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 _____

DO NOT WRITE ON THIS PAGE

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			
$^{27}Al^{3+}$			
$^{37}Cl^{-}$			

(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 g mol^{-1}) is added to 50.0 mL of 1.00 mol L^{-1} hydrochloric acid. [6 marks]

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

(a) Calculate the amount, in mol, of magnesium used. [1]

WORKING

n(Mg) = _____ mol

(b) Calculate the amount, in mol, of hydrochloric acid used. [1]

WORKING

n(HCl) = _____ 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 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 J g^{-1} 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

ΔH = _____ kJ mol^{-1}

(d) The accepted value is −1367 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 g mol^{-1}) at 25 °C and 100 kPa. [2]

WORKING

V = _____ L

END OF PAPER