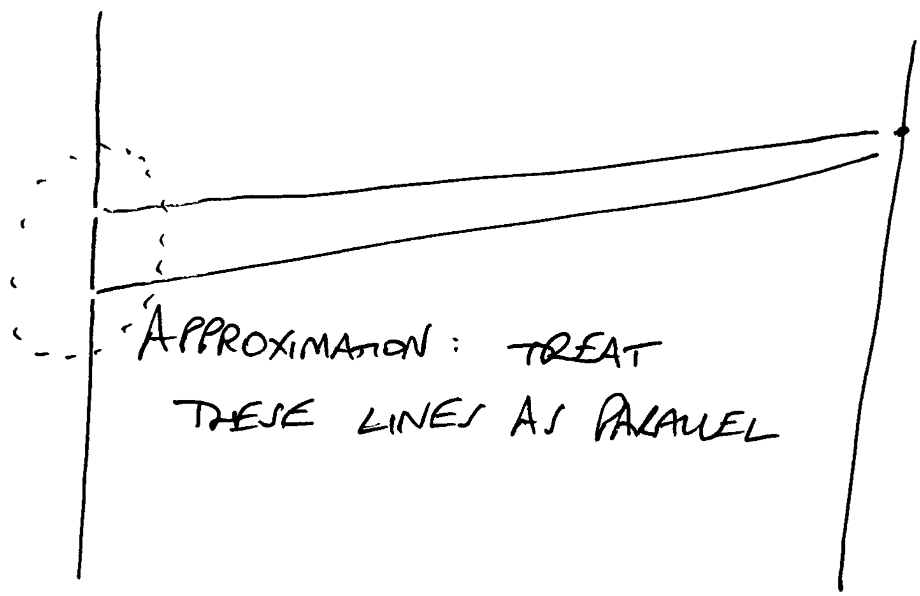
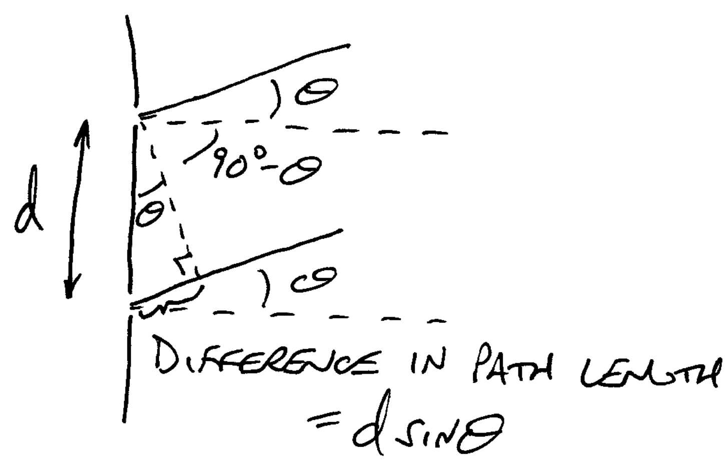
2012 MAR 28

TWO-SLIT INTERFERENCE

APPROXIMATION:

IF SCREEN IS FAR AWAY COMPARED WITH SLIT SEPARATION, WE CAN MAKE A HELPFUL APPROXIMATION.





$$\# \lambda s = \frac{d \sin\theta}{\lambda} = \begin{cases} \text{INTEGER } -1, 0, 1, 2, \ldots, & \text{CONSTRUCTIVE INTERFERENCE} \\ \text{HALF-INTEGER } -\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \ldots, & \text{DESTRUCTIVE INTERFERENCE} \end{cases}$$

$$m = \frac{d \sin\theta}{\lambda}$$ = # OF WAVELENGTHS OF PATH DIFFERENCE

SCREEN

- $m = 1$ BRIGHT 1ST ORDER
- $m = \frac{1}{2}$ DARK
- $m = 0$ BRIGHT 0TH ORDER
- $m = -\frac{1}{2}$ DARK
- $m = -1$ BRIGHT

(GG, Ch 24, P2)

$m = 3$

$\lambda = 610\,nm$

$\theta = 18^\circ$

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

$$d = \frac{m\lambda}{\sin\theta} = \frac{3(610\,nm)}{\sin 18^\circ} = 5922\,nm$$

$$= 5.9\,\mu m$$

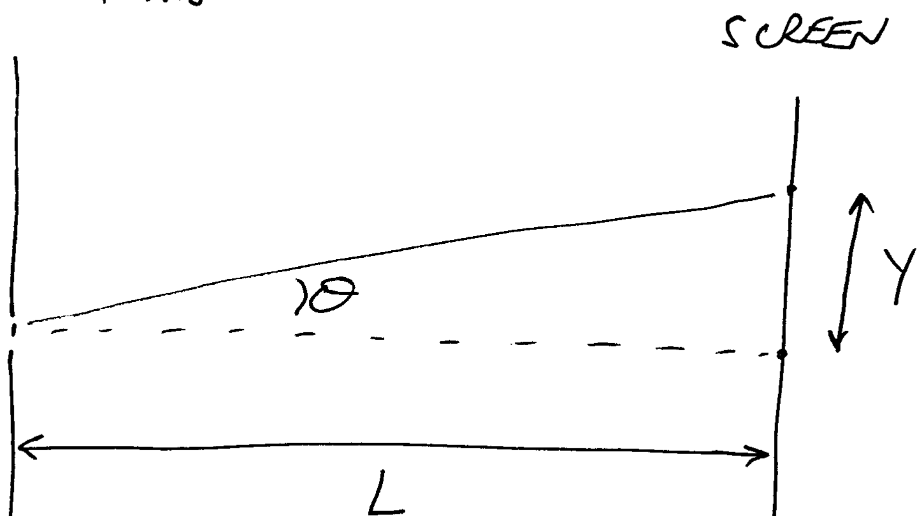
$$= 5.9 \times 10^{-6}\,m$$

SMALL ANGLE APPROXIMATION

IF θ IS SMALL (< 0.1 RAD OR 6°),

$$\theta \approx \sin\theta \approx \tan\theta$$

↑ IN RADIANS



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

(66, Ch 24, P10)

$m = 3$

$\lambda = 500\,nm$

$y = 12\,mm$

$L = 1.6\,m$

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

$$\sin\theta \approx \tan\theta = \frac{y}{L}$$

$$\frac{dy}{\lambda L} = m \qquad d = \frac{\lambda L m}{y}$$

$$d = \frac{(500\,nm)(1.6\,m)(3)}{12\,mm} = \frac{(500\,nm)(1.6\,m)(3)}{0.012\,m}$$

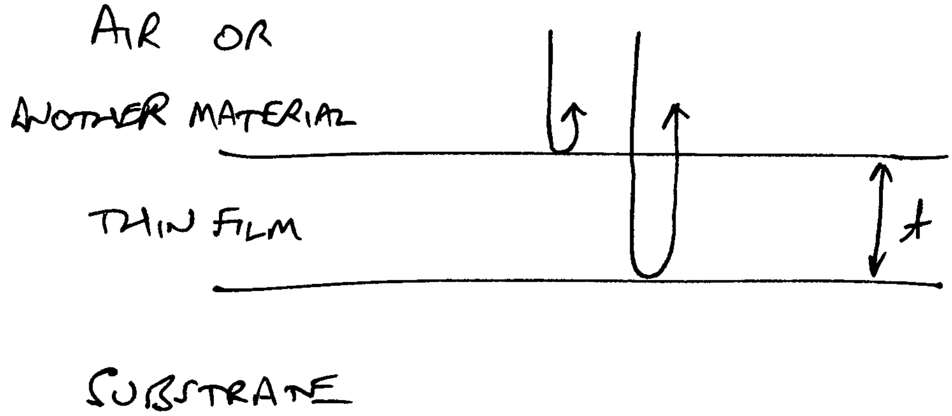
$$= 200000\,nm$$

$$= 0.2\,mm$$

$$\frac{d \sin\theta}{\lambda} = m \Rightarrow \frac{dy}{\lambda L} = m \Rightarrow y = \frac{\lambda L m}{d}$$

$$y = \frac{(650\,nm)(1.6\,m)(2)}{0.2\,mm} = 10.4\,mm$$

THIN-FILM INTERFERENCE



BASICALLY,

$$\#\lambda s = \frac{2t}{\lambda}$$

TWO COMPLICATING FACTORS

① WAVELENGTH CHANGES WHEN LIGHT ENTERS A NEW MATERIAL
(FREQUENCY OF LIGHT STAYS THE SAME.)

$$C = \frac{\lambda_0}{T} \qquad V = \frac{\lambda_n}{T}$$

IN VACUUM — IN MATERIAL

WAVELENGTH IN MATERIAL → $\lambda_n = \dfrac{\lambda_0}{n}$ ← WAVELENGTH IN VACUUM.