Name:……………………………………………….………Signature:………………….

THE CHEMISTRY DEPARTMENT

END OF TERM ONE EXAMS - 2024

CHEMISTRY

Paper 1
2 hours 45 minutes

INSTRUCTIONS:

*Answer **all** questions in this 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 attached at the end of the paper.

Mathematical tables (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used.

Illustrate your answers, with equations where applicable.

Where necessary, use the following;

  Molar gas constant, R=8.31 $JK^{-1}mol^{-1}$.
  Molar volume of a gas at s.t.p is 22.4 litres.
  Standard temperature = 273K.
  Standard pressure = 101325Nm^{-2}

For Teachers' Use Only																	
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*

1. (a) Define the term **standard enthalpy of formation.**   *(01 mark)*

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(b)(i) The standard enthalpies of combustion of zinc suphide, zinc and sulphur are -441, -348 and -297 kJmol^{-1} respectively. Calculate the standard enthalpy of formation of zinc sulphide.   *(04 ½ marks)*

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2. State what is observed and write equation for the reaction that takes place when:

(a)   Propyne is bubbled through a solution of ammoniacal silver nitrate.   *(02 marks)*

Observation;

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Equation;

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(b)   Brady's reagent is added to propanone.   *(02 marks)*

Observation;

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Equation;

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3. When 0.209g of beryllium chloride was vapurised at 521°C and a pressure of $4.60 \times 10^4\ Pa$, it occupied a volume of 200cm³.

(a)   (i) Determine the molecular mass and hence the molecular formula of beryllium chloride.

(2 ½ marks)

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(ii)   Draw the structural formula of beryllium chloride under the conditions above. *(01 mark)*

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(b)   Water was added to beryllium chloride at room temperature.

(i)   State what was observed. *(01 mark)*

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(ii)   Write the equation for the reaction that took place.

(1 ½ marks)

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4. Draw the structure and name the shape of the following species.

(4 ½ marks)

Species	Structure	Shape
$SnCl_2$		
HCO_3^-		
H_3O^+		

5. The chemical properties of beryllium differ from those of other group II elements but resemble those of Aluminium.
   (a) State the term used to describe the similarities in chemical properties between beryllium and aluminium.   (½ mark)

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   (b) State **three** reasons why the properties of beryllium;
      (i)   differ from those of other group II elements.   (1 ½ marks)

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(ii)   resemble those of aluminium.   *(1 ½ marks)*

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(c) State what will be observed and write equation for the reaction that takes place when a piece of beryllium metal is dropped into concentrated sodium hydroxide solution.

(i)   **Observation**   *(01 mark)*

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(ii)   **Equation for the reaction**   *(1 ½ marks)*

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6. (a) 0.72g of a compound **M** was dissolved in 80.0g of water and the resulting solution had a freezing point of -0.14°C. When 2.9g of the same compound was dissolved in 111g of benzene, the freezing point was depressed by 0.6°C . Calculate the apparent molecular mass of **M** in;

(i)   Water $(K_f \; for \; water = 1.90°Cmol^{-1}kg^{-1})$ *(2 ½ marks)*

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(ii)   benzene. (K_f for benzene = 5.5 $°Cmol^{-1}kg^{-1}$)   (2 $\frac{1}{2}$ marks)

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(b)   Explain why the molecular mass of **M** differs in the two solvents.
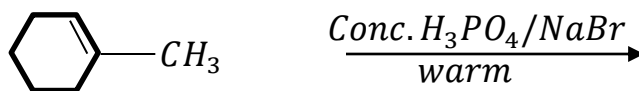
(1 $\frac{1}{2}$ marks)

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7. (a) Complete the following organic reaction and outline the mechanism.

$$\bigcirc\!\!-CH_3 \quad \xrightarrow[warm]{Conc.\,H_3PO_4/NaBr}$$

Mechanism   (03 marks)

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(b)   Name the type of reaction mechanism that took place in (a).

....($\frac{1}{2}$ mark)

8. Name the reagent which can be used to distinguish between the
   following pairs of compounds. In each case state what you would
   observe when the reagent is treated with each member of the pair.

   (a) CH_3CH_2OH and CH_3OH (03 marks)

   Reagent;

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   Observation;

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   (b) $HCOOH$ and CH_3COOH (03 marks)

   Reagent;

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   Observation;

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9. (a) Define the term **complex ion**.   (01 mark)

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(b)   Complete the following table about complexes of chromium and cobalt.   *(02 marks)*

Complex	Oxidation state of metal ion	Coordination number
$[Co(NH_3)_4(H_2O)_2Cl_2]$		
$[Cr(NH_3)_6]^{3+}$		

(c)   Name each of the complexes in (b) above.   *(01 mark)*

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SECTION B: (54 MARKS)
*Answer any **six** questions from this section.*

10.(a) State **three** reasons why fluorine differs in its properties from other elements in group VII.   *(03 marks)*

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(b)   Write equation for the reaction between fluorine and;
    (i)   Water   *(1 ½ marks)*

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    (ii)   Cold dilute sodium hydroxide   *(1 ½ marks)*

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    (iii)   Hot concentrated sodium hydroxide   *(1 ½ marks)*

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(c)   Write an equation for the reaction between hydrofluoric acid and silicon dioxide.   *(1 ½ marks)*

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11. (a) A compound , **P,** containing 12.8% carbon, 2.1% hydrogen, the rest being bromine is hydrolysed by aqueous potassium hydroxide to compound, **Q**, **Q** is oxidised in several stages by nitric acid, the final product being acid, **R** of relative formula mass 90. On warming, **R** decolourises an acidified solution of potassium manganate(VII) .

(a)   Calculate the empirical formula of **P**.   *(04 marks)*

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(b)   Identify compounds **Q** and **R**.   *(02 marks)*

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(c)   Write the equation for the reaction of **R** with acidified potassium manganate(VII).   *(01 mark)*

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(d)   Write the structural formula and name of the compound isomeric with compound **P**.   *(02 marks)*

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12. Name **one** reagent that can be used to distinguish between each of the following pairs of compounds. In each case, state the observations made.

(a) I^- and Br^- *(03 marks)*

Reagent

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Observation

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(b) HCO_3^- and CO_3^{2-} *(03 marks)*

Reagent

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Observation

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(a) Al^{3+} and Sn^{2+} *(03 marks)*

Reagent

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Observation

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13. Write equations to show how the following synthesises can be carried out. In each case indicate the necessary reagents and conditions.

(a) Benzene to 2-phenylpropene.   *(03 marks)*

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(b) methylbenzene to phenylethanone.   *(2 ½ marks)*

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(c) Chloroethane to $CH_3CH_2CONH_2$.   *(3 ½ marks)*

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14.(a) Compare the thermal stabilities of silicon(IV) chloride and tin(IV) chloride. **(Include equations of reactions if any)** *(02 marks)*

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(b) State the condition(s) of reaction between tin and chlorine and write equation for the reaction that takes place. *(2 ½ marks)*

Condition(s)

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Equation

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(c) Silicon(IV) chloride was dissolved in water.

(i) State what was observed. *(01 mark)*

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(ii) Write equation for the reaction that took place. *(1 ½ marks)*

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(d) When 0.325g of silicon(IV) chloride was dissolved in water, the resultant solution required 48cm^3 of 0.1M sodium hydroxide for complete neutralization. Calculate the percentage purity of silicon(IV) oxide. *(02 marks)*

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15.1.0 mole of phosphorus(V) chloride was strongly heated in a one litre closed glass bulb until equilibrium was obtained. The glass bulb was then rapidly broken under potassium iodide solution. The bulb was found to contain 40.70% of chlorine.

(a) Write equations for the reactions that took place when:

   (i)   the glass bulb was strongly heated.   *(01 mark)*

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   (ii)   the glass bulb was broken under potassium iodide solution.

                                              (01 mark)

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(b) State the reasons why the bulb;

   (i)   was rapidly broken   *(01 mark)*

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   (ii)   was broken under potassium iodide solution.   *(02 marks)*

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(c) Determine the;

(i)   degree of dissociation of phosphorus(V) chloride.   *(02 marks)*

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(ii)   equilibrium constant, K_c , for the reaction.   *(02 marks)*

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16.(a) Classify each of the reaction below by type.   *(05 marks)*

(i) $CH_3CHO + NaHSO_3 \longrightarrow CH_3\underset{\underset{OH}{|}}{C}HSO_3Na$

Type of reaction;..

(ii) $C_6H_5CH = CH_2 + HBr \longrightarrow C_6H_5\underset{\underset{Br}{|}}{C}HCH_3$

Type of reaction;..

(iii) $C_6H_5CH_2CH_2I + \bar{O}H(aq) \longrightarrow C_6H_5CH_2CH_2OH$

Type of reaction;..

(iv) $CH_4 + Cl_2 \longrightarrow CH_3Cl$
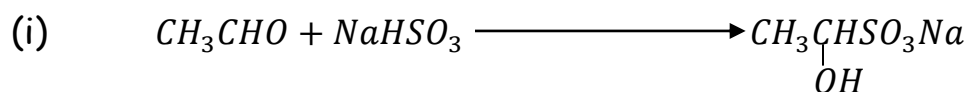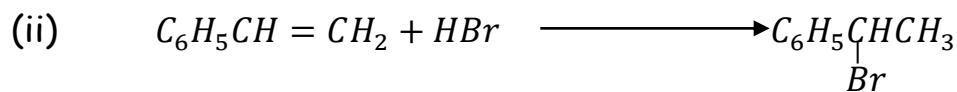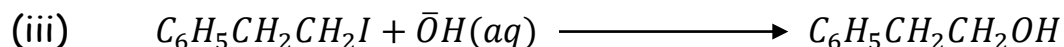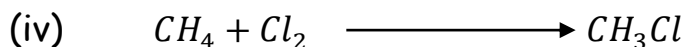
Type of reaction;...

(v)   Nitration of benzene to form nitrobenzene

Type of reaction;...

(b)   (i) Outline a mechanism for the reaction in (a)(i) above.

(03 marks)

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(c)   Give a reason why the reaction in b(iv) is not the best practical method for preparation of chloromethane. *(01 mark)*

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17. The kinetics data for the reaction between **Q** and sodium hydroxide is shown in the table below.

Concentration of Q($moll^{-1}$)	1.05	0.88	0.74	0.51	0.37	0.26	0.16	0.10
Time(minutes)	0.0	3.5	7.0	14.5	20.0	27.0	35.5	45.0

(a)   Plot a graph of concentration of **Q** against time. *(03 marks)*

(b)Use your graph to determine the;

    (i)   half life of **Q**   *(03 marks)*

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    (ii)   the order of reaction   *(01 mark)*

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    (iii)   the rate constant for the reaction   *(02 marks)*

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

END.