

Name:

Sign:

School:

Index No.

P525/1

CHEMISTRY

Paper 1

July/August 2024

2 $\frac{3}{4}$ hours



UGANDA TEACHERS' EXAMINATION SCHEME

Uganda Advanced Certificate of Education

JOINT MOCK EXAMINATIONS

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of two sections A and B. Attempt all questions in section A and six questions in section B

All answers must be written in the spaces provided.

*The Periodic Table with relative atomic masses is supplied at the end of the paper
Mathematical tables and silent non-programmable scientific electronic calculators may be used*

Illustrate your answers with equations where necessary

Molar gas constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

Molar gas volume at S.T.P = 22.4 dm^{-3}

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 MARKS)*Answer all questions in this section.*

- (a) (i) The decay ions is written as; $\frac{dN}{dt} = \lambda N$.

(1½ marks)

State what the following represent;

λ

N

$\frac{dN}{dt}$

- (ii) Using the above expression, derive the expression showing the relationship between decay constant and the half life.

(02 marks)

.....
.....
.....
.....
.....
.....

- (b) A radio Isotope has a half life of 10 minutes, calculate the percentage of the Isotope that remains after 40 minutes. *(2 marks)*

.....
.....
.....
.....
.....
.....
.....

2. (a) State three properties in which beryllium and aluminum are similar.

(1½ marks)

.....
.....
.....

(b) Write the equation(s) for the reaction(s) between the following

(i) Aluminum and Sodium hydroxide (1½ marks)

(ii) Aluminum carbide and water (1½ marks)

3. Complete the following equations, giving the IUPAC name of the main organic product in each case.

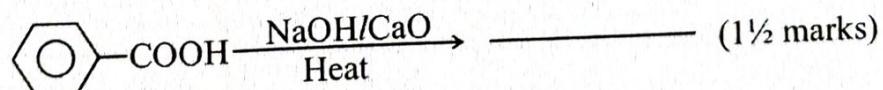
(i) $\text{CH}_3\text{CH}_2\text{CHICH}_3$ $\xrightarrow[\text{Heat}]{\text{ROH/alcohol}}$

Name of product

(ii) $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{OH} \rightleftharpoons \dots \quad (1\frac{1}{2} \text{ marks})$

Name of product

(iii)



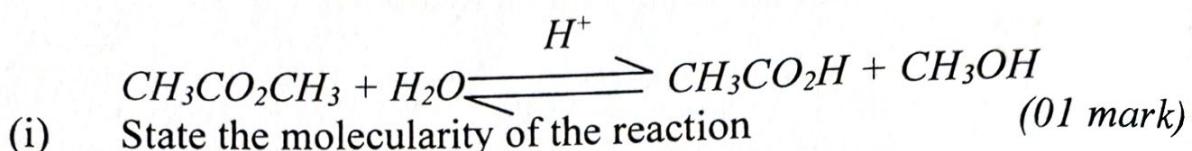
Name of product

Turn Over

4. (a) What is meant by the term "order of reaction". (02 marks)

.....
.....

- (b) Methyl ethanoate is hydrolysed by water in presence of an acid according to the following equations:



.....
.....

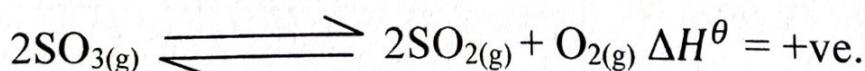
- (ii) Determine the order of the reaction (Assume that the acid takes part in the reaction). (01 mark)

.....
.....

- (iii) State the condition(s) under which the reaction can be overall first order. (01 marks)

.....
.....
.....

5. Sulphurtrioxide decomposes according to the following equation.



- (a) Write the expression for the equilibrium constant, Kc. (01 mark)

.....
.....

- (b) (i) 3.4 moles of sulphurtrioxide was decomposed at 60°C in a

50cm³ vessel. When equilibrium was established, the amount of sulphur dioxide formed was found to be 0.06 moles. Calculate the equilibrium constant, K_c for the reaction at 60°C.(04 marks)

- (ii) State what would happen to the K_c value if the reaction was carried out at 100°C . Give a reason for your answer. (02 marks)

.....
.....
.....
.....

6. (a) State what would be observed and write equation for the reaction(s) that would take place when the following pairs of compounds are reacted.

Turn Over

(i) Ethyne and silver nitrate in aqueous ammonia. (02 marks)

Observation

Equation

(ii) Ethanal and silver nitrate in aqueous ammonia (02 marks)

Observation

Equation

(b) Name a reagent that can be used to distinguish between cyclohexane and cyclohexene, state what would be observed when the compounds are separately treated with the reagent you have named. (02 marks)

Reagent

Observation

7. A weak acid, RCOOH has a concentration of 0.04 moldm^{-3} .

(a) Write an expression for the acid dissociation constant , K_a for RCOOH. (01 marks)

.....
.....

(b) Calculate its pH given that its $K_a = 1.8 \times 10^{-5} \text{ moldm}^{-3}$ and hence the value of the degree of ionisation. (04 marks)

.....
.....

3. The first ionization energies of the elements Lithium to Neon in KJmol^{-1} are given in the table below.

Li	Be	B	C	N	O	F	Ne
519	900	799	1090	1400	1310	1680	2080

- (a) Explain why the ionization energies show an overall tendency to increase across the period. *(03 marks)*

.....

.....

.....

.....

.....

.....

Turn Over

(b) Why is the ionization energy of boron lower than that of beryllium. (02 marks)

9. 0.01 mole of a hydrocarbon with molar mass 54 on complete combustion yielded 1.76g of carbondioxide. Determine its molecular formula and hence the structural formulae of two (2) straight chain Isomers of it. (03½marks)

SECTION B (54 MARKS)

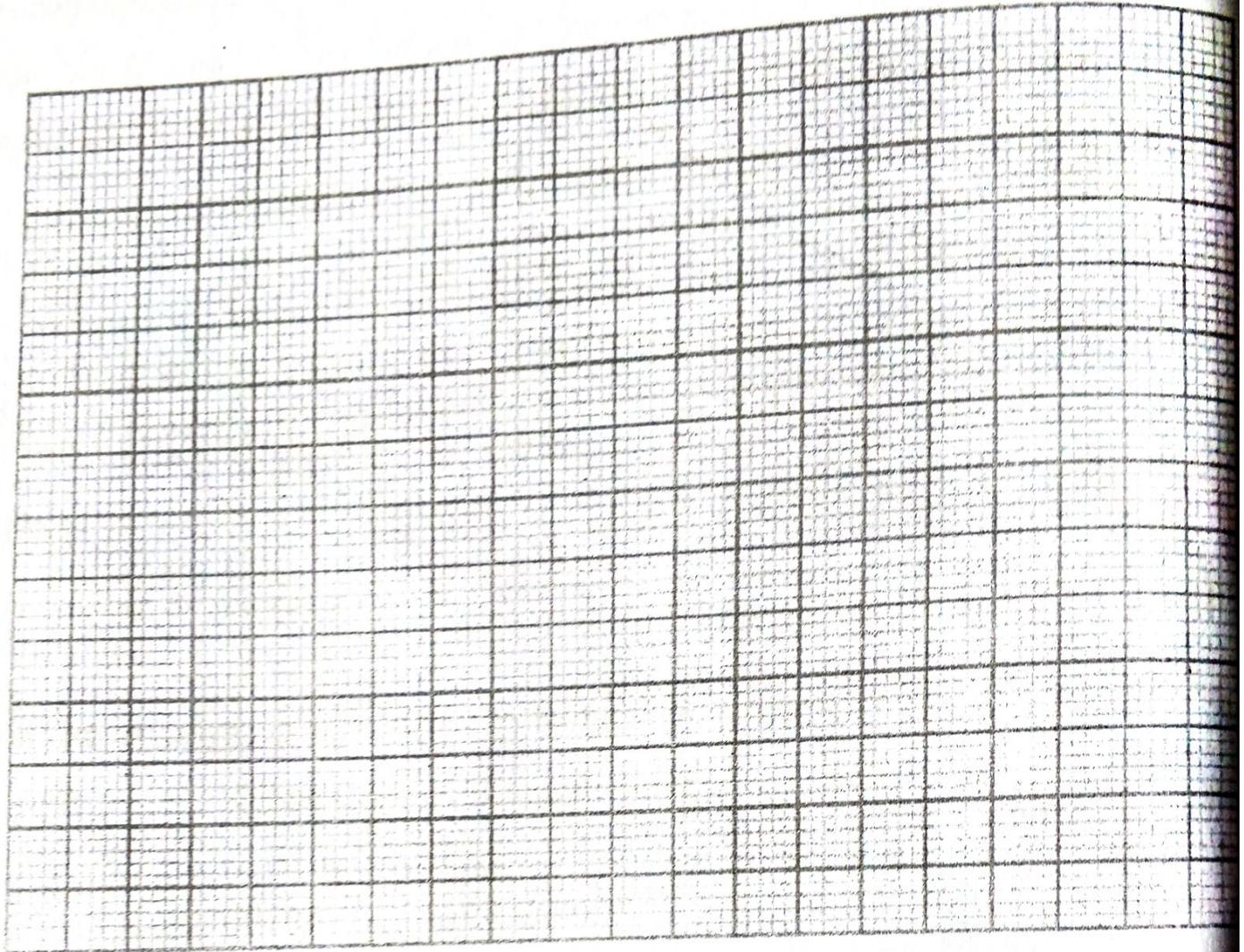
10. Q (molar mass 86) and R (molar mass 100) form an ideal solution that obeys Raoult's law. At 30°C , the saturated vapour pressures of pure Q and pure R are 30kNm^{-2} and 12kNm^{-2} respectively. The table below shows the variation of partial vapour pressures of Q and R with composition

Mole fraction of Q	0.0	0.2	0.4	0.6	0.8	1.0
Partial vapour pressure of Q/kNm ⁻²	0	6	12	18	24	30
Partial vapour pressure of R/kNm ⁻²	12	9.6	7.2	4.8	2.4	0
Total vapour pressure /kNm ⁻²	12	15.6	19.2	22.8	26.4	30

- (a) State Raoult's law *(01 mark)*

.....
.....

- (b) On the same axes, plot a graph of partial vapour pressures and total vapour pressures against composition for Q and R.



(c) Use the graph in (b) to determine;

- (i) The mole fraction of Q and R from a liquid mixture that produced the same partial vapour pressure (01 mark)

.....

.....

- (ii) The mass of Q and R from a liquid mixture whose total vapour pressure is 26 kNm^{-2} . (03 marks)

.....

.....

.....
.....
.....
.....
.....

11. Cobalt, copper, iron and manganese are d-block elements.

- (a) (i) What is meant by the term d-block element? *(01 mark)*

.....
.....
.....
.....
.....

- (ii) Write down the electronic configuration of Cu, Fe^{2+} and Mn^{2+} .
(03 marks)

.....
.....
.....
.....
.....

- (iii) Explain why Fe^{2+} ions are oxidized to Fe^{3+} but Mn^{2+} ions are not readily oxidized to Mn^{3+} . *(02 marks)*

.....
.....
.....
.....
.....

- (b) Cobalt forms a complex compound of the formula $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+\text{Cl}^-$.
- (i) What is the oxidation state of cobalt in this compound?

(01 mark)

.....
.....

Turn Over

- (ii) Give the name of the complex ion contained in this compound.
(01 mark)

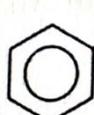
.....
.....

- (iii) How many moles of silver chloride would be immediately precipitated from one mole of this compound in aqueous solution by adding an excess of silver nitrates. (01 mark)

.....
.....
.....
.....

12. Write equations to show how the following compounds can be synthesised.

(a)

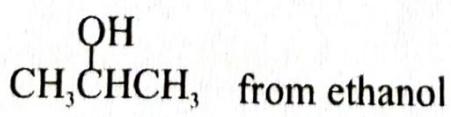


from benzene

(2½ marks)

.....
.....
.....
.....

(b)



(2½ marks)

.....
.....
.....
.....
.....

(c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}\equiv\text{CH}$ from ethene. *(04 marks)*

.....
.....
.....
.....
.....

3. Explain each of the following observations

(a) Lead (IV) oxide decomposes when heated to give lead (II) oxide and oxygen but carbon dioxide does not. *(02 marks)*

.....
.....
.....
.....
.....
.....
.....
.....
.....

(b) Butan-2-ol and ethoxyethane have the same molecular mass. Butan-2-ol boils at 124°C while ethoxyethane boils at 35°C . *(04 marks)*

.....
.....
.....
.....
.....
.....
.....
.....

Turn Over

- (c) The pH of aqueous ammonium chloride is less than 7 while that of aqueous sodium chloride is 7. *(03 marks)*

14. (a) Explain what is meant by

- (i) Polymerisation.

(01 mark)

- (ii) Copolymer

(01 mark)

-

- (b) The structural formulae of some monomers are shown in the table below. Complete the table by writing in the spaces provided; the structural formula of the polymers formed; type of polymerization and one use of each polymer. (04 marks)

Structural formula of monomer(s)	Structural formula of polymer	Type of polymerization	Use of polymer
$\text{CH}_2=\underset{\text{CH}_3}{\text{C}}-\text{COOCH}_3$			
(ii) $\text{CH}_2=\text{CH}-\text{CN}$			

- (d) A sample of polystyrene (polyphenylethene) is found to consist of molecules with an average molecular mass of 12480.
- (i) Write down the repeating unit with in polystyrene. (01 mark)
-

- (ii) How many polystyrene monomers are present in each polymeric unit? (02 marks)
-

-
.....
.....
.....
.....
.....
.....
.....
15. (a) Define the term electrolytic conductivity. (01 mark)

-
.....
.....
.....
(b) The table below gives the molar conductivity at 298K of an aqueous solution of ethanoic acid.

Concentration (mol dm^{-3})	0	0.001	0.01	0.1
Molar conductivity ($\Omega^{-1}\text{cm}^2\text{mol}^{-1}$)	390	50	16	5

Calculate;

- (i) The degree of ionization, α of 0.01M ethanoic acid. (01 mark)

.....
.....

- (ii) The pH when the solution is b (i) is diluted 10 times.

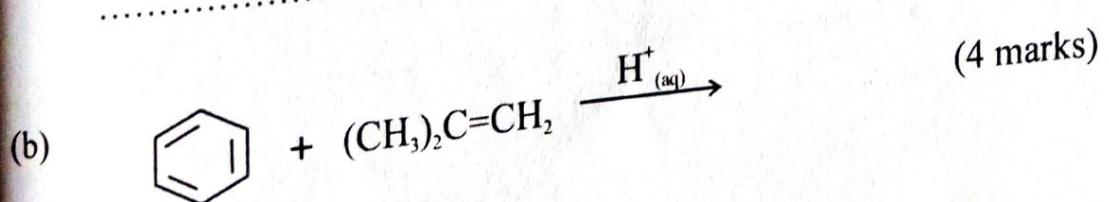
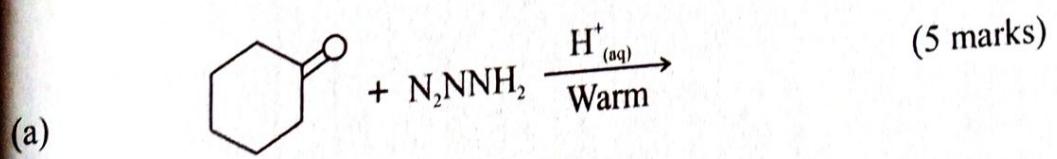
(03 marks)

.....
.....
.....
.....
.....
.....
.....
.....

- (c) Sketch a graph to show how the molar conductivity varies with concentration for methanoid acid. Explain the shape of the graph.

(04 marks)

Complete the following equations and write a mechanism for the reaction in each case.



17. (a) Write the formula for the anhydrous chloride of sodium, magnesium, aluminum and silicon. (02 marks)

.....
.....
.....
.....

(b) (i) Write equations for the reaction of chlorides in (a) above with water. (04 marks)

.....
.....
.....
.....

(ii) In terms of bonding, interpret the reaction of the chlorides in b (i) with water. (02 marks)

.....
.....
.....
.....

(c) Aluminum hydroxide is amphoterid. Using an equation(s) show the meaning of this statement. (01 mark)

THE PERIODIC TABLE

1	2													3	4	5	6	7	8
1 H 1.0														1 H 1.0	2 He 4.0				
3 Li 6.9	4 Be 9.0													5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3													13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zu 65.7	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8		
37 Rb 35.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131		
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra (226)	89 Ac (227)																	
			57 Lu 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175		
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cr 251	99 Es (254)	100 Fm (257)	101 Md (256)	102 No (254)	103 Lw		

1. **H**  Indicates atomic number.

2. **H**  Indicates relative atomic mass.