1. Members ACE and DCB are each 76.2 cm long and are connected by a pin at C. The mass center of the 9-kg member AB is located at G. Determine (a) the acceleration of AB immediately after the system has been released from rest in the position shown, (b) the corresponding force exerted by roller A on member AB. Neglect the weight of members ACE and DCB.

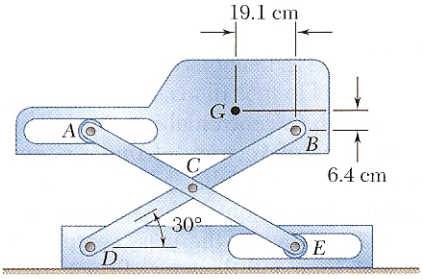


Fig. P1

2. The 100-mm-radius brake drum is attached to a flywheel which is not shown. The drum and flywheel together have a mass of 300 kg and a radius of gyration of 600 mm. The coefficient of kinetic friction between the brake band and the drum is 0.30. Knowing that a force **P** of magnitude 50 N is applied at A when the angular velocity is 180 rpm counterclockwise, determine the time required to stop the flywheel when $a = 200$ mm and $b = 160$ mm.

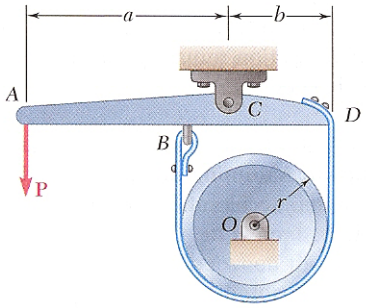
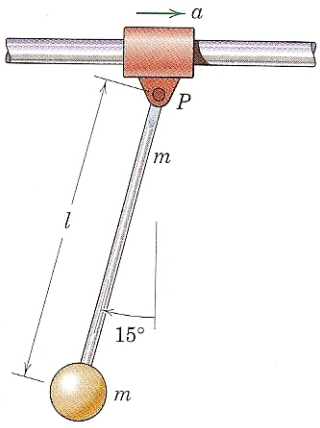


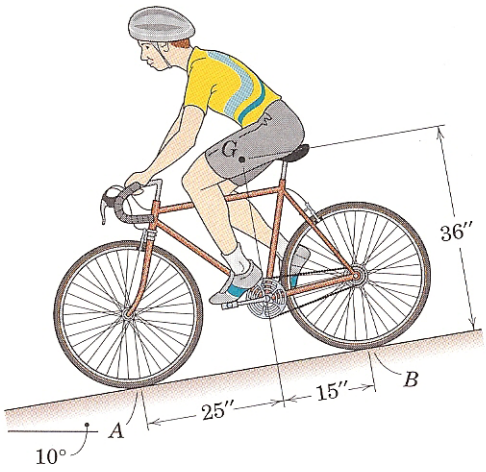
Fig. P2

3. What acceleration a of the collar along the horizontal guide will result in a steady-state 15° deflection of the pendulum from the vertical? The slender rod of length l and the particle each have mass m. Friction at the pivot P is negligible.



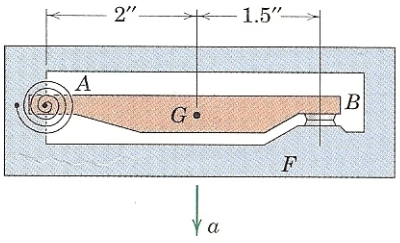
Problem 3

4. The bicyclist applies the brakes as he descends the 10° incline. What deceleration a would cause the dangerous condition of tipping about the front wheel A? The combined center of mass of the rider and bicycle is at G.



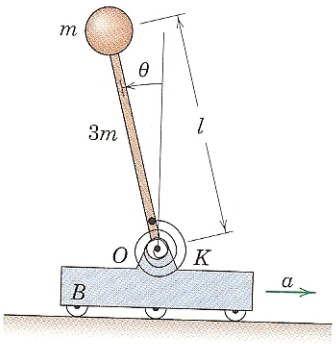
Problem 4

5. Arm AB of a classifying accelerometer has a weight of 0.25 lb with mass center at G and is pivoted freely to the frame F at A. The torsional spring at A is set to preload the arm with an applied clockwise moment of 2 lb-in. Determine the downward acceleration a of the frame at which the contacts at B will separate and break the electrical circuit.



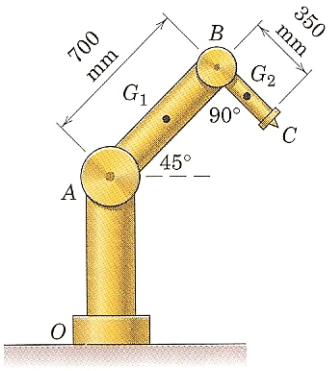
Problem 5

6. The cart B moves to the right with acceleration $a = 2g$. If the steady-state angular deflection of the uniform slender rod of mass $3m$ is observed to be 20°, determine the value of the torsional spring constant K. The spring, which exerts a moment of magnitude $M = K\theta$ on the rod, is undeformed when the rod is vertical. The values of m and l are 0.5 kg and 0.6 m, respectively. Treat the small end sphere of mass m as a particle.



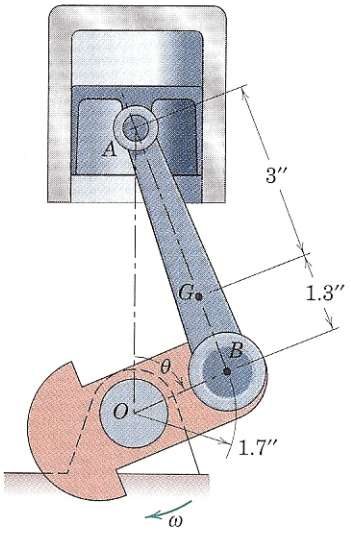
Problem 6

7. The robotic device consists of the stationary pedestal OA, arm AB pivoted at A, and arm BC pivoted at B. The rotation axes are normal to the plane of the figure. Estimate (a) the moment M_A applied to arm AB required to rotate it about joint A at 4 rad/sec^2 counterclockwise from the position shown with joint B locked and (b) the moment M_B applied to arm BC required to rotate it about joint B at the same rate with joint A locked. The mass of arm AB is 25 kg and that of BC is 4 kg, with the stationary portion of joint A excluded entirely and the mass of joint B divided equally between the two arms. Assume that the centers of mass G_1 and G_2 are in the geometric centers of the arms and model the arms as slender rods.



Problem 7

8. The connecting rod AB of a certain internal-combustion engine weighs 1.2 lb with mass center at G and has a radius of gyration about G of 1.12 in. The piston and piston pin A together weigh 1.80 lb. The engine is running at a constant speed of 3000 rev/min, so that the angular velocity of the crank is $3000(2\pi)/60 = 100\pi$ rad/sec. Neglect the weights of the components and the force exerted by the gas in the cylinder compared with the dynamic forces generated and calculate the magnitude of the force on the piston pin A for the crank angle $\theta = 90°$. (*Suggestion:* Use the alternative moment relation, Eq. 6/3, with B as the moment center.)



Problem 8

9. Computer Problem 16.C1