CH 38, 7th Ed. HW Solutions

P38.4 For destructive interference,

$$\sin\theta = m\frac{\lambda}{a} = \frac{\lambda}{a} = \frac{5.00\text{ cm}}{36.0\text{ cm}} = 0.139$$

and $\theta = 7.98°$

$$\frac{d}{L} = \tan\theta$$

gives $d = L\tan\theta = (6.50\text{ m})\tan 7.98° = 0.912\text{ m}$

$$d = \boxed{91.2\text{ cm}}.$$

P38.11 $\sin\theta = \frac{\lambda}{a} = \frac{5.00\times10^{-7}\text{ m}}{5.00\times10^{-4}} = \boxed{1.00\times10^{-3}\text{ rad}}$

P38.13 Undergoing diffraction from a circular opening, the beam spreads into a cone of half-angle

$$\theta_{min} = 1.22\frac{\lambda}{D} = 1.22\left(\frac{632.8\times10^{-9}\text{ m}}{0.005\,00\text{ m}}\right) = 1.54\times10^{-4}\text{ rad}.$$

The radius of the beam ten kilometers away is, from the definition of radian measure,

$$r_{beam} = \theta_{min}\left(1.00\times10^{4}\text{ m}\right) = 1.544\text{ m}$$

and its diameter is $d_{beam} = 2r_{beam} = \boxed{3.09\text{ m}}$.

P38.~~20~~ 18 $1.22\frac{\lambda}{D} = \frac{d}{L}$ $\qquad \lambda = \frac{c}{f} = 0.020\,0\text{ m}$

$D = 2.10\text{ m}$ $\qquad L = 9\,000\text{ m}$

$$d = 1.22\frac{(0.020\,0\text{ m})(9\,000\text{ m})}{2.10\text{ m}} = \boxed{105\text{ m}}$$

P38.22 $\sin\theta = 0.350$: $\qquad d = \frac{\lambda}{\sin\theta} = \frac{632.8\text{ nm}}{0.350} = 1.81\times10^{3}\text{ nm}$

Line spacing $= \boxed{1.81\,\mu\text{m}}$