Massachusetts Institute of Technology
Department of Aeronautics and Astronautics
Cambridge, MA 02139

16.01/16.02 Unified Engineering I, II
Fall 2003

Problem Set 8

Name: ________________________

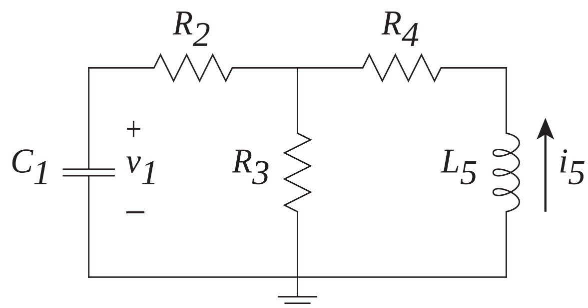
Due Date: 10/28/03

	Time Spent (min)
S10	
S11	
M5	
M6	
F1	
Study Time	

Announcements:

Unified Engineering I **Fall 2003**

Problem S10 (Signals and Systems)



Consider the circuit above, with

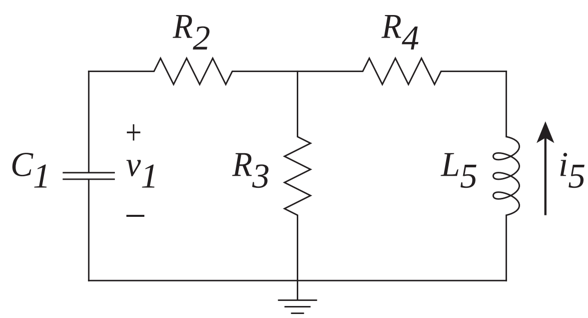
$$C_1 = 0.5 \text{ F}, \quad R_2 = 4\ \Omega, \quad R_3 = 4\ \Omega, \quad R_4 = 1\ \Omega, \quad L_5 = 2 \text{ H}$$

The initial conditions on the capacitor and inductor are

$$v_1(0) = 2 \text{ V}, \quad i_5(0) = 1 \text{ A}$$

Find $v_1(t)$ and $i_5(t)$, using the methods discussed in Lecture S10. Note: If you wish, you may use the loop method instead of the node method.

Problem S11 (Signals and Systems)



Consider the circuit of Problem S10 above, with

$$C_1 = 0.5 \text{ F}, \quad R_2 = 4\ \Omega, \quad R_3 = 4\ \Omega, \quad R_4 = 1\ \Omega, \quad L_5 = 2 \text{ H}$$

Find the state-space equations that describe the evolution of the circuit, in the form

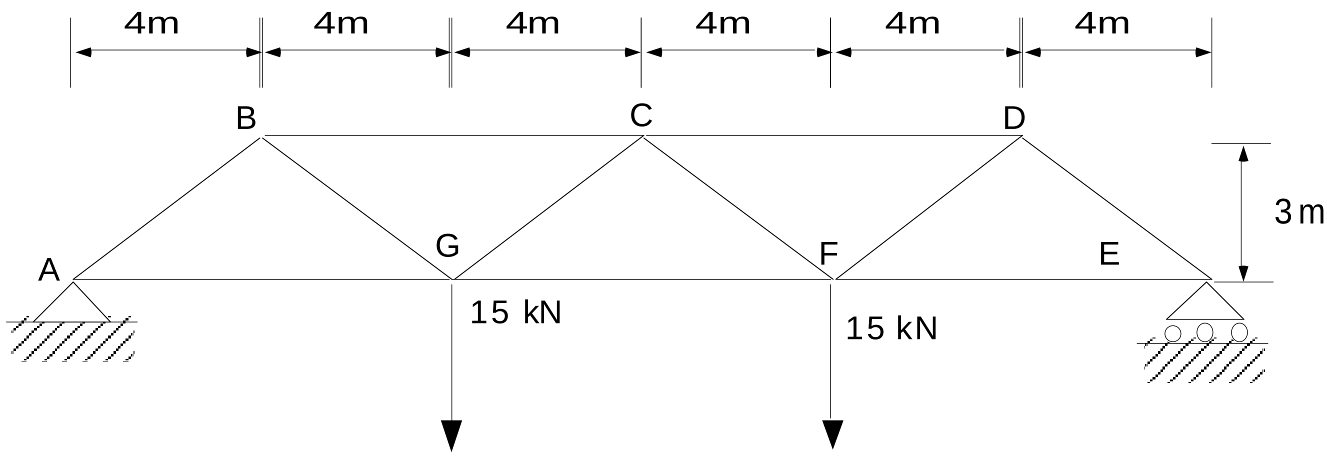
$$\frac{d}{dt}\underline{x}(t) = A\underline{x}(t)$$

where

$$\underline{x}(t) = \begin{bmatrix} v_1(t) \\ i_5(t) \end{bmatrix}$$

Problem M5 (Materials and Structures)

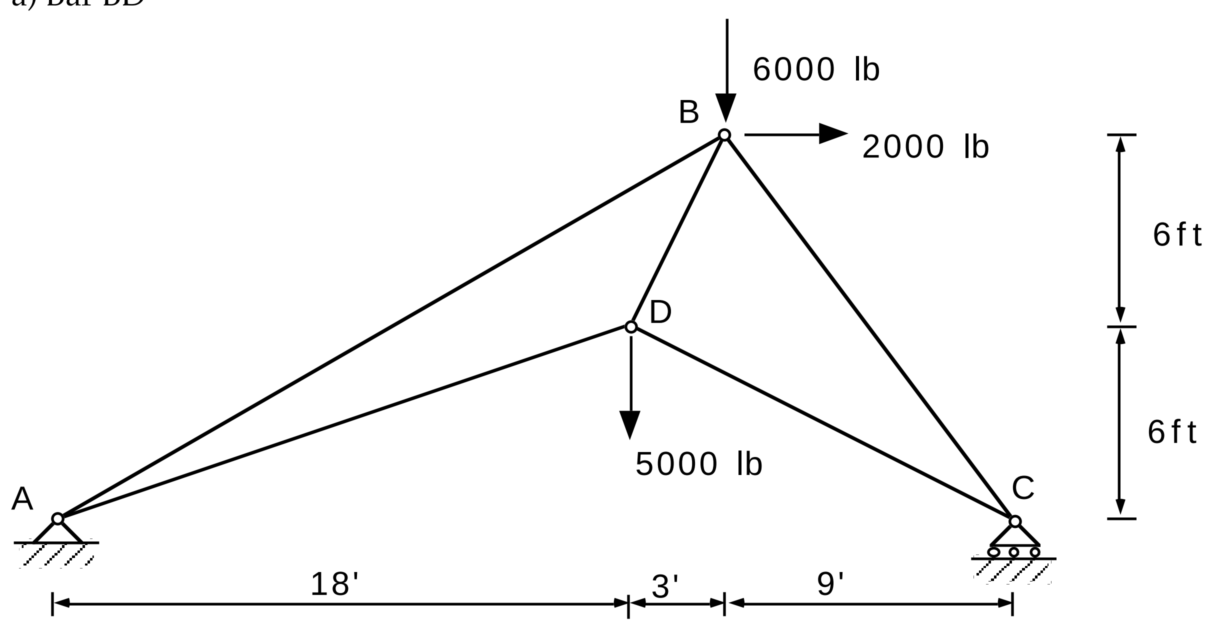
For the 2-D planar truss shown below, with the loading and support conditions shown calculate all the bar forces. Present them neatly in a table.



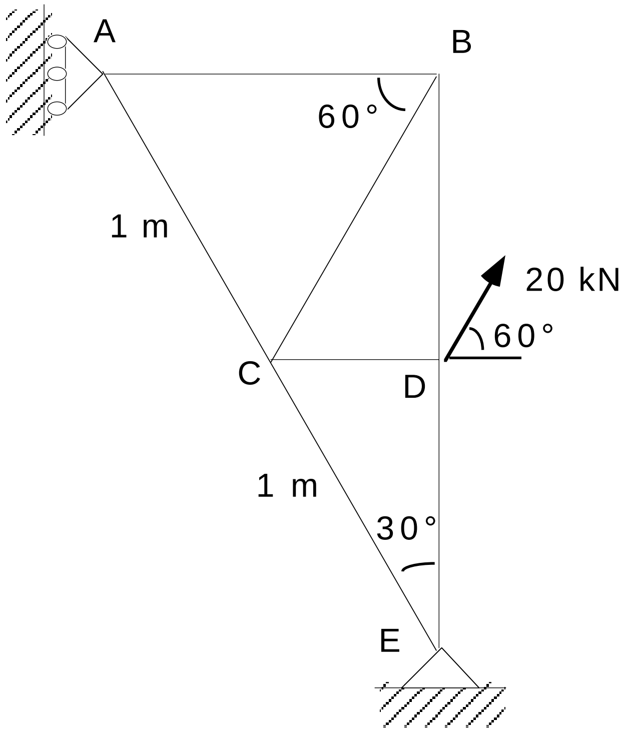
Problem M6 (Materials and Structures)

For the structures shown below calculate the forces in the specified bar(s)

a) Bar BD



b) Bar CD



Unified Engineering Fall 2003
Fluids Problem 1
Purpose: Practice using hydrostatic and state relations. Self-assessment.

Part A. (40%) Anderson Problem 1.11

Part B. (40%) Compute the weight of a 1kg mass of aluminum ($\rho = 2.7\text{g/cm}^3$) in vacuum, in air, and in water.

Part C. (20% freebie if completed) Skills self-assessment, with the following objectives:

- To establish the average UE student's understanding of material taught in the prerequisite subjects. The collective information will be reported to the class, and used by the instructor to set the appropriate level of review in subsequent lectures.
- To let you gauge your own level of understanding of the material relative to the average UE student.

Use the following scale for your responses.

1 Poor understanding, or never heard of the concept
2 Weak understanding, probably couldn't apply it properly
3 OK understanding, could apply it with considerable effort
4 Good undertanding, could apply it with little or no trouble
5 Excellent understanding, almost second nature

TOPIC OR CONCEPT	UNDERSTANDING
Equation of state for a perfect gas	1 2 3 4 5
Fluid viscosity	1 2 3 4 5
Vector addition and subtraction	1 2 3 4 5
Scalar (Dot) product of two vectors	1 2 3 4 5
Vector (Cross) product of two vectors	1 2 3 4 5
Vector relations in polar coordinates	1 2 3 4 5
Rotation of vectors between different coordinate systems	1 2 3 4 5
Normal and tangential vectors on surface	1 2 3 4 5
Gradient of a scalar field	1 2 3 4 5
Divergence of a vector field	1 2 3 4 5
Curl of a vector field	1 2 3 4 5
Stokes Theorem	1 2 3 4 5
Gauss (Divergence) Theorem	1 2 3 4 5
Gradient Theorem	1 2 3 4 5
Line, Surface, Volume integrals	1 2 3 4 5
Conservation of mass	1 2 3 4 5
Conservation of linear momentum	1 2 3 4 5
Conservation of angular momentum	1 2 3 4 5