

1. C

2. B

3.  $f = 12.0\text{cm}$       $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$   
 $d_o = x$               $\frac{1}{12} = \frac{1}{64-x} + \frac{1}{x}$   
 $d_i = 64 - x$         $\frac{1}{12} = \frac{x + (64 - x)}{x(64 - x)}$   
 $\frac{1}{12} = \frac{64}{64x - x^2}$

Cross multiply

$$64x - x^2 = 768$$

$$64x - x^2 - 768 = 0$$

Multiply by -1

$$x^2 - 64x + 768 = 0$$

solve, I will complete the square

$$x^2 - 64x + 1024 = 256$$

$$(x - 32)^2 = 256$$

$$x - 32 = \pm 16$$

$$x = 32 + 16 = 48\text{cm}$$

$$x = 32 - 16 = 16\text{cm}$$

Answer: **16 cm** because the questions asks for a larger image and if we place the object at 16 cm, we will get a larger image (object between F and 2F).

4.  $f = 15.0\text{cm}$

$$h_o = 2.0\text{cm}$$

$$d_i = ?$$

$$M = 5$$

$$M = 5$$

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

$$d_i = -Md_o$$

$$d_i = -5d_o$$

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

$$\frac{1}{f} = \frac{5}{5d_o} - \frac{1}{5d_o}$$

$$\frac{1}{f} = \frac{4}{5d_o}$$

$$d_o = \frac{4f}{5}$$

$$d_o = \frac{4(15\text{cm})}{5}$$

$$d_o = 12\text{cm}$$

$$d_i = -5d_o$$

$$d_i = -5(12\text{cm})$$

$$d_i = -60\text{cm}$$

The object is 48 cm away from the image.

5.  $f = -10.0\text{cm}$

$h_o = 4.0\text{cm}$  a)

$d_o = 15.0$

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

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

$$\frac{1}{d_i} = \frac{1}{-10.0\text{cm}} - \frac{1}{15.0\text{cm}}$$

$$\frac{1}{d_i} = \frac{-3}{30.0\text{cm}} - \frac{2}{30.0\text{cm}}$$

$$\frac{1}{d_i} = \frac{-5}{30.0\text{cm}}$$

$$d_i = \frac{30.0\text{cm}}{-5}$$

$$d_o = -6.0\text{cm}$$

b)

The object is 9.0 cm away.

$$\begin{aligned}
6. \quad f &= ? & M &= -\frac{d_i}{d_o} \\
d_o &= 20\text{cm} & d_i &= -3(20\text{cm}) \\
M &= 3 & d_i &= -60\text{cm} \\
& & \frac{1}{f} &= \frac{1}{d_o} + \frac{1}{d_i} \\
& & \frac{1}{f} &= \frac{1}{20\text{cm}} + \frac{1}{-60\text{cm}} \\
& & \frac{1}{f} &= \frac{3}{60\text{cm}} - \frac{1}{60\text{cm}} \\
& & \frac{1}{f} &= \frac{2}{60\text{cm}} \\
& & f &= \frac{60\text{cm}}{2} = 30\text{cm}
\end{aligned}$$

$$\begin{aligned}
7. \quad f &= 50\text{cm} & M &= -\frac{d_i}{d_o} \\
h_o &= 10\text{cm} & d_i &= -Md_o \\
h_i &= 20\text{cm} & d_i &= -(-2)d_o \\
d_o &= ? & d_i &= 2d_o \\
M &= -2 & & \\
& & \frac{1}{f} &= \frac{1}{d_o} + \frac{1}{d_i} \\
& & \frac{1}{f} &= \frac{1}{d_o} + \frac{1}{2d_o} \\
& & \frac{1}{f} &= \frac{2}{2d_o} + \frac{1}{2d_o} \\
& & \frac{1}{f} &= \frac{3}{2d_o} \\
& & d_o &= \frac{3f}{2} = \frac{3(50\text{cm})}{2} = 75\text{cm}
\end{aligned}$$

$$\begin{aligned} 8. \quad f &= 10\text{cm} & M &= -\frac{d_i}{d_o} \\ M &= 5 & d_i &= -Md_o \\ d_i &= -5d_o & d_i &= -5d_o \end{aligned}$$

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

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

$$\frac{1}{f} = \frac{5}{5d_o} - \frac{1}{5d_o}$$

$$\frac{1}{f} = \frac{4}{5d_o}$$

$$d_o = \frac{4f}{5} = \frac{4(10\text{cm})}{5} = 8\text{cm}$$