P525 /2
CHEMISTRY
(Theory)
Paper 2
NOV. /DEC. 2024
$2\frac{1}{2}$ hours

S.5

UGANDA ADVANCED CERTIFICATE OF EDUCATION
CHEMISTRY
Paper 2
SENIOR FIVE
END OF YEAR EXAMINATION
2hours:30minutes

INSTRUCTION TO CANDIDATES

*Attempt **five** questions including **three** questions in section **A** and **two** questions in section **B**.*

Answers must be written on the answer sheets (booklets) provided.

Begin each question on a fresh page.

Mathematical tables and squared paper are provided.

Silent non-programmable scientific electronic calculators may be used.

Write equations where necessary to illustrate your answers

Where necessary, use the following

*1 mole of gas occupies 22.4dm^3 at STP; molar gas constant (**R**) is 0.0821 atm dm^3K^{-1}. **C=12,** O=16, H=1*

SECTION A (60MARKS)

*Answer **three** questions from this section.*

1. (a) What is meant by the following terms?

(i) Ideal solutions **[02 marks]**

(ii) Azeotropic mixture **[01 mark]**

(b) Toluene **(C_6H_8)** and Benzene **(C_6H_6)** form a liquid mixture that obeys Raoult's law.

(i) State Raoult's law. **[01 mark]**

(ii) A liquid mixture was made by dissolving 15.6g of benzene in 55.2g of toluene at 25^0C. At the same temperature, the vapour pressures of toluene and benzene are 570mmHg and 1521mmHg respectively. Calculate the vapour pressure of the mixture and giving a reason, state the more volatile liquid.

[06 marks]

(c) When ethanol and water are mixed, they form a non-ideal solution and the total vapour pressure above the mixture is **higher** than expected. Explain why;

(i) They form a non-ideal solution. **[02 marks]**

(ii) Total vapour pressure above the mixture is higher than expected. **[03 marks]**

(d) At standard atmospheric pressure, hydrochloric acid and water form a constant boiling point mixture having a boiling point of 110^0C and composition of 20% by mass of hydrochloric acid.

(i) Sketch a labelled diagram of a boiling point-composition of hydrochloric acid and water if hydrochloric acid boils at 85^0C. **[03 marks]**

(ii) Using the diagram, describe what happens when a mixture containing 10% hydrochloric acid is fractionally distilled. **[03 marks]**

2. (a) Describe how **sodium hydroxide solution** can be prepared on industrial scale. Illustrate your answer with a diagram. **[06 marks]**

(b) Explain the purpose of sodium hydroxide solution during the extraction process of aluminium from its major ore. Illustrate your answers with equations where possible. **[05 marks]**

(c) Compare the reaction of the following pairs of compounds/elements with sodium hydroxide solution. In each case, state the conditions for the reaction and write equation(s) where possible.

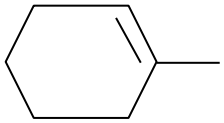
(i) Silicon (IV) oxide and aluminium oxide. **[04 marks]**

(ii) Beryllium and magnesium **[2$\frac{1}{2}$marks]**

(d) Explain your reaction in (c) (ii) above. **[2$\frac{1}{2}$marks]**

3. (a) Complete the following equations and in each case outline a mechanism for the reaction.

(i) $CH_3C{\equiv}CH \xrightarrow[Hg^{2+} / 60^0C]{\text{Dilute } H_2SO_4}$ **[03 marks]**

(ii)  $\xrightarrow[\text{Heat}]{Br_2 / \text{Conc. NaCl}}$ **[03 marks]**

(iii) $CH_3CH_2Br \xrightarrow[\text{Heat}]{\text{NaOH (aq)}}$ **[02 marks]**

(b) (i) Giving a reason for your answer; state the type of reaction in (a) (iii) above. **[01 mark]**

(ii) Draw a well labelled energy diagram for the reaction in (a) (iii) above. **[03 marks]**

(c) (i) Name the reagent that can be used to distinguish between chlorobenzene and 1-chloro propane. State what is observed and write an equation for the reaction that occurs. **[3$\frac{1}{2}$marks]**

(ii) Explain your observation in (c) (i) above. **[4$\frac{1}{2}$marks]**

4. (a) (i) Explain what is meant by **osmotic pressure.** **[01 mark]**

(ii) State the conditions under which solutions do not obey laws of osmotic pressure. **[02 marks]**

(b) (i) Describe an experiment to determine the molecular mass of a polymer using osmotic pressure method. **[06 marks]**

(ii) Explain why the freezing point method is not suitable for determining the molecular mass of a polymer. **[02 marks]**

(c) The osmotic pressure of solutions of different concentrations measured at 298K for a polymer are given in the table below.

osmotic pressure(Pa)	Concentration g/dm^3
118	2.0
480	6.0
1000	10.0
1680	14.0

(i) Plot a graph of osmotic pressure against concentration. **[03 marks]**

(ii) Using the graph you have plotted; determine the molecular mass of the polymer. **[03 marks]**

(d) State two advantages and one disadvantage of using mass spectrometer over osmotic pressure in determination of mass of a substance. **[02 marks]**

SECTION B: (40marks)

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

5. Although fluorine and chlorine are group (VII) elements of the periodic table; fluorine behaves differently form chlorine.

(a) (i) state **four** reasons why fluorine behaves differently from chlorine**.**

[02 marks]

(ii) Basing on hydrides of fluorine and chlorine; state any three differences between the two hydrides. **[03 marks]**

(b) Explain why hydrofluoric acid is a weaker acid than hydrochloric acid.

[03 marks]

(b) Compare the reaction of fluorine and chlorine with;

(i) Water **[04 marks]**

(ii) Sodium hydroxide solution. **[06 marks]**

(c) Explain what is observed and write an equation for the reaction that occurs when chlorine gas is bubbled through potassium manganate (VI) solution.

[03 marks]

6. (a) What is meant by the following terms?

(i) ***Solvent extraction***. **[01mark]**

(ii) ***Steam distillation.*** **[01mark]**

(b) (i) Describe how the Partition co-efficient for Ethane-1,2-dioc acid between water and ether can be determined. **[06 marks]**

(ii) Explain why ethoxyethane is particularly suitable for extraction of an organic compound from an aqueous solution. **[02marks]**

(ii) A solute D is three times as soluble in ethoxyethane as in water. An aqueous solution containing 4.5g of D per litre of solution was shaken by ethoxyethane in a separating funnel. Calculate the mass of D that is extracted by two successive 50.0cm^3 portions of ethoxyethane. **[04 marks]**

(c) 25cm^3 of excess ammonia solution was added to 25cm^3 of 0.1M copper (II) sulphate solution. The resulting deep blue solution was shaken with 50cm^3 of trichloromethane and the mixture allowed to settle. 50cm^3 of the trichloromethane layer required 25cm^3 of 0.05M of HCl for neutralization. 20cm^3 of the aqueous layer was neutralized by 33.3cm3 of 0.5MHCl. Find the formula of the complex. (K_D between water and trichloromethane is 25). **[05 marks]**

7. A compound W contains 76.32% carbon, 6.38% hydrogen and rest being oxygen. A solution of W in water is acidic but does not liberate carbon dioxide from carbonates. When 1.50g of Q is dissolved in 20.90g of benzene, the mixture freezes at 1.3^{0}C. The freezing point of pure benzene is 5.50^{0}C.

(a) Determine the molecular formula of W and write its structural formula.

($Cryoscopic\ constant\ of\ benzene\ = 5.49^0\text{C}\ per\ 1000\ g\ mol^{-1}$) **[05 marks]**

(b) Write the equation and mechanism for the reaction that occurs when compound W is reacted with the following.

(i) Chloroethane in presence of sodium hydroxide solution. **[03 marks]**

(ii) Ethonylchloride (CH_3COCl) **[03 marks]**

(c) Name the reagent that can be used to identify compound W. state what was observed after the reaction. **[02 marks]**

(d) Write the equations to show how the following conversions can be effected.

(i) Compound W from nitrobenzene. **[04 marks]**

(ii) Compound W to cyclohexane-1, 2-diol. **[03 marks]**

8. **Aluminium, magnesium, carbon** and **fluorine** are elements of the periodic table.

(a) Compare the reactions between following elements. Write an equation(s) where applicable;

(i) Magnesium and sodium with water **[05marks]**

(ii) Carbon and fluorine with sodium hydroxide solution. **[04 marks]**

(iii) Magnesium and carbon with concentrated sulphuric acid. **[03marks]**

(b) When fluorine reacts with hydrogen, it forms hydrogen fluoride which behaves differently from hydrides of other members of its group. State any **two differences** between the properties on hydrogen fluoride and hydrides of other members of its group. **[02 marks]**

(c) Ammonia solution was added drop wise until in excess separately in test tubes with solutions of magnesium ions and aluminium ions.

(i) Explain what was observed **[02marks]**

(ii) Write an equation for the reaction that occurred in test tube containing aluminium ions. **[01$\frac{1}{2}$marks]**

(d) In another set-up, a solution containing aluminium ions was mixed with a solution of magnesium ions. Name the reagent that can confirm presence of magnesium ions and state what is observed. **[02$\frac{1}{2}$marks]**

END

WE WISH YOU SUCCESS

MERRY CHRISTMAS AND HAPPY NEW YEAR