Name_____ Pd_____

The Problem with Lenses Is...

1. If you place a light bulb 50 cm in front of a converging lens with a focal length of 45 cm, where should you put a screen so that you'll see a focused image? What would be the magnification of the image? Is it real or virtual? What type of lens is being used?

$d_o = +50\text{ cm}$
$f' = +45\text{ cm}$
$d_i = ?$
$M = ?$

$\frac{1}{50} + \frac{1}{d_i} = \frac{1}{45}$

$M = \frac{-d_i}{d_o} = \frac{-450}{50}$

$d_i = +450\text{ cm}$
$M = -9$
Real
Convex

2. A 5 cm long ant produces a 10 cm long image when viewed through a convex lens of focal length 8 cm. How far is the ant from the lens? (Think carefully on this one!)

$h_o = +5\text{ cm}$
$h_i = +10\text{ cm}$
$f' = +8\text{ cm}$

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

$\frac{10}{5} = \frac{-d_i}{d_o} = 2$

$d_i = -2d_o$

$\frac{1}{d_o} - \frac{1}{2d_o} = \frac{1}{8}$

$\frac{2}{2d_o} - \frac{1}{2d_o} = \frac{1}{8} = \frac{1}{2d_o}$

$2d_o = 8$

$d_o = 4\text{ cm}$

3. An object and its image are the exact same size when the object is located 44 cm from the lens. What is the focal length of the lens?

at Radius R

$f' = +22\text{ cm}$

4. A diverging lens with a focal length of 10 cm reveals an image that appears to be on the same side of the lens as the object and 5 cm from the lens. How far from the lens is the original object? What will be the image's magnification?

$f' = -10\text{ cm}$
$d_i = -5\text{ cm}$
$d_o = ?$
$M = ?$

$\frac{1}{-10} = \frac{1}{d_o} + \frac{1}{-5}$

$d_o = +10\text{ cm}$

$M = \frac{-d_i}{d_o} = \frac{-(-5)}{10}$

$M = +.5$

5. Is there such a thing as a plane lens? What's another name for it if it exists? What's its focal length if it exists?

Yes; a sheet of glass; "$f = \infty$"

6. A Challenge Problem: Two lenses are 50 cm apart, and each lens has a focal length of 20 cm. An object is placed 80 cm in front of LENS 1, and the image produced by LENS 1 acts as the object for the LENS 2. Where will the final image from LENS 2 be located (as measured from LENS 2)? If the object is 12 cm tall, how tall is the final image? Is the final image real or virtual? Is it RSU or USD? Draw a quick sketch on the scale image below.

FIRST IMAGE:

$\frac{1}{20} = \frac{1}{80} + \frac{1}{d_i}$

$d_i = 26.67\text{ cm}$

$\frac{-d_i}{d_o} = \frac{h_i}{h_o}$ $\quad \frac{-26.67}{80} = \frac{h_i}{12}$

$h_i = -4\text{ cm}$

SECOND IMAGE:

$\frac{1}{20} = \frac{1}{23.33} + \frac{1}{d_i}$

$d_i = +140.1\text{ cm}$

$\frac{-d_i}{d_o} = \frac{h_i}{h_o}$ $\quad \frac{-140.1}{23.33} = \frac{h_i}{-4}$ $\quad h_i = +24.0\text{ cm}$