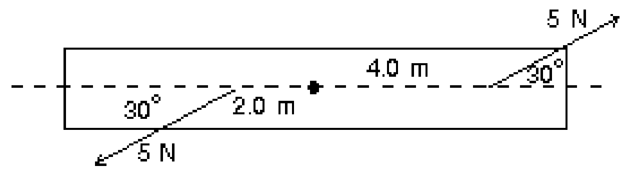
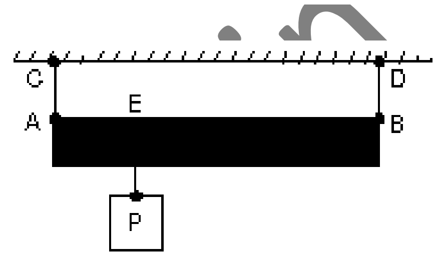
1 A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. The magnitude of the total torque (in N.m) about the pivot is:



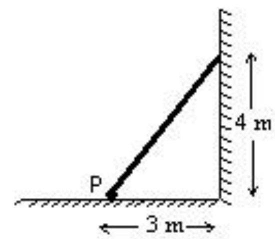
0 5 9 15 26

2 A uniform rod AB is 1.2 m long and weighs 16 N. It is suspended by strings AC and BD as shown. A block P weighing 96 N is attached at E, 0.30 m from A. The magnitude of the tension force (in N) in the string BD is:



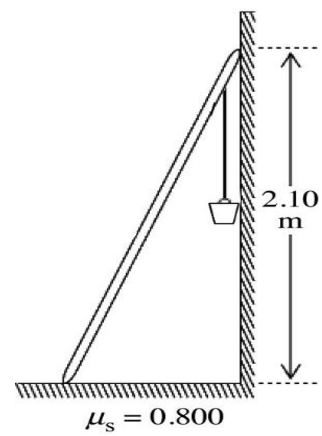
8 24 32 48 80

3 An 80-N uniform rod leans against a frictionless wall as shown. The torque (in N.m) (about point P) applied to the rod by the wall is:



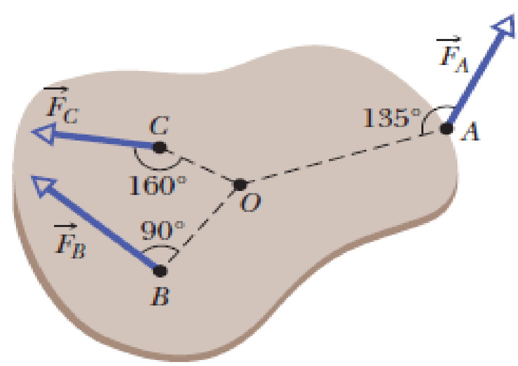
40 60 120 160 240

4 A 10.0-kg uniform ladder that is 2.50 m long is placed against a smooth vertical wall and reaches to a height of 2.10 m, as shown in the figure. The base of the ladder rests on a rough horizontal floor whose coefficient of static friction with the ladder is 0.800. An 80.0-kg bucket of concrete is suspended from the top rung of the ladder, right next to the wall, as shown in the figure. What is the magnitude of the friction force (in N) that the floor exerts on the ladder?



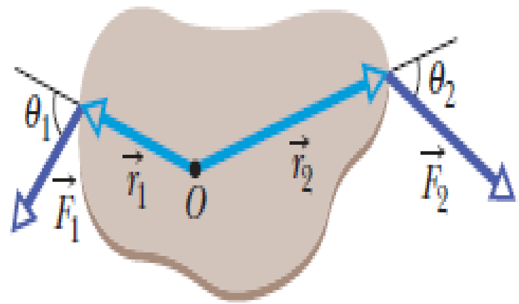
538 706 1290 833 601

5 The rigid object shown lies in a horizontal plane and is free to rotate about the pivot O. Three forces act on it: $F_A = 10$ N, $F_B = 16$ N and $F_C = 19$ N.
If AO = 8 m, BO = 4 m and CO = 3 m, what is the net torque (in N.m) about O?



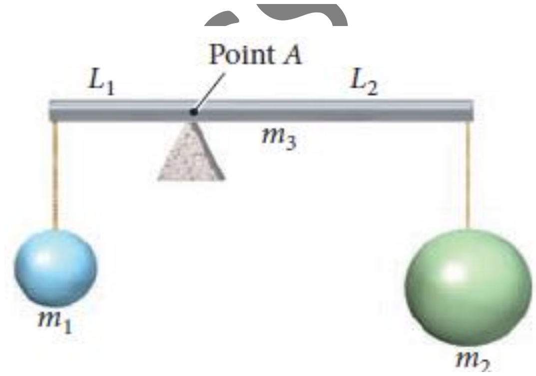
+12 –21 +101 –27 +140

6 The rigid object shown lies in a horizontal plane and is free to rotate about the pivot O. Two forces act on it; F_1= 4.2 N and F_2= 4.9 N. If r_1 =1.3 m, r_2 =2.15 m, θ_1=75°, and θ_2 = 60°, then the net torque (in N.m) about O is:



–3.85 +14.37 –14.37 +5.27 –1.07

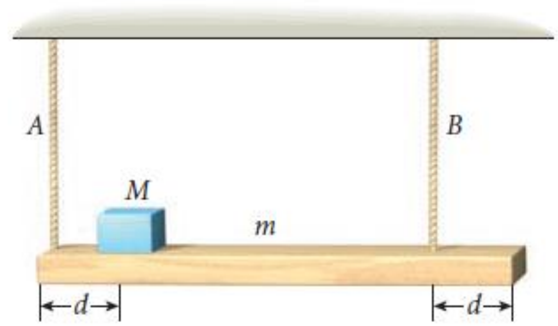
7 As shown, a rigid rod of mass m_3 is pivoted at point A, where two masses (m_1 and m_2) are hanging from it. The hanging mass m_2 is equal to $2m_1$, while the rod's mass m_3 is equal to $3m_1$. The distances L_1 and L_2 are measured from point A to m_1 and m_2, respectively. At static equilibrium, the ratio (L_1/L_2) is:



7/5 5/2 7/2 3/7 2/5

The figure below belongs to Q8 & Q9:

8 As shown, a wooden beam is supported by two vertical ropes, A and B. The weight of the beam is mg = 120 N and its length is 5 m. Rope A is connected to the left end of the beam, while rope B is connected at a distance d = 1 m from the right end. A box with a weight Mg = 20 N is placed on the beam with its center of mass at d = 1 m from rope A. If the whole system is in static equilibrium, the tension (in N) in the rope A is:

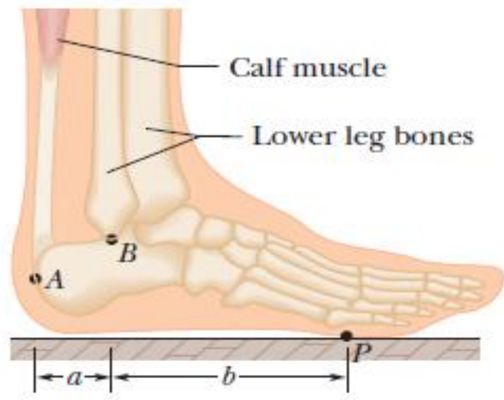


60 80 53 140 220

9 As shown, a wooden beam is supported by two vertical ropes, A and B. The weight of the beam is mg = 120 N and its length is 5 m. Rope A is connected to the left end of the beam, while rope B is connected at a distance d = 1 m from the right end. A box with a weight Mg = 20 N is placed on the beam with its center of mass at d = 1 m from rope A. If the whole system is in static equilibrium, the tension (in N) in the rope B is:

80 60 200 140 27

The figure below belongs to Q10 & Q11:



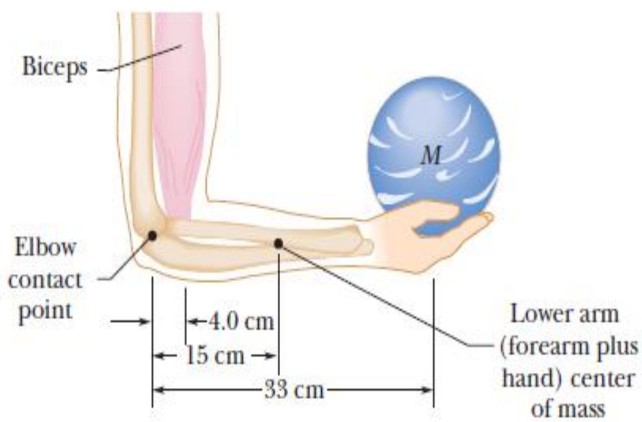
10 A patient's foot shown in the figure does contact the floor only at point P (the heel does not touch the floor). The calf muscle acts on the foot with a force at point A, while the lower leg bones act on the foot with a force at point B. If the patient's weight is 900 N, distance a = 5 cm and distance b = 15 cm, the calf's force (in N) is:

2700 upward 2700 downward 900 downward
4500 upward 4500 downward

11 The foot shown in the figure does contact the floor only at point P (the heel does not touch the floor). The calf muscle acts on the foot with a force at point A, while the lower leg bones act on the foot with a force at point B. If the student's weight is 900 N, distance a = 5 cm and distance b = 15 cm, the lower leg bones' force (in N) is:

3600 downward 3600 downward 900 downward 5400 upward 5400 downward

The figure below belongs to Q12 & Q13:



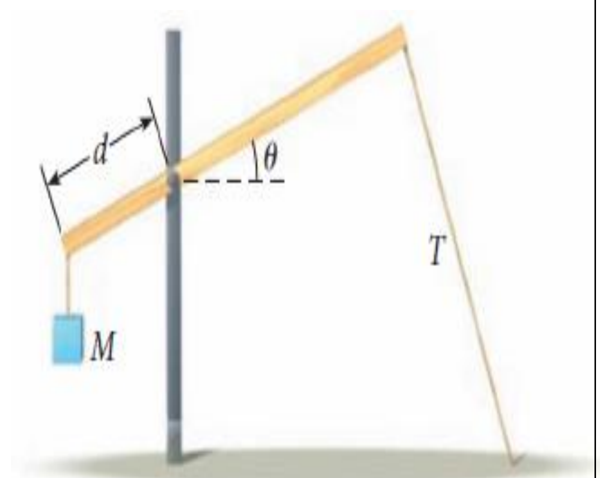
12 As shown, a PHY 105 student holds a massive ball (M= 7.2 kg) by his hand. The student's upper arm is vertical, while his lower arm (of mass 1.8 kg) is horizontal. Both of the biceps muscle and the bone of the upper arm do act on the lower arm with forces, each at a specific point as shown. The biceps' force (in N) is:

650 upward 650 downward
88 upward 88 downward
450 upward

13 As shown, a PHY 105 student holds a massive ball (M= 7.2 kg) by his hand. The student's upper arm is vertical, while his lower arm (of mass 1.8 kg) is horizontal. Both of the biceps muscle and the bone of the upper arm do act on the lower arm with forces, each at a specific point as shown. The upper arm bone's force (in N) is:

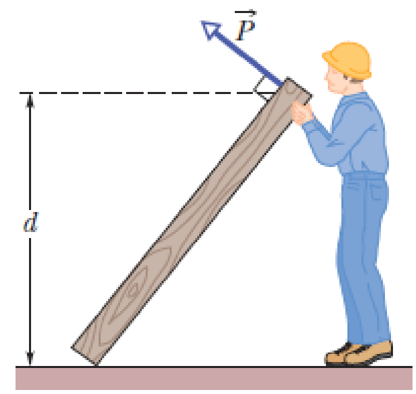
560 downward 560 upward 88 upward 88 downward 320 downward

14 As shown, a wooden beam with a length of 8 m and a mass of 100 kg is attached by a strong bolt to a vertical steel support at a distance d = 3 m from the left end. The beam makes an angle θ = 30.0° with the horizontal. A huge mass M = 500 kg is attached with a rope to the left end of the beam, and a second rope is attached at a right angle (90°) to the other end of the beam. If the whole system is in static equilibrium, the tension T (in N) in the second rope is approximately:



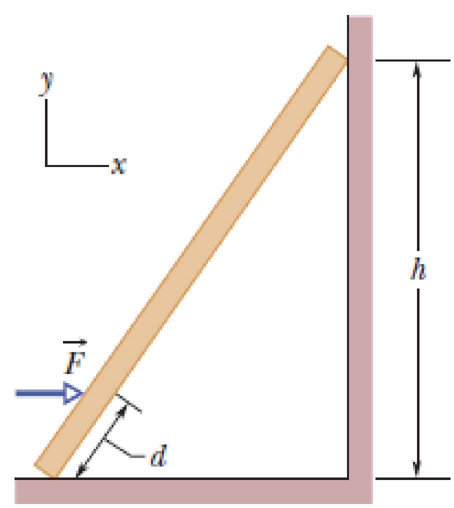
2380 7950 1190 3004 14070

15 In order to hold a beam (of weight 500 N and length 2.5 m) at rest, a PHY 105 student exerts a force P perpendicular to the beam, as shown. The vertical distance d is 1.5 m. The minimum value the coefficient of static friction between the beam and the floor can have in order for the beam not to slip is:



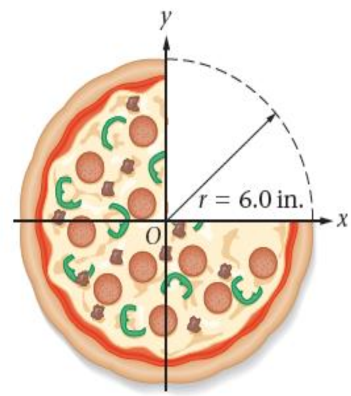
0.35 0.75 0.67 0.60 0.56

16 A uniform ladder leans against a vertical smooth wall and rests on a rough horizontal ground, as shown. The ladder is 10 m long and weighs 200 N. The height h is 8.0 m. A horizontal force F is applied to the ladder at distance d = 2 m from its bottom base. The coefficient of static friction between the ladder and the ground is 0.38. The minimum value of the force F (in N) by which the bottom base of the ladder will be on the verge of moving toward the vertical wall is:



189 76 45 35 200

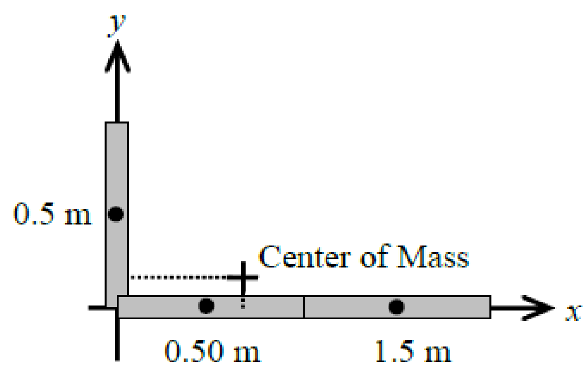
17 The location of the center of mass of the partially eaten, 12-inch-diameter pizza shown is Xcm = -1.4 in. and Ycm = -1.4 in. Assume each quadrant of the pizza to be the same. Find the center of mass of the uneaten pizza above the x axis (that is, the portion of the pizza in the second quadrant). Find the center of mass of the third quadrant and the fourth one.



For the second quadrant: (Xcm, Ycm) = (-4.2 in, +4.2 in).
For the third quadrant: (Xcm, Ycm) = (-4.2 in, -4.2 in).
For the fourth quadrant: (Xcm, Ycm) = (+4.2 in, -4.2 in).

Insight: These locations are near the crust, suggesting a concentration of mass at the edge of the pizza. Perhaps the crust is stuffed with cheese!

18 Three uniform metersticks, each of mass m, are placed on the floor as follows: stick 1 lies along the y axis from y = 0 to y = 1.0 m, stick 2 lies along the x axis from x = 0 to x = 1.0 m, stick 3 lies along the x axis from x = 1.0 m to x = 2.0 m.
(a) Find the location of the center of mass of the metersticks.
(b) How would the location of the center of mass be affected if the mass of the metersticks were doubled?

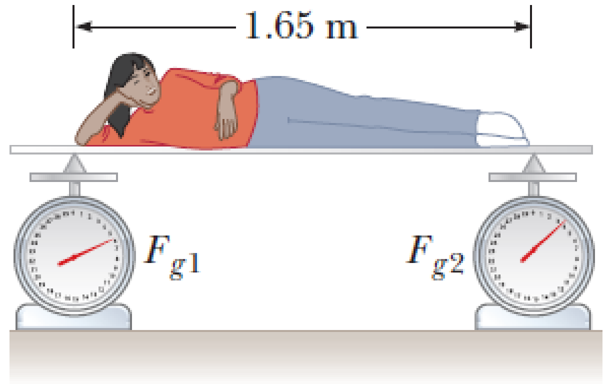


(a) (Xcm, Ycm) = (0.67 m, 0.17 m).
(b) The location of the center of mass would not be affected. The mass drops out of the equations.

19 Two point masses are located in the same plane. The distance from mass 1 to the center of mass is 3.0 m. The distance from mass 2 to the center of mass is 1.0 m. What is m_1/m_2, the ratio of mass 1 to mass 2?
3/4 4/3 4/7 7/4 1/3 3/1

20 The center of mass of the Sun and Jupiter is located
exactly at the center of the Sun.
near the center of the Sun.
exactly at the center of Jupiter.
near the center of Jupiter.
halfway between the Sun and Jupiter.

21 In exercise physiology studies, it is sometimes important to determine the location of a person's center of mass. This determination can be done with the arrangement shown in the figure. A light plank rests on two scales, which read F_{g1} = 380 N and F_{g2} = 320 N. A distance of 1.65 m separates the scales. How far (in m) from the woman's feet is her center of mass?



0.896

22 A rock climber hangs freely from a nylon rope that is 16 m long and has a diameter of 8.1 mm. (a) If the rope stretches 4.2 cm, what is the mass (in kg) of the climber? (b) What would be the stretch in the rope (in cm) if another climber with twice the mass hangs instead? Young's modulus for nylon is 3×10^9 N/m^2 (as given in Table 9.1)

(a) 41.4
(b) 8.4

23 A horizontal aluminum rod 4.8 cm in diameter projects 5.3 cm from a wall. A 1200 kg object is suspended from the end of the rod. The shear modulus of aluminum is 3.0×10^{10} N/m^2. Neglecting the rod's mass, find the vertical deflection (in m) of the end of the rod.

1.1×10^{-5}

24 A solid copper cube has an edge length of 85.5 cm. How much stress (in N/m^2) must be applied to the cube to reduce the edge length to 85.0 cm?

Hint: the bulk modulus of copper is 1.4×10^{11} N/m^2.

2.4 10^9

25 Two supports, have the same Young's modulus and initially of equal length, are 2.0 m apart. A stiff board with a length of 4.0 m and a mass of 10 kg is placed on the supports, with one support at the left end and the other at the midpoint. A block is placed on the board a distance of 0.50 m from left end. As a result, the two supports compressed by the same amount and produced the same force on the board. This compression keeps the board horizontal. The mass (in kg) of the block is:

20   2.3   6.6   10   30