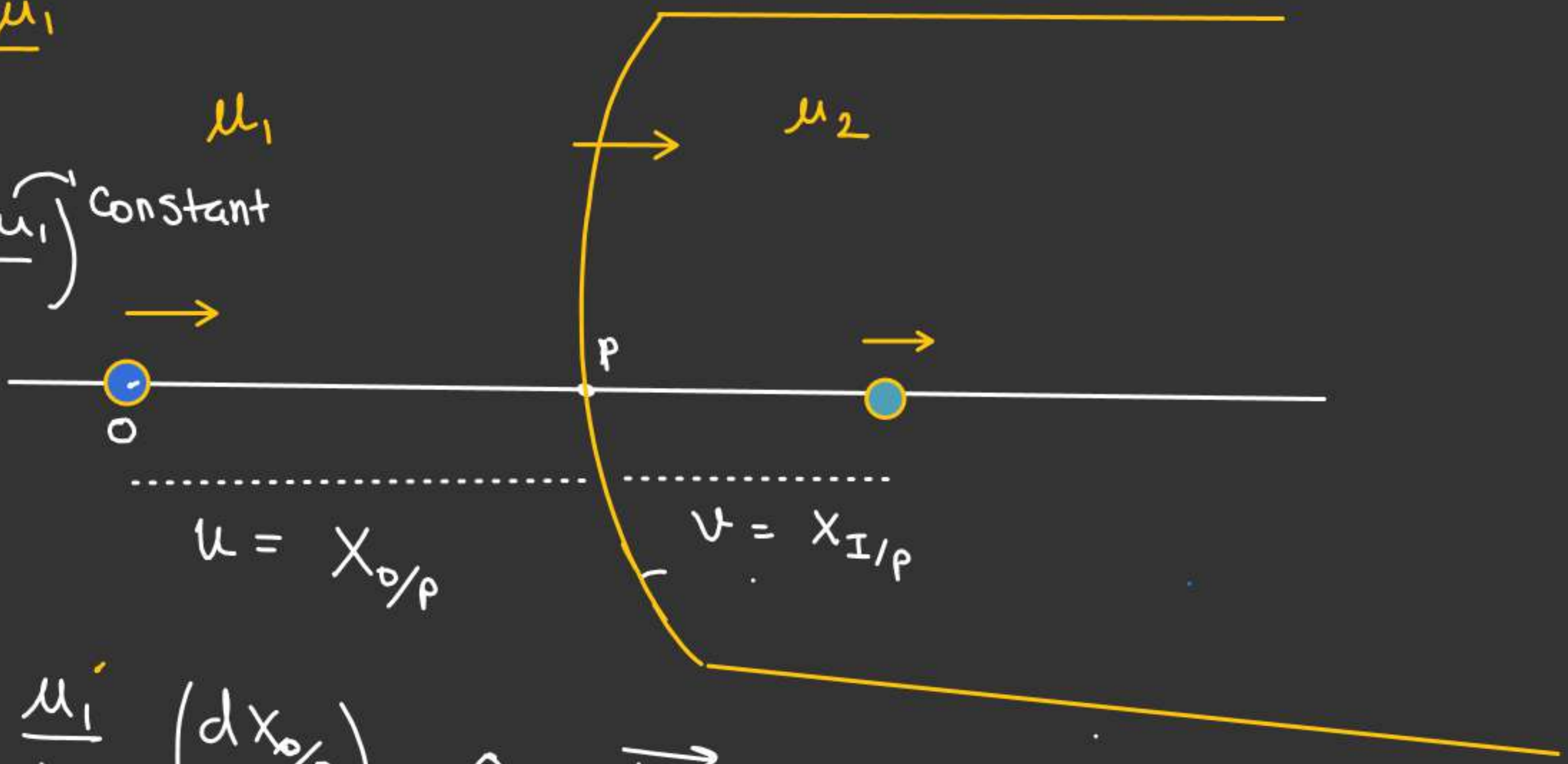
Nishant Jindal

Velocity of Image in Case of Curved refracting surface.

$$\frac{\mu_2}{\underline{\underline{V}}} - \frac{\mu_1}{\underline{\underline{u}}} = \frac{\mu_2-\mu_1}{R}$$

$$\frac{\mu_2}{X_{I/P}} - \frac{\mu_1}{X_{O/P}} = \left(\frac{\mu_2-\mu_1}{R}\right) \text{ Constant}$$



Differentiating w.r.t time

$$\mu_2 \frac{-1}{(X_{I/P})^2}\left(\frac{dX_{I/P}}{dt}\right) + \frac{\mu_1}{(X_{O/P})^2}\left(\frac{dX_{O/P}}{dt}\right) = 0$$

$$\Downarrow$$

$$\vec{V}_{I/P} = \left(\frac{\mu_1}{\mu_2}\right)\left(\frac{X_{I/P}}{X_{O/P}}\right)^2 \vec{V}_{O/P}$$

$\vec{V}_{I/P}$ = velocity of image w.r.t Refracting Surface.

$$\left(\vec{V}_{I/E} = \vec{V}_{I/\text{Refracting Surface}} - \vec{V}_{\text{Refracting surface}/E}\right) \checkmark$$

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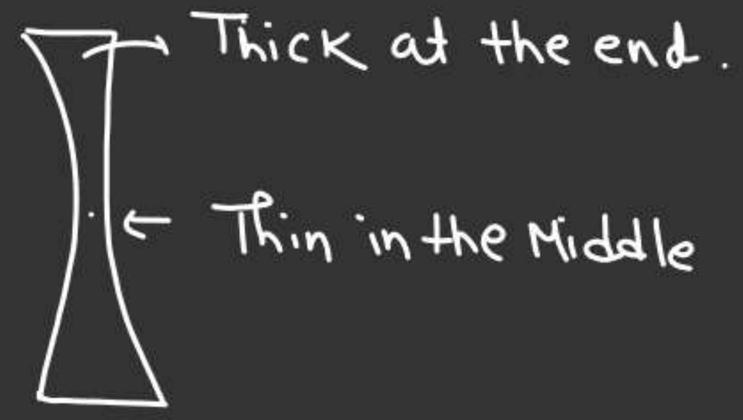
LENS

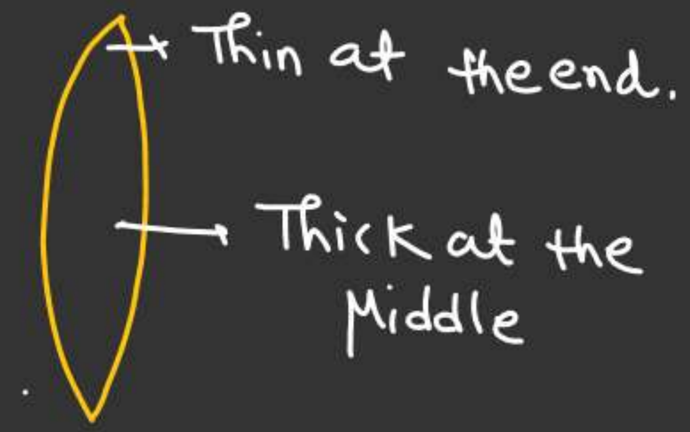
Def^n

↳ A portion of transparent Medium bounded by two Surfaces in which one of the Surface is a Curve and the other Surface may be a Curve or plane surface.

↳ Concave lens :- (Diverging lens)



Convex lens (Converging)



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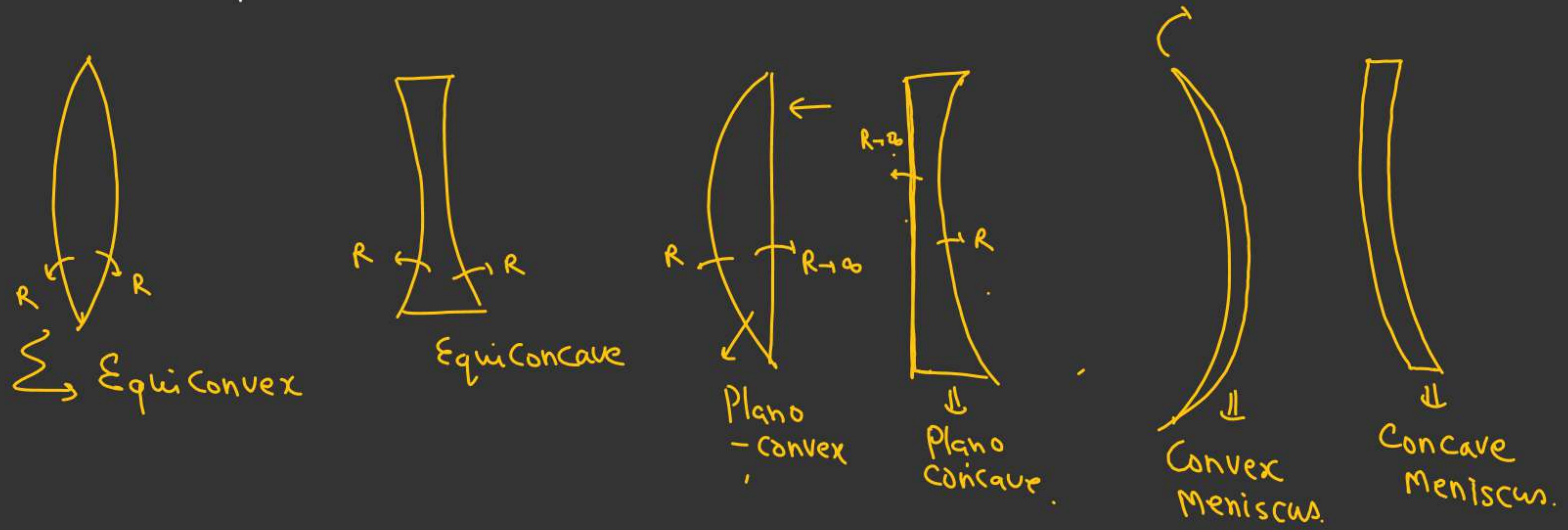
Naming of lens

While naming the lens the surface having large radius of curvature named frist.



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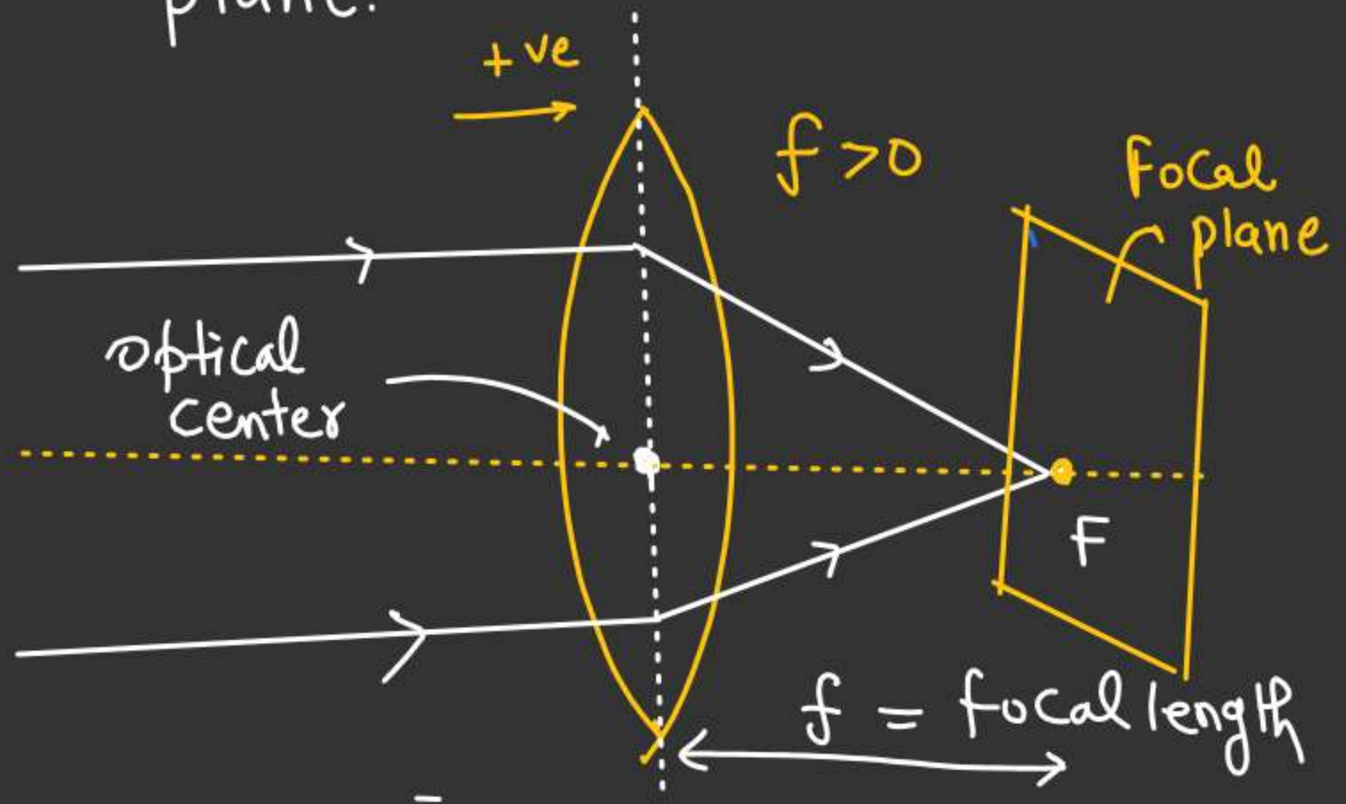
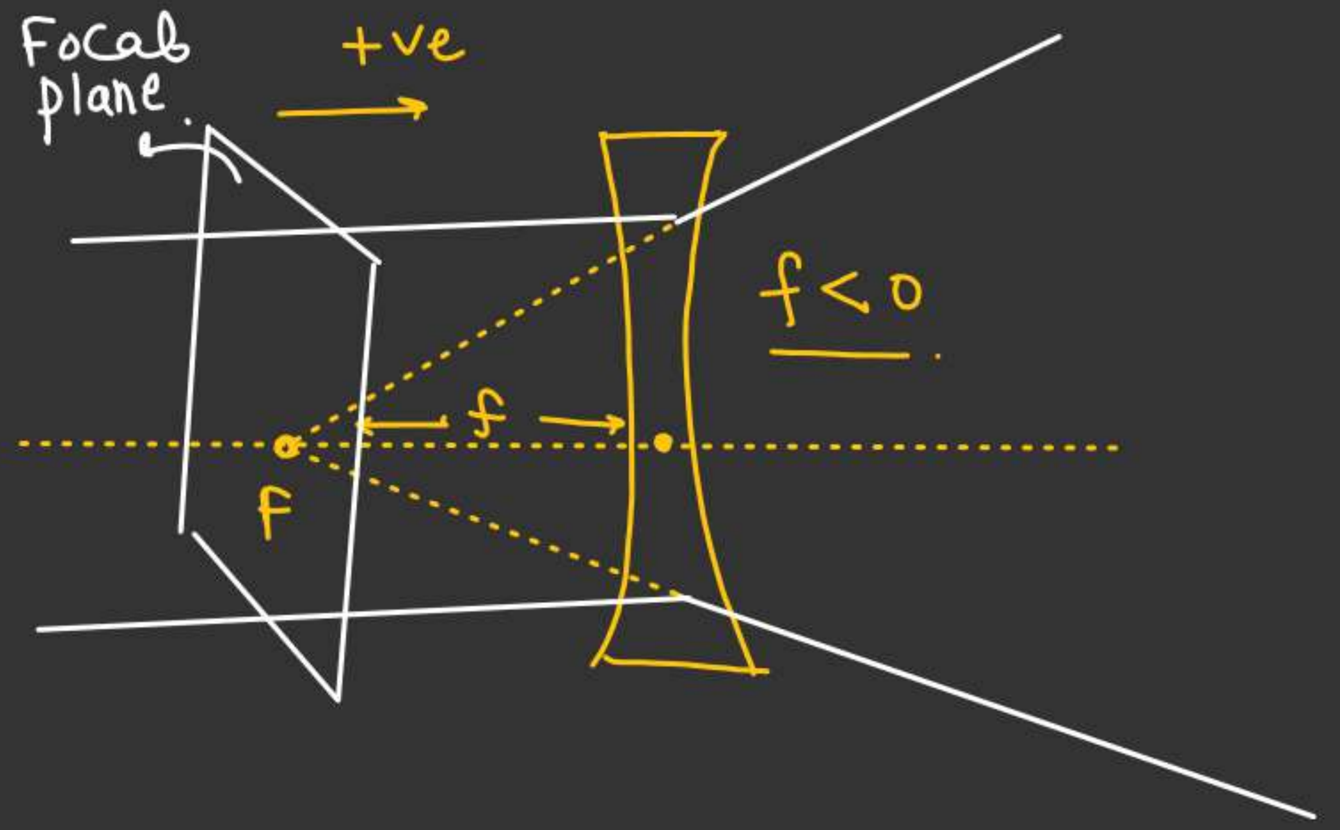
FOCUS :-

A point where light ray coming parallel to principal axis actually converge or seems to diverge. this point is called focus and the plane where this point lie is called focal plane.





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LEN'S FORMULA (Thin lens)

Distances from P_1 and P_2 same as from C.

ΔABC & $\Delta A'B'C$ Similar.

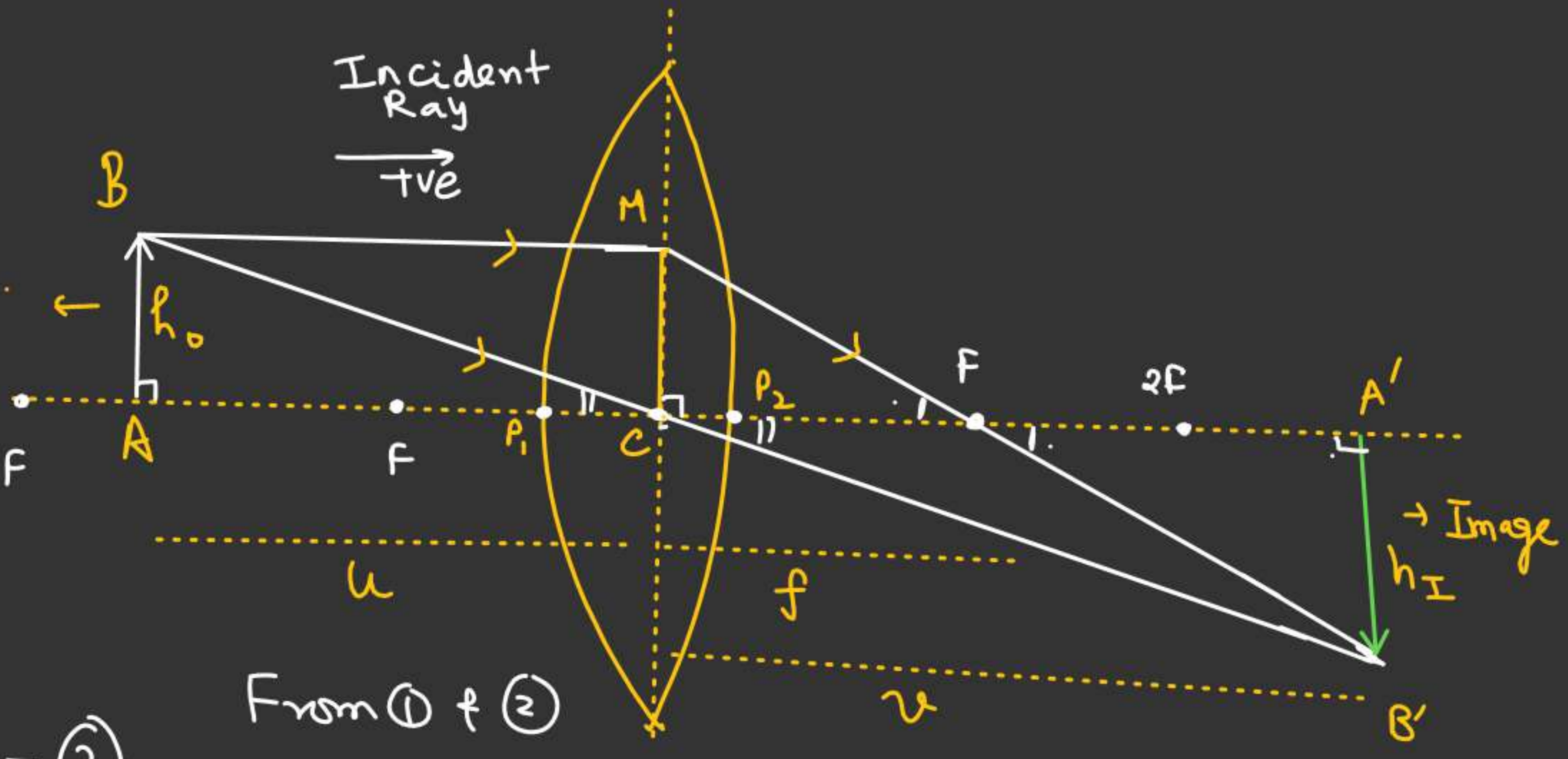
$MC = AB$.

$$\frac{AB}{A'B'} = \frac{AC}{A'C} \quad \text{— (1)}$$

ΔMCF & $\Delta A'B'F$ Similar.

$$\frac{MC}{A'B'} = \frac{AB}{A'B'} = \frac{CF}{A'F}$$

$$\frac{AB}{A'B'} = \frac{CF}{A'C - CF} \quad \text{— (2)}$$



From (1) & (2)

$$\frac{AC}{A'C} = \frac{CF}{A'C - CF}$$

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

$$-uv + uf = vf$$

Dividing both side by vuf

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

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

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**

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

Magnification [Transverse]

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

$$\boxed{m = \frac{h_I}{h_o} = \left(\frac{v}{u}\right)}$$

From Eq^n 1

$$\frac{A'B'}{AB} = \frac{A'C}{AC}$$

$$\frac{-h_I}{h_o} = \frac{v}{(-u)}$$

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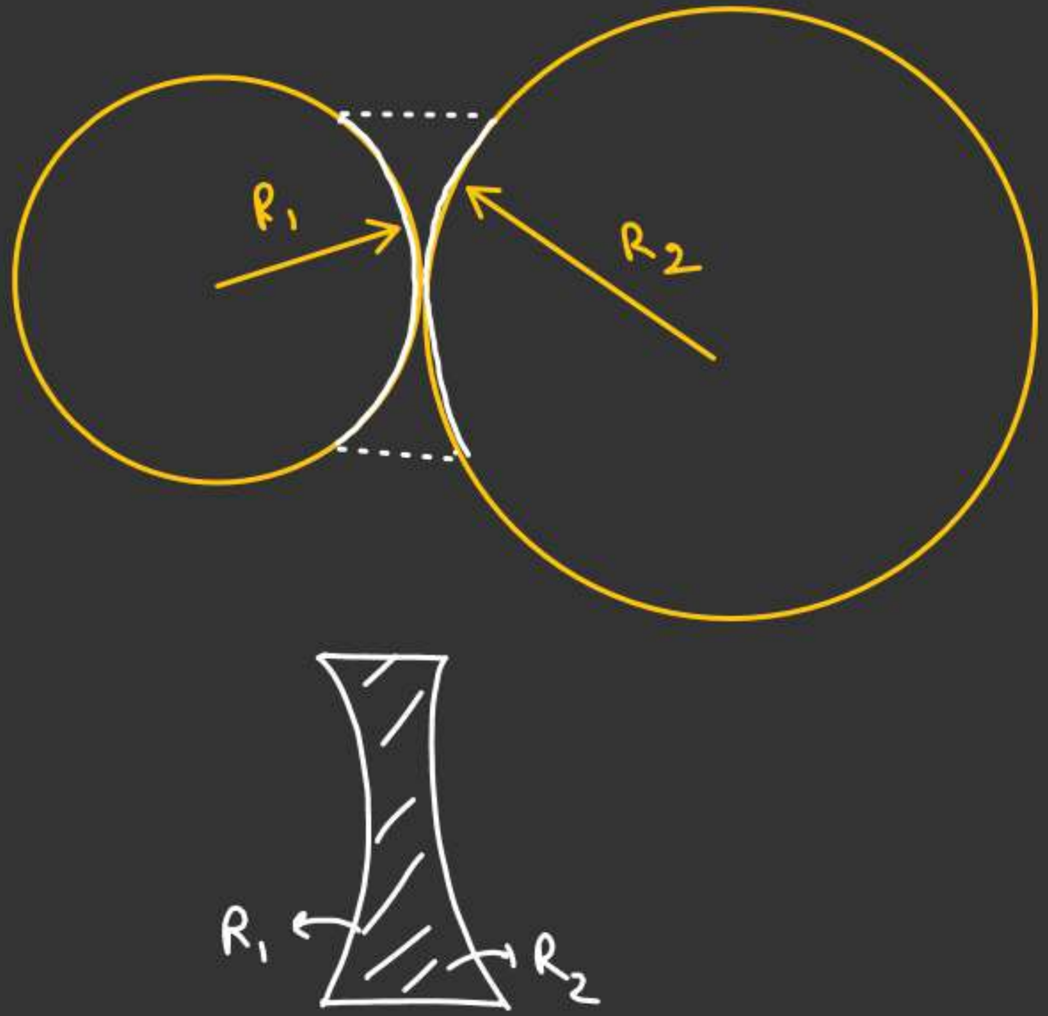
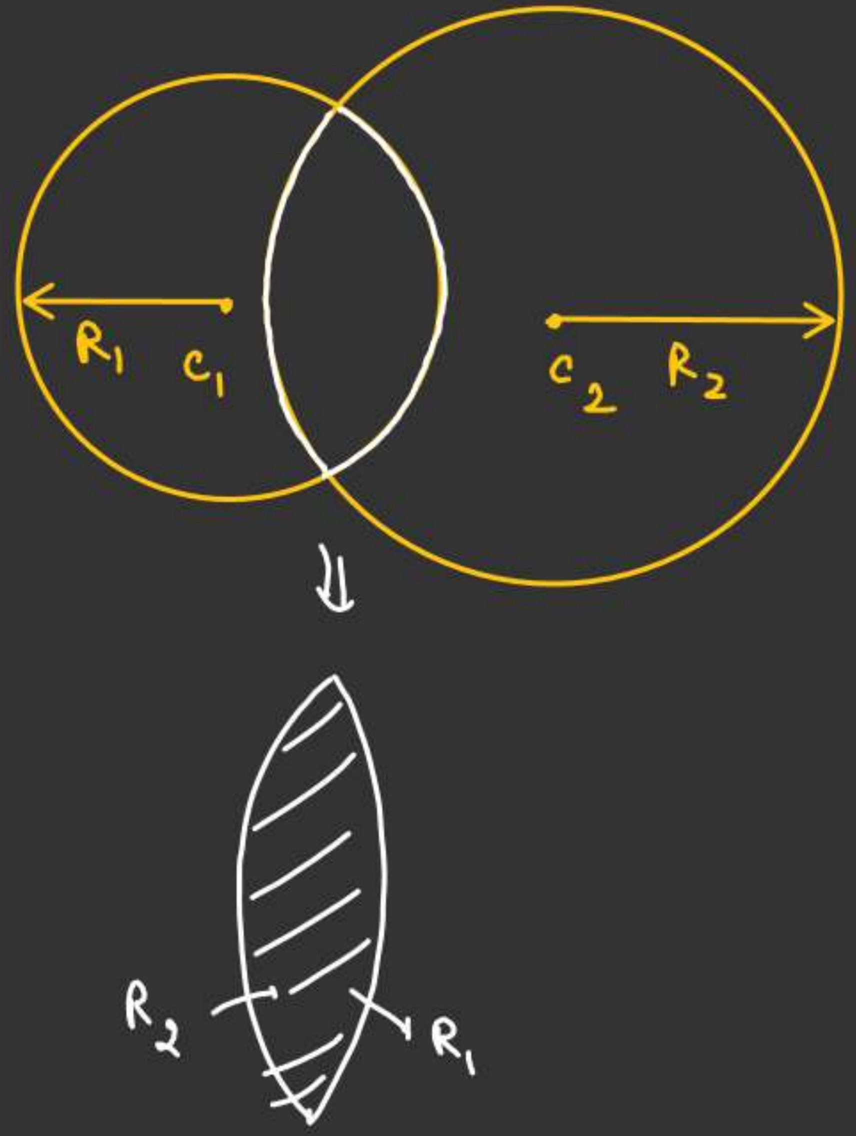
LEN'S MAKER FORMULA

AA:

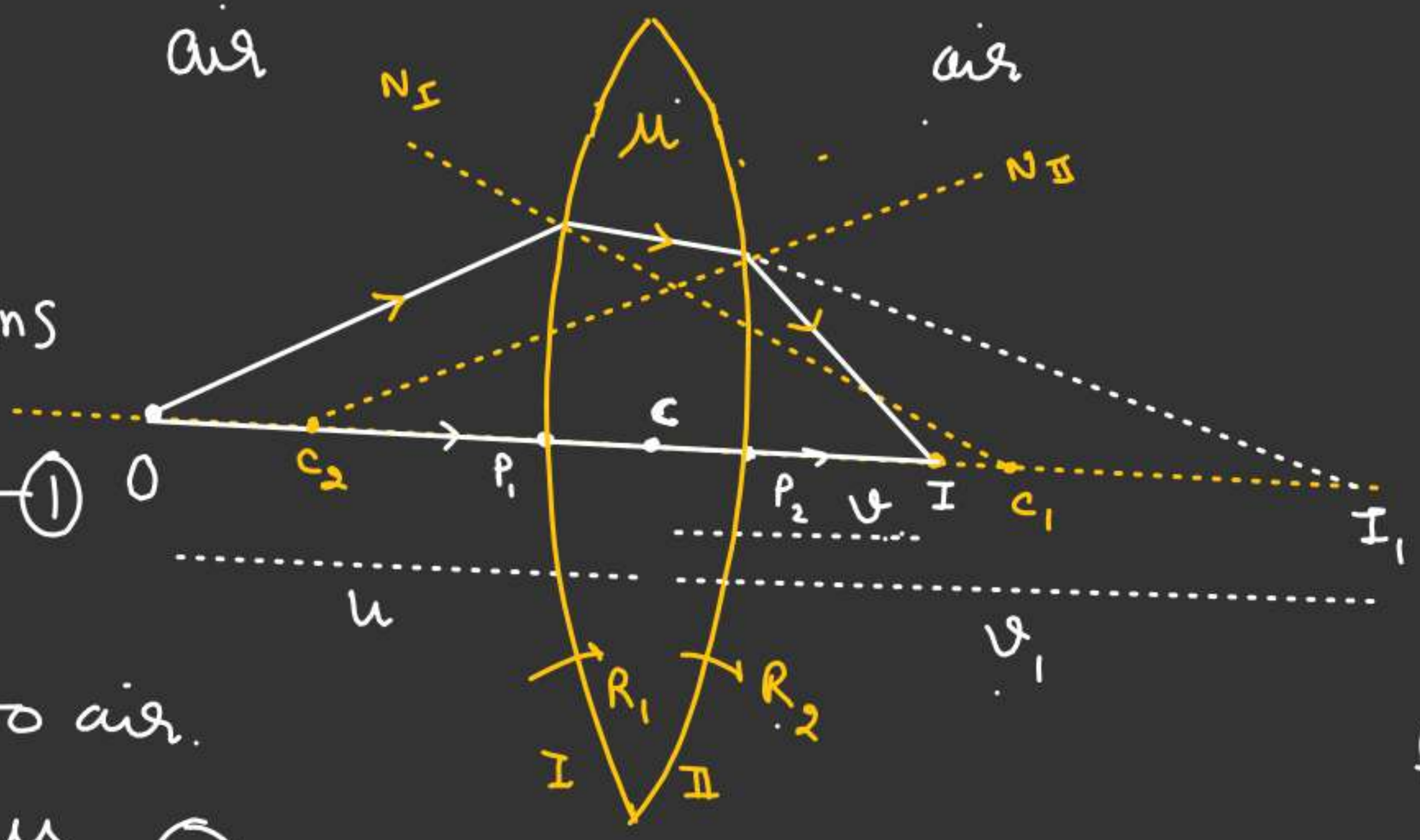




Q: LEN'S MAKER FORMULA (Thin lens)

μ_l = Refractive index of lens

μ_s = Refractive index of Surrounding.



I_1 (Acts as a Virtual Object for 2nd Refraction)

Refraction from air to lens

Without Sign

$$\frac{\mu}{v_1} - \frac{1}{u} = \frac{\mu - 1}{R_1} \quad \text{---(1)}$$

Refraction from lens to air.

$$\frac{1}{v} - \frac{\mu}{v_1} = \frac{1-\mu}{R_2} \quad \text{---(2)}$$

Adding (1) + (2)

$$\left[\frac{1}{v} - \frac{1}{u}\right] = \left(\frac{\mu - 1}{R_1}\right) + \frac{(1-\mu)}{R_2}$$

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

$$\boxed{\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]}$$

$$\boxed{\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]}$$

$\Rightarrow$ Focal length of lens not fixed.

$\Rightarrow$ Focal length of lens depend on the Medium in which kept.

$$\boxed{\frac{1}{f} = \left(\frac{\mu_l}{\mu_s} - 1\right)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]}$$

μ_s = Refractive index of Surrounding Medium in which lens is kept.

μ_l = Refractive index of lens.

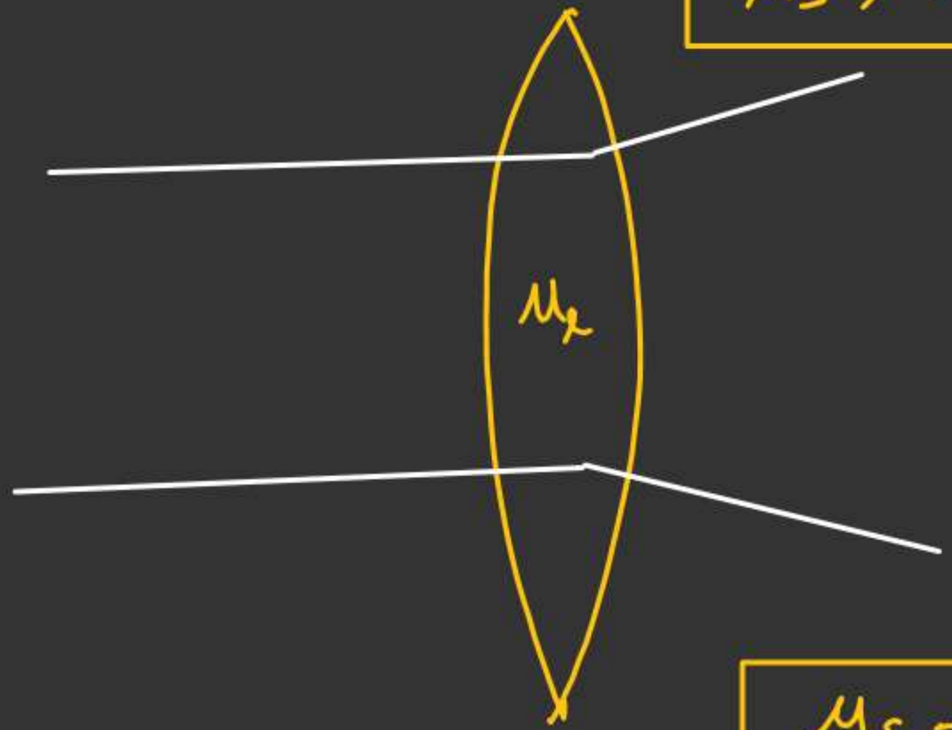
$\left[\begin{array}{l} \text{If } R_1 < R_2 \Rightarrow \frac{1}{R_1} > \frac{1}{R_2} \\ \quad \& \quad \mu_l > \mu_s \end{array}\right] \Rightarrow f > 0 \Rightarrow$ [Convex behave as convex

$\left.\begin{array}{l} \text{If } R_1 < R_2 \Rightarrow \frac{1}{R_1} > \frac{1}{R_2} \\ \quad \mu_l < \mu_s \end{array}\right] \Rightarrow f < 0. \Rightarrow$ [Convex behave as Concave

Note

If refractive index of surrounding medium is greater than lens than convex lens behave as concave lens & concave lens behave as convex

$$\boxed{\mu_s > \mu_\ell.}$$



$$\boxed{\mu_s = \mu_\ell}$$

$$\frac{1}{f} = \left(\frac{\mu_\ell}{\mu_s} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = 0 \Rightarrow f \to \infty$$

↳ Behave as a transparent glass slab.

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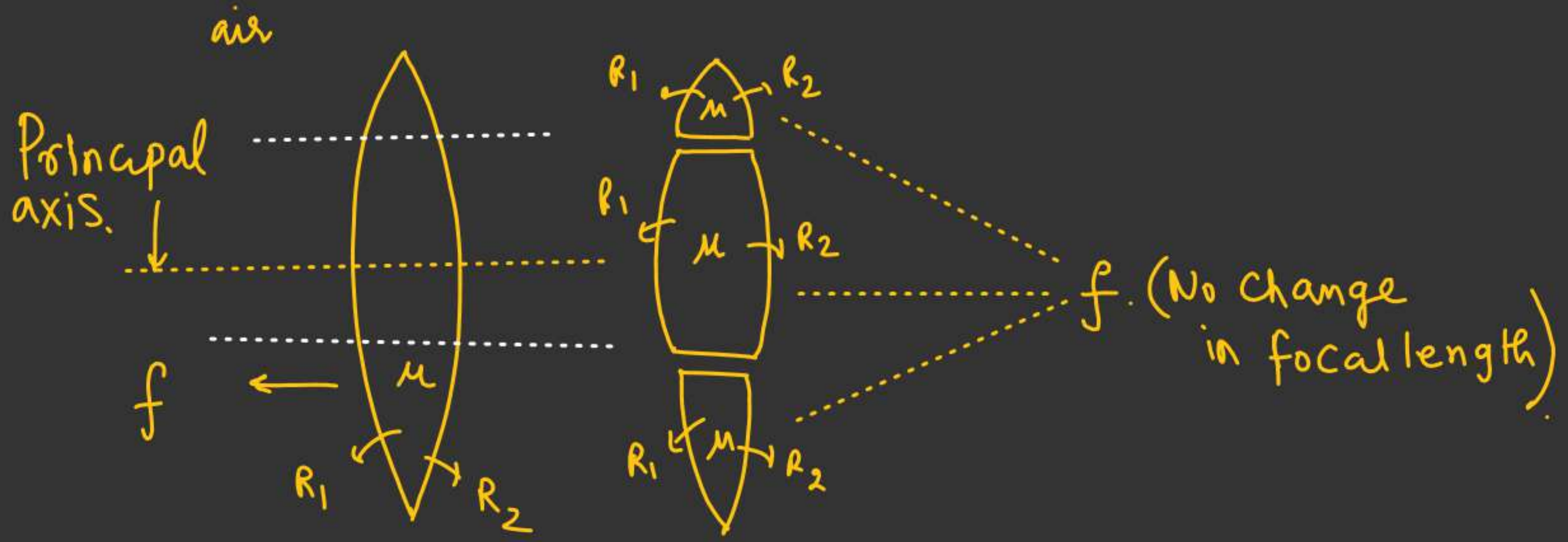
Effect on focal length of lens due to Cutting of lens

① Cutting of lens parallel to principal axis.



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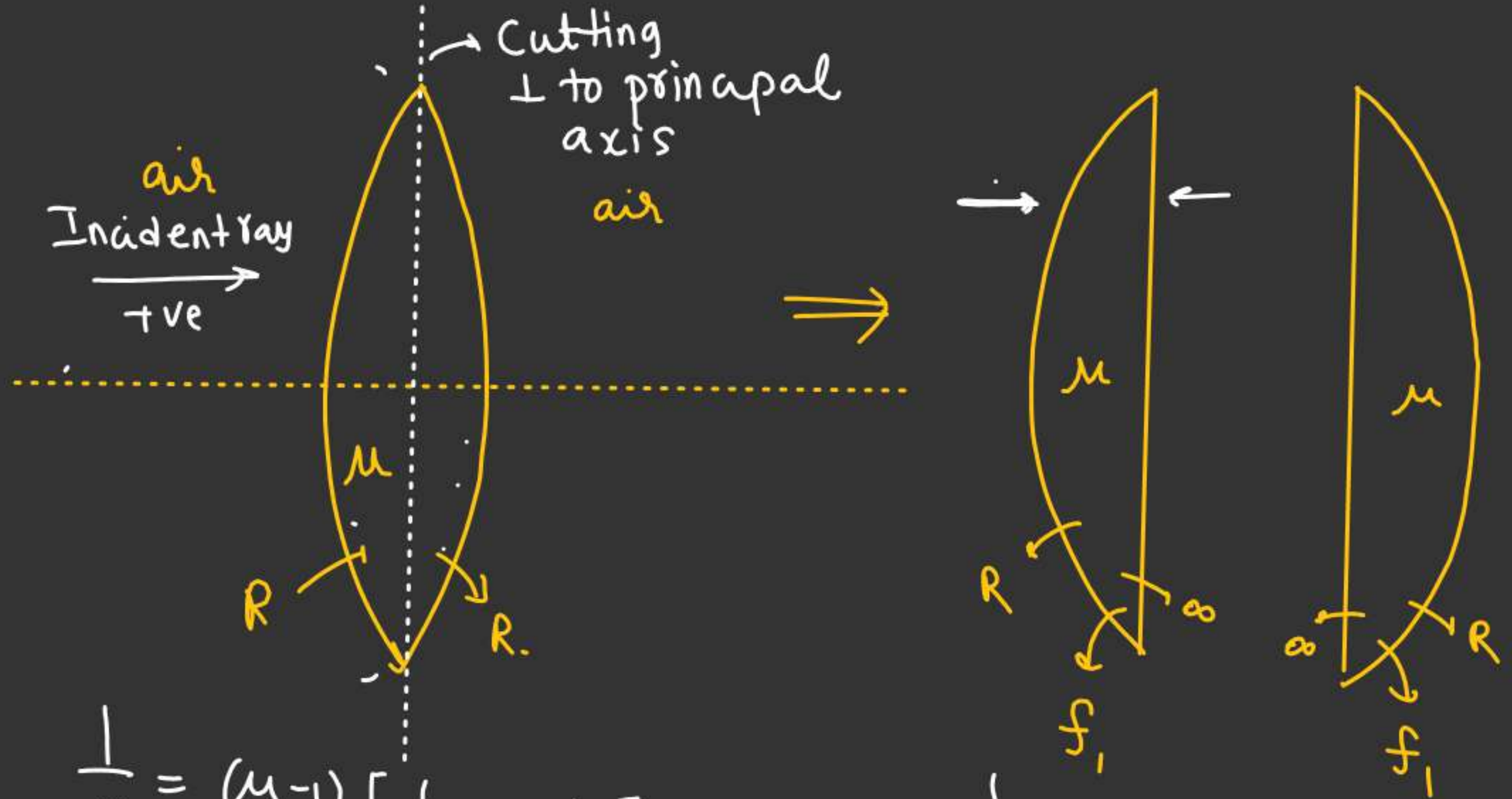
Case-2 Cutting perpendicular to principal axis



From ① & ②

$$\boxed{f_1 = 2f}$$

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

$$\frac{1}{f} = \frac{2(\mu-1)}{R} \Rightarrow f = \frac{R}{2(\mu-1)} \quad -①$$

$$\frac{1}{f_1} = (\mu-1)\left[\frac{1}{R} - \frac{1}{\infty}\right]$$

$$\frac{1}{f_1} = \frac{(\mu-1)}{R} \Rightarrow f_1 = \left(\frac{R}{\mu-1}\right) \quad -②$$