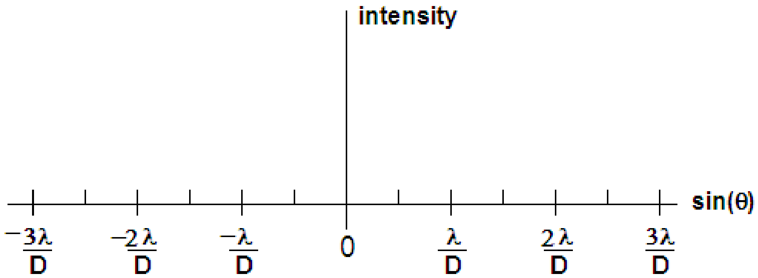
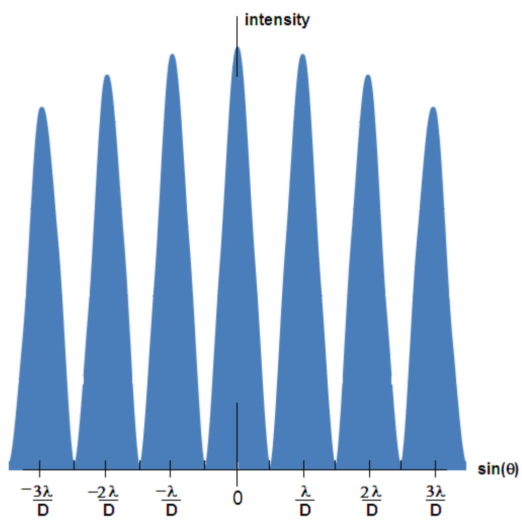
Physics II

Double Slit

Problem 1.- Sketch the intensity of light observed in the double-slit experiment. D is the distance between slits, the light wavelength is λ and sin(θ) is the sine of the deflected angle.



Solution: The figure sketches the intensity of light observed in the double-slit experiment if D is the distance between the slits, the light wavelength is λ and sin(θ) is the sine of the deflected angle.



There is a maximum in intensity anytime the sine of the angle is an integer times the wavelength over the distance between the slits. The effect of the slits' width is an overall pattern like the one for a single slit (not shown above).

Problem 2.- Two slits are scratched on an opaque slide and are separated by 0.08 mm. They are illuminated by light from a laser pointer (wavelength $\lambda = 632nm$).

(a) Calculate the angle between two bright interference fringes.

(b) Estimate the separation between two bright fringes on a screen located L=2.5 meters from the slits.

Solution: We use the equation $\theta = \sin^{-1}\left(m\frac{\lambda}{d}\right)$ to find the separation. For m=0 we get zero and for m=1 we get: $\theta = \sin^{-1}\left(\frac{\lambda}{d}\right) = \sin^{-1}\left(\frac{632nm}{0.08mm}\right) = \mathbf{0.452^o}$

And to find the separation on the screen we use a basic trigonometric equation:

$y = L\tan\theta = 2.5\tan(0.452^\circ) = \mathbf{19.8\ mm}$

Problem 3.- What happens to the interference pattern of double slits when you reduce the distance between the slits?

Solution: The angle between the central maximum and the first bright fringe in a double slit interference pattern is given by:

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

So, if the distance *d* is reduced, the angle will be larger, spreading the pattern.