AP Physics 2 Lab – Lenses and Mirrors

Goal: The purpose of this experiment is to verify the expected properties and mathematical relationships for convex/concave mirrors and thin lenses.

Procedure

Throughout the experiment, measure object distance, image distance, object height, and image height using meter sticks and/or rulers. For each converging lens and mirror project an image of a very distant object onto a screen. Taking the object distance to be essentially infinite (do not need to measure), record the distance from the lens/mirror to the screen as the measured focal length. Use an LED light source and each converging lens and mirror to create real images projected onto a screen. Measure and record the height of the object. Vary the distance to the object to generate as wide a range of values as reasonably possible. Produce three sets of data (two lenses and a mirror). Each set should have at least 5 data points – preferably more.

Analyses and Interpretations

1. Use the blank columns in the data table to calculate and record values that can be used to produce a high-quality **linear** graph that illustrates the relation between object distance and image distance. Plot data from all lenses and mirrors and include a key, using different symbols and/or colors to distinguish the three data sets. Determine and include a linear regression equation and line of best fit for each data set.
2. Create a high-quality graph of height of image vs. object distance. Plot data for all lenses and mirrors and include a key, using different symbols and/or colors to distinguish the three data sets. Determine a curve of best fit with equation of form: $y = \frac{A}{x-B}$.

Questions

1. Explain whether, and how, your data, graphs, etc. support or refute the expected properties of lenses and mirrors. Be specific.
2. Consider the linear regressions from the first graph. (a) Use one of the coefficients from each equation to calculate the focal length for each lens and the mirror. Show your work. (b) Discuss the significance of the other coefficient – is it what you would expect? Explain.
3. Consider the curve fit equations for the second graph. The coefficients A and B can be used to determine focal length and object height. (a) Derive an expected relationship for this graph: and expression for h_i in terms of d_o, h_o, f, and any appropriate constants. Show your work. (b) Use the coefficients A and B to calculate focal length and object height for each data set.
4. Determine percent error and/or deviation for each of the three data sets. There are different ways that this might be done – it is your choice! Just make it clear what you have determined and show your work.
5. Discuss error. This means you should point out specifically any signs and/or evidence of error apparent in your results. And you strive to explain the sources of error that might account for the observed imperfections.

Data/Observations

Convex Lens 1				
Object Height:		Measured Focal Length:		
Object Distance (cm)	Image Distance (cm)	Image Height (cm)		

Convex Lens 2				
Object Height:		Measured Focal Length:		
Object Distance (cm)	Image Distance (cm)	Image Height (cm)		

Concave Mirror				
Object Height:		Measured Focal Length:		
Object Distance (cm)	Image Distance (cm)	Image Height (cm)		

A completed report consists of the following (in this order):

- Completed data/observations tables
- Linearization graph for image distance and object distance, with lines of best fit and equations
- Graph of image height vs. object distance, with curve fits and equations
- Answers to questions