Assignment IX, PHYS 112 (General Physics II)
Fall 2020
Due via pdf upload to OAKS prior to Friday, November 6th at 10:00 AM

General instructions:
For this, and all other homework assignments, please turn in your solutions with all supporting work; answers without supporting work will not earn credit. You do not need to upload the sheet with the questions on it, but please clearly number your problems and circle or box your final answers. I encourage you to collaborate with classmates to discuss how to approach a particular question, but the mathematical steps to generate your final answer on your submitted work should be your own. If I see the same simple mistake on multiple homework assignments, I will take off more points for that error than I normally would. Please include *words* in your answers. When you get answer keys back from me, you'll see that there are explanations, ideas, commentary, and thought processes included – not just a set of equations one after another. Finally, please ensure that all numerical answers have units.

Since several people in class asked for this, here are some suggested (but ungraded) extra problems from the textbook for practice: (All problems out of Halliday, Resnick, and Walker, 10th Extended Edition, "Fundamentals of Physics"). (I chose all odd-numbered problems since the answers to those problems are in the back of the book and that's a good way to check if your practice is accurate.) No need to turn these in, but if you are looking for extra things you can work on if you want to practice problem solving some more, here's what I would advise.

Chapter 34, questions 5,9
Chapter 34, problems 7, 9-16, 31, 32-38, 49, 101, 107, 111, 117, 137

1. A 14 foot long, nearsighted python is stretched out perpendicular to a plane mirror, admiring its reflected image.

   a) If the greatest distance that the snake can see clearly is 25 feet, how close must the python's head be from the mirror so that it can see the reflection of its tail?

   b) If the python wanted to get glasses to improve his far point and so that he could see at least 40 feet away, what prescription would the python need? (in diopters).

2. Approximate the eye as a single thin lens 2.70 cm from the retina. What is the eye's near-point distance if the smallest focal length the eye can produce is 2.20 cm?

3. An object with a height of 46 cm is placed 2.4 m in front of a concave mirror with a focal length of 0.50 m.

   a) Determine the approximate location and size of the image using a ray diagram.

   b) Is the image upright or inverted?

   c) Now use the mirror equation to determine the exact height of the image.

4. A shaving mirror often produces upright images that are magnified. If you have a shaving mirror that magnifies your image by a factor of 2.2 when your face is 25 cm from the mirror, what is the mirror's *radius of curvature*?

5. Telescopes try to contain mirrors as large as possible. The Hale telescope on Mount Palomar has one that is 200 inches in diameter. This concave mirror has a focal length of 16.9 m. An astronomer stands 20.0 m in front of this mirror.

   a) How far *from the astronomer* is her image located?

   b) Is the astronomer's image on the same side of the mirror as the astronomer?

   c) Is the astronomer's image real or virtual?

   d) What is the magnification of the astronomer's image?

6. When an object is placed a distance $d_\circ$ in front of a curved mirror, the resulting image has a magnification m. Find an expression for the focal length of the mirror f in terms of $d_\circ$ and m *only*.

7. Two colors (we'll call them "A" and "B") are sent through a prism. Color A is bent more than color B. Which color travels more rapidly in the prism? Explain.

8. An object is a distance $f/2$ from a converging lens.

    a) Use a ray diagram to find the approximate location from the image.

    b) Is the image upright or inverted?

    c) Is the image real or virtual? Explain.

9. A diverging lens has a focal length of -32 cm. Find the image distance and magnification that result when an object is placed 29 cm in front of the lens.

10. An object and a screen are placed exactly 2.0 meters apart.

    a) Between the object and the screen, you place a converging lens with focal length 0.4 m. There are two (and only two) places you can place this lens and end up with a clear image on the screen. Where are they? (Give me the distance from the object to the lens).

    b) The two positions calculated in part (a) above give different magnifications. Which position would you put the lens at so that the final image is as large as possible?

11. A converging lens of focal length 8.000 cm is 20.0 cm to the left of a diverging lens that has a focal length -6.00 cm. A coin is placed 12.0 cm to the left of the converging lens.

    a) Find the location of the coin's final image. (Make sure your answer is descriptive enough to be unambiguous about the position).

    b) Find the magnification of the coin's final image.

12. A simple camera telephoto lens consists of two separate lenses. The objective (first) lens has a focal length $f_1 = +39.0$ cm. Exactly 36.0 cm behind this first lens is a concave lens with a focal length $f_2 = -10.0$ cm. The object to be photographed is 4.00 m in front of the objective lens.

    a) How far behind the concave lens should the film be placed?

    b) What is the total magnification of this lens combination?