

Edexcel Chemistry GCSE

CP 7: Identify the ions in unknown salts,
using the tests for the specified cations
and anions in 9.2C, 9.3C, 9.4C, 9.5C

Notes



Identifying ions

Aim

Identify the ions in unknown salts, using the tests for the specified cations and anions in 9.2C, 9.3C, 9.4C, 9.5C

Equipment list

- Distilled water
- Test tubes
- Wire loop
- Bunsen burner
- Heatproof mat
- Tongs
- Red litmus paper
- Boiling tube
- Bung and delivery tube

Chemicals required

- Unknown samples of salts
- Hydrochloric acid
- Dilute sodium hydroxide
- Limewater
- Barium chloride
- Nitric acid
- Silver nitrate

Method

For all tests below, except the flame test, dissolve the unknown solid in a small volume of distilled water before starting.

Flame test:

1. Clean a wire loop by dipping it in HCl then holding it in a blue flame until it burns without altering the colour of the flame.
2. Dip the clean wire loop into the unknown salt and then hold the loop in the blue flame of a bunsen burner. Record the colour.
3. Repeat for the other unknown samples.

Hydroxide precipitates test:

1. Place a little of the unknown solution in a test tube and add a few drops of dilute sodium hydroxide solution. Record any observations.
2. If a white precipitate forms, add an excess of sodium hydroxide solution and record any observations.

Test for ammonium ions:

1. Place a little of the unknown solution in a test tube and add a few drops of dilute sodium hydroxide solution. Warm the solution gently with a bunsen burner, holding the test tube with tongs.



2. Place a piece of damp red litmus paper over the end of the test tube and record any observations.

Test for carbonate ions:

1. Add a few drops of dilute hydrochloric acid to a boiling tube containing the unknown solution.
2. Place a bung and delivery tube onto the boiling tube and place the other end of the delivery tube into a test tube of limewater. Record any observations.

Test for sulfate ions:

1. Add a few drops of hydrochloric acid to a test tube of the unknown substance followed by a few drops of barium chloride. Record any observations.

Test for halide ions:

1. Add a few drops of nitric acid to the unknown solution followed by a few drops of silver nitrate. Record any observations.

Key points

- To distinguish between Al^{3+} ions and Ca^{2+} ions using the hydroxide precipitates test, excess sodium hydroxide must be added after the white precipitates form. The precipitate $\text{Al}(\text{OH})_3$ reacts to form a colourless solution whereas the precipitate $\text{Ca}(\text{OH})_2$ remains unchanged.
- Testing for halide ions in dilute solutions may lead to incorrect identification as faint/ pale precipitates may form. This makes difficult to identify what colour the precipitate is.
- Acid is added before testing for sulfate ions to react with carbonate ions and prevent false positives. This is because carbonate ions react with barium chloride to form a white precipitate. Sulfuric acid must not be used as this would introduce sulfate ions, giving a false positive result.
- The flame test cannot be used to identify ions in a mixture as the different flame colours produced by each ion would blend together.

Safety precautions

- Solid barium chloride is harmful and toxic. Only use a dilute solution and do not ingest.
- Silver nitrate solution causes skin and eye irritation. Wear safety goggles and gloves to avoid contact with skin. Wash skin immediately if it comes into contact with silver nitrate.
- Take care when using a Bunsen burner. Leave on the safety flame or turn gas off when not in use. Tie long hair back and keep any flammable solutions away from the naked flame.
- Treat all of the unknown samples as harmful and irritant.
- Replace lids on chemicals after use to avoid spills.
- Clear up any broken glassware or chemical spillages immediately.
- Ensure the laboratory is well ventilated.



Analysis of Results

Flame test results:

Ion	Flame colour
Lithium (Li^+)	Red
Sodium (Na^+)	Yellow
Potassium (K^+)	Lilac
Calcium (Ca^{2+})	Orange-red
Copper (Cu^{2+})	Blue-green

Hydroxide precipitates test:

Metal ion	Colour of precipitate
Aluminium (Al^{3+})	White, dissolves in excess $\text{NaOH}(\text{aq})$
Calcium (Ca^{2+})	White, no change in excess $\text{NaOH}(\text{aq})$
Copper (Cu^{2+})	Blue
Iron(II) (Fe^{2+})	Green
Iron(III) (Fe^{3+})	Brown

Positive test for ammonium ions:

Gas produced by the reaction turns damp red litmus paper blue.

Positive test for carbonate ions:

Bubbles of gas are produced. Limewater turns cloudy.

Positive test for sulfate ions:

White precipitate forms.

Positive test for halide ions:

Chloride ions (Cl^-) - white precipitate

Bromide ions (Br^-) - cream precipitate

Iodide ions (I^-) - yellow precipitate

