20P. Two identical, uniform, frictionless spheres, each of weight W, rest in a rigid rectangular container as shown in Fig. 13-34. Find, in terms of W, the forces acting on the spheres due to (a) the container surfaces and (b) one another, if the line of centers of the spheres makes an angle of 45° with the horizontal.

21P. An 1800 lb construction bucket is suspended by a cable A that is attached at O to two other cables B and C, making angles of 51° and 66° with the horizontal (Fig. 13-35). Find the tension in (a) cable A, (b) cable B, and (c) cable C. (*Hint:* To avoid solving two equations in two unknowns, position the axes as shown in the figure.)

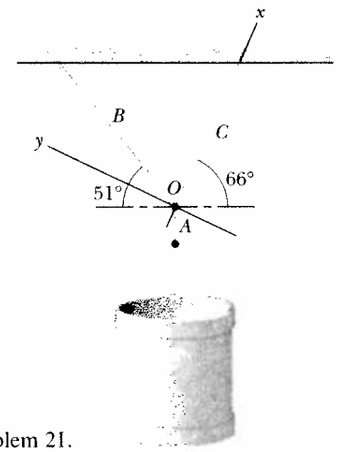

FIGURE 13-35 Problem 21.

22P. The force **F** in Fig. 13-36 is just sufficient to hold the 14 lb block and weightless pulleys in equilibrium. There is no appreciable friction. Calculate the tension T in the upper cable.

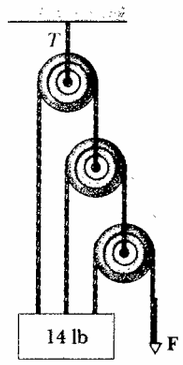

FIGURE 13-36 Problem 22.

23P. The system in Fig. 13-37 is in equilibrium with the string in the center exactly horizontal. Find (a) tension T_1, (b) tension T_2, (c) tension T_3, and (d) angle θ.

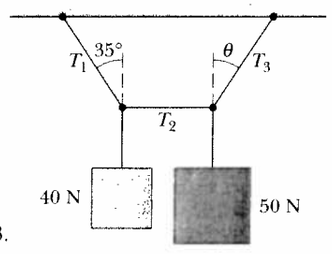

FIGURE 13-37 Problem 23.

24P. A balance is made up of a rigid, massless rod supported at and free to rotate about a point not at the center of the rod. It is balanced by unequal weights placed in the pans at each end of the rod. When an unknown mass m is placed in the left-hand pan, it is balanced by a mass m_1 placed in the right-hand pan; and when the mass m is placed in the right-hand pan, it is balanced by a mass m_2 in the left-hand pan. Show that $m = \sqrt{m_1 m_2}$.

25P. A 15 kg weight is being lifted by the pulley system shown in Fig. 13-38. The upper arm is vertical, whereas the forearm makes an angle of 30° with the horizontal. What forces are being exerted on the forearm by (a) the triceps muscle and (b) the upper-arm bone (the humerus)? The forearm and hand together have a mass of 2.0 kg with a center of mass 15 cm (measured along the arm) from the point where the forearm and upper-arm bones are in contact. The triceps muscle pulls vertically upward at a point 2.5 cm behind the contact point.

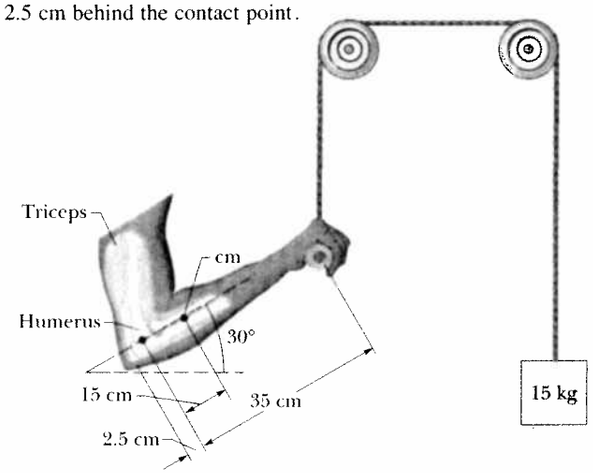

FIGURE 13-38 Problem 25.

26P. A 50.0 kg uniform square sign, 2.00 m on a side, is hung from a 3.00 m rod of negligible mass. A cable is attached to the end of the rod and to a point on the wall 4.00 m above the point where the rod is fixed to the wall (Fig. 13-39). (a) What is the tension in the cable? What are the (b) horizontal and (c) vertical components of the force exerted by the wall on the rod?

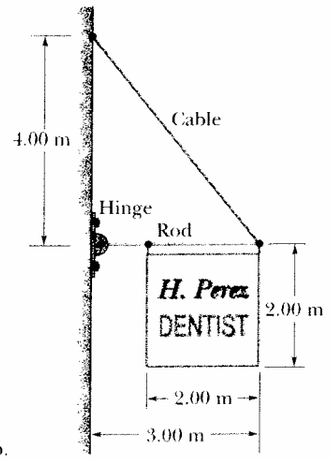

FIGURE 13-39 Problem 26.

30P. A trap door in a ceiling is 0.91 m square, has a mass of 11 kg, and is hinged along one side with a catch at the opposite side. If the center of gravity of the door is 10 cm toward the hinged side from the door's center, what forces must (a) the catch and (b) the hinge sustain?

31P. Four identical uniform bricks, each of length L, are put on top of one another (Fig. 13-43) 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.

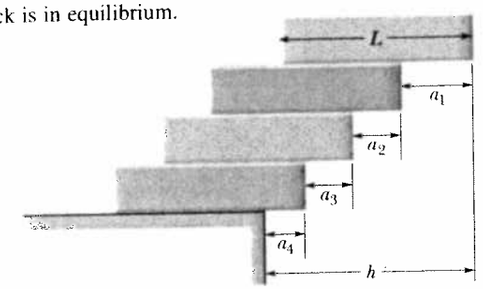

FIGURE 13-43 Problem 31.

32P. One end of a uniform beam that weighs 50.0 lb and is 3.00 ft long is attached to a wall with a hinge. The other end is supported by a wire (see Fig. 13-44). (a) Find the tension in the wire. What are the (b) horizontal and (c) vertical components of the force of the hinge on the beam?

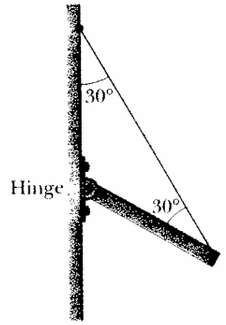

FIGURE 13-44 Problem 32.

33P. The system in Fig. 13-45 is in equilibrium. A mass of 225 kg hangs from the end of the uniform strut whose mass is 45.0 kg. Find (a) the tension T in the cable and the (b) horizontal and (c) vertical force components exerted on the strut by the hinge.

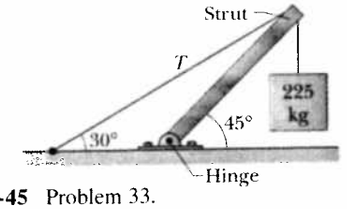

FIGURE 13-45 Problem 33.

34P. A door 2.1 m high and 0.91 m wide has a mass of 27 kg. A hinge 0.30 m from the top and another 0.30 m from the bottom each support half the door's weight. Assume that the center of gravity is at the geometrical center of the door and determine the (a) vertical and (b) horizontal force components exerted by each hinge on the door.

35P. A nonuniform bar o
horizontal position by two
One cord makes the angle
makes the angle $\phi = 53.1°$
bar is 6.10 m, compute the
the bar to its center of grav

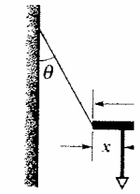

FIGURE 13-46 Problem 3

36P. In Fig. 13-47, a thin
and length L is pinned to a v
a thin wire BC that make
weight W can be moved an
defined by the distance x fro
function of x, find (a) the ter
tal and (c) vertical compone
the pin at A.

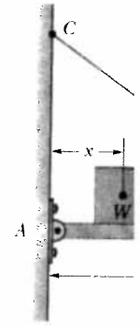

FIGURE 13-47 Problems 3

37P. In Fig. 13-47, suppos
3.0 m and its weight is 200 N
The wire can withstand a ma
is the maximum possible dist
W placed at this maximum
(c) vertical components of th
at A?

38P. Two uniform beams, A
hinges and then loosely bolte

6

FIGURE 13-48 Problem 38.