

5. (a) A plane wave is incident on the lens so it is brought to focus in the focal plane of the lens, a distance of 70 cm from the lens.
- (b) Waves leaving the lens at an angle  $\theta$  to the forward direction interfere to produce an intensity minimum if  $a \sin \theta = m\lambda$ , where  $a$  is the slit width,  $\lambda$  is the wavelength, and  $m$  is an integer. The distance on the screen from the center of the pattern to the minimum is given by  $y = D \tan \theta$ , where  $D$  is the distance from the lens to the screen. For the conditions of this problem,

$$\sin \theta = \frac{m\lambda}{a} = \frac{(1)(590 \times 10^{-9} \text{ m})}{0.40 \times 10^{-3} \text{ m}} = 1.475 \times 10^{-3} .$$

This means  $\theta = 1.475 \times 10^{-3} \text{ rad}$  and  $y = (70 \times 10^{-2} \text{ m}) \tan(1.475 \times 10^{-3} \text{ rad}) = 1.03 \times 10^{-3} \text{ m}$ .