P 525/2

CHEMISTRY

Paper 2

Nov. 2024

2 ½ Hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION

End of Term 3 Examination 2024

S.5 CHEMISTRY

(THEORY)

Paper 2

2 hour 30 minutes

INSTRUCTIONS:

*Answer any **5** questions in this paper*

Your are required to answer the questions on the answer sheets provided

Your are required to begin each question on a fresh page.

Mathematical tables and squared paper are provided.

Silent non-programmable scientific calculators may be used

Illustrate your answers with equations where applicable

Where necessary, use the following;

C = 12, H = 1, O = 16

Molar gas constant **R = 8.31 JK^{-1} mol^{-1}**

Standard temperature **= 273 K**

Standard Pressure **= 101325 Nm^{-2}**

1. An organic compound, **Q** consists of **64.9%** carbon, **13.5%** hydrogen and rest being oxygen. **3.40g** of **Q** in vapour form occupied **1.8 dm^3** at **250 ^{0} C** and **atmospheric pressure**

(a)(i). Calculate the **empirical formula** of **Q.** **(03 marks)**

(ii). Determine the **molecular formular** of **Q** **(03 marks)**

(b). **Q** reacts sodium metal, with effervescenc. Write the **structural formulae** and **IUPAC** names of the isomers of **Q** . **(04 marks)**

(c). When treated with anhydrous zinc chloride in the presence of concentrated hydrochloric acid, **Q** formed a **two layers** within **5-10** minutes. Identify **Q.** **(01 marks)**

(d). **Q** reacted with acidified potassium dichromate(vii) to give a compound **B.** Write the equation for the reaction

(i) leading to the formation of **B.** **(01 marks)**

(ii) between **B** and acidified 2,4-Dinitropheynlhydrazine and outline a **mechanism** for the reaction. **(04½marks)**

(e). Write an equation to show how how **Q** can be prepared from an alkene, and outline a **mechanism** for the reaction. **(03½ marks)**

2. Explain each of the following observations .

a). Hydrochloric acid and nitric acid are not used to acidify potassium permanganate in redox reaction. **(05 marks)**

(b). Butan-1-ol boils at **120 ^{0}C**, whereas ethoxyethane boils at **35 ^{0}C** **(05 marks)**

(c) Aluminum fluoride is **ionic** whereas aluminum chloride is mainly **covalent** **(05 marks)**

(d). Hydrogen fluoride is a **liquid** whereas hydrogen chloride is a **gas** at room temperature. **(05 marks)**

3.(a)State **five** properties in which flourine differs from iodine **(5marks)**

(a) State each of the **conditions** and write **equations** for the reaction between sodium hydroxide and

(i) flourine. **(05 mark)**

(ii) iodine. **(05 mark)**

(c) Compare the oxidizing power of flourine and iodine using their reaction with water. **(05 marks)**

4. (a)**.** State the **Le´ Chatelier's Principle.** **(02 marks)**

(b) Identify the factors affecting the **position** of the equilibrium **(02 marks)**

(c) Describe the experiment to determine the **equilibrium constant,** Kc for the esterification reaction between ethanoic acid and ethanol **(07 marks)**

(d) The esterification of ethanol by ethanoic acid is a reversible reaction and **exothermic**.

(i) Write an equation for the reaction**.** **(01 mark)**

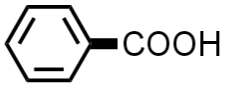
(ii). Write an expression for the **equilibrium constant,** Kc **(01 mark)**

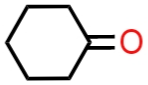
(iii) When **1.0** mole of ethanoic acid and **1.0** mole of ethanol were reacted in a **1.0 dm³** vessel**, 0.67** moles of ethylethanoate **and 0.67** moles of water were formed. Calculate the equilibrium constant at this temperature. **(02 marks)**

(iv) 1.5 moles of ethanoic acid were reacted with **2.0** moles of ethanol under similar conditions as in (d) (iii). Calculate the **mass** of the ethyl ethanoate formed. **(05 mark)**

5. Write **equations** to show how the following compounds can **synthesized**

(a) $CH_3C{\equiv}CH$ from ethene. (05marks)

(b)  from 1,2-dibromoethane (05½ marks)

(c)  from cyclohexene (04½ marks)

(d) CH_3-CCl_2-CH_3 from propene. (05 marks)

6a(i) Define the term **enthalpy of solution.** **(01 mark)**

(ii) State the energy terms that determine the magnitude and sign of enthalpy of solution of an ionic salt. **(02 marks)**

(iii) Describe an experiment that can be used to determine the enthalpy of solution of an ionic salt. **(**Diagram are **not** required) **(09 marks)**

Your answer should treatment of results and any assumptions in the experiment

(b) Some thermo-chemical data of copper, copper (II) chloride and chlorine are given below.

Enthalpy of formation of $CuCl_2$ **= -220 kJmol^{-1}**

Enthalpy of sublimation of Cu **=+338.3 kJmol^{-1}**

First ionization energy of Cu **=+745 kJmol**

Second ionization energy of Cu **= +1958 kJmol^{-1}**

First electron affinity of chlorine **= +364.0 kJmol^{-1}**

Bond dissociation energy of chlorine **= +121.1 kJmol^{-1}**

(i). Draw an **energy level diagram** which can be used to **determine** the **lattice energy** of copper(II) Chloride. **(04 marks)**

(ii) The hydration energy of copper(II) Chloride is **- 2883.9 kJmol^{-1} .** Determine the **enthalpy of solution** of copper(II) chloride. **(03 marks)**

(iii) Comment on the **solubility** of copper(II) chloride. **(01 mark)**