CHEM 2811(01) Winter 2008. CHAPTER 4.

1. **Figure out the driving force for following reactions**.

   a) $3NaOH + H_3PO_4 \text{ ---> } Na_3PO_4 + 3H_2O$

   b) $Na_2CO_3 + 2HCl \text{ ---> } H_2O + CO_2(g) + 2NaCl$

   c) $NH_4Cl + NaOH \text{ ---> } NH_3(g) + H_2O + NaCl$

   d) $Na2SO_4 + Pb(NO_3)_2 \text{ ---> } PbSO_{4(s)} + 2NaNO_3$

   e) $Zn + 2HCl \text{ ---> } ZnCl_2 + H_2$

2. **Identify the conjugate acid/base pairs in following reactions.**

   a) $HF(aq) + H_2O \text{ ---> } H_3O^+(aq) + F^-(aq)$

   b) $H_2O(l) + NH_3(aq) \text{ ---> } OH^-(aq) + NH_4^+(aq)$

   c) $H_2Fe(CO)_4 + CH_3OH \text{ ---> } [FeH(CO)_4]^- + CH_3OH_2^+$

   d) $NH_3 + H_2S \text{ ---> } NH_4^+ + HS^-$

3. **Identify the conjugate bases corresponding to the following acids:,**
   (a) $[Co(NH_3)_5(OH_2)]^{+3}$
   (b) HSO_4^{2-}
   (c) CH_3OH
   (d) $H_2PO_4^-$
   (e) $Si(OH)_4$
   (f) HS^-
   (g) $[Fe(OH2)6]^{2+}$

4. **For each of the following processes, identify the acids and bases involved and characterize the process as complex formation or acid–base displacement. Identify the species that exhibit Brønsted acidity as well as Lewis acidity.**
   a) $SO_3 + H_2O \rightarrow HSO_4^- + H^+$
   b) $CH_3[B_{12}] + Hg^{2+} \rightarrow [B_{12}]^+ + CH_3Hg^+$ (B_{12} designates the cobalt macrocycle vitamin B_{12})
   c) $KCl + SnCl_2 \rightarrow K^+ + [SnCl_3]^-$
   d) $AsF_3(g) + SbF_5(l) \rightarrow [AsF_2]^+[SbF_6]^-(s)$

5. **A acid HB is dissociating according to the following equation in water.**

   $HB(aq) \text{ <--- } H^+(aq) + B^-(aq)$

   A solution of HB was prepared by dissolving 1.00 mol of HB in 1 liter of water. After the equilibrium is established HB was found to be 20% dissociated. Calculate K_a and pK_a for the acid HB.

6. **Arrange the following compounds in order of increasing acidity:**

   HI (pK_a = -11), H_2CO_3 (pK_a = 6.37), H_2SO_3 (pK_a = 1.81), HCN (pK_a = 9.31)

7. **Explain the trend shown by following binary acids in water:**

	HF	HCl	HBr	HI
pK_a	+3	-7	-9	-11
	NH_3	H_2O	HF	
pK_a	+33	+14	+3	

8. **Which acids of the following pairs of acids is the stronger acid?**

   a) $[Fe(OH_2)_6]^{3+}/[Fe(OH_2)_6]^{2+}$

   b) $Al(OH_2)_6^{3+}/Ga(OH_2)_6^{3+}$

   c) $Si(OH)_4/Ge(OH)_4$

   d) $HClO_3/HClO_4$

   e) $H_2CrO_4/HMnO_4$

   f) H_3PO_4/H_2SO_4

   g) H_2SO_4/H_2SeO_4

   h) $HIO_4/HClO_4$

9. **Which of the following elements form oxide polyanions and which forms oxide polycations? Al, As, Cu, Mo, Si, B, Ti**

10. **Identify the Lewis acids and bases in following reactions:**

    a) $BrF_3 + F^- \text{---> } BF_4^-$
    b) $BF_3 + NH_3 \text{---> } F_3B\text{-}NH_3$
    c) $FeCl_3 + Cl^- \text{---> } FeCl_4^-$
    d) $I^- + I_2 \text{---> } I_3^-$
    e) $(SnCl_3)^- + (CO)_5MnCl \text{---> } (CO)_5Mn\text{-}SnCl_3 + Cl^-$

11. **Explain why Na^+ prefers F^- to I^- where as Cu^+ prefers I^- to F^-.**

12. **Consider the Lewis acids $(CH_3)_3Al$ and $(CH_3)_3Ga$ and the Lewis bases $(CH_3)_3N$, $(CH_3)_3P$, and $(CH_3)_3As$.**
    $(CH_3)_3Al$ will react most favorably with _____.
    $(CH_3)_3Ga$ will react most favorably with _____.

13. **Explain the reaction sequence given below in terms of hard and soft Lewis acid-base behavior:**

$$R_3SiNC \xrightarrow{AgCl} R_3SiCl \xrightarrow{AgF} R_3SiF$$

14. **Explain why HF acid is used to make marks and dissolve glass.**

15. **Which of the following metal expected to be found in alumino silicate minerals and which in sulfides? Cd, Rb, Cr, Pb, Sr, Pd**