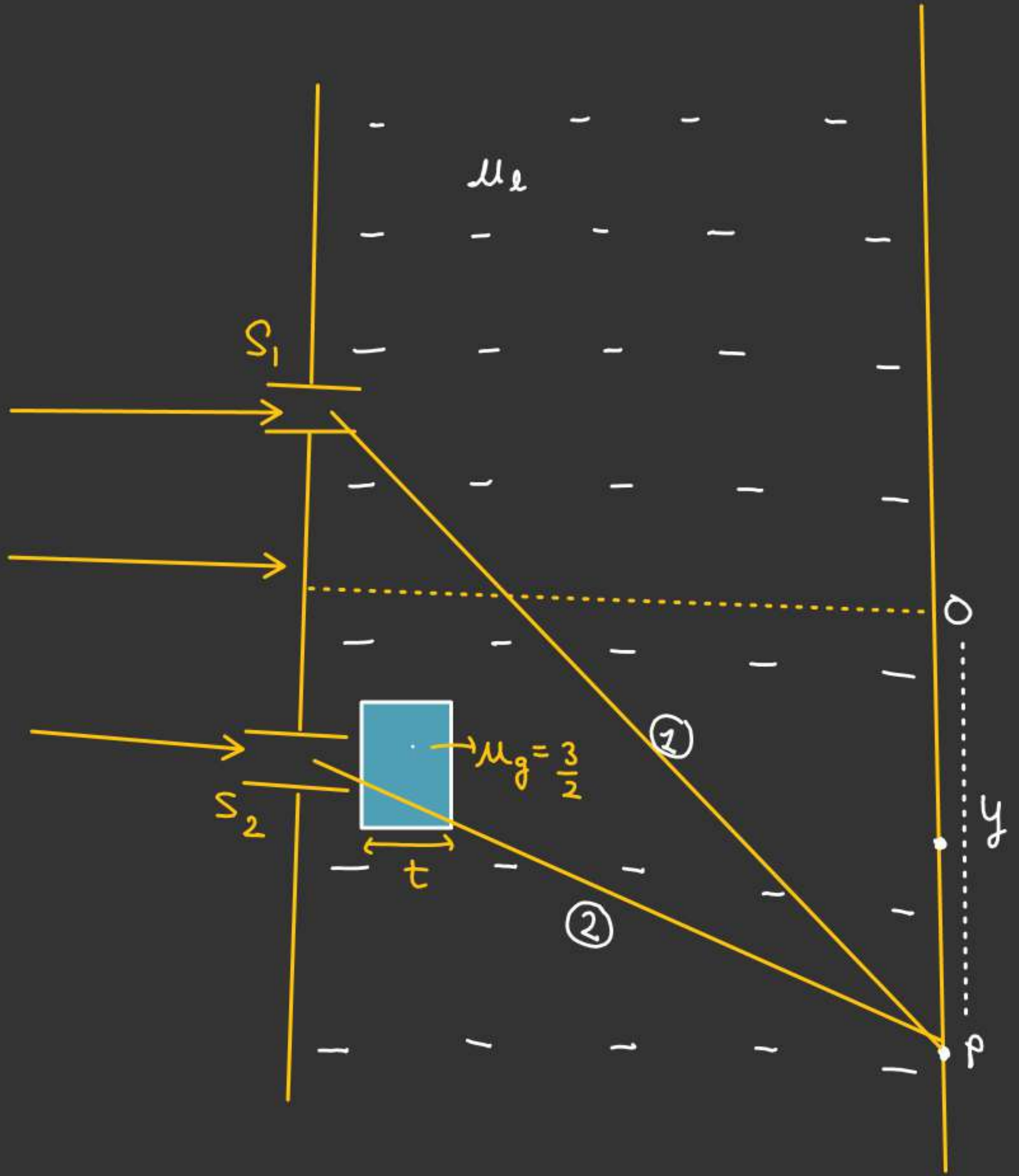
Nishant Jindal

Find the position of Central maxima if

a) $\mu_e = \frac{5}{2}$



a) For Central Maxima $\Delta x = 0$
let at P, position of Central maxima

$$\underset{\text{Ray 2}}{x_2} = [\underbrace{S_2P - t}_{\text{air}}]\mu_e + \underbrace{\mu_g t}_{\text{air}}$$

$$\underset{\text{Ray 1}}{x_1} = \underbrace{(S_1P \cdot \mu_e)}_{\text{In air}}$$

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a) For Central Maxima $\Delta x = 0$

let at P, position of Central maxima

$$x_2 = \underbrace{[S_2P - t]}_{\text{air}}\mu_l + \underbrace{\mu_g t}_{\text{air}}$$

Ray 2

$$x_1 = (\underbrace{S_1P \cdot \mu_l}_{\text{In air}})$$

Ray 1

$$\Delta x = x_2 - x_1$$

$$= (S_2P - S_1P)\mu_l + (\mu_g - \mu_l)t$$

$$= (S_2P - S_1P)\mu_l + \mu_l\left(\frac{\mu_g}{\mu_l} - 1\right)t$$

For Central Maxima

$\Delta x = 0$.

$$(S_2P - S_1P)\mu_l = -\mu_l\left(\frac{\mu_g}{\mu_l} - 1\right)t$$

$\Downarrow$

$$\frac{dy}{D} = \left(1 - \frac{\mu_g}{\mu_l}\right)t$$

$$\boxed{y = \frac{Dt}{d}\left(1 - \frac{\mu_g}{\mu_l}\right)}$$

$$\frac{\mu_g}{\mu_l} = {}_l\mu_g$$

$\Downarrow$

Refractive Index of glass w.r.t liquid.

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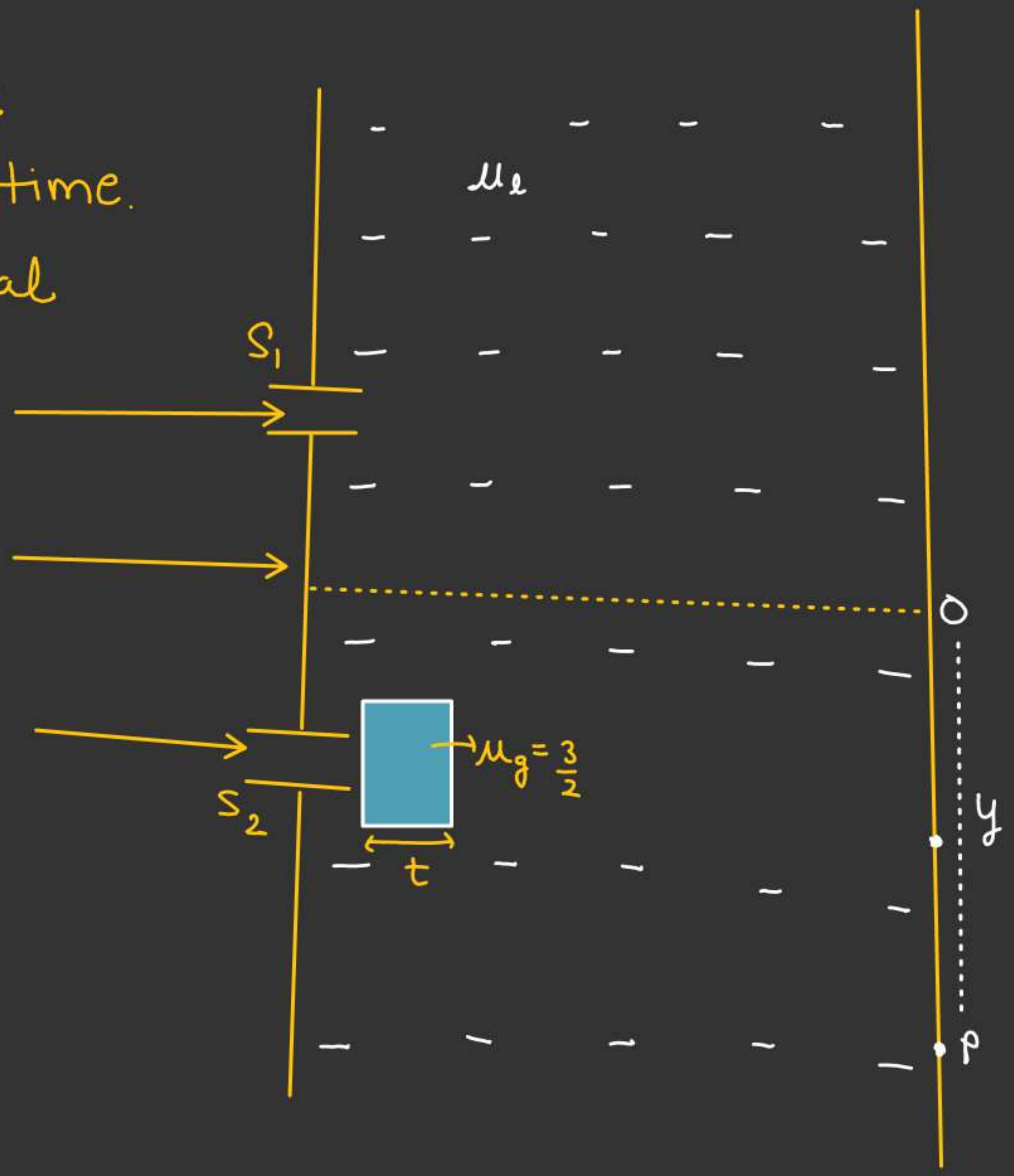
a) Find the position of Central maxima as a function of time if $\mu_l = \left(\frac{5}{2} - \frac{T}{4}\right)$ where T = time.

b) Also find the time when centeral maxima at the center of the screen.

c) What is the speed of central maxima when it is at O.

[Thickness of glass slab $t = .36\,\mu m$]



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$$\Delta x = \left[\underbrace{(S_2P - t)\mu_\ell + \mu_g t}_{\text{Ray } 2} - (S_1P)\mu_\ell\right]$$

$$\Delta x = (S_2P - S_1P)\mu_\ell + (\mu_g - \mu_\ell)t$$

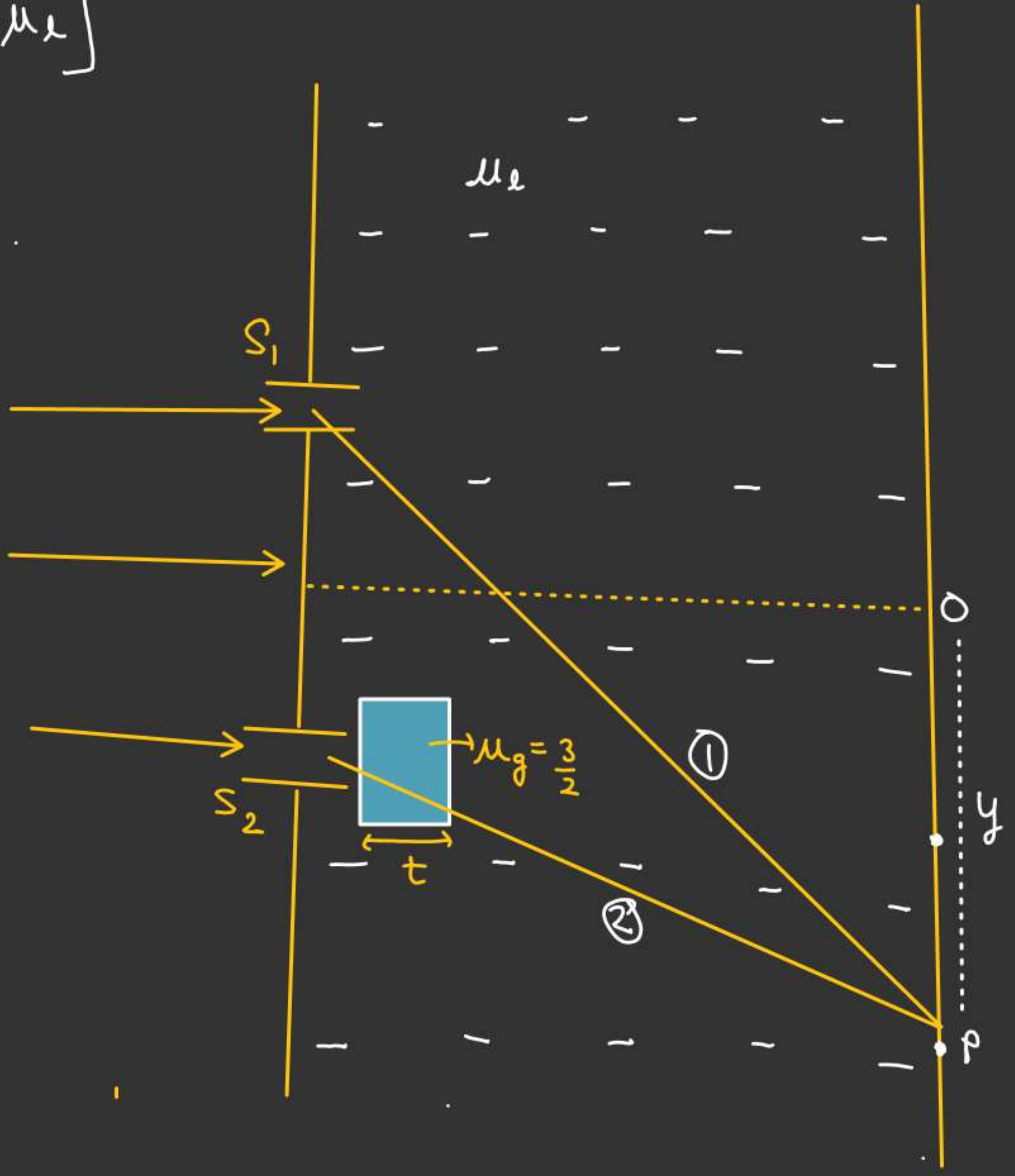
$$= \frac{dy}{D}\mu_\ell + (\mu_g - \mu_\ell)t$$

For Central Maxima

$$\Delta x = 0$$

$$(\mu_\ell - \mu_g)t = \left(\frac{d\mu_\ell}{D}\right)y$$

$$y = \frac{D}{d}\left(\frac{\mu_\ell - \mu_g}{\mu_\ell}\right)t$$



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$$y = \frac{D}{d}\left(\frac{\mu_\ell - \mu_g}{\mu_\ell}\right)t$$

$$\mu_\ell = \left(\frac{5}{2} - \frac{T}{4}\right)$$

$$\mu_g = \frac{3}{2}.$$

$$y = \frac{Dt}{d}\frac{\left(\frac{5}{2} - \frac{T}{4} - \frac{3}{2}\right)}{\left(\frac{5}{2} - \frac{T}{4}\right)}$$

$$y = \frac{Dt}{d}\left(\frac{4-T}{10-T}\right)$$

(Location of Central Maxima as a function of time)

When Central Maxima at O

$$y = 0$$

$$\frac{4-T}{10-T} = 0 \Rightarrow (T = 4\,sec)$$

Velocity of Central Maxima

$$v = \frac{dy}{dt} = \frac{Dt}{d}\left[\frac{(10-T)(-1) - (4-T)(-1)}{(10-T)^2}\right]$$

$$v = \frac{Dt}{d}\left[\frac{-10+T+4-T}{(10-T)^2}\right]$$

$$v = \frac{-6Dt}{d(10-T)^2}$$

$\frac{\text{At O}}{T = 4\,sec}$, $v_0 = \ominus\left(\frac{Dt}{6d}\right)$

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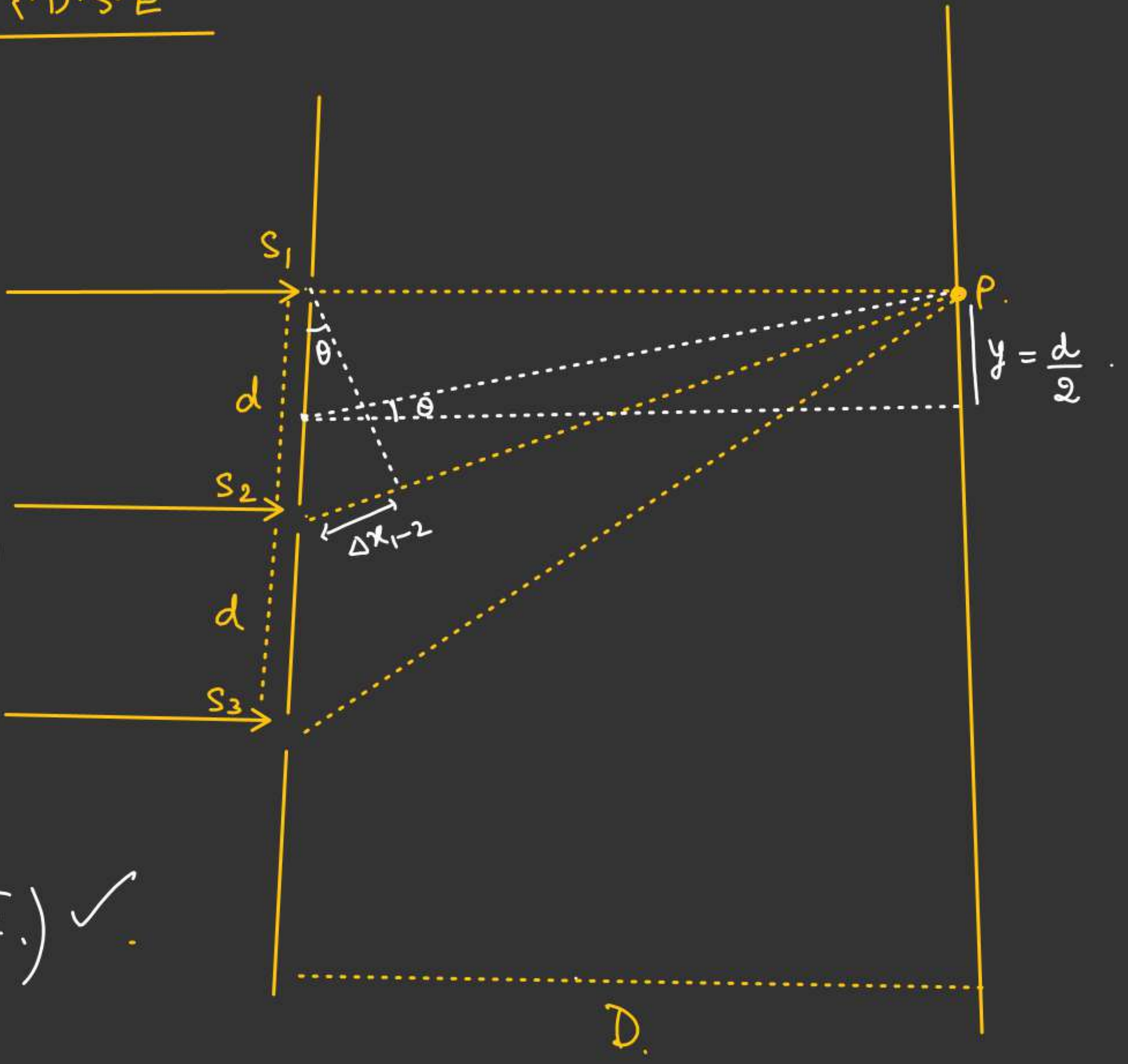
More than 2 Slits in Y.D.S.E

$$d = \sqrt{\frac{2D\lambda}{3}} \text{ (given)}$$

Find the resultant intensity at P.

P point in front of Slit S_1

Intensity of light is I_0



$$\Delta x_{1-2} = d\sin\theta \simeq d\tan\theta \simeq \left(\frac{dy}{D}\right)$$

$$\Delta x_{1-2} = \frac{d}{D}\left(\frac{d}{2}\right) = \frac{d^2}{2D}$$

$$\Delta\phi_{1-2} = \frac{2\pi}{\lambda}\cdot(\Delta x)_{1-2}$$

$$= \frac{2\pi}{\lambda} \times \frac{1}{2D} \times \left(\frac{2D\lambda}{3}\right) = \left(\frac{2\pi}{3}\right) \checkmark$$

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$$d = \sqrt{\frac{2D\lambda}{3}} \text{ (given)}$$

$$\Delta x_{1-3} = 2d \sin\theta$$

$$= 2d(\tan\theta)$$

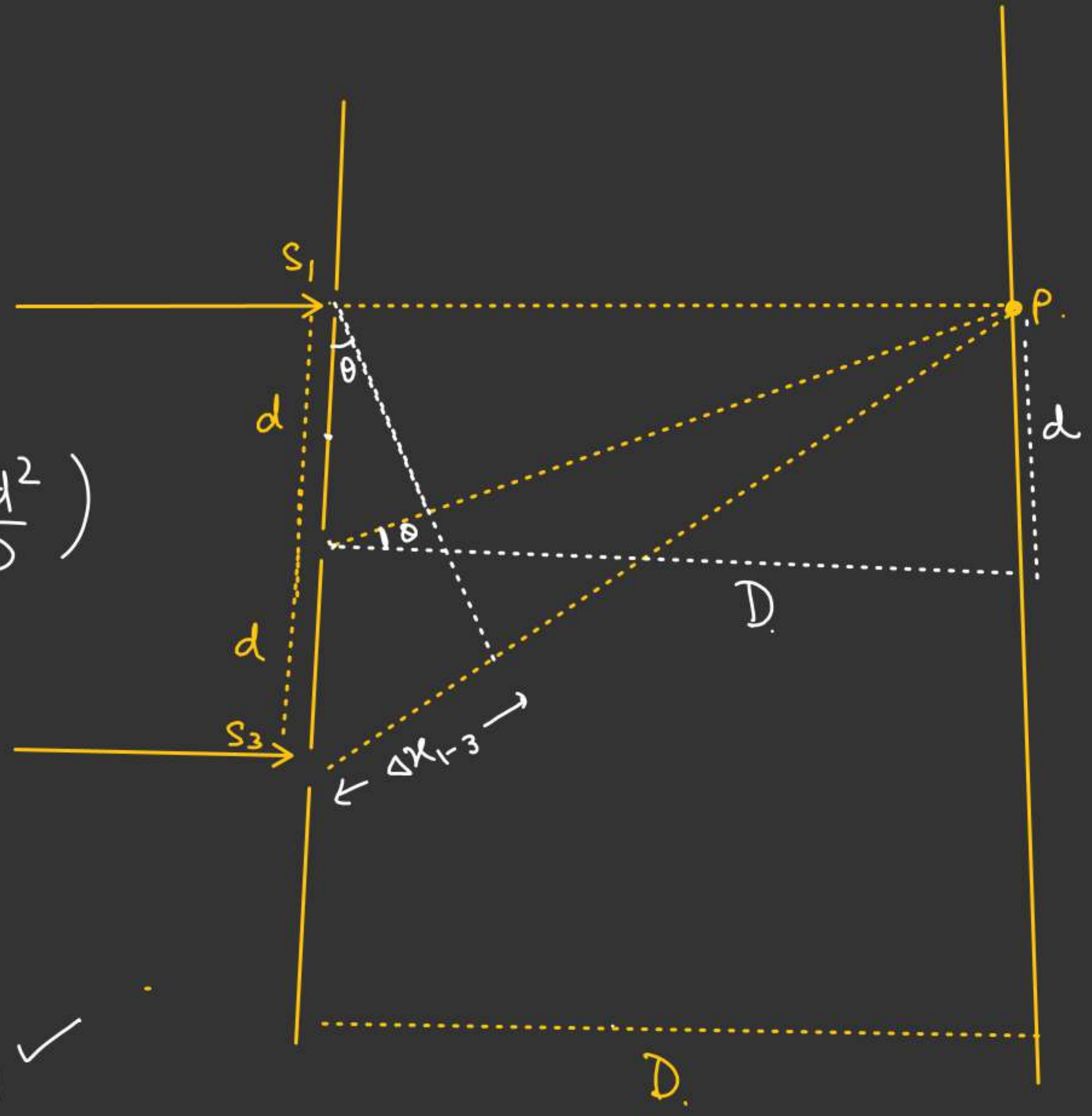
$$= (2d)\left(\frac{d}{D}\right) = \left(\frac{2d^2}{D}\right)$$

$$\Delta\phi_{1-3} = \frac{2\pi}{\lambda}\cdot(\Delta x_{1-3})$$

$$= \left(\frac{2\pi}{\lambda}\right)\left(\frac{2d^2}{D}\right)$$

$$= \frac{2\pi}{\lambda} \times \frac{2}{D} \times \frac{2D\lambda}{3}$$

$$= \frac{8\pi}{3} = \left(2\pi + 2\pi/3\right) \checkmark$$



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Phasor of Amplitude

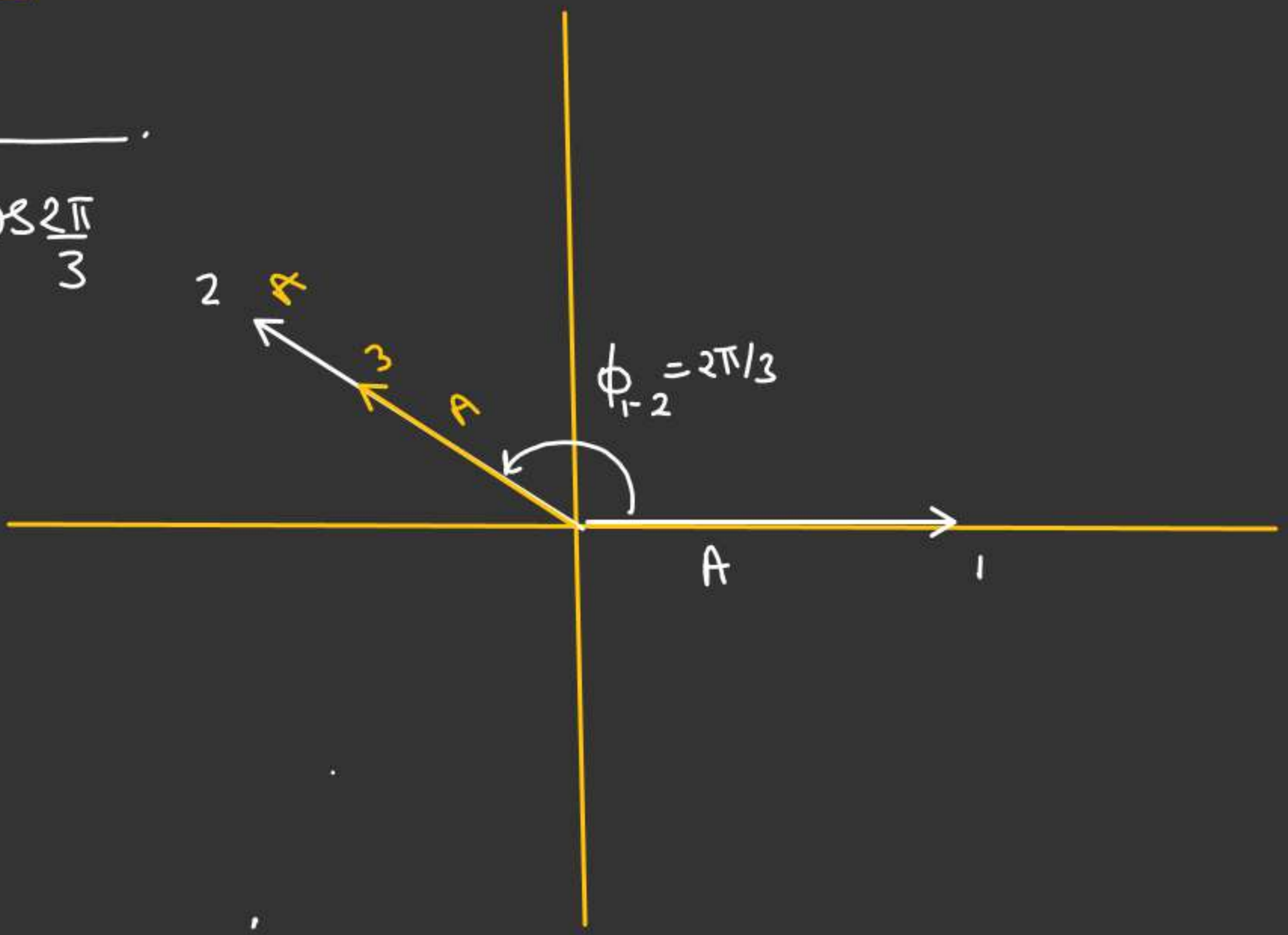
$$A_R = \sqrt{A^2 + (2A)^2 + 2 \cdot A(2A)\cos\frac{2\pi}{3}}$$

$$A_R = \sqrt{A^2 + 4A^2 - 2A^2}$$

$$A_R = \sqrt{A^2 + 2A^2} = \sqrt{3}\,A$$

$$A_R^2 = 3A^2$$

$$I_R = 3I_0$$ ✓



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H.W.

$S_2P - S_1P = \frac{\lambda}{3}$ (given)

Find resultant intensity at P.