CHEM 132A LEC A (40758)

Midterm 2 (Fall Qtr 2017) - LETTER SIZE

8158 (3821)

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
0	0	0	0	0	0	0	0	0	0

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Graded by: _____ Total Correct: _____

1._____ 2._____ 3._____ 4_____

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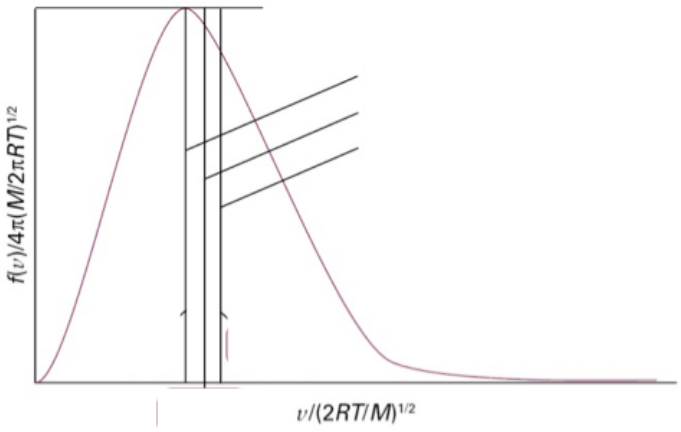
1. a 10 points
For each of the following indicate if it is an **intensive** or **extensive** property.

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. 5 points. Which gas has a higher **thermal conductivity**, He or Ar? Briefly explain why.

1c. 5 points. The figure below shows the Boltzmann speed distribution f(v) for a gas. CLEARLY label on the figure the v_{mp}, v_{mean}, and v_{rms}.



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2 **(30 points total for question 2)**
Non-Ideal Liquid Mixture

Consider the mixing of two non-ideal liquids; species 1 and species 2 respectively.

Section 2.1

Because our system is no longer ideal, what are the two most important assumptions that we use for ideal solutions, that we can no longer make about the mixing process?

Section 2.2

Analogous to the Ideal Mixing Equation, we should define the Gibbs Free Energy of a non-ideal solution to be

$$\Delta_{mix}G = nRT\ (x_1 \ln(a_1) + \ x_2 \ln(a_2))$$

Starting from this equation, show that

$$\Delta_{mix}G = nRT\ (x_1 \ln(x_1) + \ x_2 \ln(x_2) + \ \beta x_1 x_2)$$

Assume:
$\ln(\gamma_1) = \beta x_2^2$
$\ln(\gamma_2) = \beta x_1^2$

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Section 2.3

Starting from the fundamental equation for Gibbs Free Energy, determine the appropriate derivative that gives the Entropy (assume constant pressure).

Section 2.4

Assuming the variable β (defined above) is linearly proportional to temperature (i.e. β = cT) where c is a constant, develop an equation for the Entropy of Mixing, in terms of x_1 , x_2, c, and T.

Section 2.5

From the definition of the Gibbs Free Energy, develop an equation for the Enthalpy of Mixing in terms of x_1, x_2, T, and β (assume there is no change in temperature due to mixing).

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3 **(30 points total for question 3)**

Consider the reaction for methanol :

$2H_2$(g) + CO(g) → CH_3OH(g)

Section 3.1

Standard Gibbs values for the compounds are as follows :

$\Delta_f G^o$(kJ/mol) CH_3OH(g) = -161.96
$\Delta_f G^o$(kJ/mol) CO(g) = -137.17
$\Delta_f G^o$(kJ/mol) H_2(g) = 0

Calculate the standard Gibbs free energy of the reaction ($\Delta_{rxn} G^o$).

Section 3.2

Calculate K_P for the reaction at 298K.

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Section 3.3

For the following pressures : P_{CH_3OH}= 10 Bar , P_{CO}= .005 Bar , P_{H_2}= .10 Bar , write the expression for and calculate Q.
Based on the calculated Q and K_P in what direction will the reaction proceed to reach equilibrium (briefly explain your reasoning, not just a single word)?

Section 3.4

Calculate the Gibbs free energy for the calculated Q.

Section 3.5

Consider the general chemical reaction:

bB + dD → eE + gG

What is the relationship between K_P , K_γ, and K_f, in terms of this reaction?
Under what conditions does K_P approximately equal K_f and why?

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4. **(20 points)**
The Debye-Huckel Limiting Law states:

$$\log \gamma_{\pm} = -0.509 \left| z_{+} z_{-} \right| I^{1/2}$$

Section 4.1
Calculate the mean activity coefficient of a solution that is 5.0 mmol/kg of KCl in water at 25°C. KCl is a very soluble salt.

Section 4.2
Calculate the mean activity coefficient of a solution that is 1.00 mmol/kg of $CaCl_2$. $CaCl_2$ is a very soluble salt.

Section 4.3
If you did the calculations in question 4.1 and 4.2 correctly you would see that the 5.0 mmol/kg KCl solution is more ideal the 1.00 mmol/kg $CaCl_2$ solution, even though the $CaCl_2$ solution is more concentrated. What is the simple explanation for this.