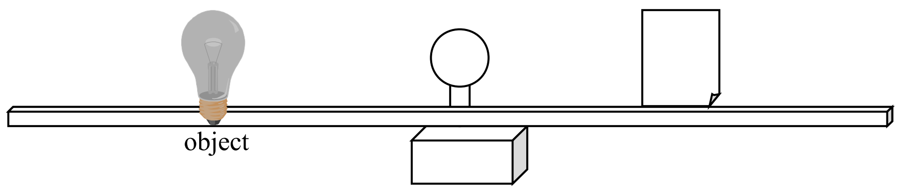
CONVEX LENSES

Name_______________

How accurately does the lens equation predict the location of the image formed by a converging (convex) lens? The equation will predict the location of an image if both the distance of object to lens and focal length of the lens are known. However, the equation is based on the assumption that "thin" (very thin!) lenses are being used. In this experiment, you will determine the focal length of a magnifying lens; then an object will be placed at several locations and images will be both calculated and experimentally determined.



PROCEDURES:

1. Begin by measuring the focal length of the convex lens. Take the lens and a screen to a window and try to obtain an image of an object from across the road on your screen. Record the distance from lens to image as the ***theoretical focal length.***

   theoretical focal length =______ cm

2. Position the light source (object) at a distance from the lens safely > 2 times the focal length. Place the screen on the optical bench (meter stick!) and move it to locate a clear image of the object. Record your values for d_{i} and d_{o} in the data table and complete row 1 of the table in its entirety.

3. Repeat this procedure, moving the source to the various locations asked of you in the data table, and determine each image experimentally. WARNING: Not all images, if they exist at all, are real!

The focal length (column 4 in data table) is to be calculated using the lens equation. DO THIS NOW before proceeding with #4.

DATA TABLE:

OBJECT LOCATION	OBJECT DISTANCE (cm)	IMAGE DISTANCE (cm)	FOCAL LENGTH (cm)	IMAGE POSITION (in terms of f)	LARGER Or SMALLER?	UPRIGHT Or INVERTED?	REAL Or VIRTUAL?
Object > 2f							
Object @ 2f							
Object b/w 2f and f							
Object @ f			*N.A.*				
Object < f			*N.A.*				

4. Place the convex lens on the table and turn the spherometer needle down until you *just* make contact with the center of the lens. Next, bring the device to the tabletop and lower the screw as needed to bring all four points into gentle contact with the surface. Record the # of revolutions of the screw needed to accomplish this.

   # of revolutions = ______

Each complete revolution lowers the screw by 0.05 cm so determine by how much the screw was lowered in the process above. Call this "**h**". h = ______cm

Let "**X**" be the distance measured between center post of the spherometer and the support legs **in centimeters**. X = ______cm

Then the radius of the sphere can be calculated as follows:

$$\mathbf{R = (x^2 + h^2)/2h}$$

Now use the *lens makers' equation* to determine the focal length of the lens.

$\mathbf{1/f = (n-1)*(2/R)}$ where n =1.52 (index of refraction of glass)

Show all work here.

RESULTS:

1. Compute the percent error between each focal length in rows 1-3 determined in the data table and the focal length from the *lens maker's equation*. Be sure to show one sample calculation.

2. Why is the image of an object <u>very far</u> away located close to the focal point? (Think ray rule #1!)

3. Where must an object be placed in front of a converging lens to produce a virtual image?

4. What device is a practical illustration of a converging lens being used when the object is between f and 2f? What device uses an object between f and a converging lens? CHOICES: overhead projector, camera, and magnifying glass.

5. What happens to the size of the image as the object is brought closer to the lens? (Look at your results!)