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| **Foundation Year** | **Identifying Unknowns Using Flame Tests and Silver Nitrate** | **Semester 1** |

**Identifying Unknowns Using Flame Tests and Silver Nitrate**

**Aim**

To qualitatively identify cations and anions present in unknown ionic compounds and their solutions.

**Introduction**

The use of chemical tests to identify unknown compounds is an important skill in chemistry. The tests in this practical are examples of qualitative analysis where the observed outcome of an experiment can support the identification of a compound.

In this experiment, the ‘unknown’ samples labelled A-E are all ionic compounds comprising an alkali metal cation and a halide anion. You will perform a flame test on each of the compounds to identify the alkali metal ion present. Metal ions give a characteristic colour when heated directly in a Bunsen flame. Once you have observed the outcome of the flame test, you will be able to make an inference regarding the identity of the alkali metal cation present in the compound.

Adding silver nitrate solution to a solution of a halide salt leads to the formation of a precipitate of the resulting silver halide salt An example equation showing what happens when silver nitrate is added to sodium chloride is given below:

NaCl(aq) + AgNO3(aq) 🡪 AgCl(s) + NaNO3(aq)

The precipitates formed for chloride, bromide and iodide salts are different in appearance, and they have different solubilities in dilute/concentrated ammonia solution. In this practical, you will explore the nature of the precipitates formed from different halide salts and you will devise a procedure that could be used to test an unknown sample for the presence of the different halides and to make the correct idenification.

**Skills associated with this practical**

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| **Practical Skills**   * Performing a flame test * Correctly handling a concentrated, corrosive solution * Making observations | **Scientific Skills**   * Writing ionic equations |

**Signposts**

Chemistry, Conoley & Hills, 3rd Edition, Chapter 23, Page 465.

**Understanding Hazard and Minimising Risk**

You must stand up throughout the practical, and safety glasses must be worn at ALL times in the lab. You must wear a labcoat whilst you are carrying out ALL practical work. Long hair must be tied back, and trousers (jeans are OK) must be worn. Open-toed shoes and clothing revealing bare skin are not permitted.

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| Substance | Amount | Hazards | Minimising Hazards | Disposal / Spillage |
| 1 M nitric acid (HNO3) | 2-3 drops | Corrosive, causes burns | Wear gloves | Pour down sink with copious amounts of water |
| 0.5 M ammonia solution (NH4OH) | 5 cm3 | Irritant | Wear gloves | Pour down sink with copious amounts of water |
| Conc. ammonia solution (NH4OH) | 5 cm3 | Corrosive, causes burns | Wear gloves, **use in fumehood** | Dilute and pour down sink **(in fumehood)** with copious amounts of water |
| 0.05 M Silver nitrate (AgNO3) | 5 cm3 | Irritant, stains skin | Wear gloves | Pour down sink with copious amounts of water |

**Procedure**

Apparatus

PER PAIR: Test tube rack and test tubes

Salts A-E

0.1 M solutions of salts A-E

test tubes

0.05 M silver nitrate solution

dropping pipettes

1 M nitric acid

0.5M ammonia solution **and** concentrated ammonia solution

Method

Record all your observations in a table. As per the Prelab, examine the method sections below and devise an appropriate structure for your results table. Ensure that you have your results table in place before you start the experiment.

**Flame Tests to Identify Metal Cations**

Five flame test stations are present in the laboratory, one for each of the unknown compounds **A-E**. Each station has its own Bunsen burner along with a heating wire (nichrome) mounted on a cork.

1. Dip the heating wire in the beaker of hydrochloric acid and heat the wire in a roaring blue Bunsen flame for about one minute. Repeat this process a second time.
2. Dip the heating wire in the distilled water, and then into the solid unknown compound you are testing. A small amount of the solid will have attached to the heating wire.
3. Heat the solid on the heating wire in a roaring blue Bunsen flame, positioning the wire so the solid compound is at the edge of the blue cone in the flame. Get your partner to take a photo of you performing the flame test for your *Skills Portfolio*.
4. Make a note of any flame colours that you observe. Take photos of the different coloured flames you observe to include in your *Skills Portfolio*.
5. Clean the heating wire by repeating step 1.
6. Repeat the experiment all unknown compounds **A-E**.

**Silver Nitrate Test for Halide Anions**

1. Pour samples of each of the solutions of compounds **A-E** into 5 separate test tubes to a depth of **no more than 1 cm**.
2. Using a dropping pipette, add 2-3 drops of 1 M nitric acid to each test tube.
3. Using a different dropping pipette, add about 0.5 cm3 of 0.05 M silver nitrate solution to each tube. Make a note of your observations (with particular reference to colour). Take photos of each of the different coloured precipitates you observe for your *Skills Portfolio*.
4. Add dilute ammonia solution (0.5 M) to each tube to a depth of ~5 cm and record any observations.
5. Take the tubes which did not show any change in Step 4 to the fume cupboard and add concentrated ammonia using a pipette (don’t add more than 5 cm3 of conc. ammonia) and again record your observations. **Wear gloves and be extremely vigilant**. Ask your partner to take a photograph of you transferring the concentrated ammonia for your *Skills Portfolio*.
6. Dispose of any solutions containing concentrated ammonia down the sink at the back of the fume cupboard with plenty of water. All other solutions can be washed down the sinks in the lab.

**Analysis and questions**

1. Draw tables to show what is observed (a) when different metal ions are subjected to flame tests and (b) different halide ions are treated with silver nitrate solution followed by the ammonia solutions.
2. Write ionic equations to show what happens when silver nitrate is added to each of the three halide ions tested in this experiment. How do your equations show that precipitates are formed?

**Deadlines, Assessment and Feedback on Performance**

You are required to complete the *Skills Portfolio* document associated with this practical. This should be completed electronically with all photos inserted in the appropriate places and accompanying text typed in. The submission deadline for *Skills Portfolio*s will normally be midnight on the Sunday following the practical, although you will be given specific guidance during the practical session. Submission is via the e-submission system Turnitin which you will be able to access in the appropriate folder in the Laboratories and Coursework Blackboard course.