ANALOG : 12.10.19

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I. Problem Statement

A parallel beam of light with a wavelength of 500 nm falls on a narrow slit, and the resulting diffraction pattern is observed on a screen 1 m away. The distance to the first minimum from the center of the screen is 2.5 mm.

Find the width of the slit given that $y = 0.0025$ m, $L = 1$ m, and $\lambda = 5 \times 10^{-7}$ m.

II. Solution

The first minimum is given by :

$$\sin\theta = \lambda/a$$

Where a is the width of the slit.

Now for small angle θ, $\sin\theta$ can be assumed to be equal to θ as well as $\tan\theta$.

So we can say $\sin\theta$ approximately equals $\tan\theta$. Therefore:

$$\lambda/a = y/L$$

Solving the expression we get

$$a = L \cdot \frac{\lambda}{y}$$

Plugging in the values,

$$a = 1 \times \frac{5 \times 10^{-}7}{0.0025} = 0.2mm$$