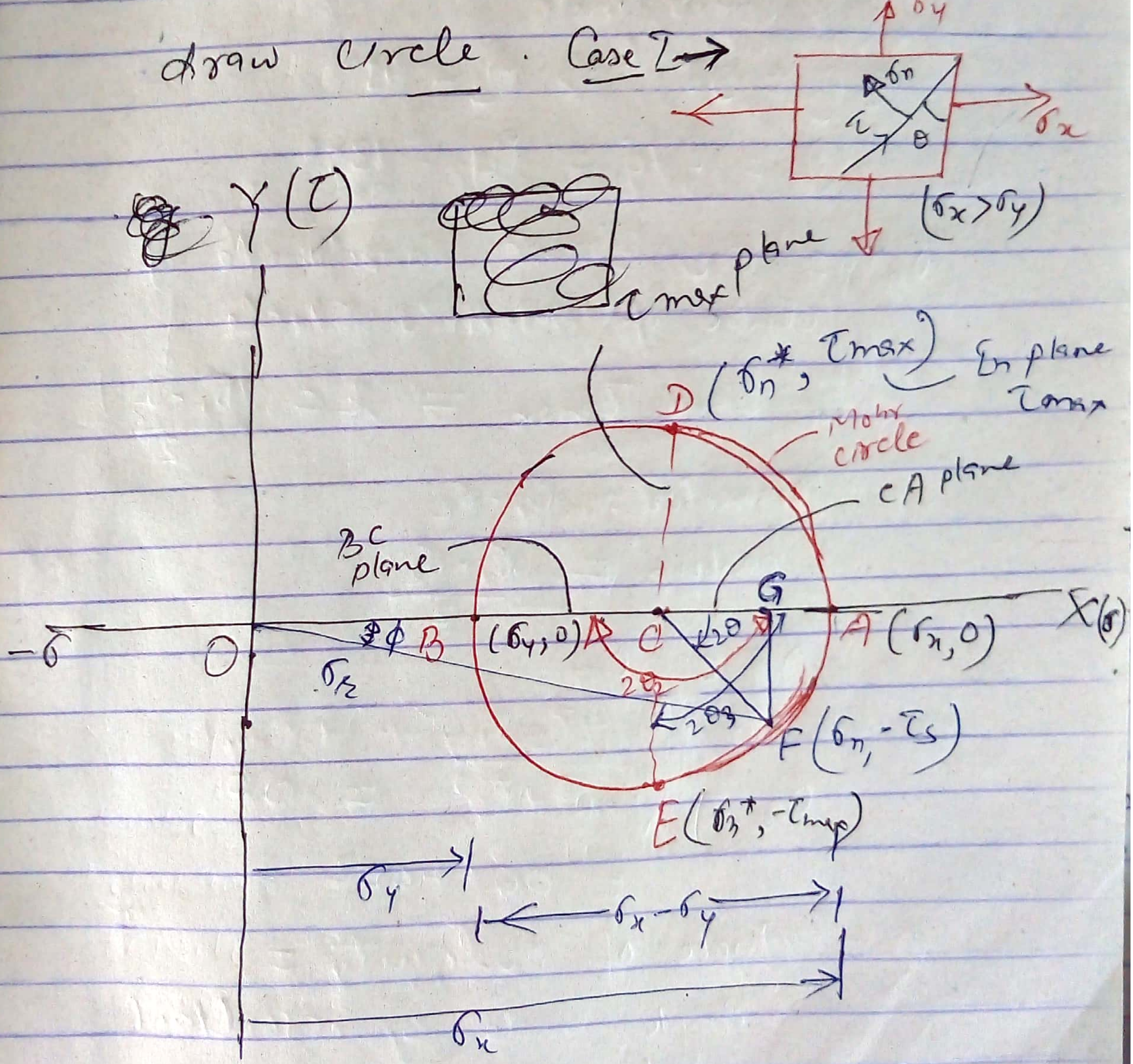
Step V → By taking bisection point 'C' as the centre of circle and radius $CA = CB$ $R = \frac{\sigma_x - \sigma_y}{2}$

draw circle. Case I →



A has larger x- coordinates

B has smaller x - coordinate

$D = (\sigma_n^*, \tau_{max})$ $E = (\sigma_n^*, -\tau_{max})$

σ_n^* normal stress in τ_{max} plane

The following conclusion can be made from the Mohr's circle

(i) Every plane is represented in the mohr circle by a radius

(ii) Every plane is represented in the Mohr circle by double it actual angle

(iii) Co-ordinate of any point on the Mohr's circle represent normal and Shear stress on the corresponding plane

(iv) Principal plane are represented by the radic line of x-axis

(v) The centre of Mohr's circle always lie on x-axis

(vi) Diameter of Mohr circle is equal to $\sigma_1 - \sigma_2$

(vii) The max shear stress plane represented by the radic parallel to Y-axis.

(viii) The normal stress acting on the τ_{max} plane (σ_n^*) is given by the x- co-ordinate of the centre of the Mohr's circle.

(ix) The in plane τ_{max} ie max shear stress is equal to the radius of Mohr's circle

In plane τ_{max}

$$= r = \frac{\sigma_1 - \sigma_2}{2}$$

$$= \frac{1}{2}\sqrt{(\sigma_x - \sigma_y)^2 + 4\tau_{xy}^2}$$

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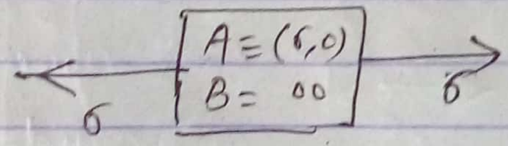
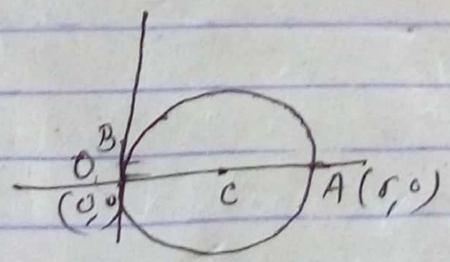
Case II →

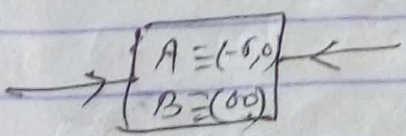


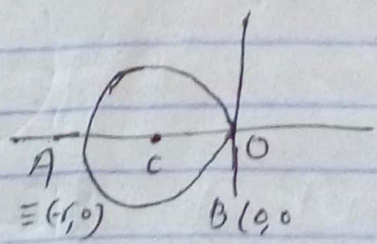
e.g → bar subjected to axial tensile load



$C \equiv (\frac{\sigma}{2}, 0)$

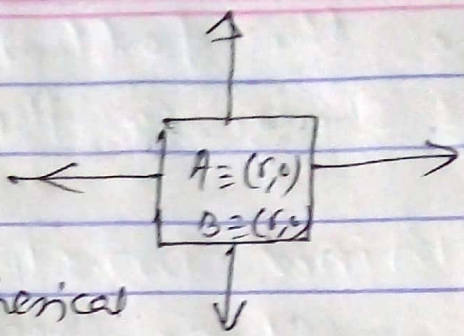
Case III →





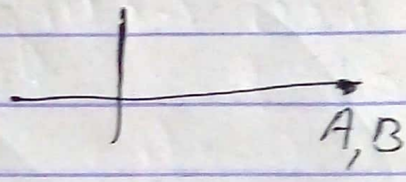
$C \equiv (-\sigma/2, 0)$

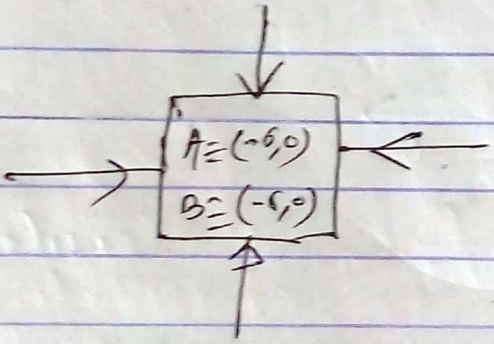
Case IV →



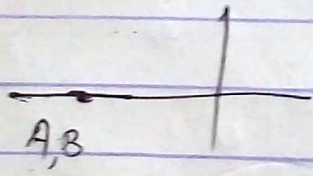
eg → thin spherical pressure vessel under internal pressure

or

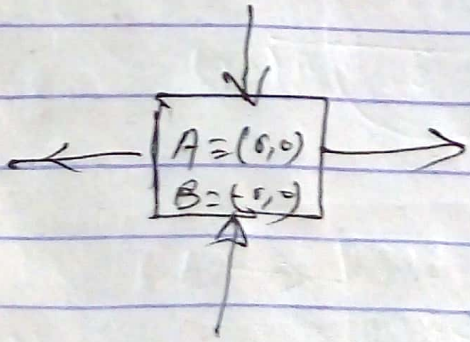


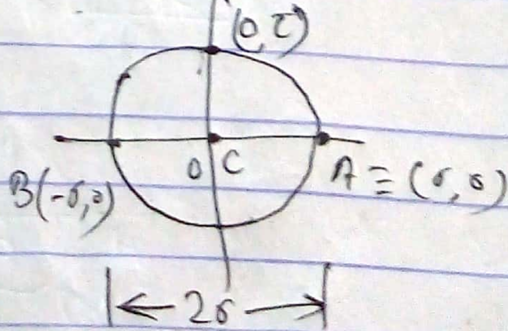


Body immersed in liquid

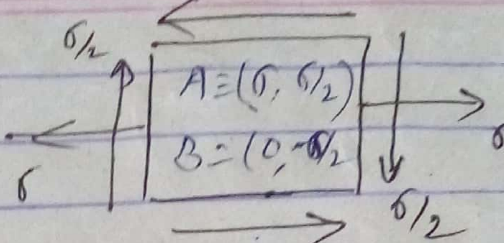


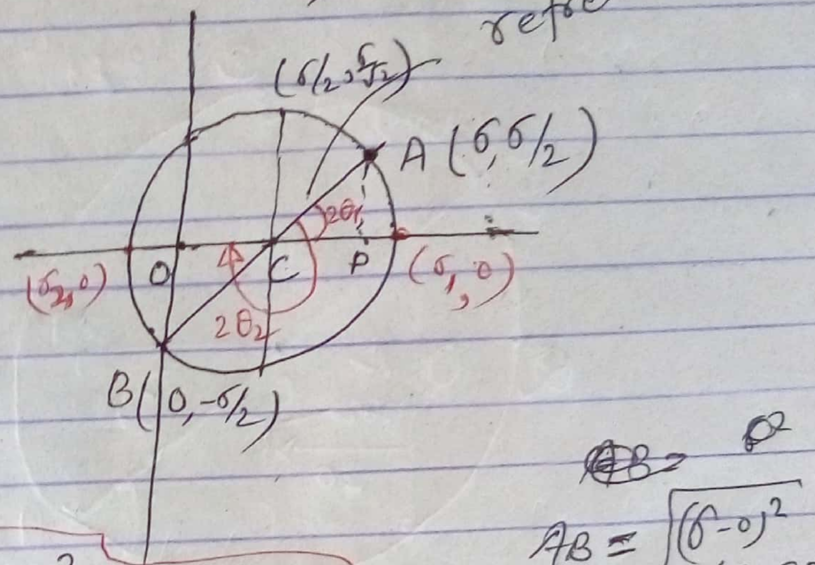
Case V →





Case VI -





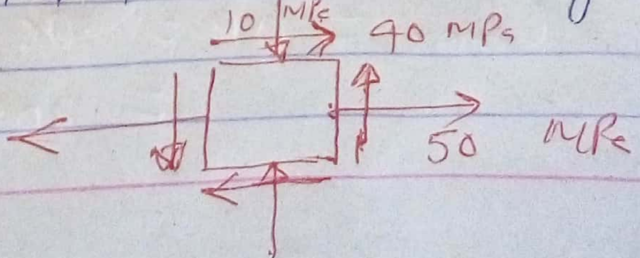
$$CA = CP^2 + AP^2$$
$$= \sqrt{\left(\frac{\sigma}{2}\right)^2 + \left(\sigma/2\right)^2}$$
$$= \sqrt{\frac{2\sigma^2}{4}} = \frac{\sigma}{\sqrt{2}}$$

$C \equiv (\sigma_{avg}, 0)$

$$\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2} = \frac{\sigma + 0}{2} = \sigma/2$$

$$AB = \sqrt{(\sigma - 0)^2 + \left(\frac{\sigma}{2} + \frac{\sigma}{2}\right)^2}$$
$$AB = \sqrt{\sigma^2 + \sigma^2}$$
$$= \sqrt{2\sigma^2} = \sqrt{2}\,\sigma$$
$$\therefore CA = \frac{\sigma}{\sqrt{2}}$$

Q→ For the state of plane stress shown in figure (a) construct Mohr's circle (b) determine the principal stresses (c) determine the maximum shearing stress and the corresponding normal stress



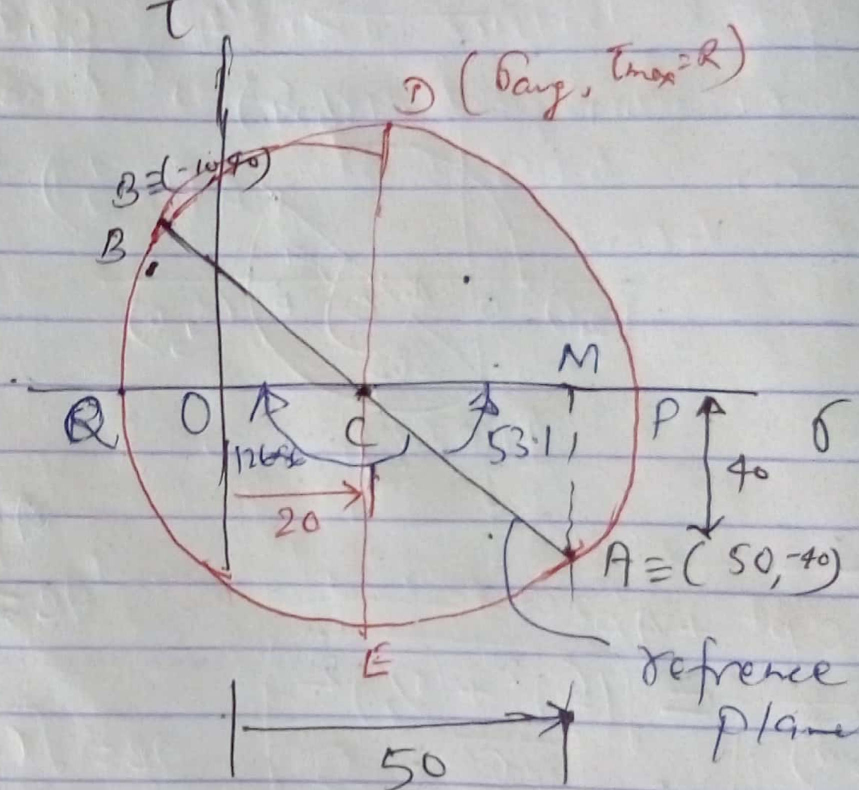
$\sigma_x = 50\,MPa$ $\quad \tau_{xy} = -40\,MPa$

$\sigma_y = -10\,MPa$

$A \equiv (50, -40)$

$B \equiv (-10, 40)$

$\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2} = \frac{50-10}{2} = 20\,MPa$



$CM = \cancel{30}\ 50 - 20 = 30$

$AM = 40$

$\therefore AC = \sqrt{CM^2 + AM^2}$

$= \sqrt{30^2 + 40^2}$

$= \sqrt{50^2} = \underline{50}$

$\sigma_{max} = OP = OC + PC$

$= 20 + AC = 20 + 50$

$= 70$

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$$\sigma_{3min} = OC - R$$
$$= OC - QC$$
$$= 20 - 50 = -30 \text{ MPa}$$

$$\tau_{max} = \frac{\sigma_1 - \sigma_2}{2} = \frac{70 - (-30)}{2}$$
$$= \frac{100}{2} = 50 \text{ MPa}$$

$$\left.\begin{array}{l}\sigma_1 = 70 \\ \sigma_2 = -30\end{array}\right\} \text{MPa}$$

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