UNIVERSITY OF ARKANSAS

Ph.D. Qualifying Exam – Mechanics of Materials (Fall 2010)

Closed books & closed notes

(Time: 2 hours)

Name:_____

ID #:_____

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 $3°$ 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 $T = 420$ lb·ft and the modulus of rigidity for steel is $G = 11.2\times10^6$ psi, determine the maximum shearing stresses $(\tau_{\max})_{AB}$ and $(\tau_{\max})_{CD}$ developed in these two shafts.

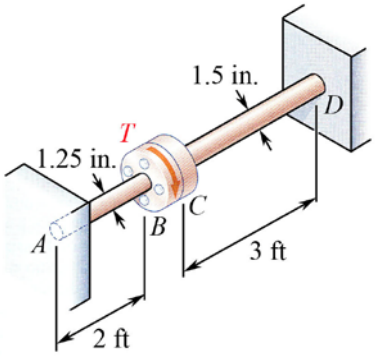

Fig. 1

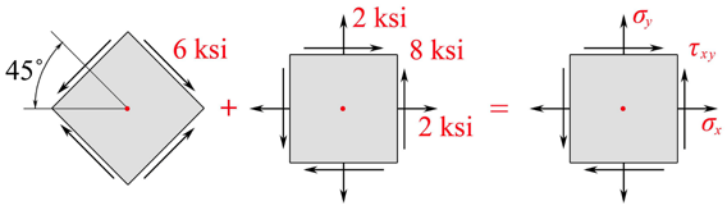

Fig. 2

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 σ_x, σ_y, and τ_{xy} as indicated; (*b*) the principal stresses $\sigma_{\max}$ and $\sigma_{\min}$ at this point; (*c*) the principle planes associated with $\sigma_{\max}$ and $\sigma_{\min}$.

3. A continuous beam *AB* with constant flexural rigidity *EI* and total length 2*L* 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 $\mathbf{A}_y$ and the slope θ_A at *A*, (*b*) the vertical reaction force $\mathbf{C}_y$ and the slope θ_C at *C*.

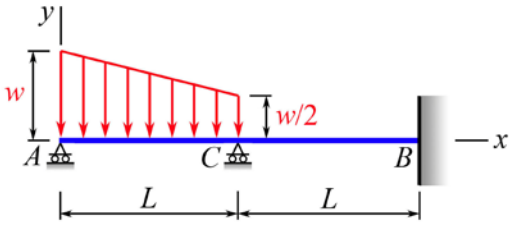

Fig. 3