2. The force $\vec{F}$ in Fig. 12-16 keeps the 6.40 kg block and the pulleys in equilibrium. The pulleys have negligible mass and friction. Calculate the tension T in the upper cable. (*Hint:* When a cable wraps halfway around a pulley as here, the magnitude of its net force on the pulley is twice the tension in the cable.)

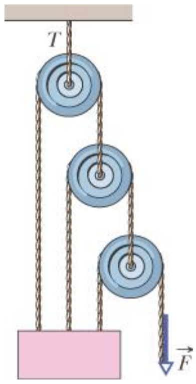

Figure 12-16 Problem 2.

8. Four bricks of length L, identical and uniform, are stacked on top of one another (Fig. 12-21) in such a way that part of each extends beyond the one beneath. Find, in terms of L, the maximum values of (a) a_1, (b) a_2, (c) a_3, (d) a_4, and (e) h, such that the stack is in equilibrium, on the verge of falling.

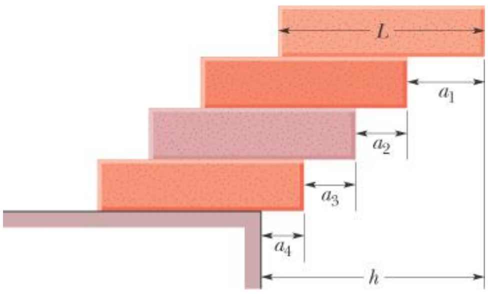

Figure 12-21 Problem 8.

13. In Fig. 12-24, what magnitude of (constant) force $\vec{F}$ applied horizontally at the axle of the wheel is necessary to raise the wheel over a step obstacle of height h = 3.00 cm? The wheel's radius is r = 6.00 cm, and its mass is m = 0.415 kg.

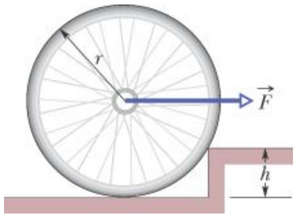

Figure 12-24 Problem 13.

22. In Fig. 12-31, two identical, uniform, and frictionless spheres, each of mass m, rest in a rigid rectangular container. A line connecting their centers is at 45° to the horizontal. Find the magnitudes of the forces on the spheres from (a) the bottom of the container, (b) the left side of the container, (c) the right side of the container, and (d) each other. (*Hint:* The force of one sphere on the other is directed along the center–center line.)

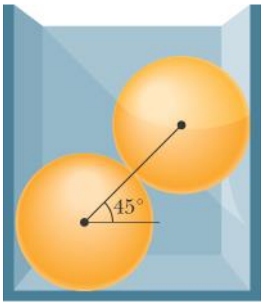

Figure 12-31 Problem 22.

23. Figure 12-32 is an overhead view of a rigid rod that turns about a vertical axle until the identical rubber stoppers *A* and *B* are forced against rigid walls at distances r_A = 7.0 cm and r_B = 4.0 cm from the axle. Initially the stoppers touch the walls without being compressed. Then force $\vec{F}$ of magnitude 220 N is applied perpendicular to the rod at a distance *R* = 5.0 cm from the axle. Find the magnitude of the force compressing (a) stopper *A* and (b) stopper *B*.

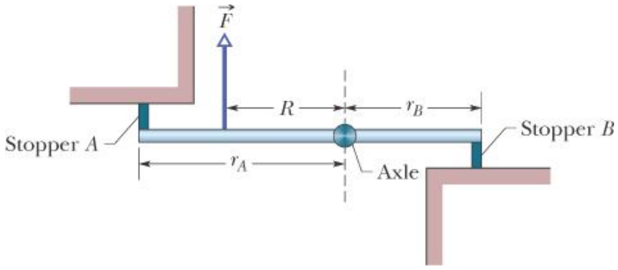

Figure 12-32 Problem 23.

33. Figure 12-39*a* shows a horizontal uniform beam of mass m_b and length *L* that is supported on the left by a hinge attached to a wall and on the right by a cable at angle θ with the horizontal. A package of mass m_p is positioned on the beam at a distance *x* from the left end. The total mass is $m_b + m_p$ = 89.00 kg. Figure 12-39*b* gives the tension *T* in the cable as a function of the package's position given as a fraction *x*/*L* of the beam length. The scale of the *T* axis is set by T_a = 500 N and T_b = 700 N. Evaluate (a) angle θ, (b) mass m_b, and (c) mass m_p.

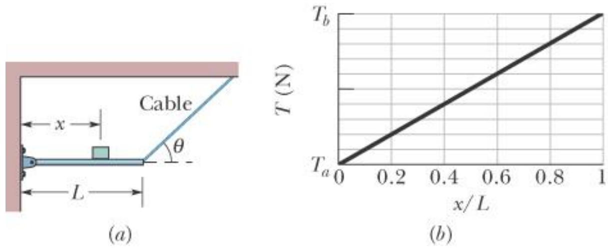

Figure 12-39 Problem 33.

45. Figure 12-48 shows a 300 kg cylinder that is horizontal. Three steel wires support the cylinder from a ceiling. Wires 1 and 3 are attached at the ends of the cylinder, and wire 2 is attached at the center. The wires each have a cross-sectional area of 2.00×10^{-6} m^2. Initially (before the cylinder was put in place) wires 1 and 3 were 2.0000 m long and wire 2 was 6.00 mm longer than that. Now (with the cylinder in place) all three wires have been stretched. What is the tension in (a) wire 1 and (b) wire 2?

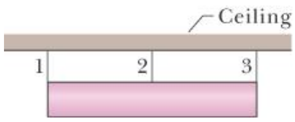

Figure 12-48 Problem 48.

50. A uniform ladder is 10 m long and weighs 200 N. In Fig. 12-51, the ladder leans against a vertical, frictionless wall at height h = 8.0 m above the ground. A horizontal force $\vec{F}$ is applied to the ladder at distance d = 2.0 m from its base (measured along the ladder). (a) If force magnitude F = 50 N, what is the force of the ground on the ladder, in unit-vector notation? (b) If F = 150 N, what is the force of the ground on the ladder, also in unit-vector notation? (c) Suppose the coefficient of static friction between the ladder and the ground is 0.38; for what minimum value of the force magnitude F will the base of the ladder just barely start to move toward the wall?

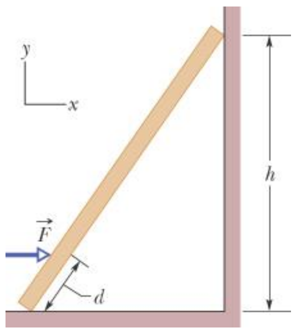

Figure 12-51 Problem 50.