7.5a) $\tan 2\theta_p = \dfrac{2\tau_{xy}}{\sigma_x - \sigma_y}$

$$\theta_p = \frac{1}{2}\tan^{-1}\left(\frac{2(35)}{-60-(-40)}\right)$$

$$= -37.027305^\circ,$$

$$52.97269795$$

$$\approx -37.0^\circ, 53.0^\circ$$

b) $\sigma_{max,min} = \dfrac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\dfrac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$

$$= \frac{-60-40}{2} \pm \sqrt{\left(\frac{-60-(-40)}{2}\right)^2 + 35^2}$$

$$= -13.59945055\,MPa,$$

$$-86.40054945\,MPa$$

$$\approx -13.6\,MPa, -86.4\,MPa$$

7.9a) $\tan 2\theta_s = -\dfrac{\sigma_x - \sigma_y}{2\tau_{xy}}$

$$\theta_s = \frac{1}{2}\tan^{-1}\left(-\frac{-60-(-40)}{2(35)}\right)$$

$= 7.972697795°, 97.972697795°$

$\approx 8.0°, 98.0°$

b) $\sigma' = \dfrac{\sigma_x + \sigma_y}{2}$

$= \dfrac{-60-40}{2}$

$= -50.0\,MPa$

8.44) $\tau_{twist} = \frac{Tc}{J}$

$$= \frac{(3+9)(120)\left(\frac{72}{2}\times10^{-3}\right)}{\frac{1}{2}\pi\left[\left(\frac{72}{2}\times10^{-3}\right)^4-\left(\left(\frac{72}{2}-5\right)\times10^{-3}\right)^4\right]}$$

$$= 43648442.32\,Pa$$

$$= 43.648442\,32\,MPa$$

$$\tau_{bend} = \frac{VQ}{It}$$

$$I = \frac{\pi}{4}\left[\left(\frac{72}{2}\times10^{-3}\right)^4-\left(\left(\frac{72}{2}-5\right)\times10^{-3}\right)^4\right]$$

$$= 5.938356244\times10^{-7}\,m^4$$

$$\tau_{bend} = \frac{6\times10^3\times\frac{2}{3}\left(\left(\frac{72}{2}\times10^{-3}\right)^3-\left(\left(\frac{72}{2}-5\right)\times10^{-3}\right)^3\right)}{5.938356244\times10^{-7}\times10\times10^{-3}}$$

$$= 11360045.98\,Pa$$

$$= 11.360045\,98\,MPa$$

$$\tau = 43.648442.32 + 11.360045\,98$$

$$= 55.008488.31\,MPa$$

$$\approx 55\,MPa$$

8.44) $\sigma_H = 0$, $\tau \simeq 55\,MPa$

$$\sigma_{max,min} \simeq \pm\sqrt{55^2}$$

$$\simeq 55\,MPa, -55\,MPa$$

$$\tan 2\theta_p = \frac{55}{0} = \infty$$

$$\therefore 2\theta_p = -90^\circ, 90^\circ$$

$$\therefore \theta_p = -45^\circ, 45^\circ$$

$$\tau_{max} \simeq \sqrt{55^2}$$

$$\simeq 55\,MPa$$