Course and Section_______ Names ____________________________

Date___________ __________________________________

LENSES AND MIRRORS

Short description:

In this experiment you will find images created by lenses and mirrors and study the laws that describe them.

Equipment:

- Optical bench
- Converging Lens and diverging lens
- Light source as an object
- Viewing screen
- Mirror
- Half-screen

Procedure:

PART I. Converging lens

Take a *converging* lens and examine it. Is it thicker or thinner in the center? What do objects look like through it? Could it be used as a magnifying glass? Try the lens both close to objects and far from them.

If a lens is used to form an image of something infinitely far away, the distance from the lens to the image is defined to be the *focal length.* This is because the rays from an infinitely remote object are essentially parallel, thus converging at the focal point.

Use the lens to form an image of "something far away". To do this, place the lens on the optical bench and move the screen on the bench until a sharp image is formed on it. Then read off the focal length using the scale on the optical bench.

Focal length = ____________ cm

PART II. Image-object relationships of a converging lens

In this part, use the light box as the object; the lens will form an image of this box on the screen. Place the object and the screen at opposite ends of the bench such that the distance between them is 110 cm. Place a white sheet of paper in front of the white screen. Move the lens between them until a sharp image is formed on the screen. You should note that there are <u>two</u> positions for the lens which give sharp images.
-Why?

Take measurements for each of these positions. Repeat these measurements for L = 100 cm and L = 90 cm.
Record the distance from the lens to the object (p) and the distance from the lens to the image (q). Measure also the height of the image (h').

Height of the object = ________________cm

L (cm)	p (cm)	q (cm)	h' (cm)	f (cm)	h'/h	q/p
110						
110						
100						
100						
90						
90						

The equation relating the image and object distances of a thin lens is

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$$

Use this equation to calculate f from each set of data in the table, and fill in that part of the table.
-Do you get consistent values for the focal length f?

-Do these results agree with the focal length you found in the first part of this experiment?

-Which method do you think is the most accurate?

Finally, look at the last two columns of the table.
-Do you find that the two ratios are equal?

PART III. Spherical mirror

Determine the focal length of the concave side of the spherical mirror. Place the mirror on the bench facing the light box with some distance between them. Place the half-screen between the light box and the mirror and adjust the position of the half-screen until you obtain a sharp image on the half screen. Use the distances to calculate the focal length of the mirror. Repeat using a different distance between the light box and the mirror and again calculate the focal length.

Object distance	Image distance	Focal length

Average value of the focal length = _____________ cm

PART IV. Diverging lens

A diverging lens will produce a virtual image of a real object. To observe this, place the lens on the optical bench about 20cm from the light box. Move the screen on the bench, can you find the image on the screen?

Now, look at the light box through the lens, can you see an image?

- Is this image smaller or bigger than the object?

- Is it image you are observing inverted?

- Is it virtual?

- Is it located in front or in the back of the lens?

In order to produce a real image you also need to use converging lens. This image can be produced by placing a converging lens between the diverging lens and the source. By suitably adjusting the distances of the two lenses and the screen, a real image is produced on the screen. Use this method to determine *f'*, focal length of the diverging lens as follow:

- Using the thin lens equation, calculate distance of the image *q* formed by the converging lens

$q =$ __________cm

This image created by the converging lens, becomes the object for the diverging lens. Next, measure the distance between the two lenses.

Distance between the two lenses, $d =$ __________ cm

The 'new' object distance *p'*, respect to the diverging lens, is given by the difference between the two distances just calculate:

$p' = q - d =$ __________ cm

Measure the distance between the screen and the diverging lens, $q' =$ __________

Finally, using the thin lens equation for *p', q'* and *f'*, find the focal length of the diverging lens

$$\frac{1}{p'} + \frac{1}{q'} = \frac{1}{f'}$$

(NOTE: in the eq. above *p'* has to be negative since the image formed by the converging lens in behind the diverging lens)

Focal length = ______________ cm

TURN OFF the light source.