9–11. Determine the equivalent state of stress on an element at the same point oriented 60° clockwise with respect to the element shown. Sketch the results on the element.

100 MPa
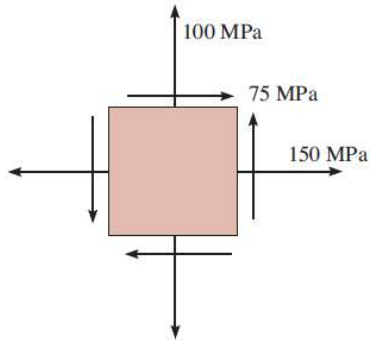
75 MPa

150 MPa

Prob. 9–11

Mechanics of Materials, R.C. Hibbeler 1oth Ed. Pearson
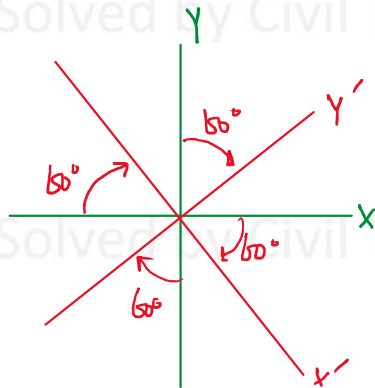
$\theta = -60° \Rightarrow 2\theta = -120°$

$\sigma_x = 150 \text{MPa}, \quad \sigma_y = 100 \text{MPa}, \quad \tau_{xy} = 75 \text{MPa}$

$\sigma_{x'} = \dfrac{\sigma_x + \sigma_y}{2} + \dfrac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta = 47.55 \text{MPa}$
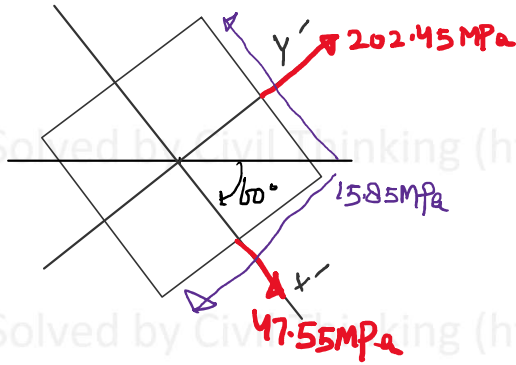
$\sigma_{y'} = \dfrac{\sigma_x + \sigma_y}{2} + \dfrac{\sigma_x - \sigma_y}{2} \cos 2(90+\theta) + \tau_{xy} \sin 2(90+\theta)$

$90° + \theta = 90° + (-60°) = 30° ; \quad 2(90+\theta) = 2 \times 30° = 60°$

$\Rightarrow \sigma_{y'} = 202.45 \text{ MPa}$

$\tau_{x'y'} = \ominus \dfrac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta = -15.25 \text{MPa}$

Y' 202.45 MPa

60°

158.5 MPa

X'

47.55 MPa