Optics Problems

1. $v = \frac{c}{n_{diamond}} = \frac{3 \times 10^8 \text{ m/s}}{2.42} = 1.24 \times 10^8 \text{ m/s}$

2. $n_{glass} \sin\theta_i = n_{water} \sin\theta_r$

$1.52 \sin\theta_i = 1.33 \sin 35^\circ$

$\sin\theta_i = \frac{1.33 \sin 35^\circ}{1.52}$

$\theta_i = \sin^{-1}\left(\frac{1.33 \sin 35^\circ}{1.52}\right)$

$\theta_i = 30.1^\circ$

3. $n_{diamond} \sin\theta_i = n_{water}$

$\sin\theta_i = \frac{n_{H_2O}}{n_{diamond}}$

$\theta_i = \sin^{-1}\left(\frac{1.33}{2.42}\right) = 33.3^\circ$

4. $n_{air} \sin 40^\circ = n_? \sin 25^\circ$

$\frac{\sin 40^\circ}{\sin 25^\circ} = n_? = 1.52$ (a.) (Glass) (b.)

6. $n_{air} \sin 30^\circ = n_{glass} \sin\theta_r$

$\frac{\sin 30^\circ}{1.52} = \sin\theta_r$

$\sin^{-1}\left(\frac{\sin 30^\circ}{1.52}\right) = \theta_r = 19.2^\circ$

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

d_i f d_o

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

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

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?

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

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