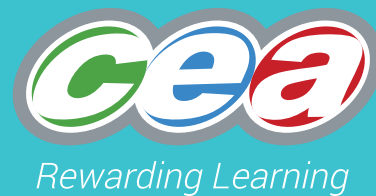


GCSE



CCEA GCSE TEACHER GUIDANCE

Chemistry Practical Manual

Unit 3: Practical Skills

C4: Identify the ions in an ionic
compound using chemical tests

Identifying the ions in an ionic compound using chemical tests

In this experiment you will carry out several tests to identify the cations and anions in ionic compounds.

Testing for Cations

There are 2 types of tests that can be used:-

1. Flame Tests

Apparatus required

Ionic compounds to test:-

Sodium chloride, calcium chloride, lithium chloride, potassium chloride, copper(II) sulfate (1 g per salt per group)

Concentrated hydrochloric acid (teacher to control and dispense small quantities or 2 mol/dm³ hydrochloric acid may be used as an alternative)

Bunsen burner, heatproof mat

Nichrome wire (in holder)

Safety

Follow safety advice given by teacher

Method

1. Take a piece of nichrome wire with a loop at one end
2. Dip the loop in the concentrated hydrochloric acid and place in the hot blue flame of the Bunsen burner
3. Repeat until the flame is no longer coloured, i.e. impurities are removed
4. Dip the clean nichrome wire in concentrated hydrochloric acid and the wire onto the solid ionic compound which is sitting in a watch glass
5. Hold the loop with the solid ionic compound in the hottest part of the flame and record the characteristic colour
6. Repeat for all the solid ionic compounds available, cleaning the wire loop each time.

Table of Results

Metal Ion	Observed colour	Actual colour
Sodium		Yellow/orange
Calcium		Brick red
Potassium		Lilac
Copper		Green-blue/Blue-green
Lithium		Crimson

Testing for Cations

2. Precipitation tests

Identifying Metal Ions:- Cu^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Zn^{2+} and Mg^{2+} using sodium hydroxide solution and ammonia solution

Apparatus and Chemicals

Copper(II) sulfate solution (0.2 mol/dm^3)
Iron(II) sulfate solution (0.2 mol/dm^3)
Iron(III) nitrate solution (0.2 mol/dm^3)
Aluminium nitrate solution (0.2 mol/dm^3)
Zinc nitrate solution (0.2 mol/dm^3)
Magnesium chloride solution (0.2 mol/dm^3)
Sodium hydroxide solution (0.5 mol/dm^3)
Ammonia solution (2 mol/dm^3)
Test tubes and stoppers (x6)
Test-tube rack
Small beaker (100 cm^3)
Disposable pipettes/droppers

Safety

Follow general safety advice of teacher

Method

1. Add approximately 5 cm^3 of the solution to be tested to a test-tube
2. Add sodium hydroxide solution slowly drop wise
3. Note your observations in the table
4. Continue adding sodium hydroxide drop wise to any precipitates until a large excess is present (about $2/3$ full)
5. Stopper and shake the test tube thoroughly
6. Note your observations in the following table:-

Name and formula of Ion	Observations when a few drops of sodium hydroxide solution added	Observation when excess sodium hydroxide solution added
Copper(II) ion Cu^{2+}		
Iron (II) ion Fe^{2+}		
Iron (III) ion Fe^{3+}		
Aluminium ion Al^{3+}		
Zinc ion Zn^{2+}		
Magnesium ion Mg^{2+}		

Repeat the tests above using ammonia solution in place of sodium hydroxide solution.

Record your results in the table below

Name and formula of Ion	Observations when a few drops of ammonia solution added	Observation when excess ammonia solution added
Copper(II) ion Cu^{2+}		
Iron (II) ion Fe^{2+}		
Iron (III) ion Fe^{3+}		
Aluminium ion Al^{3+}		
Zinc ion Zn^{2+}		
Magnesium ion Mg^{2+}		

Testing for Anions

There are many anions, however, we are required to know the tests for just a few. These are:-

- Chloride, Cl^-
- Bromide, Br^-
- Iodide, I^-
- Sulfate, SO_4^{2-}
- Carbonate, CO_3^{2-}

Sulfate and carbonate ions can be classed as molecular ion. What do you think the term molecular ion means?

Testing for each anion

Apparatus and Chemicals

Sodium sulfate solution (0.2 mol/dm^3)
Sodium carbonate solution (0.2 mol/dm^3)
Sodium chloride solution (0.2 mol/dm^3)
Potassium bromide solution (0.2 mol/dm^3)
Potassium iodide solution (0.2 mol/dm^3)
***Barium chloride solution (0.2 mol/dm^3)**
Silver nitrate solution (0.2 mol/dm^3)
Nitric Acid (0.2 mol/dm^3)
Limewater
Hydrochloric acid solution (2 mol/dm^3)
Test tubes (x 5)
Test-tube rack
Small beakers ($3 \times 100 \text{ cm}^3$)
Disposable pipettes/droppers

Safety

Follow general safety advice of teacher of all solutions – taking special care with *barium chloride solution

Note: In all the following reactions the ions are present in solutions. To test for these ions if a solid is supplied, simply dissolve 1 spatula of the solid in deionised water. The carbonate can be tested as a solid.

To test for Sulfate Ions

- Add sodium sulfate solution to the test-tube until the tube is 1/3 full
- Add barium chloride solution drop wise
- A **white precipitate** indicates a **sulfate** ion

To test for Halide Ions – these are chloride, bromide or iodide ions

- Add each of the 3 solutions to separate test-tubes until the tubes are 1/3 full each
- Add four drops of nitric acid, shake gently
- Add silver nitrate solution drop wise
- A white precipitate indicates the presence of the chloride ion
- A cream precipitate indicates the presence of the bromide ion
- A yellow precipitate indicates the presence of the iodide ion

To test for Carbonate Ions

- Take a small amount of solid or solution
- Add a little dilute hydrochloric acid
- Collect any gas formed, this is easily done by opening and closing an empty disposable pipette/dropper above the reaction. The dropper contents are then bubbled through 1cm³ of limewater
- A colourless gas is given off that turns limewater cloudy/milky indicates a carbonate ion

Record your results in the table:-

Name and formula of Ion	Description of test	Observations
Chloride, Cl ⁻		
Bromide, Br ⁻		
Iodide, I ⁻		
Sulfate, SO ₄ ²⁻		
Carbonate, CO ₃ ²⁻		

It is a good idea to take the time to really learn these tests, you may find it useful to make your own summary sheet of all the tests, both for cations and anions.