ERUVIO MENTORING · EXTERNAL-STYLE EXAMINATION

Chemistry

Units 1 and 2 · Chemical fundamentals; molecular interactions and reactions

Paper 2

SHORT RESPONSE · 50 MARKS

STUDENT DETAILS

GIVEN NAME(S) _____ FAMILY NAME _____

SCHOOL _____ DATE _____ BOOK OF _____

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Structure of this examination

PAPER	SECTION	QUESTION TYPE	TIME	MARKS
Paper 1	Section 1	Multiple choice, 20 questions	10 min perusal 90 min working	20
	Section 2	Short response, 5 questions		30
Paper 2	Section 1	Short response, 9 questions	10 min perusal 90 min working	50
Total		**34 questions**	**200 minutes**	**100**

Instructions

- **Perusal time: 10 minutes. Working time: 90 minutes.**
- You may use a QCAA-approved scientific or graphics calculator. The QCAA Chemistry formula and data book is provided.
- Write using black or blue pen. Planning paper will not be marked.
- All questions are drawn from Unit 1 (chemical fundamentals: structure, properties and reactions) and Unit 2 (molecular interactions and reactions).
- **Paper 2 contains 9 short response questions.** Answer all questions in the spaces provided. Show all working.

Show all working. Marks are awarded for method as well as for the final answer, so a response with no working cannot receive full marks.

Section 1

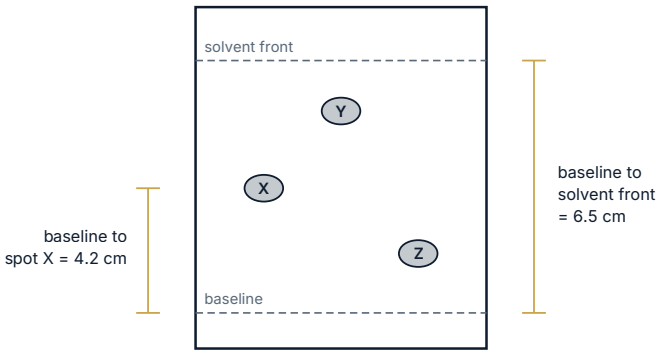
Short response · 9 questions · 50 marks

1 This question is about the classification of matter. [3 marks]

(a) Distinguish between an element, a compound and a mixture. [2]

(b) State what is meant by the term *isotope*. [1]

2 A student separates the coloured components of a food dye by paper chromatography. The chromatogram obtained is shown below. [6 marks]



(a) Calculate the R_f value of spot X. [2]

WORKING

R_f = _____

(b) Explain why the three components travel different distances up the paper. [2]

(c) A pure sample of a known dye has an R_f value of 0.65 under identical conditions. Justify whether spot X could be that dye. [2]

3 This question is about bonding and structure. [5 marks]

(a) Explain, in terms of structure and bonding, why silicon dioxide has a melting point of about 1700 °C while carbon dioxide is a gas at room temperature. [3]

(b) Explain why solid sodium chloride is brittle and shatters when struck. [2]

4 The energy profile below represents a chemical reaction. [6 marks]

(a) State whether the reaction is exothermic or endothermic and justify your answer using the diagram. [2]

(b) Determine the activation energy and the enthalpy change for the reaction. [2]

WORKING

E_a = _____ kJ mol^{-1} ΔH = _____ kJ mol^{-1}

(c) Describe how the diagram would change if a catalyst were added, and explain why the rate of reaction increases. [2]

5 Aqueous barium nitrate is mixed with aqueous sodium sulfate and a white precipitate forms. [5 marks]

(a) Write the balanced chemical equation for the reaction, including state symbols. [1]

(b) Write the net ionic equation for the reaction. [2]

(c) Identify the spectator ions. [1]

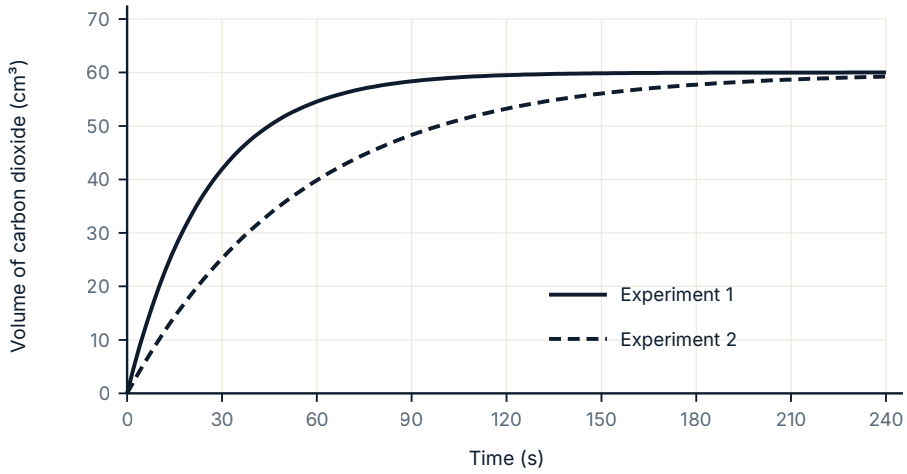
Spectator ions _____

(d) Calculate the mass of precipitate formed when 25.0 mL of 0.200 mol L^{-1} barium nitrate reacts with excess sodium sulfate. $M(BaSO_4)$ = 233.4 g mol^{-1}. [1]

WORKING

m = _____ g

6 A student investigates the rate of reaction between calcium carbonate and excess hydrochloric acid by measuring the volume of carbon dioxide produced. The same mass of calcium carbonate is used in both experiments. [7 marks]



(a) Determine the initial rate of reaction in Experiment 1. [2]

WORKING

Rate = _____ $cm^3\ s^{-1}$

(b) One experiment used powdered calcium carbonate and the other used large lumps. Identify which experiment used the powder and justify your choice. [2]

(c) Explain, using collision theory, why the powdered solid reacts more quickly. [2]

(d) State why both curves level off at the same final volume. [1]

7 This question is about acids and pH. [6 marks]

(a) Calculate the pH of a 0.0100 mol L^{-1} solution of hydrochloric acid. [2]

WORKING

pH = _____

(b) A solution of sodium hydroxide has a pH of 11.40. Calculate the concentration of hydronium ions in this solution. [2]

WORKING

$[H_3O^+]$ = _____ mol L^{-1}

(c) Write the balanced equation for the reaction between hydrochloric acid and calcium carbonate, and name the gas produced. [2]

8 A student determines the concentration of a sodium hydroxide solution by titrating 20.00 mL aliquots against 0.1050 mol L^{-1} hydrochloric acid. The titres obtained were 22.15 mL, 21.85 mL, 21.90 mL and 21.88 mL. [6 marks]

(a) Determine the average titre that should be used, justifying which results you have included. [2]

WORKING

Average titre = _____ mL

(b) Calculate the concentration of the sodium hydroxide solution. [3]

WORKING

c(NaOH) = _____ mol L^{-1}

(c) Explain why the conical flask may be rinsed with distilled water before use, but the pipette may not. [1]

9 Ammonia is produced industrially by the reaction below. In one trial, 28.0 g of nitrogen (M = 28.02 g mol^{-1}) is reacted with 9.00 g of hydrogen (M = 2.016 g mol^{-1}). [6 marks]

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

(a) Determine which reactant is limiting. Show your working. [3]

WORKING

Limiting reagent

(b) Calculate the theoretical mass of ammonia that could be produced. $M(NH_3) = 17.03\ g\ mol^{-1}$. [2]

WORKING

m = _____ g

(c) The actual mass of ammonia obtained was 24.8 g. Calculate the percentage yield. [1]

WORKING

Yield = _____ %

END OF PAPER