Ray diagrams can be used for concave spherical mirrors

Ray diagrams are useful for checking values calculated from the mirror and magnification equations. The techniques for ray diagrams that were used to locate the image for an object in front of a flat mirror can also be used for concave spherical mirrors. When drawing ray diagrams for concave mirrors, follow the basic procedure for a flat mirror, but also measure all distances along the principal axis and mark the center of curvature, *C*, and the focal point, *F*. As with a flat mirror, draw the diagram to scale. For instance, if the object distance is 50 cm, you can draw the object distance as 5 cm.

For spherical mirrors, three reference rays are used to find the image point. The intersection of any *two* rays locates the image. The third ray should intersect at the same point and can be used to check the diagram. These reference rays are described in **Table 3.**

Table 3 Rules for Drawing Reference Rays

Ray	Line drawn from object to mirror	Line drawn from mirror to image after reflection
1	parallel to principal axis	through focal point *F*
2	through focal point *F*	parallel to principal axis
3	through center of curvature *C*	back along itself through *C*

The image distance in the diagram should agree with the value for *q* calculated from the mirror equation. However, the image distance may differ because of inaccuracies that arise from drawing the ray diagrams at a reduced scale and far from the principal axis. Ray diagrams should therefore be used to obtain *approximate* values only; they should not be relied on for the best quantitative results.

Concave mirrors can produce both real and virtual images

When an object is moved toward a concave spherical mirror, its image changes, as shown in **Table 4** on next page. If the object is very far from the mirror, the light rays converge very near the focal point, *F*, of the mirror and form an image there. For objects at a finite distance greater than the radius of curvature, *C*, the image is real, smaller than the object, inverted, and located between *C* and *F*. When the object is at *C*, the image is real, located at *C*, and inverted. For an object at *C*, the image is the same size as the object. If the object is located between *C* and *F*, the image will be real, inverted, larger than the object, and located outside of *C*. When the object is at the focal point, no image is formed. When the object lies between *F* and the mirror surface, the image forms again, but now it becomes virtual, upright, and larger.