

Name \_\_\_\_\_ Section \_\_\_\_\_

**ES201**  
Examination I  
September 22, 1998

Problem	Score
1	/16
2	/20
3	/32
4	/32
Total	/100

Show all work for credit  
AND  
Turn in your signed help sheet  
AND  
Stay in your seat until the end of class

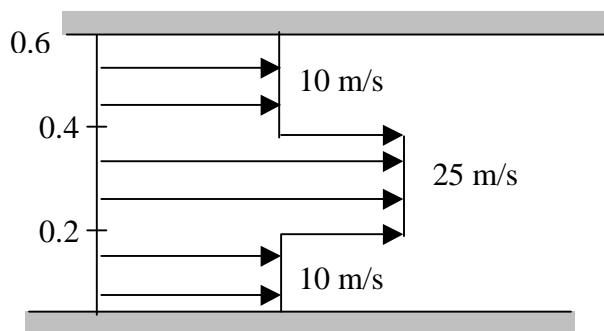
1A. An object weighs  $960 \text{ lb}_f$  on the surface of the earth where the acceleration of gravity is  $30.0 \text{ ft/sec}^2$ .

- What is its mass in slugs?
- What is its mass in  $\text{lb}_m$ ?

1B. A  $100 \text{ kg}$  batch mixture is made up of compounds A and B. The mass fractions are  $0.7$  and  $0.3$  respectively. You are given that the molar mass of A,  $M_A$ , is  $36.0$  and the molar mass of B,  $M_B$ , is  $52.0$ .

- What are the molar fractions of A and B?
- What is the equivalent or overall molar mass of the mixture?

1C. An incompressible fluid flows through a duct, which is  $0.6 \text{ m}$  high and  $1.0 \text{ m}$  wide. An approximation to the velocity distribution is shown in the figure. Your job is to calculate the corresponding volumetric flow rate in  $\text{m}^3/\text{s}$ .



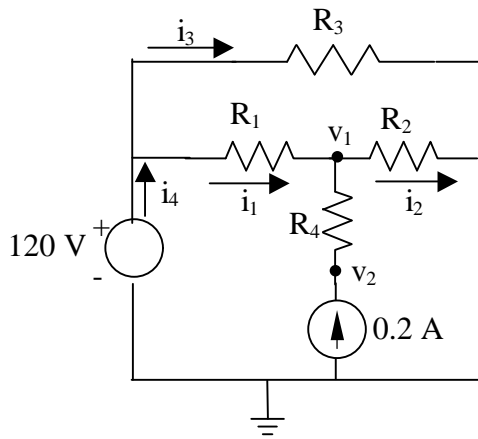
8. What does steady state mean?

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Given the circuit below write the equations necessary to solve for all the unknown currents and voltages (measured with respect to ground) in the problem. Assume  $R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$  are known. **DO NOT SOLVE THESE EQUATIONS.** Be sure to include some text telling me what you're doing and clearly label the circuit with the unknown quantities.



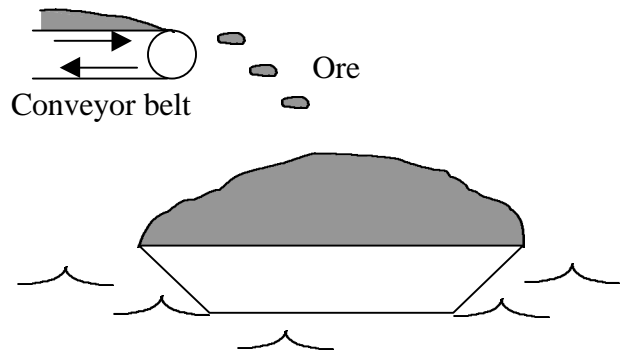
Unknowns	Equation Numbers

Ore is loaded on a barge using the conveyor system shown. The conveyor loads 2 tons of ore per hour onto the barge. Once the pile on the barge has reached 10 tons ore is lost over the side at a rate of 0.05 times the amount of mass in excess of 10 tons, that is,  $\dot{m}_{\text{lost}} = 0.05(m_{\text{pile}} - 10)$ .

Determine:

- The time,  $t_1$ , required for the ore on the barge to reach a mass of 10 tons.
- An expression for the rate of change of the mass of the pile for  $t > t_1$
- The steady state amount of ore in the pile.

NOTE: FOR MORE THAN A 70% GRADE ON THIS PROBLEM you must clearly show how you modeled the system using the given information, the fundamental laws and basic concepts of this course, and any additional assumptions.



A sugar syrup (20% by weight water) is being concentrated in a two stage evaporator. The syrup enters the first evaporator in which 75% of the entering water is removed and leaves as a pure water stream. The product rich syrup stream is further concentrated in the second stage where 60% of the entering water is removed. If 100 kg/hr of the syrup are fed to the first evaporator, determine the equations necessary to calculate the flowrates and compositions of each of the other flows. **DO NOT SOLVE THE EQUATIONS** - Your solution should consist of a list of unknowns and equations.

