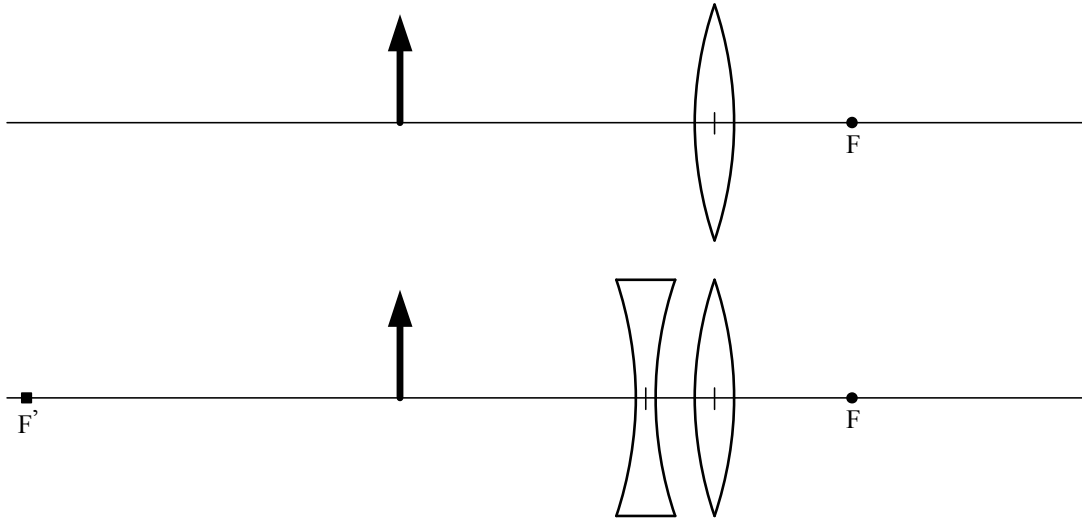# Lenses and Mirrors

Name_____ ID_____ TA_____

Partners_____

Date_____ Section_____

Please do not scratch the surface of the mirror.

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1. **Application of geometrical optics:**

2. **Real and virtual images:**

One easy method to find out whether the image is real or virtual is to find out whether you can obtain the image on a screen or not. If you have the image on the screen, it is called the real image. The virtual images cannot be seen on a screen.

☑ **Convex lens**
   What images do you obtain by illuminating a light source, only real, only virtual, or both images?

☑ **Concave lens**
   What images do you obtain by illuminating a light source, only real, only virtual, or both images?

Think about your daily life. A convex lens is used as a magnifying lens or a lens for farsightedness. A concave lens is a lens for nearsightedness,

3. The verification of the basic optics equations:

☑ **Plane mirrors**

	Angle of Incidence, θ_i	Angle of Reflection, θ_r
1		
2		

Are angles of incidence and reflection close each other?

☑ **Concave mirrors**

Focal length, f	Radius of curvature using compass, R

Does the equation $R = 2f$ hold from your experiment?

How about a convex mirror? How do you obtain the focal length?

☑ **Convex lens**

	The distance between lens and light source	Focal length of the convex lens
1		
2		

Does the focal length depend on the distance between lens and light source?

Design an experiment where you obtain the focal length of concave lens.

Lab Procedure for Lenses and Mirrors

Before you leave the lab, please show the results to TA.

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1. **Application of geometrical optics**

- **The TA will show you how to draw the light-ray lines. Then you will apply it to the pictures on the data sheet.**
  The purpose of this lab is to teach you an application of lenses. This is how a lens for nearsightedness works.

- **For people who like a challenge, you can think about the case for farsightedness.**
  For this, you have to use a convex lens.

2. **Real and virtual images**
- **Take the light source and mirrors and lenses.**

- **Use the wall to project the images.**
  Follow the data sheet. Using trial and error, find if the image is a real or virtual image.

3. **The verification of the basic optics equations**

- **Place the ray box, label side up, on a white sheet of paper on the table. Adjust the light box so one white ray is showing.**

- **Place the mirror on the table and position the plane surface of the mirror at an angle to the ray so that both the incident and reflected rays are clearly seen.**

- **Mark the position of the surface of the plane mirror and trace the incident and reflected rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.**

- **On the paper, draw the normal to the surface as follows.**
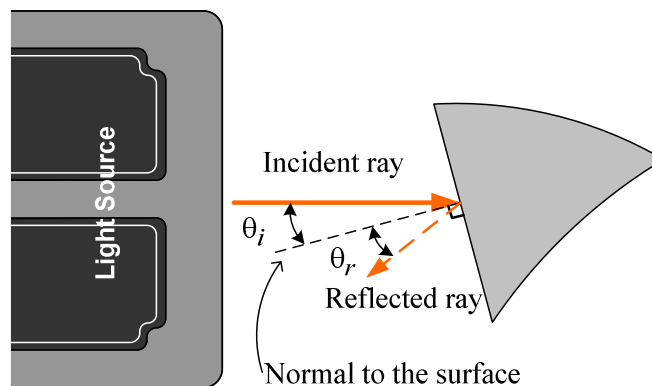
- **Measure the angle of incidence (θ_i) and the angle of reflection (θ_r). Both of these angles should be measured from the normal of the surface. Record these angles in your data sheet.**

- **A concave mirror will focus the incoming parallel rays of at the focal point. The radius of curvature of the mirror is twice the focal length.**

Radius of curvature

Mirror set

Focal point
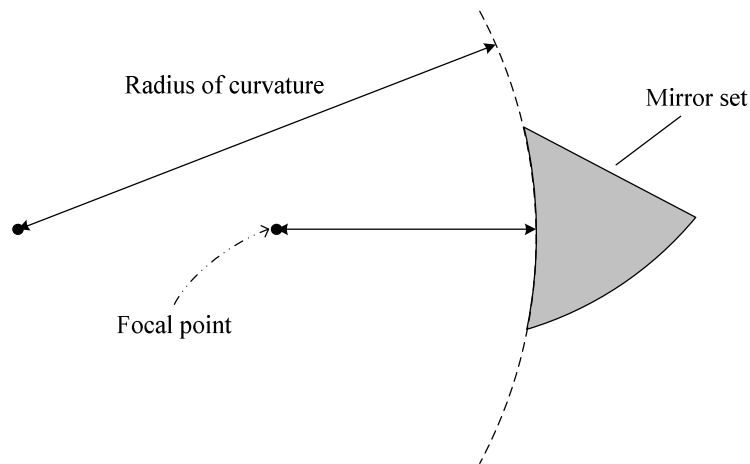
- **Using five white rays from the ray box, shine the rays straight into the concave mirror so the light is reflected back toward the ray box. Draw the surface of the mirror and trace the incident and reflected rays. Indicate the incoming and outgoing with arrows in the appropriate directions.**

Light Source
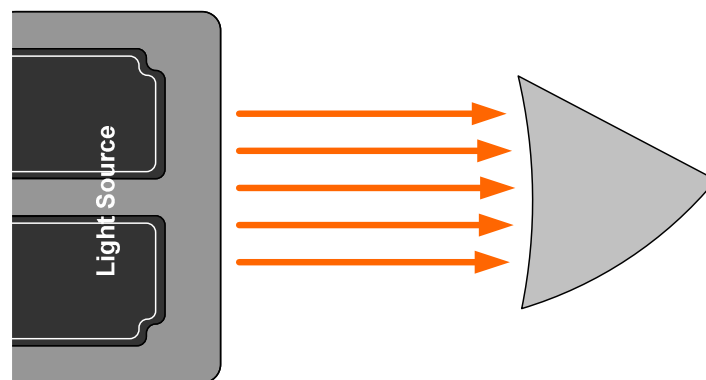
- **The place where the five reflected rays cross each other is the focal point of the mirror. Measure the focal length from the center of the concave mirror's surface to the focal point. Record your result in your data sheet.**

- **Use the compass to draw a circle that matches the curvature of the mirror. Measure the radius of the curvature using a ruler and record it in your data sheet.**

- **Place the ray box on a white place of paper. Using the five white rays from the ray box, shine the rays straight into the convex lens.**

- **Trace around the surface of the lens and trace the incident and transmitted rays. Indicate the incoming and outgoing rays with arrows in the appropriate directions. With the lens removed, mark the center of the lens.**

- **The place where the five rays cross each other is the focal point of the lens. Rather than an ideal mathematical point, you may see the fuzzy interval around where the focal point should be. Mark the boundaries of this interval to set your limits on the uncertainty and take the center of the interval to be your focal point. Measure the focal length from the center of the lens to the focal point and determine its uncertainty. Record your result in your data sheet.**

- **Choose a new distance and repeat the above step one more time to see if the focal point changes.**