Negative ions and water: testing evidence

Student activity • microscale practical

YEAR 10 / LESSON 37 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

Why must each test use a fresh sample and the right reagent?

Perform small-scale halide and sulfate tests, then interpret reference evidence for carbonate, water presence and water purity. Keep silver and barium waste collected. Water detection and purity are different questions.

Equipment

- Eye protection, six-well tile and tray; dedicated labelled droppers
- 0.1 mol dm^{-3} KCl, KBr, KI and Na_2SO_4; deionised-water control
- 0.4 mol dm^{-3} HNO_3, 0.5 mol dm^{-3} HCl, 0.1 mol dm^{-3} $AgNO_3$ and $BaCl_2$
- White background and labelled waste collection; supplied carbonate/water evidence

Wear eye protection; avoid contact and report splashes immediately. Use the laboratory eye-rinse procedure for eye exposure. Do not taste samples. Barium and silver solutions must be collected with first rinses; wash hands after cleanup.

Course coverage: 2.48–2.50: tests for Cl^-, Br^-, I^-, SO_4^{2-} and CO_3^{2-}; anhydrous copper(II) sulfate for water; a physical purity test.

Plan, model or apparatus sketch

Plan separate samples: halide test and sulfate test.

Method and reasoning

Read the whole sequence before starting

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1. Wear eye protection. Label five separate wells chloride, bromide, iodide, sulfate and water control. Use fresh samples; do not carry a mixture from one test into another.

2. Add three drops of each labelled salt to its well. Place three drops of water in the control. Keep each dropper with its own solution.

3. For the three halide wells and water control, add one drop of dilute nitric acid followed by two drops of silver nitrate. Record precipitate colours against white immediately.

4. For the fresh sulfate well, add one drop of dilute hydrochloric acid then two drops of barium chloride. Record the result. Never use this chloride-containing mixture for a later silver test.

5. Interpret the supplied carbonate evidence: acid addition produces gas, and that gas clouds limewater. Bubbles alone do not identify the gas. This step is reference evidence only.

6. Interpret the supplied water evidence and temperature ranges. Explain why a positive water test does not establish purity, and qualify any boiling-point conclusion by pressure and measurement uncertainty.

7. Write an identification argument using reagent, result and limitation. Collect all mixtures and first rinses in the labelled waste vessel.

Cleanup

• Collect all tile mixtures and first rinses as silver/barium-containing waste. Clean equipment under staff direction; wash hands.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Supplied evidence, not class results: carbonate + dilute acid gives gas that clouds limewater. White anhydrous copper(II) sulfate turns blue when water is added. Invented purity data at approximately 101 kPa: A boils over 99.8–100.2 °C; B over 101.8–102.2 °C. Compare with pure water near 100 °C at this pressure; do not taste samples.

Sample / test	Actual observation	Inference / limitation
Cl^- + acidified $AgNO_3$		
Br^- + acidified $AgNO_3$		
I^- + acidified $AgNO_3$		
SO_4^{2-} + acidified $BaCl_2$		
Water control + $AgNO_3$		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. State the reagent sequence and positive colours for the three halides.

2. Explain why nitric acid, rather than hydrochloric acid, is used before silver nitrate.

3. Explain the purpose of acidification and write the sulfate precipitation equation.

4. Describe the carbonate test, including identification of the evolved gas.

5. Explain the anhydrous copper(II) sulfate test and why it cannot show purity.

6. Interpret A and B at the stated pressure; give one uncertainty and one better follow-up check.