CHMY 361 **HOMEWORK #4** **HANDOUT#6**

October 23, 2018 12:45 pm
6 problems on 2 pages
This contains the previously announced updates + a more proper notation for the solute concentrations in problem 4.

Due Friday, Oct. 26

	$\Delta_f H^o$ kJ/mol	$\Delta_f G^o$ kJ/mol
HCl(g)	-92.31	-95.3
HCl(aq)	-167.16	-131.23

1. (a) From the values of $\Delta_f G^o$ and $\Delta_f H^o$ in the above table, what is the Henry's Law constant (i.e., equilibrium constant or partition coefficient) for ***dissolving*** HCl(g) in water at 25 ^oC. and 100 ^oC. What units does this equilibrium constant have?

(b) From your answer in (a) at 25 ^oC , what would the value be in units of bar/mol fraction, as in Table 6.1?

(c) Compare the ΔH^o for that for "dissolving H_2O(g) in liquid water", and briefly give a reason for the difference.

2. A 150 lb person contains about 50 L of water (about 4/5 of which is intracellular).
Assuming all of this water is saturated with dissolved N_2 gas after having spent way too much time at a depth of 40 m in ocean water, how many liters of N_2 gas would be released as bubbles if the person quickly came to the surface according to Henry's Law at 37° C? (Note, you will have to convert meters of sea water (density = 1.025 kg/L) to bars, knowing that 0.76 meters of mercury = 1 atm, and density of Hg = 13.56 g/mL)

3. Consider a $1x10^{-6}$ M polymer solution inside a dialysis bag that is permeable to the ligand, A, but not to the polymer. The following measurements of the free ligand outside the bag and total ligand inside the bag are measured at equilibrium. The units are M.
From a Scatchard plot find K_d for the binding of A to its binding sites on the polymer and the number of binding sites per polymer molecule. (the notation 5E-07 means 5 x 10^{-7}, etc.

Aout	Ain tot
1.429E-08	1.014E-06
3.333E-08	2.033E-06
1.000E-07	4.100E-06
7.900E-06	1.580E-05

4. The partition coefficient of solute B between liquids X and Z, $K_{XZ} = ([\mathbf{B_Z}]/[\mathbf{B_X}])_{eq}$ = approximately zero. (it is not measureable)

The following partition coefficients are known, however: $[\mathbf{B_Y}]/[\mathbf{B_X}] = 1x10^{-4}$ and $[\mathbf{B_Y}]/[\mathbf{B_Z}] = 1x10^{6}$

Is it possible to find K_{XZ} with this knowledge? If so, then what is its value?
If not, explain why it cannot be done.

5. Suppose there are bacteria in a Yellowstone **hot** spring that is very acidic and that it can be determined that the ***difference in pH*** between the intermembrane and the interior of the mitochondrion is 5 pH units, with the interior have the higher pH. In addition, the intermembrane space has an electric potential that is 100 mV more positive than that of the interior.

(a) What is the chemical potential difference ($\Delta\mu$) for H^+(intermembrane space) --> H^+(interior) for this mitochondrion?

(b) Calculate the ΔG if a total of 4 moles of protons are transferred.

(c) What is the maximum number of moles of ATP that could be obtained in this system from ADP and P at pH 7 when 4 moles of protons are transferred if [ATP]/[ADP] = 2.0 and [P] 0.003 M?

6. Parts of the Great Salt Lake are about 0.7 M in NaCl, and exhibit an osmotic pressure of 500 bar at 298 K. Using this number:
(a) what is the activity of water in this solution at 298 K?
(b) what is the vapor pressure of this solution at 298 K?
(c) what is the melting point of this solution, assuming the activity is the same as at 298?
(d) what is the boiling point of this solution, assuming the activity is the same as at 298 K?