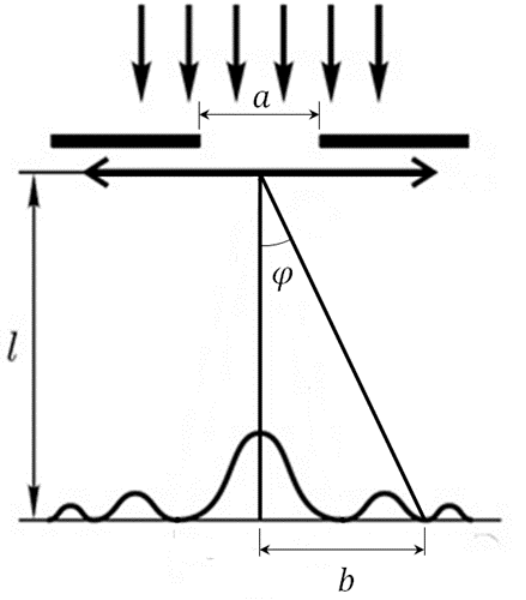
Answer on Question #73863, Physics / Optics

Question. A single slit has a width of $0.04\ mm$. A parallel beam of light of wavelength $560\ nm$ is incident normally on it. If the distance between the slit and the screen is $100\ cm$, calculate the separation between the central maximum and the second minima in the diffraction pattern.

Given. $a = 0.04\ mm = 0.04 \cdot 10^{-3}\ m; \lambda = 560\ nm = 560 \cdot 10^{-9}\ m; l = 100\ cm = 1\ m; m = 2.$

Find. $b - ?$

Solution.



The condition of diffraction minima on a single slit

$$a \sin\varphi = \pm m\lambda\ (m = 1, 2, \dots).$$

From the figure

$$b = l\,\mathrm{tg}\,\varphi.$$

$$b \ll l \ \rightarrow\ \mathrm{tg}\,\varphi \approx \sin\varphi \ \rightarrow\ b = l\sin\varphi \ \rightarrow\ \sin\varphi = \frac{b}{l}.$$

We get

$$a \cdot \frac{b}{l} = 2\lambda \ \rightarrow\ \ b = \frac{2 \cdot \lambda \cdot l}{a} = \frac{2 \cdot 560 \cdot 10^{-9} \cdot 1}{0.04 \cdot 10^{-3}} = 28 \cdot 10^{-3}\ m = 28\ mm.$$

Answer. $b = 28\ mm.$