

P525/2  
CHEMISTRY  
Paper 2  
Aug/Sept 2023  
2½ hours

**KANUNGU JOINT MOCK EXAMINATIONS 2023**  
**UGANDA ADVANCED CERTIFICATE OF EDUCATION**

**Chemistry**  
**Paper 2**  
**2 hours 30 minutes**

**INSTRUCTIONS TO THE CANDIDATES**

- Answer five questions including three questions in section A and any two questions in section B.
- Write the answers in the answer booklet provided.
- Begin each question on a fresh page.
- Mathematical tables and graph papers are provided.
- **Begin each question on a fresh page.**
- Non-programmable scientific electronic calculators may be used.
- Illustrate your answers with equations where applicable.
- Indicate the questions in the grid below.
- Where necessary use  $C = 12$ ,  $O = 16$ ,  $H = 1$
- Molar gas volume is  $22.4 \text{ dm}^3$  at s.t.p
- $1 \text{ atmosphere} = 101325 \text{ Nm}^{-2}$



### SECTION A

1. The table below shows the boiling points of chlorides of period three elements.

Element	Na	Mg	Al	Si	P	S	Cl
Atomic number	11	12	13	14	15	16	17
Formula of the chloride	NaCl	MgCl <sub>2</sub>	AlCl <sub>3</sub>	SiCl <sub>4</sub>	PCl <sub>3</sub>	S <sub>2</sub> Cl <sub>2</sub>	Cl <sub>2</sub>
Boiling point	1465	1418	180	57	76	136	-35

- a) (i) Plot a graph of boiling points of the chlorides against atomic number of elements. (3½ marks)  
 (ii) Explain the shape of the graph (7½ marks)  
 (b) Describe the reactions of chlorides with water (09 marks)

1. (a) A compound X, vapour density 58, contains carbon 62.07%, hydrogen 10.34% and the rest being oxygen. X does not burn with a sooty flame.  
 i. Calculate the empirical formula of X (C=12, O=16, H=1) (3 marks)  
 ii. Determine the molecular formula (2 marks)  
 (b) Hydrolysis of X yielded compounds, Y, C<sub>4</sub>H<sub>10</sub>O and Z, C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>. Both Y and Z react with metallic sodium. Z reacted with sodium carbonate but Y did not.

- (i) Identify Z. (1 mark)  
 (ii) Write names and the structural formulae of all the possible isomers of Y. (4 marks)  
 (iii) Name a reagent that can be used to distinguish between the isomers in (b) (ii) and state what would be observed if the reagent you have named is reacted separately with each of the isomers. (4 marks)

- (c) When Y was warmed with acidified potassium dichromate solution, there was no observable change.  
 i. Identify Y. (1 mark)  
 ii. write the structural formulae of Y (1 mark)  
 (d) (i) write equation and outline a mechanism for the reaction between Y and concentrated phosphoric acid (3½ marks)  
 (ii) Write the IUPAC name of the product in d(i). (0½ mark)

2. (a) State Raoult's Law. (3 marks)  
 (b) A mixture of ethanoic acid (B.P 118°C) and pyridine (B.p. 123°C) show negative deviation from Raoult's law.  
 (i) Draw the vapour pressure/composition curve for the mixture of ethanoic acid and pyridine and indicate the line of Ideal behavior. (4 marks)  
 (ii) Explain the shape of the curve in relation to Raoult's Law. (6 marks)  
 (c) (i) Explain what is meant by 'steam distillation' (3 marks)  
 (ii) When a compound Y, was steam distilled at standard atmospheric temperature and pressure, the temperature of distillation was 96°C. The vapour pressure of water at this temperature was 730mm Hg and the distillate contained 74% of water. Calculate the relative molar mass of Y (4 marks)

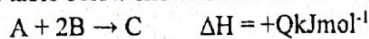
3. (a) Ethanoic acid is a weak acid  
 (i) Explain what is meant by a "weak acid" (1 marks)



- (ii) Calculate the pH of a 0.05M ethanoic acid solution ( $K_a$  of ethanoic acid =  $1.8 \times 10^{-5} \text{ mol dm}^{-3}$ ) (4 marks)
- (b) (i) Explain what is meant by a "buffer solution" (4 marks)
- (ii) Discuss the action of a buffer solution (5 marks)
- (c) A solution was made by dissolving 7.2g of ethanoic and 12.0g of sodium ethanoate to make 1 litre solution. To the solution was added 0.8 cm<sup>3</sup> of 1M hydrochloric acid. Calculate the pH of the solution. State any assumptions you make. (6 marks)

### SECTION B

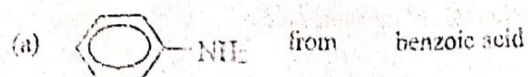
4. (a) differentiate between order and molecularity of reaction (5marks)
- (b) The table below shows some data for the reaction



Expt.	Initial concentration of Moldm <sup>-3</sup> of		Initial rate of reaction Moldm <sup>-3</sup> s <sup>-1</sup>
	A	B	
I	$1.00 \times 10^{-2}$	$2.80 \times 10^{-3}$	2.2
II	$5.00 \times 10^{-3}$	$2.80 \times 10^{-3}$	1.1
III	$1.00 \times 10^{-2}$	$5.60 \times 10^{-3}$	4.4

- (i) Determine the order of reaction with respect to A and B (3marks)
- (ii) Write the rate equation for the reaction. (1mark)
- (iii) Calculate the rate constant for the reaction and give its units (2marks)
- (iv) Calculate the rate of the reaction when the concentration of A and B are  $8.0 \times 10^{-3} \text{ moldm}^{-3}$  and  $3.83 \times 10^{-3} \text{ moldm}^{-3}$  respectively. (2marks)
- (v) State What would happen to the order of reaction in (b) if B was present in larger excess. Explain your answer. (3marks)
- (vi) Draw a fully labelled energy diagram for the reaction in (b) (4marks)
5. (a) 25cm<sup>3</sup> of a solution containing sodium carbonate and sodium hydrogen carbonate required 15.0cm<sup>3</sup> of a 0.5M hydrochloric acid for complete reaction using phenolphthalein indicator. Another 25cm<sup>3</sup> of the same solution required 34.5cm<sup>3</sup> of the acid using methyl orange indicator. Calculate the molar concentration of the solution with respect to
- (i) Sodium carbonate (9marks)
- (ii) Sodium hydrogen carbonate
- (b) Carbon, silicon, tin and lead are elements of group IV of the periodic table. State
- (i) The common oxidation state shown by elements in group IV (1mark)
- (ii) How the stability of the oxidation states of the elements vary down the group? (3marks)
- (Illustrate your answer with the chlorides of carbon and lead)
- (iii) Give a reason for your answer in (b) (ii). (1mark)
- (c) With reference to transition metals explain what is meant by the following
- (i) complex ion (2marks)
- (ii) catalyst (2marks)
- (iii) Variable oxidation state (2marks)
6. Write equation to show how each of the following compounds can be synthesized. In each case, indicate the reagents and conditions for the reaction.

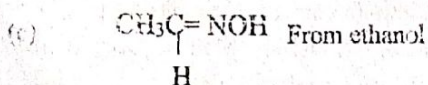




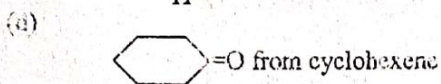
(5 marks)



(2 marks)



(5 marks)

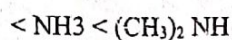
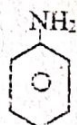


(4 marks)

7. Explain each of the following observations

(a) Calcium forms compounds containing  $\text{Ca}^{2+}$  ions but none containing  $\text{Ca}^+$  ions even though the second ionisation energy of calcium is greater than its first ionisation energy (4 marks)

(b) The basic strength of aminobenzene ammonia and dimethylamine are in the order



(6 marks)

(c) The ionic conductivities of Lithium ion is much less than that of Caesium although lithium and Caesium ions have ionic radii of 0.06 and 0.01 (nm) respectively (3 marks)

(d) A mixture of water (B.p  $100^\circ\text{C}$ ) and benzene (B.p  $80^\circ\text{C}$ ) boils at  $70^\circ\text{C}$  1 atmosphere (4 marks)

(e) Methanoic acid reacts with ammoniac silver nitrate solution whereas ethanoic acid does not (3 marks)

END