

Level 3 AAQ Applied Science

Unit 2: Chemistry

Practice Paper 1

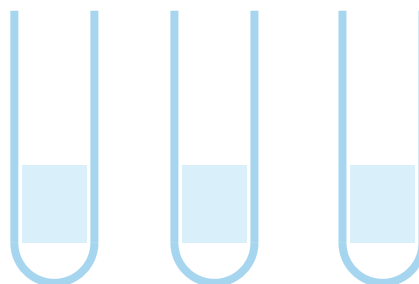
MARK SCHEME

Time allowed: 1 hour (60 minutes)

Total marks: 50

Answers and indicative marking points for teachers and learners.

Accept scientifically equivalent correct responses where appropriate.



Question 1 — Period 3 chemistry

(a) Magnesium reacts with oxygen. Give the formula of magnesium oxide. **(1)**

Marking points: MgO (1).

(b) Write a balanced equation for the reaction of sodium with oxygen to form sodium oxide. **(2)**

Marking points: Correct formulas Na, O₂ and Na₂O (1); $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$ (1).

(c) Explain why silicon dioxide has a much higher melting point than sulfur dioxide. **(3)**

Marking points: SiO₂ giant covalent structure (1); many strong covalent bonds require energy to break (1); SO₂ simple molecular with weak intermolecular forces (1).

Total for Question 1 = 6 marks

Question 2 — Mark scheme

(a) [2 marks] Identify iron's block and period.

Marking guidance: d-block (1); period 4 (1).

(b) [2 marks] Write the electron configuration of Fe²⁺.

Marking guidance: [Ar] 3d⁶ (2). Award 1 for [Ar] 3d with the correct six electrons shown but an error in subshell notation. Do not credit the neutral iron configuration.

(c) [3 marks] Calculate the relative atomic mass from 69.2% copper-63 and 30.8% copper-65.

Marking guidance: Correct weighted mean method (1); substitution $(63 \times 69.2 + 65 \times 30.8)/100$ (1); 63.616 or 63.62 (1).

Total for Question 2 = 7 marks

Question 3 — Mark scheme

(a) [1 mark] Homologous series.

Marking guidance: Alkenes (1).

(b) [1 mark] Bromine-water colour change.

Marking guidance: Orange/brown to colourless (1).

(c) [1 mark] Molecular formula of product with hydrogen bromide.

Marking guidance: C₃H₇Br (1).

(d) [5 marks] Ethene and bromine.

Marking guidance: 1,2-dibromoethane (1); C₂H₄Br₂ (1); addition (1); C=C double bond becomes a C-C single bond (1); one bromine atom bonds to each of the two carbon atoms (1).

Total for Question 3 = 8 marks

Question 4 — Energetics and equilibrium

(a) Define activation energy. (2)

Marking points: Minimum energy (1) particles must have for a successful reaction/collision (1).

(b) The enthalpy change of a reaction is -92 kJ mol^{-1} . State whether it is exothermic and explain your answer. (2)

Marking points: Exothermic (1); energy released to surroundings / products lower in enthalpy (1).

(c) Explain why a catalyst increases reaction rate but does not change the enthalpy change. (3)

Marking points: Alternative reaction pathway (1); lower activation energy (1); same reactant and product enthalpy levels (1).

(d) For $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, predict and explain the effect of increased pressure on the equilibrium yield of ammonia at constant temperature. (3)

Marking points: Ammonia yield increases (1); equilibrium shifts to right (1); fewer gas moles on right (2 vs 4) (1).

Total for Question 4 = 10 marks

Question 5 — Rates and quantitative chemistry

(a) [2 marks] State two changes that increase the rate of magnesium reacting with hydrochloric acid.

Marking points: Any two: increase acid concentration; increase temperature; increase magnesium surface area (1 each).

(b) [3 marks] Calculate the amount of HCl in 25.0 cm³ of 0.400 mol dm⁻³ acid.

Marking points: Convert volume: 25.0/1000 = 0.0250 dm³ (1); use $n = cV$ (1); 0.0100 mol (1).

(c) [2 marks] Calculate the maximum amount of H₂ produced when the HCl in part (b) reacts with excess magnesium. $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$.

Marking points: Use 2 mol HCl : 1 mol H₂ (1); 0.00500 mol H₂ (1). Allow error carried forward from (b).

(d) [2 marks] Explain why repeating rate measurements improves confidence.

Marking points: Identify anomalies or assess consistency (1); calculate a representative mean or improve reliability (1).

Total for Question 5 = 9 marks

Question 6 — Isotopes and relative atomic mass

(a) State what is meant by isotopes of the same element. (2)

Marking points: Same number of protons (1), different numbers of neutrons (1).

(b) A magnesium sample contains 79.0% magnesium-24, 10.0% magnesium-25 and 11.0% magnesium-26. Calculate the relative atomic mass. Show your working. (4)

Marking points: Weighted mean expression (1); correct substitution (1); sum of weighted terms 2432 (1); final answer 24.32 (1).

(c) Explain why the relative atomic mass of this magnesium sample is not a whole number. (2)

Marking points: It is a weighted mean of isotope masses (1); isotopes have different relative abundances (1).

(d) A second magnesium sample has a greater percentage of magnesium-26 and a smaller percentage of magnesium-24, with magnesium-25 unchanged. Predict and explain the effect on its relative atomic mass. (2)

Marking points: Relative atomic mass increases (1); a greater proportion of the heavier isotope raises the weighted mean (1).

Total for Question 6 = 10 marks

TOTAL FOR PAPER = 50 MARKS