P525/1
Chemistry
Paper 1
July - August 2023
2¾ hours

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS - 2023

NAME.....

INDEX NO..... SIGNATURE.....

UGANDA ADVANCED CERTIFICATE OF EDUCATION

Chemistry

Paper 1

2 hour 45 minutes

Answer all questions in Section A and any six in Section B.

All questions must be answered in spaces provided.

Illustrate your answers with equations where applicable.Molar gas constant, $R=8.314jk^{-1}mol^{-1}$

Molar volume for a gas at s.t.p is $22400cm^3$Standard temperature =273k

Standard pressure =101325 Nm^{-2}

FOR EXAMINERS USE ONLY																	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

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SECTION A (46 marks)

1. (a) The following scheme is part of the radioactive decay of thorium.

$$^{234}_{90}Th \longrightarrow ^{234}_{91}Pa \longrightarrow Y + a$$

(i) Identify the particle emitted in the first stage. (½ marks)

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(ii) State the atomic number and the atomic mass of Y. (1 mark)

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(b) The activity of $^{234}_{90}Th$ reduced by 80% in 160 days. Determine the time it would take the activity of Thorium to reduce to half. (2½ marks)

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2. (a) Methyl benzene reacts with chlorine to form 2-chloromethylbenzene. State the condition for the reaction. (1 mark)

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(b) Under a different condition the product is phenylchloromethane instead of chloromethyl benzene.

(i) State the condition for the reaction. (1 mark)

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(ii) Write the acceptable mechanism for the reaction. (3 marks)

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3. Write equation to show the reaction between aqueous sodium hydroxide and the following oxides:

(a). Tin (II) oxide. (1½ marks)

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(b) Silicon (IV) oxide. (1½ marks)

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(c) Trilead tetraoxide. (1½ marks)

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4. Potassium dichromate (VI) is used as a primary standard in volumetric analysis.

(a) State **two** reasons why potassium dichromate (VI) is used as a primary standard.

(2 marks)

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(b) Name **one** substance that can be standardised using potassium dichromate (VI).

(½ mark)

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(c) To acidified potassium dichromate (VI) solution, hydrogen peroxide solution was added,

(i) State what was observed. (1 mark)

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

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5. (a) Draw the structure and name the shapes of the following species. *(3 marks)*

Species	Structure	Shape
(i) IO_3^-		
(ii) ClO_4^-		

(b) To the aqueous solution of the species from (a) (i), an acidified solution of potassium iodide was added.

(i) State what was observed. (1 mark)

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

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6. (a) Phenylamine hydrochloride, $C_6H_5NH_3Cl$, undergoes hydrolysis when dissolved in water.

Write an equation for the hydrolysis reaction. (1½ marks)

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(b) A 0.02M solution of phenylamine hydrochloride has a pH of 3.4. Calculate;

(i) The molar concentration of the hydrogen ions in the solution. (2 marks)

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(ii) the hydrolysis constant, Kh, of phenylamine hydrochloride. (2½ marks)

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7. 1.18g of compound **Z**, on vapourisation occupied 300cm^3 at s.t.p.

(a) Calculate the relative molecular mass of **Z**. (1½ marks)

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(b) The empirical formula of **Z** is C_2H_4O.

(i) Determine the molecular formula of **Z**. (1½ marks)

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(ii) Write the structural formulae of the possible isomers of **Z**. (2 marks)

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(c) Compound **Z** reacts with sodium carbonate to produce a gas that turns lime water milky. Identify **Z**. (½ marks)

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8. Using equations show the following conversion can be carried out:

(a) $CH_3CH_2\overset{CH_3}{\underset{|}{C}}=NOH$ from $CH_3\overset{OH}{\underset{|}{C}}HCH_3$ (2½ marks)

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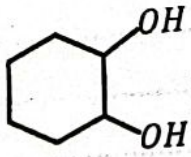
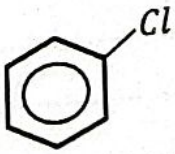
(b).  From  (3 marks)

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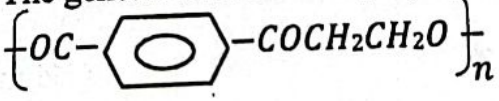
9. The general formula of a polymer **A** is



(a) Write the formula and names of the monomer(s) of **A**. (3 marks)

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(b) Name the type of polymerization by which **A** is formed. (1 mark)

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(c) Explain why depression freezing point method is not convenient for determination of the molecular mass of **A**. (1½ marks)

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SECTION B

0. The exothermic reaction between nitrogen and hydrogen takes place according to the equation.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(a) Write the expression for the equilibrium constant, Kc, for the forward reaction.

(1 mark)

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(b) At 500^0C, the equilibrium concentration of hydrogen is 0.250 $moldm^{-3}$ and nitrogen is 2.7 $moldm^{-3}$.

Calculate the equilibrium concentration of ammonia at 500^0C.

($kc = 6.0 \times 10^{-2} dm^{-6} mol^{-2}$) (3 marks)

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(c) State what would happen to;

(i) the value of Kc and equilibrium position if the pressure of the system was reduced. (1 mark)

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(ii) the volume of ammonia, if nitrogen was constantly removed from reaction mixture. (½ mark)

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(d) Explain the effect of adding helium to the equilibrium mixture at constant pressure. (2½ marks)

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11. Complete the following reactions and write a mechanism.

(a) $CH_3CH_2Br \xrightarrow[heat]{KOH/CH_3CH_2OH}$ (2½ marks)

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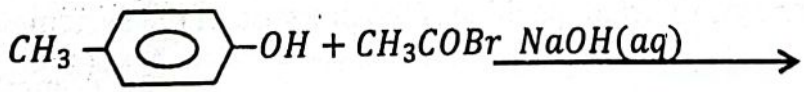
(b)  (3 marks)

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(c) $CH_3CH_2CH_2OH \xrightarrow[200^0C]{Conc.H_3PO_4}$ (3½ marks)

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12. Methanoic acid, $HCOOH$ and water are miscible in all proportions. They form a maximum boiling point mixture containing 78% methanoic acid that boils at 108^0C.

(a) (i) Define the term **maximum boiling point mixture.** (1 mark)

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(ii) Sketch a labelled boiling point – composition diagram for mixtures of water and methanoic acid. (boiling point of HCOOH=101^0C) (3 marks)

(b) Explain briefly why methanoic acid and water form a maximum boiling point mixture. (3 marks)

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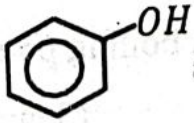
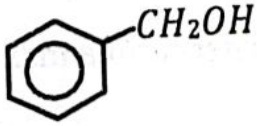
(c) Describe what would happen when a mixture containing 40% methanoic acid is distilled. (2 marks)

13. Name a reagent that can be used to distinguish the following species, in each case state what would be observed if the named reagent is separately reacted with each member of the pair.

(a) $Cr_2O_7^{2-}$ *and* CrO_4^{2-} (3 marks)

(b) Ba^{2+} *and* Ca^{2+} (3 marks)

(c)  and  (3 marks)

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14. The following half-cell reactions are given

	E^{θ}/V
$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$	+0.34
$I_2(aq) + 2e \rightarrow 2I^-(aq)$	+0.54
$H_2O_2(aq) + 2e + 2H^+(aq) \rightarrow 2H_2O_{(l)}$	+1.77
$Cl_2(g) + 2e \rightarrow 2Cl^-(aq)$	+1.36

(a) (i) Write the cell notation for the cell made up of the half cells consisting of iodide ions and acidified hydrogen peroxide. (1½ marks)

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(ii) Write the overall equation for the reaction. (1 mark)

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(iii) Calculate the e.m.f of the cell and state whether the reaction is feasible or not. (2½ marks)

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(b) (i) Will the iodide ions reduce copper (II) ions to copper solid? Give a reason for your answer. (1½ marks)

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(ii) Explain whether hydrochloric acid is suitable for acidifying hydrogen peroxide

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15. (a) Copper (II) carbonate occurs as a basic carbonate.
Write equation for the reaction to show how this carbonate can be prepared.
(1½ marks)

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(b) Copper (II) carbonate was dissolved in warm nitric acid and to the resultant solution, potassium iodide solution was added.

(i) State what was observed. (½ mark)

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(ii) Write equation for the reaction that took place. (½mark)

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(c) To the mixture from (b) above, sodium thiosulphate solution was added.

(i) State what was observed. (½ mark)

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

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(d) 0.8g of copper ore was reacted with dilute sulphiric acid and the resultant solution diluted to 250cm^3 with distilled water. To 30cm^3 of this solution, excess 0.2M potassium iodide was added. The liberated iodine required 23.5cm^3 of 0.05M solution of sodium thiosulphate for complete reaction.
Determine the percentage of copper in the ore. (3½ marks)

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6. (a) For each of the following species, determine the oxidation state of manganese.

(i) MnO_4^- (1 mark)

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(ii) MnO_4^{2-} (1 mark)

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(b) State what is observed and write equation for the reaction that occurs when;

(i) acidified hydrogen peroxide is added to potassium manganate (VII) solution.

Observation: (2½ marks)

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Equation:

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(ii) dilute sulphiric acid is added to a solution of potassium manganate (VI) solution. (2½ marks)

Observation

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Equation

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(c) Compare the reaction of manganese (II) sulphate and magnesium sulphate with excess sodium hydroxide solution when exposed to air. (2 marks)

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17. 0.155g of an organic compound W when burnt in oxygen gave 0.22g of carbon dioxide and 0.135g of water.

(a) Determine the empirical formula of **W**. (3½ marks)

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(b) When vapourised at 127^0C, 0.225g of **W** occupied 111.11cm^3 at 760mmHg.

(i) Calculate the molecular mass of **W**. (2½ marks)

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(ii) Determine the molecular formula of **W**. (1½ marks)

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(c) W reacts with acidified potassium dichromate (VI) solution to form ethane -1, 2-dioic acid. Write the formula and IUPAC name of W. (1½ marks)

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