

Identification of unknown ionic compounds using flame tests and chemical tests for ions

Introduction

Scientists need to identify the compounds that they are working with. To do this we use a series of chemical tests that allow us to identify the different metal or non-metal ions that are present in a compound.

These tests include:

- Flame tests
- Tests for carbonate
- Tests for Group 7 ions

Flame test		Test for a carbonate ion, CO_3^{2-}	Test for Group 7 ions, Cl^- , Br^- and I^-	
Dip a damp wooden splint into the solid sample being tested. Put the sample into the hottest part of a Bunsen flame (air-hole open).		Add dilute hydrochloric acid. Pipette the gas formed into the limewater.	Make a solution by dissolving the sample in water. Add silver nitrate solution.	
Result		Result	Result	
Ion	Flame colour	Fizzes when acid is added Gas formed turns limewater milky	Ion	Precipitate colour
potassium, K^+	lilac		chloride, Cl^-	white
sodium, Na^+	yellow		bromide, Br^-	cream/pale yellow
calcium, Ca^{2+}	brick red		iodide, I^-	yellow
lithium, Li^+	red			

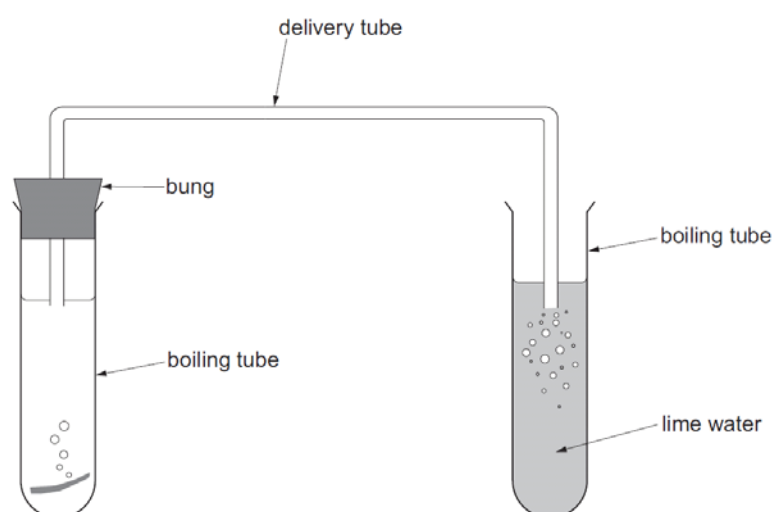
You will be provided with 5 solid compounds, labelled A, B, C, D and E.

You will use these tests to identify the five compounds you have been given.

Apparatus

5 × damp wooden splints
 Bunsen burner
 heat proof mat
 12 × test tubes
 1 × dropping pipette
 5 × spatulas
 silver nitrate solution
 dilute hydrochloric acid
 limewater

Diagram of Apparatus



Method - Flame test

1. Take a damp wooden splint and dip it into sample A.
2. Hold the splint in the roaring (blue) Bunsen burner flame.
3. Record the flame colour obtained.
4. Repeat for each of the samples with a separate damp splint.

Method - Test for carbonate ions

1. Add one of the samples to a test tube.
2. Half fill a second tube with limewater.
3. Add hydrochloric acid to the sample and quickly attach the bung and side arm tube.
4. Record what happens to the limewater.

Method – Test for Group 7 ions

1. Test each of the samples that did not give a positive result for the carbonate ion for the presence of a Group 7 ion.
2. Add a small amount of the solid to a test tube.
3. Add de-ionised water to each solid to create a solution.
4. Add silver nitrate to the solution using a dropping pipette.
5. Record the colour of the precipitate formed.

Analysis

1. Use the reference tables to identify each of the unknown compounds.

Risk Assessment

Hazard	Risk	Control measure
Hydrochloric acid is an irritant	Hydrochloric acid could get onto the skin when adding to test tube	Wash hands immediately if any hydrochloric acid gets onto them / wear laboratory gloves.
	Hydrochloric acid could get transferred from the hands to the eyes	Wear eye protection.
Limewater is corrosive	Limewater could get onto the skin when adding to test tube	Wash hands immediately if any limewater gets onto them / wear laboratory gloves.
	Limewater could get transferred from the hands to the eyes	Wear eye protection.
Silver nitrate is toxic	Silver nitrate could get onto the skin when adding to test tube	Wash hands immediately if any silver nitrate gets onto them / wear laboratory gloves.
	Silver nitrate could get transferred from the hands to the eyes	Wear eye protection.
Hot apparatus can burn	Burns to skin when moving Bunsen burner	Do not touch Bunsen burner until cool

Teacher / Technician notes

In this experiment it is important that the splints are soaked in de-ionised water not tap water.

Each splint should be no shorter than 10 cm.

An alternative to the damp splints is to use nichrome wires held in a bung or between tongs.

Reagents for flame tests:

Calcium chloride – Refer to CLEAPSS hazard 19A

Lithium chloride - Refer to CLEAPSS hazard 47B

Sodium carbonate – Refer to CLEAPSS hazard 95A

Potassium iodide – Refer to CLEAPSS hazard 47B

Potassium bromide – Refer to CLEAPSS hazard 47B

Other reagents:

Hydrochloric acid – Refer to CLEAPSS hazard 47A

Limewater – Refer to CLEAPSS hazard 18

Silver nitrate – Refer to CLEAPSS hazard 87

Students should design their own table, but a suggested table format is shown below.

Sample	Flame test observation	Carbonate test observation	Group 7 test observation	Name of Compound
A				
B				
C				
D				
E				

Working scientifically skills covered

1. Development of scientific thinking

Explain every day and technological applications of science; evaluate associated personal, social, economic and environmental implications and make decisions based on the evaluation of evidence and arguments.

2. Experimental skills and strategies

Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.

Carry out experiments appropriately having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.

Make and record observations and measurements using a range of apparatus and methods.

3. Analysis and Evaluation

Interpret observations and other data including identifying patterns and trends, making inferences and drawing conclusions.

4. Scientific vocabulary, quantities, units, symbols and nomenclature

Use SI units and IUPAC chemical nomenclature unless inappropriate.