

Flame emission spectroscopy

4.8.3.7 · Chemical analysis · revision notes

Flame emission spectroscopy is an instrumental method that identifies the metal ions in a solution from their line spectra and measures their concentrations. This is in GCSE Chemistry only (not Combined Science). You interpret spectra or data by comparing them with reference spectra.

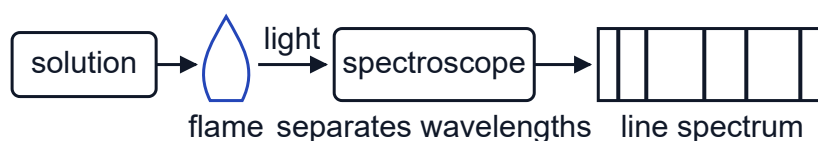
Key facts

- Sample solution in flame → light → spectroscope → line spectrum
- A metal ion is present only if ALL its reference lines appear
- More intense lines = higher concentration
- Each metal ion has its own pattern of lines
- Mixture: the spectrum shows the lines of every metal ion present
- Better than flame tests: no masking, gives concentrations, more sensitive

Notes

How it works

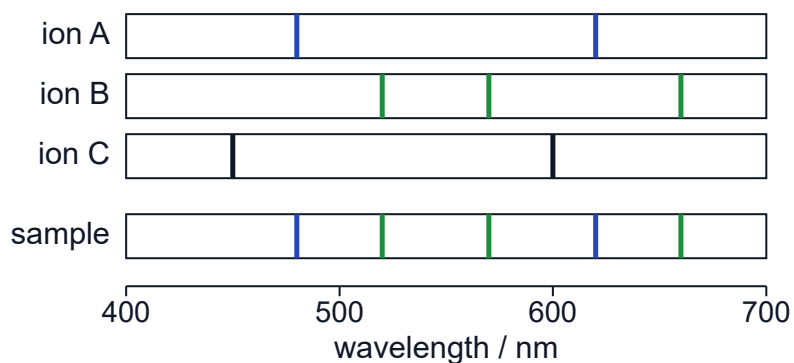
- Flame emission spectroscopy is an instrumental method used to analyse **metal ions in solutions**.
- The sample solution is put into a flame, and the metal ions give out light.
- The light given out is passed through a **spectroscope**, which separates it into different wavelengths.
- The output is a **line spectrum**: a pattern of lines at particular wavelengths.



Each metal ion gives its own pattern of lines.

Identifying metal ions

- Each metal ion gives its own pattern of lines, like a fingerprint.
- Compare the sample's spectrum with **reference spectra** of known metal ions. A metal ion is present only if **all** of its lines appear in the sample's spectrum.



Sample contains A and B: all their lines appear. C is absent: its 450 nm line is missing.

- A mixture gives a spectrum containing the lines of every metal ion present, so each ion can still be identified. With flame tests, one colour can mask another.

Measuring concentration

- The **intensity** (brightness) of the lines depends on the concentration of the metal ion: the higher the concentration, the more intense the lines.
- Compared with flame tests, it is more sensitive and accurate, works with mixtures and gives concentrations, but the equipment is expensive.

How to answer each type of question

Describe how flame emission spectroscopy is used

2 to 3 marks

Grade 4

- The sample solution is put into a flame.
- The light given out is passed through a spectroscope to give a line spectrum.
- The spectrum is compared with reference spectra of known metal ions.

Example. Describe how flame emission spectroscopy is used to identify the metal ion in a solution.

Model answer. The solution is put into a flame (1). The light given out is passed through a spectroscope to give a line spectrum (1). The spectrum is compared with reference spectra of known metal ions to find the ion whose lines match (1).

Don't lose marks

- ✗ Saying a metal ion is present when only some of its lines match.
- ✗ Forgetting that a mixture's spectrum contains the lines of every ion present.
- ✗ Describing a flame test (a colour judged by eye) instead of a line spectrum from a spectroscope.

✗ Reading a calibration graph the wrong way: start from the intensity, then read off the concentration.

More tips

Memory tricks

- A line spectrum is a fingerprint: a metal ion is only there if every one of its lines is there.
- Tick off the lines: cross out each sample line as you match it. Any line left over means another ion is present.
- Brighter lines = more ions = higher concentration.

Exam technique

- Quote the wavelengths when you explain a match, e.g. 'lines at 470, 610 and 650 nm all appear'.
- For 'describe', use three steps: flame → spectroscope → line spectrum compared with reference spectra.
- If asked for an advantage over flame tests, mention mixtures (no masking) and measuring concentration.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 4

Describe how flame emission spectroscopy works

The sample is put into a flame and the light given out passes through a spectroscope, giving a line spectrum.

Grade 5

Identify a metal ion from reference spectra

Each metal ion gives its own pattern of lines; the ion is present if all its lines appear.

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