Image location can be predicted with the mirror equation

By looking at **Figure 11(a),** you can see that object distance, image distance, and radius of curvature are interdependent. If the object distance and radius of curvature of the mirror are known, you can predict where the image will appear. Alternatively, the radius of curvature of a mirror can be determined if you know where the image appears for a given object distance. The following equation relates object distance, *p,* image distance, *q,* and the radius of curvature, *R,* is called *the mirror equation.*

$$\frac{1}{p}+\frac{1}{q}=\frac{2}{R}$$

If the light bulb is placed very far from the mirror, the object distance, *p,* is great enough compared with *R* that $1/p$ is almost 0. In this case, *q* is almost $R/2$, so the image forms about halfway between the center of curvature and the center of the mirror's surface. The image point, as shown in **Figure 12(a)** and **(b),** is in this special case called the *focal point* of the mirror and is denoted by the capital letter *F.* Because the light rays are reversible, the reflected rays from a light source at the focal point will emerge parallel to each other and will not form an image.

For light emerging from a source very far away from a mirror, the light rays are essentially parallel to one another. In this case, an image forms at the focal point, *F,* and the image distance is called the *focal length,* denoted by the lowercase letter *f.* For a spherical mirror, the focal length is equal to half the radius of curvature of the mirror. The mirror equation can therefore be expressed in terms of the focal length.

MIRROR EQUATION

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$$

$$\frac{1}{\text{object distance}}+\frac{1}{\text{image distance}}=\frac{1}{\text{focal length}}$$

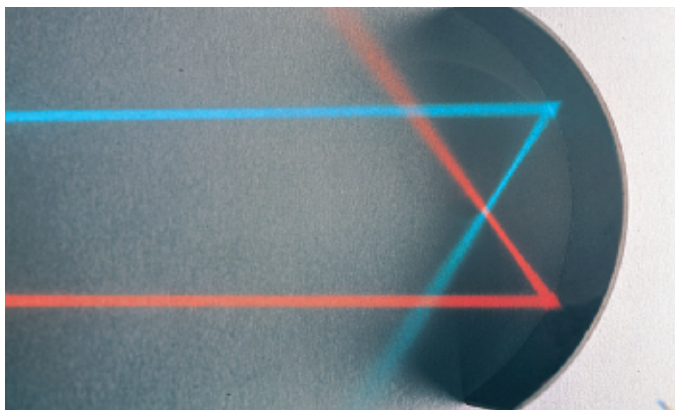
Quick Lab

Curved Mirrors

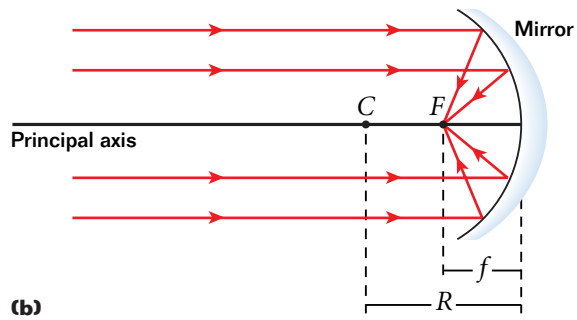
MATERIALS LIST

- **stainless-steel or silver spoon**
- **short pencil**

Observe the pencil's reflection in the inner portion of the spoon. Slowly move the spoon closer to the pencil. Note any changes in the appearance of the pencil's reflection. Repeat these steps using the other side of the spoon as the mirror.



(a)



(b)

Figure 12

Light rays that are parallel converge at a single point **(a),** which can be represented in a diagram **(b),** when the rays are assumed to be from a distant object ($p \approx \infty$).