Physics
Mirror Calculations

Name _____
Date _____

Variables:

d_o = object distance
d_i = image distance (negative if behind mirror)
h_o = object height
h_i = image height (negative if inverted)

Equations

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

Calculations with Concave Converging & Convex Diverging Mirrors

1. An object is 30.0 cm from a concave mirror of 15.0-cm focal length. The object is 1.8 cm high. Use the lens/mirror equation to answer the following:

   a) Where is the image located?

   $d_o = 30cm$, $f = 15\,cm$, $h_o = 1.8cm$, $d_i = ?$, $h_i = ?$

   $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

   $\frac{1}{15} = \frac{1}{30} + \frac{1}{d_i}$

   $\frac{1}{15} - \frac{1}{30} = \frac{1}{d_i}$

   $\frac{2}{30} - \frac{1}{30} = \frac{1}{d_i}$

   $\frac{1}{30} = \frac{1}{d_i}$

   $d_i = 30cm$

   b) How high is the image?

   $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$

   $\frac{h_i}{1.8} = \frac{-30}{30}$

   $\frac{h_i}{1.8} = -1$

   $h_i = -1.8cm$

   negative means inverted

2. An object is placed 25.0 cm away from a concave mirror that has a focal length of 5.00 cm.

   a) Where is the image located?

   $d_o = 25cm$, $f = 5\,cm$, $d_i = ?$

   $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

   $\frac{1}{5} = \frac{1}{25} + \frac{1}{d_i}$

   $\frac{1}{5} - \frac{1}{25} = \frac{1}{d_i}$

   $\frac{5}{25} - \frac{1}{25} = \frac{1}{d_i}$

   $\frac{4}{25} = \frac{1}{d_i}$

   $d_i = 6.25cm$

   b) If the object is 8.0 cm high, what is the height of the image?

   $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$

   $\frac{h_i}{8} = \frac{-(6.25)}{25}$

   $\frac{h_i}{8} = -0.25$

   $h_i = 2cm$

3. A convex security mirror in a warehouse has a radius of curvature of – 1.0 m. A 2.0-m-high forklift is 5.0 m from the mirror.

   $r = -1m \rightarrow f = -0.5cm$

   a) What is the location of the image?

   $f = -0.5m$, $h_o = 2m$, $d_o = 5.0m$, $d_i = ?$

   $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

   $\frac{1}{-0.5} = \frac{1}{5} + \frac{1}{d_i}$

   $\frac{1}{d_i} = \frac{1}{-0.5} - \frac{1}{5}$

   $\frac{1}{d_i} = -2.2$

   $d_i = -0.45m$

   b) What is the size of the image?

   $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$

   $\frac{h_i}{2} = \frac{-(-0.45)}{5}$

   $h_i = 0.18m$