Names: .....Index No: .....

School Exam Number:.....Signature:…….....

*Candidates should **NOT** write their Centre Name or Centre Number anywhere on this booklet*

P525/1
CHEMISTRY
Paper 1
7 August 2023
2 ¾ hours

ENTEBBE JOINT EXAMINATION BUREAU

Uganda Advanced Certificate of Education

CHEMISTRY

(PRINCIPAL SUBJECT)

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer **all** *questions in* Section **A** *and* **six** *questions from* Section **B**

All *questions are to be answered in the spaces provided.*

The Periodic Table, with relative atomic masses is attached at the end of the paper.

Illustrate your answers with equations where applicable.

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

Illustrate your answers with equations where applicable.

Molar gas constant, ***R*** *= 8.31JK^{-1}mol^{-1}.*

Molar volume of gas at s.t.p = 22.4 litres

Standard temperature = 273 K

Standard pressure = 101325 Nm^{-2}

FOR EXAMINER'S 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** *the questions in the* Section.

1. The standard electrode potentials for some half-cell reactions are given below;

	E^{θ} *(V)*
$2H_2O(l) \longrightarrow H_2O_2(aq) + 2H^+(aq) + 2e$	-1.77
$2I^-(aq) \longrightarrow I_2(aq) + 2e$	-0.54

(a) Write the;

(i) cell notation for the reaction that takes place when the two half cells are connected. *(1½ marks)*

.....

.....

.....

(ii) equation for the overall reaction. *(1½ marks)*

.....

.....

(b) (i) Calculate the E^{θ} for the cell in (a). *(01 mark)*

.....

.....

.....

(ii) Comment on the feasibility of the reaction. *(01 mark)*

.....

.....

2. (a) Draw the structure and state the shape of the following molecules. *(04 marks)*

Molecule	***Structure***	***Shape***
SO_2		

SO_3		
$SOCl_2$		
SO_2Cl_2		

(b) Write equation to show the reaction between;

(i) SO_2, and acidified potassium dichromate (vi) solution. *(01 mark)*

.....

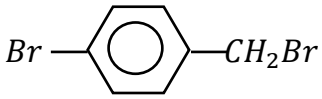
.....

(ii) $SOCl_2$ and propanoic acid. *(01 mark)*

.....

.....

3. Compound ***E*** has a molecular structure;



(a) Name the functional group for the present in ***E***. *(½ mark)*

.....

.....

(b) (i) Write the mechanism for the reaction between ***E*** and hot aqueous hydroxide solution. *(1½ marks)*

.....

.....

.....

(ii) Name the type of reaction mechanism in (b) above. *(01 mark)*

.....

.....

(c) $2.5g$ of compound E was heated with $25.0cm^3$ of 1M aqueous sodium hydroxide solution. Calculate the volume of $0.25M$ sulphuric acid needed to neutralize the mixture after the reaction. *(03 marks)*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4. (a) Write equation for the reaction between hot concentrated sodium hydroxide and;

(a) aluminum *(01 mark)*

.....

.....

.....

(b) phosphorous *(01 mark)*

.....

.....

.....

.....

(b) Write equation for the reaction between dilute sulphate acid and;

(i) copper(I) oxide *(01 mark)*

.....

.....

.....

(ii) sodium benzoate solution *(01 mark)*

.....

.....

.....

5. Potassium ethanoate undergoes hydrolysis when dissolved in water according to the equation.

$$CH_3COO^-(aq) + H_2O(l) \rightleftharpoons CH_3COOH(aq) + \bar{O}H(aq)$$

If the hydrolysis constant, *Kh*, for potassium ethanoate at $25℃$ is 5.6×10^{-10}, calculate the;

(a) pH of $0.1M$ solution of potassium ethanoate. *(03 marks)*

.....

.....

.....

.....

.....

(b) percentage hydrolysis of $0.1M$ solution of potassium ethanoate. *(02 marks)*

.....

.....

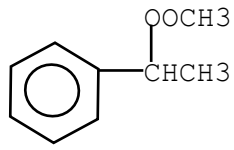
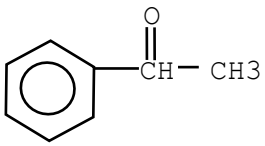
.....

.....

.....

.....

6. Write equation(s) to show how the following conversions can be effected.

(a)  from  *(3½ marks)*

.....

.....

.....

.....

.....

.....

(b) $CH_3\underset{\underset{OH}{|}}{C}H\underset{\underset{OH}{|}}{C}H_2$ from $Propan-1-ol$ *(2½ marks)*

.....

.....

.....

.....

.....

.....

7. Carbon-monoxide diffuses 2.646 times faster than a carbonyl of iron with the formula $Fe(CO)_n$;

(a) Determine the;

(i) relative formula mass of the carbonyl of iron. *(2½ marks)*

.....

.....

.....

.....

.....

.....

(ii) value of n. *(1½ marks)*

.....

.....

.....

.....

.....

(b) Write the name of the carbonyl of iron and state the oxidation of iron. *(01 mark)*

Name .....

Oxidation state .....

8. (a) A crystalline solid R dissolved in water to give a blue solution. Addition of potassium hexacyanoferate(II) solution produced a brown precipitate;

(i) Identify the cation in R. *(½ mark)*

.....

.....

(ii) Write the equation leading to the formation of the brown precipitate. *(1½ marks)*

.....

.....

.....

(b) Write equation for the reaction between the solution R in water and;

(i) excess concentrated hydrochloric acid. *(1½ marks)*

.....

.....

.....

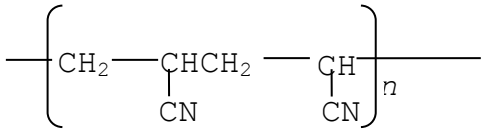
(ii) potassium iodide solution. *(1½ marks)*

.....

.....

.....

9. Polymer Z has the following structure;



(a) Write the structure and name of the monomer of Z.
(1½ marks)

.....

.....

(b) The osmotic pressure of a solution containing $2gdm^{-3}$ of polymer Z in dioxane is $0.155\,mmHg$ at $25℃$. Calculate the number of monomers in polymer Z.
(3½ marks)

.....

.....

.....

.....

.....

.....

SECTION B *(54 marks)*
Answer any **six** *questions from this sections.*
Additional questions answered will ***not*** *be marked*

10. Complete combustion of a hydrocarbon ***Q*** in excess air produced $7.04g$ of carbon dioxiode and $1.08g$ of water.

(a) Calculate the empirical formula of ***Q***. *(03 marks)*

.....

.....

.....

.....

.....

.....

.....

(b) The density of Q is $4.5536 \times 10^{-3} gcm^3$ at s.t.p. Determine the molecular formula of ***Q***. *(1½ marks)*

.....

.....

.....

(c) ***Q*** burns with a sooty flame and forms a red precipitate when treated with a solution of copper(I) chloride in excess ammonia solution;
(i) Identify ***Q*** *(½ marks)*

.....

.....
(ii) Write equation for the reaction leading to the formation of the red precipitate. *(01 mark)*

.....

.....
(d) Write equations to show how ***Q*** can be prepared from an alcohol. *(03 marks)*

.....

.....

.....

.....

.....

11. Sulphur dichloride dioxide decomposes at high temperatures according to the following equations;

$$SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$$

When $13.5g$ of sulphur dichloride dioxide was placed in a 2 litre vessel and heated at a pressure of 2 atmospheres, $1.5g$ of chlorine was formed at equilibrium.

(a) Write the expression for the equilibrium constant Kp. *(01 mark)*

.....

.....

.....

(b) Calculate the value of equilibrium constant, Kp for the reaction and state its units.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) State what would happen to the position of equilibrium when;

(i) Pressure of the system is reduced. *(½ mark)*

.....

.....

(ii) Sulphur dioxide is removed from the equilibrium mixture. *(½ marks)*

.....

.....

(iii) Chlorine is added to the equilibrium mixture. *(½ mark)*

.....

.....

.....

(d) Explain your answer in c(iii) above. *(1½ marks)*

.....

.....

.....

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

(a) Hydrogen sulphide gas is bubbled through acidified potassium dichromate(VI) solution. *(2½ marks)*

Observation;

.....

.....

Equation;

.....

.....

(b) Iodine solution and sodium hydroxide solution is added to butanone and the mixture warmed; *(02 marks)*
Observation;

.....

.....

Equation;

.....

.....

(c) Concentrated nitric acid followed by lead(IV) oxide is added to manganese(II) sulphate solution and the mixture warmed; *(02 marks)*
Observation

.....

.....

Equation

.....

.....

(d) Dilute hydrochloric acid is added to sodium thiosulphate solution. *(2½ marks)*
Observation

.....

.....

Equation

.....

.....

13. (a) (i) Write the name and formula of one ore from which zinc can be extracted. *(01 mark)*

.....

.....

(ii) Name the method by which the ore can be concentrated. *(01 mark)*

.....

.....

(b) During the concentration process, the ore is crushed and mixed with water and oil mixture and compressed air bubbled through the mixture. The ore rises up the froth and it is skimmed off and the acid is added. State the role of;

(i) oil *(1½ marks)*

.....

.....

.....

(ii) compressed air. *(1½ marks)*

.....

.....

.....

(iii) acid *(01 mark)*

.....

(c) The concentrated ore in (b) can be converted to zinc oxide;

(i) State how the conversion can be carried out. *(01 mark)*

.....

.....

(ii) Write the equation for the reaction that leads to the formation of zinc oxide. *(01 mark)*

.....

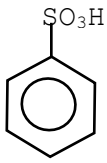
.....

(iii) Write equation to show how zinc oxide converted to zinc. *(01 mark)*

.....

.....

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

(a) 

$\xrightarrow[\text{Conc } H_2SO_4,\ \text{Heat}]{\text{Conc } HNO_3}$ . . . . . *(03 marks)*

.....

.....

.....

.....

.....

(b) $CH_3CH_2OH \xrightarrow[140^0C]{\text{Conc } H_2SO_4}$ . . . . . *(3½ marks)*

.....

.....

.....

.....

.....

.....

(c) $CH_3\overset{Cl}{\overset{|}{C}}HCH_2CH_3 \xrightarrow[CH_3CH_2OH,\ \text{Heat}]{CH3CH2\bar{O}Na^+}$ . . . . . *(2½ marks)*

.....

.....

.....

.....

.....

.....

15. Lead(II)chloride is sparingly soluble in water;

(a) Write the;

(i) equation for the solubility of lead(II) chloride in water. *(1½ marks)*

.....

.....

(ii) expression for the solubility product, Ksp of lead(II) chloride. *(½ mark)*

.....

.....

(b) $5.0g$ of Lead(II) chloride was shaken with one litre of distilled water. Determine the percentage of lead (II) chloride that dissolved. (Ksp of lead(II) chloride is $1.6 \times 10^{-5} mol^3 dm^{-9}$ at $25℃$.) *(3½ marks)*

.....

.....

.....

.....

.....

.....

(c) If $0.05M$ hydrochloric acid was used instead of water in (b), calculate the percentage of lead(II) chloride that dissolved and state the assumption that you make. *(3½ marks)*

.....

.....

.....

.....

.....

.....

16. The products of pressure and volume , PV, for $21.1g$ of a gas W at different temperatures are shown below;

PV *(atom dm³)*	0.016	0.032	0.048	0.065	0.08	0.096
Temperature (K)	299	300	301	302	303	304

(a) (i) Plot a graph PV against temperature. *(03 marks)*

(ii) Use your graph you have drawn to determine the formula mass of gas W. *(03 marks)*

.....

.....

.....

.....

.....

(b) Gas W consists of 25.93% by mass of nitrogen and the rest being oxygen. Determine the molecular formula of W. *(03 marks)*

.....

.....

.....

.....

.....

17. (a) What is **vegetable oil**? *(01 mark)*

.....

.....

(b) Describe briefly how soap can be prepared from a nut. *(03 marks)*

.....

.....

.....

.....

.....

(c) Write the general equation for the;

(i) formula of soap *(01 mark)*

.....

.....

.....

(ii) reaction between soap solution and hard water.
(01 mark)

.....

.....

.....

(d) In an experiment, $9.85g$ of soap was prepared from a vegetable oil containing an ester of hexadecanoic acid, $C_{15}H_3COOH$. Calculate the mass of ghe vegetable oil used in the experiment. *(03 marks)*

.....

.....

.....

.....

.....

.....

END