





$$\sigma_{avg} = \frac{\sigma_{xx} + \sigma_{zz}}{2} = \frac{30 + 50}{2} = 40 \text{ Mpa}$$

$$R = \sqrt{(10)^2 + (10)^2} = 14.14 \text{ Mpa}$$

$$\sigma_1 = \sigma_{avg} + R = 40 + 14.14 = 54.14 \text{ Mpa}$$

$$\sigma_2 = \sigma_{avg} - R = 40 - 14.14 = 25.86 \text{ Mpa}$$

$$\tau_{max1} = \frac{\sigma_1 - \sigma_3}{2} = \frac{54.14 - (-40)}{2} = 47.07 \text{ Mpa}$$

$$\tau_{max2} = \frac{\sigma_1 - \sigma_2}{2} = \frac{54.14 - 25.86}{2} = 14.14 \text{ Mpa}$$

$$\tau_{max3} = \frac{\sigma_2 - \sigma_3}{2} = \frac{25.86 - (-40)}{2} = 32.93 \text{ Mpa}$$

$$\tan \theta_p = \frac{10}{10} \Rightarrow \theta_p = \text{Arctan}(1) = 45^\circ$$

$$\beta = \frac{45}{2} = 22.5^\circ \text{ (rotation required to get principal stress)}$$

