PRAYAS

JEE 2025

Lecture- 03

Physics

Ray optics

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Topics *to be covered*

1. Mirror Formula

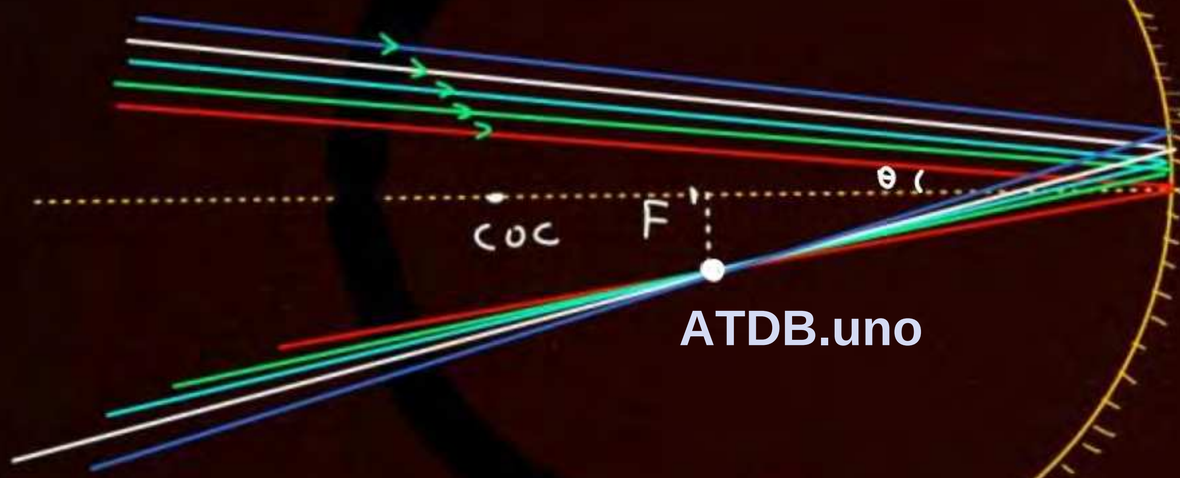
Home #

(4)

paraxial ($\angle i \to 0$)

& parallel to eachother

But not parallel to PA



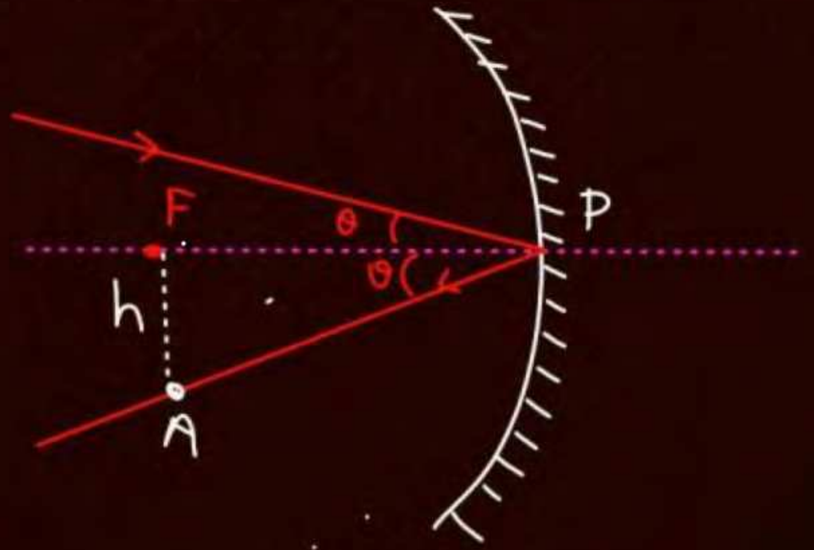
$$\tan\theta = \frac{h}{R/2} \approx \theta$$

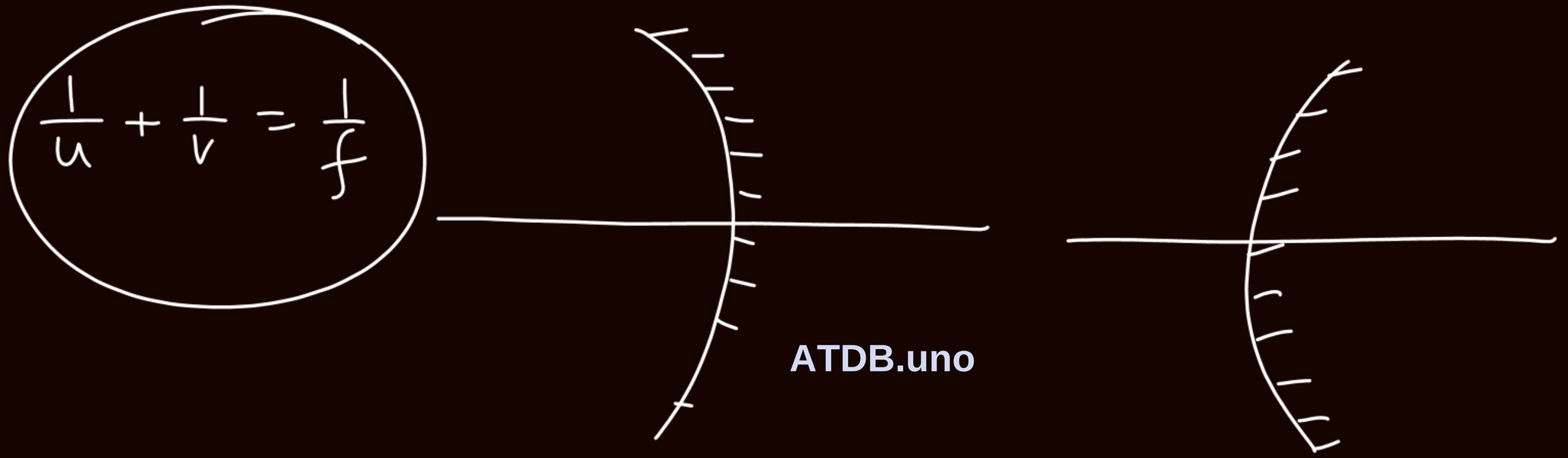
$$h = \frac{R\theta}{2}$$

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

(Paraxial rays) $\quad \theta = \frac{h}{R/2}$

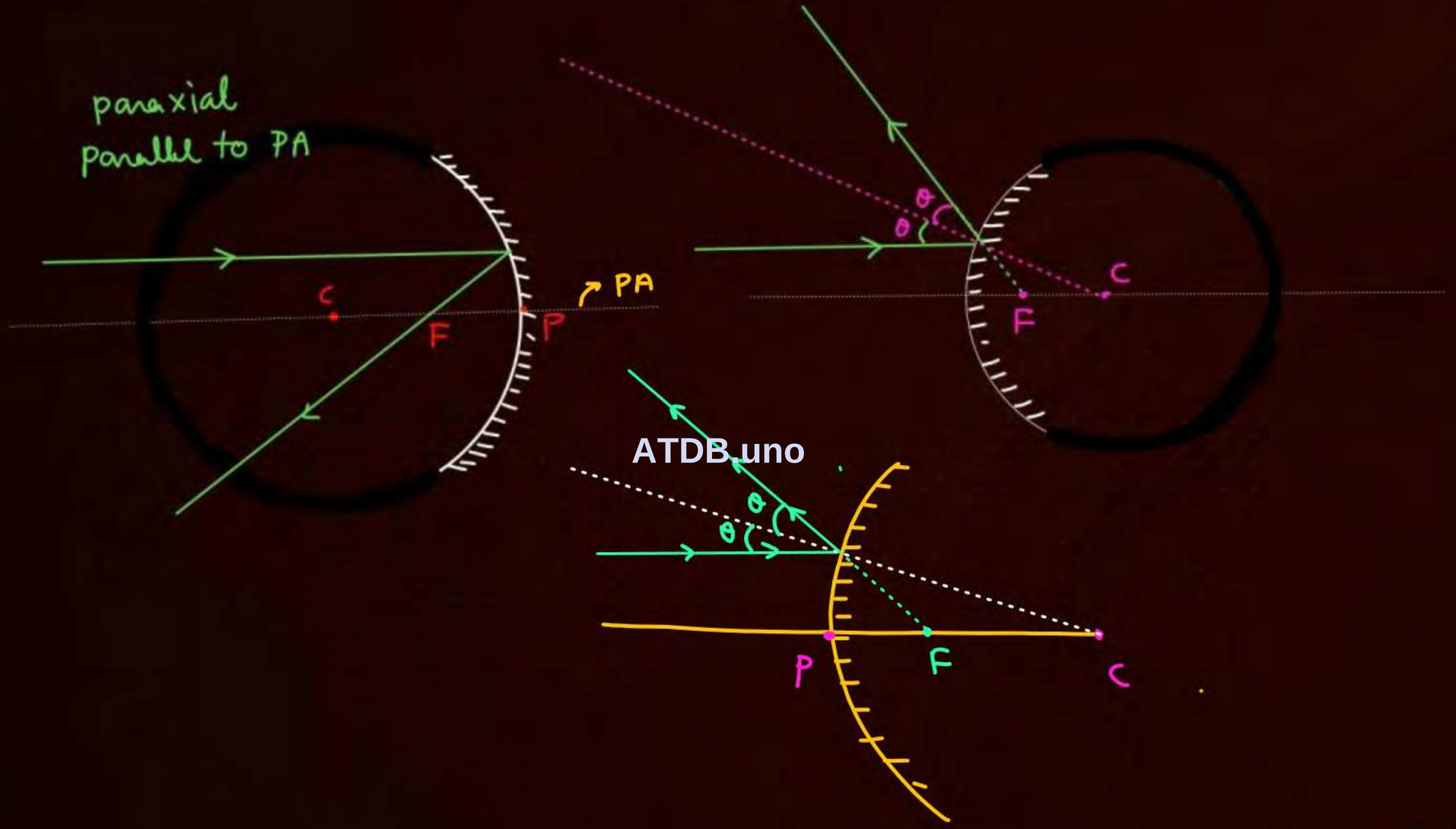
$$h \simeq \theta \cdot R/2$$

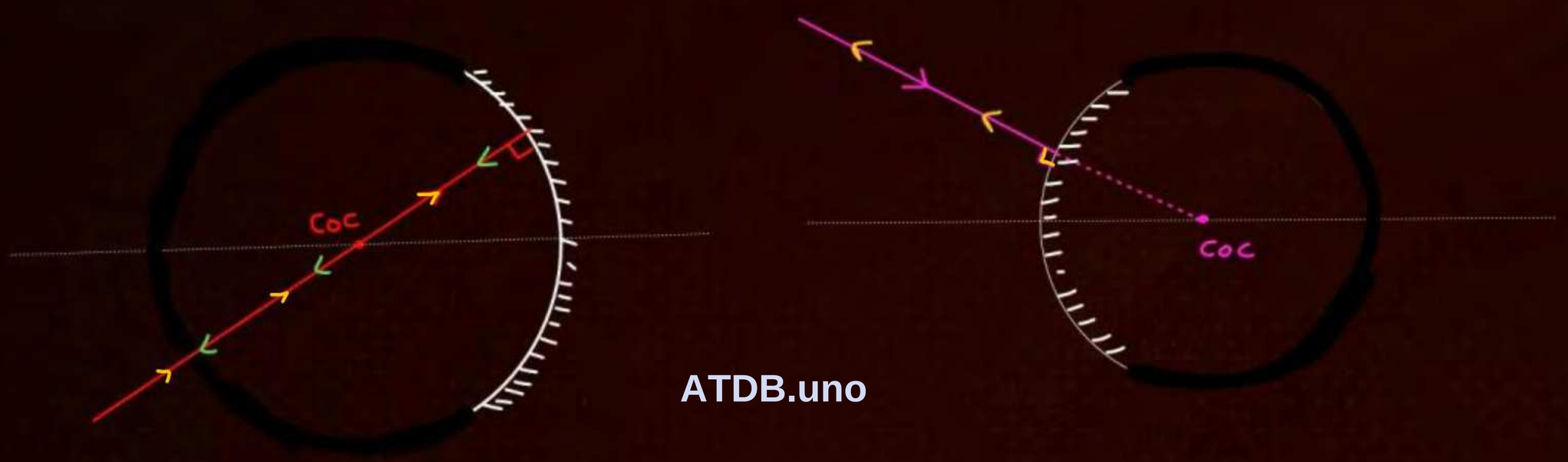




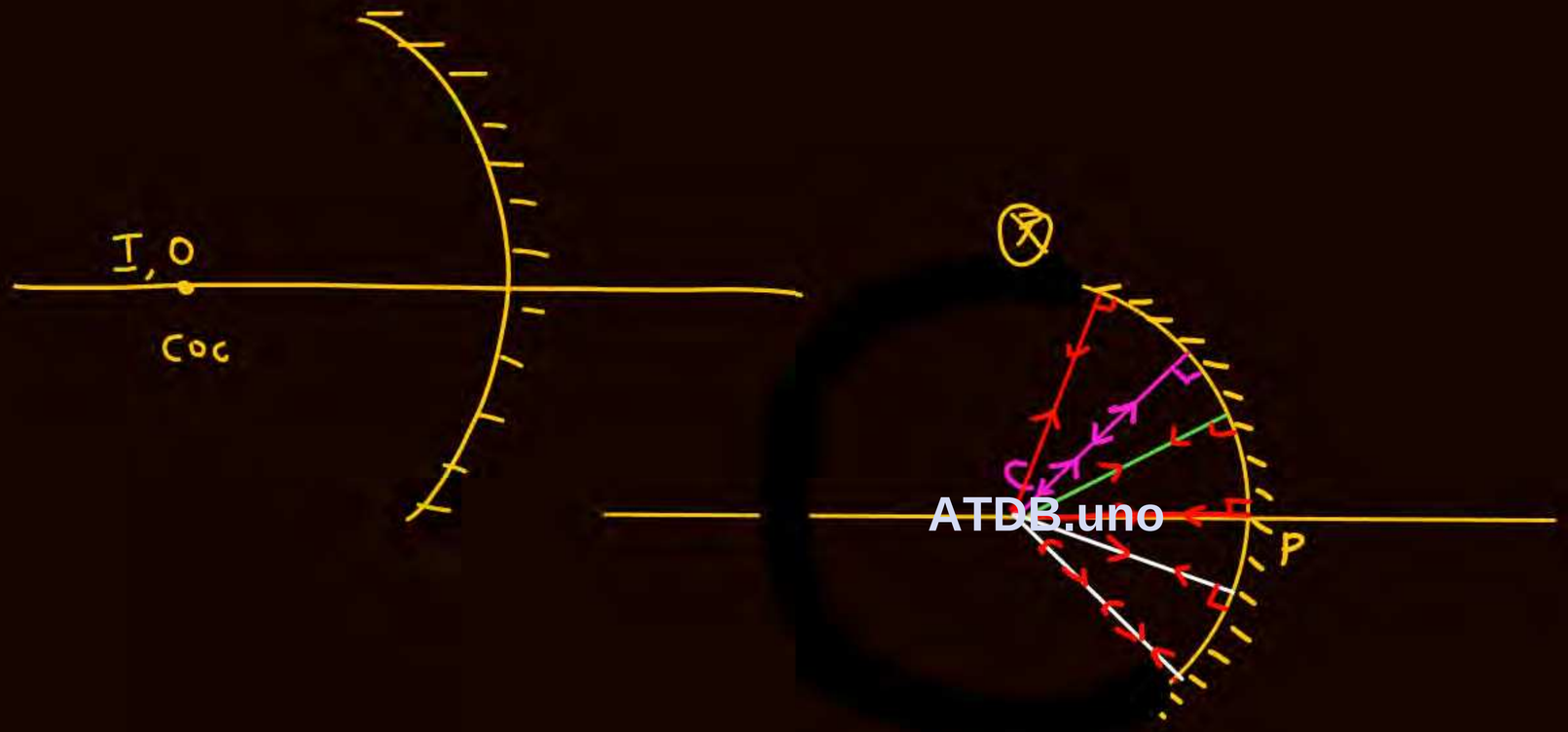
ATDB.uno

paraxial
parallel to PA



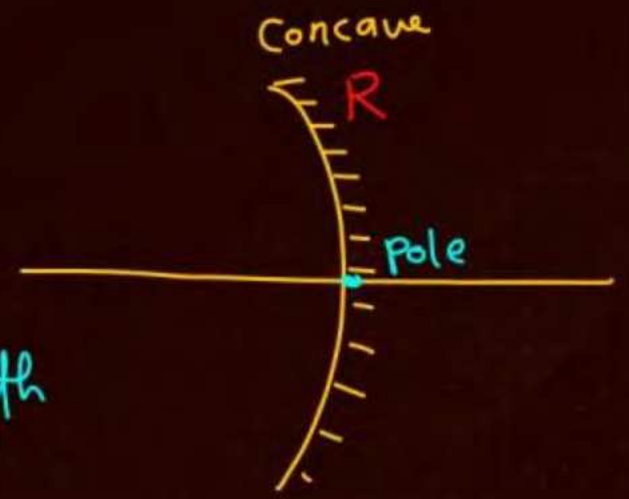


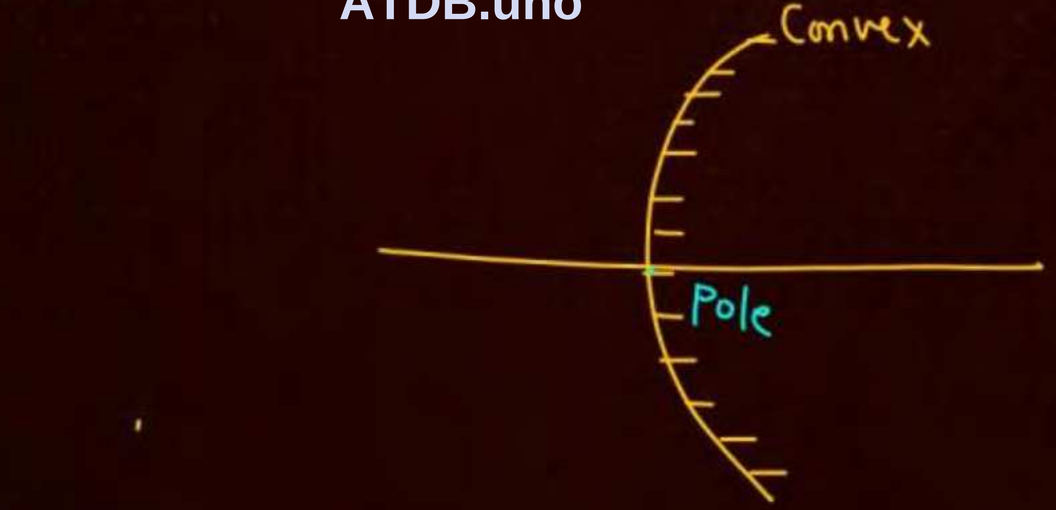
ATDB.uno



mirror formula

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





Mirror formula

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

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

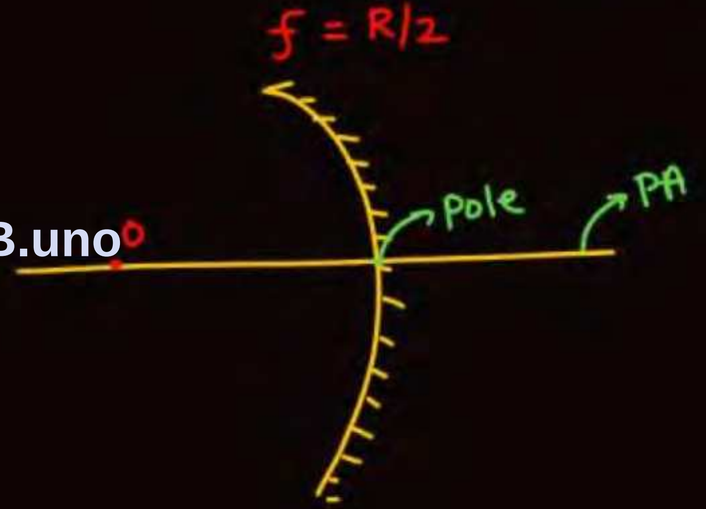
$u \longrightarrow$ distance of obj from pole along P.A

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

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

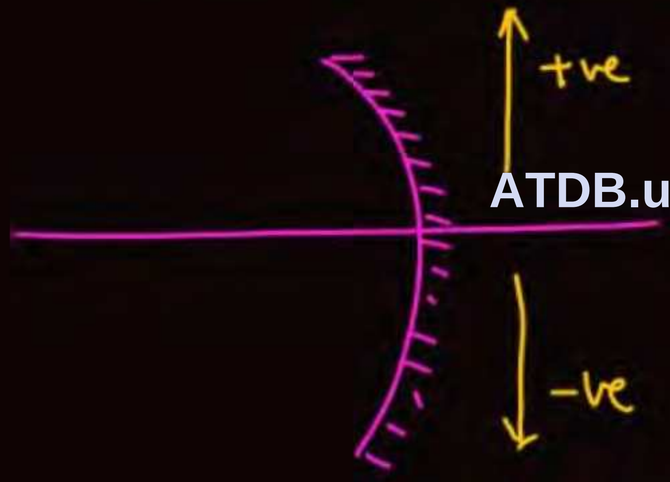
* Valid for Paraxial rays.

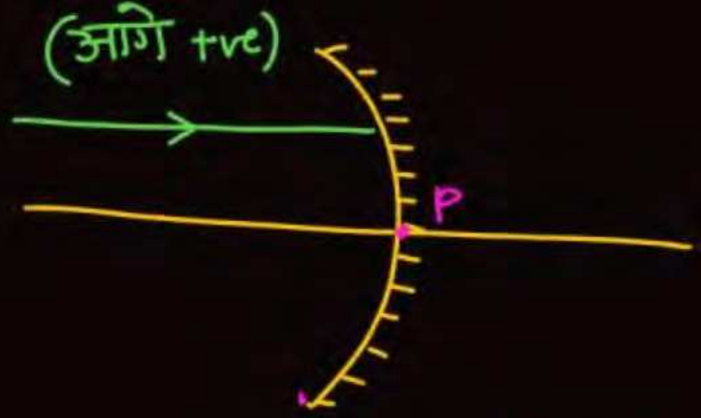
* $u, v, f \longrightarrow$ with sign

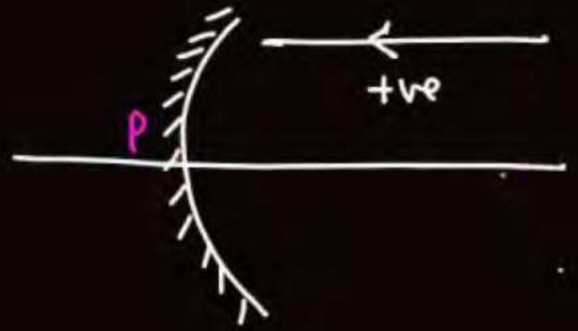


Sign Convention

* Dir^{n} of incident ray is taken as positive.
* सारे measurement pole से करते हैं



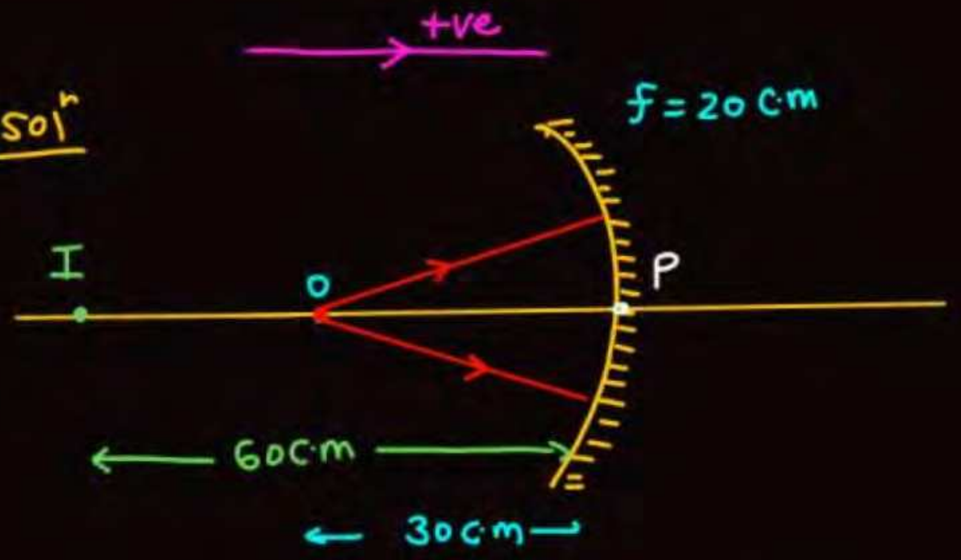




S.S.C.f.D

Q

Soln

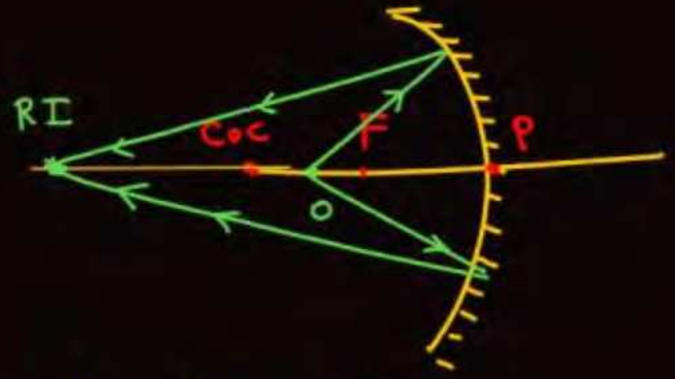


$u = -30$

$f = -20$

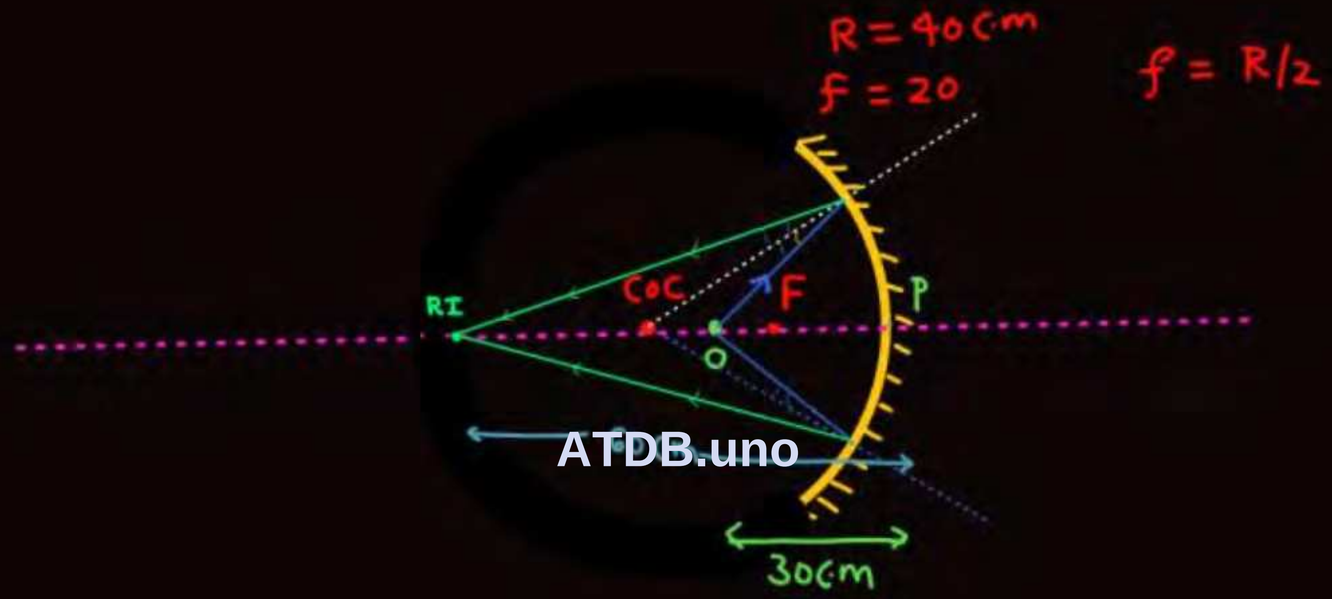
$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

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



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

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



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

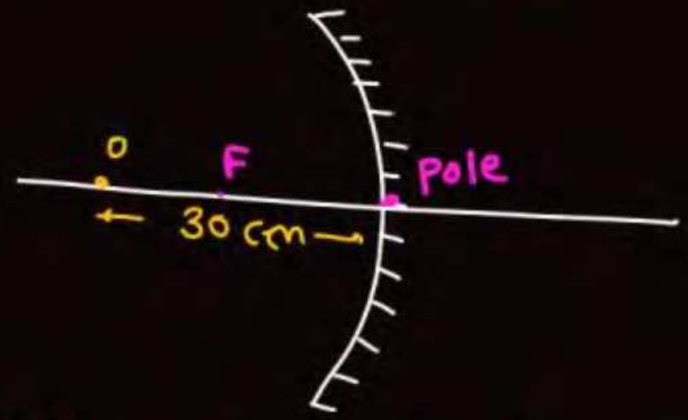
$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{u-f}{uf}$$

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

+ve

$f = 20$ cm

Q



$u = -30$

$f = -20$

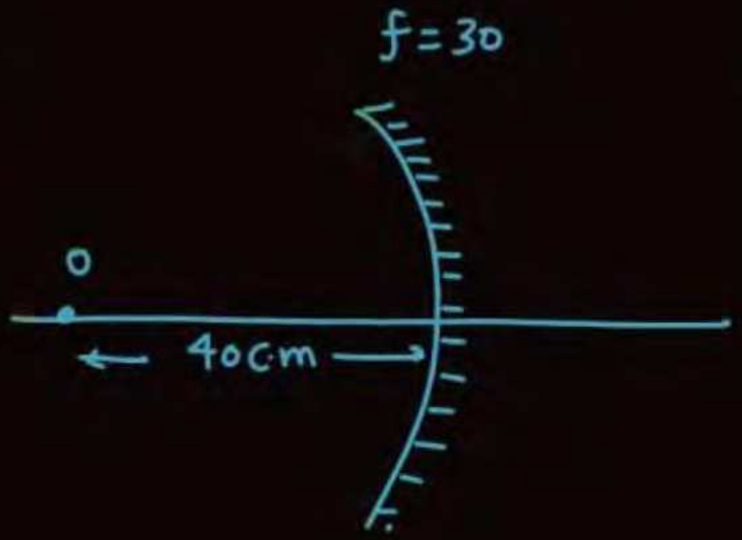
$$v = \frac{uf}{u-f} = \frac{(-30) \times (-20)}{(-30) - (-20)} = \frac{600}{-10} = -60 \text{ cm (R.I)}$$

$u = -30$ (R.O)

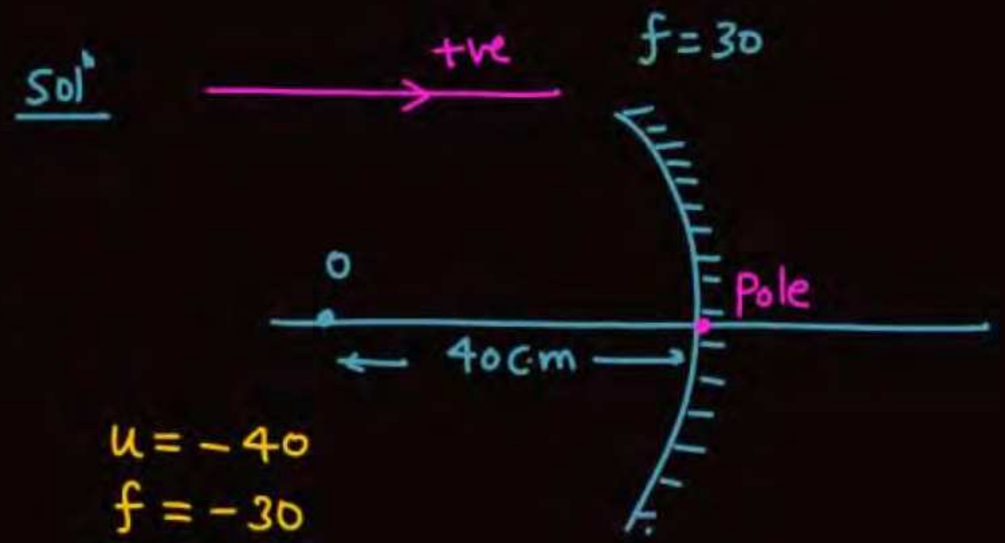
$v = -60$ (Solve) (R.I)

SSC FD

Q



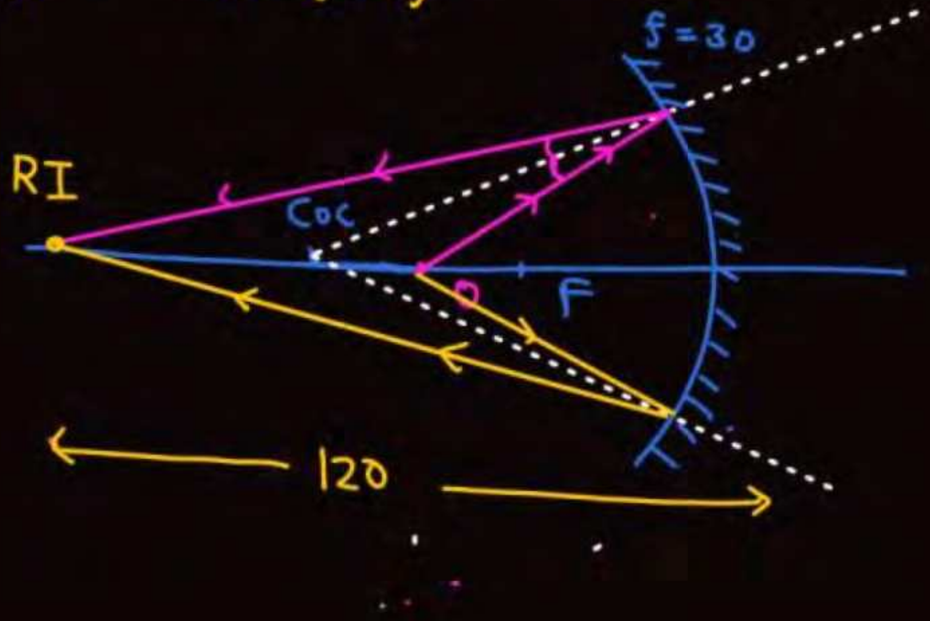
Sol^n



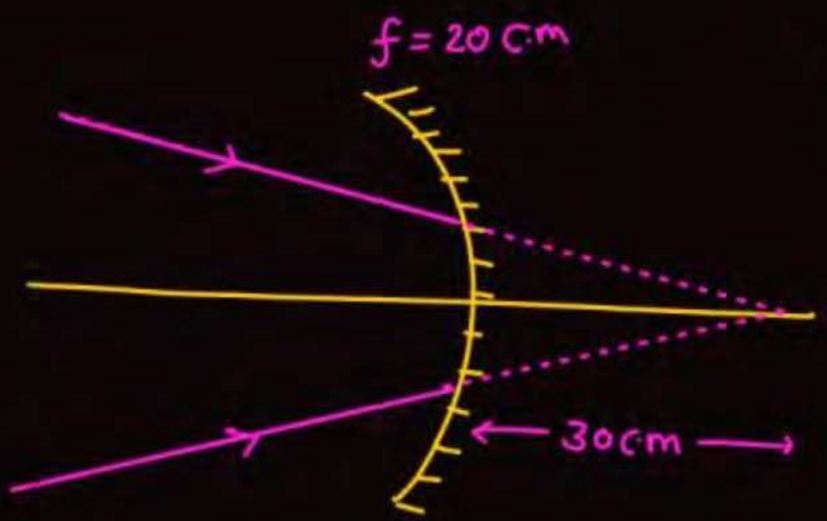
$u = -40$

$f = -30$

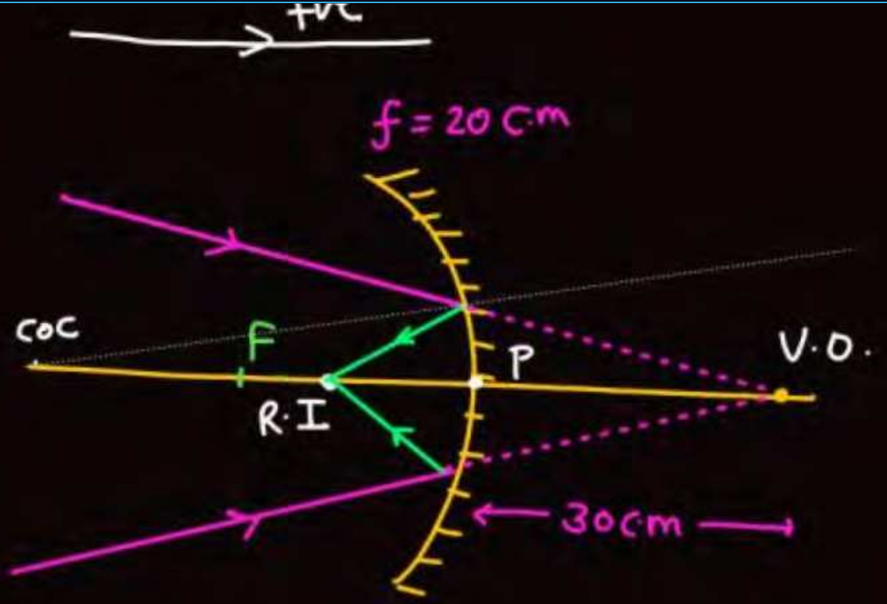
$$v = \frac{uf}{u-f} = \frac{1200}{-40-(-30)} = -120$$



Q



Sol^n



$u = -30$

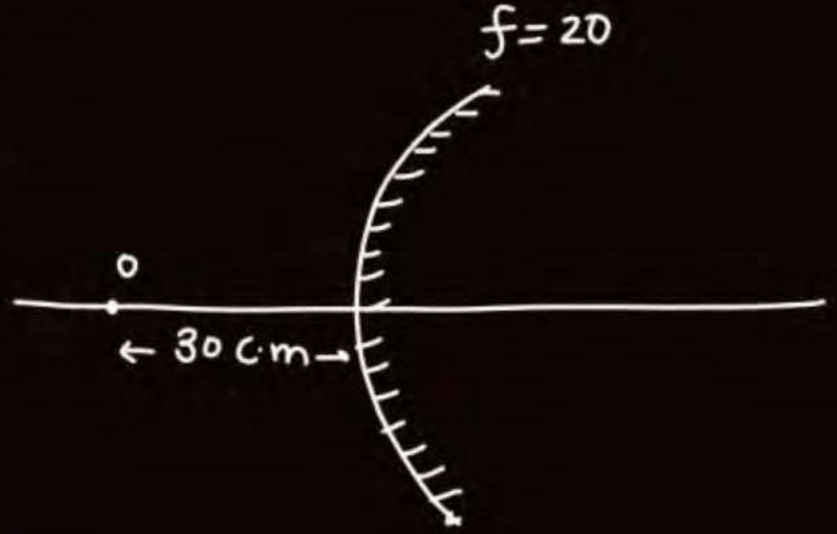
$f = -20$

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

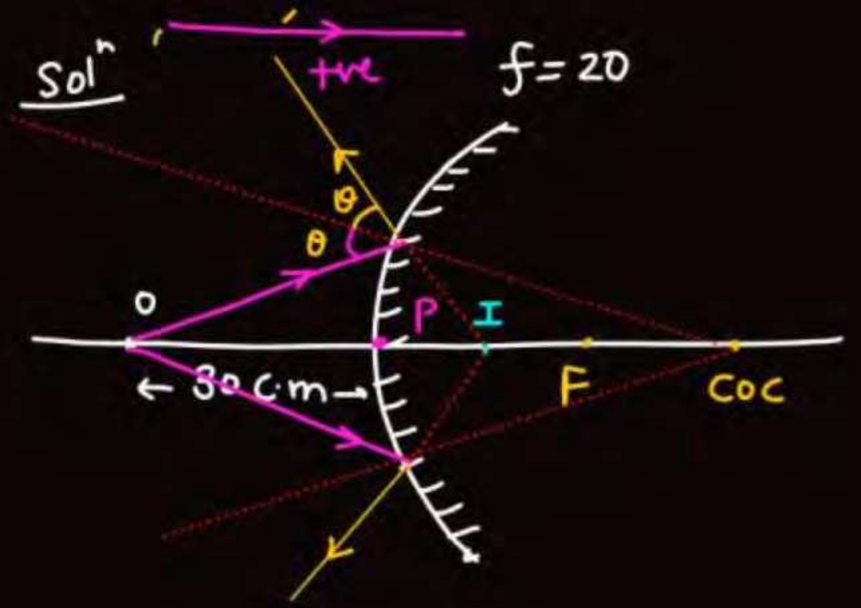
(RI)

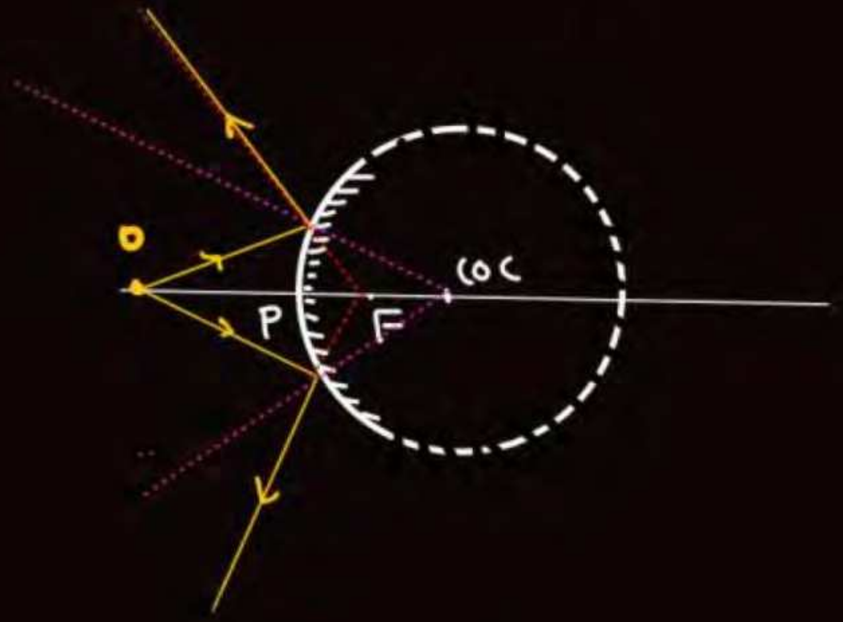
$$m = -\frac{v}{u} = -\frac{-12}{+30} = +\frac{2}{5} \text{ (erect)}$$

Q



Sol^n



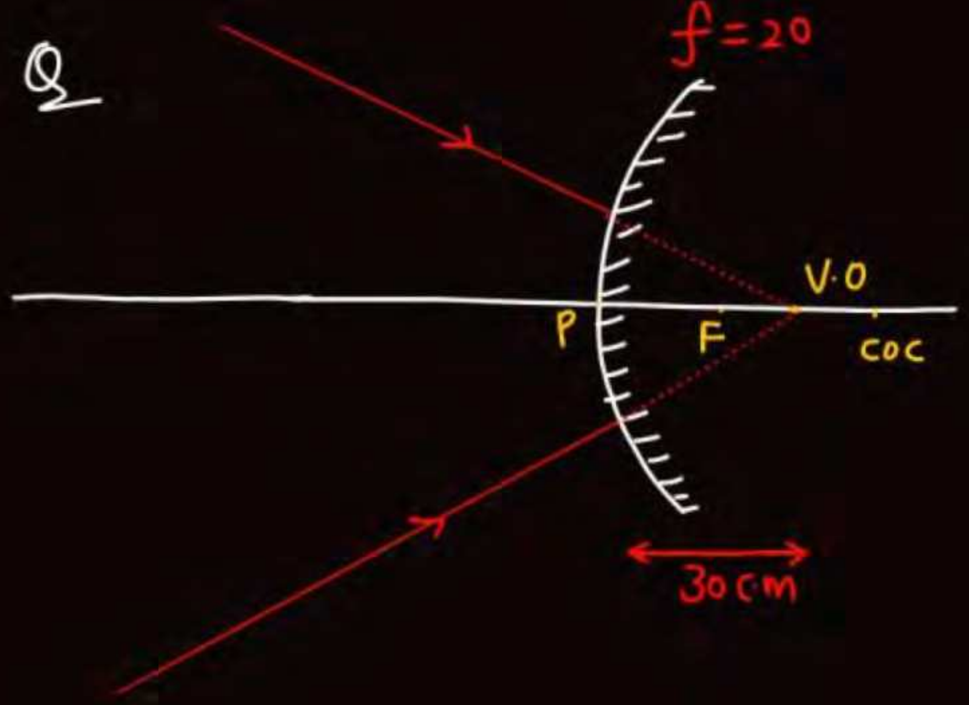


$u = -30$

$f = +20$

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

Q

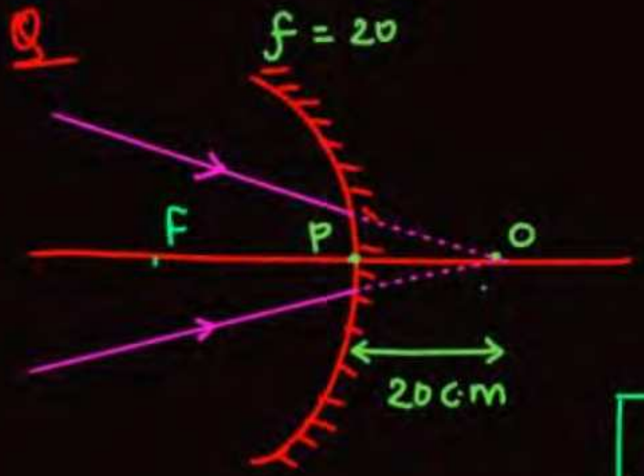


$u = +30$, (V.O.)

$f = +20$

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

Q



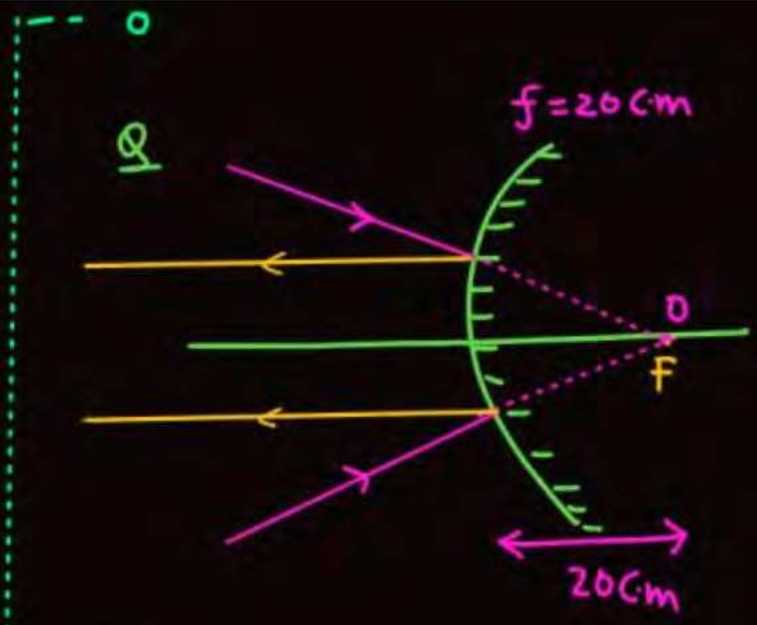
$u = +20$

$f = -20$

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

$$v = -10$$

(R.I)



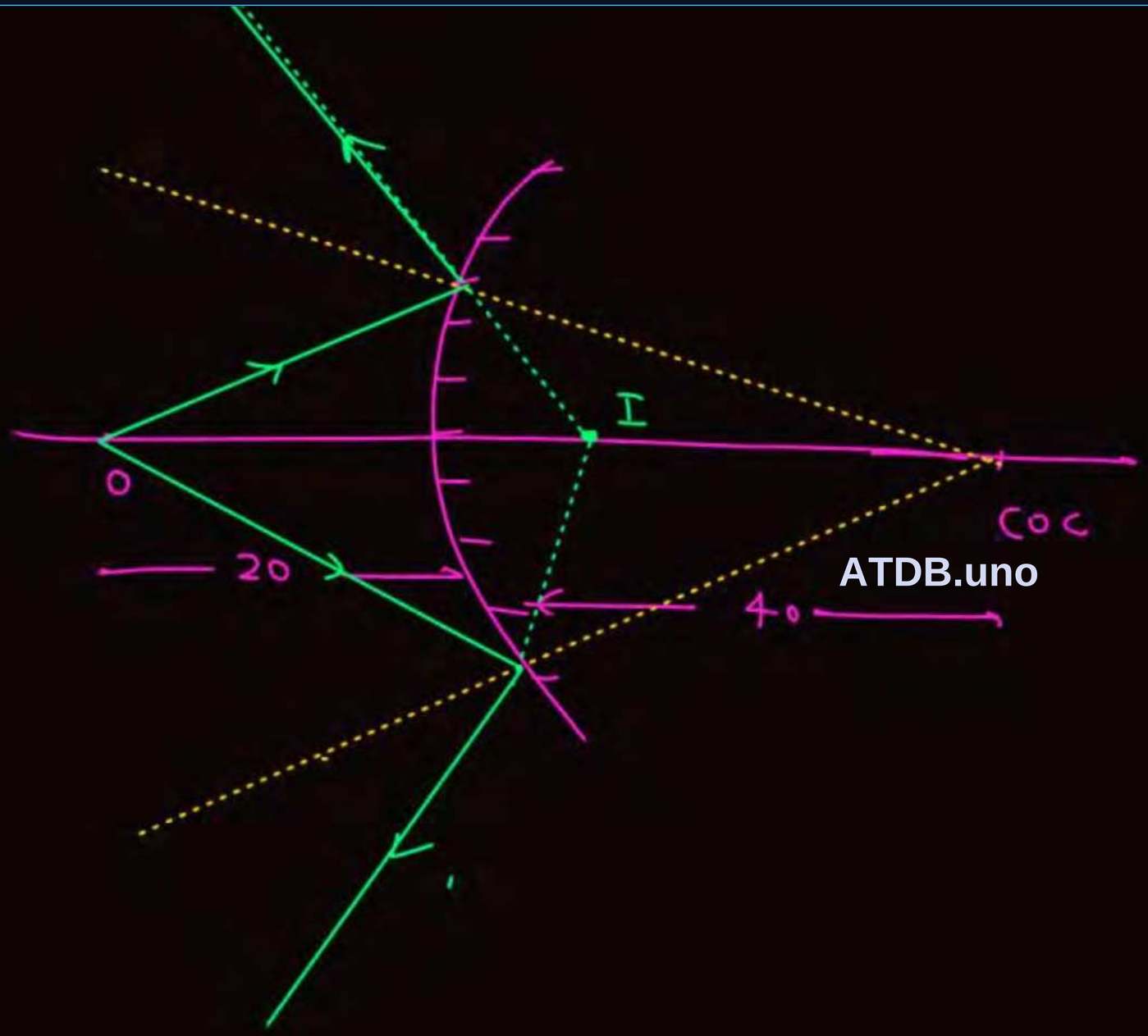
Q

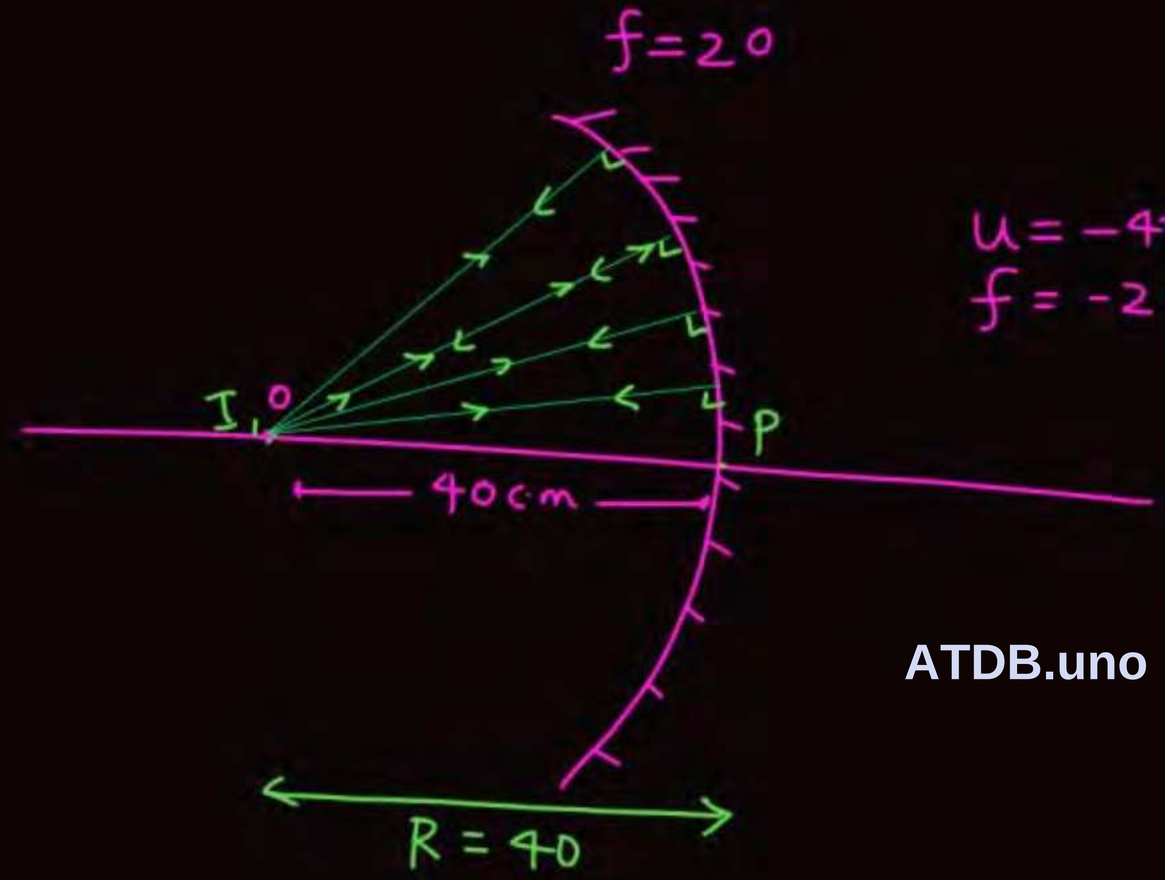
$u = +20$

$f = +20$

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

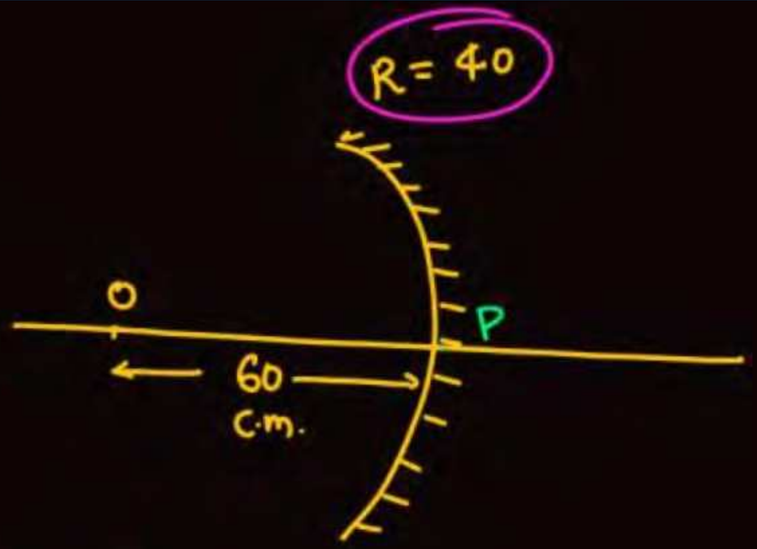
$v \longrightarrow \infty$





$$\left.\begin{matrix} u=-40 \\ f=-20 \end{matrix}\right\} \Rightarrow v=-40$$

Q

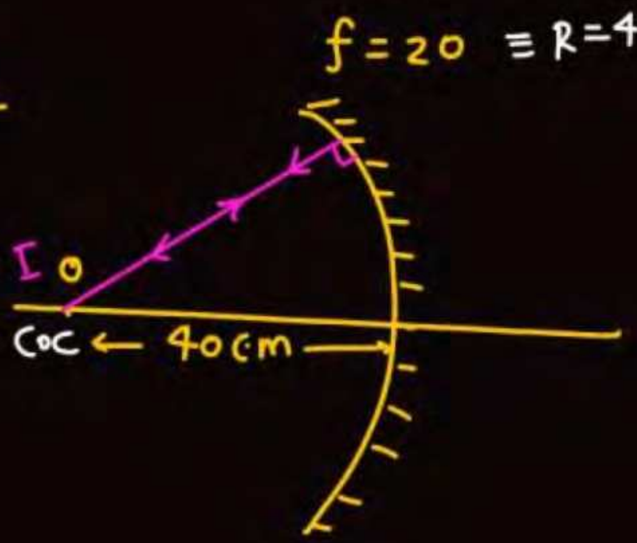


$f = -20$

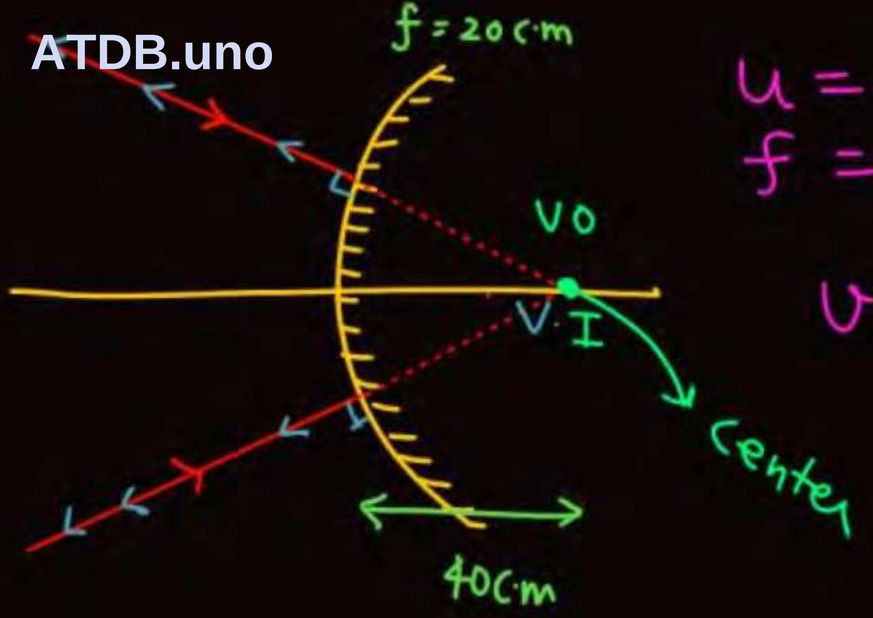
$u = -60$

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

Q



Q



$u = +40$

$f = +20$

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

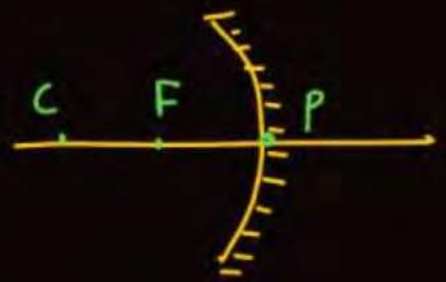
KC

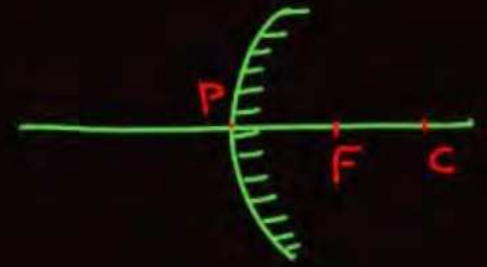
काम का सवा

- Concave mirror ⇒ $f<0$
- Convex mirror ⇒ $f>0$

$m>0 \longrightarrow$ erect

$m<0 \longrightarrow$ invented





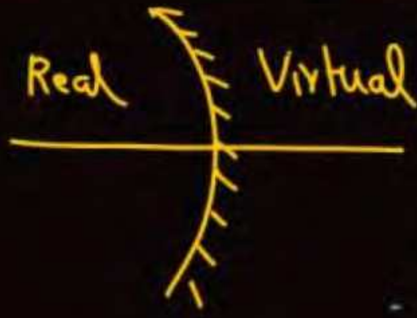
$u<0 \longrightarrow$ R.O

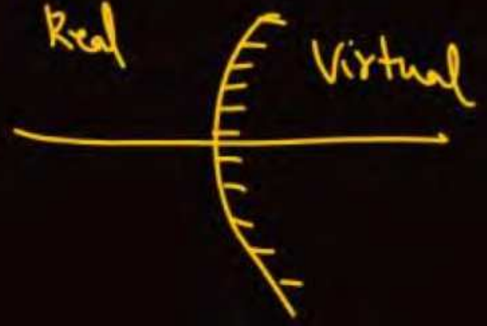
$v<0 \longrightarrow$ R.I

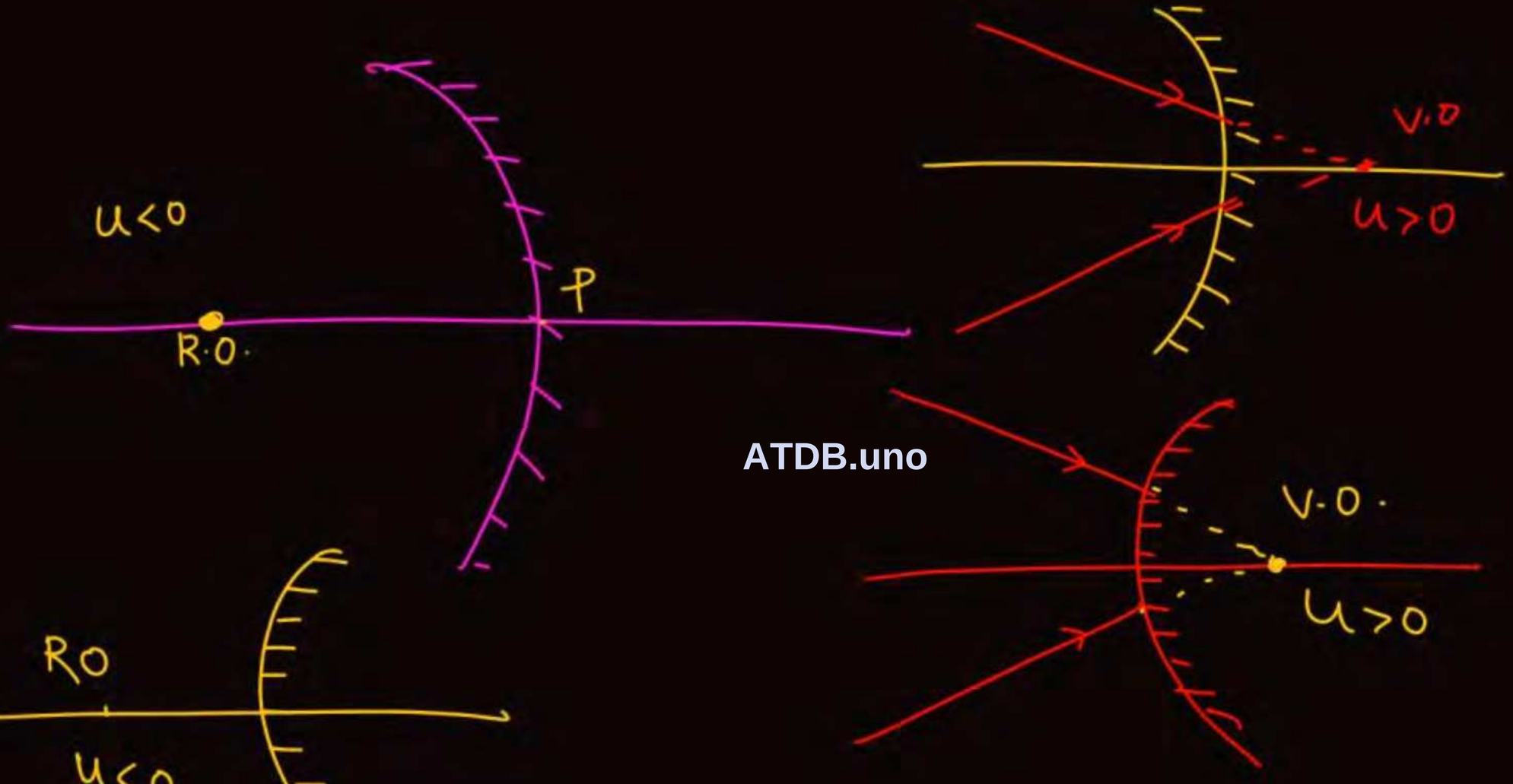
$u>0 \longrightarrow$ V.O

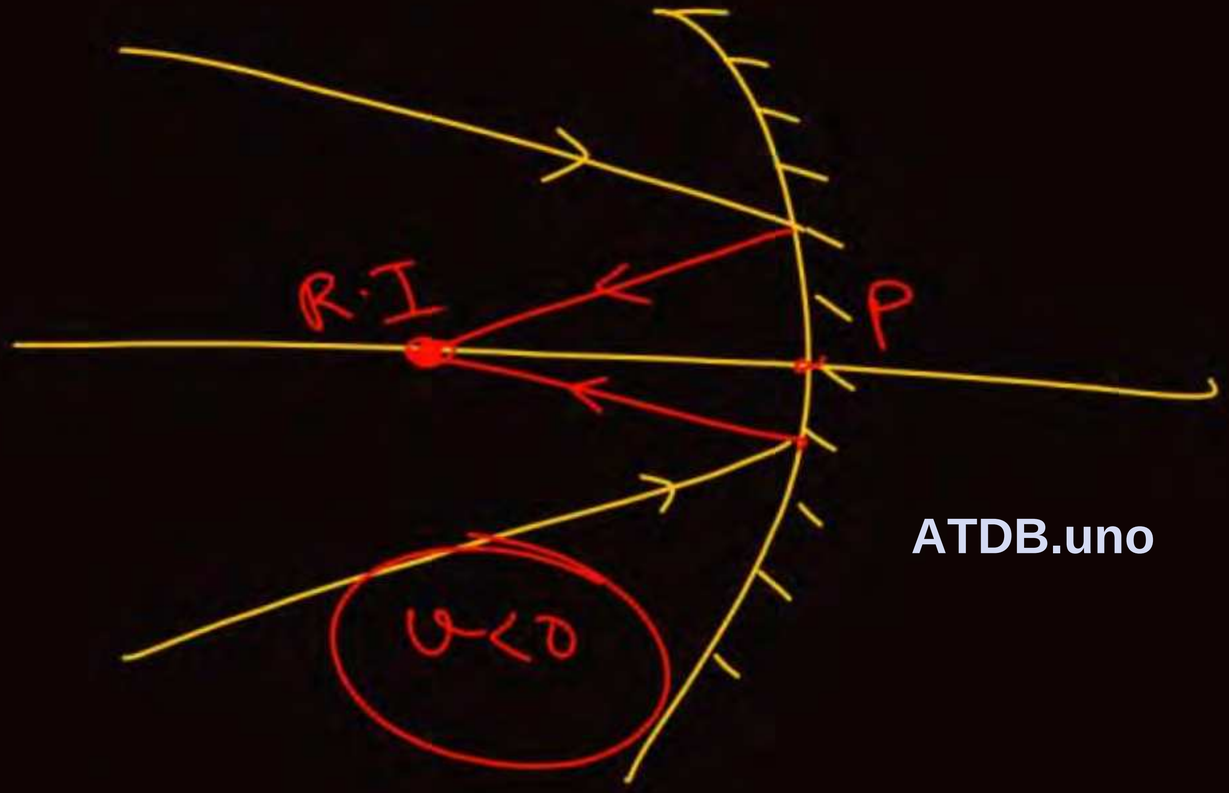
$v>0 \longrightarrow$ V.I

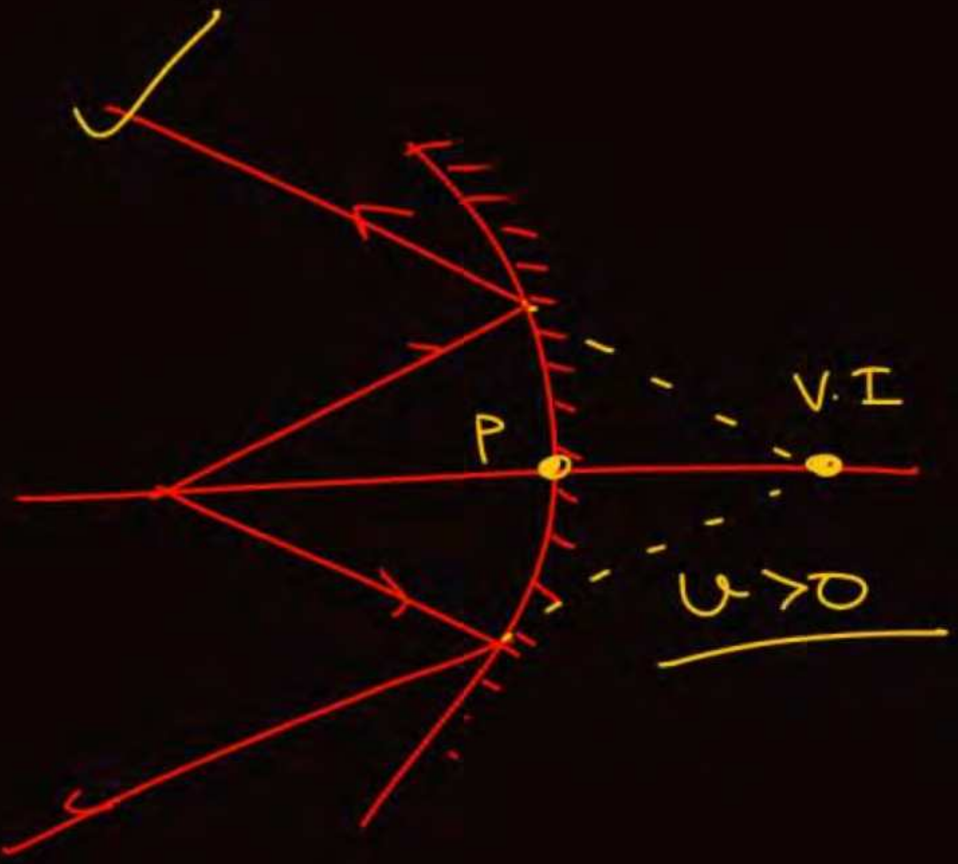
$u, v \Rightarrow$ (Negative $\longrightarrow$ Real; positive $\longrightarrow$ Virtual)



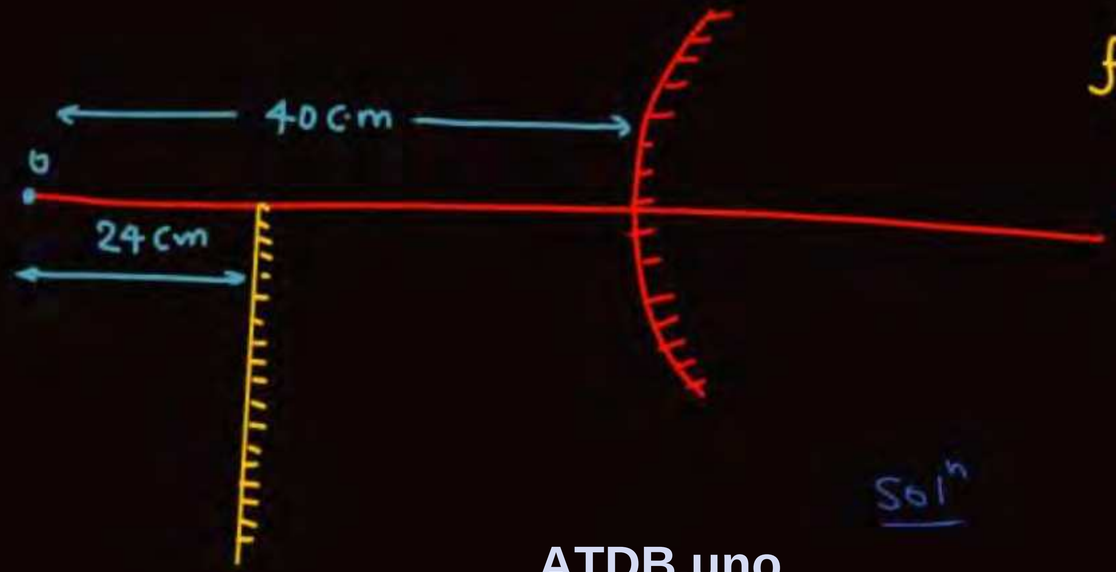








Q

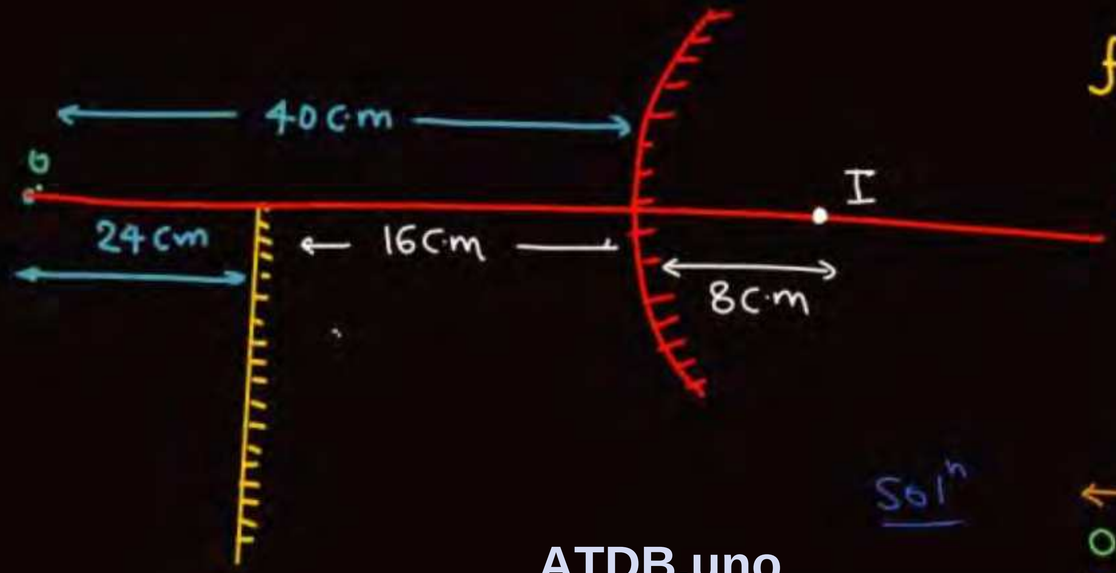


find focal length of convex mirror

If image formed by both the mirror coincide.

Soln

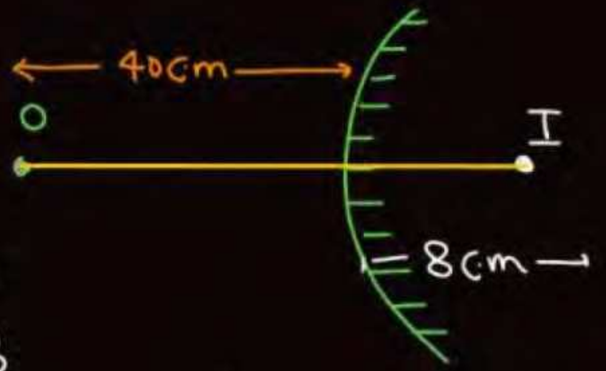
Q



find focal length of convex mirror

If image formed by both the mirror coincide.

Soln



$u = -40$

$v = +8$

$f = ?$

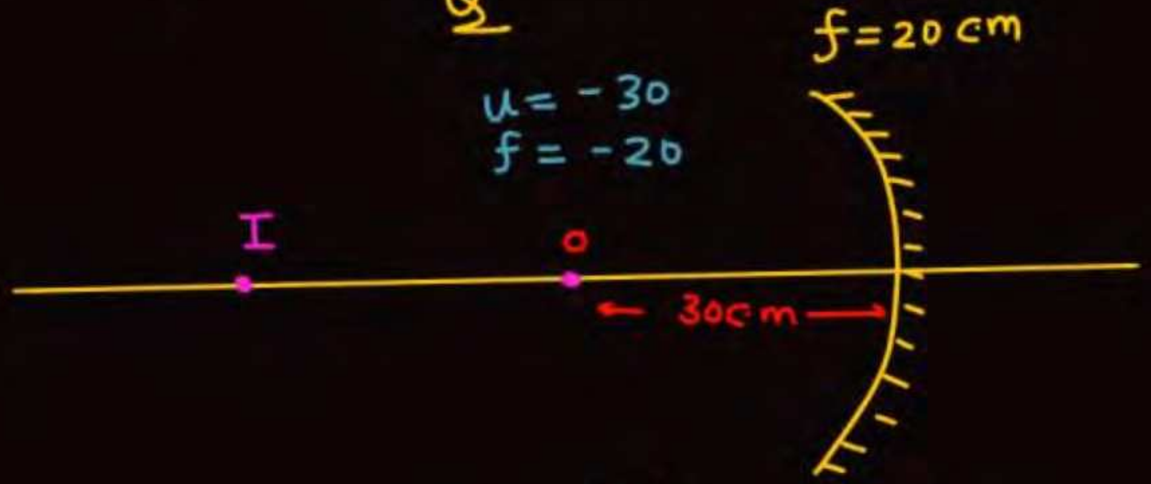
$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

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

$$f = +10$$

1

Q

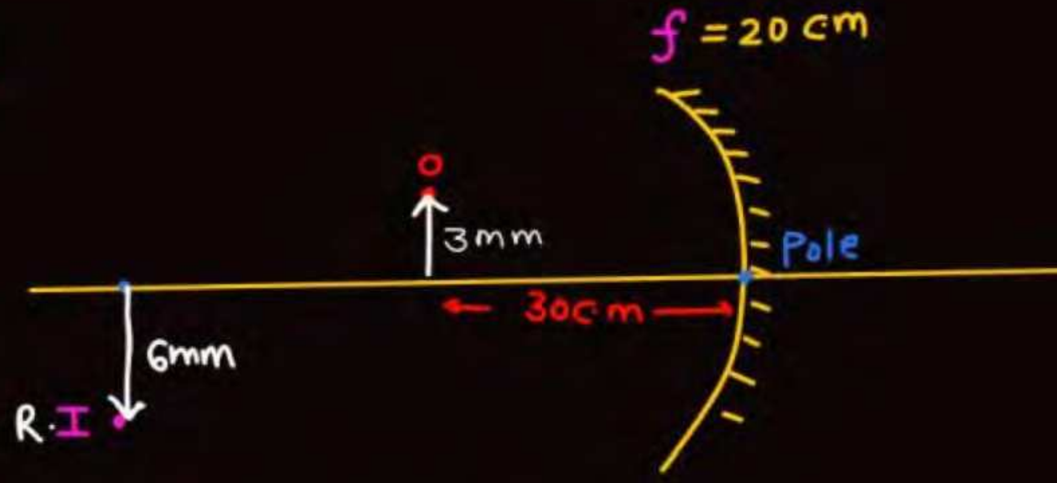


$$v = \frac{600}{-30-(-20)} = -60$$

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

$$\boxed{m = -2}$$

Q



$$\left.\begin{matrix} u = -30 \\ f = -20 \end{matrix}\right\} v = -60 \ (R.I)$$

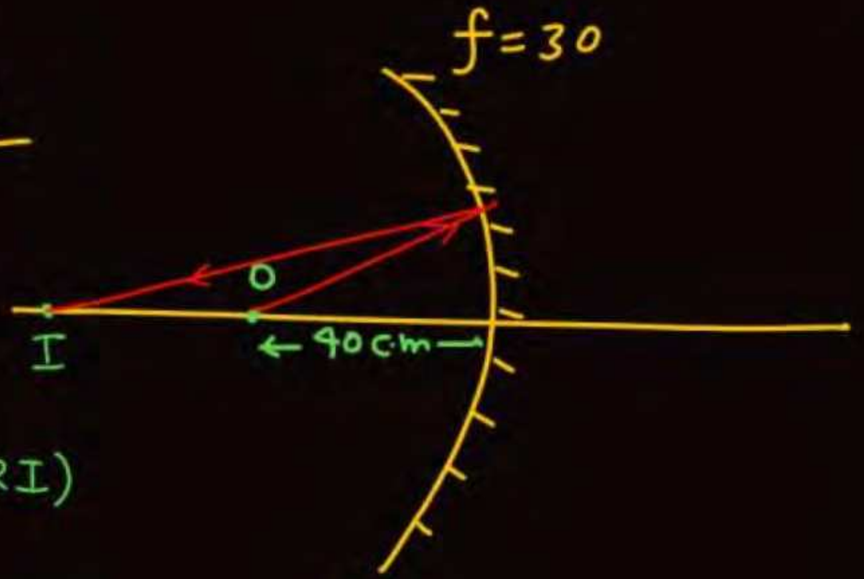
$$m = \frac{-v}{u} = -\frac{-60}{-30} = -2$$

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

$$h_I = -2 \times 3mm$$

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

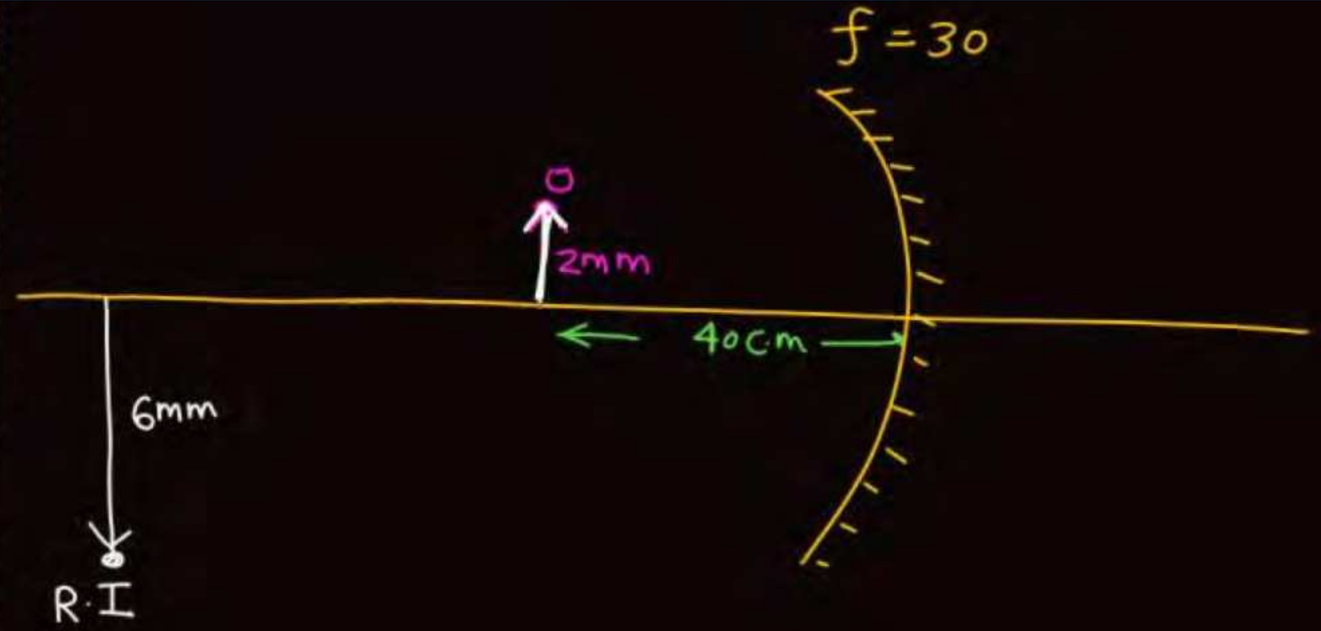
Q



(RO, RI)

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

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



ATDB.uno

$v = -120$ (same), RI

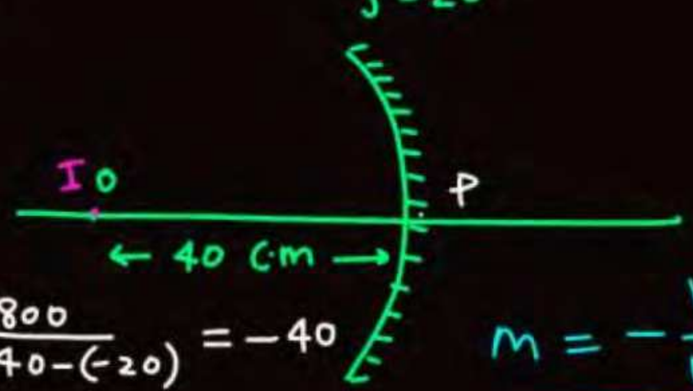
$m = -3$ (inverted, enlarge)

Q

$$v = \frac{1200}{-60-(-20)} = -30$$

$$m = -\frac{v}{u} = -\frac{-30}{-60} = \frac{-1}{2}$$

Q

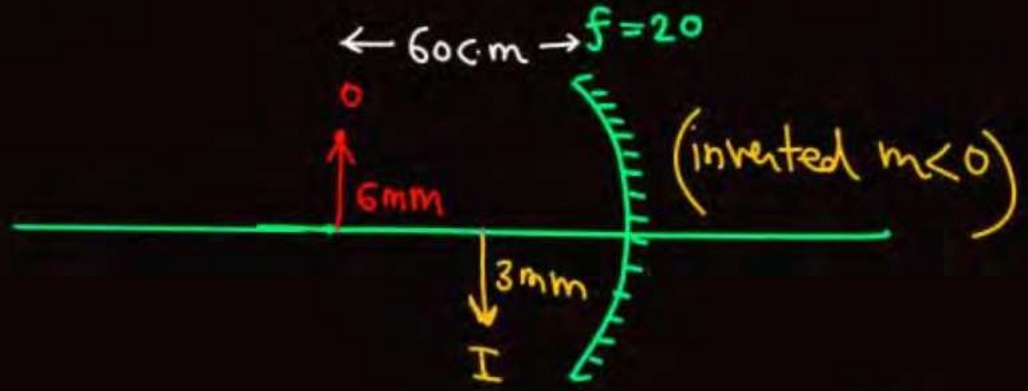


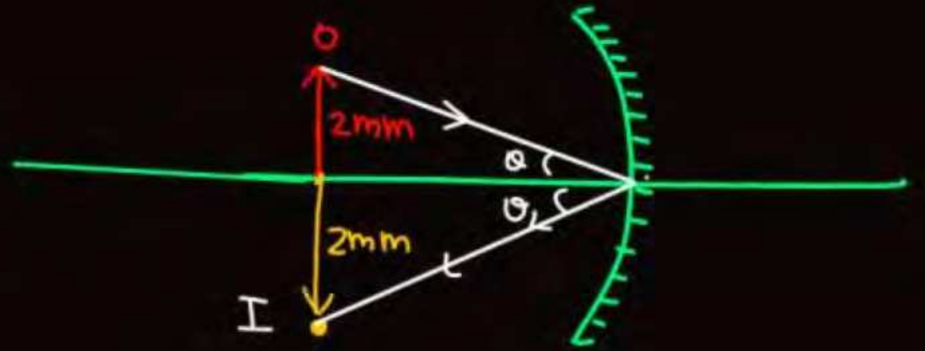
$$v = \frac{800}{-40-(-20)} = -40$$

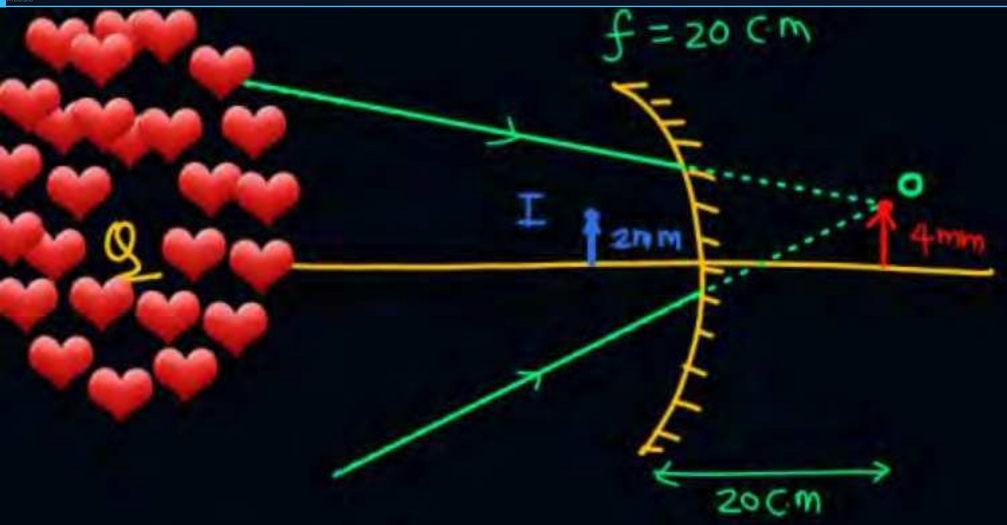
$$m = -\frac{v}{u} = -\frac{-40}{-40}$$

$$m = -1$$

Q





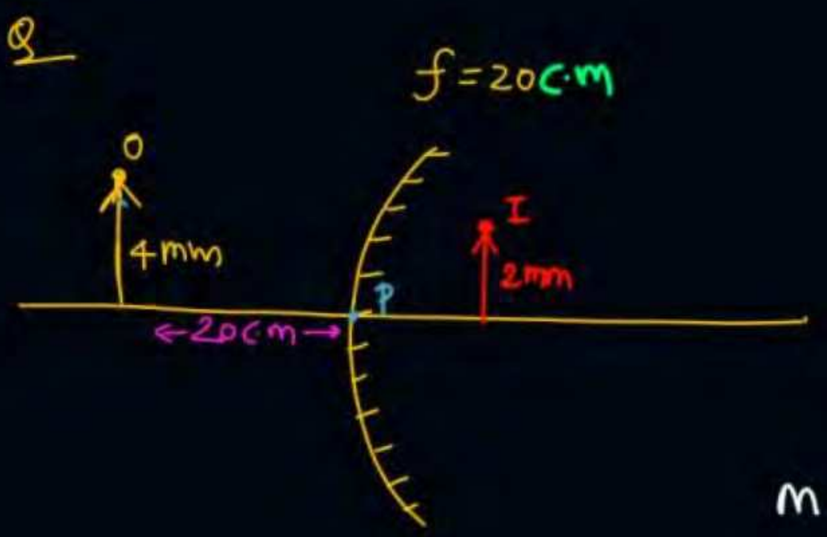


$u = +20$, $f = -20$ $\Big\}$ $v = \dfrac{-400}{20-(-20)} = -10$

$m = -\dfrac{V}{u} = -\dfrac{-10}{+20} = +\dfrac{1}{2}$

(erect)

Q



$f = +20$

$u = -20$

$v = \dfrac{-400}{-20-20} = +10$

$m = -\dfrac{v}{u} = -\dfrac{10}{-20} = \dfrac{1}{2}$

(erect)

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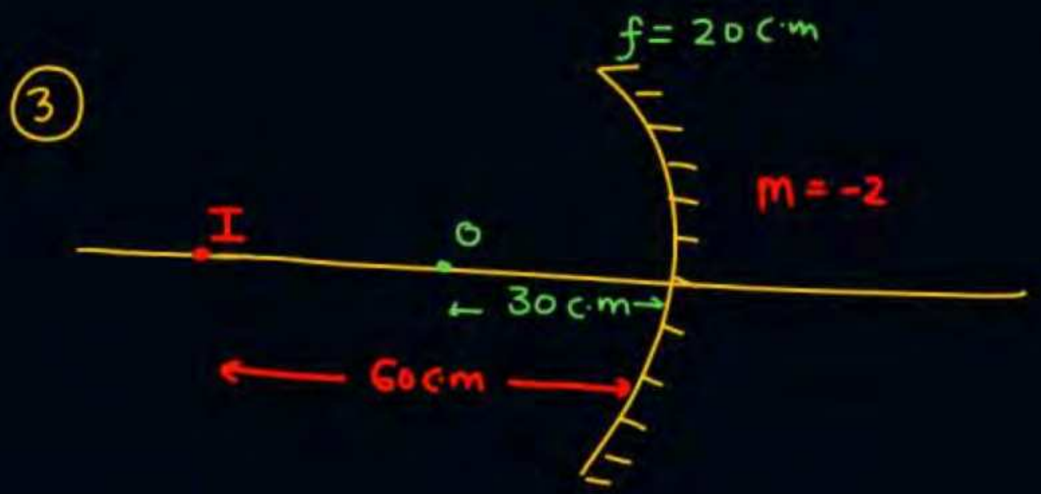
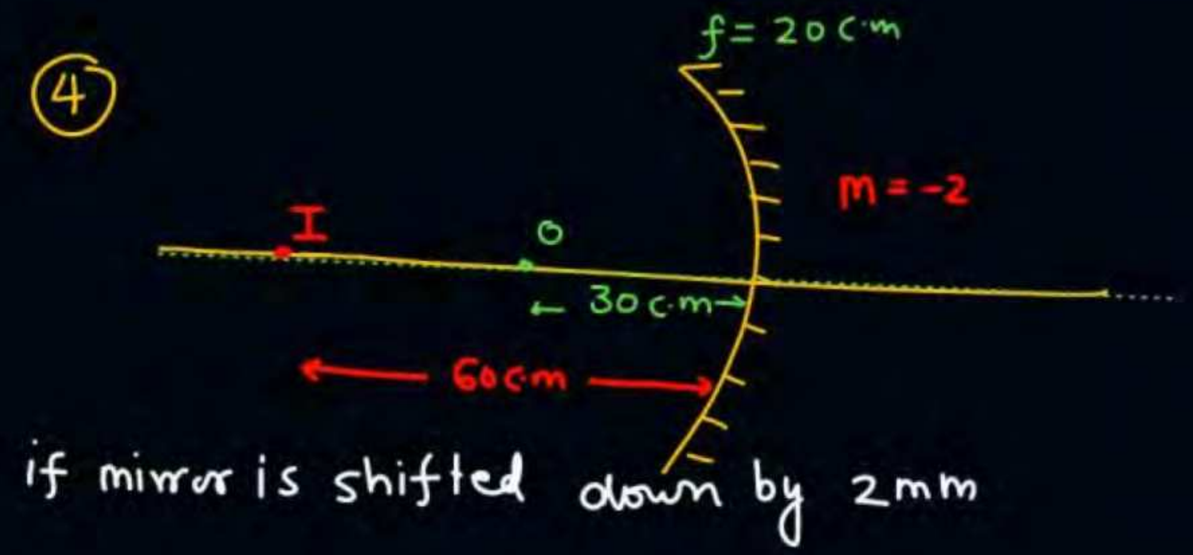
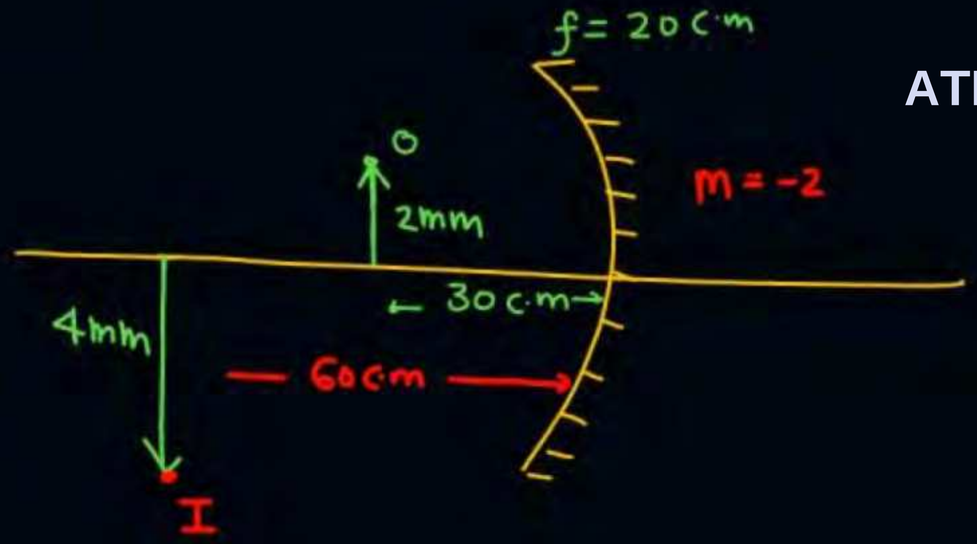
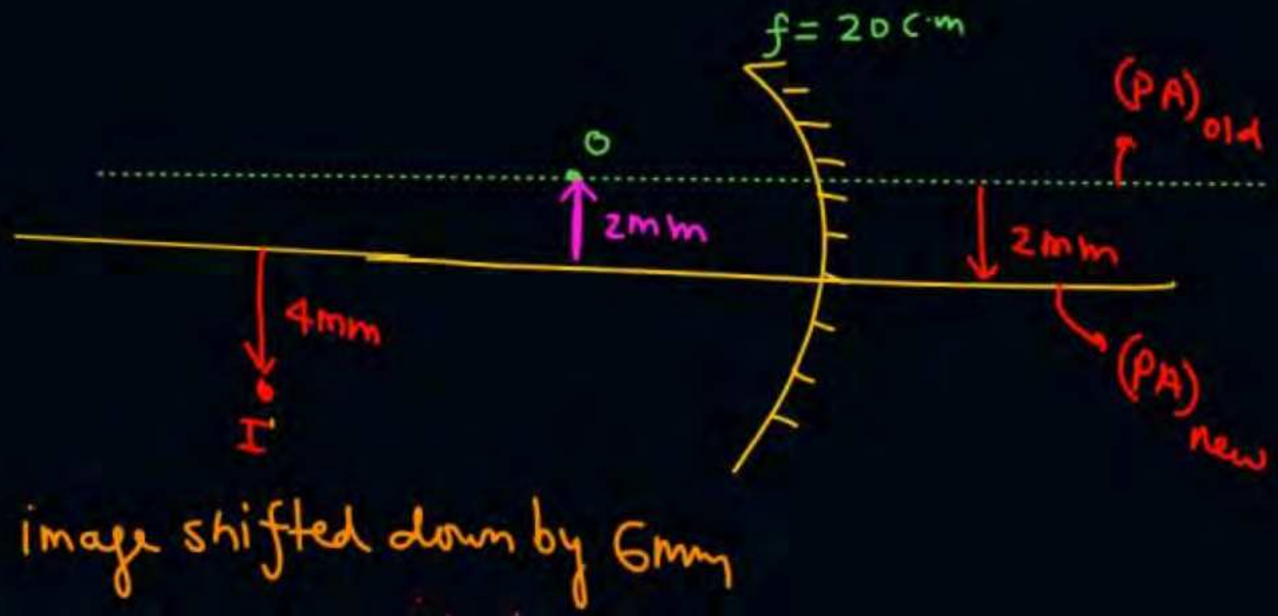
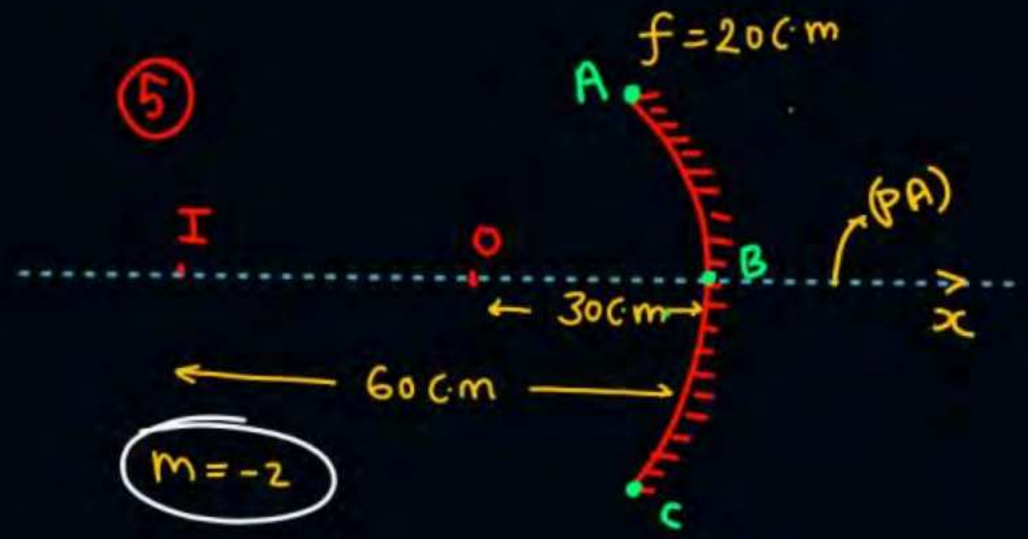






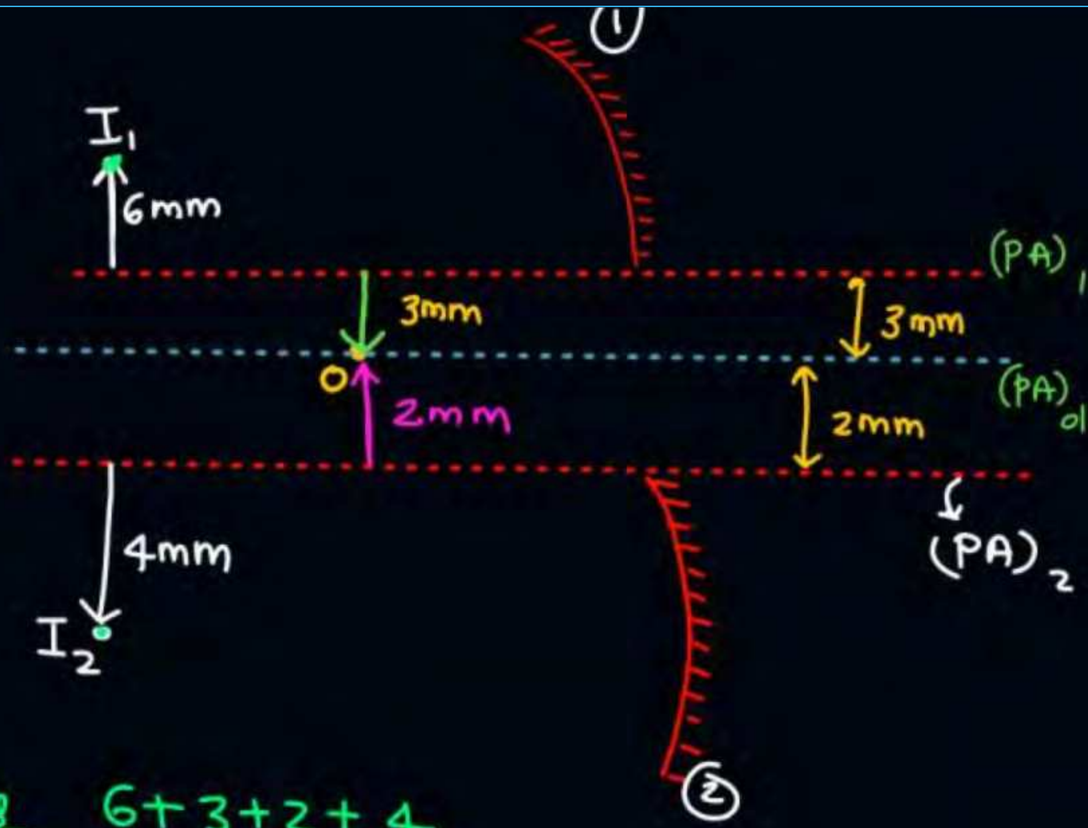


(5)



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.

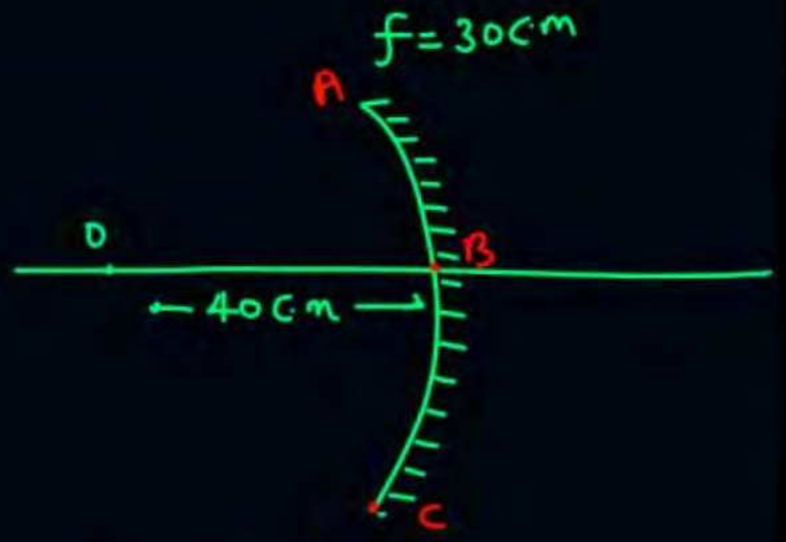
Soln



Ans 6 + 3 + 2 + 4

= 15 mm

Q



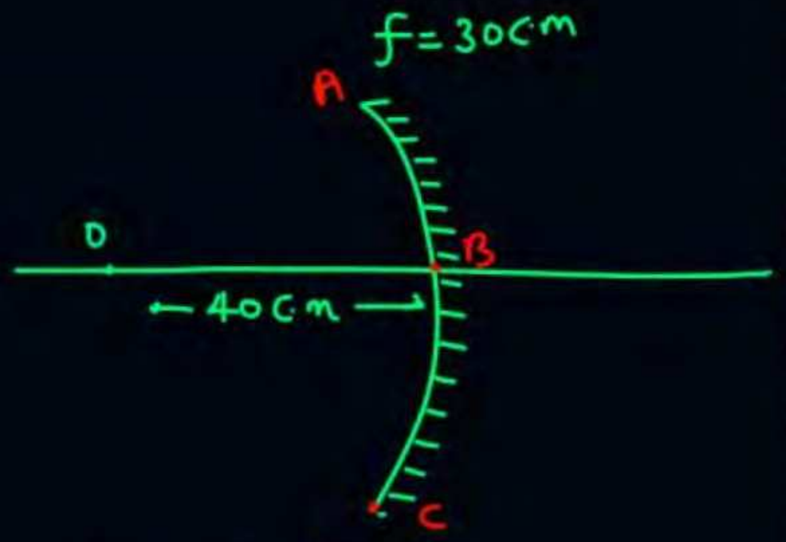
mirror is cut at 'B'
& upper part is shifted up by 2mm
& lower part is shifted down by 3mm
find Gap b/w two Image

Soln

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

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

Q



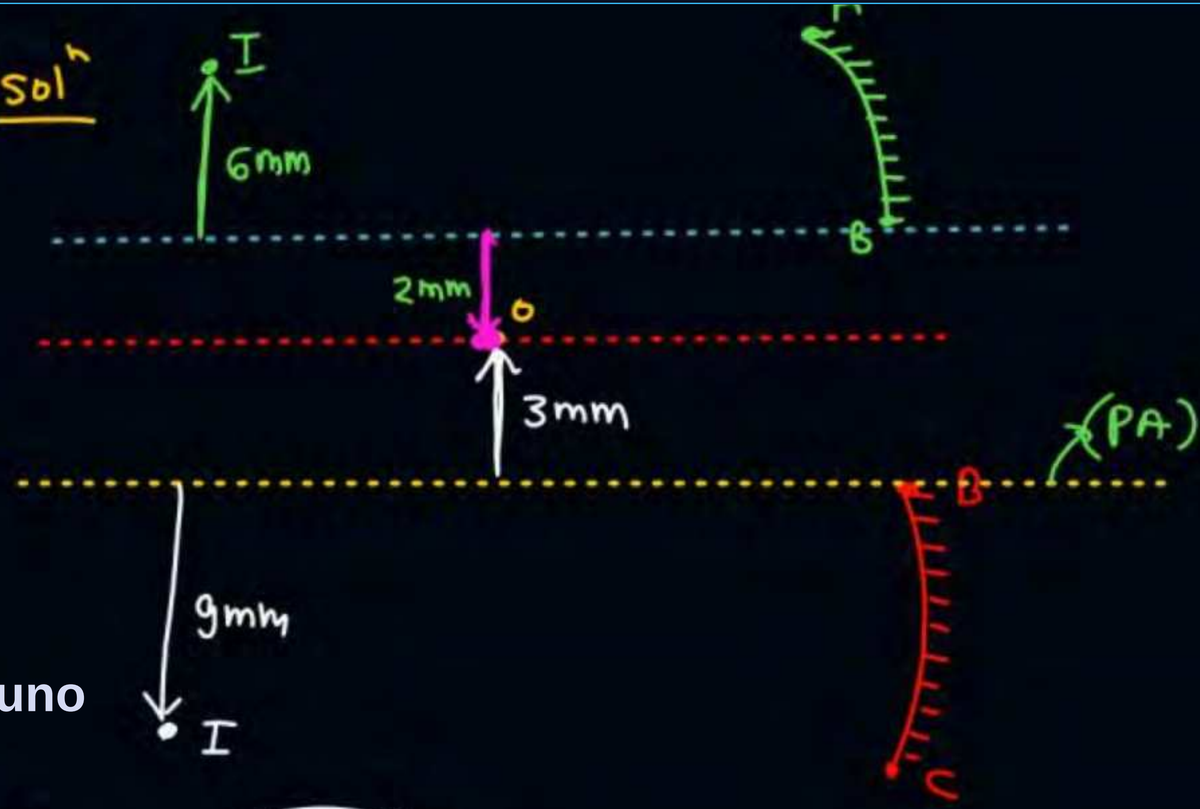
mirror is cut at 'B'
& upper part is shifted up by 2mm
& lower part is shifted down by 3mm
find Gap b/w two image

Soln

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

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

Soln



Aw ≡ 20 mm

Home work

- Revise All ques of today Class

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