Chemistry 20B Exam 2, Spring 2020

"We w*ould like to thank all students for their understanding, a*s we *navigate this unprecedented situation. In addition, the universit*y w*ould like to remind students about their obligations under the UCLA Student Conduct Code: https://www.dean of students.ucla.edu/Individual-Student-Code*"

INSTRUCTIONS:

Due: Friday May 22 at 11:59pm on Gradescope as a scanned pdf Remember to use the "Assign Pages" feature when submitting to Gradescope Please highlight or circle your answer for each part of the exam The exam is open book, open note and collaborative Please start each problem on a new page Please write your name, UID and problem number on each page For questions please email myself or the TAs. We will try to respond quickly. I will email out any announcements and post them on CCLE and Questionsly

(i) BE SURE TO SHOW ALL YOUR REASONING AND CALCULATIONS. CORRECT ANSWERS WITHOUT PROPER ARGUMENTS WILL BE MARKED WRONG
(ii) BE CAREFUL WITH UNITS: NEVER GIVE A NUMERICAL ANSWER WITHOUT UNITS
(iii) PLEASE CROSS OUT ANY WORK YOU DO NOT WANT US TO GRADE

1. 100 mole of a monatomic ideal gas are held inside of a balloon at 1 atm and 20°C. If the balloon is contacted with a 100 gram piece of ice at 0°C. (i) determine the equilibrium state for the balloon (*P. V.T*) and the water (*T. Phas*e) assuming they are insulated from their surroundings and that the balloon will adjust its internal pressure back to 1 atm. (ii) Show that the system coming to equilibrium is spontaneous. The standard enthalpy change of fusion for water is 333Jg- and the specific heat for water is 4.2 *Jg='K*-!

2. The chemical reaction Ale) + *2B* = 3C e has a standard enthalpy change of 10*Jmol* and a standard entropy change of 2*.7mollk*at 298K. (i) Determine, using the second law of **thermodynamic**s, whether the forward

reaction is spontaneous if it is carried out under standard conditions in a room at 298K and latm. (ii) Determine, using the Gibbs free energy change. whether the forward reaction is spontaneous if it is carried out under standard conditions in a room at 298K and latm. (ii) Determine whether the forward reaction is spontaneous if it is carried out at 298K with the following initial partial pressures, *P.* = *P* = 0.25a*im,* P = 0.5*atm.*

3. Show that the isothermal free expansion of an ideal gas into a vacuum, an expansion against no (zero) external pressure, is spontaneous. Be sure to show your FULL reasoning.

4. The chemical reaction 2A,) + *B* = C) has a standard enthalpy change of 2*k Jmol-'* and a standard entropy change of 4*Jmol-'K*-1 at 300K. Determine the **maximum concentration** of C that can be present in the sealed container at the onset of the reaction so that the forward reaction is spontaneous if the initial concentrations of A and B are both IM.

5. The chemical reaction Ag) + *B*) = C occurs in a sealed container at 600K. (i) If the reaction has a standard enthalpy change of 5*kJmol*-1 and a standard entropy change of 2*0Jmol*-'K-1 at 600K, and the final pressure inside the container is 15 atm, determine the equilibrium partial pressures of A and B if there is less A at equilibrium. (ii) Determine the spontaneous direction for the reaction under standard conditions at 600K. (iii) Determine which direction the reaction will proceed spontaneously at 600K if the partial pressures of A and B are 1 atm and 0.01 atm, respectively.