LAB 12
Mirrors

OBJECTIVES

(1) Explore the properties of the three types of mirrors.
(2) Study how light rays are reflected and determine the focal length and radius of curvature of the different types of mirrors.
(3) Experimentally identify whether an image is real or virtual, inverted or upright, and magnified or reduced.
(4) Experimentally measure the image distance and verify the mirror equation.

EQUIPMENT

Light ray box, plane and curved mirrors, protractor, compass, ruler, optical bench.

PROCEDURE

Part 1: Reflection from Plane Mirrors

(1) Placed the ray box on the white sheet of paper on the lab bench. Adjust the box so one light ray is showing. Place the mirror on the table and position the mirror at an angle to the ray so that the incident and reflected rays are clearly seen.

(2) Mark the position of the surface of the plane mirror and trace the incident and reflected rays. Be sure to draw the normal to the surface.

(3) Measure the angle of incidence θ_i and the angle of reflection θ_r. Repeat this procedure for a total of three different incident angles and place all of your data into one table. How do they compare?

Part 2: Reflection from Curved Mirrors

(4) Repeat steps (1) through (3) for the concave mirror.

(5) Using five white rays from the ray box, shine the rays straight into the concave mirror so the light is reflected back toward the ray box. Draw the surface of the mirror and trace the incident and reflected rays.

(6) The place where the five reflected rays cross each other is the focal point of the mirror. Measure the focal length f_{expt} from the center of the concave mirror surface to the focal point.

(7) Use a compass to draw a circle that matches the curvature of the mirror. Measure the radius of curvature using a ruler.

(8) Compare the relationship between the focal length of the spherical mirror and its radius of curvature: $f = \frac{1}{2} R$. Use a percent difference to make your comparison. How they compare?

(9) Repeat steps (4) through (8) for the convex mirror.

Part 3: Plane Mirror

(10) Stand with the toes of your shoes even with tape on the floor and look at your image in the plane mirror, then have your partner stand behind and to the side of the mirror so that their toes are *right next to the image of your toes*. Measure the object distance (from the mirror to your toes) and the image distance (from the mirror to your partner's toes). Swap places with your partner and repeat the image distance measurements so you have at least two measured values. *Is your data consistent with the prediction that the object and image distances are equal?*

- *How does the height of your image compare with your actual height (use your partner's height to estimate your image height)?*
- *Is this an example of a real or virtual image? How can you tell?*
- *What is the magnification?*
- *Is the image inverted or not?*

Part 4: Converging (Concave) Mirror

(11) Pick a very distant object and form a sharp image of it on the half screen. Describe the image characteristics (i.e., real or virtual, inverted or upright, magnified or reduced).

(12) The position of the image of a very distant object (for which the incoming light rays are parallel) is called the focal point. Find the focal length f of the mirror by measuring the distance from the center of the mirror to this focal point image.

(13) Mount the light source so it is a distance of $3.0f$ from the mirror. Use your measured value of f in the mirror equation to predict the image distance and the magnification of the image.

(14) Use a screen to find the image experimentally and compare the measured distance and the magnification with your predictions.

(15) Draw an accurate ray diagram of this optical system.

(16) Repeat steps (13) and (14) with the light source a distance of $2.5f$ from the mirror.

(17) Repeat steps (13) and (14) with the light source a distance of $1.75f$ from the mirror.