

Testing salts for anions and cations – teacher notes

Introduction

Chemists often have to identify the composition of unknown substances. This experiment involves identifying the cations and anions in various salt solutions.

This experiment should take around 1-2 hours.

Equipment

Apparatus

- Eye protection
- Test tubes

Chemicals

Access to:

- Full range indicator paper
- Ammonia solution, 2 mol dm⁻³
- Sodium hydroxide solution, 0.4 mol dm⁻³
- Hydrochloric acid solution, 0.4 mol dm⁻³
- Barium chloride solution, 0.1 mol dm⁻³
- Limewater solution, 0.02 mol dm⁻³
- Nitric acid, 0.4 mol dm⁻³
- Silver nitrate solution, 0.1 mol dm⁻³
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Unknown substances labelled A, B, C ...each might contain one of the following anions and one of the following cations:

Anions - OH⁻, SO₄²⁻, CO₃²⁻, Cl⁻, Br⁻, I⁻, NO₃⁻

Cations - H⁺, Ca²⁺, Cu²⁺, Fe³⁺, Fe²⁺, NH₄⁺

A sensible selection might be:

- Copper chloride (toxic if swallowed, causes skin irritation and eye damage)
- Potassium carbonate (harmful if swallowed, skin/eye irritant)
- Potassium iodide (skin/eye irritant)
- Copper(II) sulfate (harmful if swallowed, skin/eye/respiratory irritant)
- Iron(III) chloride (harmful if swallowed, skin irritant, causes serious eye damage)
- Iron(II) sulfate (harmful if swallowed, skin/eye irritant)
- Lead nitrate (reproductive toxin, causes serious eye damage, harmful if swallowed or inhaled, possible carcinogen and skin sensitiser)

Health, safety and technical notes

- Read our standard health and safety guidance here <https://rsc.li/3j03kxu>
- Always wear eye protection.
- Prepare dilute solutions in a fume cupboard.
- Ammonia solution is corrosive, causing burns, and gives off ammonia vapour which irritates the eyes, lungs and respiratory system. See CLEAPSS Hazcard [HC006](#)
- Sodium hydroxide is corrosive, causing burns and is extremely dangerous to the eyes. See CLEAPSS Hazcard [HC091a](#)

- Hydrochloric acid is corrosive, causing burns. It also gives off choking fumes. See CLEAPSS Hazcard [HC047a](#)
- Barium chloride is harmful by inhalation and toxic if swallowed. See CLEAPSS Hazcard [HC010a](#)
- Nitric acid is corrosive, causing burns. It also gives off toxic fumes. See CLEAPSS Hazcard [HC067](#)
- Silver nitrate is corrosive to skin and eyes and an oxidising agent. The 0.1 mol dm⁻³ solution is of Low hazard. See CLEAPSS Hazcard [HC087](#).

Notes

Test-tubes should be washed initially. Thorough washing to prevent contamination is important.

It is probably inadvisable to use concentrated hydrochloric acid to produce volatile chlorides at this level. This procedure should be effective as long as sodium, which produces a persistent yellow colour, is not given as an unknown.

Questions

1. Write word and ionic equations for those reactions that give a positive result.