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A course on
Mechanics of Materials BME301
Lecture-8:
Numericals on MOHR'S CIRCLE

by

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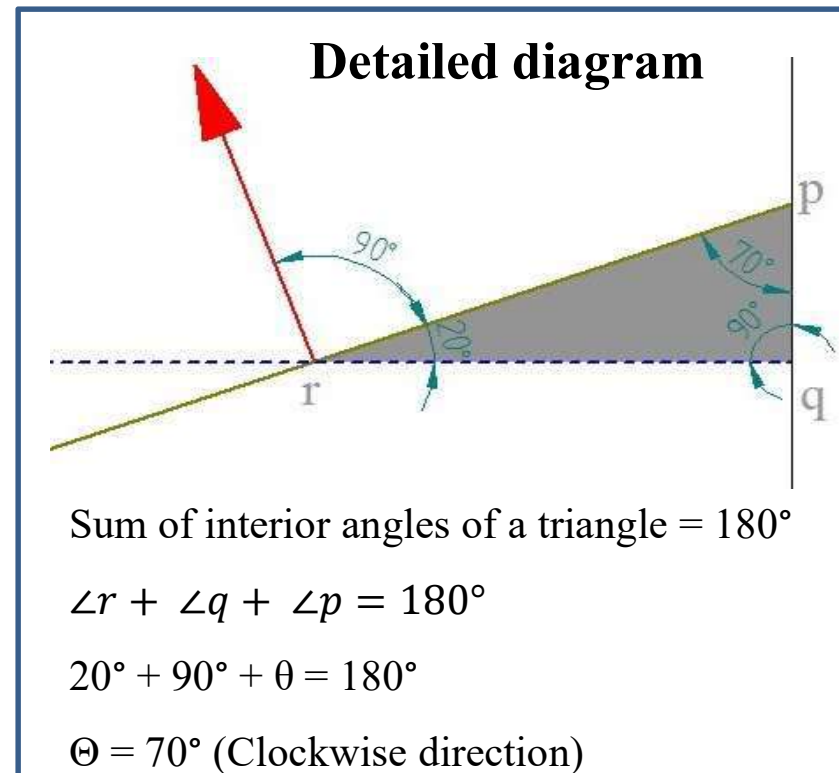
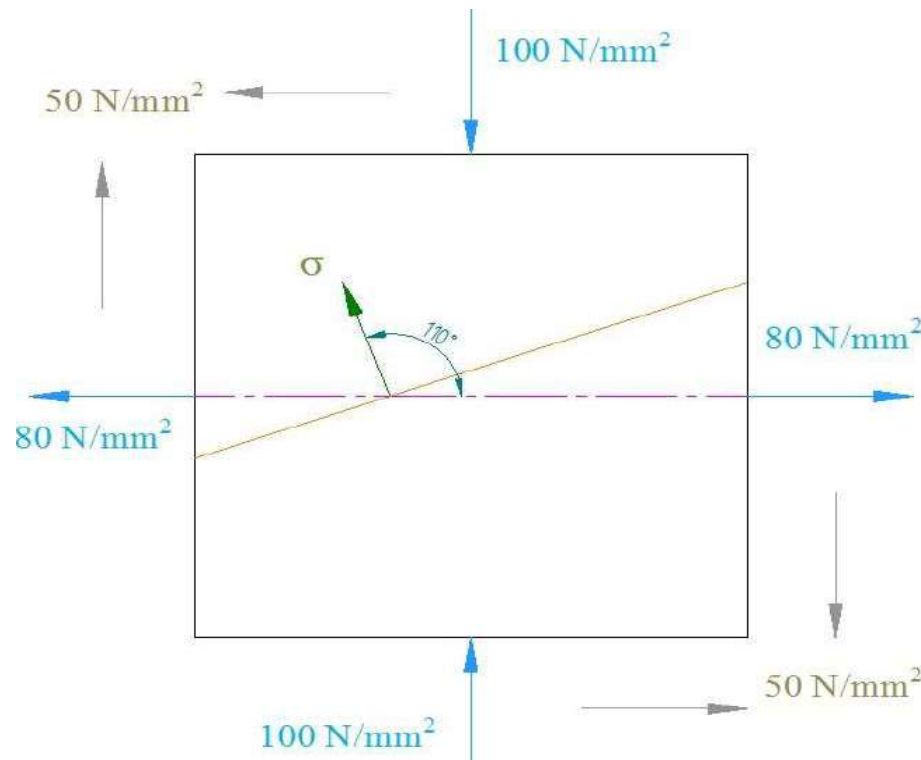
Mechanical Engineering Department

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Problem-3

An element with the stresses acting on it is shown below, determine,

- 1) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to x-axis.
- 2) Principal stresses and its locations.
- 3) Maximum shear stresses and its locations.



Data Given:

$$\sigma_x = 80 \text{ N/mm}^2$$

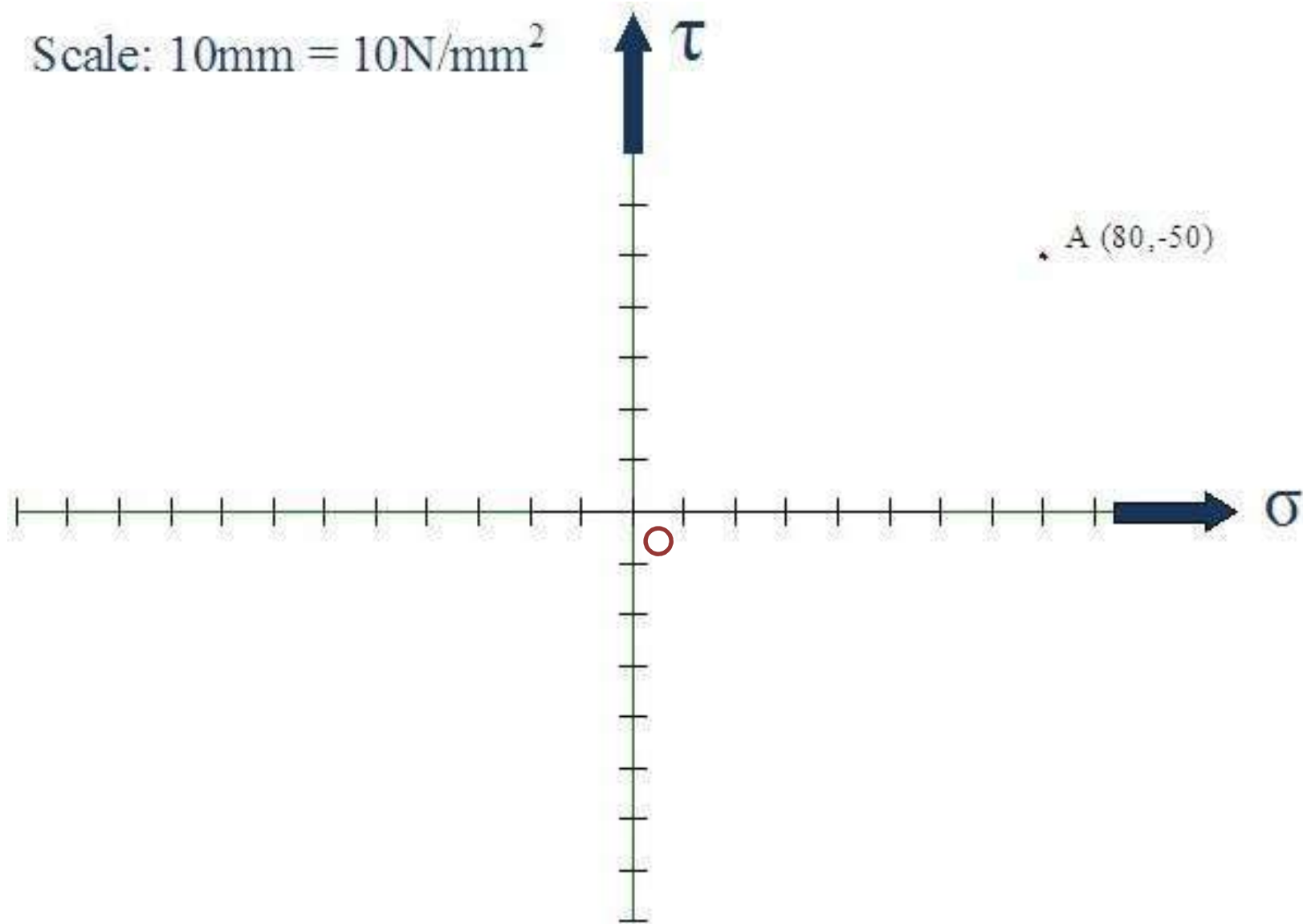
$$\sigma_y = -100 \text{ N/mm}^2$$

$$\tau_{xy} = -50 \text{ N/mm}^2$$

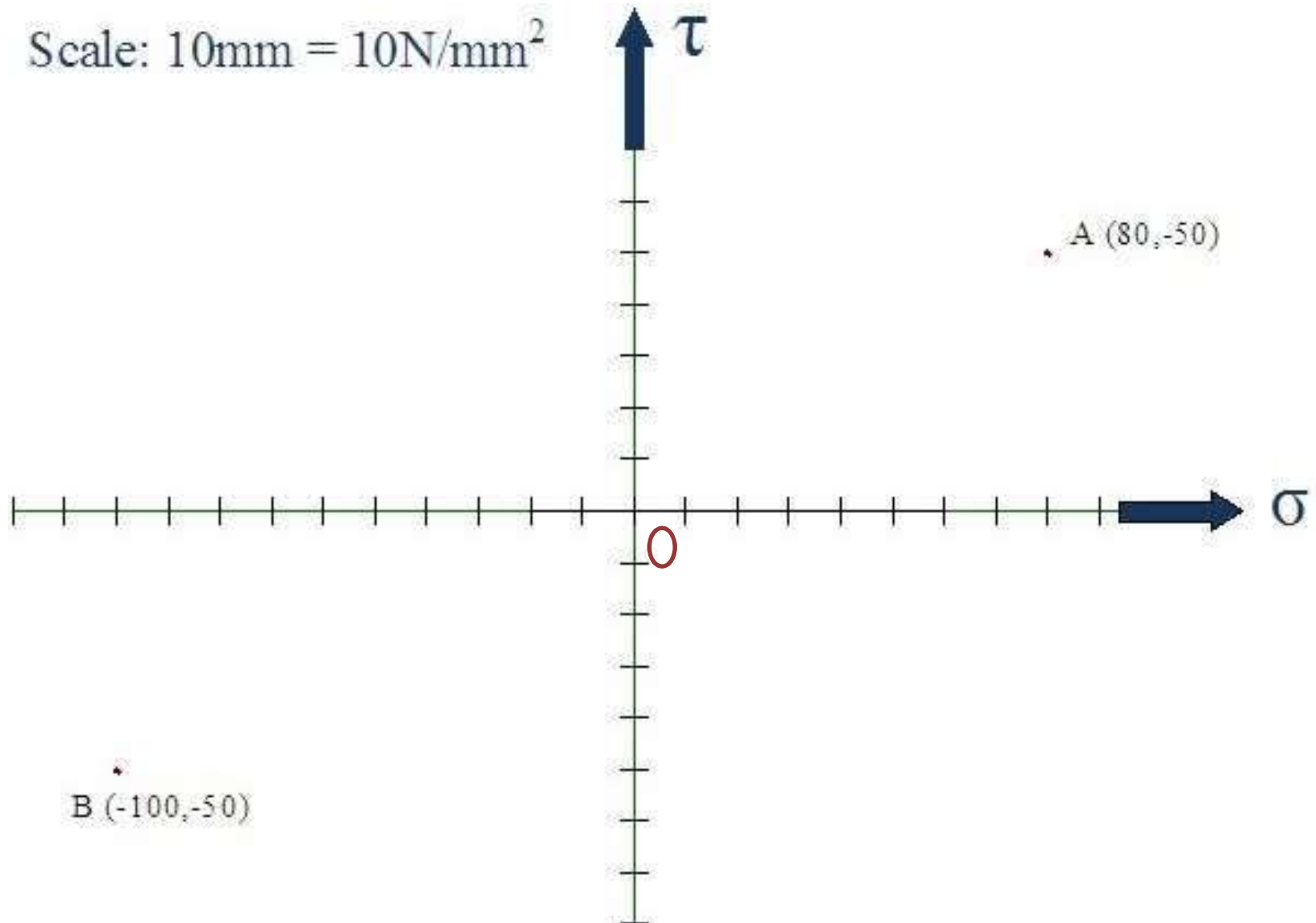
$$\Theta = -70^\circ$$

Step-1 Plotting of first point i.e. A(80,-50)

Scale: 10mm = 10N/mm²

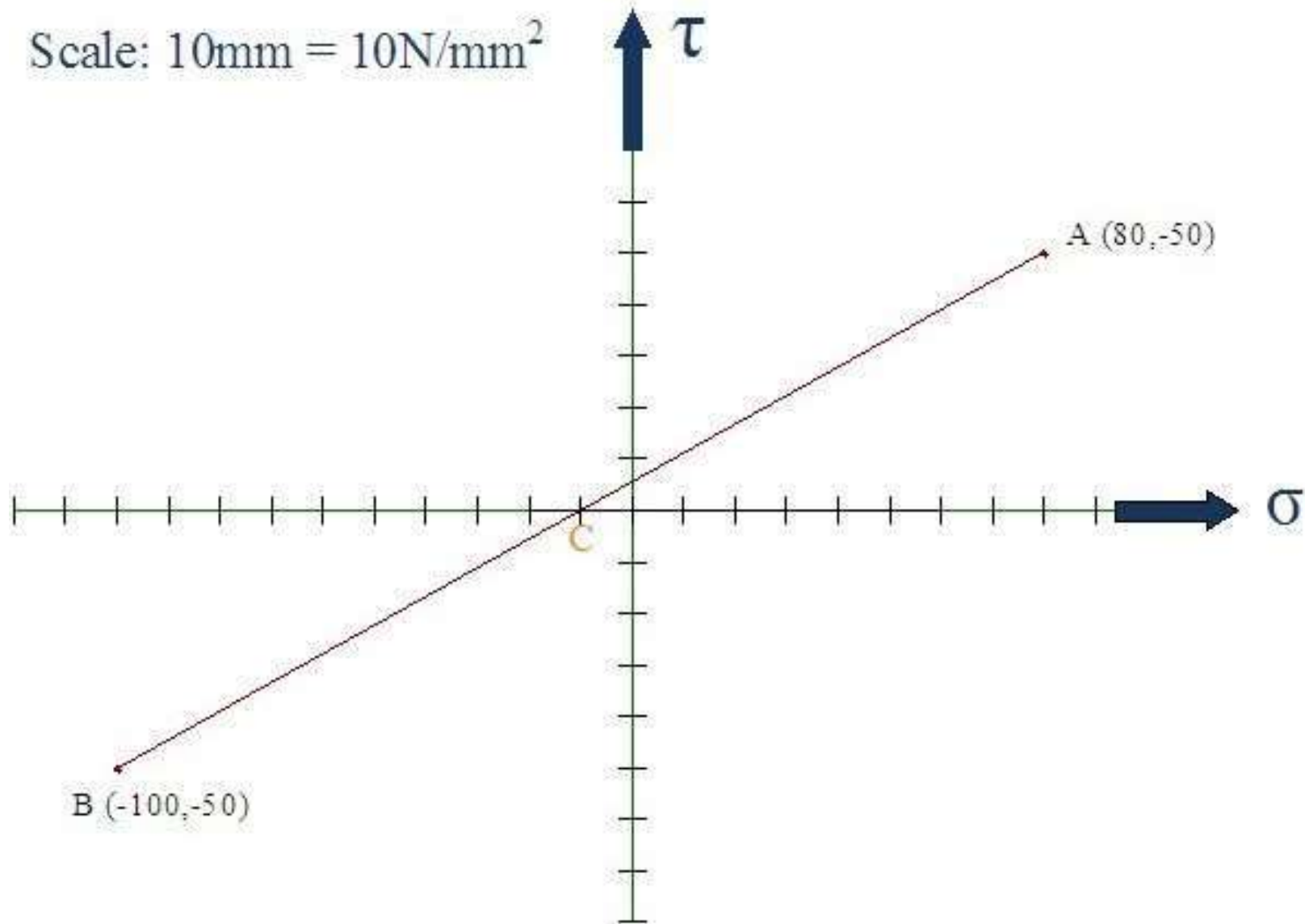


Step-2 Plotting of second point i.e. B(-100,-50)



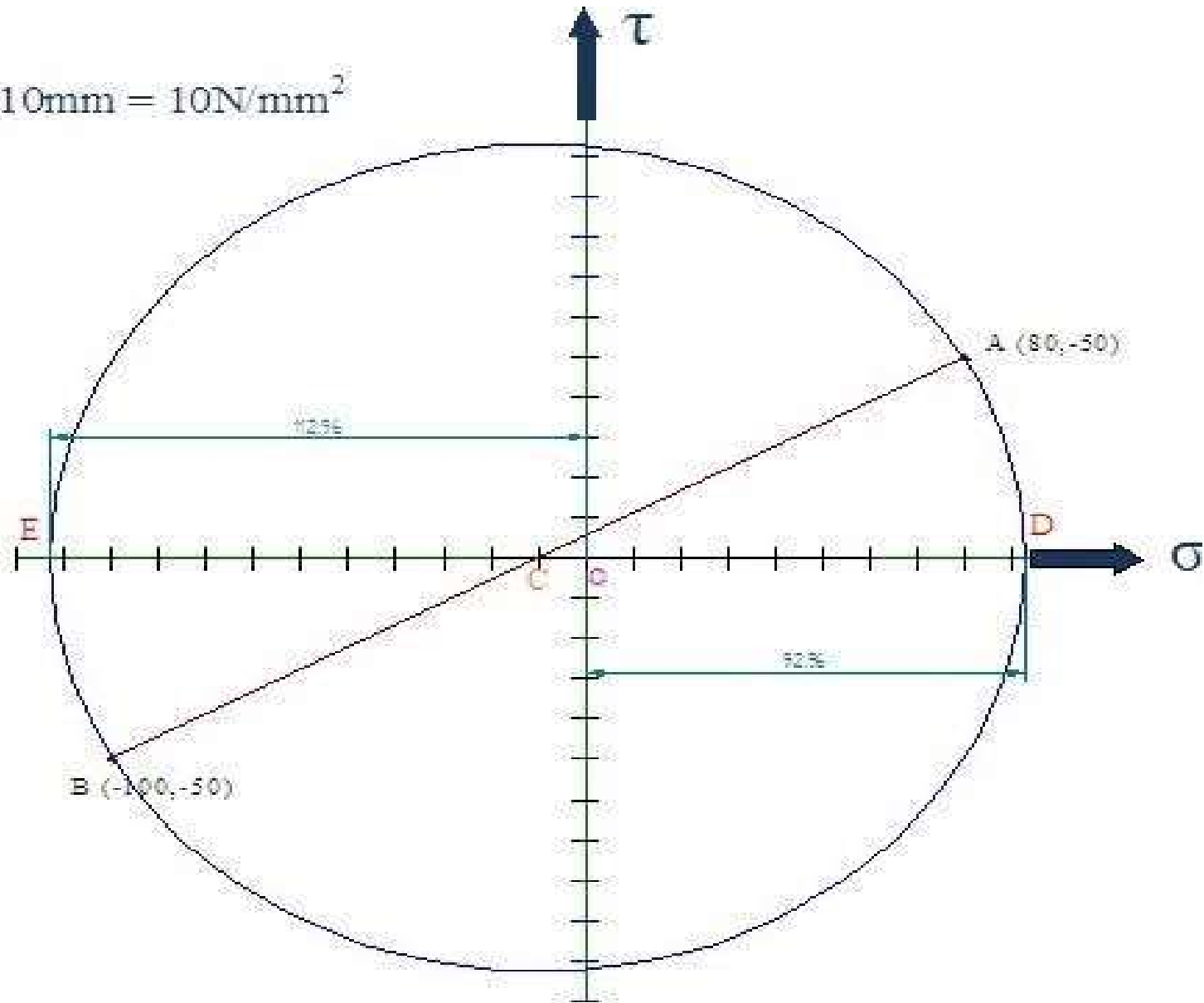
Step-3 Connecting Points A & B with a straight line cutting σ -axis at C

Scale: 10mm = 10N/mm²



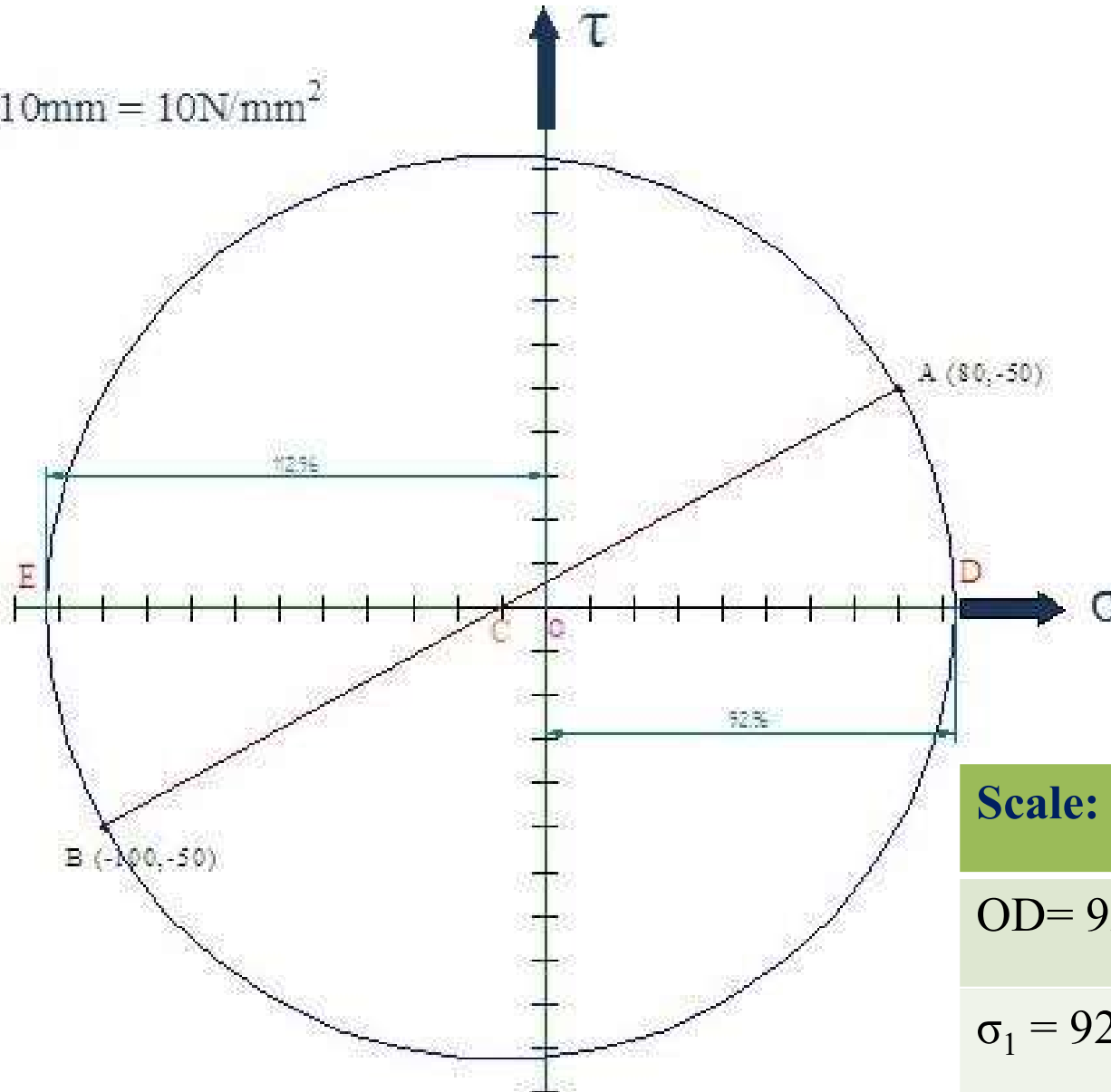
Step-4 Draw a circle with center C and radius CA.

Scale: 10mm = 10N/mm²



Step-5 Measure Principal Stresses σ_1 & σ_2

Scale: 10mm = 10N/mm²



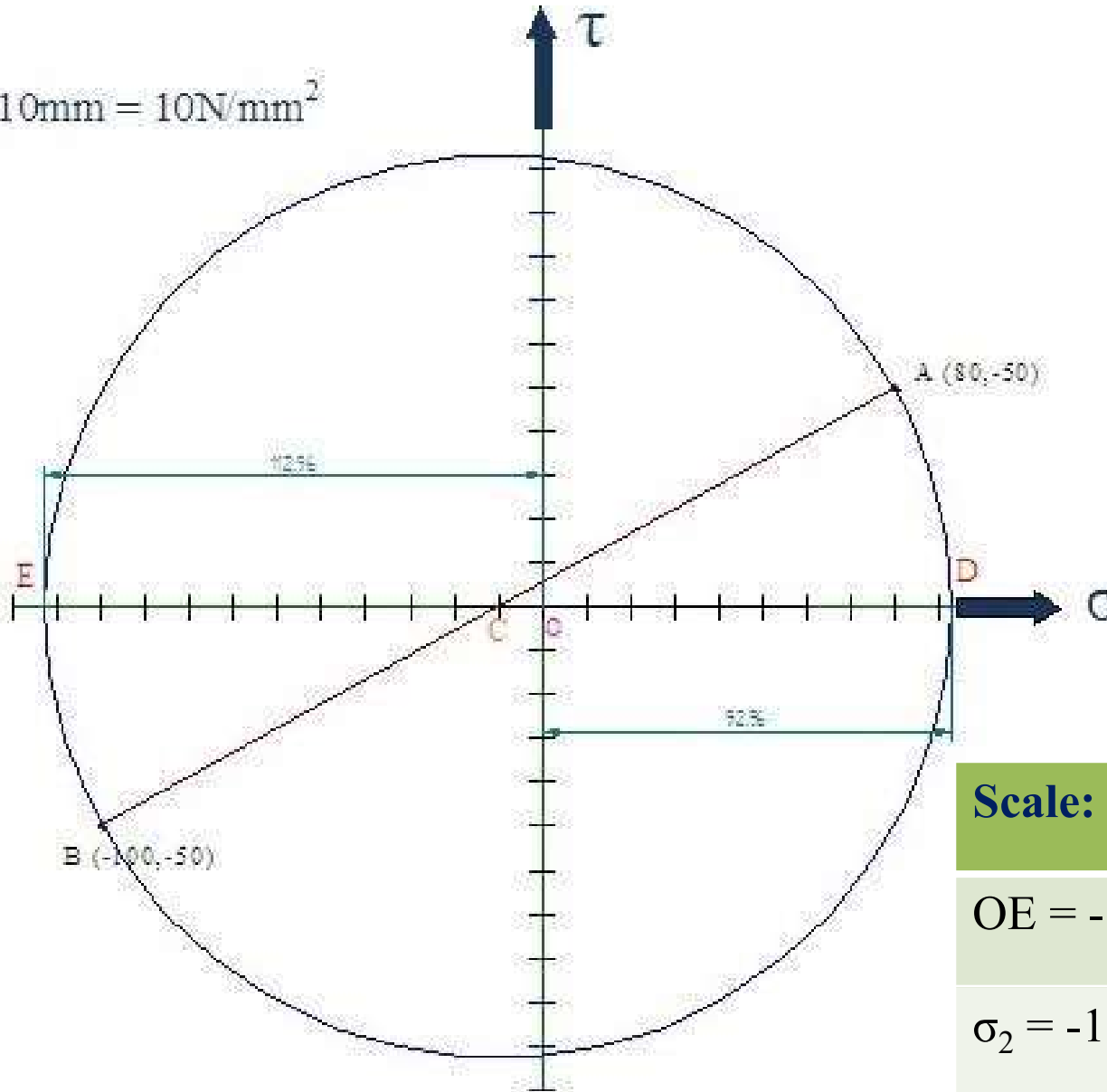
Scale: 10mm = 10N/mm²

OD = 92.96 mm

$\sigma_1 = 92.96 \text{ N/mm}^2$

Step-5 Measure Principal Stresses σ_1 & σ_2

Scale: 10mm = 10N/mm²



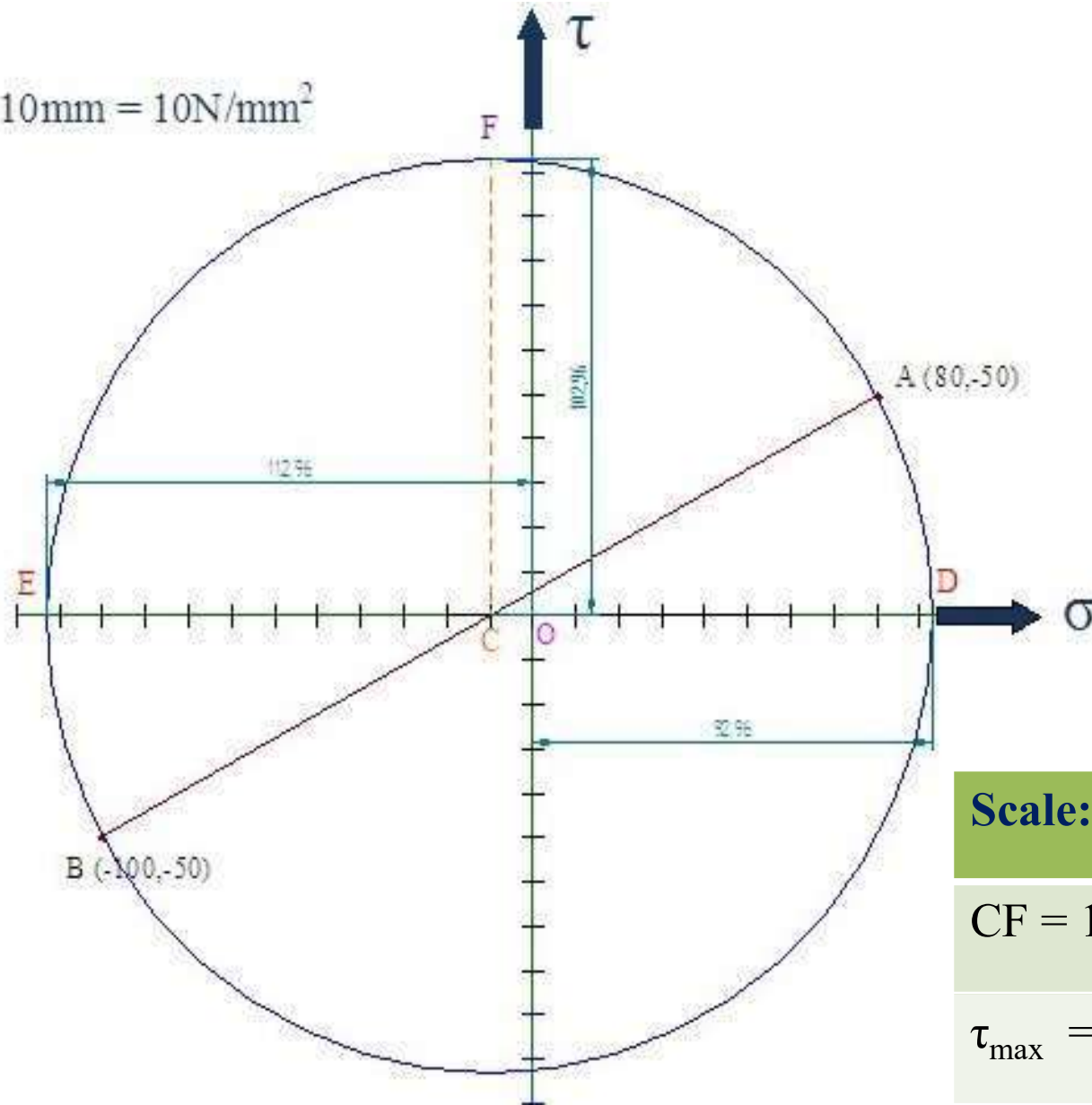
Scale: 10mm = 10N/mm²

OE = -112.96 mm

$\sigma_2 = -112.96 \text{ N/mm}^2$

Step-6 Measure Maximum Shear Stress τ_{\max}

Scale: 10mm = 10N/mm²



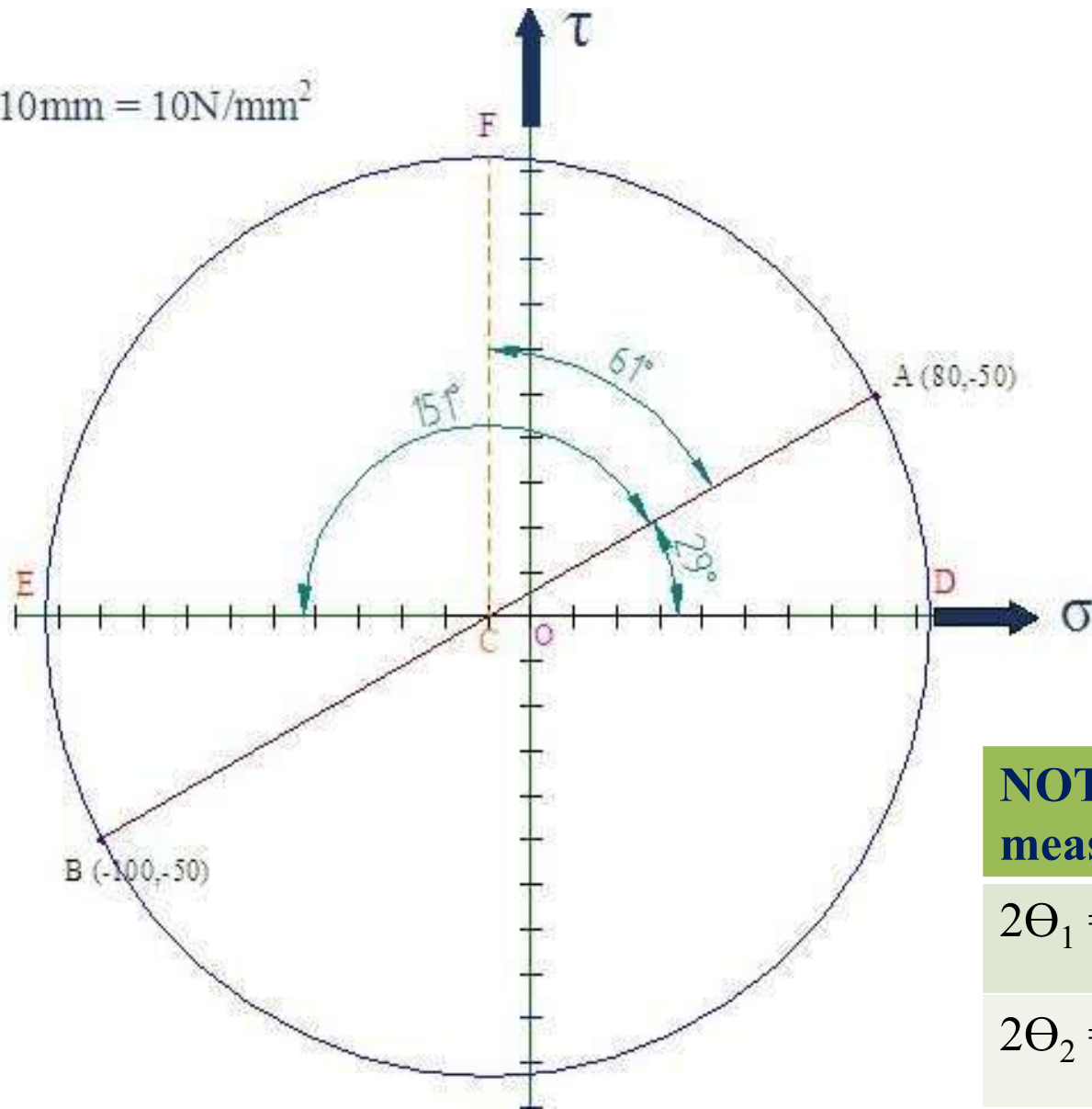
Scale: 10mm = 10N/mm²

CF = 102.96 mm

$\tau_{\max} = 102.96 \text{ N/mm}^2$

Step-7 Measure location of principal planes i.e. θ_1 & θ_2

Scale: 10mm = 10N/mm²



NOTE: All angles are measured from line CA

$$2\theta_1 = -29^\circ$$

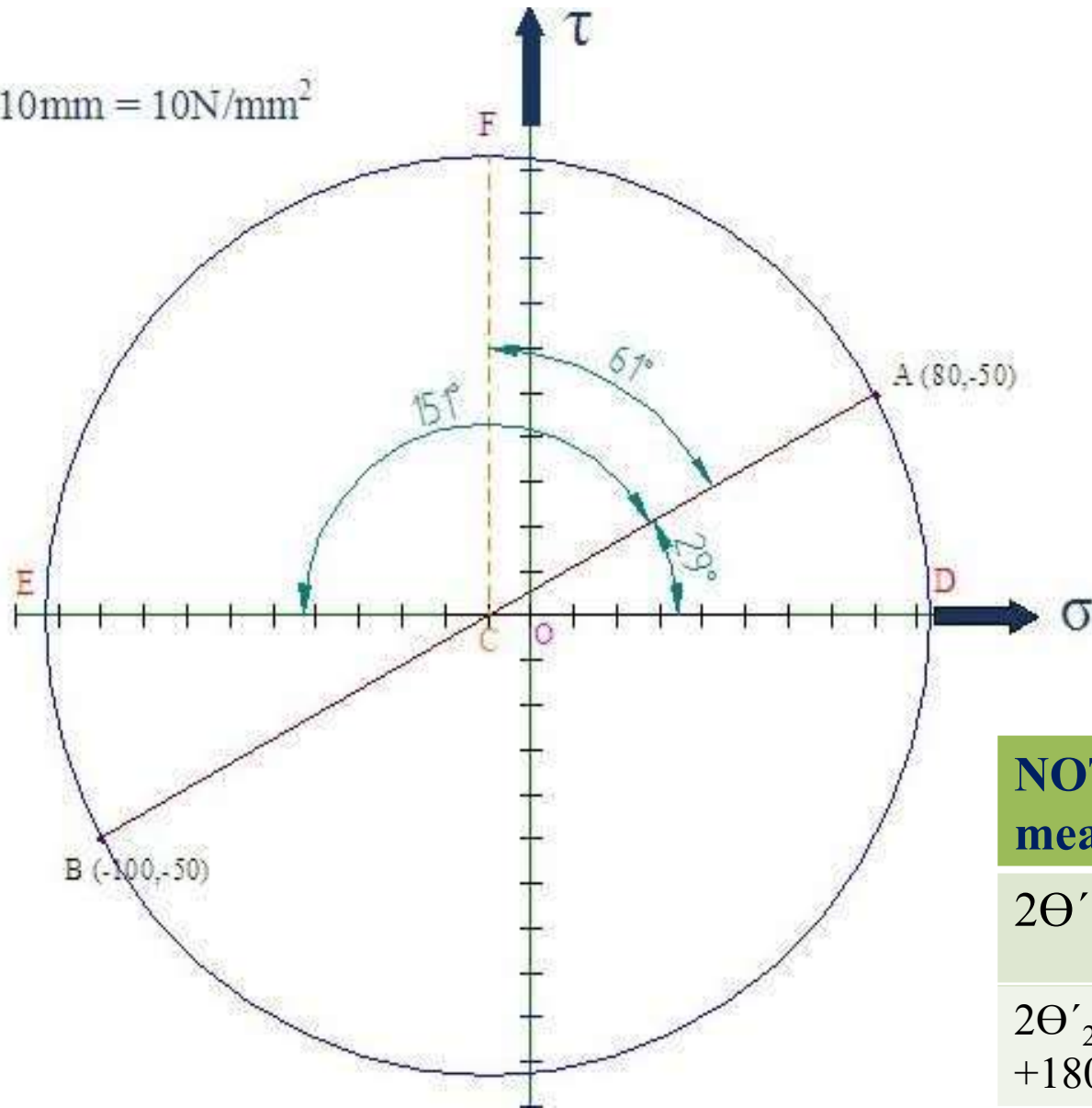
$$\theta_1 = -14.5^\circ$$

$$2\theta_2 = 151^\circ$$

$$\theta_2 = 75.5^\circ$$

Step-8 Measure location of plane of Maximum Shear Stress i.e. θ'_1 & θ'_2

Scale: 10mm = 10N/mm²



NOTE: All angles are measured from line CA

$$2\theta'_1 = 61^\circ$$

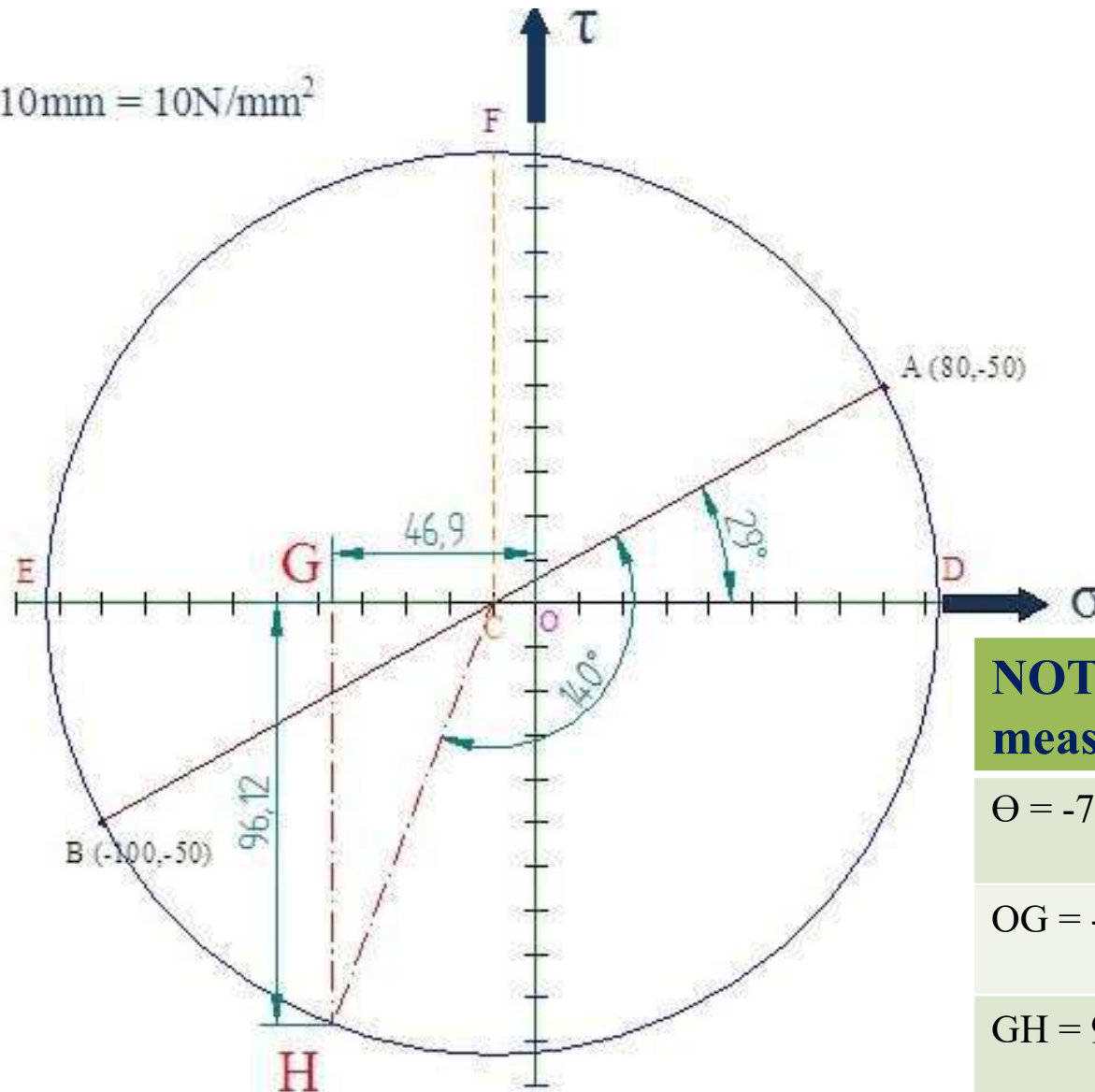
$$\theta'_1 = 30.5^\circ$$

$$2\theta'_2 = 2\theta'_1 + 180^\circ$$

$$\theta'_2 = 120.5^\circ$$

Step-9 Measure Normal stress, Shear stress to the plane at $\theta = -70^\circ$

Scale: 10mm = 10N/mm²



NOTE: All angles are measured from line CA

$$\theta = -70^\circ$$

$$2\theta = -140^\circ$$

$$OG = -46.9 \text{ mm}$$

$$\sigma_n = -46.9 \text{ N/mm}^2$$

$$GH = 96.12 \text{ mm}$$

$$\tau_n = 96.12 \text{ N/mm}^2$$