Candidate's Name:…….

Signature:……

P525/1

CHEMISTRY

Paper 1

April. /May. 2024

2 $\frac{1}{4}$ hrs.

CHEMISTRY DEPARTMENT

SAYIDINA ABUBAKAR SECONDARY SCHOOL- KABASANDA

S.6 END OF TERM ONE EXAMINATIONS 2024

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

- Answer **all** questions in section **A** and **six** questions in section **B.**
- **All** question must be answered in the space provided.
- Illustrate your answers with equation(s) where applicable.

Where necessary, use the following:

Molar gas constant, R = 8.31 $JK^{-1}mol^{-1}$

Molar volume of a gas at s.t.p is 22.4 litres

Standard temperature = 273K

Standard pressure = $101325NM^{-2}$

For examiner's use only	
Section A	
Section B	
Total	

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SECTION A (46MARKS)

Answer **all** questions in this section.

1. The standard electrode potential of some half cells reactions are given below:

Half cells	E^{θ}(V)
$Sn^{4+}(aq) + 2e \longrightarrow Sn^{2+}(aq)$	+ 0.15
$PbO_2(s) + 4H^{+}(aq) + 2e \longrightarrow Pb^{2+}(aq) + 2H_2O(l)$	+1.46

(a). Write the overall equation for the cell reaction that occurs when the half cells are combined. (01½mks)

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(b). Calculate the work done by the cell. (Faraday's constant= 96500C) (03mks)

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(c). State whether the cell is feasible or not. Give a reason for your answer. (01mk)

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2. Complete the following equations and write the accepted mechanism in each case.

(a) $CH_3CH_2CH(OH)CH_3 \xrightarrow[180^{o}C]{\text{conc. } H_2SO_4}$ ……

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…… (02½mks)

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(b) $C_6H_6 \xrightarrow[\text{Heat}]{\text{conc. } H_2SO_4}$ .....

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..... (03mks)

3. (a) (i) Explain what is meant by the order of chemical reaction. (01mks)

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(ii) Name two methods used to determine order of reaction. (01mks)

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(b) The results obtained for the kinetics of the decomposition of nitrogen (V) oxide are given in the table below.

[N2O5] (moldm^{-3})	**Initial rate (moldm^{-3}s^{-1})**
1.6×10^{-3}	0.12
2.4×10^{-3}	0.18
3.2×10^{-3}	x

Calculate the value of x. (03½mks)

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4. The table below shows the melting points of the oxides of group (II) elements.

Oxides	BeO	MgO	CaO	SrO	BaO
Melting points of oxides (^oC)	2530	2800	2580	2430	1928

Explain the trend in the melting points of these oxides. (04mks)

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5. A compound Q contains 60% carbon, 13.3% hydrogen and the rest being oxygen. W 0.698g of Q was dissolved in 100g of a solvent, there was a 0.19°C depression in freezing point of a solvent. (Kf of the solvent = $1.63^oCKg^{-1}mol^{-1}$).

(a) Calculate the simplest formula of Q. (02mks)

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(b) Determine the molecular formula of Q. (03mks)

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(c) Write the structural formula and the name of compound Q. (01mk)

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6. (a) Explain what is meant by a diagonal relationship. (01mk)

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(b) Write the electronic configuration of the following elements:

(i) Beryllium. (01mk)

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(ii) Aluminium. (01mk)

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(c) State any two reasons as to why beryllium resembles aluminium in its properties. (02mks)

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7. (a) Define the term activation energy. (01mk)

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(b) X and Y react to form W and Z according to the following equation.

X (g) + Y (g) ⟷ W (g) + Z (g) Heat of a reaction= +50KJmol^{-1}

(i) Draw a fully labelled potential energy versus reaction coordinate diagram for the reaction of X and Y. (02½mks)

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(ii) Calculate the activation energy of the backward reaction (the activation energy for the forward reaction is **+200KJmol^{-1}**) (01½mks)

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8. Complete the following equations and write the IUPAC names of the main organic product in each case.

(a) $CH_3CH_2CH_2COOH \xrightarrow[\text{Heat}]{NaOH(s)/\ CaO(s)}$ …… (01mk)

Name …… (0½mk)

(b) $CH_3CH{=}CHCH_3 \xrightarrow[2.\ H_2O,\ Zn,\ CH_3COOH.]{1.\ O_3,\ CCl_4,\ <\ 20^oC}$ …… (01mk)

Name …… (0½mk)

(c) $CH_3COCH_3 \xrightarrow[H_2O]{NaBH_4}$ …… (01mk)

Name …… (0½mk)

9. (a) State the common oxidation states exhibited by elements in group (IV) of the Periodic Table. (01mk)

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(b). Discuss the reaction of the following group (IV) elements with dilute nitric acid.

(i) Tin. (02mks)

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(ii) Lead. (02mks)

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SECTION B (54 MARKS)

Answer **six** question from this section

10. Name one functional group that can be identified using each of the following reagents. In each case state what would be observed and write equation for the reaction that would take place

(a) Bromine water:

Functional group. (01mk)

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Observation. (01mk)

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Equation. (01mk)

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(b) 2, 4-dinitrophenyl hydrazine:

Functional group. (01mk)

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Observation. (01mk)

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Equation. (01mk)

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(c) Sodium carbonate:

Functional group. (01mk)

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Observation. (01mk)

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Equation. (01mk)

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11. (a) Define the term boiling point constant of a substance. (01mk)

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(b) State any two colligative properties of a solution. (02mks)

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(c) 2.00g of phosphorus raise the boiling point of 37.4g carbon disulphide by 1.003^{o}C.

(i) Calculate the molar mass of phosphorus in carbon disulphide. (Kb for carbon disulphide is 2.35$^{o}Cmol^{-1}Kg^{-1}$) (03mks)

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(ii). Hence determine the molecular formula of phosphorous in carbon disulphide. (P= 31) (02mks)

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(iii) Comment on the results in c (iii) above. (01mk)

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12. Write equations to show how the following conversion can be effected.

(a) CH_4 from $H_2C{=}CH_2$. (03mks)

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(b) CH_3CH_2COOH from $CH_3CH{=}CH_2$. (03mks)

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(c) Benzene to Benzoic acid. (03mks)

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13. (a) (i) Sketch a graph to show the pH change when hydrochloric acid is titrated with ammonia solution. (01½mks)

(ii) Explain the shape of your sketch graph in (a) (i). (03½mks)

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(b) Calculate the pH of the resultant solution formed when $10cm^3$ of a 0.1M sodium hydroxide is added to $25cm^3$ of a 0.1M ethanoic acid at 25^oC.

(Dissociation constant of ethanoic acid at $25^oC = 1.8 \times 10^{-5}$ $moldm^{-3}$) (04mks)

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14. The table below shows the ionization energies of Group VII elements.

Element	F	Cl	Br	I
Atomic radius(nm)	0.072	0.099	0.114	0.133
Ionic radius (nm)	0.136	0.181	0.195	0.216

(a) Define the term atomic radius. (02mks)

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(b) State and explain the trend in atomic radius of the elements. (04mks)

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(c) Explain why the ionic radius is larger than the atomic radius of the corresponding neutral atom for each element. (03mks)

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15. (a) when 0.1g of aluminium chloride was vaporized at 350°C and pressure of 1 atmosphere, 19.2cm^3 of vapour was formed.

(i) Calculate the relative molecular mass of aluminium. (02mks)

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(ii) Write the molecular formula of aluminium chloride in the gaseous state at 350°c. (Al =27, Cl =35.5). (02mks)

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(b) Aluminium chloride is normally contaminated by traces of iron (III) chloride.

(i) Name one reagent that can be used to detect the presence of iron (III) ion in a contaminated solution of aluminium chloride. (01mk)

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(ii) State what would be observed if the contaminated aluminium chloride solution was treated with the reagent you have named in b (i). (0½mk)

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(c). Water was added dropwise to aluminium chloride.

(i) State what was observed. (0½mk)

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(ii) Write equation for the reaction that took place. (01½mks)

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(d) State one use of aluminium chloride in organic synthesis. (01½mks)

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16. (a) Explain the term partition coefficient. (02mks)

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(b) State two conditions under which partition coefficient is valid. (02mks)

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(c) A solute Q is three times as soluble in ethoxyethane as in water. An aqueous solution containing 4.5g of Q per litre of a solution was shaken by ethoxyethane in a separating funnel. Calculate the mass of Q that was extracted when the solution was shaken:

(i) With 100cm^3 of ethoxyethane. (02mks)

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(ii) Twice with 50cm^3 of ethoxyethane. (02mks)

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(d) Comment on your results in (c) above. (01mk)

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17. Sodium, aluminium, silicon and phosphorous are the elements in period 3 of the Periodic Table.

(a) For each element, write the formula and name the structure of the oxide (04½mks)

Element	**Formula of oxide**	**Structure**
Sodium		
Aluminium		
Silicon		
Phosphorous		

(b) Write equation for the reaction between aluminium oxide and

(i) Dilute hydrochloric acid (01½mks)

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(iii) Excess sodium hydroxide. (01½mks)

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(c) Write equation of a reaction between the oxide of silicon and sodium hydroxide. (01½mks)

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END.

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