

Lab: Making Predictions for Precipitates

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 ppts.	BaSO_4	NaNO_3		
From solubility rules	Na NO_3 is soluble BaSO_4 is not soluble			
Net Ionic Equation	$\text{Ba}^{2+}_{(\text{aq})}$	+	$\text{SO}_4^{2-}_{(\text{aq})}$	-----> $\text{BaSO}_{4(\text{s})}$

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

Objectives

- To observe the reactions of a large number of aqueous ionic solutions.
- Identify the possible new combinations of ions which might precipitates.
- Use the solubility chart to determine if one or both new combinations is insoluble.
- To write net ionic equations for reactions.

Procedure

Add 10 drops of $(\text{NH}_4)_2\text{C}_2\text{O}_4$, listed in the vertical column of the observation table, to a test tube. Add 10 drops of $\text{Mg}(\text{NO}_3)_2$, listed in the horizontal column to the same test tube. Observe if a precipitate has formed, record the observation in the appropriate square. If there is no reaction, write NR in the square. Continue to react solutions in the vertical column with solutions in the horizontal column in the same manner until the table is completed.

Discussion

- From your results answer the following questions about solubility rules:
 - From which group on the Periodic Table are elements soluble with NH_4^+ ions?
 - What property do all compounds containing NO_3^- ions have?
 - When are chlorides, bromides and iodides not soluble?
 - When are sulphates, not soluble?
 - When are carbonates, phosphates, hydroxides, and sulphides soluble?
- For each of the following reactions:
 - Write a balanced chemical equation for the following compounds in aqueous solutions, indicating which of the products is the precipitate,
 - Write a balanced net ionic equation.
 - Ammonium sulphide + lead (II) nitrate
 - Mercury (I) nitrate + sodium chloride
 - Aluminum nitrate + potassium hydroxide
 - Copper (I) nitrate + potassium hydroxide
- Explain which precipitate will form when CuNO_3 , NaCl , and MgSO_4 solutions are mixed together.
- Explain what solution you would use to separate Mg^{2+} ions and Ba^{2+} ions from an aqueous solution.
- 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. Which positive ion will remain in the solution at the end? Why?
- What ions could be present in a solution if samples of it gave:
 - a ppt. when $\text{Cl}^-_{(\text{aq})}$ or $\text{SO}_4^{2-}_{(\text{aq})}$ is added?
 - a ppt. when $\text{Cl}^-_{(\text{aq})}$ is added but none when $\text{SO}_4^{2-}_{(\text{aq})}$ is added?
 - a ppt. when $\text{SO}_4^{2-}_{(\text{aq})}$ is added but none when $\text{Cl}^-_{(\text{aq})}$ is added?

Data Table

	$(\text{NH}_4)_2\text{C}_2\text{O}_4$	$(\text{NH}_4)_2\text{CO}_3$	$(\text{NH}_4)_2\text{SO}_4$	NH_4OH	K_2CrO_4
$\text{Mg}(\text{NO}_3)_2$					
$\text{Ca}(\text{NO}_3)_2$					
$\text{Sr}(\text{NO}_3)_2$					
$\text{Ba}(\text{NO}_3)_2$					