Name…… **Centre/ Index No** ……

Signature…… **Expected score**……

P525/1

CHEMISTRY

Paper 1

1ST NOV 2023

2¾Hrs

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

- Answer all questions in Section A and six questions in Section B.
- All questions must be answered in the spaces provided.
- The periodic table, with relative atomic masses is attached at the end of the paper.
  - Molar gas constant, R= 8.31JK^{-1} mol^{-1}
  - Molar volume of gas at s.t.p is 22.4 litres.

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 from this section.

1. The standard electrode potentials for some half – cells are shown below.

   $Fe^{3+}_{(aq)}, Fe^{2+}_{(aq)}/Pt(s)$ +0.77V

   $Sn^{4+}_{(aq)}, Sn^{2+}_{(aq)}/Pt(s)$ +0.15V

   a) Write the convention for the combinedcell. (1½ marks)

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   b) Write equation for the:

      i) reaction at the cathode (01 mark)

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      ii) reaction at the anode (01 mark)

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      iii) overall cell reaction (1½ marks)

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   c) Calculate the e.m.f of the cell. (01 mark)

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   d) State one application of electrode potentials. (01 mark)

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2. a) Draw the structure and name the shape of the following oxides. In each case state the oxidation state of the Sulphur atom. (02 marks)

Oxide	**Structure**	**Shape**	**Oxidation state of sulphur**
SO_2			
SO_3			

b) i) Name the reagent that can be used to distinguish between the oxides in (a). (01 mark)

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ii) State what would be observed, if a solution of each oxide is treated separately with the reagent you have named in b(i). (01 mark)

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iii) Write equation(s) for the reaction(s) that would take place when solutions of each oxides are treated separately with the reagent you have named in b(i). ($1\frac{1}{2}$ marks)

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3. a) Define the term solubility product. (01 mark)

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b) Calculate the solubility product of a solution containing $8.35 \times 10^{-3}g$ of magnesium hydroxide in one litre of solution at 25^0C. (03marks)

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c) State one application of solubility product. (01 mark)

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4. a) Write equation for the reaction between water and

i) iron (III) chloride ($1\frac{1}{2}$ marks)

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ii) tin (II) chloride ($1\frac{1}{2}$ marks)

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b) A piece of clean magnesium ribbon was added to the solution in a(i). State what was observed and write equation for the reaction that took place. ($2\frac{1}{2}$ marks)

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5. Methylamine ionises in water according to the following equation.

$$CH_3NH_{2(aq)} + H_2O_{(l)} \rightleftharpoons CH_3NH^+_{3(aq)} + \bar{O}H_{(aq)}$$

a) Write the expression for the ionization constant K_b of methylamine. (01 mark)

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b) 0.2 moles of methyl ammonium chloride was added to one litre of 0.2M methylamine.

i) Calculate the PH of the resultant solution. [The ionization constant of methylamine is 4.4×10^{-4}mol l^{-1}, Kw is 1.0×10^{-14} mol^2 l^{-2} at 25^0C]. (03 marks)

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ii) State the assumption(s) you have made in b(i). ($\frac{1}{2}$ mark)

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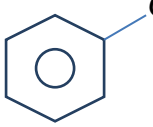
6. Write equations to show how the following compounds can be synthesized.

a)  CH = N – OH

from benzene ($2\frac{1}{2}$ marks)

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b) $CH_3\overset{OH}{\overset{|}{C}}HCH_3$ from ethanol (2½ marks)

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7. To an aqueous solution of $CoCl_2.6H_2O$ was added concentrated hydrochloric acid dropwise until in excess.

a) Name:

i) the cobalt species present in the solution before hydrochloric acid was added. (01 mark)

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ii) the cobalt species present in the solution containing excess hydrochloric acid. (01 mark)

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b) The solution containing excess hydrochloric acid was diluted with water

i) State the colour change that took place. (01 mark)

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ii) Write an equation for the reaction that took place. (1½ mark)

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8. a) When propene reacts with bromine in presence of sodium chloride solution, a mixture of a dibromo and bromochloro compounds are formed. Outline a mechanism for the reaction leading to the formation of the two compounds.

(03 marks)

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b) Name the type of mechanism for the reaction in (a).

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9. The data below was obtained for the reaction.

$A + B \longrightarrow$ Products

Experiment	Initial concentrations (mol dm^{-3})		Initial rate mol d m^{-3} S^{-1}
	A	B	
1	2.0	2.0	3.2×10^{-5}
2	2.0	4.0	6.4×10^{-5}
3	4.0	2.0	x
4	4.0	4.0	25.6×10^{-5}

a) Write the rate equation. (01 mark)

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b) Calculate

i) the value of **x** (01 mark)

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ii) the rate constant for the reaction and state its units. (02 marks)

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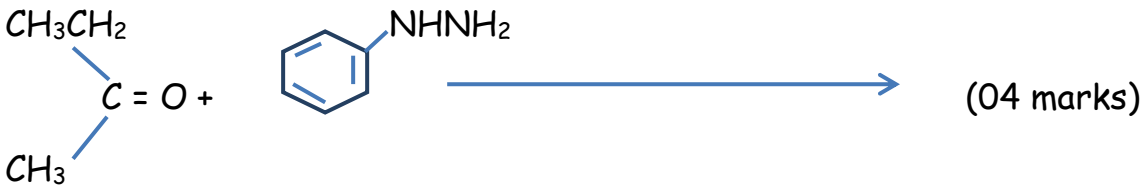
SECTION B (54 Marks)

Answer six questions from this section.

10. Complete the following equations and write a mechanism for the reaction in each case.

a) 

(04 marks)

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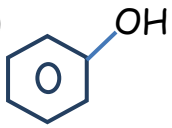
b)  + $CH_3COCl \xrightarrow{NaOH_{(aq)}}$ (3½ marks)

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c) $CH_3CH_2Cl \xrightarrow[dry\ ether]{HC\equiv CNa^+}$ (1½ marks)

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11. a) State

i) the common oxidation states of manganese. (1½ marks)

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ii) the most stable oxidation state of Manganese. (½ mark)

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iii) the reason for your answer in a(ii). (½ mark)

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b) Write a half equation for the reduction of permanganate ion in

i) acid medium (01 mark)

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ii) alkaline medium (01 mark)

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c) An acidified solution of potassium iodide was added to a solution of potassium manganate(vii).

i) State what was observed. (01 mark)

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ii) Write the ionic equation for the reaction that took place. (1½ marks)

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d) State

i) two advantages of using potassium permanganate as a reagent in volumetric analysis. (01 mark)

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ii) two reasons why potassium permanganate is not a primary standard. (01 marks)

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12.a) Define the term 'Partition coefficient" (01 mark)

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b) Copper (II) ions forms a complex $Cu(NH3)_n^{2+}$ with ammonia. The table below shows the results of partition of ammonia between **0.1M** copper(II) ions and trichloromethane.

$[NH_3]$ $(0.1M\ Cu^{2+}_{(aq)})$	0.88	1.08	1.34	1.56	1.80
$[NH_3(CHCl_3)]$.	0.02	0.03	0.04	0.05	0.06

i) Plot a graph of $[NH_3]$ $(0.1M\ Cu^{2+}_{(aq)})$ against $[NH_3(CHCl_3)]$. (03 marks)

ii) Determine the value of n in the complex. (2½ marks)

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c) i) Determine the partition coefficient, K_D of ammonia between aqueous copper (II) ions and trichloromethane. (1½ marks)

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ii) State what the value of K_D you have determined indicates about the distribution of ammonia. (01 mark)

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13. The following reagents can be used to distinguish between members of classes or organic compounds.

Nitrous acid, anhydrous zinc chloride/concentrated hydrochloric acid and neutral iron(III) chloride solution.

For each reagent state, the class of compounds and briefly describe what would be observed when the reagent is reacted with each member of the class.

a) nitrous acid

i) Class of compounds (03 marks)

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ii) Observations

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b) anhydrous zinc chloride/concentrated hydrochloric acid (03 marks)

i) Class of compounds

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ii) Observations

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c) neutral iron (III) chloride (03 marks)

i) Class of compounds

……

ii) Observations

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14. Carbon, silicon, germanium, tin and lead are in group IV of the periodic table.

a) State

i) the common oxidation states exhibited by the elements in their ions or compounds. (01 mark)

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ii) how the stability of the oxidation states of the elements in a(i) vary down the group. (01 marks)

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b) Give a reason for your answer in (a) (ii). (01 mark)

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c) Compare the thermal stabilities of carbon tetrachloride and lead tetrachloride (include equations of reactions if any) (2½ marks)

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d) Describe the reaction if any between each of carbon tetrachloride and tin(iv) chloride with water.

i) Carbon tetrachloride (01 marks)

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ii) Tin(iv) chloride (2½ marks)

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

a) Solid sodium chloride is heated with concentrated sulphuric acid. (2½ marks)

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b) A mixture of benzoic acid and iron (III) chloride solution is heated. (02 marks)

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c) Sodium nitrite solution was added to acidified potassium dichromate(vi) solution . (2½ marks)

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d) A mixture of ethanal and aqueous silver nitrate in ammonia solution. (02 marks)

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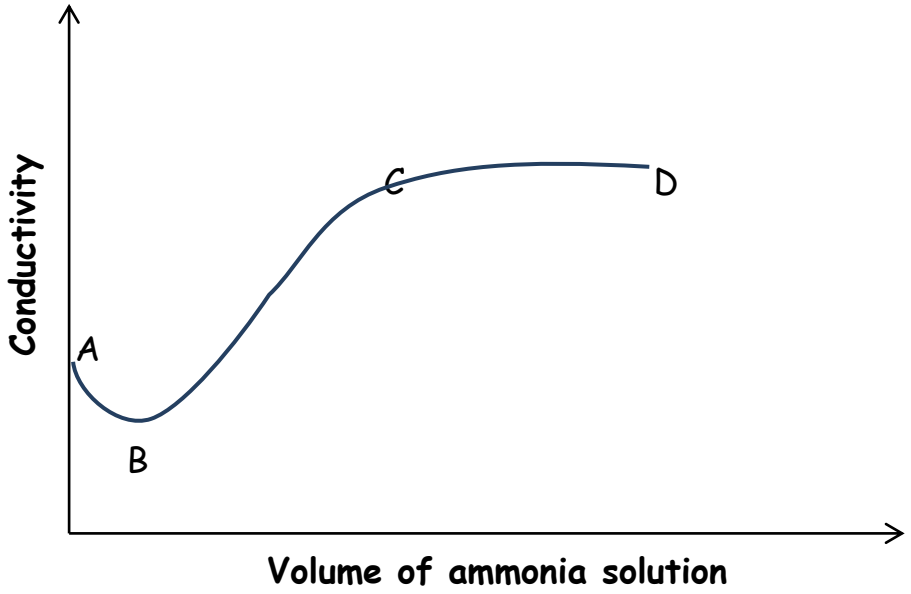
16. The conductimetric curve for the titration of ethanoic acid and ammonia solution is given below.



Explain the shape of the graph. (04 marks)

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b) The molar conductivity of nitric acid, sodium bromoethanoate and sodium nitrate acid are **421**, **89.3** and **121.3Ω^{-1}cm^2** mol^{-1} respectively at inifinite dilution at 25^{0}C.

Calculate the:

i) molar conductivity of bromoethanoic acid at infinite dilution. (1½ marks)

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ii) dissociation constant, Ka, of a 0.1M bromoethanoic acid solution. (The electrolytic conductivity of bromoethanoic acid is **$4.38 \times 10^{-3}\Omega^2cm^{-1}$**)

($3\frac{1}{2}$ marks)

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17.a) (i)Differentiate between soap and soapless detergents. (02 marks)

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ii) Define a vegetable oil (01 mark)

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b) Write equations to show how a soapless detergent can be prepared from dodecan-1-ol $CH_3(CH_2)_{10}CH_2OH$. (02 marks)

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c) Explain the cleansing action of soap. (03 marks)

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d) State the advantage and disadvantage of using a soapless detergent instead of soap in washing.

i) Advantage ($0\frac{1}{2}$ mark)

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ii) Disadvantage ($0\frac{1}{2}$ mark)

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END.