CHEM 281(01) SPRING 2017. HOMEWORK 7. CHAPTER 4.

1. Figure out the driving force for following reactions.

a) $3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$

b) $Na_2CO_3 + 2HCl \rightarrow H_2O + CO_2(g) + 2NaCl$

c) $NH_4Cl + NaOH \rightarrow NH_3(g) + H_2O + NaCl$

d) $Na2SO_4 + Pb(NO_3)_2 \rightarrow PbSO_4(s) + 2NaNO_3$

e) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

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

a) $HF(aq) + H_2O \rightarrow H_3O^+(aq) + F^-(aq)$

b) $H_2O(l) + NH_3(aq) \rightarrow OH^-(aq) + NH_4^+(aq)$

c) $H_2Fe(CO)_4 + CH_3OH \rightarrow [FeH(CO)_4]^- + CH_3OH_2^+$

d) $NH_3 + H_2S \rightarrow NH_4^+ + HS^-$

3. Calculate ΔG^0 for autoprotolysis of H_2O and NH_3 using values of $K_w = 1x10^{-14}$ and $K_{am} = 1x10^{-33}$. Which compound is the stronger acid?

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

$HB(aq) \leftarrow H^+(aq) + B^-(aq)$

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.

5. 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 ($pK_a = 9.31$)

6. 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

7. 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) $HIO_4/HClO_4$

8. 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) $(SnCl_3)^- + (CO)_5MnCl \text{---> } (CO)_5Mn\text{-}SnCl_3 + Cl^-$

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

10. 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.

$(CH3)_3Ga$ will react most favorably with.

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

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

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

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

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

15. Propose routes for following preparations.

a) C_2H_2 from CaC_2 b) $P(CH_3)_3$ from PCl_3

15. Explain the Lewis acidity observed in the following series:

$BF_3 < BCl_3 < BBr_3$

$SiI_4 < SiBr_4 < SiCl_4 < SiF_4$

16. Explain the role of Al_2Cl_6 as a Lewis acid in Friedel Craft Acylation of benzene.