Name:……

Signature: …… School……

P525/1

Chemistry **S.5**
Paper 1
AUGUST-SEPT 2024
2 ¾ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION
CHEMISTRY
END OF TERM 2
SENIOR FIVE.
Paper 1
2 ¾ hours

INSTRUCTIONS TO CANDIDATES:

- Answer all questions in **section A** and **any six questions** in section B
- All questions must be answered in the spaces provided; no answer sheet must be attached.
- The Periodic Table, with relative atomic masses, is supplied.
- Mathematical 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 22400cm^3
  Standard temperature = 273 K
  Standard pressure = 101325 N m^{-2}

	For Examiners' use Only															
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**

SECTION A. (46 marks)

*Attempt **all** questions in this section.*

1. The boiling point elevation value and relative molecular mass of ethanoic acid is affected by its **association** in solution.

(a) What is meant by the term **association?** **(01 mark)**

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(b) Explain how association of ethanoic acid in solution affects the boiling point elevation value and its relative molecular mass. **(03 marks)**

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(c) 0.53g of an organic compound A with a simplest formula of C_8H_8O in 22g of ethanoic acid lowered the freezing point of ethanoic acid by 0.78K. The kf for ethanoic acid is 3.89$Kmol^{-1}$ kg^{-1}. Determine the molecular formula of A. **(02 marks)**

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2. Beryllium like aluminium reacts with sodium hydroxide solution but other group (II) elements do not.

(a) State reasons why;

(i) Both beryllium and aluminium react with sodium hydroxide solution. **(02 marks)**

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(ii) Other group (II) elements do not react with sodium hydroxide solution but beryllium does. **(02 marks)**

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(b) Write an equation for the reaction of Beryllium with sodium hydroxide solution.

(01 mark)

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3. (a) Complete the equation below and Give the IUPAC name of the major product.

(01 mark)

$(CH_3)_2$ CHCH=CHCOOH $\xrightarrow[\text{Heat}]{\text{NaOH(s)/ CaO (s)}}$ _____

The IUPAC name of the major product

_____

(b) When the major product was reacted with hydrogen bromide followed by sodium in presence dry ether, compound **H** was formed. Write the IUPAC name and structural formula of **H.**

(i) Structural formula **H**; **(01 mark)**

_____

(ii) IUPAC name of **H**; **(01 mark)**

_____

(c) Write **an** equation and mechanism for the reaction that shows the conversion of the major product to 3-Methylbutan-2-ol. **(03 marks)**

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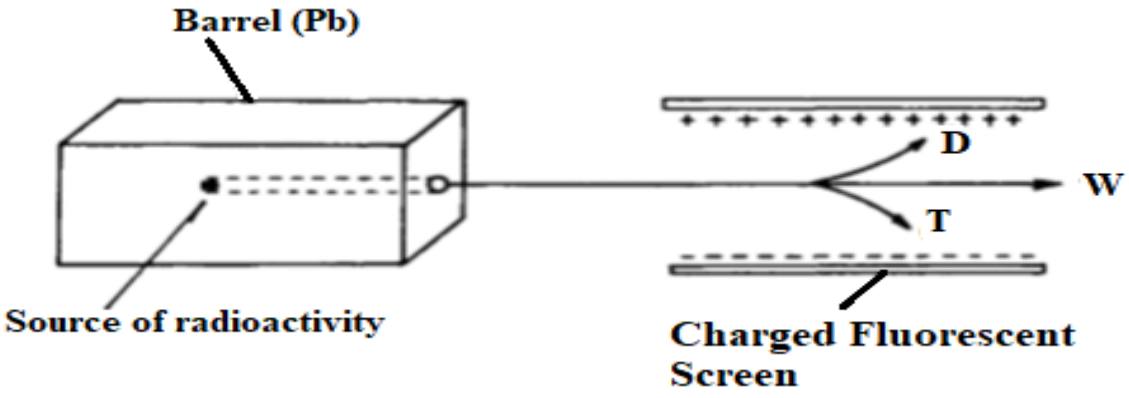
4. (a) Complete the following equations for nuclear reaction. **(02 marks)**

(i) $^{250}_{98}Cf$ + _____ ⟶ $^{257}_{103}LW$ + $4^{1}_{0}n$

(ii) _____ ⟶ $^{234}_{90}Th$ + $\propto$

(b) The diagram below demonstrates the behavior of radioactive particles.



Giving a reason in each case, state which group of radiations is represented by:

(i) Letter **T** **(01 mark)**

_____

_____

(ii) Letter **D** **(01 mark)**

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(iii) Letter **W.** **(01 mark)**

_____

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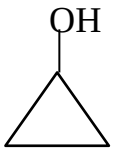
5. Complete the following equations and write a mechanism for the reaction that occurs.

(a) 

$\xrightarrow[\text{Heat}]{\text{Conc. } H_2SO_4}$ _____ **($2\frac{1}{2}$ marks)**

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(b) $CH_3CH_2Cl \xrightarrow[\text{Heat}]{\text{NaOH (aq)}}$ _____ **($2\frac{1}{2}$ marks)**

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6. The table below shows the solubility (gdm^{-3}) of the hydroxides of group (II) elements. Use the information to answer the questions below.

Compound	$Mg(OH)_2$	$Ca(OH)_2$	$Sr(OH)_2$	$Ba(OH)_2$
Solubility (gdm^{-3})	0.10	1.50	8.90	33.20

(a) State the trend in the solubility of group (II) hydroxides. **($0\frac{1}{2}$ Mark)**

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_____

(b) Explain the trend in (a) above. **($2\frac{1}{2}$ marks)**

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(c) Comment and briefly explain the reaction of calcium hydroxide with dilute sulphuric acid. **(2marks)**

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7. (a) Write the structural formula and name of the functional group for the following. **(03 marks)**

Molecular formula	**Structural formula of functional group**	**Name of functional group**
$C_3H_6O_2$		
C_4H_6		
C_4H_8O		

(b) Name **one** reagent that can identify the functional group in $\mathbf{C_3H_6O_2}$ and state what is observed when the reagent is reacted with the function group given. **(01 mark)**

Reagent.

_____

Observation.

_____

(c) Write equations to show how **one** isomer of $\mathbf{C_4H_6}$ can be converted to

2-Iodobutane. **(02 marks)**

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8. (a) What is meant by the term **steam distillation.** **(01mark)**

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(b) When Bromo benzene was steam distilled at normal atmospheric pressure of 760mmHg, the distillation temperature was found to be 95.7^0C. At the same temperature, the vapour pressure of water was 640mmHg. Calculate the percentage composition of Bromobenzene in the distillate. **(03 marks)**

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9. Explain the following observations.

(a) Alkanes are generally unreactive organic compounds. **(02 marks)**

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(b) The first ionization energy of Aluminium is less than that of Magnesium.

. **(02 marks)**

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SECTION B. (54 Marks)

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

10. (a) An organic compound Y when ozonolysed followed by hydrolysis with water in presence of metallic zinc and ethanoic acid, $CH_3CH_2COCH_3$ and CH_3CHO are formed.

(i) Write the structural formulae and IUPAC name of Y. **(01 mark)**

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_____

(ii) State what is observed when Y is treated with sodium hydrogen carbonate solution. **(01 mark)**

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(b) Write equations to show how;

(i) Compound Y can be converted to 3-methylpentan-2-ol. **(02 marks)**

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(ii) **$CH_3CH_2COCH_3$** can be converted to 3-Bromobutan-2-ol. **(03 marks)**

(c) Write an equation and a mechanism for the reaction that occurs when compound Y is reacted with bromine in presence of carbon tetrachloride. **(02 marks)**

11. Miscible liquids form solutions that are either ideal or non-ideal.

(a) Explain what is meant by an **ideal solution**. **(02 marks)**

(b) When water and nitric acid (86^0C) are mixed, they form a miscible liquid mixture that deviates positively from Raoult's law.

(i) Explain why the mixture deviates from Raoult's law positively. **(03 marks)**

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(ii) Draw a well labelled temperature-composition diagram for the mixture.
(Azeotropic mixture composition and boiling point are 86% nitric acid and 120.5^0C)

(02 marks)

(iii) Explain what happens when 80% of the solution containing nitric acid is fractionally distilled. **(02 marks)**

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12. When **0.155g** of an organic compound **W** was burnt in oxygen, **0.220g** of carbon dioxide and **0.135g** of water were formed.

(a) Determine the empirical formula of **W**. **(02 marks)**

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(b) When **0.225g** of **W** was vapourised at **127^0C** and **760mmHg**, it occupied a volume of **$119.11cm^3$**.

(i) Determine the molecular formula of W. **(03 marks)**

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(ii) Compound **W** when reacted with sodium metal, bubbles of a colourless gas are evolved. Write the structural formula and IUPAC name of compound W. **(01 mark)**

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(c) Write equations to show how **compound W** can be obtained from chloroethane.

(03 marks)

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13. (a) Define the term **Electronegativity.** **(01 mark)**

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(b) The table below shows the electronegativity values of elements of group (II) of the periodic table.

Element	Be	Mg	Ca	Sr	Ba
Electronegativity	1.57	1.31	1.00	0.95	0.89

State the trend in the electronegativity values of the elements. **(01 mark)**

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(c) Explain;

(i) Why beryllium has the highest electronegativity value. **(02 marks)**

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(ii) The trend stated above in (b). **(03 marks)**

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(d) Explain why the first electron affinity of oxygen is **-141.4KJmol^{-1}** while the second electron affinity is **+844 KJmol^{-1}**. **(02 marks)**

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14. (a) Write the formula of one functional group that can be identified using the following reagents. In each case state what was observed and write an equation for thee reaction that occurs.

(i) Alkaline potassium manganate (VII) solution. **(03 marks)**

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(ii) Ammoniacal silver nitrate solution. **(03 marks)**

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(b) When **butan-1-ol** and **Butan-2-ol** are dehydrated with concentrated sulphuric acid at 170^0C, they yield the same **principal product**.

(i) Write the structural formula and name of the principal product formed. **(01 mark)**

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(ii) Explain why dehydration of both alcohols gives the same product. **(02 marks)**

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15. (a) State Graham's law of diffusion. ***(01 mark)***

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(b) Two pieces of cotton wool were each soaked separately in concentrated ammonia solution and concentrated hydrochloric acid respectively and simultaneously inserted into opposite ends of a horizontal wide glass tube. After a short time a white ring was formed across the tube. If the distance between the inner surfaces of the cotton wool plugs is 50cm.

(i) Name the white ring. **(01mark)**

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(ii) Write the equation leading to formation of the white ring. **(01mark)**

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(iii) With a reason, state to which end of the horizontal wide glass tube was the white ring nearer. **(02 marks)**

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(c) Determine how far from the ammonia plug the white ring is formed. **(04 marks)**

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16. Compare the reaction of;

(a) Sodium and magnesium with water. **(03 marks)**

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(b) Beryllium carbide and calcium carbide with water. **(03 marks)**

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(b) Aluminium and sodium with sodium hydroxide solution. **(03 marks)**

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17. (a) State what is meant by the following terms;

(i**) Cryoscopy** **(01 mark)**

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(ii) **Colligative property** **(01 mark)**

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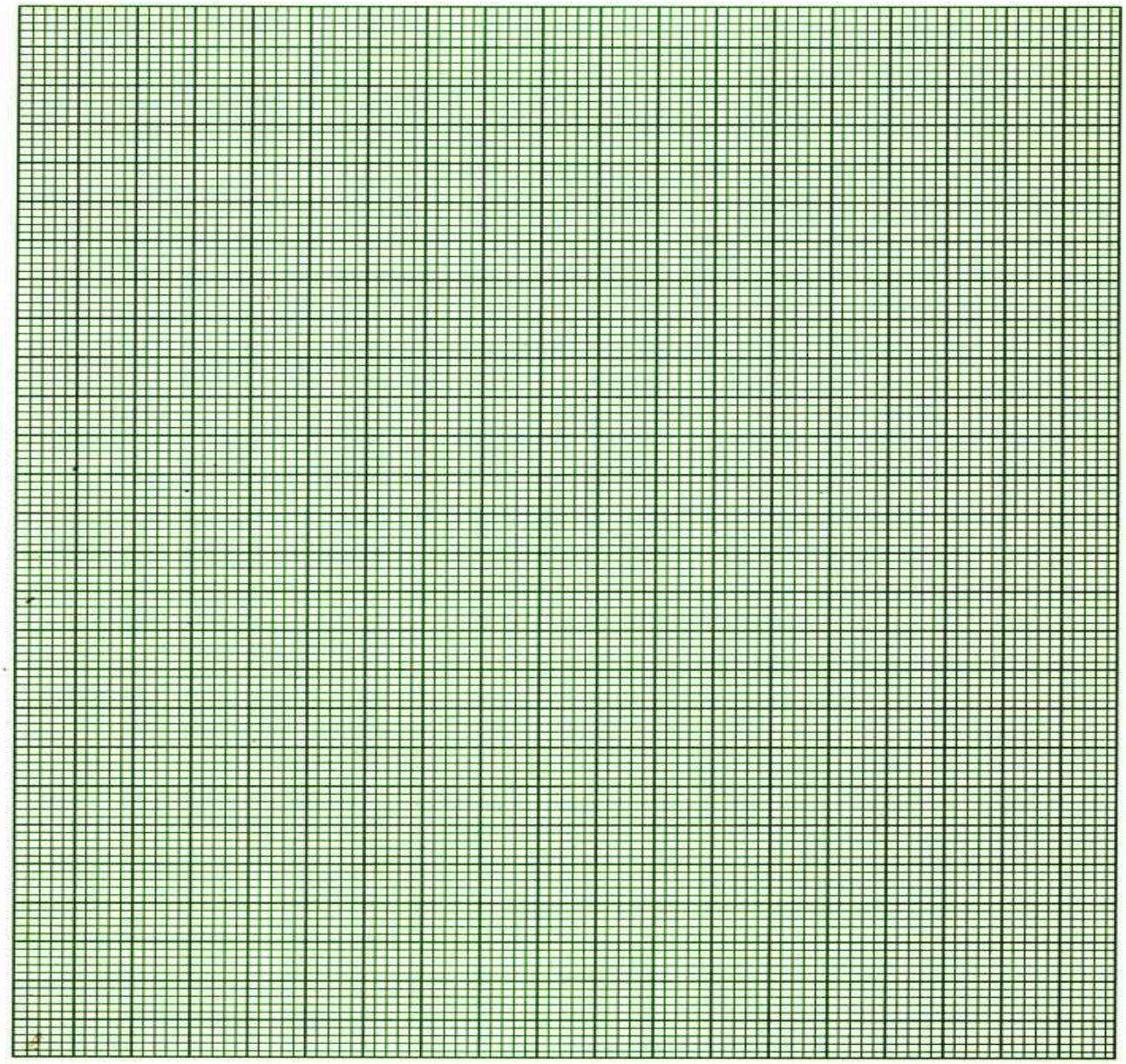
(b) The table below shows the freezing point of various concentrations of a non-volatile solute T in water at 1 atmosphere.

Concentration/ gdm^{-3}	0	20	40	60	80	100	120	140
Freezing point /^{0}C	0	-0.11	-0.22	-0.32	-0.43	-0.54	-0.65	-0.76

(i) Plot a graph of freezing point depression against concentration. **(04marks)**



Using the graph above determine the relative molecular mass of T.

(Kf for water $=1.86^0 Cmol^{-1}\ kg^{-1}$) **(03 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

WISH YOU SUCCESS AND NICE HOLIDAYS