**Chapter-34**

1. The *Apollo 11* astronauts set up a panel of efficient corner-cube retroreflectors on the Moon’s surface (Fig. 34.8a). The speed of light can be found by measuring the time interval required for a laser beam to travel from the Earth, reflect from the panel, and return to the Earth. Assume this interval is measured to be 2.51 s at a station where the Moon is at the zenith and take the center-to-center distance from the Earth to the Moon to be equal to 3.84 x 108m/s. (a) What is the measured speed of light? (b) Explain whether it is necessary to consider the sizes of the Earth and the Moon in your calculation.

Ans: (a) The Moon’s radius is 1.74 × 106 m and the Earth’s radius is 6.37 × 106 m. The total distance traveled by the light is:



This takes 2.51 s, so



(b) The sizes of the objects need to be taken into account. Otherwise the answer would be too large by 2%.

1. Find the speed of light in (a) f lint glass, (b) water, and (c) cubic zirconia.

Ans: (a) flint glass: 

(b) water: 

(c) cubic zirconia: 

1. A light beam containing red and violet wavelengths is incident on a slab of quartz at an angle of incidence of 50.08. The index of refraction of quartz is 1.455 at 600 nm (red light), and its index of refraction is 1.468 at 410 nm (violet light). Find the dispersion of the slab, which is defined as the difference in the angles of refraction for the two wavelengths.

Ans: Using Snell’s law gives



and 

Thus, the dispersion is 