

ERUVIO MENTORING · EXTERNAL-STYLE EXAMINATION

Chemistry

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

Paper 1 · Section 2

SHORT RESPONSE · 30 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).
- **Section 2 contains 5 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 2

Short response · 5 questions · 30 marks

1 This question is about atomic structure and the periodic table.

[6 marks]

(a) Complete the table below.

[3]

Species	Protons	Neutrons	Electrons
^{65}Cu			
$^{27}\text{Al}^{3+}$			
$^{37}\text{Cl}^{-}$			

(b) Write the full electron configuration of the aluminium ion Al^{3+} .

[1]

Configuration _____

(c) Explain, in terms of nuclear charge and atomic radius, why the first ionisation energy of magnesium is greater than that of sodium.

[2]

2 The table shows the properties of three substances, X, Y and Z.

[6 marks]

Substance	Melting point	Conducts as a solid	Conducts when molten	Soluble in water
X	801 °C	no	yes	yes
Y	1414 °C	no	no	no
Z	660 °C	yes	yes	no

(a) Identify the type of bonding present in each of X, Y and Z.

[3]

X _____

Y _____

Z _____

(b) Explain why substance X conducts electricity when molten but not when solid.

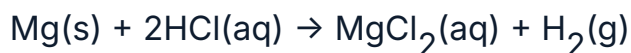
[2]

(c) State one property of metals that is explained by the presence of delocalised electrons.

[1]

3 Magnesium reacts with hydrochloric acid according to the equation below. 0.486 g of magnesium ($M = 24.31 \text{ g mol}^{-1}$) is added to 50.0 mL of 1.00 mol L^{-1} hydrochloric acid.

[6 marks]



(a) Calculate the amount, in mol, of magnesium used.

[1]

WORKING

$n(\text{Mg}) = \text{_____ mol}$ _____

(b) Calculate the amount, in mol, of hydrochloric acid used.

[1]

WORKING

$n(\text{HCl}) = \text{_____ mol}$ _____

(c) Determine which reactant is limiting. Justify your answer.

[2]

WORKING

(d) Calculate the volume of hydrogen gas produced, measured at 25 °C and 100 kPa.

[2]

WORKING

V = _____ L _____

4 A student burns 1.15 g of ethanol ($M = 46.07 \text{ g mol}^{-1}$) in a spirit burner and uses the energy released to heat 200.0 g of water. The temperature of the water rises from 20.5 °C to 55.8 °C. The specific heat capacity of water is $4.18 \text{ J g}^{-1} \text{ K}^{-1}$.

[6 marks]

(a) Calculate the energy absorbed by the water, in kJ.

[2]

WORKING

q = _____ kJ _____

(b) Calculate the amount, in mol, of ethanol burnt.

[1]

WORKING

n = _____ mol _____

(c) Determine the molar enthalpy of combustion of ethanol.

[2]

WORKING

$\Delta H = \text{_____ kJ mol}^{-1}$

(d) The accepted value is $-1367 \text{ kJ mol}^{-1}$. Suggest one reason for the difference between the experimental and accepted values.

[1]

5 This question is about molecular interactions and gases.

[6 marks]

(a) Identify the strongest type of intermolecular force present between molecules of methane, CH_4 , and between molecules of ammonia, NH_3 .

[2]

Methane

Ammonia

(b) Ammonia has a boiling point of -33°C while methane boils at -162°C , even though the two molecules have similar molar masses. Explain this difference.

[2]

(c) Calculate the volume occupied by 2.50 g of ammonia ($M = 17.03 \text{ g mol}^{-1}$) at 25 °C and 100 kPa.

[2]

WORKING

V = _____ L

END OF PAPER