Physics 4C Ch 35, 36 Practice

Name: _____

Please show your work! Answers are not complete without clear reasoning. When asked for an expression, you must give your answer in terms of the variables given in the question and/or fundamental constants.

Answer as many questions as you can, in any order. Calculators are allowed. Books and notes are not allowed. Use any blank space to answer questions, but please make sure it is clear which question your answer refers to.

Trigonometric Identities

$\sin^2\theta + \cos^2\theta = 1$

$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$

$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$

$\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$

$\cos\alpha + \cos\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\cos\left(\frac{\alpha+\beta}{2}\right)$

$\sin\left(\theta + \frac{\pi}{2}\right) = \cos\theta$

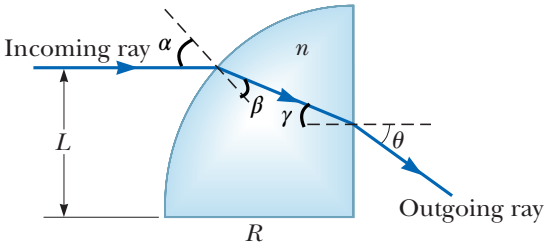
$\cos\left(\theta + \frac{\pi}{2}\right) = -\sin\theta$

1. **[10pts]** The distance between an object and its upright image is 18.0 cm. If the magnification is 0.500,

   (a) what kind of mirror is being used to form the image? [1 pt]

   (b) what is the focal length of the mirror? [9 pts]

2. A material having an index of refraction n is surrounded by vacuum and is in the shape of a quarter circle of radius R. A light ray parallel to the base of the material is incident from the left at a distance L above the base and emerges from the material at the angle θ.



(a) Show that $\sin\alpha = \frac{L}{R}$.

(b) Show that $\gamma = \alpha - \beta$.

(c) Show that

$$\theta = \sin^{-1}\left(\frac{L}{R^2}\left(\sqrt{n^2R^2 - L^2} - \sqrt{R^2 - L^2}\right)\right)$$

Hint: you might like to consider these two trig identities:
$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$, $\cos\theta = \sqrt{1 - \sin^2\theta}$.

3. The magnification of the image formed by a refracting surface is given by

$$M = -\frac{n_1 q}{n_2 p}\,.$$

A paperweight is made of a solid glass hemisphere with index of refraction 1.50. The radius of the circular cross section is 4.00 cm. The hemisphere is placed on its flat surface, with the center directly over a 2.50-mm-long line drawn on a sheet of paper. What is the length of this line as seen by someone looking vertically down on the hemisphere?