1. For the state of stress shown on the stress element below:
   a. Determine the **principal stresses** corresponding to the data shown on the sketch below. Show your answers on a properly oriented stress element. (10 points)
   b. Determine the **maximum in-plane shear stress** and **corresponding normal stress** for the stress element shown below. Show your answers on a properly oriented stress element. (10 points)
2. For this question, use Mohr’s circle and assume plane stress.
   a. Draw Mohr’s circle for the state of stress shown on the element below. (15 points)
   b. Determine the normal stress $\sigma_n$ and the shear stress $\tau_{nt}$ acting on the indicated
      inclined surface. Sketch the results to clearly indicate the directions of both $\sigma_n$ and
      $\tau_{nt}$ on the inclined surface. (10 points)
   c. Determine the absolute maximum shear stress. (5 points)

Exam 4 – Stress and strain transformations.

3. A rectangular strain gage rosette mounted on an aluminum-alloy \((E = 70 \text{ GPa, } \nu = 0.33)\) panel as shown measures the following strains:

\[\varepsilon_a = +400 \ \mu\varepsilon\]
\[\varepsilon_b = +365 \ \mu\varepsilon\]
\[\varepsilon_c = -200 \ \mu\varepsilon\]

(a) Determine \(\varepsilon_x\), \(\varepsilon_y\), and \(\gamma_{xy}\) from the measured strains. (5 points)

(b) Compute the principal strains \(\varepsilon_1\) and \(\varepsilon_2\) (note: magnitude only) (5 points)

(c) Compute the principal stresses \(\sigma_1\) and \(\sigma_2\) (note: magnitude only) (5 points)

(d) Compute the maximum in-plane shear stress in the aluminum alloy sheet. (5 points)
Refer to the figure at the right for questions 4 and 5. Assume $E = 100$ GPa and $\nu = 0.35$.

4. If the stress element is in **plane stress**:
   
   a. What is the magnitude of the normal stress in the z direction? (5 points)

   b. What is the magnitude of the normal strain in the z direction? (5 points)

5. If the stress element is in **plane strain**:
   
   a. What is the magnitude of the normal stress in the z direction? (5 points)

   b. What is the magnitude of the normal strain in the z direction? (5 points)