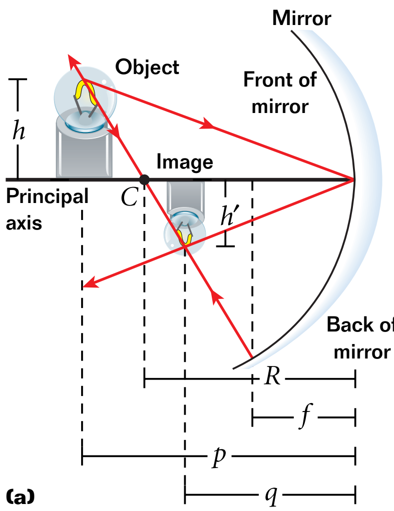
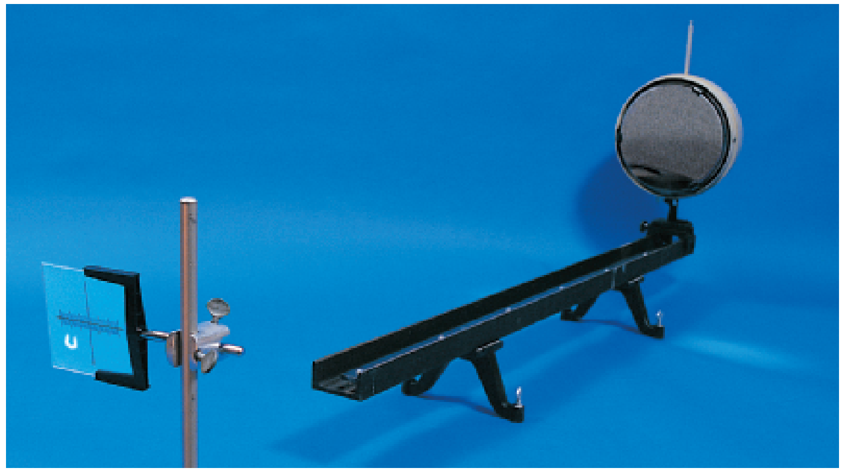


(a)



(b)

Figure 11
(a) The rays from an object, such as a light bulb, converge to form a real image in front of a concave mirror. **(b)** In this lab setup, the real image of a light-bulb filament appears on a glass plate in front of a concave mirror.

Imagine a light bulb placed upright at a distance *p* from a concave spherical mirror, as shown in **Figure 11(a).** The base of the bulb is along the mirror's principal axis, which is the line that extends infinitely from the center of the mirror's surface through the center of curvature, *C*. Light rays diverge from the light bulb, reflect from the mirror's surface, and converge at some distance, *q*, in front of the mirror. Because the light rays reflected by the mirror actually pass through the image point, which in this case is below the principal axis, the image forms in front of the mirror.

If you place a piece of paper at the image point, you will see on the paper a sharp and clear image of the light bulb. As you move the paper in either direction away from the image point, the rays diverge, and the image becomes unfocused. An image of this type is called a **real image.** Unlike the virtual images that appear behind a flat mirror, real images can be displayed on a surface, like the images on a movie screen. **Figure 11(b)** shows a real image of a light-bulb filament on a glass plate in front of a concave mirror. This light bulb itself is outside the photograph, to the left.

real image

an image that is formed by the intersection of light rays; a real image can be projected on a screen

Images created by spherical mirrors suffer from spherical aberration

As you draw ray diagrams, you may notice that certain rays do not exactly intersect at the image point. This phenomenon is particularly noticeable for rays that are far from the principal axis and for mirrors with a small radius of curvature. This situation, called *spherical aberration,* also occurs with real light rays and real spherical mirrors and will be discussed further at the end of this section when we introduce *parabolic mirrors.*

In the next pages of this section, you will learn about the mirror equation and ray diagrams. Both of these concepts are valid only for *paraxial rays,* but they do provide quite useful approximations. Paraxial rays are those light rays that are very near the principal axis of the mirror. We will assume that all of the rays used in our drawings and calculations with spherical mirrors are paraxial, even though they may not appear to be so in all of the diagrams accompanying the text.