

NAME _____ BOX NUMBER _____

Problem 1 (16) _____

Problem 2 (32) _____

Problem 3 (28) _____

Problem 4 (24) _____

Total (100) _____

INSTRUCTIONS

- **Closed book/notes exam. (Unit conversion page provided)**
 - **Help sheet allowed. (8-1/2 x 11" sheet of paper, one side)**
 - **Laptops may be used; however, no pre-prepared worksheets or files may be used.**
- 1) Show all work for complete credit.
- Start all problems at the ANALYSIS stage, but clearly label any information you use for your solution.
- **Problems involving conservation principles MUST clearly identify the system and show a clear, logical progression from the basic principle.**
- Don't expect us to read your mind as to how or why you did something in the solution. Clearly indicate how you arrived at your answer.
 - **Always crunch numbers last on an exam.** The final numerical answer is worth the least amount of points. (Especially if all I would have to do is plug in the numbers into a well-documented solution.)
- 2) Useful Rule of Thumb (Heuristic): $(100 \text{ point exam}) / (50 \text{ min}) = 2 \text{ points/minute}$. That means a 10 point problem is not worth more than 5 minutes of your time (at least the first time around).
- 3) Please remain seated until the end of class or everyone finishes. (Raise your hand and I'll pick up your exam if you have other work you need or want to do.)

Problem 1 (16 Points)

a)(4) What's the significant difference between an **extensive property** and an **intensive property**?

b)(4) What do we mean when we say that **an extensive property is conserved**?

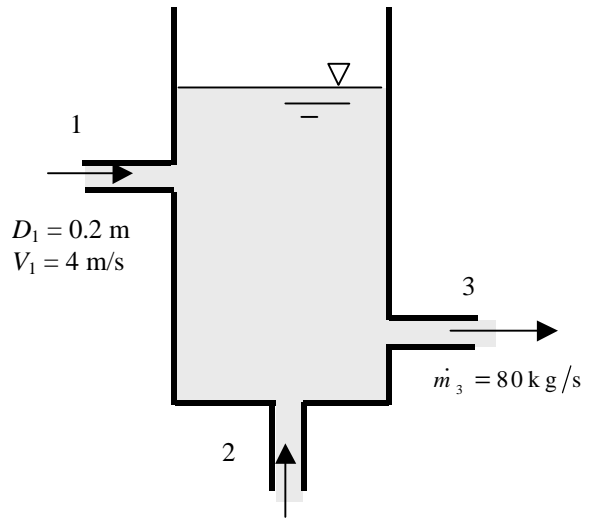
b)(8) An explorer buys a quantity of gold that weighs 10.00 lbf from a trader near the equator where the effective acceleration of gravity is 32.00 ft/s^2 . When he gets back to London where the effective acceleration of gravity is 32.20 ft/s^2 , he wants to sell the gold.

What is the mass of the quantity of gold that he bought? (Because this stuff is expensive, report your answer to four significant figures.)

Problem 2 (32 points)

The rigid-walled tank contains water ($\rho = 1000 \text{ kg/m}^3$) and is open to the atmosphere on top. The tank is basically a vertical cylinder with a diameter $D_{\text{tank}} = 3 \text{ m}$. Water flows into the tank at Inlet 1 with a velocity of 4 m/s through a pipe of diameter $D_1 = 0.2 \text{ m}$. It also flows into the tank through Inlet 2. Water flows out of the tank through Outlet 3 at a mass flow rate of 80 kg/s .

- (a) Determine the rate of change of the water level in m/s if water is entering the tank through Inlet 2 at $200 \text{ m}^3/\text{h}$ (cubic meters per hour). Is the level increasing or decreasing?
- (b) For the tank to have a steady-state operating condition with the given flow rates at Inlet 1 and Outlet 3, what value of the flow rate at Inlet 2 is required?

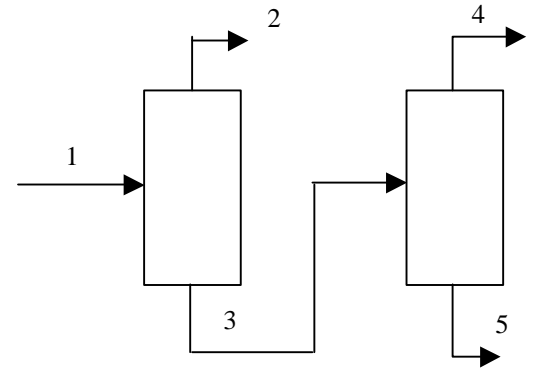


Problem 3 (28 points)

A two-column distillation column is shown at right. The system operates at steady-state conditions and there are no chemical reactions. The known flow rates and compositions are shown in the table.

Develop the necessary equations to calculate the unknown flow rates and compositions. **DO NOT SOLVE THE EQUATIONS.** For full credit, you must clearly label the unknowns and the equations you would use in solving for them.

	Stream	Mass Flow Rate (kg/h)	Composition (Mass %)		
			A	B	C
1	Feed	1000	20.0	30.0	50
2	Overhead I	250	62.0	5.0	
3	Bottoms I				
4	Overhead II		15.0	80.0	
5	Bottoms II		0.5		



Problem 4 (24 points)

For the circuit shown, determine the unknown currents and node voltages.

SET UP THE NECESSARY EQUATIONS BUT DO NOT SOLVE THEM. Clearly indicate the equations you feel are necessary and sufficient to solve for the requested information. Be sure and include some text telling me what you're doing.

[NOTE: You may have to define additional currents and/or voltages to solve for the requested information.]

