**WS # 4 Acid and Basic Anhydrides**

1. What is the strongest acid that can exist in water? Write an equation to show how a stronger acid would be reduced in strength by the leveling effect of water.

**H3O+               HCl     +     H2O         →        H3O+               +          Cl-**

2. What is the strongest base that can exist in water? Write an equation to show how a stronger base would be reduced in strength by the leveling effect of water.

**OH-                NaOH   →   Na+     +    OH-**

3. List three strong acids and three strong bases.

**HCl     HI        HClO4             NaOH             KOH               LiOH**

4. Rank the acids in decreasing strength:

            HClO4     **1**      Ka is very large           HClO3      **2**     Ka=1.2x10-2

HClO2      **3**     Ka=8.0x10-5                 HClO       **4**      Ka=4.4x10-8

5. For an oxy acid what is the relationship between the number of O’s and acid strength? (Compare H2S04and H2S03)       **The more O’s the stronger the acid.**

6.Which acid is stronger?                    **HI03** or HIO2

7.Which produces more H30+?            H2CO3or **HS04-**

8.Which produces more OH-?             F-or **HC03-**

9.Which conducts better NH3 or **NaOH** (both .1M)? Why?

**NaOH is a strong base.**

10.Which conducts better **HF**or HCN (both .1M)? Why?

**HF is a stronger acid.**

11. Compare and contrast a strong and weak acid in terms of degree of ionization, size of ka, conductivity, and concentration of H+.

**Strong acid: complete ionization, very large Ka, good conductor, high [H+].**

**Weak acid: partial ionization, small Ka, OK conductor, low [H+].**

Classify each formula as an acid anhydride, basic anhydride, strong acid, weak acid, strong, or weak base. For each formula write an equation to show how it reacts with water. For anhydrides write two equations.

Formula           Classification              Reaction

12. Na2O         **basic anhydride          Na2O     +       H2O   →         2NaOH**

13. CaO           **basic anhydride          CaO     +         H2O   →         Ca(OH)2**

14. SO3            **acid anhydride            SO3     +          H2O    →        H2SO4**

15. CO2           **acid anhydride            CO2     +          H2O    →        H2CO3**

16. SO2            **acid anhydride            SO2     +          H2O    →        H2SO3**

17. HCl           **strong acid                  HCl     +          H2O    →        H3O+     +        Cl-**

18. NH3           **weak base                  NH3     +          H2O    D        NH4+   +          OH-**

19. NaOH        **strong base                 NaOH             →        Na+      +          OH-**

20. HF             **weak acid                   HF       +          H2O    D        H3O+     +        F-**

21. H3PO4        **weak acid                   H3PO4 +          H2O    D        H3O+     +        H2PO4-**

**WS # 5     Hydrolysis of Salts and Reactions of Acids and Bases**

Describe each as an acid, base, neutral salt, acidic salt, or basic salt. For each salt write a parent acid-base formation equation, dissociation equation, and hydrolysis equation (only for acidic and basic salts). For acids and bases write an equation to show how each reacts with water.

1. **NaHCO3**                 **basic salt**

**H2CO3 +         NaOH             →        NaHCO3+          H2O**

**NaHCO3          →        Na+                  +          HCO3-**

**HCO3-             +          H2O                ⇄        H2CO3            +                OH-**

2. AlCl3                       **acid salt**

**3HCl               +         Al(OH)3    →   AlCl3+          3H2O**

                                    **AlCl3**               **→        Al+3     +          3Cl-**

                                  **Al(H2O)63+      ⇄        Al(H2O)5(OH)2+                     +          H+**

3. NaC6H5O                 **basic salt**

**C6H5OH         +          NaOH    →     NaC6H5O+          H2O**

**NaC6H5O       →        Na+      +          C6H5O-**

**C6H5O-           +          H2O    ⇄        C6H5OH         +          OH-**

4. Co(NO3)3                 **acid salt**

**3HNO3    +   Co(OH)3    →   Co(NO3)3+      3H2O**

                                    **Co(NO3)3**        **→        Co+3     +         3NO3-**

                                  **Co(H2O)63+     ⇄    Co(H2O)5(OH)2+                        +   H+**

5. Na2CO3                  **basic salt**

**H2CO3          +          2NaOH    →  Na2CO3+           2H2O**

**Na2CO3          →        2Na+   +           CO3-2**

**CO3-2              +          H2O    ⇄        HCO3-            +          OH-**

6. H2C2O4                   **weak acid**

**H2C2O4           +          H2O    ⇄        H3O+               +          HC2O4-**

7. NH3                        **weak base**

**NH3     +          H2O    ⇄        NH4+   +          OH-**

8. KCl                         **neutral salt**

**HCl    +          KOH    →       KCl                 +          H2O**

                                    **KCl     →        K+     +             Cl-**

9. HNO3                     **strong acid**

**HNO3  +          H2O    →        H3O+   +          NO3-**

10. RbOH                   **strong base**

**RbOH             →        Rb+                  +          OH-**

**WS # 6     Hydrolysis of Salts and Reactions of Acids and Bases**

Describe each as an acid, base, neutral salt, acidic salt, or basic salt. For each salt write a parent acid-base formation equation, dissociation equation, and hydrolysis equation (only for acidic and basic salts). For acids and bases write an equation to show how each reacts with water.

1. NH3                          **weak base**

**NH3     +          H2O    ⇄        NH4+   +          OH-**

2. NaCl                        **neutral salt**

                                    **NaCl → Na+     +    Cl-**

3. HCl                         **strong acid**

**HCl     +          H2O    →        H3O+     +        Cl-**

4. NaCN                      **basic salt**

**NaCN     →     Na+   +             CN-**

**CN-      +   H2O           ⇄        HCN      +       OH-**

5. NaOH                      **strong base**

**NaOH    →     Na+      +          OH-**

6. FeCl3                       **acid salt**

                                    **FeCl3**      **→     Fe+3   +            3Cl-**

                                  **Fe(H2O)63+     ⇄    Fe(H2O)5(OH)2+            +   H+**

7. HF                          **weak acid**

**HF       +          H2O    ⇄        H3O+     +        F-**

8. LiHCO3                   **basic salt**

**LiHCO3          →        Li+   +              HCO3-**

**HCO3-   +   H2O         ⇄        H2CO3   +       OH-**

9. Fe(NO3)3                 **acid salt**

                                    **Fe(NO3)3**        **→        Fe+3   +            3NO3-**

                                  **Fe(H2O)63+     ⇄        Fe(H2O)5(OH)2+        +   H+**

10. MgCO3                  **basic salt**

**MgCO3           →        Mg+2   +          CO3-2**

**CO3-2   +   H2O           ⇄        HCO3-  +        OH-**

11. H2S                        **weak acid**

**H2S     +          H2O    ⇄        H3O+     +        HS-**

12. HF                        **weak acid**

**HF       +          H2O    ⇄        H3O+     +        F-**

13. CaI2                       **neutral salt**

                                    **CaI2 → Ca+2     +    2I-**

14. Be(OH)2               **weak base**

**Be(OH)2       ⇄        Mg+2    +          2OH-**

15. Ba(OH)2               **strong base**

**Ba(OH)2   → Ba+2     +          2OH-**

16. Describe why Tums (CaCO3) neutralizes stomach acid. **It is a weak base and will neutralize acid.**

**basic salt**

**CaCO3            →        Ca+2   +           CO3-2**

**CO3-2   +   H2O           ⇄        HCO3-  +        OH-**

17. Describe why Mg(OH)2 is used in Milk of Magnesia  as an antacid instead of NaOH.

**Mg(OH)2 is** **strong base, however, acts like a weak base due to its low solubility, and releases OH- slowly,**

**whereas NaOH is a strong base which releases OH- in high concentrations which is corrosive.**

**Mg(OH)2(s)       ⇄        Mg+2    +          2OH-**

**NaOH             →        Na+      +          OH-**