LAB: MAKING PREDICTIONS FOR PRECIPITATES

INTRODUCTION

When solutions of soluble ionic salts are mixed, a double displacement reaction occurs between pairs of ions of opposite charge. For example, when aqueous solutions of barium nitrate and sodium sulphate are mixed, which precipitate will form?

Ions present	Ba^{2+}	NO_3^-	Na^+	SO_4^{2-}
Possible precipitates	$BaSO_4$	$NaNO_3$		
From solubility rules	$NaNO_3$ is soluble			
	$BaSO_4$ is NOT soluble			

Net Ionic Equation $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

It is therefore, possible to survey a large number of combinations of ions simply by mixing solutions of various ions and by using the solubility rules to identify and to predict the precipitates formed, and hence to write ionic equations for these precipitates.

OBJECTIVES

1. To observe the reactions of a large number of aqueous ionic solutions.
2. Identify the possible new combinations of ions that might precipitate.
3. Use the solubility chart to determine if one or both new combinations are insoluble.
4. To write net ionic equations for reactions.

PROCEDURE

1. Add 10 drops of NH_4CH_3 COOH listed in the vertical column of the observation table to a test tube.
2. Add 10 drops of $Mg(OH)_2$ listed in the horizontal column of the observation table to the same test tube.
3. Observe if a precipitate has formed, record the observation in the appropriate square.
4. If there is no reaction, write NR in the square.
5. Continue to react solutions in the vertical column with solutions in the horizontal column in the same manner until the table is complete.

DISCUSSION

1. From your results, answer the following questions about the solubility rules:

a) From which group on the periodic table are elements soluble with NH_4^+ ions?
b) What property do all compounds containing NO_3^- ions have?
c) When are chlorides, bromides and iodides *not* soluble?
d) When are sulphates *not* soluble?
e) When are carbonates, phosphates, hydroxides and sulfides soluble?

2. For each of the following reactions:

a) Write a balanced chemical equation for the following compounds in aqueous solutions, indicating which of the products is the precipitate.
b) Write a balanced net ionic equation.
i) Ammonium sulfide + lead (II) nitrate
ii) Mercury (I) nitrate + sodium chloride
iii) Aluminum nitrate + potassium hydroxide
iv) Copper (I) nitrate + potassium hydroxide

3. Explain which precipitate will form when $CuNO_3$, NaCl and $MgSO_4$ solutions are mixed together.
4. Explain what solutions you would use to separate Mg^{2+} ions from Ba^{2+} ions from an aqueous solution.
5. A solution is known to contain Ba^{2+}, Pb^{2+}, Cu^{2+} and Na^+. If a student wants to separate these ions by precipitating them "selectively" one by one from the solution by adding negative ions in the correct order. Explain how the student may perform this (flow chart). Which positive ion will remain in the solution at the end. Why?
6. What ions could be present in a solution if samples of it gave:

(a) A precipitate when $Cl^-_{(aq)}$ or SO_4^{2-} (aq) is added?
(b) A precipitate when $Cl^-_{(aq)}$ is added but none when $SO_4^{2-}{}_{(aq)}$ is added?
(c) A precipitate when $SO_4^{2-}{}_{(aq)}$ is added but none when $Cl^-_{(aq)}$) is added?

Data Collection

	$NH_4CH_3COOH_{(aq)}$	$(NH_4)_2CO_{3(aq)}$	$(NH_4)_2SO_{4(aq)}$	$NH_4OH_{(aq)}$	$K_2CrO_{4(aq)}$
$Mg(NO_3)_{2(aq)}$					
$Ca(NO_3)_{2(aq)}$					
$Sr(NO_3)_{2(aq)}$					
$Ba(NO_3)_{2\ (aq)}$					