LENSES

Purpose: To explore image formation by lenses.

Background: Understanding Physics Chapter 35 sections 7-10.

NOTE: Always record positions of the various optical components. Then calculate distances between components from these positions. Include drawings labeled with positions.

Procedure:

1. Using either the optical bench in the observatory at the top of Hoyt or the optical bench on your lab table focus the image of a very distant object (building across walkway or light at end of hallway) on a viewing screen to determine the focal length of converging lens #2.

2. Now use this converging lens on the optical bench at your table with the light source as the object. Use a distance of ~38 cm between the light and the lens. Using your measured values for the object distance and focal length, predict where you think the image will be.

   Place the viewing screen on the bench and adjust until you have a sharp image of the source on the screen. Note the nature of the image. Is it inverted or upright? Is it reversed left to right? Is it smaller or larger than the object?

   Draw a ray diagram of the situation and compare your ray diagram's prediction to the actual location of the image.

   Use your measured values for the object distance and image distance to calculate your focal length. How does it compare to the value you estimated in part 1? Use this new value from now on.

3. Measure the height of the object arrow and the height of the image arrow. Compute the magnification from this. Compare this to the value predicted by the object and image distances.

4. Predict what you think will happen to the image if you cover the top half of the lens with a card. **Write down your prediction before you try it**!

Place a card over the top half of the lens and compare the results to your prediction. Based on your observation, what do you think will happen if you now block off the bottom half of the lens? Try it. Explain the results.

5. There is another location for the lens with a sharply focused image on the viewing screen which does not require moving the light source and the viewing screen. Find it and note its location. How does the object distance for this part compare to the image distance in part 2 and how does the image distance for this part compare to the object distance in part 2? Is there any relationship between the magnification in this part to that obtained in part 3?

6. Place the screen about 33 cm from the lens. Using the known image distance and focal length, predict where the object will be to give you a sharp image on the viewing screen.

Place the light there and check. Adjust as necessary to give the sharpest image and compare to your prediction.

7. With the viewing screen still 33 cm from the lens, move the light to a distance 60 cm away from the lens. The image should <u>not</u> be sharp. Why not?

We will try to make a sharp image on the viewing screen by using a second lens. You have another converging lens (#1) and a diverging lens. Which is the most appropriate to try? Why?

Place the one you chose in front of the original lens (so light passes through this new lens first) and check out your guess. You may see a very good improvement in image quality, but it probably will not be as sharp as it could be. Adjust the position of the new lens to give the best possible image on the screen.

8. Record the position of the viewing screen, and the two lenses. The light from the source encounters the new lens first and forms an image (image 1). This image becomes the object for our original lens (converging #2), which forms an image (image 2) on the viewing screen.

From part 6 you know where the object of our original lens must be to give you a sharp image on the screen in this position. That must be the location of image 1. You know the object distance for the new lens from the set up. Use this information to calculate the focal length of the new lens.

If this system were a human eye, this additional lens would be the kind of correction necessary to give a near-sighted (myopic) person in-focus vision at a greater distance.