EXAM # 1

INSTRUCTIONS:

This is closed book and closed notes exam. You are only allowed to use the basic equation sheet and property tables attached here, a pen/pencil, and a simple calculator.

Show your work clearly and follow the standard problem solving procedure for problems 2 and 3. Although you may not be able to complete the calculations for some of the problems, significant credit for problems 2 and 3 will be given if you complete the system sketch and list all assumptions, basic equations and methods by which you propose to solve the problem correctly.

Do not hesitate to ask the instructor if you do not understand a problem statement. For your own benefit, please write clearly and legibly. Work only on one side of each page. If you need extra space, work on the extra paper available, and clearly indicate problem to which the work refers. If you give multiple solutions, you will receive only a partial credit although one of the solutions might be correct. Delete the solution you do not want graded. Maximum credit for each problem is indicated below.

Important Note: The use of PDAs, iPads and other tablets, cell phones, laptop computers, or any other sources of communication (wireless or otherwise) are strictly prohibited during examinations. Doing so is cheating. If you bring a cell phone or other communication device to the examination, they must be turned off prior to the start of the exam, placed in your backpack, and the backpack stored below your seat, and only picked up as you leave the examination room for the final time. They are not to be turned on again until after you have exited the examination room. Otherwise it will be considered a form of cheating and treated as such.

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Problem 1: (30/100 points)
Each part of this problem is worth 6 points. There is no partial credit and your answer must be placed in the box. **Do not solve (c) and (e) as practice for Exam-1 in Fall 2013**

The standard problem solving procedure is not required for Problem 1, but you must support your answers by providing appropriate equations, tables, or charts. Without appropriate equations, tables, or charts, you will receive zero score although the answer may be correct.

(a) The pressure in a rigid tank of 0.1 m³ containing liquid water at 20°C is decreased from 10 atm to 1 atm. Estimate the work done by the system, in kJ.

(b) An object of 10 lbm is lifted by 10 feet. Which case will need more energy, on the earth or on the moon?

(c) In a piston-cylinder device containing air, can the state be changed from 1 to 2 at constant internal energy while producing work? Neglect kinetic energy and potential energy change.

(d) A mixture of water liquid and vapor in a container is compressed at constant volume. Will it be possible to compress the mixture to liquid?

(e) Determine if the following cycle is a power cycle or a refrigeration cycle.
Problem 2: (35/100 points)
Given: A well-insulated vertical piston-cylinder device contains air. The diameter of the piston is 8 inches. Atmospheric pressure of 14.7 lb/in$^2$ acts outside the cylinder and the piston mass is 165 lbm. An electric resistor within the cylinder receives a current of 1 A from an external battery of 10 V for a duration of 60 minute causing the piston to move upwards by 9.85 inches. Consider that changes in kinetic and potential energy of air are negligible and that the acceleration due to gravity $g = 32.2$ ft/s$^2$.

Do not solve (g) as practice for Exam-1 in Fall 2013

Find: (a) Draw the system sketch in the following space provided;
    (b) Draw qualitatively the process for air on the P-v diagram provided and label the initial state as 1 and the final state as 2;
    (c) Calculate the pressure of air inside the cylinder before the piston moves, in lb/in$^2$;
    (d) Calculate the work due to expansion of air in the cylinder, in Btu;
    (e) Indicate whether the work is done by the system or on the system used for part (d);
    (f) Determine the electrical work from the resistor, in Btu;
    (g) Calculate the change in internal energy of air, in Btu.

System sketch:
(a) 
(b) 

Assumptions:

Basic equations:
Last Name: ___________________  First Name: ___________  Middle Initial: ______

Solution:
(c)
Problem 3: (35/100 points)

Given: A piston-cylinder assembly contains 0.5 kg water-vapor mixture with 80.8% of quality and 2 bar (state 1). The piston is initially resting on a set of stops. Then, the cylinder is heated from an external heat source until the piston head just starts to move at a pressure of 0.3 MPa (state 2). Now the volume increases with an additional heat addition from the heat source until the specific internal energy (u₃) of the final state reaches 3030.6 kJ/kg (state 3). (Neglect the changes in kinetic and potential energy. Do not interpolate and use the closest table value) Unless stated clearly in problem, interpolation will be required when necessary!

Do not solve (f) as practice for Exam-1 in Fall 2013

Find:  
(a) Mark the system boundary to be used for process 2-3 in the system sketch provided and show heat and work through the system boundary;  
(b) Draw approximately the processes for the water-vapor mixture on the P-v diagram provided and label the states on the diagram;  
(c) Determine the specific internal energy at state 1 and state 2, respectively, in kJ/kg;  
(d) Calculate the final volume (V₃) of the piston-cylinder assembly, in m³;  
(e) Find the total work produced by the system, in kJ;  
(f) Calculate the total heat addition to the system, in kJ.

System sketch:

(a)  

(b)

Assumptions:

Basic equations:
Solution:
(c)
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