ES 202 - Exam I Spring 1999-2000 Richards

Name:______________________________________ Campus Mail Box ____________

Problem 1-A	(50)	__________
Problem 1-B	(12)	__________
Problem 2	(38)	__________
TOTAL	(100)	__________

General Comments

(1) Anytime you apply a conservation or accounting principle in solving a problem, you must **sketch and clearly identify the system** you have selected. In addition, you must **clearly indicate how your assumptions or information given in the problem simplifies the general equations.**

(2) Closed book/notes; however, you may use any of the following:
... yellow equation pages provided by instructor
... unit conversion page
... material in Appendices and end flaps of Wark/Richards text
... your equation page (single side of 8-1/2 x 11 sheet of paper

(3) For maximum credit,
... solve problems symbolically first showing logic and reasoning for solution,
... substititute numbers into the equations clearly showing any required unit conversion factors
... then and only then crunch numbers on your calculator.
If I only have to punch your numbers into a calculator to get a correct answer (including units) you will receive full credit. **Don't make me guess what you are doing and why you chose to do this.**

NOTE: Since the main focus of this test is on finding properties, be sure you demonstrate that you can find the appropriate numerical values. Don't just say "Look in the tables."

(4) Watch the time and feel free to remove the staple and take the test apart so that you don't have to keep flipping pages around.

Problem 1 - Part A (50 points)

Complete the unshaded portions of the following table for **WATER** (H_2O):

For **phase**, clearly indicate whether it is a compressed liquid (CL), saturated liquid (SL), saturated mixture (SM), saturated vapor (SV), or superheated vapor (SHV).

For **properties** and **quality**, provide a number or indicate it is not applicable (N/A).

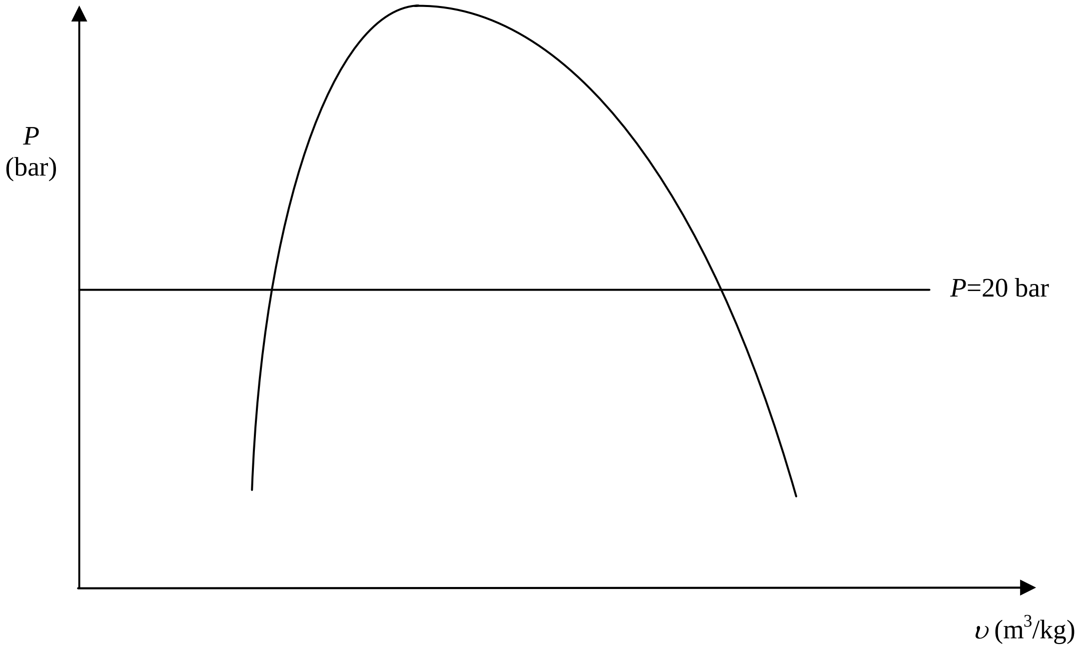
(Information that requires calculations is worth information that only require a lookup.)

State	**Phase**	***T*** °C	***P*** bar	***x***	***υ*** m^3/kg	***h*** kJ/kg	***s*** kJ/(kg·K)
1		200	10				
2		200				1500.0	
3		200	20				
4			10	0.70			
5		100	10				
6	SV	200					
7			20		0.1530		

Use this space to show your work where necessary: (Full credit will be given if I only had to punch your numbers into my calculator.)

Problem 1 - Part B (12 points)

On the P-υ diagram drawn below, sketch the 200^{o}C isotherm and locate and label States 1 - 6 found in Problem 1- Part A on the previous page. Take care to show the relative position of each state with respect to the saturation lines, the appropriate isobars, *and* the 200^{o}C isotherm.



Problem 2 (38 points)

A rigid, insulated tank contains air that is stirred by a small circulating fan driven by a shaft that extends through the tank wall. The air in the tank occupies a volume of 50 m^3. The fan mechanism inside the tank has a mass of 3.0 kg and is made of aluminum.

Initially, the fan is stationary and in thermal equilibrium with the gas, and the gas is at a temperature and pressure of 300 K and 500 kPa, respectively. Over a 24-hour period, the fan cycles on and off. At the end of the 24-hour period, the fan is off and the temperature of the gas and the fan mechanism has *increased* by 50 K. Assume the air can be modeled as an ideal gas, and the fan mechanism can be modeled as an incompressible substance.

Determine:

(a) the mass of the air in the tank, in kg.

(b) the final pressure of the air in the tank, in kPa.

(c) the work done on the gas-fan system during the 24-hour period, in kJ.

(d) the entropy generation for the gas-fan system during the 24-hour period, in kJ/K.