1. Two solid steel shafts $AB$ and $CD$ are fitted with flanges at $B$ and $C$ that are then connected by bolts as shown in Fig. 1. The bolts are slightly undersized and permit a $3^\circ$ rotation of one flange with respect to the other before the flanges begin to rotate as a single unit. Knowing that the torque applied to the flange at $B$ has a magnitude $T = 420 \text{ lb-ft}$ and the modulus of rigidity for steel is $G = 11.2 \times 10^6 \text{ psi}$, determine the maximum shearing stresses $(\tau_{\text{max}})_{AB}$ and $(\tau_{\text{max}})_{CD}$ developed in these two shafts.

![Fig. 1](image1)

![Fig. 2](image2)

2. A state of stress at a point is obtained by the superposition of two states of stress at the same point as shown in Fig. 2. Using Mohr’s circle, determine (a) the values of $\sigma_x$, $\sigma_y$, and $\tau_{xy}$ as indicated; (b) the principal stresses $\sigma_{\text{max}}$ and $\sigma_{\text{min}}$ at this point; (c) the principle planes associated with $\sigma_{\text{max}}$ and $\sigma_{\text{min}}$.

![Fig. 3](image3)

3. A continuous beam $AB$ with constant flexural rigidity $EI$ and total length $2L$ has a roller support at $A$, a roller support at $C$, a fixed support at $B$ and carries a linearly distributed load as shown in Fig. 3. Determine (a) the vertical reaction force $A_y$ and the slope $\theta_A$ at $A$, (b) the vertical reaction force $C_y$ and the slope $\theta_C$ at $C$. 

![Fig. 3](image4)