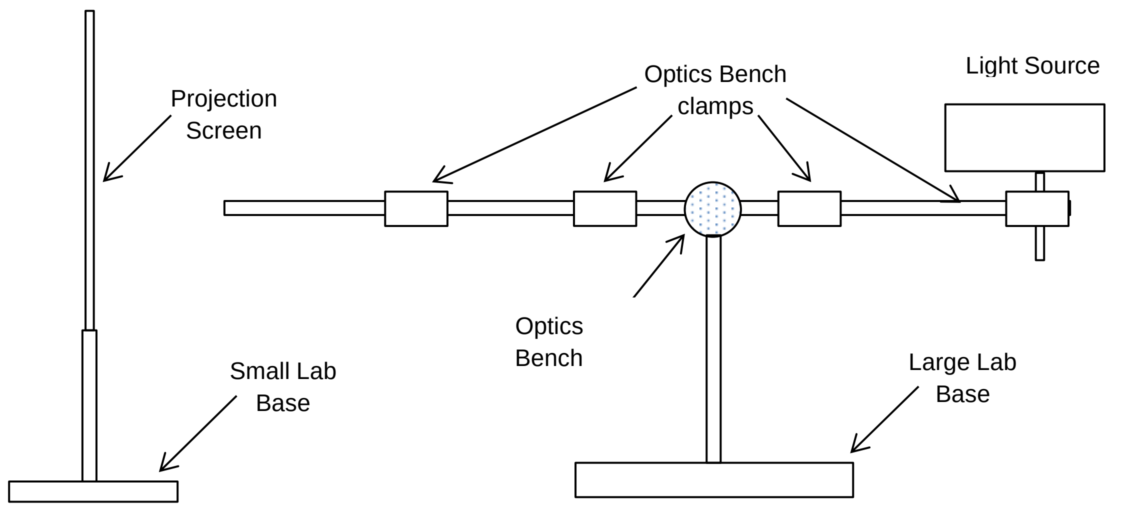
PHYS 263

Mirrors and Thin Lenses

I. EQUIPMENT LIST

- (1) Optics Bench
- (1) Large Lab Stand Base
- (1) Small Lab Stand Base
- (4) Optics Bench Clamps
- (1) Light Source w/ Transformer
- Meter Stick, ruler, caliper
- (1) Object Slide
- (1) Slide Holder
- (1) Converging Mirror
- (1) Converging Lens
- (1) Spring-loaded Mirror Holder
- (1) Projection Screen



II. BACKGROUND INFORMATION

Curved surface mirrors and lens can be constructed by taking a section of a sphere and using that as a reflective surface for a mirror or as the refractive surface for a lens. The laws of reflection and re-fraction studied in the previous lab hold even for a curved surface. When the light impinges on the curved surface an image can be formed. Because of the curvature, the image will not necessarily be the same size as the object and the image's distance from the mirror will not necessarily be the same as the distance of the object.

For both spherical mirrors and thin spherical lenses, the object distance d_0 and the image distance d_i are related to the focal distance f through the equation:

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

The magnification can be determined either as the ratio of the image height h_i to the object height h_o or as the negative of the image distance d_i to the object distance d_o.

III. EXPERIMENTAL PROCEDURE AND DATA

Part A: **Refraction through a converging (convex) lens**

A1. Direct measurement of the focal distance

• Use the optical bench, a +100 mm lens, and a screen to find the best image of an infinitely distant object on the screen. Measure and record the image distance and compare with the given focal distance of the lens.

A2. Images formed at different object distances

• Measure and record the size of the object.

• Place the object slide at one end of the optical bench, place the lens at a distance of about $4f$ from the object, and find the position of the screen where the best image is formed.

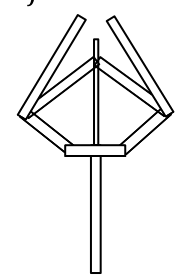
• Measure and record the object distance, the image distance, the image height, orientation (erect or inverted), and type (real or virtual).

• Repeat the previous operations for other object distances including $3f, 2f, 1.5f$, and $0.5f$.

Part B: R**eflection from a converging (concave) mirror**

Place the mirror in a spring-loaded holder (see figure).

Repeat the procedure you used for the lens for a couple of object positions.



IV.DATA ANALYSIS

1. Calculate the focal length using the thin lens/mirror formula and the calculate the average focal length. Note: add a column to your data table.

2.Determine the magnification of the lens and mirror at the various object positions, both as the ratio of the image height h_i to the object height h_o and as the negative of the image distance d_i to the object distance d_o. Compare quantitatively the results and comment. Note: this will add three more columns to your data table.

3. Use the data for the lens to graph the inverse of the object distance $1/d_i$ versus $1/d_o$. Write the equation of the line in terms of the relevant quantities. Use the graph to find the focal distance of the lens.

4. Compare quantitatively the focal distance values you obtained through the three different methods:

a. Focusing on an infinitely distant object;
b. Measuring object and image distances and calculating using the mirror/thin lens formula;
c. Using the graphical method

Which method would you chose and why?

V.QUESTIONS

1. Choose one of the setups for the lens and one for the mirror and sketch a “Light Ray Diagram”. Make your drawing to scale. Compare your calculated results with those from the light ray diagram.
2. Qualitatively describe what happens to the size, type and position of an image from the mirror, as the object starts at "infinity" and moves toward the mirror. Identify the “special ranges” when characteristics change. Answer for both a concave and convex mirror.