

PHY 252
Lab 6 – Simple (Thin) Lenses

Objectives:

The objective of this lab is to determine the focal lengths of simple converging and diverging lenses.

Theory:

A thin lens is defined as a lens whose thickness is significantly less than its radius of curvature. For thin lenses, a simple formula can be used to relate the object distance (d_o), image distance (d_i), and focal length (f) of the lens:

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

By measuring the object and image distances experimentally, one can calculate the focal length. However, if the lens has a negative focal length (therefore a diverging lens), a real image cannot be obtained, and so the image distance cannot be measured. If a negative lens is used along with a positive (converging) lens, a real image can be obtained and the combined focal length calculated. From this, one can obtain the focal length of the negative lens.

Procedure:

1. You will be working with 3 lenses. Examine each one and by simply viewing a distance object (at least 4 meters away), determine whether the lens is positive (converging) or negative (diverging).
2. Position the screen and the lighted object 90 cm apart on the optical bench. **Do not change this distance until specifically told to do so in the procedure.**
3. For each positive lens, position the lens between the object and the screen so that you have an enlarged image. Determine and record the object distance, image distance, object height, and image height. Note the orientation of the image compared to the object (inverted or upright). *You may not be able to measure the whole image. Measure an appropriate part of the image as needed.*
4. Change the screen object distance to 125 cm. Repeat Procedure Step 3.
5. Use the more powerful positive lens with the negative lens to produce a focused image. You should have the positive lens between the object and the negative lens. Measure the object distance from the positive lens, the image distance from the negative lens, and the distance between the lenses.

Calculations:

1. From the data of Procedure Steps 3 and 4, calculate the focal lengths of the two positive lenses. You should get 2 values for each positive lens. Determine the average focal length value for each lens.
2. Compute the actual magnifications obtained by finding the ration of the image size to the object size. Don't forget to include the proper sign. Also, compute the theoretical magnification using the actual image and object distances you obtained. Present these magnifications in a table for side by side comparison.
3. From the data of Procedure Step 5, calculate the focal length of the negative lens.