M7.1 *(15 points)* An aluminum rod has a solid circular cross-section with a 20-cm
diameter and is 3 meters in length. The rod is clamped to a solid wall at one
end, and is subjected to a distributed negative torque of linearly increasing
intensity: from 0 at the wall to 100 N-m/m at the tip. There also is a
concentrated positive torque of 200 N-m at the midpoint of the rod. The
configuration is shown below. The modulus of aluminum is 67 GPa and the
Poisson's ratio is 0.3.

Cross-Section
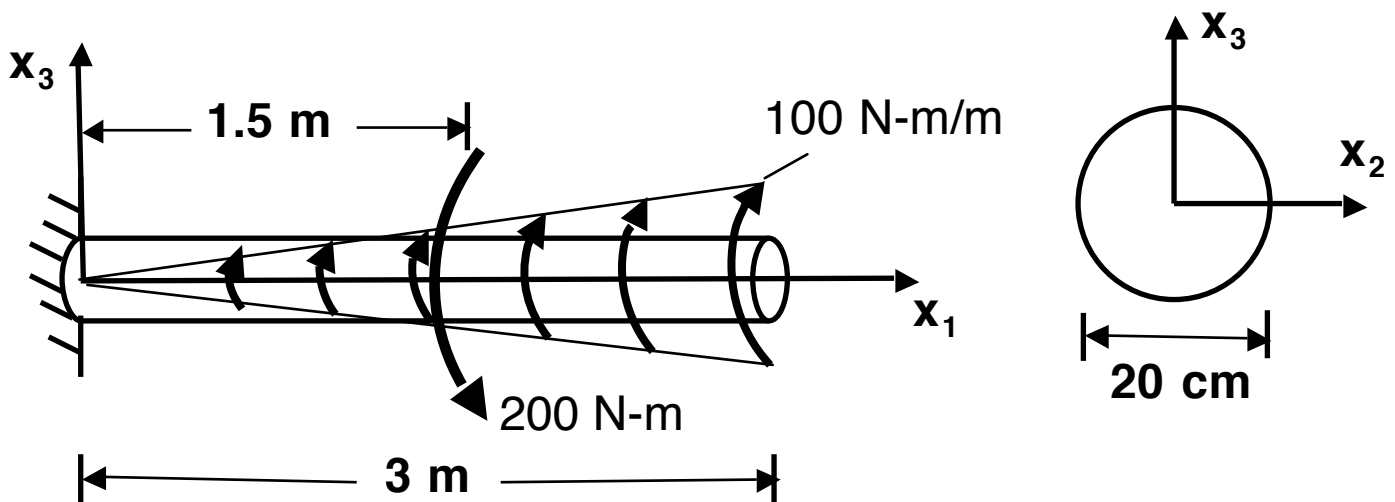
(a) Determine the torque distribution in the rod structural configuration and
sketch this as a function of x_1.

(b) Determine the twist at the tip of the rod.

(c) Determine the maximum shear stress in the rod and its location.

(d) If the rod were a hollow tube with the same outer radius and a wall with a
thickness of 20 mm, how would these answers change?