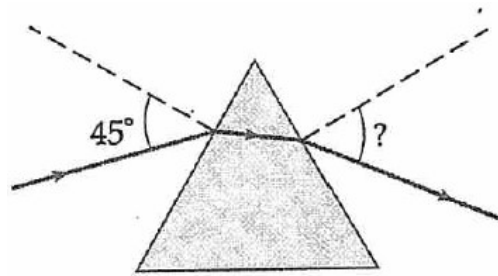
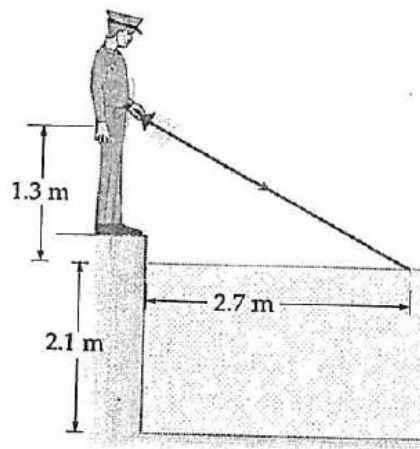


TUTORIAL CHAPTER 6 – PROPERTIES OF LIGHT

1. The speed of light in ice is 2.29×10^8 m/s. What is the index refraction of ice?
2. The speed of light in certain substance is 85% of its value in water. What is the index refraction of this substance? (Given: $n_{\text{water}} = 1.33$)
3. A flash beam light strikes the surface of a plane of glass ($n = 1.50$) at 63° angle to the normal. What is the angle of refraction?
4. A light beam coming from an underwater spotlight exits the water at an angle of 60° . At what angle of incidence did it hit the air water interface from below the surface?
5. A diver shines a flashlight upward from beneath the water at a 42.5° angle to the vertical. At what angle does the light leave the water?
6. Light is incidence on an equilateral crown glass prism at a 45° angle to one face, shown in Figure 1. Calculate the angle at which light emerges from the opposite face. Assume that $n = 1.52$.

**Figure 1**

7. In searching the bottom of a pool at night, a watchman shines narrow beam of light from his flashlight, 1.3 m above the water, onto the surface of the water at a point 2.7 m from his foot at the edge of the pool (Figure 2). Where does the spot of light hit the bottom of the pool, relative to the edge, if the pool is 2.1 m deep?

**Figure 2**

8. We wish to determine the depth of a swimming pool filled with water by measuring the width ($x = 5.50$ m) and then noting that the bottom edge of the pool is just visible at an angle of 14.0° above the horizontal as shown in Figure 3. Calculate the depth of the pool.

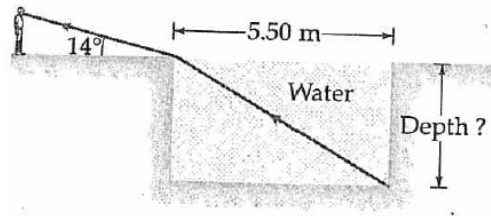


Figure 3

9. What is the critical angle for the interface between water and Lucite? To be internally reflected, the light must start in which material? (Given that the refractive index of Lucite is 1.51).
10. The critical angle of a certain piece of plastic in air is $\theta_c = 37.3^\circ$. What is the critical angle of the same plastic if it is immersed in water?
11. A beam of light is emitted in a pool of water from a depth of 62.0 cm. Where must it strike the air-water interface, relative to the spot directly above it, in order the light does not exit the water?
12. A ray of light enters a light fiber at an angle of 15° with the long axis of the fiber, as in Figure 4. Calculate the distance the light ray travels between successive reflections if the sides of the fiber have an index of refraction 1.6 and is 10^{-4} mm in diameter.

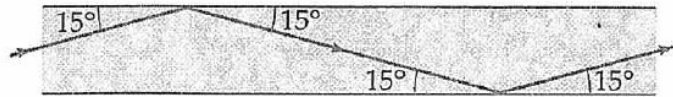


Figure 4

13. Suppose a ray strikes the left face of the prism in Figure 1 (from question 6), but is totally internally reflected at the opposite side. If the apex angle (at the top) is $\theta = 75^\circ$, what can you say about the index of refraction of the prism?
14. If the apex angle of a prism is $\phi = 72^\circ$ (Figure 5), what is the minimum incident angle for a ray if it is to emerge from the opposite side? (i.e., not to be totally internally reflected).

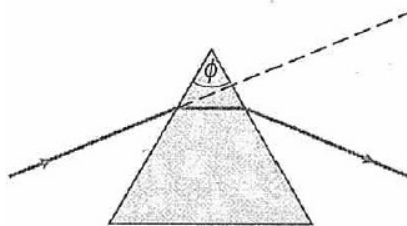


Figure 5

15. If 720 nm and 660 nm light passes through two slits 0.58 mm apart, how far apart are the second order fringes for these two wavelengths on a screen 1.0 m away?
16. In a double slit experiment it is found that blue light of wavelength 460 nm gives a second order maximum at a certain location on the screen. What wavelength of visible light would have a minimum at the same location?
17. If a slit diffracts 550 nm light so that the diffraction maximum is 8.0 cm wide on a screen 2.50 m away, what will be the width of the diffraction maximum for light with a wavelength of 400 nm?
18. How wide is the central diffraction peak on a screen 3.50 m behind a 0.0655 mm wide slit illuminated by 400 nm light?
19. A source produces first order lines when incident normally on a 10000 lines/cm diffraction grating at angles 29.8° and 39.6° . What are the wavelengths?
20. White light containing wavelengths from 400 nm to 750 nm falls on a grating with 7800 lines/cm. How wide is the first order spectrum on a screen 2.80 m away?

Answers:

1. $n = 1.31$.
2. $n = 1.56$.
3. $\theta_2 = 36^\circ$.
4. $\theta_1 = 41^\circ$.
5. $\theta_2 = 64.0^\circ$.
6. $\theta_4 = 54.3^\circ$ from the normal.
7. $L = 4.6$ m.
8. $h = 5.2$ m.
9. $\theta_1 = 61.7^\circ$. Because Lucite has the higher index, the light must start in Lucite.
10. $\theta_{\text{plastic}} = 53.7^\circ$.
11. 70.7 cm.
12. $L = 3.9 \times 10^{-4}$ m.
13. $n \geq 1.414$.
14. $\theta_1 \geq 51.3^\circ$.
15. 0.21 mm
16. $\lambda = 613$ nm
17. 11.64 cm
18. 4.28 cm
19. 497 nm , 637 nm
20. 76.44 cm