Student's Name:……

Signature:……

COMBINATION	ROLL CALL No.		

P525/1
CHEMISTRY
Paper 1
Nov./Dec. 2024
2 ¾ hours

THE CHEMISTRY DEPARTMENT

Uganda Advanced Certificate of Education
END OF YEAR EXAMS
CHEMISTRY
Paper 1
2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

Answer **all** *questions in this Section* **A** *and* **six** *questions in Section* **B**.
All *questions must be written in the spaces provided.*
The Periodic Table, with relative atomic masses, is attached at the end of the paper.
Mathematical tables (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used.
Illustrate your answers, with equations 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 Examiners' Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	**Total**

SECTION A: (46 MARKS)

Answer **all** *questions in this section*

1. Complete the following equations and write the IUPAC name of the major organic product.

   (a) $CH_3CH_2Br + HC \equiv \bar{C}Na^+ \xrightarrow{NH_3(l)}$ ... ...

   Name;..... *(1 ½ marks)*

   (b) $CH_3\overset{\overset{Cl}{|}}{C} = CH_2 \xrightarrow{HCl}$ ... ...

   Name;..... *(1 ½ marks)*

   (b)  $\xrightarrow{Cl_2/\ u.v\ light}$ ... ...

   Name;..... *(1 ½ marks)*

2. (a) Name **three** types of radiations emitted by radioactive substances.

   (1 ½ marks)

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   (b) Identify the particles $\boldsymbol{x}$ and $\boldsymbol{y}$ in the following radioactive decay equation.

   (02 marks)

   $$^{218}_{84}Po \longrightarrow {}^{214}_{82}Pb + x \longrightarrow {}^{214}_{83}Bi + y$$

   $\boldsymbol{x}$ is.....

   $\boldsymbol{y}$ is.....

3. State what is observed and write equation for the reaction that takes place when;

   (a) 2-methylpropene is bubbled through a solution of bromine water.

   (02 marks)

   Observation;

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   Equation;

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(b) propyne is bubbled through a solution of ammoniacal silver nitrate.

(02 marks)

Observation;

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Equation;

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4. Write equation to show the reaction between aqueous sodium hydroxide solution and the following oxides;

(a) aluminium oxide. *(1 ½ marks)*

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(b) silicon(IV) oxide. *(1 ½ marks)*

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(c) sulphur(VI) oxide. *(1 ½ marks)*

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5. (a) What is meant by the term **standard enthalpy of formation**? *(01 mark)*

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(b) (i) The standard enthalpies of combustion of zinc sulphide(ZnS), zinc and sulphur are $-441, -348$ and $-297\ kJmol^{-1}$ respectively. Calculate the standard

enthalpy of formation of zinc sulphide. *(4 ½ marks)*

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(ii) State whether zinc sulphide is a stable compound or not. Give a reason for your answer. *(1 ½ marks)*

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6. A compound ***Q*** , contains 8.10% aluminium, 14.43% sulphur, 28.86% oxygen and the rest being water of crystallisation.

   (a) (i) Determine the molecular formula of ***Q***. *(02 marks)*

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(ii) Deduce the molecular formula of ***Q***.(***Vapour density of Q is*** $0.0298 g cm^{-3}$ ***at s.t.p***)

(2 ½ marks)

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(b) Magnesium ribbon was added to an aqueous solution of **Q**.

(i) State what was observed. *(01 mark)*

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(ii) Write equation for the reaction that took place. *(1 ½ marks)*

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7. (a) State what is meant by the term **osmotic pressure.** *(01 mark)*

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(b) A solution containing 2.8% of a polymer was found to have an osmotic pressure of 7.0×10^{-4} atmospheres at 25°C. Calculate the relative molecular mass of the polymer *(02 marks)*

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(c) Explain why in the determination of molecular mass of a polymer, osmotic pressure is used instead of freezing point depression and boiling point elevation. *(02 marks)*

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8. An aqueous solution of substance ***Y*** was made and divided into 3 portions. When sodium hydroxide solution was added to the first portion, a white precipitate soluble in excess was formed. The second portion formed a white precipitate soluble in excess ammonia to form a colourless solution. The third portion formed a white precipitate soluble on warming with lead(II) nitrate solution.

   (a) Identify ;

   (i) the cation in ***Y***. *(½ mark)*

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   (ii) the anion in ***Y***. *(½ mark)*

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   (b) (i) Write an ionic equation for the formation of the white precipitate with sodium hydroxide solution. *(1 ½ mark)*

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   (ii) Give a reason why the white precipitate is soluble in excess sodium hydroxide solution. *(½ mark)*

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   (c) Describe a chemical test that can be used to confirm the cation in ***Y***. Include observation for the reaction but no equation is required. *(1 ½ marks)*

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9. Complete the following equations and in each case outline the accepted mechanism for the reaction.

   (a)  $\xrightarrow{Br_2 / H_2O}$ *(03 marks)*

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(b)  $\xrightarrow{Conc.HNO_3/\ Conc.H_2SO_4/\ heat}$ *(03 marks)*

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SECTION B: (54 MARKS)

Answer any **six** *questions from this section.*

10.(a) Differentiate between the terms **half life** and **decay constant**. *(02 marks)*

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(b) The data in the table below was obtained for the reaction;

$3A \longrightarrow Products$

Time(minutes)	0	60	120	180	240	320
$\mathbf{log_{10}}[A]$	-0.62	-0.80	-1.00	-1.14	-1.34	-1.47

Plot a graph of $\log_{10}[A]$ against time. *(03 marks)*

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(c) From the graph, determine the order of reaction. *(01 mark)*

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(d) Calculate the ;

(i) decay constant for the reaction. *(02 marks)*

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(ii) the half life for the reaction. *(01 mark)*

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11.(a) Using equations only, show how nitric acid can be manufactured from ammonia. *(04 marks)*

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(c) Briefly describe how concentrated nitric acid reacts with;

(i) Magnesium *(2 ½ marks)*

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(ii) Sulphur *(2 ½ marks)*

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

(a) $CH_3CH_2C \equiv CH$ from $H_2C = CH_2$ *(03 marks)*

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(b) Ethanol to butan-2-ol *(03 marks)*

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(a) Ethyne to chlorobenzene *(03 marks)*

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13. (a) The table below shows the melting points of period 3 elements of the Periodic Table.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Melting point(K)	370.8	923	933.3	1687	317.2	388.2	171.5	83.6

Explain why;

(i) magnesium has a higher melting point than sodium. *(03 marks)*

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(ii) silicon has the highest melting point *(03 marks)*

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(iii) sulphur has a higher melting point than phosphorus. *(03 marks)*

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14. Name **one** reagent that can be used to distinguish between the following pairs of ions. In each case state what would be observed if each of the ions is treated with the reagent you have named.

(a) $Ba^{2+}(aq)$ and $Mg^{2+}(aq)$ *(03 marks)*

Reagent;

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Observations;

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(b) $Al^{3+}(aq)$ and $Zn^{2+}(aq)$ *(03 marks)*

Reagent;

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Observations;

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(c) $Cl^-(aq)$ and $I^-(aq)$ *(03 marks)*

Reagent;

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Observations;

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15. During the manufacture of sulphuric acid by the contact process, sulphur dioxide is catalytically oxidized to sulphur trioxide according to the following equation;

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad \Delta H^{\theta}(298K) = -197\ kJmol^{-1}$$

(a) Name **one** source of sulphur dioxide and **one** source of oxygen used in the contact process. *(01 mark)*

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(b) State the industrial conditions used to obtain a maximum yield of sulphur dioxide. *(1 ½ marks)*

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(c) State the conditions under which sulphuric acid reacts with aluminium and phosphorus and in each case write equation for the reaction.

(i) aluminium *(02 marks)*

Condition(s);

…….....

Equation;

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…….....

(i) phosphorus *(02 marks)*

Condition(s);

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Equation;

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(d) Concentrated sulphuric acid is 98% w/w and has a density of $1.84 gcm^{-3}$. Calculate the molarity of the concentrated sulphuric acid. *(2 ½ marks)*

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16.20.0 cm^3 of a gaseous hydrocarbon ***G***, were exploded with 150 cm^3 of excess oxygen. After complete combustion, the residual gas was found to be 110 cm^3. When concentrated potassium hydroxide solution was added to residual gas, the volume reduced to 30 cm^3.

(a) Determine the molecular formula of ***G***. *(2 ½ marks)*

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(b) Write the structural formulae and names of all possible isomers of ***G.***
(03 marks)

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(c) Ozonolysis of ***G*** yields only one product.

(i) Identify ***G*** *(½ mark)*

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(ii) Write the mechanism for the reaction between ***G*** and warm acidified water.
(03 marks)

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17. (a) State what is meant by the term **freezing point constant**. *(01 mark)*

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(b) The table below shows the freezing points of various concentrations of a non-volatile solute ***X*** in water at 760mmHg.

Concentration (gdm^{-3})	0	30	60	90	120	150
Freezing point(°C)	0	-0.16	-0.22	-0.49	-0.65	-0.85
Freezing point depression(ΔT)						

(i) Complete the table above. *(03 marks)*

(ii) Plot a graph of freezing point depression against concentration of ***X***. *(03 marks)*

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(c) Use your graph to calculate the relative formula mass of ***X***.(Freezing point constant, K_f of water is 1.86℃$mol^{-1}kg^{-1}$) *(02 marks)*

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 TI 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

		139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
		227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

END.