

Flame tests

What do the table salt, street lamp, and fireworks have in common?

They all contain **sodium**, which gives off a unique **yellow** flame when heated.



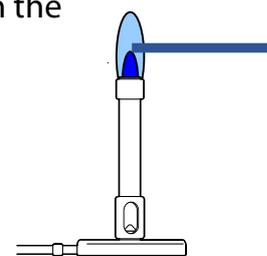
You are going to discover the flame colours produced by the metal ions in five different known salt solutions. You will then use your results to work out which metal ions are in four unknown salt solutions.



Job 1 The first job is to make sure that you have a clean flame test wire. Your teacher may ask you to skip this Job if each solution has its own station.

Check that your flame test wire is clean. Do this by holding the metal loop in the hottest part of the Bunsen burner flame. If it is clean, there should be no change in the colour of the flame when the metal loop is put in the flame.

If the metal loop is not clean, clean it by dipping it into the concentrated acid provided, then holding the loop in the Bunsen burner flame. Repeat this cleaning until there is no more change in the colour of the flame.



Job 2 The next job is to do your flame tests. Dip the flame test loop into one of the known test solutions, then hold the metal loop in the hottest part of the Bunsen burner flame. Make a note of the colour of the flame on your **Flame Test Chart**.

If necessary, clean the flame test wire as you did in Job 1, then test another known test solution. Keep going until you have recorded the colour of all of the known solutions.



Ask one of the teachers to check your Results before going on to the next job.

Job 3 Repeat Job 2, but this time with each of the four unknown test solutions. Use your results to work out which metal is in each solution.



Every atom consists of a nucleus with tiny electrons whizzing round it. The further away from the nucleus they are, the more energy the electrons have. If a metal atom is heated, the electrons get enough energy to jump higher away from the nucleus. When the electrons fall back closer to the nucleus, they give off this extra energy as light.

Different metals produce different coloured light. If we look at the colour of the light made when a solution is heated in a flame, we can tell which metal is there.

Flame Test Chart

Name _____

Record your results during Job 2 in the table below.

metal ion	lithium, Li ⁺	sodium, Na ⁺	potassium, K ⁺	calcium, Ca ²⁺	copper, Cu ²⁺
flame colour					

Record your results during Job 3 in the table below.

unknown solution	1	2	3	4
flame colour				
metal ion				

Flame Test Chart

Name _____

Record your results during Job 2 in the table below.

metal ion	lithium, Li ⁺	sodium, Na ⁺	potassium, K ⁺	calcium, Ca ²⁺	copper, Cu ²⁺
flame colour					

Record your results during Job 3 in the table below.

unknown solution	1	2	3	4
flame colour				
metal ion				

Flame tests

Teacher Guide



Contents

- Activity notes
- Student checklist
- Technician notes

Activity notes

We investigate lithium, sodium, potassium, calcium and copper(II) salts. They give readily identifiable colours and are specified for GCSE courses. Solutions are safer to use than solids, although both work in flame tests.

The activity is most easily carried out using different stations, one for each solution and with labelled flame test loops. This avoids the need to clean the flame test loops, and is desirable if adequate supervision of the students cannot be obtained. If required, the flame test wires can be cleaned between each test by dipping in hydrochloric acid and heating. Sodium ions in particular are difficult to remove, and students will end up thinking everything contains sodium or makes a yellow flame!

The expected colours are shown in the table below.

metal ion	flame test colour
lithium, Li ⁺	red (crimson)
sodium, Na ⁺	yellow
potassium, K ⁺	lilac
calcium, Ca ²⁺	orange-red
copper, Cu ²⁺	blue-green

Note that solutions copper salts are coloured, whereas the other solutions are colourless.

5 M Hydrochloric acid

Irritant to the skin, eyes and respiratory system.

Wear eye protection. Avoid skin contact and do not inhale the vapour.

Salt solutions

At a concentration of 0.5 M, these metal chlorides are low hazard. Note that 0.5 M copper(II) sulfate is corrosive to the eyes and irritant to the skin, so copper(II) chloride solution is preferable.

Flame tests

Student checklist

Check that you have the following things.

- 1 × Bunsen burner
- 1 × heat-resistant mat
- flame test wires
- 5 × named salt solutions
- 4 × 'unknown' solutions



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Flame tests

Technician notes

In the lab

test-tube racks

heat-resistant mats

Bunsen burners

nichrome flame test wires (minimum of 10, cleaned)

5 M hydrochloric acid in labelled test tubes (optional) ⚠

Flame test charts (1 per student)

In test tubes, approx. 0.5 M solutions of:

lithium chloride (labelled **Li⁺**)

sodium chloride (labelled **Na⁺**)

potassium chloride (labelled **K⁺**)

calcium chloride (labelled **Ca²⁺**)

copper(II) chloride (labelled **Cu²⁺**)

Four of these five solutions as unknowns (labelled **1, 2, 3** and **4**)

Maintain stocks of these solutions for replenishment