Limiting reactants and gas volumes

Teacher / technician

YEAR 10 / LESSON 44 / CHEMISTRY ONLY

Staff preparation and answer guidance. Keep separate from student sheets. Teacher-operated gas collection only. Gas-volume calculations are Chemistry-only. No hydrogen generation or flame; local trial and risk assessment required.

Coverage and delivery

Chemistry-only timetable lesson: 1.35C gas volumes at rtp, supported by shared reacting-mass point 1.29. Use 24 dm^3 mol^{-1} only for the stated room conditions.

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
Gas syringe / flask / clamp / tray	Teacher demonstration	1 checked set
Balance / cylinder / timer	Teacher demonstration	1 each
Eye protection	1 per observer	30 + teacher
Marble / HCl solutions	A/B/C as method	1 g; 50 cm^3 of each HCl

Immediate safety

Wear eye protection and observe from the teacher's designated position. Staff handle acid and glassware. Keep syringe free to move; stop for obstruction or leaks. No heating or flames.

Preparation and delivery

Read alongside the student method

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1. Prepare one teacher demonstration set, not 15 pupil stations. Three runs require 0.50 g marble, 20 cm^3 0.50 M HCl and 10 cm^3 0.20 M HCl; supply 1.0 g and 50 cm^3 of each solution for a repeat/spare.

2. Check free syringe travel, supports, gas path and seals. Use a 100 cm^3 syringe: the largest theoretical volume here is 48 cm^3. Trial chip size and completion time before class. Do not use powder, magnesium or a larger mass.

3. Place acid in the flask, add weighed chips and promptly fit the bung. Do not heat or shake. Keep the syringe outlet unobstructed and the plunger free; stop if it sticks. Record actual initial and final readings.

4. Run A/B/C with fresh materials and rinsed equipment. Collection must finish before disconnection. If a run remains active, keep monitoring; unfinished readings must be labelled partial.

5. Allow 15 minutes prediction, 20 demonstration, 15 calculation and 10 evaluation. Acid amount is supplied to avoid requiring the next lesson's concentration method in advance.

Close of lesson

- After reaction stops, staff collect residues and rinses under the school disposal plan; 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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• A: 0.0010 mol $CaCO_3$ versus 0.0025 mol CO_2 allowed by HCl; marble limits, 24 cm^3. B: 0.0020 versus 0.0010; HCl limits, 24 cm^3. C: 0.0020 versus 0.0025; marble limits, 48 cm^3.

• B consumes 0.0010 mol $CaCO_3$ = 0.10 g, leaving about 0.10 g if the marble is pure and reaction completes.

• B has only half the acid amount required to react with all 0.20 g. C has excess acid. These are maximum yield comparisons, not direct rate measurements.

• 0.072 dm^3 = 72 cm^3; n = 0.072/24 = 0.0030 mol.

• Compare amounts divided by their equation coefficients, not masses. Different substances have different molar masses and stoichiometric requirements.

• Gas loss, dissolved CO_2, leaks and differing conditions can reduce collected volume. A low reading alone does not establish the wrong chemical ratio.

References and provenance

Pearson Chemistry specification

Pearson core practical techniques

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.