

IDENTIFICATION OF CATIONS IN SOLUTION

Introduction

The process of determining the composition of a sample of matter by conducting chemical tests is called qualitative analysis. In this experiment, you will learn how to conduct qualitative tests to determine if certain cations are present in solution. You will then use these tests to determine the ionic composition of an unknown solid.

In this experiment you will observe several types of chemical tests that are commonly used as tests in qualitative analysis. These tests include flame tests and chemical reactions. In the flame tests you will note the characteristic color of certain cations when heated in a flame. In the chemical tests you will use several types of reactions that include a color change, and the formation of a precipitate.

Materials

0.1 M Iron(III) sulfate $\text{Fe}_2(\text{SO}_4)_3$
0.1 M Potassium thiocyanate KSCN
0.1 M Calcium nitrate $\text{Ca}(\text{NO}_3)_2$
0.1 M Sodium oxalate $\text{Na}_2\text{C}_2\text{O}_4$
6 M Hydrochloric acid
2 M Sulfuric acid

Sodium chloride NaCl
Potassium chloride KCl
Lithium chloride LiCl
Calcium chloride CaCl_2
Distilled or deionized water

Equipment

6 beral pipets
1 24-well culture plate
moistened wooden splints
bunsen burner
toothpicks
labeling pen

Safety

1. Wear safety goggles and aprons
2. Sulfuric and hydrochloric acids are corrosive and can cause severe injury.

Procedure

1. Prepare a data table
2. Label 6 beral pipets with the names of the reagents you will be using, Iron(III) sulfate, potassium thiocyanate, calcium nitrate, sodium oxalate, hydrochloric acid, sulfuric acid.
3. **Test for iron(III), Fe^{3+} .** To one well of the 24-well culture plate add 10 drops of iron(III) sulfate solution. Add 2 drops of 2M sulfuric acid and 5 drops of potassium thiocyanate solution. Stir gently to mix. Record your observations.
4. **Flame test for potassium ion, K^+ .** Take a moistened wooden splint and dip it into the potassium chloride. Immediately hold it in the hot burner flame. Observe the color of the flame. You may repeat the test.
5. **Flame test for sodium ion, Na^+ .** Take a clean moistened wooden splint and dip it into the sodium chloride. Immediately hold it in the hot burner flame. Observe the color of the flame.
6. **Flame test for lithium ion, Li^+** Take a clean moistened wooden splint and dip it into the lithium chloride. Immediately hold it in the hot burner flame. Observe the color of the flame.
7. **Tests for calcium ion, Ca^{2+} .** There are two tests for calcium ion. One is a chemical test: in one well of the culture plate add 10 drops of calcium nitrate solution. Add 10 drops of sodium oxalate solution. Record your observations. The second is a flame test: Dip a clean moistened wooden splint into the calcium chloride. Immediately hold it in the hot burner flame. Observe the color of the flame.

TEST FOR COMMON IONS		
Ion	Test Reagents/ Test Procedure	Test Results
Fe ³⁺		
K ⁺		
Na ⁺		
Ca ²⁺		
Li ⁺		

Questions:

1. The iron(III) solution is a reference solution. What does that mean?
2. Name the other reference solutions that were used in this laboratory.
3. Name one reagent that was a test solution.

IDENTIFICATION OF ANIONS IN SOLUTION

Introduction

The process of determining the composition of a sample of matter by conducting chemical tests is called qualitative analysis. In this experiment, you will learn how to conduct qualitative tests to determine if certain anions are present in solution. You will then use these tests to determine the ionic composition of an unknown solid.

In this experiment you will observe several types of chemical reactions that are commonly used as tests in qualitative analysis. These reactions include the evolution of a gas, and the formation of a precipitate. In precipitation reactions, two ionic solutions are combined and, upon mixing, a solid product - the precipitate - is formed. This solid is a compound formed from ions from each solution and it precipitates or "falls out of solution", because it is insoluble in water.

Materials

0.1 M Silver nitrate	6M nitric acid
0.1 M Sodium sulfate	6 M hydrochloric acid
0.1 M Barium chloride	distilled water
0.1 M Sodium carbonate	
0.1 M Sodium chloride	

Equipment

- 1 24-well culture plate
- 7 beral pipets or dropper bottles for the solutions
- labeling pen

Safety

1. Wear safety goggles and aprons
2. Nitric and hydrochloric acids are corrosive and can cause severe injury.

Procedure

1. Prepare a data table as instructed by your teacher.
2. Obtain a 24-well culture plate.
3. The ion tests are very sensitive. Plain tap water may give a positive result. Prepare your culture plate by cleaning it thoroughly and rinsing it very well with distilled water.
4. **Test for chloride ion, Cl^- .** Add 10 drops of sodium chloride solution to one well of your culture plate. Add 10 drops of nitric acid and stir to mix the contents. Add 5 drops of silver nitrate, AgNO_3 , solution to the well. Record your observations.
5. **Test for sulfate ion, SO_4^{2-} .** Add 10 drops of sodium sulfate to a second well of the culture plate. Add 10 drops of hydrochloric acid to the well. Stir to mix the contents. Add 5 drops of barium chloride to the well. Record your observations.
6. **Test for carbonate ion, CO_3^{2-} .** Add 10 drops of sodium carbonate solution to a third well of the culture plate.. Carefully observe the well as you add 10 drops of 6 M hydrochloric acid. Is there any evidence of a chemical change? Repeat the test, but use nitric acid instead of the hydrochloric acid. Is there any evidence of a chemical change?

Table 1 Tests for Anions

Ion	Tests Reagents/ Test Procedure	Test Results
Cl^-		
SO_4^{2-}		
CO_3^{2-}		

Questions:

1. Name the reference solutions used in this laboratory.
2. Name the test solutions used in this laboratory.
3. If you were testing for chloride in a substance, would you add sodium chloride to your substance. Justify your answer.

IDENTIFICATION OF AN UNKNOWN SALT

Problem:

You will use the techniques learned in the two previous laboratories (Identification of Anions & Identification of Cations) to identify the composition of your unknown salt. You will be given 2.00 g of an unknown salt. The materials listed below will be available for your use.

You must write a detailed procedure in your laboratory notebook which must be approved by your instructor before you begin work. You will record your observations and analyze your data. Your conclusion will be the correct chemical name and formula of your compound.

Materials

6 M Hydrochloric Acid HCl

2 M Sulfuric Acid H_2SO_4

6 M Nitric Acid HNO_3

0.1 M Silver nitrate $AgNO_3$

0.1 M Barium chloride $BaCl_2$

0.1 M Potassium thiocyanide

0.2 M Sodium oxalate $Na_2C_2O_4$

Equipment

Moistened wood splints

Bunsen burner

24-well culture plates

tooth picks

spatula

distilled water

