Name _____ Pd _____

Concave Mirror Math

1. How far away from a concave mirror with focal length 15 cm should an 8 cm tall object be placed to form a real image 50 cm from the mirror? What would be the magnification of the image? Fully describe the image (type, orientation, height)

$f = 15\text{cm}$ $h_o = 8\text{cm}$ $d_i = 50\text{cm}$

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

$\frac{1}{15} = \frac{1}{d_o} + \frac{1}{50}$

$d_o = 21.43\text{cm}$

$M = \frac{-d_i}{d_o} = \frac{-50}{21.43} = -2.33$

$M = -2.33 = \frac{h_i}{h_o} = \frac{h_i}{8}$ $h_i = -18.64\text{cm}$

$d_o = 21.43\text{cm}$
$M = -2.33$
$h_i = -18.64\text{cm}$
Real
USD

2. A 2 cm tall bug is 20 cm from a concave mirror with focal length 30 cm. Fully describe the image (location, type, height, orientation).

$h_o = 2\text{cm}$
$d_o = 20\text{cm}$
$f = 30\text{cm}$

$\frac{1}{30} = \frac{1}{20} + \frac{1}{d_i}$ $d_i = -60$

$M = \frac{-d_i}{d_o} = \frac{-(-60)}{20} = +3 = \frac{h_i}{h_o}$

2cm → $h_i = +6\text{cm}$

$d_i = -60\text{cm}$
VIRTUAL
$h_i = +6\text{cm}$
RSU
$(M = +3)$

3. A 10 cm tall upright image appears to be located 40 cm behind a concave mirror with a radius of curvature of 1 m. Fully describe the object.

↑ vert $h_i = 10\text{cm}$
$d_i = -40\text{cm}$
$R = 1\text{m}$
$\frac{R}{2} = f = 50\text{cm}$

$\frac{1}{50} = \frac{1}{d_o} + \frac{1}{-40}$

$d_o = 22.22\text{cm}$

$\frac{-d_i}{d_o} = \frac{h_i}{h_o}$ $\frac{-(-40)}{22.22} = \frac{10}{h_o}$ $h_o = 5.56\text{cm}$

H is 5.56cm tall and 22.22cm in front of the mirror.

4. A concave mirror produces an image that is the same size as the object when the object is 60 cm from the mirror. What is the focal length of the mirror?

$M = -1$ → Only happens at R

$R = 60\text{cm}$ $f = 30\text{cm}$

5. Where should you place a candle in front of a concave mirror of focal length 45 cm to produce an inverted image that is half the size of the object?

$M = -.5$

$f = 45$

$M = \frac{-d_i}{d_o}$

$-.5 = \frac{-d_i}{d_o}$

$.5d_o = d_i$

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

$\frac{1}{45} = \frac{1}{d_o} + \frac{1}{.5d_o} = \frac{1}{d_o} + \frac{2}{d_o} = \frac{3}{d_o}$

$\frac{1}{45} = \frac{3}{d_o}$ $d_o = 135\text{cm}$

6. A concave mirror produces an upright image that is twice the size of the object when the object is 35 cm in front of the mirror. What is the focal length of the mirror.

$M = +2$ d_o

$M = \frac{-d_i}{d_o}$

$+2 = \frac{-d_i}{35}$

$d_i = -70\text{cm}$

$\frac{1}{f} = \frac{1}{35} + \frac{1}{-70}$

$f = 70\text{cm}$

7. Repeat the last problem, but assume the image was inverted instead of upright! (Well, only do this problem if it's possible...)

$M = -2$

$M = \frac{-d_i}{d_o}$

$-2 = \frac{-d_i}{d_o} = \frac{-d_i}{35}$

$-d_i = -70$

$d_i = 70\text{cm}$

$\frac{1}{f} = \frac{1}{35} + \frac{1}{70}$

$f = 23.33\text{cm}$