

Microscale reactions of metals with acids – teacher notes

In this experiment students observe the reactions between various metals and acids.

Topic

Metals – reactions with acids; reactivity series

Timing

20 minutes

Equipment

Apparatus

- Eye protection
- Student worksheet
- Clear plastic sheet (eg ohp sheet)
- Magnifying glass
- Petri dish and lid

Chemicals

Solutions should be contained in plastic pipettes. See the accompanying guidance on apparatus and techniques for microscale chemistry (<https://rsc.li/3nN5nDj>), which includes instructions for preparing a variety of solutions.

- Hydrochloric acid, 1 mol dm⁻³
- Dilute nitric acid, 1 mol dm⁻³
- Concentrated nitric acid, 5 mol dm⁻³
- Sulfuric acid, 1 mol dm⁻³
- Magnesium ribbon
- Zinc metal – small granules
- Iron filings
- Tin granules
- Copper turnings

Notes and expected observations

The magnesium ribbon reacts vigorously with each acid. The zinc and iron also react, but less vigorously. In each case hydrogen gas is produced as well as the metal salt. The reaction between iron and nitric acid eventually produces a red-brown rust colour (iron(III) oxide). Students could link this with corrosion and acid rain. Tin and copper do not react with

the hydrochloric and sulfuric acids but a few bubbles may be seen (using the magnifying glass) with the nitric acid.

The reaction between copper and concentrated nitric acid produces a blue solution and bubbles (of brown nitrogen dioxide). Students MUST put the lid over the Petri dish as soon as they add the acid. Nitrogen dioxide is very toxic.

Students can write word and symbol equations for the reactions involved.

Health, safety and technical notes

- Read our standard health and safety guidance (<https://rsc.li/33kJQrW>).
- Wear eye protection throughout (splash-resistant goggles to BS EN166 3).
- Do NOT increase quantities mentioned and work in a well-ventilated laboratory. Nitrogen oxides are formed, gases are CORROSIVE and very TOXIC (fatal if inhaled) – see CLEAPSS Hazcard HC068B.
- Hydrochloric acid, $\text{HCl}(\text{aq})$, 1 mol dm^{-3} is low hazard – see CLEAPSS Hazcard HC047a and CLEAPSS Recipe Book RB043.
- Dilute nitric acid, $\text{HNO}_3(\text{aq})$, 1 mol dm^{-3} is CORROSIVE – see CLEAPSS Hazcard HC067 and CLEAPSS Recipe Book RB061.
- Concentrated nitric acid, $\text{HNO}_3(\text{aq})$, 5 mol dm^{-3} is OXIDISING, CORROSIVE and gives off TOXIC fumes – see CLEAPSS Hazcard HC067 and CLEAPSS Recipe Book RB061.
- Sulfuric acid, $\text{H}_2\text{SO}_4(\text{aq})$, 1 mol dm^{-3} is CORROSIVE – see CLEAPSS Hazcard HC098a and CLEAPSS Recipe Book RB098.
- Magnesium ribbon is FLAMMABLE – see CLEAPSS Hazcard HC059A.
- Zinc powder, $\text{Zn}(\text{s})$, is FLAMMABLE and hazardous to the aquatic environment – see CLEAPSS Hazcard HC107.