PHY 157
Images with a Concave Mirror
(Experiment 8)

Names of Group Members: ______________________________

1 Introduction

In this lab you will observe the reflection of light rays by a concave mirror and draw the paths of selected rays using ray tracing techniques.

A light box will be used to produce light rays that will be directed toward the mirror. The behavior of the rays can be observed and the rays can be marked with a pencil and then drawn to show their path.

2 Apparatus

- Light box
- Ray slits
- Centimeter ruler
- White paper
- Light box power supply
- Optical shapes

- Protractor
- Night light

Note: The light ray box will get hot. Use care when touching it. To mark the path of a light ray, use the old maxim "*two points determine a straight line*". Mark a small dot at the center of a ray at two points: one point near the optical surface and the other point farther away. Use a straightedge to draw the ray.

This experiment does not have a separate analysis section. *Read through the procedure before starting so that you can plan ahead and include all the drawing, calculations, and comments on the same side of the paper.* You will submit one report for your group.

3 Procedure

Select the concave mirror with the *smallest* radius and direct three parallel rays into the center of the *concave* surface. Notice that the reflected rays intersect at a point. This point is the **focal point** of the concave mirror.

1. **Focal Length.**

   (a) Trace the reflecting surface of the mirror on the paper and mark the incident and reflected rays. Remove the mirror and draw the rays. Measure and record the distance between the focal point and the mirror. This is the **focal length** f of the mirror:

   f (measured) = ______________________

   (b) Since the mirror is essentially a hemisphere, you can estimate its diameter and determine its radius of curvature R. Do so and record the results:

   R = ______________________

   In theory, the focal length of a circular mirror is ½ its radius of curvature. How will does your measurement agree with theory? ______________________

2. **Image Position.**

   (a) Trace the reflecting surface at a new position on your paper. Place a dot about 8 cm in front of the mirror along its axis and imagine this dot to be an *object point*. Label it as **O**. Then direct a single ray through this point toward the mirror and *mark the reflected ray*. Repeat for two other rays, but keep the rays near the axis of the mirror.

(b) Draw all three reflected rays and determine where they meet. This is the *image point* of the object point. Label it as **I**. Is the image behind the mirror or in front of the mirror? ______________________

(c) Measure and record the distance of the object **O** from the mirror (along the axis of the mirror) (d_o). Do the same for the image **I** (d_i):

d_o = ______________________

d_i = ______________________

Theory predicts that

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}, \tag{1}$$

where d_o is the object distance, d_i is the image distance, and f is the focal length. Use your measured image and object distances in this expression to obtain a value for the focal length f of the mirror:

f (theory) = ______________________

How well does this value match the measured value you found earlier?

____