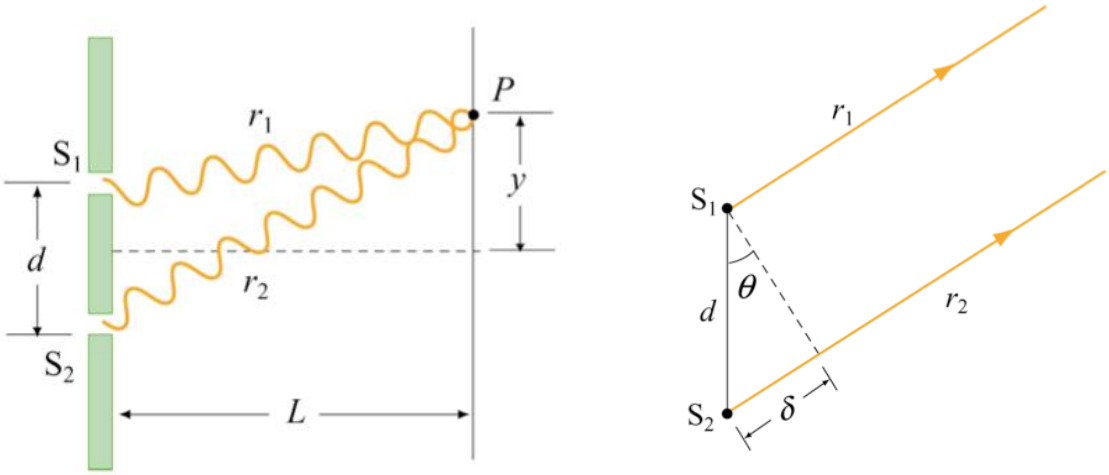
Answer on Question #41983 – Physics – Other

In the young's double slit experiment, the intensity on the screen at a point where path difference is λ is K. What will be the intensity at the point where path difference is (λ/4) ?

(1) K/4 (2) K/2 (3) K (4) Zero

Solution:



The intensity I is proportional to the time-average of the square of the total electric field

$$I \propto \langle E^2 \rangle = 4E_0^2 \cos\left(\frac{\phi}{2}\right) \langle \sin^2\left(\omega t + \frac{\phi}{2}\right) \rangle = 2E_0^2 \cos^2\left(\frac{\phi}{2}\right)$$

Therefore the intensity is

$$I = I_0 \cos^2\left(\frac{\phi}{2}\right)$$

where I_0 is maximum intensivity on the screen. Substitute $\phi = \frac{2\pi}{\lambda}\delta$ (δ – path difference)

$$I = I_0 \cos^2\left(\frac{\pi\delta}{\lambda}\right)$$

Intensivity is first case ($\delta = \lambda$):

$$I_1 = K = I_0 \cos^2\left(\frac{\pi\lambda}{\lambda}\right) = I_0 \cos^2(\pi) = I_0 \qquad (1)$$

Intensivity is second case ($\delta = \frac{\lambda}{4}$):

$$I_2 = I_0 \cos^2\left(\frac{\pi\lambda}{\lambda 4}\right) = I_0 \cos^2\left(\frac{\pi}{4}\right) = \frac{I_0}{2} \qquad (2)$$

$$(1) \text{in} (2):$$

$$I_2 = \frac{I_0}{2} = \frac{K}{2}$$

Hence, correct answer is (2) K/2

Answer: (2) K/2