FOCAL LENGTH OF LENSES

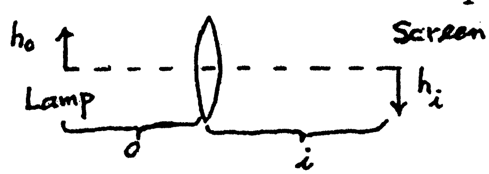
OBJECTIVE: To measure the focal length of convex (positive or convergent) lenses and concave (negative or divergent) lenses.

APPARATUS: Optical bench, lens holders, screen, illuminated object (lamp) convex lenses, concave lenses

THEORY: The lens equation $(1/o)+(1/i)=(1/f)$ holds both for convex and concave lenses, and for real and virtual objects and images. o is object-to-lens distance, i is image-to-lens distance, f is focal length of lens. Magnification M is $h_i/h_o = i/o$, where h_i is image size, h_o is object size.

PROCEDURE FOR CONVEX LENS:

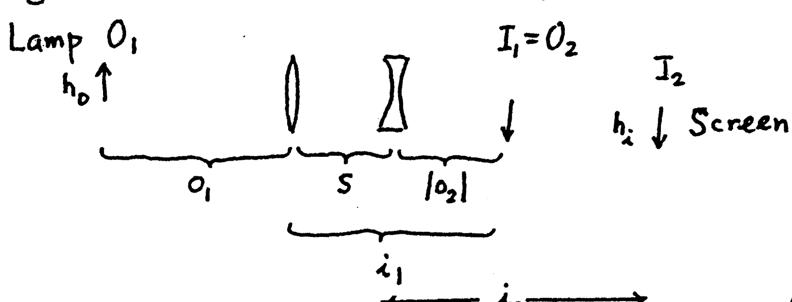
1. Place the lamp and screen on the optical bench about 40 cm apart. Place the convex lens in between the lamp and the screen. Adjust the lens position until a sharp image is formed on the screen. Record object distance o, image distance i, object size h_o (size of arrow on lamp) and image size h_i (size of inverted arrow on screen). You will find two positions of the lens for which sharp images are produced. Use the lens equation to calculate focal length f. Calculate M from h_i/h_o and from i/o. You should obtain comparable values.



2. Repeat the above procedure for other distances between the lamp and the screen.

PROCEDURE FOR CONCAVE LENS:

Since a concave lens does not form a real image, it is necessary to use an additional convex lens with known focal length f_1. The focal length of concave lens will be denoted as f_2. (f_1 is positive; f_2 is negative). When a sharp image is observed on the screen, record the distances o_1, s, i_2 Also, record the object size h_o (size of arrow on lamp) and image size h_i (image size of arrow on screen). Calculate $M=h_i/h_o$.



First image (I_1) is same as second object (O_2).

$(1/o_1)+(1/i_1)=1/f_1$

$(1/o_2)+(1/i_2)=1/f_2$

$o_2=s-i_1$ o_2 is negative!

Compare M with $(i_1/o_1)(i_2/o_2)$.

2. Repeat the above procedure for other distances.