
A-level Chemistry exemplar for required practical 4

Carry out simple test-tube reactions to identify cations and anions in aqueous solution:

To carry out tests for the presence of cations and anions and to make accurate observations.

Student sheet

These tests may be split over several lessons.

Requirements

You are provided with the following:

General

- test tubes and stoppers
- test-tube racks
- plastic graduated dropping pipettes
- deionised or distilled water
- forceps.

Test 1

- 0.1 mol dm⁻³ barium chloride solution
- 0.6 mol dm⁻³ sodium hydroxide solution
- 0.1 mol dm⁻³ calcium bromide solution (or calcium nitrate/potassium bromide)
- 0.1 mol dm⁻³ magnesium chloride solution
- 0.1 mol dm⁻³ strontium chloride solution.

Test 2

- 0.1 mol dm⁻³ barium chloride solution
- 1.0 mol dm⁻³ sulfuric acid
- 0.1 mol dm⁻³ calcium bromide solution (or calcium nitrate/potassium bromide)
- 0.1 mol dm⁻³ magnesium chloride solution
- 0.1 mol dm⁻³ strontium chloride solution.

Test 3

- 0.1 mol dm⁻³ ammonium chloride
- 0.4 mol dm⁻³ sodium hydroxide solution
- red litmus paper
- kettle
- water bath.

Test 4

- 0.4 mol dm⁻³ sodium hydroxide solution
- red litmus paper (or universal indicator paper)
- 1.0 mol dm⁻³ ammonia solution
- petri dish with lid.

Test 5

- 0.5 mol dm⁻³ sodium carbonate solution
- 0.5 mol dm⁻³ hydrochloric acid
- 0.02 mol dm⁻³ calcium hydroxide solution (limewater).

Test 6

- 0.1 mol dm⁻³ barium chloride solution
- 0.1 mol dm⁻³ magnesium sulfate solution.

Test 7

- 0.1 mol dm⁻³ potassium chloride solution
- 0.1 mol dm⁻³ potassium bromide solution
- 0.1 mol dm⁻³ potassium iodide solution
- 0.1 mol dm⁻³ nitric acid
- 0.05 mol dm⁻³ silver nitrate solution
- concentrated ammonia solution
- 2.0 mol dm⁻³ ammonia solution.

Test 8

- potassium chloride solid
- potassium bromide solid
- potassium iodide solid
- 0.1 mol dm⁻³ lead nitrate solution (or lead ethanoate solution)
- blue litmus paper
- filter paper
- small spatula.
- concentrated sulfuric acid in dropping bottles
- 0.5 mol dm⁻³ acidified potassium dichromate(VI) solution.

Suggested method

In every case, you should present **all** of your observations in a neat table. The presentation of a clearly organised record of your observations is an important skill which you **will** be expected to demonstrate.

Tests 1 and 2: Testing for Group 2 metal cations

Test 1: Dilute sodium hydroxide

- Place about 10 drops of 0.1 mol dm^{-3} barium chloride in a clean test tube.
- Add about 10 drops of 0.6 mol dm^{-3} sodium hydroxide solution, mixing well.
- Now continue to add this sodium hydroxide solution, dropwise with gentle shaking, until in excess.

The test tube should **not** be more than half full. 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.

Test 2: Dilute sulfuric acid

- Place about 10 drops of 0.1 mol dm^{-3} barium chloride in a clean test tube.
- Add about 10 drops of 1.0 mol dm^{-3} sulfuric acid, mixing well.
- Now continue to add this dilute sulfuric acid, dropwise with gentle shaking, until in excess.

The test tube should not be more than half full. 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.

Test 3: Testing for ammonium ions

- Place about 10 drops of 0.1 mol dm^{-3} ammonium chloride in a clean test tube.
- Add about 10 drops of 0.4 mol dm^{-3} sodium hydroxide solution. Shake the mixture.
- Warm the mixture in the test tube gently using a water bath.
- 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.
- Dispose of the contents by using the previous method.

Tests 4, 5, and 7: Tests for anions in aqueous solution

Test 4: Test for hydroxide ions in aqueous solution

- Test about 1 cm³ of 0.4 mol dm⁻³ sodium hydroxide solution in a test tube with red litmus paper or universal indicator paper.
- Record your observations. Dispose of the test tube contents.

This approach can also be used to test for the alkaline gas, ammonia, which forms hydroxide ions when it comes into contact with water.

- Take 5 drops of 1 mol dm⁻³ ammonia solution and place on a filter paper and place inside a petri dish with lid. Dampen a piece of red litmus paper with deionised water and place on the other side of the petri dish. Replace the lid and observe over a few minutes.
- Record your observations.

Test 5: Test for carbonate ions in aqueous solution

- Have about 2 cm³ of calcium hydroxide (limewater) ready in a test tube.
- To about 3 cm³ of 0.5 mol dm⁻³ sodium carbonate solution in a test tube, add an equal volume of 1.0 mol dm⁻³ dilute hydrochloric acid.
- Immediately put in delivery tube with open end into the limewater test tube. Make sure that the end of the tube is below the level of the liquid.
- Record your observations. Dispose of the test tube contents.

Test 6: Test for sulfate ions in aqueous solution

- To about 1 cm³ of 0.1 mol dm⁻³ magnesium sulfate solution in a test tube, add an equal volume of dilute hydrochloric acid followed by an equal volume of 0.1 mol dm⁻³ barium chloride solution.
- Record your observations. Dispose of the test tube contents.

Test 7: Test for halide ions in aqueous solution

Test for chloride, bromide and iodide ions in aqueous solution

- Place about 10 drops of 0.1 mol dm⁻³ potassium chloride in a clean test tube.
- Add about 5 drops of dilute nitric acid. Shake well.
- To the solution add another 10 drops of 0.05 mol dm⁻³ silver nitrate solution.
- Then add an excess of 2 mol dm⁻³ ammonia solution and shake to mix thoroughly. Dispose of the tube contents.
- Repeat steps a) and b), but this time add an excess of concentrated ammonia solution, working in a fume cupboard. Dispose of the tube contents.
- Repeat steps a) to d) but using potassium bromide and then potassium iodide instead of potassium chloride.

Test 8: Test for halide ions in solid salts using concentrated sulfuric acid

Test for chloride, bromide and iodide ions in solid potassium halides

Note: Gloves **must** be worn for this procedure.

These experiments must be done in a fume hood

- a) Place a small spatula of solid potassium chloride in a clean dry test tube.
- b) Slowly add a few (2 to 5) drops of concentrated sulfuric acid.
- c) Record what happens.
- d) Test the gas evolved with moist blue litmus paper, taking care that the paper does not touch the sides of the test tube.
- e) Repeat this experiment with solid potassium bromide, but this time test the gas produced using a narrow strip of filter paper that has been dipped in acidified potassium dichromate solution.
- f) Repeat this experiment with potassium iodide, but this time test the gas produced using a narrow strip of filter paper that has been dipped in lead nitrate solution.