CHEM 132A LEC A (40758)

Midterm 1 (Fall Qtr 2017) - LETTER SIZE

8076 (3770)

Assigned Seat#:_____

Instructions to Instructor:

Do not alter this coversheet in ANY way. Substantial delays and additional fees may apply.

Instructions to Student:

1. Clearly print your Last Name, First Name and the Date
2. Clearly print your Student ID number in the boxes provided. Use large, dark numbers. These numbers are captured automatically during the scanning process.
3. Bubble in each number of your Student ID completely. The bubbles are used only if your written ID number is not captured.
4. Write your Name and Student ID number in the upper right corner of all following pages of your exam.

Last Name, First Name: _____ Date: ____/____/____

STUDENT ID: *For Access UCI student, leave first column blank then enter your 7-digit Student ID number.*

	_____	_____	_____	_____	_____	_____	_____	_____	
1	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	4
5	0	0	0	0	0	0	0	0	5
6	0	0	0	0	0	0	0	0	6
7	0	0	0	0	0	0	0	0	7
8	0	0	0	0	0	0	0	0	8
9	0	0	0	0	0	0	0	0	9
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Graded by: _____ Total Correct: _____

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1. a 10 points
For each of the following indicate if it is an **intensive** or **extensive** property.

Property	**intensive or extensive?**
Volume	_____
Mass	_____
Entropy	_____
Ratio of mass to volume (density)	_____
Internal Energy	_____
Pressure	_____
Temperature	_____
Gibbs free energy	_____
Helmholtz free energy	_____
Constant pressure heat capacity	_____

1.b. 10 points
Indicate whether the indicated properties are state functions or not

Function	State function or not?
Temperature	_____
Gibbs free energy	_____
Work	_____
Heat	_____
Entropy	_____

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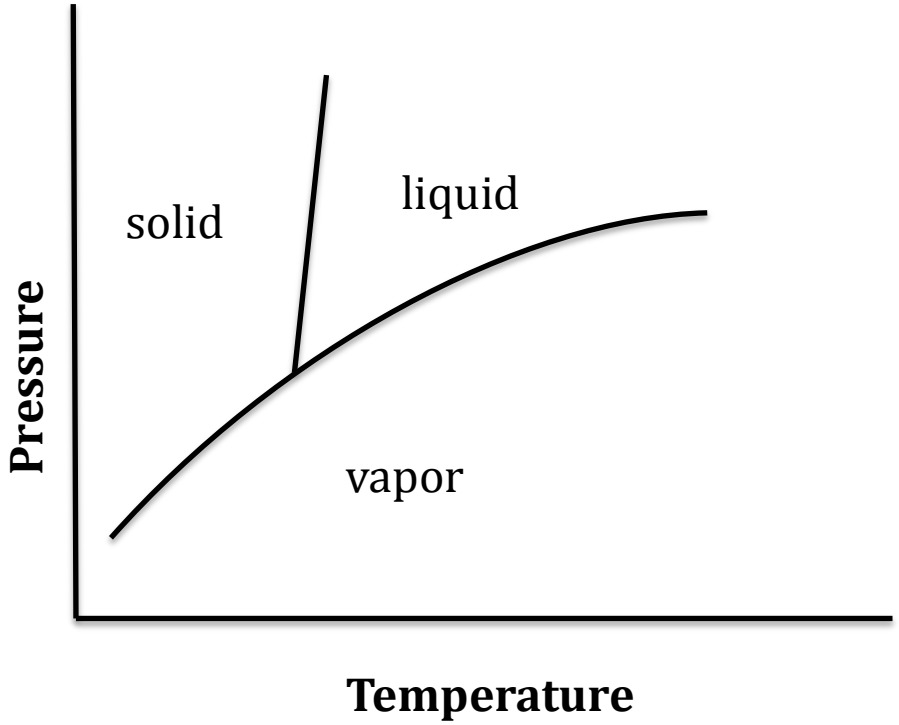
2. 10 points



Consider the phase diagram shown above.

Is the difference in molar volumes [V_m(liquid) – V_m(solid)] positive or negative. State clearly how you arrive at your answer. A simple "positive" or "negative" without any explanation will receive no credit.

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3. 25 points

a. Reversible Work:
Consider a reversible, constant temperature process.
Starting from the definition of the Helmholtz Free Energy, show that the Helmholtz Free Energy is equal to the reversible work for the process.

b. Maximum Work for Propane Combustion:

Consider the reaction associated with the combustion of propane:
$C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$
Note that as written this reaction is not balanced—you should balance it.

Assuming propane is an ideal gas and a constant temperature of 298K, compute the maximum work that can be obtained from the combustion of propane:

Given at 298K:

$\Delta G_{rxn}^0 = -2108$ kJ/mol R = 8.314 J/mol•K

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4. 25 points

Consider the following diagram for one mole of a gas. For this system, all processes are done reversibly and the Internal Energy of the gas is only a function of temperature.

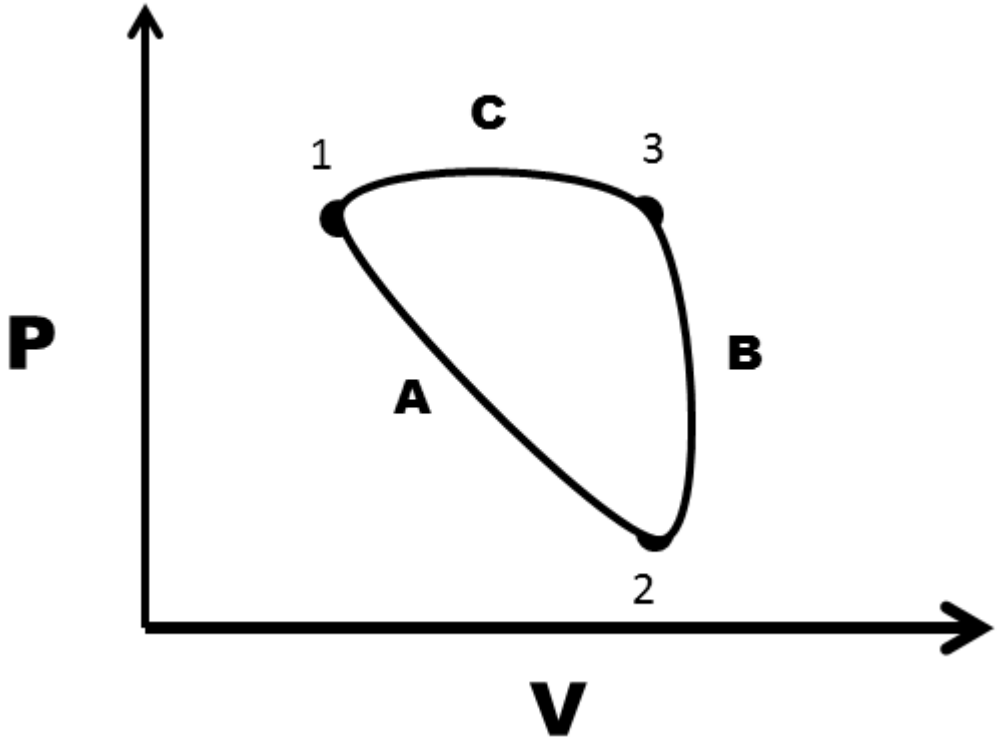

Figure 1: Point 1: (P1,V1,T1), Point 2: (P2,V2,T1), Point 3: (P1,V2,T3).

Consider only pV work. Calculate the Internal Energy (ΔU) , the Entropy (ΔS), the Heat (q), and the work (w) associated with pathways A,B, and C. Comment: Be sure to algebraically simplify each step as much as possible. Label all variables with associated pathway and points.

PUT YOUR ANSWER ON THIS PAGE AND THE NEXT BLANK PAGE.

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5. 20 points

Consider the combustion of ethanol under constant pressure conditions (1 atm) and at a temperature of 370K. The balanced reaction for this combustion is shown below. Use the data provided here to calculate the ΔH_{rxn}(370K).

$CH_3CH_2OH(gas) + 3\ O_2(gas) = 2\ CO_2(gas) + 3\ H_2O(liquid)$

For ethanol (**liquid)** the following data are available

$\Delta H_f^0(298K) = -277.69 kJmol^{-1}$

$\Delta H_{vap}^0 = 38.6 kJmol^{-1}$

Normal boiling point of ethanol = 351.45K

C_p(ethanol liquid) = 111.46 $JK^{-1}mol^{-1}$

C_p(ethanol gas) = 65.44 $JK^{-1}mol^{-1}$

For O_2(gas): C_p = 29.355 $JK^{-1}mol^{-1}$

For CO_2(gas)

$\Delta H_f^0(298K)$ = –393.51 $kJmol^{-1}$

C_p = 37.11 $JK^{-1}mol^{-1}$

For H_2O (liquid)

$\Delta H_f^0(298K)$ = -285.83 $kJmol^{-1}$

C_p = 75.291 $JK^{-1}mol^{-1}$

Show your reasoning and your work. Simple numerical answers will receive no credit. **Clearly indicate any assumptions you make.** You can continue your answer on the next blank page if necessary.

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5. Extra page for your answer to problem 5.