

P525/2

CHEMISTRY

Paper 2

July / Aug. 2022

2 ½ hours



UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Advanced Certificate of Education

CHEMISTRY

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.

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

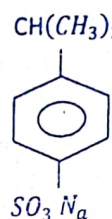
[C = 12, H = 1, 1 mol of a gas occupies 22.4 dm³ at s.t.p.]

SECTION A:

Answer **THREE** questions from this section

1. (a) Explain what is meant by the term **partition coefficient**. (02 marks)
- (b) Describe an experiment used to determine partition coefficient of phenol between water and methyl benzene. (5 ½ marks)
- (c) State **four** conditions under which the partition law is valid. (02 marks)
- (d) 50 cm³ of 1.5M aqueous ammonia solution were shaken with 50 cm³ of trichloromethane and the mixture left to settle to attain equilibrium at 200K. At equilibrium, 20cm³ of trichloromethane layer required 23.0 cm³ of 0.05M hydrochloric acid for neutralization. Calculate the partition coefficient of ammonia between water and trichloromethane at 200K. (3 ½ marks)
- (e) 1.5 g of an impure ore of zinc was dissolved in excess ammonia and the resultant solution shaken with trichloromethane and mixture left to settle to attain equilibrium. At equilibrium, 50 cm³ of the organic layer required 30cm³ of 0.062M hydrochloric acid for neutralization which 20 cm³ of the aqueous layer required 40cm³ of 0.5M hydrochloric acid for neutralization using methyl orange as indicator. The partition coefficient of ammonia between water and trichloromethane is 25.0 at 20°C and 1 mole of zinc complexes 4 moles of ammonia ($\text{Zn}(\text{NH}_3)_4^{2+}$). Calculate;
- (i) Concentration of ammonia in trichloromethane in mol dm⁻³. (½ marks)
- (ii) Concentration of free ammonia in aqueous layer in mol dm⁻³. (½ marks)
- (iii) Concentration of complexed ammonia in aqueous layer in mol dm⁻³. (04 marks)
- (iv) Percentage purity of the zinc ore. (Zn = 65)
2. An organic compound **Q** contains 40% carbon, 6.67% hydrogen, the rest being oxygen.
- (a) Determine the simplest formula of **Q**. (C=12, H = 1, O=16). (03 marks)
- (b) A solution of 28.145g of **Q** in 250g of water had a freezing point of -349°C.
- (i) Determine the molecular formula of **Q** if cryoscopic constant K_f of water is 1.86°C mol⁻¹ per kg⁻¹. (3 ½ marks)
- (ii) Write structural formulae and IUPAC names of all possible isomers of **Q**. (02 marks)
- (c) When sodium hydrogen carbonate was added to **Q** there was no observable change.
- (i) Name **Q** (½ mark)
- (ii) Using equations, show how **Q** is synthesized from bromomethane.

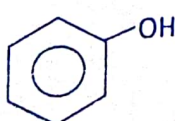
- (1 ½ mark)
- (d) (i) Write equation for the reaction between **Q** and water in presence of alkali catalyst and heat. (½ mark)
- (ii) Outline a mechanism for the reaction in (d) (i). (02 marks)
- (e) Name the process in (d) and state **one** practical application of it. (01 mark)

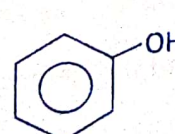
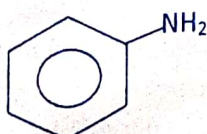
- (f) (i) By means of equations only show how  can be formed from Ethyne. (04 marks)
- (ii) State one practical application of the reactions in (f) (i) and one advantage and disadvantage of the product. (02 marks)

3. (a) (i) Name the major ore from which copper is extracted. (½ mark)
- (ii) Describe how copper is extracted from the ore you have named in (a) above. (06 marks)
- (b) Describe the reaction of copper with acids. (Include equations for the reaction). (08 marks)
- (c) State what is observed and in each case explain your observation when;
- (i) Dilute sulphuric acid is added to copper (I) oxide. (2 ½ marks)
- (ii) Ammonia solution is added to a solution of copper (II) sulphate drop wise until in excess. (03 marks)

4. (a) Name a reagent which is added to each of the following pairs of organic compounds, give the same or similar observations in each case. State what is observed and write equations for the reaction that takes place. (04 marks)

- (i) $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CH}$ and $\text{CH}_3\text{CH} = \text{CHCH}_3$ (03 marks)

- (ii)  and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (05 marks)

- (iii)  and  (05 marks)

- (b) For each of the pairs of organic compounds shown in (a)(i) and (a) (ii), name a reagent which is used to distinguish in each case state what is observed and write equations for the reaction that takes place. (08 marks)

SECTION B
Attempt TWO questions only

- ✓ (a) State two Faradays laws of electrolysis. (02 marks)
- (b) A current of 3A was passed for 20 minutes through a cell containing dilute sulphuric acid. Calculate the volume of hydrogen produced at the cathode collected at 25°C and 120KNm⁻² (IF = 96500C). (05 marks)
- (c) The molarity of a sample of hydrochloric acid approximately 0.1M was determined accurately by measuring the conductivity of the solution as 1.0M sodium hydroxide solution was added to 50 cm³ of the acid and the results shown in the table below:

Conductivity ($\Omega^{-1}cm^{-1}$)	4.1	3.3	2.4	1.7	1.5	1.8	2.2	2.5
Volume of 1M NaOH(cm ³)	1	2	3	4	5	6	7	8

- (i) Plot a graph of conductivity against volume of 1M sodium hydroxide added. (03 marks)
- (ii) Calculate the molarity of hydrochloric acid. (02 marks)
- (iii) Explain the shape of your graph. (4 ½ marks)
- (b) 2.72g of anhydrous zinc chloride was dissolved in water to make one litre of solution with distilled water. The conductivity of the solution was found to be $5.175 \times 10^{-3} \Omega^{-1} cm^{-1}$ at 25°C. Determine the molar ionic conductivity of chloride ions. (molar conductivity of zinc ions is $106 \Omega^{-1} cm^2 mol^{-1}$ $Zn = 64.5, Cl = 35.5$). (3 ½ marks)

6. The atomic numbers and boiling points of some of period 3 elements is shown below:

Element	P	S	Cl	Ar
Atomic number	15	16	17	18
Boiling point (°C)	500	550	400	0

- (a) (i) Plot a graph of boiling point against atomic number of the elements. (1 ½ marks)
- (ii) Explain the shape of your graph. (3 ½ marks)
- (b) Describe the reaction of phosphorus, sulphur and chlorine with sodium hydroxide. (5 ½ marks)

- (c) During extraction of aluminium from Bauxite; the ore is first roasted crushed into powder and digested with hot concentrated sodium hydroxide and filtered. State why:
- (i) The ore is roasted (½ mark)
 - (ii) Digested with sodium hydroxide and filtered. (½ mark)
- (d) Write equation(s) for the reaction(s) in (c) (ii). (01 mark)
- (e) Briefly describe how pure aluminium can be obtained from the product of the reaction in (c) (ii). (5 ½ marks)
- (f) (i) Write equations for the reactions between aluminium and trimanganese tetra oxide. (½ mark)
- (ii) Name the process in (f) (i). (½ mark)
- (g) Write equation to show how pure anhydrous aluminium chloride can be prepared. (½ mark)
7. Explain the following observations;
- (a) When a solution of sulphur dioxide is added to potassium dichromate (VI) solution, orange solution turns to colourless. (02 marks)
 - (b) Hydrogen fluoride is liquid at room temperature while hydrogen chloride is gas at room temperature. (03 marks)
 - (c) An aqueous solution of chromium (III) chloride turns blue litmus paper to red. (2 ½ marks)
 - (d) Tin (II) chloride is polar while boron trichloride is non – polar. (05 marks)
 - (e) Methanoic acid is a stronger acid than ethanoic acid. (05 marks)
 - (f) When a limited amount of chlorine is bubbled through sodium thiosulphate solution, a yellow solid is deposited. (2 ½ marks)
8. (a) In the laboratory preparation of 2, 3 – dibromobutane, 50g of but – 2 – ene gas was passed through 80g of liquid bromine covered by a layer of tetra chloromethane. (1 ½ marks)
- (i) State what was observed.

- (ii) Write equation for the reaction that took place and suggest mechanism for the reaction. (3 ½ marks)
- (iii) Assuming that all the bromine reacted with the alkene, calculate the mass of 2, 3, - dibromobutane that was formed. (4 ½ marks)
- (iv) If the actual mass of 2, 3 – dibromo butane was 43.2g, calculate the percentage yield of 2,3 – dibromobutane from the reaction. (C=2, H=1, Br=80). (01 mark)
- (b) 1, 2 – dibromo ethane was heated with excess alcoholic aqueous potassium hydroxide solution.
- (i) Write equation for the reaction and suggest mechanism for the reaction. (05 marks)
- (c) By means of words only, show how the product in (b) can be converted to propanone. (4 ½ marks)

END