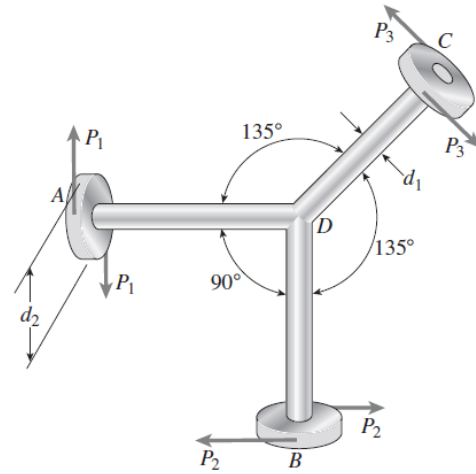


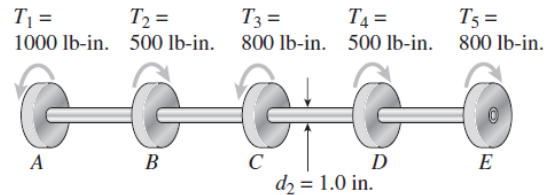
## Homework #5

**Problem 3.3-9** Three identical circular disks  $A$ ,  $B$ , and  $C$  are welded to the ends of three identical solid circular bars (see figure). The bars lie in a common plane and the disks lie in planes perpendicular to the axes of the bars. The bars are welded at their intersection  $D$  to form a rigid connection. Each bar has diameter  $d_1 = 0.5$  in. and each disk has diameter  $d_2 = 3.0$  in.

Forces  $P_1$ ,  $P_2$ , and  $P_3$  act on disks  $A$ ,  $B$ , and  $C$ , respectively, thus subjecting the bars to torsion. If  $P_1 = 28$  lb, what is the maximum shear stress  $\tau_{\max}$  in any of the three bars?



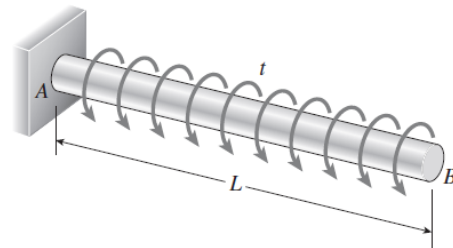
**Problem 3.4-5** A hollow tube  $ABCDE$  constructed of monel metal is subjected to five torques acting in the directions shown in the figure. The magnitudes of the torques are  $T_1 = 1000$  lb-in.,  $T_2 = T_4 = 500$  lb-in., and  $T_3 = T_5 = 800$  lb-in. The tube has an outside diameter  $d_2 = 1.0$  in. The allowable shear stress is 12,000 psi and the allowable rate of twist is  $2.0^\circ/\text{ft}$ .



Determine the maximum permissible inside diameter  $d_1$  of the tube.

**Problem 3.4-12** A prismatic bar  $AB$  of length  $L$  and solid circular cross section (diameter  $d$ ) is loaded by a distributed torque of constant intensity  $t$  per unit distance (see figure).

- Determine the maximum shear stress  $\tau_{\max}$  in the bar.
- Determine the angle of twist  $\phi$  between the ends of the bar.



**Problem 3.5-9** A solid steel bar ( $G = 11.8 \times 10^6$  psi) of diameter  $d = 2.0$  in. is subjected to torques  $T = 8.0$  k-in. acting in the directions shown in the figure.

- Determine the maximum shear, tensile, and compressive stresses in the bar and show these stresses on sketches of properly oriented stress elements.
- Determine the corresponding maximum strains (shear, tensile, and compressive) in the bar and show these strains on sketches of the deformed elements.



**Problem 3.8-1** A solid circular bar  $ABCD$  with fixed supports is acted upon by torques  $T_0$  and  $2T_0$  at the locations shown in the figure.

Obtain a formula for the maximum angle of twist  $\phi_{\max}$  of the bar. (Hint: Use Eqs. 3-46a and b of Example 3-9 to obtain the reactive torques.)

