General Physics II **Recitation Quiz 9 - Refraction, Mirrors, Lenses** **Mar. 24, 2010**

Name:

For full credit, make your work clear. Show the formulas you use, all the essential steps, and results with correct units and correct number of significant figures.

1(3). Rays of the Sun are seen to make a 30.0° angle to the vertical beneath the water. At what angle above the horizon is the Sun?

$$\frac{n_{water}}{n_{air}} = \frac{\sin\theta_{air}}{\sin\theta_{water}}; \qquad 1.33 = \frac{\sin\theta_{air}}{\sin 30.0^\circ}; \quad \theta_{air} = arcsin(1.33 \times 0.5) = 41.6^\circ$$

This is the angle to the vertical. The angle above the horizon is

$$\theta_{horizon} = 90^\circ - 41.6^\circ = 48.4^\circ$$

2 (4). A dentist wants a small mirror that, when 2.50 cm from a tooth, will produce a 5× upright image. What kind of mirror must be used and what must its radius of curvature be?

$$d_0 = 2.5 \text{ cm}; \quad m = -\frac{d_i}{d_o} = 5; \quad d_i = -2.5 \text{ cm} \times 5 = -12.5 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{2.5} - \frac{1}{12.5}; \quad f = 3.125 \text{ cm}; \quad r = 2f = 6.25 \text{ cm}$$

$f > 0$, therefore concave mirror

3. a (2). A certain lens focuses light from an object 4 m away as an image 50 cm on the other side of the lens. What type of lens is it and what is its focal length?

$$d_0 = 4 \text{ m}; \quad d_i = 0.5 \text{ m}; \quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{4} + \frac{1}{0.5};$$

$f = 44.4$ cm, $f > 0$, therefore converging lens

b(1). Is the image real or virtual?

Image behind the lens, therefore real

c(1). Is the image upright or inverted?

$m = -0.5/4 = -0.125 < 0$, therefore inverted

d(1). What is the magnification of the image?

$m = -0.5/4 = -0.125$