Catalysts, energy and reaction rates

Teacher / technician

YEAR 10 / LESSON 40 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Live dilute-peroxide comparison with staff-preloaded solids; Chemistry-only reaction-profile extension. No concentrated-peroxide demonstration or lead catalysts.

Coverage and delivery

Shared core: 3.9–3.13 and practical 3.16. Chemistry-only extension: 3.14C reaction profiles, activation energy and ΔH.

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
Syringe/flask/stand/timer/cylinder	1 checked set per pair	15 sets plus control
Eye protection / preloaded flasks	1 protector each; 2 flasks per pair	30 protectors; 30 loaded flasks
1% w/v H_2O_2	10.0 cm^3 per run	400 cm^3 incl. control/spare
MnO_2 / Fe_2O_3 / CuO	0.05 g per assigned run	0.60 g of each incl. spare

Immediate safety

Wear eye protection. Avoid peroxide/oxide contact; report splashes and use the laboratory eye-rinse procedure for eye exposure. Keep powders in staff-preloaded flasks. Keep away from flames; oxygen supports combustion. Stop if gas flow is obstructed or foam reaches tubing.

Preparation and delivery

Read alongside the student method

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1. Split 15 pairs into five testing each of MnO_2, Fe_2O_3 and CuO. Each pair performs two runs: 30 pupil runs plus two teacher no-solid controls. Use 32 × 10.0 cm^3 = 320 cm^3 of 1% w/v working peroxide; supply 400 cm^3 including spare. No concentrated peroxide is issued to pupils.

2. Staff prepare ten 0.05 g portions of each solid in labelled flasks (0.50 g each total; allow 0.60 g each). Avoid raising dust; check current SDS/local assessment for peroxide and each oxide. Do not substitute lead compounds, metals, detergent or larger quantities.

3. Trial this reduced-scale method and actual solids first. Iron oxide may act slowly; inconclusive results are recorded honestly. Expected oxygen is about 35 cm^3, so a 100 cm^3 free-moving syringe provides margin. A trial must confirm foam stays out of tubing.

4. Use one no-solid control before class and one alongside it, with the same temperature/volumes. Clean apparatus thoroughly between solids to prevent trace catalyst contamination. No ignition, oxygen splint test, thiosulfate/acid experiment or heating is included.

5. Collect all oxide residues and first rinses in labelled waste; technician handles disposal under the local plan. Shared-core pupils complete questions 1–5. Question 6 and profile drawing are explicitly Chemistry-only; omit for Double Award.

Close of lesson

• Wait for reaction to stop; staff direct collection of oxide residues and rinses. Do not return mixtures to stock. 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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• Use actual gradients and repeats. A faster curve than the no-solid control supports a rate effect; do not invent an ordering if differences are unclear.

• $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$; oxygen volume is measured.

• Particle size, accessible surface area, purity and contamination can differ despite equal mass. The ranking applies to the tested samples and conditions.

• Higher temperature increases kinetic energy and the fraction of collisions with sufficient energy. Increased pressure raises gaseous reactant concentration at fixed temperature; it is not the variable in this liquid-peroxide test.

• A catalyst is regenerated overall and is not consumed stoichiometrically. Mechanical loss, contamination and moisture can change recovered mass; this gas test does not weigh recovered catalyst.

• Chemistry only: the catalysed path has lower E_a but the same reactant/product energy levels and ΔH. A catalyst supplies an alternative route, not extra energy to reactants.

References and provenance

Pearson Chemistry specification

RSC catalyst investigation principles

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.