1. The dimensions of a rectangular bar are 3 in. wide by 1 in. thick. The bar is subjected to a tension force of \( P = 36 \) kips. The plane surface \( NN' \) is inclined as shown on the sketch and the normal and shear stresses acting on this surface are to be calculated.
   
   a. Sketch a free-body diagram appropriate for this calculation in the space below. (10 points)
   
   b. Determine the value of the normal stress acting on the \( NN' \) plane. (10 points)
   
   c. Determine the value of the shear stress acting on the \( NN' \) plane. (10 points)
2. The compound rod ABC is attached to rigid supports at A and C. The cross-sectional area of the aluminum rod is \( A_1 = 1.25 \text{ in}^2 \) and the elastic modulus is \( E_1 = 10,000 \text{ ksi} \). The cross-sectional area of the steel rod is \( A_2 = 1.00 \text{ in}^2 \) and the elastic modulus is \( E_2 = 30,000 \text{ ksi} \). If the allowable normal stress in the aluminum is 24 ksi and the allowable normal stress in the steel is 42 ksi, determine the maximum force \( P \) that can be applied to the rigid flange at B. (30 points)
3. A solid steel shaft (G = 80 GPa) has a diameter of 25 mm. A concentrated torque of 12 N·m is applied to the shaft at gear B. At gear C, a concentrated torque $T_C$ is applied to the shaft. (Note: consider the shaft fixed at motor A.)
   a. Determine the magnitude of torque $T_C$ that can be applied to the shaft if the angle of rotation at C is not to exceed 1 degree. (20 points)
   b. Compute the maximum shear stress in the shaft if the torque $T_C = 36$ N·m. (10 points)