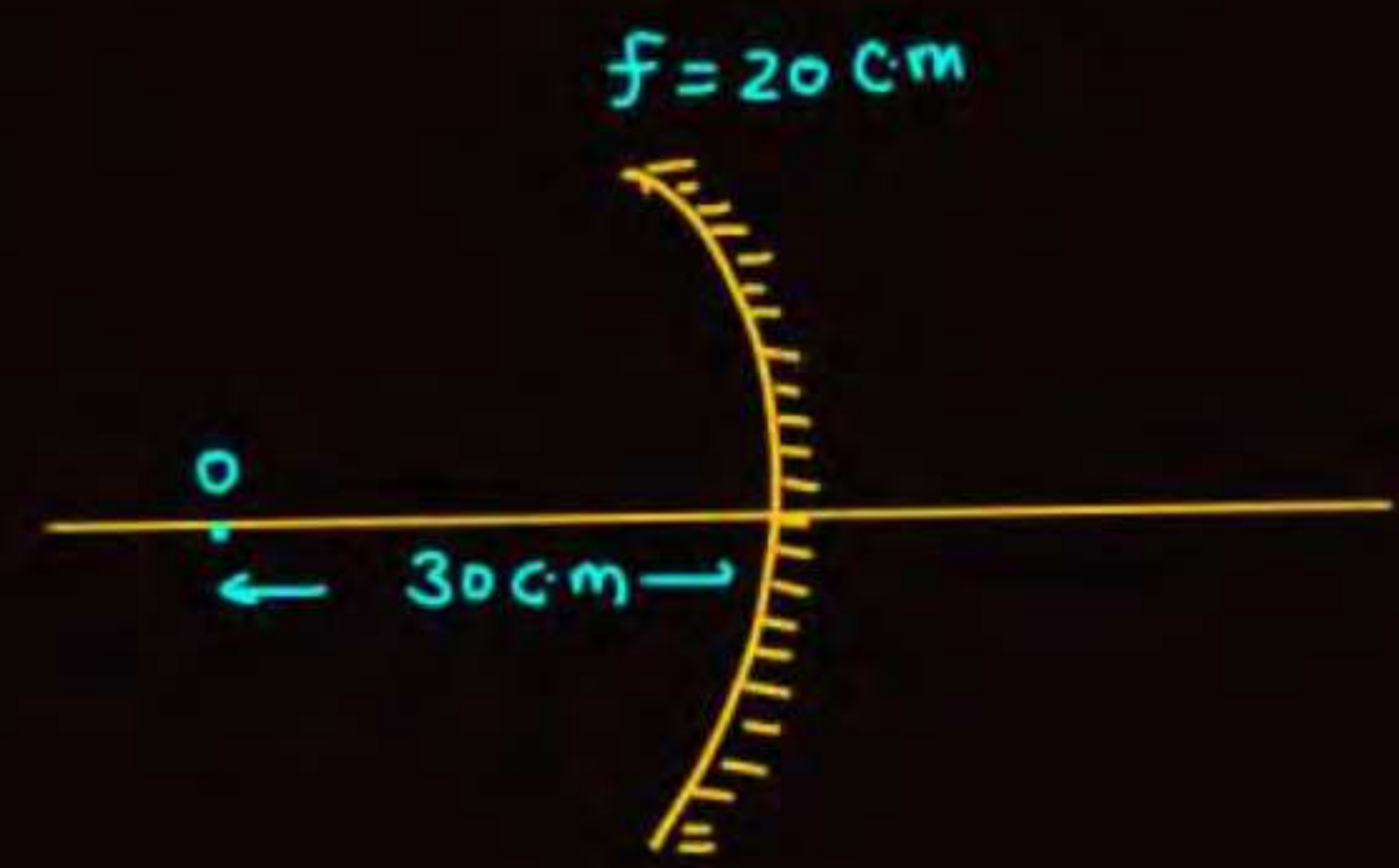


Sign convention

- * Dirⁿ of incident ray is taken as positive.
- * सारे measurement pole से करते हैं



S.S.C.F.D
Q



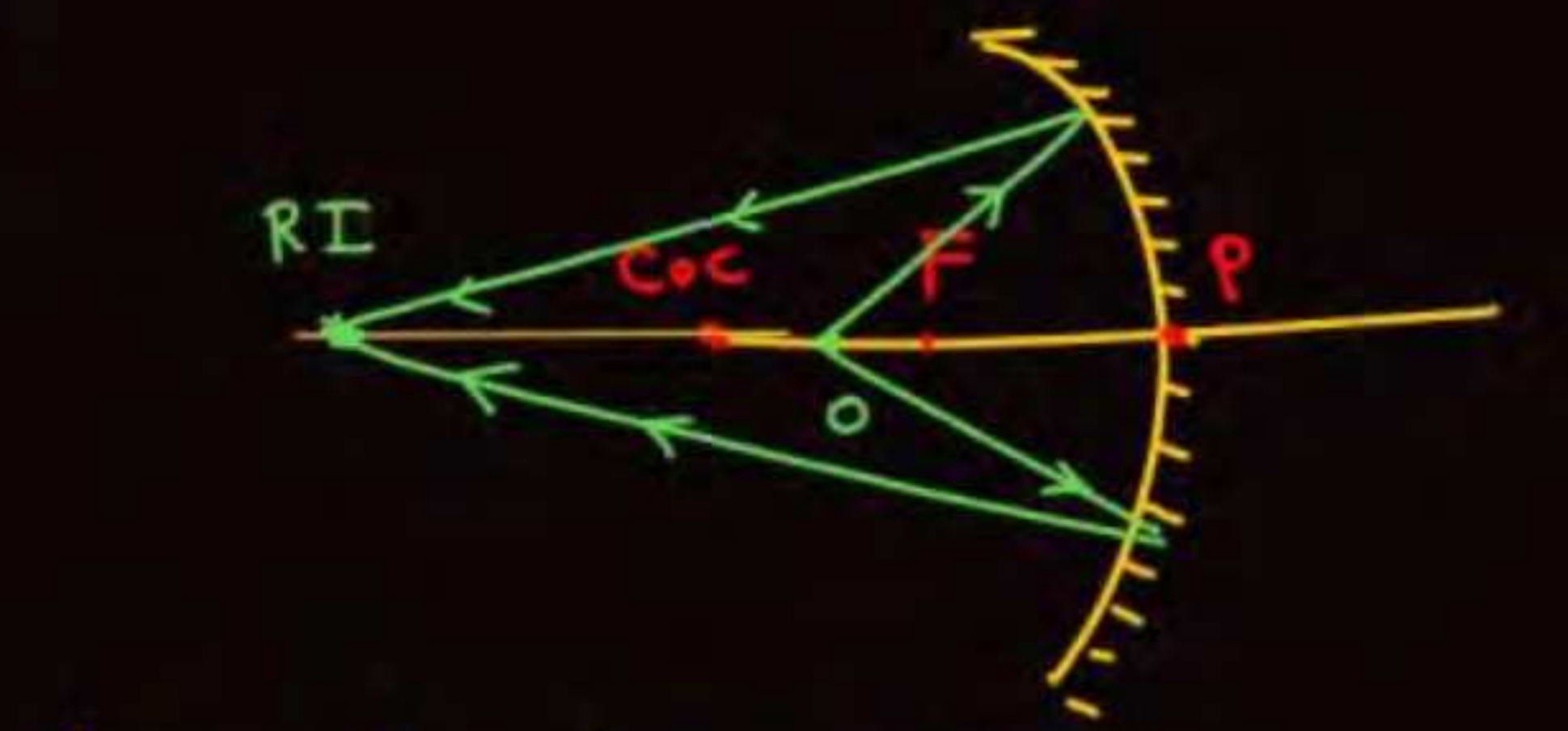
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$$u = -30$$

$$f = -20$$

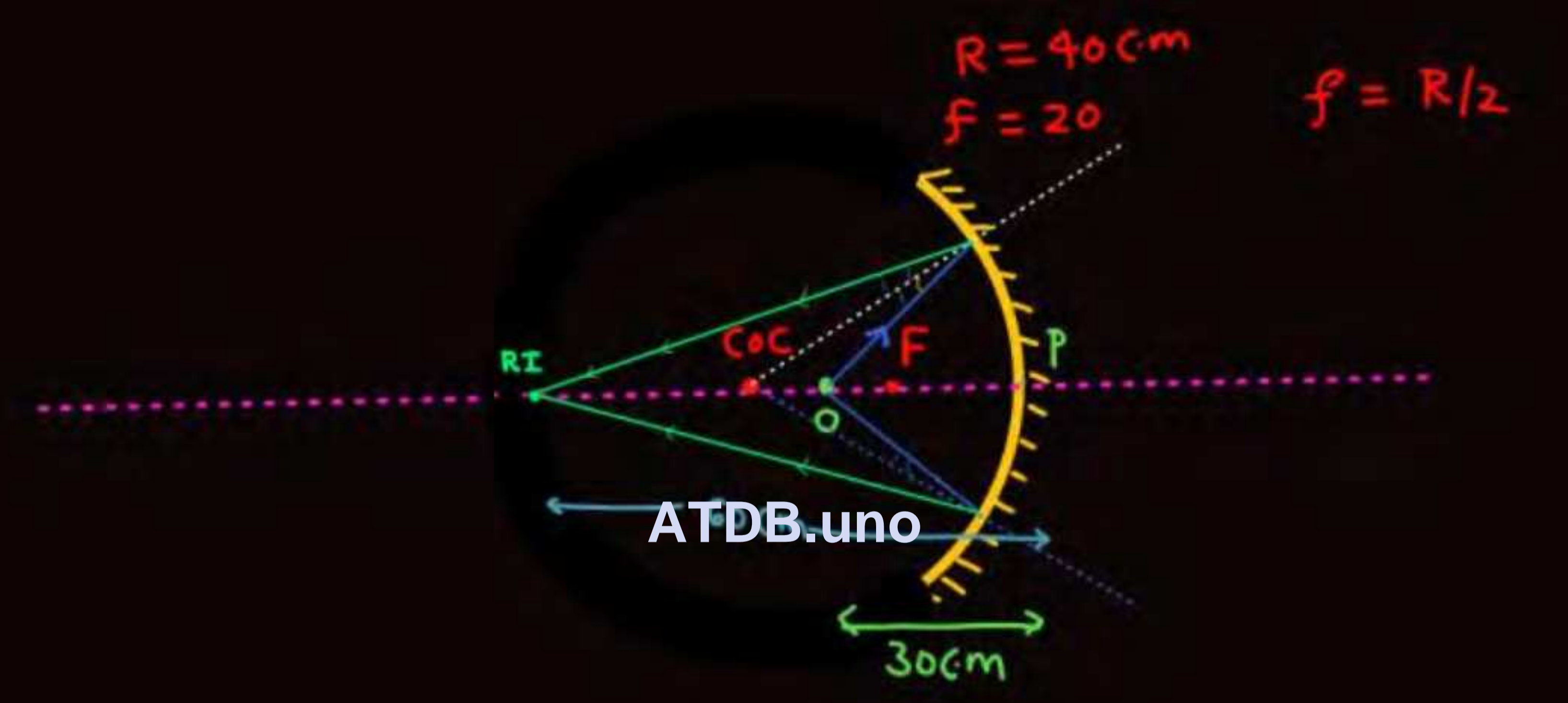
$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{-30} + \frac{1}{v} = -\frac{1}{20}$$



$$\frac{1}{v} = -\frac{1}{20} + \frac{1}{30} = \frac{-3+2}{60}$$

$$\boxed{v = -60} \equiv \text{R.I}$$



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

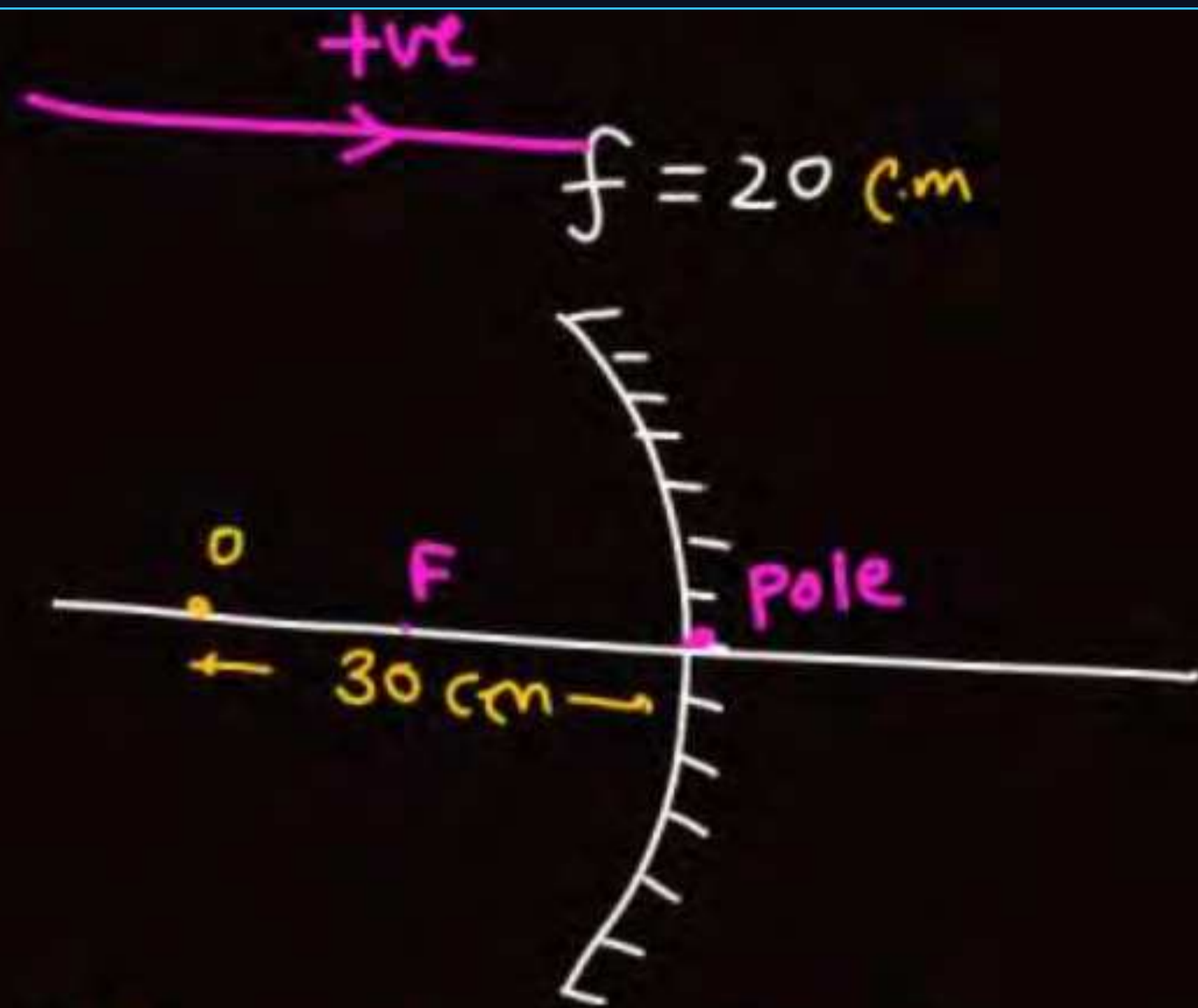
$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{u-f}{uf}$$

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

Q

$$u = -30$$

$$f = -20$$

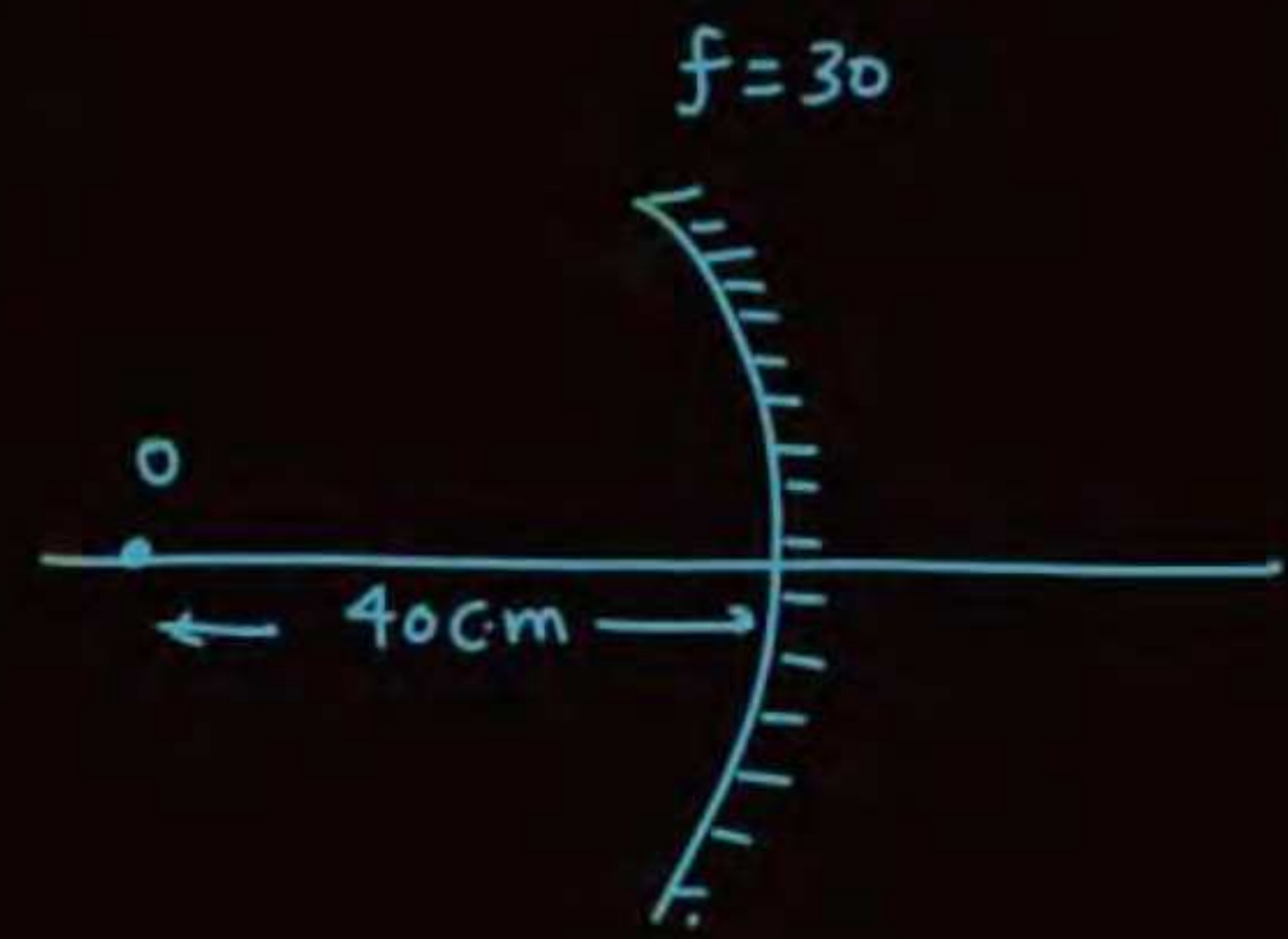


$$v = \frac{uf}{u-f} = \frac{(-30) \times (-20)}{(-30) - (-20)} = \frac{600}{-10} = -60 \text{ cm (R.I)}$$

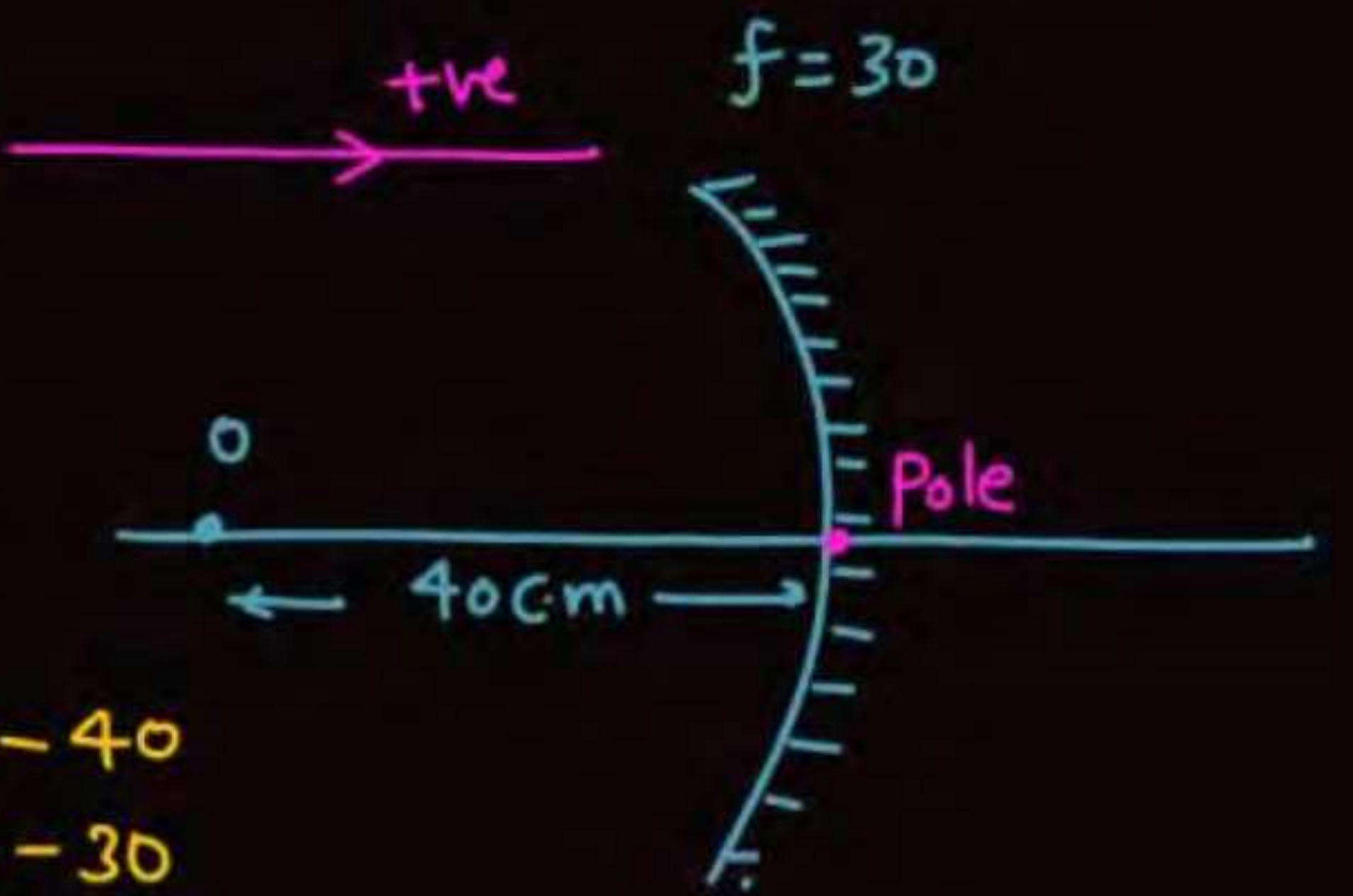
$$u = -30 \text{ (R.O)}$$

$$v = -60 \text{ (solue) (R.I)}$$

SSC FD
Q

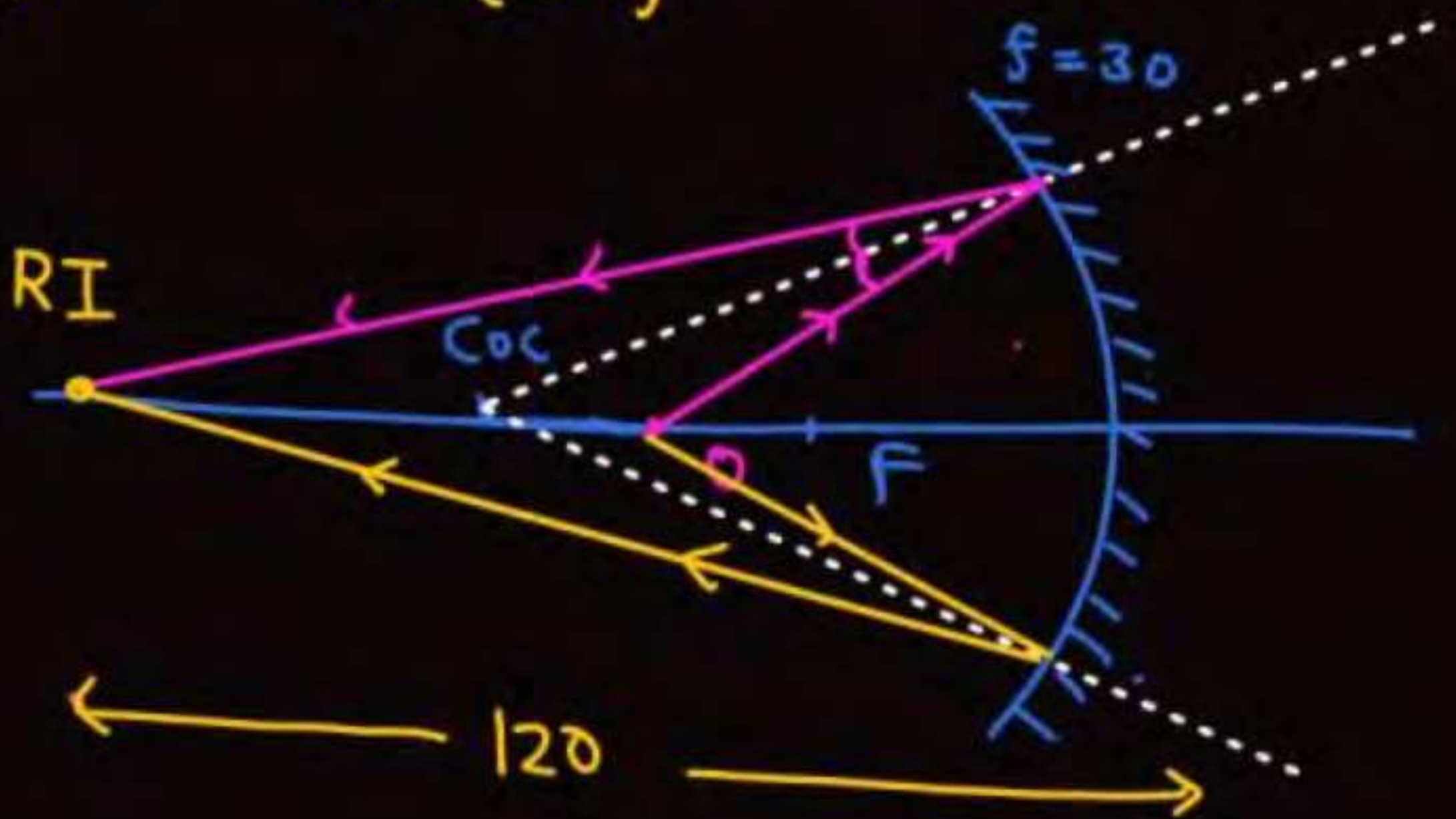


Solⁿ

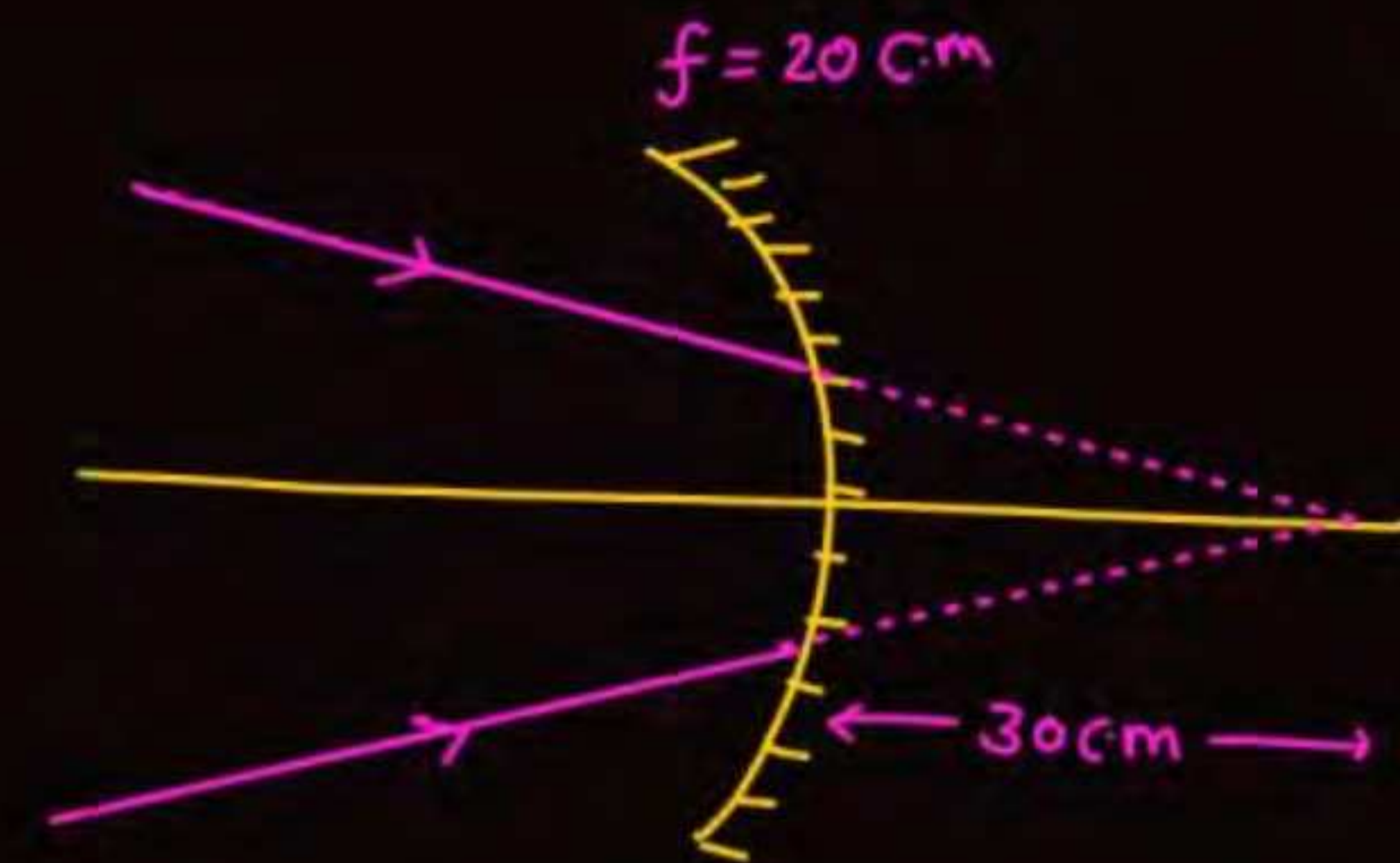
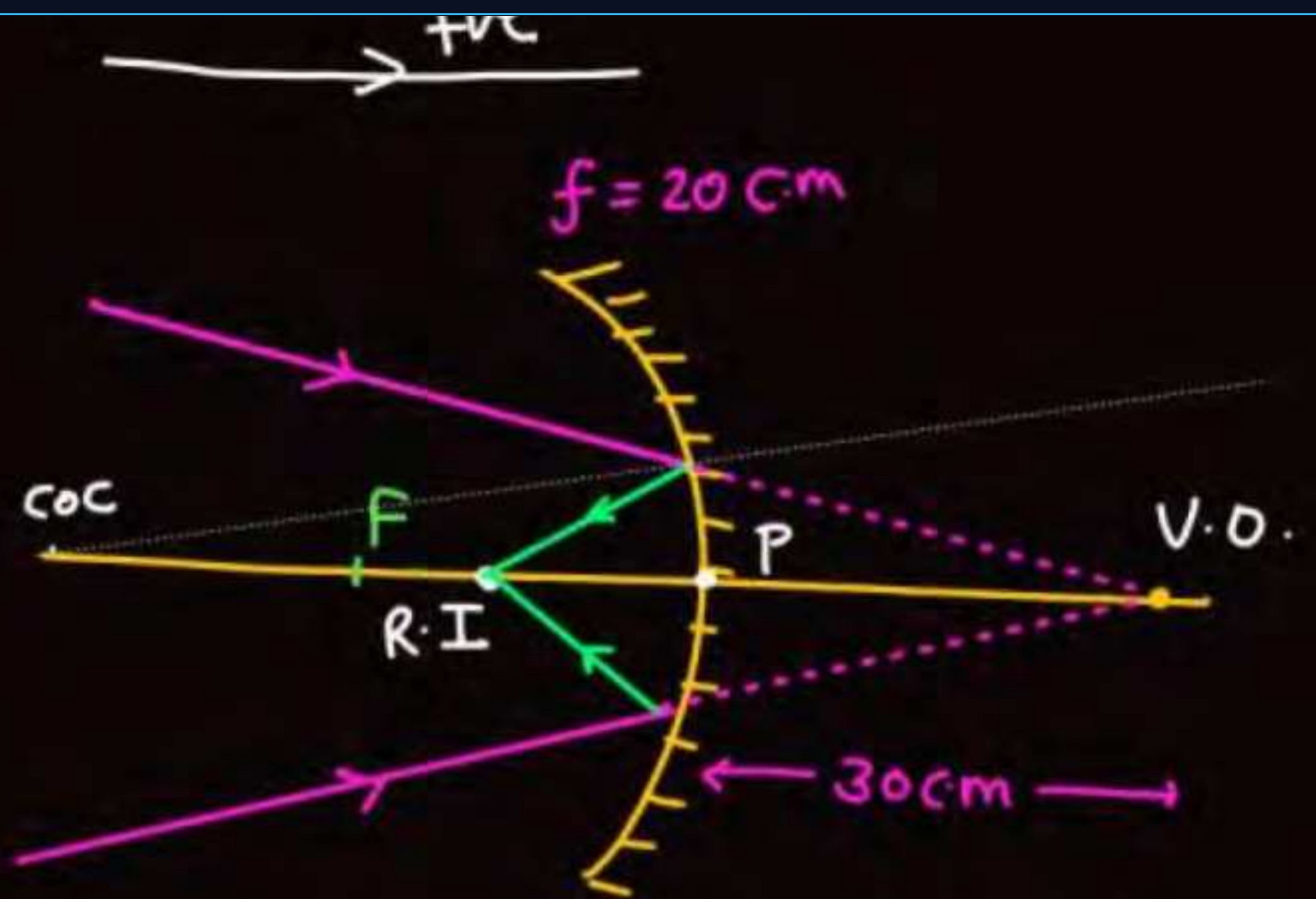


$u = -40$
 $f = -30$

$v = \frac{uf}{u-f} = \frac{1200}{-40 - (-30)} = -120$



Q

Solⁿ

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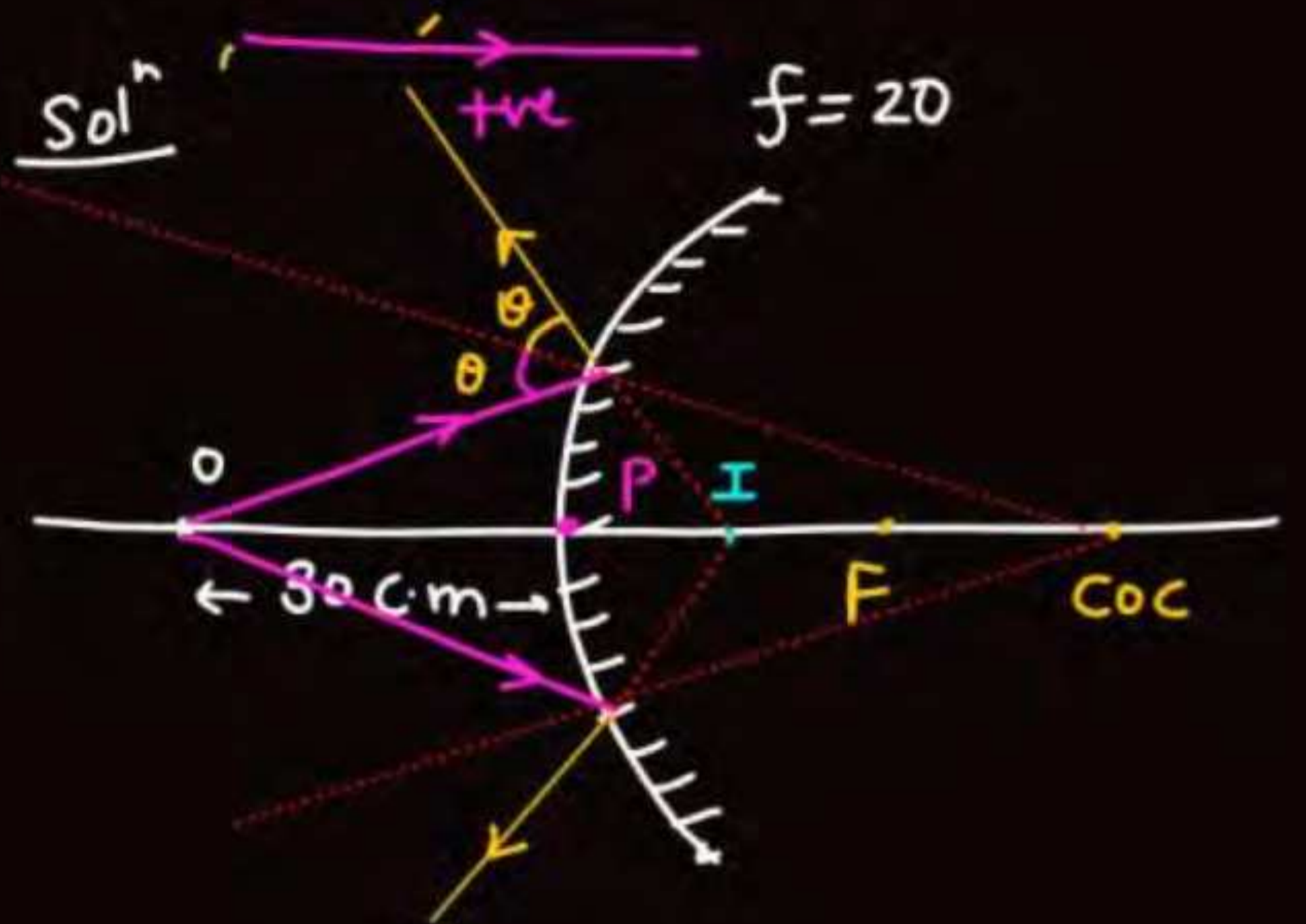
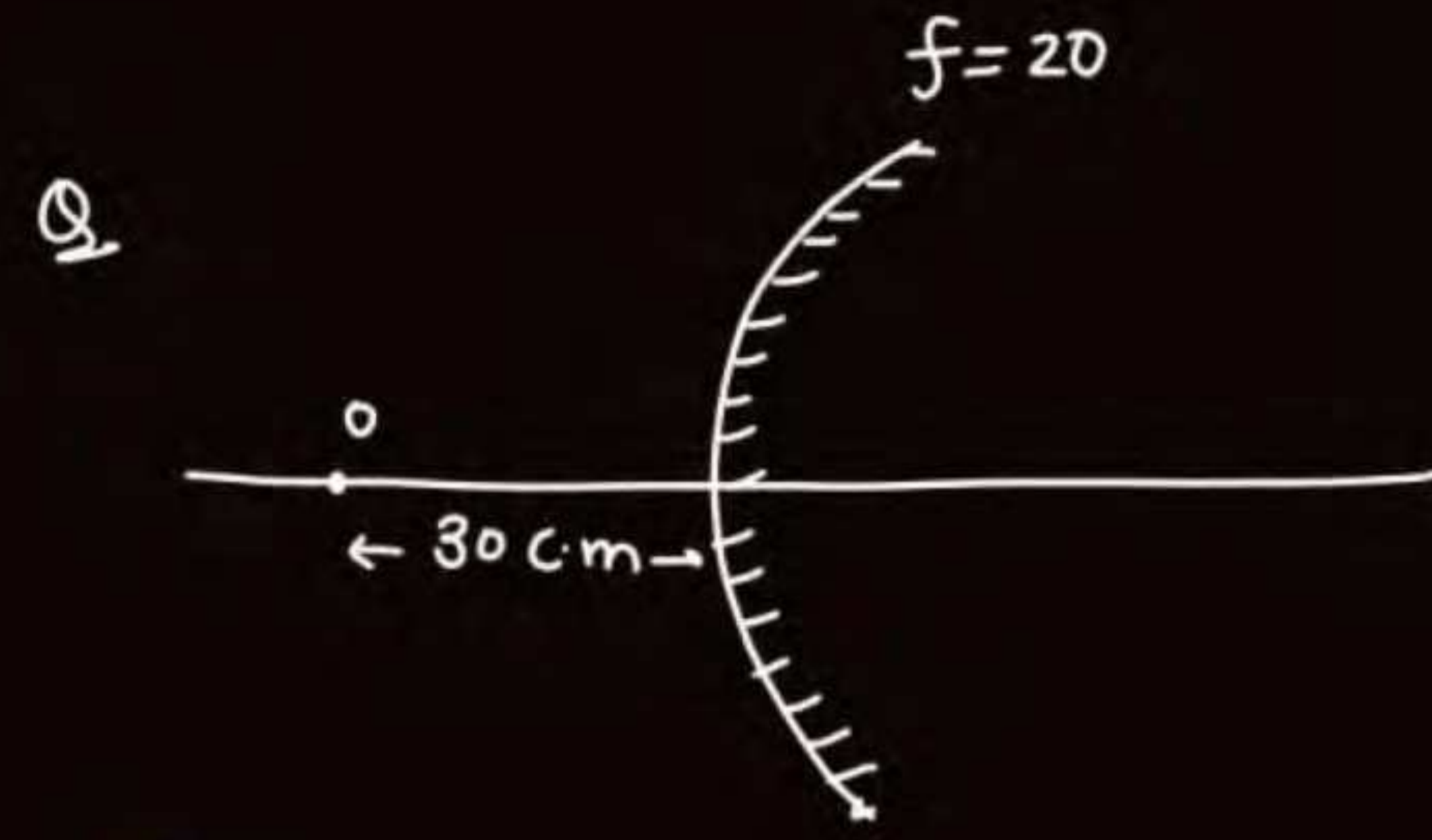
$$u = +30$$

$$f = -20$$

$$v = \frac{uf}{u-f} = \frac{-600}{30 - (-20)} = -12$$

(R.I)

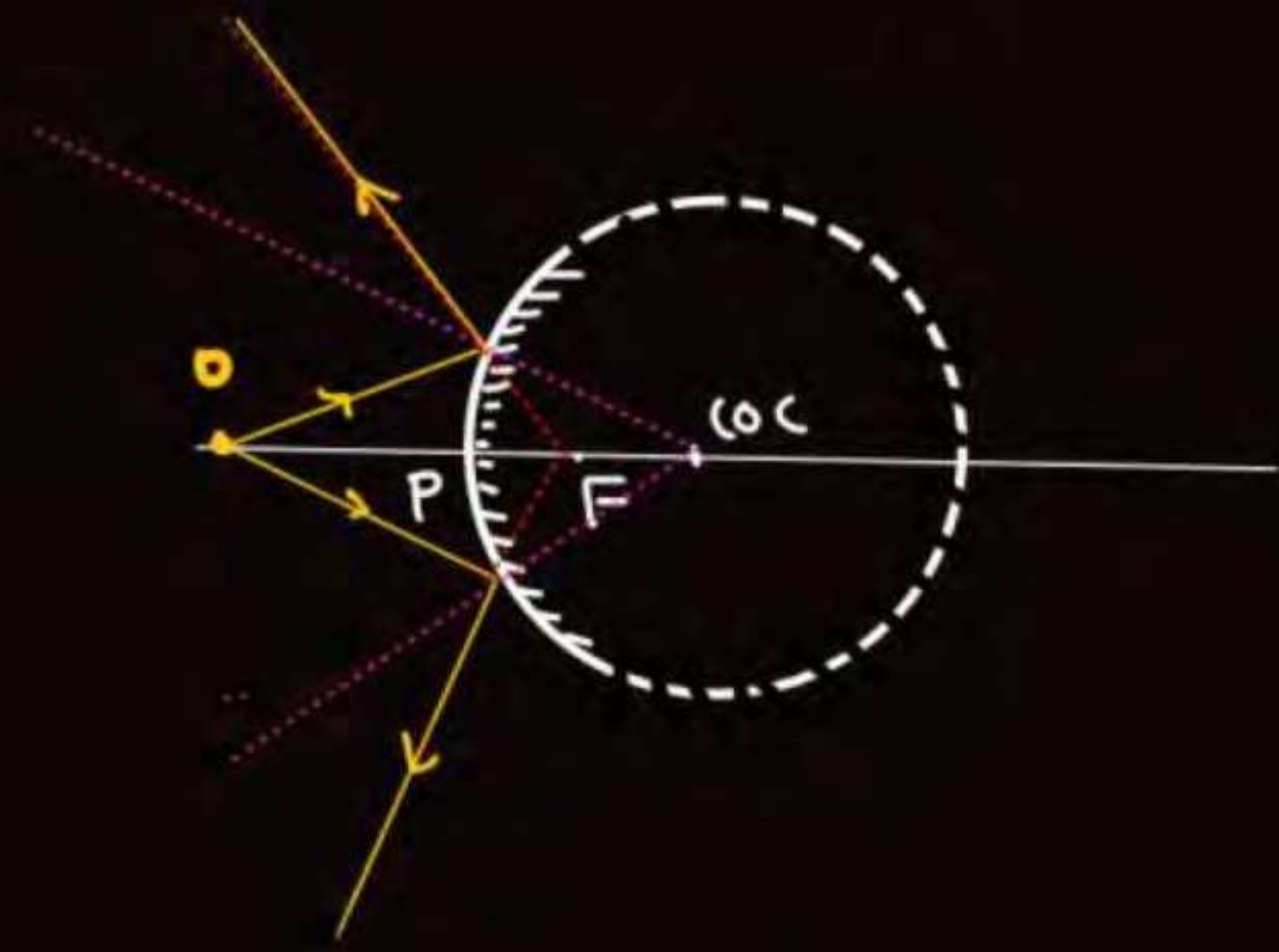
$$m = -\frac{v}{u} = -\frac{-12}{+30} = +\frac{2}{5} \text{ (erect)}$$

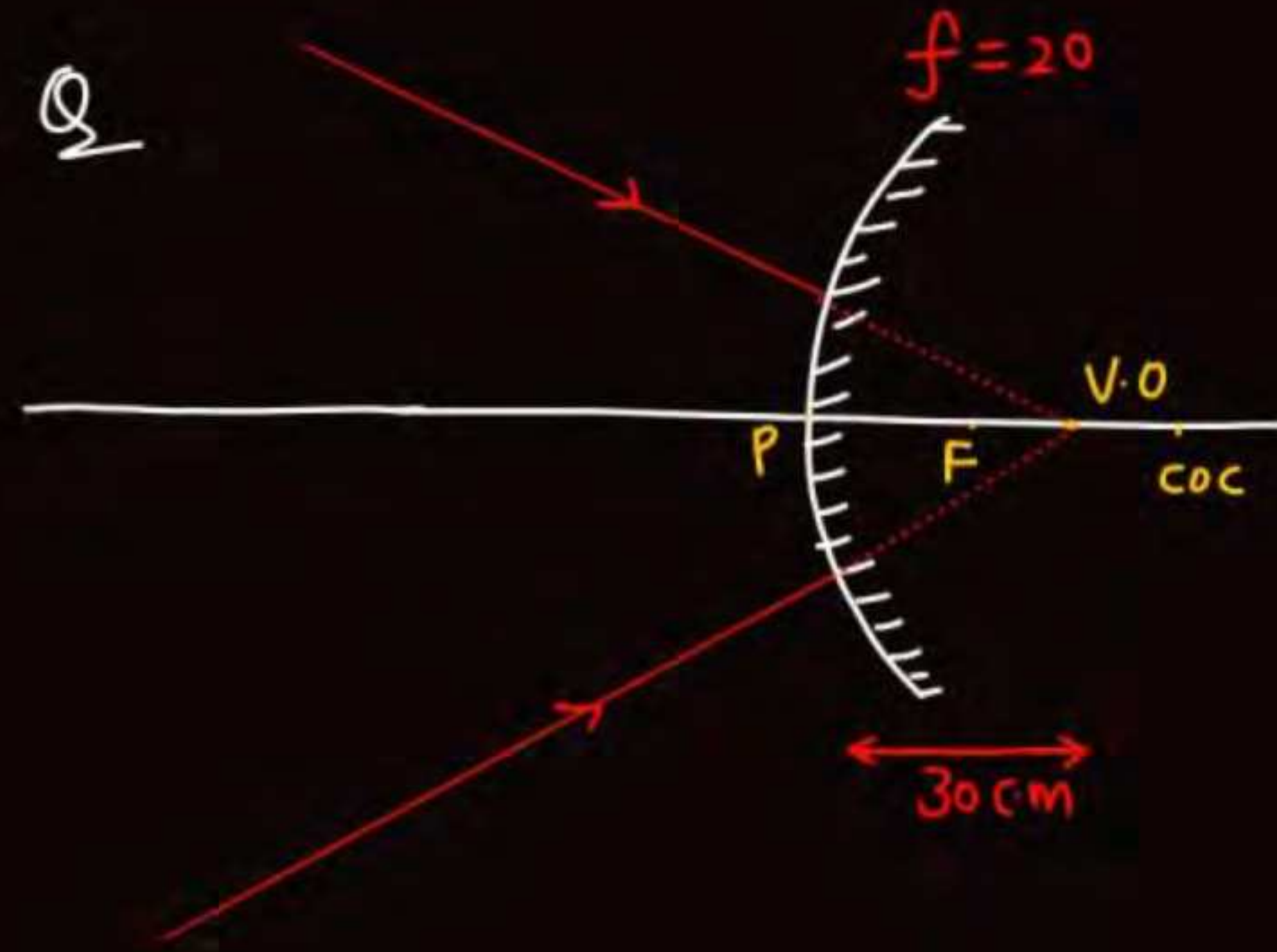


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$u = -30$
 $f = +20$

$$v = \frac{uf}{u-f} = \frac{-600}{-30-(20)} = +12 \text{ (V.I.)}$$



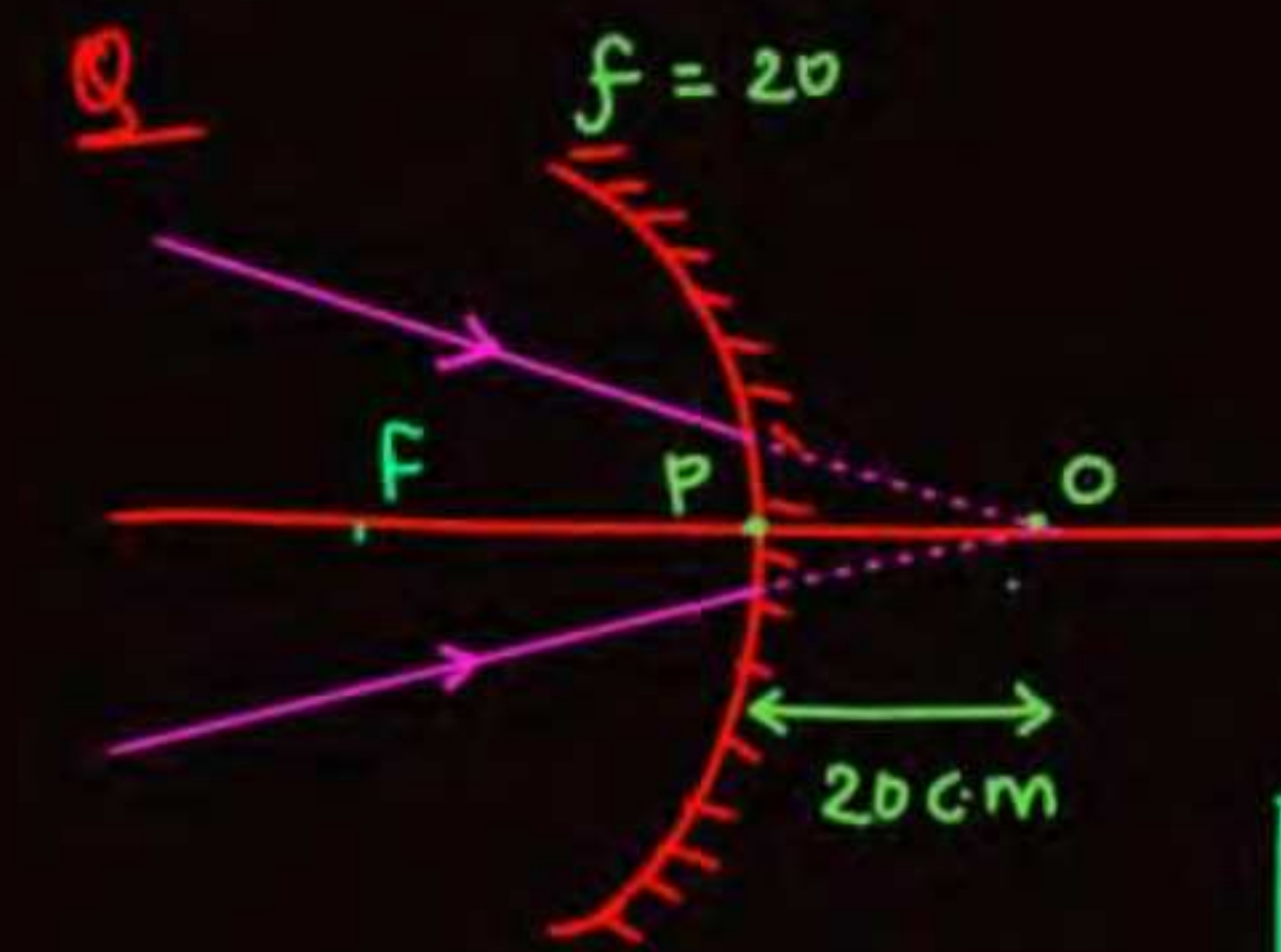


$$u = +30, (V.O.)$$

$$f = +20$$

$$v = \frac{uf}{u-f} = \frac{600}{30-20} = +60, (V.I.)$$

ATDB.uno



$$u = +20$$

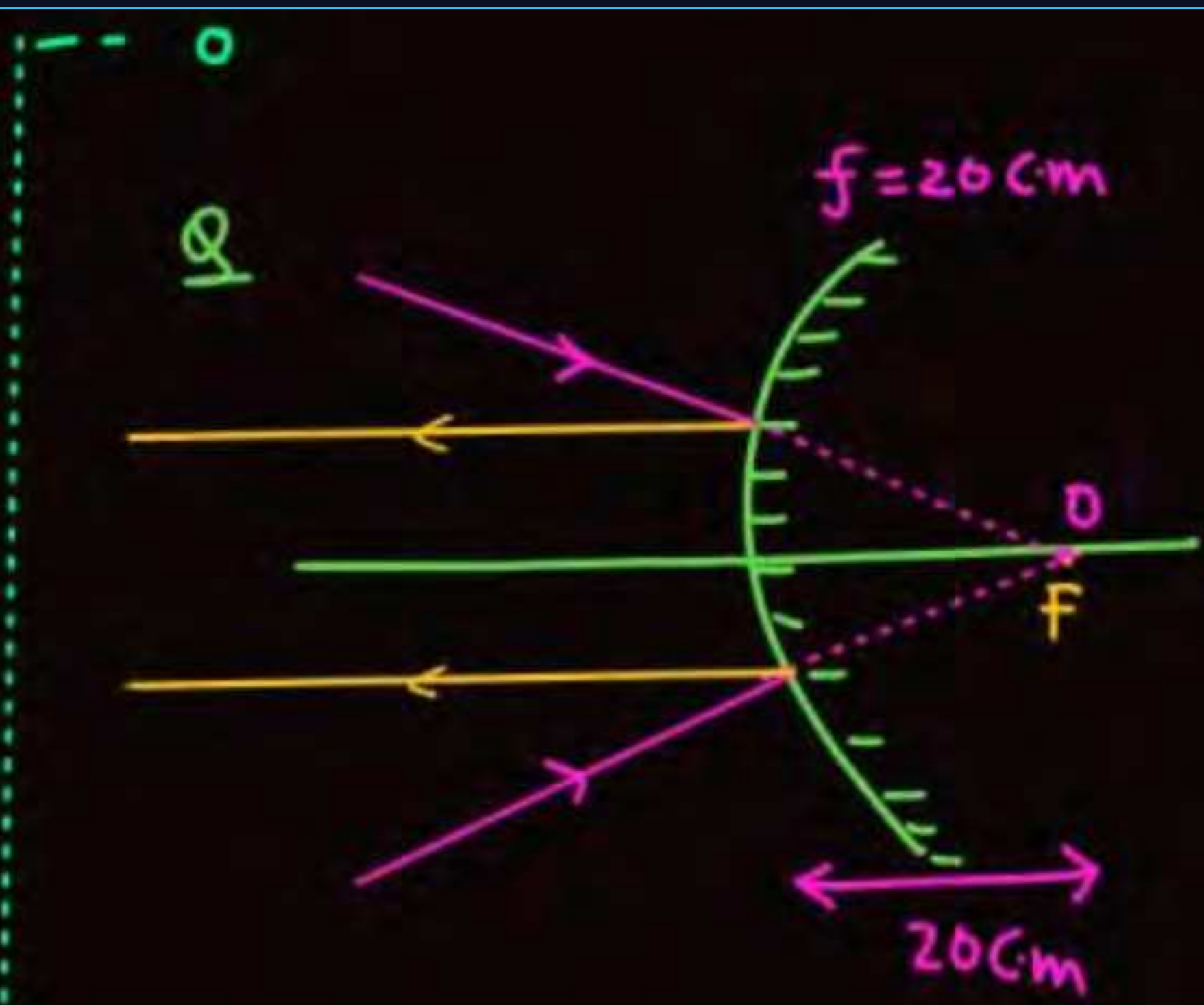
$$f = -20$$

$$v = \frac{-400}{20 - (-20)}$$

$$v = -10$$

(R.I)

ATDB.uno

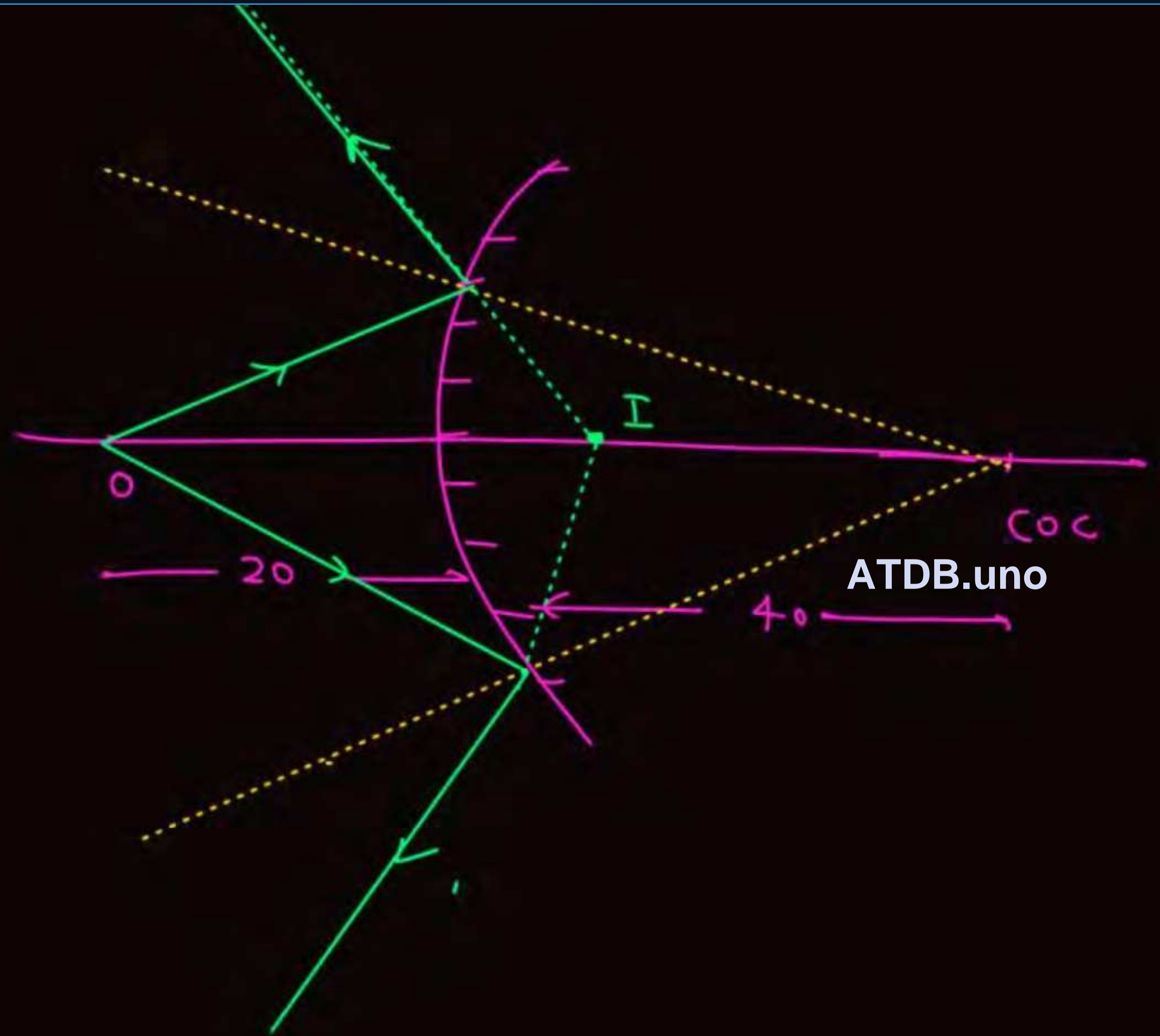


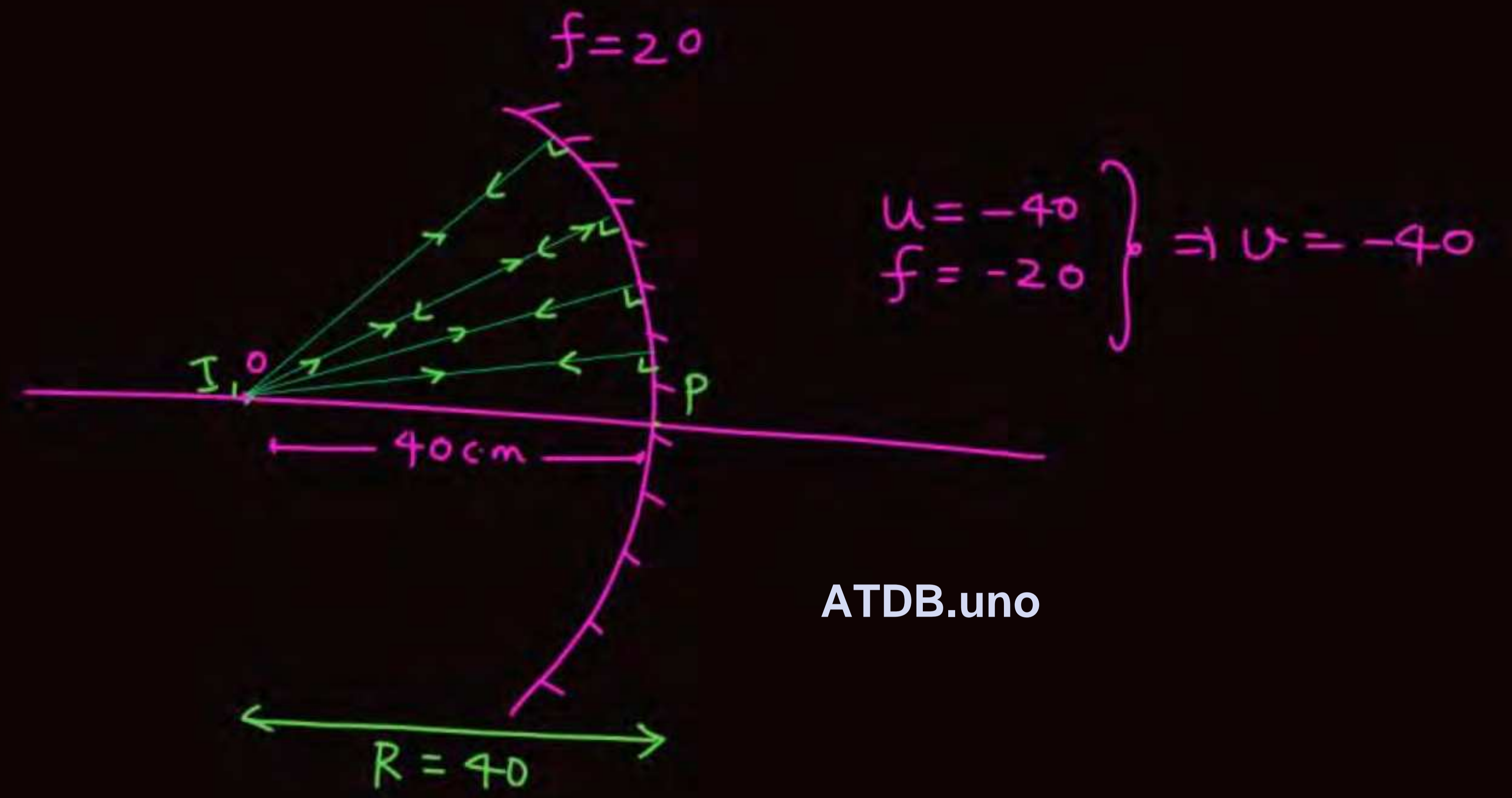
$$u = +20$$

$$f = +20$$

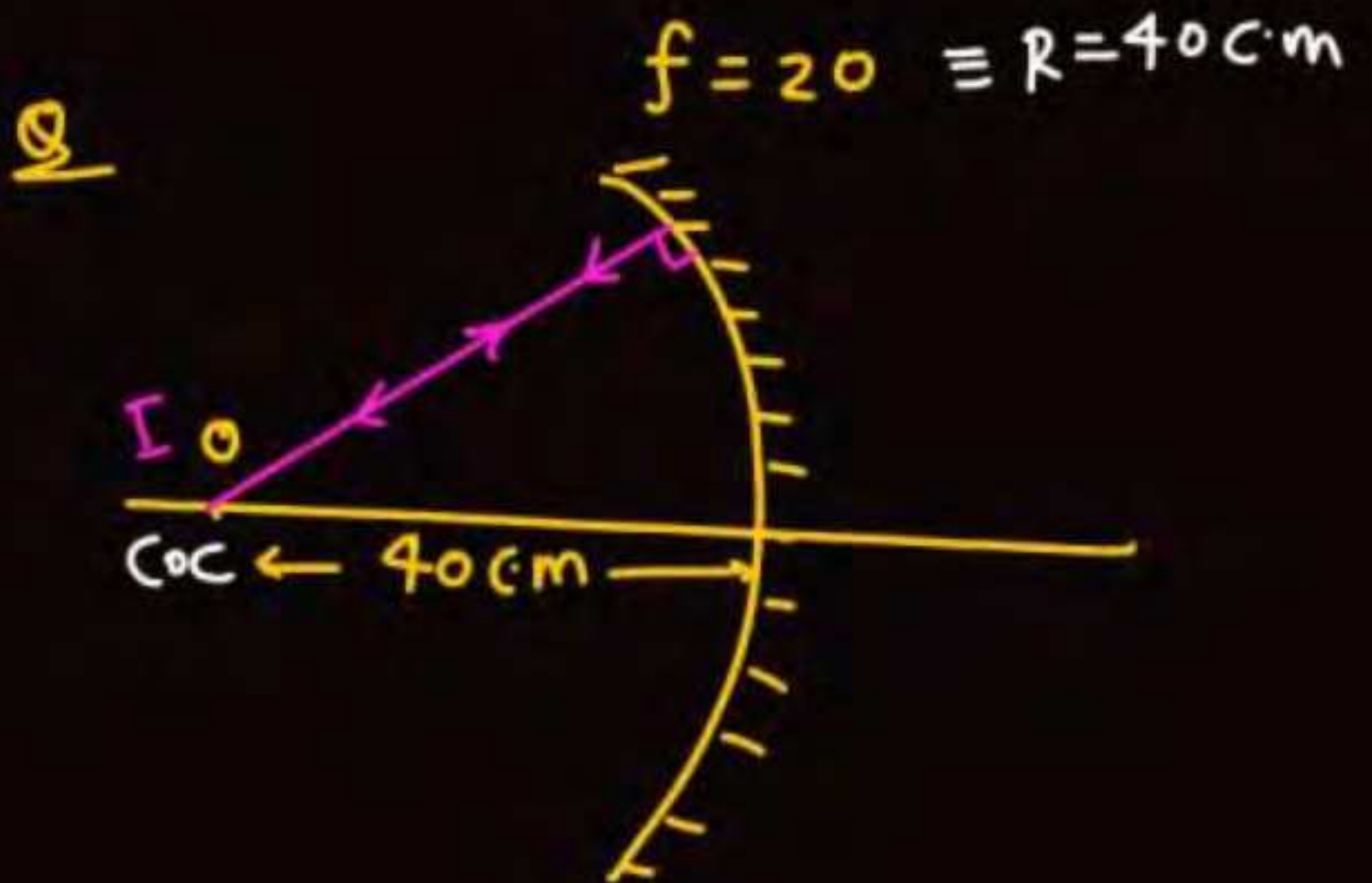
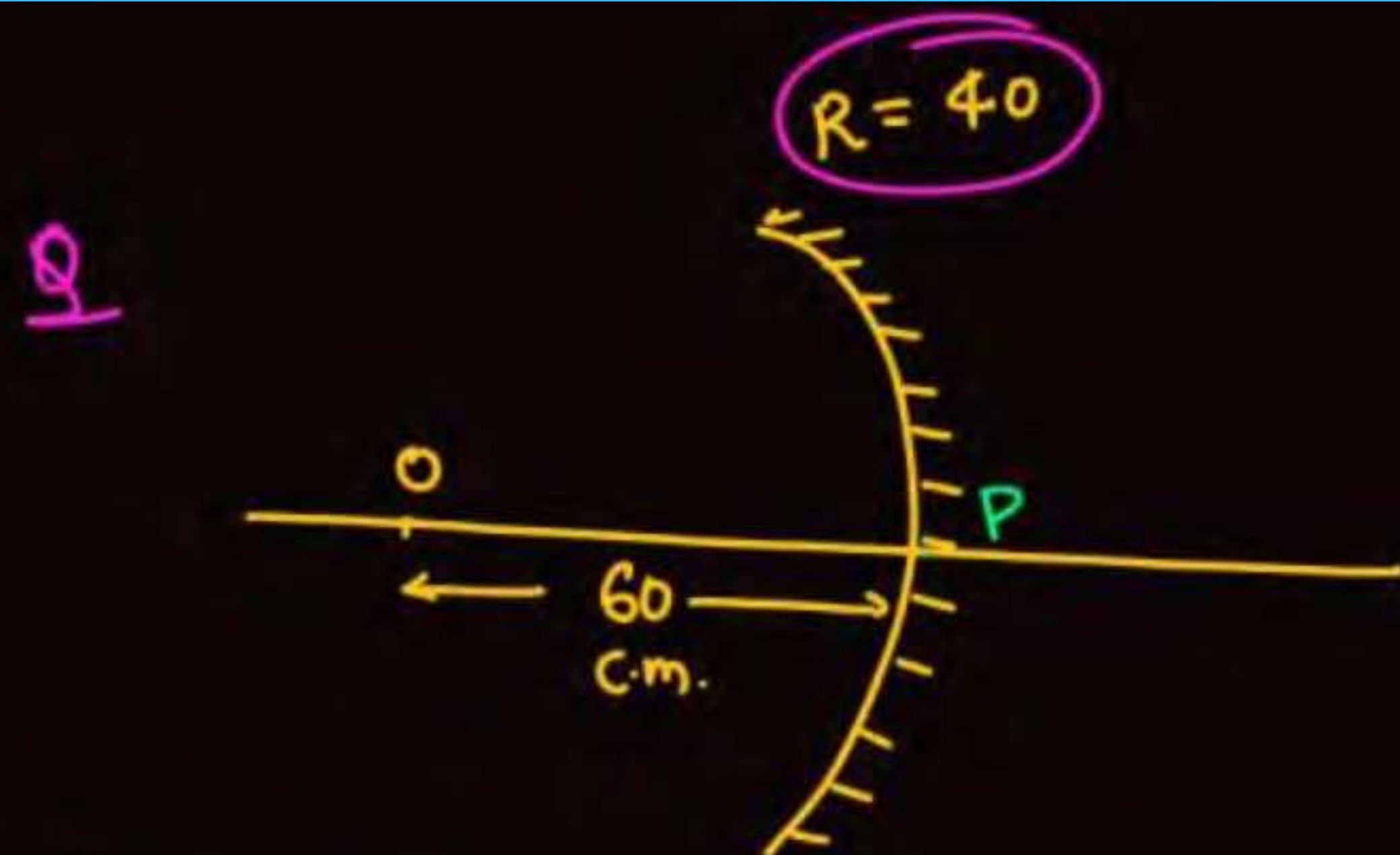
$$v = \frac{uf}{u-f} = \frac{400}{20-20}$$

$$v \rightarrow \infty$$





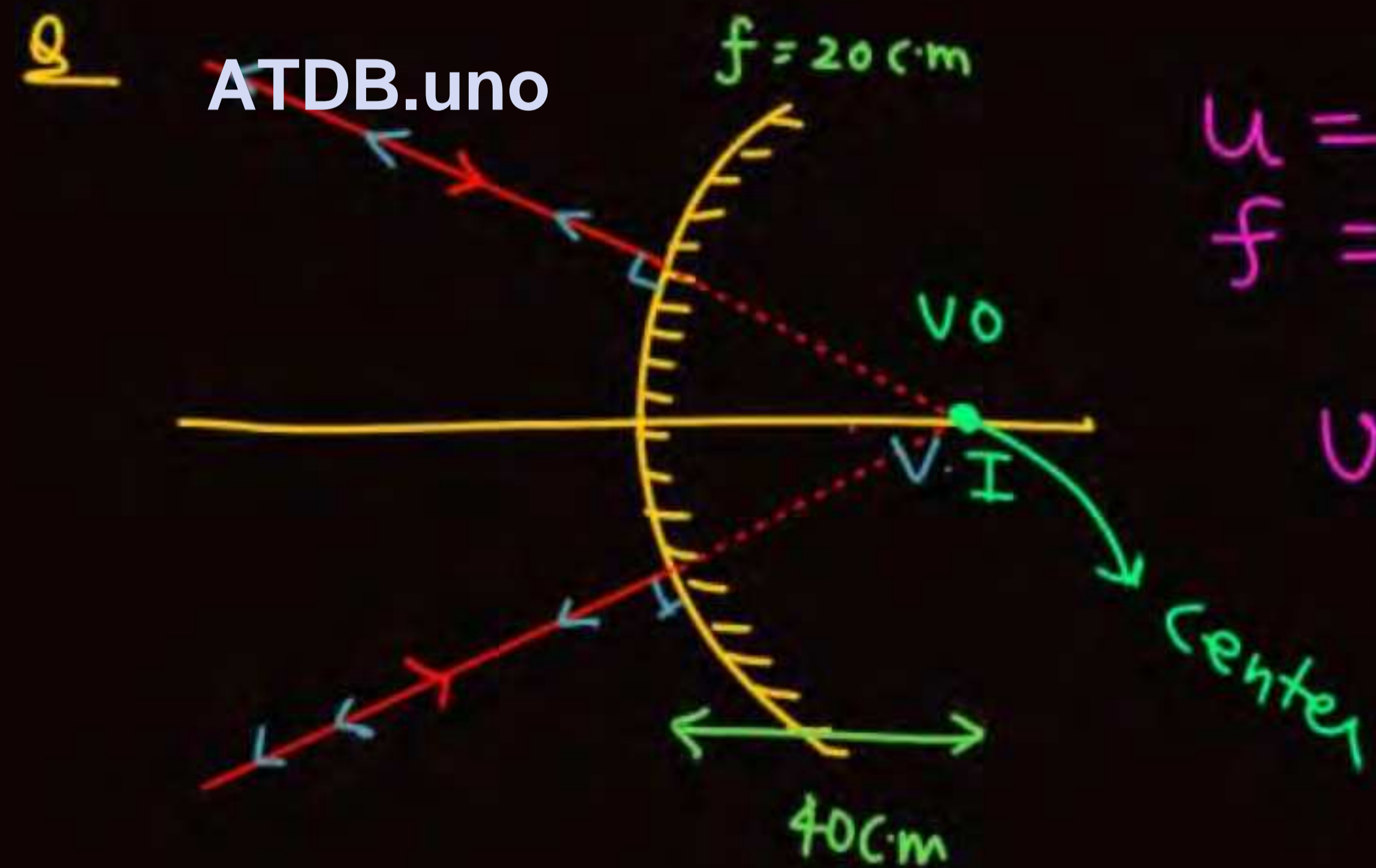
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$$f = -20$$

$$u = -60$$

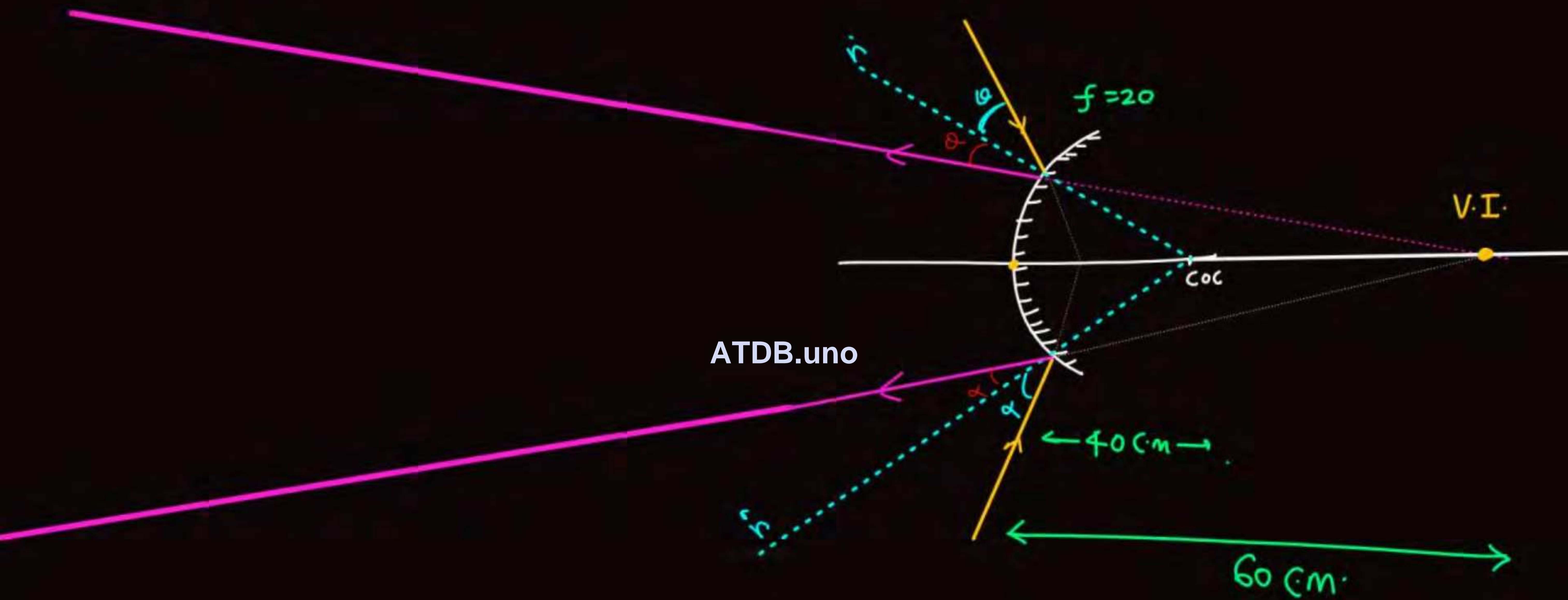
$$v = \frac{1200}{-60 - (-20)}$$



$$u = +40$$

$$f = +20$$

$$v = \frac{800}{40 - 20} = +40$$



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(57C)

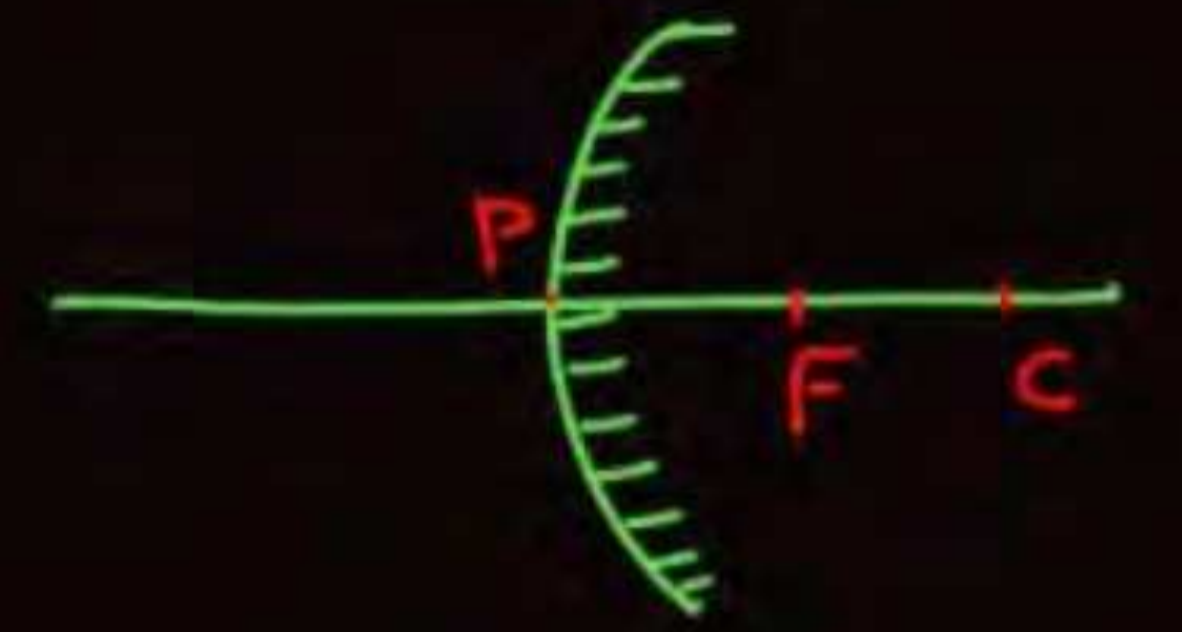
चित्र की सीट

- Concave mirror $\Rightarrow f < 0$
- Convex mirror $\Rightarrow f > 0$

$m > 0 \rightarrow$ erect
 $m < 0 \rightarrow$ inverted

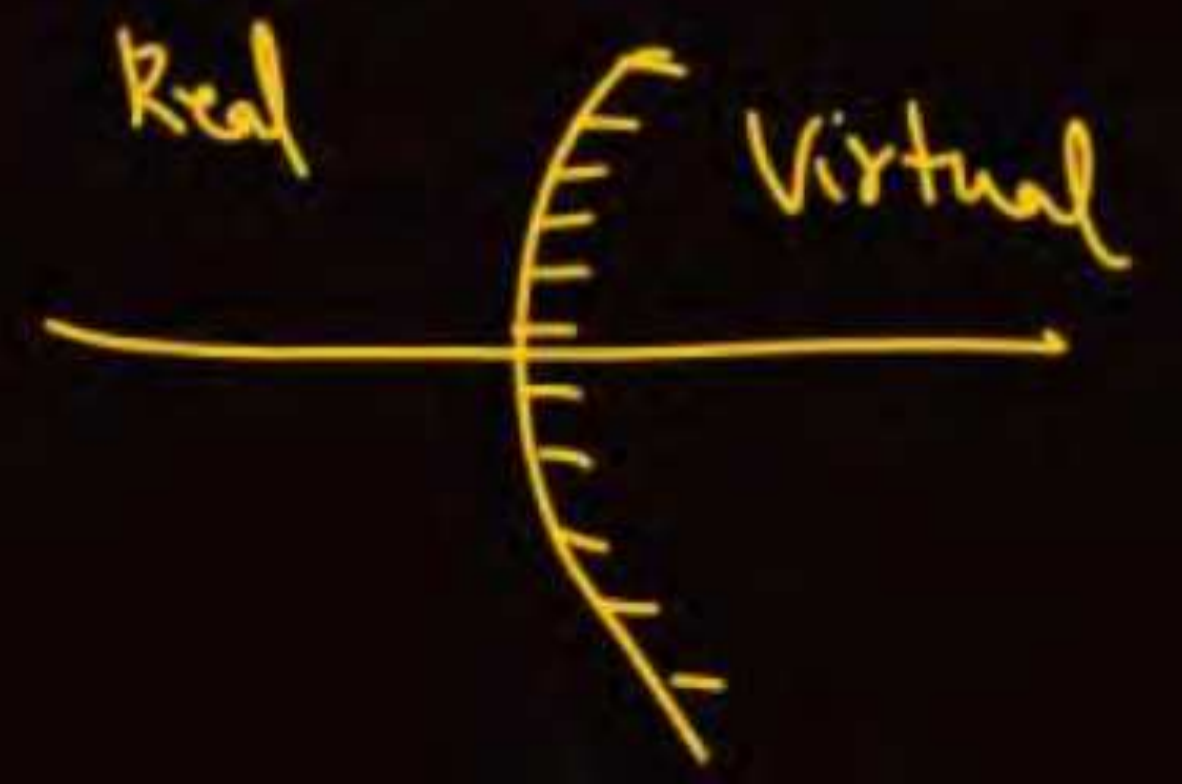
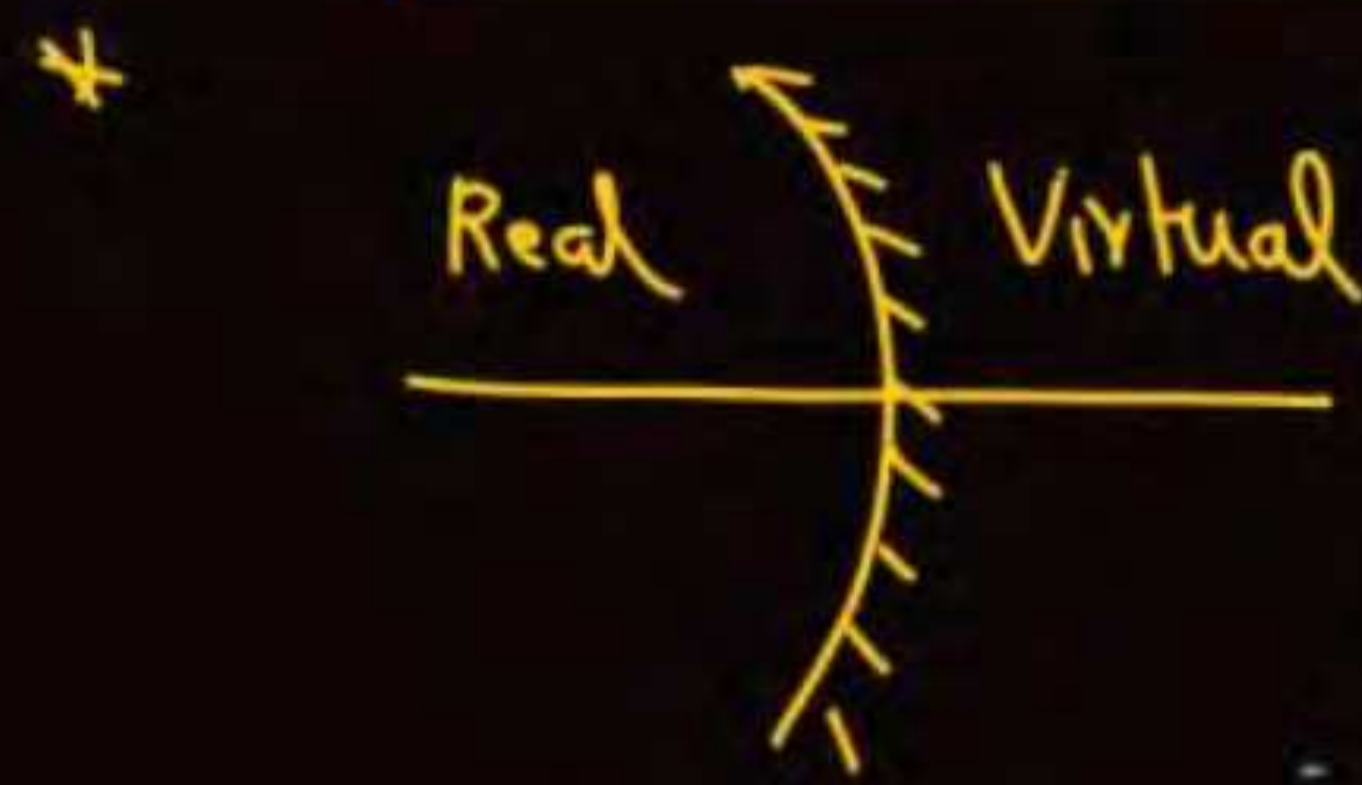
* $u < 0 \rightarrow$ R.O
 $v < 0 \rightarrow$ R.I

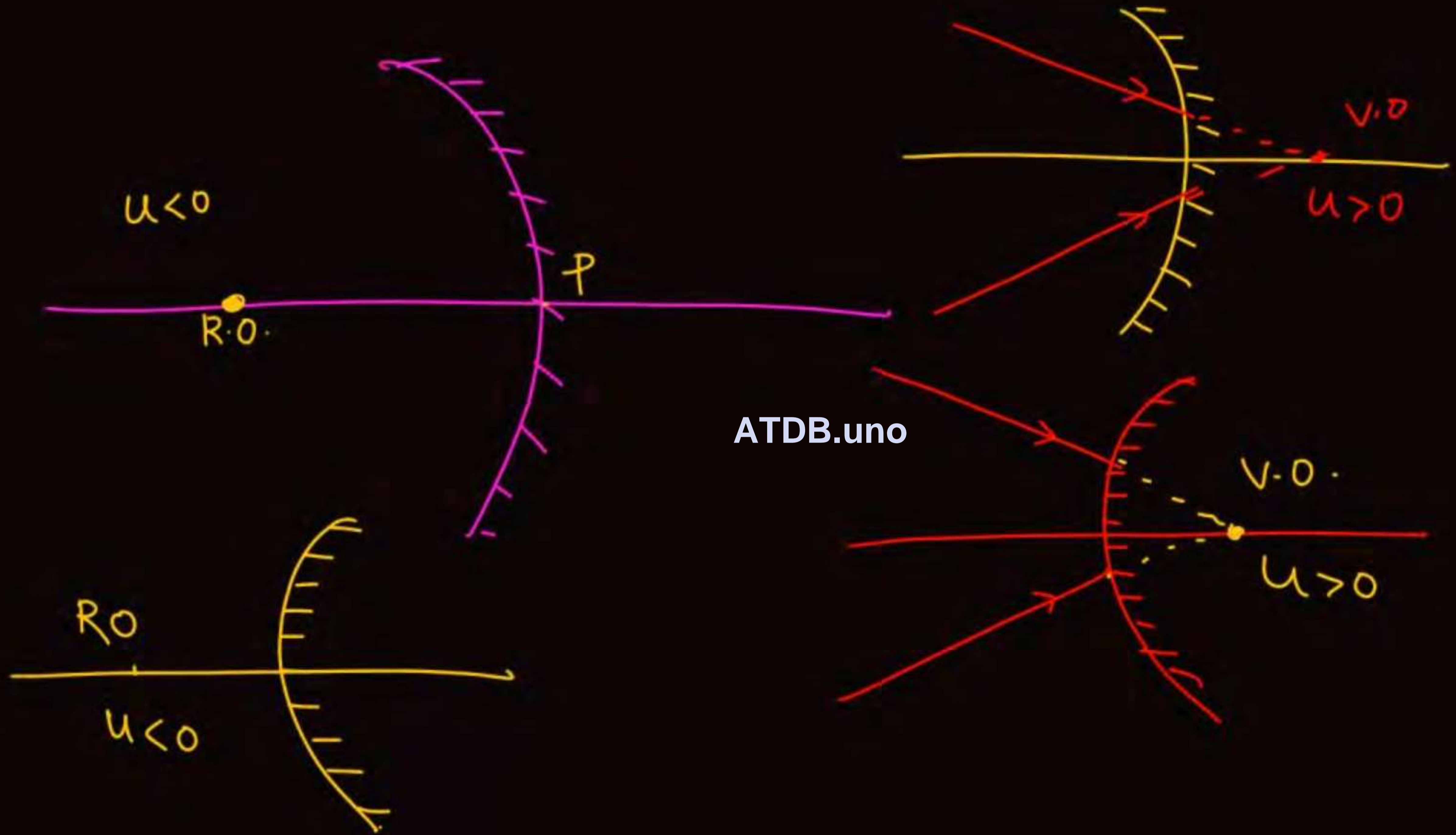
$u > 0 \rightarrow$ V.O
 $v > 0 \rightarrow$ V.I



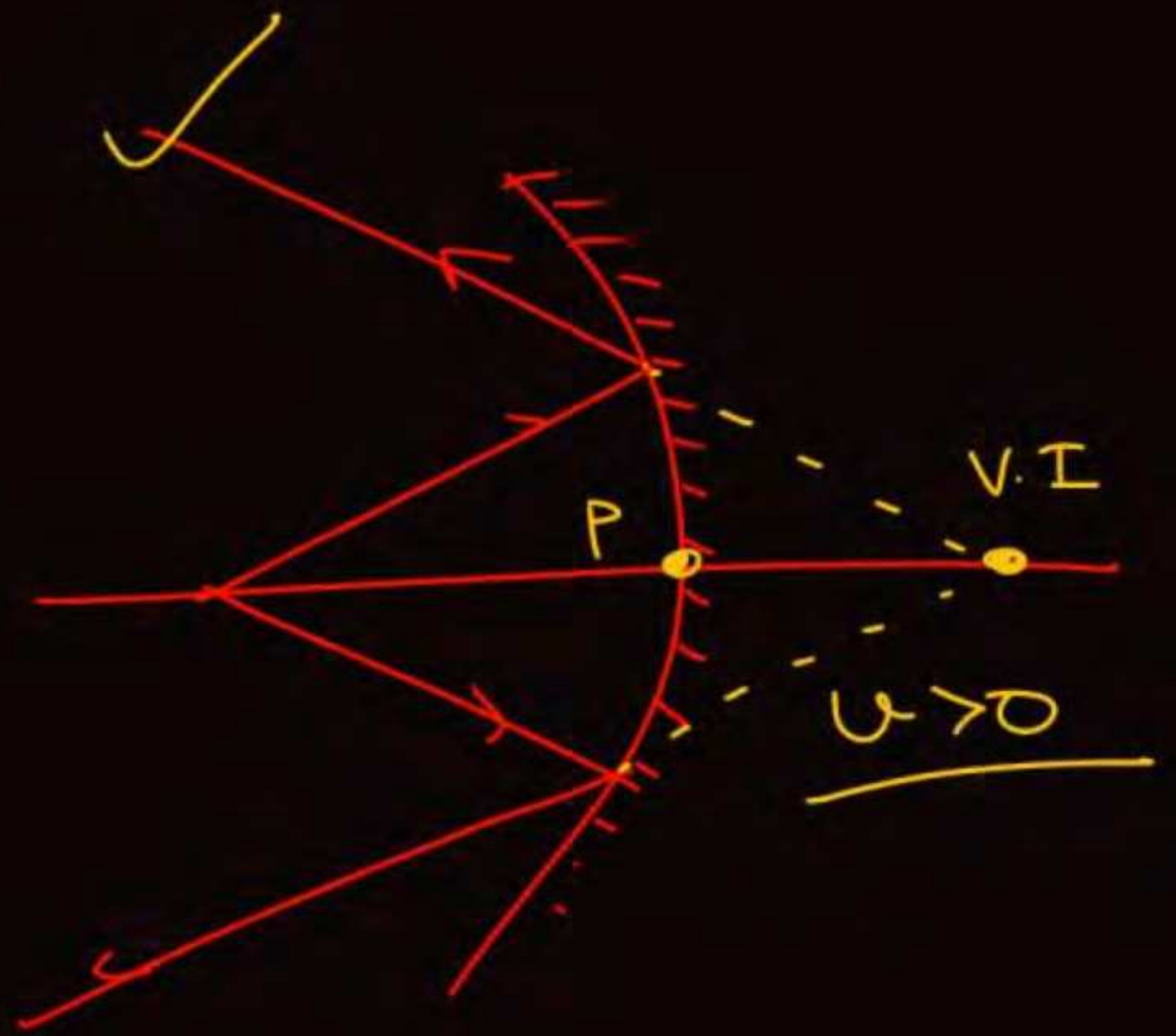
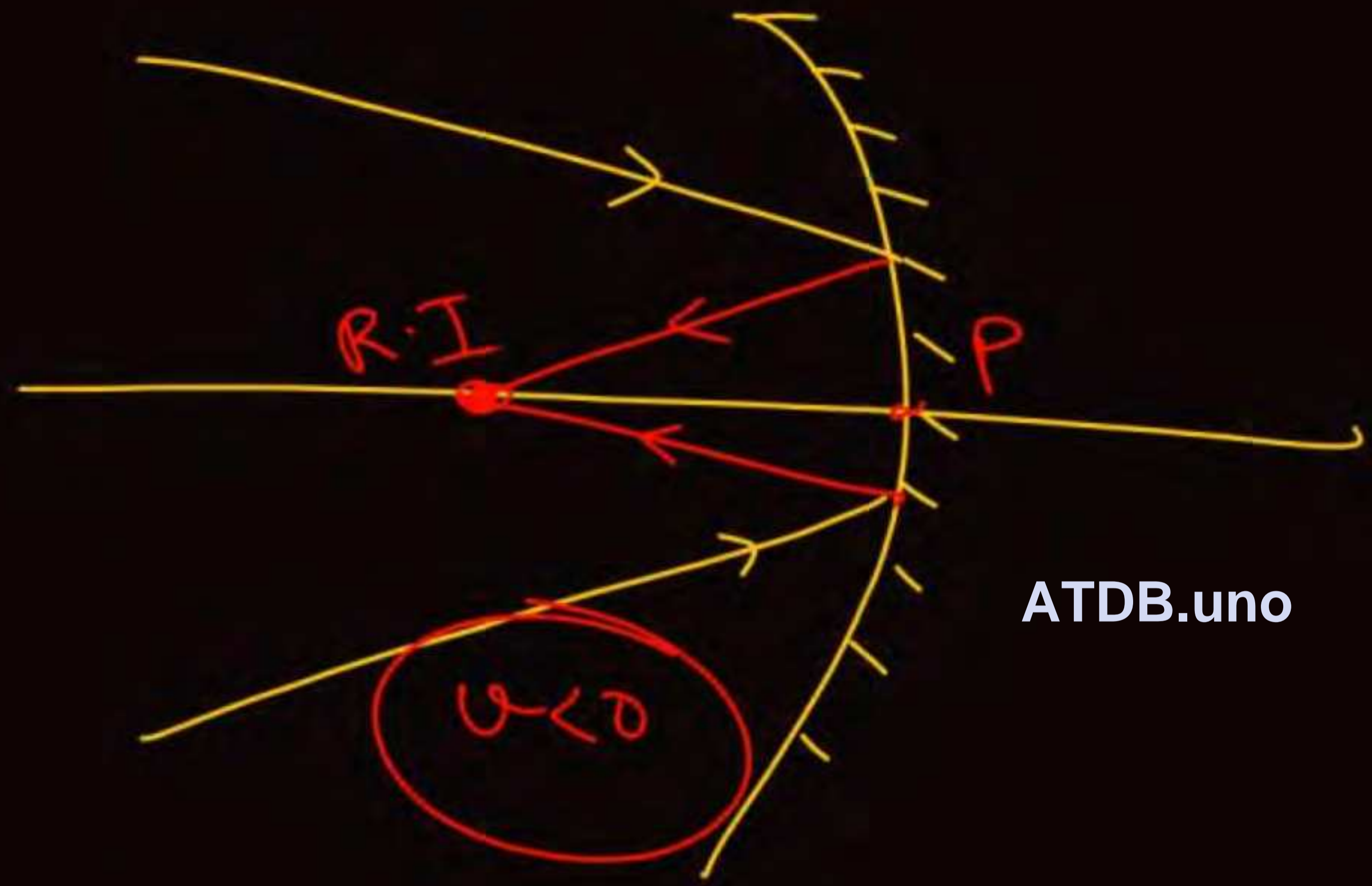
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$u, v \Rightarrow$ (Negative \rightarrow Real
 positive \rightarrow Virtual)

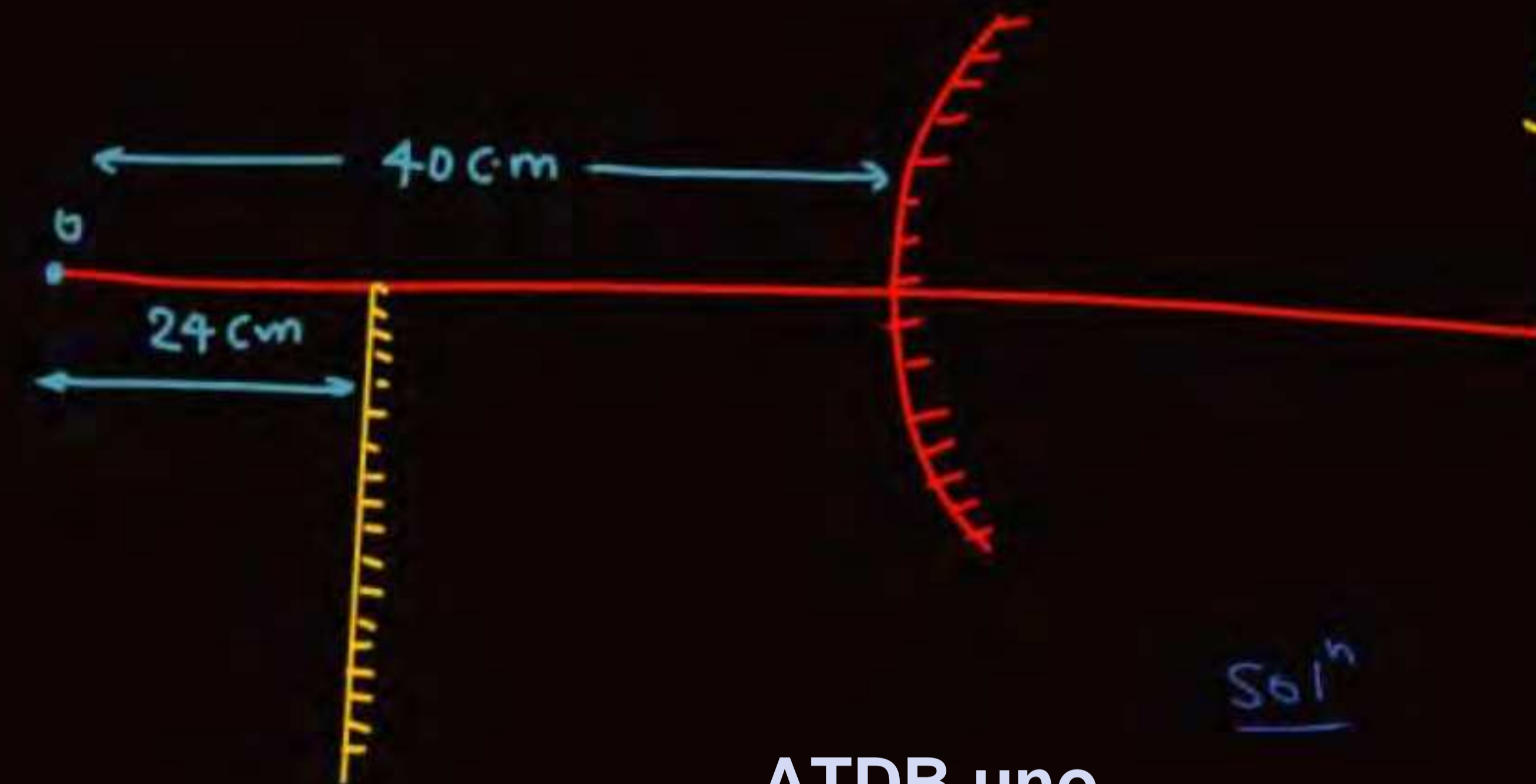




ATDB.uno



Q

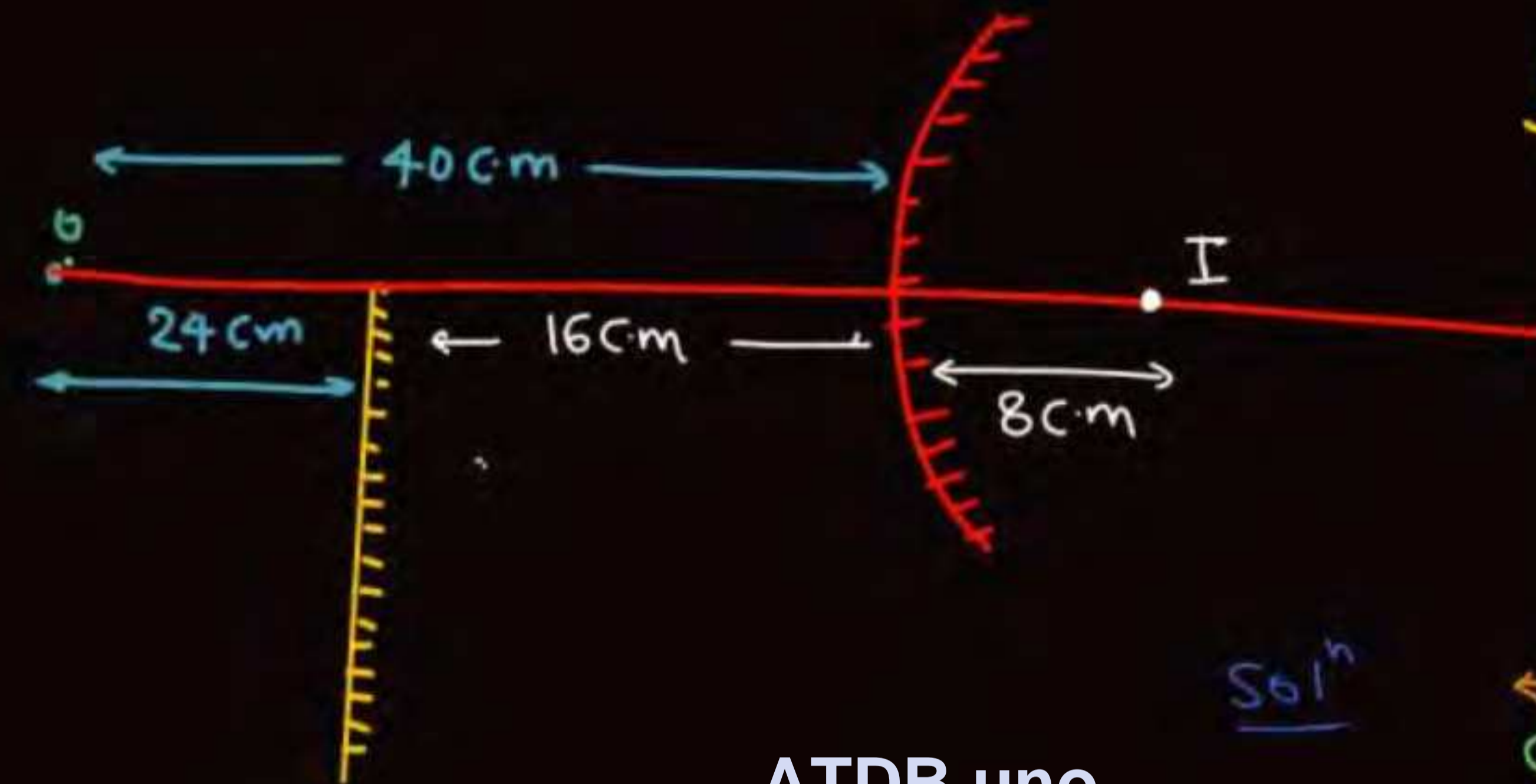


find focal length of convex mirror
If image formed by both the mirrors coincide.

Solⁿ

ATDB.uno

Q



find focal length of convex mirror
 If image formed by both the mirrors coincide.

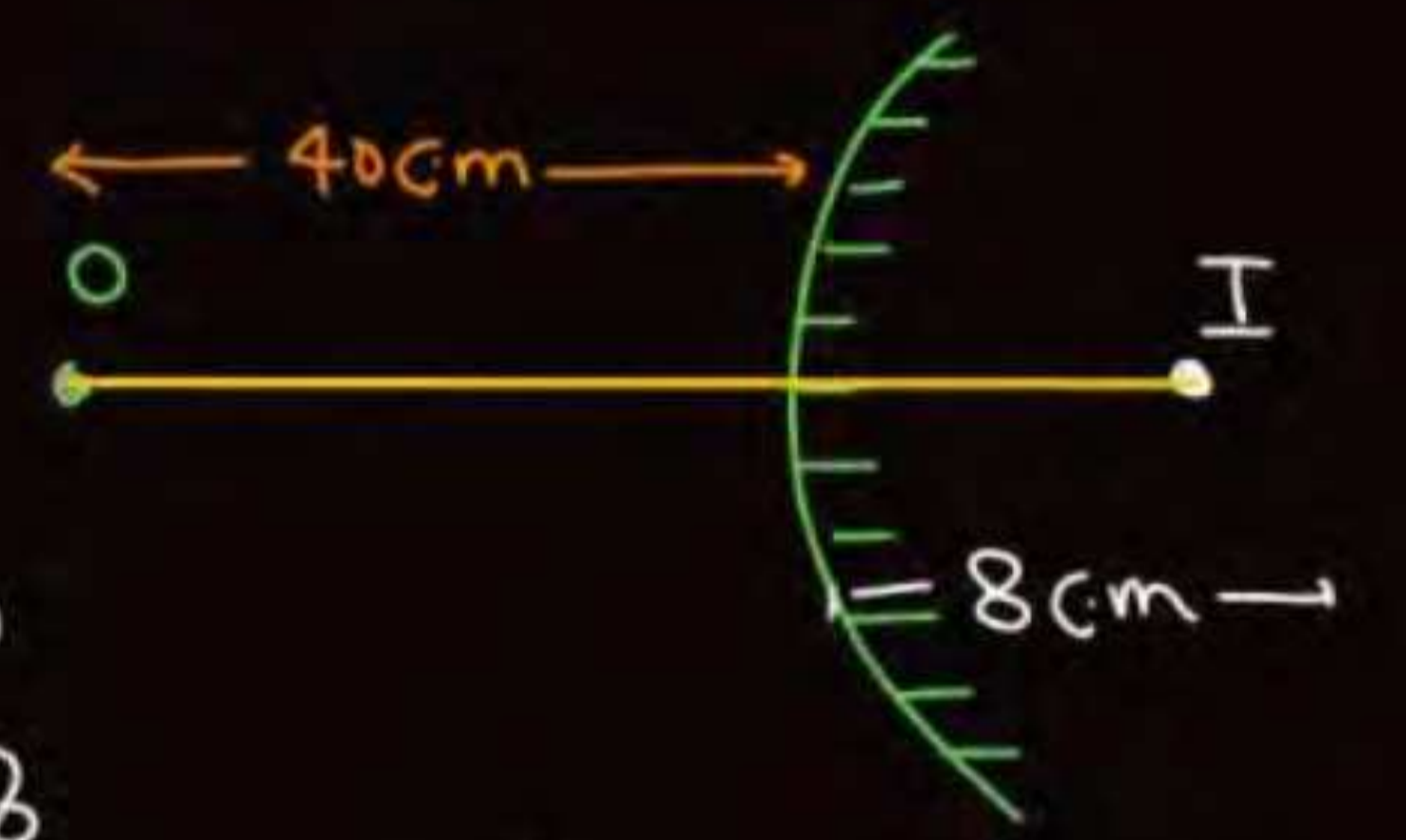
ATDB.uno

Solⁿ

$$u = -40$$

$$v = +8$$

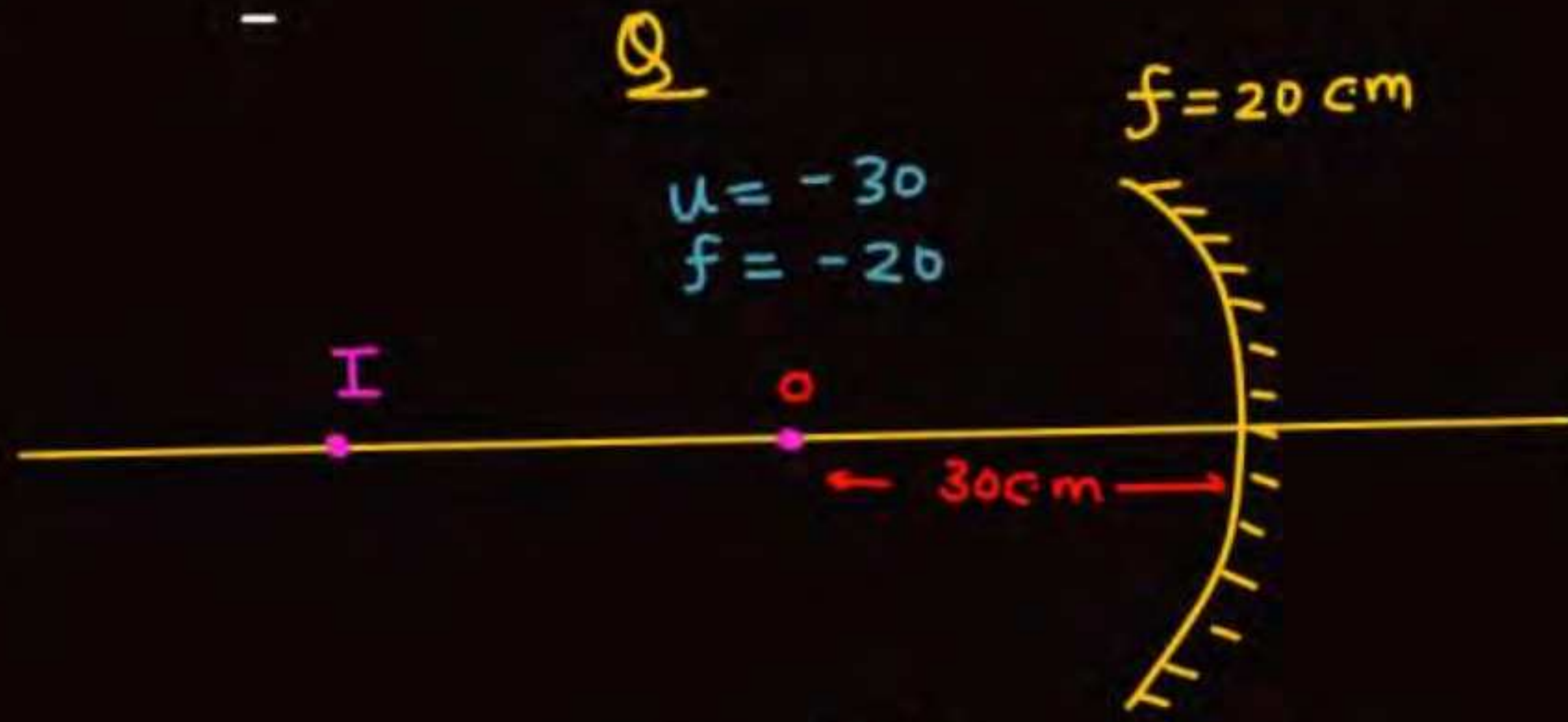
$$f = ?$$



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

$$\frac{1}{8} - \frac{1}{40} = \frac{1}{f}$$

$$f = +10$$

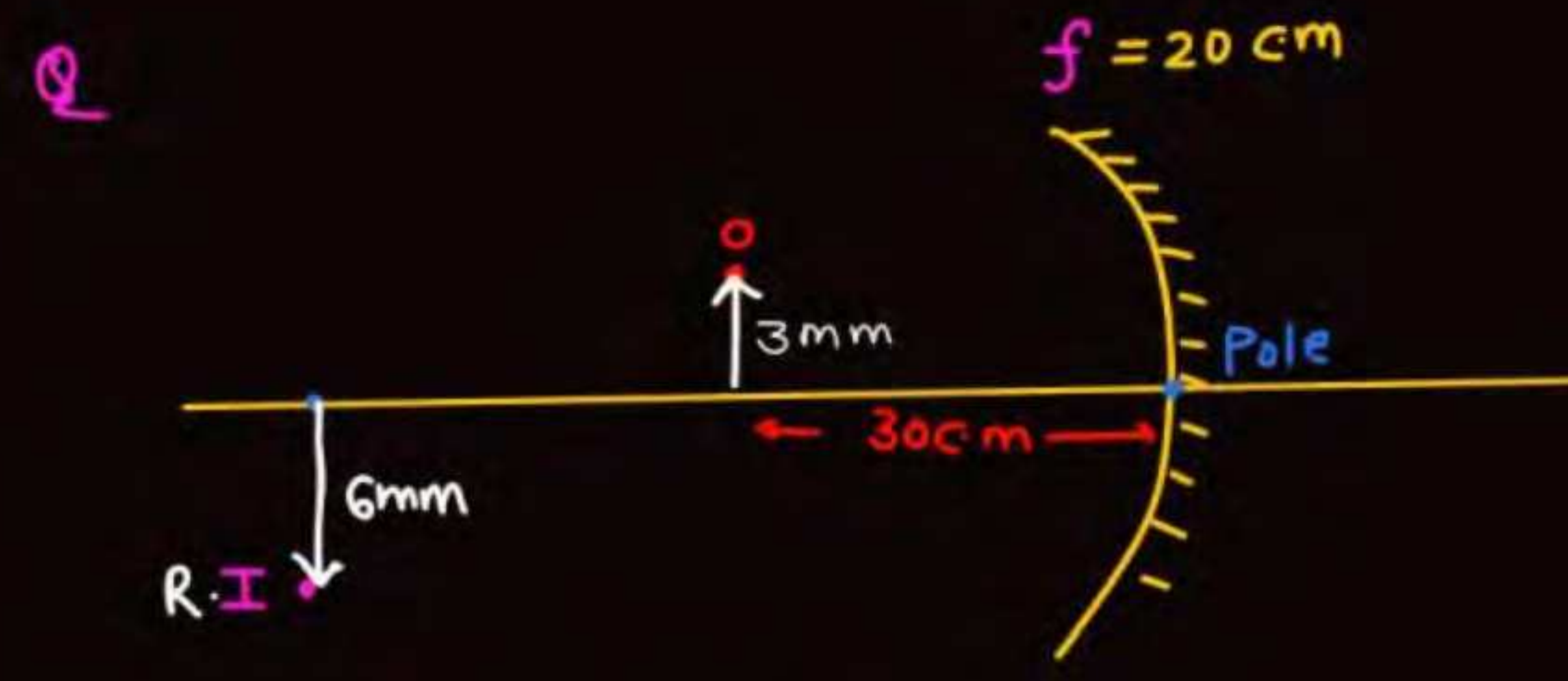


$$v = \frac{600}{-30 - (-20)} = -60$$

$$m = -\frac{v}{u} = -\frac{(-60)}{-30}$$

$$m = -2$$

ATDB.uno



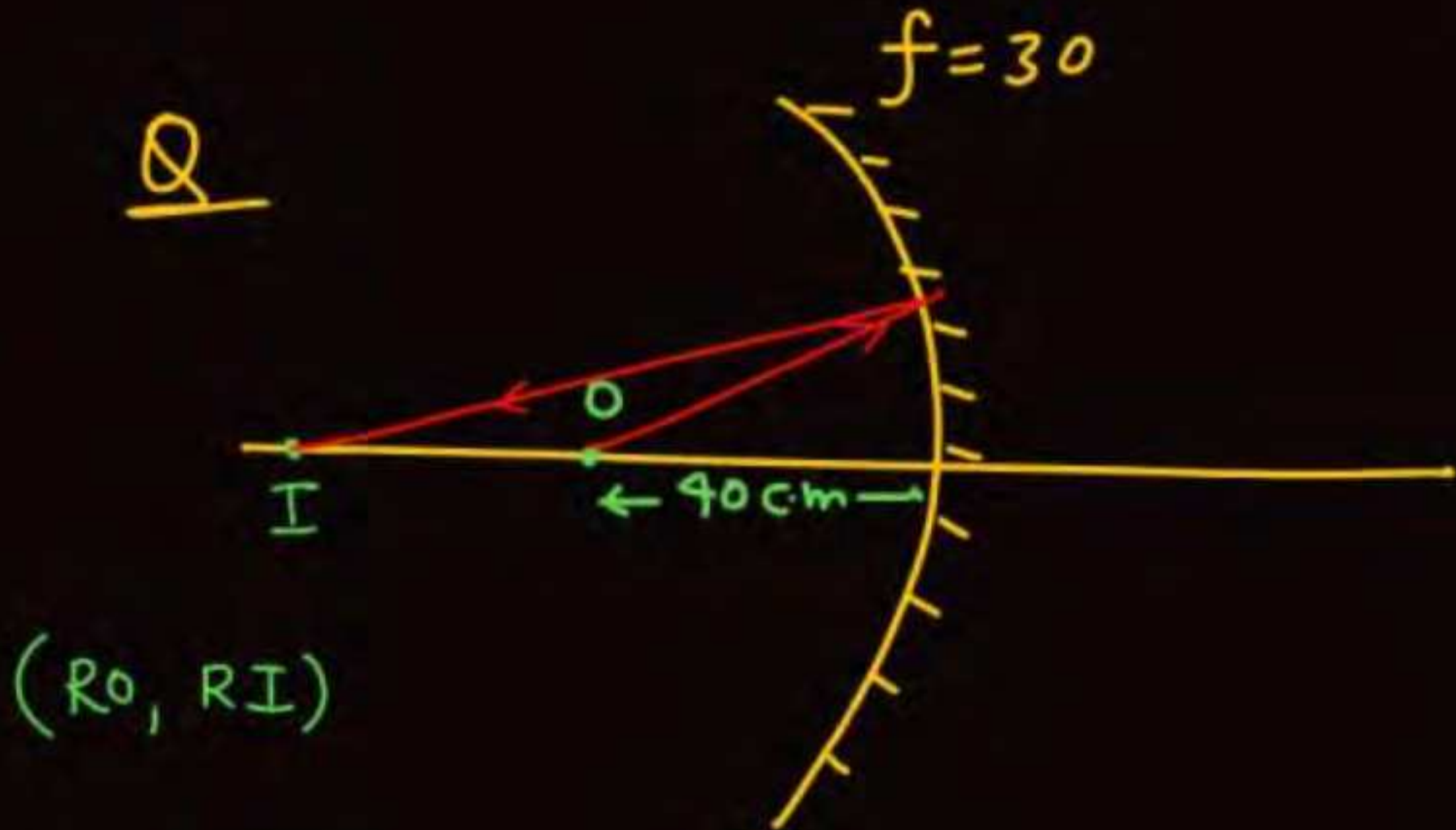
$$u = -30, f = -20 \left. \vphantom{u, f} \right\} u = -60 \text{ (R.I)}$$

$$m = -\frac{v}{u} = -\frac{-60}{-30} = -2$$

$$m = -2 = \frac{h_I}{h_o}$$

$$h_I = -2 \times 3 \text{ mm}$$

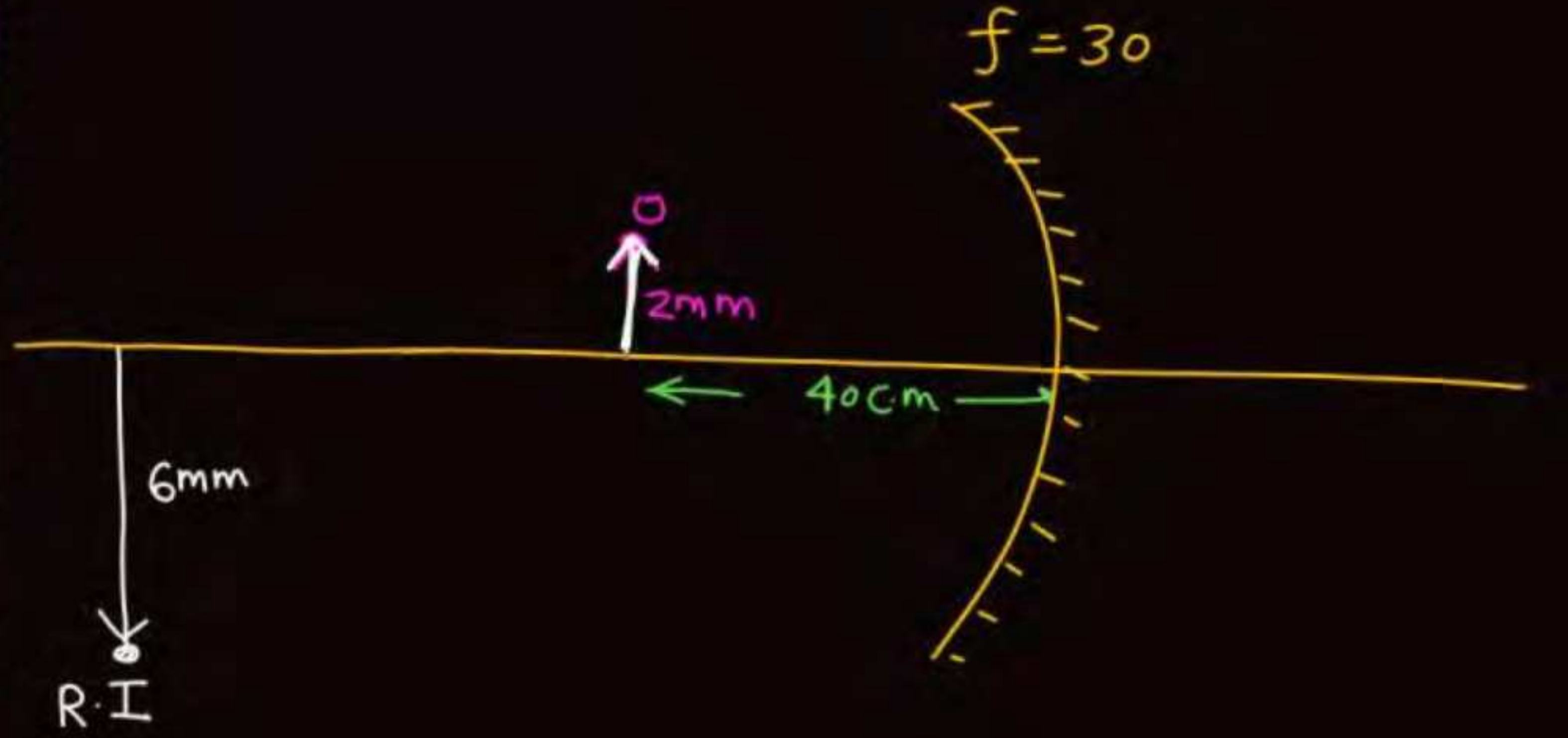
$$h_I = -6 \text{ mm}$$



$$v = \frac{uf}{u-f} = \frac{1200}{-10} = -120$$

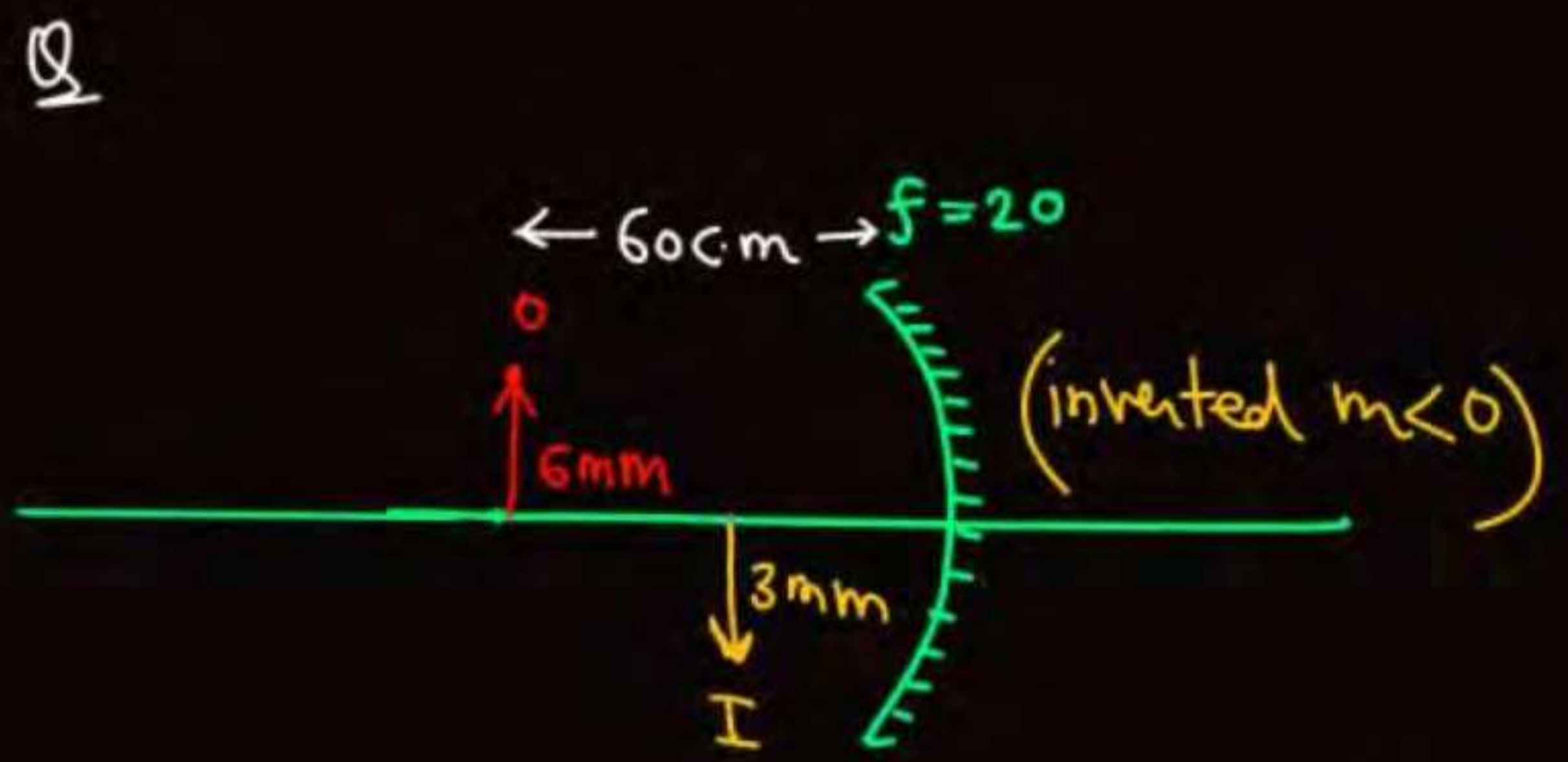
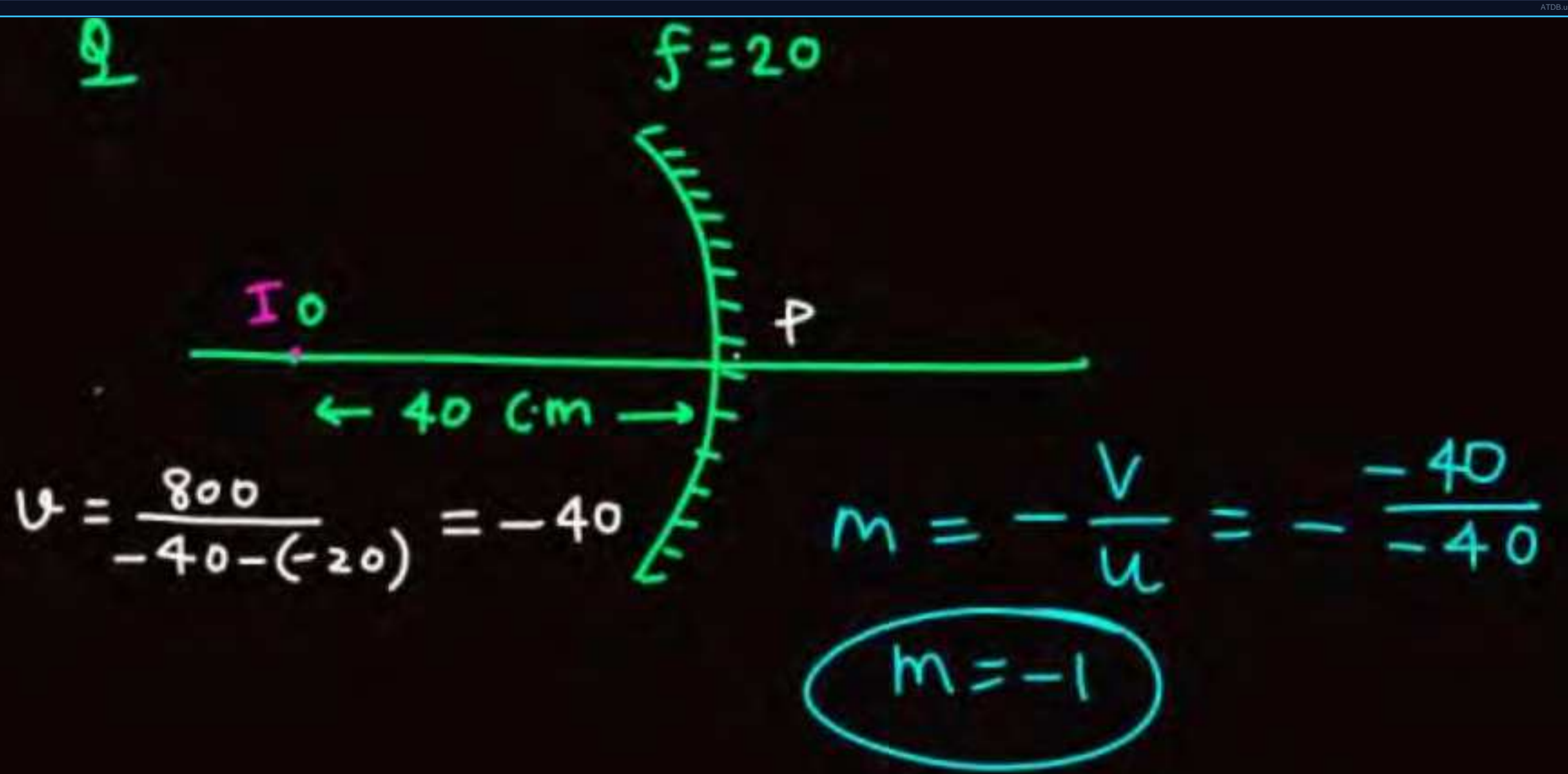
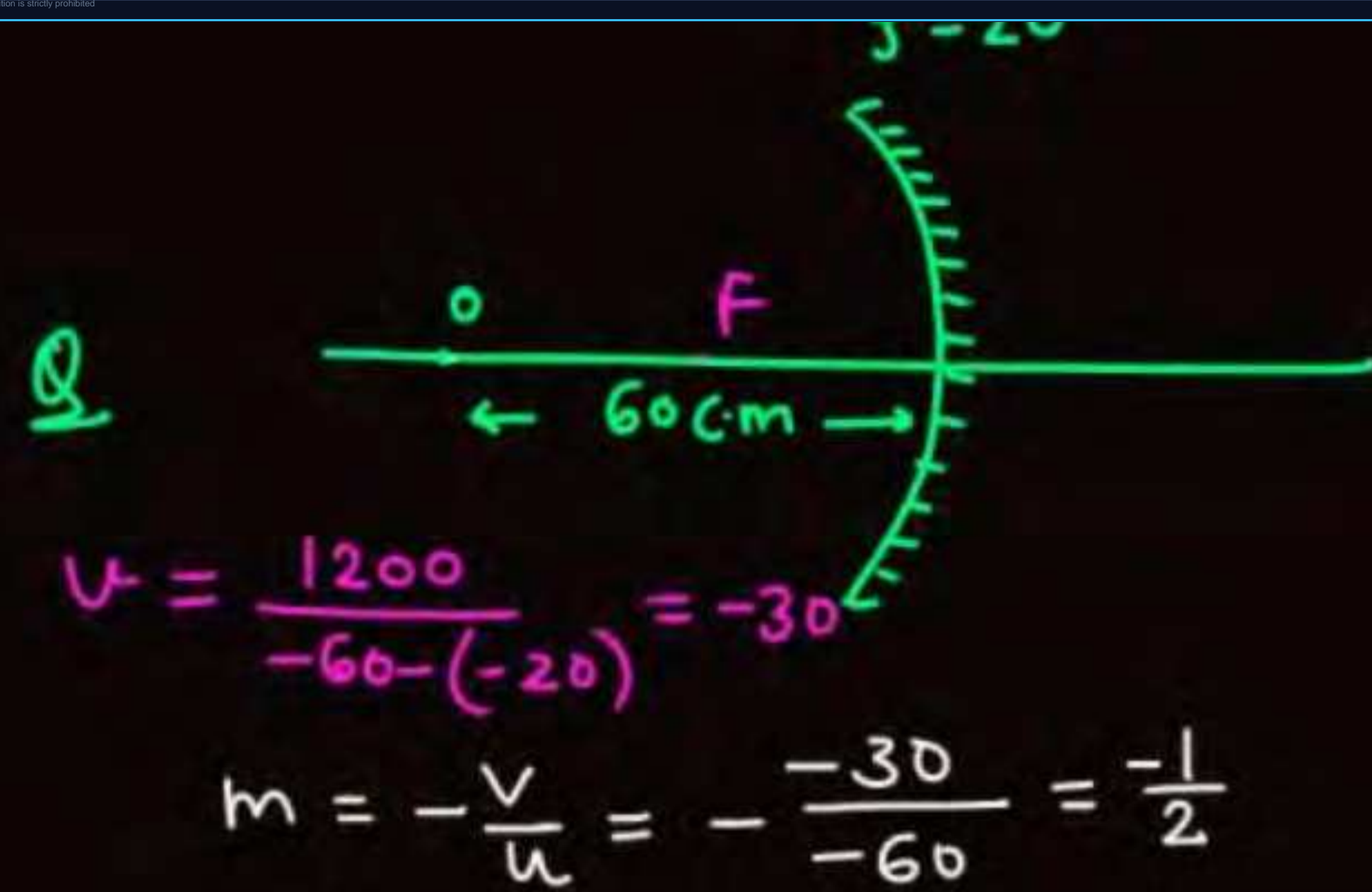
$$m = -\frac{v}{u} = -\frac{-120}{-40} = -3$$

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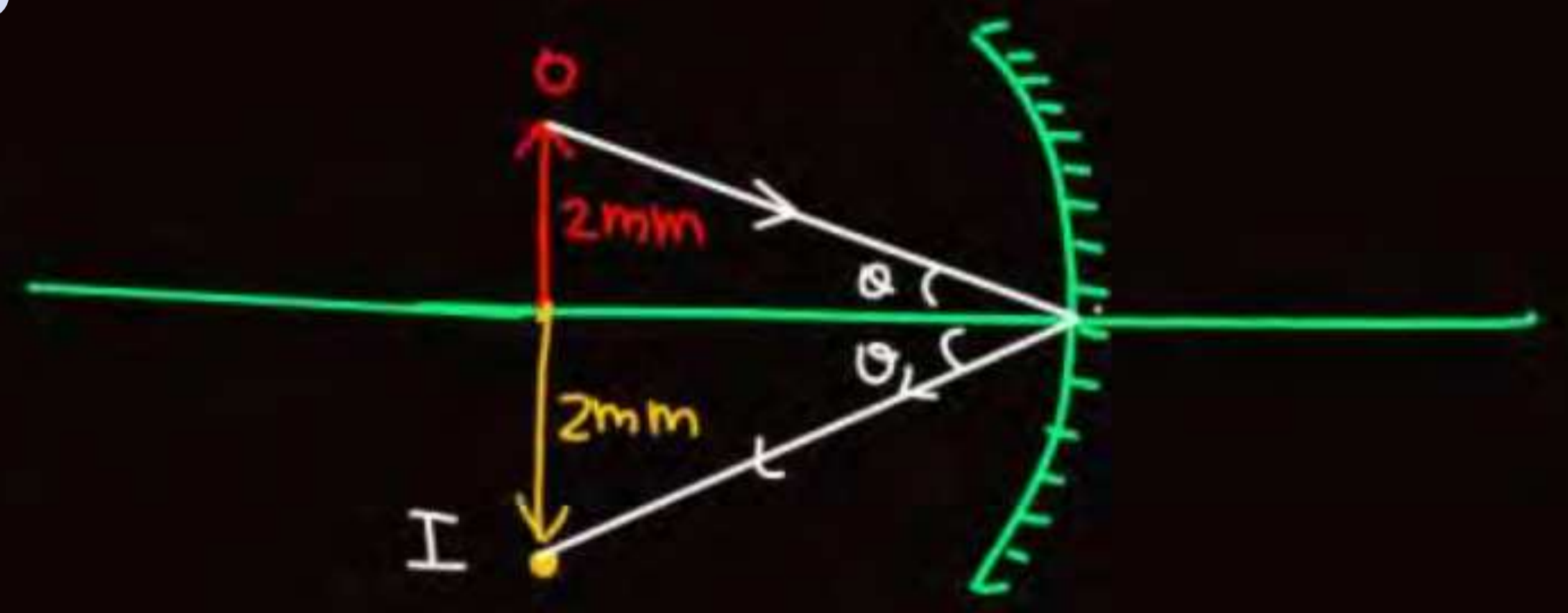


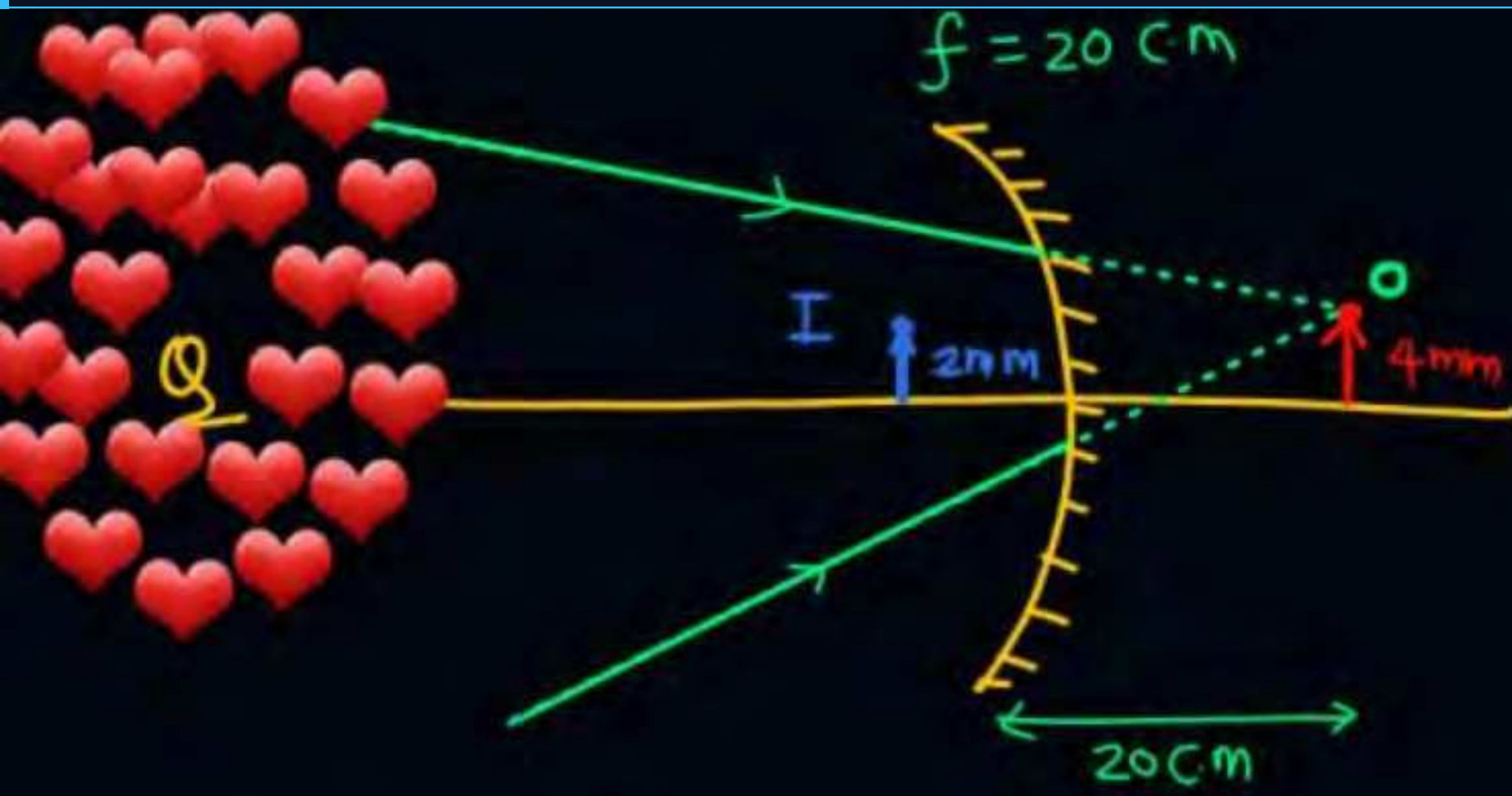
$$v = -120 \text{ (same), } R I$$

$$m = -3 \text{ (inverted, enlarge)}$$



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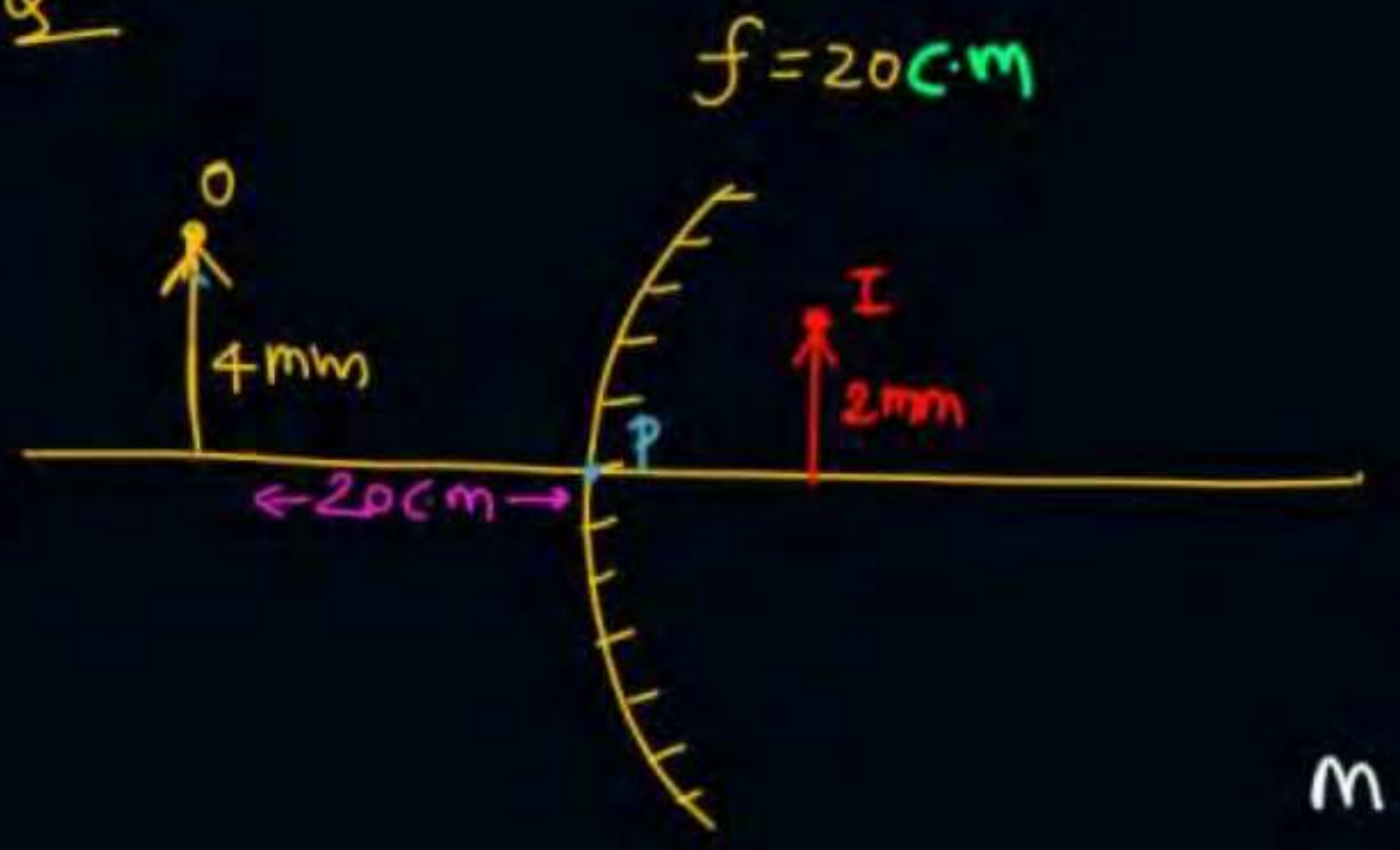




$$\left. \begin{matrix} u = +20 \\ f = -20 \end{matrix} \right\} v = \frac{-400}{20 - (-20)} = -10$$

$$m = -\frac{v}{u} = -\frac{-10}{+20} = +\frac{1}{2} \text{ (erect)}$$

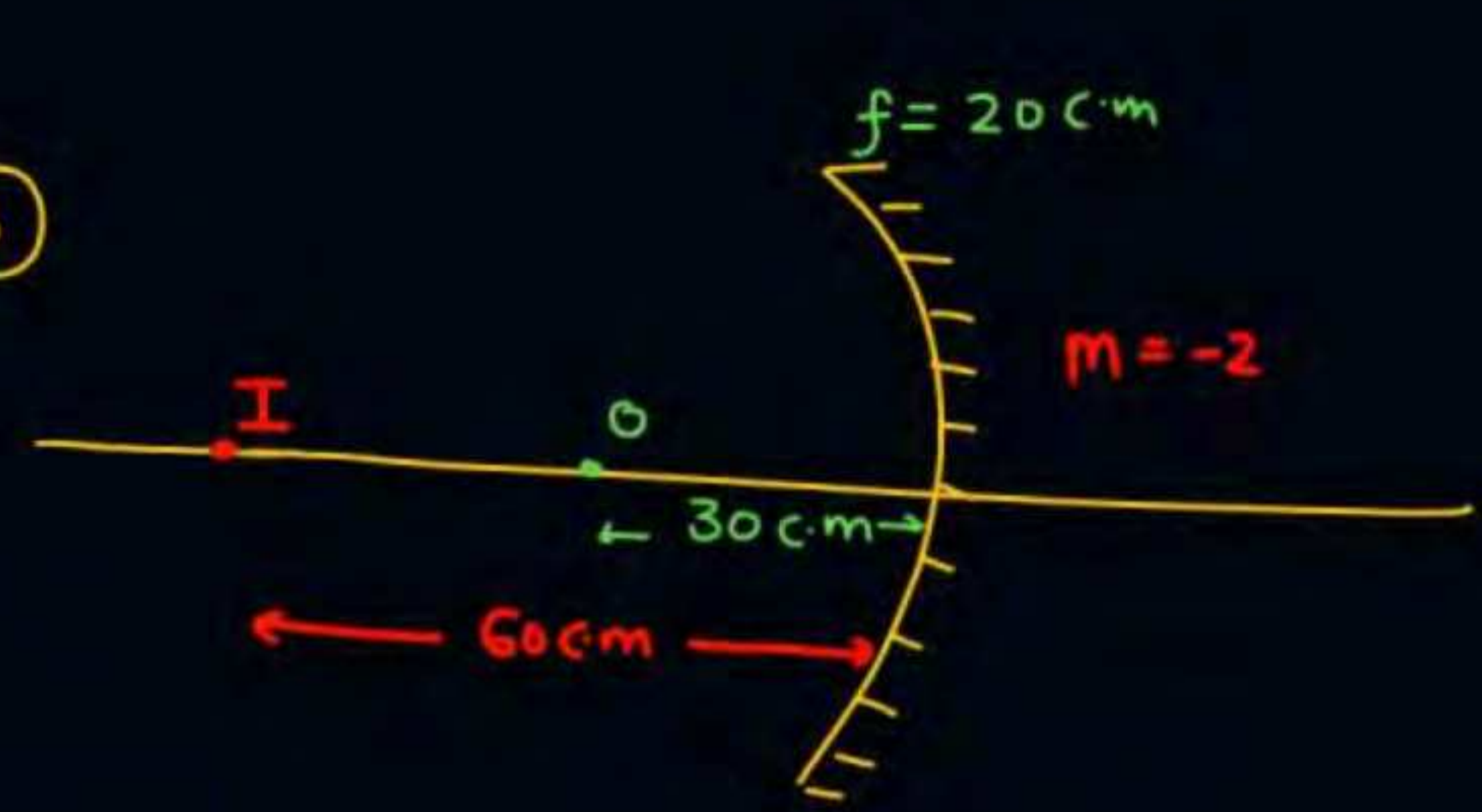
Q



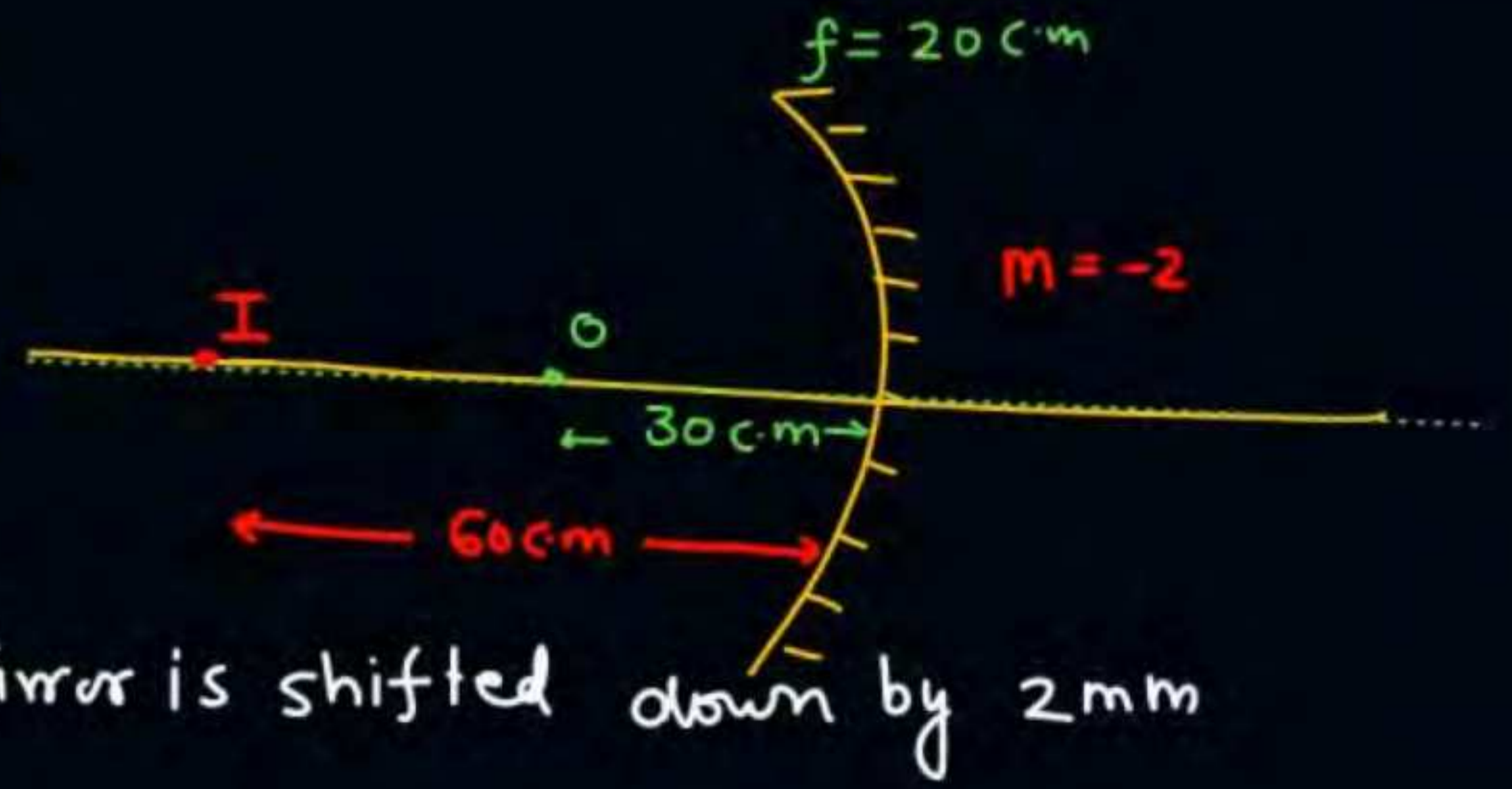
$$\begin{aligned} f &= +20 \\ u &= -20 \\ v &= \frac{-400}{-20 - 20} = +10 \\ m &= -\frac{v}{u} = -\frac{10}{-20} = +\frac{1}{2} \text{ (erect)} \end{aligned}$$

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3



4



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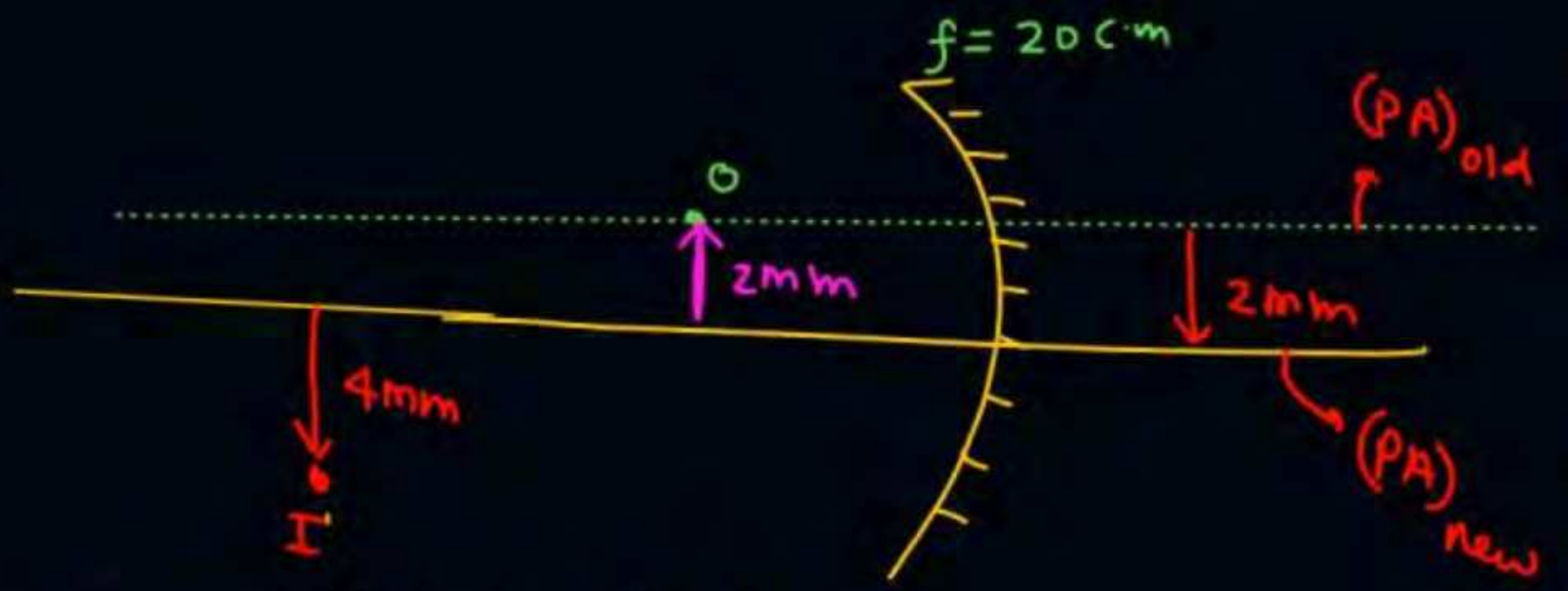
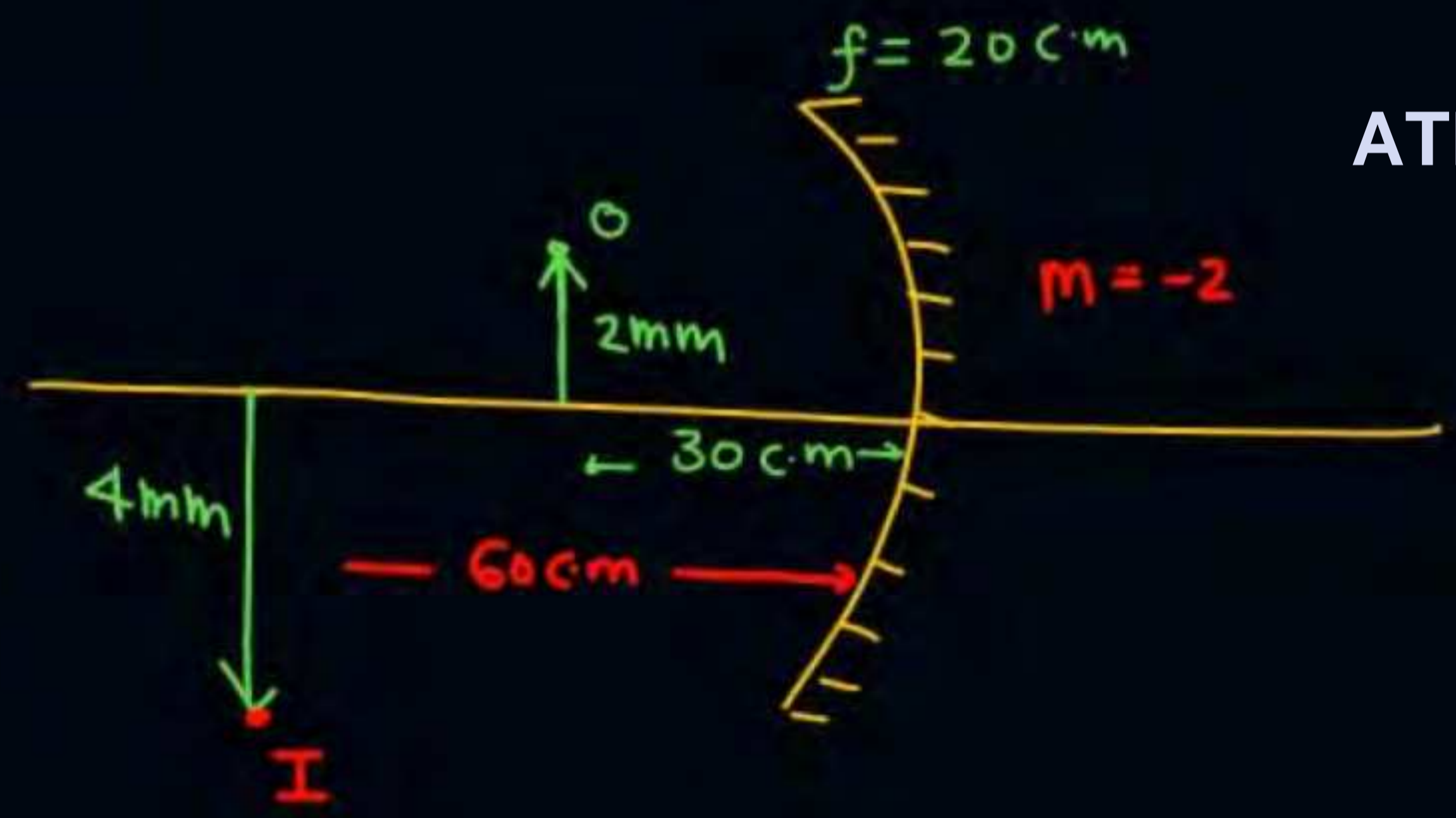
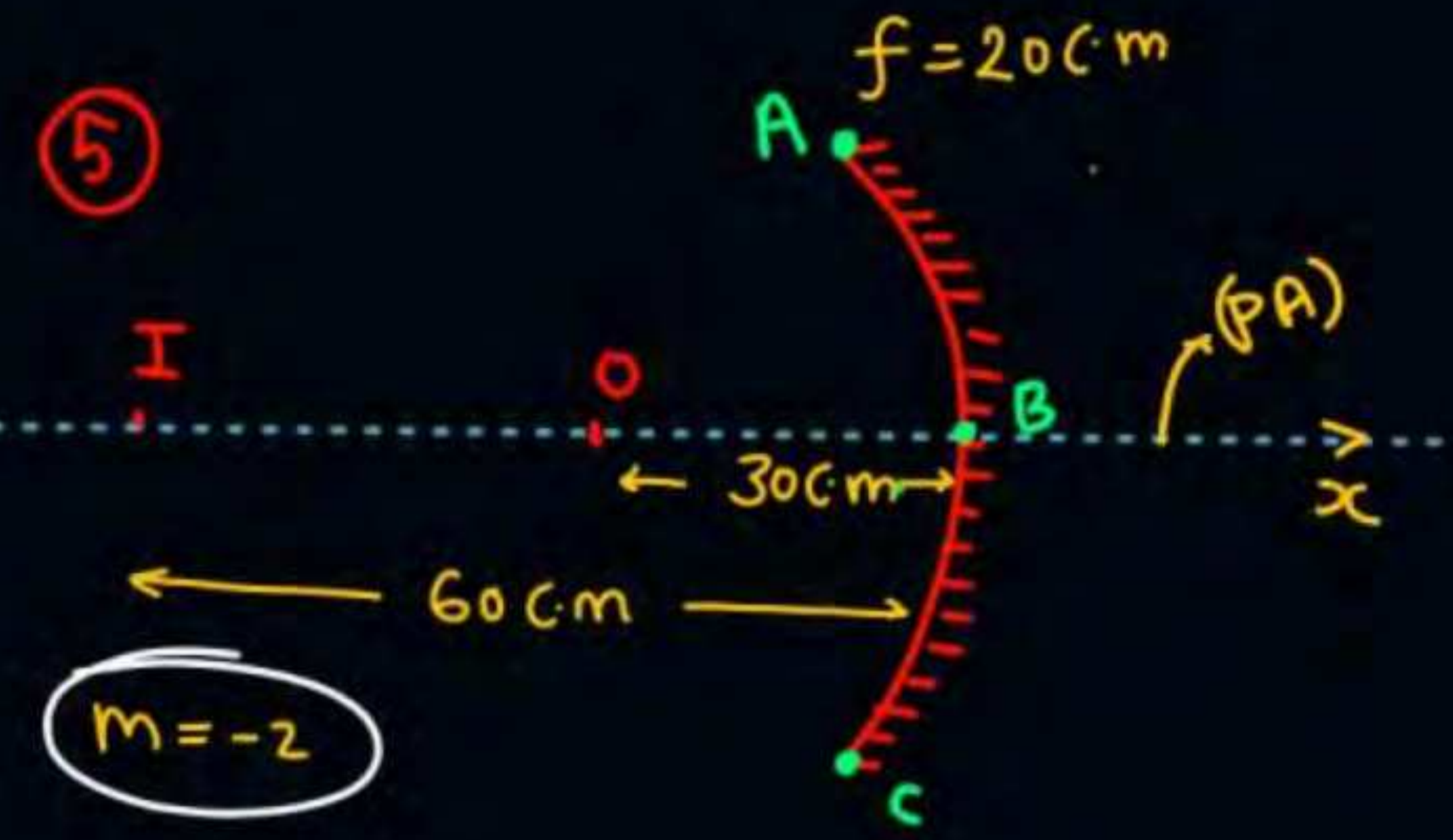


image shifted down by 6mm



If mirror is cut at B & upper half of the mirror shifted upward by 3mm & lower half of the mirror is shifted down by 2mm. find gap b/w two image formed.

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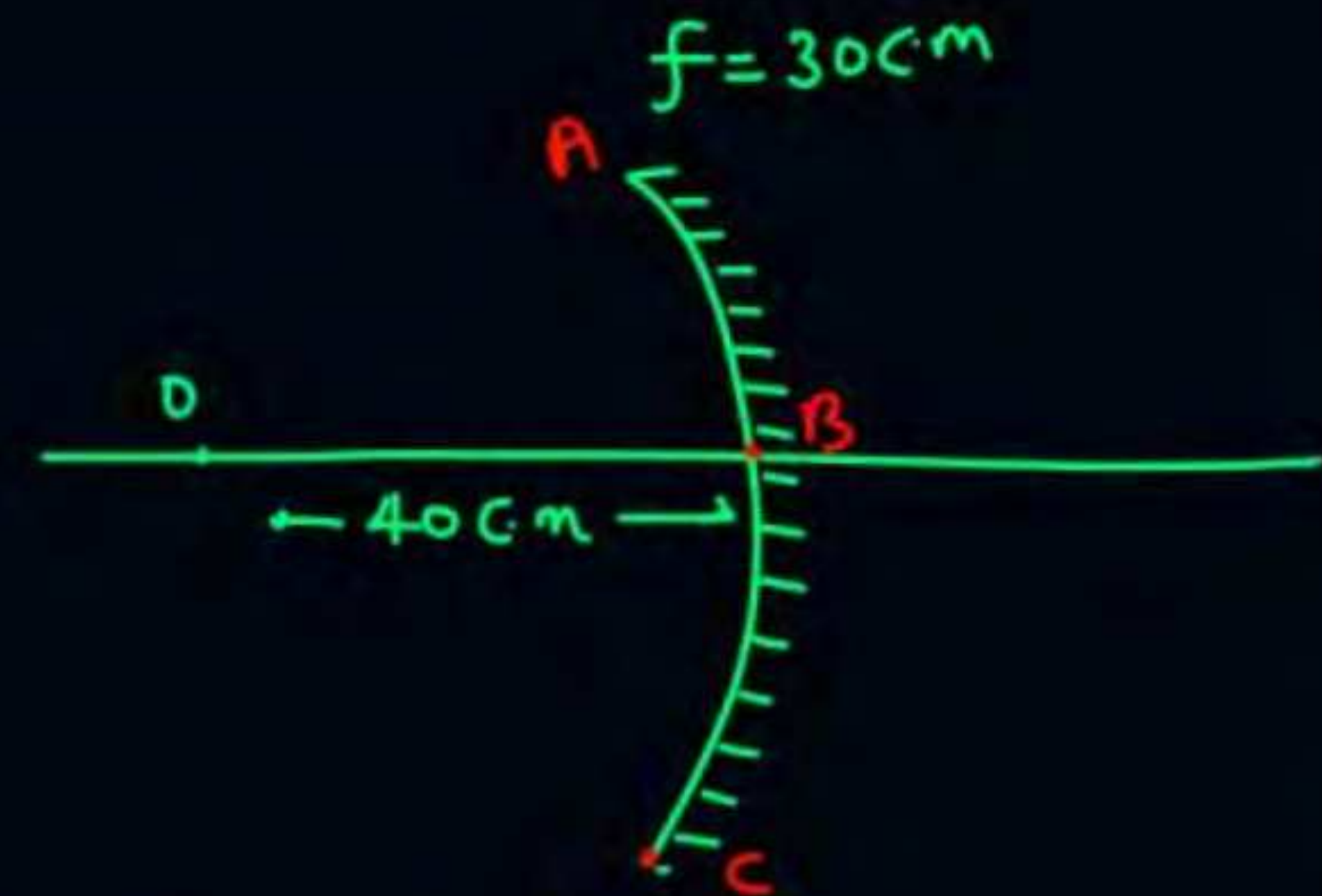
Solⁿ



Ans

$$6 + 3 + 2 + 4 = \underline{\underline{15}} \text{ mm}$$

Q



mirror is cut at 'B'
 & upper part is shifted up by 2mm
 & lower part is shifted down by 3mm
 find gap b/w two image

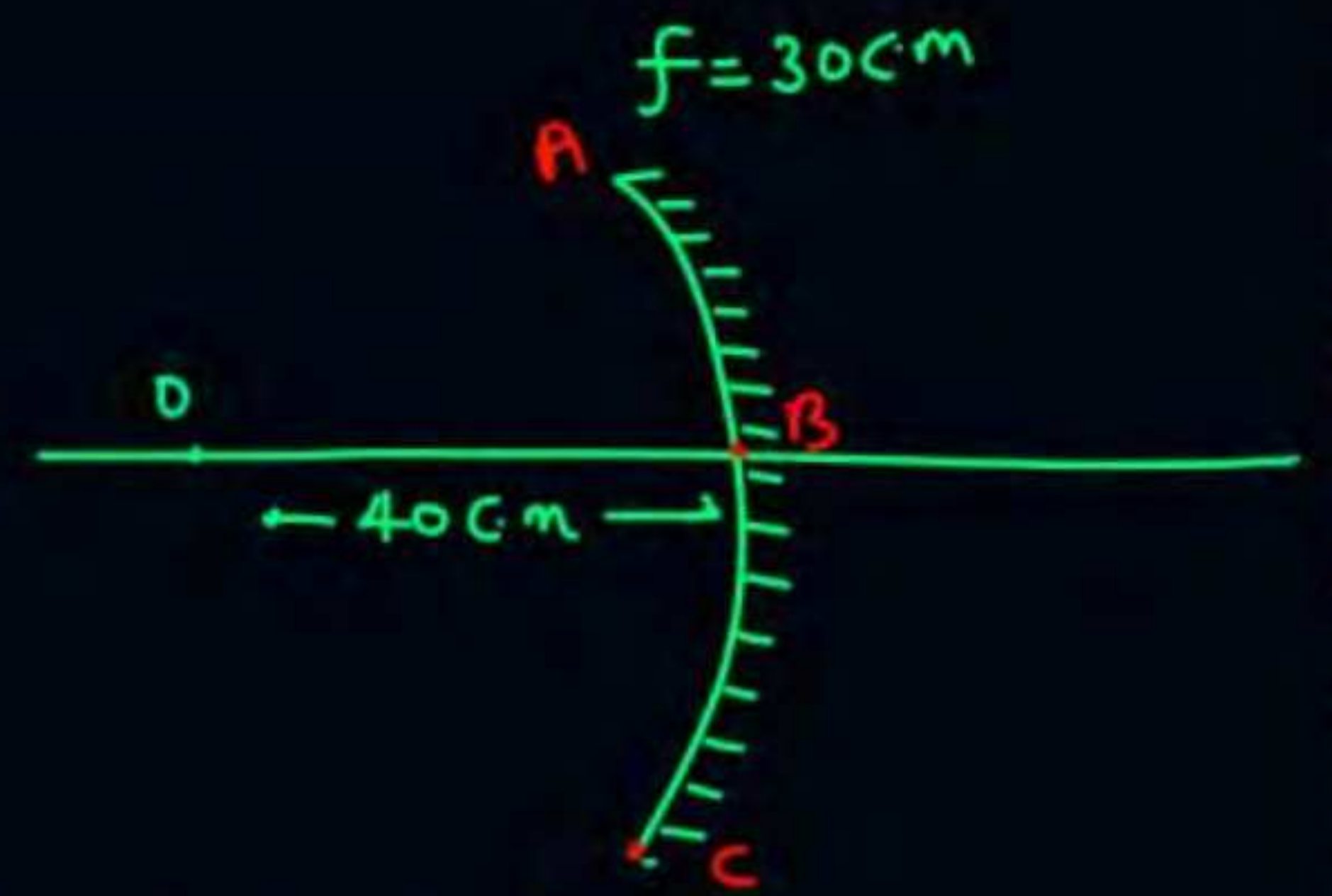
Solⁿ

$$u = \frac{1200}{-40 - (-30)} = -120$$

$$m = - \frac{-120}{-40} = -3$$

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Q



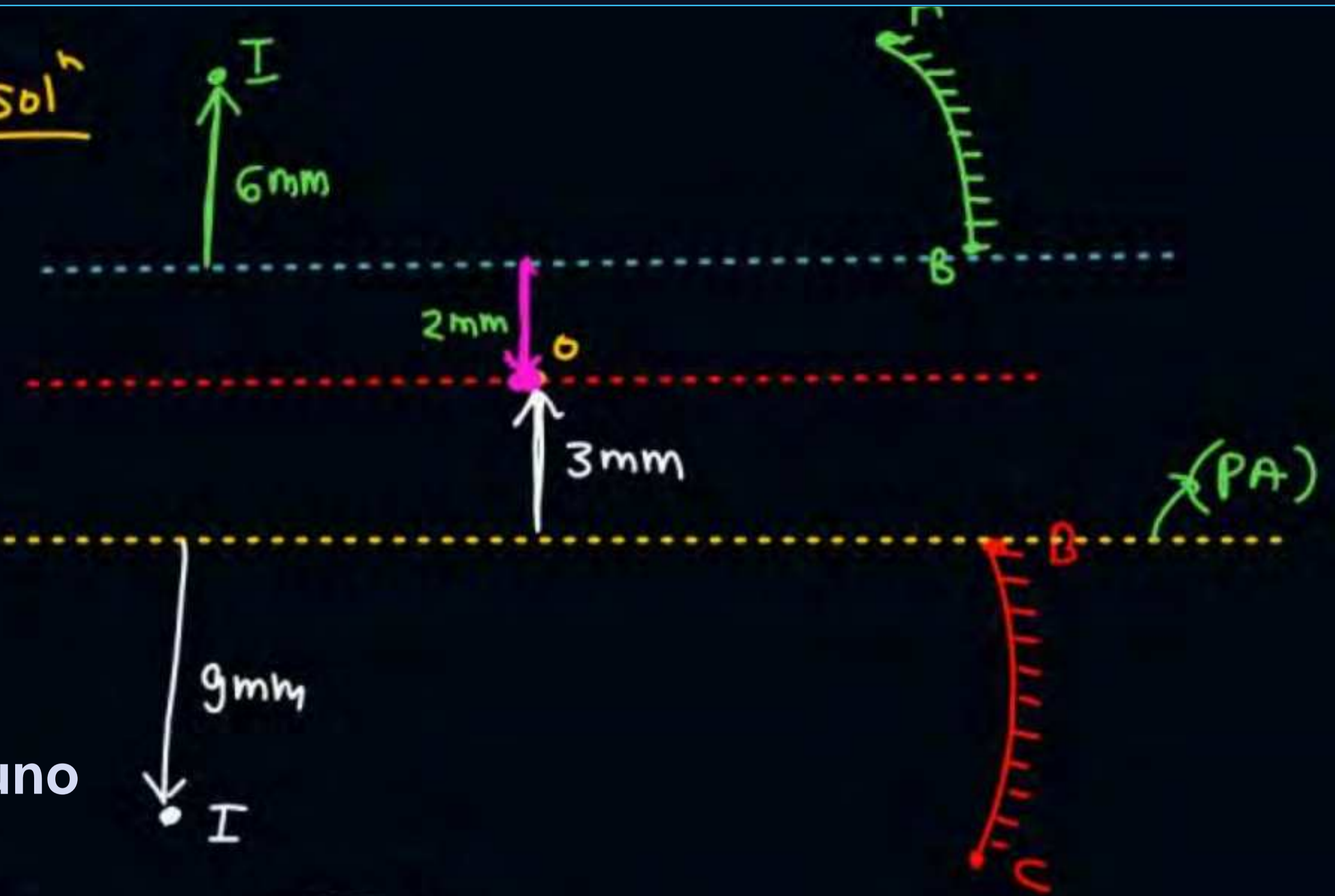
Mirror is cut at B
 & upper part is shifted up by 2 mm
 & lower part is shifted down by 3 mm
 find gap b/w two image

Solⁿ

$$u = \frac{1200}{-40 - (-30)} = -120$$

$$m = - \frac{-120}{-40} = -3$$

Solⁿ



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Ans \equiv 20 mm

Home work

– Revise All ques of today Clous

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THANK YOU

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