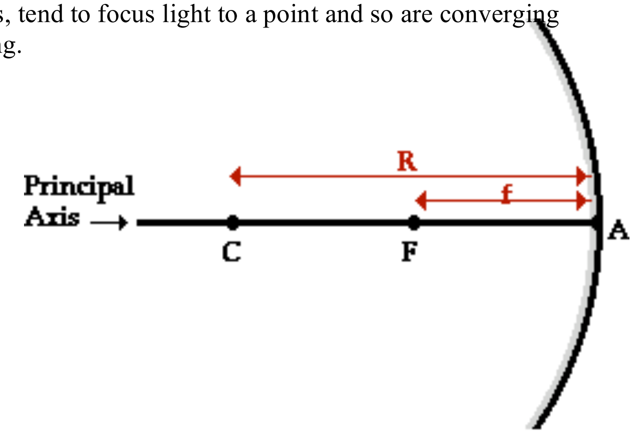
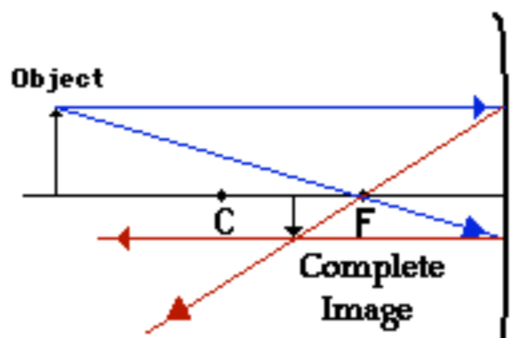
W10.04

Ray-Tracing Rules for Spherical Mirrors.

For mirrors, we use the law of reflection in order to determine the path that individual rays take from the object in order to form a real or virtual image. There are two types of spherical mirrors, **concave** and **convex.** Both are formed by cutting away a section of a sphere. Covcave mirrors are silvered on the inside and covex on the outside surface of the sphere. Cocave mirrors, like convex lenses, tend to focus light to a point and so are converging mirrors. Covex mirrors, like concave lenses, are diverging.

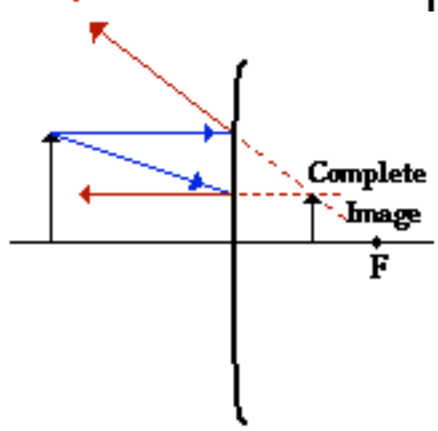


A concave mirror converges rays of light which are traveling parallel to its principal axis to a focal point at half its radius of curvature (the radius of the sphere from which the mirror has been cut). A convex mirror is a diverging mirror that spreads out rays of light which are traveling parallel to its principal axis.



Refraction Rules for a Converging Mirror

- Any incident ray traveling parallel to the principal axis of a converging mirror will reflect through the focal point.
- Any incident ray traveling through the focal point on the way to the mirror will reflect off the mirror and travel parallel to the principal axis.
- An incident ray that strikes the vertex will leave at the same angle on the other side of the principle axis.



Refraction Rules for a Diverging Mirror

- Any incident ray traveling parallel to the principal axis of a diverging mirror will reflect along the line that extends through the focal point.
- Any incident ray traveling towards the focal point on the way to the mirror will reflect along a line parallel to the principal axis.
- An incident ray that strikes the vertex will leave at the same angle on the other side of the principle axis.

As with lenses, mirror obey the equations:

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \text{ and } M = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

where f is the focal length, d_i is the image distance, d_o is the object distance, h_i is the image height, h_0 is the object height, and M is the magnification. The focal length is positive for converging and negative for diverging optics.

The above images are from http://www.physicsclassroom.com. This site has excellent tutorials on optics.

(over)

Sketch a ray diagram for the following lenses and complete the chart. (Note f>0 is converging; f<0 is diverging.)

f	d_o	h_o	d_i	h_i	Notes: (enlarged/reduced) (erect/inverted) (real/virtual)
+6	18	4			
+6	9	4			
+6	3	4			
+6	12	4			
+6	6	4			
-6	9	6			