Chemistry 14B: Week 7 Workshop Midterm Review UA: Kate Santoso

Q1. ATP hydrolysis, ATP + $H_20 \rightarrow$ ADP + HPO_4^{2-} , is a highly exergonic reaction that provides the energy necessary for most endergonic biological processes to occur. $\Delta G^{\circ} = -30.2 \text{ kJ/mol.}$

a) Calculate the equilibrium constant for ATP hydrolysis at 25°C.

b) If the concentration of ATP is adjusted to four times its equilibrium concentration, what is the value of ΔG ?

Q2A. Calculate the work, in kJ, associated with the isothermal, reversible expansion of 1.00 mol of an ideal gas from 7.00 L to 15.50 L at 25.0°C.
Q2B. Calculate the work, in kJ, associated with the irreversible adiabatic expansion of the
sample of gas described in part A against a constant atmospheric pressure of 760. Torr.
O2C Calculate the final temperature of the gas in part D
Q2C. Calculate the final temperature of the gas in part B.

Q3.

a) The photosynthesis of glucose inside the chloroplast of an old growth Coastal Redwood tree.

$$\Delta G < 0$$
 $\Delta G = 0$ $\Delta G > 0$

b) The cooling of a hot bowl of soup after being removed from the microwave.

$$\Delta G < 0$$
 $\Delta G = 0$ $\Delta G > 0$

c) The rusting of an iron fence as it is left outside over time.

$$\Delta G < 0$$
 $\Delta G = 0$ $\Delta G > 0$

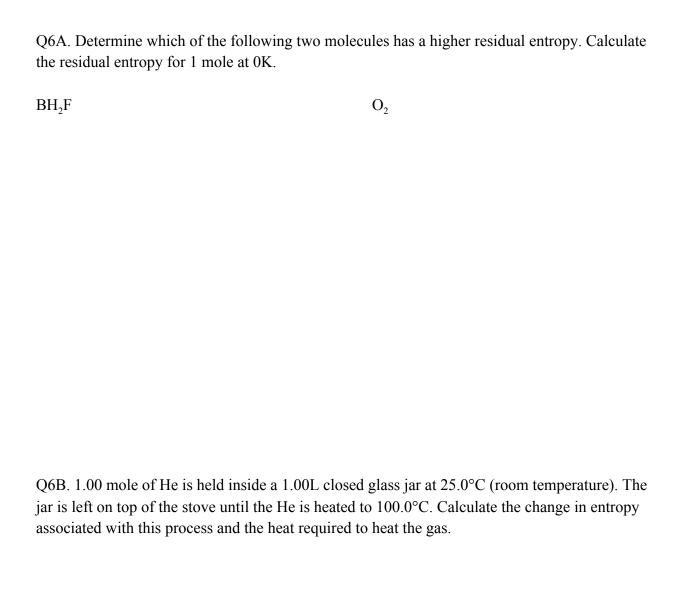
Q4. Calculate the change in molar Gibbs free energy for the process NH $_3$ (I) \rightarrow NH $_3$ (g) at 1 atm and (a) -15.0 °C and (b) -45.0 °C. In each case, indicate whether vaporization would be spontaneous. $\Delta H_{vap} = 23.4$ kJ/mol, $\Delta S_{vap} = 97.6$ J/K*mol

Q5. The compound P_4O_{10} is often used to adsorb water vapor in dry boxes by the following reaction: $6H_2O(g) + P_4O_{10}(s) \rightarrow 4H_3PO_4(s)$

	ΔS° (298K) J/K*mol	$\Delta H_{\rm f}^{\circ}$ (298K) kJ/mol
$H_3PO_4(s)$	110.5	-1279
$P_4O_{10}(s)$	228.9	-2984
$H_2O(g)$	188.7	-241.8

a) Calculate ΔG° and K at 25.0°C and decide whether the reaction is spontaneous in the forward direction.

b) The P_4O_{10} (s) is regenerated by heating the H_3PO_4 (s) and removing the water. To what temperature should the H_3PO_4 (s) be heated (i.e. at what temperature does the reaction become spontaneous in the reverse direction)? What assumption are you making to solve this problem?



Q7. A student leaves a bowl of 56 grams of ice cream sitting out in the hot sun. The heat completely melts the ice cream and raises its temperature to 30.0°C. Assuming that the ice cream was initially completely solid and at its freezing point (0.0°C), how much energy was supplied to the ice cream?

Enthalpy of fusion of ice cream = 210. J/g; Specific heat capacity of liquid ice cream = 3.1 $J/g*^{\circ}C$