

# Qualitative Analysis

## Analysing cations

### Flame test colours

Metal ions in compounds give off characteristic colours in flame tests. A platinum wire loop is cleaned in concentrated hydrochloric acid or nitric acid. It is dipped into the solid compound or its solution, and then held in a Bunsen burner flame.

metal cation	flame test colour
lithium	crimson red
sodium	yellow-orange
potassium	pale lilac
calcium	brick red
barium	green

### Precipitates with sodium hydroxide

Around 1 – 2 cm<sup>3</sup> of a solution of the test compound is put into a test tube and a few drops of dilute sodium hydroxide solution added. Transition metal ions form coloured precipitates but other metal ions form white precipitates. Some metal hydroxide precipitates redissolve if you add an excess of sodium hydroxide solution.

Metal cation	Observations
calcium	white precipitate of calcium hydroxide
magnesium	white precipitate of magnesium hydroxide
aluminium	white precipitate of aluminium hydroxide (redissolves in excess sodium hydroxide)
copper(II)	pale blue precipitate of copper(II) hydroxide
iron(II)	green precipitate of iron(II) hydroxide
iron(III)	brown precipitate of iron(III) hydroxide

### Ammonium salts

Sodium hydroxide solution is added to the test compound. When the mixture is heated, ammonia gas is given off. The ammonia has a characteristic smell and it turns damp litmus paper blue.

## Analysing anions

### Silver nitrate test for halide ions (chloride, bromide and iodide)

Around 1 – 2 cm<sup>3</sup> of a solution of the test compound is put into a test tube. A few drops of dilute nitric acid are added, followed by a few drops of silver nitrate solution. Precipitates of silver chloride, silver bromide and silver iodide form. These have characteristic colours.

halide ion	observation with silver nitrate
chloride	white precipitate forms
bromide	cream precipitate forms
iodide	yellow precipitate forms

### Barium chloride test for the sulphate ion

Around 1 – 2 cm<sup>3</sup> of a solution of the test compound is put into a test tube. A few drops of dilute hydrochloric acid are added, followed by a few drops of barium chloride solution. A white precipitate of barium sulphate forms.

### Test for the nitrate ion

A few drops of dilute sodium hydroxide are added to the test compound, followed by some aluminium powder. When the mixture is heated, ammonium ions are produced which break down to form ammonia.

### Test for the carbonate ion

A few drops of dilute acid are added to the test substance (most carbonates are insoluble so solids are usually used). Bubbles of carbon dioxide gas are given off (the gas can be confirmed using limewater).

Note that solid copper carbonate breaks down, when heated, to form black copper oxide. Zinc carbonate breaks down, when heated, to form white zinc oxide (zinc oxide is yellow while it is hot).