Roster #_____

Thermodynamics I

ME 513

Exam Two – Extra Credit

Due: October 30, 2019 – 8:30 AM

Name:_____

People I worked with to complete this extra credit (if applicable):_____

_____

_____

The following extra credit assignment has the same rules that apply to homework. You are encouraged to work with others, but the work you submit must represent knowledge you have gained by yourself or through a collaborative process. (Don't put something down because "That is what someone else had"! Be able to support all of your work!)

Posting problems from this exam on Chegg and asking for help from that community will be considered a violation of the honor code and will result in an XF.

You must show all your work **AND BOX YOUR ANSWERS**. Each problem will be graded with no partial credit for each part of the problem. Points will be awarded as indicated in the () near the problem statement. Note: Correct means that your answer has the correct numerical value, sign and units.

Points:

Page 1._____/1

Page 2._____/1

Page 3._____/1

Page 4._____/1

Total = _____/4

1. Air contained in a rigid, insulated tank fitted with a paddle wheel, initially at 27°C, 2 bar, and a volume of 2 m^3 is stirred until its temperature is 227°C. Assuming ideal gas behavior for the air determine:
    a. (0.1) The final pressure, in bar.
    b. The paddle wheel work (with appropriate thermodynamic sign), in kJ

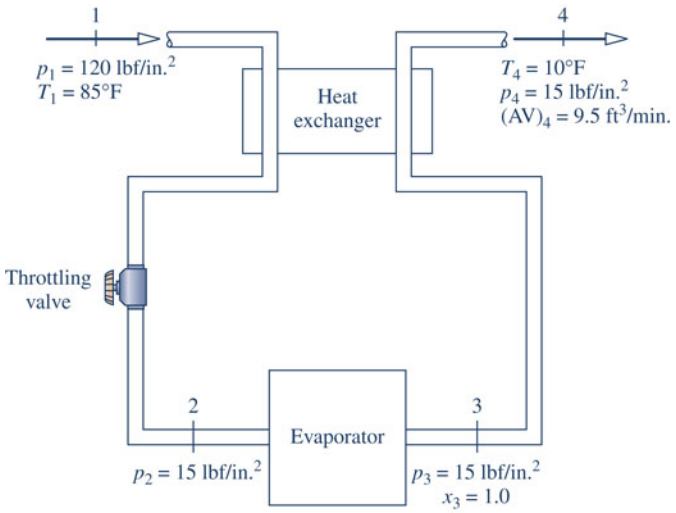
Assuming:	**Work (kJ)**
(0.4) Variable Specific Heat	
(0.4) Constant Specific Heat	

(0.1) Without completing a calculation, if the system was no longer an insulated rigid tank but rather an insulated piston-cylinder between the same two temperatures, would your answer for total work be higher, lower, or the same? Why?

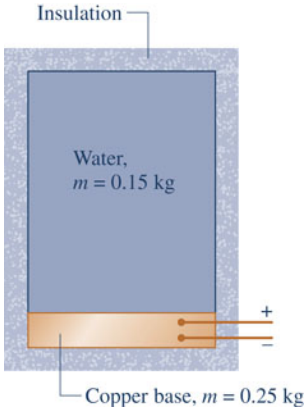
2. (0.7) Air at 400 kPa, 707°C enters a turbine operating at steady state with a volumetric flow rate of 0.35 m^3/s and exits at 100 kPa, 397°C. Heat transfer from the turbine occurs at a rate of 30 kJ per kg of air flowing. Assuming the air is modeled as an ideal gas with variations in specific heat determine the rate of power developed, in kW.

3. (0.3) Carbon Dioxide in a closed system undergoes an isothermal process from a pressure of 5 bar, specific volume of 1 m^3/kg to a pressure of 1 bar, specific volume of 5 m^3/kg. What is the work per unit mass, in kJ/kg?

4. The figure shows a refrigeration system consisting of a heat exchanger, an evaporator, a throttling valve, and associated piping. Data for steady-state operation with Refrigerant 134a are given in the figure. There is no significant heat transfer to or from the heat exchanger, valve, or piping. Kinetic and potential energy effects are negligible. Determine:
   a. (0.3) The mass flow rate at state 1 in lb/hr
   b. (0.7) The rate of heat transfer between the evaporator and its surroundings, in Btu/hr



5. (0.7) As shown in the figure, a closed, insulated tank contains 0.15 kg of liquid water and has a 0.25 kg copper base. The thin walls of the container have negligible mass. Initially, the tank and its contents are all at 30°C. A heating element embedded in the copper base provides 12 kJ of energy to the copper. Determine the final temperature in °C for the tank and its contents.



6. (0.3) Can carbon dioxide at 47°C and 55 bar be considered an ideal gas? Show steps that indicate your process for determination.