Hydrolysis

Hydrolysis reaction – the reaction of water with a substance, resulting in the formation of a new element – oxygen bond.

We will use the knowledge of **equilibrium** and an understanding of **pH** to determine the interactions of ionic substances and water.

When **a strong acid** (or **base**) is placed in water the result is a definite acidic (basic) solution. The total ionization of this acid (or base) increases the hydrogen ion concentration (or decreases) well above the normal or neutral level of water. This phenomenon is expected when dealing with strongly ionized acids and bases.

When **the salts of strong acids and bases** are dissolved in water there is no apparent effect on the concentration of the hydrogen ion concentration. On the other hand when **a weak acid** (or **base**) is dissolved in water there is an increase in the concentration of hydrogen ion or (OH^-) but not to the extent of the strong acid or base. When **a salt of the weak acid** (or **base**) is place in water the effect is to balance the equilibrium equation, i.e.:

$$\mathbf{HA + H_2O \Leftrightarrow H_3O^+ + A^-}$$

$$\mathbf{A^- + H_2O \Leftrightarrow HA + OH^-}$$

where the anion reacts with water to generate the nondissociated acid (or base).

The experiment will present the effect of various ionic salts on the hydrogen or hydroxide ion concentrations with respect to their interaction with water.

Procedure:

In this experiment the use of the pH-meter will be necessary to evaluate the hydrogen concentration of the solutions. The assistant will provide detailed procedures in the use and care of the pH-meter and the associated electrodes.

Prepare 100 ml 0.1 M of the following salts:

- Na_2SO_4;
- KCl;
- $Al_2(SO_4)_3$;
- $ZnSO_4$;
- Na_2CO_3;

- CH_3COONa;
- NH_4Cl;
- $NaHCO_3$.

When the solutions are prepared proceed to test each solution according to the directions outlined by your assistant. Record the pH reading of each solution and what ions it contained.

Requirements for report

For each determination write an equation that explains the observation that was made.

Questions

1. A solution has $[H_3O^+]$ of 1×10^{-5}. What is the pH of this solution?

2. Which of these substances are strong acids or strong bases? HNO_2, HF, HBr, LiOH, $Mg(OH)_2$

3. A 15.00 ml sample of an HBr solution that is titrated with 26.2 ml of 0.560 M NaOH solution has what molarity?
   $HBr(aq) + NaOH(aq) \rightarrow H_2O(l) + NaBr(aq)$

Indicator	Color of acid form	pH range of color change	pK_{In}	Color of base form
thymol blue	red	1.2 to 2.8	1.7	yellow
methyl orange	red	3.2 to 4.4	3.4	yellow
bromophenol blue	yellow	3.0 to 4.6	3.9	blue
bromocresol green	yellow	3.8 to 5.4	4.7	blue
methyl red	red	4.8 to 6.0	5.0	yellow
litmus	red	5.0 to 8.0	6.5	blue
bromothymol blue	yellow	6.0 to 7.6	7.1	blue
phenol red	yellow	6.6 to 8.0	7.9	red
thymol blue	yellow	8.0 to 9.6	8.9	blue
phenolphthalein	colorless	8.2 to 10.0	9.4	pink
alizarin yellow R	yellow	10.1 to 12.0	11.2	red
alizarin	red	11.0 to 12.4	11.7	purple