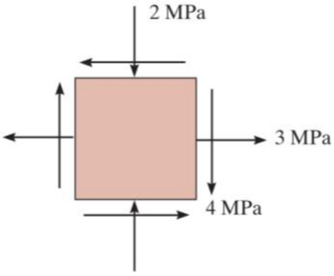
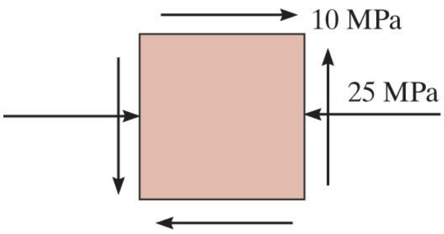
1. Determine the equivalent state of stress if an element is oriented 20^0 clockwise from the element shown. Show the result on the element. [15%] Ans: 4.99, -1.46, -3.99 MPa



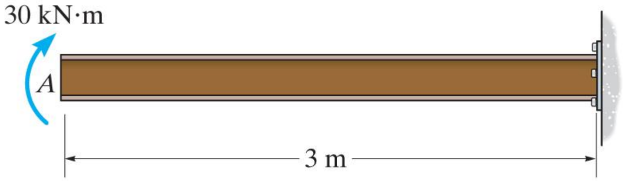
2. The state of stress at a point is shown on the element. (a) Determine the principal stresses and the corresponding orientation of the element. (b) Determine the maximum in-plane shear stress and average normal stress at the point, and specify the orientation of the element. You must use Mohr's circle to solve this problem. [20%] Ans: (a) 3.51, -28.51 MPa, -19.3^0, 70.7^0 (b) +-16.0, -12.5 MPa, 25.7^0, -64.3^0



3. The state of plane strain at a point has components $\varepsilon_x = 400(10^{-6})$, $\varepsilon_y = -250(10^{-6})$, $\gamma_{xy} = 310(10^{-6})$. Determine the state of strain on an element oriented 30^0 counterclockwise from the reported position. [15%] Ans: $248(10^{-6})$, $-348(10^{-6})$, $-233(10^{-6})$(shear)

4. The state of plane strain at a point is represented on an element having components $\varepsilon_x = 520(10^{-6})$, $\varepsilon_y = -760(10^{-6})$, and $\gamma_{xy} = -750(10^{-6})$. (a) Determine the in-plane principal strains and specify the orientation of the corresponding element. (b) Determine the maximum in-plane shear strain and average normal strain and specify the orientation of the corresponding element. You must use Mohr's circle to solve this problem. [15%] Ans: (a) $622(10^{-6})$, $-862(10^{-6})$, -15.2^0, 74.8^0 (b) $+-1484(10^{-6})$, $-120(10^{-6})$, -29.8^0, 60.2^0

5. Determine the slope and deflection of end A of the cantilevered beam. E= 200 GPa and I=65.0 (10^6) mm^4. [15%]



$$v = \frac{1}{EI}(15x^2 - 90x + 135)$$

For end A, $x = 0$

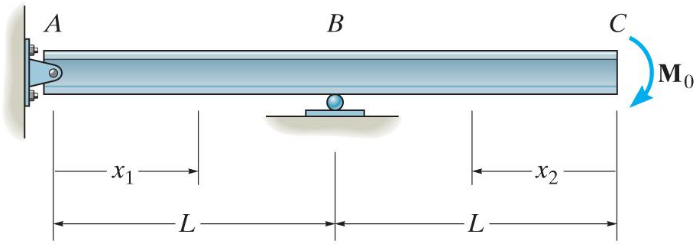
$$\theta_A = \left.\frac{dv}{dx}\right|_{x=0} = -\frac{90(10^3)}{200(10^9)[65.0(10^{-6})]} = -0.00692 \text{ rad}$$

Ans.

$$v_A = v|_{x=0} = \frac{135(10^3)}{200(10^9)[65.0(10^{-6})]} = 0.01038 \text{ m} = 10.4 \text{ mm}$$

Ans.

6. Determine the equation of the elastic curve for the beam using the coordinates x_1 and x_2, and specify the deflection and slope at C. EI is constant. [20%]



$$v_1 = \frac{M_0}{6EIL}[-x_1^3 + L^2x_1]$$

$$v_2 = \frac{M_0}{6EIL}[-3Lx_2^2 + 8L^2x_2 - 5L^3]$$

$$v_C = v_2|_{x_2=0} = -\frac{5M_0L^2}{6EI} \qquad \theta_C = \left.\frac{dv_2}{dx_2}\right|_{x_2=0} = \frac{4M_0L}{3EI}$$