# Reactions of acids: patterns and particles

Teacher / technician

YEAR 10 / LESSON 53 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Small-scale open-tube observation only. No pupil gas ignition, gas collection, nitric acid, heating or copper-oxide powder handling.

## Coverage and delivery

Shared core: 2.35–2.37, proton transfer and acid reactions. Nitric-acid/metal reactions are excluded; chloride, sulfate and nitrate naming is practised on paper.

Allow about 60 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 |
| Test tubes / rack / tray / acid pipette | 3 tubes; 1 set per pair | 45 tubes; 15 sets |
| Eye protection | 1 each | 30 |
| 0.50 M HCl | 3 $cm^3$ per pair | 60 $cm^3$ incl. spare |
| Preloaded Mg / CuO / $CaCO_3$ | Maximum 0.01 / 0.01 / 0.02 g | 0.20 / 0.20 / 0.40 g incl. spare |

## Immediate safety

Wear eye protection; avoid acid splashes and report them. Staff preload powders. Keep tubes open, in racks and away from faces; hydrogen is flammable, so no flames or heating. Copper residues must be collected separately.

# Preparation and delivery

Read alongside the student method

YEAR 10 / LESSON 53 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

**1.** Staff preload 45 tubes: 15 each with 0.5 cm Mg ribbon (maximum 0.01 g), about 0.01 g CuO and 0.02 g $CaCO_3$. Required totals: Mg up to 0.15 g, CuO 0.15 g, $CaCO_3$ 0.30 g; prepare up to 0.20, 0.20 and 0.40 g including spare.

**2.** Supply 45 $cm^3$ 0.50 M HCl for 15 pairs; issue 60 $cm^3$ including spare. Staff handle CuO powder to prevent pupil dust exposure. Use the exact small quantities; no nitric acid is issued.

**3.** Each tube receives 0.5 mmol HCl. The stated solids need at most about 0.83 mmol for Mg if 0.01 g, 0.25 mmol for CuO and 0.40 mmol for $CaCO_3$. Mg may remain because acid can limit; this does not disprove its reaction.

**4.** Trial the oxide response at room temperature; accept slow/incomplete observations. No heating or extra acid is authorised by this method. Keep tubes open and remove all ignition sources because hydrogen can form.

**5.** Gas-test descriptions are references only; this replaces the old repeated ignition at the reaction-tube mouth. Collect copper-containing residues separately and follow the school waste plan. Allow 10 minutes setup, 15 observation, 25 reasoning and 10 cleanup.

## Close of lesson

• Leave any active tubes in their rack for staff supervision.

• Staff collect copper-containing waste separately; dispose of other residues under the local plan. Rinse equipment as instructed and 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

YEAR 10 / LESSON 53 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

• Use actual observations. Expected possibilities are bubbling with Mg/$CaCO_3$ and gradual CuO dissolution/solution colour. Lack of complete dissolution in the lesson is not proof of no reaction.

• Mg + 2HCl → $MgCl_2$ + $H_2$; CuO + 2HCl → $CuCl_2$ + $H_2O$; $CaCO_3$ + 2HCl → $CaCl_2$ + $H_2O$ + $CO_2$. Add (s), (aq), (l), (g) appropriately.

• Both hydrogen and carbon dioxide can produce bubbles. A specific gas test is additional evidence; it was not performed in this lesson.

• Magnesium chloride, magnesium sulfate and magnesium nitrate respectively.

• The aqueous acid supplies $H^+$; $OH^-$ accepts a proton to form water. Carbonate accepts protons, with the resulting carbonic acid giving water and $CO_2$: $CO_3^{2-}$ + $2H^+$ → $H_2O$ + $CO_2$.

• The metal must react with the chosen acid under those conditions. Nitric acid is oxidising and its metal reactions do not follow the simple hydrogen pattern used here; those reactions are excluded.

## References and provenance

Pearson Chemistry specification

RSC microscale metal–acid reactions

RSC microscale acid–base observations

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.