Assignment for SP226 Due 04/20/00 Name _____
Chapter 34

1* • Can a virtual image be photographed?

5* • Two plane mirrors make an angle of 90°. Show by considering various object positions that there are three images for any position of an object. Draw appropriate bundles of rays from the object to the eye for viewing each image.

8 •• True or False

(*a*) The virtual image formed by a concave mirror is always smaller than the object.

(*b*) A concave mirror always forms a virtual image.

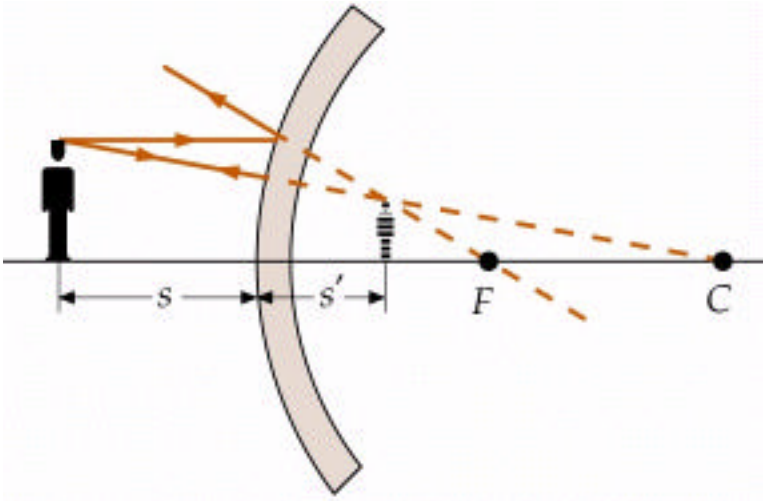
(*c*) A convex mirror never forms a real image of a real object.

(*d*) A concave mirror never forms an enlarged real image of an object.

9* •• Under what condition will a concave mirror produce an erect image? A virtual image? An image smaller than the object? An image larger than the object?

10 •• Under what condition will a convex mirror produce an erect image? A virtual image? An image smaller than the object? An image larger than the object?

11 •• Convex mirrors are often used for rear-view mirrors on cars and trucks to give a wide-angle view. Below the mirror is written, “Warning, objects are closer than they appear.” Yet according to a ray diagram such as Figure 34-19, the image distance for distant objects is much smaller than the object distance. Why then do they appear more distant?



20 •• A certain telescope uses a concave spherical mirror of radius 8 m. Find the location and diameter of the image of the moon formed by this mirror. The moon has a diameter of 3.5×10^{6} m and is 3.8×10^{8} m from the earth.

13* • A concave spherical mirror has a radius of curvature of 40 cm. Draw ray diagrams to locate the image (if one is formed) for an object at a distance of (*a*) 100 cm, (*b*) 40 cm, (*c*) 20 cm, and (*d*) 10 cm from the mirror. For each case, state whether the image is real or virtual; erect or inverted; and enlarged, reduced, or the same size as the object.

24 •• An object located 100 cm from a concave mirror forms a real image 75 cm from the mirror. The mirror is then turned around so that its convex side faces the object. The mirror is moved so that the image is now 35 cm behind the mirror. How far was the mirror moved? Was it moved toward or away from the object?

27 • A bird above the water is viewed by a scuba diver submerged beneath the water's surface directly below the bird. Does the bird appear to the diver to be closer to or farther from the surface than it actually is?

35 •• A glass rod 96 cm long with an index of refraction of 1.6 has its ends ground to convex spherical surfaces of radii 8 cm and 16 cm. A point object is in air on the axis of the rod 20 cm from the end with the 8-cm radius. (*a*) Find the image distance due to refraction at the first surface. (*b*) Find the final image due to refraction at both surfaces. (*c*) Is the final image real or virtual?

30 •• A very long glass rod of 2-cm diameter has one end ground to a convex spherical surface of radius 5 cm. Its index of refraction is 1.5. (*a*) A point object in air is on the axis of the rod 20 cm from the surface. Find the image and state whether it is real or virtual. Repeat for (*b*) an object 5 cm from the surface and (*c*) an object very far from the surface. Draw a ray diagram for each case.

37* • Under what conditions will the focal length of a thin lens be positive? Negative?

38 • The focal length of a simple lens is different for different colors of light. Why?

39 •• An object is placed 40 cm from a lens of focal length –10 cm. The image is

(*a*) real, inverted, and diminished.
(*b*) real, inverted, and enlarged.
(*c*) virtual, inverted, and diminished.
(*d*) virtual, upright, and diminished.
(*e*) virtual, upright, and enlarged.

46 • For the following object distances and focal lengths of thin lenses in air, find the image distance and the magnification and state whether the image is real or virtual and erect or inverted: (*a*) $s = 40$ cm, $f = 20$ cm; (*b*) $s = 10$ cm, $f = 20$ cm; (*c*) $s = 40$ cm, $f = -30$ cm; (*d*) $s = 10$ cm, $f = -30$ cm.

53* •• A thin lens of index of refraction 1.5 has one convex side with a radius of magnitude 20 cm. When an object 1 cm in height is placed 50 cm from this lens, an upright image 2.15 cm in height is formed. (*a*) Calculate the radius of the second side of the lens. Is it concave or convex? (*b*) Draw a sketch of the lens.

58 ••• An object is placed 2.4 m from a screen, and a lens of focal length *f* is placed between the object and the screen so that a real image of the object is formed on the screen. When the lens is moved 1.2 m toward the screen, another real image of the object is formed on the screen. (*a*) Where was the lens located before it was moved? (*b*) What is the focal length of the lens?

64 •• Myopic (nearsighted) persons sometimes claim to see better under water without corrective lenses. Why?

(*a*) The accommodation of the eye's lens is better under water.

(*b*) Refraction at the water–cornea interface is less than at the air–cornea interface.

(*c*) Refraction at the water–cornea interface is greater than at the air–cornea interface.

(*d*) No reason; the effect is only an illusion and not really true.

65* •• A nearsighted person who wears corrective lenses would like to examine an object at close distance. Identify the correct statement.

(*a*) The corrective lenses give an enlarged image and should be worn while examining the object.

(*b*) The corrective lenses give a reduced image of the object and should be removed.

(*c*) The corrective lenses result in a magnification of unity; it does not matter whether they are worn or removed.

78 • A person with a near point distance of 25 cm wishes to obtain a magnifying power of 5 with a simple magnifier. What should be the focal length of the lens used?

83 •• Show that when the image of a simple magnifier is viewed at the near point, the lateral and angular magnification of the magnifier are equal.

86 •• A crude symmetric hand-held microscope consists of two converging 20-D lenses fastened in the ends of a tube 30 cm long. (*a*) What is the "tube length" of this microscope? (*b*) What is the lateral magnification of the objective? (*c*) What is the magnifying power of the microscope? (*d*) How far from the objective should the object be placed?

95 •• A disadvantage of the astronomical telescope for terrestrial use (for example, at a football game) is that the image is inverted. A standard Galilean telescope uses a converging lens as its objective, but a diverging lens as its eyepiece. The image formed by the objective is behind the eyepiece at its focal point so that the final image is virtual, erect, and at infinity. Suppose a Galilean telescope is designed so that the final image is at the near point, which is 25 cm (rather than at infinity). The focal length of the objective is 100 cm and that of the eyepiece is –5 cm. (*a*) If the object distance is 30 m, where is the image of the objective? (*b*) What is the object distance for the eyepiece so that the final image is at the near point? (*c*) How far apart are the lenses? (*d*) If the object height is 1.5 m, what is the height of the final image? What is the angular magnification?

123 ••• (*a*) Show that a small change dn in the index of refraction of a lens material produces a small change in the focal length df given approximately by $df/f = -dn/(n - 1)$. (*b*) Use this result to find the focal length of a thin lens for blue light, for which $n = 1.53$, if the focal length for red light, for which $n = 1.47$, is 20 cm.