

Solid and Structural Mechanics

August 2008

Exam Number: -----

Department of Mechanical Engineering

Michigan State University

**Solid and Structural Mechanics
Ph.D. Qualifying Examination**

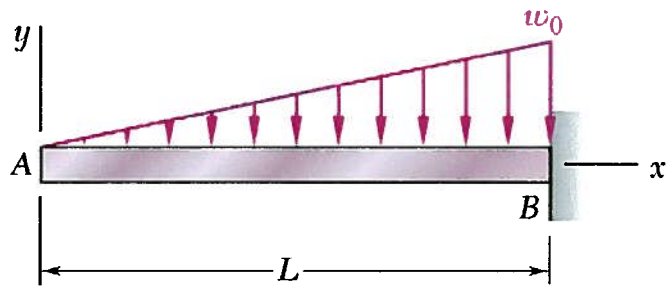
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**Closed Book and Notes
You may use a one page formula sheet
All Questions are weighted equally.**

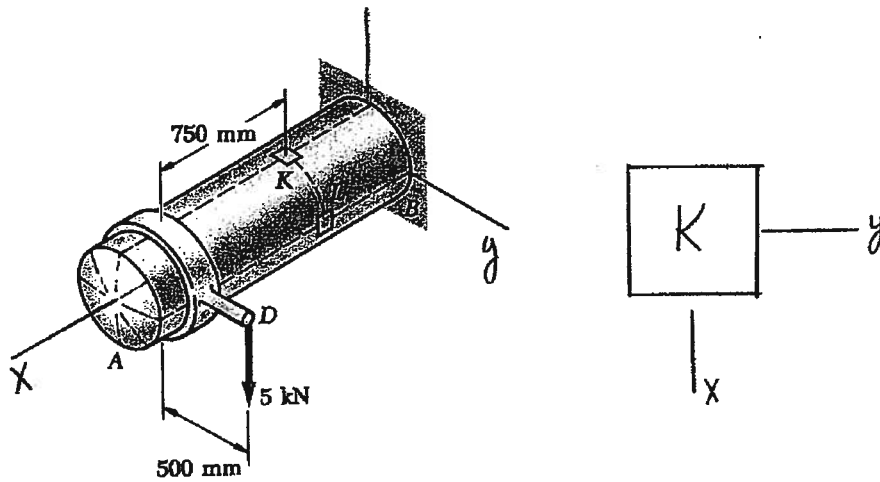
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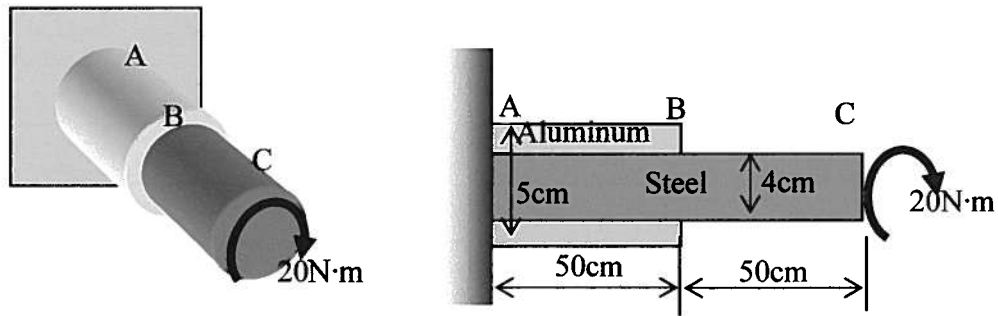
1. For the loading shown, determine (a) the equation of the elastic curve (deflection curve $y(x)$) for the cantilever beam AB , (b) the deflection of the free end, (c) the slope of the free end.



2. The compressed-air tank AB has an outside diameter of 462 mm and a uniform wall thickness of 6 mm. Knowing that the gage pressure inside the tank is 120 kPa, determine the state of stress at point K . Draw the state of stress on the element below.



3. Determine the maximum shear stresses in aluminum and steel between A and B when they are loaded at C with $20\text{N}\cdot\text{m}$ of torque. The shear modulus of steel and aluminum are 77GPa and 27GPa , respectively.



4. A rod consisting of two solid cylinders, AB and BC, is constrained between two rigid walls. The section AB whose diameter is 60mm is made of brass ($E=105\text{GPa}$ and $\alpha=20.9\times 10^{-6}/^{\circ}\text{C}$) and the section BC whose diameter is 40mm is made of aluminum ($E=72\text{GPa}$ and $\alpha=23.9\times 10^{-6}/^{\circ}\text{C}$), respectively. Both sections are 50cm long with no stress in the rod. Then the temperature is raised by 50°C .

- (a) Determine the reaction forces in the rod.
- (b) Determine the stresses in AB and BC.
- (c) Determine the deflection of the point B. Does the point B move to right or left?

