

# Testing salts for anions and cations

## Topic

Qualitative analysis.

## Timing

1–2 hours.

## Description

Students attempt to identify the anions and cations present in a salt by a combination of tests.

## Apparatus and equipment (per group)

- Test-tubes.

## Chemicals (per group)

Access to:

- Full range indicator paper
- Ammonia solution  $2 \text{ mol dm}^{-3}$  (Causes eye damage)\*
- Sodium hydroxide solution  $0.4 \text{ mol dm}^{-3}$  (**Skin/eye Irritant**)
- Hydrochloric acid solution  $0.4 \text{ mol dm}^{-3}$
- Barium chloride solution  $0.1 \text{ mol dm}^{-3}$  (**Harmful**)
- Limewater solution  $0.02 \text{ mol dm}^{-3}$
- Nitric acid  $0.4 \text{ mol dm}^{-3}$  (**Skin/eye Irritant**)
- Silver nitrate solution  $0.1 \text{ mol dm}^{-3}$
- Unknown substances labelled A, B, C ...each might contain one of the following anions and one of the following cations:  
Anions -  $\text{OH}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{CO}_3^{2-}$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$   
Cations -  $\text{H}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{NH}_4^+$

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**).

## Extension – for flame tests

Nichrome wire loops attached to wooden handles (cleaned before lesson in concentrated hydrochloric acid).



## Safety

Pupils wear goggles (BS EN 166 3). \* If the ammonia is reduced to  $1.5 \text{ mol dm}^{-3}$  or less then ordinary eye protection will suffice)

When preparing solutions:

Ammonia solution is corrosive, causing burns, and gives off ammonia vapour which irritates the eyes, lungs and respiratory system. Prepare dilute solutions in a fume cupboard

Sodium hydroxide is corrosive, causing burns and is extremely dangerous to the eyes.

Hydrochloric acid is corrosive, causing burns. It also gives off choking fumes – prepare dilute solutions in a fume cupboard.

Barium chloride is harmful by inhalation and Toxic if swallowed.

Nitric acid is corrosive, causing burns. It also gives off toxic fumes – prepare dilute solutions in a fume cupboard.

Silver nitrate is corrosive to skin and eyes and an oxidising agent. The  $0.1 \text{ mol dm}^{-3}$  solution is of Low hazard.

## Teaching tips

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

### Flame tests

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.

For another method of flame test demonstration, see *Classic Chemistry Demonstrations*, p. 80. London: RSC, 1995.

This experiment is probably suitable for able 15/16 year old students in this format. Teachers may wish to adapt this for less able students and or spread the work over 2 or 3 lessons.

## Background theory

A knowledge of precipitation reactions is helpful as is pre-knowledge of the chemistry of the tests. Otherwise, the students should test known substances to ensure they know what is a positive result.

## Credits

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*Health & safety checked January 2018*

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