NAME:……Centre/Index No……./……..

Signature: ……

P525/1

CHEMISTRY

Jul/August, 2023

PAPER 1

2 HOURS 45 Minutes.

MATIGO EXAMINATIONS 2022

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 supplied at the end of the paper.

Mathematical tables (3- figure tables) are adequate or non-programmable scientific electronic calculators may be used.

Illustrate your answer with equations where applicable

SECTION A (46 MARKS)

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

1. Complete the following nuclear reaction equations

(a) ${}^{1}_{0}\Omega + {}^{235}_{92}\mathrm{U} \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr +$ ……. (01 mark)

(b) ${}^{230}_{90}\mathrm{Th} \rightarrow$ ……. $+ {}^{226}_{88}\mathrm{Ra}$ (01 mark)

(c) ${}^{27}_{12}\mathrm{Mg} \rightarrow {}^{27}_{13}\mathrm{Al} +$ ……. (01 mark)

2. Draw the structure and name the shape of each of the species in the table below. ($4\frac{1}{2}$ marks)

Species	Structure	Shape
SB_{r6}		
SO_4^{2-}		
Clo_3^-		

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

(a) $\mathrm{HCO_2H} + \mathrm{C_2H_5OH} \overset{\text{conc } \mathrm{H_2}SO_4}{\underset{Warm}{\rightleftharpoons}}$ ……. (03 marks)

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(b) $\mathrm{CH_3COCH_3} \xrightarrow{NaCN/H_2SO_4}$ ……. (03 marks)

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4. (a) (i) Write the general electronic configuration of group (iv) elements. ($\frac{1}{2}$ mark)

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(ii) State the common oxidation state of group (iv) elements in their compounds. (01 mark)

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(b) What is meant by the term inert pair effect? (01 mark)

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(c) State and explain the trend in inert pair effect down (iv) elements. (02 marks)

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5. The equation for the redox reaction that occurs in an electrochemical cell is shown below.

$$Z_{n(s)} + H_gSO_{4(aq)} \rightarrow Z_nSO_{4(aq)} + Hg_{(l)}$$

(a) Write the cell notation. ($1\frac{1}{2}$marks)

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(b) Write the equation for the reaction that takes place at the;

(i) Cathode ($1\frac{1}{2}$marks)

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(ii) Anode ($1\frac{1}{2}$marks)

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(c) The standard reduction potentials for the half cell reactions at the cathode and anode are$+0.6V$ and $-0.76V$ respectively.
Calculate the EMF of the cell. ($1\frac{1}{2}$marks)

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6. (a) Butane - 1, 4 – dioic acid is a weak acid.
(i) Define the term weak acid (01 mark)

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(ii) Write an equation to show that Butane – 1,4- dioic acid is a Weak acid (01 mark)

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(b) 1.18g of butan – 1, 4- dioic acid were dissolved in distilled water to make $200cm^3$of solution whose $p^H$was 3.20. Calculate the acid Ionisation constant, $K_a$for Butane- 1, 4 – dioic acid and state its units. (03 marks)

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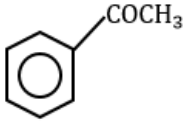
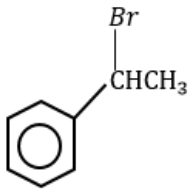
7. Write equations to show the following compounds can be synthesized.

(a)  From  (03 marks)

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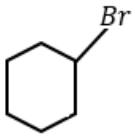
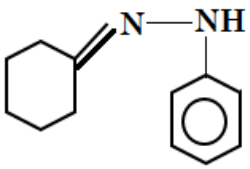
(b)  to  (03 marks)

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8. Cobolt forms a complex of formula $Co(NH_3)_5SO_4Br$

(a) State the oxidation state and co-ordination number for cobolt in the complex. (01 mark)

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(b) Write the formulae for the Ionisation Isomers of the complex. (02 marks)

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(c) Name the reagent that can be used to distinguish between the isomers in (b). (01 mark)

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(d) In each case, state what is observed when the isomers are separately treated with the reagent you have named in (c). (02 marks)

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9. (a) Define the term bond energy. ($1\frac{1}{2}$marks)

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(b) Hydrazine reacts exothermically with hydrogen peroxide when used as a rocket fuel. The table below shows some bond energies.

Bond	O—H	N—N	O—O	N—H	N—N
Bond Energy (KJmol^{-1})	463	163	146	388	944

Calculate the enthalpy change for the reaction;

$H_2O_2 + N_2H_4 \rightarrow 4H_2O + N_2$

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SECTION B (54 ARKS)

*Answer **six** questions from this section*

Any additional question(s) answered will not be marked.

10. (a) A saturated compound B contains 38.710% carbon and 51.613% oxygen the rest being hydrogen. The density of B at $s.t.p$ is $2.7662 g l^{-1}$

(i) Calculate the simplest formula of B (02 marks)

(ii) Determine the molecular formula of B (02 marks)

(b) B reacts with sodium metal to liberate hydrogen gas but gives no effervescence on addition of sodium carbonate solution.

(i) Write the structural formula of B (01 mark)

(ii) State the reason why B has higher boiling point than Propanol.

(01 mark)

(c) B combines with Benzene – 1, 4- dicarboxylic acidto form a polymer called Terylene

(i) State the type of polymerization that leads to the formation of Terylene. (01 mark)

(ii) Write the structural formula of Terylene. (01 mark)

(iii) State any one use of Terylene. (01 mark)

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

(a) tin(ii) chloride is added to acidified aqueous solution of potassium manganite (vii) solution. ($2\frac{1}{2}$marks)

Observation

Equation

(b) bromine in tetrachloromethane is added to phenylethene (02 marks)

Observation

Equation

(c) Chlorine water is added to aqueous solution of iron (ii) sulphate. (02 marks)

Observation

Equation

(d) Aqueous potassium iodide is added to copper (ii) sulphate solution.

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

12. Chloroethane reacts with aqueous sodium hydroxide solution according to the following equation.

$CH_3CH_2Cl + NaOH_{(aq)} \xrightarrow{\text{heat}} c + NaCl_{(aq)}$

(a) Write the mechanism for the reaction (02 marks)

(b) Name the type of mechanism in (a) (01 mark)

(c) Write the rate equation for the reaction (01 mark)

(d) Sketch a labelled diagram to show an energy profile for the reaction. (01 mark)

(e) Write equation to show how CH_3CH_2Cl can be converted to $CH_3CH_2OCOCH_3$ ($2\frac{1}{2}$marks)

13. Name a reagent that can be used to distinguish between the following pairs of Ions. In each case, state what would be observed if each iron is separated treated with the reagent you have named.

(a) $Ba^{2+}_{(aq)}$ and $Ca^{2+}_{(aq)}$ (03 marks)

(b) $I^{-}_{(aq)}$and $Cl^{-}_{(aq)}$ (03 marks)

(c) $SO^{2-}_{3(aq)}$ and $S_2O^{2-}_{3(aq)}$ (03 marks)

14. A compound Q having composition of carbon, C 12.8%, hydrogen, H, 2.1% and 85.1%Bromine is hydrolysed by aqueous potassium hydroxide to compound X. This compound in several stages by Nitric acid and the final product is acid B of relative formula mass 90. On warming, acid B decolourises acidified solution of potassium manganate (vii).

(a) Calculate the molecular formula of Q (04 marks)
(C=12, H=1, Br =79.9)

(b) Identify compounds X and B (02 marks)

(c) Write the equation for the equation of B with acidified potassium manganite (vii) (02 marks)

(d) Write the structural formula of compound isomeric with compound Q. (01 mark)

15. To a solution of $25cm^3$of 0.1M copper (ii) irons was added to $25cm^3$of ammonia solution at one end and the resulting solution was shaken with thrichloromethane and allowed to stand to form two layers. $20cm^3$ of organic layer required $10.2cm^3$ of 0.05M hydrochloric acid for complete Neutrolization. $10cm^3$ of aqueous layer was titrated with $16.5cm^3$ of 0.5M hydrochloric acid. The partition coefficient of ammonia between water and trichloromethane is 25.0 given that the complex is

$Cu^{2+}_{(aq)} + nNH_{3(aq)} \rightarrow [Cu(NH_3)_n]^{2+}_{(aq)}$

(a) Calculate the concentration of ammonia in the trichloromethane layer. (02 marks)

(b) Calculate the concentration of free ammonia in water. (01 mark)
(c) Calculate the concentration of complexed ammonia. (03 marks)
(d) Calculate the value of n in the complex. (03 marks)

16. (a) State three properties exhibited by copper as a transitional element. ($1\frac{1}{2}$marks)
(b) Describe reactions of copper with Nitric acid. (04 marks)
(c) An aqueous solution of ethane- 1,2-diammine was added to a solution of copper (ii) sulphate.
(i) State what was observed. ($1\frac{1}{2}$marks)
(ii) Write equation(s) for the reactions that took place. (02 marks)

17. (a) State what is meant by the term buffer solution. (02 marks)
(b) Calculate the $p^H$of the solution formed when 0.61g of benzoic acid is dissolved in 1d$m^3$of a 0.02M sodium benzoate. (Ka of benzoic acid = $6.3 \times 10^{-5} moldm^{-3}$) ($2\frac{1}{2}$marks)
(c) Explain what would happen to the $p^H$of the solution in (b) if a few drops of the following reagents were added.
(i) Potassium hydroxide solution. (02 marks)
(b) Hydrochloric acid ($2\frac{1}{2}$marks)

END
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