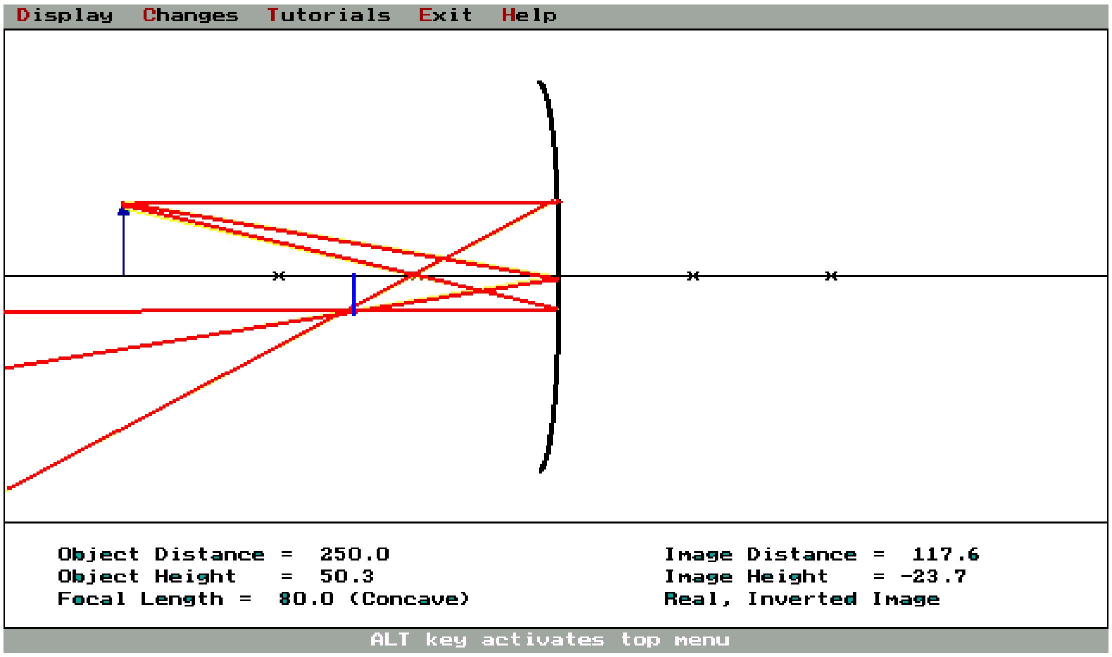
Exercises with GeoOptics - Introduction to Mirrors - Part I Concave Mirrors

Open GeoOptics and select Display - Mirror Diagram. Then use the Changes menu to set the object height, the object distance, and the focal length as shown in the figure below. The mirror starts as a concave mirror by default. Don't change that yet.

You're starting with the object outside of the center. Note that the magnification can be calculated from the distance ratio ($M = -d_i/d_o = -i/o$) or from the height ratio ($M = h_i/h_o$).



(This figure has been altered to show all three of the rays that can be used to find the image. All students are responsible for learning to draw, with the aid of a ruler, scale drawings like this one showing the so called parallel-focus and focus-parallel rays. The center reflection is not required. If you cannot identify each of these rays in the figure, then now is the time to learn.)

From this starting position determine the magnification when the object is at the following positions:

a) at the starting position $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

b) at the center, C $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

c) half-way between C and F $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

d) half-way between the mirror and F $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

Note that for concave mirrors the magnification, computed as $M = h_i/h_o$ or as $M = -d_i/d_o = -i/o$, is always negative when the object is outside the focal point and is always positive when the object is inside the focal point. The negative sign indicates that the image is inverted. When the image is upright, the magnification has a positive sign.

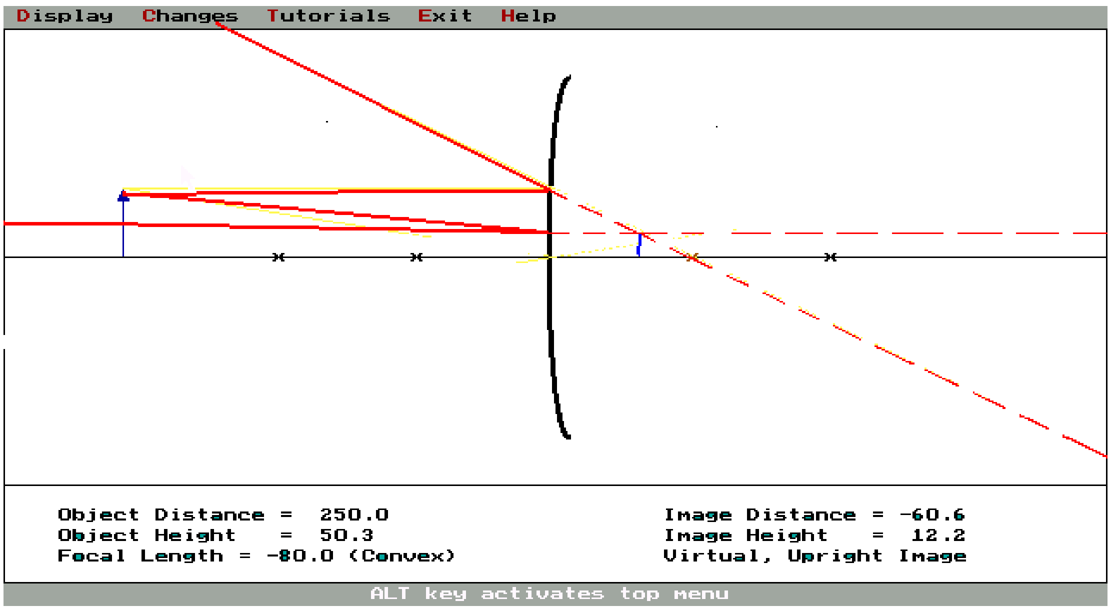
Activate the menu using the Alt key. You can change the focal length by typing the new focal length under the Changes menu. Do not attempt to use the mouse to move items on the screen. Under Windows XP the mouse will simply disappear. Use the letters or arrow keys with the menu instead of trying to use the mouse.

Exercises with GeoOptics - Introduction to Mirrors - Part II Convex Mirrors

Now change to a convex mirror using the Changes menu. Set the focal distance at –80.0. The center reflection ray has been erased from the figure below to make it easier to see the two main rays; the focus-parallel and parallel-focus rays, and the extensions of their reflected paths behind the mirror.

The image is located behind the mirror. It is upright and therefore virtual. Its magnification will be a positive number. On the other hand, because it is a virtual image, it cannot be projected on a screen. Only real images, which can only be formed by concave mirrors, are studied in the laboratory session.

Set the starting position of your convex mirror to match the heights and distances shown in the figure below.



(This figure has been altered to show only two of the rays that can be used to find the image. All students are responsible for learning to draw, with the aid of a ruler, scale drawings like this one showing the so called parallel-focus and focus-parallel rays, but not the center reflection ray. If you cannot identify these two rays on the figure, then now is the time to learn.)

From this starting position determine the magnification when the object is at the following positions:

a) at the starting position $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

b) at o = +160.0 $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

c) at o = +120.0 $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

d) at o = +80.0 $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

e) at o = +40.0 $M = h_i/h_o =$ ______ $= -d_i/d_o = -i/o =$ ______

The magnification, either the height ratio $M = h_i/h_o$ or the distance ratio $M = -d_i/d_o = -i/o$, is always positive for convex mirrors because the images are always virtual and upright. A positive Magnification indicates that the image is upright and upright images are always virtual.