1. A round bar under deformation in a tension test as shown below. The diameters before and after deformation are shown below. Calculate engineering strain and true strain in (8 pts) (Hint: assume constant volume).

(1) the longitudinal direction (4 pts)
(2) the diametrical direction (4 pts)

2. The engineering stress vs. strain curve from a tension test is shown as below (6 pts).

(1) Sketch the true stress vs. true strain curve. (2 pts)
(2) Label the position where necking occurs on the appropriate stress vs. strain curve. (2 pts)
(3) What is the load characteristic at necking? (2 pts)

3. A cable material behaves according to $\sigma = K\varepsilon^n$. A log plot is given as below. (16 pts)

(1) Find $K, n$ (6 pts)
(2) If the original cross section area is 5 mm$^2$, find the maximum tensile force that this cable can withstand prior to necking. (10 pts)
4. A closed-end, thin-walled cylinder of original length \( l \), thickness \( t \), and internal radius \( r \) is subjected to an internal pressure \( p \). A uniform tensile force \( \pi pr^2 \) also applies on the end of the thin tube as shown below. (20 pts)

(1) Show the stress state and find their magnitudes. (8 Points)
(2) Find principal strains and explain how the tube thickness changes (assume Young’s modulus and Poisson ratio are \( E \) and \( v \), respectively) (4 pts)
(3) Find effective stress and effective strain. (4 pts)
(4) Find the maximum pressure \( p \) just to yield the tube, suppose the yield strength is \( \sigma_y \). You may use the Tresca or von Mises yield criterion. (4 pts)