**SOLUTION TO SIMILAR PROBLEMS**

#  Chapter 35: NATURE OF LIGHT AND GEOMETRIC OPTICS

NOTE: Q no: 2, 5, 6, 8, 20, 30, 33, 35, 39, 65

1. As a result of his observations, Ole Roemer concluded that eclipses of Io by Jupiter were delayed by 22 min during a six-month period as the Earth moved from the point in its orbit where it is closest to Jupiter to the diametrically opposite point where it is farthest from Jupiter. Using the value 1.50 × 108 km as the average radius of the Earth’s orbit around the Sun, calculate the speed of light from these data.



1. The wavelength of red helium–neon laser light in air is 632.8 nm. (a) What is its frequency? (b) What is its wavelength in glass that has an index of refraction of 1.50? (c) What is its speed in the glass?



1. An underwater scuba diver sees the Sun at an apparent angle of 45.0° above the horizontal. What is the actual elevation angle of the Sun above the horizontal?



1. Figure P35.8 shows a refracted light beam in linseed oil making an angle of *α* = 20.0° with the normal line *NN* ′. The index of refraction of linseed oil is 1.48. Determine the angles (a) *θ* and (b) *θ* ′.



1. A narrow beam of ultrasonic waves reflects off the liver tumor illustrated in Figure P35.20. The speed of the wave is 10.0% less in the liver than in the surrounding medium. Determine the depth of the tumor.



1. The index of refraction for red light in water is 1.331 and that for blue light is 1.340. If a ray of white light enters the water at an angle of incidence of 83.0°, what are the underwater angles of refraction for the (a) red and (b) blue components of the light?



1. The index of refraction for violet light in silica flint glass is 1.66, and that for red light is 1.62. What is the angular spread of visible light passing through a prism of apex angle 60.0° if the angle of incidence is 50.0°? See Figure P35.33.



1. A glass optical fiber (*n* = 1.50) is submerged in water (*n* = 1.33). What is the critical angle for light to stay inside the fiber?



39. Assume a transparent rod of diameter *d* = 2.00 *μ*m has an index of refraction of 1.36. Determine the maximum angle *θ* for which the light rays incident on the end of the rod in Figure P35.39 are subject to total internal reflection along the walls of the rod. Your answer defines the size of the *cone of acceptance* for the rod.



1. As shown in Figure P35.65, a light ray is incident normal to one face of a 30°–60°–90° block of flint glass (a prism) that is immersed in water. (a) Determine the exit angle *θ*3 of the ray. (b) A substance is dissolved in the water to increase the index of refraction *n*2. At what value of *n*2 does total internal reflection cease at point *P*?

