Chapter 37

2. $\lambda = 530 \times 10^{-9}\ m$

$d = 0.3 \times 10^{-3}\ m$

$l = 2\ m$

@ $m = 0$

$$d\left(\frac{y}{l}\right) = \left(m + \frac{1}{2}\right)\lambda$$

$$y_1 = \left(\frac{l}{d}\right)(\lambda)\left(\frac{1}{2}\right)$$

@ $m = 1$

$$d\left(\frac{y}{l}\right) = \left(m + \frac{1}{2}\right)\lambda$$

$$y_2 = \left(\frac{l}{d}\right)(\lambda)\left(\frac{3}{2}\right)$$

Distance between fringes

$= y_2 - y_1$

$$= \frac{3}{2}\left(\frac{\lambda l}{d}\right) - \frac{1}{2}\left(\frac{\lambda l}{d}\right)$$

$$= \frac{\lambda l}{d}$$

$$= \frac{530 \times 10^{-9} \times 2}{0.3 \times 10^{-3}}$$

$$= 3.533\ mm$$

4. $\lambda = 589 \times 10^{-9}\ nm$

$l = 2\ m$

$\Delta y = 7.26 \times 10^{-3}\ m$

$m = 9$

$\Delta y = y_{9\ dark} - y_{0\ bright}$

$$= \frac{(m+1/2)\lambda l}{d} - \frac{m\lambda l}{d}$$

$$= \frac{\lambda l}{d}\left(\frac{19}{2}\right)$$

$$7.26\times10^{-3} = \frac{2\times589\times10^{-9}}{d} \times \frac{19}{2}$$

$$\frac{7.26\times10^{-3}\times 2}{19\times2\times589\times10^{-9}} = \frac{1}{d}$$

$$d = \frac{19\times2\times589\times10^{-9}}{2\times7.26\times10^{-3}}$$

$$= 1.54 \text{ mm}$$

5. $l = 1.2$ m

$d = 0.12\times10^{-3}$ m

$\lambda = 500\times10^{-9}$

a) $\theta = 0.5°$

$$\Phi = \frac{2\pi\delta}{\lambda}$$

$$\Phi = \frac{2\pi d \sin\theta}{\lambda}$$

$$= \frac{2\pi\times0.12\times10^{-3}\sin(0.5)}{500\times10^{-9}}$$

$$= 13.16 \text{ rad}$$

b) $y = 5\times10^{-3}$ m

$$\Phi = \frac{2\pi d y}{l\lambda}$$

$$= \frac{2\pi\times0.12\times10^{-3}\times5\times10^{-3}}{}$$

$1.2 \times 500 \times 10^{-9}$

$= 6.28$ rad

$= 2\pi$

c) $\phi = 0.333$ rad

$$\phi = \frac{2\pi d \sin\theta}{\lambda}$$

$$\frac{\lambda\phi}{2\pi d} = \sin\theta$$

$$\theta = \sin^{-1}\left(\frac{\lambda\phi}{2\pi d}\right)$$

$=$

d) $\delta = d \sin\theta$

$$\frac{\lambda}{4} = d \sin\theta$$

$$\theta = \sin^{-1}\left(\frac{\lambda}{4d}\right)$$

Chapter 38

1. $\lambda = 587.5 \times 10^{-9}$ m

a) $a = 0.75 \times 10^{-3}$ m

$\Delta y = 0.85 \times 10^{-3}$ m @ $m = 1$

$$\frac{ay}{\ell} = m\lambda$$

$$L = \frac{ay}{m\lambda}$$

$$= \frac{0.75 \times 10^{-3} \times 0.85 \times 10^{-3}}{587.5 \times 10^{-9}}$$

$$= \underline{1.085 \text{ m}}$$

b) Width of central max $= 2y$

$$= \underline{1.7 \text{ mm}}$$

4. $a = \frac{1}{250} = 4 \ \mu m$

$\lambda_1 = 400 \times 10^{-9}$ m

$\lambda_2 = 700 \times 10^{-9}$ m

$a \sin\theta_{dark} = m\lambda$

a) $m = \frac{a \sin\theta}{\lambda}$

$0 \leq \sin\theta \leq 1$

@ $\sin\theta = 1$

$m = \frac{4 \times 10^{-6}}{700 \times 10^{-9}}$

$= 5.71 \Rightarrow$ doesn't reach 6 $\therefore m = 5$

$\therefore \underline{m = 5}$

b) $m = \frac{a \sin\theta_{dark}}{\lambda}$

$= \frac{4 \times 10^{-6}}{400 \times 10^{-9}}$

$= 10$

$\therefore m = \pm 10$