Salt Hydrolysis Lab

Theory

A salt formed in the neutralization reaction between a strong acid and a strong base will dissolve in water to give a solution that has a pH of 7. Salts formed in the neutralization reactions of other types of acids and bases can give solutions having pHs different than 7. The salt of a strong acid and a weak base, for instance, yields an acidic solution in water. The salt of a weak acid and a strong base gives a basic solution. The acidic or basic character of these nonneutral salt solutions is the result of a phenomenon called *salt hydrolysis*.

In salt hydrolysis, one of the ions of the dissolved salts reacts with water to produce either hydronium ions, forming an acidic solution, or hydroxide ions, forming a basic solution. In this experiment, you will measure the pH of solutions of various salts. You will analyze your results to determine if one of the ions produced in solutions is capable of reacting with water to produce hydronium ions or hydroxide ions.

While acidic or basic properties of salt solutions can be measured in the laboratory, the acidic or basic nature of a salt can also be predicted by considering the properties of its ions. In general, as shown in Table 1, neutral anions are those derived from strong acids and neutral cations are those derived from strong bases. Acidic cations include the HSO_4^- and $H_2PO_4^-$ anions. Basic anions include any anion derived from a weak acid; there are no common basic cations.

Table 1. Acid-Base Properties of Common Ions in Aqueous Solutions

	Neutral	Basic	Acidic
Anion	Cl^- NO_2^- Br^- ClO_4^- I^- SO_4^-	$C_2H_3O_2$- CN^- F^- NO_2^- CO_3^{-2} HS^- HCO_3^- HPO_4^{-2} S^{-2} PO_3^{-3}	HSO_4^- $H_2SO_4^-$
Cation	Li^+ Ca^{+2} Na^+ Ba^{+2} K^+	none	Mg^{+2} Al^{+3} NH_4^+ **Transition metal ions**

Purpose: To prepare aqueous solutions of several salts and to measure the pHs of the solutions. To explain the results by means of chemical equations of salt hydrolysis.

Procedure:

1. Place small quantities (less than the size of a pea) of the following salts into separate labeled test tubes: sodium chloride, sodium acetate, ammonium chloride, sodium carbonate, sodium bicarbonate, sodium phosphate, aluminum chloride.
2. Add 4-5 mL of DI water to each tube and flick gently to dissolve the sample.
3. Using the stirring rod method, apply the solution to a piece of hydrion paper and record the color and corresponding number, and if it was acidic, basic, or neutral.
4. Then, to the tubes, add 2 drops of universal indicator. Record the color and corresponding number and if it was acidic, basic, or neutral.
5. Clean up by putting the chemicals in the sink with lots of water.

Data:

Measured pH of salt solutions

Aq Solutions	Chemical Formula	Hydrion Paper	Universal Indicator

Discussion:

1. For each salt, write a balanced equation to show how it ionizes in solution.
2. For those salt solutions that are acidic, write an additional equation to show which ion in solution reacts with water to produce the hydronium ion. (2 of them)

3. For all salt solutions that are basic, write an additional equation to show which ion in solution reacts with water to produce the hydroxide ion.

Conclusion: