# Reflection of Light—Plane Mirrors

**Purpose:** To trace light rays as they reflect from a plane mirror and draw conclusions about the law of reflection.
To observe multiple reflections of light as light rays reflect from plane mirrors inclined at an angle with respect to each other.

**Equipment:** plane mirrors, mirror holders, flat cardboard, 2 backstops, protractor, cm ruler, pins, laser pointer, laser tripod, wood blocks (for elevating flat cardboard)

**Introduction:** The law of reflection simply states that the angle of incidence for a light ray coming into a reflecting surface (such as a mirror) is equal to the angle of reflection. These angles are measured with respect to a line perpendicular to the reflecting surface (often called the normal to the surface) as shown in Figure 1.

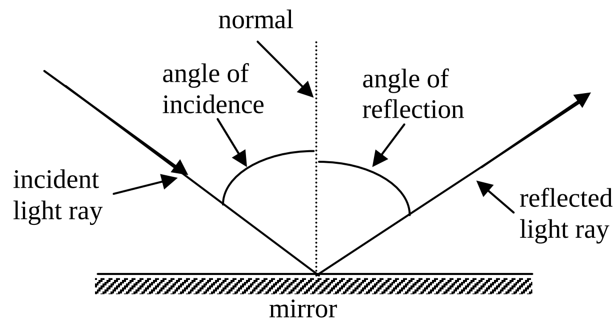


**Figure 1**

**Note: You will be using a low power laser in this experiment that requires some caution in its use. ALWAYS keep the laser on the table top when in operation and be aware of the where the laser is pointed before turning it on. NEVER look directly into the laser beam since eye damage could result.. Be sure that your backstop is in place to prevent the beam from travelling outside your experimental area.**

**Procedure:**

1. Tape a blank white sheet of paper onto the flat cardboard and set the cardboard on the wood blocks to raise your paper a few centimeters above the lab table. Place the plane mirror in its holder near the center of the paper. Using a sharp pencil draw a line on the paper along the back side of the mirror using the mirror as a straight edge. For the rest of the experiment the mirror should remain along this line that you just drew.
2. Place a straight pin into the paper about 10 cm from the mirror and perhaps 5 cm to the right of the center of the mirror (see Figure 2). Be sure that the pin is as nearly vertical as possible. Label the location of the pin "O" on your paper.
3. Set the backstops in place as shown in Figure 2 and be sure that the laser beam cannot travel beyond the immediate area of your experiment (See above Note). Place the laser as shown in Figure 2 and adjust its height so that the beam skims along the surface of your paper. The beam should intersect the pin at O and reflect off of the mirror. Place a second pin into the cardboard in the path of the reflected ray (point $P_1$). With your pencil, mark on your paper the point ($Q_1$) below where the laser beam strikes the mirror.

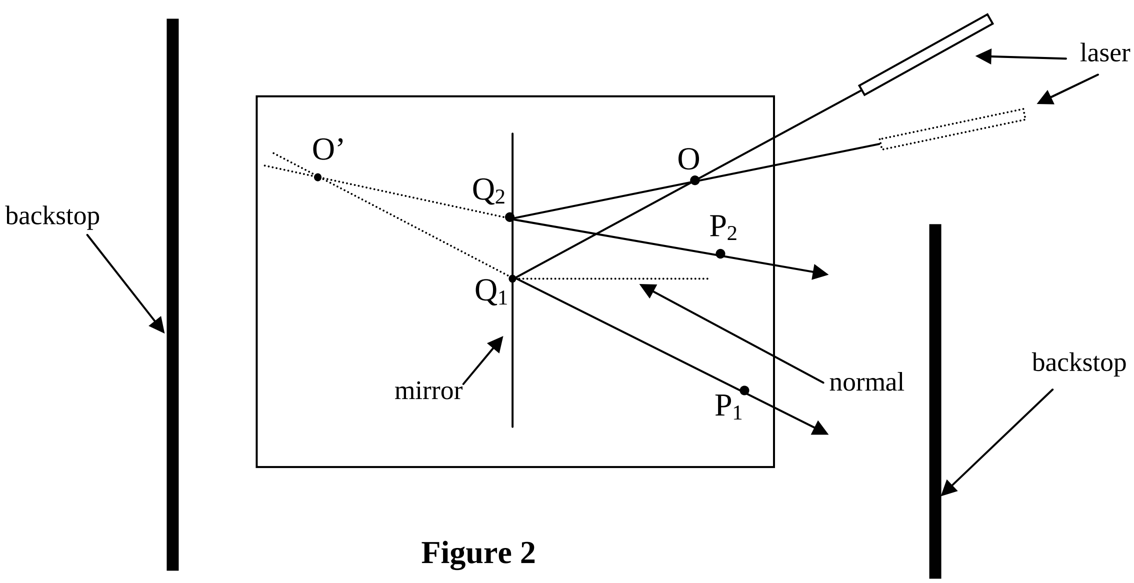


**Figure 2**

4. Without moving the pin at O, shift the laser's position so that the beam passes across this pin in a slightly different direction (again see Figure 2). Repeating the procedure of part 3 above, locate and mark points $P_2$ and $Q_2$. If time permits, repeat this procedure one more time and locate points $P_3$ and $Q_3$.
5. Turn off the laser and remove the mirror from your paper sheet. Using a straight edge, draw lines from O to Q to P for each of your light rays. Put an arrow on each ray to show the direction of its travel. Draw a perpendicular dashed line (the normal) that is perpendicular to the mirror surface at each point Q on your paper.
6. Using a protractor measure the angle of incidence and the angle of reflection for each light ray. Calculate the percent difference between the angle of incidence and the angle of reflection each light ray and record all numbers in the data table.

| Light Ray | Angle of Incidence (deg) | Angle of Reflection (deg) | Percent Difference |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |

7. Notice on your sheet the line QP. Extend each of these lines (use a dashed line) back behind the mirror to a point where they intersect (see Figure 2). Label this point O'. This is the point where all reflected light rays appear to originate. We call this point the image of the object at O.
8. Measure the shortest distance from O to the mirror and call this the object distance. Measure the shortest distance from O' to the mirror and call this the image distance. Find the percent difference between the two distances and record this information in the table below:

| Object distance (cm) | Image distance (cm) | Percent Difference |
|---|---|---|
| | | |

**Questions**:

How well do the results of your experiment validate the law of reflection? Discuss any sources of error that you can think of.

What conclusion can you draw concerning the image distance compared with the object distance when dealing with reflections in a plane mirror? Discuss sources of error.

Suppose you wanted to see your complete reflection in a plane mirror mounted on a wall. What minimum length does the mirror have to be in order to see your entire reflection? **Hint:** On a separate sheet of paper make a light ray diagram like you did for this experiment and show a light ray that comes from the top of your head to the mirror and then to your eyes. Similarly, draw another ray that leaves from your feet and arrives at your eyes.