

Chapter 14 Assessment

74. How long must a pendulum be to have a period of 2.3 s on the Moon, where $g = 1.6 \text{ m/s}^2$?

14.2 Wave Properties

75. **Building Motion** The Sears Tower in Chicago, shown in **Figure 14-22**, sways back and forth in the wind with a frequency of about 0.12 Hz. What is its period of vibration?



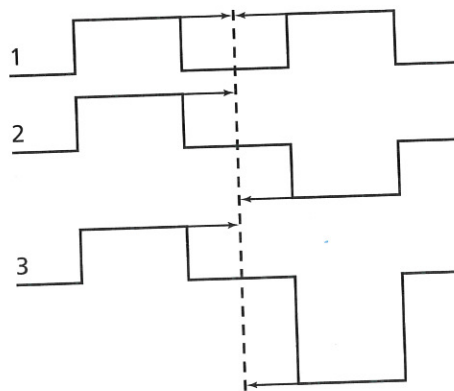
■ **Figure 14-22**

76. **Ocean Waves** An ocean wave has a length of 12.0 m. A wave passes a fixed location every 3.0 s. What is the speed of the wave?
77. Water waves in a shallow dish are 6.0-cm long. At one point, the water moves up and down at a rate of 4.8 oscillations/s.
- What is the speed of the water waves?
 - What is the period of the water waves?
78. Water waves in a lake travel 3.4 m in 1.8 s. The period of oscillation is 1.1 s.
- What is the speed of the water waves?
 - What is their wavelength?
79. **Sonar** A sonar signal of frequency $1.00 \times 10^6 \text{ Hz}$ has a wavelength of 1.50 mm in water.
- What is the speed of the signal in water?
 - What is its period in water?
 - What is its period in air?
80. A sound wave of wavelength 0.60 m and a velocity of 330 m/s is produced for 0.50 s.
- What is the frequency of the wave?
 - How many complete waves are emitted in this time interval?
 - After 0.50 s, how far is the front of the wave from the source of the sound?

81. The speed of sound in water is 1498 m/s. A sonar signal is sent straight down from a ship at a point just below the water surface, and 1.80 s later, the reflected signal is detected. How deep is the water?
82. Pepe and Alfredo are resting on an offshore raft after a swim. They estimate that 3.0 m separates a trough and an adjacent crest of each surface wave on the lake. They count 12 crests that pass by the raft in 20.0 s. Calculate how fast the waves are moving.
83. **Earthquakes** The velocity of the transverse waves produced by an earthquake is 8.9 km/s, and that of the longitudinal waves is 5.1 km/s. A seismograph records the arrival of the transverse waves 68 s before the arrival of the longitudinal waves. How far away is the earthquake?

14.3 Wave Behavior

84. Sketch the result for each of the three cases shown in **Figure 14-23**, when the centers of the two approaching wave pulses lie on the dashed line so that the pulses exactly overlap.



■ **Figure 14-23**

85. If you slosh the water in a bathtub at the correct frequency, the water rises first at one end and then at the other. Suppose you can make a standing wave in a 150-cm-long tub with a frequency of 0.30 Hz. What is the velocity of the water wave?
86. **Guitars** The wave speed in a guitar string is 265 m/s. The length of the string is 63 cm. You pluck the center of the string by pulling it up and letting go. Pulses move in both directions and are reflected off the ends of the string.
- How long does it take for the pulse to move to the string end and return to the center?
 - When the pulses return, is the string above or below its resting location?
 - If you plucked the string 15 cm from one end of the string, where would the two pulses meet?

87. Sketch the result for each of the four cases shown in Figure 14-24, when the centers of each of the two wave pulses exactly overlap.

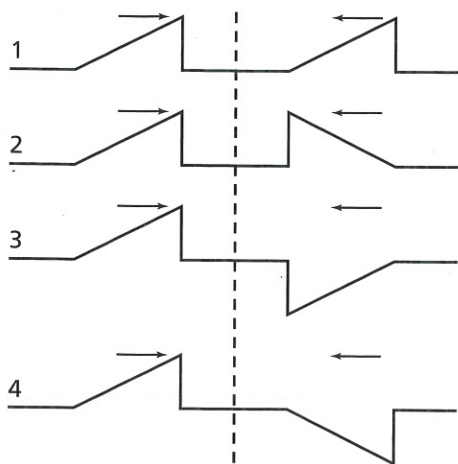


Figure 14-24

Mixed Review

88. What is the period of a pendulum with a length of 1.4 m?
89. The frequency of yellow light is 5.1×10^{14} Hz. Find the wavelength of yellow light. The speed of light is 3.00×10^8 m/s.
90. **Radio Wave** AM-radio signals are broadcast at frequencies between 550 kHz (kilohertz) and 1600 kHz and travel 3.0×10^8 m/s.
- What is the range of wavelengths for these signals?
 - FM frequencies range between 88 MHz (megahertz) and 108 MHz and travel at the same speed. What is the range of FM wavelengths?
91. You are floating just offshore at the beach. Even though the waves are steadily moving in toward the beach, you don't move any closer to the beach.
- What type of wave are you experiencing as you float in the water?
 - Explain why the energy in the wave does not move you closer to shore.
 - In the course of 15 s you count ten waves that pass you. What is the period of the waves?
 - What is the frequency of the waves?
 - You estimate that the wave crests are 3 m apart. What is the velocity of the waves?
 - After returning to the beach, you learn that the waves are moving at 1.8 m/s. What is the actual wavelength of the waves?
92. **Bungee Jumper** A high-altitude bungee jumper jumps from a hot-air balloon using a 540-m-bungee cord. When the jump is complete and the jumper is just suspended from the cord, it is stretched 1710 m. What is the spring constant of the bungee cord if the jumper has a mass of 68 kg?
93. The time needed for a water wave to change from the equilibrium level to the crest is 0.18 s.
- What fraction of a wavelength is this?
 - What is the period of the wave?
 - What is the frequency of the wave?
94. When a 225-g mass is hung from a spring, the spring stretches 9.4 cm. The spring and mass then are pulled 8.0 cm from this new equilibrium position and released. Find the spring constant of the spring and the maximum speed of the mass.
95. **Amusement Ride** You notice that your favorite amusement-park ride seems bigger. The ride consists of a carriage that is attached to a structure so it swings like a pendulum. You remember that the carriage used to swing from one position to another and back again eight times in exactly 1 min. Now it only swings six times in 1 min. Give your answers to the following questions to two significant digits.
- What was the original period of the ride?
 - What is the new period of the ride?
 - What is the new frequency?
 - How much longer is the arm supporting the carriage on the larger ride?
 - If the park owners wanted to double the period of the ride, what percentage increase would need to be made to the length of the pendulum?
96. **Clocks** The speed at which a grandfather clock runs is controlled by a swinging pendulum.
- If you find that the clock loses time each day, what adjustment would you need to make to the pendulum so it will keep better time?
 - If the pendulum currently is 15.0 cm, by how much would you need to change the length to make the period lessen by 0.0400 s?
97. **Bridge Swinging** In the summer over the New River in West Virginia, several teens swing from bridges with ropes, then drop into the river after a few swings back and forth.
- If Pam is using a 10.0-m length of rope, how long will it take her to reach the peak of her swing at the other end of the bridge?
 - If Mike has a mass that is 20 kg more than Pam, how would you expect the period of his swing to differ from Pam's?
 - At what point in the swing is KE at a maximum?
 - At what point in the swing is PE at a maximum?
 - At what point in the swing is KE at a minimum?
 - At what point in the swing is PE at a minimum?