Chem CP7b Tests for negative ions

Objectives

C9.5 Describe tests to identify the following ions in solids or solutions as appropriate:

- **a** carbonate ion, CO_3^{2-}, using dilute acid and identifying the carbon dioxide evolved
- **b** sulfate ion, SO_4^{2-}, using dilute hydrochloric acid and barium chloride solution
- **c** chloride ion, Cl^-, bromide ion, Br^-, iodide ion, I^-, using dilute nitric acid and silver nitrate solution.

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

6th **SC9.5aC** Describe how to identify carbonate ions.

6th **SC9.5aC** Describe how to identify carbon dioxide.

6th **SC9.5bC** Describe how to identify sulfate ions in solution.

5th **SC9.5cC** Recall the colours of silver halide precipitates.

6th **SC9.5cC** Describe how to identify halide ions in solution.

Exploring

1. Identifying anions

This practical forms one part of the core practical requirement of the specification. It is further supported by the information on *Students' sheet CP7b(Identifying Ions-Negative)* and information in the Student Book, in which the various methods for identifying anions and cations (met in *SC25a, SC25b* and *Sc25c*) are brought together.

Students should use: silver nitrate solution to identify Cl^-, Br^- and I^- ions; barium chloride solution to detect sulfate ions; and dilute acid to detect carbonate ions in sodium carbonate solution via effervescence. They should then identify the negatively charged ions 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 results have been identified and agreed upon, the students could then test the five unknown solutions.

Support: Check that the students appreciate that they can use either acid for their carbonate test, but they must use dilute nitric acid with silver nitrate and dilute hydrochloric acid with barium chloride solution.

Stretch: Challenge the students to investigate why they must use dilute nitric acid with silver nitrate and dilute hydrochloric acid with barium chloride solution. (They will already have the solutions needed to show the precipitate formed by carbonate ions if barium chloride solution is used without acidifying first; and the precipitates formed if the wrong acid is used to acidify the sample when testing for sulfate and halide ions).

⚠ Safety

Eye protection should be worn.

Avoid skin contact with the substances used.

Barium chloride solution is harmful.

Dilute nitric acid is an irritant.

Expected results

Chloride salts produce a white precipitate, bromide salts produce a cream precipitate, and iodide salts produce a yellow precipitate. Sulfate salts produce a white precipitate, and carbonate salts produce bubbles of carbon dioxide gas (which turns limewater milky).

Course resources

Chem Students' sheet CP7b

Equipment

eye protection, dropping pipettes, test tubes, test tube rack, 0.1 mol dm^{-3} barium chloride, 0.05 mol dm^{-3} silver nitrate, 0.4 mol dm^{-3} nitric acid, 1.0 mol dm^{-3} hydrochloric acid, 0.1 mol dm^{-3} potassium chloride labelled Cl^-, 0.1 mol dm^{-3} potassium bromide labelled Br^-, 0.1 mol dm^{-3} potassium iodide labelled I^-, 0.1 mol dm^{-3} sodium sulfate labelled SO_4^{2-}, 0.5 mol dm^{-3} sodium carbonate labelled CO_3^{2-}, unknown solutions labelled 1–5 and randomly assigned from the five labelled solutions above