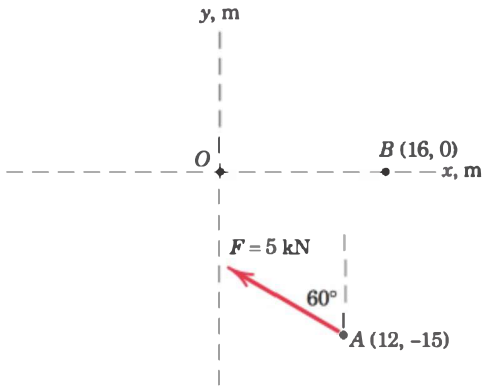
PROBLEMS

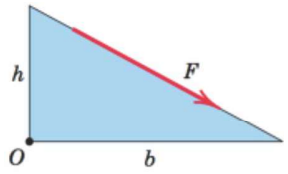
Introductory Problems

2/31 Determine the moments of the 5-kN force about point O and about point B.



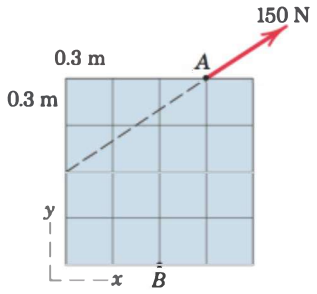
Problem 2/31

2/32 The force of magnitude F acts along the edge of the triangular plate. Determine the moment of **F** about point O.



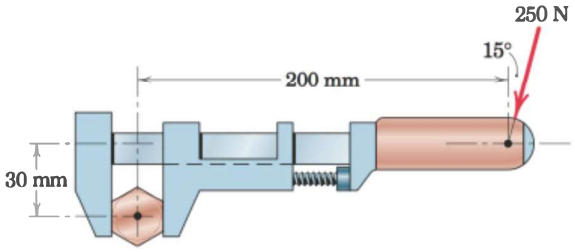
Problem 2/32

2/33 The rectangular plate is made up of 0.3-m squares as shown. A 150-N force is applied at point A in the direction shown. Calculate the moment M_B of the force about point B by at least two different methods.



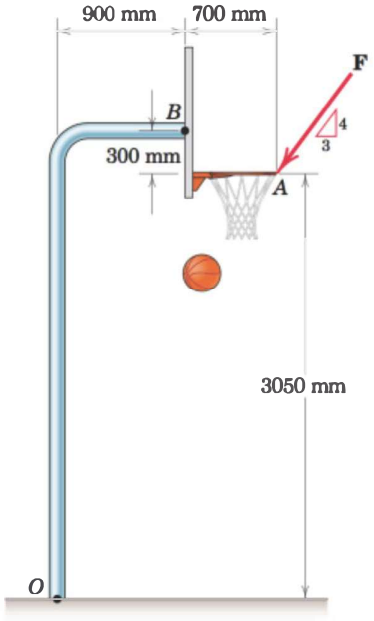
Problem 2/33

2/34 Calculate the moment of the 250-N force on the handle of the monkey wrench about the center of the bolt.



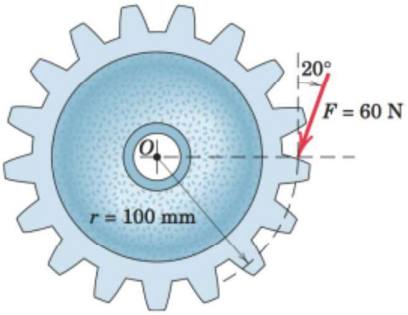
Problem 2/34

2/35 An experimental device imparts a force of magnitude F = 225 N to the front edge of the rim at A to simulate the effect of a slam dunk. Determine the moments of the force F about point O and about point B. Finally, locate, from the base at O, a point C on the ground where the force imparts zero moment.



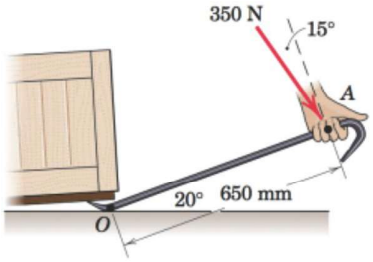
Problem 2/35

2/36 A force **F** of magnitude 60 N is applied to the gear. Determine the moment of **F** about point O.



Problem 2/36

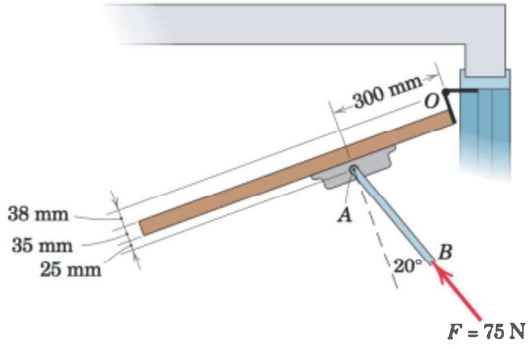
2/37 A man uses a crowbar to lift the corner of a hot tub for maintenance purposes. Determine the moment made by the 350-N force about point O. Neglect the small thickness of the crowbar.



Problem 2/37

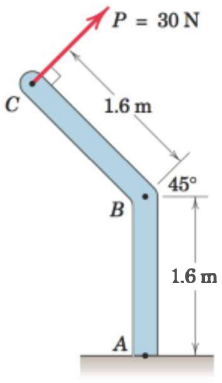
Representative Problems

2/38 An overhead view of a door is shown. If the compressive force F acting in the coupler arm of the hydraulic door closer is 75 N with the orientation shown, determine the moment of this force about the hinge axis O.



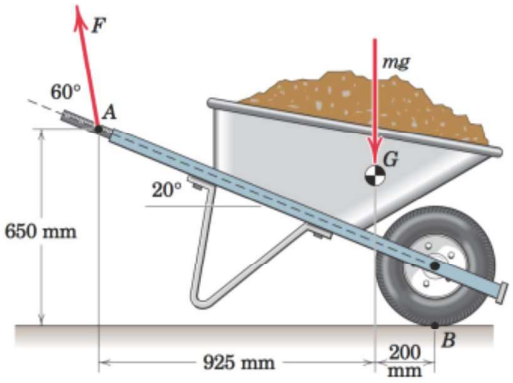
Problem 2/38

2/39 The 30-N force **P** is applied perpendicular to the portion BC of the bent bar. Determine the moment of **P** about point B and about point A.



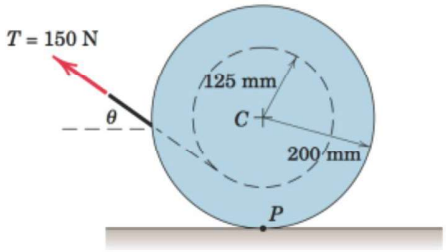
Problem 2/39

2/40 A man exerts a force F on the handle of the stationary wheelbarrow at A. The mass of the wheelbarrow along with its load of dirt is 85 kg with center of mass at G. For the configuration shown, what force F must the man apply at A to make the net moment about the tire contact point B equal to zero?



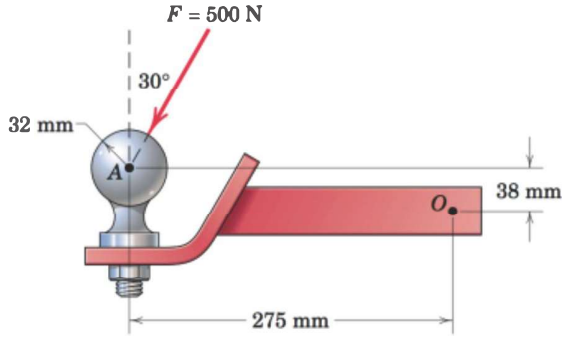
Problem 2/40

2/41 A 150-N pull T is applied to a cord, which is wound securely around the inner hub of the drum. Determine the moment of T about the drum center C. At what angle θ should T be applied so that the moment about the contact point P is zero?



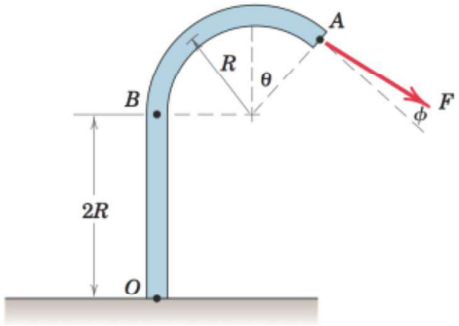
Problem 2/41

2/42 As a trailer is towed in the forward direction, the force $F = 500$ N is applied as shown to the ball of the trailer hitch. Determine the moment of this force about point O.



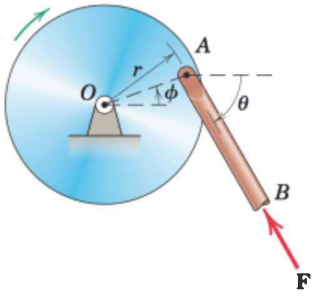
Problem 2/42

2/43 Determine the general expressions for the moments of F about (a) point B and (b) point O. Evaluate your expressions for $F = 750$ N, $R = 2.4$ m, $\theta = 30°$, and $\phi = 15°$.



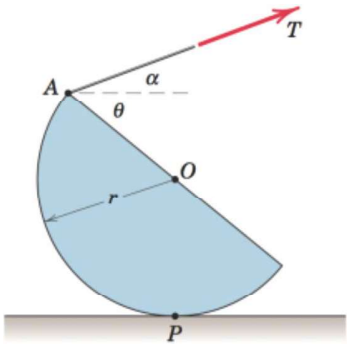
Problem 2/43

2/44 The mechanism of Prob. 2/15 is repeated here. Develop a general expression for the moment M_O of the force acting on the coupler arm AB about the center O of the disk. Evaluate your expression for (a) $F = 500$ N, $\theta = 60°$, $\phi = 20°$, and (b) $F = 800$ N, $\theta = 45°$, $\phi = 150°$. Assume a value of $r = 0.4$ m for both cases.



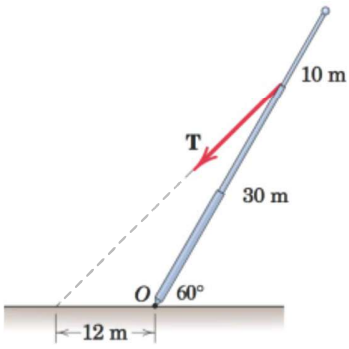
Problem 2/44

2/45 Determine the moments of the tension T about point P and about point O.



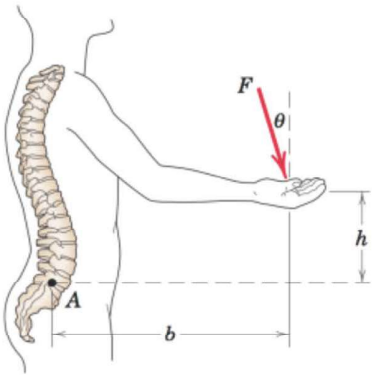
Problem 2/45

2/46 In raising the pole from the position shown, the tension T in the cable must supply a moment about O of 72 kN·m. Determine T.



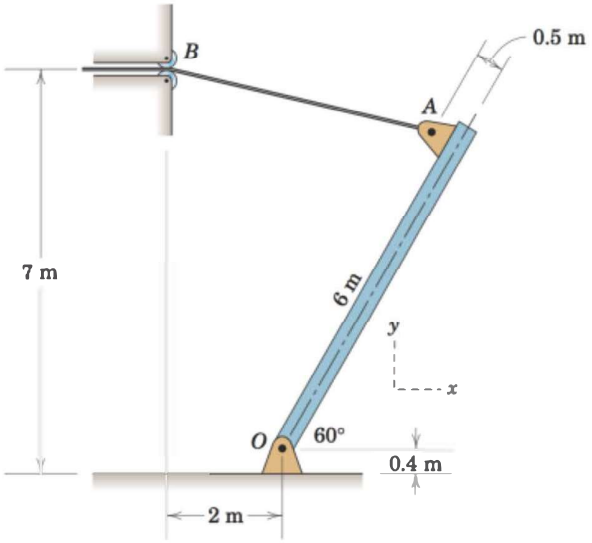
Problem 2/46

2/47 The lower lumbar region A of the spine is the part of the spinal column most susceptible to abuse while resisting excessive bending caused by the moment about A of a force F. For given values of F, b, and h, determine the angle θ which causes the most severe bending strain.



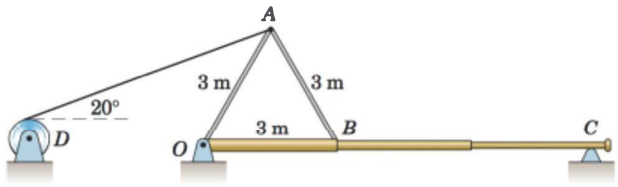
Problem 2/47

2/48 A gate is held in the position shown by cable AB. If the tension in the cable is 6.75 kN, determine the moment $\mathbf{M}_O$ of the tension (as applied to point A) about the pivot point O of the gate.



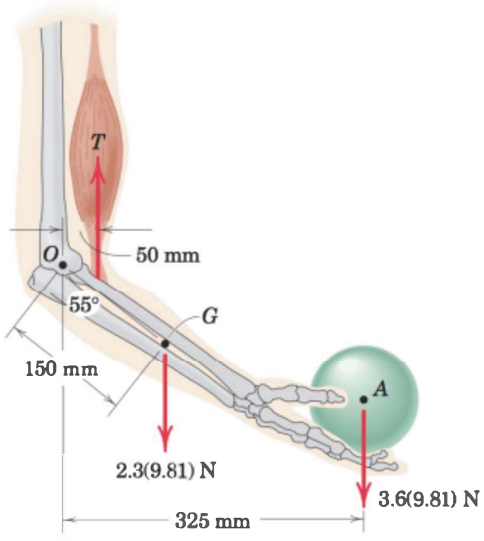
Problem 2/48

2/49 In order to raise the flagpole OC, a light frame OAB is attached to the pole and a tension of 3.2 kN is developed in the hoisting cable by the power winch D. Calculate the moment M_O of this tension about the hinge point O.



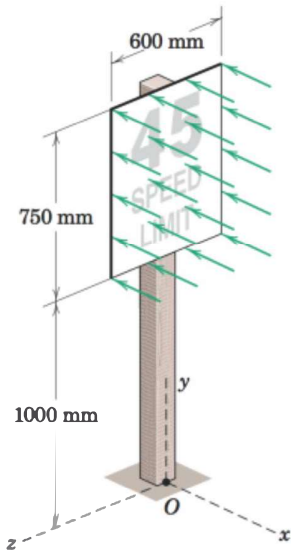
Problem 2/49

2/50 Elements of the lower arm are shown in the figure. The mass of the forearm is 2.3 kg with center of mass at G. Determine the combined moment about the elbow pivot O of the weights of the forearm and the sphere. What must the biceps tension force be so that the overall moment about O is zero?



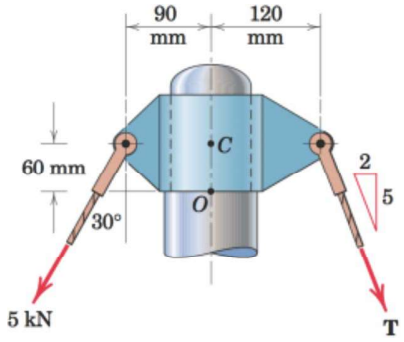
Problem 2/50

2/51 As the result of a wind blowing normal to the plane of the rectangular sign, a uniform pressure of 175 N/m^2 is exerted in the direction shown in the figure. Determine the moment of the resulting force about point O. Express your result as a vector using the coordinates shown.



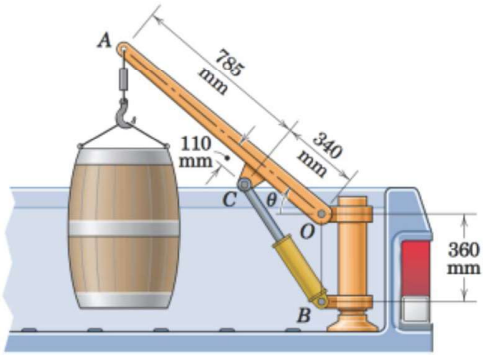
Problem 2/51

2/52 The masthead fitting supports the two forces shown. Determine the magnitude of **T** which will cause no bending of the mast (zero moment) at point O.



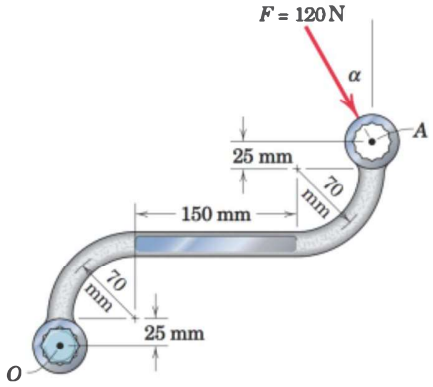
Problem 2/52

2/53 The small crane is mounted along the side of a pickup bed and facilitates the handling of heavy loads. When the boom elevation angle is $\theta = 40°$, the force in the hydraulic cylinder BC is 4.5 kN, and this force applied at point C is in the direction from B to C (the cylinder is in compression). Determine the moment of this 4.5-kN force about the boom pivot point O.



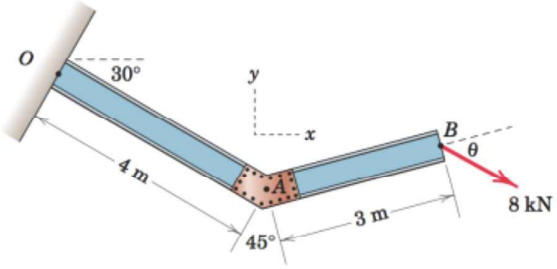
Problem 2/53

2/54 The 120-N force is applied as shown to one end of the curved wrench. If $\alpha = 30°$, calculate the moment of F about the center O of the bolt. Determine the value of α which would maximize the moment about O; state the value of this maximum moment.



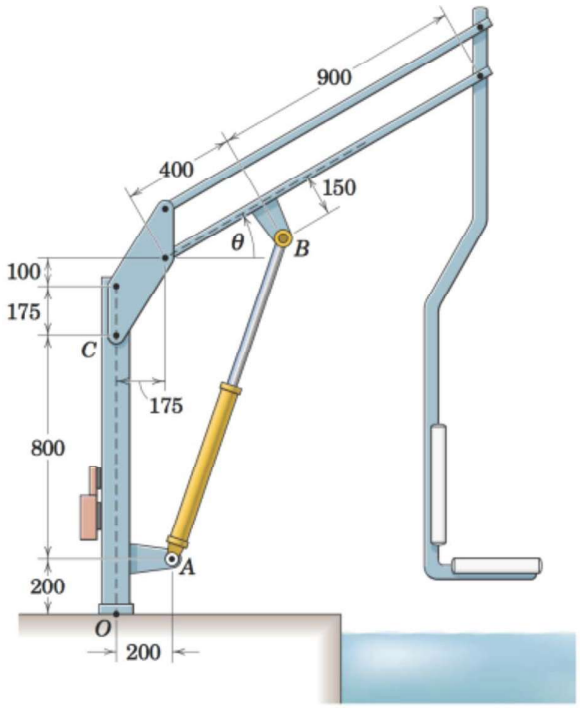
Problem 2/54

2/55 The bent cantilever beam is acted upon by an 8-kN force at B. If the angle $\theta = 35°$, determine (a) the moment $\mathbf{M}_O$ of the force about point O and (b) the moment $\mathbf{M}_A$ of the force about point A. What value(s) of θ ($0 < \theta < 360°$) will result in the maximum possible moment about point O, and what is the magnitude of the moment at those orientations?



Problem 2/55

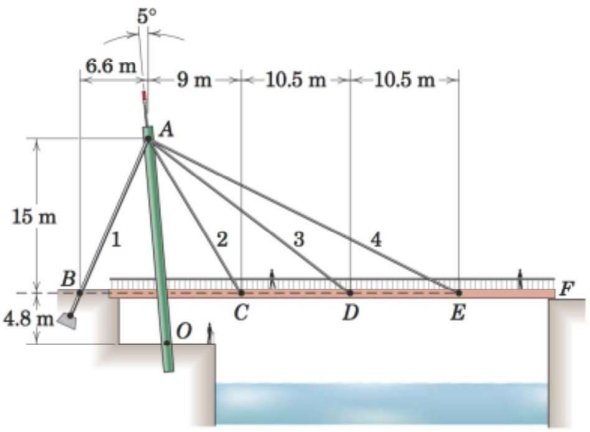
2/56 The mechanism shown is used to lower disabled persons into a whirlpool tub for therapeutic treatment. In the unloaded configuration, the weight of the boom and hanging chair induces a compressive force of 575 N in hydraulic cylinder AB. (Compressive means that the force which cylinder AB exerts on point B is directed from A toward B.) If $\theta = 30°$, determine the moment of this cylinder force acting on pin B about (*a*) point O and (*b*) point C.



Dimensions in millimeters

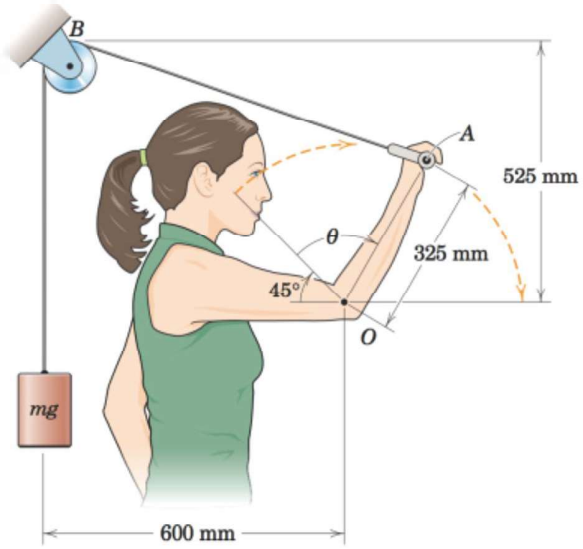
Problem 2/56

2/57 The asymmetrical support arrangement is chosen for a pedestrian bridge because conditions at the right end F do not permit a support tower and anchorages. During a test, the tensions in cables 2, 3, and 4 are all adjusted to the same value T. If the combined moment of all four cable tensions about point O is to be zero, what should be the value T_1 of the tension in cable 1? Determine the corresponding value of the compression force P at O resulting from the four tensions applied at A. Neglect the weight of the tower.



Problem 2/57

***2/58** The woman maintains a slow steady motion over the indicated 135° range as she exercises her triceps muscle. For this condition, the tension in the cable can be assumed to be constant at $mg = 50$ N. Determine and plot the moment M of the cable tension as applied at A about the elbow joint O over the range $0 \le \theta \le 135°$. Find the maximum value of M and the value of θ for which it occurs.



Problem 2/58