Quiz 3

Name: _____

Total = 10 marks

1. (2 marks) Find the matrix describing the effect on paraxial rays of a dielectric interface shown below.

n_1 | n_2 *See lecture notes.*

2. (4 marks) Consider a glass lens of focal length of 10 cm measured when the lens is in air. Find the focal length when the lens is immersed in water.

From notes, for a lens with curved surface radii
R_1 & R_2 we found:

$$n_{med}\left(\frac{1}{S_0} + \frac{1}{S_i}\right) = (n - n_{med})\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\text{For } S_0 = \infty \Rightarrow S_i^{-1} = \frac{n - n_{med}}{n_{med}}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \equiv f^{-1}$$

$$\therefore f_{air}^{-1} = \frac{1.5 - 1}{1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \frac{1}{10} \Rightarrow \frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{5}.$$

$$\therefore f_{H_2O}^{-1} = \frac{1.5 - 1.33}{1.33} \cdot \frac{1}{5} = 0.026 \cdot \Rightarrow f_{H_2O} = 39 \text{ cm.}$$

3. (2 marks) Why are the leading research telescopes reflecting rather than refracting telescopes?

1. It is easier to make a mirror with 1 surface than a lens with 2 surfaces.

2. One does not need to worry about $n(\lambda)$ dependence of rays traversing through glass.

4. (2 marks) Explain with a diagram what is meant by astigmatism.

−different focal lengths for rays emanating from so called radial & tangential parts of object

See lecture notes.