Honors Physics Rotation HW, statics (Homework)

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Include file name: Physics_Worksheet_0058
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1.
If the torque required to loosen a nut that is holding a flat tire in place on a car has a magnitude of 54.0 N·m, what *minimum* force must be exerted by the mechanic at the end of a 31.0-cm lug wrench to accomplish the task?

2.
A simple pendulum consists of a 2.0 kg point mass hanging at the end of a 2.3-m-long light string that is connected to a pivot point. Calculate the magnitude of the torque (due to the force of gravity) about this pivot point when the string makes a 5.0° angle with the vertical.

3.

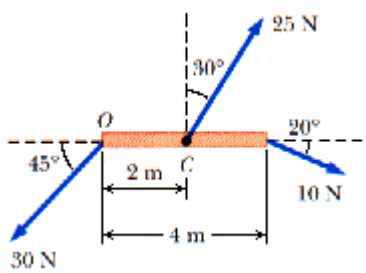

Figure P8.5.

Calculate the net torque (magnitude and direction) on the beam in Figure P8.5 about
(a) an axis through *O*, perpendicular to the page, and
Magnitude
Direction
(b) an axis through *C*, perpendicular to the page.
Magnitude
Direction

4.
A water molecule consists of an oxygen atom with two hydrogen atoms bound to it as shown in Figure P8.7. The bonds are 0.100 nm in length and the angle between the two bonds is 106°. Use the *x*-*y* axis shown and determine the location of the center of gravity of the molecule. Consider the mass of an oxygen atom to be 16 times the mass of a hydrogen atom.

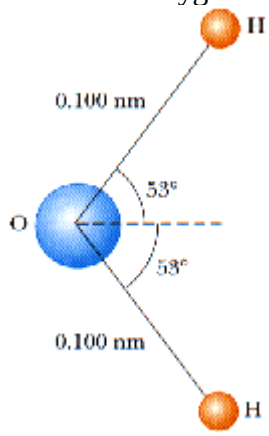

Figure P8.7.

5.
Find the *x*- and *y*-coordinates of the center of gravity of a 4.00 ft by 8.00 ft uniform sheet of plywood with a rectangular piece removed from the upper right corner as shown in the figure below. The dimensions of the cutout are a = 4.10 ft and b = 2.90 ft.

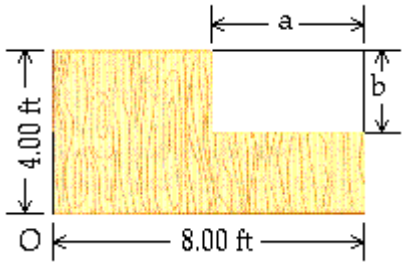

Figure P8.9.

6.
A cook holds a 1.60 kg carton of milk at arm's length (Fig. P8.11). What force $\mathbf{F}_B$ must be exerted by the biceps muscle? (Ignore the weight of the forearm.)

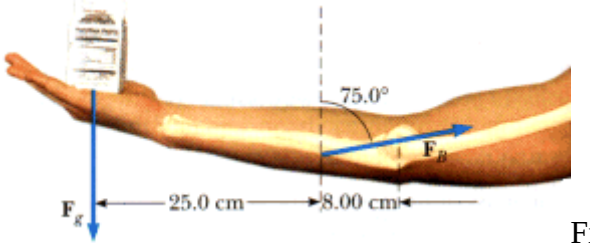

Figure P8.11.

7.
The chewing muscle, the masseter, is one of the strongest in the human body. It is attached to the mandible (lower jawbone) as shown in Figure P8.13a. The jawbone is pivoted about a socket just in front of the auditory canal. The forces acting on the jawbone are equivalent to those acting on the curved bar in Figure P8.13b: **C** is the force exerted against the jawbone by the food being chewed, **T** is the tension in the masseter, and **R** is the force exerted on the mandible by the socket. Find **T** and **R** if you bite down on a piece of steak with a force of 40.0 N.

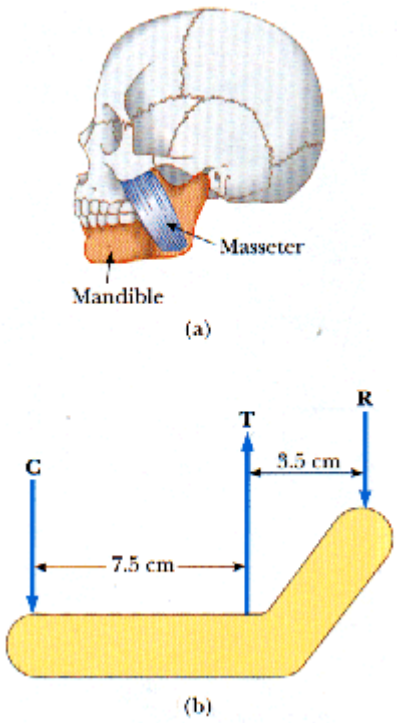

Figure P8.13.

8.
A uniform semicircular sign 1.00 m in diameter and of weight *W* is supported by two wires as shown in Figure P8.15. What is the tension in each of the wires supporting the sign?

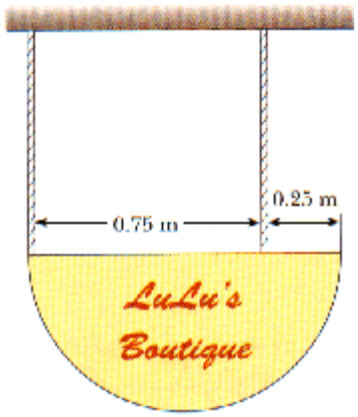

Figure P8.15.

9.
A 500 N uniform rectangular sign 4.00 m wide and 3.00 m high is suspended from a horizontal, 6.00 m long, uniform, 100 N rod as indicated in Figure P8.17. The left end the rod is supported by a hinge and the right end is supported by a thin cable making a 30.0° angle with the vertical.

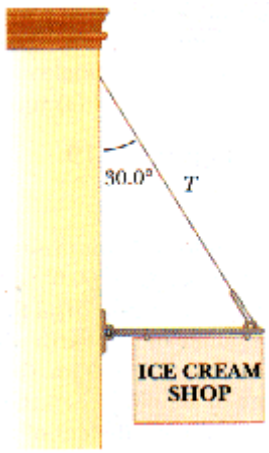

Figure P8.17.

(a) Find the tension, *T*, in the cable.
(b) Find the horizontal and vertical components of force exerted on the left end of the rod by the hinge. (Take up and to the right to be the positive directions.)

10.
A uniform plank of length 2.00 m and mass 27.5 kg is supported by three ropes, as indicated by the blue vectors in Figure P8.19. Find the tension in each rope when a 675-N person is 0.500 m from the left end.

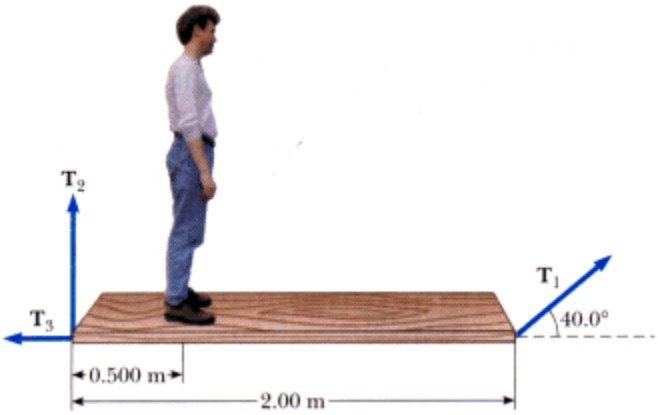

Figure P8.19.

11.
An 7.0-m, 240-N uniform ladder rests against a smooth wall. The coefficient of static friction between the ladder and the ground is 0.55, and the ladder makes a 50.0° angle with the ground. How far up the ladder can an 800-N person climb before the ladder begins to slip?

12.
A 1400 N uniform boom is supported by a cable perpendicular to the boom, as in Figure P8.22. The boom is hinged at the bottom, and a 1800 N weight hangs from its top.

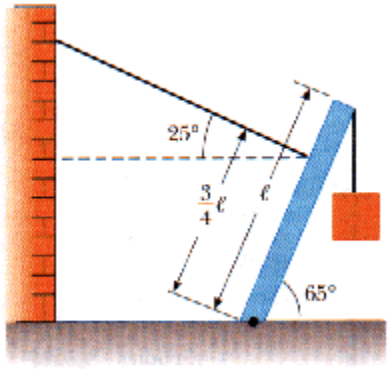

Figure P8.22.

(a) Find the tension in the supporting cable.
(b) Find the components of the reaction force exerted on the boom by the hinge.

13.
One end of a uniform 6.0 m long rod of weight *w* is supported by a cable. The other end rests against the wall, where it is held by friction (see Fig. P8.24). The coefficient of static friction between the wall and the rod is $\mu_s = 0.50$. (The wire makes an angle of 37° with the rod.) Determine the minimum distance, *x*, from point *A* at which an additional weight *w* (same as the weight of the rod) can be hung without causing the rod to slip at point *A*.

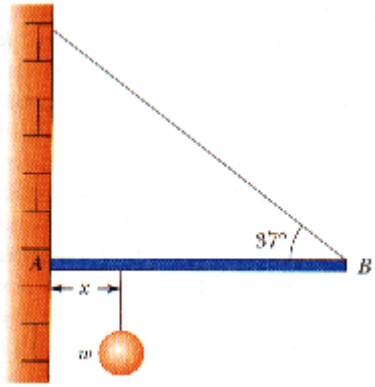

Figure P8.24.