LAB 32, LENS MAGNIFICATION

Name ________________________ Period_____

Please bring a flashlight for this lab.

A converging lens of short focal length is frequently used to magnify small objects.

The lens is held slightly less than one focal length away from the object and the eye is placed close to the lens on the side opposite the object. This is a practical application of the principle of Case 6 for converging lenses; the image is virtual, erect, enlarged, and appears to be on the same side of the lens as the object. The linear magnification **M** of a lens is simply the ratio of the image size $\mathbf{h_i}$ to the object size $\mathbf{h_o}$. And from $h_o/h_i = d_o/d_i$ it is apparent that the lens magnification may be expressed in terms of the image distance $\mathbf{d_i}$ and object distance $\mathbf{d_o}$. The normal eye can focus on objects as close as 25 cm; this distance is known as the distance for most distinct vision.

$$M = \frac{h_i}{h_o} \qquad M = \frac{d_i}{d_o} \qquad M = \frac{25\text{ cm}}{f}$$

OBJECTIVE: To find the magnification of a lens.

Part I: PROCEDURE:

Determine the focal lengths, **f**, of two lenses in cm by a flashlight's parallel rays and record each measurement in the data table. **The focal length is measured from the lens to the paper screen. It matters not where the flashlight is placed because its rays are parallel.**

Magnification data will be taken for the two lenses in the order in which you have listed them in the data table.

Set up as shown in Figure 32-1. Arrange the image screen on the base of the stand.

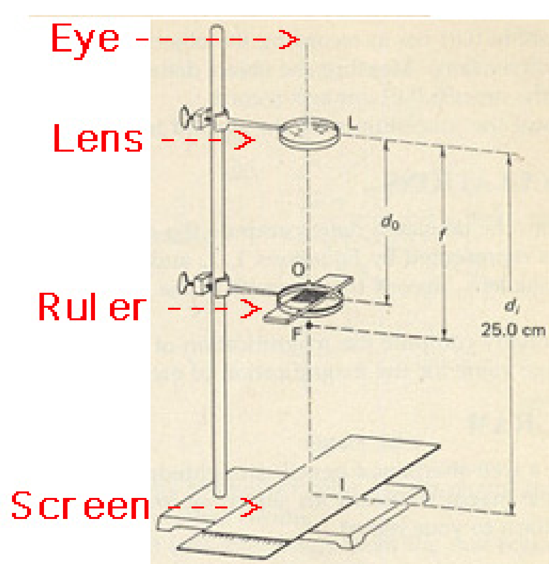

Figure 32-1

Mount or hold the first lens for a value of $\mathbf{d_i}$ of 25.0 cm, measured from the lens plane to the image screen.

Record $\mathbf{d_i}$ (25.0 cm) in the data table for both lenses since this distance will remain constant for both lenses.

Arrange the object (the ruler) below the lens so the object is centered on the principal axis of the lens.

With one eye close to the lens and sighting through the lens along the principal axis and the other eye focused on the image screen, vary the object position until a sharp image appears to fall on the of the image screen.

Determine whether a final adjustment of the object position is required by moving the eye laterally back and forth across the lens (parallax). Readjust the object position, if necessary, to eliminate any relative motion (parallax) between the virtual image and the lines of the metric scale as the eye moves.

Position the object screen and the image screen as necessary to locate one edge of the ruler on an appropriate mark on the metric scale.

Carefully read the image size $\mathbf{h_i}$ on the scale to the neatest 0.01 cm and record. Measure the object distance to the nearest 0.01 cm and record. Repeat the procedure with the second lens and record the required data in the date columns of the data table.

Repeat using the second lens and record the required data as before. **Data Table:**

Lens	**f (cm)**	$\mathbf{d_i}$ **(cm)**	$\mathbf{d_o}$ **(cm)**	$\mathbf{h_i}$ **(cm)**	$\mathbf{h_o}$ **(cm)**
1	.	.	.	.	.
2	.	.	.	.	.

CALCULATIONS (show them on the back):

1. From the tabulated data, compute the magnification of Lens 1 by the three equations above: Determine the average value for the magnification of the lens. Record these results in the calculations table.

2. Similarly compute the magnification of the Lens 2. Determine the average value for the magnification of each lens and record all results in the calculations table.

Calculation Table: .... **MAGNIFICATION**

Lens	$\mathbf{d_i/d_o}$	$\mathbf{h_i/h_o}$	**25cm/f**	**Average**
1	.	.	.	.
2	.	.	.	.

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DIAGRAM

Using a pen, straight edge, and compass, carefully construct a ray diagram for a simple magnifier. Show an object, an image, and all necessary construction lines.

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Part II: Make a telescope with two or more lenses on a meter stick. Diagram it and show how the image from the first lens is the object for the second lens.

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CRITIQUE: