Physics Exploration Homework Supplement **P111-4.pdf**

An Image formed by a Lens and the Human Eye

Go to the Physics Exploration Center. Enter through the resource room 311/312 Thaw Hall.

The first part of the exploration involves learning about the image formed by a lens and the second part is about the human eye. Go to the station with a source of light, convex lens, a slide of the first step on the moon, a white screen, a photocell and a multimeter (set-up P111.4A.pdf). (Note: The photocell produces a voltage that is proportional to the intensity of light that strikes it (the photocell) and the multimeter is used to measure this voltage.)

(1) Before you turn on the source of light, write down the voltage reading V_o displayed on the multimeter due to the spurious light in the room (background light). You will have to subtract this from the voltage reading obtained after turning the light source on. Then, turn on the source of light behind the slide (first step on the moon), and have the lens and the photocell in front of the light source. Hold the white screen just in front of the photocell to see the image clearly. Take the voltage reading on the multimeter and subtract it from V_o to get the voltage due to the light intensity of the image of the "first step on moon" slide on the screen.

(2) Predict what would happen if you covered half of the lens with the cover so that the light is passing through only half of the lens. Do you expect the image of the "first step on moon" to get cut in half. Why or why not? You must be very clear about your reasoning. Now do the experiment by covering half the lens. What do you observe on the photocell (put the white screen in front to make the image clear)? If you do not see what you expected, please provide a reasoning for what you observed based upon what you learned in the class.

(3) Measure the voltage for the case where the screen is half covered and subtract V_o from it. How does the voltage in this case compare to that in case (1)? What does it tell you about what happens to the intensity of light forming the image in this case vs. case (1). Does it make sense?

(4) Now predict what would happen to the image on the screen if you remove the lens from the optical bench, but kept everything similar to case (1). Do you expect the image to be there on the screen but fuzzier? Why or why not? Explain. Now do the experiment and comment on what you observe. What was the role of the lens in image formation of the object? Make sure you put the lens back in the holder when you are done. Also, turn off the light and the voltmeter.

Now go to the experiment involving the human eye (set-up P111-4B.pdf). Your goal is to measure the focal length of the human eye for two values of object distances.

(5) Put the object (letter E on a stand) in front of the eye at a certain distance from the eye. The retina is the white sheet of paper on the wall, similar to the setup we had in class. Change the focal length of the eye by using the syringe to focus the image at the retina. Do not pump too much water into the eye! Calculate the focal length assuming eye is a convex spherical lens using the lens equation learned in the class and measuring the object and image distances.

(6) Move the object either closer OR farther away from the eye. Predict whether the image of the object (letter E) is forming in front of the retina or behind the retina now based upon what you learned in the class. Predict whether you should increase or decrease the focal length of eye lens (remember focal length is related to the radius of curvature!) if you wanted the image to be formed on the retina. Now change the focal length of the eye lens with the syringe and check that the lens is becoming more or less curved as you had expected.

(7) Use the lens equation to find the focal length of eye lens by measuring the object and image distance in case (6) [remember that once the image is focused on the retina, the image distance is the same as in case (5)]. If the eye had a defect, what would it not be able to do (give a general answer rather than talking about a particular type of defect of the eye)? Make sure to turn off the projector when done.