Halogen displacement

Teacher / technician edition • aqueous 15-well tile method only

YEAR 10 / LESSON 21 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff use only; keep separate from student copies. This document is not a local risk assessment or classroom authorisation. No local physical validation is claimed. Complete normal teacher/technician checks and follow the employer's risk assessment before use.

Scope, equipment and audience

Year 10 IGCSE Chemistry and Science (Double Award). Published investigation: 2.7 displacement evidence for the Group 7 trend. It uses only a 15-well spotting tile/dimple tray: nine pairings, three halogen + water dilution controls and three halide + water controls. The school tube method, hydrocarbon layer, electrolysis and bleaching are not operational options in this booklet.

Per group of up to three: eye protection; clean dry white tile or dimple tray with 15 wells; grid/white background; named, concentration/hazard-labelled dropper bottles of water, KCl, KBr, KI TEST solution, chlorine water, bromine water and iodine solution; optional map/pen/paper towel. About 5 cm^3 of each reagent covers the wells and one repeat as a planning estimate. Provide access to the used-mixture collection container and a SEPARATE tray wash bucket.

Ordinary pre-lesson checks

Check one complete tile under classroom lighting: issued chlorine water still gives visible changes with bromide and the possibly adjusted iodide TEST solution; iodine wells are readable. If chlorine water has deteriorated, prepare fresh. These are normal pre-lesson checks, not a physical-pilot publication gate, and are not claimed as already completed.

Follow the school health procedure for known chlorine sensitivity: respiratory effects may be delayed. Complete the employer's risk assessment; check ventilation, labels and eye protection. Teacher dispenses halogen waters; keep bottles closed between uses, no sniffing or leaning over wells.

BEFORE the lesson, local staff must confirm a compatible used-mixture container and closure, its short pending-handoff storage arrangement, and the school-designated chemical-waste service/handoff route. Page 3 specifies the staff route; it is not an already approved employer procedure.

2.8C is CHEMISTRY ONLY: electronic-configuration explanation is a possible Single/Chemistry follow-up, not measured here and not a Double Award objective. It is omitted from the shared student booklet. Staff may ask eligible Chemistry pupils: "In terms of electronic configurations, why is chlorine more reactive than bromine?"

Preparation and working labels

Staff recipes only • do not issue this page to students

YEAR 10 / LESSON 21 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Halide TEST solutions

Prepare 0.1 mol dm^{-3} potassium halide test solutions: KCl 7.46 g dm^{-3} (M_r 74.55), KBr 11.9 g dm^{-3} (M_r 119.0), KI 16.6 g dm^{-3} (M_r 166.0). Sodium salts may substitute only with labels naming the actual salt; the shared student map uses potassium labels and must match what is issued.

If chlorine water plus the KI TEST solution gives a black iodine precipitate rather than a light brown solution, adjust THAT potassium iodide TEST solution as in RSC technician notes pp. 1–2. Label it “adjusted KI test solution” with its issued concentration. This is not an adjustment of the separate iodine stock. Students do not adjust reagents.

Halogen reagents • current school procedures required

• Chlorine water: 0.1–0.3% w/v, freshly prepared on the day in a fume cupboard under the school’s approved procedure; use current CLEAPSS RB025 / HC022b. Full cards are not reproduced here. Do not substitute unlabelled saturated chlorine water.

• Bromine water: 0.1% w/v. Preparing/diluting from liquid bromine or more concentrated stock is a fume-cupboard technician task under HC015b / RB017. Liquid bromine and saturated bromine water are not student reagents.

• Iodine stock: 0.1 mol dm^{-3} I_2 in 0.5 mol dm^{-3} KI carrier (HC054 / RB050). Arithmetic for 1.00 dm^3: 25.38 g I_2 (M_r 253.8) and 83.0 g KI (0.5 × 166.00). Do not silently change these defaults.

Issued-label and method check

Every handler sees actual name, concentration and hazard. Distinguish the iodide TEST bottle from carrier iodide already in iodine stock. The halogen + water controls are made without adding a TEST halide solution; the iodine control already contains carrier iodide. Three drops + three drops is a drop-count control, not measured equal volumes.

The 3 × 4 grid is Cl_2 / Br_2 / I_2 against H_2O / KCl / KBr / KI. Add three separate halide + water controls (no halogen). Compare pairings to the same-row halogen dilution control AND matching halide control after about one minute. Allow one clean-well repeat without overwriting the first observation.

Used-mixture collection and handoff

Staff-only waste route • confirm local arrangements BEFORE the lesson

YEAR 10 / LESSON 21 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

This page is not a claim of RSC-approved final disposal, a completed employer procedure or a hazardous shipment already made. Local staff must confirm compatibility, closure, short storage and service/handoff before use. No student treatment recipe is provided.

1. Collect used well contents and leftover USED aqueous halogen/halide mixtures in a suitable, clearly labelled, chemically compatible container reserved for this practical's mixtures only. Locate it in a WORKING FUME CUPBOARD during collection (RSC 733 chemicals note 3). Keep it separate from reusable stocks and the tray wash bucket.

2. Combine only compatible mixtures from this practical; do not mix other waste. Keep a record of what has been added. Label it clearly as waste, identifying the contents so it cannot be mistaken for stock.

3. Use a compatible secure screw-cap or equivalent tight-fitting closure; close it except while adding waste. Do not overfill; prevent escape. Confirm the actual container AND closure locally before the lesson. A screw-top glass bottle is source-informed background from UNUSED-stock practice, not an RSC specification of a used-waste container.

4. After collection, keep the labelled closed container only pending TIMELY authorised handoff. Do not accumulate waste or use a fume cupboard as a long-term store. Confirm the short pending-handoff arrangement before the lesson: a short interval in the working fume cupboard, or another school-designated secure location.

5. The technician arranges handoff to the school's designated chemical-waste service for final disposal under applicable requirements. Follow school procedures; where waste is hazardous, removal requires an authorised/registered carrier to an appropriately permitted site. This document does not classify the mixtures or claim that a consignment occurred.

6. Do not pour USED mixtures down the drain. Do not improvise treatment, including a universal thiosulfate recipe. The distinct unused-stock and tray wash-water routes on page 4 do NOT apply to mixed used well contents.

What the sources do and do not specify

RSC 733 note 3 gives the collection LOCATION ("a suitable waste container in a fume cupboard"), not material, closure, storage duration or final treatment. Closure/short storage above are general local choices informed by ASE Topics in Safety, Topic 11 (2015): compatible wastes, content records, clear waste labels, prevention of escape, no long-term fume-cupboard storage, timely disposal and school procedures. RSC technician notes ac=512210 describe screw-top glass storage for unused iodine/bromine solutions and iodine discolouration of plastic bottles/caps; they are not a used-waste container specification.

Separate leftovers and sources

Staff only • never collapse these routes into mixed-waste treatment

YEAR 10 / LESSON 21 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Unused stocks and tray wash water • distinct routes

Tray wash bucket — separate from used mixtures. Place into large buckets of water in the laboratory; rinse; that wash water may be poured down a foul-water drain where permitted (RSC technician PDF, disposal section / p. 3). This wash bucket is separate from the used-mixture collection container.

UNUSED iodine stock only. Dilute down to at least 0.04 mol dm^{-3} using 1 mol dm^{-3} sodium thiosulfate solution, then pour down a foul-water drain where permitted (technician PDF p. 3).

UNUSED bromine water only. Use small quantities and work in a fume cupboard; add slowly to 1 mol dm^{-3} sodium carbonate solution (heat may be produced); test the resulting solution for alkalinity with an acid/base indicator and, when just alkaline, pour down a foul-water drain with further dilution where permitted (technician PDF p. 3).

UNUSED chlorine water only. May be diluted and poured down a foul-water drain; work in a fume cupboard or a well-ventilated room (technician PDF p. 3). The PDF does not specify thiosulfate for chlorine water.

UNUSED halide TEST solutions. May be kept; store iodide test solution in a dark bottle (technician PDF p. 3).

Interpretation and sources

No pre-filled colour grid is class data. A clear change beyond the controls may support displacement; paler colour alone can be dilution. Old chlorine water and faint iodine colours can leave the supported order incomplete. Do not add a solvent layer to force a visible outcome.

• Pearson Edexcel IGCSE Chemistry, Issue 3 (2024): 2.7; 2.8C Chemistry only. Existing school Lesson 21 provides context, not expected class data.

• RSC 733: edu.rsc.org/experiments/halogens-in-aqueous-solution-and-their-displacement-reactions/733.article; RSC 4012012 microscale video; technician notes edu.rsc.org/download?ac=512210, pp. 1–3.

• ASE Topics in Safety, Topic 11 (2015): www.ase.org.uk/download/file/fid/18910. CLEAPSS identifiers cited by RSC: HC022b / RB025, HC015b / RB017, HC054 / RB050; consult current school resources. Full cards are not reproduced.

Student booklets contain 5 pages. This separate staff file contains 4 pages. Never append staff pages to a student file. Hosted staff downloads require access controls; filename labels alone do not restrict access.