Slit Diffraction

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

Interference and Diffraction of Light – Simulation

Open the Virtual Diffraction simulation to do this lab.

Explore the Apparatus

Your assigned "unknown number" for this lab is 2. (*Note: The value given may be different in the WebAssign question.*) This is the number which you'll use to select your unknowns. So if you are told to use your assigned unknown wavelength, you'll just select 2 with the wavelength stepper.

1. Drag the wavelength slider all the way to the left. We'll call this color violet. What's its wavelength?

2. Drag the wavelength slider all the way to the right. We'll call this color red. What's its wavelength?

3. It's useful in our work to know about the order of these colors in the spectrum and how they relate to wavelengths. So, let's get to know them. Select a wavelength in the range of each color in the sequence ROYGBIV. There are no exact answers. Just try again if your estimate is rejected and blame it on your monitor.

   (a) Red

   (b) Orange

(c) Yellow (very narrow)

(d) Green

(e) Blue

(f) Indigo no way

(g) Violet (very narrow)

5. As the wavelength decreases, the width of the central, bright fringe ____________ .

6. What three significant changes do you observe as you *increase* the slit width? One involves the Intensity Graph.

7. Change the number of slits to two. Scan. Describe the changes in the Fringe Display and the Intensity Graph. Also comment on what stays the same.

I. Double Slit Interference – Measuring an Unknown Wavelength

Complete Table 1.

Table 1: Double Slit Diffraction, $L = 1$ m

Trial	**Un-known #**	**Data**					**Calculated**			**% error (λ)**
		m	d (μm)	w (μm)	λ_{theo} (nm)	$-y_3$ to $+y_3$ (mm)	y_3 (mm)	θ_3 (°)	λ_{exp} (nm)	
1		3	250	40	540					
2	2	3	250	40						
3	2	3	500	40						

10. Show your calculations of θ_3, λ, and your percentage error for trial 1.

13. Show your calculations of θ_3 and your wavelength for trial 2.

15. You should now be able to make an estimate of what would happen to your trial 2 data if you doubled the slit spacing.

(a) What was your value that you recorded for the distance "$-y_3$ to $+y_3$" from trial 2?

(b) What do you predict will be the value for "$-y_3$ to $+y_3$" if you double the slit spacing?

16. Let's summarize some of the basic ideas that you've learned so far. For light passing through a pair of narrow slits, how is the spacing of the fringes affected by the spacing of the slits, the wavelength of the light, and the distance from the slits to the screen (you weren't able to test this with the apparatus, but geometry helps)?

II. Single Slit Diffraction

3. Take a **Screenshot** of the bottom portion of the lab screen — the part below the apparatus. Upload it as "interference_doubleslits.png". (*You will upload this file in the WebAssign question.*)

6. Take a **Screenshot** of the bottom portion of the lab screen — the part below the apparatus. Upload it as "interference_singleslit.png". (*You will upload this file in the WebAssign question.*)

Slit Diffraction/Interference

10. When light passes through a narrow slit, the amount of diffraction ______________

with wavelength and ______________ with to the width of the slit.

11. For the first dark fringe on a screen, and slit width w, as the wavelength, λ, increases the angle θ ______________.

12. For the first dark fringe on a screen, and wavelength, λ, as the slit width, w, increases the angle θ ______________.

Complete Table 2.

Table 2: Single Slit Diffraction, $L = 1$ m, Unknown #: 2

Trial	m	λ (nm)	y_{-m} to y_{+m} (mm)	y_m (mm)	w (μm)	w_{exp} (μm)	λ_{exp} (nm)	% difference (λ)
1					40			
2								

15. Show your calculations for the experimental value of your wavelength in trial 1.

19. Show your calculations of the unknown slit width in trial 2. You'll need to show your calculation of y_m and w.

III. Two Slit Interference with Single Slit Diffraction

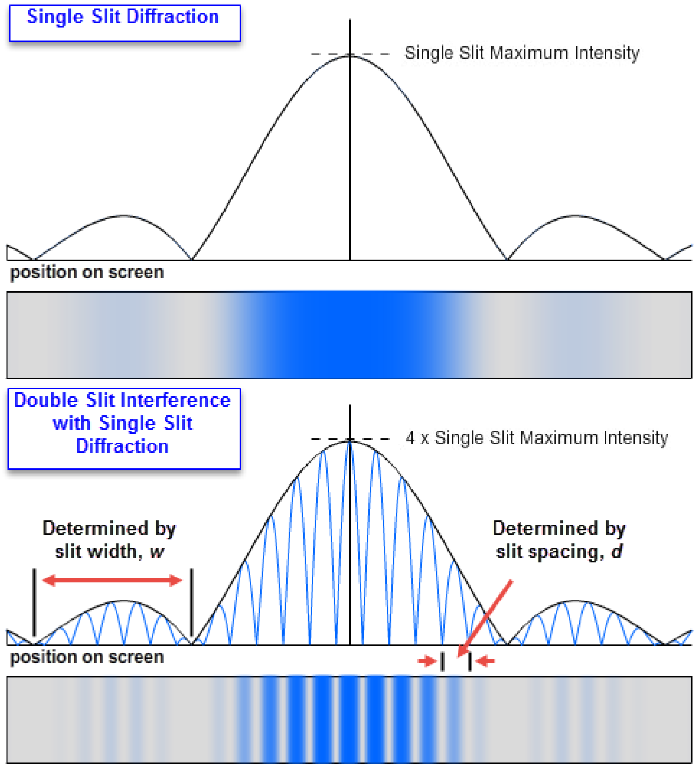

Figure 21

2. Increasing the slit spacing, d, will ____________ the number of bright fringes in Figure 21.

3. It will ____________ the widths of the peaks of the envelope.

4. Replacing the blue light with ____________ will reduce the distance between the two first order ($m = 1$) dark fringes of the double slit pattern.

5. Thus we can say the spacing of the bright fringes is ____________ proportional to wavelength.

6. ____________ the widths of the slits will reduce the distance between the two first order ($m = 1$) dark fringes of the double slit pattern.

7. Thus we can say that the spacing of the dark fringes is ____________ proportional to slit width.