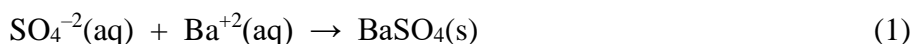

Experiment #12 – Qualitative Analysis of Common Anions

The principles that are employed in the identification of cations can also be applied to the analysis of anions. The qualitative detection of anions in a sample depends on the distinctive solubility properties of particular salts of the ions and specific chemical reactions that are (ideally) unique to a particular ion. In this experiment, we will explore ways to detect the presence of CO_3^{2-} , SO_4^{2-} , PO_4^{3-} , Cl^- , and I^- . You will be testing both known and unknown solutions.

Procedure

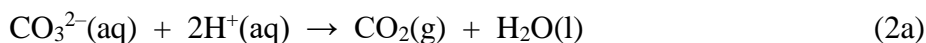
1. Test for the Sulfate Ion

To 1 mL of the test solution, add 6 M HNO_3 drop by drop until the solution is acidic. Then add 1 mL of 0.1 M BaCl_2 solution in order to produce a white precipitate of BaSO_4 .



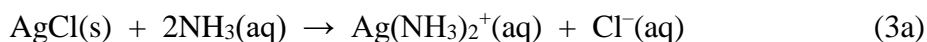
2. Test for the Carbonate Ion

To 1 ml of a new test solution, observe to see if any gas bubbles form while adding 20 drops of 6 M HNO_3 . Verify it is acidic. This gas formation is a strong indication of the presence of CO_3^{2-} .

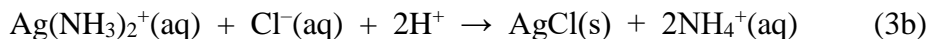


3. Test for the Chloride Ion

To 1 mL of a new test solution, add a couple drops of 6 M HNO_3 as needed to make the solution slightly acidic. Add 10 drops of 0.1 M AgNO_3 . No precipitate proves the absence of Cl^- , Br^- , or I^- . Centrifuge the mixture. Test the clear filtrate with 1 drop of 0.1 M AgNO_3 for complete precipitation. If necessary, centrifuge again. Discard the filtrate. To this precipitate, add 1 mL of D.I. water, 2 drops of 6 M NH_3 , and 6 drops of 0.1 M AgNO_3 . The proportions are important, since we want to dissolve ONLY AgCl .



Shake the mixture well and centrifuge. Transfer the clear solution to a clean test tube, and acidify once again with 6 M HNO_3 . A white precipitate of AgCl confirms the presence of Cl^- .



Name: _____

Section: _____

4. Test for the Iodide Ion

Acidify a 2 mL sample of a new test solution by adding 6 M HCl. Add 1 mL of 0.1 M FeCl₃ to oxidize any I⁻ to I₂. Add 1 mL of hexane and agitate the mixture. A purple color of I₂ in the hexane layer indicates I⁻ was present in the original sample.

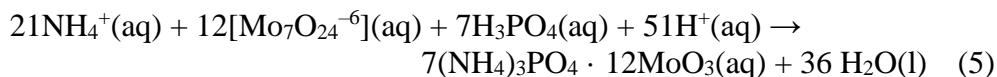


5. Test for the Phosphate Ion

(A) If no I⁻ was present, mix about 2 drops of 0.5 M (NH₄)₆Mo₇O₂₄ reagent with 5 drops of 6 M HNO₃ to 1 mL of a new test solution.

(B) If I⁻ was present, add 5 drops of 6 M HNO₃ to 1 mL of a new test solution and boil the test tube for 5 to 10 minutes to remove the iodide. Then add 2 drops of the ammonium molybdate reagent to the test solution.

A yellow precipitate of ammonium phosphomolybdate, (NH₄)₃PO₄·12MoO₃, appearing at once or after the mixture has been warmed a few minutes to 40 °C indicates the presence of PO₄⁻³.



Record your observations for your known and unknown solutions below. Determine the identity of your unknown.

Experiment Observations and Results:

UNKNOWN_____

IONS PRESENT_____

Name: _____

Section: _____

Pre-Lab Assignment:

1. Construct separate flow charts for the identification of the various five anions in a known sample. Refer to Experiment #10 for guidelines on preparing your flow charts.

Name: _____

Section: _____

Post-Lab Assignment: Anion Analysis

1. A solution may contain Cl^- , CO_3^{2-} , PO_4^{3-} , and/or SO_4^{2-} . No effect is observed upon addition of 6 M HNO_3 ; this resulting mixture will be referred to as solution 1. No effect is observed on addition of 0.1 M AgNO_3 to solution 1. A white precipitate is reported on addition of 1 M BaCl_2 to solution 1. Finally, a yellow precipitate is observed on addition of 0.5 M $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}$ to solution 1. Which of the ions are present, which are absent, and which remain undetermined? State your reasoning below. NOTE: simply listing ions below without the appropriate reasoning will NOT earn you any credit!

Present _____

Absent _____

In Doubt _____