General Problems

67. A tsunami of wavelength 250 km and velocity 750 km/h travels across the Pacific Ocean. As it approaches Hawaii, people observe an unusual decrease of sea level in the harbors. Approximately how much time do they have to run to safety? (In the absence of knowledge and warning, people have died during tsunamis, some of them attracted to the shore to see stranded fishes and boats.)

68. An energy-absorbing car bumper has a spring stiffness constant of 550 kN/m. Find the maximum compression of the bumper if the car, with mass 1500 kg, collides with a wall at a speed of 2.2 m/s (approximately 5 mi/h). [*Hint*: Use conservation of energy.]

69. A 65-kg person jumps from a window to a fire net 18 m below, which stretches the net 1.1 m. Assume that the net behaves like a simple spring, and (*a*) calculate how much it would stretch if the same person were lying in it. (*b*) How much would it stretch if the person jumped from 35 m?

70. A mass m is gently placed on the end of a freely hanging spring. The mass then falls 33 cm before it stops and begins to rise. What is the frequency of the oscillation?

71. A 950-kg car strikes a huge spring at a speed of 22 m/s (Fig. 11–54), compressing the spring 5.0 m. (*a*) What is the spring stiffness constant of the spring? (*b*) How long is the car in contact with the spring before it bounces off in the opposite direction?

FIGURE 11–54 Problem 71.

72. When you walk with a cup of coffee (diameter 8 cm) at just the right pace of about 1 step per second, the coffee sloshes more and more until eventually it starts to spill over the top (Fig. 11–55). Estimate the speed of waves in the coffee.

FIGURE 11–55 Problem 72.

73. The ripples in a certain groove 10.8 cm from the center of a 33-rpm phonograph record have a wavelength of 1.70 mm. What will be the frequency of the sound emitted?

74. A 2.00-kg mass vibrates according to the equation $x = 0.650 \cos 7.40t$, where x is in meters and t in seconds. Determine (*a*) the amplitude, (*b*) the frequency, (*c*) the total energy, and (*d*) the kinetic energy and potential energy when $x = 0.260$ m.

75. A simple pendulum oscillates with frequency f. What is its frequency if it accelerates at $0.50g$ (*a*) upward, and (*b*) downward?

76. A 220-kg wooden raft floats on a lake. When a 75-kg man stands on the raft, it sinks 4.0 cm deeper into the water. When he steps off, the raft vibrates for a while. (*a*) What is the frequency of vibration? (*b*) What is the total energy of vibration (ignoring damping)?

77. Two strings on a musical instrument are tuned to play at 392 Hz (G) and 440 Hz (A). (*a*) What are the frequencies of the first two overtones for each string? (*b*) If the two strings have the same length and are under the same tension, what is the ratio of their masses (m_G/m_A)? (*c*) If the strings instead have the same mass per unit length and are under the same tension, what is the ratio of their lengths (L_G/L_A)? (*d*) If their masses and lengths are the same, what must be the ratio of the tensions in the two strings?

78. Consider a sine wave traveling down the stretched two-part cord of Fig. 11–33. Determine a formula (*a*) for the ratio of the speeds of the wave in the heavy section versus that in the lighter section, v_H/v_L, and (*b*) for the ratio of the wavelengths in the two sections. (The frequency is the same in both sections. Why?) (*c*) Is the wavelength greater in the heavier section of cord or the lighter?

79. A tuning fork vibrates at a frequency of 264 Hz, and the tip of each prong moves 1.8 mm to either side of center. Calculate (*a*) the maximum speed and (*b*) the maximum acceleration of the tip of a prong.

80. A diving board oscillates with simple harmonic motion of frequency 1.5 cycles per second. What is the maximum amplitude with which the end of the board can vibrate in order that a pebble placed there (Fig. 11–56) will not lose contact with the board during the oscillation?

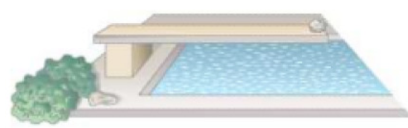

FIGURE 11–56 Problem 80.

81. A string can have a "free" end if that end is attached to a ring that can slide without friction on a vertical pole (Fig. 11–57). Determine the wavelengths of the resonant vibrations of such a string with one end fixed and the other free.

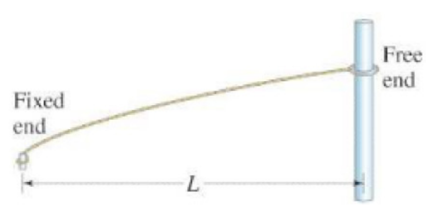

FIGURE 11–57 Problem 81.