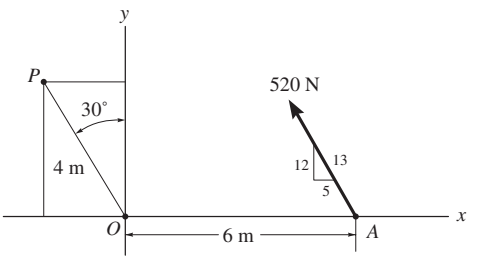
PROBLEMS

4–1. The man exerts the two forces on the handle of the shovel. Determine the resultant moment of these forces about the blade at A.

Prob. 4–1

4–2. Determine the magnitude and directional sense of the moment of the force at A about point O.

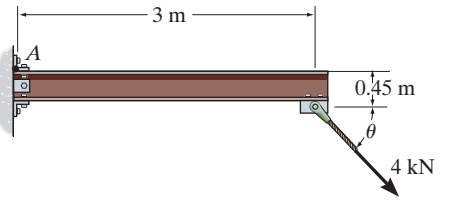
4–3. Determine the magnitude and directional sense of the moment of the force at A about point P.



Probs. 4–2/3

**4–4.* If $\theta = 45°$, determine the moment produced by the 4-kN force about point A.

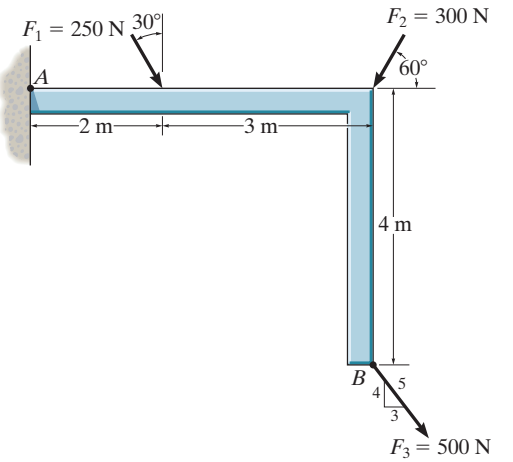
4–5. If the moment produced by the 4-kN force about point A is 10 kN · m clockwise, determine the angle θ, where $0° \le \theta \le 90°$.



Probs. 4–4/5

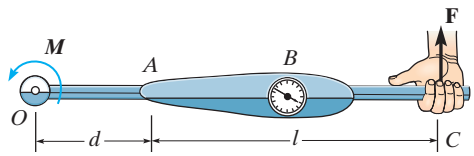
4–6. Determine the moment of each of the three forces about point A.

4–7. Determine the moment of each of the three forces about point B.



Probs. 4–6/7

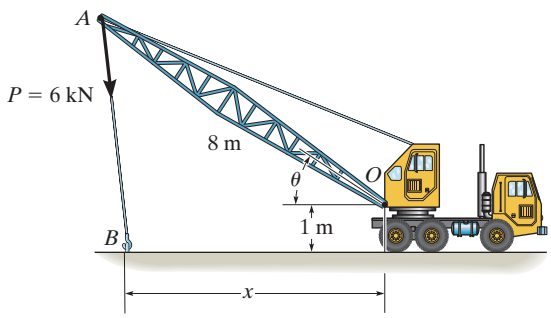
*4–8. The torque wrench ABC is used to measure the moment or torque applied to a bolt when the bolt is located at A and a force is applied to the handle at C. The mechanic reads the torque on the scale at B. If an extension AO of length d is used on the wrench, determine the required scale reading if the desired torque on the bolt at O is to be M.



Prob. 4–8

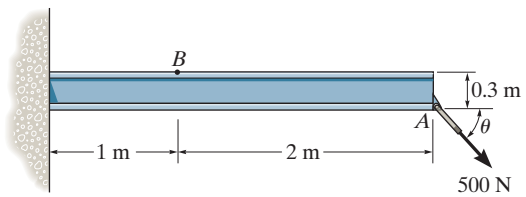
4–9. The cable exerts a force of $P = 6$ kN at the end of the 8-m-long crane boom. If $\theta = 30°$, determine the placement x of the boom at B so that this force creates a maximum moment about point O. What is this moment?

4–10. The cable exerts a force of $P = 6$ kN at the end of the 8-m-long crane boom. If $x = 10$ m, determine the angle θ of the boom so that this force creates a maximum moment about point O. What is this moment?



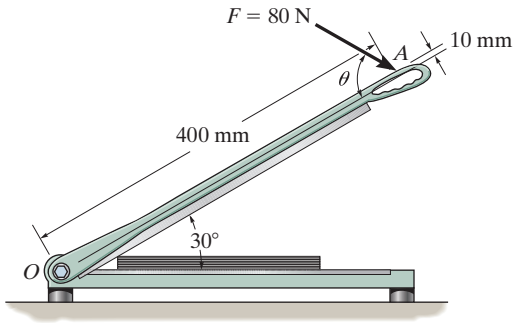
Probs. 4–9/10

4–11. Determine the angle θ at which the 500-N force must act at A so that the moment of this force about point B is equal to zero.



Prob. 4–11

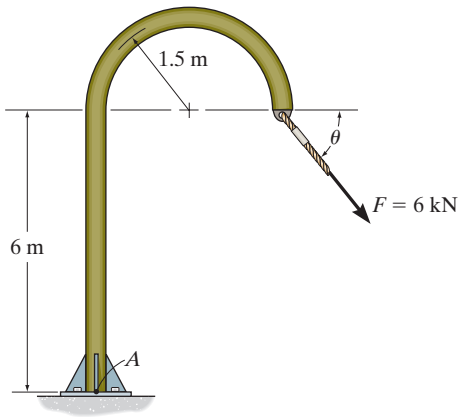
*4–12. A force of 80 N acts on the handle of the paper cutter at A. If $\theta = 60°$, determine the moment created by this force about the hinge at O. At what angle θ should the force be applied so that the moment it creates about point O is a maximum (clockwise)? What is this maximum moment?



Prob. 4–12

4–13. The member is subjected to a force of $F = 6$ kN. If $\theta = 45°$, determine the moment produced by **F** about point A.

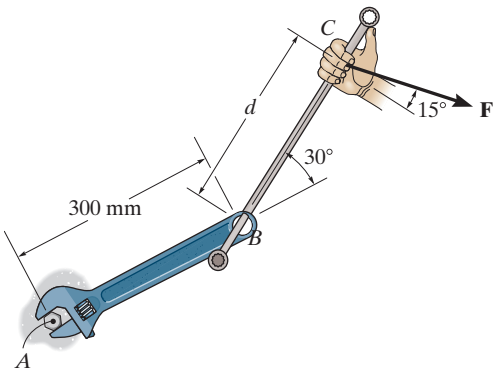
4–14. Determine the angle θ ($0° \le \theta \le 180°$) of the force **F** so that it produces a maximum moment and a minimum moment about point A. Also, what are the magnitudes of these maximum and minimum moments?



Probs. 4–13/14

4–15. The connected bar BC is used to increase the lever arm of the crescent wrench as shown. If a clockwise moment of $M_A = 120\ \text{N}\cdot\text{m}$ is needed to tighten the bolt at A and the force $F = 200\ N$, determine the required extension d in order to develop this moment.

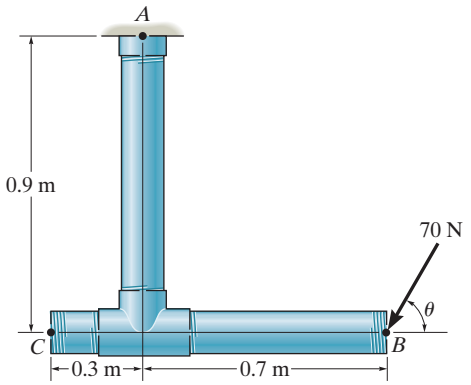
***4–16.** The connected bar BC is used to increase the lever arm of the crescent wrench as shown. If a clockwise moment of $M_A = 120\ \text{N}\cdot\text{m}$ is needed to tighten the nut at A and the extension $d = 300$ mm, determine the required force **F** in order to develop this moment.



Probs. 4–15/16

4–17. The 70-N force acts on the end of the pipe at B. Determine (a) the moment of this force about point A, and (b) the magnitude and direction of a horizontal force, applied at C, which produces the same moment. Take $\theta = 60°$.

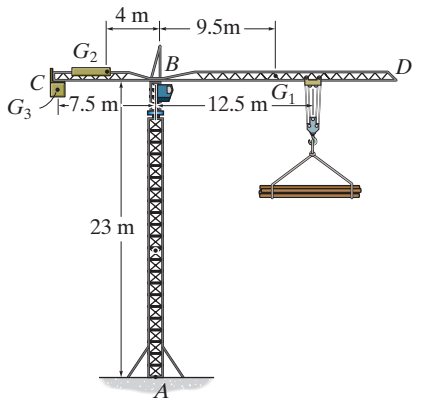
4–18. The 70-N force acts on the end of the pipe at B. Determine the angles θ ($0° \le \theta \le 180°$) of the force that will produce maximum and minimum moments about point A. What are the magnitudes of these moments?



Probs. 4–17/18

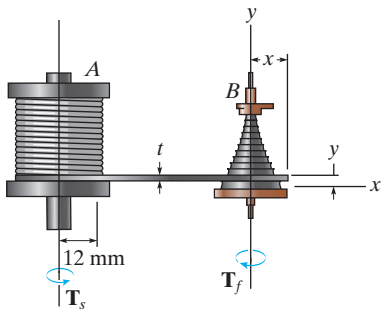
4–19. The tower crane is used to hoist the 2-Mg load upward at constant velocity. The 1.5-Mg jib BD, 0.5-Mg jib BC, and 6-Mg counterweight C have centers of mass at G_1, G_2, and G_3, respectively. Determine the resultant moment produced by the load and the weights of the tower crane jibs about point A and about point B.

***4–20.** The tower crane is used to hoist a 2-Mg load upward at constant velocity. The 1.5-Mg jib BD and 0.5-Mg jib BC have centers of mass at G_1 and G_2, respectively. Determine the required mass of the counterweight C so that the resultant moment produced by the load and the weights of the tower crane jibs about point A is zero. The center of mass for the counterweight is located at G_3.



Probs. 4–19/20

4–21. Old clocks were constructed using a *fusee* B to drive the gears and watch hands. The purpose of the fusee is to increase the leverage developed by the mainspring A as it uncoils and thereby loses some of its tension. The mainspring can develop a torque (moment) $T_s = k\theta$, where $k = 0.015\ \text{N}\cdot\text{m/rad}$ is the torsional stiffness and θ is the angle of twist of the spring in radians. If the torque T_f developed by the fusee is to remain constant as the mainspring winds down, and $x = 10$ mm when $\theta = 4$ rad, determine the required radius of the fusee when $\theta = 3$ rad.



Prob. 4–21