Salt Hydrolysis

We expect solutions of substances such as HCl and HNO_2 to be acidic and solutions of NaOH and NH_3 to be basic. However, we may be somewhat surprised at first to discover that aqueous solutions of some salts such as sodium nitrite, $NaNO_2$, and potassium acetate, $KC_2H_3O_2$, are basic, whereas others such as NH_4Cl and $FeC1_3$ are acidic. Recall that salts are the products formed in neutralization reactions of acids and bases. For example, when NaOH and HNO_2 (nitrous acid) react, the salt $NaNO_2$ is formed.

Nearly all salts are strong electrolytes and exist as ions in aqueous solutions. Many ions react with water to produce acidic or basic solutions. The reactions of ions with water are frequently called hydrolysis reactions. We will see that anions such as CN^- and $C_2H_3O_2^-$ that are the conjugate bases of the weak acids HCN and $HC_2H_3O_2$, respectively, react with water to form OH^- ions. Cations such as NH_4^+ and Fe_3^+ come from weak bases and react with water to form H+ ions.

In this lab, you will predict whether various salt solutions will be acidic or basic. You will then test those salts to determine whether your predictions were correct or not.

Chemicals

0.10 M solutions of the following salts:

$AlCl_3$	Na_3PO_4	$ZnSO_4$
K_3PO_4	$Ba(NO_3)_2$	Na_2CO_3
KNO_3	$NaHCO_3$	$CuCl_2$
$Ca(NO_3)_2$	NaCl	$NaC_2H_3O_2$
Na_2SO_4	NH_4Cl	$FeCl_3$

Equipment

Dropper bottles, Universal pH paper with color codes, scissors

Procedure

1. Make Predictions

On your data sheet, predict whether each solution will be acidic, basic, or neutral.

2. Test solutions

Obtain 4 pieces of universal indicator (orange) pH paper. Cut each pH paper into 4 smaller pieces. Apply a drop of a solution to one of the small pieces of pH paper. Record the pH value indicated by the paper on your data sheet. Repeat for all solutions.

Disposal

As you test each salt solution, place all used test strips on a piece of paper towel. At the end of the lab, throw away the paper towel and all test strips.

Name: _____

Salt Hydrolysis Lab

Predictions:

$AlCl_3$ = _____ Na_3PO_4 = _____ $ZnSO_4$ = _____

K_3PO_4 = _____ $Ba(NO_3)_2$ = _____ Na_2CO_3 = _____

KNO_3 = _____ $NaHCO_3$ = _____ $CuCl_2$ = _____

$Ca(NO_3)_2$ = _____ $NaCl$ = _____ $NaC_2H_3O_2$ = _____

Na_2SO_4 = _____ NH_4Cl = _____ $FeCl_3$= _____

Experimental Result:

$AlCl_3$ = _____ Na_3PO_4 = _____ $ZnSO_4$ = _____

K_3PO_4 = _____ $Ba(NO_3)_2$ = _____ Na_2CO_3 = _____

KNO_3 = _____ $NaHCO_3$ = _____ $CuCl_2$ = _____

$Ca(NO_3)_2$ = _____ $NaCl$ = _____ $NaC_2H_3O_2$ = _____

Na_2SO_4 = _____ NH_4Cl = _____ $FeCl_3$= _____

Questions:

1) Select one of the acidic salts above and write the hydrolysis reaction for this salt.

2) Select one of the basic salts above and write the hydrolysis reaction for this salt.

3) Calculate the pH of the NH_4Cl solution you used in the lab. How does your answer compare with the experimental result?