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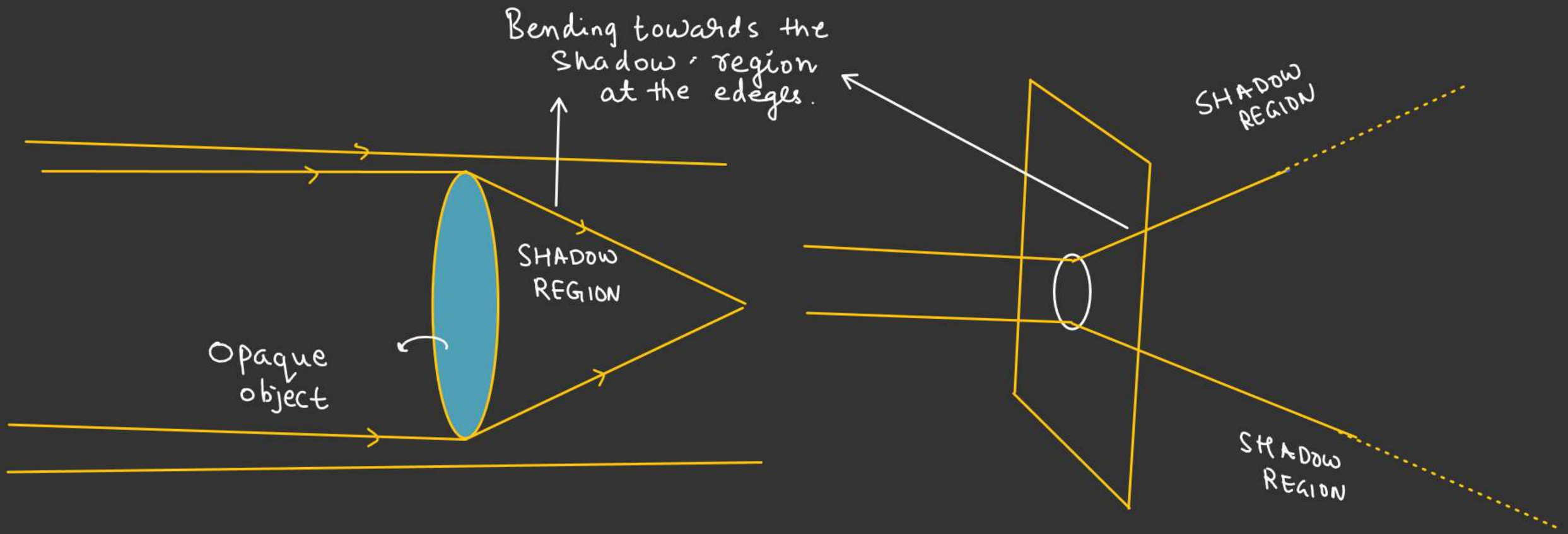
DIFFRACTION



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Defⁿ :- Bending of light rays at the sharp edges of an opque object or obstacle towards the geometrical shadow region. This phenomena of light is called Diffraction

Points :-

1. Diffraction shown by all the waves ie Mechanical as well as E.M wave.
2. It is observed that diffraction phenomena not observed. When Obstacle dimension is equal to or more than 5Oλ.
3. In Sound wave diffraction phenomena is more. Wavelength of Sound wave in b/w (16mm to 16m) & our obstacle pratically possible for such dimension.

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Type of diffraction

1. FRESNEL Diffraction

↳ (Source and Screen at finite distance)

2. FRAUNHOFER Diffraction

↳ (Source and Screen at infinite distance)

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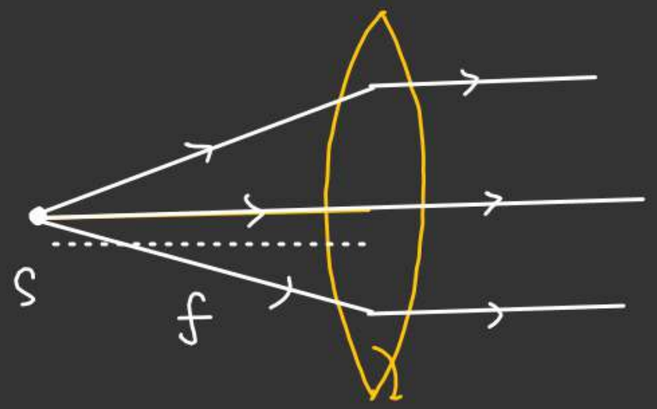

Convex lens.

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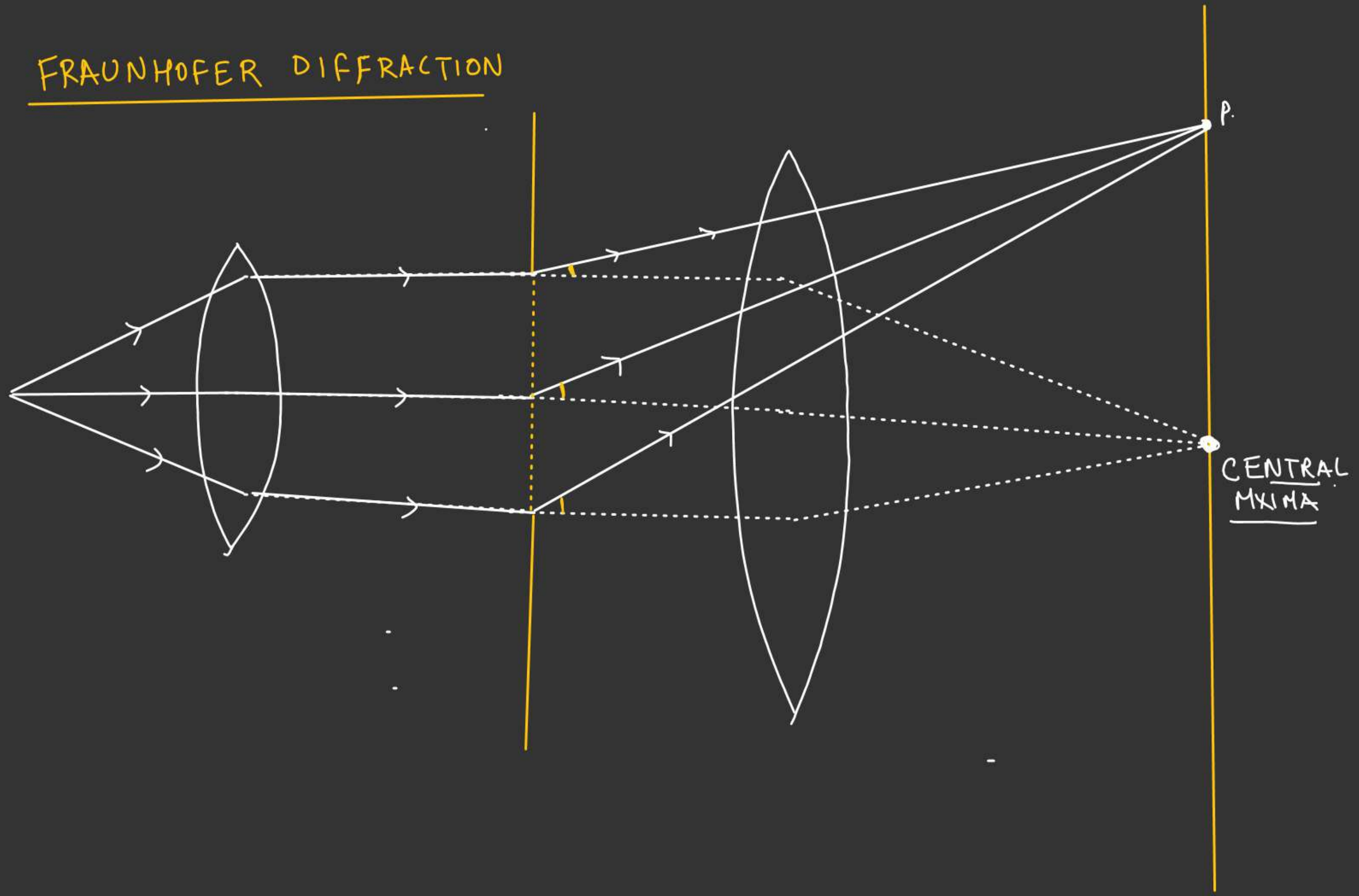
FRAUNHOFER DIFFRACTION



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Central Maxima

↳ At the Center of Screen where intensity is Maximum.

SECONDARY MINIMA'S

Condition

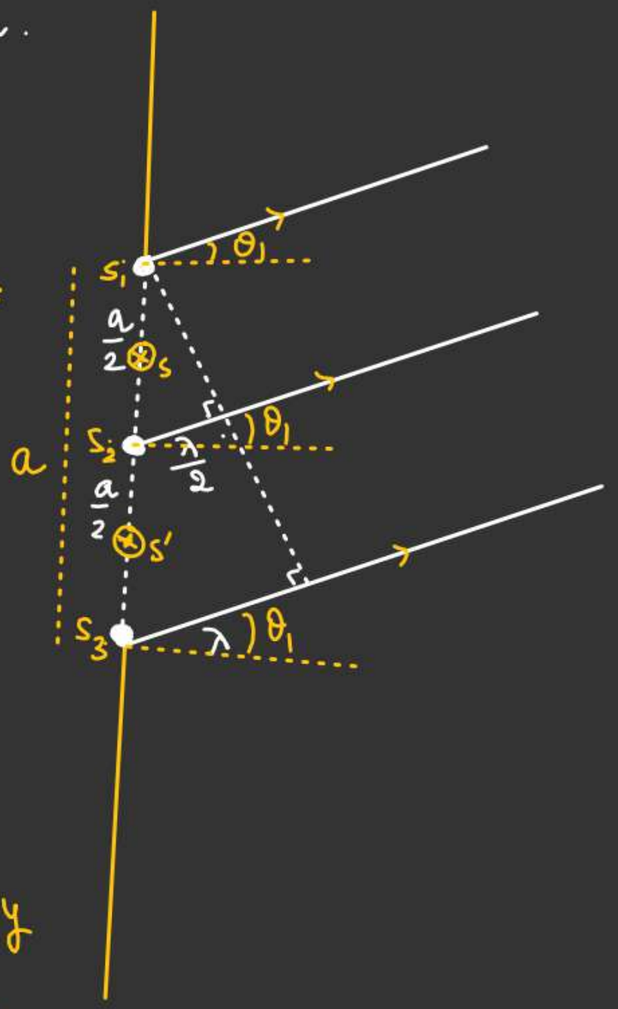
$$\Delta x = a \sin\theta = n\lambda$$

$n = 1, 2, 3, \ldots$

$\left[\Delta x_{S_1S_2} = \frac{\lambda}{2}\right.$

$\left.\Delta x_{S_2S_3} = \frac{\lambda}{2}\right]$

$\left[\Delta x_{SS'} = \frac{\lambda}{2}\right]$



For 1st Secondary Minima.
divide the Slit into equal parts & take path difference as λ.

$(a \sin\theta_1 = \lambda) \Rightarrow$ For 1st Secondary Minima.

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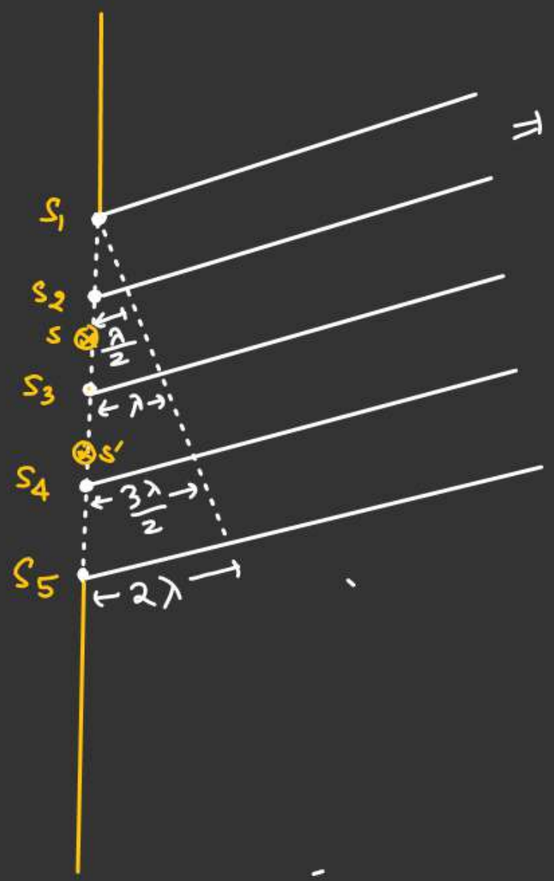
2nd Secondary Minima :-

Divide the Slit into 4 equal parts. & take the path difference as 2λ.



$\Rightarrow$ Path difference of each pair of light ray is $\frac{\lambda}{2}$

So destructive interference.

In general for Secondary Minima.

$$a \sin\theta_n = n\lambda$$

$$\sin\theta_n = \frac{n\lambda}{a}$$

$$\Downarrow$$

$$\boxed{\theta_n = \frac{n\lambda}{a}}$$

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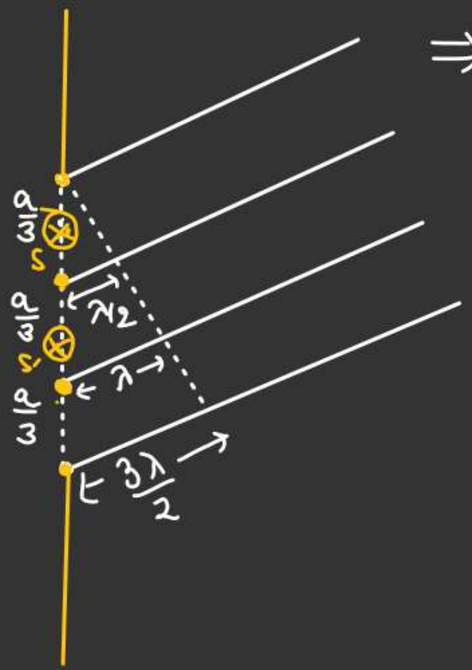
SECONDARY MXIMA'S

1st Secondary Maxima

Divide the Slit into 3-Equal parts and take the path difference b/w 1st & last ray as $\frac{3\lambda}{2}$.

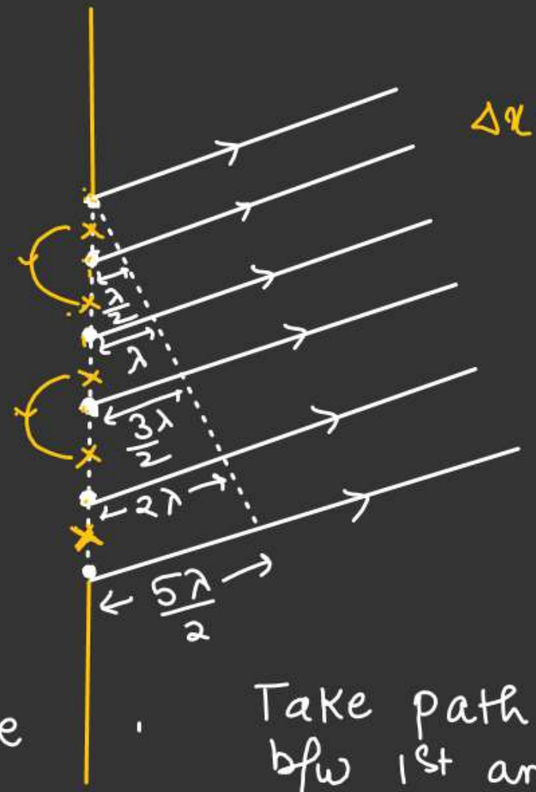


⇒ Two pairs of Source have Wavelength $\frac{\lambda}{2}$ So they form destructive interference on the Screen. but one of the Source. light reaches to screen which doesn't form pair

For 1st Secondary Maxima

$\Delta x = a\sin\theta = \frac{3\lambda}{2}$.

For 2nd Secondary Maxima



$\Delta x = a\sin\theta = \frac{5\lambda}{2}$.

Take path difference b/w 1st and last ray $\frac{5\lambda}{2}$ and divide it into 5 Equal parts.

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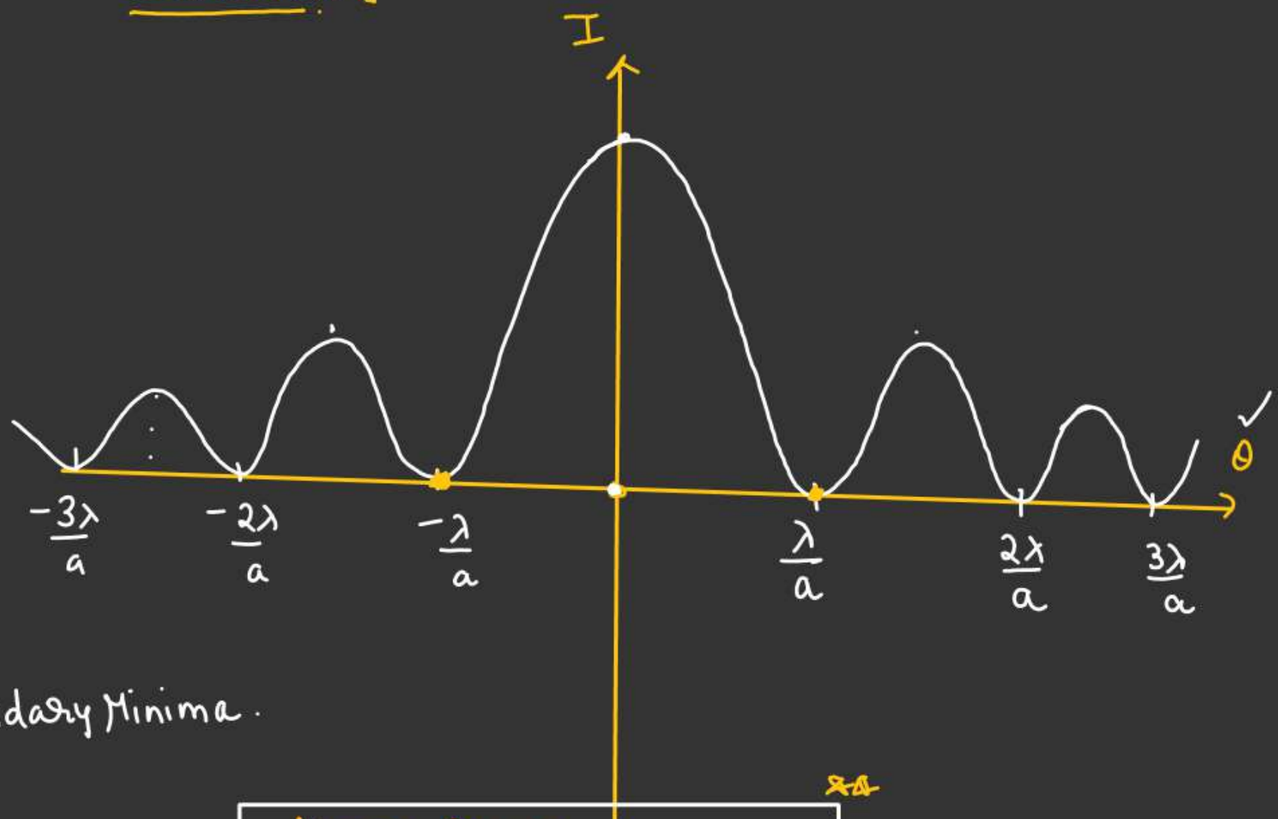
In general for Maxima.

$$\Delta x = (2n+1)\frac{\lambda}{2}$$

$$a\sin\theta = (2n+1)\frac{\lambda}{2}$$

$(n = 1, 2, 3, 4, 5 \ldots)$

Intensity

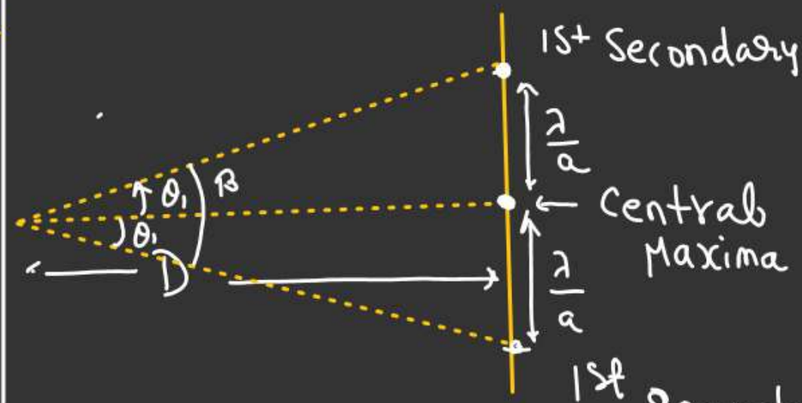


For 1st Secondary Minima.

Angular fringe Width

$= 2\theta_1$

$= \left(\frac{2\lambda}{a}\right)$



Linear fringe Width $= \left(\frac{2\lambda}{aD}\right)$