Physics 214 PreLab 1: Interference and Diffraction

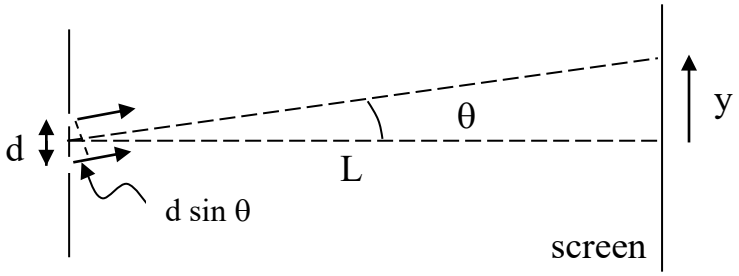
Name_____

Section _____ **Date** _____

<u>Your TA will collect this paper at the *beginning* of your lab section.</u>

The basic problem is shown in the following figure, which represents light of a given wavelength λ passing through two slits separated by a distance *d*. The distance to the screen is *L*. In this lab experiment you will **measure the intensity at a position y** along the screen, which corresponds to a scattering angle θ.

Fig. 1



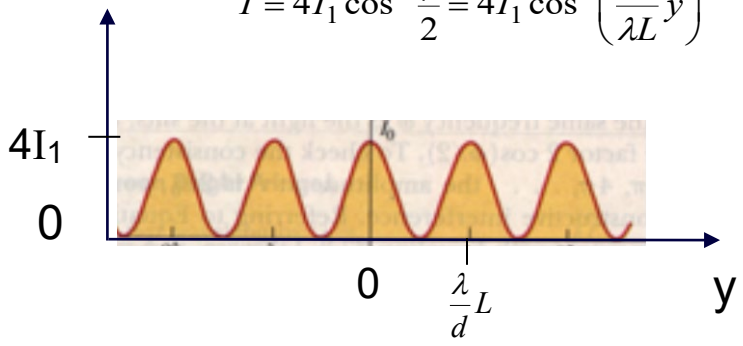
As shown in class, the **phase difference** between the two light beams at position y is:

$$\phi = 2\pi\,(\delta/\lambda) \qquad \text{where} \qquad \delta = d\sin\theta \approx d(y/L) \qquad (1)$$

is the path difference between the two beams. From phasor analysis, if the intensity arriving at the screen from each slit is I_1, the total intensity at *y* from both slits is:

$$I = 4I_1\cos^2\frac{\phi}{2} = 4I_1\cos^2\left(\frac{\pi d}{\lambda L}y\right)$$

Fig. 2



The more general form for the interference pattern from N slits is: $I = I_1\left(\dfrac{\sin(N\phi/2)}{\sin(\phi/2)}\right)^2$

1. Show that this reduces to the 2-slit case when N = 2.

When we consider the **diffraction** of light through a single slit of width a, we find that the single-slit intensity, I_1, in the above equation is not simply a constant but also depends on angle. The **single-slit pattern** looks like the following plot:

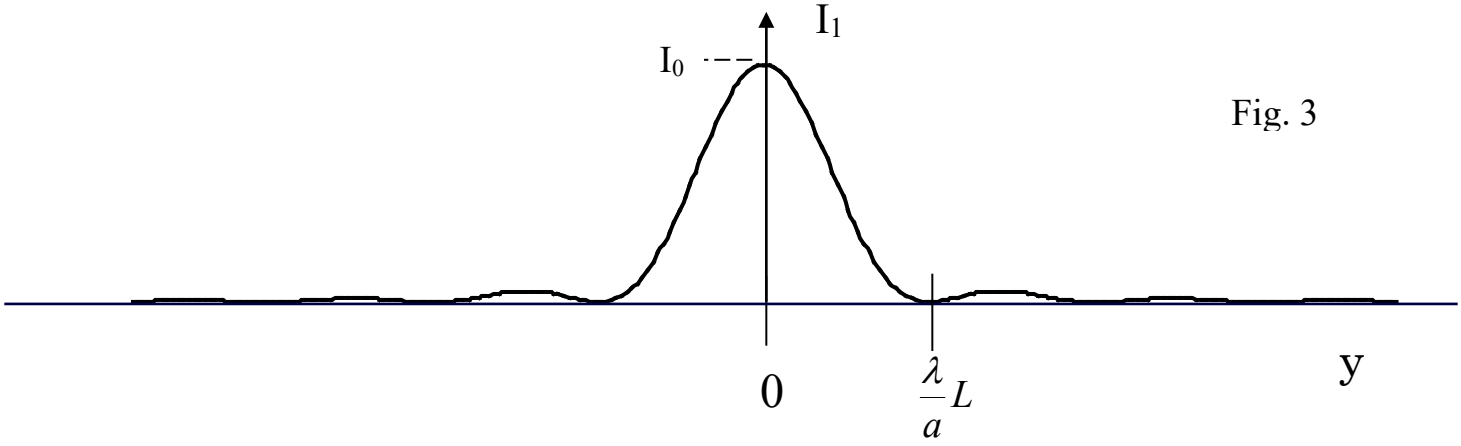


Fig. 3

2. Calculate the position of the **first diffraction minimum** assuming a laser wavelength of 633 nm, a slit width of 20 μm, and a screen distance of 1 m.

y =

!!DO NOT FORGET TO INDICATE UNITS FOR ALL NUMERICAL ANSWER YOU PROVIDE!!

So the net result due to both **interference and diffraction** is the product of the curves in Figs. 2 and 3 (see also 214 Lecture 3):

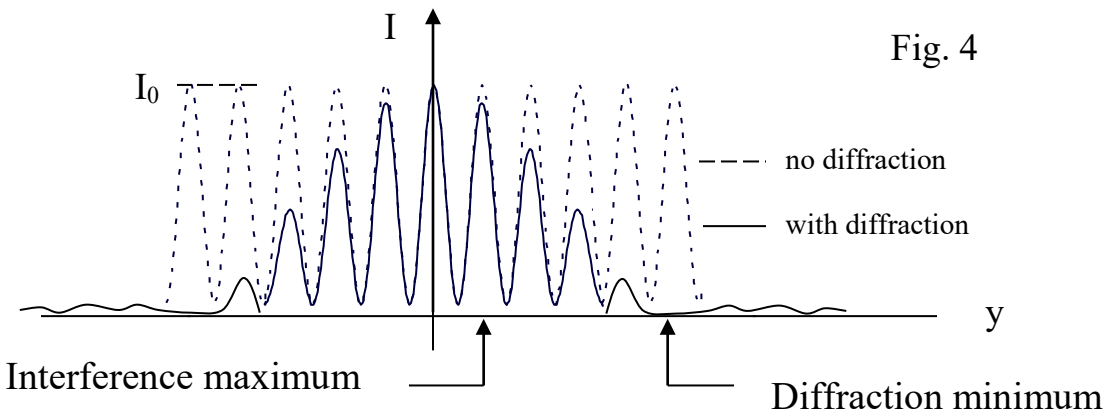


Fig. 4

3. You should be able to tell what the ratio d/a is by just looking at the above pattern.

d/a =

Explain your method:

End of Prelab Exercise