Name: Key

Practice - 25.6 Image Formation by Lenses - Part 2

1. How far from the lens must the film in a camera ($d_i$) be, if the lens has a 35.0 mm focal length ($f$) and is being used to photograph a flower 75.0 cm away? ($d_o$)

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f} \Rightarrow d_i=\left(\frac{1}{f}-\frac{1}{d_o}\right)^{-1}=\left(\frac{1}{35.0\text{mm}}-\frac{1}{750\text{mm}}\right)^{-1}$$

$$=\boxed{36.7\text{mm}}=3.67\times10^{-2}\text{m}$$

2. A certain slide projector has a 100 mm focal length lens.

   A. How far away is the screen, if a slide is placed 103 mm from the lens and produces a sharp image?

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f} \Rightarrow d_i=\left(\frac{1}{f}-\frac{1}{d_o}\right)^{-1}=\left(\frac{1}{100\text{mm}}-\frac{1}{103\text{mm}}\right)^{-1}=3.43\times10^{3}\text{mm}$$

$$=\boxed{3.43\text{m}}$$

   B. If the slide is 24.0 by 36.0 mm, what are the dimensions of the image?

$$m=\frac{-d_i}{d_o}=\frac{-3.43\text{m}}{0.103\text{m}}=-33.3$$

$$24.0\text{mm}(33.3)\times36.0\text{mm}(33.3)=800\text{mm}\times1200\text{mm}$$

$$=\boxed{0.800\text{m}\times1.20\text{m}}$$

3. A magnifying glass produces a magnification of 3.00 when held 5.00 cm from an object, such as a rare coin.

   A. What is the focal length of the magnifying glass?

$$m=\frac{-d_i}{d_o}=3 \Rightarrow d_i=-3d_o \Rightarrow d_i=-3(5.00\text{cm})=-15.0\text{cm}$$

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f} \Rightarrow f=\left(\frac{1}{d_i}+\frac{1}{d_o}\right)^{-1}=\left(\frac{1}{-15.0\text{cm}}+\frac{1}{5.00\text{cm}}\right)^{-1}=\boxed{7.50\text{cm}}$$

   B. Calculate the power of the magnifier in diopters.

$$P=\frac{1}{f}=\frac{1}{7.50\times10^{-2}\text{m}}=\boxed{13.3\text{D}}$$

4. Suppose your 50.0 mm focal length camera lens is 51.0 mm away from the film in the camera.

A. How far away is an object that is in focus?

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f} \Rightarrow d_o=\left(\frac{1}{f}-\frac{1}{d_i}\right)^{-1}=\left(\frac{1}{50.0\text{mm}}-\frac{1}{51.0\text{mm}}\right)^{-1}=2.55\times10^{3}\text{mm}$$

$$=\boxed{2.55\text{m}}$$

B. What is the height of the object if its image is 2.00 cm high?

$$\frac{h_i}{h_o}=\frac{-d_i}{d_o} \Rightarrow h_o=-\frac{d_o h_i}{d_i}=-\frac{(2.55\text{m})(-2.00\times10^{-2}\text{m})}{51.0\times10^{-3}\text{m}}$$

$$=\boxed{1.00\text{m}}$$