QUIZ 1- November 30, 2000
Fall 2000-2001
CVEV 041 – MECHANICS OF MATERIALS
CLOSED BOOK, 1 ½ HOURS

Name: ____________________ **ID#:** ______________

2 Pages, 2 Problems

Read all questions before you start and manage your time carefully.
Return the question sheet with the answering booklet.

Problem I: *(65 points + Take a Break)*

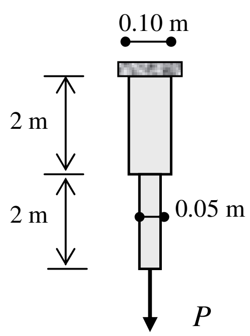

Figure I-a

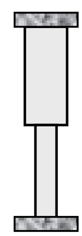

Figure I-b

The bar system shown in Figure I (I-a and I-b, not to scale) is composed of two parts with widths of 0.10 m (10 cm) and 0.05 m (5 cm), respectively. The bar system has a uniform thickness of 0.01 m (1 cm), a modulus of elasticity E=2x10^6 kPa (kN/m2), and a unit weight γ=100 kN/m^3.

1. Referring to Figure I-a, and considering the own weight of the bar only (P=0)
   - Determine the maximum stress (value and location). **(5)**
   - Compute the displacements in the middle and at the *tip* (at the bottom). **(15)**
2. Referring to Figure I-a, and ignoring the own weight of the bar
   - Determine the force P which will cause the same *tip* displacement in the bar as computed in question 1. **(10)**
   - Compare this P with the total weight of the bar, and briefly comment. **(5)**
   - Compute the maximum stress in the bar due to P, and compare with the stress computed at the same location due to own weight. **(5)**
   - Draw the force, stress, strain, and displacement diagram in the bar. **(10)**
3. Referring to Figure I-b, use (some of) the results obtained in questions 1 and 2 to deduce the displacement at the middle due to the own weight of the bar. **(15)**

Take a Break: Write the full names of the following (answer on the question sheet)

CVEV041 Professor:________________ CE Chairman:________________
FEA Dean: ________________ AUB President:________________

Problem II: *(35 points + Bonus)*

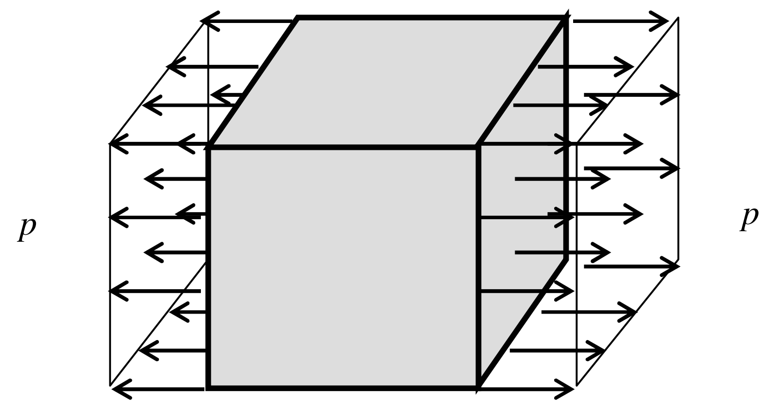

Figure II

A cube (1x1x1 m) has the following material properties:
Modulus of elasticity $E=10^6$ kPa (kN/m^2) and Poisson's Ratio $\nu=0.2$
Assume linear elastic, small deformation behavior, and neglect the weight of the cube.

The cube is subjected to a uniform tensile pressure p=5,000 kPa as shown in Figure II.

1. What is the state of stress and strain in the cube. **(13)**
2. Sketch the cube after deformation, and calculate its deformed volume using the product of the three sides. Deduce the volumetric strain. **(7)**
3. The axial strain ε due a change in temperature applies uniformly in all directions and is given by:
   $\varepsilon = \alpha.(\Delta T)$
   where ΔT is the change in temperature in degree Celsius (^{O}C), positive for *increase* in temperature, and α is the coefficient of linear expansion in (1/ ^{O}C), a physical property of the material.
   After p=5,000 kPa is applied, a temperature *drop* of 50 ^{o}C was needed to bring the elongated dimension of the cube to the original 1 m. Compute α. What are the final dimensions of the cube. **(10)**
   If this problem is repeated with a cube of dimensions (2x2x2 m), estimate α (do not perform any computations, just give your answer with a very brief 1-line comment). **(5)**

Bonus Question:

The material is now bi-linear as shown below. For the same p and E, and no temperature drop, what is elongation of the cube (in the direction of the pressure p)? Compare with the value obtained in question 2 and very briefly comment.