SECTION A [40 MARKS]

ANSWER **ALL** QUESTION

Question 1 **[15]**

a) **For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there is more than one choice circled, NO score will be awarded.**

i. The concentration unit Normality is measured in

A $molL^{-1}$.
B $geq.L^{-1}$.
C $molKg^{-1}$.
D gL^{-1}.

ii. A drop of tear with pH 7.4 contains hydrogen ion concentration of

A 2.5×10^{7}mol/L.
B 8.6×10^{-1} mol/L.
C 3.9×10^{8} mol/L.
D 3.9×10^{-8} mol/L.

iii. If the standard reduction potentials of silver, iron, zinc and lead are +0.80V, -0.44V, -0.76V, and -0.13V respectively, then solution of copper sulphate can be stored only in a container made of

A silver.
B iron.
C zinc.
D lead.

iv. For the elementary reaction: $2A+B\longrightarrow C+D$, the unit of rate constant is

A mol T^{-1}.
B mol $L^{-1}T^{-1}$.
C $mol^{-1}LT^{-1}$.
D $mol^{-1}L^{2}T^{-1}$.

v. Gamma rays have high penetrating power because they possess high

A mass.
B charge.
C velocity.
D ionising power.

vi. The IUPAC name of the complex $[Co(NH_3)_4(H_2O)(Br)](NO_3)_2$ is

A Tetraammineaquabromodinitrocobalt (III).
B Tetraammineaquabromocobalt (III) nitrate.
C Tetraammineaquabromonitrocobaltate (III).
D Tetraammineaquabromidocobalt (III) nitrate.

vii. Which is the Cannizzaro reaction for formaldehyde?

A $2HCHO + NaOH \xrightarrow[dil]{} CH_3OH + HCOONa$

B $2HCHO + NaOH \xrightarrow[conc]{} CH_3OH + HCOONa$

C $2HCHO + NaOH \xrightarrow[dil]{\Delta} CH_3OH + HCOONa$

D $2HCHO + NaOH \xrightarrow[conc]{\Delta} CH_3OH + HCOONa$

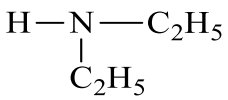
viii. Ester is one of the derivatives of carboxylic acid. The part of functional group that facilitates the formation of ester is

A –COOH group.
B –H atom of –COOH.
C –CO- group of COOH.
D –OH group of –COOH.

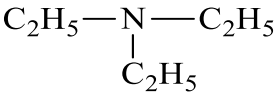
ix. Which **ONE** of the following is the correct order of reactivity of carboxylic acid derivatives?

A Acetamide < Ethyl acetate < Acetyl chloride
B Ethyl acetate < Acetamide < Acetyl chloride
C Acetyl chloride<Acetamide < Ethyl acetate
D Ethyl acetate< Acetyl chloride < Acetamide

x. The given structures (I) and (II) are the derivatives of ammonia. The basic nature of structure (I) is due to



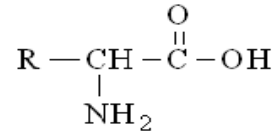
(I)

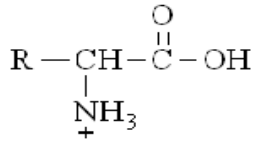


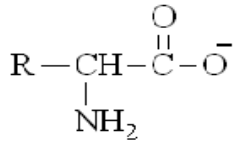
(II)

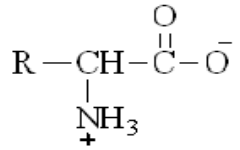
A higher + I effect.
B higher steric hindrance.
C more higher hydration of conjugate acid.
D more number of lone pair of elections.

xi. The structure of amino acid in neutral solution is

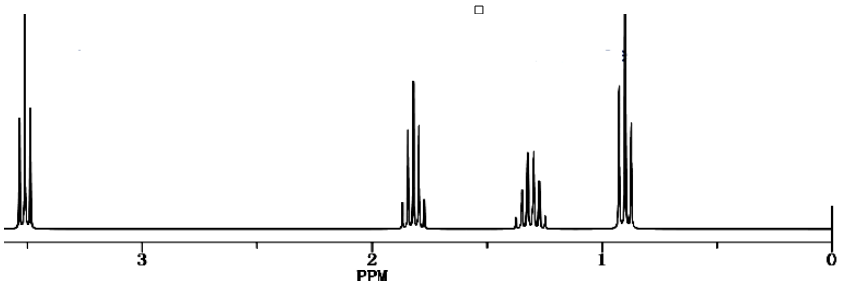
A 

B 

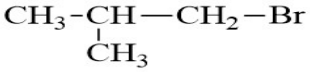
C 

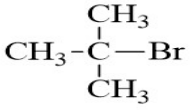
D 

xii. The structural formula of a compound deduced from the interpretation of given HNMR specturm is



A 

B 

C 

D 

xiii. Which of the following statement is **TRUE** for sodium chloride solution at sea level?

A The solution boils at 95^0C.
B The solution boils at 100^0C.
C The solution freezes at 0^0C.
D The solution freezes at -5^0C.

xiv. For the given acid-base neutralization reaction, which of the following pairs represent the correct conjugate acid-base pairs?

$$H_2O + NH_3 \longrightarrow NH_4^+ + OH^-$$

A $H_2O - NH_3$ and $NH_4^+ - OH^-$

B $H_2O - NH_4^+$ and $NH_3 - OH^-$

C $H_2O - OH^-$ and $NH_3 - NH_4^+$

D $H_2O - NH_3$ and $NH_3 - NH_4^+$

xv. IR spectrum shows an absorption peak between 3650 cm^{-1} and 3200 cm^{-1}. Which substance is present in the sample?

A CH_3-CH_2-OH

B CH_3-CH_2-CH_3

C CH_3-CO-CH_3

D CH_3-CH_2-CH_2-Cl

b) Fill in the blanks with appropriate word/words. **[5]**

i. The cathode used in Daniel cell is _____.

ii. The rate of reaction _____with the increase in the value of rate constant(K).

iii. When an alpha particle is emitted from a radioactive element, it is displaced _____places to the left in the periodic table.

iv. Reduction of ketones with $NaBH_4$ produces_____alcohol.

v. Formic acid is prepared by the _____of methyl alcohol.

vi. For a second order reaction, a plot of rate of reaction versus _____is a straight line.

vii. The radioisotope used in the treatment of blood disorder is_____.

viii. Aldehydes with low molecular mass are soluble in water due to _____.

ix. Acetic acid reacts with ethanol in the presence of concentrated _____to form ethylacetate.

x. Nernst equation is used to calculate emf of a galvanic cell under_____ condition.

c) Match each item of Column A with the most appropriate item of Column B. Rewrite the correct pairs by writing the alphabet against the number in the spaces provided. **[5]**

Column A	Column B
i. Relative lowering of vapour pressure	a. molecular ion
ii. Elevation of boiling point	b. reference peak
iii. Lowers dissociation of weak electrolytes	c. Saponification
iv. Increase dissociation of weak electrolytes	d. base peak
v. Basic hydrolysis of ester	e. Raoult's law
vi. Conversion of primary amide to primary amine	f. $–NH_2$
vii. Amphoteric nature of amino acids	g. Beckmann's method
viii. Acidic group of amino acid	h. common ion effect
ix. Extreme right peak in mass spectrum	i. Hoffmann degradation
x. Extreme right peak in NMR spectrum	j. zwitter ion
	k. –COOH
	l. Dilution

Column A	Column B
i.	
ii.	
iii.	
iv.	
v.	
vi.	
vii.	
viii.	
ix.	
x.	

d) Correct the following statements by changing the words given in BOLD. Write the answers only. DO NOT copy the whole sentence. **[5]**

i. In a **neutral** solution, the concentation of H^+ ions is less than $10^{-7}molL^{-1}$.

ii. The electrode in standard hydrogen electrode is made of **gold**.

iii. Oxidation number of iron in $[Fe(CN)6]^{-3}$ ion is **-3**.

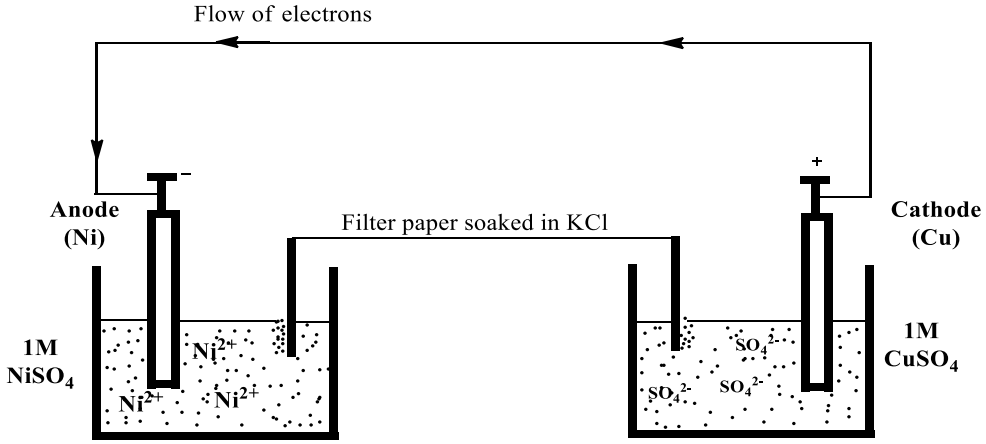
iv. The IUPAC name of acetamide is **methanamide**.

v. The packing materials used in HPLC column act as **solvent delivery system**.

e) Answer the following questions.

i. 0.05 mole of glucose is dissolved in 500 g of water.What is the molality of the solution? **[1]**

ii. Study the diagram of a galvanic cell carefully and spot the mistake. **[1]**



iii. What is the essential feature required in a molecule or an ion for it to be the ligand of coordination compound? **[1]**

iv. Write **ONE** difference between aldehydes and ketones. **[1]**

Aldehydes	**Ketones**	

v. Compound **A** has a molecular formula C_7H_6O and on oxidation with alkaline $KMnO_4$ gives Compound **B.** Compound **B** is a white crystalline solid, sparingly soluble in cold water and readily soluble in hot water, benzene and ether. Identify the compounds **A** and **B**. **[1]**

vi. Complete the following reaction: $CH_3COCl + H_2O \longrightarrow$ ..... + ... **[1]**

vii. Explain why the boiling point of primary amine is higher than tertiary amine. **[1]**

viii. In a mass spectrum of alkane, what fragment of ion is represented by the peak at m/e value 43? **[1]**

ix. Do you agree that the order of a reaction can be determined from the stoichiometric coefficients of reactants in a balanced chemical equation? Support your answer with **ONE** reason. **[2]**

SECTION B [60 MARKS]

ATTEMPT **ANY SIX** QUESTIONS

Question 2

a) Define the following terms:

i. Osmotic pressure **[1]**

ii. Mole fraction **[1]**

b) Why do amino acids migrate towards cathode and anode in acidic and basic solutions respectively? **[2]**

c) Complete the following nuclear reactions:

i. $_{7}N^{14} + ... \longrightarrow [_{9}F^{18}] \longrightarrow {}_{9}F^{17} + ...$ **[1]**

ii. $_{4}Be^{9} + ... \longrightarrow [_{5}B^{10}] \longrightarrow {}_{4}Be^{8} + ...$ **[1]**

d) The reaction between gaseous hydrogen bromide and oxygen at 400^0C – 600^0C shows the following mechanism:

$$HBr + O_2 \longrightarrow HOOBr \text{ ----------slow}$$

$$HOOBr + HBr \longrightarrow 2HOBr\text{--------fast}$$

$$\underline{[HOBr + HBr \longrightarrow H_2O + Br_2] \times 2\text{-fast}}$$

$$3HBr + O_2 \longrightarrow 2H_2O + 2Br_2$$

Study the reaction mechanism and answer the questions that follow:

i. Determine the molecularity and the order of the reaction. **[1]**

ii. What will happen to the rate of reaction if the concentration of HBr is doubled while the concentration of O_2 is kept same? **[1]**

e) Explain the polar nature of aldehydes with a suitable example. **[2]**

Question 3

a) Explain how the solubility of carboxylic acids depends on the molecular mass. **[2]**

b) Study the given formula of a coordination compound and answer the questions that follow:

$[Co(NH_3)_6]Cl_3$

i. Draw the structure of the compound showing only the secondary valencies. **[1]**

ii. Why are secondary valencies important? **[1]**

iii. How many ions are formed when it is dissolved in water? **[1]**

c) A substance 'X' is prepared by the catalytic reduction of ethane nitrile as shown in the chemical equation below.

$$CH_3C \equiv N + 4[H] \xrightarrow{LiAlH_4} \underset{\text{---------}}{X}$$

Study the reaction and answer the following questions:

i. Identify 'X'. **[1]**

ii. What will be observed if a few drops of phenolphthalein are added to an aqueous solution of substance 'X'? **[1]**

d) The table below consists of a list of compounds.

Sl. No	Compound	Sl. No	Compound
1	NaCl	6	NH_4Cl
2	CH_3COONa	7	$NaHCO_3$
3	NH_3	8	NH_4OH
4	H_2CO_3	9	CH_3COOH
5	KCl	10	HCl

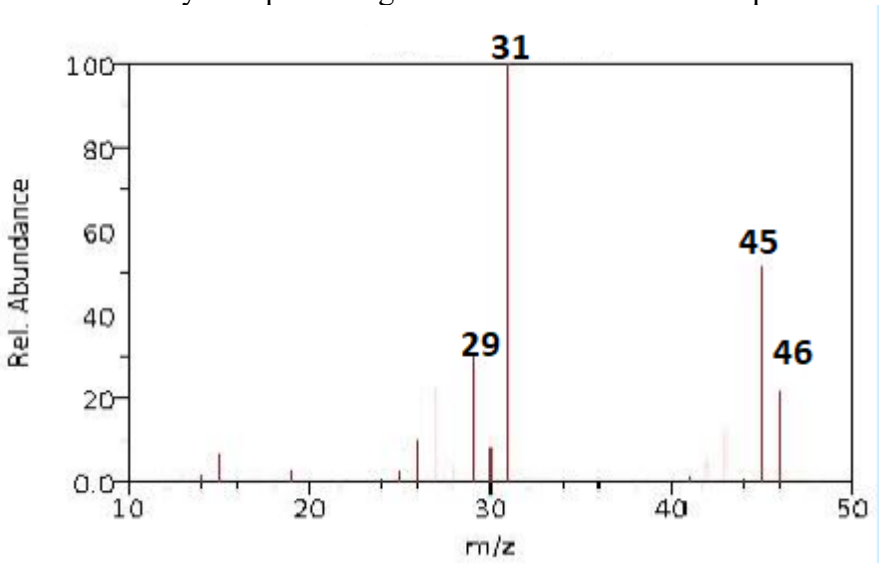
i. From the table select any **TWO** compounds that can act as a buffer pair. **[1]**

ii. Write the buffer action of the buffer pair mentioned in question i. **[2]**

Question 4

a) Discuss how concentration affects the magnitude of electrode potential of both oxidation and reduction half-cells. **[2]**

b) A sample of organic compound containing C, H and O is analysed using mass spectrometer. Study the spectrum given below and answer the questions that follow:



i. What fragment ion is obtained as a base peak? **[1]**

ii. Write the molecular formula of the compound. **[1]**

c) Compare the hydrolysis reaction of acetyl chloride and ethyl acetate. **[2]**

Acetyl Cholride	Ethyl Acetate	

d) Complete the following reactions and write the name of the products formed: **[1]**

i. $CH_3COCH_2CH_3 + HCN \longrightarrow$

ii. $CH_3CH_2CHO + ... \xrightarrow{K_2Cr_2O_7/H_2SO_4}$ **[1]**

e) What is standard hydrogen electrode (SHE)? Write the IUPAC notation of SHE when it is coupled with zinc half-cell. **[2]**

Question 5

a) Exposure to radioactive radiation is harmful to living tissues. Do you agree? Support your answer with a valid reason. **[1]**

b) When 1.5 g of unknown solute is dissolved in 100 g of water, the boiling point of the solvent is raised by 0.13ºC. What is the molecular mass of the solute? { K_b for water is 0.52ºC mol^{-1}} **[2]**

c) In an experiment, about 0.5 g of an unknown chemical substance was added to 5.0 mL of benzoic acid solution which gave a spontaneous brisk effervescence.

i. Write a chemical test to identify the gas evolved. **[1]**

ii. Write a balanced chemical equation to represent the given experimental observation. **[1]**

d) In the preparation of methyl amine by Hoffmann's method, the percent yield of the product depends on ethyl alcohol used. Do you agree? Support your choice with **TWO** reasons. **[2]**

e) Design a mass spectrum of a compound having molecular formula C_3H_8O showing any **FOUR** possible major fragments with their formulae and m/e values. Assume that the NMR spectrum of a compound contains three peaks (i.e. singlet, triplet and quartet). **[3]**

Question 6

a) Define the following: **[1]**

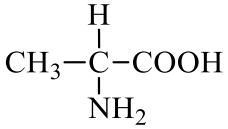
i. Order of a reaction

ii. Molecularity of a reaction **[1]**

b) Transition elements form coloured compounds. Justify. **[2]**

c) Calculate the pH and $[OH^-]$ if the pOH of a solution is 3.5. **[2]**

d) Show the charge in the structure of the amino acid given below in the presence of HCl and NaOH with the help of a reaction each**.** **[2]**



e) Why are aldehydes more reactive than ketones? **[2]**

Question 7

a) Why is consuming whole milk dairy products and red meat unhealthy? **[2]**

b) Determine the number of signals formed by compound A and B, and indicate the multiplicity of the various signals. **[2]**
Given: Compound A: CH_3CHBr_2 and Compound B: CH_3CH_2CHO.

c) A galvanic cell is constructed by using aluminium and nickel half-cells.
Given:

$E^{o}_{Al^{3+}/Al} = -1.67$ V, $E^{o}_{Ni^{2+}/Ni} = -0.24$ V

i. Identify the anode and cathode in the given cell. **[1]**

ii. Calculate the emf of the cell under standard conditions. **[1]**

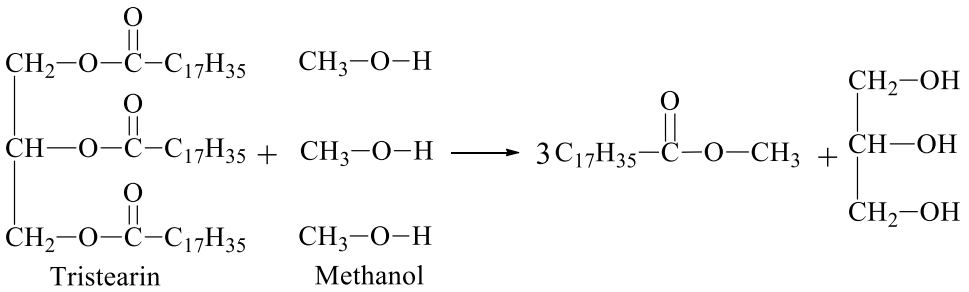
d) Explain why intravenous solution used in hospitals is isotonic with the cells in the human body? **[2]**

e) Complete the given table : **[2]**

Common name	IUPAC	Structure
i. Ethyl acetate	ii. _____	iii. _____
iv. _____	v. Ethanedioic acid	vi. _____

Question 8

a) Study the reaction given below and answer the questions that follow:



i. Name the products formed in the reaction. **[1]**

ii. Define the reaction. **[1]**

b) For a generic reaction $A + 2B \longrightarrow C$, the following experimental data were obtained. Use the data and answer the questions that follow.

Experiment	**Initial concentration ($molL^{-1}$)**		**Initial rate**
	A	**B**	
1	0.150	0.100	4.0×10^{-5}
2	0.150	0.200	8.0×10^{-5}
3	0.450	0.100	3.6×10^{-4}

i. Determine the order of reaction. **[1]**

ii. Determine the rate constant of the reaction. **[1]**

c) The table given below shows a list of weak acids and their K_a values. Use the table to answer the questions that follow:

Acid	**K_a value at 25°C**
H_2CO_3	4.4×10^{-7}
HF	6.7×10^{-5}
CH_3COOH	1.8×10^{-5}

i. Which acid has the lowest pH value? Explain. **[1]**

ii. What is the degree of dissociation of the acid mentioned in (i) in 0.2 M solution? **[1]**

d) If a coating of zinc on iron gets scratched, the exposed portion of iron does not rust easily. Give a reason. Given: $E^{o}_{Zn^{2+}/Zn} = -0.76$ V, $E^{o}_{Fe^{2+}/Fe} = -0.44$ V **[2]**

e) Write **TWO** differences between functional group region and finger print region **[2]**

Functional group region	**Finger print region**	

Rough Work