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P525/1
CHEMISTRY
Paper 1
July/Aug. 2023
2 $\frac{3}{4}$ hours



**PROVINCIAL - NAMIREMBE DIOCESE
COUHEIA SECONDARY
MOCK EXAMINATIONS 2023**



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 from section B.
- All questions are to be answered in the spaces provided.
- The periodic table with relative atomic masses is provided at the back.
- Any additional question(s) answered will not be marked.

COUHEIA 2023

"Restoring the church in Education"

TURN OVER

SECTION A (46 MARKS)

Answer all Questions from this Section.

1. An organic compound P has a structural formula $\text{CH}_3\text{C}(\text{OH}) = \text{CHCHO}$.

- a) Name the functional groups present in the organic compound P above.

(01 marks)

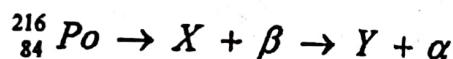
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- b) Name reagent(s) that can be used to identify each of the functional group(s) and in each case state what is observed in each case.

(03 marks)

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2. Polonium $^{216}_{84}\text{Po}$ undergoes radioactive decay to give element X and Y according to the following equation.



- (a) Identify elements X and Y with their atomic mass and atomic numbers.

(01 mark)

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- (b) (i) Calculate the half-life of Y if the decay constant of Y is $6.54 \times 10^{-4} \text{ min}^{-1}$.

(02 marks)

(ii) Determine the time taken for the reaction to be two-thirds complete.

(01 mark)

3. (a) State three factors that can affect electron affinity. (1½ marks)

(b) Explain the following observations;

(i) The first and second electron affinities of Sulphur are -200 and +649 kJmol⁻¹ respectively. Explain the difference. (1½ marks)

(ii) The first electron affinity of phosphorous -40 kJmol⁻¹ is less than that of Sulphur -200 kJmol⁻¹. (1½ marks)

4. (a) Draw the shape and name the structure adopted by the following species.
(03 marks)

Species	Structure	Shape
i. NH_3		
ii. NO_3^-		
iii. SO_3^{2-}		

- (b) State what is observed and write an equation for the reaction when the species in 4(a)(iii) was reacted with acidified potassium dichromate solution.
(02 marks)

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5. Write equations for the reaction between the following.

- (i) Sodium hydroxide and Zinc oxide. **(01½ marks)**

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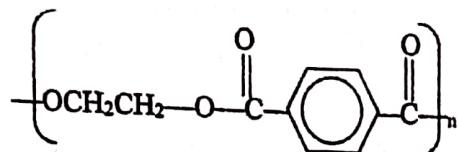
- (ii) Sodium hydroxide and silane. **(1½ marks)**

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(iii) Magnesium and iron(III) chloride solution.

(1½ marks)

6. The structural formula of a polymer J is represented as shown below.



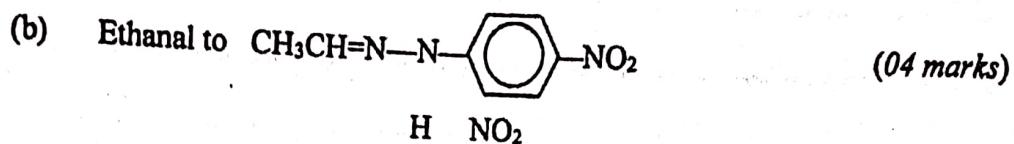
(a) (i) State the type of polymerization by which J is formed. (01 mark)

(ii) Write structural formula of the monomers and their names. (02 marks)

(b) 1.8% solution of J in benzene has the same pressure as 11.8cm^3 of a solution containing 1.65g of a polymer of molecular mass 1040 at 298K. Calculate the relative molecular mass of J. (03 marks)

7. Write a mechanism to show how each of the following conversion can be effected.

(a) $(CH_3)_2C=CHCH_3$ to $(CH_3)_2C(OH)CH_2CH_3$ (02½ marks)



8. When 4.16g of phosphorous (V) chloride was allowed to reach equilibrium at 200°C in a 1dm³ capacity vessels, the equilibrium constant was $4 \times 10^{-6} \text{ mol dm}^{-3}$ at the same conditions stated. Calculate the percentage of dissociation of phosphorous at equilibrium.

(04 marks)

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9. The standard electrode potentials of some half cells are given below.

Half-cell	E^θ / V
$\text{Fe}^{2+}(\text{aq}), \text{Fe}^{3+}(\text{aq})/\text{Pt(s)}$	-0.77
$\text{Cr}^{3+}(\text{aq}), \text{Cr}_2\text{O}_7^{2-}(\text{aq}), \text{H}^+(\text{aq})/\text{Pt(s)}$	-1.33

- (a) Write the cell notation for the cell formed when the half cells are connected.
(01 mark)
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- (b) Write equations for the reaction at;

(i) Anode *(01 mark)*

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(ii) Cathode *(01 mark)*

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(c) Calculate the *Emf* of the cell formed and state whether the reaction is feasible or not. (02 marks)

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SECTION B (54 MARKS)

Attempt Any Six Questions from this Section.

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

10.(a) Explain what is meant by the term Partition coefficient. (1½ marks)

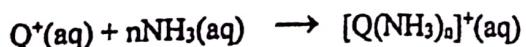
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(b) State two conditions under which the partition coefficient is valid other than constant temperature. (01 mark)

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(c) 25cm³ of ammonia solution was added to 25cm³ of a 0.1M aqueous solution of a metal Q ion, followed by 50cm³ of trichloromethane. The mixture was shaken periodically and allowed to reach equilibrium at 25°C. On titrations, the aqueous layer required 27.5cm³ of 1.0M nitric acid while the trichloromethane layer required 18.00cm³ of 0.05M nitric for complete neutralization.

Ions of the metal Q in aqueous solution react with excess ammonia to form a complex according to the following reaction equation.



Calculate: -

- i. the concentration of ammonia in trichloromethane layer. (1½ marks)

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- ii. the concentration of ammonia that formed the complex with Q^+ ions.
(distribution coefficient between water and trichloromethane is 25 at
 25°C) (03 marks)

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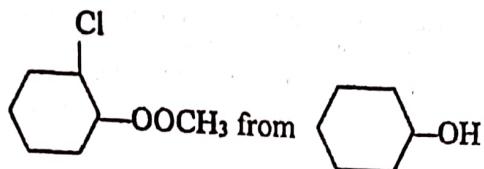
- iii. Determine the value of n in the complex, $[Q(\text{NH}_3)_n]^+$. (02 marks)

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11. Write equations to show how the following conversions can be carried out. In case indicate the conditions for the reactions.

- a) 2-chloropropane to amino propane. (1½ marks)

b)



(02 marks)

c) Propan-2-ol to 2 - methylpropan-2-ol.

(02 marks)

d) Ethanol to propanone.

(3½ marks)

12. Explain the following observations.

a) An aqueous solution of sodium sulphite is alkaline while that of sodium hydrogen sulphite is acidic.

(03 marks)

b) Silicon tetrachloride can be hydrolyzed by water while carbon tetra chloride is not. (04 marks)

c) Amino ethane is a stronger base compared to phenyl amine. (02 marks)

13. State what is observed and write an equation for the reaction that would take place if;

a) Copper(II) sulphate solution is reacted with potassium hexacyanoferrate(II) solution. (2½ marks)

Observation:

Equation.

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- b) Ethanal and ammoniacal silver nitrate solution.

(02 marks)

Observation

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Equation.

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- c) Sodium iodide and concentrated sulphuric acid.

(02 marks)

Observation

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Equation.

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- d) Hydrogen sulphide gas is bubbled through acidified solution of potassium dichromate(VI) solution.

(2½ marks)

Observation

Equation

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14. (a) What is meant by the term common ion effect? (01 mark)

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(b) Silver ethanedioate is sparingly soluble. Write;

(i) The equation for the solubility of silver ethanedioate in water. (1½ marks)

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(ii) the expression for the solubility product, K_{sp} of silver ethanedioate. (0½ mark)

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(c) If the solubility product of silver ethanedioate at 25°C is $5.30 \times 10^{-3} \text{ mol dm}^{-3}$. Calculate the concentration of the following ions in a saturated solution of silver ethanedioate.

(i) silver ions. (02 marks)

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(ii) ethanedioate ions (01 mark)

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- (d) Calculate the mass of silver nitrate that should be added to the saturated solution in(b) in order to reduce the concentration of the ethanedioate ions to a fifth of its original value. (02 mark)

- (e) Sodium ethanedioate solution was added to the solution in(b). State how the concentration of the silver ions was affected and give a reason for your answer. (01 mark)

15. (a) Nitric acid and water are miscible in all proportions. They form a constant boiling point mixture having a boiling point of 121°C, composition 68% by mass of nitric acid and density 1.42gcm⁻³.

- (i) Define the term constant boiling mixture. (01 mark)

- (ii) Sketch a labelled diagram of the boiling point - composition for nitric acid and water system. (Boiling point of water and nitric acid are 100°C and 83°C).

(03 marks)

- (iii) Describe what would happen when 50% nitric acid is fractionally distilled.
(2½ marks)

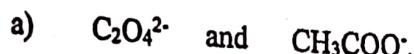
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- (b) Explain why nitric acid and water forms a constant boiling point mixture.
(01 mark)

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- (c) Calculate the molarity of the constant boiling point mixture. (1½ marks)

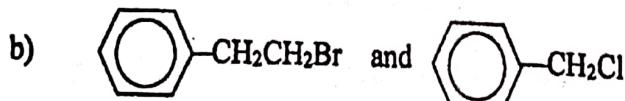
16. Name a reagent that can be used to distinguish between the following pairs of species and in each case state what would be observed if the reagent is/are treated with each species.



(03 marks)

Reagent(s)

Observation(s)



(03 marks)

Reagent(s)

Observation(s)

c) Ba^{2+} and Ca^{2+}

(03 marks)

Reagent(s)

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Observation(s)

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17. (a) Differentiate between a d-block element and a transition element. (1 mark)

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(c) State properties in which zinc differs from chromium. (1½ marks)

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(d) When ammonium dichromate was heated strongly, a green solid W was formed. Write equation for the reaction that took place. (1½ marks)

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(e) Solid W was heated with potassium hydroxide in contact with air.

i. State what was observed. (0½ mark)

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

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(f) The compound formed in(d) above when treated with water gave a yellow solution which turned orange when acidified with dilute sulphuric acid:-

i. Write the ionic equation for reaction leading to the formation of the orange colour. (1 mark)

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ii. To the resultant solution in(e) was reacted with excess sodium hydroxide solution. State what was observed and write equation for the reaction that took place. (02 marks)