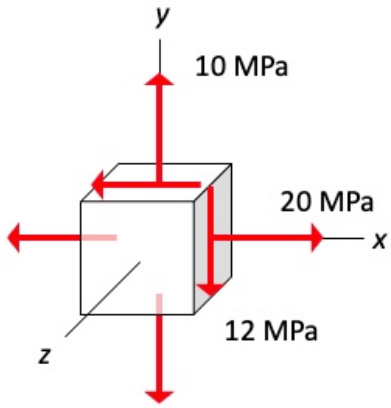
ME 323 – Fall 2023 **Name** SOLUTION

Quiz 12 – 9:30 section

Given the shown state of plane stress. Answer the following questions regarding this state of stress. You are encouraged to draw the Mohr's circles for this problem as you answer these questions.



1. What are the principal components of stress for the rotation of this stress element about the z-axis?

$$\begin{cases} \sigma_{ave} = \dfrac{\sigma_x + \sigma_y}{2} = \dfrac{20+10}{2} = 15\ \text{MPa} \\ R = \sqrt{\left(\dfrac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{\left(\dfrac{20-10}{2}\right)^2 + (-12)^2} = 13\ \text{MPa} \end{cases}$$

$\therefore$

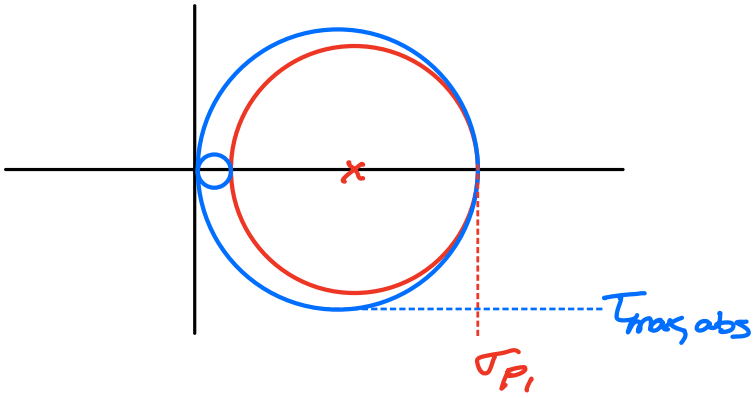
$$\sigma_{p1} = \sigma_{ave} + R = 15 + 13 = 28\ \text{MPa}$$

$$\sigma_{p2} = \sigma_{ave} - R = 15 - 13 = 2\ \text{MPa}$$

2. What is the maximum *absolute* shear stress?

From Mohr's circle diagram, we have:

$$\tau_{max,abs} = \frac{\sigma_{p1}}{2} = 14\ \text{MPa}$$



3. If the yield stress of this material is 20 MPa, does the maximum absolute shear stress criterion predict failure?

MSS predicts failure for $\tau_{max,abs} > \frac{\sigma_Y}{2} = \frac{20}{2} = 10\ \text{MPa}$

Since $\tau_{max,abs} > \frac{\sigma_Y}{2} \Rightarrow$ failure