

Name:.....Signature: .....

P525/1

Chemistry

Paper 1

AUGUST-SEPT 2023

2 ¾ hours

**UGANDA ADVANCED CERTIFICATE OF EDUCATION**

**S.5 CHEMISTRY**

**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  $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$

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

Standard temperature = 273 K

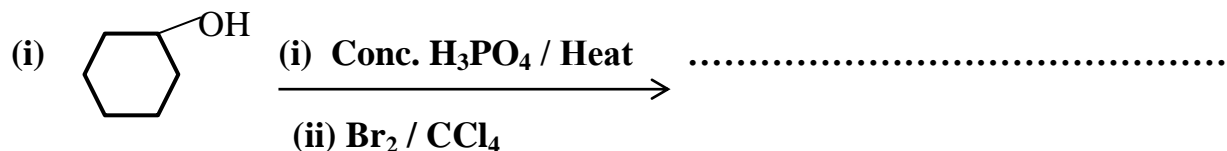
Standard pressure =  $101325 \text{ N m}^{-2}$

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

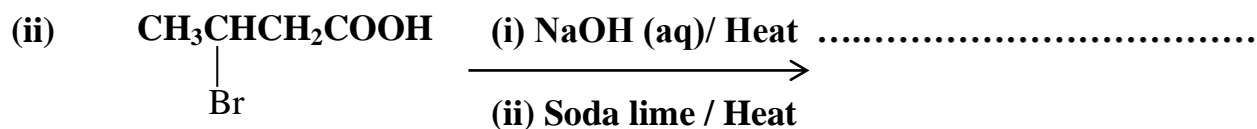
**SECTION A. (46 marks)**

**Attempt all questions in this section**

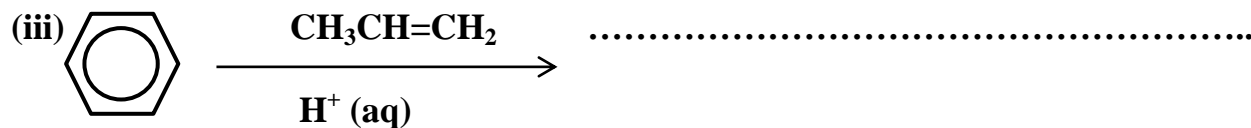
1. (a) Complete the following equations and name the major product. **(03marks)**



Name of major product.....



Name of major product.....



Name of major product.....

(b) Write a mechanism for the reaction that took place in step (ii) of (a) (i) above.

**(02marks)**

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2. Draw the structures and name the shapes for the following species. (03 marks)

species	Structure	Shape
(i) $S_2O_3^{2-}$		
(ii) $H_2S$		
(iv) $SO_3^{2-}$		

(b) Explain the structure of the  $SO_3^{2-}$  ion. (02 marks)

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3. (a) (i) What is meant by **nuclear stability**? (01mark)

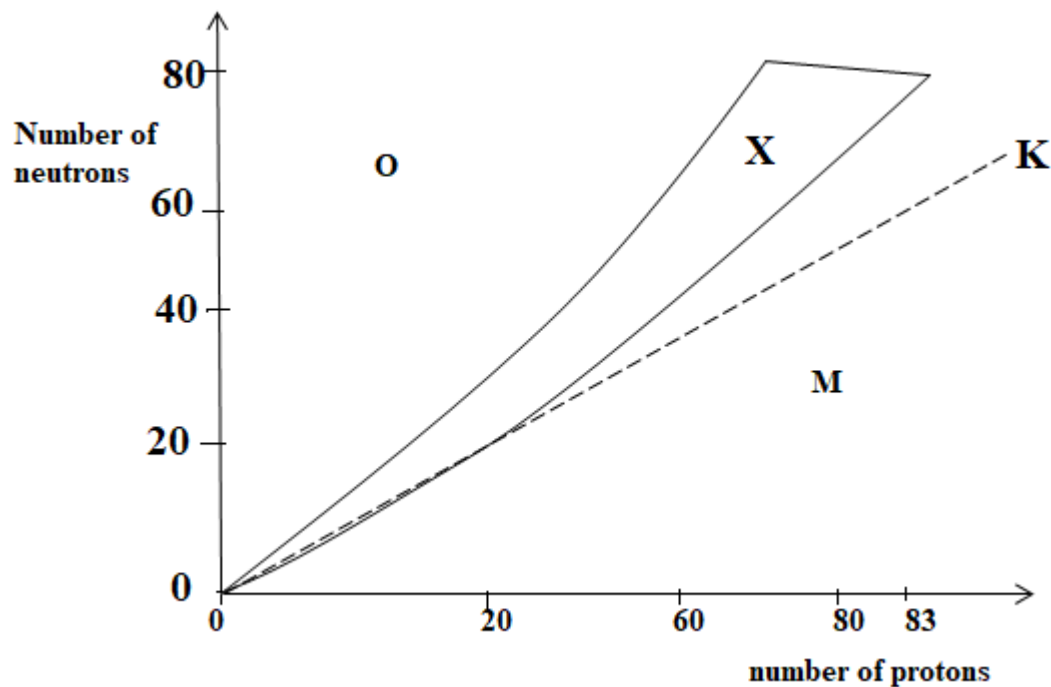
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(ii) State how binding energy affects the stability of a nucleus. (01mark)

(b) The graph below shows how the number of neutrons varies with that of protons.



(i) State what line **K** and region **X** represent. (01mark)

(ii) State why nuclei in the following regions **O** is unstable (01mark)

(iii) Briefly explain how nuclei in the regions **M** can gain stability. (02marks)

4. Write equations to show how the following compounds can be synthesized. In each case state the conditions required for the reactions to take place.

(a)  $\text{CH}_3\text{CH}_2\text{CHO}$  to 2-Bromo propane. ( $02\frac{1}{2}$  marks)

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(b) 1, 2-Dichloropropane from Propan-1-ol (02 marks)

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(c) Propyne to 2, 3- Dimethyl butane. (02 marks)

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5. (a) State three conditions for steam distillation. (1 ½ marks)

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(b) State one advantage of steam distillation over fractional distillation. (01 mark)

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(c) The vapour pressure of water at  $95^{\circ}\text{C}$  is  $84.7\text{kPa}$ . A liquid Y is insoluble in water and has a relative molecular mass of 160. A mixture of Y and water steam distills at  $95^{\circ}\text{C}$  under standard atmospheric pressure. Calculate the mass of water collected in the distillate if the mass of Y in the distillate is  $40\text{g}$ . (2 ½ marks)

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6. (a) State what is meant by the term **diagonal relationship**?. (01mark)

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(b) Give three reasons why lithium and magnesium resemble. (1 ½ marks)

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(c) State three properties to show the diagonal relationship between lithium and magnesium. (03marks)

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7. State what would be observed and write an equation for the reaction that would take place when;

(a) Ethene gas was bubbled through bromine water solution. (1 ½ marks)

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(b) Ammonium hydroxide was added to lead (ii) nitrate solution drop wise until in excess. (1 ½ marks)

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(c) Copper (ii) carbonate was strongly heated until no further change. (1 ½ marks)

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8. (a) State the laws of osmotic pressure. (02marks)

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(b) A solution containing 1.5% of a polymer was found to have an osmotic pressure  $3.6 \times 10^{-4}$  of atmospheres at 25°C. Calculate the molecular mass of the polymer.

(02marks)

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9. A compound W contains 40% carbon and 6.67% hydrogen, the rest being oxygen.

(a) Calculate the empirical formula of W.

**(1 ½ marks)**

(b) A solution containing 28.145g of W in 250g of water froze at  $-3.490^{\circ}\text{C}$ .

(i) Determine the molecular formula of W. ( The freezing point constant,  $K_f$  of water is  $1.86^{\circ}\text{C mol}^{-1}$  per 1000g.) **(02marks)**

(ii) W reacted with sodium carbonate with effervescence. Write the structural formula of W.

(ii) Write equations to show how R can be synthesized from ethene. (1 ½ marks)



**Section B. (54marks)**

**Attempt any 6 questions from this section.**

10. Beryllium, magnesium, calcium and barium are some of the elements that belong to Group (II) of the Periodic Table.

(a) State how the elements react with sulphuric acid and give the conditions for the reactions. **(03 marks)**

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(b) (i). State how the solubilities of the Sulphates of Group (II) elements vary down the group. **(01 mark)**

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(ii). Explain your answer in (b) (i). **(02 marks)**

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(c) Write equation for the reaction of:

(i) Beryllium with sodium hydroxide solution. **(01½ marks)**

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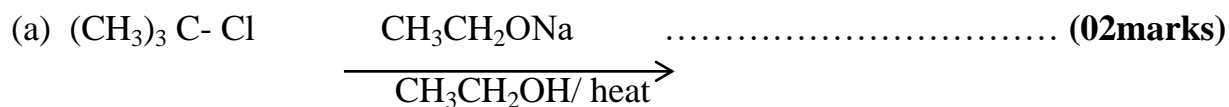
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(ii) Calcium carbide with water.

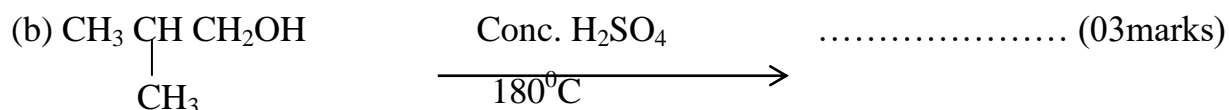
(01½ marks)

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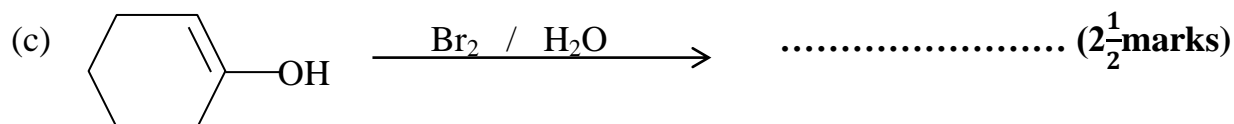
11. Complete the following equations and in each case outline a mechanism for the reaction.



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(d)  $\text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow{\text{HCl}}$  ..... (1 $\frac{1}{2}$ marks)

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12. The vapour pressure of a solution containing 108.2g of a substance P in 1000g of water at 20<sup>0</sup>C was reduced by 0.186mmHg. (The vapour pressure of water at 20<sup>0</sup>C is 17.5mmHg.)

(a) Calculate the relative molecular mass of substance P. (04marks)

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(b) State any three assumptions made in (a) above. (02marks)

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(c) Explain why the vapour pressure of a solution containing a non-volatile solute is less than the vapour pressure of a pure solvent. (03marks)

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[illegible][illegible]

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14. a) What is meant by **first electron affinity**? **(01 mark)**

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(b) Explain why the first electron affinity of fluorine is less than that of chlorine. **(02 marks)**

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(c) Write equations to show how fluorine and chlorine react with cold dilute potassium hydroxide Solution. **(03 marks)**

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(d) With reasons, arrange the following Oxo-acids in order of increasing acid strength.  $\text{HClO}_2$ ,  $\text{HOCl}$ ,  $\text{HClO}_4$ ,  $\text{HClO}_3$ . **(03 marks)**

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15. (a) State **Kohlrausch's law** of independent migration of ions. (01mark)

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(b) Outline any two applications of Kohlrausch's law of independent migration of ions. (02marks)

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(c) Given that the molar conductivities at infinite dilution of some electrolytes are as shown below;

Compound	$\lambda_0 \text{ ( } \text{scm}^2\text{mol}^{-1}\text{)}$
Sodium chloride	113
Ammonium chloride	134.1
Sodium methanoate	101.2
Hydrochloric acid	397.8
Sodium hydroxide	225.2

Calculate the molar conductivity at infinite dilution of:

(i) Ammonium methanoate. (1½marks)

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(ii) Ammonia solution (1½marks)

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(iii) Methanoic acid

(1½marks)

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(b) Explain the differences in your answers in a (i) and (iii) above. (1½marks)

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16. When an organic compound **Q** was heated with potassium hydroxide solution; compound **T** was formed, which when heated with concentrated phosphoric acid ; 2- Methyl propene was formed.

(a) Write the structural formulae of compound **Q** and **T**. (02marks)

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(b) Write the chemical formulae of any two possible positional isomers from compound **T**. (01mark)

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(c) Write an equation and a mechanism for the reaction that leads to formation compound **Q** from 2- Methyl propene. (03marks)

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 (d) Write equations and conditions to show how compound T can be converted to  
 2, 2, 3, 3-Tetramethylbutane. **(03marks)**

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

(i) Radioactivity

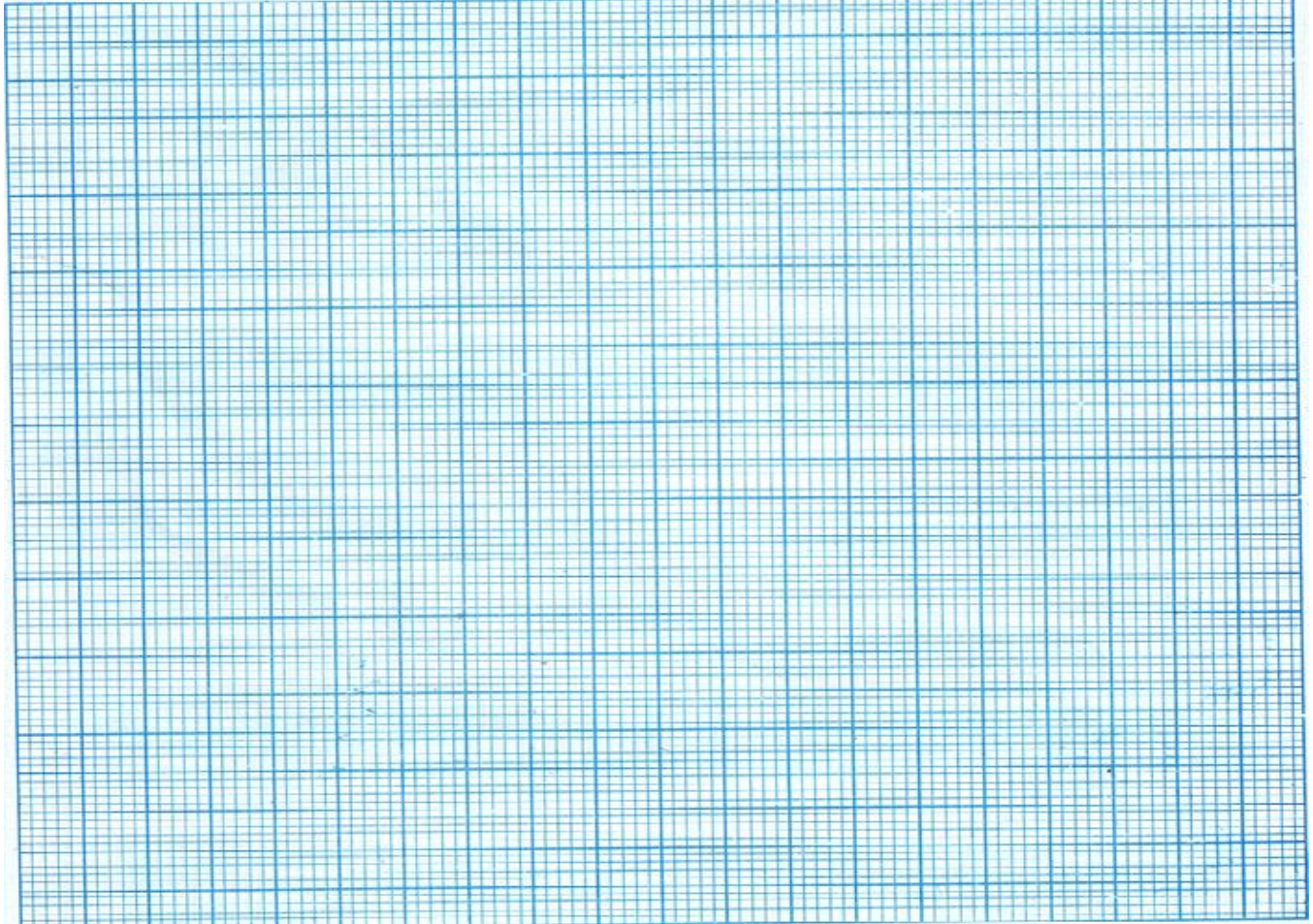
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 (ii) Half-life

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 (b) The table below shows data for radioactive decay of element A

<b>Time (hours)</b>	0.0	5.0	10.0	15.0	20.0	25.0	30.0
<b>Activity (counts per minute)</b>	25.00	23.00	21.25	19.50	18.00	16.50	15.25

(i) Plot a graph of activity against time. **(03marks)**





(ii) Determine the half-life of element A. (02marks)

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(iii) Determine the decay constant and state its units. (02marks)

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**END**

**WISH YOU NICE HOLIDAYS**