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Signature:.....Combination.....

P525/1
CHEMISTRY
Paper 1
2 $\frac{3}{4}$ hours



**Uganda Advanced Certificate of Education
S.5 END OF TERM III CHEMISTRY-2024
Paper 1**

2 hours 45 minutes

INSTRUCTIONS:

Answer **all** questions in section **A** and **six** questions in section **B**

All questions must be answered in the spaces provided

The Periodic Table, with relative atomic masses, is supplied.

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 $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$

Molar volume of a gas at s.t.p is 22.4 litres.

Standard temperature = 273 K

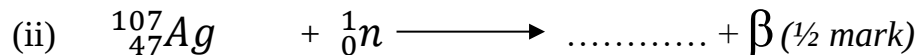
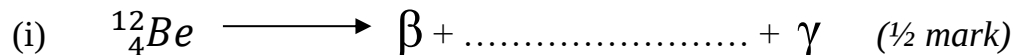
Standard pressure = 101325 N m^{-2}

For Examiner's 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 from this section.

1. (a) Complete the following equations.



- (b) If nobelium ${}^{259}_{102}\text{No}$ has a half-life of 58 minutes. How long will it take for nobelium to decay to ¼ of its original weight? (2½ marks)

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2. (a) Write an expression for the acid dissociation constant, K_a , of ethanoic acid in water. (01 mark)

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- (b) Explain the trend in the K_a values in the following series of acids in water. (3 marks)

Acid	CH_3COOH	ClCH_2COOH	Cl_2CHCOOH	Cl_3CCOOH
K_a at 25°C	1.7×10^{-5}	1.4×10^{-3}	5.1×10^{-3}	2.2×10^{-1}

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3. Show by use of an equation the reaction involving aqueous sodium hydroxide with

(a) Beryllium oxide

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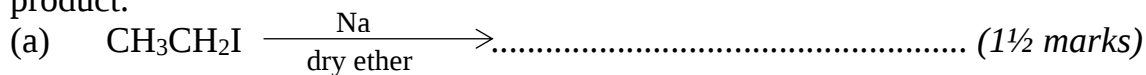
(b) Lead(II) oxide

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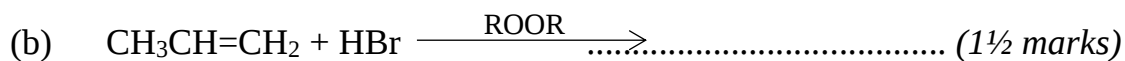
(c) Aluminium oxide

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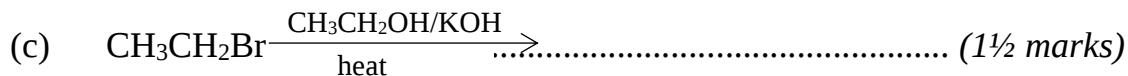
4. Complete the following equations and in each case name the main organic product.



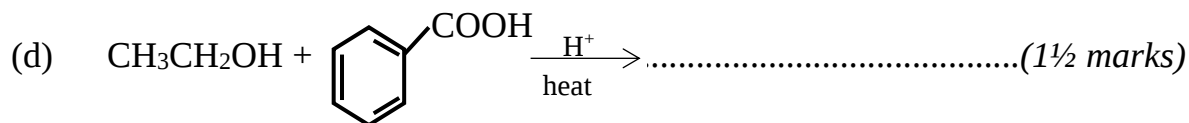
Name of product.....



Name of product.....



Name of product.....



Name of product.....

5. (a) Define the term **hydration energy**. (02 marks)

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(b) State **two** factors which affect the magnitude of hydration energy. (01 mark)

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(c) The table below shows enthalpies of hydration of Ca^{2+} and Cl^- ions.

Ion	Enthalpy of hydration (kJ mol^{-1})
Ca^{2+}	1577
Cl^-	381

(i) State whether the values of enthalpies of hydration given in the table above are positive or negative. Give a reason for your answer. (1 ½ mark)

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(ii) Calculate the enthalpy of hydration of calcium chloride

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6. Using equations show how the following organic compounds can be synthesised.

- (a) Propanoic acid from Ethene
(2½ marks)

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- (b) Hex-2-yne from Quicklime (3 marks)

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7. Name a reagent that can be used to distinguish between each of the following pairs of ions. In each case, state what would be observed if each member of the pair was treated with the reagent you have named.

- (a) $\text{H}_2\text{C}_2\text{O}_4$ and HCOOH (3marks)

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- (b) Sn^{2+} and Sn^{4+} (3marks)

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8. a) An alkyne X has molecular formula C_4H_6 . Write the names and structural formulae of all possible isomers of X. (2marks)

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- (b) **X** reacts with an ammoniacal solution of silver nitrate.
- i) State what is observed. (½ mark)
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- ii) Write the equation for the reaction that takes place. (1 mark)
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- c) Write equations to show how **X** can be synthesized from ethane. (4 marks)
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9. Draw the structures and name the shapes of the following species. (4½ marks)

species	structure	Name
(a) NO ₂ ⁻		
(b) POCl ₃		
(c) NO ₃ ⁻		

SECTION B: (54 MARKS)

Answer **six** questions from this section.

Additional questions answered will **not** be marked.

10. (a) (i) What is a **complex ion**? (1 mark)

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(ii) Name **two** factors that affect complex ion formation. (1 mark)

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(b) Name the following complexes and in each case state the oxidation state of the central metal ion. (4½ marks)

Complex	Name of complex	Oxidation state
$[\text{Zn}(\text{OH})_4]^{2-}$		
$[\text{Fe}(\text{CN})_6]^{4-}$		
$[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$		

(c) A fresh solution of sodium carbonate was added to a solution of iron(III) chloride. Explain what was observed. (2½ marks)

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

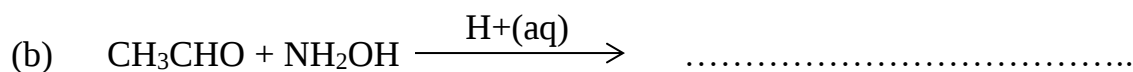
(a) $\text{CH}_3\text{CH}_2\text{I} + \text{KOH (aq)} \longrightarrow$

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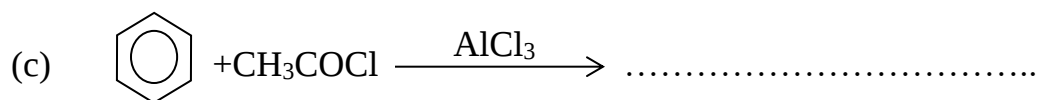
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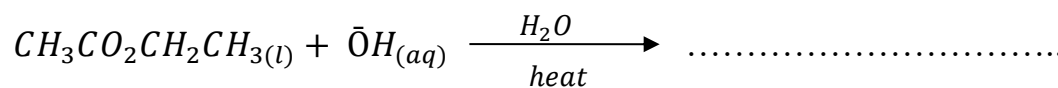
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12. (a) Complete the following equation and write the accepted mechanism for the reaction. (03 marks)



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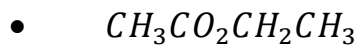
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- (b) The results obtained for the kinetics of the reaction in (a) above are shown in the table below.

Exp't	$[CH_3CO_2CH_2CH_3] / \text{mol dm}^{-3}$	$[\bar{O}H] / \text{mol dm}^{-3}$	Initial rate ($\text{mol dm}^{-3}\text{s}^{-1}$)
1	7.6×10^{-2}	7.6×10^{-2}	1.13×10^{-3}
2	3.8×10^{-2}	1.52×10^{-1}	1.13×10^{-3}
3	1.9×10^{-2}	1.52×10^{-1}	5.65×10^{-4}

(i) Deduce the order of reaction with respect to



(1 mark)

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(2 mark)

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(ii) Write the rate equation for the reaction.

(1 mark)

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(d) Calculate the rate constant, **K**, for the reaction and state its units.

(2 marks)

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14. During the extraction of zinc, the zinc ore is roasted and the oxide obtained is reduced.

(a) Write

(i) the name of one ore used in the extraction of zinc. ($\frac{1}{2}$ mark)

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(ii) the reducing agent used ($\frac{1}{2}$ mark)

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(iii) the equation for the reaction between zinc oxide and the reducing agent named in (a)(ii) above. ($1\frac{1}{2}$ mark)

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(b) State

(i) how the impure zinc obtained in (a) is purified. ($2\frac{1}{2}$ mark)

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(ii) one method by which zinc can be obtained. (1 mark)

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(c) Write equation for the reaction between zinc and

(i) hot concentrated sulphuric acid ($1\frac{1}{2}$ mark)

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(ii) water ($1\frac{1}{2}$ mark)

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15. (a) What is a **catalyst**? (01 mark)

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(b) Differentiate between a **positive catalyst** and a **negative catalyst**. (02 marks)

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(c) State four general properties of a positive catalyst. (02 marks)

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(d) Give **one** example of a catalyst used in industry and in nature. Name the processes involved. (02 marks)

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(e) State the difference between a **homogeneous** and **heterogeneous** catalyst. (02 marks)

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16. (a) (i) Explain what is meant by the term **osmotic pressure**. (01 mark)

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(ii) State **two** factors that can affect osmotic pressure of solutions.
(01 mark)

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(iii) Under what conditions are osmotic pressure laws valid?
(1½ marks)

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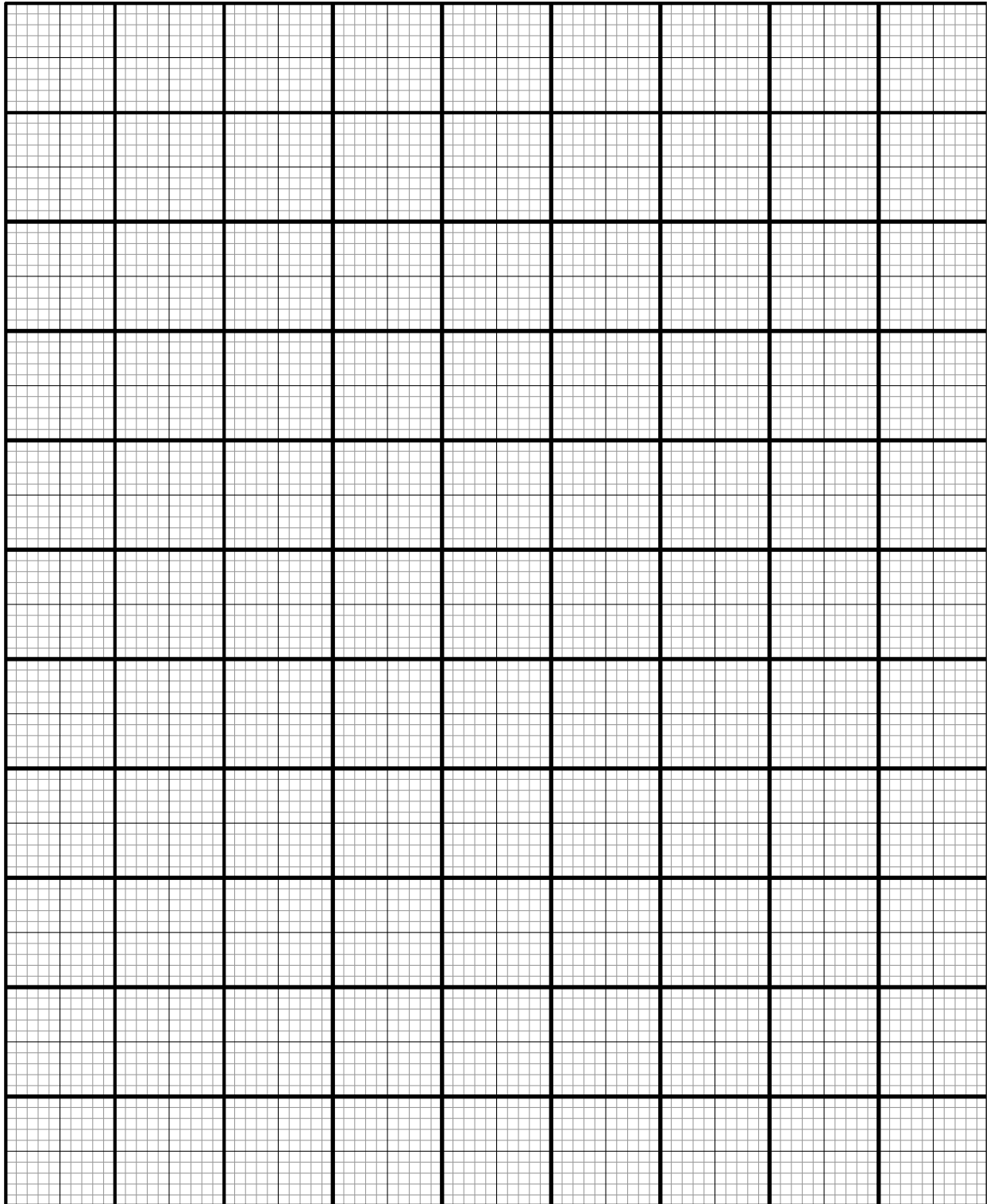
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(b) The osmotic pressure of solutions of different concentrations measured at 298 K for a polymer are given in the table below.

Osmotic pressure/ Pa	Concentration /g dm ⁻³
118	2.0
480	6.0
1000	10.0
1680	14.0

(i) Plot a graph of osmotic pressure against concentration. (03 marks)



17. State what would be observed and write equation(s) for the reaction(s) that would take place when

(a) Dilute sulphuric acid was added to a solution of potassium chromate(VI).
(2½ marks)

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(b) Iron(II) sulphate solution was added to acidified potassium
manganate(VII) solution (2½ marks)

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(c) Aqueous sodium hydroxide was added drop wise until in excess to
a solution of manganese(II) chloride. (4 marks)

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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 Zn 65.	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 85.5	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 103	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 Ti 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 La 139	58 Ce 140	59 Fr 141	60 Nd 144	61 Pm (145)	62 Sm 150	63 Eu 152	64 Gd 157	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 Cf 251	99 Ea (254)	100 Fm (257)	101 Mv (256)	102 No (254)	103 Lw 260

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1. H – indicates Atomic number

2. H – indicates relative Atomic mass

1.0

END