Name:……Signature: ……

P525/1

Chemistry

Paper 1

APRIL/MAY 2024

2 ¾ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION

S.5 CHEMISTRY

Paper 1

END OF TERM ONE

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

(b) $250cm^3$ of an **alkene** diffuse through a porous medium in 10 seconds and $716cm^3$ of oxygen diffuse through the same medium in 25 seconds under the same conditions.
(i) Calculate the molecular mass of the **alkene**. **(03 marks)**

(ii) Deduce the structural formula and give its name. **(01mark)**

2. (a) What is meant by the term **oxidation number**. **(01 mark)**

(b) Calculate the oxidation state of **manganese** and **chromium** in the following compounds. **(04 marks)**

(i) $\mathbf{MnO_4^-}$	(ii) $\mathbf{Mn_2O_4}$
(iii) $\mathbf{Cr_2O_7^{2-}}$	(iv) $\mathbf{CrO_3}$

3. (a) What is meant by **colligative property**. **(01mark)**

(b) Give two;

(i) Colligative properties**.** **(02 marks)**

(ii) Conditions under which the above colligative properties operate. **(02marks)**

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(c) State one significance of the above colligative properties. **(01mark)**

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_____

4. (a) Explain what is meant by a **functional group**. **(01mark)**

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_____

_____

(b) An organic compound M has a structural formula of

$$CH_3CH{=}CHC{\equiv}CCH_2CH_2COOH$$

(i) Write the **names** of any three functional groups in compound M ***(1$\frac{1}{2}$ marks)***

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_____

_____

_____

(b) (i) State **three** possible homologous series to which compound M can belong.

. ***(1$\frac{1}{2}$ marks)***

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(ii) State two properties that qualify a given compound to be under a given homologous series. **(01 mark)**

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5. Ammonia gas can be manufactured industrially through a given process.

(a) Name the **process** by which ammonia gas can be manufactured. **(01 mark)**

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_____

(b) (i) State the raw materials from which ammonia can be manufactured **(01 mark)**

_____

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(ii)State the conditions required for manufacture of ammonia in an industry.

. **(01 mark)**

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_____

(c) Write an equation for the reaction that leads to manufacture of ammonia**.(01mark)**

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_____

6. (a) An organic compound Y contains 68.8% carbon, 4.92% hydrogen and the rest being oxygen .

(i) Calculate the empirical formula of Y. **(02 marks)**

_____

_____

_____

_____

_____

_____

(ii) The vapour density of Y is 61. Determine the molecular formula of Y. **(02 mark)**

_____

_____

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(b) (i) Write the structural formula of compound Y. **(01 mark)**

_____

_____

_____

(ii) Giving a reason for your answer, state the homologous series to which Y belongs. **(01 mark)**

7. (a) What is meant by **ionization energy**. **(01 mark)**

(b) Explain how;

(i) **Nuclear charge** affects first ionization energy. **(02 marks)**

(ii) **Screening effect** affects atomic radius. **(02 marks)**

(c) State any other **two** factors that affect ionization energy. **(01 mark)**

8. (a) State **Dalton's law** of partial pressures. **(01 mark)**

(b) Explain why a mixture of hydrogen chloride and ammonia gas does not hold for Dalton's law off partial pressures. **(01 marks)**

(c) At the same pressure of $1x\ 10^5\ Nm^{-2}$, 150 cm^3 of hydrogen was mixed with 50.0cm^3 of carbon dioxide. Calculate the **partial pressure** of carbon dioxide if the pressure of the mixture is $1.00x10^5\ Nm^{-2}$. **(02 marks)**

9. 15 cm^3 of gaseous hydrocarbon **Q** was exploded with 105cm^3 off excess oxygen. The residual gas occupied 75cm^3. When the residual gas was passed through a combustion chamber with copper turnings, the volume reduced to 45 cm^3.

(a) (i) What is meant by a **hydrocarbon.** **(01 mark)**

(b) (i) Write an equation for the reaction that occurred in a combustion chamber.

(01 mark)

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

(c) Write the structural formula and I.U.P.A.C name of hydrocarbon Q. **(01 mark)**

SECTION B. (54 marks)
Attempt any six questions from this section

10. (a) On complete combustion of 7.50g of compound M, 17.8g of carbon dioxide and 9.27g of water.

(i) Determine the empirical formula of M. **(03marks)**

(ii) The vapour density of M is $1.64755gl^{-1}$ at s.t.p. Determine the molecular mass of compound M. **(02 marks)**

(b) Write the structural formulae of any two chain and positional isomers of compound M and give their I.U.P.A.C names. **(04 marks)**

11. (a) State the kinetic theory of matter. **(01 mark)**

(ii) State **three** assumptions of the kinetic theory of matter. **(03 marks)**

(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. **($\frac{1}{2}$Mark)**

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

(iii) With a reason, state to which end of the horizontal wide glass tube was the white ring nearer. **($1\frac{1}{2}$marks)**

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_____

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_____

(c) Determine how far from the ammonia plug the white ring is formed. **(02 marks)**

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12. (a) What is meant by **electronegativity**? **(01 mark)**

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

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

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

_____

_____

(ii) Explain the trend in the electronegativity values of the elements above. **(04marks)**

_____

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(b) The ions $\mathbf{Na^+}$ and $\mathbf{Mg^{2+}}$ have the same electron configuration but the ionic radius of $\mathbf{Mg^{2+}}$ is lower than that of $\mathbf{Na^+}$**.** **(03 marks)**

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13. (a) What is meant by **boiling point constant of a liquid**. **(01 mark)**

(b) The boiling point of a solution containing 2.8g of a compound T in 20g of water is 100.2^0C at standard pressure (boiling point of water is 1000C at standard pressure).
(i) Explain how the solute affects the boiling point of water. **(04 marks)**

(ii) Calculate the relative molecular mass of T. **(03 marks)**

(c) Explain what would happen to the molecular mass of T if there was association of the solute in solution. **(02 marks)**

14. (a) Define the following terms as applied to organic chemistry

(i) **Homologous series.** **(01 mark)**

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_____

_____

(ii) **Locant** **(01 mark)**

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_____

(iii) **Functional isomers.** **(01 mark)**

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_____

(b) An organic compound X has a molecular formula of $\mathbf{C_5H_{10}}$. Write the structural formulae and IUPAC names of any two;

(i) Chain isomers **(02 marks)**

_____

_____

(ii) Position isomers. **(02 marks)**

_____

_____

(ii) Geometric isomers. **(02 marks)**

_____

_____

_____

15. (a) Write the electronic configurations of the following. **(03 marks)**

(i) Chromium

_____

_____

(iii) Calcium

_____

_____

(iii) Copper

_____

_____

(b) The table below shows the first four successive ionization energies of elements **A, B and C**

Element	**1st I.E (KJmol-1)**	**2nd I.E (KJmol-1)**	**3rd I.E (KJmol-1)**	**4th I.E (KJmol-1)**
A	800	2400	3700	25000
B	900	1800	14800	21000
C	500	4600	6900	9500

State the group of the periodic table to which the elements A, B and C belong

(i) A **(01 mark)**

_____

_____

_____

(ii) B **(01 mark)**

_____

_____

_____

(iii) **C** **(01 mark)**

_____

(c) Explain your answer in (b) (ii) above. **(03 marks)**

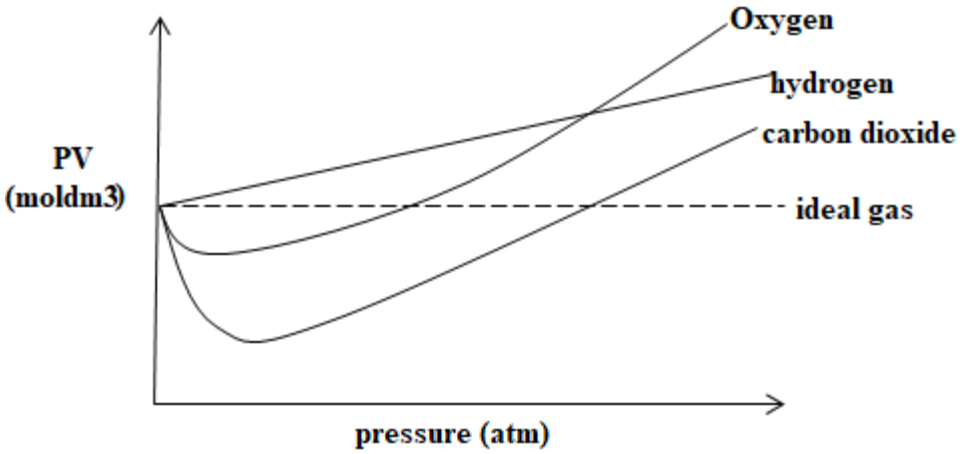
16. (a) Explain what is meant by an **ideal gas** ***(02 marks)***

(b) Explain how liquefication of a gas can be affected by;

(i) Pressure. ***($1\frac{1}{2}$marks)***

(ii)Temperature ***(02 marks)***

(c) The curves below show deviations of some gases from ideal behavior.



(i) State why hydrogen shows a small deviation from ideal behavior compared to the other gases. ***(1$\frac{1}{2}$marks)***

_____

_____

_____

(ii) Compare the deviation of oxygen and carbon dioxide from ideal behavior **(02marks)**

_____

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_____

17. 25cm^3 of a gaseous hydrocarbon W was exploded with 200cm^3 oxygen. The mixture was cooled at room temperature. The residual gases occupied 150cm^3. On addition of sodium hydroxide solution, there was a reduction in volume to 50cm^3.
(a) State why there was a decrease in volume when the residual gases were shaken with sodium hydroxide solution. **(2marks)**

_____

_____

_____

(b) (i) Deduce the molecular formula of compound W. **(03marks)**

(ii) Write the structural formulae of any two **chain** isomers and give their IUPAC names. **(2marks)**

(c) Distinguish between **Alicyclic organic compounds** and **Aromatic organic compounds.** **(02 marks)**

END

WISH YOU NICE HOLIDAYS