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

WAKISSHA

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)

SECTION A

Attempt only three questions from this section.

1. (a) What is meant by the term **freezing point depression constant.** (01 mark)

   (b) (i) Describe how the relative molecular mass of naphthalene can be determined using freezing point depression. (08 marks)

   (ii) State **four** limitation of the method in (i) above. (02 marks)

   (c) The freezing points of solutions of various concentrations of naphthalene in cyclohexane at 760mmHg are shown in the table below.

Concentration (g/1000g of cyclohexane)	10	20	30	40	50	60
Freezing point (°C)	4.93	3.36	1.79	0.22	-1.35	-2.92

   (i) Plot a graph of freezing point against concentration. (04 marks)
   (ii) Use the graph to determine freezing point of pure cyclohexane. (01 mark)
   (iii) Determine the slope of the graph and use it to determine the relative molecular mass of the naphthalene. (4 marks)
   (Kf for cyclohexane = 20.1 °C/mol /1000g of cyclohexane)

2. (a) Define the term **buffer solution.** (01 mark)

   (b) Describe how a solution containing a mixture of ammonia and ammonium chloride can function as a buffer solution. (05 marks)

   (c) (i) $50cm^3$ of 0.2M ammonia solution were mixed with $30cm^3$ of 0.25M ammonium chloride solution. Calculate the pH of the resultant mixture. (04 marks)
   (K_b for ammonia = $1.78 \times 10^{-5}\ moldm^{-3}$ and $K_w = 1.0 \times 10^{-14} mol^2 dm^{-6}$)

   (ii) State and explain what would happen to the pH of the mixture in (c)(i) above if few drops of 2M sodium hydroxide solution were added to it. (03 marks)

   (d) (i) Sketch a graph of pH changes that take place when ammonia solution is being titrated with dilute hydrochloric acid. (1½ marks)

   (ii) Explain the shape of the graph (03 marks)

   (iii) Which of the following indicators would be suitable for the above titration. Give a reason for your answer. (2½ marks)

Indicator	**pH range**
Thymol blue	1.2 – 2.8
Phenolphthalein	8.3 – 10.0
Methyl red	4.2 – 6.3

3. Fluorine , chlorine , bromine and iodine are some of the elements in group(VII) of the Periodic Table.

   (a) Write the outer most electronic configuration of the elements. (01 mark)

   (b) Discuss the reactions of the elements with;

   (i) water (04 marks)
   (ii) sodium hydroxide solution (5½ marks)
   (iii) sulphurous acid (02½ marks)

(c) State what would be observed and write equation for the reaction when chlorine gas was bubbled through the following solution.

(i) iron(II) chloride solution (2½ marks)

(ii) sodium thiosulphate solution (2½ marks)

(iii) potassium manganate(VI) solution. (2½ marks)

4. An organic compound **P** contains 66.4% by mass of carbon, 5.53% by mass of hydrogen and the rest being for chlorine.

(a) Calculate the empirical formula of **P**. (2½ marks)

(b) When vaporized , 0.35g of **P** occupied a volume of 75.43cm^3 at 103°C and 860mmHg. Determine the molecular formula of P. (03 marks)

(c) **P** burns with a sooty flame. Write the structural formulae and IUPAC names of the possible isomers of **P**. (02 marks)

(d) When **P** was refluxed with aqueous sodium hydroxide solution , compound **Q** was formed. **Q** reacted with hot acidified potassium dichromate solution to form compound **R**. **R** formed orange precipitate with 2,4-dinitrophenylhydrazine in acidic medium. Identify **P**,**Q** and **R.** (1½ marks)

(e) Write equation and suggest a mechanism for the reaction between

(i) **P** and phenol in the presence of aqueous sodium hydroxide solution. (2½ marks)

(ii) **R** and 2,4-dinitrophenylhydrazine in acidic medium. (05 marks)

(f) Using equations only show how **P** can be synthesized from benzene. (3½ marks)

SECTION B

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

5. Sodium thiosulphate solution reacts with hydrochloric acid according to the following equation.

$S_2O_3^{2-}(aq) + 2H^+(aq) \longrightarrow S(s) + SO_2(g) + H_2O(l)$

The kinetic data for the above reaction at 25°C is shown in the table below.

	$[S_2O_3^{2-}]$ $(moldm^{-3})$	$[H^+]$ $(moldm^{-3})$	Initial rate $(moldm^{-3}\,s^{-1})$
1	0.40	0.20	7.00×10^{-4}
2	0.40	0.60	6.30×10^{-3}
3	0.80	0.60	1.26×10^{-2}

(a) (i) Differentiate between **order** and **rate constant** of reaction. (02 marks)

(ii) Determine the order of reaction with respect to $S_2O_3^{2-}$ and H^+ ions. (03 marks)

(iii) Write an expression for the rate law. (01 mark)

(iv) Calculate the rate constant for the reaction at 25°C and indicate its units. (2½ marks)

(b) Explain the effect of temperature on the **rate constant** and **activation energy** of the reaction. (04 marks)

(c) Using the above reaction, describe an experiment that can be carried out to determine the order of reaction with respect $S_2O_3^{2-}ions$. (7½ marks)

6. Using equations only show how the following conversions can be effected. Indicate the reagents and conditions for the reaction. (04 marks)

(a) Propan -1- ol from 2- bromopropane. (04 marks)

(b) Benzene cyanide (C_6H_5CN) from nitrobenzene (04 marks)

(c) 2- methylpropanoic acid from propene (05 marks)

(d) Phenylethanoate from benzene (03 marks)

(e) Aminoethane from propanoic acid.

7. Explain the following observations.

(a) When lead(IV) oxide is warmed with concentrated hydrochloric acid, effervescence of a greenish yellow gas is evolved. (3½ marks)

(b) When hydrogen sulphide gas was bubbled through iron(III) chloride solution, a yellow precipitate was formed. (3½ marks)

(c) A mixture of water(Bpt 100°C) and chlorobenzene (Bpt 136°C) boils at 98°C at atmospheric pressure. (04 marks)

(d) When sodium hydroxide solution was added to chromium(III) sulphate solution drop – wise until in excess, followed by hydrogen peroxide and the mixture warmed, it formed a green precipitate soluble in excess sodium hydroxide to give a green solution which turned yellow on warming with hydrogen peroxide solution. (05 marks)

(e) Aluminium chloride sublimes on heating whereas sodium chloride does not. (04 marks)

8. (a) (i) What is meant by the term **ore**? (01 mark)

(ii) Write formulae and names of two ores from which zinc can be extracted. (02 marks)

(b) Describe how pure zinc can be extracted from **one** of the ores in (a)(ii) above. (06 marks)

(c) Describe the reactions of zinc with

(i) sulphuric acid (04 marks)

(ii) sodium hydroxide (2½ marks)

(d) Ammonia solution was added to zinc sulphate solution drop-wise until in excess.

(i) State what would be observed. (1½ marks)

(ii) write equation(s) for the reaction(s) that took place. (03 marks)

END