I	C

Name: ______________________________

Date of lab: __________________ Due date: ____________________

❑ 01 ❑ 02 ❑ 03 ❑ 04 ❑ 05 ❑ 06 ❑ 07 ❑ 08

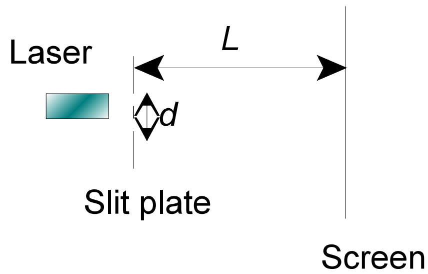
SPH4U

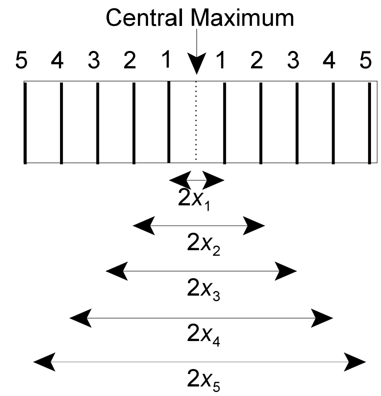
Lab: Young's Double Slit Experiment

PART A: Helium-neon Laser

Purpose
To determine the wavelength of a helium-neon laser.

Apparatus





Method

1. Position the slit plate on your assigned line and line up the laser so that it passes through the second diffraction grating and the interference pattern can be clearly seen on the door.

2. Tape a sheet of chart paper to the door. Mark and label the locations of <u>antinodal</u> lines 0 to 5 in both directions on the paper. Turn off the laser when you are done. Remove the paper from the door.

3. Mark the location of the <u>nodal</u> lines 1 to 5 in both directions. Measure the spacing, $2x_n$, between symmetric pairs of nodal lines (as shown in the diagram) for the first five pairs of nodal lines.

4. Measure the distance L, from the diffraction grating to the screen. __________________

5. Create a data table in Graphical Analysis like the one below.

   a. The column "$2x_n$" is your **data column**. Enter your measurements manually.

   b. The remaining columns are **calculated columns**. Select "New Calculated Column" from the Data menu and enter an equation to calculate x_n. Repeat for the fourth and fifth column.

   c. Select the Notes window in the bottom left corner and enter: (1) Your group members' names, (2) your L measurement, and (3) the value of d.

n	$2x_n$ (m)	x_n (m)	$\frac{x_n}{L}$	$\frac{n-\frac{1}{2}}{d}$ (m^{-1})
1				
2				
3				
4				
5				

6. Create a graph of $\frac{x_n}{L}$ ver: $\frac{n - \frac{1}{2}}{d}$ and determine the slope.

For PART A you must hand in:

- ONE PRINTOUT PER GROUP showing: The completed data table, graph with error bars, and Notes box **on one page.**
- The chart paper on which you recorded your measurements with your names recorded.

Analysis

1. Based on the slope of the graph, the wavelength of the laser is ___________________.

2. Determine the uncertainty of your calculation.

3. Calculate the percent difference between your experimental value for the wavelength of the laser and the known value ($\lambda = 6.328 \times 10^{-7}$ m).

4. Explain why the slope of the graph represents the wavelength of the laser.

5. How good is your wavelength calculation? Does your value fall within the accepted range? Why or why not?

6. Compare your results with those obtained by other groups. Aside from human error, why can you not expect all groups in your class to obtain the same wavelength values?

PART B: Colours of Light

Purpose
To determine what the diffraction patterns will look like as the colour of light changes, and how this explains the patter seen through a white light.

Prediction
Predict how the diffraction patterns for wavelengths of red and blue light will compare.

Materials
- clear showcase lamp
- diffraction grating plate
- red and blue transparent filters
- clamp
- retort stand

Note: The light bulbs will become very hot. Allow them to cool before changing bulbs.

Procedure
1. View the clear lamp through the 3rd (middle) diffraction grating in the middle column, ensuring that the slits in the diffraction grating are parallel to the filament of the lamp. Sketch and describe the pattern seen. Be precise.

2. Turn off the clear lamp and turn on the ones with the red and blue filters. View the lamps through the same diffraction grating as in step 1. Sketch and label scale diagrams of the diffraction patterns of the different colours of light, with longest at the top and shortest at the bottom. Turn off the lamps when finished.

Analysis

1. Using your sketches in step 2, explain the diffraction pattern you saw with the clear showcase lamp. What is this pattern called?

2. If you were trying to calculate the wavelength of the light, which colour of light would be easiest to use? Explain why.

3. Could you use this set-up to determine the wavelength of ultra-violet light? Why or why not?

4. Discuss any sources of error in your results for part A.