82. A "seconds" pendulum has a period of exactly 2.000 s—each one-way swing takes 1.000 s. (*a*) What is the length of a seconds pendulum in Austin, Texas, where $g = 9.793\ \mathrm{m/s^2}$? (*b*) If the pendulum is moved to Paris, where $g = 9.809\ \mathrm{m/s^2}$, by how many millimeters must we lengthen the pendulum? (*c*) What would be the length of a seconds pendulum on the Moon, where $g = 1.62\ \mathrm{m/s^2}$?

83. A mass hanging from a spring can oscillate in the vertical direction or can swing as a pendulum of small amplitude, but not both at the same time. Which one is longer, the period of the vertical oscillations or the period of the horizontal swings, and by what amount? [*Hint*: Let l_0 be the length of the unstretched spring, and L be its length with the mass attached at rest.]

84. A block with mass $M = 5.0\ \mathrm{kg}$ rests on a frictionless table and is attached by a horizontal spring ($k = 130\ \mathrm{N/m}$) to a wall. A second block, of mass $m = 1.25\ \mathrm{kg}$, rests on top of M. The coefficient of static friction between the two blocks is 0.30. What is the maximum possible amplitude of oscillation such that m will not slip off M?

85. A 10.0-m-long wire of mass 123 g is stretched under a tension of 255 N. A pulse is generated at one end, and 20.0 ms later a second pulse is generated at the opposite end. Where will the two pulses first meet?

86. A block of mass M is suspended from a ceiling by a spring with spring stiffness constant k. A penny of mass m is placed on top of the block. What is the maximum amplitude of oscillations that will allow the penny to just stay on top of the block? (Assume $m \ll M$.)

* **87.** A crane has hoisted a 1200-kg car at the junkyard. The steel crane cable is 22 m long and has a diameter of 6.4 mm. A breeze starts the car bouncing at the end of the cable. What is the period of the bouncing? [*Hint*: Refer to Table 9–1.]

* **88.** A block of jello rests on a plate as shown in Fig. 11–58 (which also gives the dimensions of the block). You push it sideways as shown, and then you let go. The jello springs back and begins to vibrate. In analogy to a mass vibrating on a spring, estimate the frequency of this vibration, given that the shear modulus (Section 9–5) of jello is $520\ \mathrm{N/m^2}$ and its density is $1300\ \mathrm{kg/m^3}$.

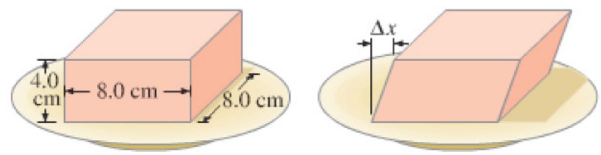

FIGURE 11–58 Problem 88.

Answers to Exercises

A: (*a*), (*c*), (*d*).
B: (*a*) Increases; (*b*) increases; (*c*) increases.
C: Empty.
D: (*a*) 25 cm; (*b*) 2.0 s.