**The Calculator Pad – Reflection and Mirrors**

From <http://www.physicsclassroom.com/calcpad/refln/problems.cfm>

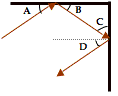
**Problem 1:**

aa. A light ray approaches a mirror at an angle of incidence of 25°. What is the angle of reflection?

**Problem 2:**

aa. A light ray approaches a mirror at an angle of 22° with the mirror surface. What is the angle of reflection of this light ray?

**Problem 3:**

aa. In a physics lab, Ray Zuvlite arranges two mirrors with a right angle orientation as shown. Ray then directs a laser line at one of the mirrors. The light reflects off both mirrors as shown. If angle A is 38°, then what is the angle measure of angles B, C, and D?

**Problem 4:**

aa. Anna Litical is doing the Plane Mirror Lab in physics class. She places a pin a distance of 4.9 cm from a plane mirror. How far behind the mirror can the image be expected to appear?

**Problem 5:**

aa. Baldwin Young stands 68 cm from his dresser mirror, inspecting his scalp. How far is the image of his scalp located from his scalp?

**Problem 6:**

aa. A meter stick (object) is placed in an upright position in front of a plane mirror as shown in the diagram at the right. The image of the meter stick is equidistant from the mirror. Suppose that the meter stick is equipped with a working eyeball capable of viewing the top and the bottom of its image. The eyeball is located at the 90-cm mark on the meter stick. Using either a ray diagram or geometry, determine …

a. … the location of the intersection of the eye's line of sight with the mirror as the eyeball sights at the top of the image.

b. … the location of the intersection of the eye's line of sight with the mirror as the eyeball sights at the bottom of the image.

c. … the amount of mirror required by the meter stick to view the image.

**Problem 7:**

aa. A spherical concave mirror has a radius of curvature of +62 cm. What is the focal length of the mirror?

**Problem 8:**

aa. A decorative garden sphere has a diameter of 44 cm. The reflecting surface of the shiny sphere makes a great convex mirror. What is the focal point of the convex surface?

**Problem 9:**

aa. In a physics demonstration, a concave mirror having a 50.0 cm focal length is used to create images of a candle located at various locations along its principal axis. Beginning from a distance of several meters from the mirror, a candle is moved forward and its image is projected onto an opaque screen. Determine the image distances (distance from mirror to image) for object distances (distance from object to mirror) of …

a. … 125.0 cm

b. … 100.0 cm

c. … 75.0 cm

d. … 50.0 cm (Be careful with your math; the result is surprising.)

e. … 25.0 cm

**Problem 10:**

aa. Obtaining a large spherical mirror with a focal length of 0.654 m from the Physics Storeroom, Mr. H takes his last period class outside for a fascinating demo. A student volunteer holds the mirror at an angle such that the face of the mirror is directed towards the Sun - roughly 1.46x1011 m away. Mr. H then uses a piece of paper with George Washington's picture on it to focus the image of the sun on the sheet of paper. Before the paper engulfs in flames, a bright image of the sun can be seen on the paper. Use the mirror equation to calculate the distance from the mirror to the image of the sun.

**Problem 11:**

aa. Every morning Bob Gillette uses a shaving mirror with a focal length of 72 cm to view the image of his face. Supposing his face is 18 cm from the mirror, determine the image distance and the magnification of his face.

**Problem 12:**

aa. The infamous Chinese magician Foo Ling Yu places a 56-mm tall light bulb a distance of 124 cm from a spherical concave mirror with a focal length of 62 cm.

a. Determine the image distance and image height.

b. Describe the orientation and type of the image.

**Problem 13:**

aa. In a physics lab, Anna Litical and Noah Formula position a small night light bulb at several locations along the principal axis of a concave mirror. Using a note card, they locate the image of the light bulb. The mirror has a focal length of 32.0 cm. What image distances would you expect Anna and Noah to observe when the object is located at distances of …

a. … 85.3 cm from the mirror?

b. … 64.0 cm from the mirror?

c. … 48.1 cm from the mirror?

**Problem 14:**

aa. Ima Primpin uses a cosmetic mirror to magnify her eyelashes during the traditional morning painting session. Her 1.2-cm long eyelashes are magnified to 1.6 cm when placed 5.8 cm from the mirror.

a. Determine the image distance for such an upright image.

b. Determine the focal length of the mirror.

**Problem 15:**

aa. In the Fall of 2006, the [Sky Mirror sculpture](http://publicartfund.org/pafweb/projects/06/kapoor/kapoor-06.html) was opened in Rockefeller Center in New York City. Standing three stories tall and weighing 23 tons, its concave side faced the Rockefeller Center and its convex side faced Fifth Avenue.

a. A taxi on Fifth Avenue is located 38 m from the convex side of the sculpture and its image is one-fifth the size of the taxi. Determine the focal length of the mirror.

b. Estimate the image size and image distance of the 260-m tall Rockefeller Center if it is located an estimated distance of 95 meters from the concave mirror surface. Assume the focal length of the concave side is the same magnitude as the focal length of the convex side.

**Problem 16:**

aa. A convex spherical mirror has a focal point located a distance of 24.6 cm from the surface of the mirror. (You will have to decide for yourself whether f is + or -.)

a. Find the image distance (in cm) for an object distance of 76.8 cm.

b. Determine the magnification of this image.

**Problem 17:**

aa. A convenient store mounts a convex mirror in the corner of the store to serve as a security mirror and reduce the frequency of *five-finger discounts*. When Robin Storz is positioned a distance of 4.8 m from the mirror, her image is magnified by a factor of one-half. Determine the focal length of the mirror.

**Problem 18:**

aa. Kerry Uss is studying the convex side of her soup spoon. She notices that her 3.8-cm tall nose appears to be 1.2 cm tall when positioned a distance of 2.4 cm from the spoon.

a. Determine the image distance for this particular object distance.

b. Determine the focal length of the convex side of the spoon.

**Problem 19:**

aa. A large spherical mirror sculpture is constructed in the town square at Physicston, Illinois. The sculpture consists of a large sphere with a diameter of 24 meters that is coated with a reflecting material. A 1.8 meter tall photographer stands a distance of 38 m from the concave side of the sculpture and takes a picture. Determine the image distance and the magnification of the photographer.

**Problem 20:**

aa. Baxter Nachure lives in the country along Sinewave road. It is difficult to pull out of the driveway onto the road since the road is curved and trees prevent him from seeing around the corner. He recently installed a large convex mirror at one of the curves to give him a wider angle of view. It has a focal length of -1.54 meters. Determine the magnification of an oncoming car located 35.8 m from the mirror.

**Problem 21:**

aa. A virtual image is formed 26.9 cm from a concave mirror having a radius of curvature of 48.1 cm. Determine the object distance.

**Problem 22:**

aa. An 4.9-cm tall object is positioned 14.8 cm from a mirror. Determine the radius of curvature that the mirror must have in order to produce an upright image that is 7.2 cm tall?

**Problem 23:**

aa. A dentist uses a spherical mirror to produce an upright image of a patient's tooth that is magnified by a factor of 4.5 when placed 1.8 cm from the tooth.

a. What type of mirror - concave or convex - is being used?

b. What is the focal length of the mirror?

**Problem 24:**

aa. The real image produced by a concave mirror is observed to be six times larger than the object when the object is 34.2 cm in front of a mirror. Determine the radius of curvature of this mirror.

**Problem 25:**

aa. A shiny bauble (ornament) hangs on Mr. H's Christmas tree. The bauble has a radius of 4.8 cm. Matthew looks into the bauble and observes an image of his face which is one-eighth the size of his face. How far from the bauble is Matthew's face?

**Problem 26:**

aa. A child at an amusement park stands in front of a concave mirror with a focal length of 73.9 cm. With great amusement, the child holds her cotton candy close to the mirror and observes that its image is magnified by a factor of five. Determine the object distance that creates this magnification of five.