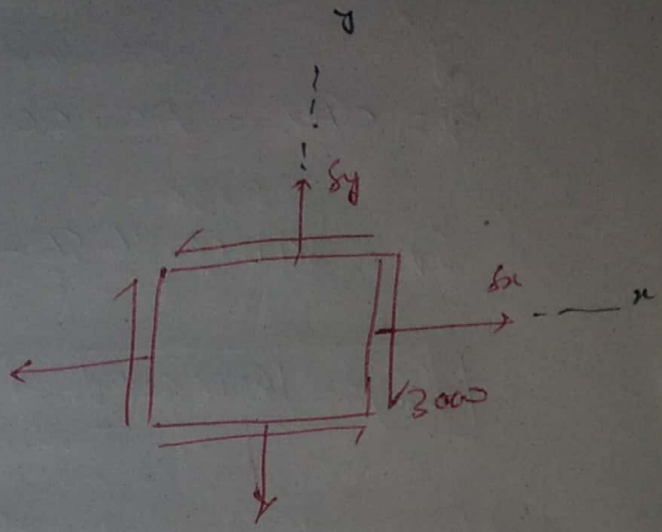
Pb # 935:-

Find σ_x & σ_y = ?



Sol:-

$\sigma_x' = 2000$ psi

& $\sigma_y' = -8000$

$\tau_{xy} = 3000$

To find centre;

$$C = \frac{\sigma_x' + \sigma_y'}{2} = \frac{2000 - 8000}{2}$$

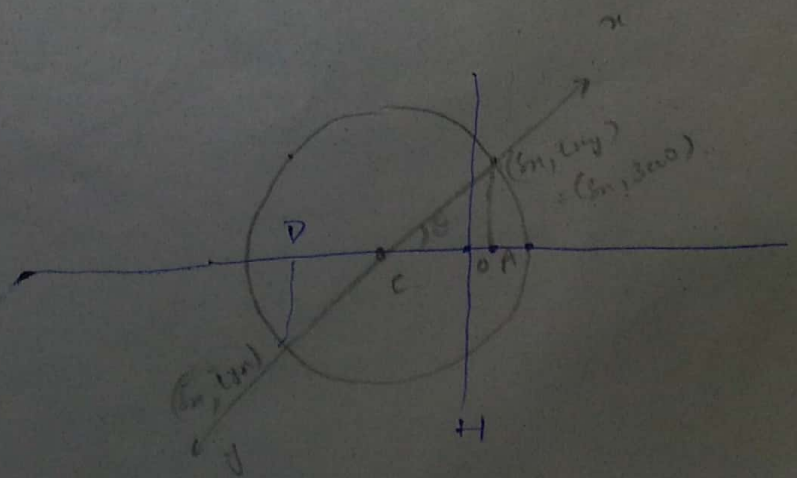
$$C = -3000$$

$$R = \sqrt{\left(\frac{\sigma_x' - \sigma_y'}{2}\right)^2 + (\tau_{xy})^2}$$

$$R = \sqrt{\left(\frac{10000}{2}\right)^2 + 0^2} \Rightarrow \boxed{R = 5000}$$

$$\sin^2\theta = \frac{3000}{5000}$$

$\theta = 36.86$



$\delta_x = OA. = AC - OC.$

$\delta_x = 5000 \cos 36.86 - 3000.$

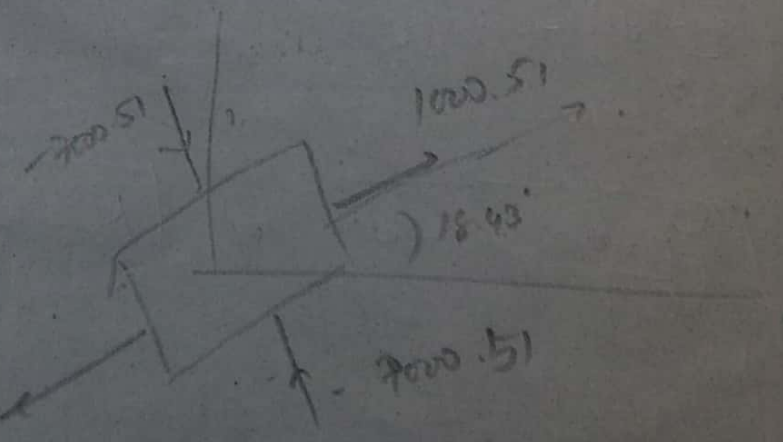
$\boxed{\delta_x = 1000.51}$

$\delta_2 = \delta_y = OC + CD$

$= 3000 + 5000 \cos 36.86.$

$\boxed{\delta_y = -7000.51.}$

In reality



Pb # 931:-

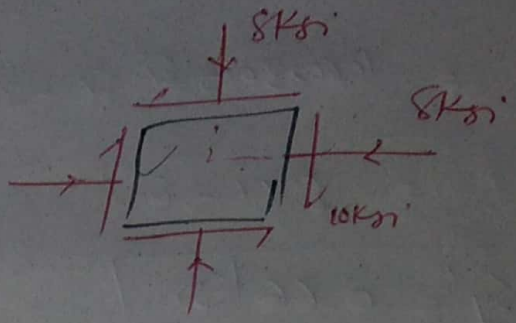
Given

$\sigma_y = -8$ ksi

$\sigma_x = -8$ ksi

$\tau_{xy} = 10$ ksi

$\theta_{given} = 60° \& 120°$



Solution:-

By Mohar Circle:-

$$C = \frac{\sigma_x + \sigma_y}{2} = \frac{-8-8}{2} = \boxed{-8 = C}$$

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + (\tau_{xy})^2}$$

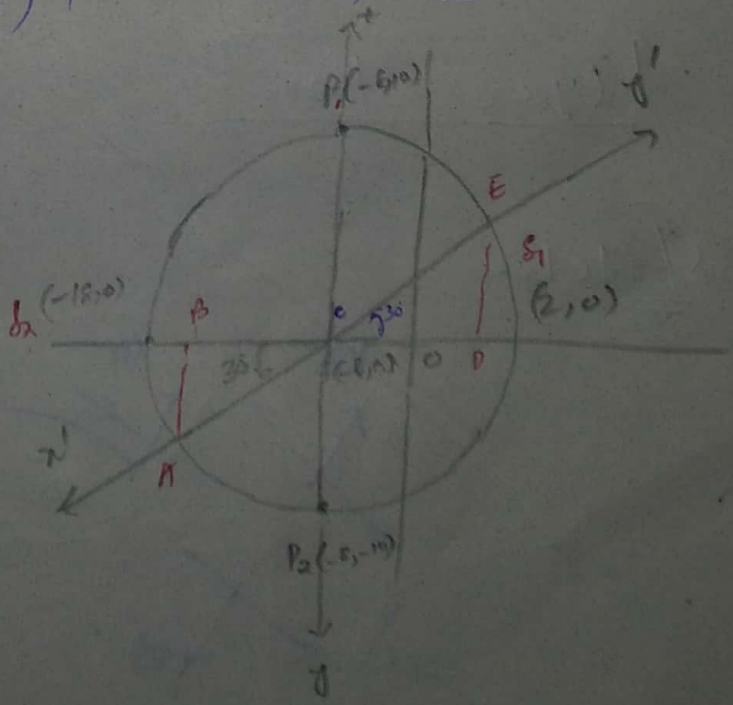
$$R = \sqrt{\left(\frac{-8+8}{2}\right)^2 + (10)^2} \Rightarrow \boxed{10 = R}$$

$P_1(\sigma_x, \tau_{xy})$

$P_1(-8, 10)$

$P_2(\sigma_y, \tau_{yx})$

$P_2(-8, -10)$



$\sigma_{x'} = OC + CB$

$= +8 + 10\cos 30$

$\boxed{\sigma_x = -16.66 \text{ Ksi}}$ As on left side of origin.

$\sigma_y' = OD = CD - OC$

$= 10\cos 30 - 8$

$= 8.66 - 8$

$\boxed{\sigma_y' = 0.66 \text{ ksi}}$

Now to find shearing stresses.

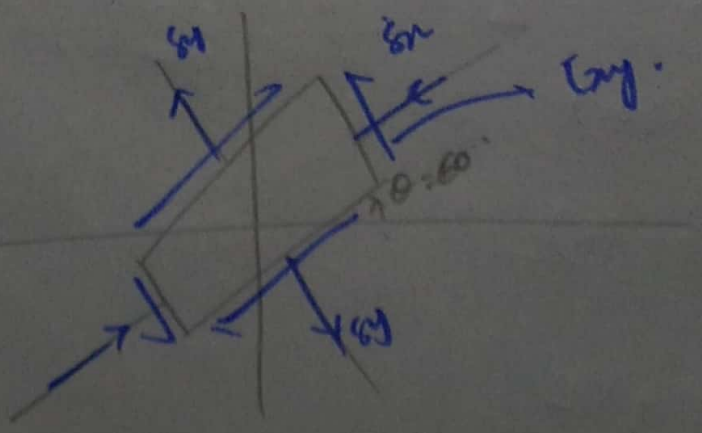
As $\tau_{xy} = \frac{R}{2}$

$\tau_{xy} = \frac{10}{2}$

$\boxed{\tau_{xy} = -5 \text{ ksi}}$

$\boxed{\tau_{yx} = 5 \text{ ksi}}$

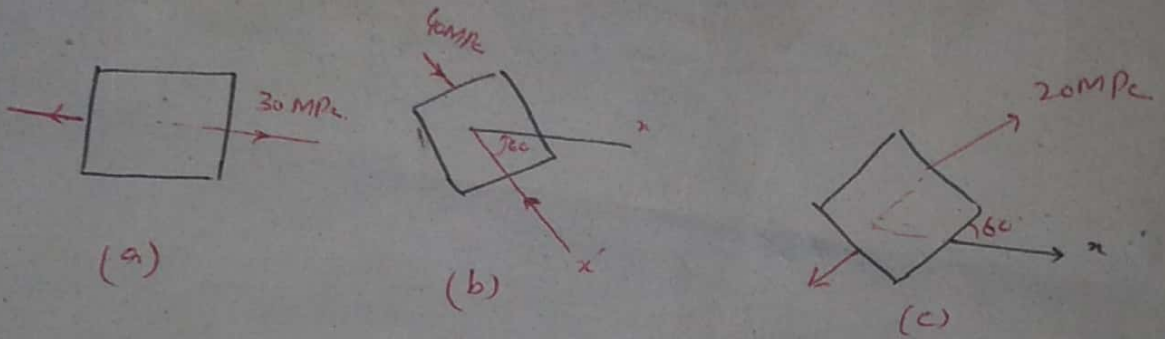
Sketch-



Principal stresses-

Pb # 940:-

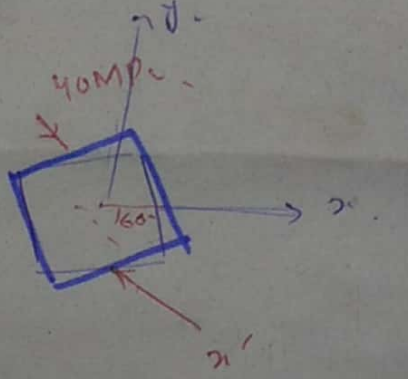
Determine the principal stresses & principal planes by superposition of these three states.



Solution:-

First find the combined state of these three states.

Case # b:-



Here $\sigma_{x'} = -40 MPa$

$\sigma_{y'} = 0$.

$\tau_{x'y'} = 0$.

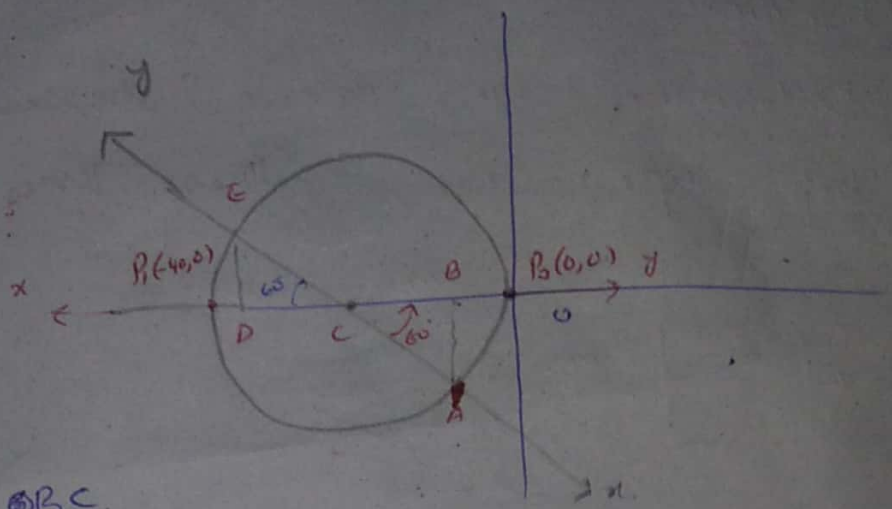
Find the stresses along x & y-axis.

$$C = \frac{\sigma_x + \sigma_y}{2} = -20.$$

$$R = \sqrt{\left(\frac{-40+0}{2}\right)^2 + (0)^2} = \boxed{R = 20}$$

$P_1(\sigma_x, \tau_{xy}) = (-40, 0)$

$P_2(0, 0)$.



$\sigma_x = CB = OC - OB$

$\sigma_x = 20 - 20\cos 60$

$\boxed{\sigma_x = -10}$ ✓

$\sigma_y = OC + CD$

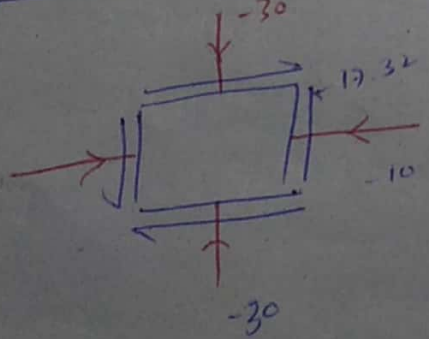
$= 20 + 20\cos 60$

$\boxed{\sigma_y = -30}$ ✓

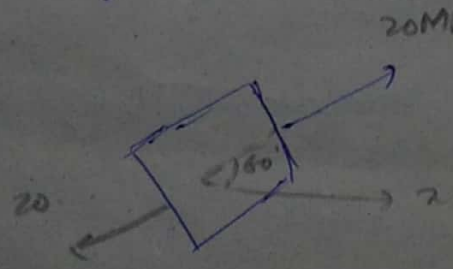
$\tau_{xy} = AB$

$= 20\sin 60$

$\tau_{xy} = -17.32$ ✓



New State #3



$\sigma_x = 20$

$\sigma_y = 0$

$\tau_{xy} = 0$

$C = 10$

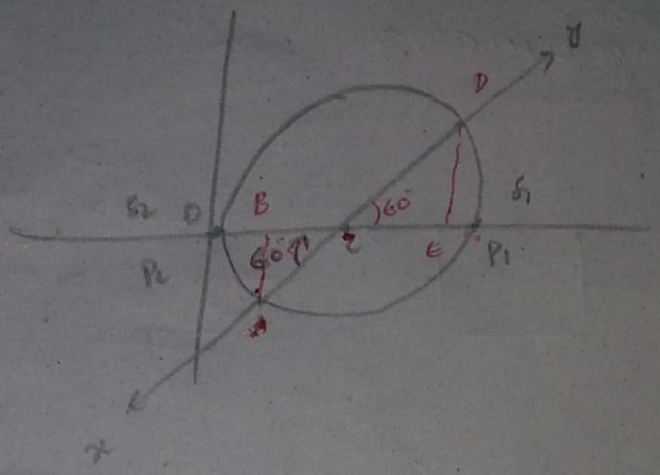
$R = 10$

$P_1(\sigma_x', \tau_{xy}')$.

$P_1(20, 0)$

$P_2(\sigma_y', \tau_{yx}')$

$P_2(0, 0)$.



$\sigma_x = OB = OC - CB$.

$= 10 - 10\cos 60$.

$\boxed{\sigma_x = 5}$

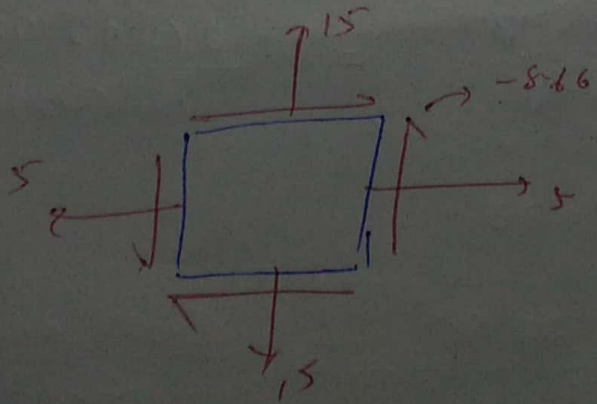
$\sigma_y = OE = OC + CE$.

$= 10 + 10\cos 60$.

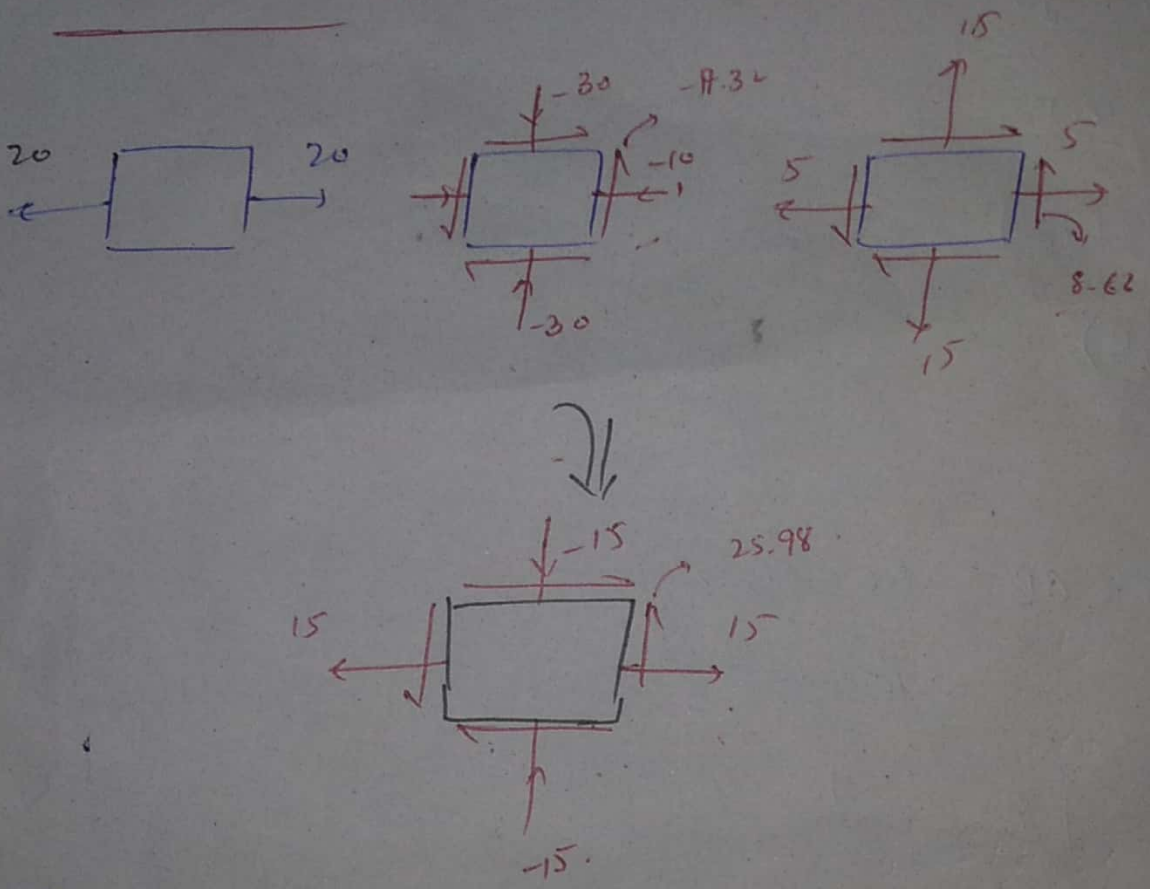
$\boxed{\sigma_y = 15}$.

$\tau_{xy} = AB = 10\sin 60$.

$\boxed{\tau_{xy} = -8.66}$



Combination is:-



So the new stresses are:

$\sigma_x = 15 MPa$

$\sigma_y = -15 MPa$

$\tau_{xy} = -25.98 MPa$

$\tan 2\theta_n = \frac{-2(-25.98)}{30}$

By using analytical method;

Principal plane is;

$$\tan 2\theta_n = \frac{-2\tau_{xy}}{\sigma_x - \sigma_y} = \frac{-2(-25.98)}{15-(-15)}$$

$$\tan 2\theta_n = 1.73$$

$$\boxed{\theta_n = 29.98^\circ}$$

Book answer is wrong

Principal stresses-

$\theta_n = 29.98°$

$\sigma_x = \sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta_n - \tau_{xy}\sin 2\theta_n$

$\sigma_1 = \frac{15}{2} + \frac{15+15}{2}\cos 2(29.98) + 25.98 \sin 2(29.98)$

$\sigma_1 = 7.51 + 22.5$

$\boxed{\sigma_1 = 30 MPa}$

$\sigma_2 = ?$ for σ_2 = Put $\theta = 29.98 + 90°$.

$\theta = 119.98$.

$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta_n \mp \tau_{xy}\sin 2\theta$.

$\sigma_2 = \frac{15}{2} + \frac{30}{2}\cos 2(119.98) + 25.98 \sin 2(119.98)$

$= -7.51 - 22.5$.

$\boxed{\sigma_2 = -30 MPa}$

Sketch