

WJEC Chemistry GCSE

Specified Practical 4

Identifying Unknown Substances

[Methods are taken from [AQA Chemistry GCSE Practical handbook](#) and the [Royal Society of Chemistry](#)]

England Specification





Identifying Ions

Aim

Use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from flame tests and sulphates.

Equipment List

- Nichrome wire mounted in handle
- Limewater
- 0.4 M dilute hydrochloric acid
- 0.1 M barium chloride solution
- 0.4 M dilute nitric acid
- 0.05 M silver nitrate solution
- 0.4 M known labelled cation salt solutions: LiCl, NaCl, KCl, CaCl₂, CuCl₂
- 0.4 M known labelled anion salt solutions: Na₂CO₃, Na₂SO₄, NaCl, NaBr, NaI
- 0.4 M salt solution labelled 'unknown'.

1. Flame Tests for Metal Ions

Method

1. Pour 1 cm³ of each known chloride solution into 5 test tubes.
2. Clean the nichrome wire by dipping it in dilute hydrochloric acid.
3. Dip the nichrome wire into solution and hold the tip in a blue Bunsen flame.
4. Record the colour of the flame.
5. Repeat for the following solutions and make sure to clean the wire after each test.
6. Pour 1 cm³ of the unknown salt solution into a test tube.
7. Dip the nichrome wire into solution and hold the tip in a blue Bunsen flame.
8. Record the colour of the flame, you should be able to compare results with the known chloride with the matching colour flame.

Results

- | | |
|--|---|
| - Lithium (Li ⁺) – crimson flame | - Copper (II) (Cu ²⁺) – green flame |
| - Sodium (Na ⁺) – yellow flame | - See diagram for other common chemicals. |
| - Potassium (K ⁺) – lilac flame | |
| - Calcium (Ca ²⁺) – orange-red flame | |





FLAME TEST COLOURS

 LITHIUM Li^+	 SODIUM Na^+	 POTASSIUM K^+	 RUBIDIUM Rb^+	 CAESIUM Cs^+	 CALCIUM Ca^{2+}
 STRONTIUM Sr^{2+}	 BARIUM Ba^{2+}	 RADIUM Ra^{2+}	 COPPER Cu^{2+}	 IRON $\text{Fe}^{2+}/\text{Fe}^{3+}$	 BORON B^{3+}
 INDIUM In^{3+}	 LEAD Pb^{2+}	 ARSENIC As^{3+}	 ANTIMONY $\text{Sb}^{3+}/\text{Sb}^{5+}$	 SELENIUM $\text{Se}^{2+}/\text{Se}^{4+}$	 ZINC Zn^{2+}

A flame test is an analytical procedure used by chemists to detect the presence of particular metal ions, based on the colour of the flame produced. When heated, the electrons in the metal ion gain energy and can jump into higher energy levels. Because this is energetically unstable, the electrons tend to fall back down to where they were before, releasing energy as they do so. This energy is released as light energy, and as these transitions vary from one metal ion to another, it leads to the characteristic colours given by each metal ion.



© COMPOUND INTEREST 2015 - WWW.COMPOUNDCHEM.COM | @COMPOUNDCHEM
Shared under a Creative Commons Attribution-NonCommercial-NoDerivatives licence.



Image Source: [Compound Interest CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)





2. Test for Carbonate Ions (CO_3^{2-})

Method

1. Place a 2 cm^3 of lime water in a clean test tube.
2. Add a little dilute hydrochloric acid to the unknown solution.
3. If you see bubbles, transfer the gas produced to the limewater using a delivery tube.
4. Repeat this process for the known sodium solutions to identify carbonate ions.

Results

- Bubbles produced and lime water goes cloudy if present.

3. Test for Sulphate Ions (SO_4^{2-})

Method

1. Add 10 drops of dilute hydrochloric acid to the unknown solution in a test tube.
2. Add a 2 cm^3 barium chloride solution.
3. Pour 1 cm^3 of the known sodium solutions into separate test tubes.
4. Add 5 drops of dilute hydrochloric acid and then 2 cm^3 of barium chloride.

Results

- White precipitate formed if present.





4. Test for the Halide Ions (Cl^- , Br^- , I^-)

Method

1. Add 10 drops of dilute nitric acid to the unknown solution in a test tube.
2. Add a 1 cm^3 silver nitrate solution to the test tube with the unknown solution.
3. Pour 1 cm^3 of the known sodium solutions into separate test tubes.
4. Repeat steps 1 and 2 for which of the solutions.
5. Record colour of precipitate formed in each test tube.

Results

- Chloride – white precipitate produced
- Bromide – cream precipitate produced
- Iodide – yellow precipitate produced

