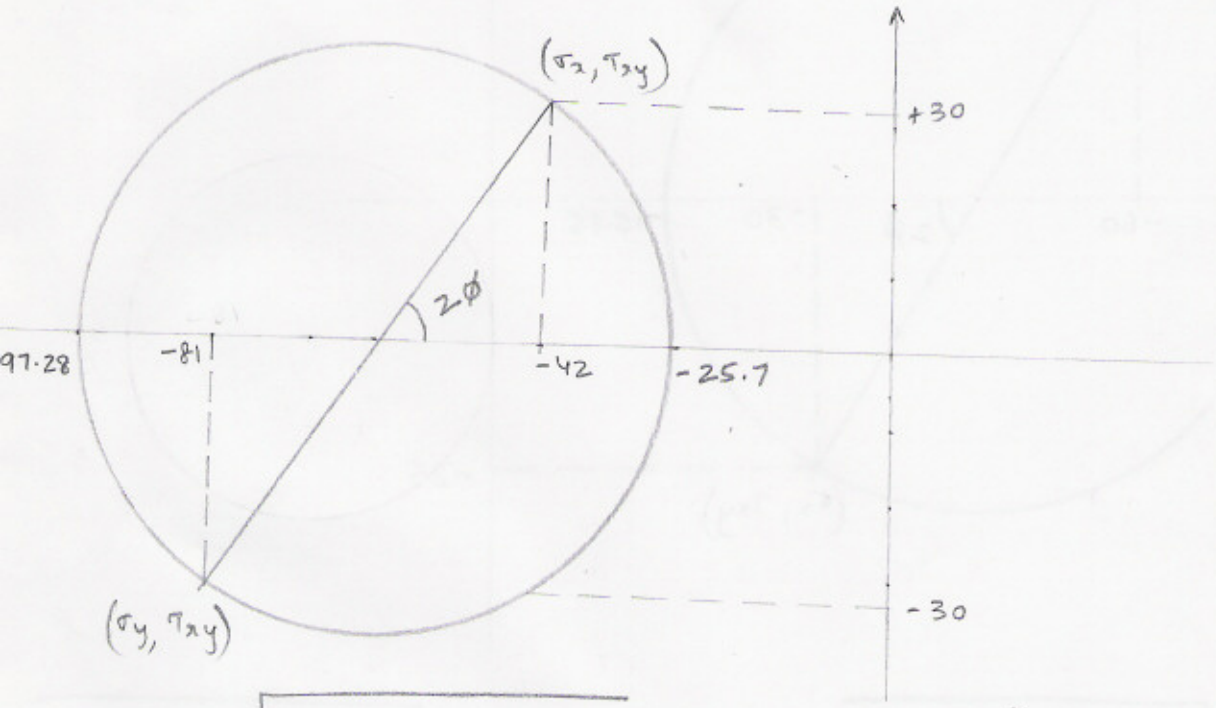
ME 403

HOME WORK #1

) $\sigma_x = -42$, $\sigma_y = -81$, $\tau_{xy} = 30$ (CW)



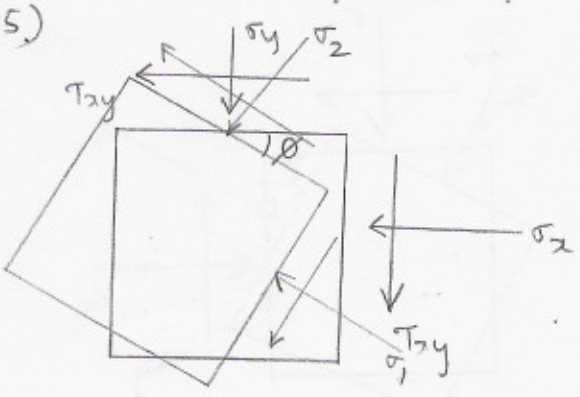
$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left[\frac{(\sigma_1 - \sigma_2)}{2}\right]^2 + \tau_{xy}^2} = \frac{-42-81}{2} + \sqrt{\left(\frac{-42+81}{2}\right)^2 + (30)^2}$$

$$= -61.5 + 35.78 = -25.7$$

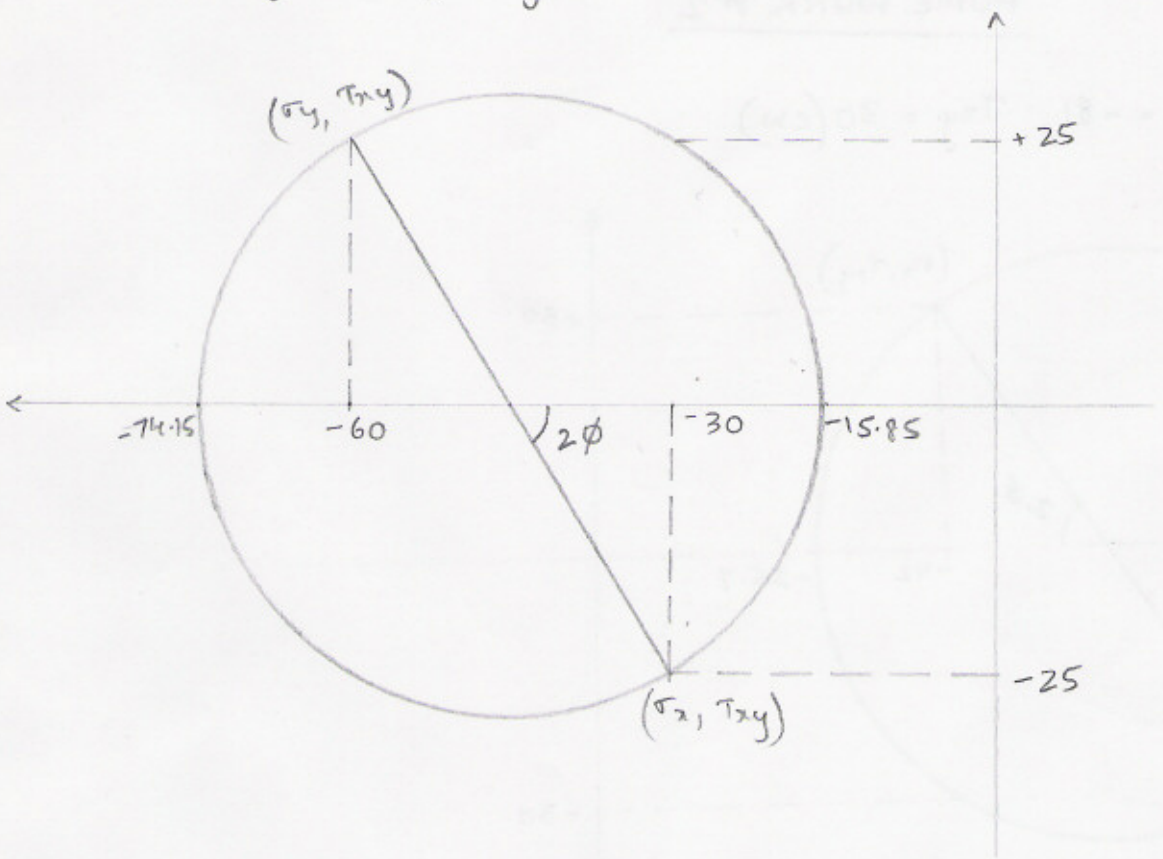
$$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left[\frac{(\sigma_1 - \sigma_2)}{2}\right]^2 + \tau_{xy}^2} = \frac{-42-81}{2} - \sqrt{\left(\frac{-42+81}{2}\right)^2 + (30)^2}$$

$$= -61.5 - 35.78 = -97.28$$

$$2\phi = \tan^{-1}\frac{30}{(-42+61.5)} = 56.98 \Rightarrow \phi = 28.49 \qquad \tau_{max} = 35.78$$



B) $\sigma_x = -30$, $\sigma_y = -60$, $\tau_{xy} = 25$ CCW



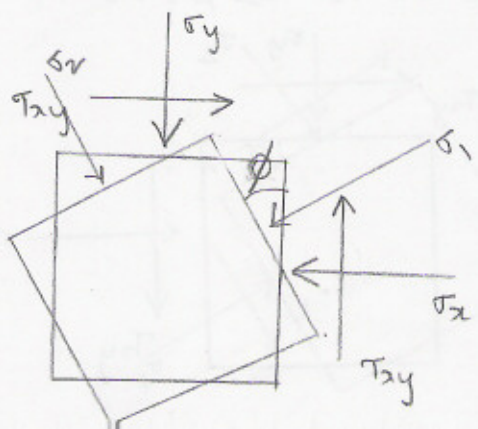
$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left[\frac{\sigma_x - \sigma_y}{2}\right]^2 + \tau_{xy}^2} = \frac{-30-60}{2} + \sqrt{\left(\frac{-30+60}{2}\right)^2 + (25)^2}$$

$$\sigma_1 = -45 + 29.15 = -15.85$$

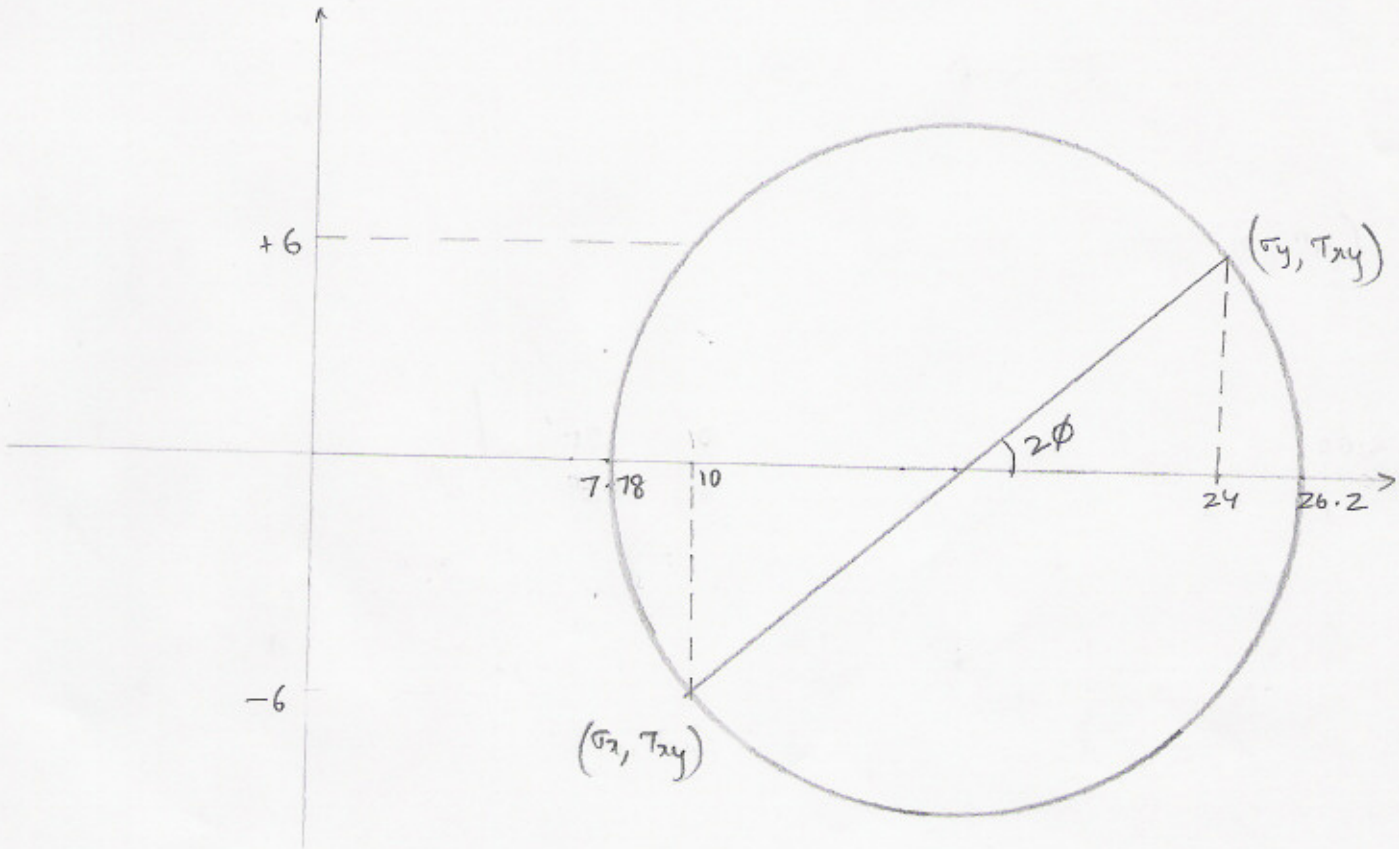
$$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left[\frac{\sigma_x - \sigma_y}{2}\right]^2 + \tau_{xy}^2} = \frac{-30-60}{2} - \sqrt{\left(\frac{-30+60}{2}\right)^2 + (25)^2}$$

$$\sigma_2 = -45 - 29.15 = -74.15$$

$$2\phi = \tan^{-1}\left(\frac{25}{15}\right) = 59.04^\circ \Rightarrow \phi = 29.52 \qquad \tau_{max} = 29.15$$



(c) $\sigma_x = 10, \quad \sigma_y = 24, \quad \tau_{xy} = 6 \ (ccw)$



$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left[\frac{\sigma_x - \sigma_y}{2}\right]^2 + \tau_{xy}^2} = \frac{10+24}{2} + \sqrt{\left[\frac{10-24}{2}\right]^2 + (6)^2}$$

$$\sigma_1 = 17 + 9.2 = 26.2$$

$$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left[\frac{\sigma_x - \sigma_y}{2}\right]^2 + \tau_{xy}^2} = \frac{10+24}{2} - \sqrt{\left[\frac{10-24}{2}\right]^2 + (6)^2}$$

$$\sigma_2 = 17 - 9.2 = 7.78$$

$$2\phi = \tan^{-1}\left(\frac{9.2}{7}\right) = 52.7^\circ \Rightarrow \phi = 26.4^\circ \qquad \tau_{max} = 9.2$$