P525/2
CHEMISTRY
Paper 2
July/August
$2^1/_2$ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

(Principal Subject)

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES;

- Answer **five** questions including **three** questions from section **A** and any **two** questions from section **B**.
- Write the answers in the answer booklet/sheets provided.
- **Begin each question on a fresh page.**
- Mathematical tables and graph papers are provided.
- Non programmable, silent scientific electronic calculators may be used.
- Illustrate your answers with equations where applicable.
- Where necessary use (C = 12, O = 16, H = 1, N = 14, Br = 80, IF = 96500C)

Turn Over

SECTION A

*Attempt only **three** questions from this section.*

1. An organic compound **P**, $C_6H_{12}O_2$ has the following properties.
   - It forms a yellow precipitate with both Brady's reagent and iodine solution in presence of sodium hydroxide solution.
   - It burns with yellow non sooty flame.
   - It forms a cloudy solution immediately when treated with concentrated hydrochloric acid in presence of anhydrous zinc chloride.

   (a) Write structural formula and IUPAC name of **P**. (02 marks)

   (b) Write equation and suggest a mechanism for the reaction between **P** and
   (i) concentrated hydrochloric acid in presence of anhydrous zinc chloride. (3½marks)
   (ii) Hot concentrated orthophosphoric acid at 160°C. (4½ marks)
   (iii) Potassium cyanide in the presence of dilute sulphuric acid at the temperature less than 20°C. (03 marks)
   (iv) Brady's reagent. (05 marks)

   (c) Using equations only, show how **P** can be synthesized from propan-2-ol. (02 marks)

2. (a) Distinguish between order of reaction and activation energy. (02 marks)

   (b) The table below shows the concentration of iodine varying with time during the acid catalysed iodination of propanone.

   $CH_3COCH_3 + I_{2(aq)} \xrightarrow{H^+} CH_3COCH_2I_{(aq)} + HI_{(aq)}$

Time (min)	0	2	4	6	8	10	12
$[I_2]$ ($moldm^{-3}$)	0.210	0.190	0.166	0.150	0.134	0.110	0.090

   Plot a graph of iodine against time and use it to determine: (3½ marks)
   (i) units. (1½marks)
   (ii) the order of reaction. (02 marks)

   (c) Describe an experiment to show how the results in (b) can be determined. (06 marks)

   (d) Ethanal decomposes thermally to form methane and carbon monoxide according to the following equation.

   $$CH_3CHO_{(g)} \longrightarrow CH_{4(g)} + CO_{(g)}$$

   Standard enthalpy of formation are $\Delta H_f^{\theta}(CH_3CHO) = -166kJmol^{-1}$, $\Delta H_f^{\theta}(CH_{4(g)}) = -75kJmol^{-1}$ and $\Delta H_f^{\theta}(CO_{(g)}) = -110KJmol^{-1}$.
   The activation energy, $E_a = +190kJmol^{-1}$
   Draw the reaction profile for the reaction indicating the values of E_a and $\Delta H^{\theta}_{Reaction}$. (05 marks)

3. (a) Define the following terms;
   (i) Partition coefficient. (01 mark)
   (ii) Solvent extraction. (01 mark)

   (b) Describe an experiment that can be used to determine the distribution coefficient of butane-1,4-dioic (succinic) acid between trichloromethane and water. (06 mark)

   (c) 50 cm^3 of iodine solution in 0.16M potassium iodide was shaken with 50cm^3 of trichloromethane in a separating funnel until equilibrium was attained at room temperature. The mixture was allowed to stand for the layers to separate. 20cm^3 of the aqueous layer required 21.30 cm^3 of 0.15M sodium thiosulphate solution using starch indicator. 20cm^3 of the trichloromethane layer required 26.70cm^3 of 0.15M sodium thiosulphate solution using starch indicator. (KD of iodine between trichloromethane and water is 85 at room temperature) Calculate;
   (i) the molar concentration of free iodine in trichloromethane layer. (03 marks)

(ii) the molar concentration of free iodine aqueous layer. (02 marks)

(iii) the molar concentration of complexed (fixed) iodine in aqueous layer. (2½ marks)

(iv) the equilibrium constant, Kc for the reaction;

$$I_2(aq) + I^-aq) \rightleftharpoons I_3^-(aq)$$ (2½ marks)

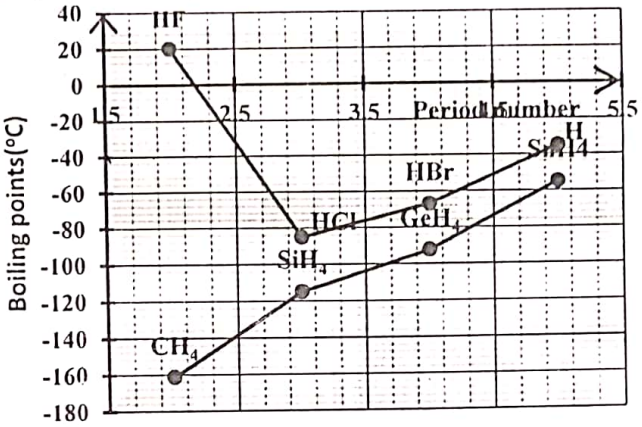
(d) State;

(i) one application of partition coefficient. (01 mark)

(ii) one reason why starch is used as an indicator in titration involving sodium thiosulphate. (01 mark)

4. The boiling points of hydrides of group (IV) and group(VII) are shown in the graph below.

A graph of Boiling points of hydrides of group (IV) and group (VII) elements



(a) Explain why;

(i) the graph for the hydrides of group(IV) is almost linear. (2½ marks)

(ii) the boiling point of the hydride of fluorine is abnormally high compared to that of the hydride of carbon. (3½ marks)

(iii) the boiling points of other hydrides of group seven elements increase with increase in period number. (2½ marks)

(b) Describe the reactions of;

(i) the hydrides of group(VII) elements with concentrated sulphuric acid.(3½ marks)

(ii) the hydrides of group(IV) elements with sodium hydroxide. (04 marks)

(c) Write equation for the reaction between;

(i) Hydrogen fluoride with silicon (IV) oxide. (1½marks)

(ii) Methane with hot copper(II) oxide. (1½marks)

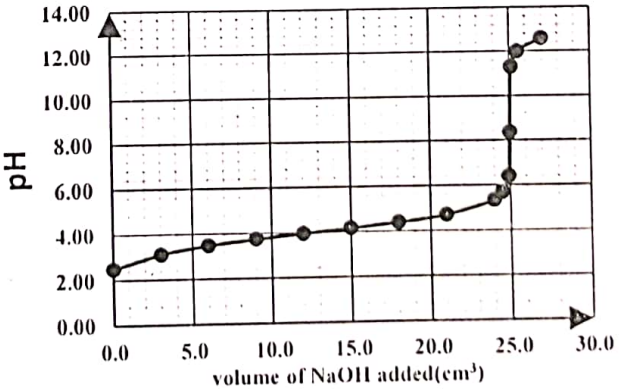
(iii) Hydrogen Chloride gas with aqueous potassium manganate (VII) solution. (1½marks)

SECTION B

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

5. The graph below shows the pH changes that occur when 25cm^3 of 0.1M weak acid HA was titrated against sodium hydroxide solution.

A graph of pH against volume of NaOH added



(a) Use the graph to determine;
(i) the Ka of the weak acid(HA). (03 marks)
(ii) the pH and volume at the end point. (02 marks)

(b) Calculate the.
(i) molarity of sodium hydroxide solution. (03 marks)
(ii) the hydrolysis constant of the salt formed at the end point. (04 marks)

(c) Explain the shape of the graph. (06 marks)

(d) Which of the indicators methyl orange and phenolphthalein would be suitable for this titration. Give the reason for your answer. (02 marks)

6. Without using equations, describe how the following conversions can be effected.
(a) Phenyl methanol from benzene. (04 marks)
(b) Benzene from calcium oxide. (3½ marks)
(c) Phenol from nitrobenzene. (05 marks)
(d) 2-hydroxypropanoic acid from ethanol. (4½ marks)
(e) phenyl ethyne from phenyl ethane. (03 marks)

7. Explain each of the following observations:
(a) An aqueous solution of sodium sulphate is neutral to litmus while aqueous solution of sodium sulphite turns red litmus paper blue. (04 marks)

(b) When excess carbon dioxide gas was separately bubbled through sodium aluminate solution and sodium carbonate solution both form white precipitate. (04 marks)

(c) When warm concentrated nitric acid was added to sulphur, the yellow solid dissolved with effervescence of reddish brown gas and colorless solution was formed. (03 marks)

(d) The shapes of the molecules BF_3 and PCl_3 are different. (05 marks)

(e) The melting point of sodium is 98^0C where as that of magnesium is 650^0C. (04 marks)

8. One of the ores of copper is copper pyrites ($CuFeS_2$).
(a) (i) What is meant by the term **ore**? (01 mark)
(ii) Name and write the formulae of **two** other ores of copper. (02 marks)

(b) Copper pyrites can be concentrated by froth flotation. Describe briefly how the process is carried out. (02 marks)

(c) The concentrated ore in (b) above is roasted in a limited supply of air. The roasted product is mixed with silicon (IV) oxide and the mixture heated in the absence of air. Explain why;
(i) the concentrated ore is roasted in limited supply of air. (2½ marks)
(ii) the roasted product is heated with silicon(IV) oxide in the absence of air. (02 marks)

(d) Describe briefly how the;
(i) impure copper can be obtained from roasted product. (03 marks)
(ii) impurities in the copper can be removed. (03 marks)

(e) State what would be observed and write equation for the reaction that took place when pure copper is added to;
(i) moderately concentrated nitric acid. (02 marks)
(ii) silver nitrate solution. (1½ marks)

END