P525/2
CHEMISTRY
THEORY
Paper 1
7 August 2023
2 ½ hours

ENTEBBE JOINT EXAMINATION BUREAU

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 2

.

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Attempt **any five** *questions including* **three** *questions from* Section **A** *and any* **two** *questions from* Section **B.**

Mathematical tables and graph papers are provided.

Non – programmable scientific calculators may be used

Where necessary, use the following values:

[C = 12, O = 16,H = 1]

Begin each question on a fresh page.

EXAMINERS' USE ONLY						**Total mark**
QUESTION						
SCORE						

SECTION A (60 marks)

Answer **three** *questions from this* Section

1. (a) State what is meant by **salt hydrolysis.** *(01 mark)*

(b) Calculate the pH of the solution prepared by mixing 80cm^3 of 1M ammonia solution and an equal volume of 1M hydrochloric acid. *(Kb of ammonia = 1.75 x 10^{-5} moldm^{-3} at 25^{0}C* and *Kw = 1.0 x 10^{-14} mol^{2}dm^{-6} at 25^{0}C)* *(05 marks)*

(c) Explain what happens when the resultant solution in (b) above is treated with the following substances.

(i) sodium thiosulphate *(02 marks)*
(ii) calcium powder *(1½ marks)*

(d) The table below shows the pH of a solution obtained when different volumes of hydrochloric acid were added to 25.0cm^3 of 0.1M ammonia solution.

Volume of HCl (cm^3)	0	10.0	15.0	16.5	17.0	20.0	25.0	30.0
pH of solution	9.90	9.08	8.30	6.70	2.97	1.96	1.60	1.40

(i) Plot a graph of pH against volume of hydrochloric acid. *(03 marks)*

(ii) Explain the shape of the graph you have drawn. *(3½ marks)*

(e) Determine from the graph:

(i) concentration of hydrochloric acid in moldm^{-3}. *(03 marks)*

(ii) base ionization constant, *kb* for ammonia. *(02 marks)*

2. (a) (i) Write the electronic configuration of a chromium atom. *(Atomic number =24).* *(½ mark)*

(ii) State the common oxidation states of chromium in its compounds. *(01 mark)*

(b) Describe the reaction of chromium with

(i) Sodium hydroxide *(02 marks)*

(ii) Sulphric acid *(04 marks)*

(c) Dilute sodium hydroxide solution was added to Chromium(III) chloride solution drop wise until in excess, followed by a few drops of hydrogen peroxide and the mixture warmed.

(i) State what was observed. *(02 marks)*

(ii) Explain your observation in (c) (i) above. *(6½ marks)*

(d) Potassium chromium(III)sulphate was dissolved in water and a few drops of concentrated potassium hydrogen carbonate were added. Explain what was observed. *(04 marks)*

3. The molecular structure of compound ***Z*** is $CH_2 = CHCOCH_3$.

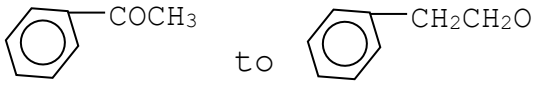
(a) Write the mechanism for the reaction that would take place when ***Z*** reacts with the following reagents.

(i) bromine water. *(03 marks)*

(ii) 4-nitrophenyl hydrazine solution. *(04 marks)*

(iii) Saturated sodium hydrogen sulphite. *(03 marks)*

(b) Write equations to show how the following conversions can be carried out. Indicate the conditions and reagent for the reactions.

(i)  *(04 marks)*

(ii) Ethene to methylbenzene *(03 marks)*

iii)  to methyl benzoate *(03 marks)*

4. (a) Describe the term **partition coefficient.** *(01 mark)*

(b) Describe an experiment that can be carried out to determine the partition coefficient, K_D of ethanedioic acid(oxalic acid) between ethoxyethane and water. *(06 marks)*

(c) $50cm^3$ of an aqueous solution containing 6g of *T* was in equilibrium with $100cm^3$ of ethaxyethane containing 108g of *T*. Calculate the partition coefficient , K_D. *(02 marks)*

(d) Using your answer in (c) above, calculate the mass of *T* extracted by shaking $100cm^3$ of an aqueous solution containing 30*g* of *T* with

(i) $100cm^3$ of ethoxyethane. *(02 marks)*

(ii) two portions of $50cm^3$ of ethoxyethane. *(03 marks)*

(e) $50cm^3$ of 0.8M aqueous ammonia solution was added to $50cm^3$ of trichloromethane in a flask. To the resultant mixture was added 0.1M nickel(II)sulphate solution. The mixture was shaken and allowed to stand at constant temperature. Some ammonia reacted with nickel(II)ions to form a complex, $Ni(NH_3)_n^{2+}$ $25cm^3$ of the organic layer required $20cm^3$ of 0.01M hydrochloric acid for complete reaction.

Determine the value of *n* in the complex formed. *(K_D of ammonia between trichloromethane and water is 0.04 at 25^0C).* (06 marks)

SECTION B (40 MARKS)

Answer any **two** *questions from this* Section

5. (a) (i) Describe the industrial preparation of sulphuric acid. *(01 mark)*

(ii) State the uses of sulphuric acid. *(01 mark)*

(b) Describe the reactions of sulphuric acid with:
(i) Copper *(02 marks)*
(ii) Iron *(04 marks)*

(c) Write an equation to show how sulphuric acid is used to prepare a super phosphate fertilizer. *(01 mark)*

(d) Concentrated sulphuric acid is 98% acid and has a density of $1.84gcm^{-3}$. Calculate the volume of the acid required to prepare one litre of 2M dilute acid solution. *(04 marks)*

6. A compound *X* contains 14.8% Carbon, 1.8% Hydrogen, 19.7% Oxygen and the rest being Lead.

(a) Determine the molecular formular of *X(X = 325).*
(Pb = 207, H = 1, O = 16, C = 12) *(03 marks)*

(b) When *X* was heated with concentrated sulphuric acid, a solid *A* and a colorless sharp-smelling liquid *B* was formed.

(i) Identify *A* and *B.* *(01 mark)*
(ii) Write equation for the reaction leading to formation of *A* and *B.* *(01 mark)*

(c) Using equations, show how

(i) *X* can be converted to 1,2-dichloropropane. *(3½ marks)*

(ii) *B* can be prepared from methanol. *(04 marks)*

(d) State what would be observed and write equation(s) for the reaction(s) that would take place when an aqueous solution of *X* is reacted with the following:

(i) potassium chromate(iv)solution. *(1½ marks)*

(ii) concentrated hydrochloric acid drop wise until in excess. *(02 marks)*

(e) Write an equation and outline the mechanism for the reaction between *B* and ethanol in the presence of concentrated sulphuric acid. *(04 marks)*

7. (a) Define the terms:
(i) Solubility product *(01 mark)*
(ii) Common ion effect *(01 mark)*

(b) Strontium hydroxide is sparingly soluble in water according to the following equation:

$$Sr(OH)_{2(s)} \rightleftharpoons Sr^{2+}_{(aq)} + 2OH_{(aq)}$$

(i) Write the expression for the solubility product, Ksp for strontium hydroxide. *(01 mark)*

(ii) Describe an experiment which can be carried out to determine the solubility product of strontium hydroxide. *(08 marks)*

(c) The solubility of Strontium hydroxide is 5.24gdm^{-3} of water at 293K. Calculate the
(Sr = 87.6,0 = 16, H = 1)

(i) Solubility product of Strontium hydroxide at 20^{0}C and give its units. *(3½ marks)*

(ii) volume of 0.02M potassium chromate(VI) solution that must be added to 1dm^3 of a saturated solution of strontium hydroxide to precipitate Strontium Chromate(VI).
(Ksp of Strontium Chromate(vi)is3.6x10^{-5}mol^{2}dm^{-6}at 293k) *(3½ marks)*

(d) Potassium hydroxide solution was added to a saturated solution of strontium hydroxide. Explain what happened to the solubility of strontium hydroxide. *(02 marks)*

8. Explain the following observations. Illustrate your answer with equations where possible.

(a) A solution of iodine and sodium hydroxide gives a pale yellow precipitate with ethanol but gives no observable change with methanol. *(05 marks)*

(b) The molar ionic conductivity of sodium and Rubidium ions are 50.0 and 78.3 $\Omega^{-1}cm^2mol^{-1}$ respectively. *(05 marks)*

(c) When sodium hydrogen carbonate solution is added to zinc chloride solution, a white precipitate is formed with effervescence of a colourless gas. Calcium chloride solution gives no observable change when reacted with the same reagent. *(05 marks)*

(d) An aqueous solution of ammonium sulphate turns blue litmus red while an aqueous solution of potassium sulphite turns red litmus to blue. *(04 marks)*

(e) When Lead(IV) oxide is added to manganese(II) chloride followed by concentrated nitric acid, a purple solution is formed. *(02 marks)*

END