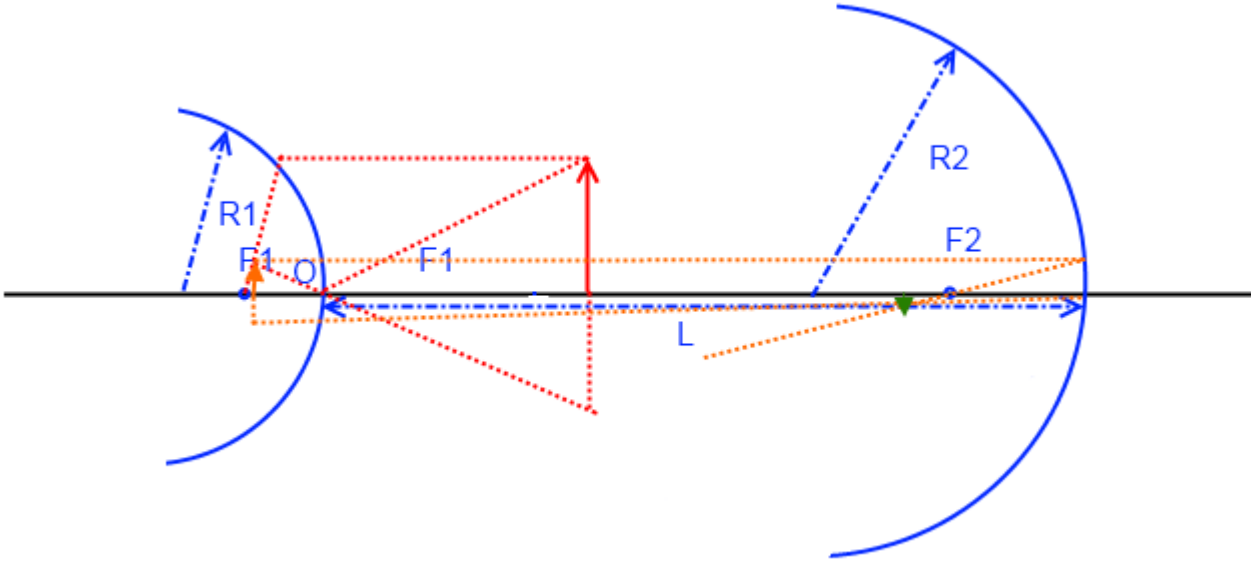
Two spherical mirrors of radii of curvature -20cm and +24cm are placed coaxially 41.33cm apart. An object is placed 20cm from the convex mirror. Find the nature and the position of the final image formed after reflection in the convex mirror, and then in the concave mirror.

Solution



For spherical mirrors radii of curvatures related to focal distance as:

$$R = 2F$$

Thus:

$$F_1 = \frac{R_1}{2}$$

$$F_2 = \frac{R_2}{2}$$

We are given:

$$R_1 = -20\ cm$$

$$R_2 = 24\ cm$$

So:

$$F_1 = -10\ cm$$

$$F_2 = 12\ cm$$

Using the Gaussian mirror equation: (http://en.wikipedia.org/wiki/Curved_mirror)

$$\frac{1}{d_0} + \frac{1}{d_i} = \frac{1}{F}$$

Take point O as the point of origin:

So for object (red arrow):

$$d_0 = 20\ cm$$

Substituting to mirror equation:

$$\frac{1}{20} + \frac{1}{d_i} = \frac{1}{-10}$$

$$\frac{1}{d_i} = -\frac{1}{10} - \frac{1}{20}$$

So, position of object's image in convex mirror (orange arrow) is

$$d_i \approx -6.6667\ cm$$

The magnification of a mirror is defined as the height of the image divided by the height of the object:

$$m_1 = \frac{h_i}{h_0} = -\frac{d_i}{d_0} = \frac{6.666667}{20} = \mathbf{\frac{1}{3}}$$

So image (orange arrow) is placed at

$$d_{o2} = 6.67 + 41.33 = \mathbf{48\ cm}$$

in front of second mirror

Using mirror equation for the second mirror:

$$\frac{1}{48} + \frac{1}{d_{i2}} = \frac{1}{12}$$

Thus image is placed at:

$$d_{i2} = \mathbf{16\ cm}$$

in front of concave mirror.

Magnification of concave mirror:

$$m_2 = -\frac{16}{48} = \mathbf{-\frac{1}{3}}$$

Thus, total magnification is:

$$m = m_1 * m_2 = -\frac{1}{3} * \frac{1}{3} = \mathbf{-\frac{1}{9}}$$

So final image (green arrow) will formed 16 cm from concave mirror, it is real, inversed and 9 times smaller than the object.