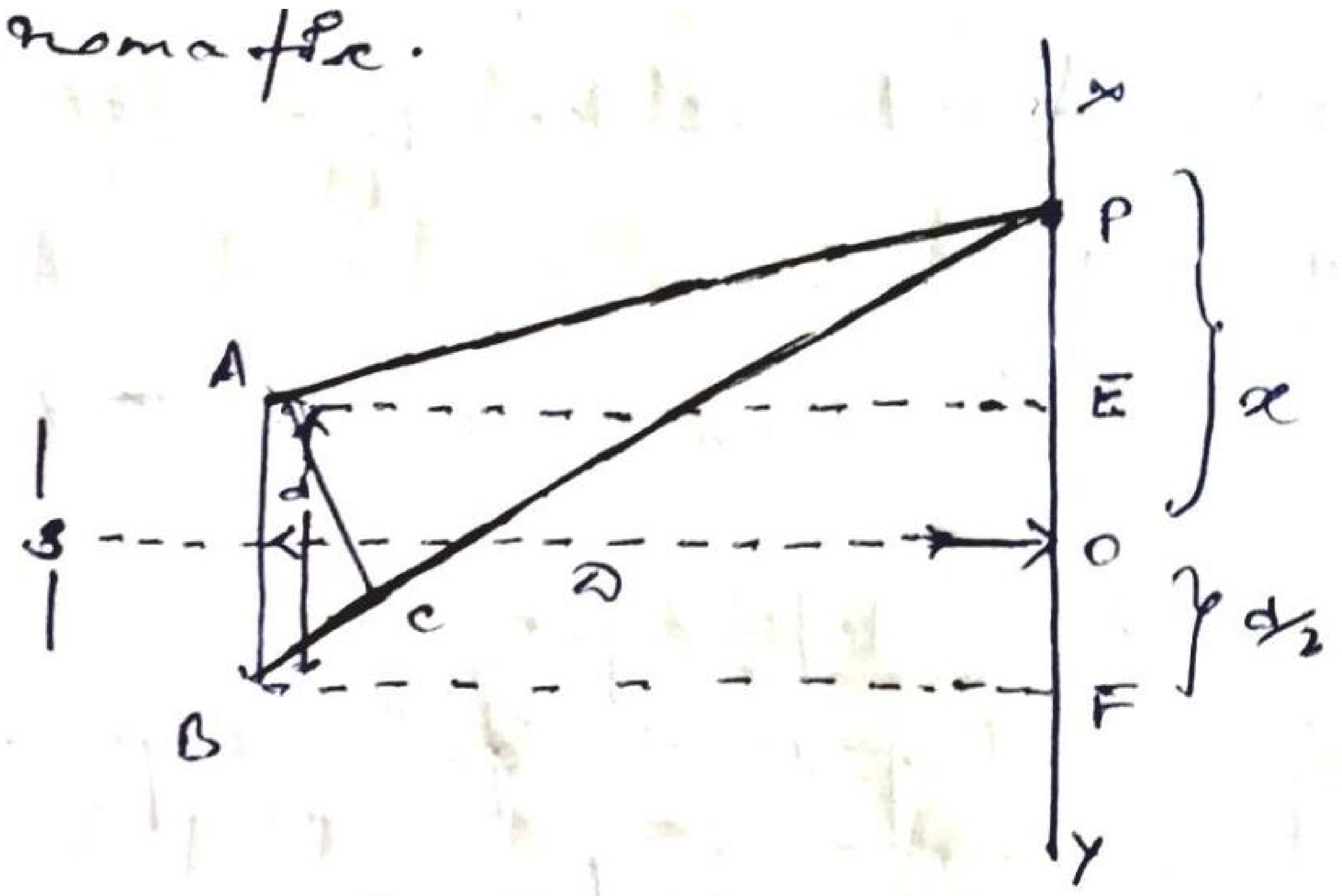
... be monochromatic.

Young's double slit experiment -



fig

$BP^2 = BF^2 + FP^2$

$= D^2 + \left(x + \frac{d}{2}\right)^2 \longrightarrow (i)$

$= D^2 + x^2 + \frac{d^2}{4} + xd$

$AP^2 = AE^2 + PE^2$

$= D^2 + \left(x - \frac{d}{2}\right)^2 \longrightarrow (ii)$

$= D^2 + x^2 + \frac{d^2}{4} - 2 \cdot x \left(\frac{d}{2}\right)$

$= D^2 + x^2 + \frac{d^2}{4} - 2x\frac{d}{2}$

$= D^2 + x^2 + \frac{d^2}{4} - xd$

$BP^2 - AP^2 = \left(D^2 + x^2 + \frac{d^2}{4} + xd\right) - \left(D^2 + x^2 + \frac{d^2}{4} - xd\right)$

$= D^2 + x^2 + \frac{d^2}{4} + xd - D^2 - x^2 - \frac{d^2}{4} + xd$

$= 2xd$

$\Rightarrow (BP - AP)(BP + AP) = 2xd$

using the close approximation that, P lies near to O

then $AP \approx D$

$BP \approx D$

Scanned by TapScanner

$\Rightarrow (BP-AP)(2D) = 2xd$

$\Rightarrow BP-AP = \frac{2xd}{2D}$

$\Rightarrow BC = \frac{xd}{D}$

Condition for dark fringe -

Dark fringe appear on screen when the path difference is $(2n+1)\lambda/2$, Hence, $\frac{xd}{D} = (2n+1)\lambda/2$

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

where, n is an integer

Condition for bright fringe -

The condition for a bright fringe to appear on the screen is path difference $= n\lambda$

i.e. $BC = n\lambda$

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

$$x = n\lambda \times \frac{D}{d}$$

Thickness of bright fringe -

The distance betn two consecutive bright fringes β, is given by

$$\beta = x_n - x_{n-1}$$

where x_n is the distance of nth bright fringes and x_{n-1} is the distance of (n-1) th bright fringe.

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

Thickness of dark fringe -

The distance betn two consecutive dark fringes.

$$\beta = \frac{D}{d}(2n+1)\frac{\lambda}{2} - \frac{D}{d}[2(n-1)+1]\frac{\lambda}{2} = \frac{D}{d}\lambda$$

This show that the distance between two consecutive dark or two consecutive bright fringes is equal. This is known as the fringe-width.

This prove that in this case dark and bright bands are ~~#~~ of equal width.

If D and d are constants, then the fringe-width

$$\beta \propto \lambda$$

Hence fringes produced by light of shorter wavelengths will be narrow as compared to those produced by longer wavelengths.

β-α

Q.1 Two narrow and parallel slits 0.1 cm apart are illuminated with a monochromatic light of wavelength 589.3 nm. The interference pattern is observed at a distance of 25 cm from the slits calculate the fringe with.

$$\lambda = 589.3\ \text{nm} = 589.3 \times 10^{-6}\ \text{m}$$

$$d = 0.1\ \text{cm} = 0.1 \times 10^{-2}\ \text{m}$$

$$D = 25\ \text{cm} = 25 \times 10^{-2}\ \text{m}$$

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

$$= \frac{25 \times 10^{-2}}{10^{-3}} \times 589.3 \times 10^{-6}$$