

AQA Chemistry A-level

Required Practical 4

Carry out simple test-tube reactions to identify cations and anions



Cations: Group 2 ions or NH_4^+

Test for group 2 ions: sodium hydroxide

Method	Accuracy	Explanation
1. Place 10 drops of 0.1 mol dm^{-3} barium chloride in a clean test tube.		Must be clean to ensure a clear test result.
2. Add 10 drops of 0.6 mol dm^{-3} sodium hydroxide solution, mixing well and recording any observations.		
3. Continue to add this sodium hydroxide solution, dropwise with gentle shaking, until in excess. Record any observations.	<ul style="list-style-type: none"> The test tube should not be more than half full. 	
4. Once completed, dispose of the contents by placing the test tube in a bowl of water. Repeat this test with the calcium bromide, magnesium chloride and strontium chloride.		

Expected results:

	Barium chloride	Calcium bromide	Magnesium chloride	Strontium chloride
Initial	colourless solution	colourless solution	colourless solution	colourless solution
10 drops of 0.6 mol dm^{-3} NaOH	colourless solution	slight white precipitate	slight white precipitate	slight white precipitate
Excess NaOH	colourless solution	slight white precipitate	white precipitate	slight white precipitate



Test for group 2 ions: dilute sulphuric acid

Method	Accuracy	Explanation
1. Place 10 drops of 0.1 mol dm^{-3} barium chloride in a clean test tube. Add 10 drops of 1.0 mol dm^{-3} sulfuric acid, mixing well and recording any observations.		Must be clean to ensure a clear test result.
2. Continue to add this sulfuric acid, dropwise with gentle shaking, until in excess.	<ul style="list-style-type: none"> The test tube should not be more than half full. 	
3. Once completed, dispose of the contents by placing the test tube in a bowl of water. Repeat this test with the calcium bromide, magnesium chloride and strontium chloride.		

Expected results:

	Barium chloride	Calcium bromide	Magnesium chloride	Strontium chloride
10 drops of $1.0 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$	white precipitate	slight white precipitate	slight white precipitate	white precipitate
Excess H_2SO_4	white precipitate	slight white precipitate	colourless solution	white precipitate

Safety precautions:

- Some barium salts are toxic so wear gloves.



Overall results for Group 2:

	Mg ²⁺	Ca ²⁺	Sr ²⁺	Ba ²⁺
Ammonium solution	White precipitate of Mg(OH) ₂	No change	No change	No change
Excess NaOH	White precipitate of Mg(OH) ₂	White precipitate of Ca(OH) ₂	Slight white precipitate	No change
Excess H ₂ SO ₄	Colourless solution	Slight white precipitate	White precipitate	White precipitate

Test for ammonium ions:

Method	Accuracy	Explanation
1. Place 10 drops of ammonium chloride into a clean test tube. Add about 10 drops of sodium hydroxide solution. Shake the mixture.	<ul style="list-style-type: none"> Shaking ensure the reactant combine properly. 	
2. Warm the mixture in the test tube gently using a water bath. (necessary because ammonia gas is very soluble)		A water bath is more gentle than using a flame.
3. Test the fumes released from the mixture by using forceps to hold a piece of damp red litmus paper in the mouth of the test tube.		
4. Dispose of the contents by placing in a test tube full of boiling water		
5. Record the observation of the damp red litmus paper (should turn blue).		Ammonium ions are basic.



Anions – Group 7 (halide ions) or OH^- , CO_3^{2-} , SO_4^{2-}

Test for hydroxide ions: aqueous solution

1. Test a 1 cm depth of solution in a test tube with red litmus paper or universal indicator paper.
2. Record your observations. Dispose of the test tube contents.
3. Sodium hydroxide will turn damp red litmus paper blue.

Test for hydroxide ions: ammonia (hydroxide ions form when it comes into contact with water)

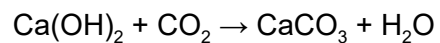
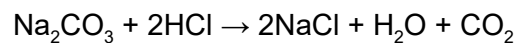
1. Take 5 drops of 1.0 mol dm^{-3} ammonia solution and place on a filter paper and place inside a petri dish with lid.
2. Dampen a piece of red litmus paper with deionised (distilled) water and place on the other side of the petri dish.
3. Replace the lid and observe over a few minutes.
4. Ammonia solution vapours will turn damp red litmus paper blue.

Test for carbonate ions: aqueous solution

Method	Accuracy	Explanation
1. Add an equal, small volume of dilute hydrochloric acid to sodium carbonate solution in a test tube.		
2. Use a delivery tube to transfer the gas produced into a second test tube containing a small volume of calcium hydroxide solution (limewater).	<ul style="list-style-type: none"> • Using a tube with a bung prevents product loss. 	
3. Put a stopper into the test tube containing the calcium hydroxide solution (limewater).	<ul style="list-style-type: none"> • Shake the tube from side to side. 	



4. The limewater will go cloudy if carbonate ions present.		CO ₂ is produced which turns the limewater cloudy.
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Equations:

Test for sulfate ions: aqueous solution

Method	Accuracy	Explanation
1. Add an equal volume of dilute hydrochloric acid then an equal volume of barium chloride solution to the solution.	<ul style="list-style-type: none"> The HCl ensures any other compounds which may react are removed. 	
2. Barium sulphate formed (white precipitate).		Barium sulfate is an insoluble salt.
3. Add a small volume of dilute HCl.		
4. As precipitate does not dissolve, sulphate or hydrogensulfate ions are present.		

Equations:


Safety precautions:

- Barium Chloride is HARMFUL so wear gloves and a lab coat.

Test for halide ions: aqueous solution

Method	Accuracy	Explanation
1. Add a small volume of dilute nitric acid to the solution of potassium chloride.	<ul style="list-style-type: none"> • This removes any ions which may form a different precipitate. 	
2. Add 2 cm of silver nitrate to the solution. Record any observations.		
3. Swirl the tubes to ensure that the precipitates formed in each case are evenly distributed and then divide the contents of each tube in half.		Allows further identification tests as initial precipitates can be hard to distinguish.
4. To one half of the contents, add an excess of dilute aqueous ammonia solution and observe what happens. Record your observations.		
5. To the other half, working in a fume cupboard, add an excess of concentrated ammonia solution and observe what happens. Record your observations.		
6. Repeat with solutions of potassium bromide and potassium iodide in new, separate test tubes.		



Safety:

- Concentrated ammonia is corrosive so chemical splash-proof eye protection and nitrile gloves should be worn.
- Use a fume cupboard.
- Dilute nitric acid is an irritant.

Overall results for Group 7:

	Silver nitrate	Dilute ammonia	Conc. ammonia
KCl	White precipitate	Colourless solution	Colourless solution
KBr	Cream precipitate	Cream precipitate	Colourless solution
KI	Yellow precipitate	Yellow precipitate	Yellow precipitate

Test for group 7 ions: solid salts

1. Place a small spatula measure of solid potassium chloride in a dry test tube in a test tube rack.
2. Working in a fume cupboard, add a few drops of concentrated sulfuric acid. Record any observations.
3. Test any gas evolved with moist blue litmus or universal indicator paper.
4. Repeat the experiment with solid potassium bromide and solid potassium iodide, recording any observations.



Overall results for Group 7:

	Conc. sulfuric acid	Blue litmus paper
KCl	White, steamy fumes	Turns red
KBr	Orange fumes	Turns red
KI	Purple fumes and purple/black solid	Turns red

Safety:

- Concentrated sulfuric acid is corrosive.
- Gases produced are toxic and corrosive, therefore carry out in a fume cupboard using small quantities of chemicals.
- Wear chemical splash-proof eye protection and nitrile gloves.

