1. A rigid-perfectly plastic beam of the length $l$ and cross section $b \times a$ is subjected to a uniform load $q_0$. The beam is fully clamped at one end and simply supported at the other.

(a) Determine the load-carrying capacity of the beam, $q_c$ (the maximum external load that the beam can resist), as a function of $a$, $b$, $l$ and the yield stress of the material $\sigma_y$.

(b) How does this critical load compare to the “first” yield load, $q_y$? The first yield is reached where the mostly stressed point in the beam reaches the yield stress.

(Hint: Solve the elastic problem for the beam with bending rigidity $EI$.)

Figure 1: A diagram for problem 1
2. A thick-walled steel cylinder with open ends is subjected to an outside pressure $p_0$. The inner pressure is assumed to be zero. The radial and circumferential stress are given by

$$
\sigma_r(r) = \frac{p_0a^2}{a^2-b^2} \left( \frac{b^2}{r^2} - 1 \right)
$$

$$
\sigma_\theta(r) = \frac{p_0a^2}{a^2-b^2} \left( \frac{b^2}{r^2} + 1 \right)
$$

(a) Find the locations and magnitudes of the maximum normal and shear stresses.
(b) Find the pressure corresponding to first yield. (Use von Mises and Tresca yield condition.)

![Figure 2: A diagram for problem 2](image)

3. A flat dog-bone specimen is subjected to a tensile load $P$. The true(Cauchy) stress-strain relation of that material is approximated by the power law

$$
\sigma = Ae^u
$$
Find the UTS (Ultimate Tensile Strength) of the material in the engineering measures.