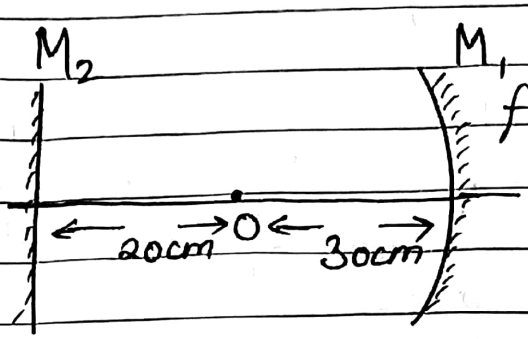
Ray Optics - 08

Combination of Mirrors: Mirror's Formula (virtual object)

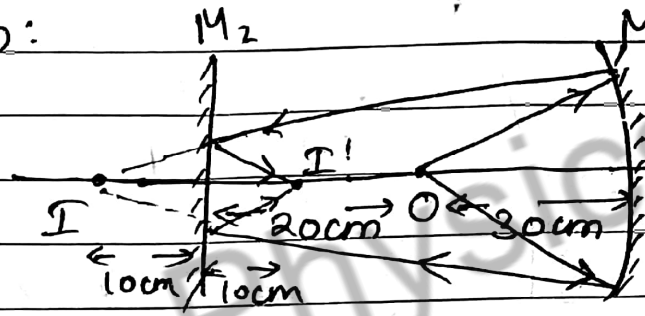
Q1)



$f = 20cm$

Find the final image after two reflections if first reflection is considered from M_1

Solution:



for 1st reflection from M_1

$u = -30$

$f = -20$

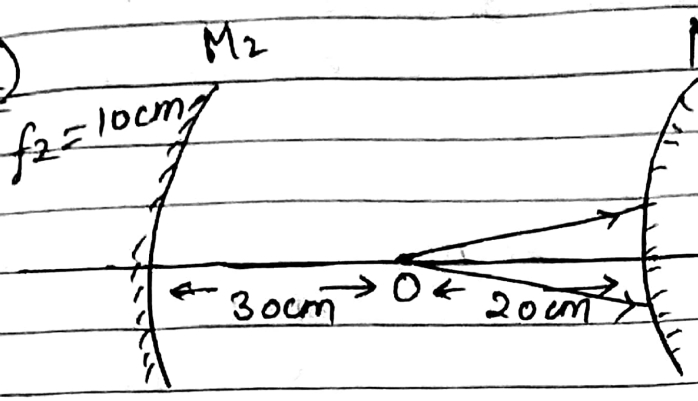
$v = ?$

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

$$v = \frac{+600}{-10} = -60cm$$ at I

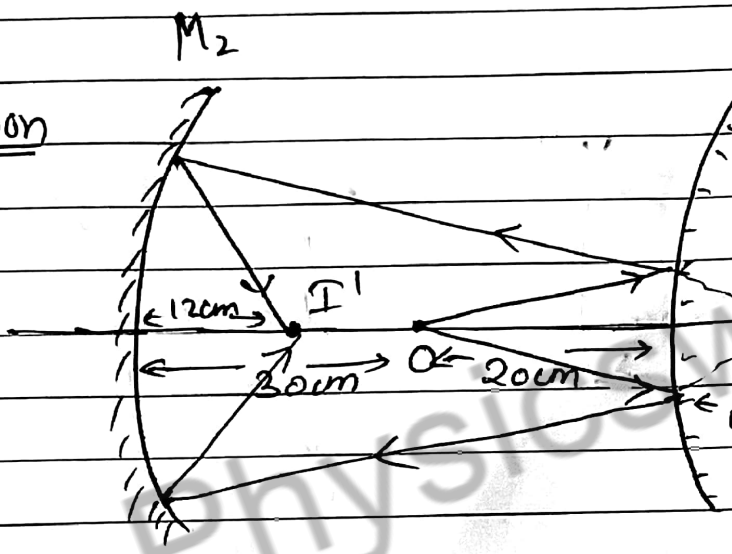
Now I acts as Virtual Object for M_2. Final Image is at 10cm right of M_2 at I'

Q2)



Find final image after two reflections if first reflection is considered from M_1.

Solution



for 1st reflection from M_1

$u = -20cm$

$f = +20cm$ (Convex)

$v = ?$

$$v = \frac{uf}{u-f} = \frac{(-20)(+20)}{-20-20}$$

$$v = \frac{-400}{-40} = +10cm \text{ at } I$$

Now I acts as virtual object for M_2

for M_2

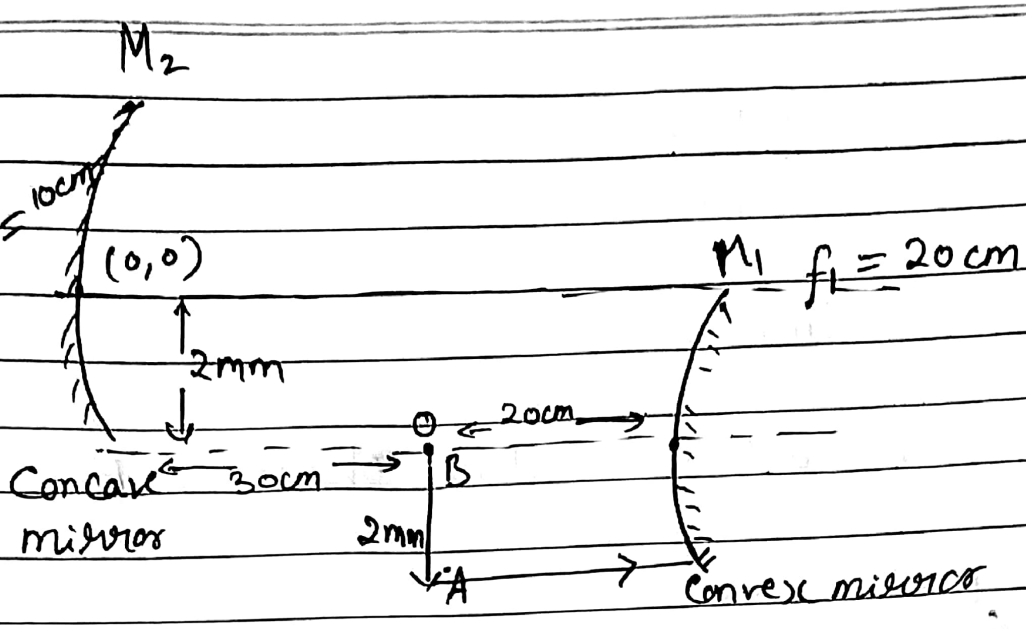
$u = -60cm$

$f = -10cm$

$$v = \frac{uf}{u-f} = \frac{(-60)(-10)}{-60+10} = \frac{+600}{-50} = -12cm \text{ at } I'$$

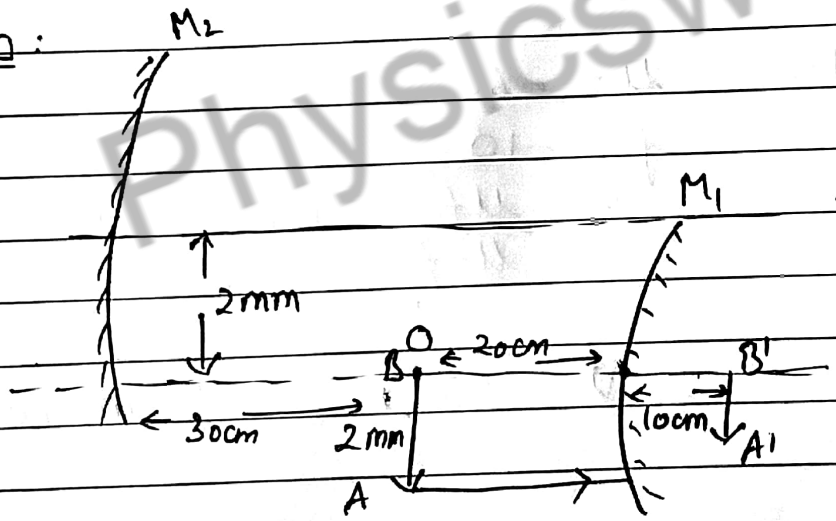
final image at 12cm right of M_2 at I'

Q3)



Find final co-ordinates of head of image (point A) after two reflections if first reflection is considered from M_1.

Solution:



for I^{st} reflection from M_1

$u = -20$

$f = +20cm$

$v = ?$

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

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

$$v = \frac{-400}{-40} = +10cm \text{ at } A'$$

Height of Image?

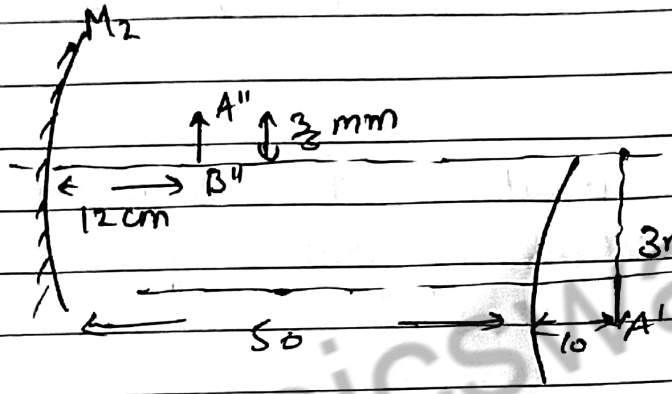
$h_o = -2mm$

$$m = \frac{h_i}{h_o} = \frac{-v}{u}$$

$$\frac{h_i}{-2mm} = \frac{(+10)}{+20}$$

$$h_i = -1mm$$

Now A' acts as virtual object for M_2



for M_2 $\quad u = -60$

$f = -10$

$$v = \frac{uf}{u-f} = \frac{(-60)(-10)}{-60+10}$$

$$v = \frac{+600}{-50} = -12cm \text{ at } A''$$

Height of image $m = \frac{h_i}{h_o} = -\frac{v}{u}$

$h_o = -3mm$

$$\Rightarrow \frac{h_i}{-3mm} = -\frac{(+12)}{+60}$$

$$h_i = +\frac{3}{5} mm.$$

final coordinates of image of $A = A''$ $\left(12\,cm, \frac{3}{5}mm\right)$