

Light and Lenses

Objective

The objective of this activity is to investigate the behavior and uses of lenses.

Materials

1. Component carrier (large)
2. Component carrier (small)
3. Crossed-arrow target
4. Diffuser
5. Flashlight
6. Incandescent light source
7. Lenses (+120,-440,-53,+50)
8. Optical bench

Background

Real images, besides being viewable when we look into a lens, can be formed on a screen (for example, a projection screen, a wall, or a sheet of white paper). *Virtual* images cannot be formed on a screen. Focal length is the distance from the lens to its image of an object at infinity.

Procedure

Use the given lenses to view a distant scene by holding each lens at arms length and looking through the lens at the scene. What you see is an image of the scene that is formed by the lens. Characterize the image you see (its size and orientation) compared to the actual objects. Associate types of images with types of lens.

1. For each type of lens start at arms length and bring the lens slowly toward one of your eyes. Carefully note any image change that occurs along the way.
2. Hold each type of lens next to your eye and examine the image of an object (such as a finger tip) brought near the lens. From your observations, what type of lens do you think is involved in the magnifying eyepieces often worn by jewelers or doctors?

3. With each of your lenses try to form a real image of a bright scene such as what you see through a window. If it is too dark to get an image from outside, form an image of a light in the room. Hold your lens between the screen and the scene to get a real image. Which type of lenses form real images? Characterize the real images you see.
4. Which of the lenses form virtual images? How would you convince yourself that all lenses can form virtual images?
5. For the lenses that form real images, measure the focal length. For the other lenses, where do you think the image is located?
6. Three important examples of real images occur in eyes, cameras, and projectors. In the eye a real image is formed on the retina at the back of the eye. In a camera there is a real image on the film. Are the images right side up? A slide projector forms a real image on a screen. How should the slide be placed in the projector? Why?
7. Is the image at the focal point? To determine the answer to this question, use a lighted object on the optical bench. Measure both the image and object distances for a range of object distances. Use a positive focal length lens for this.
8. For what range of object distances are real images possible? Graph image distance vs object distance. Try to extrapolate beyond distances actually measured.