P525/ 2
CHEMISTRY
Paper 2
July/Aug 2023
2½hours

SHURE MOCK EXAMINATIONS 2023

Uganda Advanced Certificate of Education

CHEMISTRY

PAPER 2

2 hours 30 minutes

INSTRUCTIONS TO THE CANDIDATES:

*Answer **five** questions including **three** questions in section A and any **two** questions in section **B**.*

Write the answers in the answer booklet provided.

Mathematical tables and graph papers are provided.

Begin each question on a fresh page.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Indicate the questions in the grid below.

*Where necessary use **Ag = 108, Na = 23 , C = 12 , O = 16 , H =1***

Question						Total
Marks						

SECTION A

Answer three questions from this section.

1. (a) What is meant by the term **weak acid?** *(01mark)*

(b) State and explain how temperature affects the pH of weak acids. *(03marks)*

(c) (i) 35 cm^3 of 0.089M sodium benzoate solution were added to 45cm^3 of 0.1M benzoic acid .Calculate pH of the resultant solution. State any assumptions made in your calculations. (Ka for benzoic acid = 6.3×10^{-5} $moldm^{-3}$) *(05marks)*

(ii) State and explain what would happen to the pH of the resultant solution in c(i)when a small amount of dilute hydrochloric acid was added to it. *(03marks)*

(d) The table below shows the variation in pH when 30$cm^3$of 0.2M ammonia solution was titrated with hydrochloric acid

Volume of HCl (cm^3)	0	4	8	12	16	18	19	19.4	19.8
pH of the solution	10.8	9.9	9.4	9.1	8.7	8.3	8.0	7.8	7.3

Volume of HCl (cm^3)	20.2	20.6	21	22	26	28
pH of the solution	3.9	3.5	3.2	2.9	2.5	2.4

(i) Plot a graph of pH against volume of hydrochloric acid. *(3½marks)*

(ii) Determine the pH at the end point. *(0½mark)*

(iii) Determine the hydrolysis constant of ammonium chloride formed at the end point. *(04marks)*

2. (a) Write the names and formulae of the possible oxides of lead. *(03marks)*

(b) Describe how the oxides in (a) react with:

(i) Acids. *(09marks)*

(ii) Sodium hydroxide *(03marks)*

(c) One of the oxides in (a) is used to confirm manganese (II) ions in solution.

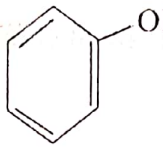
(i) Identify the oxide. *(01mark)*

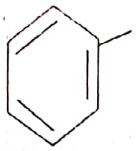
(ii) Describe briefly how the oxide in (i) can be used to confirm manganese (II) ions. Illustrate your answer with an equation. *(04marks)*

3. (a) Complete the Following equations and in each case outline a mechanism for the reaction.

(i) $CH_3CH = CH_2 \xrightarrow{Br_2/\ CCl_4}$ *(03marks)*

(ii)  $\xrightarrow[\text{heat}]{Cl_2\ /\ Al}$ *(04marks)*

(iii)  $\xrightarrow{CH_3CH_2Cl\ /\ NaOH(aq)}$ *(03marks)*

(iv)  $\xrightarrow{CH_3\overset{\overset{O}{\|}}{C}-Cl}$ *(04marks)*

(b) An organic compound **X** with a general molecular formula, $C_nH_{2n}O_2$ contains 40% by mass of carbon.

(i) Determine the molecular formula of **X** *(02marks)*

(ii) Write the structural formulae and IUPAC names of all the possible isomers of **X**. *(02marks)*

(iii) When X was treated with sodium carbonate solution, there was no observable change. Identify **X**. *(0½mark)*

(iv) Write an equation to show how **X** can be converted into an alcohol. *(1½marks)*

4. (a) What is meant by the following terms

(i) Standard enthalpy of formation? *(01marks)*

(ii) Standard enthalpy of combustion? *(01mark)*

(b) Describe an experiment that can be carried out to determine the enthalpy of combustion of hexane.(Diagram **not** required) *(05marks)*

(c) The standard enthalpies of combustion of the first five straight chain alkanes are shown in the table below.

Number of carbon atoms	1	2	3	4	5
Enthalpy of combustion of alkanes ($kJmol^{-1}$)	-890	-1560	-2220	-2877	-3509

(i) plot a graph of the enthalpy of combustion of alkanes against number of carbon atoms. *(03marks)*

(ii) Use the graph to determine the enthalpy of combustion of hydrogen and hexane. *(01mark)*

(iii) Explain the shape of the graph. *(03marks)*

(d) Calculate standard enthalpy of formation of hexane. Given that the standard enthalpy of combustion of carbon is $-393kJmol^{-1}$. *(03marks)*

(e) Draw an energy level diagram for the formation of lithium nitride from its elements.

(03marks)

SECTION B

Answer any two questions from this section

5. (a) What is meant by the term **solubility product?** *(01marks)*

(b) Describe an experiment that can be used to determine the solubility product of silver(I) ethanedioate. *(06marks)*

(c) The solubility product of silver(I) ethanedioate at 25°C is 2.32×10^{-4} mol^3dm^{-9}.

Calculate:

(i) the solubility in $moldm^{-3}$ of silver(I) ethanedioate in pure water. *(02marks))*

(ii) the solubility in $moldm^{-3}$ of silver(I) ethanedioate in 0.1M sodium ethanedioate solution. *(03marks)*

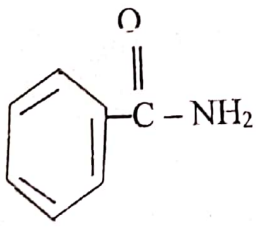
(d) $25cm^3$ of 0.05M sodium ethanedioate solution were mixed with $25cm^3$ of 0.05M silver nitrate solution. State whether there will be precipitation or not. Give a reason for your answer. *(03marks)*

(e) Explain how the solubility of silver(I) ethanedioate would be affected if to a saturated solution of silver(I) ethanedioate was added:

(i) silver nitrates solution. *(2½marks)*

(ii) aqueous ammonia solution. *(2½marks)*

6. Using equations only show how the following conversions can be effected.

(a)  from phenyl amine *(4½marks)*

(b) $CH_3CHBrCH_2Br$ from ethyne *(04marks)*

(c) $CH_3CH_2NH_2$ from propanoic acid *(3½marks)*

(d) CH_3OCH_3 from ethanol *(04marks)*

(e) 2-amino propane from propan- 1- ol *(04marks)*

7. Explain the following observations.

(a) Aluminium chloride dissolves in ethanol where as aluminium fluoride is insoluble in ethanol. *(04marks)*

(b) An aqueous solution of sodium sulphite turns red litmus paper blue where as an aqueous solution of sodium hydrogen sulphite turns blue litmus paper red. *(05marks)*

(c) When aqueous ammonia solution was added to nickel (II) sulphate solution a green precipitate was formed which dissolved to form a blue solution. *(05marks)*

(d) Iodine is insoluble in water but soluble potassium iodide solution. *(03marks)*

(e) Ice floats on water. (03marks)

8. (a) Describe briefly how concentrated sulphuric acid is manufactured from iron pyrites (FeS_2). *(06marks)*

(b) Discuss the reactions of sulphuric acid with:
(i) iron
(ii) carbon
(iii) phosphorus *(08marks)*

(c) Concentrated sulphuric acid is 98%w/w and has a density of $1.84gcm^{-3}$
Calculate
(i). the molarity of concentrated sulphuric acid. *(03marks)*
(ii) the volume of the concentrated acid required to prepare $500cm^3$ of 2.5M sulphuric acid. *(03marks)*

END