† *4-20* Repeat Problem 4-19 for 12 rods each 10-mm dia and 10 m long. The desired rod stress is 200 MPa. The allowable normal stress in the clevis and pin is 280 MPa and their allowable shear stress is 140 MPa. Each clevis flange is 20 mm wide.

4-21 Figure P4-9 shows an automobile wheel with two common styles of lug wrench being used to tighten the wheel nuts, a single-ended wrench in (*a*), and a double-ended wrench in (*b*). In each case two hands are required to provide forces, respectively, at *A* and *B* as shown. The distance between points *A* and *B* is 1 ft in both cases and the handle diameter is 0.625 in. The wheel nuts require a torque of 70 ft-lb. Find the maximum principal stress and maximum deflection in each wrench design.

*4-22 An in-line "roller-blade" skate is shown in Figure P4-10. The polyurethane wheels are 72-mm dia and spaced on 104-mm centers. The skate-boot-foot combination weighs 2 kg. The effective "spring rate" of the person-skate system is 6000 N/m. The axles are 10-mm-dia steel pins in double shear. Find the stress in the pins for a 100-kg person landing a 0.5-m jump on one foot. (a) Assume that all four wheels land simultaneously. (b) Assume that one wheel absorbs all the landing force.

*4-23 A beam is supported and loaded as shown in Figure P4-11*a*. Find the reactions, maximum shear, maximum moment, maximum slope, maximum bending stress, and maximum deflection for the data given in the assigned row(s) in Table P4-2.

*4-24 A beam is supported and loaded as shown in Figure P4-11*b*. Find the reactions, the maximum shear, maximum moment, maximum slope, maximum bending stress, and maximum deflection for the data given in the assigned row(s) in Table P4-2.

*4-25 A beam is supported and loaded as shown in Figure P4-11*c*. Find the reactions, the maximum shear, maximum moment, maximum slope, maximum bending stress, and maximum deflection for the data given in the assigned row(s) in Table P4-2.

*4-26 A beam is supported and loaded as shown in Figure P4-11*d*. Find the reactions, maximum shear, maximum moment, maximum slope, maximum bending stress, and maximum deflection for the data given in the assigned row(s) in Table P4-2.

† *4-27* A storage rack is to be designed to hold the paper roll of Problem 4-8 as shown in Figure P4-12. Determine suitable values for dimensions *a* and *b* in the figure. Consider bending, shear, and bearing stresses. Assume an allowable tensile/compressive stress of 100
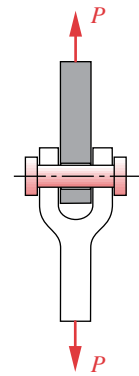

FIGURE P4-8

Problems 4-19 and 4-20

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* Answers to these problems are provided in Appendix D.

Problem numbers in **boldface** are extended from similar problems in earlier chapters with the same dash number.

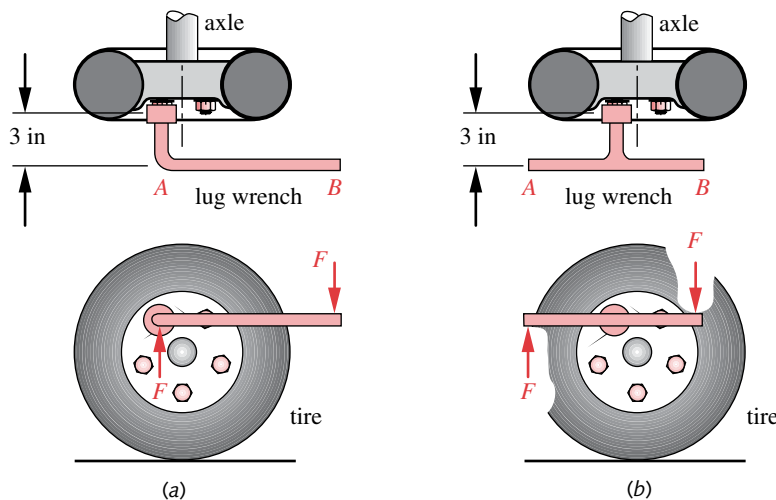† Problems with numbers in *italics* are design problems.

FIGURE P4-10

Problem 4-22

(*a*)   (*b*)

FIGURE P4-9

Problem 4-21