Lab #5
Converging Lenses and Mirrors

Objectives

The objective of this lab is to study the images formed by convex lenses and concave mirrors and to determine experimentally their focal lengths.

Theory

Serway sections 36.2 and 36.4 should be read previous to this lab. In this section we only summarize the different symbols used:

p : object distance

q : image distance

f : focal length

h : height of the object

h' : height of the image

$M = h'/h$: magnification

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

Part A
Convex lens

Procedure

To take advantage of the full length of the optical bench, it is advisable to place the object at one extremity and leave it there, and to vary distances by moving the lens and the screen. As we shall deal with real images only, the lens will always lie between the object and the screen.

Place the screen at the end of the bench, opposite the object, and move the lens until you obtain the sharpest image. Measure p, q, h, h'. Move the lens until you obtain another sharp image, measure p, q, h, h' again.

If the initial set of results is p_1 and q_1, and the second set is p_2 and q_2, check that $p_1 = q_2$ and $p_2 = q_1$. This pair of images, where p and q are interchanged, is called "conjugate image pair".

Move the screen closer to the object, and repeat, at least 3 more times, for a total of eight images.

Also locate the special case where $p = q$

Analysis

a) Plot p as a function of q. What type of function is this?

b) Transform the variables p and q in order to get a linear relationship. What do the intercepts represent? Is the slope what you expected? Explain.

c) From the special case, where $p = q$, verify that $p = q = 2f$.

d) Calculate the magnification ($M = h'/h$) for each image. Plot M as a function of q/p, find the slope and compare it to theory.

Part B
Spherical concave mirror

Using a similar method, show the validity of the mirror equation, and determine as precisely as possible the focal length of a concave mirror.