UNIVERSITY OF CALIFORNIA
Mechanical Engineering

ME 40/Spring 2018
Prof.C.Fernandez-Pello

NAME_____

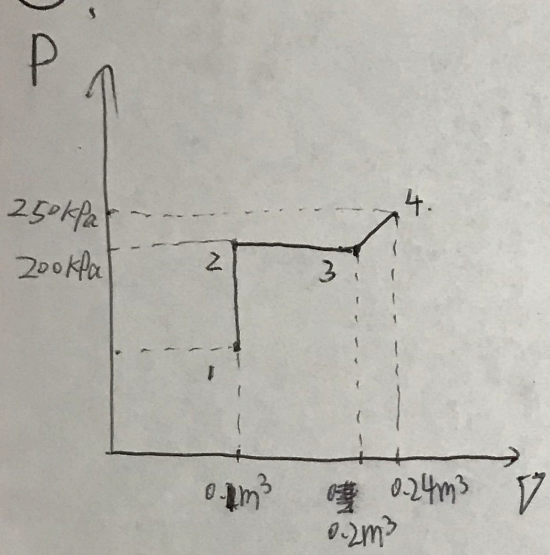
SID_____

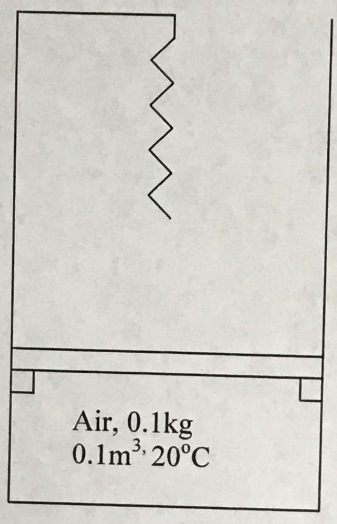
MIDTERM EXAMINATION #1 (2/28/2018)

1. Complete the following property table for H_20. All the cases are equally graded. Show your work; please indicate where the answer is from. No partial credit for numbers only.

T[C]	P[kPa]	v[m^3/kg]	u[kJ/kg]	h[kJ/kg]	x	State
30	100	0.001004	125.73	125.74	N.A.	Comp. liq.
150	476.16	0.2543	1878.71	2000	0.647	Sat. mix.
212.38	2000	0.0671	2040.4	2174.7	0.67	Sat. mix.
300	1000	0.25799	2793.7	3051.6	N.A.	Super. heat.
500	1000	0.35411	3125	3479.1	N.A.	Super. heat.
500	50	7.1338	3132.6	3489.3	N.A	Super. heat.

2. Consider the piston/cylinder configuration below with a frictionless piston of cross sectional area $0.2m^2$. The piston is initially resting on a set of stops such that the contained volume is $0.1m^3$ and the contained mass is 0.1 kg of air at a temperature of 20°C. Heat is added to the system until the piston begins to move. The piston cannot move until the pressure inside the volume reaches 200 kPa. At this point, the piston begins to move until it touches a linear spring and the enclosed volume is $0.2m^3$. The spring is pushed until the pressure is 250kPa and is deflected 0.2m. Assume air is ideal gas with constant specific heat, R = 0.287 kJ/kg·K, c_v = 0.718 kJ/kg·K, and c_p = 1.005 kJ/kg·K.





Find:

1. Final state of the air
2. Work done during the process
3. Heat transferred to the air
4. Draw a P-v diagram of the process

(4). P

(1) $P_4V_4 = mRT_4 \Rightarrow$

$V_4 = 0.24\ m^3$, $P_4 = 250kPa$

$T_4 = 2090.59\ K$

(2) $W_{1-4} = W_{1-2} + W_{2-3} + W_{3-4}$

$= 0 + P_2(V_3 - V_2) + \frac{P_3+P_4}{2}(V_4 - V_3)$

$= 200\ kPa \cdot 0.1m^3 + \frac{200kPa + 250kPa}{2}(0.04m^3)$

$= 29\ kJ.$

(3). $\Delta U_{1-4} = m c_v (T_4 - T_1) = 0.1kg \times 0.718\ kJ/kg\cdot K \times (2090.59K - 293K)$

$= 129.07\ kJ.$

$Q_{1-4} = \Delta U_{1-4} + W_{1-4} = 158.07kJ.$