

P525/2  
**CHEMISTRY**  
**Paper 2**  
**(Theory)**  
**July/August.2024**  
2 ½ hours



**TORORO ARCHDIOCESE EXAMINATIONS BOARD**

Uganda Advanced Certificate of Education

**MOCK EXAMINATIONS 2024**

**CHEMISTRY**

**Paper 2**

**(Theory)**

2 hours 30 minutes.

**INSTRUCTIONS TO CANDIDATES:**

*Answer **five** questions including **three** questions from section A and any **two** from section B.*

*Write the answers in the answer booklet(s) provided.*

**Begin each question on a fresh page.**

*Mathematical tables and graph papers are provided. Non- programmable scientific electronic calculators may be used.*

*Use equations where necessary to illustrate your answer.*

*Where necessary use the following:*

*[H = 1; C = 12; N = 14; O = 16]*

**Turn Over**

### SECTION A; (60 MARKS)

Answer **three** questions from this section.

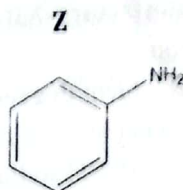
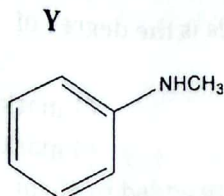
Any additional question answered will **not** be marked.

1. (a)(i) State Raoult's law. (1 mark)
- (ii) Explain what is meant by an **ideal solution**. (2 marks)
- (b) Two pure liquids **A** and **B** have vapour pressures of  $1.7 \times 10^4 \text{ Nm}^{-2}$  and  $3.5 \times 10^4 \text{ Nm}^{-2}$  respectively at  $25^\circ\text{C}$ . Given that a mixture of **A** and **B** obeys Raoult's law, calculate the mole fraction of **A** in a mixture of **A** and **B** which has a total vapour pressure of  $2.78 \times 10^4 \text{ Nm}^{-2}$  at  $25^\circ\text{C}$ .
- (c) An acid, **Q**, and water are completely miscible. The boiling points of a mixture of **Q** and water at different compositions of **Q** are given in the table below. (4 marks)

Boiling point/ $^\circ\text{C}$	118	115	110	106	103	100
Composition of <b>Q</b> (liquid)	100	90.0	70.0	50.0	30.0	0
Composition of <b>Q</b> (vapour)	100	84.0	54.0	32.0	16.0	0

- (i) On the same axes, Plot boiling point/Composition curves for mixtures of **Q** and water. (4 marks)
- (ii) Which of the two liquids is more volatile? Give a reason for your answer. (2 marks)
- (iii) Determine the composition of the vapour produced when a mixture containing 40% water is boiled. (2 marks)
- (iv) Using the diagram, describe how pure liquid acid **Q** can be obtained from a mixture containing 50% **Q**. (5 marks)

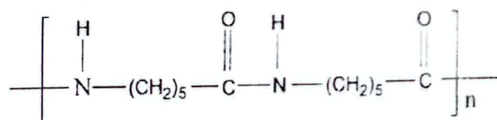
2. The structural formulae of the organic compound **Y** and **Z** are shown below.



- (a) Describe the reactions of **Y** and **Z** with nitric(III) acid.  
(Your answer should include observations and equations for the reaction.) (5marks)
- (b)(i) Write equation(s) to show how **Z** can be prepared from nitrobenzene.  
(Your answer should include reagents and conditions) (3marks)
- (ii) **Z** can be used in the manufacture of a zo-dye, Phenylazo - 2 - naphthol.

Outline the steps you would follow in preparing the azo-dye starting from **Z**.  
(Your answer should include observations and equations) (4 marks)

- (c) A polymer **X** formed by loss of water molecules has the structure.



When  $5 \times 10^{-3}$  moles of polymer **X** were completely hydrolysed, 13.1g of the monomers were obtained.

- (i) Write the structure and name of the monomer. (2 marks)
- (ii) State the type of polymerization involved in the formation of the polymer. (1 mark)
- (iii) Calculate the value of **n** and the relative formula mass of the polymer. (4marks)
- (iv) Give one use of the polymer **X**. (1 mark)



3. (a) What is meant by the **term weak acid**? (1 mark)
- (b) One of the factors that affect the pH of weak acids is the degree of ionization. (1 mark)
- (i) Define the term **degree of ionization**. (4 marks)
- (ii) State and explain the other **two** factors. (4 marks)
- (c)(i) 35cm<sup>3</sup> of 0.089M sodium hydroxide solution were added to 45cm<sup>3</sup> of 0.1M benzoic acid. Calculate the pH of the resultant solution. State any assumptions made in your calculations. (4marks)
- (Ka for benzoic acid =  $6.4 \times 10^{-5} \text{mol dm}^{-3}$ ).
- (ii) State and explain what would happen to the pH of the resultant solution in c(i) above when a small amount of dilute hydrochloric acid was added to it. (3 marks)
- (d) To 50cm<sup>3</sup> of a 0.02M benzoic acid was added an equal volume of 0.02M sodium hydroxide solution.
- (i) Calculate the pH of the resultant solution. (5 marks)
- (ii) Explain your answer in (d) (i) (3 marks)
4. (a) Describe **one** general method for preparing the halogens (excluding fluorine) in the laboratory and write an equation for the reaction. (4 ½ marks)
- (b) Describe the reactivity of fluorine, chlorine and bromine with:
- (i) water (6marks)
- (ii) concentrated hot sodium hydroxide solution. (6marks)
- (your description should include equations for reaction)
- (c) How would you distinguish between sodium bromide and sodium iodide, given dilute nitric acid, bleaching powder and tetra chloromethane? (3 ½ marks)

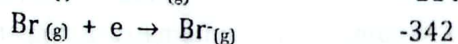
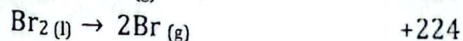
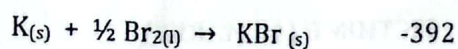
### SECTION B (40 MARKS)

Answer any **two** questions from this section.

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

5. (a) A saturated organic compound **G** contains 72% carbon, 12% hydrogen and the rest oxygen.
- (i) Determine the empirical formula of **G**. (2marks)
  - (ii) Given that the vapour density of **G** is 50, determine the molecular formula of **G**. (2marks)
- (b) **G** is neutral to litmus and reacts with sodium metal to form bubbles of hydrogen gas and compound **T**. Identify **G** and **T**. (2marks)
- (c) Write the equation and suggest a mechanism for the reaction between:
- (i) **G** and hot orthophosphoric acid. (3marks)
  - (ii) **G** and ethanoyl chloride. (3½ marks)
- (d) **G** was heated with acidified chromium(VI) oxide.
- (i) State what was observed and write equation for the reaction. (2marks)
  - (ii) the organic product from d(i) was treated with semi-carbazide in dilute sulphuric acid. Write equation for the reaction and suggest the mechanism for the reaction. (5 ½ marks)
6. (a) Explain what is meant by the terms;
- (i) **Ionisation energy**. (2marks)
  - (ii) **Atomisation energy**. (2marks)
- (b) Draw a complete, well labeled energy diagram for the formation of potassium bromide. (4marks)
- (c) Using the information supplied below, calculate the lattice energy of potassium bromide. (3marks)

**Reaction**  **$\Delta H/\text{kJ mol}^{-1}$**

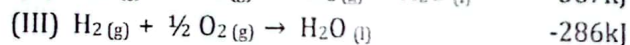
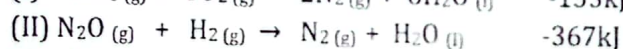
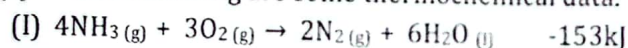


- (d) The values of the lattice energies of the potassium halides are shown below.

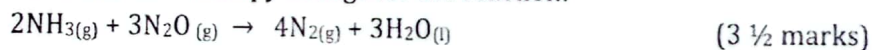
Compound	KF	KCl	KI
Lattice energy/ $\text{kJ mol}^{-1}$	-813	-710	-643

State the trend and explain the variation in the lattice energies of the potassium halides (4 marks)

- (e) The following are some thermochemical data.



- (i) Calculate the enthalpy change for the reaction:



- (ii) Is the reaction in e(i) above feasible or not? Give a reason for your answer. (1 ½ marks)

7. Explain each of the following observations.

- (a) Lead(IV) oxide does not react with dilute hydrochloric acid but reacts with cold concentrated hydrochloric acid to form a bright yellow liquid. (4marks)

- (b) Ethanol can be dehydrated by concentrated sulphuric acid at  $170^\circ\text{C}$  whereas 2-methyl propan-2-ol can be dehydrated by the same acid at  $100^\circ\text{C}$ . (3 ½ marks)



- (c) 0.1M urea solution and 0.2M ethanoic acid solution have the same freezing point when benzene is used as a solvent. (3marks)
- (d) A mixture of water and bromobenzene boils at 98.6°C whereas the boiling points of pure water and bromobenzene are 100°C and 150°C respectively. (3½ marks)
- (e) When aqueous sodium hydroxide is added to lead(II) nitrate solution, a white precipitate is formed which dissolves in excess alkali to form a colourless solution. When ammonia solution is used, a white precipitate is formed insoluble in excess. (6marks)
8. (a) (i) Name and write the formula of the principal ore of aluminium. (1mark)
- (ii) Describe how aluminium is extracted from the ore in a(i) above. [ Your answer should include equations. Diagram is not required] (8marks)
- (b) With reference to aluminium oxide, explain the term **amphoteric oxide**. [Write appropriate equations] (2marks)
- (c) Explain, giving necessary equations, why:
- (i) solutions of aluminium nitrate are acidic. (2½ marks)
- (ii) aluminium utensils should not be washed in strongly soapy solutions. (2marks)
- (d) Dilute sodium hydroxide solution was added dropwise to aluminium nitrate solution until in excess in a test tube.
- (i) State what was observed. (1½ marks)
- (ii) Write equations for the reaction(s) taking place. (3marks)

END