Name: ____CM Box: ___________

Circle your section:

Lui – 01 | Lui – 02 | Richards – 03 | Richards – 04

Sanders – 05 | Sanders – 06 | Mech – 07

ES 202
Fluid & Thermal Systems

Examination I
December 19, 2005

Problem	Score
1	/ 40
2	/ 33
3	/ 27
Total	/100

Clearly show all work for credit.
Open table ONLY
One side of an 8.5” x 11” equation sheet is allowed.
Laptops allowed

Problem 1 (40 points)

(a) (31 points) Complete the table of thermodynamic property information shown below for **Water (H_2O).** Skip the shaded boxes. You are encouraged to use the blank space on this page and the next page as work space.

Numerical answers should be provided with an **accuracy of at least 4-significant figures**. (Round-off can get you in trouble!)

Please use the following abbreviations as required:

CL = compressed (subcooled) liquid		NA = not applicable	
SL = saturated liquid		INSUF = insufficient information	
SM = saturated two-phase mixture			
SV = saturated vapor			
SHV = superheated vapor			

State	Pressure P (MPa)	Temperature T (°C)	Quality, x	Specific Volume v (m³/kg)	Specific Enthalpy h (kJ/kg)	Phase
1	4.0		0.3			
2	4.0	200				
3	4.0			0.0715		
4	4.0	300				
5		300				SV
6		300			2543	

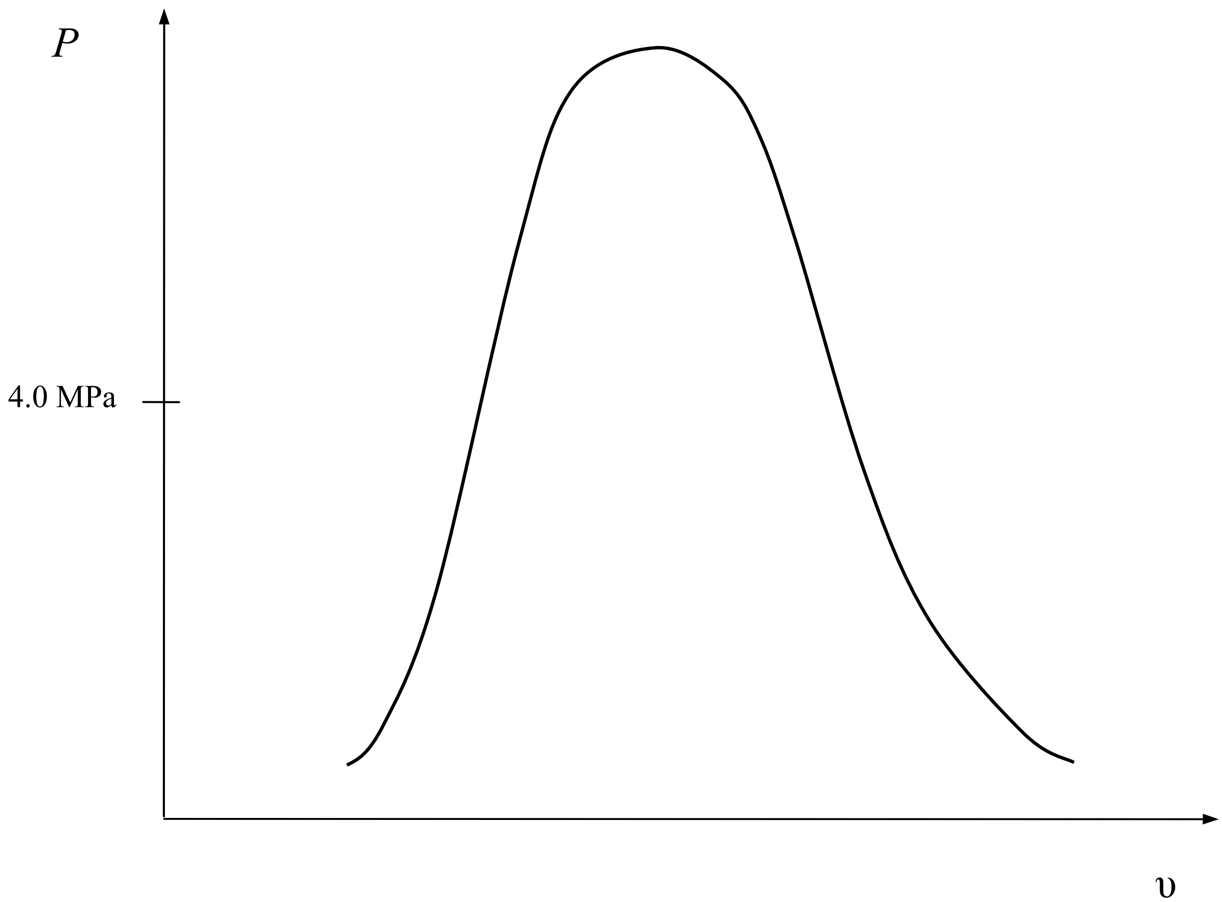
Workspace

Problem 1 (continued)

(b) (9 points) On the following *P*-*v* diagram,

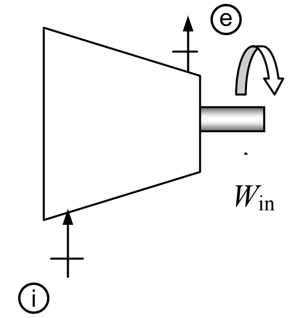
i. Carefully sketch the 4.0 MPa isobar and the 300 °C isotherm.

ii. Carefully locate all six states (1-6) from Problem 1 (a). Take care to correctly locate the states relative to the saturation curves and the appropriate isotherm and isobar.



Problem 2 (33 points)

Analyze the AIR compressor in the diagram at the right. The AIR enters the compressor at 100 kPa and 290 K. It exits at 550 K and 683 kPa. Treat the AIR as an ideal gas and apply standard assumptions for a compressor. Use the ideal gas table for air (Table A-21).

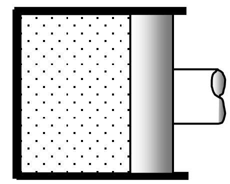


(a) The power required to drive the compressor is 375 kW. What is the mass flow rate of the air at the inlet, in kg/s?

(b) What is the entropy generation rate, in kW/K?

(c) Prove that the AIR can be modeled as an ideal gas at the exit state.

Problem 3 (27 points)



A piston-cylinder device contains air. Initially the air occupies 0.34 m^3 at 575 kPa and 167 °C. The air undergoes a constant-pressure heat transfer process until it reaches a temperature of 437 °C. Assume air is an ideal gas. Find the <u>direction</u> and <u>magnitude</u> (in kJ) of the heat transfer for this process.