

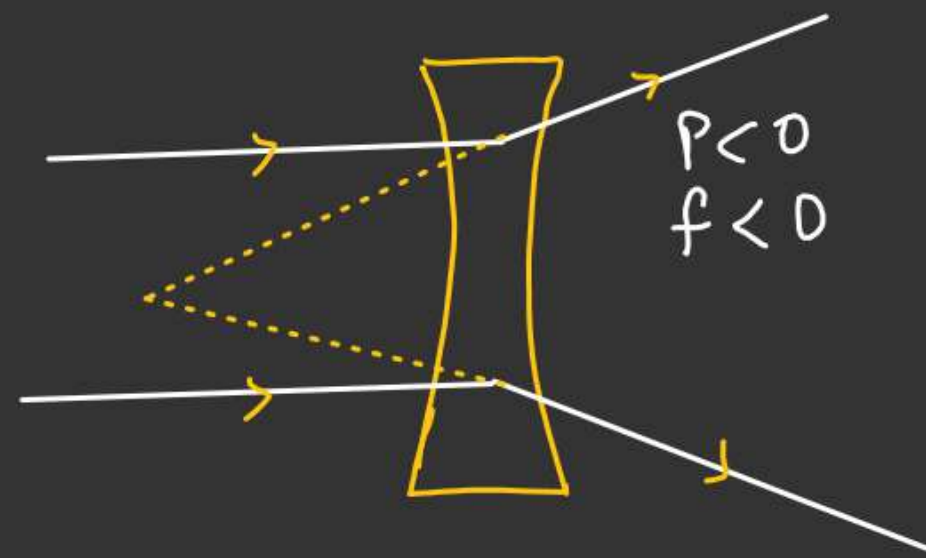
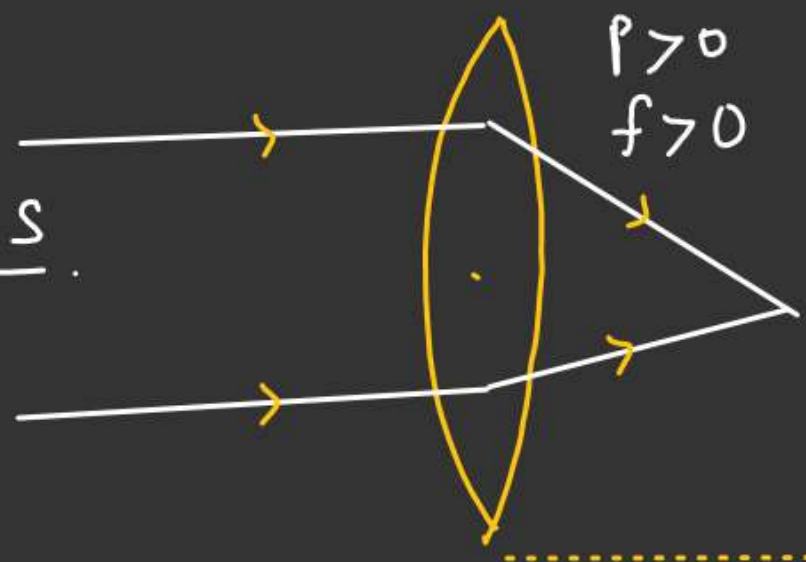
★★

# Power

$$P = \frac{1}{f}$$

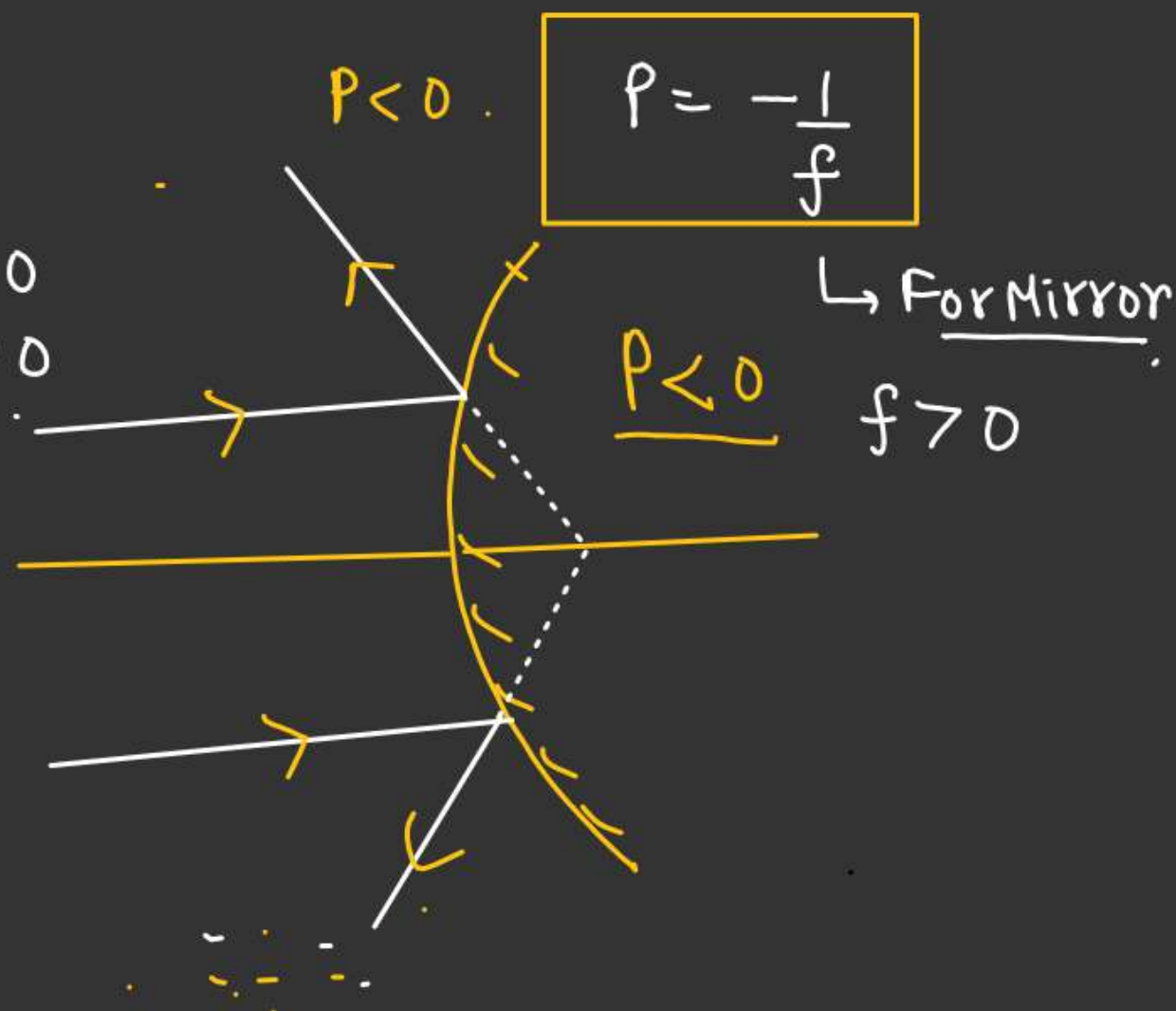
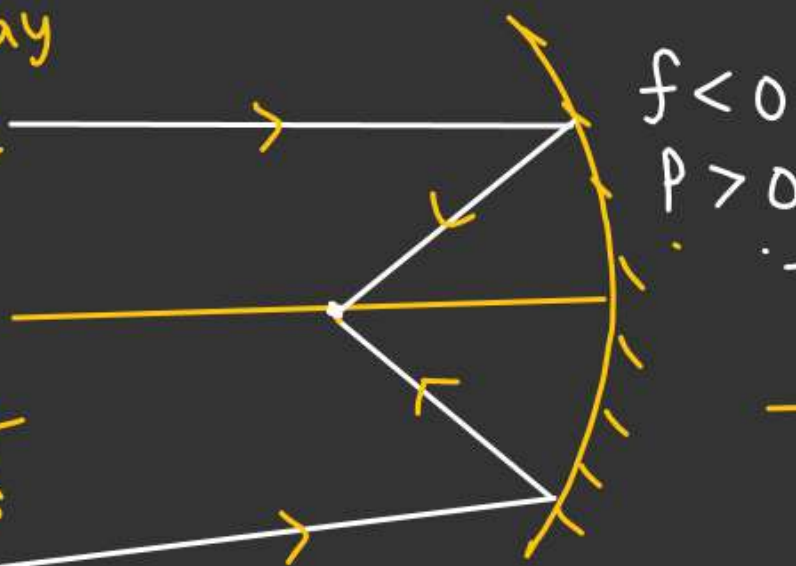
→ For lens

" Diopetre " → Unit of power



Ability of optical instrument to deviate the incident ray is called of the power of Optical instrument.

If optical instrument converge the incident ray parallel to principal axis its power is +ve & if it diverge then power is -ve



$$P_{\text{net}} = P_1 + P_2 + \dots + P_n$$

$$\frac{1}{f_{\text{eq}}} = \frac{1}{f_1} + \frac{1}{f_2} + \dots + \frac{1}{f_n}$$

Distance b/w  $C_1$  &  $C_2$   
negligible (Thin lens)

lens formula for lens-①

$$\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f_1}$$

For lens-2

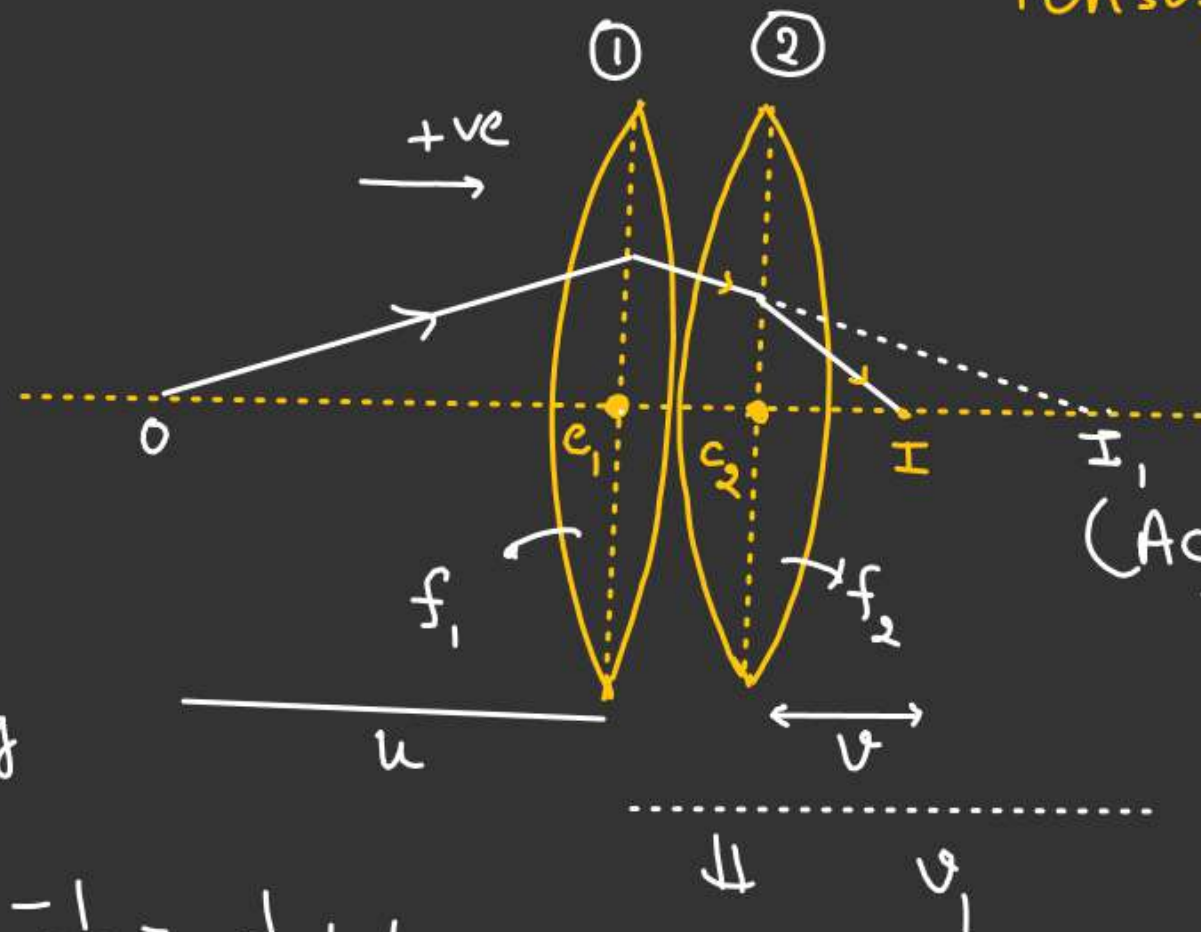
$$\frac{1}{v} - \frac{1}{v_1} = \frac{1}{f_2}$$

Adding

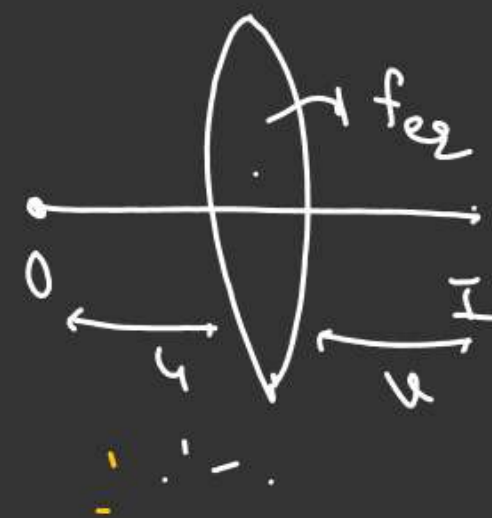
$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2}$$

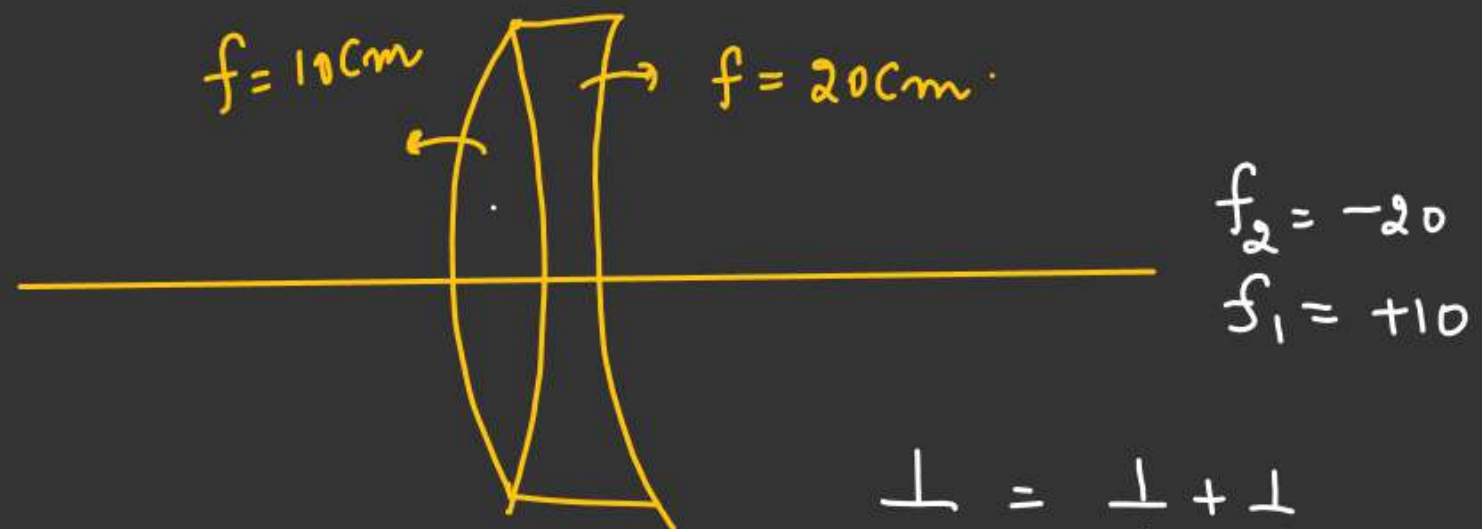
$$\frac{1}{f_{\text{eq}}} = \frac{1}{f_1} + \frac{1}{f_2}$$

Equivalent focal length  
of two lenses (separation negligible b/w two lenses)



(Acts as a virtual object for lens 2)





$$f_2 = -20$$

$$f_1 = +10$$

$$P_{\text{net}} = ??$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{f_{eq}} = \frac{1}{10} - \frac{1}{20}$$

$$P = \left( \frac{100}{20} \right)$$

$$= \underline{5 \text{ dioptre}}$$

$$\frac{1}{f_{eq}} = \frac{2-1}{20} = \left( \frac{1}{20} \right)$$

$$f_{eq} = 20\text{ cm.}$$

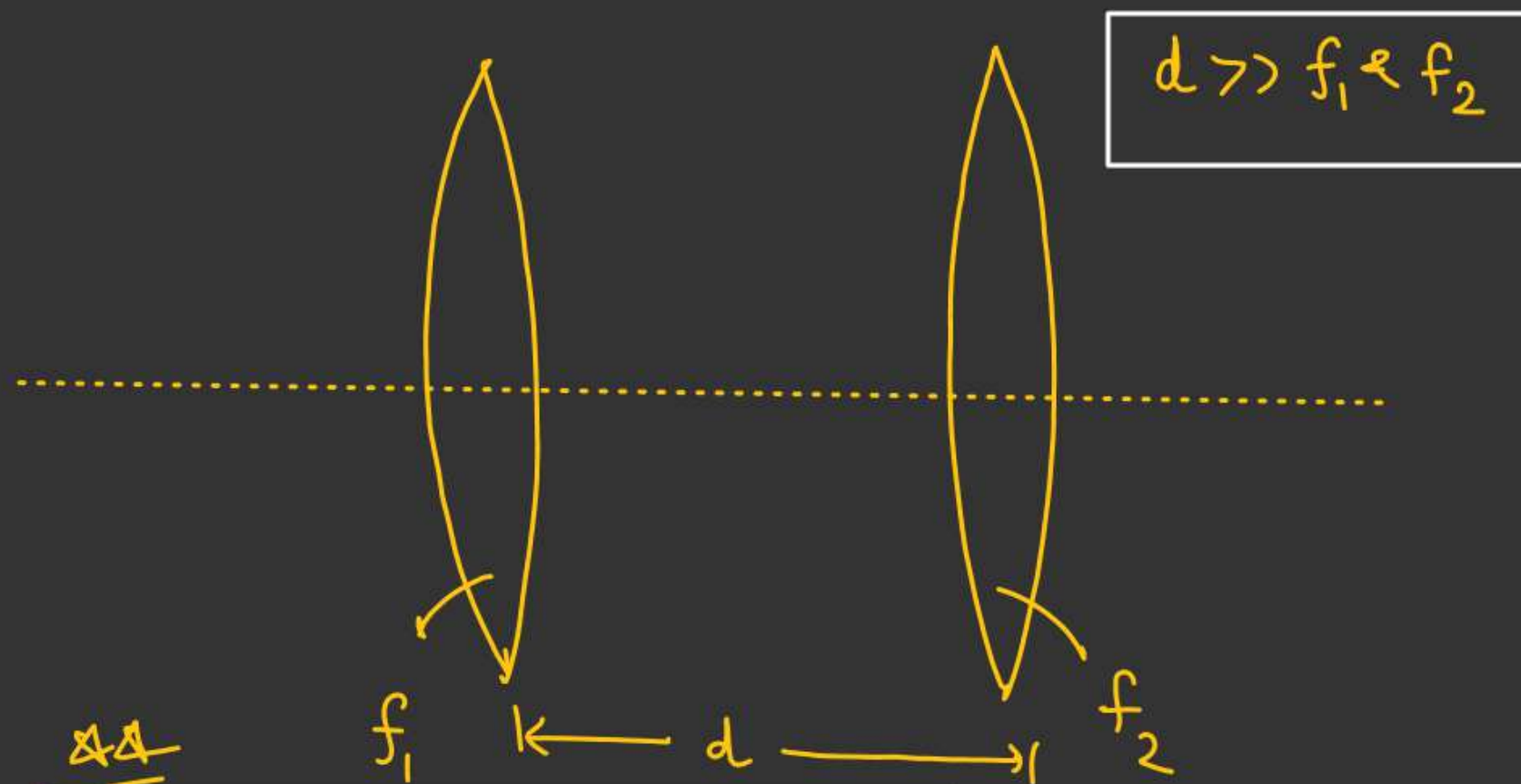
$$P = \frac{1}{f \times 10^{-2}}$$

$$P = \frac{100}{f}$$

cm

QA:

If two lenses at a separation  $d$ .

QA

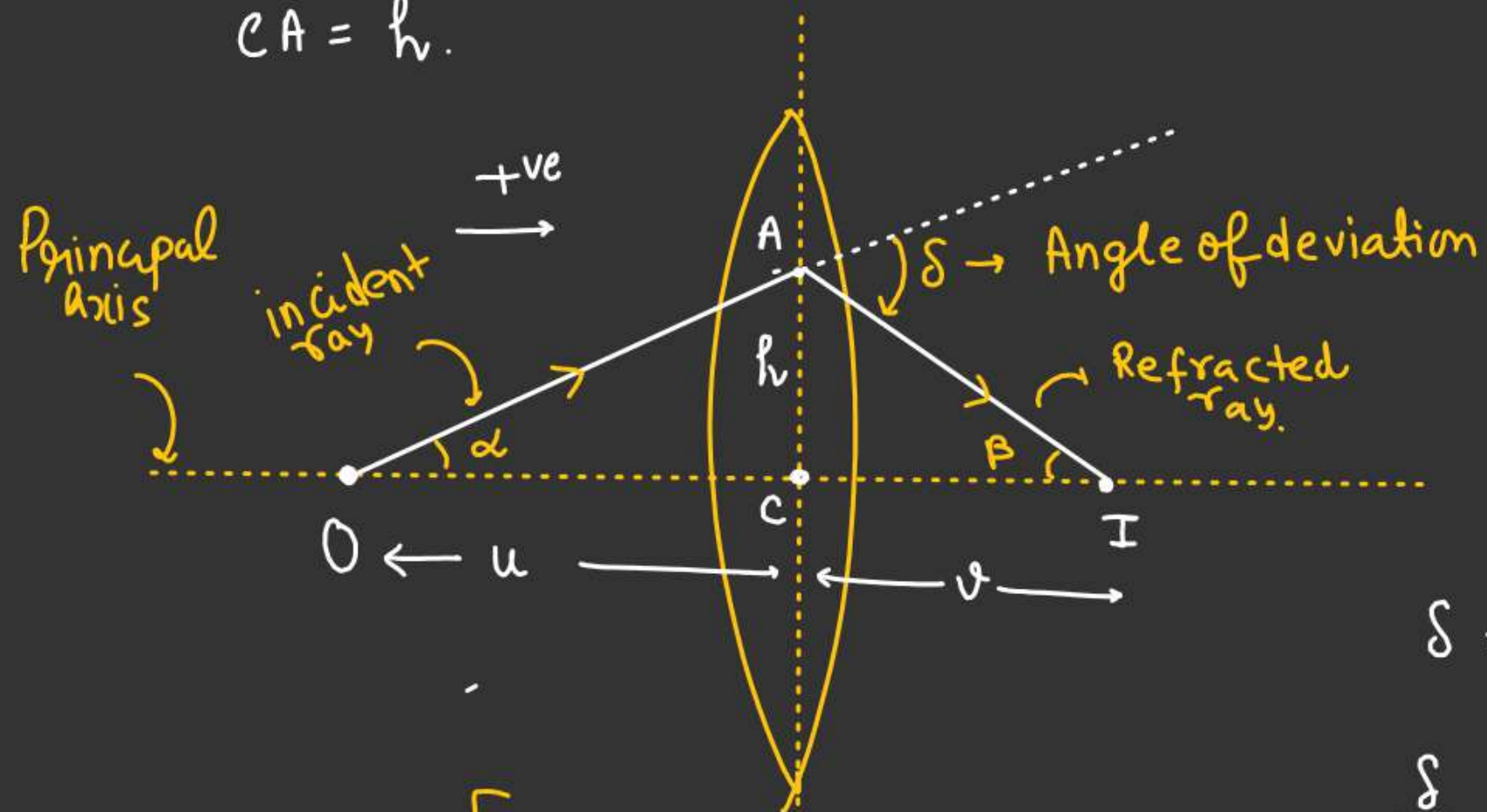
$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$

→ (put  $f_1 \& f_2$   
with sign)

QA

Angle of deviation in case of lens ✓

$$CA = h.$$

In  $\triangle OAI$ .

$$\delta = \alpha + \beta.$$

$$\tan \alpha \approx \alpha = \left( \frac{h}{-u} \right)$$

$$\tan \beta \approx \beta = \left( \frac{h}{v} \right)$$

$$\delta = \frac{h}{-u} + \frac{h}{v}$$

$$\frac{\delta}{h} = \left( \frac{1}{v} - \frac{1}{u} \right)$$

$$\frac{\delta}{h} = \frac{1}{f}$$

$$\delta = \frac{h}{f}$$

$h$  = height from optical center where incident ray hit the lens

In  $\triangle ABC$ .

$$\delta_{\text{net}} = \delta_1 + \delta_2$$

$$\frac{h_1}{f_{\text{eq}}} = \frac{h_1}{f_1} + \frac{h_2}{f_2} \quad \text{--- (1)}$$

In  $\triangle CBC$

$$BD = (h_1 - h_2) \quad \checkmark$$

In  $\triangle ABD$ .

$$\tan \delta_1 = \frac{BD}{AD}$$

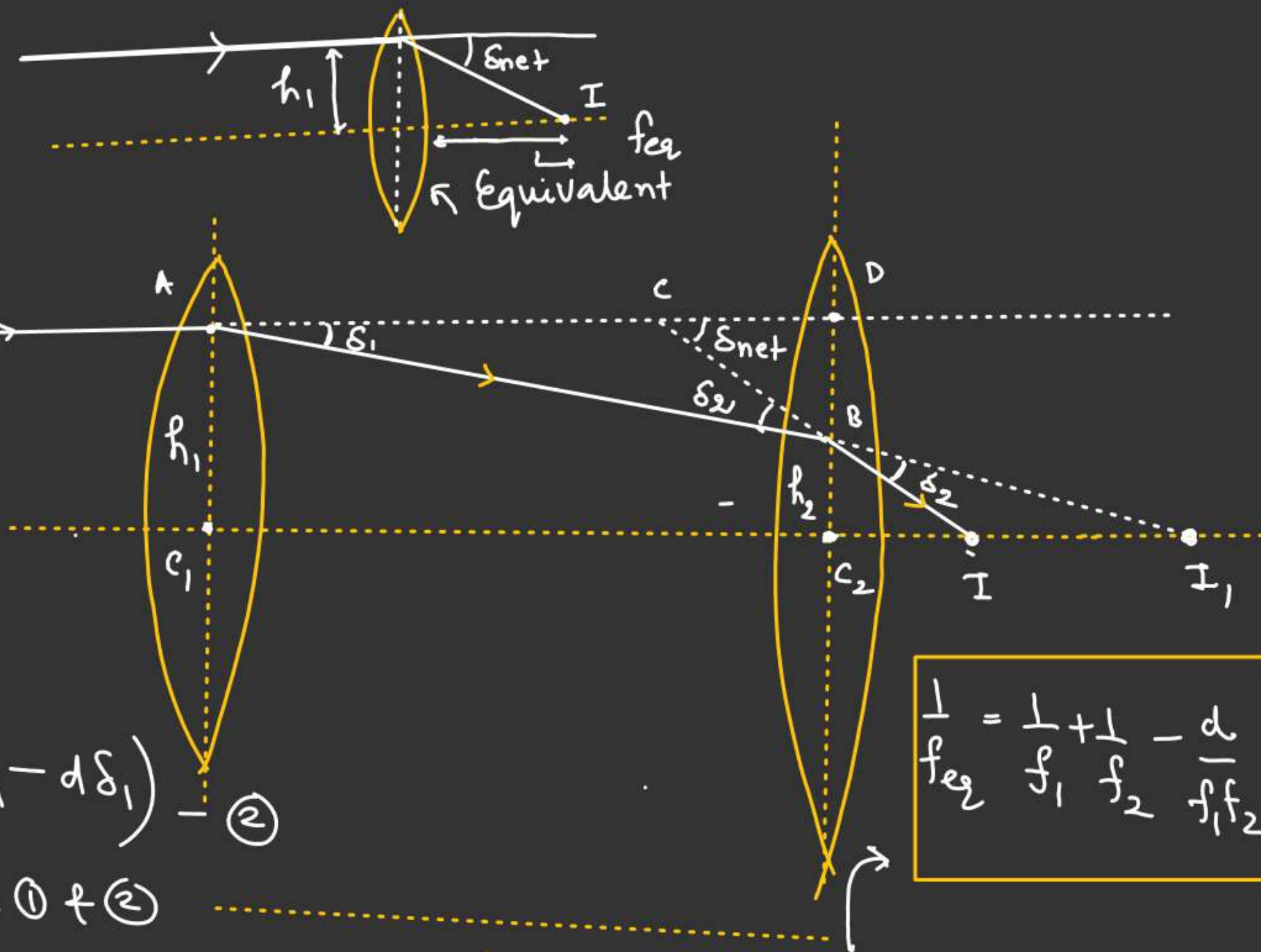
$$\delta_1 = \left( \frac{h_1 - h_2}{d} \right)$$

$$d \delta_1 = h_1 - h_2$$

$$\Rightarrow h_2 = (h_1 - d \delta_1) \quad \text{--- (2)}$$

From (1) & (2)

$$\frac{h_1}{f_{\text{eq}}} = \frac{h_1}{f_1} + \frac{h_1 - d \delta_1}{f_2} \Rightarrow \frac{h_1}{f_{\text{eq}}} = \frac{h_1}{f_1} + \frac{h_1}{f_2} - \frac{d}{f_2} \left( \frac{h_1}{f_1} \right)$$



$$\frac{1}{f_{\text{eq}}} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$



along Cut  
Principal axis.

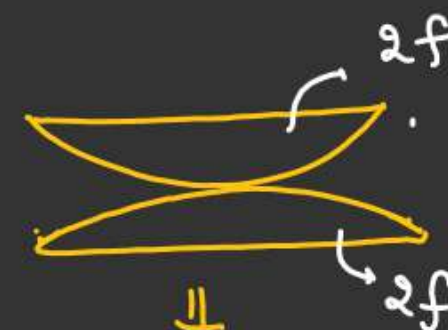
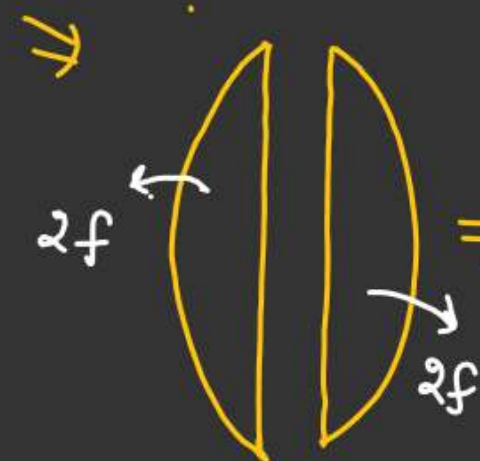
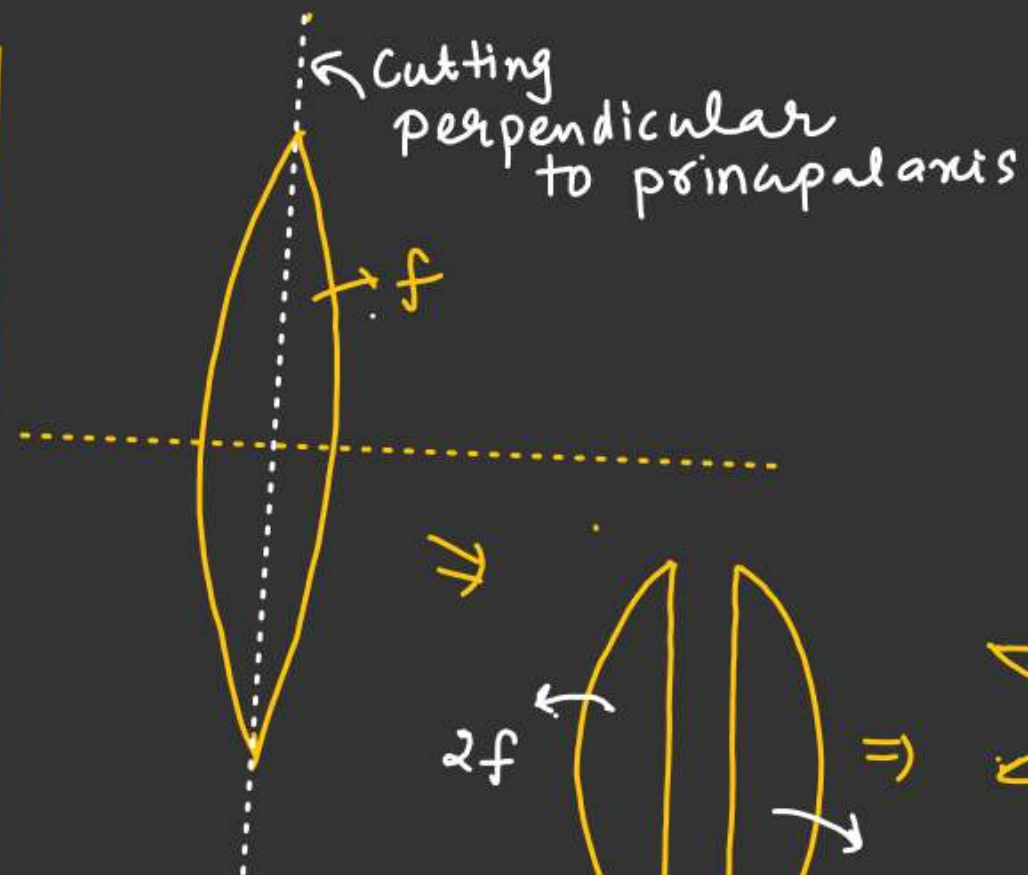


$\Rightarrow f_{eq} = ??$

$$\frac{1}{f_{eq}} = \frac{1}{f} + \frac{1}{f}$$

$$\frac{1}{f_{eq}} = \frac{2}{f}$$

$$f_{eq} = f/2$$



$f_{eq} = ??$

$$\frac{1}{f_{eq}} = \frac{1}{2f} + \frac{1}{2f} = \frac{2}{2f}$$

$$\underline{f_{eq} = f} \quad \checkmark$$



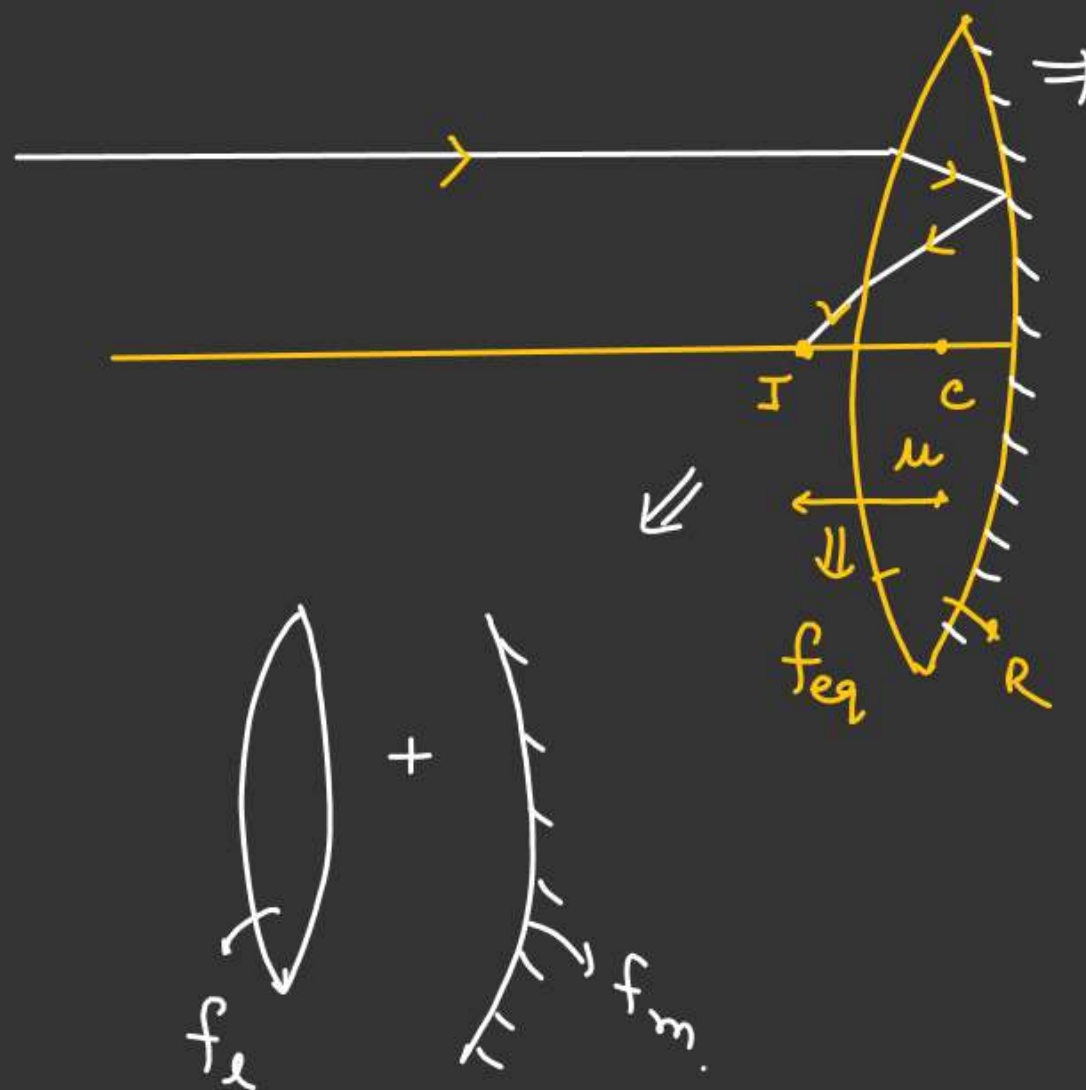
## Equivalent focal length of a lens when it's one side is silvered

$$\frac{1}{f_{eq}} = - \left[ \frac{n}{f_l} - \frac{m}{f_m} \right]$$

$n$  = No of refraction

$m$  = No of reflection

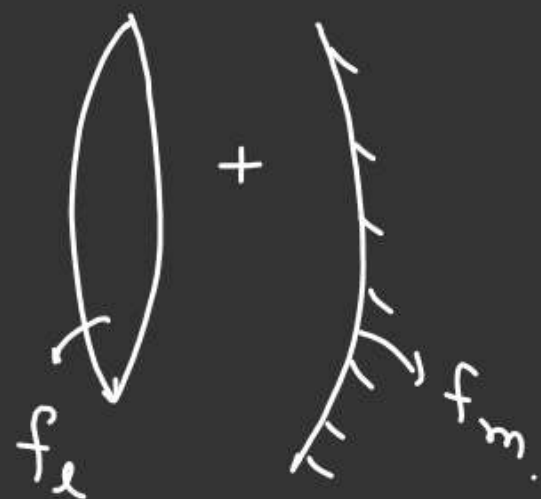
$$\begin{cases} f_l = \text{focal length of lens} \\ f_m = \text{focal length of mirror} \end{cases}$$



Overall whole system behave as Mirror.

if  $f_{eq} = -ve$   
then behaves as Concave mirror

if  $f_{eq} = +ve$   
then behave as Convex Mirror



$$\frac{1}{f_{eq}} = - \left[ \frac{2}{f_e} - \frac{1}{f_m} \right]$$

$$\frac{1}{f_{eq}} = - \left[ 2 \left( \frac{(\mu-1)^2}{R} \right) - \left( -\frac{2}{R} \right) \right]$$

$f_e = ??$

or

$\xrightarrow{+ve}$

$$\frac{1}{f_e} = (\mu-1) \left[ \frac{1}{R} - \frac{1}{(-R)} \right]$$

$$\frac{1}{f_e} = (\mu-1) \frac{2}{R}$$

$f_m = ??$

$\xrightarrow{+ve}$

$$f_m = \left( -\frac{R}{2} \right)$$

$$\frac{1}{f_{eq}} = -\frac{2}{R} [2\mu - 2 + 1]$$

$$\frac{1}{f_{eq}} = -\frac{2}{R} [2\mu - 1]$$

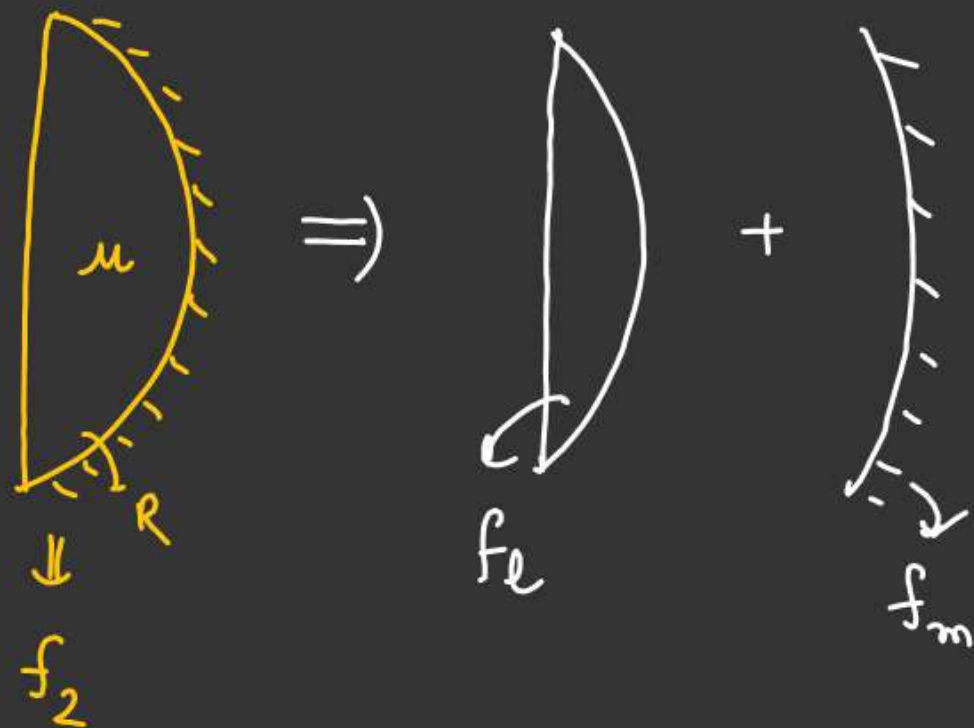
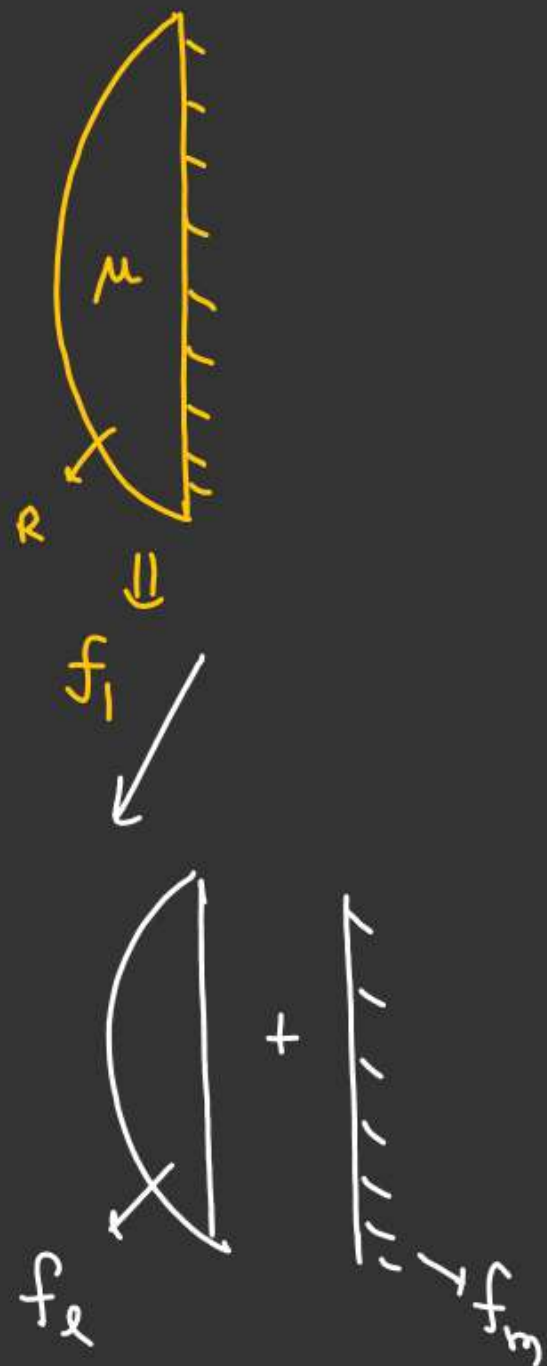
$$\frac{1}{f_{eq}} = -\frac{2(2\mu-1)}{R}$$

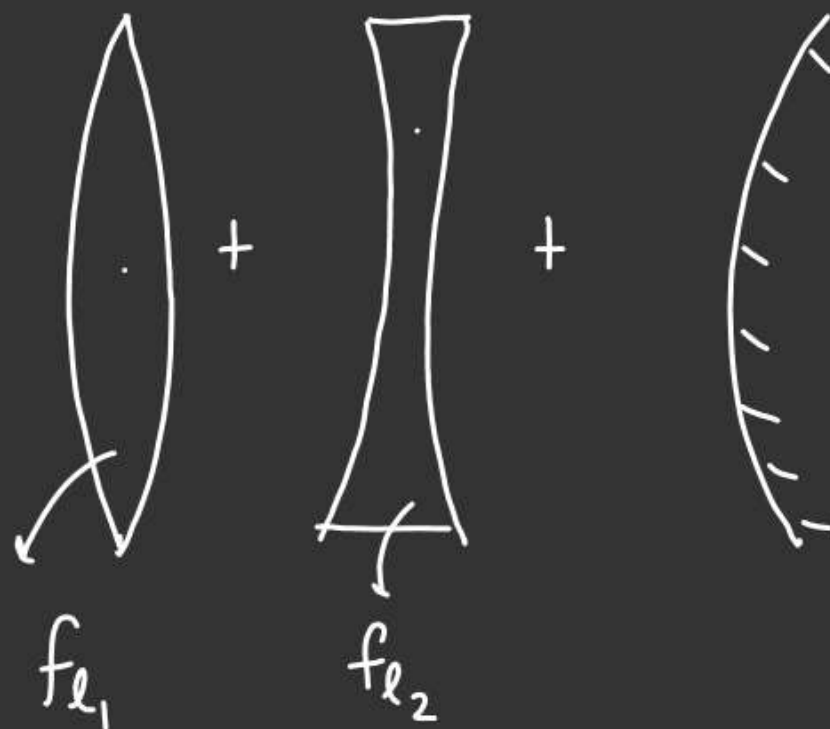
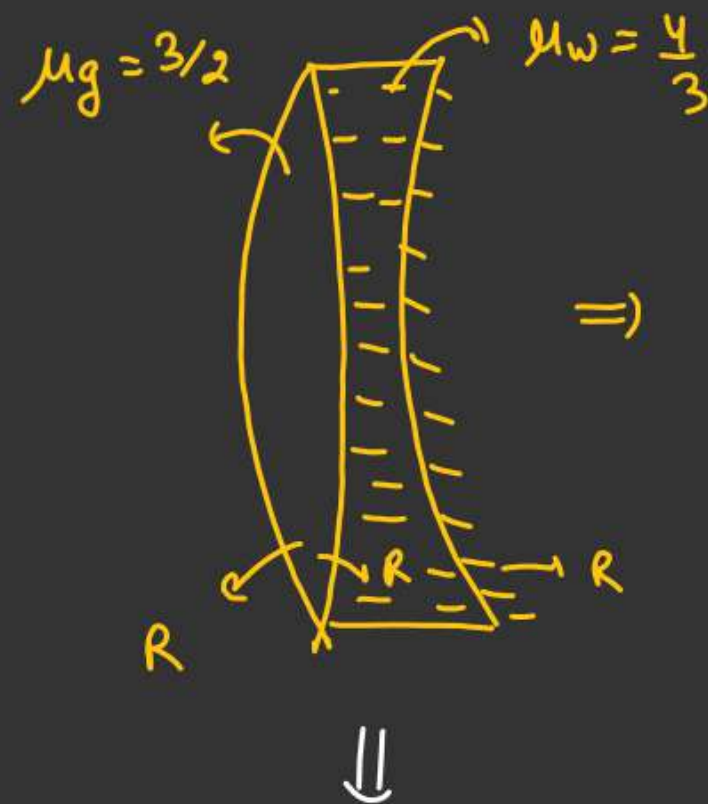
$$f_{eq} = \frac{-R}{2(2\mu-1)}$$

Q8. H.W ✓

Find

$$\frac{f_1}{f_2} = ??$$



H.W

$$\frac{1}{f_e} = \left( \frac{1}{f_{e1}} + \frac{1}{f_{e2}} \right)$$

put  $n=2$ for  $\left( \frac{1}{f_e} \right)$ .