SECTION A (40 MARKS)

ANSWER **ALL** QUESTIONS

Question 1

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 are more than one choice circled, NO score will be awarded.** **[15]**

i. Boiling point of pure water is the temperature at which vapour pressure of water becomes equal to atmospheric pressure. When common salt is added the boiling point of water increases. This is due to

A increase in vapour pressure of the solution containing common salt.

B decrease in vapour pressure of the solution containing common salt.

C no change in vapour pressure of the solution containing common salt.

D increase in the vapour pressure of both the pure water and solution containing common salt.

ii. For an Acid-Base titration of HCOOH and NaOH, phenolphthalein indicator changes from colorless to pink. This change in the colour of phenolphthalein is due to

A high concentration of OH^- ions.

B low concentration of OH^- ions.

C high concentration of H^+ ions.

D same concentration of OH^- ions and H^+ ions.

iii. When a radioactive element emits rays, the new element formed will occupy a new place in the periodic table. If ${}_6C^{13}$ emits an alpha and beta particle each, the new element formed will fall in group

A III.

B IV.

C V.

D VI.

iv. Coordination compounds play an important role in industries, biological systems and medical fields. Which one of the following statement is correct?

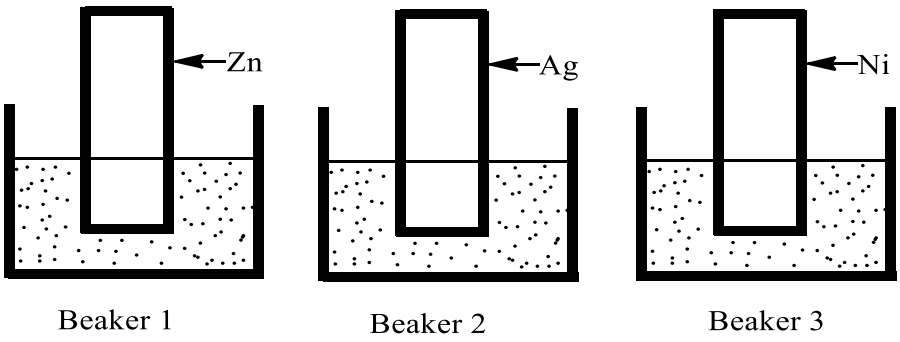
A Chlorophyll is a green pigment in plants and contains calcium.

B Cisplatin is used in the treatment of cancer and contains platinum.

C Haemoglobin a complex of Fe^{3+} has oxygen molecules bonded to protein.

D Coordination compounds act as catalysts due to paired electrons in d-orbitals.

v. Three beakers contain 1.0 M $CuCl_2$. A piece of different metal is placed in each of the beakers as shown below. (E^o values for Ag^+/Ag = 0.80 V, Cu^{2+}/Cu = 0.34 V, Zn^{2+}/Zn = - 0.76 V and Ni^{2+}/Ni = - 0.24 V)



Reactions will occur only in beakers

A 1 and 2.

B 2 and 3.

C 1 and 3.

D 1, 2 and 3.

vi. NH_4NO_2 decomposes as: $NH_4NO_2 \longrightarrow N_2 + 2H_2O$

When the initial concentration of the salt is doubled, the evolution of N_2 becomes two times faster. This is an example of a

A zero order reaction.

B first order reaction.

C second order reaction.

D third order reaction.

vii. A complex of nickel has a molecular formula containing five ammonia molecules, a nitrosyl ion and two chloride ions. One mole of the complex produces three moles of ions in its aqueous solution.

The correct formula of the complex is

A $[Ni(NH_3)_5\ NOCl]Cl$.

B $[Ni(NH_3)_5\ NOCl_2]$.

C $[Ni(NH_3)_5\ NO]Cl_2$.

D $[Ni(NH_3)_5\ Cl_2]NO$.

viii. A student was asked to carry out an experiment to test the two compounds, formaldehyde and benzaldehyde. Which of the following reagents will help to differentiate between the two?

A Tollen's reagent

B Fehling's solution

C Schiff's reagent

D 2,4-dinitrophenyl hydrazine

ix. Benzyl alcohol undergoes oxidation in presence of alkaline solution of potassium permanganate to form product **X,** which is a white crystalline solid and reacts with alcohol to form ester. Identify the product **X.**

A Oxalic acid

B Acetic acid

C Formic acid

D Benzoic acid

x. Four students were given the same compound CH_3-O-CH_3 to determine the number and multiplicity of various signals using NMR spectrum. The student who got the correct answer is

A Student 1 = 6 signals and septet.

B Student 2 = 6 signals and singlet.

C Student 3 = 1 signal and singlet.

D Student 4 = 1 signal and septet.

xi. If one mole of ammonia and one mole of hydrogen chloride gases are mixed in a closed container to form solid ammonium chloride gas, then

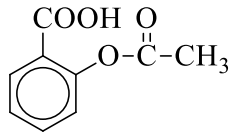
A $\Delta H > \Delta E$.

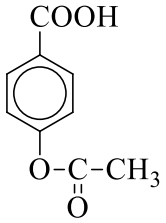
B $\Delta H = \Delta E$.

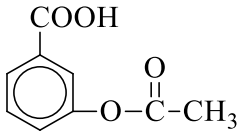
C $\Delta H < \Delta E$.

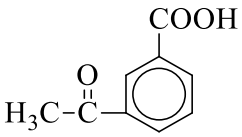
D $\Delta H = 0$.

xii. A colourless organic solid with a melting point 135°C is used to reduce fever and relieve mild to moderate pain such as common cold, toothaches and headaches. Based on the above information, choose the correct structure of the compound.

A 

B 

C 

D 

xiii. People suffering from heart problems are advised **'NOT'** to consume red meat, whole milk and dairy products as these products contain high amount of

A monounsaturated fats.

B polyunsaturated fats.

C unsaturated fats.

D saturated fats.

xiv. Calculate the concentration of H^+ ions in 0.1 M HCOOH solution.

(K_a of formic acid = 1.8×10^{-5})

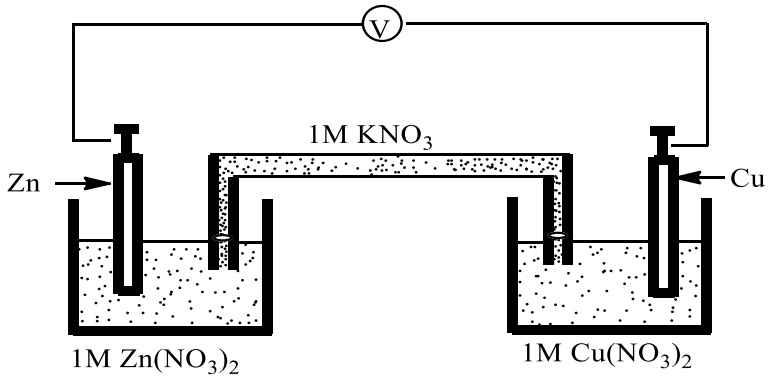
A 1.8×10^{-4}

B 1.8×10^{-6}

C 1.3×10^{-2}

D 1.3×10^{-3}

xv. Study the diagram given below:



In the above electrochemical cell, the electrons flow from

A copper to zinc through a wire.

B zinc to copper through a wire.

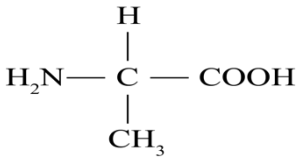
C copper to zinc through a salt bridge.

D zinc to copper through a salt bridge.

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

i.	According to the splitting pattern of proton, the number of peaks given by $-CH_3$ group in CH_3-CH_2-Cl is_____ peaks.	
ii.	The slope obtained by plotting the values of rate of reaction against the concentration of reactant helps to determine the value of _____.	
iii.	The heating of water to its boiling point in a beaker is an example of _____ process.	
iv.	The region of IR-spectrum below 1500 cm^{-1} that contains signals resulting from vibration of bonds of a molecule is called_____.	
v.	A solution obtained by dissolving 342 g of sucrose in 100 g of water is _____ molal.	
vi.	The relationship between rate constant and temperature of a reaction is given by _____ equation.	
vii.	The polymer used for making water hoses for firefighting operations is called _____	
viii.	The total entropy of the universe for an irreversible spontaneous process is _____ than zero.	
ix.	When a solute is dissolved in a solvent, the change in the boiling point of the solution is experimentally determined by _____ method.	
x.	In nylon-66, monomers are linked together by the _____linkage.	

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

Column A	Column B
a) Acid prepared from $C_{12}H_{22}O_{11}$	i) Zwitter ions
b) Reduction of carbonyl compounds to secondary alcohols in presence of $NaBH_4$.	ii) Formaldehyde
c) $CH_3CN + 4[H] \xrightarrow{LiAlH_4}$	iii) Acetyl chloride
d) The doubly charged ions of amino acid	iv) Ethylacetate
e) The product obtained by treating CH_3COOH and Na_2CO_3	v) Aldehyde
f) A carbonyl compound used for preservation of biological specimens	vi) 
g) Acid derivative known as lachrymators	vii) Oxalic acid
h) Optically active amino acid	viii) Biodiesel
i) Compound produced from vegetable oil and alcohol	ix) Hoffmann degradation
j) Produces amine with one carbon atom less than amides	x) $CH_3COONa + H_2O + CO_2\uparrow$
	xi) $CH_3COONa + H_2CO_3$
	xii) $CH_3CH_2NH_2$
	xiii) $H_2NCH_2\text{-}CH_2COOH$
	xiv) Acetic acid
	xv) Ketone

a)	
b)	
c)	
d)	
e)	
f)	
g)	
h)	
i)	
j)	

d) Correct the following statement by changing the word given in BOLD. Rewrite the correct word/s only. DO NOT copy the whole sentence. **[5]**

i. The primary source of electrical energy in Apollo Moon Mission was **lead-storage cell**.

ii. A reaction at 298 K is **spontaneous** where the enthalpy and entropy change is 13.41 kJ mol^{-1} and 45 JK^{-1} mol^{-1}.

iii. Most of the transition metal complexes are coloured due to the presence of **empty** d-orbitals.

iv. The reaction of acetic acid with ethyl alcohol in the presence of conc. H_2SO_4 is called **decarboxylation**.

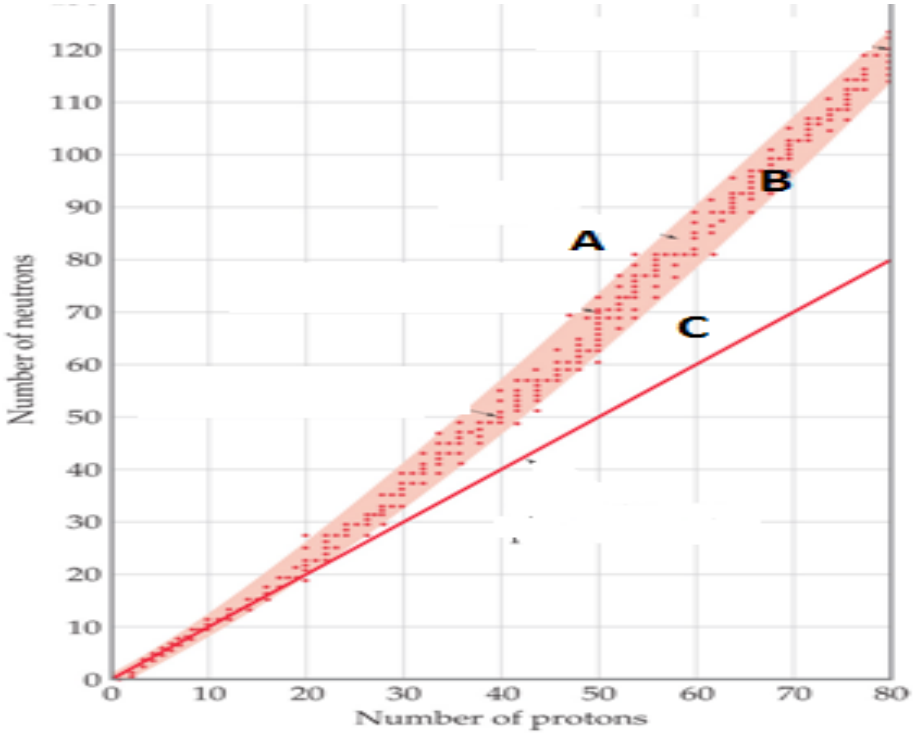
v. Distinction of primary aromatic amine from primary aliphatic amines can be done by performing **Schiff's test.**

e) Answer the following questions. **[10]**

i. Standard Hydrogen Electrode (SHE) consist of a platinum wire fused in a glass tube and a platinum plate coated with finely divided platinum black which acts as the electrode. Why is the platinum plate coated with finely divided platinum black? [1]

ii. Name a technique that can be used for the detection of drugs in the blood and urine samples of drug abusers. [1]

iii. The diagram given below is a serge chart representing different regions labelled A, B & C. How a nucleus placed in region C does attains stability? [1]

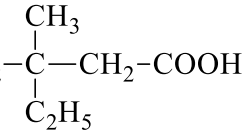


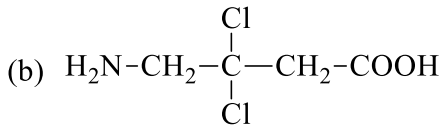
iv. Does the value of $\Delta H = -110.5\,kJ\,mol^{-1}$ for the reaction $C + \frac{1}{2}O_2 \longrightarrow CO$ represent the heat of combustion? Why? [1]

v. Propan-2-one and propanal are functional isomers having same molecular mass but propan-2-one has higher boiling point than propanal. Explain. [1]

vi. What are the advantages of choosing terylene materials over cotton materials to stich a tego? [1]

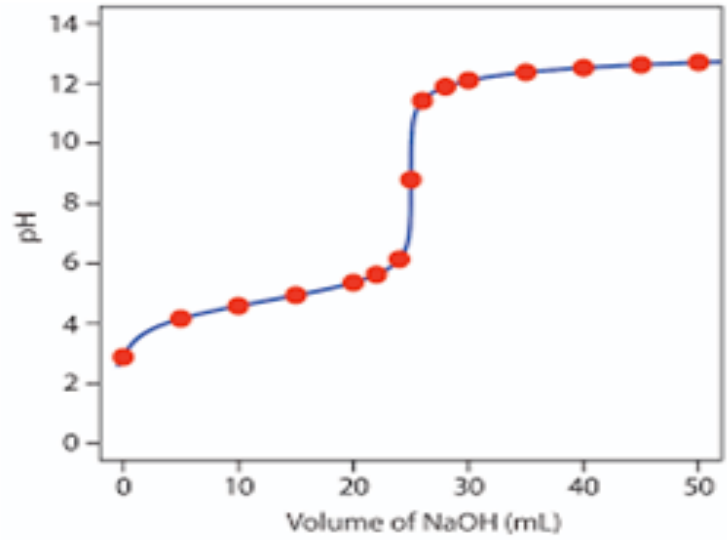
vii. Give the IUPAC name of the following organic compounds. [1]

(a) 

(b) 

viii. The order of a given reaction, A + B ⟶ product is a second order. Show that the unit of rate constant is mol^{-1} litre $time^{-1}$. [1]

ix. Given below is the titration curve of CH_3COOH and NaOH.



[1]

What is the significance of a titration curve?

x. The table given below shows the solubility of CO_2 gas under different pressures at 25°C. [1]

Pressure (cm Hg)	**Mass of gas dissolved in one litre of water (gram)**
50	0.083
40	0.062
30	0.045
20	0.029

a) What conclusion can you draw from the above data about the relation between pressure and mass of gas dissolved?

b) Give **ONE** application of this principle.

SECTION B (60 MARKS
ATTEMPT ANY **SIX** QUESTIONS

Question 2

a) What ratio of concentration of ammonia and ammonium chloride should be mixed to prepare a buffer solution of pOH 5? (K_b for NH_3 =1.8 x 10^{-5}) **[2]**

b) Nitrogen fixation is a process by which atmospheric nitrogen is reduced to NH_3 for use by organisms. The reactions for this process are given in the following table. **[3]**

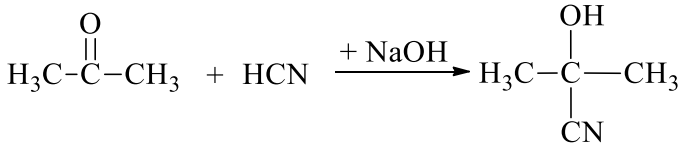
	Reaction	ΔH^o (kcal/mol)	ΔS^o (cal/mol)
A	$\frac{1}{2}N_2 + O_2 \longrightarrow NO_2$	-11	-52.7
B	$\frac{1}{2}N_2 + \frac{1}{2}O_2 \longrightarrow NO$	-21.6	29

Which of the reaction A or B is spontaneous at 25°C? Why? Justify your answer with the help of calculation.

c) i. Rainbow smelt, a species of fish living in arctic region can survive harsh environment by producing glycerol and some other protein molecules in their serum. Why is the production of glycerol and protein important to this fish? **[1]**

ii. Why people with high blood pressure are advised to take less salt? **[1]**

d) Acetone reacts with HCN in the presence of NaOH to form a cyanohydrin. **[3]**



Write the mechanism for the above chemical reaction.

Question 3

a) A galvanic cell is constructed using two electrodes 'A' and 'B' dipped in solutions containing their own ions having the same concentrations. It is observed that the current flows from 'B' to 'A'. Both 'A' and 'B' are divalent metals. **[2]**

i. Which electrode has a higher reduction potential?

ii. Write a symbolic representation of the cell.

iii. Represent the reaction at cathode.

b) The rate law equation for a reaction A + B $\longrightarrow$ product is rate $= K[A]^1[B]^0$. **[3]**
Complete the following table.

Experiment	$[A]$ mol/L	$[B]$ mol/L	Initial rate $molL^{-1}min^{-1}$
I	0.1	0.1	2×10^{-2}
II	***x***	0.2	4.0×10^{-2}
III	0.4	0.4	***y***

c) NMR spectrum helps to determine the structure of unknown compounds depending upon the type of protons present in the molecule. Based on this, draw the structure of each compound given below that will give only one signal in NMR spectrum. **[2]**

A = $C_3H_6Br_2$

B = C_3H_6O

C = C_5H_{12}

D = C_4H_9Br

A	
B	
C	
D	

d) i. Differentiate between monodentate and bidentate ligands in the table given below. **[2]**

Monodentate ligand	**Bidentate ligand**

ii. Name the radioisotope used for the treatment of cancer growth. What type of rays are emitted by the radioisotope? **[1]**

Question 4

a) i. Study the following conversions of the reactions given below: **[2]**

$$CH_3COOH \xrightarrow[conc.H_2SO_4]{C_2H_5OH} A \xrightarrow{PCl_5} B \xrightarrow{NH_3} C \xrightarrow{KOH/Br_2} D$$

Write the molecular formula of compounds A, B, C and D.

A	
B	
C	
D	

ii. Write a balanced chemical reaction for the conversion of the compound C to D. **[2]**

b) A radioisotope element 'X' with mass number 38 and atomic number 19 is bombarded with α-particles. A new element Y is formed along with emission of 2 neutron particles. Write the nuclear reaction and find the atomic number and mass number of the new element. **[2]**

c) Pemo and her father went to buy a battery for their camera. The two types available were lead storage and Nickel-Cd batteries. The latter was more expensive. In your opinion, which battery should they choose? Give a reason for your answer. **[1]**

d) Explain the following.

i. There is no suitable indicator for the titration of formic acid and ammonium hydroxide. **[1]**

ii. Ethyl amine is a stronger base than aniline. **[1]**

iii. Manufacturing of polyesters and nylons helps in the conservation of forest. **[1]**

Question 5

a) Enantiomers are a pair of molecules which are mirror images of each other. Draw the structure of a pair of enantiomers shown by the given complex $[Co(NH_3)(Py)_2Cl_2]^{2+}$. **[2]**

b) A study published in the Journal of Nutrition revealed that a human body absorbs protein from a boiled egg at a rate of 91 percent while raw egg protein is absorbed at a rate of 50 percent over a 24-hour period.

i. What changes occurred in the protein that made the absorption of boiled egg protein more than raw egg protein? **[1]**

ii. What is the effect of boiling on the chemical properties of egg protein? **[1]**

c) The vapour pressure of water at 20°C is 17.51 mmHg and lowering of vapour pressure of a sugar solution is 0.0614 mmHg. Calculate the:

i) relative lowering of vapour pressure. **[1]**

ii) mole fraction of water. **[2]**

d) i. You are given two solutions of amino acid 'A' (pH = 3.8) and 'B' (pH = 10.2) . This mixture is subjected to electrophoresis. **[1]**

1. Which amino acid will migrate to the cathode?

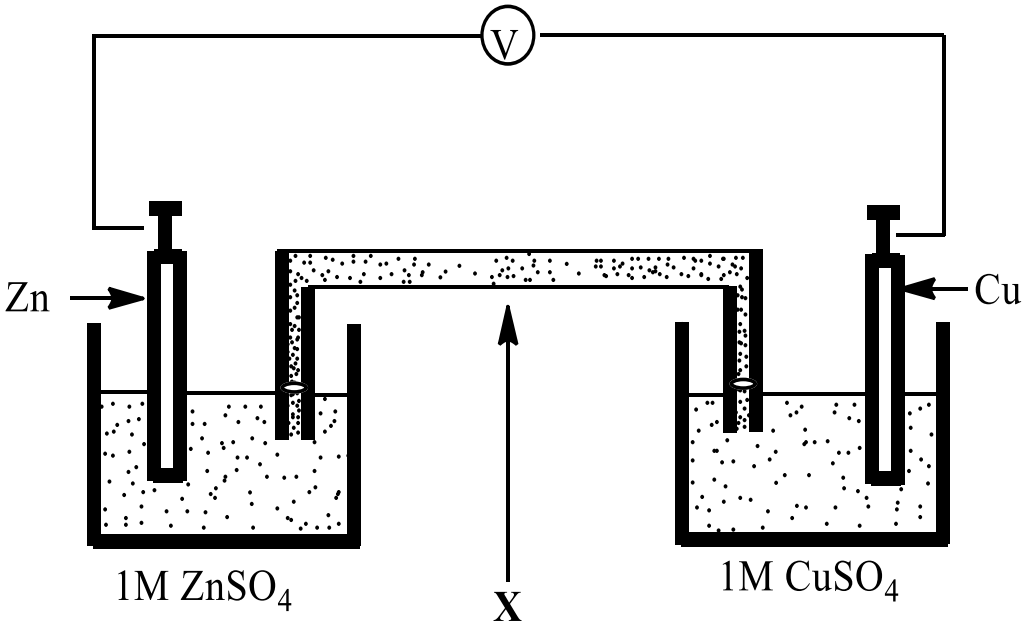
2. Which amino acid will migrate to the anode?

ii. Write the nuclear reaction for $_{13}Al^{27}(n,\alpha)$. **[1]**

iii. An acid extracted from ants is more soluble in water than acid extracted from vinegar. Explain. **[1]**

Question 6

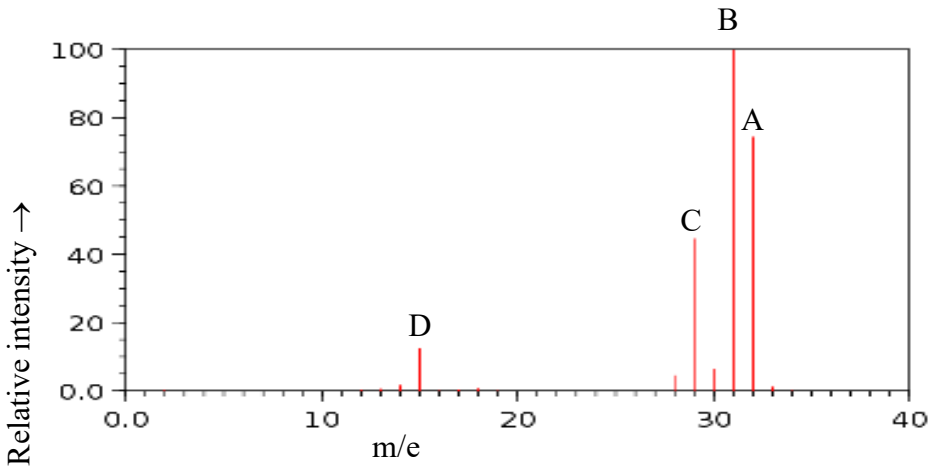
a) Study the electrochemical cell given below. **[1]**



i. Name 'X'

ii. Mention **ONE** function of X.

b) Study the mass spectrum of CH_3OH given below. **[2]**



i. Write the formulae of the fragments that gave rise to the peaks labelled A, B, C and D.

A	
B	
C	
D	

ii. Define peak B. **[1]**

c) i. Tetrahedral complexes do not show geometrical isomerism. Explain. **[1]**

ii. Find the oxidation number of chromium in [Cr $(NH_3)_3$ H_2OCl_3]. **[1]**

d) i. The standard reduction potentials of cadmium and silver electrodes are - 0.04 volts and 0.08 volts. Calculate the standard emf of the cell. **[1]**

ii. Calculate the emf of a cell if 0.01M solution of each of Cd^{2+} and Ag^{+} are used. **[1]**

e) i. Nylon-66 is made from two monomers, hexan-1, 6-dioc acid and hexan-1, 6-diamine. Draw the structures of the two monomers. **[1]**

ii. What chemical change occur in the structure of Nylon when sulphuric acid spills over nylon gho making a hole in it? **[1]**

Question 7

a) i. What do you observe when sodium bicarbonate is added to an aqueous solution of benzoic acid? **[1]**

ii. Write a balanced chemical equation for the above observation. **[1]**

b) In a first order reaction, ten percent of the reactant is consumed in 25 minutes.

i. What is the rate constant of the reaction? **[1]**

ii. Find the time taken for 19 percent and 75 percent of the reaction to take place. **[2]**

c) i. How can you distinguish acetone from acetaldehyde using Tollen's reagent? **[1]**

ii. Chhimi dissolved 20 g of common salt and 5 g of sugar with 250 g of water. What is the sum of mole fraction of the three components present in the solution? **[1]**

iii. Like ionic compounds, amino acids are quite soluble in water but insoluble in non-polar solvent. Give a reason. **[1]**

d) In a chemical reaction, element 'A' changes directly to element 'D' as shown below:

$A \longrightarrow D$; $\Delta H = \Delta H$

Next, the same element 'A' changes to element 'D' in three steps as given below:

$A \longrightarrow B$; $\Delta H_a = \Delta H_1$

$B \longrightarrow C$; $\Delta H_b = \Delta H_2$

$C \longrightarrow D$; $\Delta H_c = \Delta H_3$

and $\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$.

i. State the law that explains the above concept. **[1]**

ii. If the law stated in (i) is not obeyed, what would happen? Mention **TWO** possibilities. **[1]**

Question 8

a) i. You are provided with an aqueous solution of ethylamine, blue and red litmus papers. Complete the table given below. **[1]**

Solution	**Litmus**	**Change in colour**
Ethylamine	Red litmus	
	Blue litmus	

ii. Based on your observation, what is the nature of ethylamine solution? Justify your answer with the help of a chemical equation. **[2]**

b) Give reasons for the following: **[1]**

i. Acetyl chloride is the most reactive derivative of acetic acid towards nucleophilic substitution reaction.

ii. The number of hydrogen ions in an aqueous solution of acetic acid increases on dilution while this does not happen with hydrochloric acid. **[1]**

c) What is a buffer solution? **[1]**

d) All non-equivalent protons in a molecule give more than one signal in NMR spectrum. Explain. **[1]**

e) The value of ΔH for the neutralization of 1 gram equivalent of NaOH and 1 gram equivalent of CH_3COOH is -52.5 kJ. Calculate the heat dissociation of CH_3COOH. **[2]**

f) Standard reduction potential of elements M,N,O and P are in the order M<N<O<P. Compare the reducing power of element P and M. **[1]**

Rough Work

Rough Work