Prob 5-2

Given: The following stress states:

(a.) $\sigma_A = 100\ MPa$, $\sigma_B = 100\ MPa$

(b.) $\sigma_A = 100\ MPa$, $\sigma_B = -100\ MPa$

(c.) $\sigma_A = 100\ MPa$, $\sigma_B = 50\ MPa$

(d.) $\sigma_A = 100 MPa$, $\sigma_B = -50 MPa$

(e.) $\sigma_A = -50 MPa$, $\sigma_B = -100 MPa$

Reqd: Determine the factor of safety for ductile yield, with $S_y = 350\ MPa$, for both MSS & DE theories. Include graphical representation and estimated values in addition to calculated values.

Soln: Graphical estimater will be done first, with the diagram on the next page.

(a.) $n_{MSS} \approx 3.5$ $n_{DE} \approx 3.5$

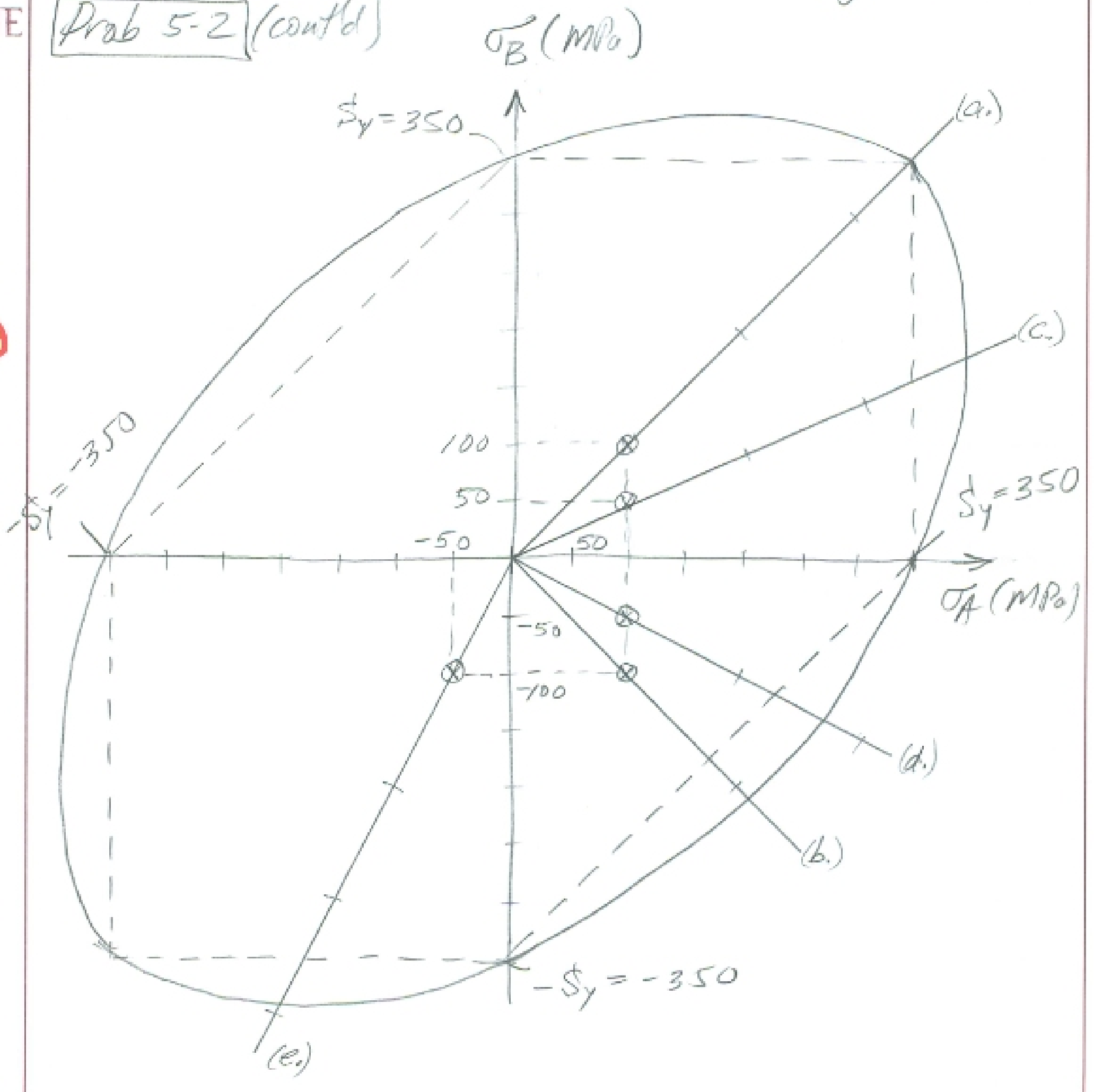
(b.) $n_{MSS} \approx 1.7-1.8$ $n_{DE} \approx 2.2$

(c.) $n_{MSS} \approx 3.4-3.5$ $n_{DE} \approx 3.8$

(d.) $n_{MSS} \approx 2.2-2.3$ $n_{DE} \approx 2.6-2.7$

(e.) $n_{MSS} \approx 3.5$ $n_{DE} \approx 3.8$

Prob 5-2 (cont'd)



Calculated values start on next page.

Prob 5-2 (cont'd) $S'_y = 350\ MPa$

(a.) $\sigma_A = 100\ MPa = \sigma_1$, $\sigma_B = 100\ MPa = \sigma_2$, $\sigma_3 = 0$

$$n_{MSS} = \frac{S'_y}{\sigma_1 - \sigma_3} = \frac{S'_y}{\sigma_A - 0} = \frac{350}{100} = \boxed{3.5 = n_{MSS}}$$

$$n_{DE} = \frac{S'_y}{\sigma'}, \quad \sigma' = \sqrt{\sigma_A^2 - \sigma_A \sigma_B + \sigma_B^2}$$

$$\underline{\sigma' = \sqrt{(100)^2 - (100)(100) + (100)^2} = 100\ MPa}$$

or $n_{DE} = \frac{350}{100} = \boxed{3.5 = n_{DE}}$

(b.) $\sigma_A = 100\ MPa = \sigma_1$, $\sigma_B = -100\ MPa = \sigma_3$, $\sigma_2 = 0$

$$n_{MSS} = \frac{S'_y}{\sigma_A - \sigma_B} = \frac{350}{100 - (-100)} = \frac{350}{200} = \boxed{1.75 = n_{MSS}}$$

$$\underline{\sigma' = \sqrt{(100)^2 - (100)(-100) + (-100)^2} = 173.2\ MPa}$$

$$n_{DE} = \frac{S'_y}{\sigma'} = \frac{350}{173.2} = \boxed{2.02 = n_{DE}}$$

(c.) $\sigma_A = 100\ MPa = \sigma_1$, $\sigma_B = 50\ MPa = \sigma_2$, $\sigma_3 = 0$

$$n_{MSS} = \frac{S'_y}{\sigma_A - 0} = \frac{350}{100 - 0} = \boxed{3.5 = n_{MSS}}$$

$$\underline{\sigma' = \sqrt{(100)^2 - (100)(50) + (50)^2} = 86.6\ MPa}$$

$$n_{DE} = \frac{350}{86.6} = \boxed{4.04 = n_{DE}}$$