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INTERFERANCE

$$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$$

If $I_1 = I_2 = I$

$$I_R = (2I + 2I\cos\phi)$$

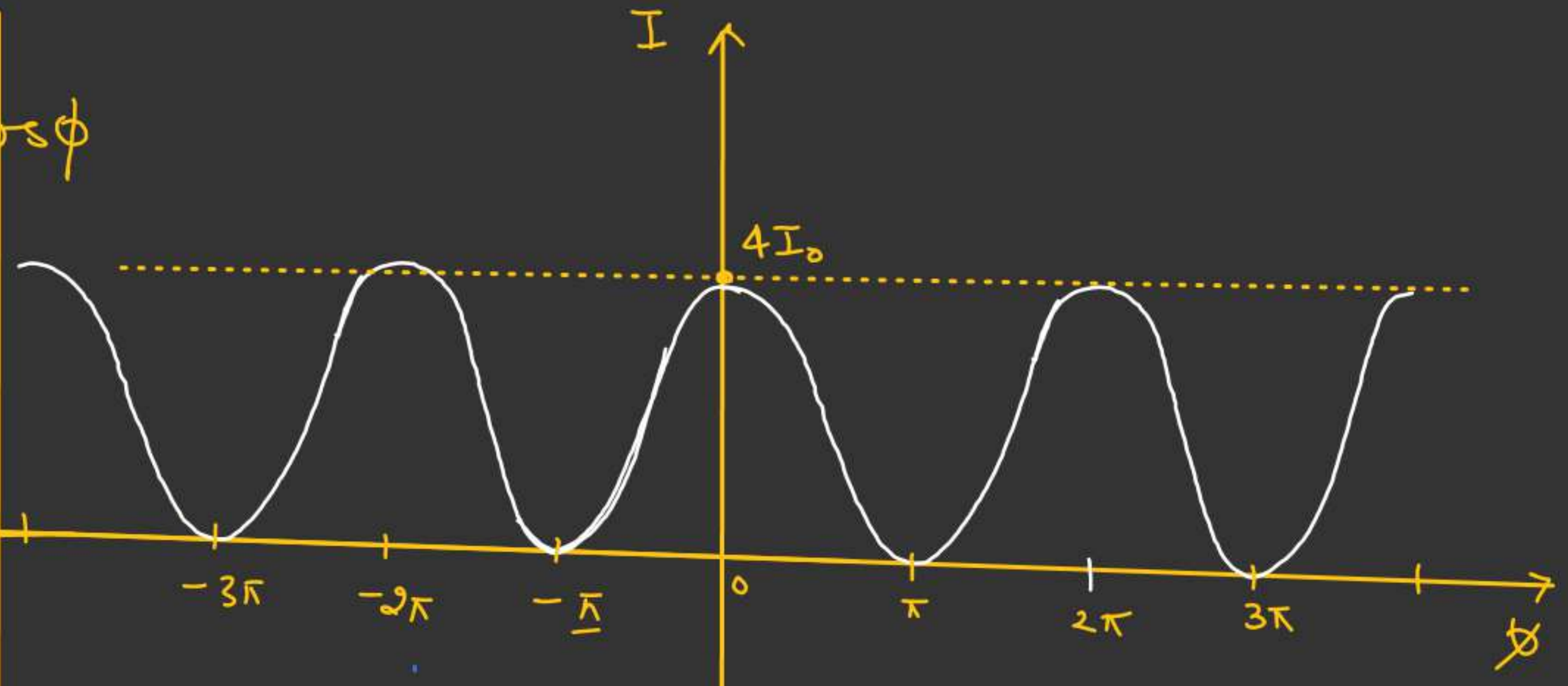
$$I_R = 2I(1 + \cos\phi)$$

$$I_R = 2I\left(1 + 2\cos^2\frac{\phi}{2} - 1\right)$$

$$\boxed{I_R = 4I\cos^2(\phi/2)}$$

$(I_R)_{max} = 4I$ $\Downarrow$ $\phi = 2n\pi$

$(I_R)_{min} = 0$ $\Downarrow$ $\phi = (2n+1)\pi$



$\frac{\phi}{2} = 0$, $\phi = 0$

$\frac{\phi}{2} = \pi$, $\phi = 2\pi$

$\frac{\phi}{2} = 2\pi$, $\phi = 4\pi$

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(A) Coherent Sources:-

- Sources which have constant phase difference are called coherent sources.
- Two Independent light source never be coherent.
- From a single light source if we generate two secondary light sources then these light sources are coherent in nature.

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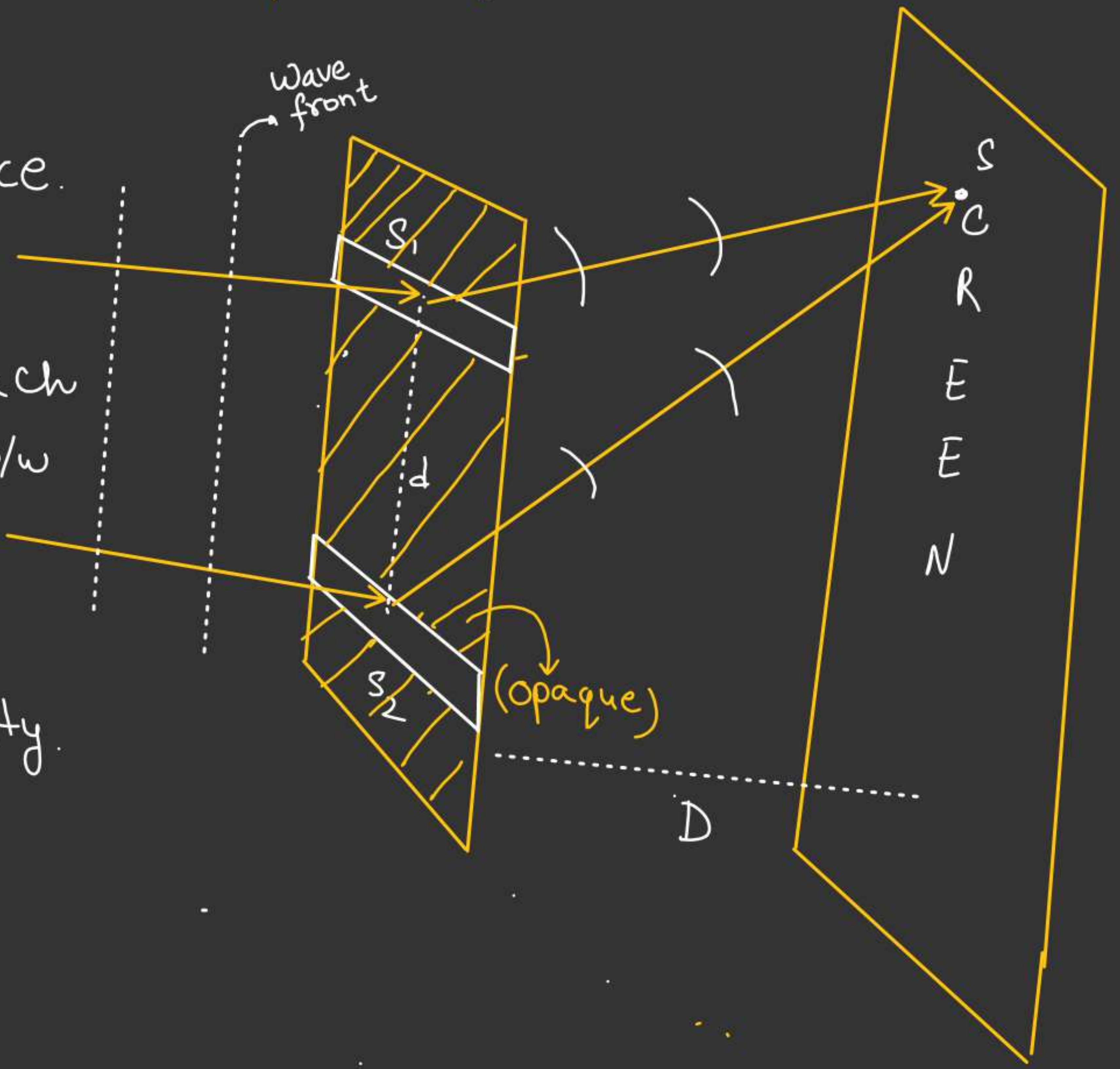
Y.D.S.E (Young's Double Slit experiment)

Assumption:-

1. Monochromatic light source. (Single wave length)

2. Distance b/w slits is much smaller than distance b/w screen. $(d << D)$

3. light source at infinity.



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Since $\underline{D >> d}$.

S_1P, OP & S_2P assumed to be parallel.

In ΔS_1S_2M.

$$\sin\theta = \frac{S_2M}{S_1S_2}$$

$$S_2M = S_1S_2 \sin\theta$$

$$\underline{\Delta x} = d\sin\theta = d\tan\theta \quad -(1)$$

θ very small.

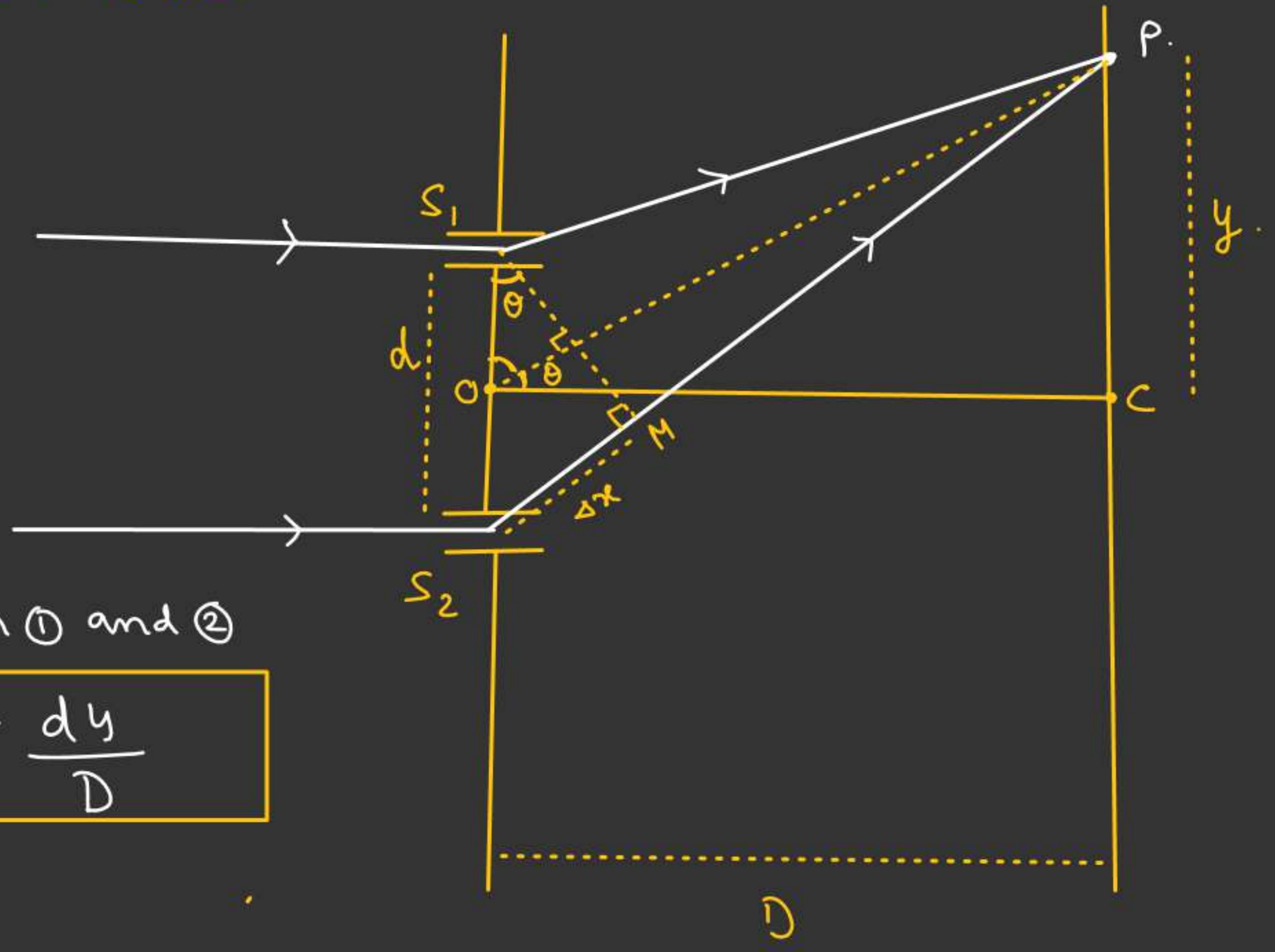
$$\sin\theta \simeq \tan\theta.$$

In ΔPOC

$$\tan\theta = \frac{y}{D} \quad -(2)$$

From (1) and (2)

$$\boxed{\Delta x = \frac{dy}{D}}$$



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For Constructive interference.

$$\Delta x = n\lambda$$

$$\frac{dy}{D} = n\lambda$$

$$\boxed{y = \frac{n\lambda D}{d}}$$

For $n=0$, $y=0$ $\Rightarrow$ Central bright fringe OR Central Maxima

$n=1$, $y = \frac{D\lambda}{d}$ $\Rightarrow$ 1^{st} bright fringe OR 1^{st} Maxima

$n=2$, $y = \frac{2D\lambda}{d}$ $\Rightarrow$ 2^{nd} bright fringe OR 2^{nd} Maxima

For destructive Interference

$$\Delta x = (2n+1)\frac{\lambda}{2} \quad (n = 0, 1, 2, 3 \ldots)$$

$$\frac{dy}{D} = (2n+1)\frac{\lambda}{2}$$

$$y = \frac{(2n+1)D\lambda}{2d}$$

$n=0$, $y = \frac{D\lambda}{2d}$ $\Rightarrow$ 1^{st} Mimina.

$n=1$, $y = \frac{3D\lambda}{2d}$ $\Rightarrow$ 2^{nd} Minima

$n=2$, $y = \frac{5D\lambda}{2d}$ $\Rightarrow$ 3^{rd} Minima

⋮

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FRINGE WIDTH

↳ Distance b/w two Consecutive Maxima or two Consecutive minima Called Fringe Width

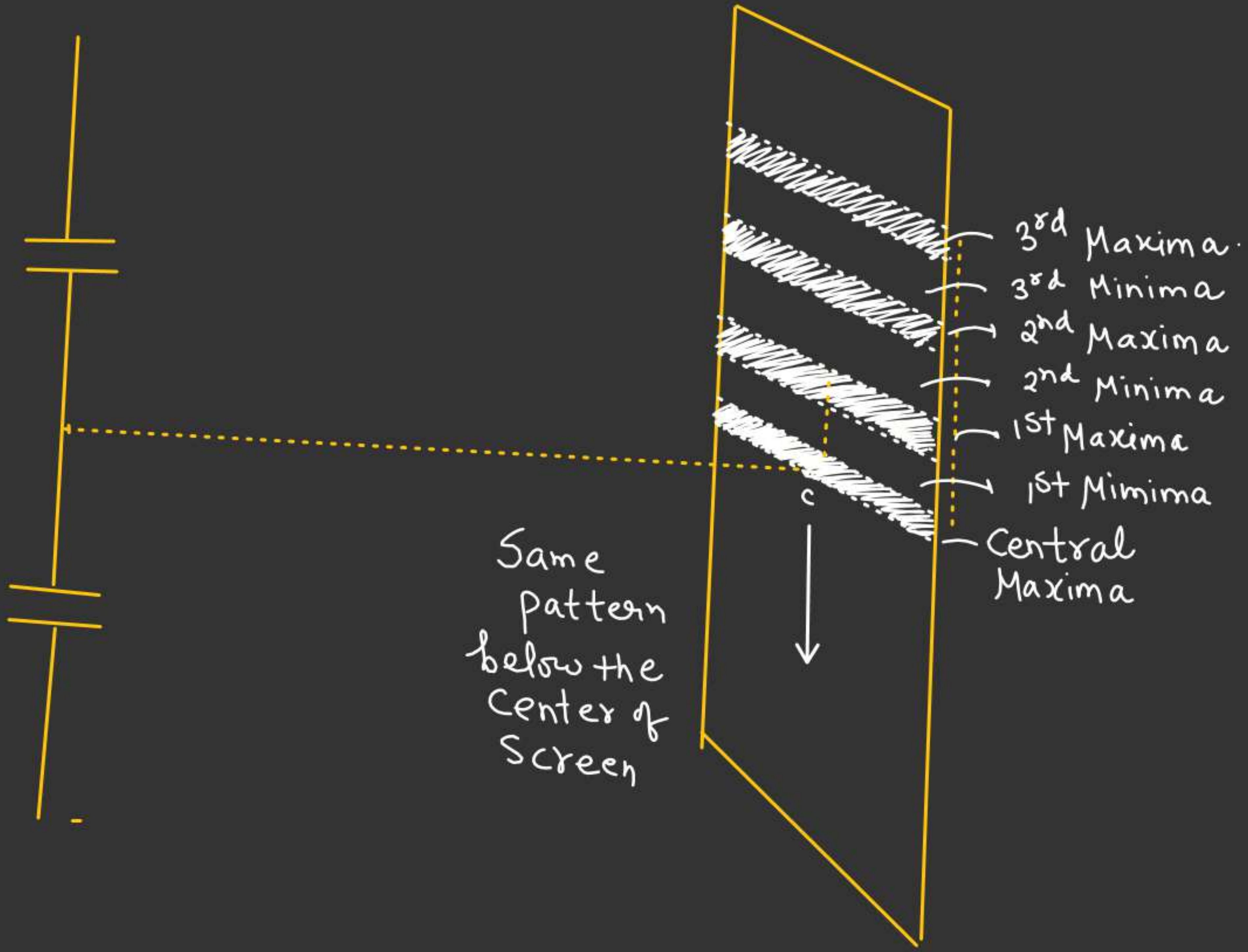
For Maxima

$$y_n = \frac{nD\lambda}{d}$$

$$y_{n-1} = (n-1)\frac{D\lambda}{d}$$

$$W = y_n - y_{n-1}$$

$$\boxed{W = \frac{D\lambda}{d}}$$



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A A :

Angular fringe Width

$$\tan\beta = \frac{W}{D}$$

$$\tan\beta \simeq \beta = \left(\frac{W}{D}\right)$$

$$W = \frac{D\lambda}{d}$$

$$\beta = \frac{\cancel{D}\lambda}{d \cdot \cancel{D}}$$

$$\boxed{\beta = \frac{\lambda}{d}}$$ **A A**