

4. (a) We use Eq. 37-3 to calculate the separation between the first ($m_1 = 1$) and fifth ($m_2 = 5$) minima:

$$\Delta y = D\Delta \sin \theta = D\Delta \left(\frac{m\lambda}{a} \right) = \frac{D\lambda}{a} \Delta m = \frac{D\lambda}{a} (m_2 - m_1) .$$

Solving for the slit width, we obtain

$$a = \frac{D\lambda(m_2 - m_1)}{\Delta y} = \frac{(400 \text{ mm})(550 \times 10^{-6} \text{ mm})(5 - 1)}{0.35 \text{ mm}} = 2.5 \text{ mm} .$$

- (b) For $m = 1$,

$$\sin \theta = \frac{m\lambda}{a} = \frac{(1)(550 \times 10^{-6} \text{ mm})}{2.5 \text{ mm}} = 2.2 \times 10^{-4} .$$

The angle is $\theta = \sin^{-1}(2.2 \times 10^{-4}) = 2.2 \times 10^{-4} \text{ rad}$.