CHEMISTRY THEORY (043)

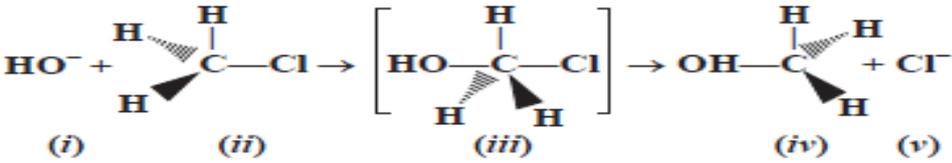**Max. Marks:70**   **Time: 3 hours**
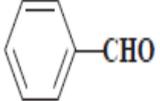
GENERAL INSTRUCTIONS:

Read the following instructions carefully.

(a) There are **33** questions in this question paper with internal choice.

(b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.

(c) SECTION B consists of 5 short answer questions carrying 2 marks each.

(d) SECTION C consists of 7 short answer questions carrying 3 marks each.

(e) SECTION D consists of 2 case-based questions carrying 4 marks each.

(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

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	SECTION A	
	The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.	
1	K_H value for $Ar(g)$, $CO_2(g)$, $HCHO(g)$ and $CH_4(g)$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility. (a) $HCHO < CH_4 < CO_2 < Ar$ (b) $HCHO < CO_2 < CH_4 < Ar$ (c) $Ar < CO_2 < CH_4 < HCHO$ (d) $Ar < CH_4 < CO_2 < HCHO^+$	1
2	Which one has highest molar conductivity? (a) $[Pt(NH_3)_2 Cl_2]$ (b) $[Co(NH_3)_4 Cl_2] Cl$ (c) $K_4[Fe(CN)_6]$ (d) $[Cr(H_2O)_6] Cl_3$	1
3	Toluene reacts with Br_2 in presence of sunlight to give (a) o–Bromo toluene (b) p–bromo toluene (c) Benzyl bromide (d) All of these	1
4	A primary alkyl halide would prefer to undergo _____. (a) S_N1 reaction (b) S_N2 reaction (c) α–Elimination (d) Racemisation	1
5	Choose the amide which on reduction with $LiAlH_4$ gives secondary amine. (a)Ethanamide (b)N-Methylethanamide (c)N,N-diethylethanamide (d) Benzamide	1
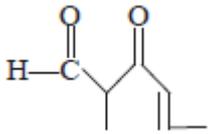
6	The IUPAC name of above compound is (a) 2-Formyl hex-2-en-3-one (b) 5-methyl-4-oxo hex-2-en-5al (c) 3-keto-2-methyl hex-5en-al (d) 3-keto-2-methyl hex-4-en-1-al	1
7	Phenol can be distinguished from ethanol by the reactions with _____ (a) Nitrogen (b) Na (c) Neutral $FeCl_3$ (d) All the above	
8	Which of the following is not a consequence of lanthanide contraction? a) From La+3 to Lu+3, the ionic radii changes from 106 pm to 85 pm b) As the size of the lanthanide ions decreases the basic strength increases c) The basic character of oxides and hydroxides decreases with increase in atomic number d) The atomic radii of 4d and 5d series is similar	
9	Consider the following reaction and answer the questions Which of the statements are correct about above reaction? (a) (i) and (v) both are nucleophiles. (b) In (iii) carbon atom is sp^3 hybridised. (c) In (iii) carbon atom is sp^2 hybridised. (d) (i) and (v) both are electrophiles	
10	Proteins are found to have two different types of secondary structures viz. α-helix and β-pleated sheet structure. α-helix structure of protein is stabilised by : (a) Peptide bonds (b) van der Waals forces (c) Hydrogen bonds (d) Dipole-dipole interactions	
11	Match the terms given in Column I with the units given in Column II.	

Table for question 11:

Column I	Column II
(a) Λ_m	(i) $S\ cm^{-1}$
(b) E_{Cell}	(ii) m^{-1}
(c) k	(iii) $S\ cm^2\ mol^{-1}$
(d) G*	(iv) V

(a) Λ_m – $S\ cm^2\ mol^{-1}$, E_{Cell} – V, k – m^{-1}, G* – $S\ cm^{-1}$

(b) Λ_m – $S\ cm^2\ mol^{-1}$, E_{Cell} – V, k – $S\ cm^{-1}$, G* – m^{-1}

(c) Λ_m – $S\ cm^2\ mol^{-1}$, E_{Cell} – m^{-1}, k – $S\ cm^{-1}$, G* – V

(d) Λ_m – m^{-1}, E_{Cell} – V, k – $S\ cm^{-1}$, G* – $S\ cm^2\ mol^{-1}$

| 12 | Which of the following compounds do not undergo aldol condensation?

(a) CH_3—CHO (b) [benzene ring]—CHO (c) CH_3—$\overset{O}{\overset{\|}{C}}$—$CH_3$ (d) CH_3—$\overset{\overset{CH_3}{\|}}{\underset{\underset{CH_3}{\|}}{C}}$—CHO

(a) a
(b) b & d
(c) a ,b & c
(d) b & d	
13	Assertion: D (+) – Glucose is dextrorotatory in nature.
Reason: 'D' represents its dextrorotatory nature.
   Select the most appropriate answer from the options given below:
   (a) Both A and R are true and R is the correct explanation of A
   (b) Both A and R are true but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true. | |
| 14 | Assertion: Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.   i
Reason: For weak electrolytes degree of dissociation increases with dilution of solution.
   Select the most appropriate answer from the options given below:
   (a) Both A and R are true and R is the correct explanation of A
   (b) Both A and R are true but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true. | |
| 15 | Assertion:Acetanilide is less basic than aniline.
Reason: Acetylation of aniline results in decrease of electron density on nitrogen.
Select the most appropriate answer from the options given below:
   (a) Both A and R are true and R is the correct explanation of A
   (b) Both A and R are true but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true. | |
| 16 | Assertion: When a solution is separated from the pure solvent by a semipermeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.
Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.
   Select the most appropriate answer from the options given below:

   (a) Both A and R are true and R is the correct explanation of A
   (b) Both A and R are true but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true. | |

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17	a.On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?	1
	b. What happens when we place the blood cell in water (hypotonic solution)? Give reason.	1
18	Write the state of hybridization, shape and IUPAC name of the complex $[Co(NH_3)_6]^{3+}$. (Atomic no. of Co = 27).	2
19	Following data were obtained for the given reaction. X + Y → Product	2

Exp.	[X]/M	[Y]/M	Initial Rate M min^{-1}
1.	0.1 M	0.2 M	0.05
2.	0.2 M	0.2 M	0.10
3.	0.1 M	0.1 M	0.05

  (i) Find the order of reaction with respect to X and Y
  (j) (ii) Find the rate constant.

20	Explain
	   a. Carbylamine reaction
	   b. Hoffmann bromamide reaction
		1
		
		 1

21	Write chemical equations when: (i) ethyl chloride is treated with aqueous KOH. (ii) chlorobenzene is treated with CH_3COCl in presence of anhydrous $AlCl_3$	1 1

<div align="center">OR</div>

	Account for the following: (i) The boiling point of ethanol is higher than that of methanol. (ii) Phenol is a stronger acid than an alcohol.	1 1

SECTION C

This section contains 7 questions with internal choice in one question. The followingquestions are short answer type and carry 3 marks each.
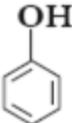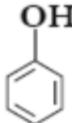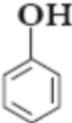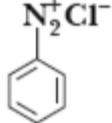
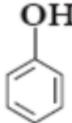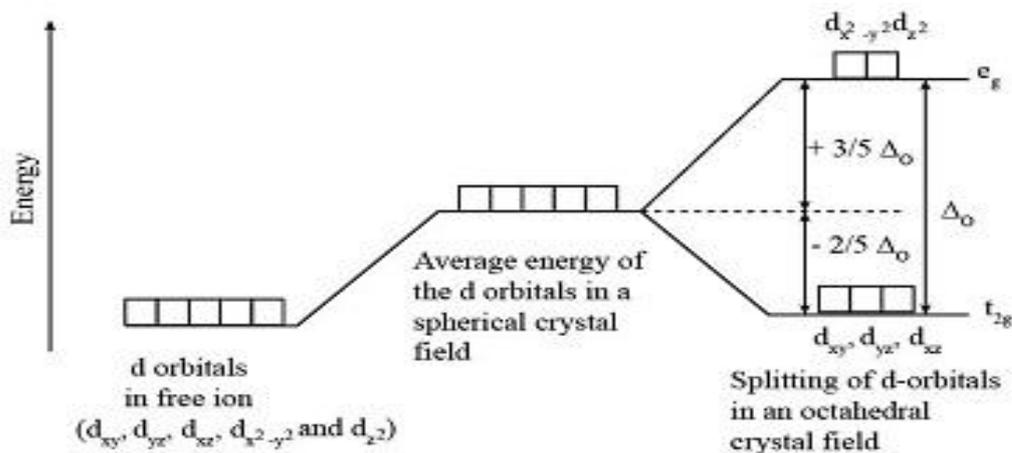|		

22	Give reasons for the following:
	   (k) The transition metals generally form coloured compounds.
	   (ii) E^o value for ($Mn^{3+}|Mn^{2+}$) is highly positive than that for ($Cr^{3+}|Cr^{2+}$) couple.
	   (iii) Zr and Hf have almost similar atomic radii.
		1
		 1
		 1

23	(i)Complete the following reaction and also write the mechnism	2

	$CH_2=CH_2 + H_2O \xrightarrow{\text{conc } H_2SO_4}$?	
	(ii) Out of o-nitro phenol and p-nitro phenol which is steam volatile and why.	1
	OR	
	Complete any three of the following (a) phenol (OH) $+ HNO_3$ (dil.) $\longrightarrow$ (b) phenol (OH) $+ CHCl_3 + NaOH \xrightarrow{343K}$ (c) phenol (OH) $+$ benzene diazonium ($N_2^+Cl^-$) $\longrightarrow$ (d) phenol (OH) $+ CH_3COCl \xrightarrow{\text{base}}$	1 1 1
24	(i) Calculate e.m.f. and ΔG for the following cell: Mg (s) /Mg^{2+}(0. 001 M) // Cu^{2+}(0. 0001 M)/Cu(s) Given :E^0 Mg^{2+}/Mg= -2.37V. E^0 Cu^{2+}/Cu = +0.34 V) (ii) Write charging reaction of lead storage battery	2 1
25	When a chromite ore(A) is fused with sodium carbonate in free excess of air and the product is dissolved in water, a yellow solution of compound (B) is obtained. After treatment of this yellow solution with sulphuric acid, compound (C) can be crystallised from the solution. When compound (C) is treated with KCl, orange crystals of compound (D) crystallise out. Identify A to D and also explain the reactions	1 1 1
26	(i)Write the structural formulae of the organic compounds 'A', 'B', 'C' and 'D' in the following sequence of reactions: 'A' + CH$_3$MgBr $\xrightarrow{H_2O}$ CH$_3$—CH$_2$—CH(OH)—CH$_3$ $\downarrow$ Conc. H$_2$SO$_4$ 'D' $\xleftarrow{\text{alc. KOH}}$ 'C' $\xleftarrow{Br_2}$ 'B' (ii) Why Grignard reagent is prepared under anhydrous condition	1 1 1
27	Distinguish between the following: (i) Acetone and ethanal (ii) 2-Pentanone and 3-pentanone (iii) Phenol and benzoic acid	1 1 1
28	Calculate the amount of CaCl$_2$ (molar mass 111 g mol^{-1}) which must be added to 500 g of water to lower the freezing point by 2K, assuming CaCl$_2$ is completely dissociated. (K_f = 1.86 K kg mol^{-1})	3
	SECTION D	

		The following questions are case-based questions. Each question has an internal choice and carries 4 (2+1+1) marks each. Read the passage carefully and answer the questions that follow.	
29		Observe the diagram of splitting of d-orbitals in octahedral field and answer the questions based on the diagrams and related studied concepts.	2
			1
		(a) What is crystal field splitting anergy? How is the crystal field splitting energy for octahedral (Δ_0) and tetrahedral (Δt) complexes related?	
		(b) Arrange the following complex ions in the increasing order of Crystal field splitting energy	1
		[CrCl6] 3- , [CrCN6] 3- , [Cr(NH3)6] 3+	
		(c) What is electronic configuration of d5 ion if Δ 0< P?	1
30		Simplest electrolytic cell consist of two copper strips dipping in an aqueous solution of $CuSO_4$. DC voltage is applied between two electrodes. Many metals like Na, Mg, Al etc. are produced on large scale by electrochemical reduction of their respective cations where no suitable reducing agent are available for this purpose. Sodium and magnesium are produced by electrolysis of fused chlorides and aluminium is produced by electrolysis of Al_2O_3 in presence of bauxite.	
		(a) Write the reaction taking place at anode when acidified $CuSO_4$ is electrolysed using copper electrodes?	1
		(b) What is sign of $\Delta G°$ in electrolytic cell?	
		(c) Why are highly reactive metals obtained by electrolytic reduction and not by chemical reduction of molten ores and not from aqueous solutions?	
		Or	1
		What will be products of electrolysis at cathode and anode in electrolysis of NaCl(aq) using platinum electrodes?	2
		SECTION E	
		The following questions are long answer types and carry 5 marks each. All questionshave an internal choice	
31	i.	Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain.	5*1
	ii.	Name one water soluble vitamin which is a powerful antioxidant.	
	iii.	Name the products of hydrolysis of lactose.	
	iv.	Mention one important function of nucleic acids in our body.	

	v. Write name of two types of RNA molecules which perform different functions?	
	OR	
	i. Write down the structures and names of the products formed when D-glucose is treated with Bromine water ii. What you understand by secondary structure of proteins iii. Which component of starch is insoluble in water? iv. What is meant by the denaturation of a protein? v. Name the bases present in RNA. Which one of these is not present in DNA?	5*1
32	(a)How will you convert the following: (i) Propanone to Propan-2-ol (ii) Ethanal to 2-Hydroxypropanoic acid (iii) Toluene to Benzoic acid (b) (i) Aniline does not undergo Friedel–Crafts Reaction. (ii) p-methyl aniline is more basic than p-nitroaniline	5*1
	OR	
	(a) Account for the following: (i) Cl—CH$_2$COOH is a stronger acid than CH$_3$COOH. (ii) Carboxylic acids do not give reactions of carbonyl group. (b) An organic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br$_2$ and KOH forms a compound 'C' of molecular formula C$_6$H$_7$N. Write the structure and IUPAC names of A, B and C.	5*1
33	(a)For a chemical reaction R → P, the variation in the concentration, ln[R] vs. time (s) plot is given as shown in figure (i) Predict the order of the reaction. (ii) What is the slope of the curve? (iii) Write the unit of rate constant for this reaction. (b) Show that the time required for 99% completion is double of the time required for the completion of 90% reaction.	1 1 1 2
	OR	
	(a)For a reaction A + B → P, the rate is given by Rate = k[A] [B]^2 (i) How is rate reaction affected if the concentration of 'B' is doubled. (ii) What is overall order of reaction if 'A' is present in large excess? (b) A first order reaction takes 23.1 minutes for 50% completion. Calculate the time required for 75% completion of this reaction. log 2 = 0.301 log 3 = 0.4771, log 4 = 0.6021	1 1 3