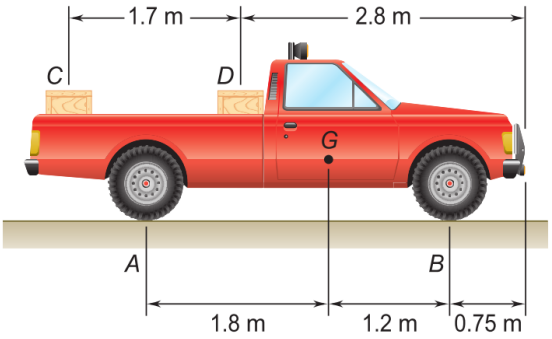
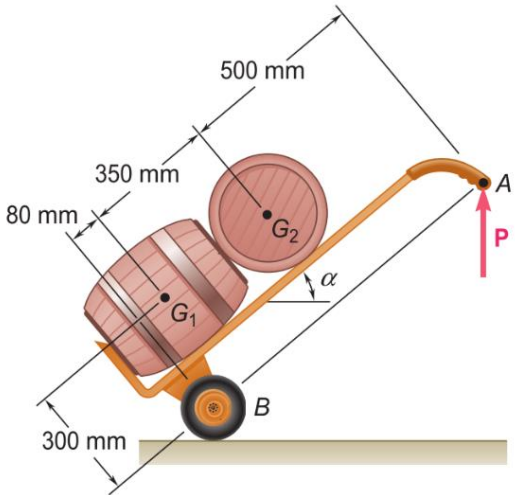
ENGINEERING MECHANICS: UNIT 1

(Note: Questions bear the same number as in **Vector Mechanics for Engineers 10th Edition**)

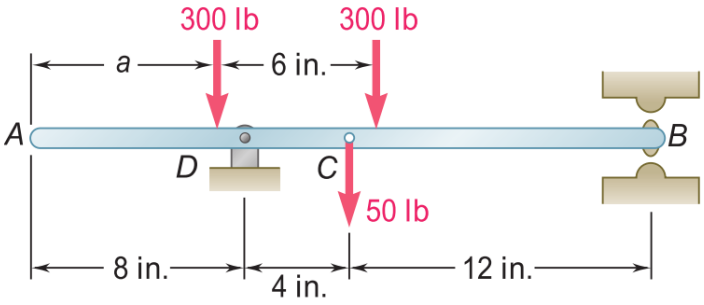
4.1 Two crates, each of mass 350 kg, are placed as shown in the bed of a 1400-kg pickup truck. Determine the reactions at each of the two (a) rear wheels A, (b) front wheels B.



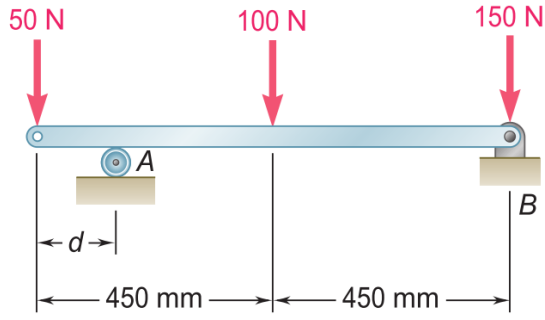
4.5 A hand truck is used to move two kegs, each of mass 40 kg. Neglecting the mass of the hand truck, determine (a) the vertical force **P** that should be applied to the handle to maintain equilibrium when $\alpha = 38°$, (b) the corresponding reaction at each of the two wheels.



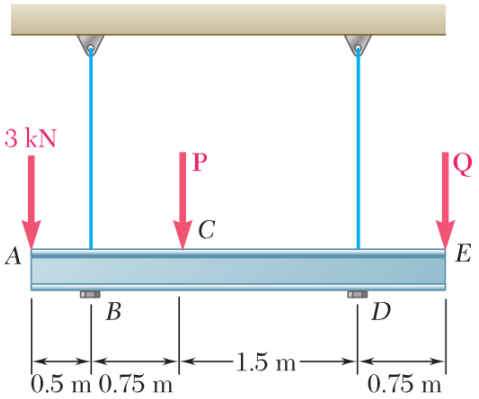
4.9 For the beam and loading shown, determine the range of the distance *a* for which the reaction at B does not exceed 100 lb downward or 200 lb upward.



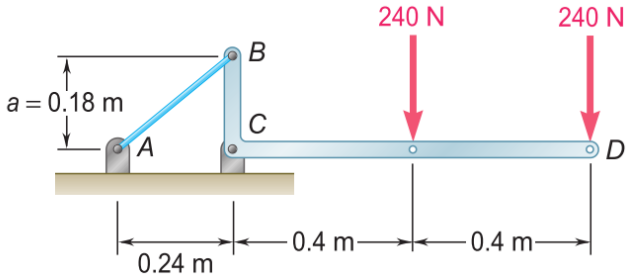
4.10 The maximum allowable value of each of the reactions is 180 N. Neglecting the weight of the beam, determine the range of the distance *d* for which the beam is safe.



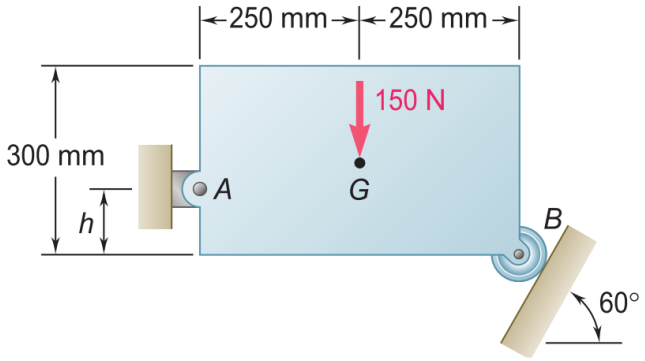
4.11 Three loads are applied as shown to a light beam supported by cables attached at B and D. Neglecting the weight of the beam, determine the range of values of Q for which neither cable becomes slack when P=0.



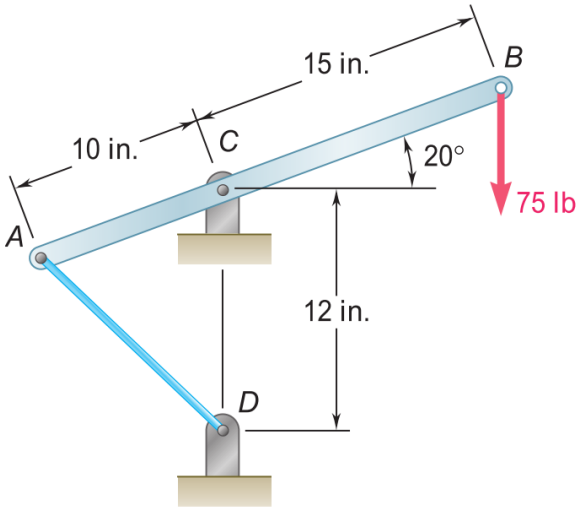
4.15 The bracket BCD is hinged at C and attached to a control cable at B. For the loading shown, determine (a) the tension in the cable, (b) the reaction at C.



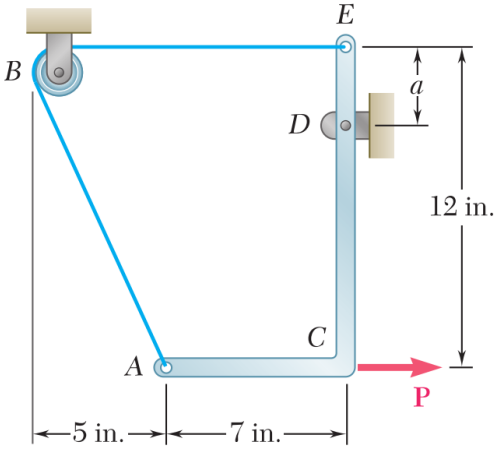
4.23 Determine the reactions at A and B when (a) h = 0, (b) h = 200 mm.



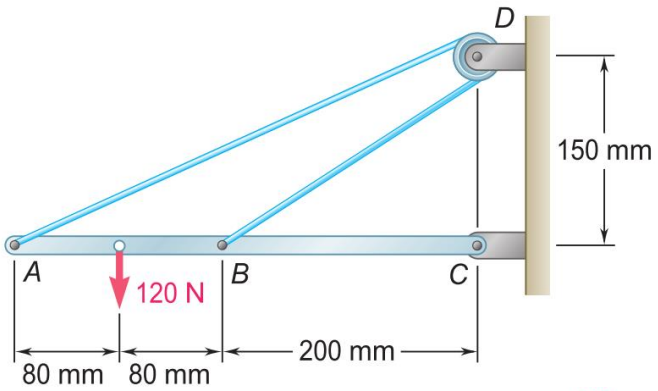
4.24 A lever AB is hinged at C and attached to a control cable at A. If the lever is subjected to a 75-lb vertical force at B, determine (a) the tension in the cable, (b) the reaction at C.



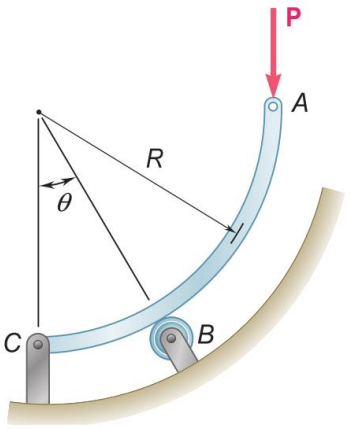
4.29 A force **P** of magnitude 90 lb is applied to member ACE, which is supported by a frictionless pin at D and by the cable ABE. Since the cable passes over a small pulley at B, the tension may be assumed to be the same in portions AB and BE of the cable. For the case when a = 3 in., determine (a) the tension in the cable, (b) the reaction at D.



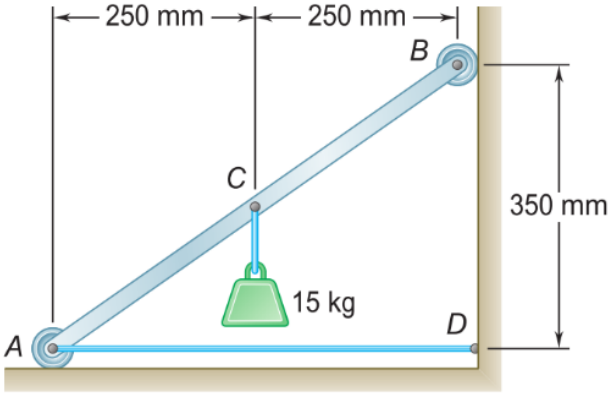
4.32 Neglecting friction and the radius of the pulley, determine (a) the tension in cable ADB, (b) the reaction at C.



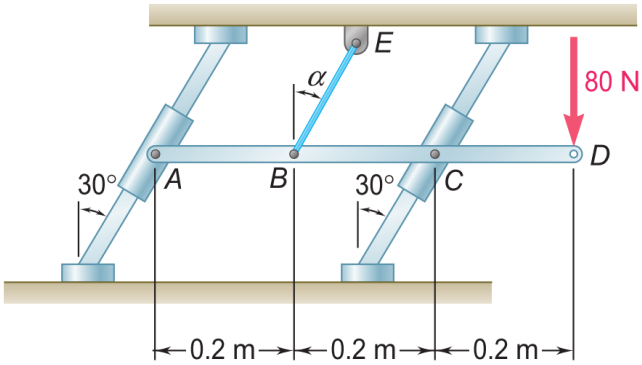
4.33 Rod ABC is bent in the shape of an arc of circle of radius R. Knowing that $\theta = 30°$, determine the reaction (a) at B, (b) at C.



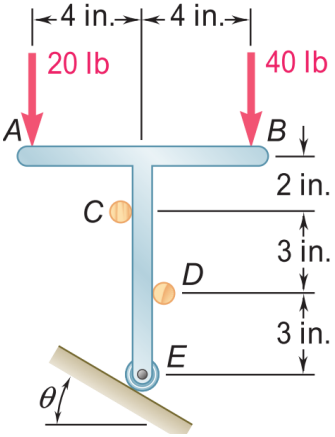
4.36 A light bar AB supports a 15-kg block at its midpoint C. Rollers at A and B rest against frictionless surfaces, and a horizontal cable AD is attached at A. Determine (a) the tension in cable AD, (b) the reactions at A and B.



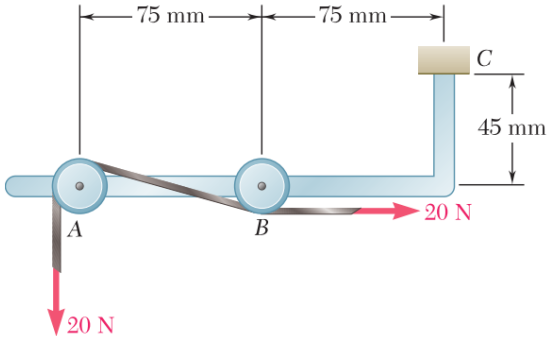
4.39 Bar AD is attached at A and C to collars that can move freely on the rods shown. If the cord BE is vertical (a = 0), determine the tension in the cord and the reactions at A and C.



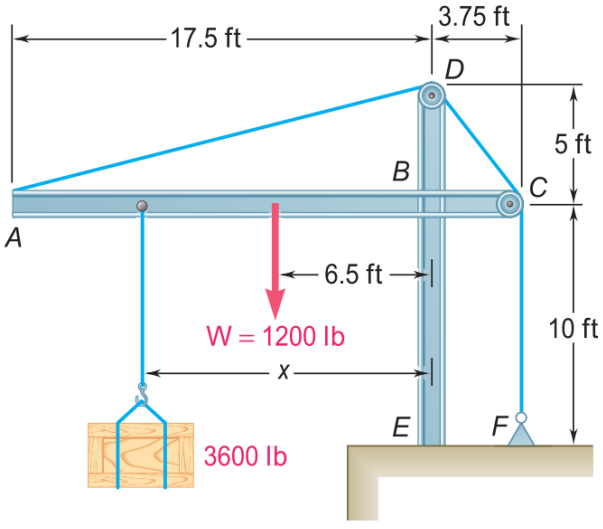
4.41 The T-shaped bracket shown is supported by a small wheel at E and pegs at C and D. Neglecting the effect of friction, determine the reactions at C, D, and E when $\theta = 30°$.



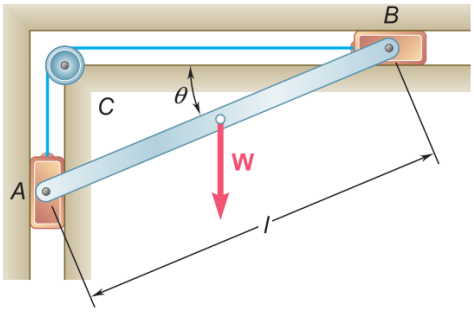
4.46 A tension of 20 N is maintained in a tape as it passes through the support system shown. Knowing that the radius of each pulley is 10 mm, determine the reaction at C.



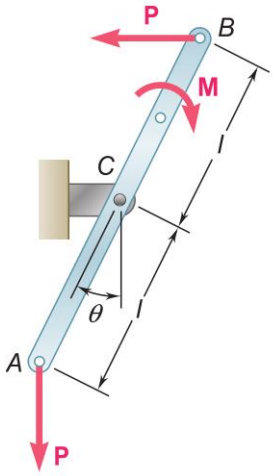
4.48 The rig shown consists of a 1200-lb horizontal member ABC and a vertical member DBE welded together at B. The rig is being used to raise a 3600-lb crate at a distance *x* = 12 ft from the vertical member DBE. If the tension in the cable is 4 kips(1 kip= 1000 lb), determine the reaction at E, assuming that the cable is (a) anchored at F as shown in the figure, (b) attached to the vertical member at a point located 1 ft above E.



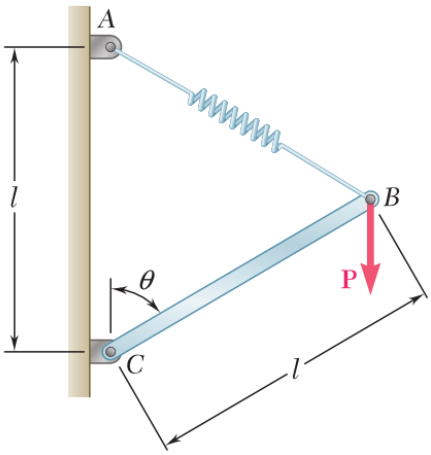
4.53 A slender rod AB, of weight W, is attached to blocks A and B, which move freely in the guides shown. The blocks are connected by an elastic cord that passes over a pulley at C. (a) Express the tension in the cord in terms of W and θ. (b) Determine the value of u for which the tension in the cord is equal to 3W.



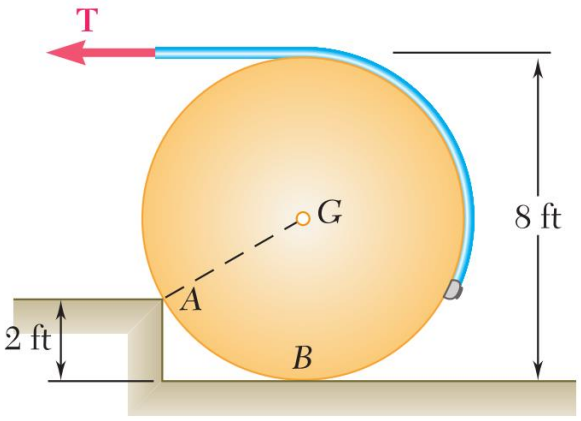
4.54 Rod AB is acted upon by a couple **M** and two forces, each of magnitude P. (a) Derive an equation in u, P, M, and *l* that must be satisfied when the rod is in equilibrium. (b) Determine the value of θ corresponding to equilibrium when M = 150 Nm, P = 200 N, and *l* = 600 mm.



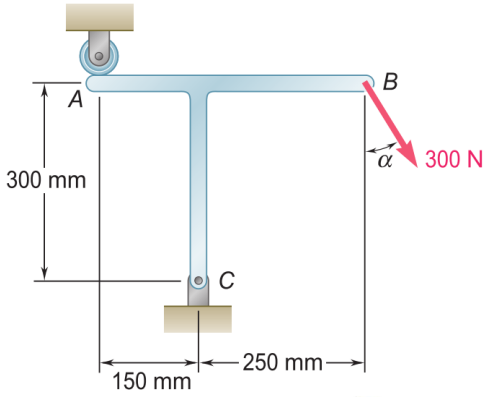
4.57 A vertical load **P** is applied at end B of rod BC. The constant of the spring is *k*, and the spring is unstretched when $\theta = 60°$. (a) Neglecting the weight of the rod, express the angle θ corresponding to the equilibrium position in terms of *P, k*, and *l*. (b) Determine the value of θ corresponding to equilibrium if $P = \frac{1}{4}kl$



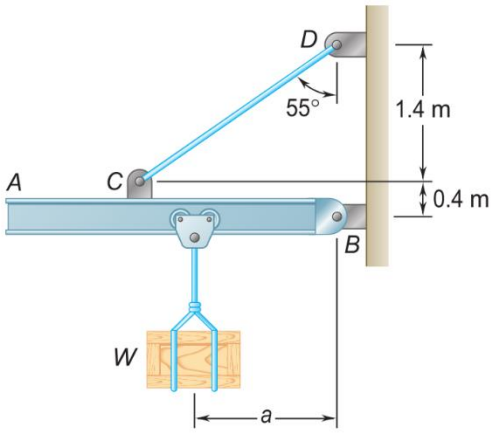
4.64 A 500-lb cylindrical tank, 8 ft in diameter, is to be raised over a 2-ft obstruction. A cable is wrapped around the tank and pulled horizontally as shown. Knowing that the corner of the obstruction at A is rough, find the required tension in the cable and the reaction at A.



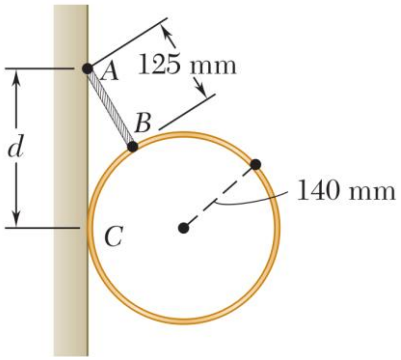
4.69 A T-shaped bracket supports a 300-N load as shown. Determine the reactions at A and C when $\alpha = 45°$.



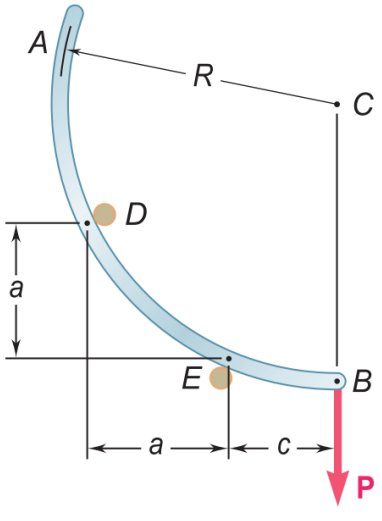
4.73 A 50-kg crate is attached to the trolley-beam system shown. Knowing that a = 1.5 m, determine (a) the tension in cable CD, (b) the reaction at B.



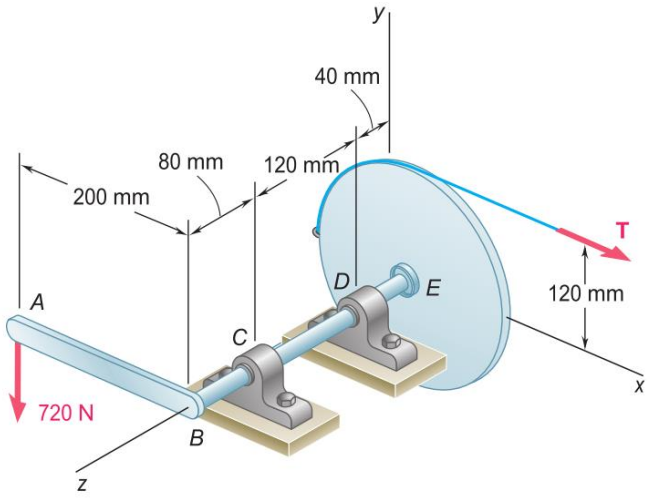
4.83 A thin ring of mass 2 kg and radius r = 140 mm is held against a frictionless wall by a 125-mm string AB. Determine (a) the distance *d*, (b) the tension in the string, (c) the reaction at C.



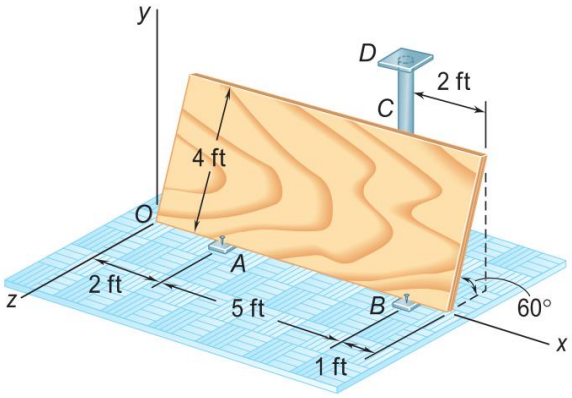
4.88 Rod AB is bent into the shape of an arc of circle and is lodged between two pegs D and E. It supports a load **P** at end B. Neglecting friction and the weight of the rod, determine the distance *c* corresponding to equilibrium when a = 20 mm and R = 100 mm.



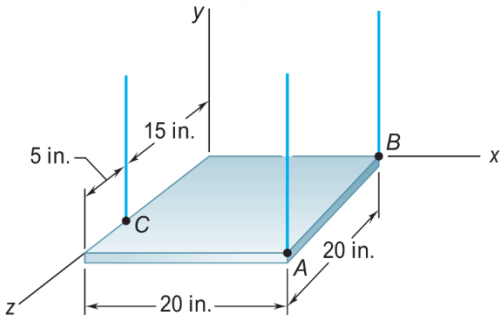
4.91 A 200-mm lever and a 240-mm-diameter pulley are welded to the axle BE that is supported by bearings at C and D. If a 720-N vertical load is applied at A when the lever is horizontal, determine (a) the tension in the cord, (b) the reactions at C and D. Assume that the bearing at D does not exert any axial thrust.



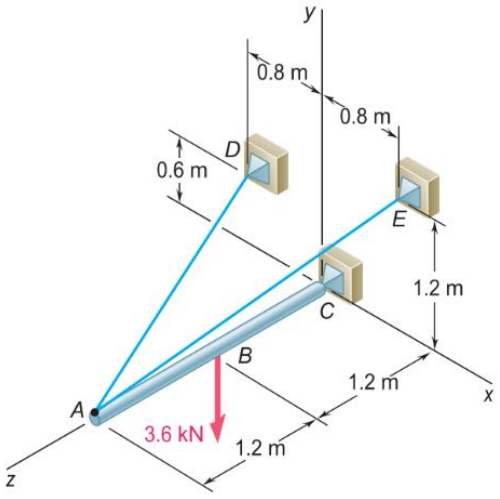
4.93 A 4 x 8-ft sheet of plywood weighing 40 lb has been temporarily propped against column CD. It rests at A and B on small wooden blocks and against protruding nails. Neglecting friction at all surfaces of contact, determine the reactions at A, B, and C.



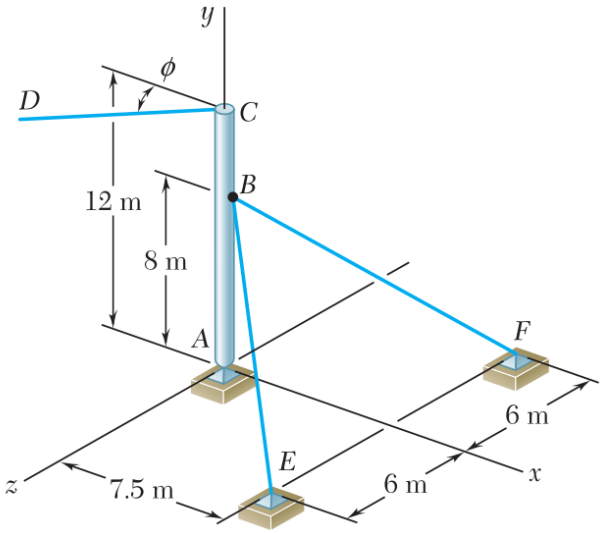
4.99 The 45-lb square plate shown is supported by three vertical wires. Determine the tension in each wire.



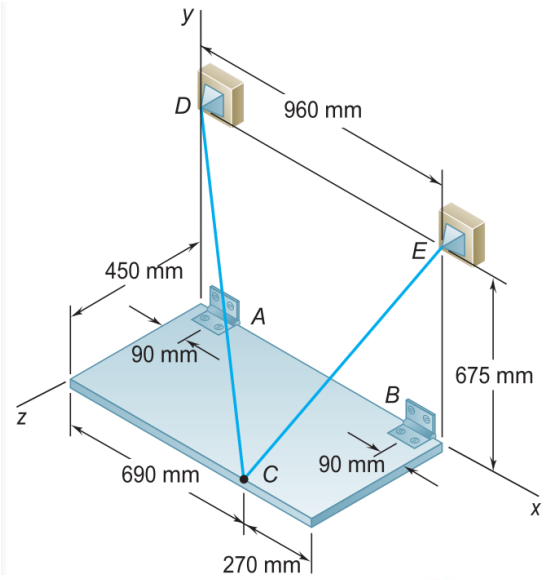
4.105 A 2.4-m boom is held by a ball-and-socket joint at C and by two cables AD and AE. Determine the tension in each cable and the reaction at C.



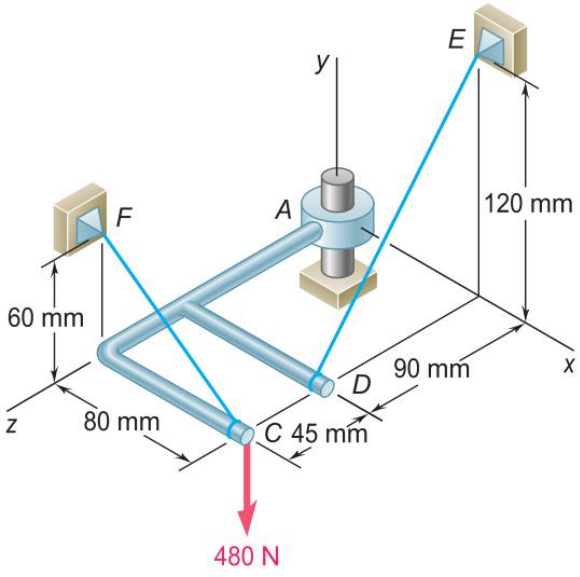
4.108 A 12-m pole supports a horizontal cable CD and is held by a ball and socket at A and two cables BE and BF. Knowing that the tension in cable CD is 14 kN and assuming that CD is parallel to the x axis ($\phi = 0°$), determine the tension in cables BE and BF and the reaction at A.



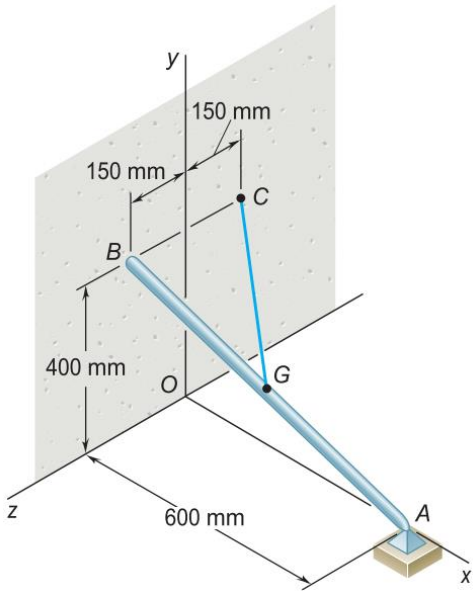
4.113 A 100-kg uniform rectangular plate is supported in the position shown by hinges A and B and by cable DCE that passes over a frictionless hook at C. Assuming that the tension is the same in both parts of the cable, determine (a) the tension in the cable, (b) the reactions at A and B. Assume that the hinge at B does not exert any axial thrust.



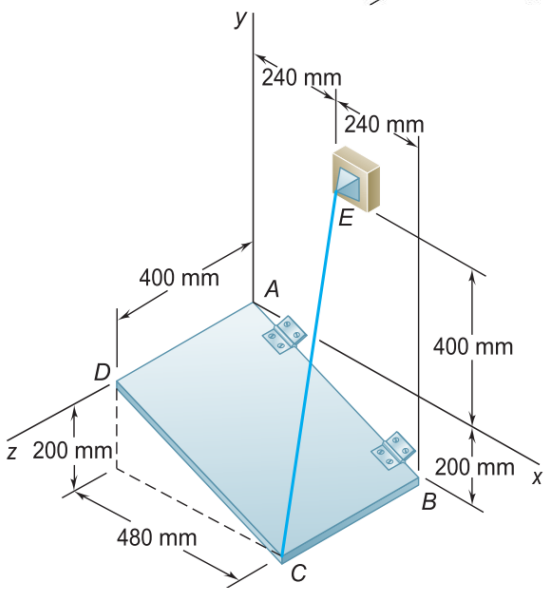
4.121 The assembly shown is welded to collar A that fits on the vertical pin shown. The pin can exert couples about the x and z axes but does not prevent motion about or along the y axis. For the loading shown, determine the tension in each cable and the reaction at A.



4.128 The uniform 10-kg rod AB is supported by a ball-and-socket joint at A and by the cord CG that is attached to the midpoint G of the rod. Knowing that the rod leans against a frictionless vertical wall at B, determine (a) the tension in the cord, (b) the reactions at A and B.



4.133 The 50-kg plate ABCD is supported by hinges along edge AB and by wire CE. Knowing that the plate is uniform, determine the tension in the wire.



4.140 The bent rod ABDE is supported by ball-and-socket joints at A and E and by the cable DF. If a 60-lb load is applied at C as shown, determine the tension in the cable.