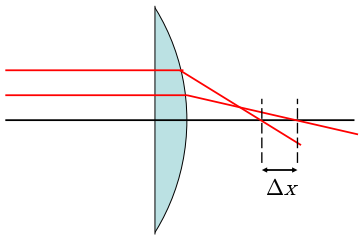
Physics 123 section 2 CID _____

Homework 28

Score _____ / 30

1. (5 pts) You want to take a picture of an ant. You place your camera such that the film is 250 mm from the ant. The lens has a focal length of 50 mm. (a) Show that there are two possible positions for the lens which will produce a focused image of the ant on the film. Find p and q for both cases. (b) What is the magnification of the image for the case where $p > q$? (c) What is M for the case where $q > p$?

2. (7 pts) Let's take a look as spherical aberration. Imagine a plano-convex lens (meaning that one side is flat and one side is convex) made of a glass with an index of refraction of 1.51. The magnitude of the a radius of curvature of the curved side is 30 cm. Two rays of light strike the flat side of the lens, both traveling parallel to the principle axis, as shown in the figure below. One beam hits the lens a distance of 0.5 cm from the principle axis, and the other a distance of 10 cm from the principle axis. After being bent by the lens, the two rays both cross the principle axis. If the lens were free of aberrations, they would cross the principle axis at the same point. But, in fact, they don't. What is the distance Δx between the points where the two rays cross the principle axis?



3. (5 pts) A nearsighted person (let's call him Bob) cannot see anything further than 50 cm away from him. Assuming he has no astigmatism, what power of lens does he need in his glasses in order to see things which are very far away from him? Assume that the distance from his eyes to his glasses (when he is wearing them) is negligible, and give your answer in diopters.

4. (5 pts) A farsighted person (let's call her Jane) cannot see anything closer than 2.12 m away from her. Assuming that she has no astigmatism, what power of lens does she need in her glasses in order to read a book at the "normal" near point of 25 cm? Assume that the distance from her eyes to her glasses (when she is wearing them) is negligible, and give you answer in diopters.

5. (4 pts) Lost in the woods, you use your friends glasses to focus sunlight and start a fire. You find that the sunlight comes to a focus 50 cm from the lens. (a) Is your friend farsighted or nearsighted? (b) Assuming that your friend does not suffer from presbyopia, what is your friends far point and near point?

6. (4 pts) Consider an object placed a distance p in front of a thin lens with a focal length f. (a) If p and f are both positive, under what conditions will a lens create an image which is inverted? (b) If p and f are both positive, under what conditions will a lens create a virtual image? (c) If p is positive and f is negative, under what conditions will a lens create an image which is inverted? (d) If p is positive and f is negative, under what conditions will a lens create a virtual image?

Extra problems I recommend you work (not to be turned in)

- You shine red light on a penny. You place a glass lens 1 m from the penny, and a red image of the penny forms at a distance of 30 cm from the lens on the opposite side of the lens. You then shine blue light on the penny. How far from the lens will the blue image form? Assume that the index of refraction for the glass is 1.50 for the red light and 1.53 for the blue light.

- A man has contacts which have a power of 3.0 diopters. If he wants to switch to glasses, which will sit 2 cm in front of his eyes, what power of lenses should he use?

- When the sun heats a hot desert, the air near the ground heats up and becomes less dense than the air above it, such that the density of the air increases with the distance from the ground. Explain why this creates a mirage.

- Find a friend who has glasses. By looking at things through their glasses held at arms length, determine if they are far sighted or near sighted (they meaning your friend, not the glasses).

- Find Δx for the lens above if you flip the lens around.