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| Chemical Investigations |
| Analysing Cations |
| Pupil Guide |



Introduction

Identifying substances is a very important aspect of chemistry.

To test for many cations, it is common to use flame tests, which are covered in a different document. Here we look at a variety of simple tests that will allow for the identification of a variety of cations in solution: aluminium, ammonium, calcium, copper, iron II, iron III, lead and zinc.

You will need

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| Your samples | Test tubes & rack |
| Sodium hydroxide (0.4 mol l-1) | Ammonia (1 mol l-1 ) |
| Potassium hexacyanoferrate III (0.2 mol l-1) | Potassium thiocyanate (0.2 mol l-1) |
| Potassium iodide (0.2 mol l-1) | Alizarin S (0.1%) |

The concentrations are not critical here as the tests are qualitative.

Safety

0.4 mol l-1 sodium hydroxide is an irritant. Wear eye protection.

To do

The first set of tests involves adding sodium hydroxide and ammonia to two different samples of your unknown.

**Part 1 – adding sodium hydroxide**

1. Add a few cm3 of your unknown solution to a test tube.
2. Add a few drops of sodium hydroxide – Is a precipitate formed?
3. Now add more sodium hydroxide – until the test tube is about ¾ full. Stir and see if the precipitate dissolves.

**Part 2 - Results and further actions**

1. No precipitate – in this case it is probably one of the following – ammonium, potassium sodium, lithium or barium.

Hold a piece of moist red litmus over the top of the mixture with sodium hydroxide. If it goes blue, ammonia is being released so it was an **ammonium** ion

If there is no change, you need a flame test to distinguish the ions.

1. Blue precipitate – probably copper

To confirm – to another sample, add excess ammonia. If a blue precipitate forms and then dissolves to a deep blue solution, it is **copper**

1. Green precipitate – probably iron II but possibly Chromium

To confirm, to another sample add a few drops of potassium hexacyanoferrate III (ferricyanide) a deep blue colour shows it is **iron II**

1. Brown precipitate – red/brown is iron III but a white precipitate that goes brown could be manganese II

To confirm, to another sample add a few drops of potassium thiocyanate a deep red colour shows it is **iron III**

1. White precipitate that does not dissolve in excess hydroxide – **calcium or magnesium**

These can be distinguished by a flame test.

1. White precipitate that does dissolve in excess hydroxide – aluminium, zinc or lead

Add ammonia in excess. If the white precipitate formed dissolves in excess, it is **zinc**.

If not, Add a few drops of potassium iodide solution. A brilliant yellow colour means it is **lead**

No colour means it is **aluminium**

To confirm aluminium:

* To 5 cm3 of the (neutral or acid) test solution, add 1 cm3 of alizarin and then ammonia until the solution is alkaline – as shown by it going purple.
* Boil for a few moments and allow to cool.
* Add dilute ethanoic acid. A red colour or precipitate remaining is evidence of aluminium.