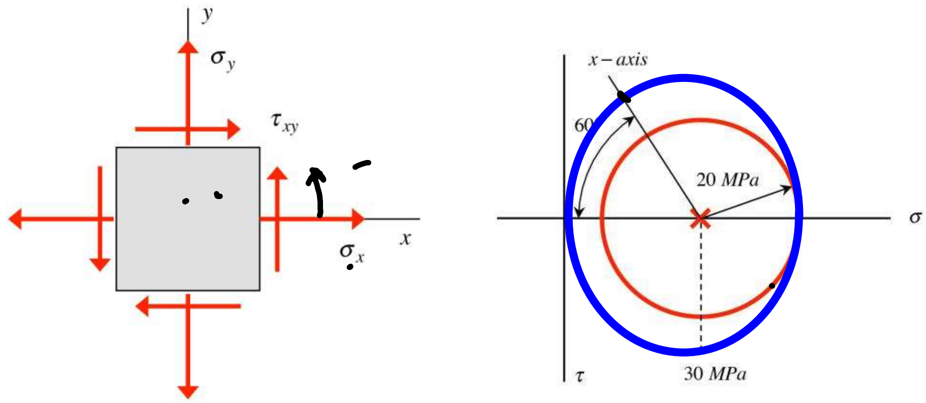
Example 13.8



The Mohr's circle for a stress state is presented above.

a) Show the locations of the y-axis in the Mohr's circle above.

b) Determine the principal stresses and the absolute maximum shear stress for this state.

c) Determine the values for σ_x, σ_y and τ_{xy} of this stress state.

b) $\sigma_{avg} = 30 \text{ MPa}$

$R = 20 \text{ MPa}$

$\sigma_{p1} = 30 + 20 = 50 \text{ MPa}$

$\sigma_{p2} = 30 - 20 = 10 \text{ MPa}.$

$\tau_{max,abs} = \frac{50}{2} = 25 \text{ MPa}.$

$\cos(2\theta) = \frac{(\sigma_{avg} - \sigma_x)}{R}$

$\sigma_x = \sigma_{avg} - R\cos(2\theta)$

$\sigma_x = 30 - 20\cos(60°) = 20 \text{ MPa}$

$\sigma_y = 30 + 10 = 40 \text{ MPa}.$

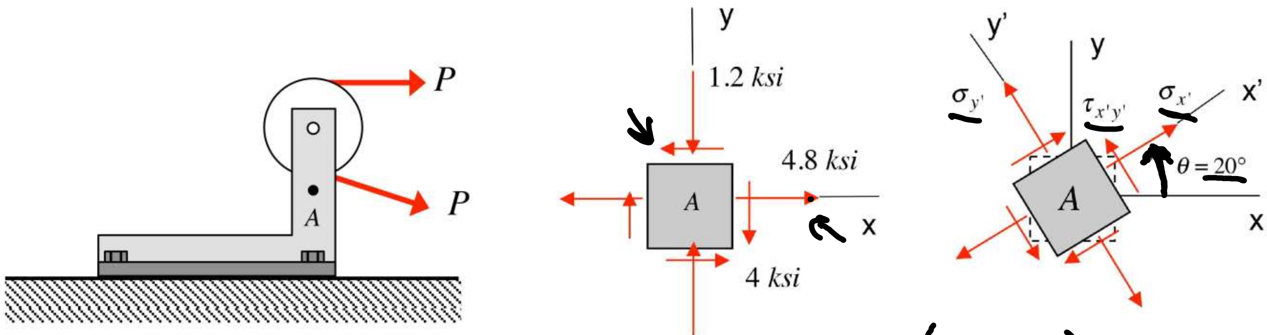
$\tau_{xy} = -R\sin(60°) = -20\left(\frac{\sqrt{3}}{2}\right)$

Example 13.9

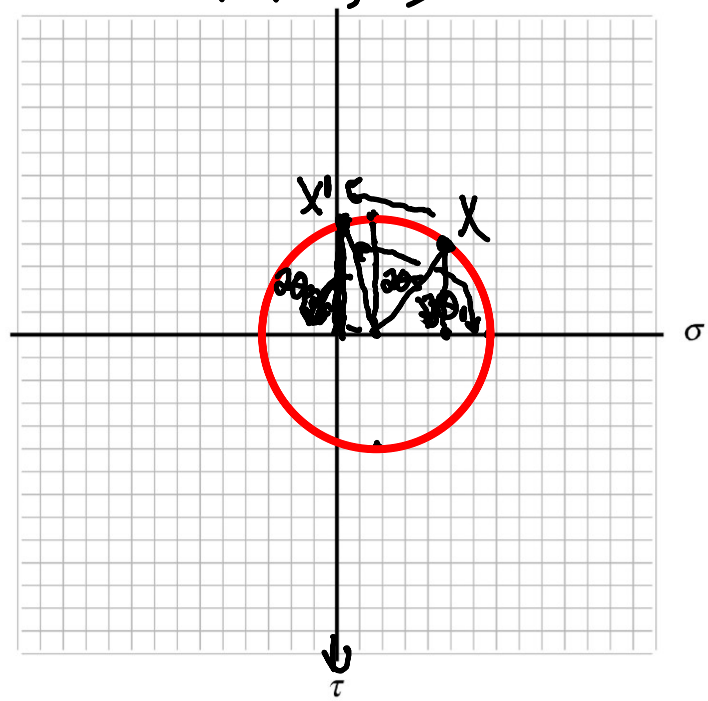
Consider the loaded pulley bracket shown below.

a) Determine $\sigma_{x'}$, $\sigma_{y'}$ and $\tau_{x'y'}$ corresponding to $\theta = 20°$.

b) Determine the principal stresses and maximum in-plane shear stress, along with the corresponding rotation angles.



X = (4.8, -4)



1:1.

b) $\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2} = \frac{4.8 - 1.2}{2} = 1.8$ ksi

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$R = \sqrt{\left(\frac{4.8 + 1.2}{2}\right)^2 + 4^2} = 5 \text{ ksi}$$

$\sigma_{p1} = 1.8 + R = 6.8$ ksi

$\sigma_{p2} = 1.8 - R = -3.2$ ksi

$2\theta_{p1} = \sin^{-1}\left(\frac{4}{5}\right) = 53°$

$2\theta_{p2} = 180 - 2\theta_{p1} - 40° = 87°$

$\sin(2\theta_{p2}) = \frac{\tau_{xy}}{R} \Rightarrow \tau_{xy} = -4.99$ ksi

$\sigma_{x'} = \sigma_{avg} - \underbrace{\cos(2\theta_{p2})R} \Rightarrow \sigma_{x'} = 1.53$ ksi