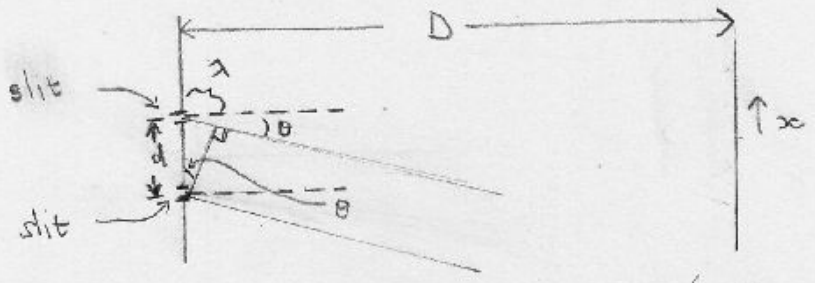
e_81_2_012

t.

a)



Constructive interference for pathlengths differing by an integral number of wavelengths

$$d \sin\theta = m\lambda \quad , \quad m = 0, 1, 2, \ldots$$

$$x = D \tan\theta$$

Now, $\lambda \ll d \Rightarrow \sin\theta \approx \theta$, $\tan\theta \approx \theta$

so $$x = \frac{mD\lambda}{d}$$

$\Rightarrow$ distance between adjacent maxima

$$\Delta x = \frac{D\lambda}{d} = \frac{Dh}{dp} \qquad (\text{since } \lambda = h/p)$$

b) Kinetic energy $K = Ve = \frac{p^2}{2m}$ (non-relativistic)

$$\Rightarrow \lambda = \frac{h}{\sqrt{2mVe}} = \frac{6.626 \times 10^{-34}}{\sqrt{2 \times 9.109 \times 10^{-31} \times 50 \times 10^{3} \times 1.602 \times 10^{-19}}}$$

$$= 5.5 \times 10^{-12} \text{ m}$$

$$= 0.055 \text{ Å}$$

$$\Rightarrow \Delta x = \frac{D\lambda}{d} = 10^{-6} \text{ m} = 10^{-4} \text{ cm}$$