CHM 51-Dang **Chapter 16 – Homework** **Name**

Due Thursday 11/19/2020

1. Predict the sign of ΔS in the system for each of the following reactions

a. $PCl_5(s) \rightarrow PCl_3(l) + Cl_2(g)$

b. $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l)$

c. $2H_3O^+(aq) + CO_3^{2-}(aq) \rightarrow CO_2(g) + 3H_2O(l)$

2. Use the data from the appendix in the back of your book to calculate ΔS^o_{sys}, ΔS^o_{surr} and ΔS^o_{total} at 25°C for the reactions. Is the reaction spontaneous under standard-state conditions at 25°C?

a. $N_2(g) + 2O_2(g) \rightarrow N_2O_4(g)$

3. Use the standard entropy to calculate ΔS^o_{surr} and ΔS^o_{univ} and Gibs free energy ΔG^o for the following reaction at 25°C.

$C_3H_8(g) + 5\ O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$

Determine the at what temperature will the reaction become spontaneous or nonspontaneous or NEVER

4. Use the standard free energies of formation (G^o_f) to calculate the ΔG^o (in kJ) for the following reactions
   a. $CH_3OH(l) + O_2(g) \rightarrow HCO_2H(l) + H_2O(l)$

5. Calculate ΔG for the Haber process at 365 K for a mixture of 1.5 atm N_2, 4.5 atm H_2 and 0.75 atm NH_3
   $N_2(g) + 3H_2(g) \rightleftharpoons 2\ NH_3(g)$

6. At 25°C, K_a for acid dissociation of aspiring ($C_9H_8O_4$) is 3.0×10^{-4}. Calculate ΔG^o for the reaction
   $C_9H_8O_4\ (aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_8H_7O_4^-(aq)$

7. Consider the dissolution of AgBr in water at 25°C
   $AgBr(s) \rightleftharpoons Ag^+(aq) + Br^-(aq)$

   a. Use the standard heats formation and standard molar entropies to calculate ΔG^o for the reaction

b. Calculate K_{sp} for AgBr at 25°C

c. Calculate ΔG for the dissolution of AgBr at 25°C when $[Ag^+] = [Br^-] = 1.00 \times 10^{-5}$ M
Is your result consistent with the relative values of Q and K_{sp}

8. If ΔG°_f for gaseous bromine is 3.14 kJ/mol at 25°C above bromine solid, what is the vapor pressure of bromine? (Hint: write the chemical equation for the sublimation of bromine solid)