

P525/2

CHEMISTRY PAPER 2

MOCK 2024

AUGUST

TIME:2 HRS:30 MIN



# MEBU EXAMINATIONS CONSULT

Uganda Advanced Certificate Of Education

MOCK EXAMINATIONS 2024

CHEMISTRY

PAPER 2

TIME:2 HRS:30 MINS

## INSTRUCTIONS TO CANDIDATES.

This paper consists of **TWO** sections, **A** and **B**.

Answer any **FIVE** questions including **THREE** questions in section **A** and two questions in section **B**.

Write your answers in answer booklets provided.

Mathematical tables and graph papers may be used.

Begin each question on a fresh page.

Non-programmable scientific calculators may be used.

Illustrate your answers with equations where applicable.

Where necessary, use the following values:

(H=1, N=14, O=16)

## SECTION A (60 MARKS)

Attempt **THREE** questions from this section

- 1(a).State what is meant by the term boiling point constant of a substance? (01 mark)
- b) Describe an experiment that can be used to determine the molecular mass of a compound using the method of elevation of boiling point. (Diagram not required). (07 marks)
- c) Explain why the method you have described in (b) above is not suitable for determining the molecular mass of:
- Starch in aqueous solution. (02 marks)
  - Aluminium chloride dissolved in benzene. (02 marks)
- d) The osmotic pressure of various concentrations of solute X in methylbenzene at room temperature is given below.

Concentration (g/dm <sup>3</sup> )	1.0	2.0	3.0	4.0	5.0	6.0
Osmotic pressure (N/m <sup>2</sup> )	23	37	53	75	92	109

- Plot a graph of osmotic pressure against concentration. (03 marks)
- Use the graph in (d) (i) above to determine the molecular mass of X. (Universal gas constant,  $R = 8.314\text{J/K/mol}$ ) (04 marks)

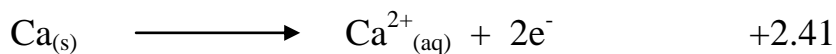
2(a).Describe an experiment that can be carried out to determine enthalpy of solution of sodium hydroxide. (09 marks)

- b) State what is observed and write equation(s) for the reaction(s) that occur(s) when aqueous sodium hydroxide is added to each of the following solutions drop wise until in excess.
- Copper (II) nitrate. (02½ marks)
  - Aluminium sulphate. (04½ marks)

(c). You are given standard electrode potentials for half-cell reactions at 25°C.

**Half-cell reactions:**

**E<sup>0</sup> (Volts)**



- Write cell notation for the cell reaction formed when the half-cells are connected. (01 mark)
- Write equation for the reaction at each electrode. (03 marks)

3(a). An organic compound, Y with a molecular mass of 106 contains 79.25% carbon, 5.66% hydrogen and the rest being oxygen.

Determine the:

- Empirical formula of an organic compound, Y. (03 marks)
  - Molecular formula of an organic compound, Y. (01 mark)
- a) Compound, Y burns with a sooty flame and forms a yellow precipitate with 2, 4-dinitrophenylhydrazine. Write the name and structural formula of an organic compound, Y. (02 marks)
- b) Write equation for the reaction between an organic compound, Y and 2, 4-dinitrophenylhydrazine under acidic condition and outline a mechanism for the reaction. (05 marks)
- c) Using equations only, show how an organic compound, Y can be:
- Obtained from 1, 2-dibromoethane. (04 marks)
  - Converted to nitrobenzene. (03 marks)
  - Converted to benzoyl chloride. (03 marks)

4(a) State what is meant by the following terms?

- Hydration energy. (01 mark)
  - Heat of combustion. (01 mark)
- b) Describe an experiment that can be used to determine the enthalpy of combustion of graphite by a method of Bomb calorimeter. (Diagram is not required) (05 marks)
- c) When 30g of graphite was burnt completely in oxygen gas, the heat liberated raised the temperature of 2.67kg of water from 44.7°C to 37.6°C. Calculate the molar heat of combustions of graphite. ( $\rho_{\text{H}_2\text{O}} = 1\text{g/cm}^3$ , SHC of water = 4.2J/g/K)

- d) Explain why the value of the molar heat of combustion of graphite is than that of theoretical value. (01 mark)
- e) Some thermo chemical data of copper, copper (II) chloride and chlorine are given below.

Process	Enthalpy Change (Kj/Mol)
Enthalpy of formation of copper (II) chloride	$-420.0$
Enthalpy of sublimation of copper	$+358.3$
First ionization energy of copper	$+795.0$
Second ionization energy of copper	$+1,948$
First electron affinity of chlorine	$-374.0$
Bond dissociation energy of chlorine	$+121.1$

- f) Use the values above to draw an energy level diagram which can be used to determine the lattice energy of copper (II) chloride. (04 marks)
- g) The hydration energy of copper (II) chloride is  $-2,883.9 \text{ kJ/mol}$ . determine the enthalpy of solution of copper (II) chloride. (02 marks)
- h) Comment on the effect of temperature on the solubility of copper (II) chloride. (01 mark)

### SECTION B :( 40 MARKS)

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

- 5(a).What is meant by the term ideal solution? (03 marks)
- b) The boiling points of pure water and hydrogen chloride are  $100^\circ\text{C}$  and  $-85^\circ\text{C}$  respectively. A mixture of water and hydrogen chloride boils at  $108.5^\circ\text{C}$  when the mixture is 20% hydrochloric acid.
- i. Sketch a boiling point-composition diagram for water and hydrochloric acid. (03½ marks)

- ii. Describe what happens when a solution containing less than 20.2% hydrochloric acid is fractionally distilled. (04 marks)
- iii. Explain why the mixture shows this deviation from ideal behavior. (03 marks)
- (c). The vapour pressure of ethanol at 20°C is 43.6mmHg while that of benzene at the same temperature is 75.2mmHg. The mole fraction of benzene is 0.09 for a mixture of benzene and ethanol at 20°C. Calculate the:
- Vapour pressure of the mixture. (04½ marks)
  - Mole fraction of ethanol in the vapour phase. (02 marks)
6. Some of the elements in the Period 3 of the Periodic Table are sodium, Aluminium, silicon, phosphorus and chlorine.
- Write the formulae of the oxide(s) of each of the elements given above. (04 marks)
  - Describe the reaction(s) of the oxides of sodium, Aluminium and phosphorus with water. In each case comment on the pH of the resultant solution. (05½ marks)
  - Write equation:
    - For the reaction between the oxides of Aluminium and silicon with aqueous sodium hydroxide. (02 marks)
    - To show how the anhydrous chlorides of silicon and Aluminium can be prepared. In each case state the condition(s). (04 marks)
  - Aluminium chloride was dissolved in water and to the resultant solution was added concentrated potassium hydrogen carbonate solution. State what was observed and explain your answer. (04½ marks)
- 7(a). A compound Q contains carbon, hydrogen and nitrogen only and burns with a sooty flame. On complete combustion, 2.325g of Q yields 3.36 liters of carbon dioxide at s.t.p and 295.5 cm<sup>3</sup> of nitrogen gas measured at 15°C and 1 atmosphere.
- Calculate the empirical formula of compound, Q. (06 marks)
  - When Q was steam distilled at 98°C and 760mmHg, the distillate contained 45.49 % by mass of Q (the saturated vapour pressure of water at this temperature is 655mmHg).
    - Determine the molecular formula of compound, Q. (03 marks)
    - Write the structural formula of compound, Q. (01 mark)

- c) When Compound Q was treated with sodium nitrite solution and concentrated hydrochloric acid in a boiling tube kept at  $0^{\circ}\text{C}$ , compound R was formed to which hydroxy benzene was added in presence of sodium hydroxide solution.
- (i) Write the equation for the reaction leading to formation of compound R. (02 marks)
- (ii) State what is observed when hydroxy benzene was added to compound R in presence of sodium hydroxide and write the equation for the reaction. (02 marks)
- d) Without equations describe how:
- (i) Compound Q can be converted to nitrobenzene. (03 marks)
- (ii) Compound Q can be synthesized from benzene sulphonic acid. (03 marks)
- 8(a). Using suitable examples explain what is meant by the terms:
- (i) Salt hydrolysis. (02 marks)
- (ii) Acidic buffer solution. (02 marks)
- b) Explain why it's not advisable to use soap solutions to wash Aluminium utensils. (03 marks)
- c) The pH reading below refers to the titration of sodium hydroxide solution against  $25\text{cm}^3$  of 0.1M ethanoic acid.

Volume of $\text{NaOH}$ ( $\text{cm}^3$ )	0	4	8	12	16	20	22	22.5	23	24	28
pH of the mixture	2.8	3.5	4.0	4.5	5.1	5.8	7.0	9.0	10.5	11.4	12.3

- (i) Plot a graph of pH against volume of sodium hydroxide. (03 marks)
- (ii) Explain the shape of the curve. (03 marks)
- (iii) Determine the PH at end point. (01 mark)
- (iv) Calculate the morality of sodium hydroxide solution. (02 marks)
- (v) Determine the dissociation constant,  $K_a$  of ethanoic acid used. (04 marks)

**END**