
PHYSICS 126 EXPERIMENT NO. 8

LENS OPTICS

In this experiment we will investigate the image-forming properties of lenses, using the thin-lens equation:

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

where s and s' are the object and image distances from the lens and f is the focal length of the lens.

A. Equipment

1 Optical Bench, Several Convex and Concave lenses, 1 Light source, 1 Mirror, 1 Screen.

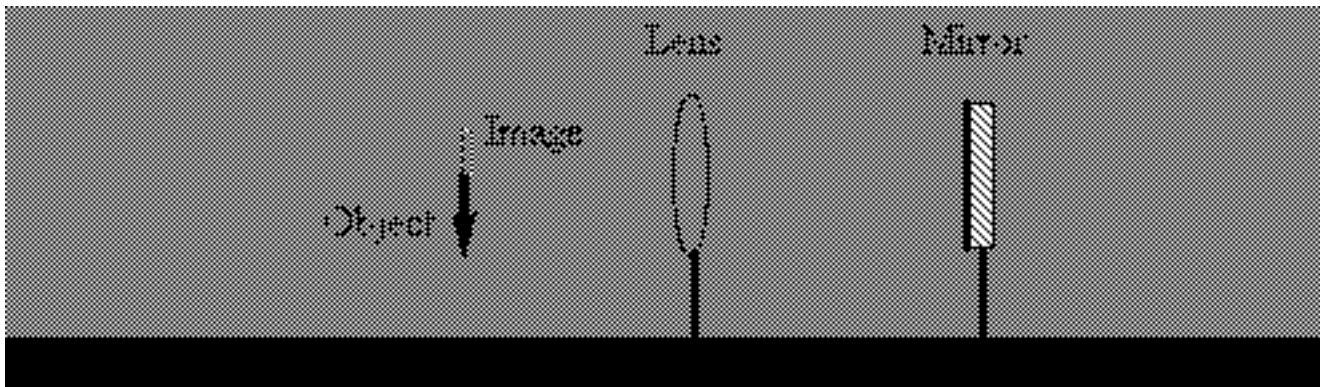
C. Procedure

I. Measuring Focal Length

1. The focal length of a lens is equal to the image distance of an object at infinity. Image the overhead lights on a piece of paper and measure the distance from the paper to the lens.

Q1. Prove using the thin lens equation the statement from step 1.

2. Set up on your optic bench the equipment shown below:



3. Move the lens until the reflected image forms a clear focus at the same position as the object. Determine how to get the focal length from this configuration.

Q2. Is the location of the mirror important?

Q3. Draw a ray diagram to show how the image is formed.

4. Repeat for each of your lenses.

II. *Converging lenses and Real Images.*

1. For each of your convex lenses, measure the s and s' (as well as the image size) for at least six different object distances.

Q4. What is the smallest object distance for which a real image can be formed?

2. For each lens, make a plot of $1/s'$ vs. $1/s$. Determine the focal length of each lens from the plot and compare with your previous results.

3. Use your measurements to test the relation $m = -s'/s$.

III. *Two Lens Systems.*

1. Mount a diverging lens on the optical bench in front of an

illuminated object.

Q5. Where is the image formed? Can you see it? Why?

2. Put a strong (short focal length) lens behind the concave lens. If the converging lens is strong enough, it will be possible to form a real image.

3. The virtual image created by the diverging lens acts as the object for the converging lens. Using the measured distance to the image of the converging lens (s' for that lens), and its known focal length, measure the location of the virtual image from the diverging lens.

4. Using the known object location and **JUST MEASURED** image location, calculate the focal length of the diverging lens.

5. Construct a simple two-lens telescope. Try a few different lens combinations to verify the relationship between the focal lengths of the lenses and the magnifying power.