CHMY 361 **HANDOUT#6**
October 19, 2017
6 problems on 2 pages **HOMEWORK #4**

Due Thursday, Oct. 26

1. (a) From numbers Table 6.1, what is the Henry's Law constant (i.e., equilibrium constant or partition coefficient) for ***dissolving*** $N_2(g)$ in water at 25°C. What units does this equilibrium constant have?

(b) Do the same as (a) at 37°C

(c) From (a) and (b), calculate ΔH^o and ΔS^o for the process of dissolving $N_2(g)$ in water.

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

2. Although not nearly as common as from returning from depth in water, symptoms of "the bends" have been reported by airplane passengers flying for a length of time above 18000 ft in an unpressurized cabin. (pains in the joints).

A 115 lb person contains about 40 L of water (about 4/5 of which is intracellular).
Assuming all of this water is saturated with dissolved N_2 gas, according to Henry's Law, how many liters of N_2 gas would be released from this person's water if suddenly exposed to the air pressure at 18,600 ft = 0.5 bar at 37° C?

3. Consider a $1x10^{-5}$ 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.

$[A]_{out}$	$[A]_{in}$ total
5.00E-06	5.05E-05
1.00E-06	4.31E-05
2.00E-07	1.00E-05

4. The partition coefficient of solute B between water and ethanol cannot be directly measured because water and ethanol are completely miscible.
(a) Calculate this partition coefficient **B(ethanol)])/ ([B(aq)]** if the solubility of B in water = 0.20 M and the solubility of B in ethanol = 0.010 M at 25° C.
From the data in (a), calculate the following:
(b) What is ΔG^o for the process B(ethanol)-->B(aq)?
(c) What is ΔG^o for the process B(ethanol) --> B(s)?

5. Suppose in certain mitochondria, the oxidation of glucose products pumps protons into the intermembrane space between the double membrane to reach a pH of 4.5. In the interior of the mitochondrion, the pH is 7.5. In addition, the intermembrane space has an electric potential difference of +67 mV relative to the interior.

ATP is synthesized from the combined Gibbs energy change per mol of protons ($\Delta\mu$) flowing down the concentration gradient from the intermembrane space (out) to the interior (in) and from the change of electrical free energy coming from the voltage difference.

(a) What is $\Delta\mu$ for H^+(out) --> H^+(in) for this mitochondrion?

(b) Calculate the ΔG if a total of 3 moles of protons are transferred.

(c) What is the maximum number of moles of ATP that can be obtained from ADP and P at pH 7 when 3 moles of protons are transferred if [ATP]/[ADP] = 3.0 and [P] 0.004 M?

6. The vapor pressure of an aqueous solution is found to be 2500.0 bar at 298 K. Using this number:
(a) what is the activity of water in this solution at 298 K?
(b) what is the osmotic pressure of this solution at 298 K, given that for pure water it is 3300 Pa?
(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?