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 one meter long optics bench, convex lens, a metal plate to cover the lens, a light source with an arrow on it, 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) Place the photocell at the far end of the optics bench away from the light source. Place the lens (and its carrier) on the optics bench somewhere between the photocell and the light source. Turn on the power strip at the top of the table to turn on the Light Source and the Voltmeter. Hold (or place) a white screen up against the photocell and adjust the placement of the lens so that a sharp image of the arrow falls on the screen. Remove the screen and record the voltage reading on the Voltmeter.

(2) Predict what would happen if you covered half of the lens so that the light is passing through only half of the lens. Do you expect the image of the "Arrow" to be cut in half? Why or why not? (You must be very clear about your reasoning.) Now do the experiment by recovering the photocell with the white screen and covering half the lens with the provided metal plate that will stick to the magnetic strip on the lens holder. What do you observe on the white screen? Remove the white screen and record the voltage on the photocell. 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) 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 else the same [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 on the optics bench when you are done. Does it matter which direction the lens faces, when making an image [(| or |)] ? Also, when finished with this experiment, please turn off the light source 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 small square white screen clamped to the table behind the eye). 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, based upon what you learned in the class. Predict whether you should increase or decrease the focal length of eye lens; if you want the image to be formed on the retina (remember focal length is related to the radius of curvature). 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 light source when you are finished with the experiment.