

## 3.4 PROBLEMS

**Problem 3.4.1.** (a) Find the magnification of a compound microscope that has a 10-cm focal length objective and a 15-cm focal length eyepiece. (b) If an object of transverse dimension 0.02 mm is placed 12.5 cm from the objective, find the location and sizes of the images from each of the lenses, and compare the magnification of image obtained this way to the magnification you found in part (a). For part (b), work out the magnification of each lens one at a time. (c) State the source of difference if any.

**Problem 3.4.2.** A far-sighted person has a near point of 100 cm. How far in front or behind the retina does the image of a object placed 25 cm from the eye form? Use the cornea to retina distance of 2.5 cm. Ans: 0.2 cm behind the retina.

**Problem 3.4.3.** A near-sighted person has a far point of 80 cm. (a) What kind of corrective lens the person will need if the lens is to be placed 1.5 cm from the eye? (b) What would be the power of the contact lens needed? Assume distance to contact lens from the eye to be zero. Ans: (a) Focal length of the corrective lens  $f_c = -80$  cm, (b)  $-1.25$  D.

**Problem 3.4.4.** In a reflecting telescope the objective is a concave mirror of radius of curvature 2-meters and an eyepiece is a convex lens of focal length 5 cm. Find the apparent size of a 25-meter tree at a distance of 10-kilometers that you would perceive when looking through the telescope. Ans:  $h_i = 1.25$  cm.

**Problem 3.4.5.** Two stars that are  $10^9$  km apart are viewed by a telescope and found to be separated by an angle of  $10^{-5}$  radians. If the eyepiece of the telescope has a focal length of 1.5 cm and the objective has a focal length of 3 meters, how far away are the stars from the observer? Ans:  $2 \times 10^{16}$  km.

**Problem 3.4.6.** What is the angular size of the Moon if viewed from a binocular that has a focal length of 1.2 cm for the eyepiece and a focal length of 8 cm for the objective? Use the radius of the Moon  $1.74 \times 10^6$  m and the distance of the Moon from the observer to be  $3.8 \times 10^8$  m. Ans:  $1.75^\circ$

**Problem 3.4.7.** An unknown planet at a distance of  $10^{12}$  m from the Earth is observed by a telescope that has a focal length of the eyepiece of 1 cm and a focal length of the objective of 1 m. If the far away planet is seen to subtend an angle of  $10^{-5}$  radian at the eyepiece, what is the size of the planet? Ans:  $10^5$  m.