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Refractive Index

Absolute Refractive Index :- $\mu = \dfrac{c}{v}$

c = Speed of light in air
v = Speed of light in medium

Relative Refractive index

$${}_1\mu_2 = \frac{\mu_2}{\mu_1}$$

$$\left(\mu_2 = \frac{c}{v_2},\ \mu_1 = \frac{c}{v_1} \right)$$

$$\boxed{\begin{aligned} \mu &= \frac{c}{v} \\ v &= \frac{\lambda}{T} = (\lambda \cdot f) \end{aligned}}$$

$f \rightarrow$ only depends on Source not on medium.

$$f = \left(\frac{v}{\lambda}\right)$$

$\Downarrow$

Constant

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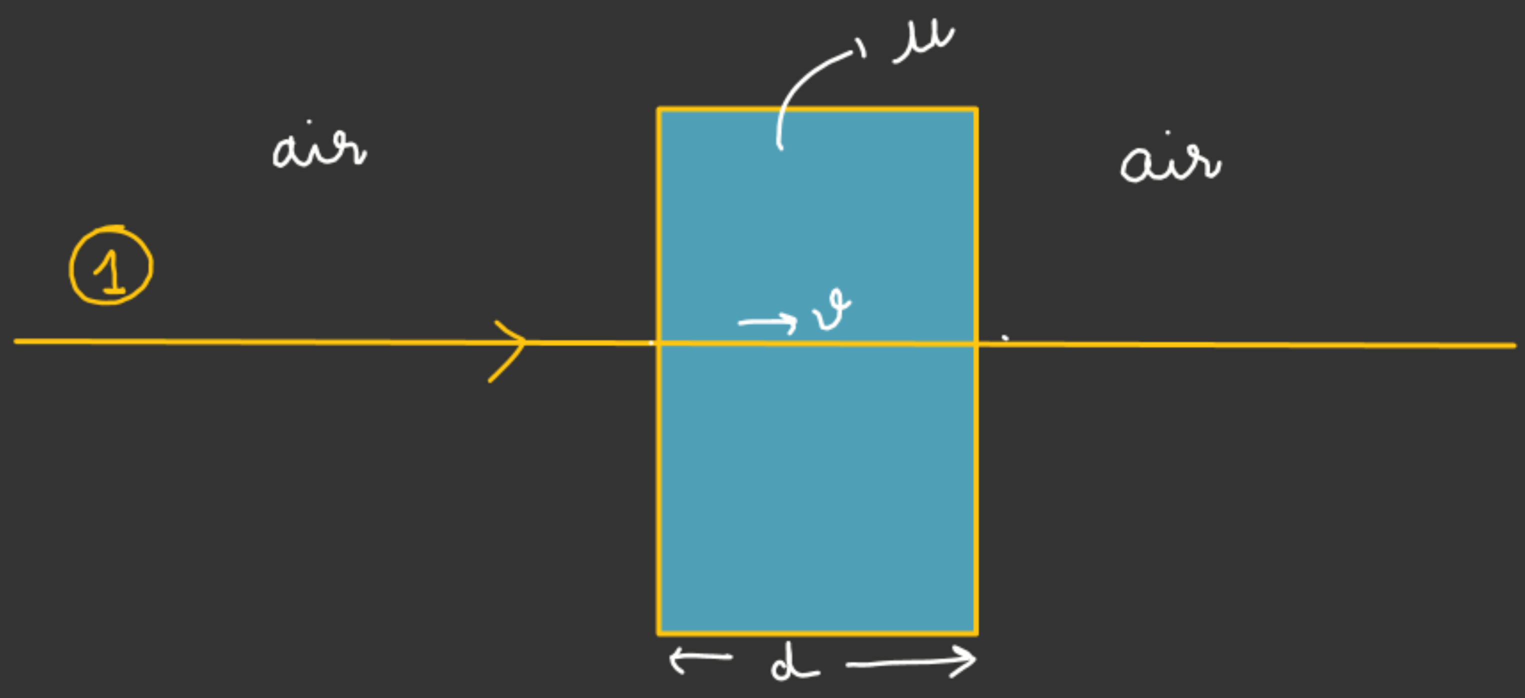
Concept of optical path length.

Time taken by ray 1 to cover 'd' distance in medium

$$t = \frac{d}{v}$$

$$\mu = \frac{c}{v} \Rightarrow v = \left(\frac{c}{\mu}\right)$$

$$t = \left(\frac{\mu d}{c}\right)$$



Distance travelled by ray 2 in time t.

$$d' = c \times t \Rightarrow \boxed{d' = \mu d}$$

$$d' = \cancel{c} \times \frac{\mu d}{\cancel{c}}$$

Note :- 'd' distance travel in medium is equivalent to 'μd' distance travel in air.

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★★: Some Important points regarding Y.D.S.E

① $\omega_{air} = \left(\frac{D\lambda_{air}}{d}\right)$

If whole Y.D.S.E Appratus is dipped in a medium having refractive index μ.

$$W_{medium} = \frac{D\lambda_{medium}}{d}$$

$$\frac{c}{f} = \lambda_{air}$$

$f \rightarrow$ (frequency)

$$\lambda = c \times T = \frac{c}{f}$$

$$\mu = \frac{c}{v} = \frac{c}{f\lambda_{medium}}$$

$$\lambda_{medium} = \left(\frac{c}{\mu f}\right) = \left(\frac{\lambda_{air}}{\mu}\right)$$

$$W_{medium} = \left(\frac{D}{d}\right)\frac{\lambda_{air}}{\mu}$$

$$\boxed{W_{medium} = \frac{W_{air}}{\mu}}$$

$$\underline{W_{medium} < W_{air}}$$

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Q. (2) If White light is used Instead of Monochormatic light source then Center of Screen is white and Is Surrounded by few Coloured fringes.
& then Uniform illumination due to overlapping of interference pattern.

Q. (3) In many numerical problem order of maxima or minima asked.

$$\Delta x = d\sin\theta.$$

For maxima

$$d\sin\theta = n\lambda$$

$$\boxed{n = \left(\frac{d}{\lambda}\right)\sin\theta}$$

n → Order of Maxima

Maximum Order $= \left(\frac{d}{\lambda}\right)$

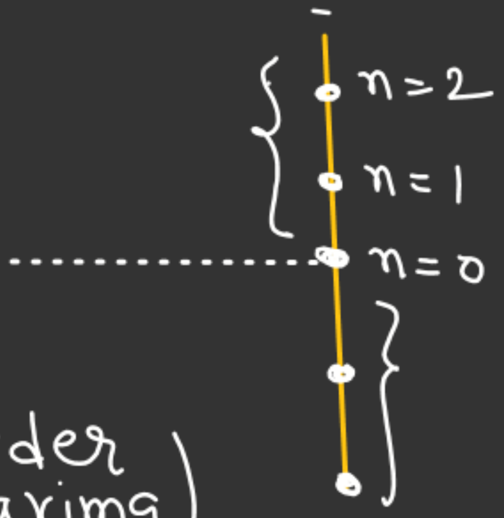
Ex:- If $d = 2\lambda$

$n = 2 \Rightarrow$ (2^{nd} order Maxima)

⇓

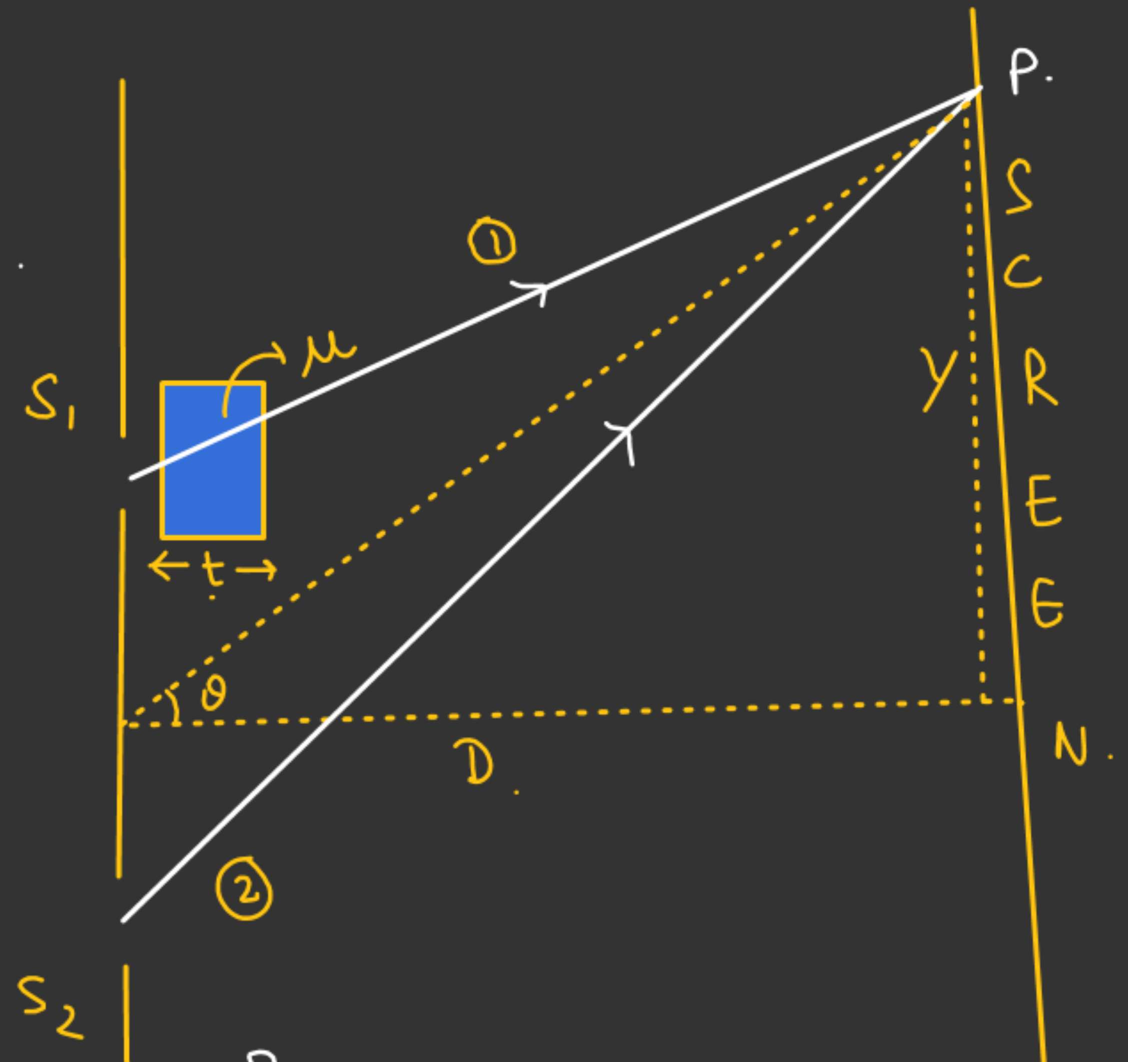
(Maximum Order)

$(0, \pm 1, \pm 2) \rightarrow 5$ brige fringe.



★★: Case of glass slab in front of one of slit.

Note: → While writing the path difference of two light rays. Write the equivalent or total distance travel by both light ray in air & then take the difference.



$$\Delta x = S_2P - \left[(S_1P - t) + \mu t\right]$$

$$\Delta x = (S_2P - S_1P) - (\mu - 1)t$$

$$S_2P - S_1P = d\sin\theta \simeq d\tan\theta$$
$$= \frac{dy}{D}$$

$$\boxed{\Delta x = \frac{dy}{D} - (\mu - 1)t}$$

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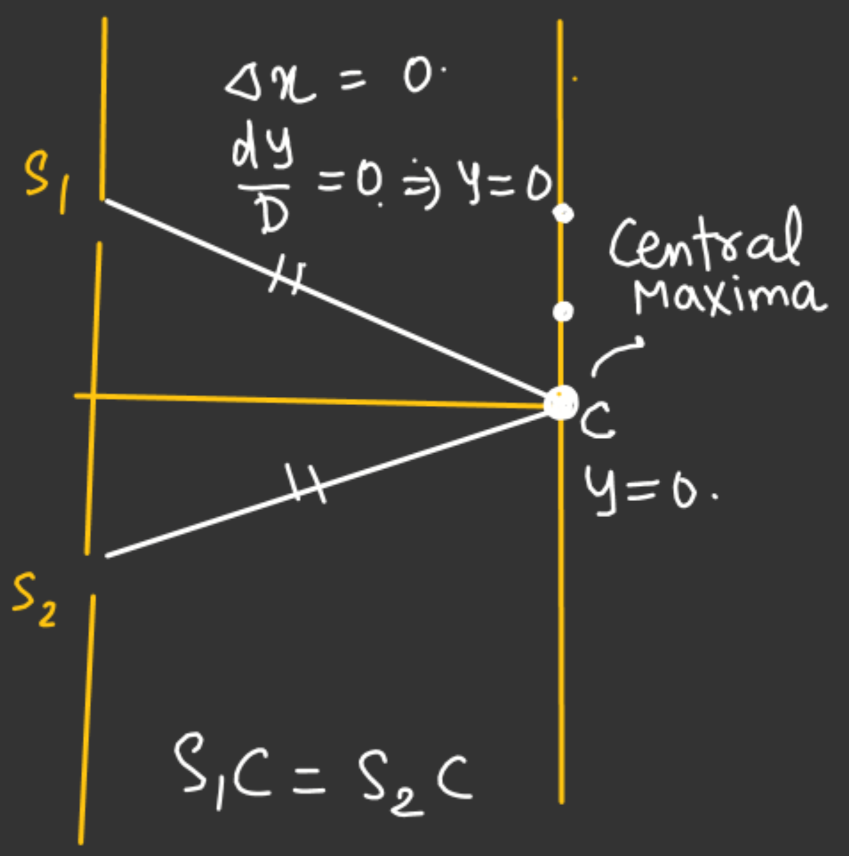
For Central Maximum.

$\Delta x = 0$, $(n = 0)$

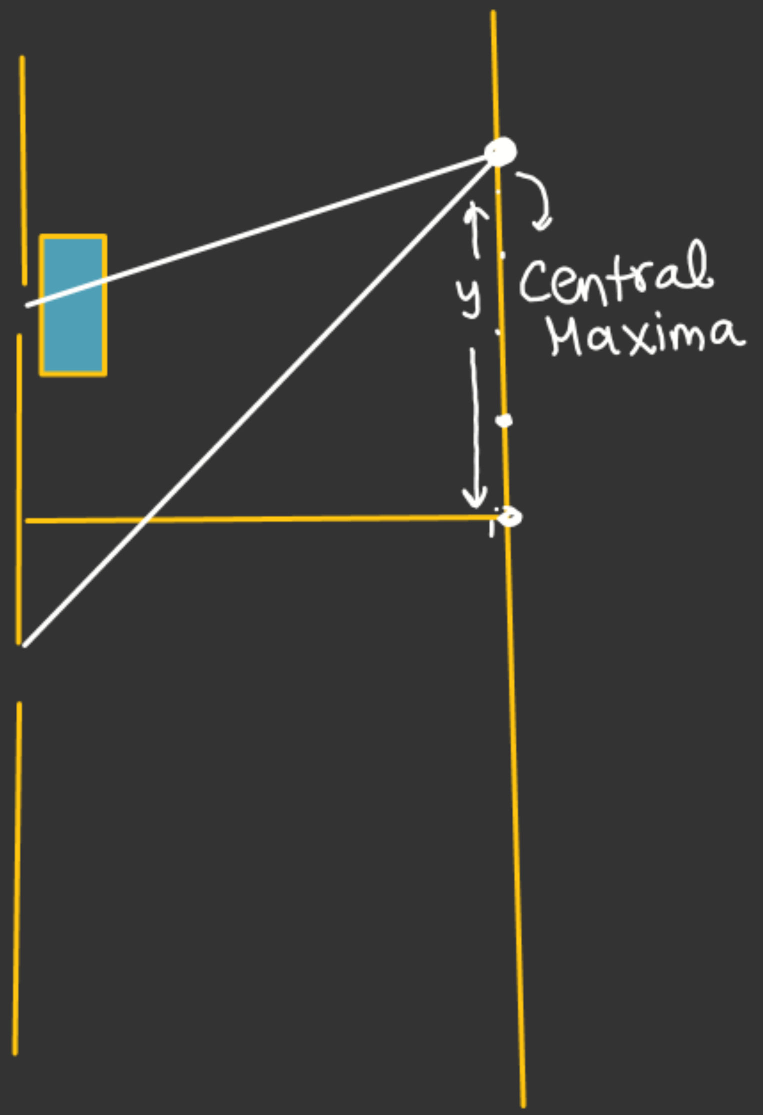
$$\frac{dy}{D} - (\mu - 1)t = 0$$

$$\boxed{y = \frac{D(\mu-1)t}{d}}$$



$S_1C = S_2C$

$\Delta x = 0$



No of fringes Shifted

$$\text{No of fringe Shifted} = \left(\frac{y}{w}\right)$$

$$= \frac{\cancel{D}(\mu-1)t}{\cancel{d}\left(\frac{\cancel{D}\lambda}{\cancel{d}}\right)}$$

$$\boxed{\text{No of fringe shifted} = \frac{(\mu-1)t}{\lambda}}$$

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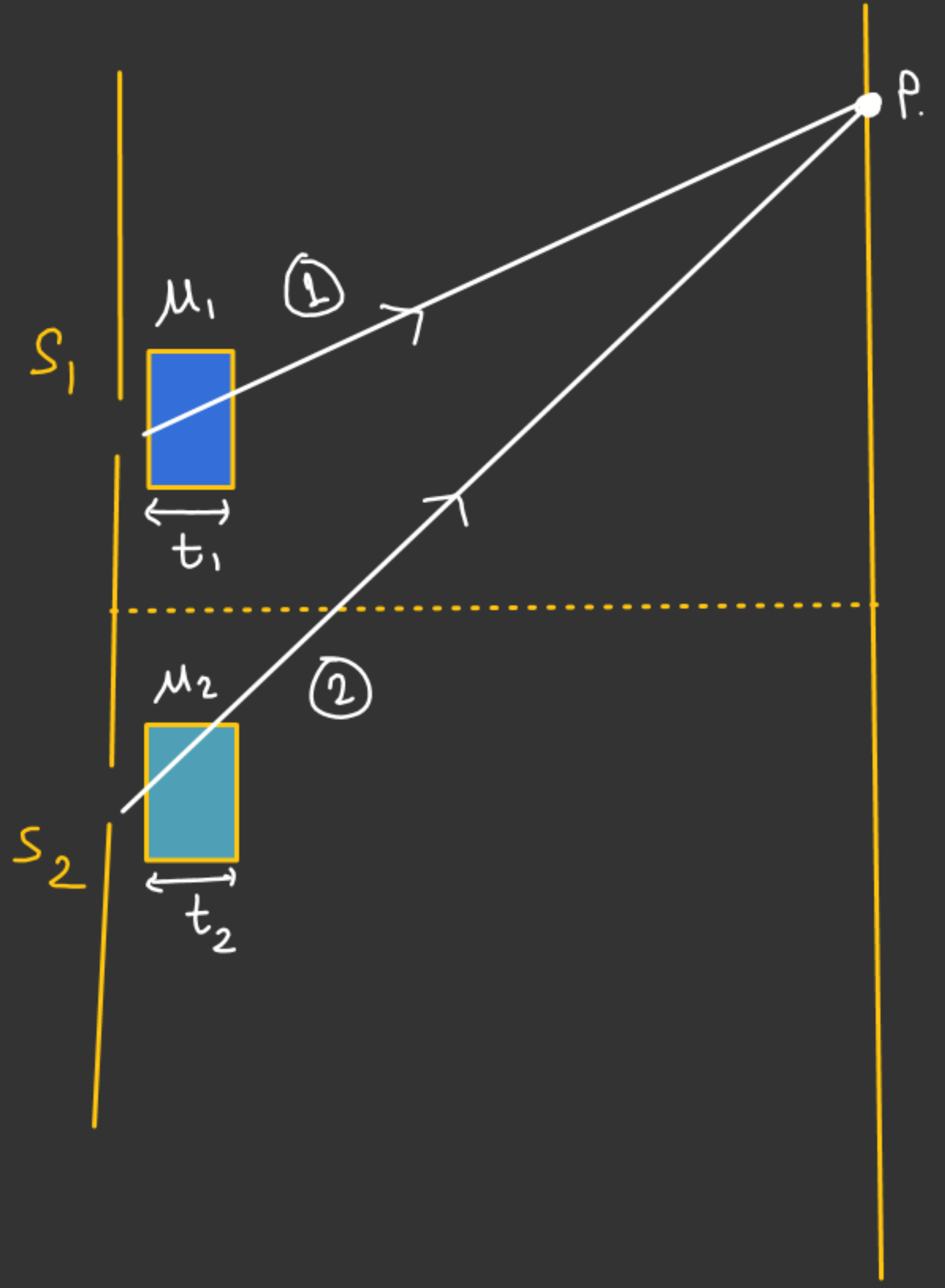
Case when Slab kept in front of both the Slits

$$\Delta x = \left[\underbrace{(S_2P - t_2)}_{\text{Ray ② in air}} + \mu_2 t_2\right] - \left[\underbrace{(S_1P - t_1)}_{\text{Ray ① in air}} + \mu_1 t_1\right]$$

$$\Delta x = \underbrace{(S_2P - S_1P)}_{\Downarrow} + (\mu_2 t_2 - \mu_1 t_1) + (t_1 - t_2)$$

$$\boxed{\Delta x = \frac{dy}{D} + (\mu_2 t_2 - \mu_1 t_1) + (t_1 - t_2)}$$



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$$\boxed{\Delta x = \frac{dy}{D} + (\mu_2 t_2 - \mu_1 t_1) + (t_1 - t_2)}$$

For Central Maxima

$$\Delta x = 0.$$

$$\frac{dy}{D} + (\mu_2 t_2 - \mu_1 t_1) + (t_1 - t_2) = 0.$$

$$\frac{dy}{D} = (\mu_1 t_1 - \mu_2 t_2) - (t_1 - t_2)$$

$$y = \frac{D}{d}\left[(\mu_1 t_1 - \mu_2 t_2) - (t_1 - t_2)\right]$$

if $\underline{t_1 = t_2 = t}$.

For central maxima

$$y = \frac{D}{d}\cdot(\mu_1 - \mu_2)t$$

$\underline{y > 0}$ when $\mu_1 > \mu_2$

i.e Fringe pattern shifted upward.

$\underline{y < 0}$ $\Rightarrow$ when $(\mu_2 > \mu_1)$

i.e Fringe pattern shifted downward.