Positive ions: colours and precipitates

Student activity • microscale practical

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The question

How can different tests support the identity of a positive ion?

Observe three metal-hydroxide tests on a spotting tile, then use recorded or reference evidence for flame colours and ammonium. Keep actual observations separate from expected colours. No pupil flame test or warming step is used in this edition.

Equipment

- Eye protection, six-well tile, tray, dedicated labelled droppers
- 0.1 mol dm^{-3} $CuSO_4$, fresh $FeSO_4$ and $FeCl_3$ solutions; 0.4 mol dm^{-3} NaOH
- Water control and white background; optional RSC flame-test recording

Wear eye protection. NaOH can damage eyes; avoid contact with all solutions. Report splashes immediately and follow the laboratory eye-rinse procedure. No heating or flames. Collect all liquids and first rinses; wash hands.

Course coverage: 2.45–2.47: flame-test procedure and five flame colours; sodium hydroxide tests for Cu^{2+}, Fe^{2+}, Fe^{3+} and NH_4^+.

Plan, model or apparatus sketch

Label separate wells for Cu^{2+}, Fe^{2+}, Fe^{3+} and a water control.

Method and reasoning

Read the whole sequence before starting

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1. Wear eye protection. Label wells Cu^{2+}, Fe^{2+}, Fe^{3+} and water control. Use separate droppers and keep the tile on a tray.

2. Put three drops of the labelled solution into each ion well and three drops of water into the control. Record initial appearance.

3. Add two drops of 0.4 mol dm^{-3} sodium hydroxide to each well. Observe immediately against a white background, and again after five minutes. Do not touch the liquids.

4. Record the colour and whether a solid precipitate appears. A coloured solution and a coloured precipitate are different observations.

5. Study the flame-test recording or reference: a clean wire loop, checked for contamination, introduces a little salt into a non-luminous flame. Record the five specified colours as reference knowledge; no burner is used here.

6. Read the ammonium reference: warming with sodium hydroxide releases ammonia, which turns damp red litmus blue. Explain why the paper must not touch the alkaline liquid. Do not perform this warming step.

7. Interpret the test set, write one precipitation equation and collect the mixtures and first rinses as directed.

Cleanup

- Collect tile contents and first rinses in labelled metal-salt waste. Clean equipment as instructed and wash hands.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Reference flame colours: Li^+ red, Na^+ yellow, K^+ lilac, Ca^{2+} orange-red, Cu^{2+} blue-green. Reference ammonium test: add sodium hydroxide and warm; ammonia turns damp red litmus blue. Flame colour and precipitate tests are interpreted within the supplied sample set, not as universally unique identifications.

Sample	Immediately after NaOH	After five minutes
Cu^{2+}		
Fe^{2+}		
Fe^{3+}		
Water control		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Distinguish a solution colour from a precipitate colour using your results.

2. Write the ionic equation for Cu^{2+} reacting with OH^{-}.

3. Compare Fe^{2+} and Fe^{3+} results, including any change on standing.

4. Describe how a flame-test loop is checked and why sodium contamination matters.

5. Recall all five specified flame colours.

6. Explain the ammonium test and why touching litmus to sodium hydroxide could give a misleading result.