Computer Problems

4.C1 A slender rod *AB* of weight *W* is attached to blocks at *A* and *B* which can move freely in the guides shown. The constant of the spring is *k* and the spring is unstretched when the rod is horizontal. Neglecting the weight of the blocks, derive an equation in terms of (θ, *W*, *l*, and *k* which must be satisfied when the rod is in equilibrium. Knowing that $W = 10$ lb and $l = 40$ in., (*a*) calculate and plot the value of the spring constant *k* as a function of the angle θ for $15° \leq \theta \leq 40°$, (*b*) determine the two values of the angle θ corresponding to equilibrium when $k = 0.7$ lb/in.

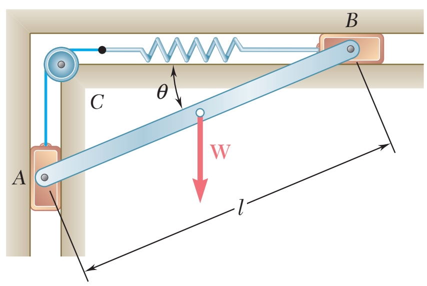

Fig. P4.C1

4.C2 The position of the L-shaped rod shown is controlled by a cable attached at point *B*. Knowing that the rod supports a load of magnitude $P = 200$ N, use computational software to calculate and plot the tension *T* in the cable as a function of θ for values of θ from 0 to 120°. Determine the maximum tension T_{max} and the corresponding value of θ.

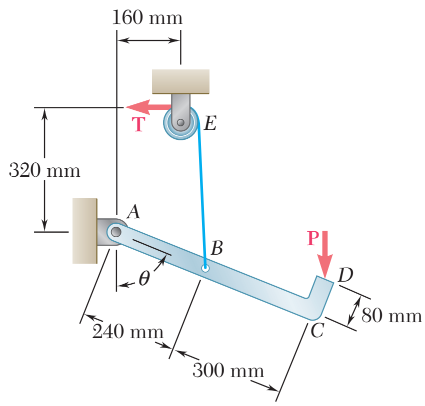

Fig. P4.C2

4.C3 The position of the 20-lb rod *AB* is controlled by the block shown, which is slowly moved to the left by the force **P**. Neglecting the effect of friction, use computational software to calculate and plot the magnitude *P* of the force as a function of *x* for values of *x* decreasing from 30 in. to 0. Determine the maximum value of *P* and the corresponding value of *x*.

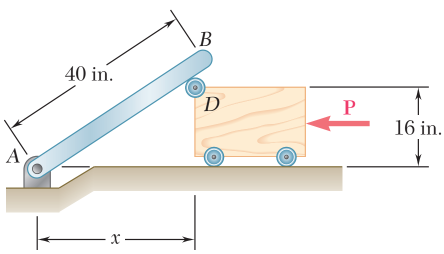

Fig. P4.C3

***4.C4** Member *ABC* is supported by a pin and bracket at *C* and by an inextensible cable of length 3.5 m that is attached at *A* and *B* and passes over a frictionless pulley at *D*. Neglecting the mass of *ABC* and the radius of the pulley, (*a*) plot the tension in the cable as a function of *a* for $0 \le a \le 2.4$ m, (*b*) determine the largest value of *a* for which equilibrium can be maintained.

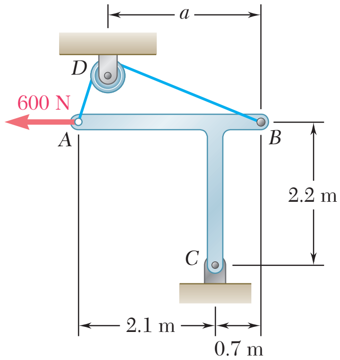

Fig. P4.C4

4.C5 and 4.C6 The constant of spring *AB* is *k*, and the spring is unstretched when $\theta = 0$. Knowing that $R = 200$ mm, $a = 400$ mm, and $k = 1$ kN/m, use computational software to calculate and plot the mass *m* corresponding to equilibrium as a function of θ for values of θ from 0 to 90°. Determine the value of θ corresponding to equilibrium when $m = 2$ kg.

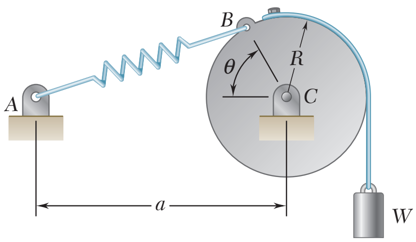

Fig. P4.C5

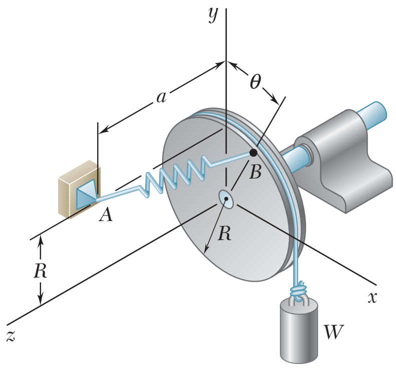

Fig. P4.C6

4.C7 An 8 × 10-in. panel of weight $W = 40$ lb is supported by hinges along edge *AB*. Cable *CDE* is attached to the panel at point *C*, passes over a small pulley at *D*, and supports a cylinder of weight *W*. Neglecting the effect of friction, use computational software to calculate and plot the weight of the cylinder corresponding to equilibrium as a function of θ for values of θ from 0 to 90°. Determine the value of θ corresponding to equilibrium when $W = 20$ lb.

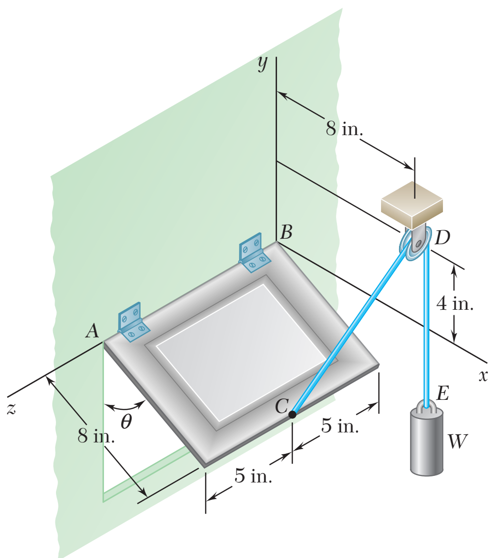

Fig. P4.C7

4.C8 A uniform circular plate of radius 300 mm and mass 26 kg is supported by three vertical wires that are equally spaced around its edge. A small 3-kg block *E* is placed on the plate at *D* and is then slowly moved along diameter *CD* until it reaches *C*. (*a*) Plot the tension in wires *A* and *C* as functions of *a*, where *a* is the distance of the block from *D*. (*b*) Determine the value of *a* for which the tension in wires *A* and *C* is minimum.

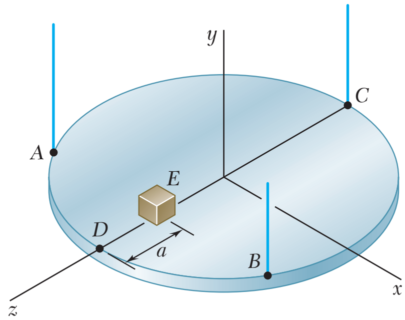

Fig. P4.C8

4.C9 The derrick shown supports a 4000-lb crate. It is held by a ball-and-socket joint at point *A* and by two cables attached at points *D* and *E*. Knowing that the derrick lies in a vertical plane forming an angle ϕ with the *xy* plane, use computational software to calculate and plot the tension in each cable as a function of ϕ for values of ϕ from 0 to 40°. Determine the value of ϕ for which the tension in cable *BE* is maximum.

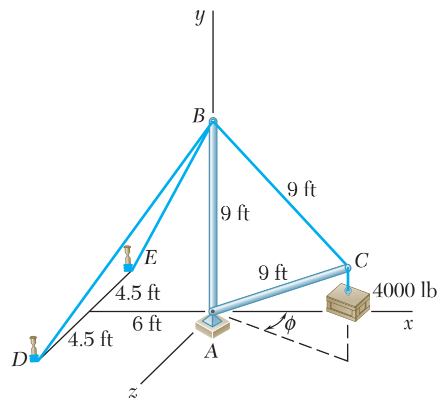

Fig. P4.C9

4.C10 The 140-lb uniform steel plate *ABCD* is welded to shaft *EF* and is maintained in the position shown by the couple **M**. Knowing that collars prevent the shaft from sliding in the bearings and that the shaft lies in the *yz* plane, plot the magnitude *M* of the couple as a function of θ for $0 \leq \theta \leq 90°$.

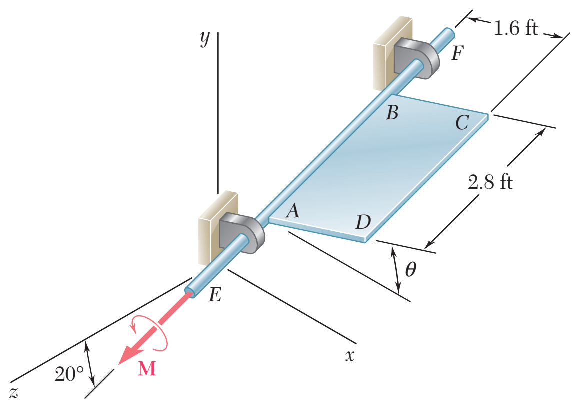

Fig. P4.C10