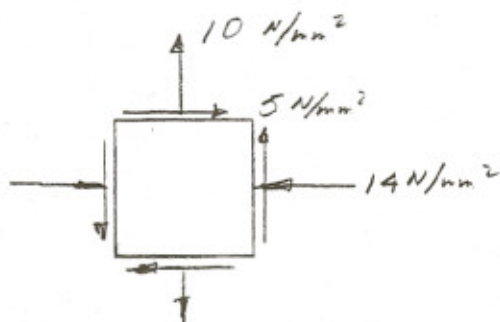


Solid Mechanics Exam

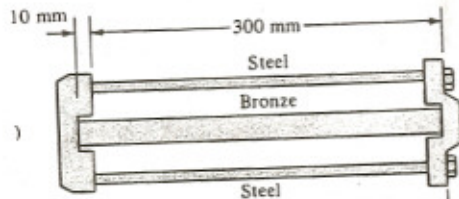
Answer all four questions, showing appropriate detail. You may use a one page formula sheet.

1. For the state of stress shown, compute the principal stresses and show them acting on a properly oriented element.

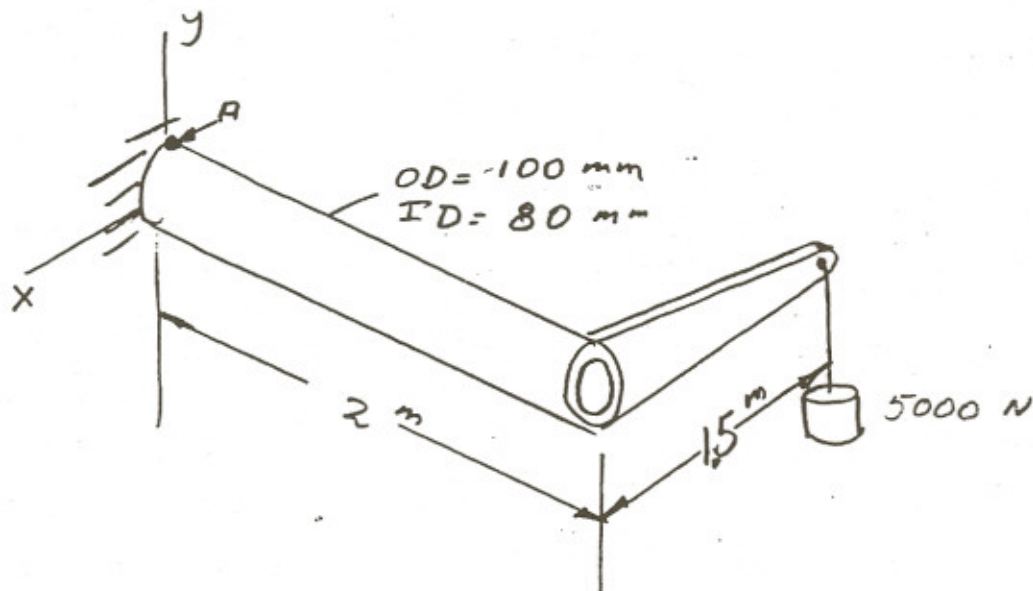


2

a 30-mm-diameter bronze cylinder is secured between a rigid cap and slab tightening two 20-mm-diameter steel bolts. At 20°C, no deformation and stress exist in the assembly. Determine the stress in the bronze and steel at 70°C. Use $E_s = 200$ GPa, $E_b = 83$ GPa, $\alpha_s = 11.7 \times 10^{-6}/^\circ\text{C}$, and $\alpha_b = 18.9 \times 10^{-6}/^\circ\text{C}$.



- 9 The tube has one end fixed and has an arm attached to the free end. The structure supports a load of 5000 N as shown. Determine the stresses acting at point A and show them on a sketch of an element.



4. The circular shaft anchored to the wall at A is solid from A to C and hollow from C to F. The outer diameter is 50 mm and the inner diameter is 30 mm. Locations B, C, D, E, and free end F are at respective distances a , $2a$, $3a$, $4a$, and $5a$ from A. It is subject to torques: $-200 \text{ N}\cdot\text{m}$, $+150 \text{ N}\cdot\text{m}$, $-80 \text{ N}\cdot\text{m}$ and $+50 \text{ N}\cdot\text{m}$ at B, D, E, and F as shown. The stress-strain behavior is well described by isotropic, linear, infinitesimal elasticity theory, with Young's modulus E and shear modulus G .

- What is the largest shear stress in the shaft and where does it occur?
- what is the total angle of twist of the end of the shaft relative to the fixed end (your answer will contain the parameters G and a)?

