Refraction Problems

1. Light passes from air into water. If the angle of refraction is 20°, what is the angle of incidence? (27°)
2. The speed of light in a material is 2.07 x 10^8 m/s. What is the index of refraction? (1.45)
3. A ray of light is incident on a plane surface separating two sheets of glass with refractive indexes of 1.80 and 1.52. The angle of incidence is 35.0 degrees, and the ray originates in glass with the higher refractive index. Compute the angle of refraction.
4. Light with a frequency of 5.00 x 10^{14} Hz travels in a block of plastic that has an index of refraction of 2.00. What is the wavelength of the light while it is in the plastic and while it is in a vacuum?
5. Under what conditions will total internal reflection occur?
6. After a long day of driving, you take a late night swim in a motel swimming pool. When you go to your room, you realize that you have lost your room key in the pool. You borrow a powerful flashlight and walk around the pool, shining the light into it. The light shines on the key, which is lying on the bottom of the pool, when the flashlight is held 1.2 m above the water surface and is directed at the surface a horizontal distance of 1.5 m from the edge. If the water here is 4.0 m deep, how far is the Key from the edge of the pool?
7. You sight along the rim of a glass with vertical sides so that the top rim is lined up with the opposite edge of the bottom. The glass is a thin walled hollow cylinder 16.0 cm high with top and bottom diameter of 8.0 cm. While you keep your eye in the same position, a friend fills the glass with a transparent liquid, and you see the dime that is lying in the center of the bottom of the glass. What is the index of refraction of the liquid?
8. Extra dense flint glass has one of the highest indices of refraction of any type of glass. Suppose a beam of light passes from air into a block of extra dense flint glass. If the light has an angle of incidence of 72° and an angle of refraction of 34°, what is the index of refraction of the glass?
9. An arrangement of three glass blocks with indices of refraction of 1.5, 1.6, and 1.7 are sandwiched together. A beam of light enters the first block from air at an angle of 48° with respect to the normal. What is the angle of refraction after the light enters the third block?