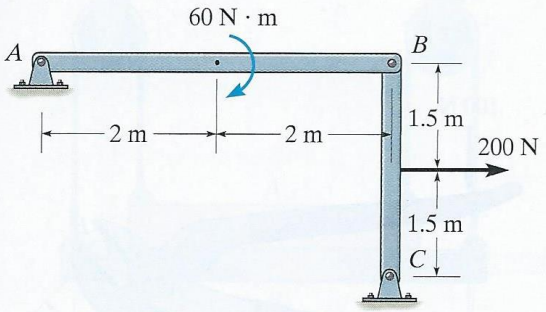
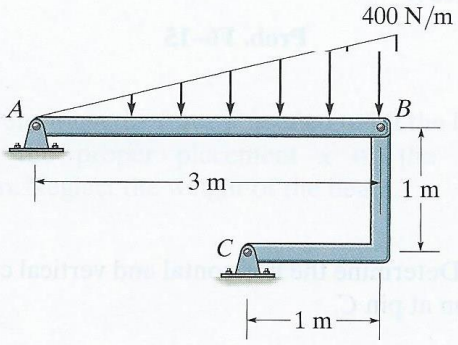
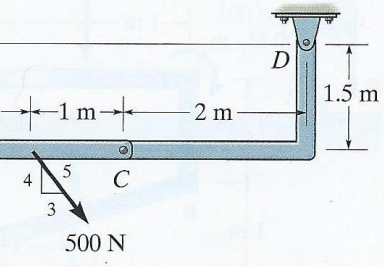
P6–3. In each case, identify any two-force members, and then draw the free-body diagrams of each member of the frame.



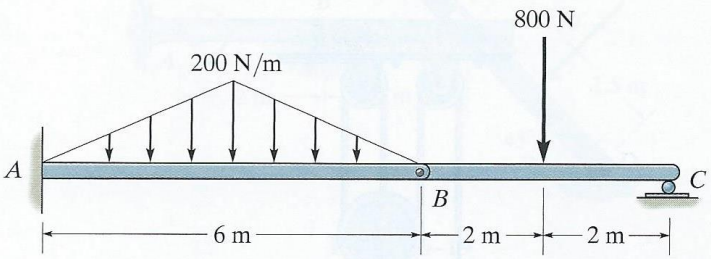
(a)



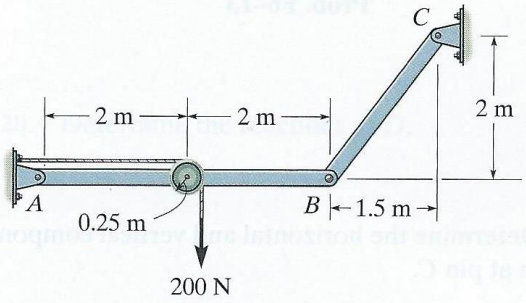
(b)



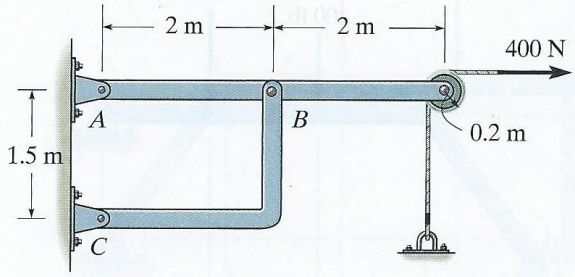
(c)



(d)



(e)

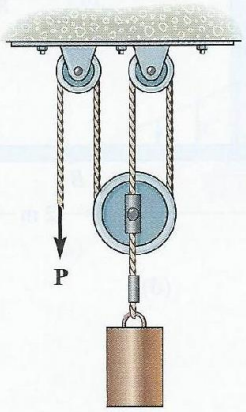


(f)

Prob. P6–3

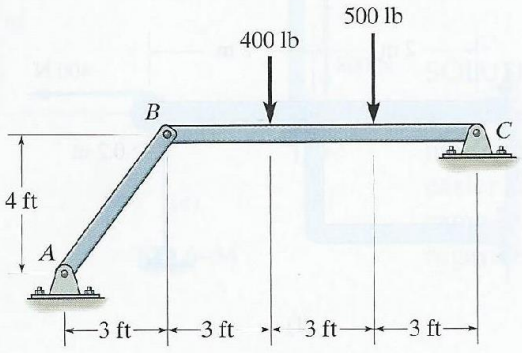
All problem solutions must include FBDs.

F6–13. Determine the force P needed to hold the 60-lb weight in equilibrium.



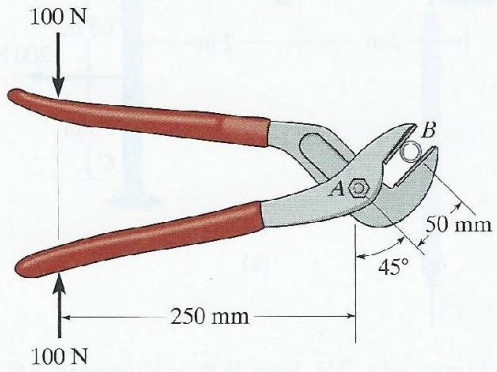
Prob. F6–13

F6–14. Determine the horizontal and vertical components of reaction at pin C.



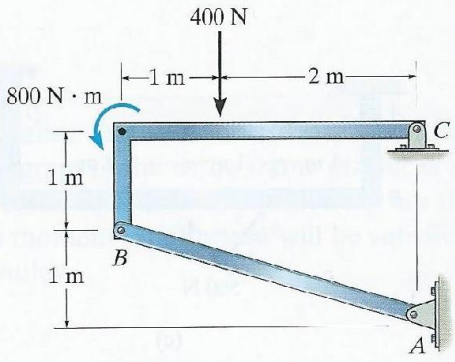
Prob. F6–14

F6–15. If a 100-N force is applied to the handles of the pliers, determine the clamping force exerted on the smooth pipe B and the magnitude of the resultant force that one of the members exerts on pin A.



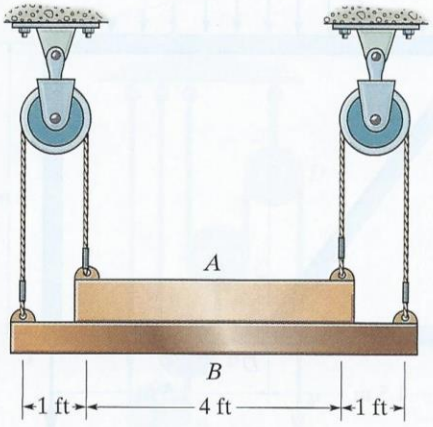
Prob. F6–15

F6–16. Determine the horizontal and vertical components of reaction at pin C.



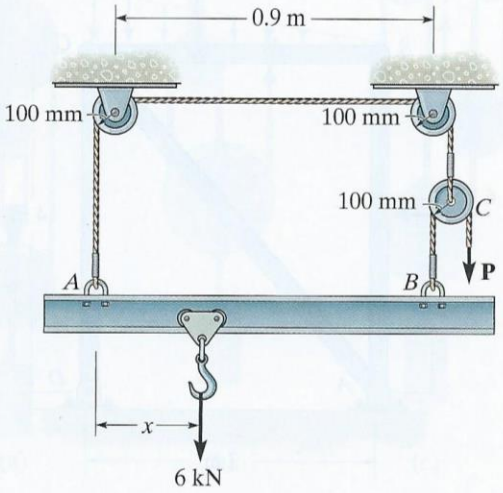
Prob. F6–16

F6–17. Determine the normal force that the 100-lb plate A exerts on the 30-lb plate B.



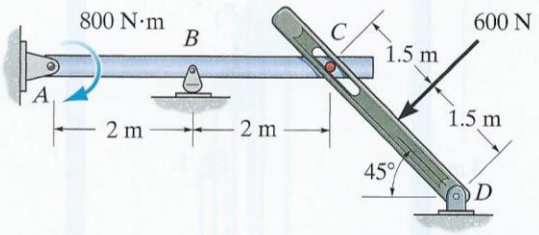
Prob. F6–17

F6–18. Determine the force P needed to lift the load. Also, determine the proper placement x of the hook for equilibrium. Neglect the weight of the beam.



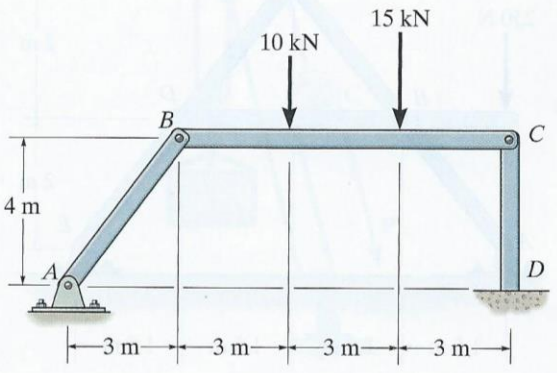
Prob. F6–18

F6–19. Determine the components of reaction at A and B.



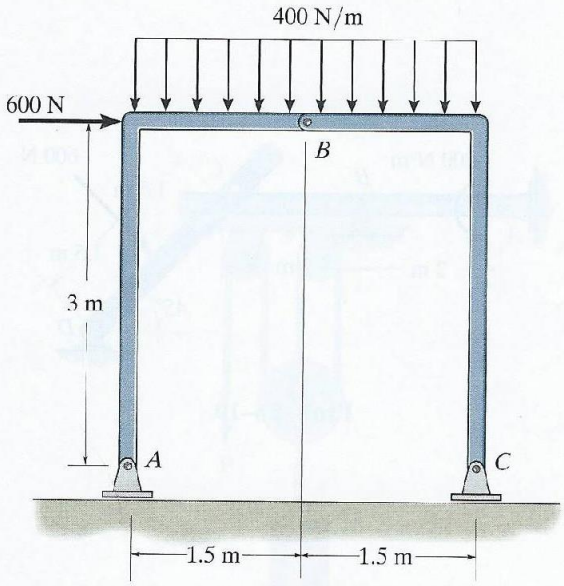
Prob. F6–19

F6–20. Determine the reactions at D.



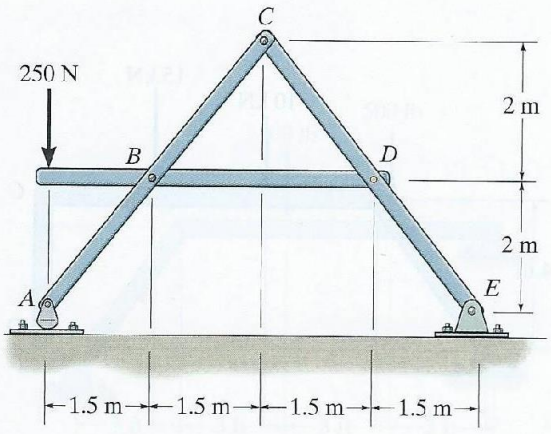
Prob. F6–20

F6–21. Determine the components of reaction at A and C.



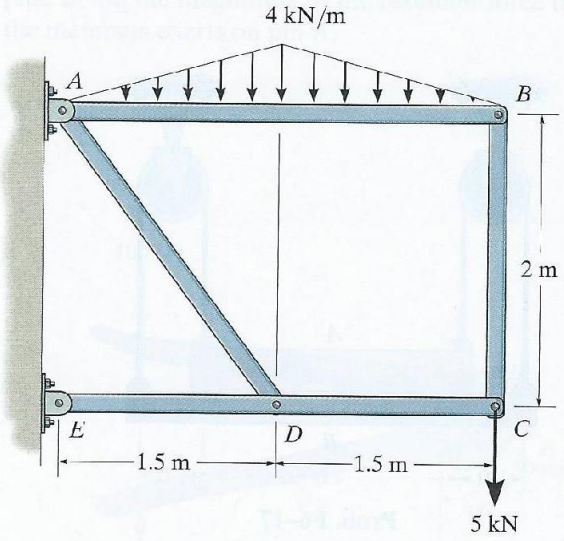
Prob. F6–21

F6–22. Determine the components of reaction at C.



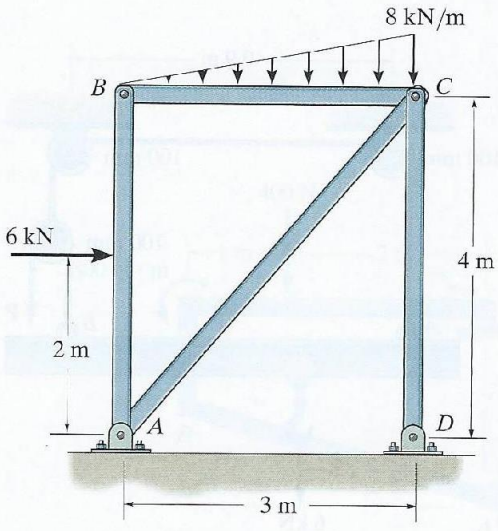
Prob. F6–22

F6–23. Determine the components of reaction at E.



Prob. F6–23

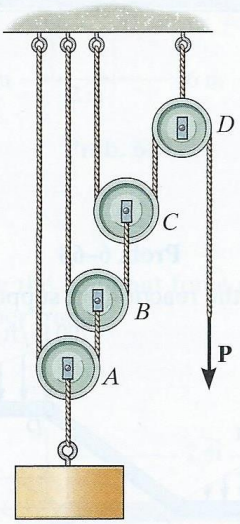
F6–24. Determine the components of reaction at D and the components of reaction the pin at A exerts on member BA.



Prob. F6–24

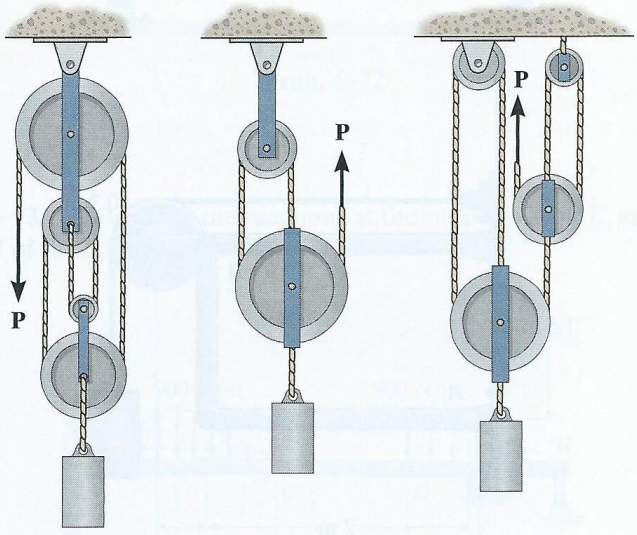
All problem solutions must include FBDs.

6–61. Determine the force **P** required to hold the 100-lb weight in equilibrium.



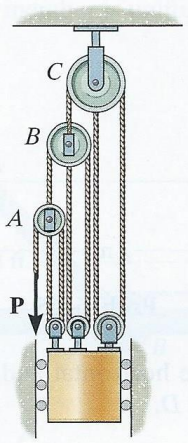
Prob. 6–61

6–62. In each case, determine the force **P** required to maintain equilibrium. The block weighs 100 lb.



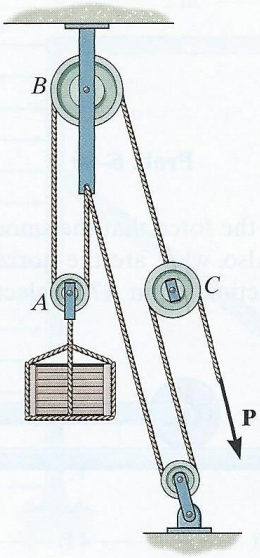
Prob. 6–62

6–63. Determine the force **P** required to hold the 50-kg mass in equilibrium.



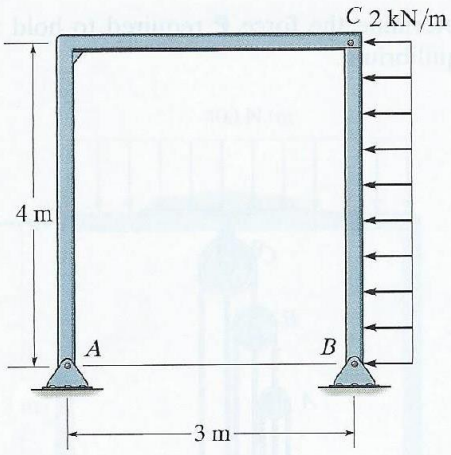
Prob. 6–63

***6–64.** Determine the force **P** required to hold the 150-kg crate in equilibrium.



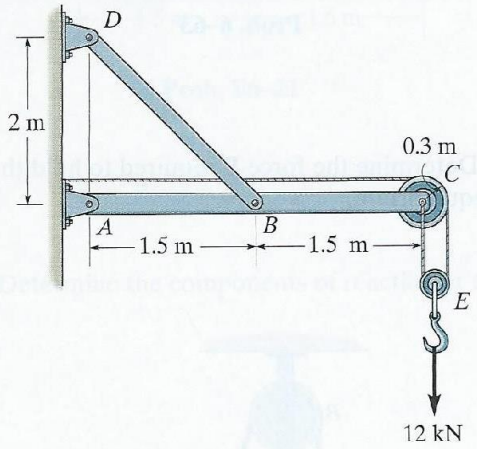
Prob. 6–64

6–65. Determine the horizontal and vertical components of force that pins A and B exert on the frame.



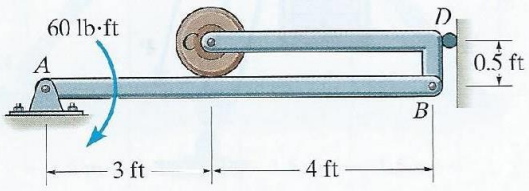
Prob. 6–65

6–66. Determine the horizontal and vertical components of force at pins A and D.



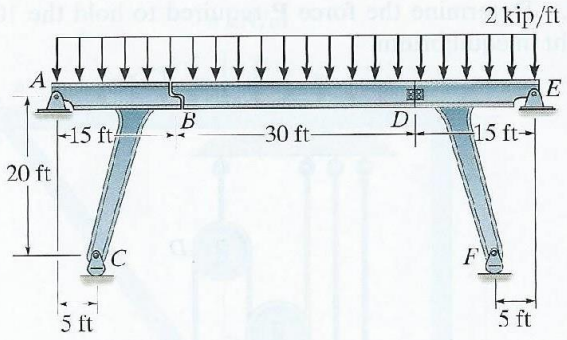
Prob. 6–66

6–67. Determine the force that the smooth roller C exerts on member AB. Also, what are the horizontal and vertical components of reaction at pin A? Neglect the weight of the frame and roller.



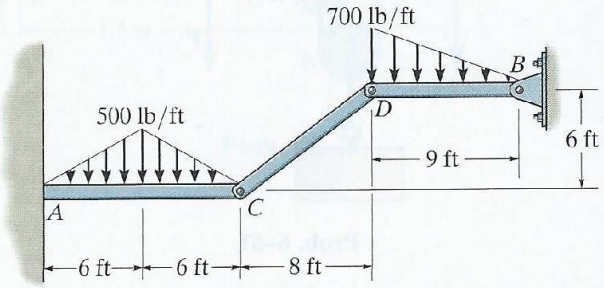
Prob. 6–67

***6–68.** The bridge frame consists of three segments which can be considered pinned at A, D, and E, rocker supported at C and F, and roller supported at B. Determine the horizontal and vertical components of reaction at all these supports due to the loading shown.



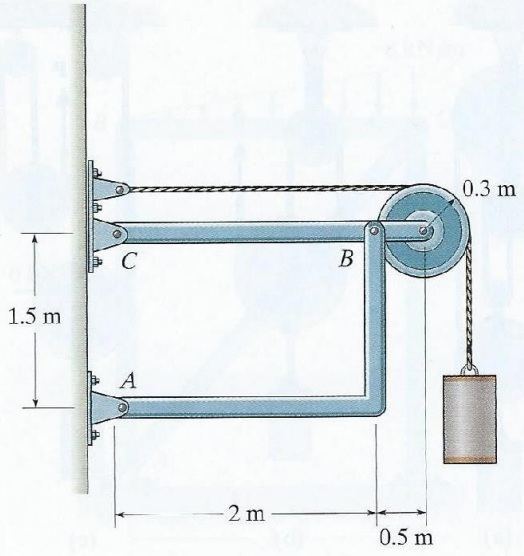
Prob. 6–68

6–69. Determine the reactions at supports A and B.



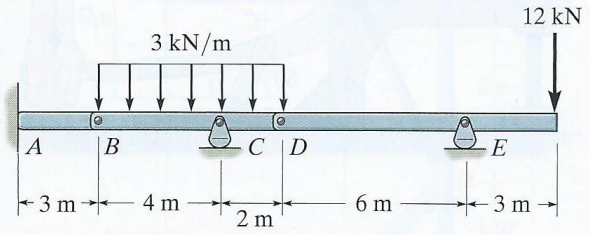
Prob. 6–69

6–70. Determine the horizontal and vertical components of force at pins B and C. The suspended cylinder has a mass of 75 kg.



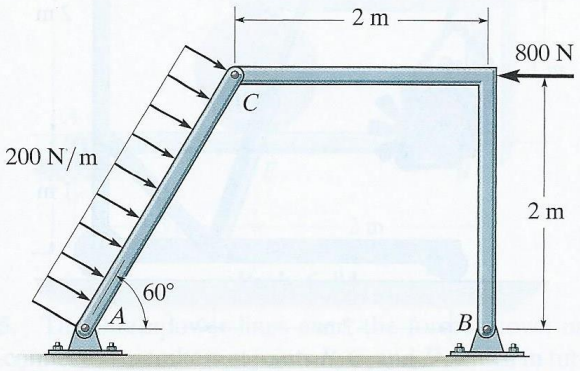
Prob. 6–70

6–71. Determine the reactions at the supports A, C, and E of the compound beam.



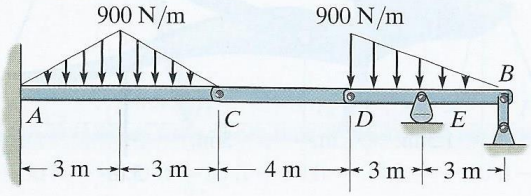
Prob. 6–71

***6–72.** Determine the resultant force at pins A, B, and C on the three-member frame.



Prob. 6–72

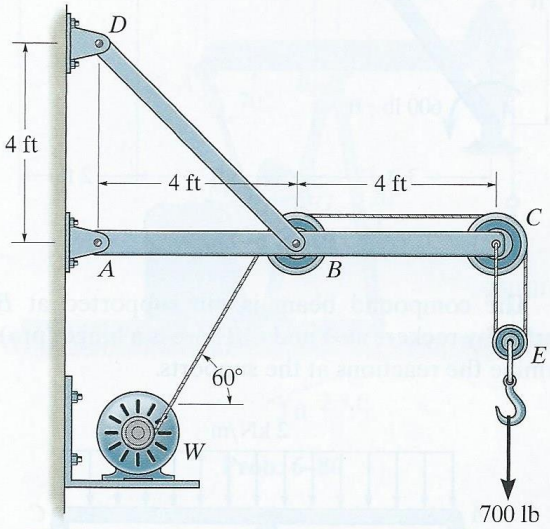
6–73. Determine the reactions at the supports at A, E, and B of the compound beam.



Prob. 6–73

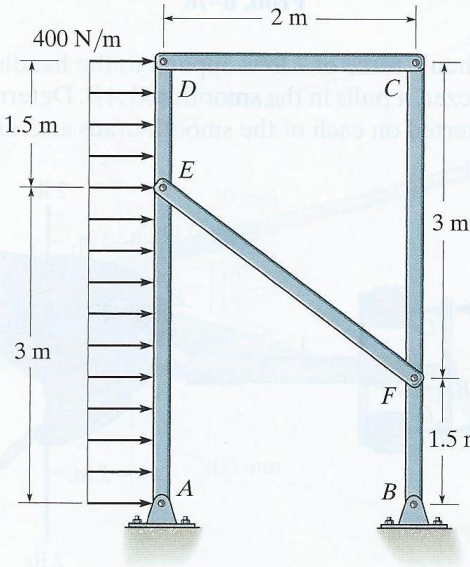
6–74. The wall crane supports a load of 700 lb. Determine the horizontal and vertical components of reaction at the pins A and D. Also, what is the force in the cable at the winch W?

6–75. The wall crane supports a load of 700 lb. Determine the horizontal and vertical components of reaction at the pins A and D. Also, what is the force in the cable at the winch W? The jib ABC has a weight of 100 lb and member BD has a weight of 40 lb. Each member is uniform and has a center of gravity at its center.



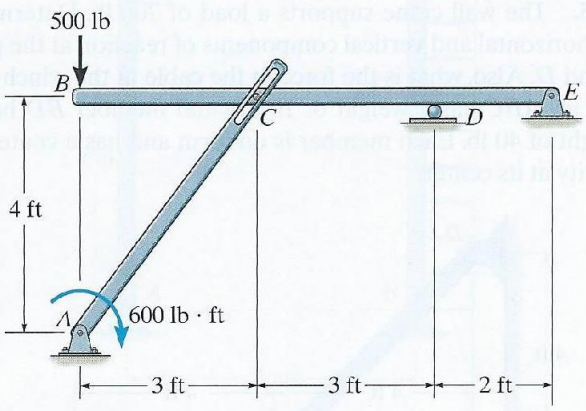
Probs. 6–74/75

***6–76.** Determine the horizontal and vertical components of force which the pins at A and B exert on the frame.



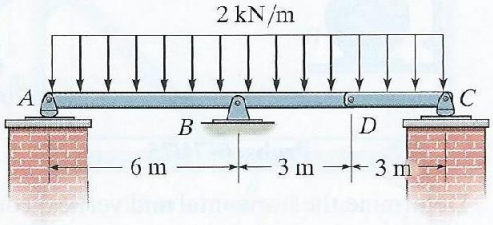
Prob. 6–76

6–77. The two-member structure is connected at C by a pin, which is fixed to BDE and passes through the smooth slot in member AC. Determine the horizontal and vertical components of reaction at the supports.



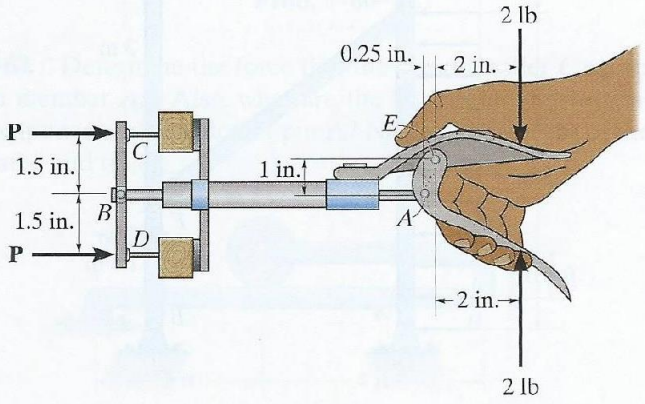
Prob. 6–77

6–78. The compound beam is pin supported at B and supported by rockers at A and C. There is a hinge (pin) at D. Determine the reactions at the supports.



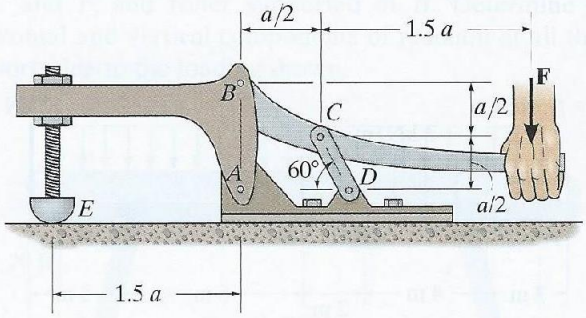
Prob. 6–78

6–79. When a force of 2 lb is applied to the handles of the brad squeezer, it pulls in the smooth rod AB. Determine the force **P** exerted on each of the smooth brads at C and D.



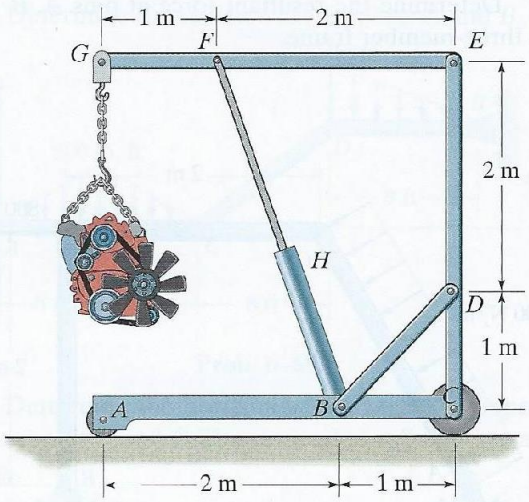
Prob. 6–79

***6–80.** The toggle clamp is subjected to a force **F** at the handle. Determine the vertical clamping force acting at E.



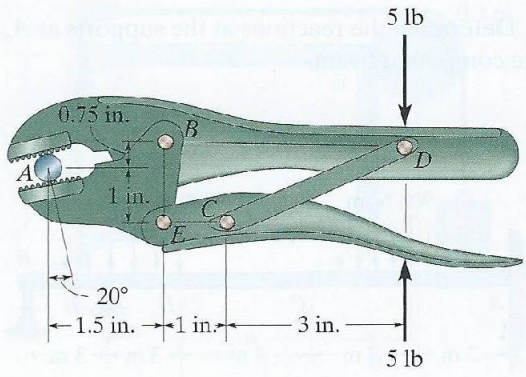
Prob. 6–80

6–81. The hoist supports the 125-kg engine. Determine the force the load creates in member DB and in member FB, which contains the hydraulic cylinder H.



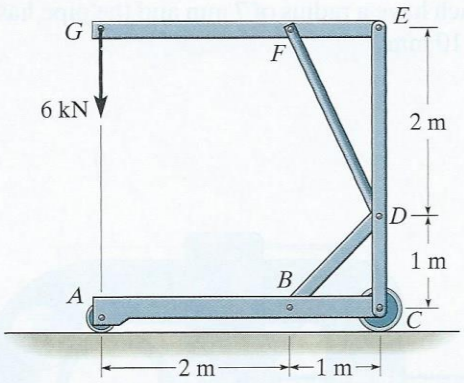
Prob. 6–81

6–82. A 5-lb force is applied to the handles of the vise grip. Determine the compressive force developed on the smooth bolt shank A at the jaws.



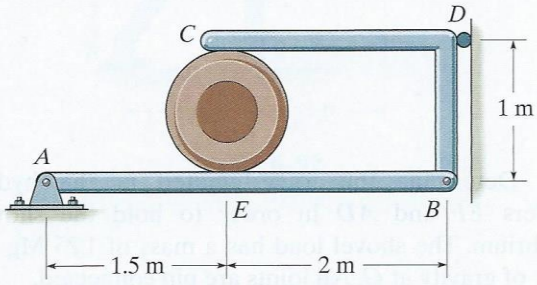
Prob. 6–82

6–83. Determine the force in members FD and DB of the frame. Also, find the horizontal and vertical components of reaction the pin at C exerts on member ABC and member EDC.



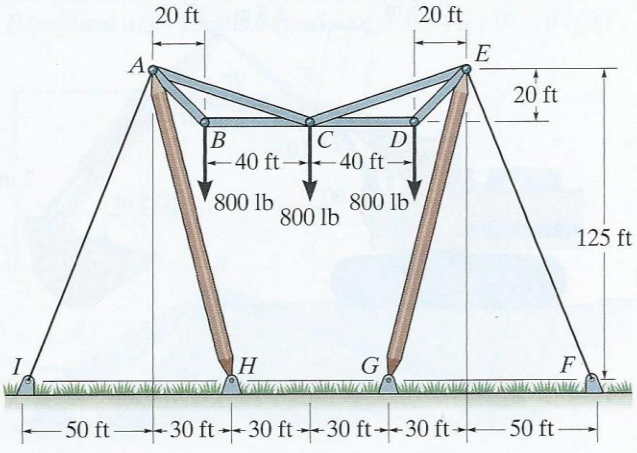
Prob. 6–83

***6–84.** Determine the force that the smooth 20-kg cylinder exerts on members AB and CDB. Also, what are the horizontal and vertical components of reaction at pin A?



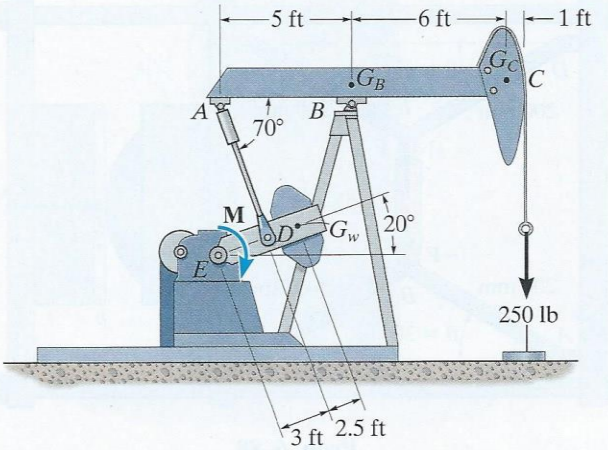
Prob. 6–84

6–85. The three power lines exert the forces shown on the pin-connected members at joints B, C, and D, which in turn are pin connected to the poles AH and EG. Determine the force in the guy cable AI and the pin reaction at the support H.



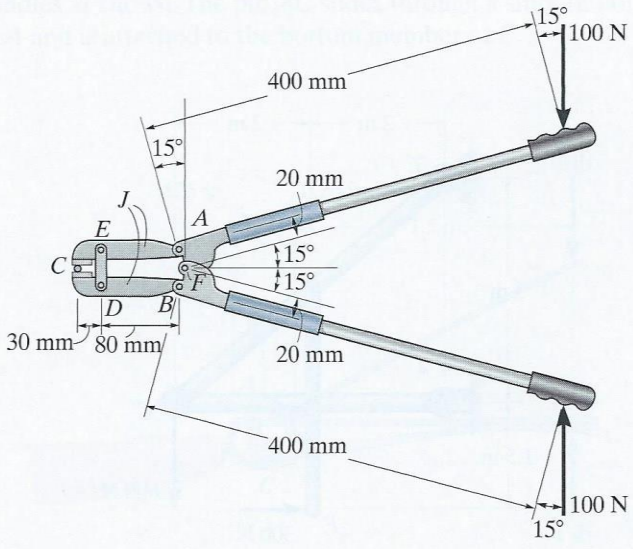
Prob. 6–85

6–86. The pumping unit is used to recover oil. When the walking beam ABC is horizontal, the force acting in the wireline at the well head is 250 lb. Determine the torque $\mathbf{M}$ which must be exerted by the motor in order to overcome this load. The horse-head C weighs 60 lb and has a center of gravity at G_C. The walking beam ABC has a weight of 130 lb and a center of gravity at G_B, and the counterweight has a weight of 200 lb and a center of gravity at G_W. The pitman, AD, is pin connected at its ends and has negligible weight.



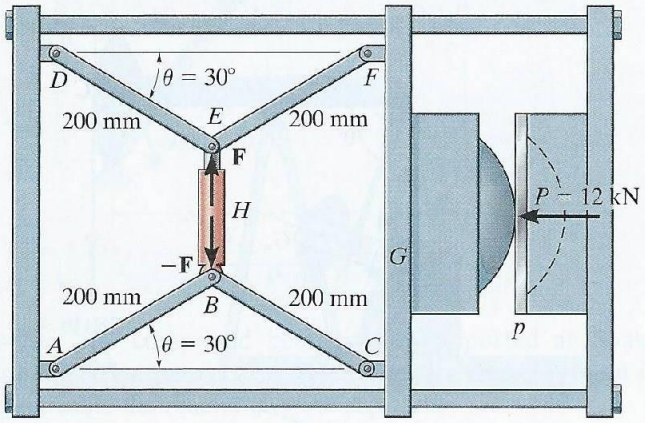
Prob. 6–86

6–87. Determine the force that the jaws J of the metal cutters exert on the smooth cable C if 100-N forces are applied to the handles. The jaws are pinned at E and A, and D and B. There is also a pin at F.



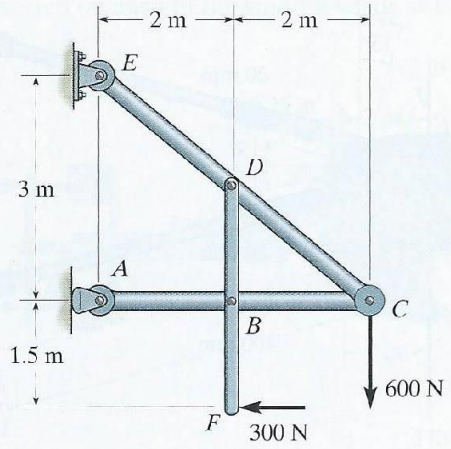
Prob. 6–87

***6–88.** The machine shown is used for forming metal plates. It consists of two toggles ABC and DEF, which are operated by the hydraulic cylinder H. The toggles push the movable bar G forward, pressing the plate p into the cavity. If the force which the plate exerts on the head is $P = 12$ kN, determine the force F in the hydraulic cylinder when $\theta = 30°$.



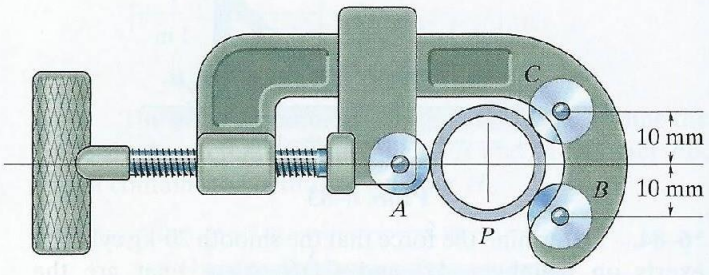
Prob. 6–88

6–89. Determine the horizontal and vertical components of force which pin C exerts on member ABC. The 600-N load is applied to the pin.



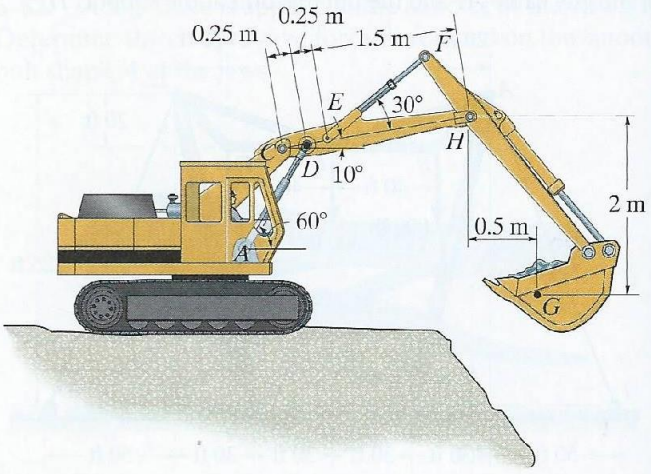
Prob. 6–89

6–90. The pipe cutter is clamped around the pipe P. If the wheel at A exerts a normal force of $F_A = 80$ N on the pipe, determine the normal forces of wheels B and C on the pipe. Also compute the pin reaction on the wheel at C. The three wheels each have a radius of 7 mm and the pipe has an outer radius of 10 mm.



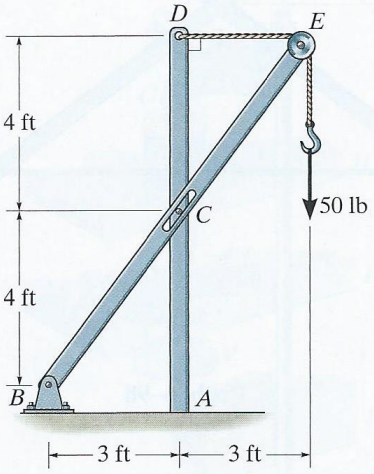
Prob. 6–90

6–91. Determine the force created in the hydraulic cylinders EF and AD in order to hold the shovel in equilibrium. The shovel load has a mass of 1.25 Mg and a center of gravity at G. All joints are pin connected.



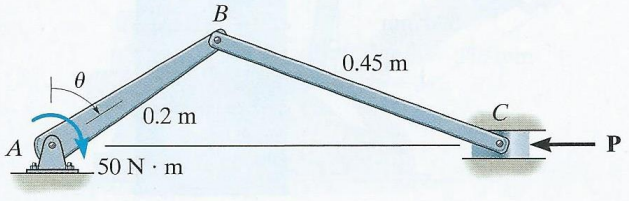
Prob. 6–91

*6–92. Determine the horizontal and vertical components of force at pin B and the normal force the pin at C exerts on the smooth slot. Also, determine the moment and horizontal and vertical reactions of force at A. There is a pulley at E.



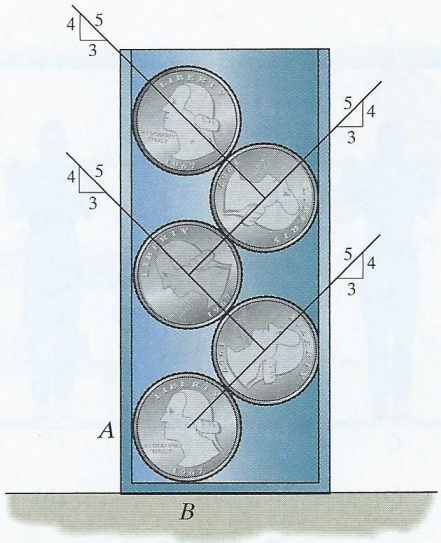
Prob. 6–92

6–93. The constant moment of 50 N · m is applied to the crank shaft. Determine the compressive force P that is exerted on the piston for equilibrium as a function of θ. Plot the results of P (vertical axis) versus θ (horizontal axis) for $0° \le \theta \le 90°$.



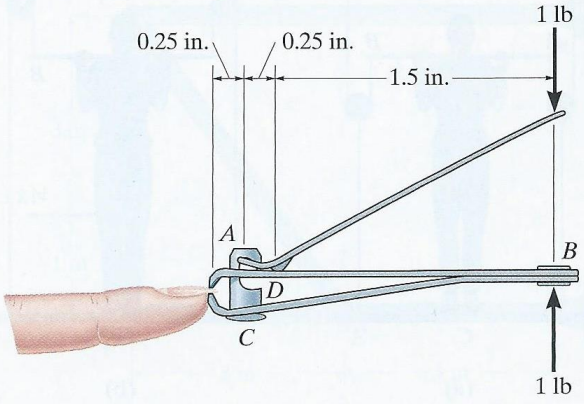
Prob. 6–93

6–94. Five coins are stacked in the smooth plastic container shown. If each coin weighs 0.0235 lb, determine the normal reactions of the bottom coin on the container at points A and B.



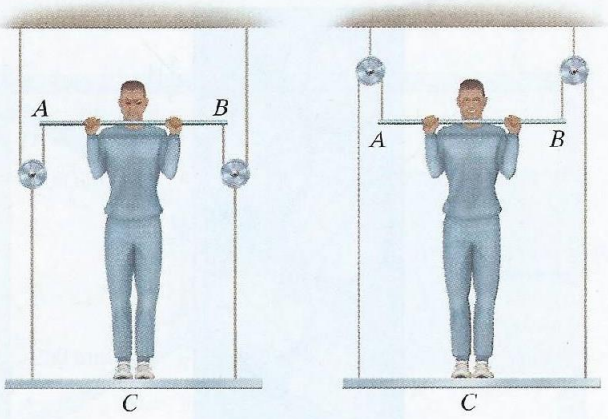
Prob. 6–94

6–95. The nail cutter consists of the handle and the two cutting blades. Assuming the blades are pin connected at B and the surface at D is smooth, determine the normal force on the fingernail when a force of 1 lb is applied to the handles as shown. The pin AC slides through a smooth hole at A and is attached to the bottom member at C.



Prob. 6–95

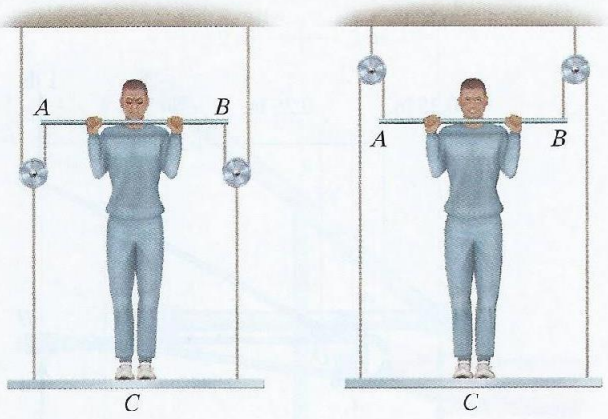
*6–96. A man having a weight of 175 lb attempts to hold himself using one of the two methods shown. Determine the total force he must exert on bar AB in each case and the normal reaction he exerts on the platform at C. Neglect the weight of the platform.



(a) (b)

Prob. 6–96

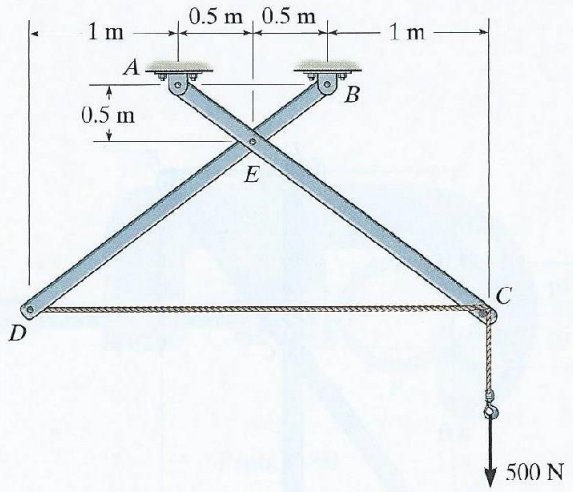
6–97. A man having a weight of 175 lb attempts to hold himself using one of the two methods shown. Determine the total force he must exert on bar AB in each case and the normal reaction he exerts on the platform at C. The platform has a weight of 30 lb.



(a) (b)

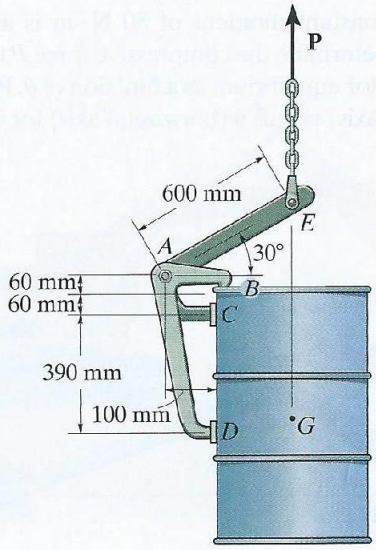
Prob. 6–97

6–98. The two-member frame is pin connected at E. The cable is attached to D, passes over the smooth peg at C, and supports the 500-N load. Determine the horizontal and vertical reactions at each pin.



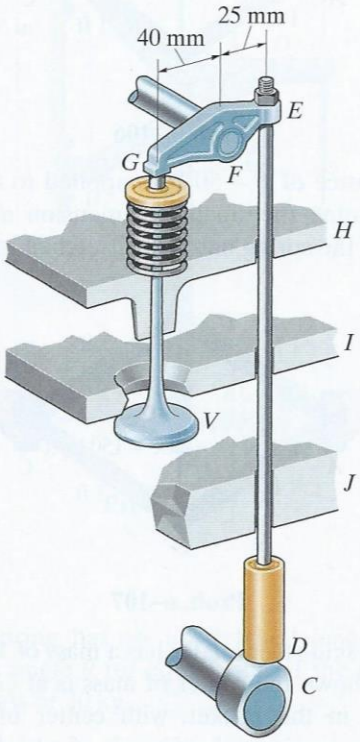
Prob. 6–98

6–99. If the 300-kg drum has a center of mass at point G, determine the horizontal and vertical components of force acting at pin A and the reactions on the smooth pads C and D. The grip at B on member DAB resists both horizontal and vertical components of force at the rim of the drum.



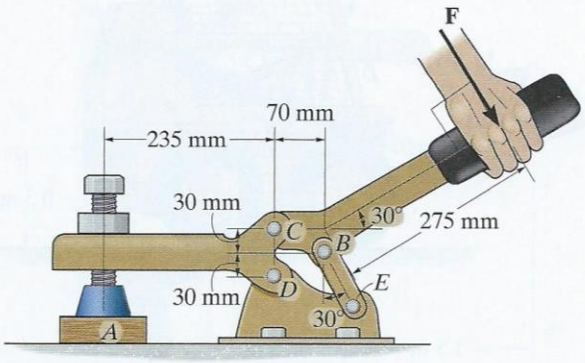
Prob. 6–99

*6–100. Operation of exhaust and intake valves in an automobile engine consists of the cam C, push rod DE, rocker arm EFG which is pinned at F, and a spring and valve, V. If the compression in the spring is 20 mm when the valve is open as shown, determine the normal force acting on the cam lobe at C. Assume the cam and bearings at H, I, and J are smooth. The spring has a stiffness of 300 N/m.



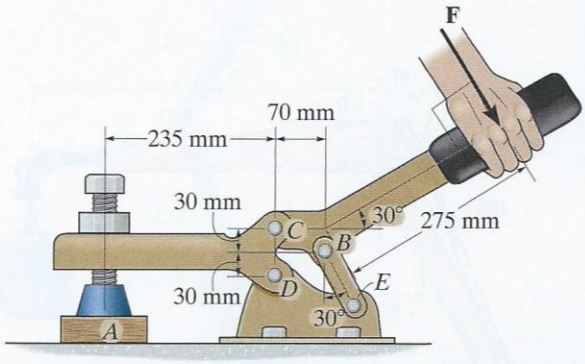
Prob. 6–100

6–101. If a clamping force of 300 N is required at A, determine the amount of force **F** that must be applied to the handle of the toggle clamp.



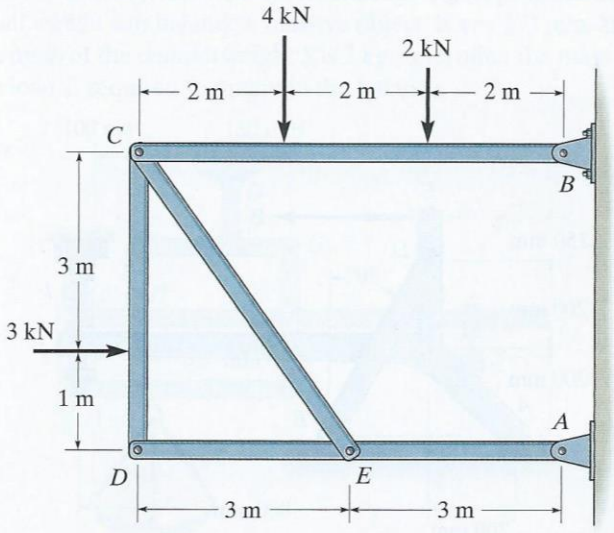
Prob. 6–101

6–102. If a force of $F = 350$ N is applied to the handle of the toggle clamp, determine the resulting clamping force at A.



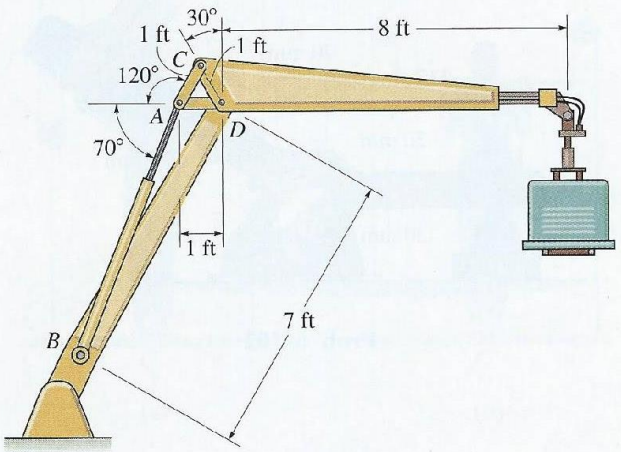
Prob. 6–102

6–103. Determine the horizontal and vertical components of force that the pins at A and B exert on the frame.



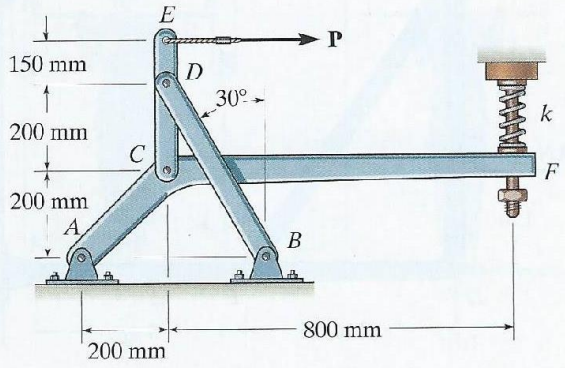
Prob. 6–103

*6–104. The hydraulic crane is used to lift the 1400-lb load. Determine the force in the hydraulic cylinder AB and the force in links AC and AD when the load is held in the position shown.



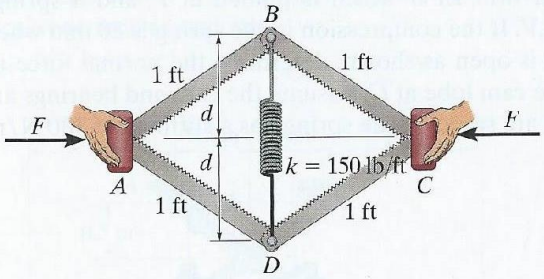
Prob. 6–104

6–105. Determine force **P** on the cable if the spring is compressed 0.025 m when the mechanism is in the position shown. The spring has a stiffness of $k = 6$ kN/m.



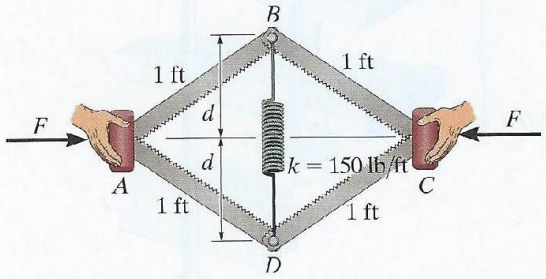
Prob. 6–105

6–106. If $d = 0.75$ ft and the spring has an unstretched length of 1 ft, determine the force F required for equilibrium.



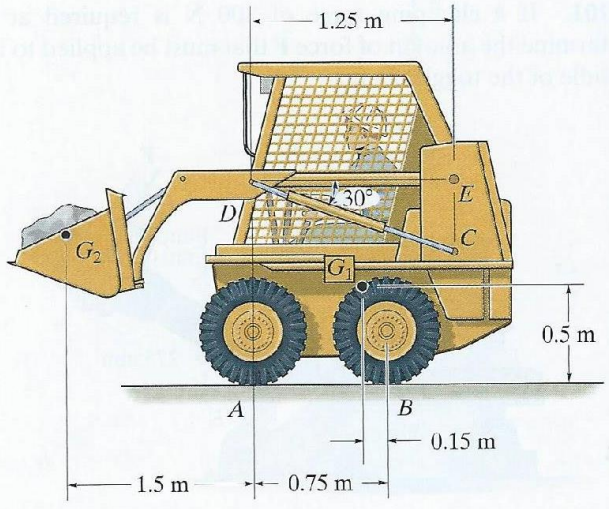
Prob. 6–106

6–107. If a force of $F = 50$ lb is applied to the pads at A and C, determine the smallest dimension d required for equilibrium if the spring has an unstretched length of 1 ft.



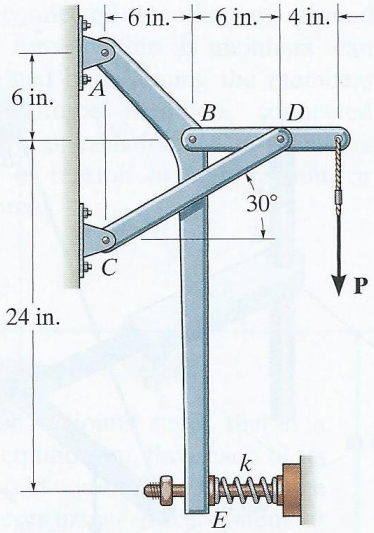
Prob. 6–107

*6–108. The skid-steer loader has a mass of 1.18 Mg, and in the position shown the center of mass is at G_1. If there is a 300-kg stone in the bucket, with center of mass at G_2, determine the reactions of each pair of wheels A and B on the ground and the force in the hydraulic cylinder CD and at the pin E. There is a similar linkage on each side of the loader.



Prob. 6–108

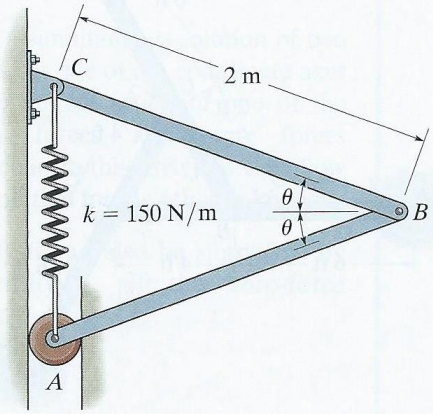
6–109. Determine the force **P** on the cable if the spring is compressed 0.5 in. when the mechanism is in the position shown. The spring has a stiffness of $k = 800$ lb/ft.



Prob. 6–109

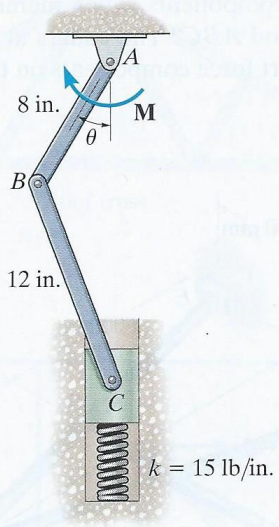
6–110. The spring has an unstretched length of 0.3 m. Determine the angle θ for equilibrium if the uniform bars each have a mass of 20 kg.

6–111. The spring has an unstretched length of 0.3 m. Determine the mass m of each uniform bar if each angle $\theta = 30°$ for equilibrium.



Probs. 6–110/111

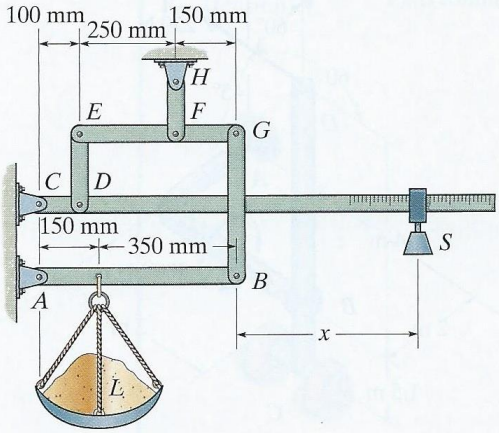
***6–112.** The piston C moves vertically between the two smooth walls. If the spring has a stiffness of $k = 15$ lb/in., and is unstretched when $\theta = 0°$, determine the couple **M** that must be applied to AB to hold the mechanism in equilibrium when $\theta = 30°$.



Prob. 6–112

6–113. The platform scale consists of a combination of third and first class levers so that the load on one lever becomes the effort that moves the next lever. Through this arrangement, a small weight can balance a massive object. If $x = 450$ mm, determine the required mass of the counterweight S required to balance a 90-kg load, L.

6–114. The platform scale consists of a combination of third and first class levers so that the load on one lever becomes the effort that moves the next lever. Through this arrangement, a small weight can balance a massive object. If $x = 450$ mm, and the mass of the counterweight S is 2 kg, determine the mass of the load L required to maintain the balance.



Probs. 6–113/114