ME 2210 Dynamics Handout #6: Homework: 16.2, 16.8, 16.15, 16.28, 16.33, 16.38, 16.49, 16.56, 16.64, 16.77, 16.96, 16.101, 16.118, 16.126

16.1 A conveyor system is fitted with vertical panels, and a 300-mm rod *AB* of mass 2.5 kg is lodged between two panels as shown. Knowing that the acceleration of the system is 1.5 m/s² to the left, determine (*a*) the force exerted on the rod at *C*, (*b*) the reaction at *B*.

16.2 A conveyor system is fitted with vertical panels, and a 300-mm rod *AB* of mass 2.5 kg is lodged between two panels as shown. If the rod is to remain in the position shown, determine the maximum allowable acceleration of the system.

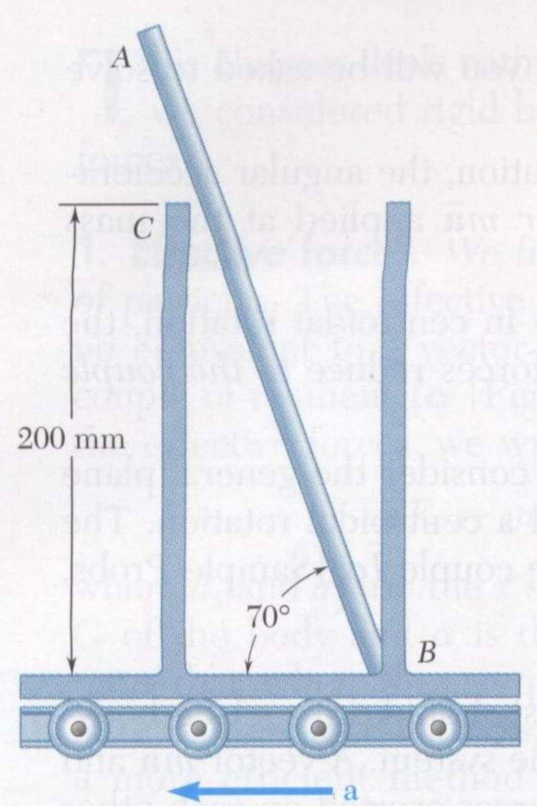

Fig. P16.1 and P16.2

16.7 A 20-kg cabinet is mounted on casters that allow it to move freely ($\mu = 0$) on the floor. If a 100-N force is applied as shown, determine (*a*) the acceleration of the cabinet, (*b*) the range of values of h for which the cabinet will not tip.

16.8 Solve Prob. 16.7, assuming that the casters are locked and slide on the rough floor ($\mu_k = 0.25$).

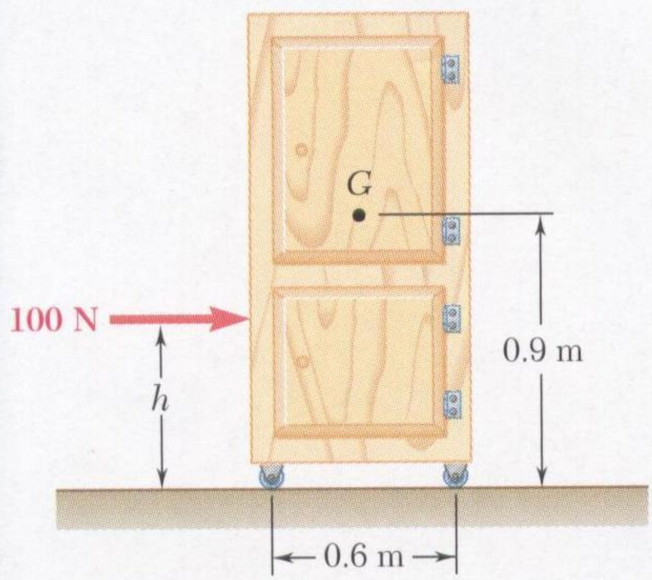

Fig. P16.7

16.9 The forklift truck shown weighs 2250 lb and is used to lift a crate of weight $W = 2500$ lb. Knowing that the truck is at rest, determine (*a*) the upward acceleration of the crate for which the reactions at the rear wheels B are zero, (*b*) the corresponding reaction at each of the front wheels A.

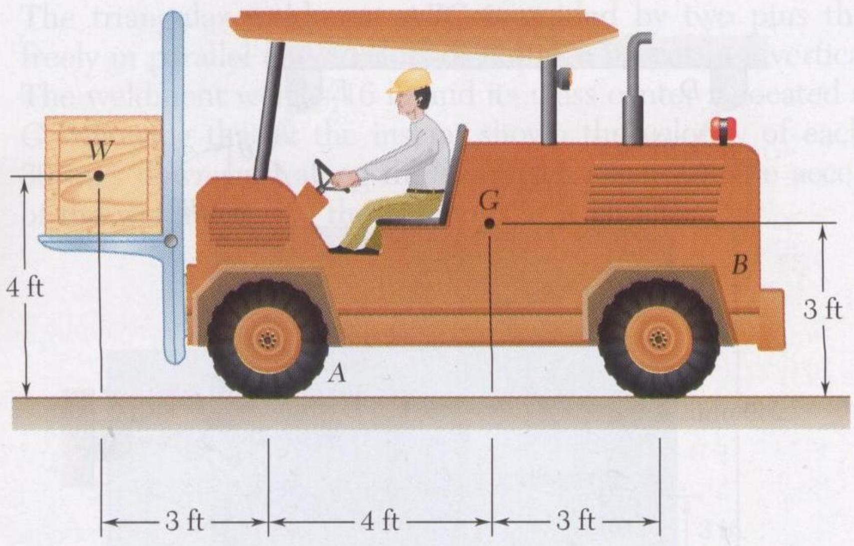

Fig. P16.9 and P16.10

16.10 The forklift truck shown weighs 2250 lb and is used to lift a crate of weight $W = 2500$ lb. The truck is moving to the left at a speed of 10 ft/s when the brakes are applied on all four wheels. Knowing that the coefficient of static friction between the crate and the fork lift is 0.30, determine the smallest distance in which the truck can be brought to a stop if the crate is not to slide and if the truck is not to tip forward.

16.11 The support bracket shown is used to transport a cylindrical can from one elevation to another. Knowing that $\mu_s = 0.25$ between the can and the bracket, determine (*a*) the magnitude of the upward acceleration **a** for which the can will slide on the bracket, (*b*) the smallest ratio h/d for which the can will tip before it slides.

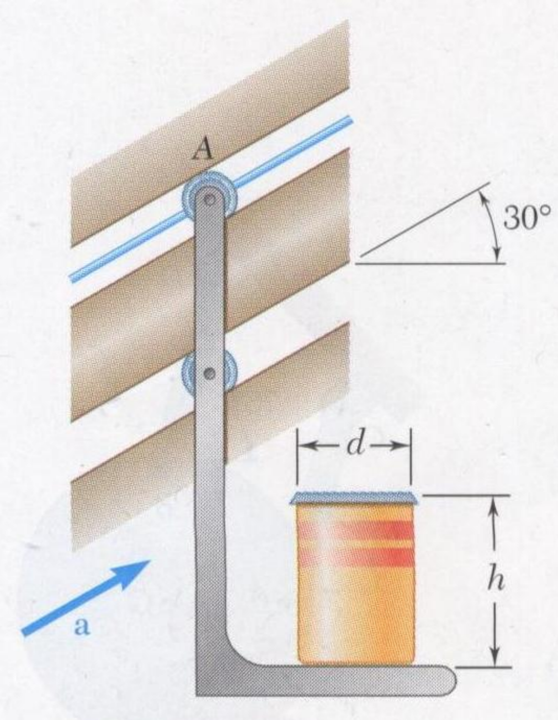

Fig. P16.11

16.12 Solve Prob. 16.11, assuming that the acceleration **a** of the bracket *is directed downward.*

16.14 A uniform rectangular plate has a mass of 5 kg and is held in position by three ropes as shown. Knowing that $\theta = 30°$, determine, immediately after rope *CF* has been cut, (*a*) the acceleration of the plate, (*b*) the tension in ropes *AD* and *BE*.

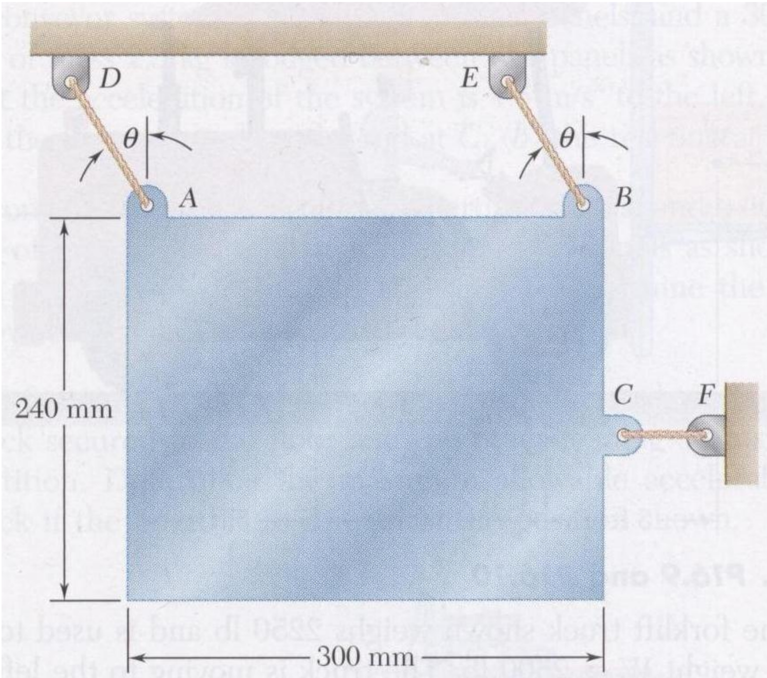

Fig. P16.14 and *P16.15*

16.15 A uniform rectangular plate has a mass of 5 kg and is held in position by three ropes as shown. Determine the largest value of θ for which both ropes AD and BE remain taut immediately after rope CF has been cut.

16.17 Three bars, each of weight 8 lb, are welded together and are pin-connected to two links BE and CF. Neglecting the weight of the links, determine the force in each link immediately after the system is released from rest.

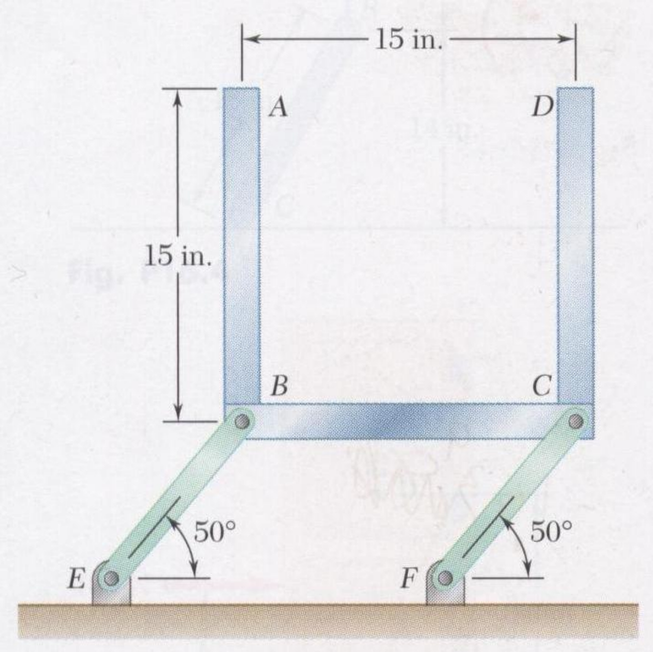

Fig. P16.17

16.27 The 180-mm-radius disk is at rest when it is placed in contact with a belt moving at a constant speed. Neglecting the weight of the link AB and knowing that the coefficient of kinetic friction between the disk and the belt is 0.40, determine the angular acceleration of the disk while slipping occurs.

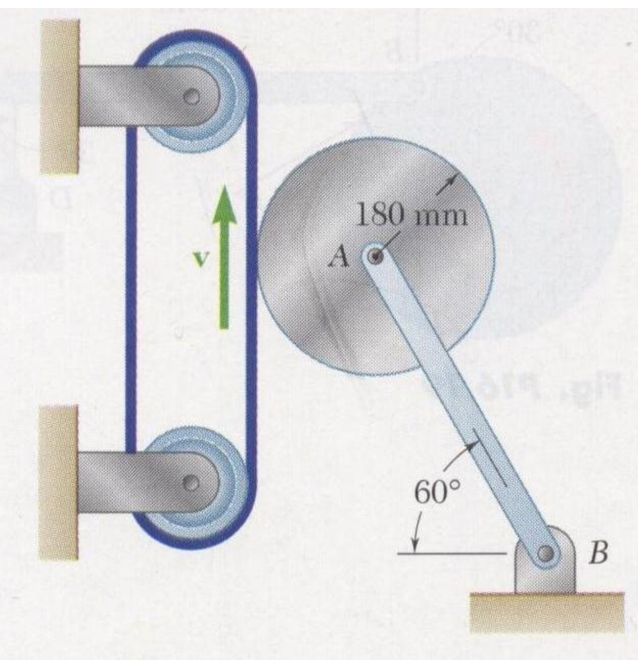

Fig. P16.27

16.28 Solve Prob. 16.27, assuming that the direction of motion of the belt is reversed.

16.32 The flywheel shown has a radius of 500 mm, a mass of 120 kg, and a radius of gyration of 375 mm. A 15-kg block *A* is attached to a wire that is wrapped around the flywheel, and the system is released from rest. Neglecting the effect of friction, determine (*a*) the acceleration of block *A*, (*b*) the speed of block *A* after it has moved 1.5 m.

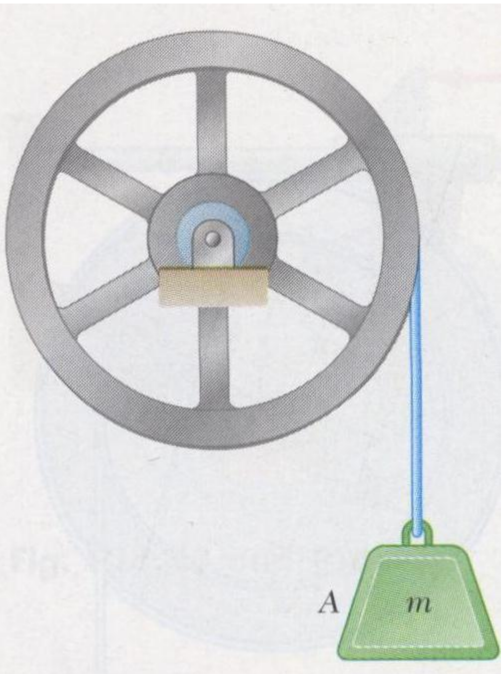

Fig. *P16.32* and *P16.33*

16.33 In order to determine the mass moment of inertia of a flywheel of radius 600 mm, a 12-kg block is attached to a wire that is wrapped around the flywheel. The block is released and is observed to fall 3 m in 4.6 s. To eliminate bearing friction from the computation, a second block of mass 24 kg is used and is observed to fall 3 m in 3.1 s. Assuming that the moment of the couple due to friction remains constant, determine the mass moment of inertia of the flywheel.

16.35 Each of the gears A and B weighs 20 lb and has a radius of gyration of 7.5 in.; gear C weighs 5 lb and has a radius of gyration of 3 in. If a couple **M** of constant magnitude 50 lb · in. is applied to gear C, determine (a) the angular acceleration of gear A, (b) the tangential force which gear C exerts on gear A.

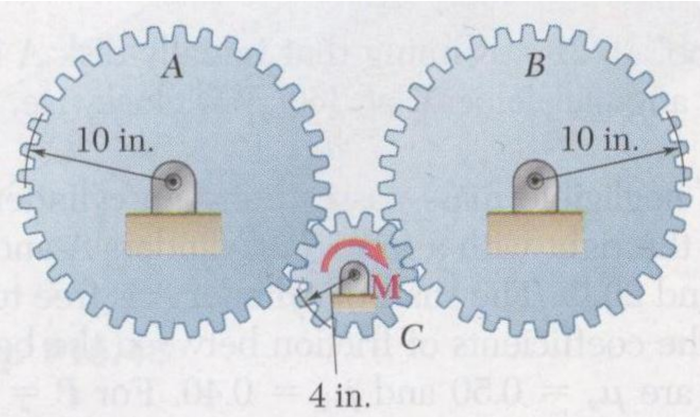

Fig. P16.35

16.36 Solve Prob. 16.35, assuming that the couple **M** is applied to disk A.

16.37 and 16.38 Two uniform disks and two cylinders are assembled as indicated. Disk A weighs 20 lb and disk B weighs 12 lb. Knowing that the system is released from rest, determine the acceleration (a) of cylinder C, (b) of cylinder D.

16.37 Disks A and B are bolted together and the cylinders are attached to separate cords wrapped on the disks.

16.38 The cylinders are attached to a single cord that passes over the disks. Assume that no slipping occurs between the cord and the disks.

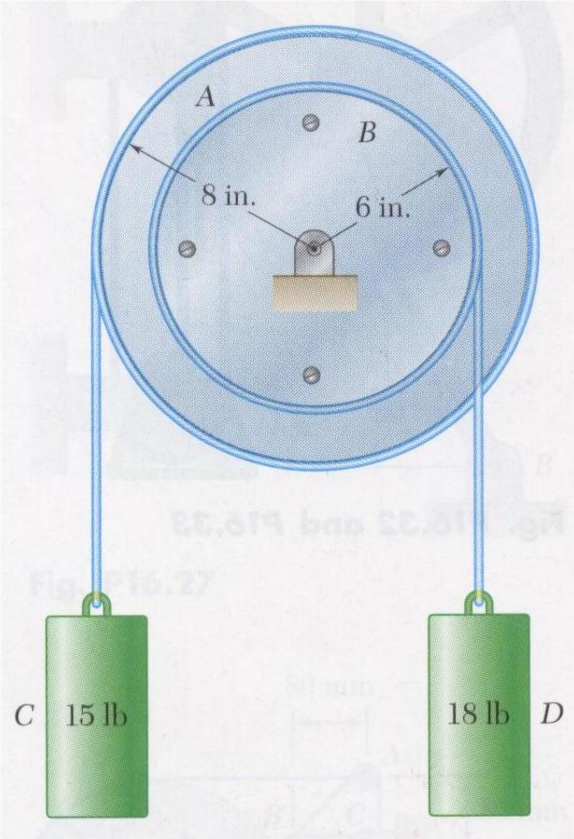

Fig. P16.37

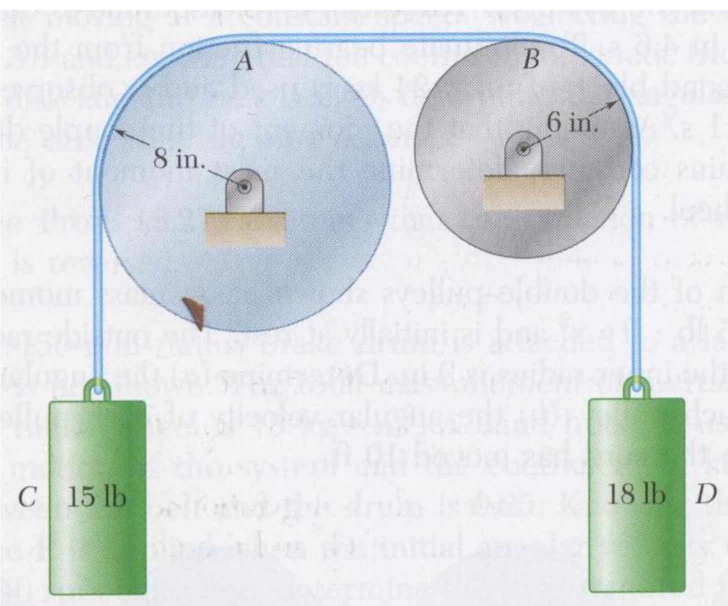

Fig. P16.38

16.39 Disk A has a mass of 6 kg and an initial angular velocity of 360 rpm clockwise; disk B has a mass of 3 kg and is initially at rest. The disks are brought together by applying a horizontal force of magnitude 20 N to the axle of disk A. Knowing that $\mu_k = 0.15$ between the disks and neglecting bearing friction, determine (*a*) the angular acceleration of each disk, (*b*) the final angular velocity of each disk.

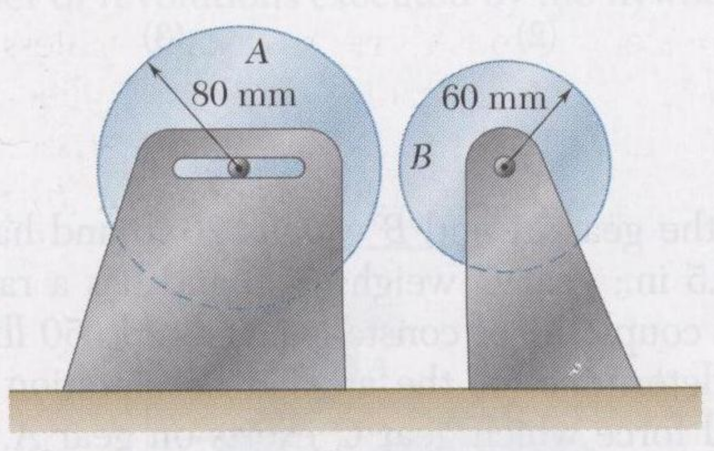

Fig. P16.39

16.40 Solve Prob. 16.39, assuming that initially disk A is at rest and disk B has an angular velocity of 360 rpm clockwise.

16.48 A uniform slender rod AB rests on a frictionless horizontal surface, and a force **P** of magnitude 0.25 lb is applied at A in a direction perpendicular to the rod. Knowing that the rod weighs 1.75 lb, determine the acceleration of (*a*) point A, (*b*) point B.

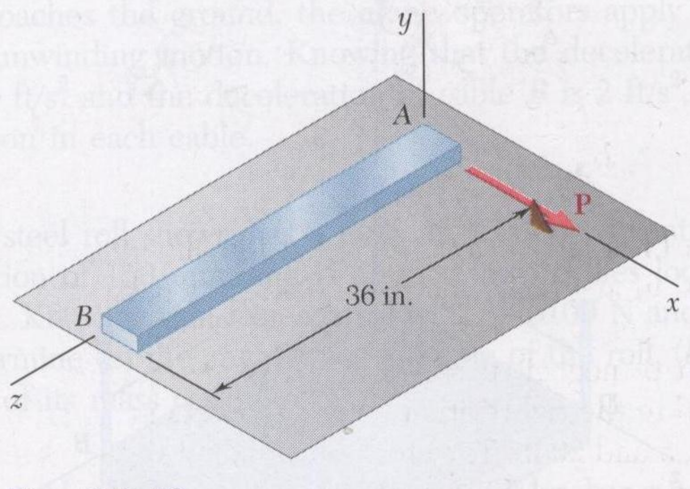

Fig. P16.48

16.49 (*a*) In Prob. 16.48, determine the point of the rod *AB* at which the force **P** should be applied if the acceleration of point *B* is to be zero. (*b*) Knowing that $P = 0.25$ lb, determine the corresponding acceleration of point *A*.

16.50 and 16.51 A force **P** of magnitude 3 N is applied to a tape wrapped around the body indicated. Knowing that the body rests on a frictionless horizontal surface, determine the acceleration of (*a*) point *A*, (*b*) point *B*.

16.50 A thin hoop of mass 2.4 kg.

16.51 A uniform disk of mass 2.4 kg.

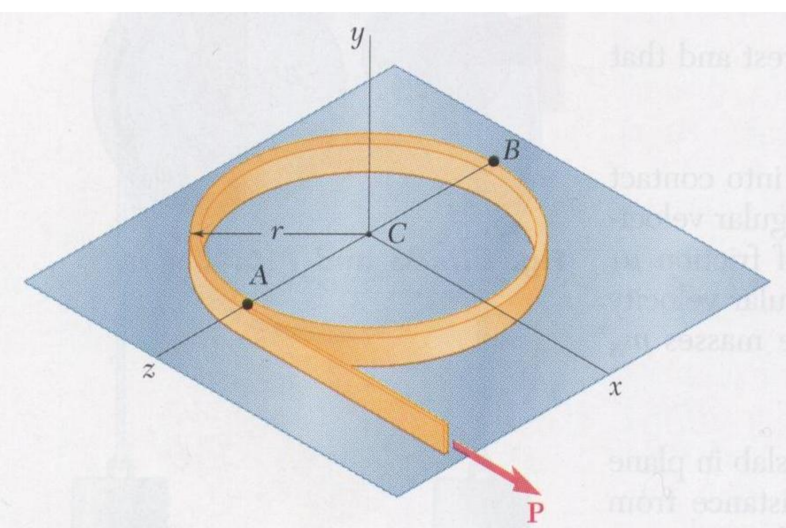

Fig. P16.50

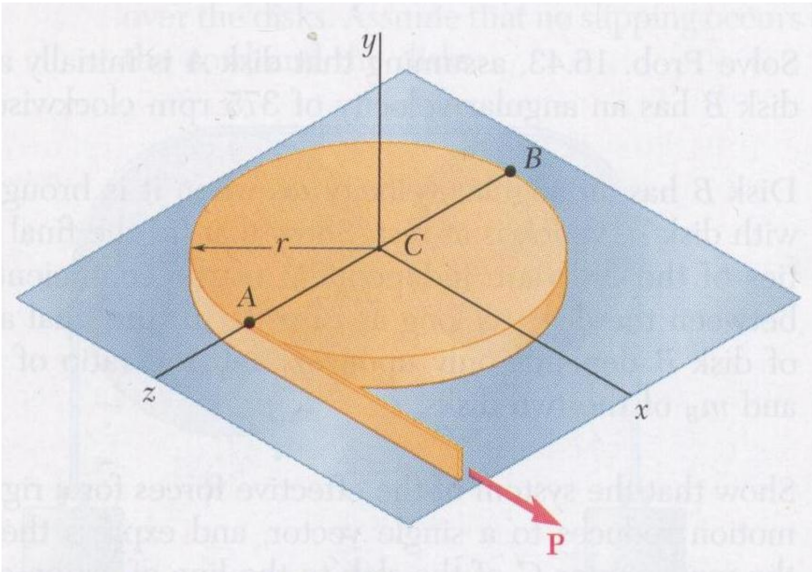

Fig. P16.51 and P16.52

16.52 A force **P** is applied to a tape wrapped around a uniform disk that rests on a frictionless horizontal surface. Show that for each 360° rotation of the disk the center of the disk will move a distance πr.

16.54 A rectangular plate of mass 5 kg is suspended from four vertical wires, and a force **P** of magnitude 6 N is applied to corner C as shown. Immediately after **P** is applied, determine the acceleration of (a) the midpoint of edge BC, (b) corner B.

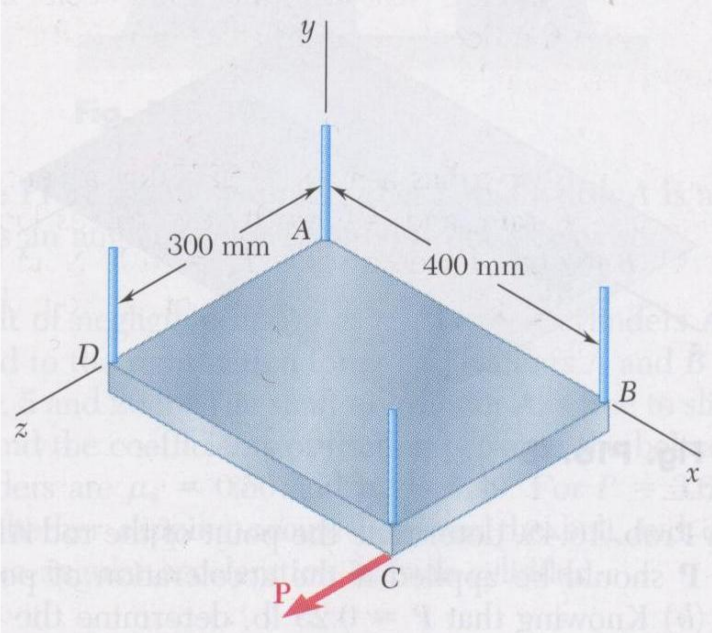

Fig. P16.54

16.55 A 3-kg sprocket wheel has a centroidal radius of gyration of 70 mm and is suspended from a chain as shown. Determine the acceleration of points A and B of the chain, knowing that $T_A = 14$ N and $T_B = 18$ N.

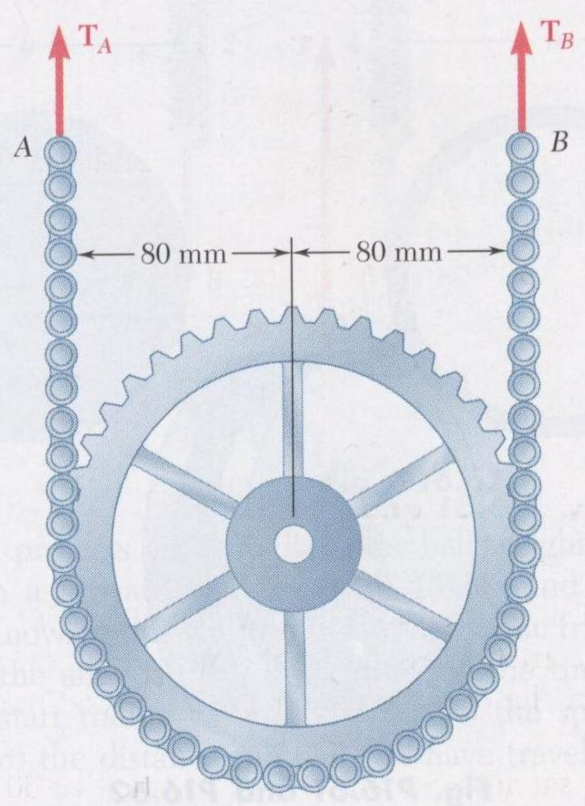

Fig. P16.55

16.56 Solve Prob. 16.55, assuming that $T_A = 14$ N and $T_B = 12$ N.

16.57 and 16.58 A 15-ft beam weighing 500 lb is lowered by means of two cables unwinding from overhead cranes. As the beam approaches the ground, the crane operators apply brakes to slow the unwinding motion. Knowing that the deceleration of cable A is 20 ft/s^2 and the deceleration of cable B is 2 ft/s^2, determine the tension in each cable.

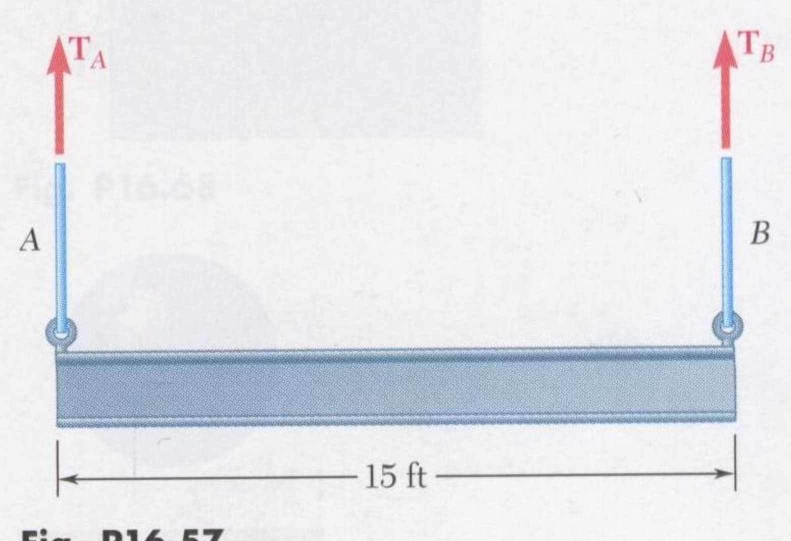

Fig. P16.57

16.63 through 16.65 A beam AB of mass m and of uniform cross section is suspended from two springs as shown. If spring 2 breaks, determine at that instant (*a*) the angular acceleration of the bar, (*b*) the acceleration of point A, (*c*) the acceleration of point B.

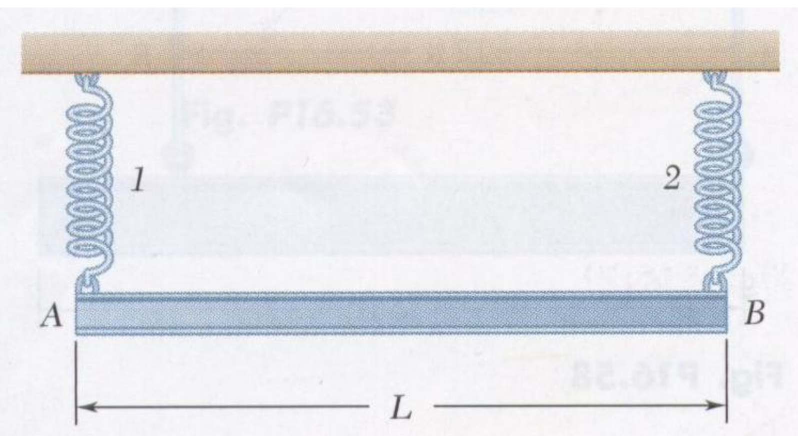

Fig. P16.63

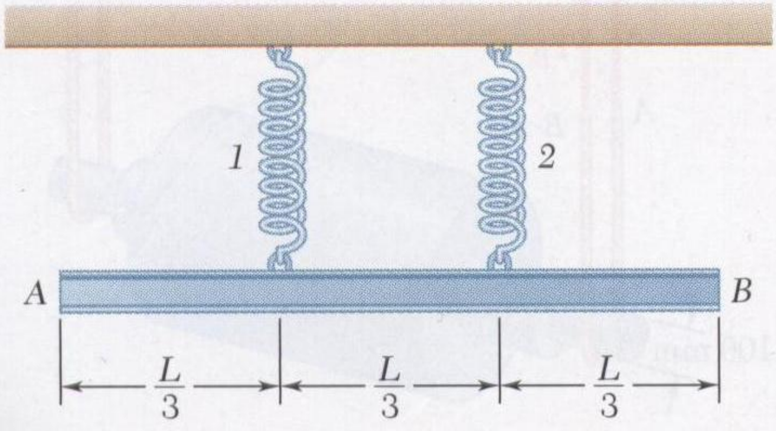

Fig. P16.64

16.69 A bowler projects an 8-in.-diameter ball weighing 12 lb along an alley with a forward velocity $\mathbf{v}_0$ of 15 ft/s and a backspin $\boldsymbol{\omega}_0$ of 9 rad/s. Knowing that the coefficient of kinetic friction between the ball and the alley is 0.10, determine (*a*) the time t_1 at which the ball will start rolling without sliding, (*b*) the speed of the ball at time t_1, (*c*) the distance the ball will have traveled at time t_1.

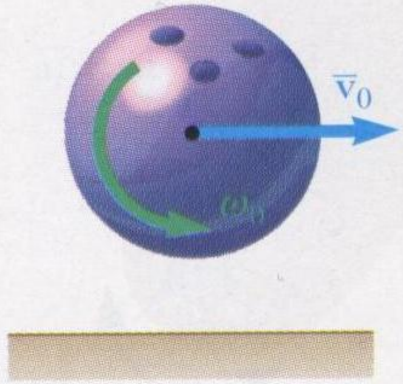

Fig. P16.69

16.76 A uniform slender rod of length $L = 36$ in. and weight $W = 4$ lb hangs freely from a hinge at A. If a force **P** of magnitude 1.5 lb is applied at B horizontally to the left ($h = L$), determine (*a*) the angular acceleration of the rod, (*b*) the components of the reaction at A.

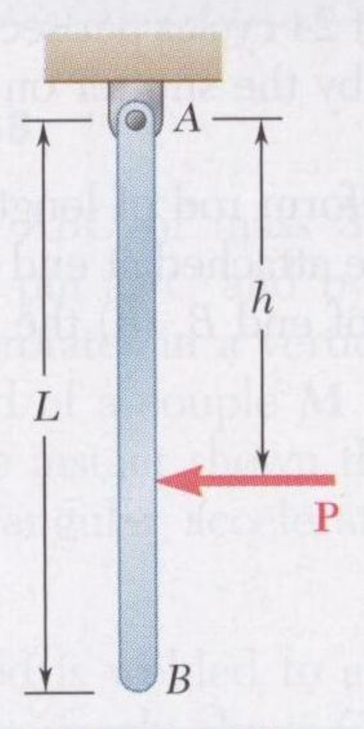

Fig. P16.76

16.77 In Prob. 16.76, determine (*a*) the distance h for which the horizontal component of the reaction at A is zero, (*b*) the corresponding angular acceleration of the rod.

16.78 A uniform slender rod of length $L = 900$ mm and mass $m = 4$ kg is suspended from a hinge at C. A horizontal force **P** of magnitude 75 N is applied at end B. Knowing that $\bar{r} = 225$ mm, determine (*a*) the angular acceleration of the rod, (*b*) the components of the reaction at C.

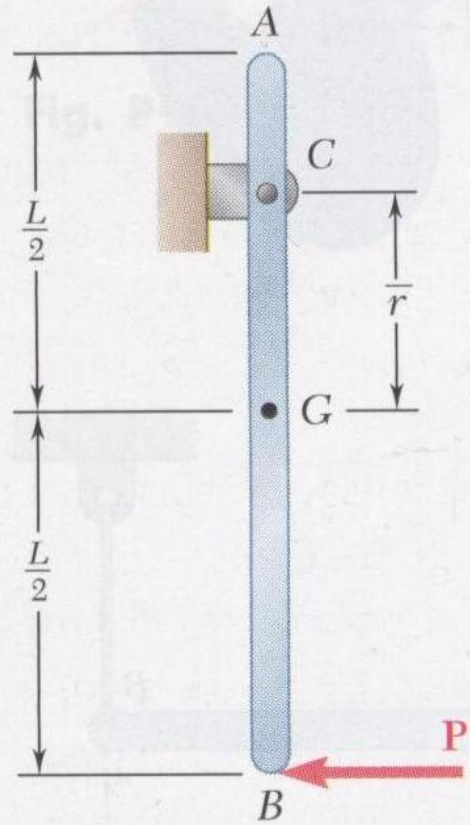

Fig. P16.78

16.79 In Prob. 16.78, determine (*a*) the distance $\overline{r}$ for which the horizontal component of the reaction at C is zero, (*b*) the corresponding angular acceleration of the rod.

16.84 and 16.85 A uniform rod of length L and mass m is supported as shown. If the cable attached at end B suddenly breaks, determine (*a*) the acceleration of end B, (*b*) the reaction at the pin support.

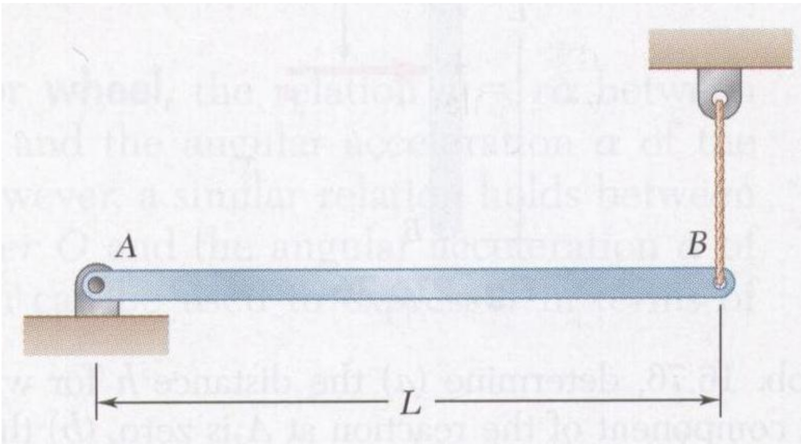

Fig. P16.84

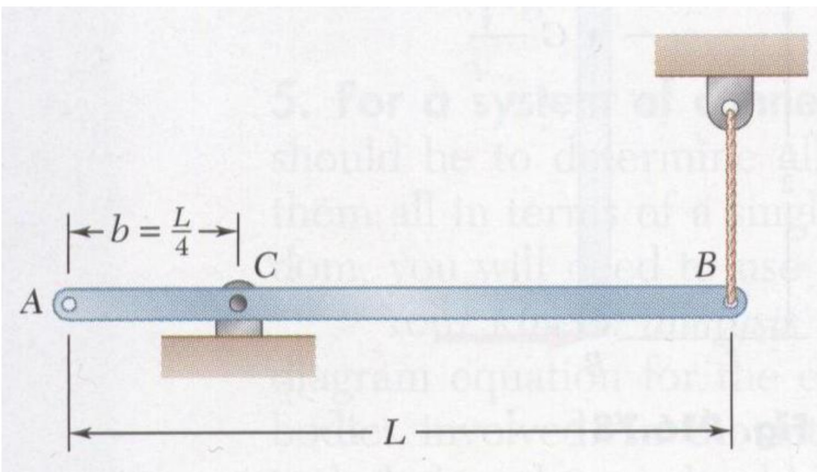

Fig. P16.85

16.90 A 1.5-kg slender rod is welded to a 5-kg uniform disk as shown. The assembly swings freely about C in a vertical plane. Knowing that in the position shown the assembly has an angular velocity of 10 rad/s clockwise, determine (a) the angular acceleration of the assembly, (b) the components of the reaction at C.

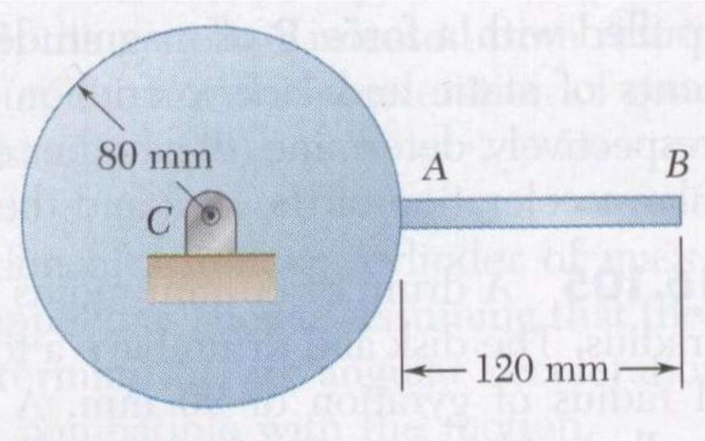

Fig. *P16.90*

16.95 A flywheel is rigidly attached to a shaft of 1.5-in. radius that can roll along parallel rails as shown. When released from rest, the system rolls 16 ft in 40 s. Determine the centroidal radius of gyration of the system.

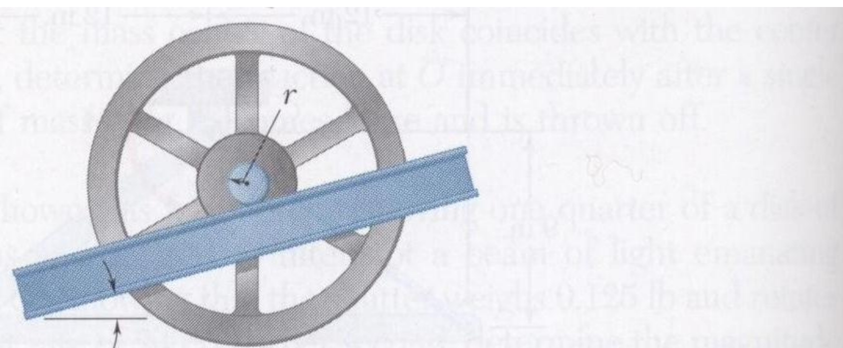

Fig. P16.95 and P16.96

16.96 A flywheel of centroidal radius of gyration $\bar{k}$ is rigidly attached to a shaft that can roll along parallel rails. Denoting by μ_s the coefficient of static friction between the shaft and the rails, derive an expression for the largest angle of inclination β for which no slipping will occur.

16.98 through 16.101 A drum of 4-in. radius is attached to a disk of 8-in. radius. The disk and drum have a combined weight of 10 lb and a combined radius of gyration of 6 in. A cord is attached as shown and pulled with a force **P** of magnitude 5 lb. Knowing that the coefficients of static and kinetic friction are $\mu_s = 0.25$ and $\mu_k = 0.20$, respectively, determine (*a*) whether or not the disk slides, (*b*) the angular acceleration of the disk and the acceleration of *G*.

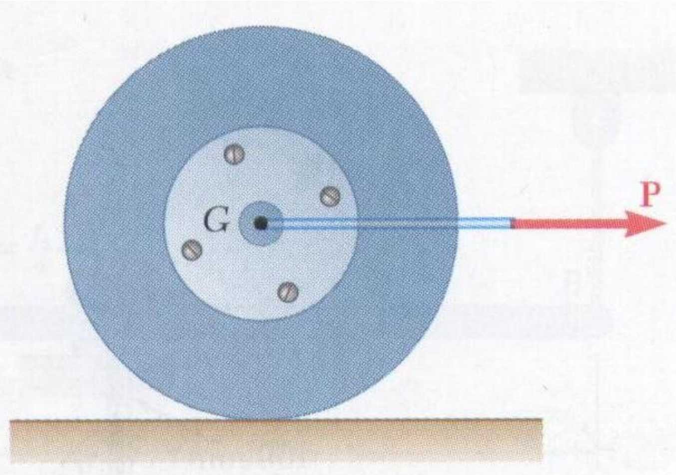

Fig. P16.98 and P16.102

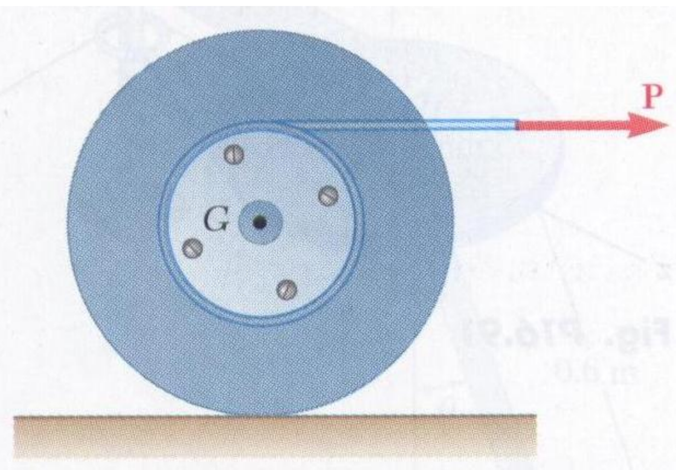

Fig. P16.99 and *P16.103*

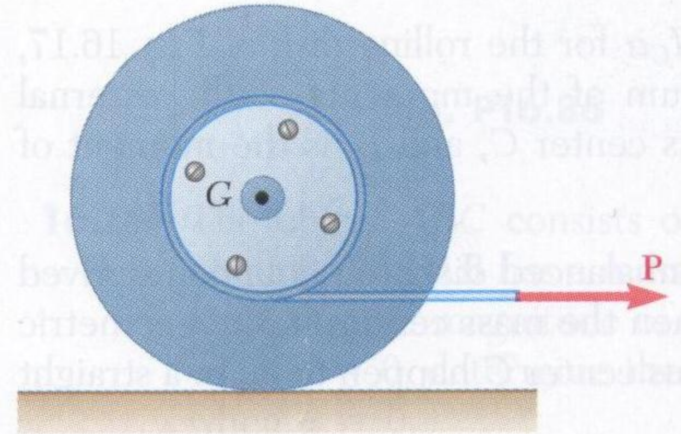

Fig. P16.100 and *P16.104*

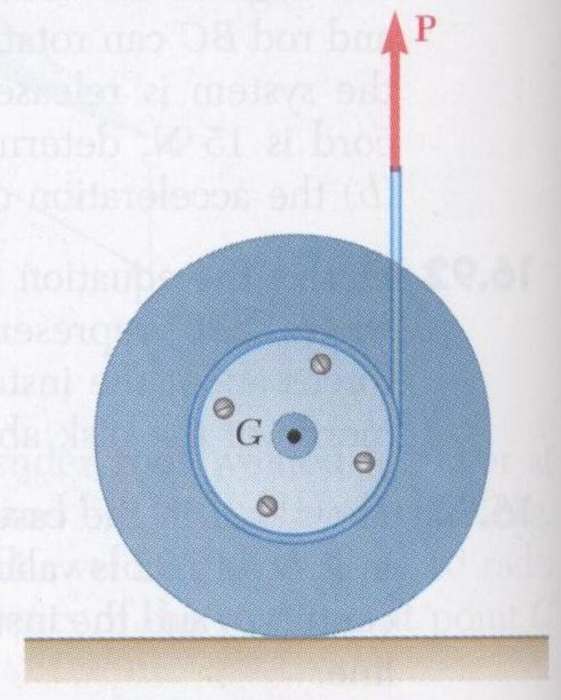

Fig. P16.101 and P16.105

16.109 Two uniform disks A and B, each of weight 4 lb, are connected by a 3-lb rod CD as shown. A counterclockwise couple **M** of moment 1.5 lb · ft is applied to disk A. Knowing that the disks roll without sliding, determine (a) the acceleration of the center of each disk, (b) the horizontal component of the force exerted on disk B by pin D.

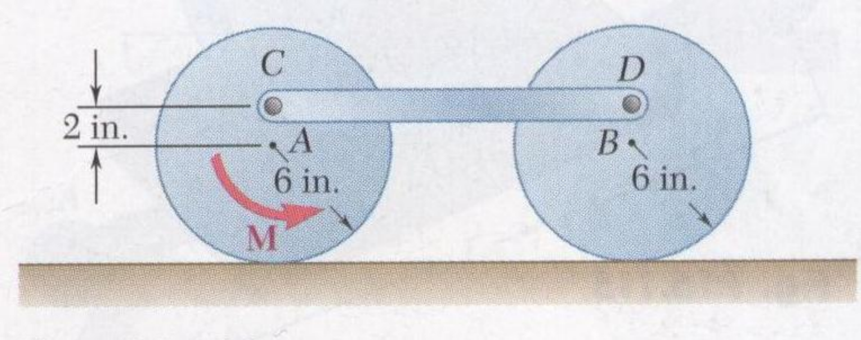

Fig. P16.109

16.110 Gear C has a weight of 10 lb and a centroidal radius of gyration of 3 in. The uniform bar AB has a weight of 6 lb and gear D is stationary. If the system is released from rest in the position shown, determine (*a*) the angular acceleration of gear C, (*b*) the acceleration of point B.

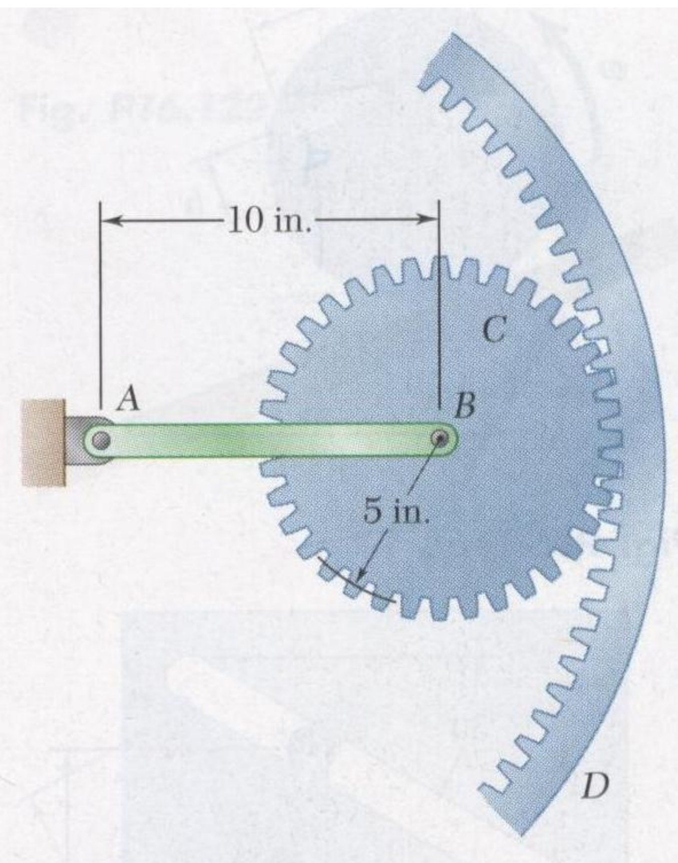

Fig. P16.110

16.117 The ends of the 10-kg uniform rod *AB* are attached to collars of negligible mass that slide without friction along fixed rods. If the rod is released from rest when $\theta = 25°$, determine immediately after release (*a*) the angular acceleration of the rod, (*b*) the reaction at *A*, (*b*) the reaction at *B*.

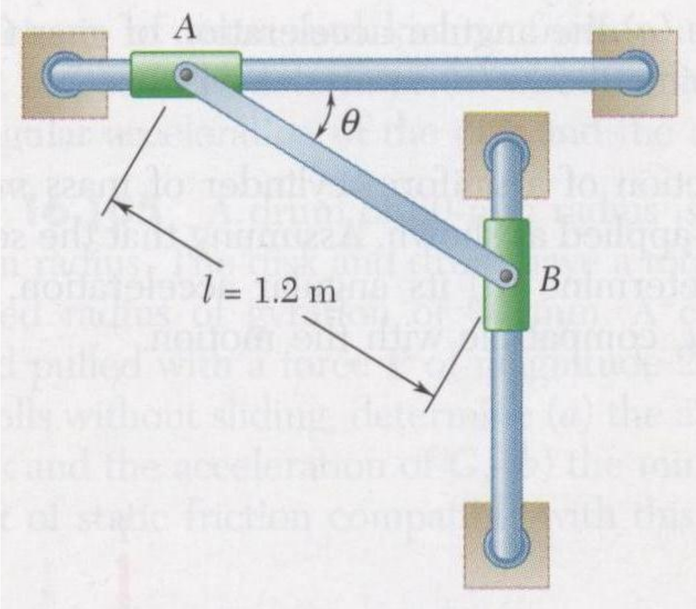

Fig. P16.117 and P16.118

16.118 The ends of the 10-kg uniform rod *AB* are attached to collars of negligible mass that slide without friction along fixed rods. A vertical force **P** is applied to collar *B* when $\theta = 25°$, causing the collar to start from rest with an upward acceleration of 12 m/s^2. Determine (*a*) the force **P**, (*b*) the reaction at *A*.

16.125 The 250-mm uniform rod *BD*, of mass 5 kg, is connected as shown to disk *A* and to a collar of negligible mass, which may slide freely along a vertical rod. Knowing that disk *A* rotates counterclockwise at a constant rate of 500 rpm, determine the reactions at *D* when $\theta = 0$.

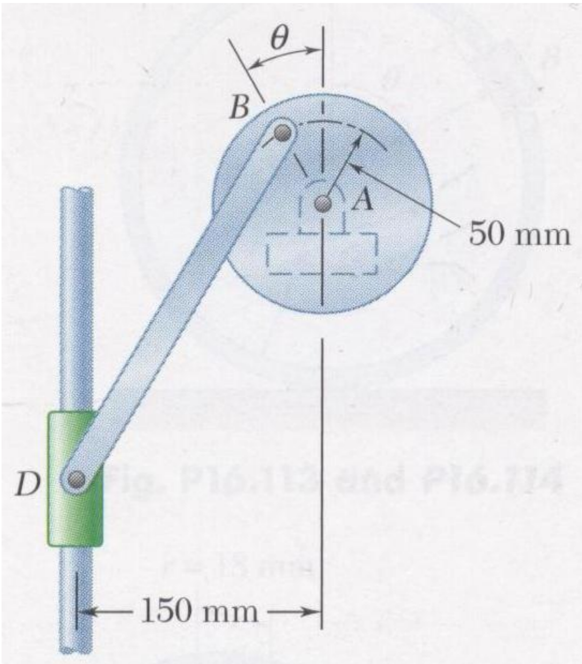

Fig. P16.125

16.126 Solve Prob. 16.125 when $\theta = 90°$.