

### Physics 1214, Homework #8: solutions

Answers to multiple choice questions: M1: B; M2: B; M3: B; M4: A,D.

$$\text{P1: } \sin \theta_a = n \sin 30^\circ = 0.84 \quad \theta_a = \arcsin(0.84) = 57.1^\circ \quad \theta = 2\theta_a = 114.2^\circ$$

$$\text{P2: } \sin \theta_b = \frac{\sin \theta_a}{n} = 0.5, \quad \theta_b = 30^\circ$$

$$d = s \sin(\theta_a - \theta_b) \quad s = \frac{h}{\cos \theta_b} \quad d = h \frac{\sin(\theta_a - \theta_b)}{\cos \theta_b} = 0.577 \text{ cm}$$

$$\text{P3: } m = -\frac{s'}{s} \quad s' = -ms \quad \frac{1}{s} - \frac{1}{ms} = \frac{1}{f} \quad s = f \left(1 - \frac{1}{m}\right) = 1.5 \text{ cm}$$

$$\text{P4: } \frac{1}{s_1} + \frac{1}{s'_1} = \frac{1}{f_1} \quad s'_1 = \frac{1}{\frac{1}{1 \text{ cm}} - \frac{1}{s_1}} = \frac{s_1}{s_1 - 1 \text{ cm}}$$

$$s'_1 + s_2 = d \quad s_2 = 2 \text{ cm} - s'_1 = \frac{s_1 - 2 \text{ cm}}{s_1 - 1 \text{ cm}}$$

$$\frac{1}{s_2} + \frac{1}{s'_2} = \frac{1}{f_2} \quad s'_2 = \frac{1}{\frac{1}{1 \text{ cm}} - \frac{1}{s_2}} = 2 \text{ cm} - s_1$$

The distance between the object and the image  $\Delta = s_1 + d + s'_2 = 4 \text{ cm}$  and does not depend on the object position.