653.

Problem 46.9 (RHK)

A slit 1.16 mm wide *is illuminated by light of wavelength* 589 nm. *The diffraction pattern is seen on a screen* 2.94 m *away. We have to find the distance between the first two diffraction minima on the same side of the central maximum.*

Solution:

On the same side of the central maximum the diffraction minima are given by the relation

$a\sin\theta = m\lambda,\ m = 1, 2, 3...,$

where a is the slit width.

Therefore, the difference in angles of the first two minima will be

$$\theta_2 - \theta_1 = \frac{\lambda}{a}\ \text{rad} = \frac{589\times10^{-9}}{1.16\times10^{-3}}\ \text{rad} = 507.7\times10^{-6}\ \text{rad.}$$

As the angles θ_1 and θ_2 are very small, the approximation $\sin\theta$; θ is justified.

The distance of the screen from the slit D is 2.94 m. Therefore, the distance between the first two minima as seen on the screen will be

$$\Delta y = y_2 - y_1 = D \times (\theta_2 - \theta_1) = 2.94 \times 507.7 \times 10^{-6} \text{ m}$$
$$= 1.49 \text{ mm}.$$