

MIDTERM EXAMINATION #1 (2/27/2015)

NAME _____

This examination is open book and open notes.
Please write your name in the space provided above.
Please **BOX** your answers.

1. A mass of 1 kg water (H_2O) at $100^\circ C$ is contained in a cylinder-piston device with a volume of 1 m^3 . The piston is initially held in place by a set of latches so it cannot move. The latches break when the pressure inside the cylinder is 200 kPa at which point the piston moves at constant pressure. Heat is added to the device until the volume of the cylinder-piston is 3 m^3 .
 - a) Fill out the property table of the following states: (30%)
 1. at the initial state,
 2. when the latches break,
 3. at the final state
 - b) Sketch a P-v diagram of the process undergone by the system, including the saturation dome. (10%)
 - c) Find the work done by the system. (5%)
 - d) Find the heat added to the system. (15%)

Answers:

States \ Properties	P	T	v	u	x
	[kPa]	[C]	[m^3/kg]	[kJ/kg]	[-]
1	101.42	100	1	1667.1	0.598
2	200	166	1	2601.9	-
3	200	1027	3	4110.2	-

2. Now consider 1 kg of air at the same initial volume 1 m^3 , and same initial pressure as the water process above. Consider that air is an ideal gas with $c_v=0.718 \text{ [kJ/kg K]}$ and $R=0.287 \text{ [kJ/kg K]}$,

e) Find three properties of state at: (20%)

1. at the initial state,
2. when the latches break,
3. at the final state

f) Find the work done by the system. (5%)

g) Find the heat added to the system. (15%)

States \ Properties	P	T	v
	[kPa]	[C]	[m ³ /kg]
1	101.42	100	1
2	200	423.86 ✓	1
3	200	1817.6 ✓	3

3. Explain the reason for any differences in work done by the system and heat added to the system in cases 1 and 2.