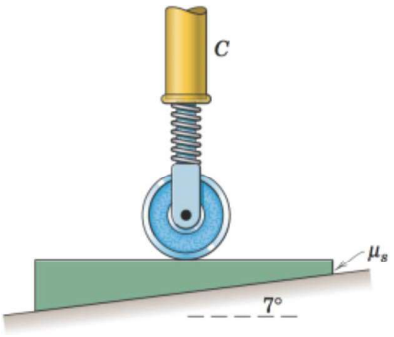
PROBLEMS

(Unless otherwise instructed, neglect the weights of the wedges and screws in the problems which follow.)

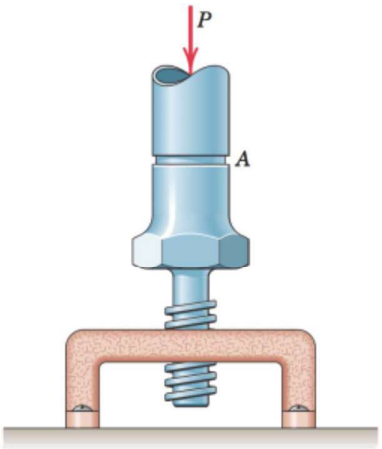
Introductory Problems

6/53 The 7° wedge is driven under the spring-loaded wheel whose supporting strut C is fixed. Determine the minimum coefficient of static friction μ_s for which the wedge will remain in place. Neglect all friction associated with the wheel.



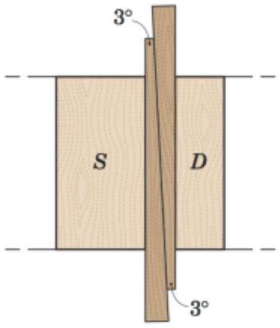
Problem 6/53

6/54 The device shown is used for coarse adjustment of the height of an experimental apparatus without a change in its horizontal position. Because of the slip-joint at A, turning the screw does not rotate the cylindrical leg above A. The mean diameter of the thread is 12 mm and the coefficient of friction is 0.15. For a conservative design which neglects friction at the slip joint, what should be the minimum number N of threads per centimeter to ensure that the single-threaded screw does not turn by itself under the weight of the apparatus?



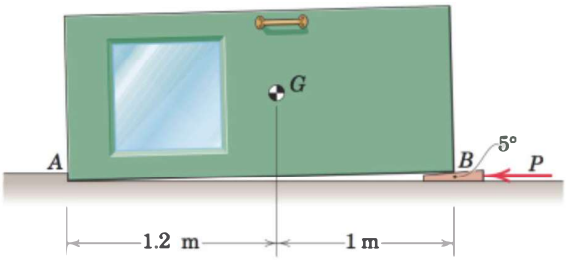
Problem 6/54

6/55 In wood-frame construction, two shims are frequently used to fill the gap between the framing S and the thinner window/door jamb D. The members S and D are shown in cross section in the figure. For the 3° shims shown, determine the minimum necessary coefficient of static friction so that the shims will remain in place.



Problem 6/55

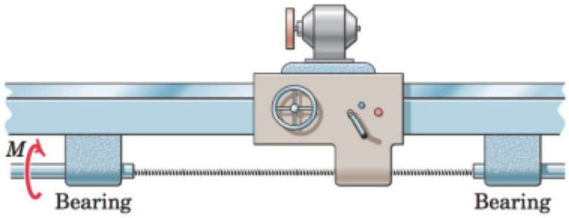
6/56 The 100-kg industrial door with mass center at G is being positioned for repair by insertion of the 5° wedge under corner B. Horizontal movement is prevented by the small ledge at corner A. If the coefficients of static friction at both the top and bottom wedge surfaces are 0.60, determine the force P required to lift the door at B.



Problem 6/56

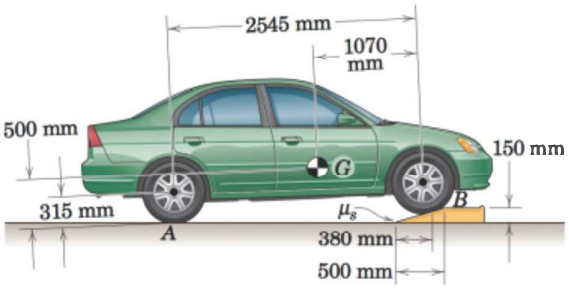
6/57 Calculate the rightward force P' which would remove the wedge from under the door of Prob. 6/56. Assume that corner A does not slip for your calculation of P', but then check this assumption; the coefficient of static friction at A is 0.60.

6/58 Specify the required torque M on the power screw necessary to overcome a resistance of 450 N to motion of the carriage along its horizontal ways. The screw has a mean diameter of 25 mm and has two separate square threads which move the carriage 20 mm per revolution of the screw. The coefficient of friction may be taken as 0.20.



Problem 6/58

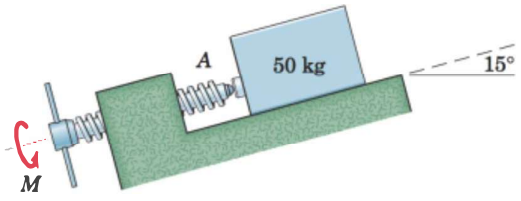
6/59 A 1600-kg rear-wheel-drive car is being driven up the ramp at a slow steady speed. Determine the minimum coefficient of static friction μ_s for which the portable ramp will not slip forward. Also determine the required friction force F_A at each rear drive wheel.



Problem 6/59

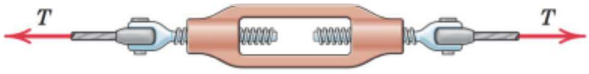
Representative Problems

6/60 Determine the torque M which must be applied to the handle of the screw to begin moving the 50-kg block up the 15° incline. The coefficient of static friction between the block and the incline is 0.50, and the single-thread screw has square threads with a mean diameter of 25 mm and advances 10 mm for each complete turn. The coefficient of static friction for the threads is also 0.50. Neglect friction at the small ball joint A.



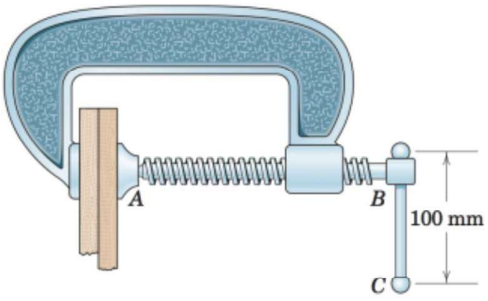
Problem 6/60

6/61 The large turnbuckle supports a cable tension of 40 kN. The screws have a mean diameter of 30 mm and have square threads with a lead of 3.5 mm. The coefficient of friction for the greased threads does not exceed 0.25. Determine the moment M applied to the body of the turnbuckle (*a*) to tighten it and (*b*) to loosen it. Both screws have single threads and are prevented from turning.



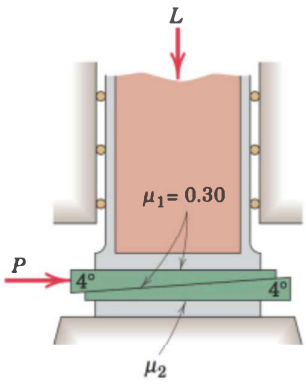
Problem 6/61

6/62 A compressive force of 600 N is to be applied to the two boards in the grip of the C-clamp. The threaded screw has a mean diameter of 10 mm and advances 2.5 mm per turn. The coefficient of static friction is 0.20. Determine the force F which must be applied normal to the handle at C in order to (*a*) tighten and (*b*) loosen the clamp. Neglect friction at point A.



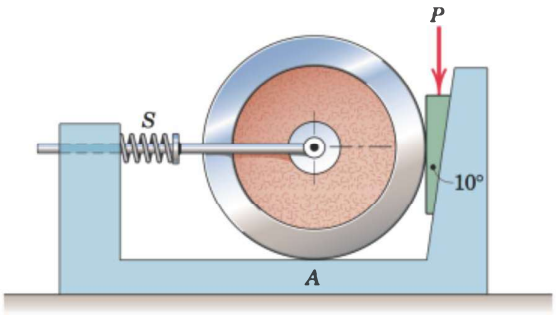
Problem 6/62

6/63 The two 4° wedges are used to position the vertical column under a load L. What is the least value of the coefficient of friction μ_2 for the bottom pair of surfaces for which the column may be raised by applying a single horizontal force P to the upper wedge?



Problem 6/63

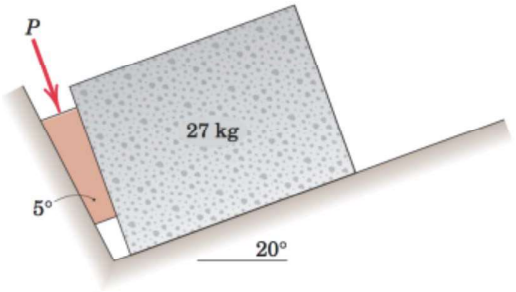
6/64 Compute the force P required to move the 20-kg wheel. The coefficient of friction at A is 0.25 and that for both pairs of wedge surfaces is 0.30. Also, the spring S is under a compression of 100 N, and the rod offers negligible support to the wheel.



Problem 6/64

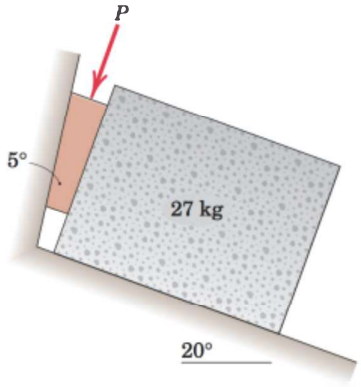
6/65 Work Prob. 6/64 if the compression in the spring is 200 N. All other conditions remain unchanged.

6/66 The coefficient of static friction for both wedge surfaces is 0.40 and that between the 27-kg concrete block and the 20° incline is 0.70. Determine the minimum value of the force P required to begin moving the block up the incline. Neglect the weight of the wedge.



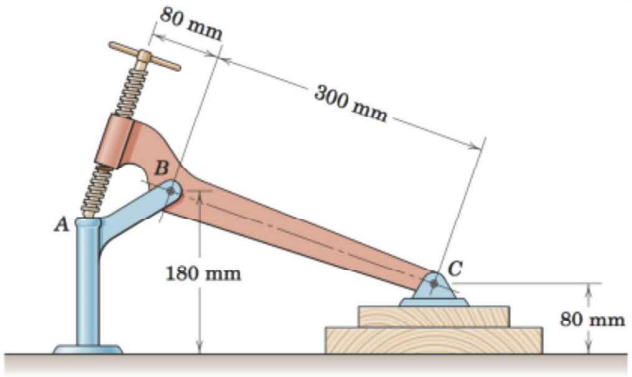
Problem 6/66

6/67 Repeat Prob. 6/66, only now the 27-kg concrete block begins to move down the 20° incline as shown. All other conditions remain as in Prob. 6/66.



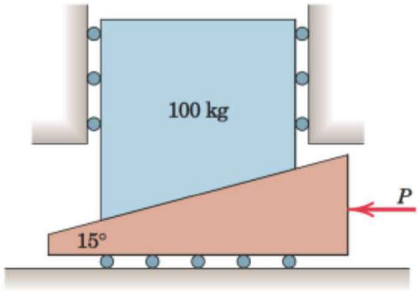
Problem 6/67

6/68 The bench hold-down clamp is being used to clamp two boards together while they are being glued. What torque M must be applied to the screw in order to produce a 900-N compression between the boards? The 12-mm-diameter single-thread screw has 2 square threads per centimeter, and the coefficient of friction in the threads may be taken to be 0.20. Neglect any friction in the small ball contact at A and assume that the contact force at A is directed along the axis of the screw. What torque M' is required to loosen the clamp?



Problem 6/68

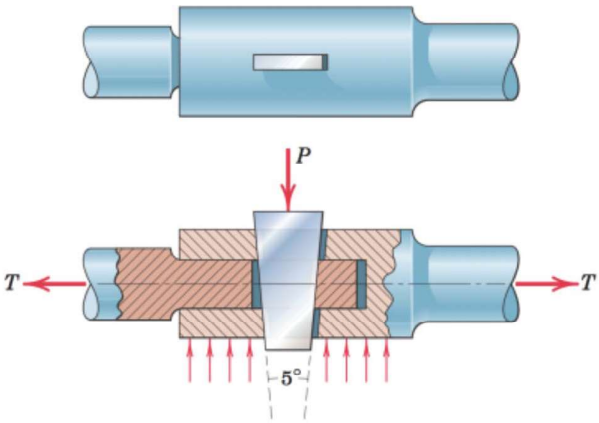
6/69 The coefficient of static friction μ_s between the 100-kg body and the 15° wedge is 0.20. Determine the magnitude of the force P required to begin raising the 100-kg body if (*a*) rollers of negligible friction are present under the wedge, as illustrated, and (*b*) the rollers are removed and the coefficient of static friction $\mu_s = 0.20$ applies at this surface as well.



Problem 6/69

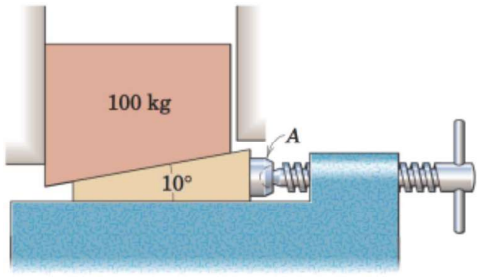
6/70 For both conditions (*a*) and (*b*) as stated in Prob. 6/69, determine the magnitude and direction of the force P' required to begin lowering the 100-kg body.

6/71 The design of a joint to connect two shafts by a flat 5° tapered cotter is shown by the two views in the figure. If the shafts are under a constant tension T of 900 N, find the force P required to move the cotter and take up any slack in the joint. The coefficient of friction between the cotter and the sides of the slots is 0.20. Neglect any horizontal friction between the shafts.



Problem 6/71

6/72 The vertical position of the 100-kg block is adjusted by the screw-activated wedge. Calculate the moment M which must be applied to the handle of the screw to raise the block. The single-thread screw has square threads with a mean diameter of 30 mm and advances 10 mm for each complete turn. The coefficient of friction for the screw threads is 0.25, and the coefficient of friction for all mating surfaces of the block and wedge is 0.40. Neglect friction at the ball joint A.



Problem 6/72