Chem CP7a Tests for positive ions

Objectives

C9.1 Explain why the test for any ion must be unique.

C9.3 Describe tests to identify the following ions in solids or solutions as appropriate:

- **a** aluminium ion, Al^{3+}
- **b** calcium ion, Ca^{2+}
- **c** copper ion, Cu^{2+}
- **d** iron(II) ion, Fe^{2+}
- **e** iron(III) ion, Fe^{3+}
- **f** ammonium ion, NH_4^+

using sodium hydroxide solution.

C9.4 Describe the chemical test for ammonia.

C9.6 *Core Practical (part): Identify the ions in unknown salts, using the tests for the specified cations and anions.*

C9.7 Identify the ions in unknown salts, using results of the tests above.

Maths requirements

1c Use ratios, fractions and percentages.

Learning outcomes

5th **SC9.1C** Explain why the test for a given ion must be unique to that ion.

5th **SC9.3C** Recall some metal hydroxide precipitate colours.

6th **SC9.3C** Describe how to identify metal ions using sodium hydroxide solution.

6th **SC9.4C** Describe how to identify ammonium ions and ammonia.

Exploring

1. Metal hydroxide precipitate tests

This practical forms one part of the core practical requirement of the specification. It is further supported by the information on Students' sheet CP7a(Identifying Ions -Positive ions) and on *SC25c Core practical – Identifying ions* in the Student Book and on , in which the various methods for identifying anions and cations (met in *SC25a, SC25b* and *Sc25c*) are brought together.

Ask students to carry out hydroxide precipitate tests on solutions containing Al^{3+}, Ca^{2+}, Cu^{2+}, Fe^{2+} or Fe^{3+}. If a white precipitate forms, the students should add excess sodium hydroxide solution and record any changes. Students should use sodium hydroxide solution to identify the metal ion present in unknown samples.

You may wish to set each known solution at five or ten stations around the lab to avoid cross-contamination, and run the first part of the activity as a circus. Once the expected metal hydroxide precipitate colours have been identified and agreed, the students could then test five unknown solutions.

Support: Check that students keep the volumes of solution small, because it becomes difficult to mix the contents of the test tube if the excess occupies a large part of the test tube.

Stretch: Challenge the students to write a balanced ionic equation for the formation of each precipitate.

⚠ Safety

Eye protection should be worn. 1.0 mol dm^{-3} sodium hydroxide solution is corrosive, so avoid skin contact.

Expected results

Copper compounds produce a blue precipitate, iron(II) compounds produce a green precipitate (which turns brown on standing), and iron(III) compounds produce a brown precipitate. Aluminium compounds and calcium compounds both produce white precipitates, but only the aluminium hydroxide precipitate reacts with excess sodium hydroxide solution and disappears to form a colourless solution.

Course resources

Chem Students' sheet CP7a

Equipment

eye protection, dropping pipettes, test tubes, test-tube rack, 1.0 mol dm^{-3} sodium hydroxide, 0.1 mol dm^{-3} aluminium nitrate labelled Al^{3+}, 0.1 mol dm^{-3} calcium chloride labelled Ca^{2+}, 0.1 mol dm^{-3} copper(II) sulfate labelled Cu^{2+}, 0.1 mol dm^{-3} iron(II) sulfate labelled Fe^{2+}, 0.1 mol dm^{-3} iron(III) nitrate labelled Fe^{3+}, unknown solutions labelled 1–5 and randomly assigned from the five labelled solutions above