Negative ions and water: testing evidence

Teacher / technician

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

Staff preparation and answer guidance. Keep separate from student sheets. Live halide/sulfate tests only; carbonate and water tests are clearly labelled reference data. No lead salts or heating.

Coverage and delivery

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.

Allow about 50 minutes. Follow the student sequence and use the answers to check reasoning.

Requisition • class of 30, working in 15 pairs

Item	Per pair / setup	Class total
Booklet / writing tools	1 per learner	30 sets
Tile / tray / eye protection	1 tile/tray per pair; 1 protector each	15 sets; 30 protectors
KCl / KBr / KI / Na_2SO_4 at 0.1 mol dm^{-3}	1 cm^3 each per pair	20 cm^3 each incl. spare
HNO_3 / HCl / $AgNO_3$ / $BaCl_2$	1 cm^3 each per pair	20 cm^3 each incl. spare
Dedicated droppers / water / waste	9 droppers per pair; shared waste	135 droppers; water; 1 vessel

Immediate safety

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.

Preparation and delivery

Read alongside the student method

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1. For 15 pairs issue 15 six-well tiles/trays, 30 eye protectors and dedicated droppers. Each pair needs about 1 cm^3 of each of the four known salt solutions and each reagent; provide 20 cm^3 each stock including spare. Use the concentrations on the student equipment list.

2. Trial colour discrimination on white backgrounds. Silver halides can change on light exposure, so record promptly. Check supplier SDS and the school assessment: barium chloride is harmful and silver-containing waste needs collection.

3. Use only nitric acid with the halide aliquots. Hydrochloric acid adds chloride and can give a false positive. Acidification helps remove interfering carbonate; it does not remove every other anion.

4. The carbonate and copper sulfate hydration tests are supplied evidence in this edition, not additional live procedures. No lead nitrate, ammonia-solubility test, hot unknown liquid or dry copper sulfate is requisitioned.

5. Allow 20 minutes live tests, 20 evidence interpretation and 10 cleanup/corrections. Collect silver/barium residues and rinses through the local approved waste route. Do not discharge them to drains.

Close of lesson

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

Check before teaching

Check the cards, reference data and quantities against this requisition. Keep the staff answer guide separate until the checking stage. Supplied numerical practice datasets are labelled examples; they are not class measurements.

Answers and teaching notes

Expected explanations • do not give as experimental observations

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• Nitric acid then silver nitrate: chloride white, bromide cream, iodide yellow precipitate. These are expected colours; students retain their actual observations.

• Hydrochloric acid supplies chloride ions which precipitate with Ag^+; nitric acid avoids that contamination. Use a fresh aliquot for each test.

• Acid consumes interfering carbonate. $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$, a white precipitate. Acidification is not a universal removal of other anions.

• Add dilute acid to a carbonate sample and pass the evolved gas through limewater; cloudiness supports carbon dioxide. $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$.

• White anhydrous copper(II) sulfate turns blue in the presence of water. An aqueous salt solution also contains water and can give a positive result, so this is not a purity test.

• A is consistent with pure water within the stated resolution and pressure; B is not consistent under the same conditions. Calibration, pressure and contamination affect interpretation. Repeat with calibrated apparatus or use a second independent purity measurement.

References and provenance

Pearson Chemistry specification

RSC negative-ion tests

RSC identifying ions evidence

Prepared 22 November 2026. Original wording, tables and questions. Sources inform the concepts and technique; the lesson scope and classroom quantities are explicitly described here. No laboratory trial or final school risk approval is claimed.