

**P525/2**  
**CHEMISTRY**  
**Paper 2**  
**2½ 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)
- (K<sub>f</sub> 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<sup>3</sup> of 0.2M ammonia solution were mixed with 30cm<sup>3</sup> of 0.25M ammonium chloride solution. Calculate the pH of the resultant mixture. (04 marks)
- (K<sub>b</sub> for ammonia = 1.78 x 10<sup>-5</sup> mol dm<sup>-3</sup> and K<sub>w</sub> = 1.0 x 10<sup>-14</sup> mol<sup>2</sup> dm<sup>-6</sup>)
- (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. (2½ marks)
- (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. (2½ marks)
- (a) Calculate the empirical formula of **P**. (2½ marks)
  - (b) When vaporized, 0.35g of **P** occupied a volume of 75.43cm<sup>3</sup> 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.



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

	$[S_2O_3^{2-}]$ (mol dm <sup>-3</sup> )	$[H^+]$ (mol dm <sup>-3</sup> )	Initial rate (mol dm <sup>-3</sup> s <sup>-1</sup> )
1	0.40	0.20	$7.00 \times 10^{-4}$
2	0.40	0.60	$6.30 \times 10^{-3}$
3	0.80	0.60	$1.26 \times 10^{-2}$

- (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)

**Turn Over**



6. Using equations only show how the following conversions can be effected. Indicate the reagents and conditions for the reaction.
- Propan -1- ol from 2- bromopropane. (04 marks)
  - Benzene cyanide ( $C_6H_5CN$ ) from nitrobenzene (04 marks)
  - 2- methylpropanoic acid from propene (04 marks)
  - Phenylethanoate from benzene (05 marks)
  - Aminoethane from propanoic acid. (03 marks)
7. Explain the following observations.
- When lead(IV) oxide is warmed with concentrated hydrochloric acid, effervescence of a greenish yellow gas is evolved. (3½ marks)
  - When hydrogen sulphide gas was bubbled through iron(III) chloride solution, a yellow precipitate was formed. (3½ marks)
  - A mixture of water(Bpt  $100^\circ C$ ) and chlorobenzene (Bpt  $136^\circ C$ ) boils at  $98^\circ C$  at atmospheric pressure. (04 marks)
  - 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)
  - 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
- sulphuric acid (04 marks)
  - sodium hydroxide (2½ marks)
- (d) Ammonia solution was added to zinc sulphate solution drop-wise until in excess.
- State what would be observed. (1½ marks)
  - write equation(s) for the reaction(s) that took place. (03 marks)

END