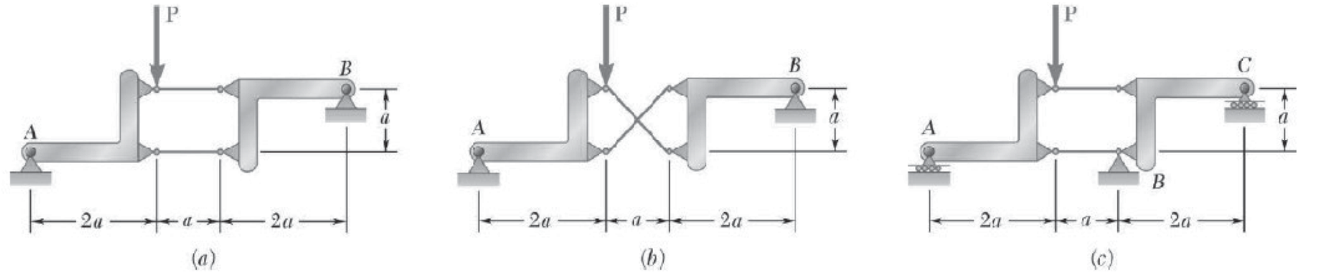
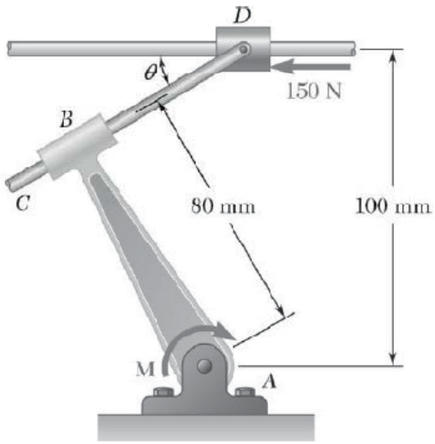
PROBLEM 6.119

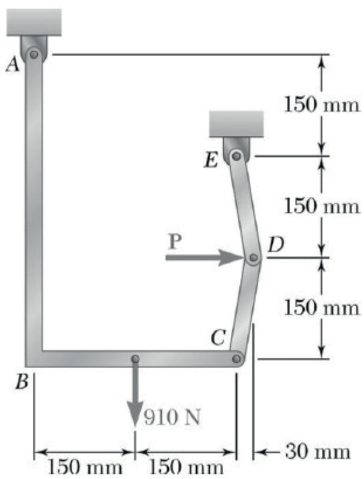
Each of the frames shown consists of two L-shaped members connected by two rigid links. For each frame, determine the reactions at the supports and indicate whether the frame is rigid.





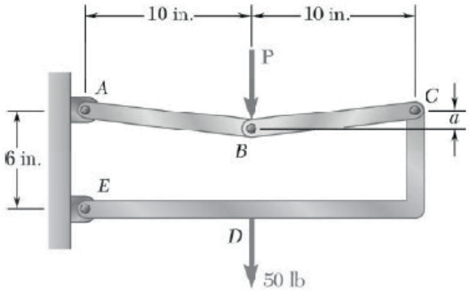
PROBLEM 6.135

Rod *CD* is attached to the collar *D* and passes through a collar welded to end *B* of lever *AB*. Neglecting the effect of friction, determine the couple **M** required to hold the system in equilibrium when $\theta = 30°$.



PROBLEM 6.150

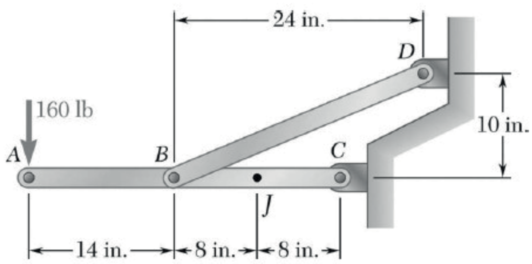
Determine the force **P** that must be applied to the toggle *CDE* to maintain bracket *ABC* in the position shown.



PROBLEM 6.175

Knowing that the frame shown has a sag at *B* of $a = 1$ in., determine the force **P** required to maintain equilibrium in the position shown.

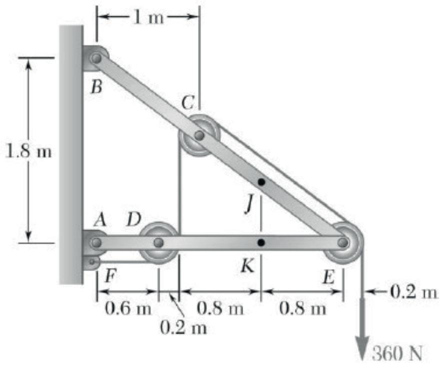
Forces in Beams and Cables



PROBLEM 7.1

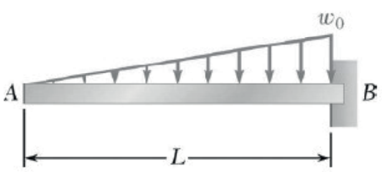
Determine the internal forces (axial force, shearing force, and bending moment) at Point *J* of the structure indicated.

Frame and loading of Problem 6.75.



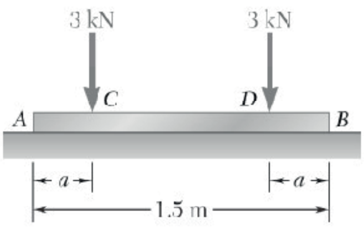
PROBLEM 7.15

Knowing that the radius of each pulley is 200 mm and neglecting friction, determine the internal forces at Point *J* of the frame shown.



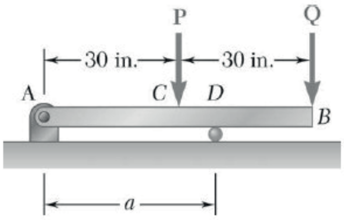
PROBLEM 7.30

For the beam and loading shown, (*a*) draw the shear and bending-moment diagrams, (*b*) determine the maximum absolute values of the shear and bending moment.



PROBLEM 7.45

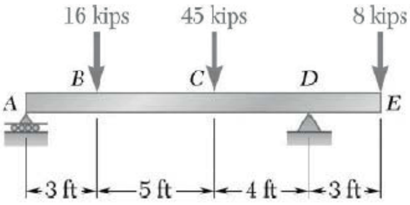
Assuming the upward reaction of the ground on beam *AB* to be uniformly distributed and knowing that $a = 0.3$ m, (*a*) draw the shear and bending-moment diagrams, (*b*) determine the maximum absolute values of the shear and bending moment.



PROBLEM 7.60

Knowing that $P = Q = 150$ lb, determine (*a*) the distance *a* for which the maximum absolute value of the bending moment in beam *AB* is as small as possible, (*b*) the corresponding value of $|M|_{max}$. (See hint for Problem 7.55.)

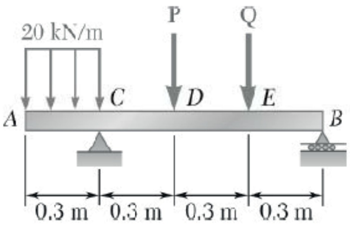
(*Hint:* Draw the bending-moment diagram and then equate the absolute values of the largest positive and negative bending moments obtained.)



PROBLEM 7.75

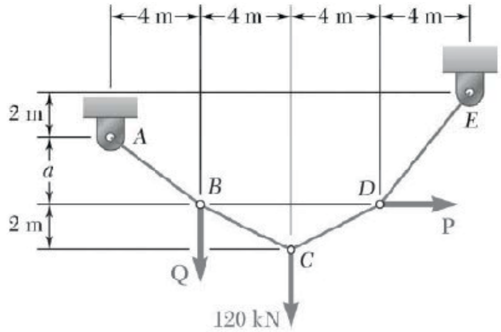
For the beam and loading shown, (*a*) draw the shear and bending-moment diagrams, (*b*) determine the maximum absolute values of the shear and bending moment.

PROBLEM 7.90



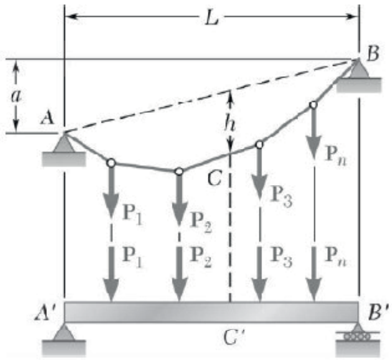
Solve Problem 7.89 assuming that the bending moment was found to be +650 N·m at *D* and +1450 N·m at *E*.

PROBLEM 7.89 The beam *AB* is subjected to the uniformly distributed load shown and to two unknown forces **P** and **Q**. Knowing that it has been experimentally determined that the bending moment is +800 N·m at *D* and +1300 N·m at *E*, (*a*) determine **P** and **Q**, (*b*) draw the shear and bending-moment diagrams for the beam.



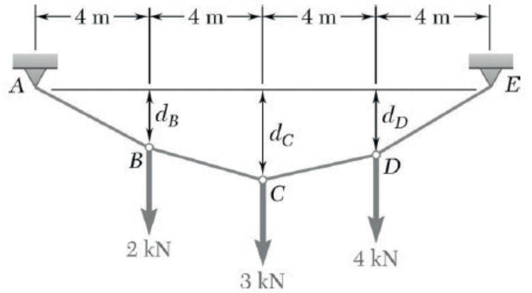
PROBLEM 7.105

If $a = 3$ m, determine the magnitudes of **P** and **Q** required to maintain the cable in the shape shown.



PROBLEM 7.119*

A cable AB of span L and a simple beam $A'B'$ of the same span are subjected to identical vertical loadings as shown. Show that the magnitude of the bending moment at a point C' in the beam is equal to the product T_0h, where T_0 is the magnitude of the horizontal component of the tension force in the cable and h is the vertical distance between Point C and the chord joining the points of support A and B.

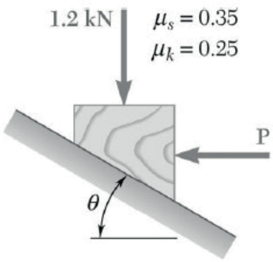


PROBLEM 7.120

Making use of the property established in Problem 7.119, solve the problem indicated by first solving the corresponding beam problem.

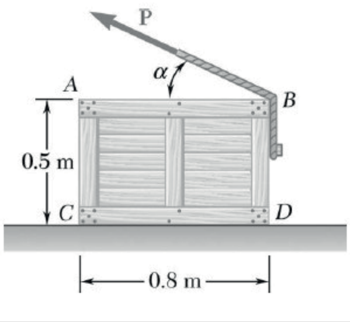
PROBLEM 7.94 Knowing that the maximum tension in cable $ABCDE$ is 13 kN, determine the distance d_C.

Friction



PROBLEM 8.1

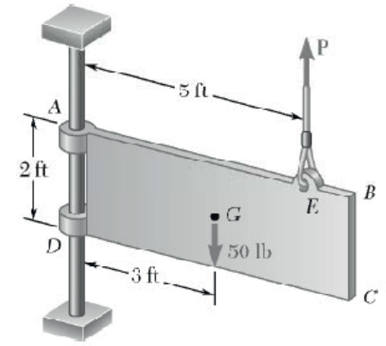
Determine whether the block shown is in equilibrium and find the magnitude and direction of the friction force when $\theta = 25°$ and $P = 750$ N.



PROBLEM 8.15

A 40-kg packing crate must be moved to the left along the floor without tipping. Knowing that the coefficient of static friction between the crate and the floor is 0.35, determine (*a*) the largest allowable value of α, (*b*) the corresponding magnitude of the force **P**.

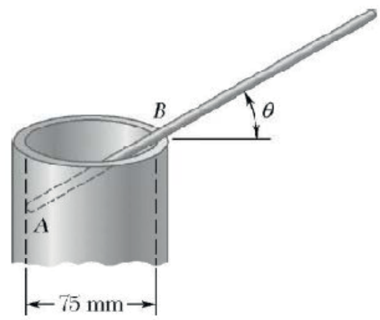
PROBLEM 8.30



In Problem 8.29, determine the range of values of the magnitude P of the vertical force applied at E for which the plate will move downward.

PROBLEM 8.29 The 50-lb plate $ABCD$ is attached at A and D to collars that can slide on the vertical rod. Knowing that the coefficient of static friction is 0.40 between both collars and the rod, determine whether the plate is in equilibrium in the position shown when the magnitude of the vertical force applied at E is (*a*) $P = 0$, (*b*) $P = 20$ lb.

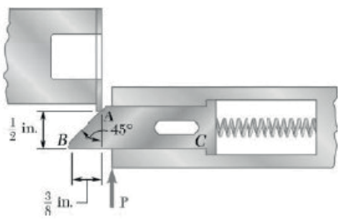
PROBLEM 8.45



In Problem 8.44, determine the smallest value of θ for which the rod will not fall out the pipe.

PROBLEM 8.44 A slender steel rod of length 225 mm is placed inside a pipe as shown. Knowing that the coefficient of static friction between the rod and the pipe is 0.20, determine the largest value of θ for which the rod will not fall into the pipe.

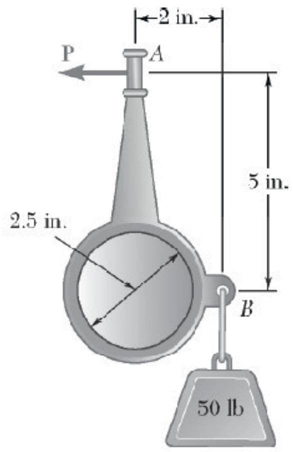
PROBLEM 8.60



The spring of the door latch has a constant of 1.8 lb/in. and in the position shown exerts a 0.6-lb force on the bolt. The coefficient of static friction between the bolt and the strike plate is 0.40; all other surfaces are well lubricated and may be assumed frictionless. Determine the magnitude of the force **P** required to start closing the door.

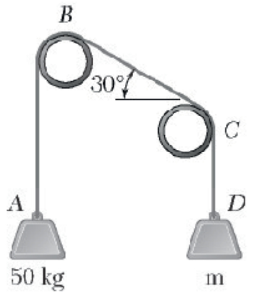
PROBLEM 8.75

The ends of two fixed rods A and B are each made in the form of a single-threaded screw of mean radius 6 mm and pitch 2 mm. Rod A has a right-handed thread and rod B has a left-handed thread. The coefficient of static friction between the rods and the threaded sleeve is 0.12. Determine the magnitude of the couple that must be applied to the sleeve in order to draw the rods closer together.



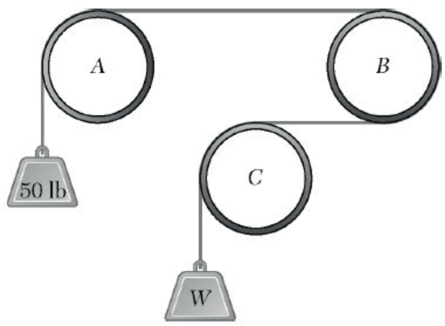
PROBLEM 8.90

A lever AB of negligible weight is loosely fitted onto a 2.5-in.-diameter fixed shaft. Knowing that the coefficient of static friction between the fixed shaft and the lever is 0.15, determine the force **P** required to start the lever rotating clockwise.



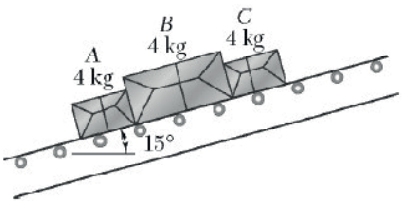
PROBLEM 8.105

A rope $ABCD$ is looped over two pipes as shown. Knowing that the coefficient of static friction is 0.25, determine (*a*) the smallest value of the mass m for which equilibrium is possible, (*b*) the corresponding tension in portion BC of the rope.



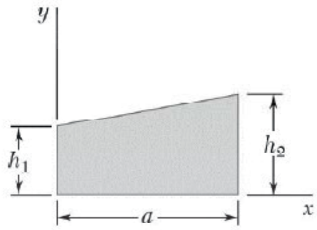
PROBLEM 8.120

A cable is placed around three parallel pipes. Knowing that the coefficients of friction are $\mu_s = 0.25$ and $\mu_k = 0.20$, determine (*a*) the smallest weight W for which equilibrium is maintained, (*b*) the largest weight W that can be raised if pipe B is slowly rotated counterclockwise while pipes A and C remain fixed.



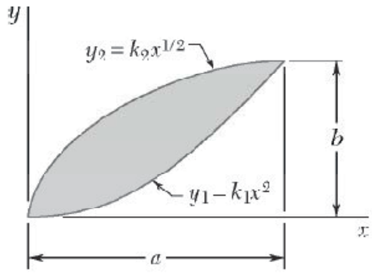
PROBLEM 8.135

Three 4-kg packages A, B, and C are placed on a conveyor belt that is at rest. Between the belt and both packages A and C the coefficients of friction are $\mu_s = 0.30$ and $\mu_k = 0.20$; between package B and the belt the coefficients are $\mu_s = 0.10$ and $\mu_k = 0.08$. The packages are placed on the belt so that they are in contact with each other and at rest. Determine which, if any, of the packages will move and the friction force acting on each package.



PROBLEM 9.1

Determine by direct integration the moment of inertia of the shaded area with respect to the y axis.

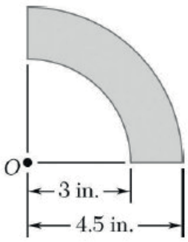


PROBLEM 9.15

Determine the moment of inertia and the radius of gyration of the shaded area shown with respect to the x axis.

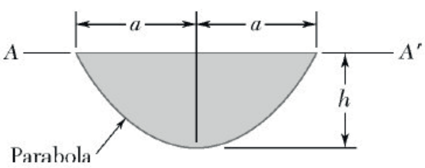
PROBLEM 9.30*

Prove that the centroidal polar moment of inertia of a given area A cannot be smaller than $A^2/2\pi$. (*Hint:* Compare the moment of inertia of the given area with the moment of inertia of a circle that has the same area and the same centroid.)



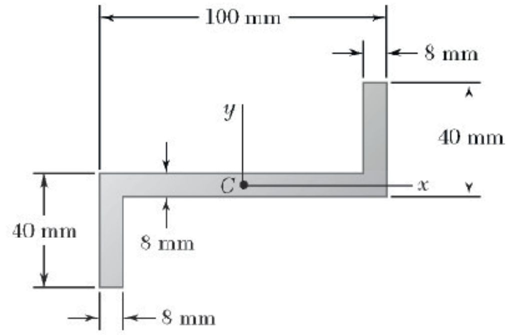
PROBLEM 9.45

Determine the polar moment of inertia of the area shown with respect to (*a*) Point O, (*b*) the centroid of the area.



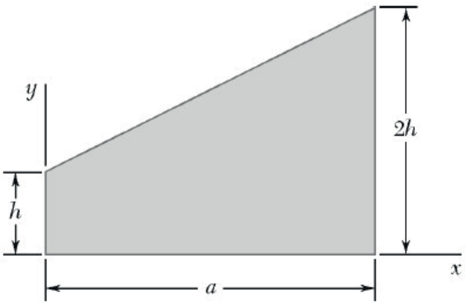
PROBLEM 9.60*

The panel shown forms the end of a trough that is filled with water to the line AA'. Referring to section 9.2, determine the depth of the point of application of the resultant of the hydrostatic forces acting on the panel (the center of pressure).



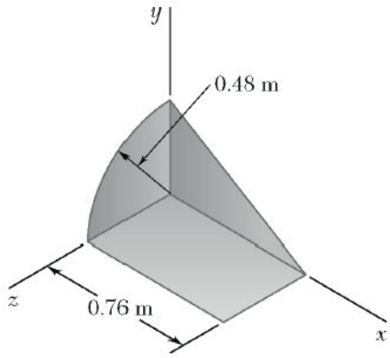
PROBLEM 9.75

Using the parallel-axis theorem, determine the product of inertia of the area shown with respect to the centroidal x and y axes.



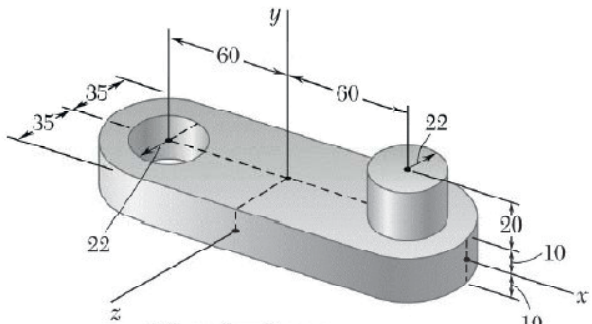
PROBLEM 9.120

The area shown is revolved about the x axis to form a homogeneous solid of revolution of mass m. Using direct integration, express the mass moment of inertia of the solid with respect to the x axis in terms of m and h.



PROBLEM 9.135

A 2-mm thick piece of sheet steel is cut and bent into the machine component shown. Knowing that the density of steel is 7850 kg/m^3, determine the mass moment of inertia of the component with respect to each of the coordinate axes.



Dimensions in mm

PROBLEM 9.150

Determine the mass products of inertia I_{xy}, I_{yz}, and I_{zx} of the steel machine element shown. (The density of steel is 7850 kg/m^3.)