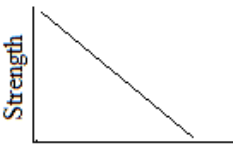
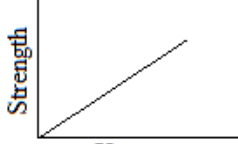
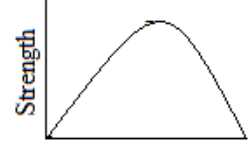
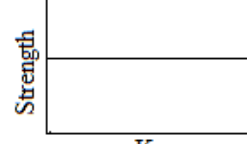
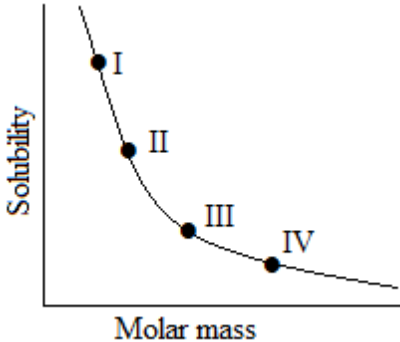


SECTION		Full Marks
SECTION A [10 MARKS] ANSWER ALL QUESTION		
Question 1		
a)	For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. DO NOT circle more than ONE alternative. If there is more than ONE circled alternative, NO score shall be awarded.	[25 × 1]
i.	The strength of acid depends on their K_a values. Which of the following graphs illustrate the most appropriate relationship between K_a values and strength of acids?  Graph I  Graph II  Graph III  Graph IV	
	A Graph I B Graph II C Graph III D Graph IV	
ii.	If 5.0 grams of NaCl is dissolved in 1.0 litre of water at sea level, which of the following changes is likely to be observed about water?	
	A Water freezes below 0°C B Water boils below 100°C C The vapour pressure of water increases D The osmotic pressure of water decreases	
iii.	During World War II, nuclear bomb was dropped in the island of Hiroshima which had a huge impact on lives and environment	

due to radiations. The long term effects caused by the radiations is	
A hair fall. B skin burn. C dehydration. D gene mutation.	
iv. The diagram below shows a circuit diagram with a dry cell. Design a galvanic cell which would replace the dry cell shown in the diagram above. Which of the following pair of electrodes would you choose?	
A $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V}$ and $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$ B $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = +0.77 \text{ V}$ and $E^\circ_{\text{Pb}^{2+}/\text{Pb}} = -0.13 \text{ V}$ C $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$ and $E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.70 \text{ V}$ D $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.45 \text{ V}$ and $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V}$	
v. Which of the following analytical techniques is used to test the amount of steroid in a urine sample?	
A Mass spectrometry B Infra-red spectroscopy C High performance liquid chromatography	

D	Nuclear magnetic resonance spectroscopy	
vi.	Thermoflask is designed in such a way that it maintains the constant temperature inside for certain period of time. Which of the following thermodynamic systems best describes the functioning of thermoflask?	
A	Ideal system	
B	Open system	
C	Closed system	
D	Isolated system	
vii.	A graph was plotted as shown below to compare the solubility of four organic acids in water.  Identify the acid indicated at point II.	
A	Acetic acid	
B	Butyric acid	
C	Formic acid	
D	Propionic acid	
viii.	The reaction below shows the preparation of acetyl chloride using acetic acid and an unknown inorganic reagent X. $\text{CH}_3\text{COOH} + \text{X} \rightarrow \text{Acetyl chloride}$	

Which reagent among the following is suitable for the separation of the product formed?	
A PCl_5 B PCl_3 C POCl_3 D SOCl_2	
ix. The formaldehyde is used as a preservative in laboratory. In recent times, its use has been decreased drastically. Which among the following could be the reason for its decline?	
A Rarely available B Corrosive nature C Toxic and carcinogenic nature D Sophisticated manufacturing process	
x. For a reaction, $2\text{R} + 2\text{Q} \rightarrow \text{P}$, a group of students plotted the graph of rate versus concentration as shown as shown in the figure given below to study the order of reaction. Which of the following rate equations corresponds to the graph above? A $r = k$ B $r = k[\text{R}][\text{Q}]$	

C $r = k[R]^2[Q]$ D $r = k[R][Q]^2$	
xi. Study the structure of amino acid given below. $\begin{array}{c} \text{COOH} \\ \\ \text{H}-\text{C}-\text{NH}_2 \\ \\ \text{CH}_3 \end{array}$ The above amino acid is optically active because it has	
A symmetric C – atom B asymmetric C – atom NH_2 C centrally bonded C – atom D group present on right-hand side BONUS	
xii. Considering factors which determine basicity of amines such as +I effect, steric factor and hydration of ions, the observed order of their basic strength is	
A $2^\circ - \text{amine} > 1^\circ - \text{amine} > 3^\circ - \text{amine}$ B $3^\circ - \text{amine} > 1^\circ - \text{amine} > 2^\circ - \text{amine}$ C $1^\circ - \text{amine} > 2^\circ - \text{amine} > 3^\circ - \text{amine}$ D $3^\circ - \text{amine} > 2^\circ - \text{amine} > 1^\circ - \text{amine}$	
xiii. Due to modernisation and industrialisation, the demand for factory products in the world is very high. To curb this problem and to speed up the manufacturing processes, many compounds of transition metals are used as catalysts. The suitability of such compounds to be used as catalyst is mainly because	

A of formation of coloured ions. B they are cheap and readily available. C of their ability to undergo d – d transition. D of their ability to provide large surface area.	
xiv. The figure below shows equal volume of NaCl solution prepared using different concentration units. In which of the above set up, the concentration of the solution is more likely to remain unchanged when heated?	
A Set up I B Set up II C Set up III D Set up IV	
xv. The correct order for entropy 'S' of a substance existing in three different phases is A $S_s > S_l < S_g$ B $S_s < S_l < S_g$	

C	$S_s > S_l < S_g$	
D	$S_s < S_l > S_g$	

xvi.	You are provided with four different electrodes with corresponding standard reduction potentials.											
	<table><tr><td>Electrode</td><td>P</td><td>Q</td><td>R</td><td>S</td></tr><tr><td>E_o (V)</td><td>-0.13</td><td>-0.21</td><td>-0.19</td><td>-0.25</td></tr></table>	Electrode	P	Q	R	S	E_o (V)	-0.13	-0.21	-0.19	-0.25	
Electrode	P	Q	R	S								
E_o (V)	-0.13	-0.21	-0.19	-0.25								
	If $E^o_{Ni^{2+}/Ni} = -0.24$ V, which electrode would be dipped in $NiSO_4$ solution to obtain Ni metal?											

A	P	
B	Q	
C	R	
D	S	

xvii.	A compound X is an organic compound made up of C, H and O. The compound on oxidation with nitric acid gives compound Y with following properties: - miscible in water - an active poison - removes ink-stains The compound X and Y respectively represent	
A	ethanol and ethanal	
B	sucrose and oxalic acid	
C	ethanal and ethanoic acid	
D	isopropyl alcohol and acetone	

xviii.	Carboxylic acid derivatives undergo nucleophilic acyl substitution reactions. Among the acid derivatives, which one is most susceptible to nucleophilic attack at the carbonyl group?	
--------	---	--

A CH_3COCl B CH_3CONH_2 C $\text{CH}_3\text{COOCH}_3$ D $\text{CH}_3\text{COOC}_2\text{H}_5$	
xix. The oxidation number and the coordination number of $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{NO}_3$ respectively are	
A +6 and 3. B +3 and 6. C +3 and 7. D +7 and 6.	

xx. The experimental record for a reaction $2X \rightarrow Y$ is given below.			
Initial concentration		Final concentration	Time taken
0.50 M		0.38 M	10 minutes
What is the rate of reaction in moles per second during this interval?			
A 2×10^{-4}			
B 2×10^{-2}			
C 1×10^{-2}			
D 4×10^{-4}			
xxi. If 50 mL of pure water is added to 200 mL of acetic acid, which of the following changes in the solution would take place?			
A pH of the solution increases			
B Number of hydrogen ions increases			
C The strength of acetic acid decreases			
D Concentration of acetic acid increases			
xxii. Which of the following statements accurately describes the biological importance of coordination compounds?			
A Digest lactic acid during muscle fatigue			
B Essential for maintaining structure of cell membrane			
C Play a crucial role in oxygen transport in the bloodstream			
D Primarily involved in maintaining pH balance in the body			
xxiii. Which of the following statements correctly describes an aspect of redox equilibria?			
A Redox reaction occurs in the same solution			

B Electric current is generated due to flow of ions C Electrode with negative electrode potential always acts as anode D e.m.f of the cell is the sum of electrode potentials of the electrodes	
xxiv. Mixture X consisting of food colorants was analysed against four colours marked as 2, 3, 4 and 5 on a thin layer chromatography (TLC) plate. The following chromatogram was obtained after the analysis as shown in the figure below. The colour(s) present in the mixture X is (are)	
A 2 only. B 4 only. C 2 and 4. D 3 and 5.	
xxv. Ethanamide is prepared by heating ammonium acetate in presence of glacial acetic acid as shown below in the reaction. $\text{CH}_3\text{COONH}_4 \xrightarrow{\text{Glacial acetic acid}} \text{CH}_3\text{CONH}_2 + \text{H}_2\text{O}$ The formation of the product acetamide in the reaction can be enhanced by I. preventing the dissociation of ammonium acetate into acetic acid II. maintaining the temperature of the reaction III. preventing hydrolysis of acetamide into acetic acid	

IV. trapping of water molecules formed as by-product The appropriate roles of glacial acetic acid among the enhancing methods described above are?	
A I and II. B I and III. C II and III. D III and IV.	

b) Match each item under column A with the most appropriate item in column B. Write the correct alphabet under the ‘answer’ column in the space provided.				[10 × $\frac{1}{2}$]	
	Answer	Column A	Column B		
	d	i. Buffer in biological system	a) Ziz-zag structure		
	e	ii. Movement of solvent molecules	b) Zwitter ion		
	f	iii. Bombardment of substance with electrons	c) Tetra ammonium salts		
	j or l	iv. Boiling of water	d) Homeostasis		
	h	v. Law of mass action	e) Tonicity		
	i	vi. Disintegration of $^{226}_{88}\text{Ra}$ into $^{222}_{86}\text{Rn}$	f) Fragmented ions		
	a	vii. Melting point of carboxylic acids	g) Esterification		
	k	viii. Manufacture of biofuel	h) Reactant concentration		
	c	ix. Exhaustive alkylolation of amines	i) Transmutation		
	b	x. Amphoteric nature of amino acid	j) $dP = 0$		
			k) Trans-esterification		
			l) $dV > 0$		

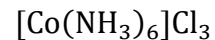
c)	Fill in the blanks with most appropriate word(s).	$[10 \times \frac{1}{2}]$
i.	The radiation emitted from a radioactive substance having velocity equal to that of light and penetrates metal is <u>gamma / γ ray</u> .	
ii.	Alcohol on prolonged exposure to open air loses its normal taste. This is due to formation of <u>organic acid/ carboxylic acid/ RCOOH</u>	
iii.	The type of reaction that occurs when fats and oils are treated with NaOH or KOH solution is termed as <u>saponification</u>	
iv.	According to Bronsted Lowry concept, acids are proton donors whereas according to Lewis concept they are <u>electron pair/ lone pair of electrons</u> acceptors.	
v.	Spraying salt on icy road <u>lowers/ decreases/ reduces</u> the freezing point of ice.	
vi.	The normality of 1 M solution of C_6H_5COOH is <u>1/ one</u>	
vii.	In the NMR spectroscopy, the type of signal obtained for $-NH_2$ protons in $CH_3CH_2NH_2$ is <u>singlet</u>	
viii.	If a given electrode is to evolve hydrogen gas by reacting with dilute acid, its reduction potential should be <u>negative/ less than 0/ less than SHE/NHE</u>	
ix.	The compound commonly found in alcoholic beverages which is produced during the metabolism of ethanol in the liver is <u>acetaldehyde/ Ethanal/ CH_3CHO</u>	
x.	Highlanders add salt while boiling eggs. The colligative property applied here is <u>elevation of boiling point/ ebullioscopy/ΔT_b</u>	

d) Circle the appropriate letter T for True and F for False against each statement.	$10 \times \frac{1}{2}$
i. An acid and its conjugate base differ by a proton. T	
ii. 0.1 N solution of $C_6H_{12}O_6$ is hypertonic with respect to its 0.12 N solution. F	
iii. As we grow older dementia is a common brain disorder. This medical condition is diagnosed using the principle of NMR. T	
iv. For the elementary reaction, $N_2O_5 \rightarrow N_2O_4 + \frac{1}{2}O_2$, the order and molecularity is 1. T	
v. An aldehyde molecule gets reduced when treated with Tollen's reagent. F	
vi. The basic strength of ammonia is greater than that of aromatic amine. T	
vii. At iso-electric point an amino acid exists as negatively charged ion in the solution. F	
viii. The e.m.f generated by the galvanic cell remains constant throughout the redox reaction. F	
ix. The peaks in the finger print region of IR spectrum are usually due to bending vibrations of the molecules. T	
x. The sum of H^+ ions concentration and OH^- ions concentration in a solution at $25^\circ C$ is 14 . F	

SECTION B [50 MARKS]
ATTEMPT ANYFIVE QUESTIONS

Question 2

a) Refer the coordination compound below and answer the questions that follow.



i. Name the ligand present in the compound.

[0.5]

NH_3 / ammonia / ammine.....0.5

ii. What is the primary valency of the central metal atom?

[0.5]

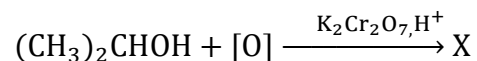
+3.....0.5

iii. Write the IUPAC name of the compound.

[1]

Hexaaminecobalt(III)chloride.....1

b) Study the conversion reaction carefully and answer the questions that follow.



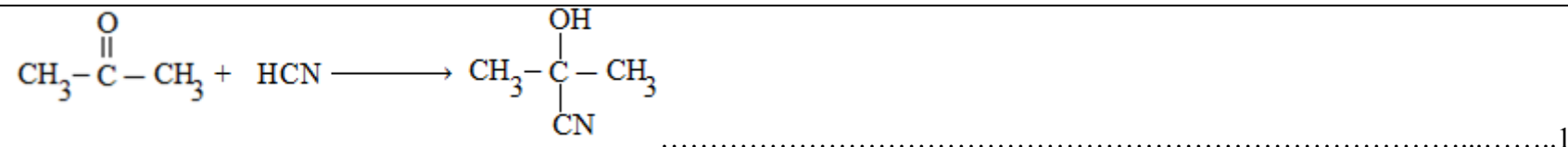
i. Identify the product X.

[1]

Acetone / 2-propanone / propan-2-one / CH_3COCH_3 1

ii. Write the reaction of X with HCN in basic medium.

[1]

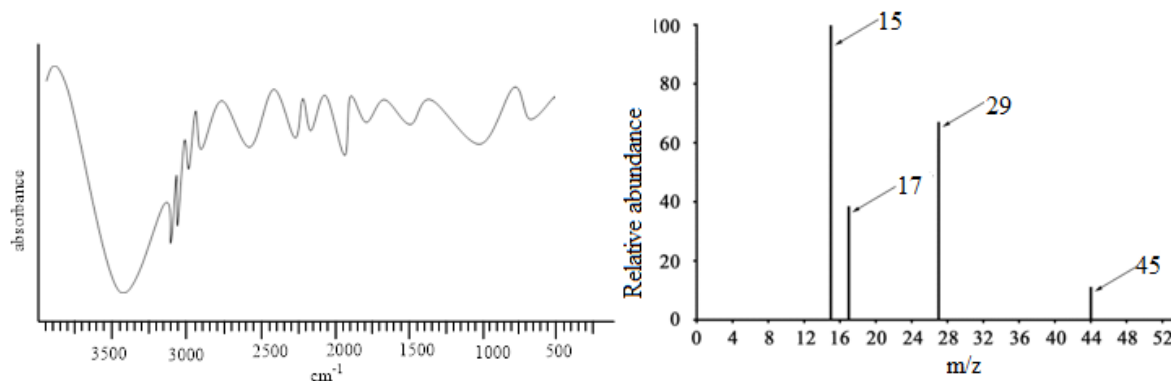


c)	Give a suitable reason for the following statements.	
i.	Consumption of saturated fats is generally not recommended by health experts.	[1]
	ANY ONE - Increases the level of bad (LDL) cholesterol in the body - Promotes blockages in arteries in heart - Increases risk of heart diseases or stroke - Promotes hypertesion.....1	
ii.	Acyl chlorides have lower boiling points than corresponding carboxylic acids.	[1]
	ANY ONE - Due to absence of inter-molecular hydrogen bonding in acyl chlorides - Due to absence of hydrogen bonding in acyl chlorides - Due to presence of hydrogen bonding (inter or intra-molecular) in carboxylic acids.....1	
d)	An auto-mechanic was given 5 kg of propylene glycol (C ₃ H ₈ O ₂) to prepare a coolant for car radiators. What volume of water is required to make the coolant so that it prevents the freezing of car radiators at – 0.5°C? The density of water is 1 g cm ⁻³ . (K _f water = 1.86°C kg mol ⁻¹)	[2]
	$\Delta T_f = k_f \times m$ OR $\Delta T_f = k_f \times \frac{\text{weight of solute}}{\text{molar mass of solute} \times \text{weight of solvent in kg}} \dots\dots\dots 0.5$ $0.5 = \frac{1.86 \times 5000 \times 1000}{76 \times \text{Weight}}$ OR	

Weight = $\frac{1.86 \times 5000 \times 1000}{76 \times 0.5}$ 0.5 Weight = 244.7 kg Volume = $\frac{244.7 \text{ kg}}{1} = \mathbf{244.7 \text{ L}}$(answer + unit) 0.5+0.5	
e) The order of the reactions can be derived from stoichiometric coefficients of a balanced chemical equation. Justify.	[2]
Yes.....0.5 OR For elementary reactions which take place in single step the order of the reactions can be derived from stoichiometric coefficients of a balanced chemical equation 2 OR..... No.....0.5 OR For complex reactions the order of the reactions is determined by the slowest step or rate determining through experiment step.....2	
Question 3	

a)	You are provided with NH_4OH , CH_3COOH , NaOH and HCl solutions to prepare a buffer solution. Choose an appropriate pair of the substances to prepare a buffer solution that can be used for haemodialysis and explain its buffer mechanism.	[2]
	$\text{NH}_4\text{OH} + (\text{NH}_4\text{OH} + \text{HCl})$ OR $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl} \dots\dots\dots 0.5$ Buffer action $\text{NH}_4\text{OH} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$ OR $\text{NH}_4\text{Cl} \rightleftharpoons \text{NH}_4^+ + \text{Cl}^- \dots\dots\dots 0.5$ When acid is added, OH^- ions from buffer combines with H^+ from acid and form water thereby keeping pH constant.....0.5 When base is added, NH_4^+ ions from buffer combines with OH^- from base and form NH_4OH which do not further dissociate due to common ion effect thereby keeping pH constant.....0.5	
b)	A class of organic compound when treated with sodium bicarbonate solution produces brisk effervescence and forms a salt.	
i.	Name the type of reaction.	[0.5]
	Neutralisation reaction / acid-base reaction.....0.5	
ii.	Give a reason, why the brisk effervescence takes place in the reaction?	[0.5]
	Due to evolution of carbon dioxide gas.....0.5	
iii.	Represent the above reaction with the help of a chemical equation using general formula of the compound.	[1]
	$\text{RCOOH} + \text{NaHCO}_3 \rightarrow \text{RCOONa} + \text{CO}_2 + \text{H}_2\text{O} \dots\dots\dots (\text{award mark for completely correct equation}) \dots\dots\dots 1$	
c)	A chemist analysed an organic compound using IR and mass spectroscopic techniques and obtained the following spectra. Study	

the spectra and answer the following questions.



i. Name the compound analysed.

[1]

Ethanol / ethyl alcohol / C₂H₅OH.....1

ii. Write **TWO** differences between the above spectra?

[2]

ANY TWO

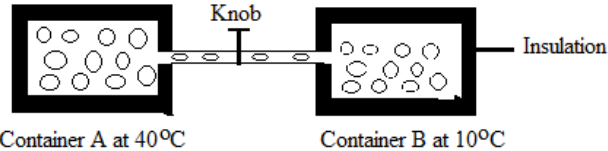
IR Spectrum

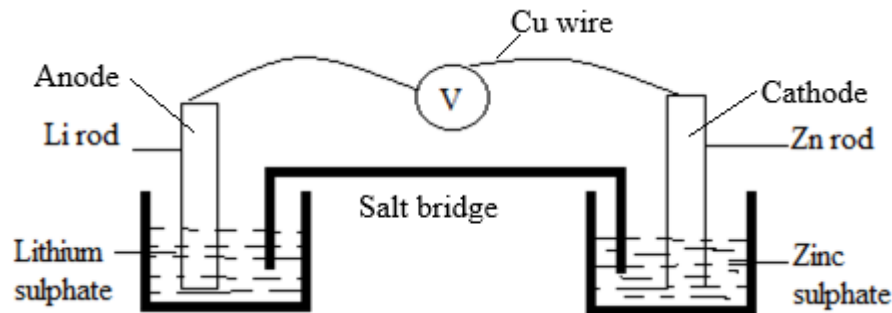
Mass spectrum

- Plot of absorbance versus wave number
- Shows stretching and bending vibrations of different functional groups
- Identifies the compound along with the functional group
- Determines molecular frequencies/ vibrations

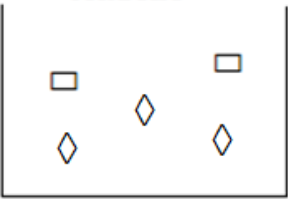
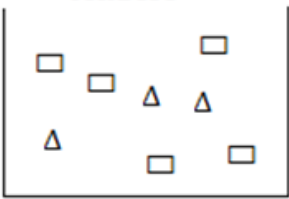
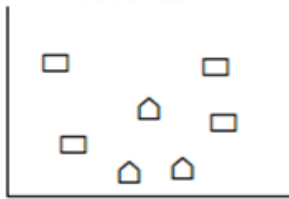
- Plot of relative intensity versus m/z ratio
- Shows the fragmentations of molecular ions
- Identifies the compound along with the molecular formula
- Determines masses of the compounds

.....(consider two differences).....0.5 × 4 = 2

d) Container A and container B containing equal number of gas molecules are maintained at different temperatures as shown below. Initially the knob was closed.  Container A at 40°C Container B at 10°C													
i. Compare the entropy of gases in two containers.	[0.5]												
Entropy of gas in container A is more than entropy of gas in container B.....0.5 OR Entropy of gas in container B is less than entropy of gas in container A.....0.5													
ii. What happens to the temperature of the containers if the knob is opened? Support your answer with a reason.	[1.5]												
The temperature in container A will fall down.....0.5 The temperature in container B will rise up. 0.5 OR Both the containers will have same / equal OR temperature/ both containers will attain thermal equilibrium.....1.5													
e) Nuclear power plant uses radioactive materials to generate electricity. Mention ONE risk associated and its safety measure that we need to considered when using such materials?	[1]												
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2">ANY ONE (or any relevant risk and measure)</th></tr> <tr> <th style="width: 50%;">Risk associated</th><th style="width: 50%;">Safety measures</th></tr> <tr> <td>• Accidents due to nuclear meltdown or radioactive release</td><td>• Design safety measures and reduce risk of accidents</td></tr> <tr> <td>• Radioactive waste remains hazardous for long period of time</td><td>• Proper management and disposal of radioactive waste</td></tr> <tr> <td>• Natural disasters such as earthquake, flood and tsunami</td><td>• Design the power-plants withstand such natural disaster and have backup evacuating plan</td></tr> <tr> <td colspan="2" style="text-align: right;">.....0.5+0.5</td></tr> </table>		ANY ONE (or any relevant risk and measure)		Risk associated	Safety measures	• Accidents due to nuclear meltdown or radioactive release	• Design safety measures and reduce risk of accidents	• Radioactive waste remains hazardous for long period of time	• Proper management and disposal of radioactive waste	• Natural disasters such as earthquake, flood and tsunami	• Design the power-plants withstand such natural disaster and have backup evacuating plan	0.5+0.5	
ANY ONE (or any relevant risk and measure)													
Risk associated	Safety measures												
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.....0.5+0.5													

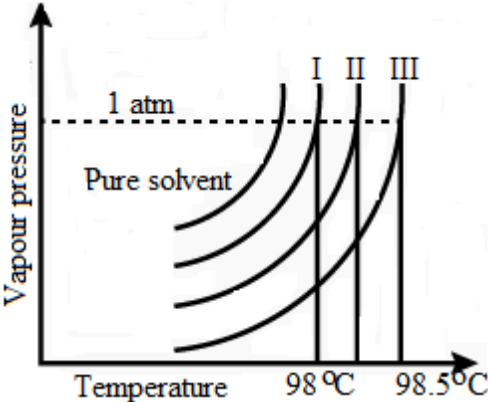
Question 4						
a) You are provided with following materials and chemicals.. [Beakers, salt bridge, zinc rod, lithium rod, voltmeter, insulated copper wire, lithium sulphate and zinc sulphate]						
i.	Using the above materials and chemicals construct a functional galvanic cell with a neatly labelled diagram. ($E^\circ_{\text{Li}^+/\text{Li}} = -3.04 \text{ V}$ and $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$)	[1.5]				
 award 0.5 mark for correct diagram and 0.5+0.5 marks for any two correct labelings						
ii.	What happens to the value of e.m.f if zinc half-cell is replaced by $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ half-cell?	[0.5]				
The e.m.f will increase.....0.5						
OR						
e.m.f. will be equal to 3.38 V.....0.5						
b) Some of the properties of organic acids A and B are given in the table below.						
<table><tr><td>Organic acid A</td><td>Organic acid B</td></tr><tr><td> - forms fruity smelling compound with alcohol </td><td> - forms prismatic crystals with two molecules of </td></tr></table>		Organic acid A	Organic acid B	forms fruity smelling compound with alcohol	forms prismatic crystals with two molecules of	
Organic acid A	Organic acid B					
forms fruity smelling compound with alcohol	forms prismatic crystals with two molecules of					

	- smells like vinegar - boils around 118°C - hygroscopic in nature	water - has pungent to strong odour - boils around 160°C - soluble in water and alcohol but insoluble in ether.		
i.	Identify acid A and B based on the above mentioned physical properties.			[1]
	A= acetic acid / ethanoic acid / CH_3COOH 0.5			
	B= oxalic acid / 1,2-ethanedioic acid / $(\text{COOH})_2$ 0.5			
ii.	Compare the solubility of organic acid A and B in water.			[1]
	Organic acid A is more soluble than organic acid B in water.....1			
c)	The use of biodiesel may be given more importance over fossil fuels. Justify the statement with FOUR points.			[2]
	ANY FOUR - Biodiesel can be domestically produced - Clean burning - Renewable - Increases energy security - Improve air quality - Provides safety benefits - Cheaper Consider any relevant justification.....0.5 × 4 = 2			

d) The following sets of acid solutions contain different number of particles represented with certain symbols as shown below. $\square = \text{H}^+, \diamond = \text{X}^-, \triangle = \text{Y}^-, \triangleup = \text{Z}^-$ Acid HX  Acid HY  Acid HZ 	
i. Which of the acids is the strong acid?	[1]
Acid HY.....1	
ii. Which acid will have lowest value of K_a?	[1]
Acid HX.....1	
iii. Which acid will have highest pH value?	[1]
Acid HX.....1	
e) Give ONE specific medical use of benzoic acid.	[1]
ANY ONE * Used as urinary antiseptic * Dental care * Preservative in pharmaceuticals industry * Treatment of skin diseases like eczema.....1 * Antifungal agent * Treatment of hyperhidrosis * Disinfecting bronchial tubes	

Question 5				
a)	A chemist prepared ethyl amine in the laboratory. The equation for the preparation is given below. $X + 4[H] \xrightarrow{\text{LiAlH}_4} \text{C}_2\text{H}_5\text{NH}_2$			
i.	Identify compound X in the above reaction.			[1]
	Methyl cyanide / ethane nitrile / CH_3CN 1			
ii.	Name the reagent that can be used in place of LiAlH_4 ?			[1]
	Na with $\text{C}_2\text{H}_5\text{OH}$ 1			
b)	Following data were obtained for the study of kinetics of the reaction $2\text{A} + \text{B}_2 \rightarrow \text{P}$.			
	Experiment	[A] (mole L^{-1})	[B] (mole L^{-1})	Rate (mole $\text{L}^{-1}\text{sec}^{-1}$)
	1	0.60	0.60	0.8×10^{-4}
	2	0.60	1.20	1.6×10^{-4}
	3	1.20	1.20	3.2×10^{-4}
i.	Derive the rate equation.			[1.5]
	$\frac{1.6 \times 10^{-4}}{3.2 \times 10^{-4}} = \frac{k[0.6]^x \times [1.2]^y}{k[1.2]^x \times [1.2]^y}$ $\left[\frac{1}{2}\right] = \left[\frac{1}{2}\right]^2$ Order w.r.t reactant A = 1.....0.5			
	$\frac{0.8 \times 10^{-4}}{1.6 \times 10^{-4}} = \frac{k[0.6]^x \times [0.6]^y}{k[0.6]^x \times [1.2]^y}$ $\left[\frac{1}{2}\right] = \left[\frac{1}{2}\right]^2$ Order w.r.t reactant B = 1.....0.5			

$r = k[A]^1[B]^1$ OR $r = k[A][B]$ 0.5	
ii. How will the rate constant of the reaction change with the change in temperature?	[0.5]
With the increase in temperature rate constant also increases and vice versa.....0.5	
c) Many radioactive elements are artificially synthesised through artificial transmutations. However, one of the examples of natural transmutation is natural decay of ${}^{40}_{19}\text{K}$ to ${}^{40}_{18}\text{Ar}$ which forms most of the argon in the air.	
i. Suggest a nuclear reaction for this transmutation.	[1]
${}^{40}_{19}\text{K} \rightarrow {}^{40}_{18}\text{Ar} + {}^0_{+1}e$ OR ${}^{40}_{19}\text{K} + {}^0_{-1}e \rightarrow {}^{40}_{18}\text{Ar}$ 1	
ii. Does the argon formed in the above transmutation have the tendency to undergo further decay? Why?	[1]
No.....0.5	
because its n/p ratio (1.22) is almost equal to one.....0.5	
iii. If you are to redesign the transmutation reaction and convert ${}^{40}_{19}\text{K}$ to ${}^{40}_{20}\text{Ca}$, which projectile will you use? Write the equation for the transmutation.	[1]
Projectile used is proton/ protium.....0.5 ${}^{40}_{19}\text{K} + {}^1_1\text{H} \rightarrow {}^{40}_{20}\text{Ca}$ 0.5	

d) The vapour pressure curves of the same solute in the same solvent at different temperatures are shown below. The curves are parallel to each other and do not intersect. 	
i. Arrange the solutions in increasing order of their concentration.	[0.5]
I < II < III.....0.5	
ii. How is vapour pressure curve affected by change in the temperature?	[0.5]
As temperature increases the vapour pressure also increases or vice versa.....0.5	
iii. What is the molality of solution III if K_b of solvent is $1.86 \text{ K Kg mol}^{-1}$?	[1]
$\frac{0.75}{1.86} = 0.40 \text{ mol Kg}^{-1}$(ans + unit).....0.5+0.5	
iv. How can the vapour-pressure curve of a solute be used to determine its boiling point?	[1]
By finding the temperature on vapour pressure curve where the vapour pressure of the solute is equal to the atmospheric pressure.....1	

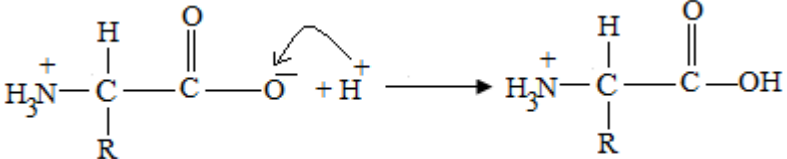
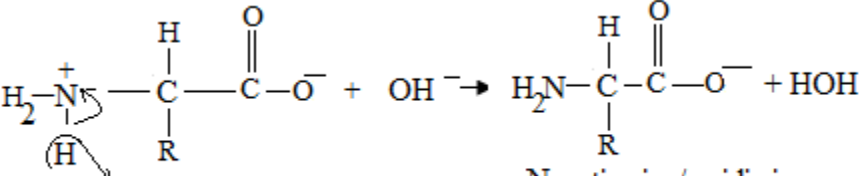
Question 6	
a) Answer the following questions briefly.	
i. What is a base peak in mass spectrum?	[1]
The peak having the highest intensity in mass spectrum OR tallest peak.....1	
ii. Why TMS is taken as a standard reference in NMR Spectroscopy?	[1]
Because all the twelve protons are highly shielded so its chemical shift is taken as 0 and used as reference.....1	
b) The presence of amino acid in our diet is essential for the normal functioning of our body. Support this statement with any TWO relevant points.	[2]
ANY TWO • Helps in repair and build body tissues • It drives metabolic reactions in the body • It synthesis proteins which build muscle mass • Makes hormones and brain chemicals (neurotransmitters) • It provides energy when carbohydrates and fats intake is limited.....1+1	
c) An unknown compound A with empirical formula $C_7H_6O_2$ is a white crystalline solid which is sparingly soluble in cold water but readily dissolves in hot water. The compound A on reacting with sodium carbonate solution produces compound B which is used as a food preservative.	
i. Identify compound A and B.	[1]
A= C_6H_5COOH OR Benzoic acid.....0.5	
B= C_6H_5COONa OR Sodium benzoate.....0.5	
ii. Write a balanced chemical equation for the reaction of A with sodium carbonate solution.	[1]
$2C_6H_5COOH + Na_2CO_3 \rightarrow 2C_6H_5COONa + CO_2 + H_2O$ 1 (award 0.5 marks for correct but unbalanced equation)	
d) You are provided with chemicals such as $C_{17}H_{35}COOH$, NaOH or KOH and glycerol. Write the steps with relevant chemical	[2]

equations, involved in preparing a bathing soap with the chemicals provided.	
$ \begin{array}{c} \text{H}_2\text{C}-\text{OH} \\ \\ \text{HC}-\text{OH} \\ \\ \text{H}_2\text{C}-\text{OH} \\ \text{Glycerol} \end{array} + 3 \begin{array}{c} \text{H}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \text{H}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \text{H}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \text{3 molecules of Stearic acid} \end{array} \xrightarrow{-3\text{H}_2\text{O}} \begin{array}{c} \text{H}_2\text{C}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \\ \text{HC}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \\ \text{H}_2\text{C}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \text{Tristearin} \end{array} $ 1 $ \begin{array}{c} \text{H}_2\text{C}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \\ \text{HC}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \\ \text{H}_2\text{C}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{C}_{17}\text{H}_{35} \\ \text{Tristearin} \end{array} \xrightarrow{\text{NaOH or KOH}} \begin{array}{c} 3\text{C}_{17}\text{H}_{35}\text{COONa} \\ \text{OR} \\ 3\text{C}_{17}\text{H}_{35}\text{COOK} \\ \text{Soap} \end{array} + \begin{array}{c} \text{H}_2\text{C}-\text{OH} \\ \\ \text{HC}-\text{OH} \\ \\ \text{H}_2\text{C}-\text{OH} \\ \text{Glycerol} \end{array} $ 1 (If only the explanation is there, award 0.5 marks each in both the steps)	
e) i. Define entropy.	[1]
Thermodynamic property of the system which measures the degree or disorder or randomness of the constituents particles of the system.....1	
ii. The entropy of universe is increasing, explain.	[1]
Because S tends to be maximum and is positive.....1 (consider any one suitable example)	

Question 7	
a) A factor affecting the rate of reaction is investigated by reacting zinc granules in container I and zinc powder in container II with dilute HCl.	
i. Which container produces higher volume of hydrogen gas in a fixed given time?	[1]
Container II.....1	
ii. Explain the factor which is being investigated above?	[1]
Factor investigated is surface area/ physical size of the reactant.....0.5 Larger the surface area or smaller the physical size of the reactants, greater the rate of reaction.....0.5	
b) A galvanic cell is constructed using zinc and silver electrodes whose electrode potentials are given as follows. $E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.76 \text{ V}$, $E_{\text{Ag}^+/\text{Ag}}^0 = 0.80 \text{ V}$	
i. Write the balanced cell reaction.	[1]
$\text{Zn} + 2\text{Ag}^+ \rightarrow \text{Zn}^{2+} + 2\text{Ag}$ 1	
ii. Calculate the emf of the cell if $\text{Ag}^+(0.1 \text{ M})$ and $\text{Zn}^{2+}(1.0 \text{ M})$ are used.	[2]
$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{0.05912}{n} \log \frac{[\text{Product}]}{[\text{Reactant}]}$ 0.5 $E_{\text{cell}} = [0.80 - (-0.76)] - \frac{0.05912}{2} \log \frac{[1]}{[0.1]^2}$ 0.5 $E_{\text{cell}} = 1.50 \text{ V}$ 0.5 + 0.5	
c) Answer the following questions with reference to carbonyl compounds.	
i. What precautionary considerations should be taken into account when utilising aldehydes in industrial processes or consumer products?	[1]
ANY TWO (any other relevant option) - Have to wear personal protective equipment (gloves, gowns, shields, goggles) - If ever used in consumer products, the pH, ratio, acidity or any other parameter have to be fixed - The products containing such compounds should be labelled and composition stated.	

• In case of splash on body parts, wash immediately with cold water • Use air purifying respirators/ ventilators/ exhaust fan in the room where such compounds are used or stored. • Properly dispose the solution or expired products.....0.5+0.5	
ii. Why do ketones have higher boiling points than its isomeric aldehydes?	[1]
Ketones have higher boiling points due to presence of two alkyl groups which increases the polarity of the compound. 1 OR +I effect is more in ketone than its isomeric aldehyde.....1	
d) In what ways HPLC technique of analysis is more efficient than TLC? Justify with FOUR points.	[2]
ANY FOUR • HPLC gives precise separation of the sample components • It is a faster process • It can give quantitative as well as qualitative information • It uses precise amount of sample is taken using the injector • It has horizontal separation column • The results are computer generated • The results are accurate<i>Consider any other relevant answer</i>.....0.5 × 4 = 2	
e) How is HPLC made more efficient than TLC?	[1]
ANY ONE • The sample in HPLC is injected with high pressure • Uses computer system • Separation column is placed horizontally.....1	

Question 8								
a)	Discuss any TWO coordination compounds in biological system.	[2]						
ANY TWO (with role/function) • Haemoglobin containing the central metal atom Fe in blood transports oxygen. • Chlorophyll containing central metal atom Mg in green plants traps sunlight for photosynthesis. • Vitamin B₁₂ (cyanocobalamine) containing central metal atom Co is used to treat pernicious anaemia OR inflammation of tongue or mouth. 1+1								
b)	If the hydrogen ion concentration present in a sample of coca cola is 2×10^{-5} M, calculate its pH and pOH values.	[2]						
pH = $-\log_{10}[\text{H}^+]$ 0.5								
pH = $-\log_{10}2 \times 10^{-5}$ 0.5								
pH = 4.6.....0.5								
pOH = $14 - 4.6 = 9.4$ 0.5								
c)	Colligative properties of solutions describe how the properties of the solvent will changes as solutes are added. Some of the colligative properties play vital role in maintaining healthy status of a person.							
i.	Which colligative property of solution is most important in biological system?	[1]						
Osmotic pressure OR Π OR $\Pi = CRT$ 1								
ii.	What are some of the implications of higher dietary intake of common salt in hypertensive patient?	[1]						
It further increases pressure of blood.....1								
d)	You are provided with chemical compounds and reagents as shown in the table below.	[2]						
<table><tr><td>Chemical compounds</td><td>Reagents</td></tr><tr><td rowspan="3">HCHO and CH₃CHO</td><td>Concentrated NaOH solution</td></tr><tr><td>I₂ solution</td></tr><tr><td>Dilute NaOH solution</td></tr></table>		Chemical compounds	Reagents	HCHO and CH ₃ CHO	Concentrated NaOH solution	I ₂ solution	Dilute NaOH solution	
Chemical compounds	Reagents							
HCHO and CH ₃ CHO	Concentrated NaOH solution							
	I ₂ solution							
	Dilute NaOH solution							

Use the appropriate reagents and write the chemical test to differentiate the two chemical compounds given in the above table.	
For HCHO Reagent used: Conc. NaOH.....1 Test: Cannizzaro's reaction.....1 OR..... For CH₃CHO Reagent used: I₂ solution and Dilute NaOH solution.....0.5+0.5 Test: Iodoform reaction.....1 (If correct equations are written, award the marks)	
e) The pH of surrounding solution influences the ionic state of amino acids. Explain.	[2]
In acidic solution, amino acid exist as positive ion / cation/ basic ion.....0.5  Zwitter ion acting as a base Positive ion/ basic ion 0.5 In basic solution, amino acid exist as negative ion / anion/ acidic ion.....0.5  Zwitter ion acting as acid Negative ion/ acidic ion 0.5 Consider if the explanation is sufficient even without structures)	

Question 9								
a)	The direction of flow of electrons in a redox reaction is predicted by referring the standard reduction potential values of combining electrodes. Explain.	[1]						
Electrons will flow from species with lower reduction potentials to species with higher reduction potentials. OR Electrons will flow from species with higher tendency to be oxidised to species with higher tendency to be reduced. 1								
b)	Hydrolysis of ester like CH ₃ COOC ₂ H ₅ is carried out in acidic medium as well as in basic medium. Study the table and identify A and B. <table><tr><td>Type of hydrolysis</td><td>Product(s) formed</td></tr><tr><td>Acid hydrolysis</td><td>A.....</td></tr><tr><td>Base hydrolysis</td><td>B.....</td></tr></table>	Type of hydrolysis	Product(s) formed	Acid hydrolysis	A.....	Base hydrolysis	B.....	[2]
Type of hydrolysis	Product(s) formed							
Acid hydrolysis	A.....							
Base hydrolysis	B.....							
A: CH ₃ COOH/ acetic acid/ ethanoic acid OR C ₂ H ₅ OH/ ethyl alcohol/ ethanol.....1 B: CH ₃ COOK (consider other basic salts)/ potassium acetate OR C ₂ H ₅ OH/ ethyl alcohol/ ethanol.....1								
c)	A chemical reaction is carried out by treating alkanamide with bromine water in the presence of caustic soda solution.							
i.	Write the class of organic compound formed in the reaction.	[1]						
Amine(s)								
ii.	What is the main characteristic and significance of this reaction?	[1]						
Amine formed will have one C-atom less than in parent amide.....0.5 This reaction can be employed to degrade homologous series of amides to amines.....0.5								
d)	Study the thermodynamic process below and answer the questions that follow.							

Pressure A B C Volume						
i.	A thermodynamic system at state A changes and finally attains the same state via state B and C. What is the work done?	[1]				
	Zero.....1					
ii.	Name the thermodynamic process that occurs when the system changes from A to C and A to B respectively.	[1]				
	A to C = Isobaric.....0.5					
	A to B = Isochoric 0.5					
e)	You are provided with the information shown in the table below to answer the following questions.					
	<table><tr><td>Species</td><td>K</td><td>Cl</td><td>NH₃</td></tr></table>	Species	K	Cl	NH ₃	
Species	K	Cl	NH ₃			
i.	Use any oxidation states from +2 to +4 of platinum and write the correct formula of the complex applying all the species given in the table.	[1]				
	ANY ONE • K[Pt(NH₃)₃Cl₃] • K[Pt(NH₃)₂Cl₄] • K[PtNH₃Cl₅].....1					
ii.	Write the name of the ligands in the complex that you have written in i.	[1]				
	Ammonia/ ammine/ NH ₃ and chlorine/ Cl.....0.5+0.5					
iii.	What is the impact of improper disposal of used galvanic cells to environment?	[1]				

ANY ONE • It pollutes the soil • Kills the organisms present in the soil • Changes the pH of the soil • Increases or decreases the acidity or basicity of soil <i>Consider any relevant answer.....1</i>	