[This question paper contains 8 printed pages.]

Your Roll No.....

I

Sr. No. of Question Paper : 1354

Unique Paper Code : 2172011101

Name of the Paper : DSC: Atomic Structure and Chemical Bonding (Inorganic Chemistry – I)

Name of the Course : **B.Sc. (H) Chemistry**

Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt 6 questions in all. All the questions carry equal marks.
3. The questions should be numbered in accordance to the number in the question paper.
4. Calculators and log tables may be used.

P.T.O.

1. Explain the following **(Any Five)**

(i) The bond angle of $OF_2 < H_2O$ whereas $Cl_2O > H_2O$.

(ii) NF_3 has a dipole moment, while BF_3 has zero dipole moment.

(iii) PF_5 exists but PH_5 does not.

(iv) Though the radii of Ag^+ is comparable with the radii of K^+, but the melting point of AgCl is much lower than that of KCl.

(v) The first electron gain enthalpy of O is exothermic, whereas its second electron gain enthalpy is endothermic; still, it exists as O^{2-} in oxides.

(vi) Electronic configuration of Cr is $3d^5 4s^1$ and not $3d^4 4s^2$.

(5×3)

2. (a) Name the quantum numbers which arise as a consequence of the solution of the wave equation for H-atom. What idea do you get from all these quantum numbers?

(b) Write the Kaputinskii equation for lattice energy and define the terms involved. What are the advantages and disadvantages over Born-Lande equation?

(c) What do you understand by partial ionic character in a covalent bond? The electronegativity of hydrogen and bromine are 2.2 and 3.0 respectively. Calculate percent ionic character of HBr. Also predict the nature of HBr molecule.

(d) On the basis of the Slater's rule, explain why 4s orbital is filled before the filling up of 3d orbitals in potassium atom? (4,5,4,2)

3. (a) Given the equation :

$$\Psi_{4,1,0} = R_{4,1} \cdot \theta_{1,0} \cdot \phi_0$$

Based upon the equation, answer the following questions.

(i) Name the equation.

(ii) Define the terms involved in the equation.

(iii) Which orbital is related with the equation?

P.T.O.

(b) Why the covalent radius of Ge (122 pm) is almost the same as that of Si (117 pm) even though Ge has 18 electrons more than Si?

(c) Arrange the following in order of increasing bond angles X – P – X and justify your answer.

PF_3, PCl_3, PBr_3 and PI_3

(d) The dipole moment of HX molecule is 1.92 D and the bond distance 1.2 Å. Calculate the percent ionic character of HX. (1D = 3.336×10^{-30} Cm, charge on one electron = 1.6×10^{-19}C).

(4,3,4,4)

4. (a) Draw the radial probability distribution curves for 3s, 3p, and 3d orbitals. Based on these plots explain their shielding effect and penetration power.

(b) Calculate the limiting radius ratio of cation to that of anion when coordination number is six.

Given $r_{A^{2+}}$ = 59 pm and $r_{B^{2-}}$ = 170 pm, predict the geometry of AB.

(c) Using VSEPR theory, predict the shapes of the following species : (5,5,5)

$I_3^-, ClF_3, PCl_6^-, SF_4, ICl_4^-$.

5. (a) Give the mathematical expression for the conditions of orthogonality and normalization wave function. What is meant by well-behaved wave function?

(b) Write the following in order of as mentioned in each case with suitable reasons:

(i) Increasing acidity – Acetylene, ethane and ethene.

(ii) Decreasing melting points – KF, KCl, KBr, KI

(c) Ψ_A and Ψ_B are wave functions of two atomic orbitals A and B. Draw the molecular orbital diagrams obtained by combination of the atomic orbitals when

(i) $\chi_A = \chi_B$

(ii) $\chi_A < \chi_B$

where χ_A and χ_B are the electronegativities of atoms A and B. (6,6,3)

P.T.O.

6. (a) (i) What is a radial node? How many radial nodes are there in a 3s orbital?

(ii) What is radial probability distribution function? Explain it for Is orbital.

(b) "In case of B_2, C_2 and N_2 molecules s-p_z mixing cannot be neglected while in case of O_2 and F_2, MO diagrams explain most of the characteristics of these molecules without considering s-p_z mixing." Justify the statement.

— Draw MO diagram of N_2 molecule using s-p_z mixing.

(c) On which law is the Born-Haber cycle based? Set up a Bom Haber cycle for the formation of MgO from magnesium metal and oxygen, i.e.

$Mg(s) + \frac{1}{2} O_2 (g) \rightarrow MgO (s)$ — (5,6,4)

7. (a) The bond angle in water molecule is 104.5°. Calculate the S character used by the oxygen atom directed to the two bonded orbitals and two non-bonded orbitals.

(b) Arrange the following in increasing order of dipole moment: BF_3, NH_3, NF_3. Justify your answer.

(c) Define Bent's Rule. How does it help to decide the bond angles of CH_2F_2?

(d) What is the expected change in Bond order during the following ionization processes :

(i) $O_2 \rightarrow O_2^+ + e^-$

(ii) $N_2 + e^- \rightarrow N_2^-$

(iii) $NO \rightarrow NO^+ + e^-$ (4,4,4,3)

8. (a) What do you understand by the term effective nuclear charge? Calculate the shielding constant and effective nuclear charge (Z_{effe}) for the electron present in 4s and 3d of Scandium (Z = 21).

(b) Differentiate between :

(i) Orbit and orbital.

(ii) Electronegativity and electron affinity

P.T.O.

[This question paper contains 8 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **1374** **I**

Unique Paper Code : 2172011102

Name of the Paper : DSC 2 - Basic Concepts and Aliphatic Hydrocarbons (Organic Chemistry-1)

Name of the Course : **B.Sc. (Hons.)**

Semester : I

Time : 3 Hours ***Maximum Marks : 90***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **six** questions.

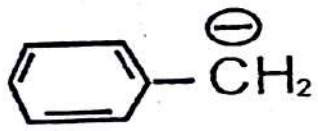
(c) **All** questions carry **15** marks.

1. (a) An alcohol **A** having molecular formula C_2H_6O, when treated with conc. H_2SO_4 gives an alkene **B**. When **B** is bubbled through

P.T.O.

bromine water (Br_2/H_2O) and the product obtained is dehydrohalogenated with an excess of strong base sodamide a new compound **C** is obtained. Compound **C** is also obtained by reacting calcium carbide with water. Compound **C** gives **D** when treated with dilute H_2SO_4 in presence of $HgSO_4$. Identify **A** to **D**. Write the sequence of chemical reactions involved. 5

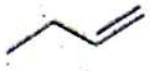
(b) Out of following pairs, which is more stable ? Give reason. 5

(i)  ; $CH_3\overset{\ominus}{C}H_2$

(ii) $(CH_3)_3\overset{\oplus}{C}$; 

(c) Define the terms racemic mixture. Demonstrate the chemical method for resolving a racemic mixture of an acid, using an example. 5

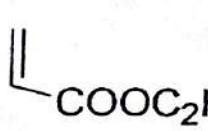
2. (a) How many stereoisomers are possible for tartaric acid ? Draw their Fischer projection structures, describe the relationships between them and identify which are optically active and which are optically inactive. 5

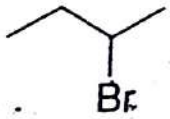
(b)  $\xrightarrow{BH_3.THF}$ B $\xrightarrow{H_2O_2 + NaOH}$ C

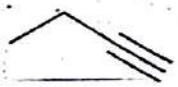
(c) $H_3C-C\equiv C-CH_3 \xrightarrow[Liq\ NH_3]{Na}$ D

(d) $CH_2=CH-CH=CH_2 \xrightarrow{1\ mole\ Br_2}$ E (-80 °C), F (+80 °C)

(e)  $\xrightarrow[(ii)\ NaBH_4]{(i)\ Hg(OAc)_2}$ G

(f)  +  $\xrightarrow{\Delta}$ H

(g)  $\xrightarrow{Alcoholic\ KOH}$ I

(h)  $\xrightarrow{HgSO_4 + dil\ H_2SO_4}$ J

8. Write short note on the following (attempt any **three**) : 5×3=15

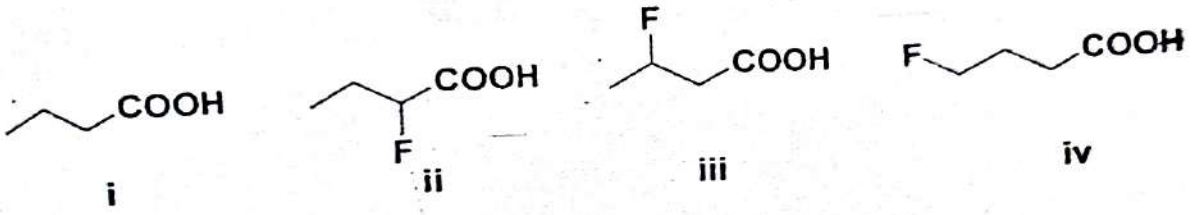
(a) Wurtz-Fittig reaction

(b) Elcb reaction

(b) *trans*-2-Butene upon bromination gives meso-dibromo product, while cis-2-butene gives racemic mixture ? 5

(c) Bromination is more selective than chlorination of alkanes ? 5

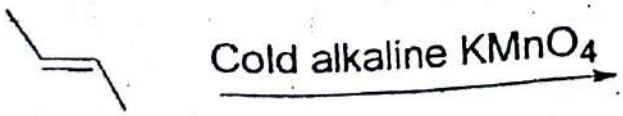
6. (a) What do you mean by inductive effect ? Arrange the following carboxylic acids in the ***increasing order*** of their acidity strength. 5



(b) 2, 3-Dimethylbut-2-ene is more stable than 2-methylbut-1-ene. Explain. 5

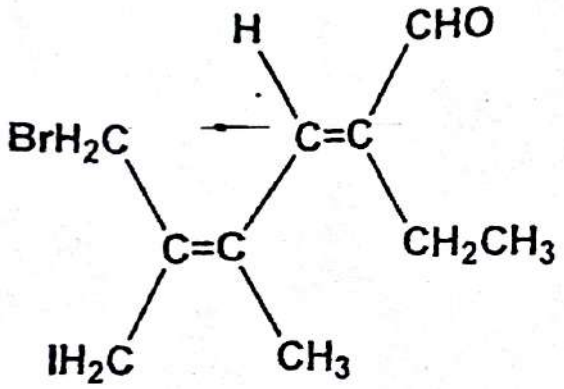
(c) Draw and name various Conformations of Cyclohexane and arrange them in increasing order of their Stability. Draw their potential Energy diagram. 5

7. Write the structure of product(s) **A** to **J**: $10\times1.5=15$

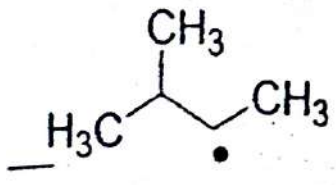
(a) 

(b) (i) A 90° in the plane rotation is not allowed in a Fischer projection, while a 180° rotation is permitted. Justify this statement with a suitable example. 2.5

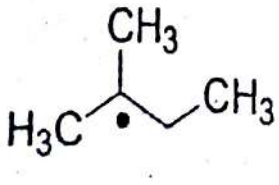
(ii) Assign E/Z configuration at all the stereogenic centre(s) present in the following molecule : 2.5



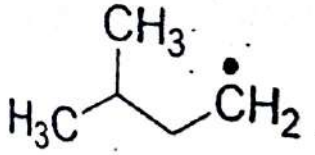
(c) Define the term hyperconjugation effect and arrange the following free radicals in the increasing order of their stability, giving a suitable reason. 5



i



ii



iii

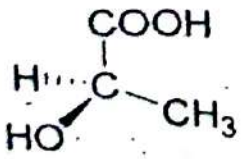
3. (a) Draw all conformations of *n*-butane resulting from rotation about the C2-C3 bond and arrange them in order of increasing stability, providing reasons for the stability order. Also, illustrate the potential energy diagram. 5

(b) (i) Classify the following into Electrophiles or Nucleophiles with explanation. 2.5

$AlCl_3$, BF_3, CN^-, NH_3, SO_3

(ii) Define the terms optical rotation and specific rotation. Explain the factors on which they depend. 5

(c) Assign the R/S nomenclature at all the chiral centre(s) present in the following molecules : (Do any **two**). 5



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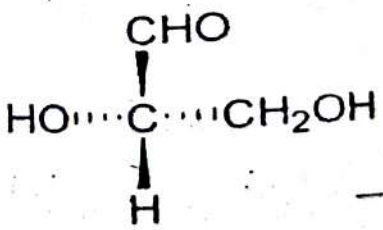

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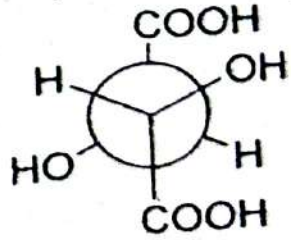
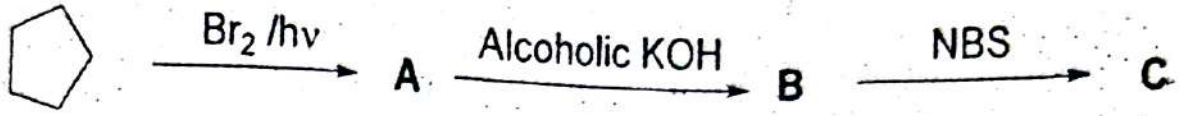


iii

4. (a) Complete the following set of chemical reactions : 5



(b) 2-Methylropane is brominated at 125°C in the presence of light. What % of product will be 2-bromo-2-methylpropane. The relative reactivity for 1°, 2°, 3° hydrogens are 1, 82 and 1600, respectively. 5

(c) (i) Arrange the following in the decreasing order of their acidic strength and give suitable explanation. 2.5

$H-C\equiv C-H$; $H_2C=CH_2$; H_3C-CH_3

(ii) How will you distinguish between 1-butyne and 2-butyne ? Provide the chemical reaction. 2.5

5. Give suitable explanations with mechanism (if involved).

(a) 3, 3, 3-Trifluoropropene when treated with HBr gives 3-bromo-1, 1, 1-trifluoropropane ? 5

[This question paper contains 4 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **1393** **I**

Unique Paper Code : 2172011103

Name of the Paper : DSC 3 : Gaseous and Liquid State (Physical Chemistry - I

Name of the Course : **B.Sc.(Hons.) Chemistry**

Semester : I

Time : 2 Hours ***Maximum Marks : 60***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt **four** questions in **all**. Question **NO.1** is compulsory.

(c) The questions should be numbered in accordance to the number in the question paper.

(d) Use of Scientific Calculator is permitted.

($R = 8.314\ J\ K^{-1}\ mol^{-1}$ $k = 1.38\times10^{-23}JK{-}1$ $N_A = 6.023\times10^{23}$)

1. Answer **any 5** of the following :

(a) Why are viscosity of gases increases with increase in temperature whereas viscosity of liquids decreases with increase in temperature ? 3

P.T.O.

(b) Explain the effect of temperature and pressure on collision frequency of a gas. 3

(c) At same temperature the distribution of molecular speeds of hydrogen and helium is same. Explain. 3

(d) Why the composition of gases in the earth's atmosphere varies with height ? 3

(e) Discuss the effect of detergent concentration on the surface tension of water giving graphical representation. Why surface tension becomes nearly constant at higher concentrations of detergent ? 3

(f) Explain the dependence of surface tension on temperature and why the surface tension of a liquid becomes zero at its critical temperature. 3

2. (a) Starting from the postulates of the kinetic theory of gas derive the following equation

$$PV = \frac{1}{3}mN\langle c^2 \rangle$$ 5

(b) Calculate the root mean square speed, average speed and most probable speed of H_2 molecules at 298K. 5

(c) Draw labelled diagram of P-V isotherms of CO_2. Explain these isotherms and continuity of states. 5

3. (a) Using the van der Waals equation of state, derive the following relation :

$$P_r = \frac{8T_r}{3V_r - 1} - \frac{3}{V_r}$$

State law of corresponding states based on this relation and significance of this relation. 5

(b) Calculate the fraction of oxygen gas molecules at 27°C and I atm possessing velocities between $400 \pm 10 m/s$. 5

(c) Derive an expression for the coefficient of viscosity of a gas, η in terms of the mean free path, λ and show that η of a gas is dependent on temperature, but is independent of pressure. 5

4. (a) Derive the expression of Barometric law :

$$p = p_0 \exp\left(-\frac{Mgh}{RT}\right)$$

Explain the effects of temperature and molar mass of the gas on the variation of pressure with height. 5

(b) Determine the molar mass of a gas if its pressure falls to one – fourth of its value in a vertical distance of 8 km at 27°C 5

(c) The Critical constants for water are $T_c = 647K$, $P_c = 218$ atm and $V_c = 0.05\ dm^3\ mol^{-1}$. Calculate the van der Waals constants and critical compressibility factor. 5

P.T.O.

5. (a) Starting with the Clapeyron equation, derive the expression for Clausius– Clapeyron equation that explains the effect of temperature on pressure of a liquid. 5

(b) The vapour pressure of water at 90°C is 70.13 kPa and the molar enthalpy of vaporization between 90°C and 100°C is 2.268 kJ/g. Calcualate the vapour pressure of water at 100°C. 5

(c) Calculate the surface tension of liquid toluene and the radius of the capillary tube, if the level of water and toluene rose in the capillary is 9.8 cm and 5.2 cm, respectively. Given surface tension of water at 20°C = 72.75 dyne cm^{-1}, density of water = 998.2kg m^{-3} and density of toluene = 890.5 kg m^{-3}. 5

6. (a) Define coefficient of viscosity. Write SI unit of viscosity. Derive the expression for determination of viscosity of a liquid by using Ostwald's viscometer method. 5

(b) The viscosity of a liquid is 5×10^{-4} Nsm^{-2} at 27°C and 2.5×10^{-4} Ns m^{-2} at 327°C. Calculate the energy of activation of viscous flow assuming it to be constant in this temperature range. 5

(c) (i) The heat of vaporization of water is 1.5 times that of CCl_4. Which liquid will have the higher surface tension and why ? 2

(ii) Comment on the effect of addition of sucrose on the viscosity of water ? 2

(iii) Is it possible to liquify an ideal gas ? Explain. 1

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[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1075 **I**

Unique Paper Code : 2172012301

Name of the Paper : DSC 7: Chemistry of d and f Block Elements & Quantitative Inorganic Analysis (NEP-UGCF-2022)

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : III

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **four** questions in all.
3. **All** questions carry equal marks.

P.T.O.

1. Explain :

(a) (i) The factors responsible for formation of a large number of complexes by transition metals.

(ii) Actinides have a greater tendency to form complexes than lanthanides. (5)

(b) Electronic spectra of Ln^{3+} complexes are similar irrespective of change of ligand. (5)

(c) The coordination numbers of the elements of second and third transition series tend to be greater than for the first transition series. (5)

2. Explain why :

(a) (i) Fewer number of oxidation states are available at each end of the first transition series than in the middle?

(ii) Transition metals in high oxidation states are generally available as fluorides or oxides? (5)

(b) Lanthanides predominantly exhibit a +3 oxidation state while actinides exhibit other than +3 oxidation states. (5)

(c) (i) Transition elements and their compounds act as good catalysts.

(ii) Absorption spectra of transition metal ions are broad. (5)

3. (a) (i) Write the number of unpaired electrons in Ce^{4+}(At. No.=58) and Eu^{3+}(At. No.=63).

(ii) Why aqueous solutions of Eu^{3+} is pale pink while Ce^{4+} is orange red? (5)

(b) Calculate the magnetic moment of Europium (III) (L=3). Explain the discrepancy between observed (3.4-3.6 BM) and calculated value. (5)

(c) Explain **(any one)** :

(i) Micas are harder than clay.

(ii) Structure of cyclic phosphazene (trimer).

(2.5)

(d) Advantages and disadvantages of digestion in gravimetric analysis. (2.5)

4. (a) Given below are the Latimer diagrams of Mn (Reduction potential, E° in Volt) in acidic medium and basic medium :

Acidic medium:

$$MnO_4^- \xrightarrow{+0.56} MnO_4^{2-} \xrightarrow{+2.27} MnO_2 \xrightarrow{+0.95} Mn^{3+} \xrightarrow{+1.51} Mn^{2+} \xrightarrow{-1.18} Mn$$

Basic medium:

$$MnO_4^- \xrightarrow{+0.58} MnO_4^{2-} \xrightarrow{+0.6} MnO_2 \xrightarrow{+0.15} Mn^{3+} \xrightarrow{-0.25} Mn(OH)_2 \xrightarrow{-1.56} Mn$$

Answer the following questions with the help of above diagrams :

(i) Write the balanced half reaction for the reduction of MnO_4^- to Mn^{2+} in acidic medium. Find the standard reduction potential for the reaction.

(ii) In which of the medium, acidic or basic Mn(III) is more stable? Justify your answer.

(iii) Using the given Latimer diagram for manganese in acidic medium, construct the Frost diagram to determine the most stable oxidation state of manganese. Explain your reasoning based on the diagram.

(2+1.5+4=7.5)

(b) (i) Explain the reason for the validity of spin only expression to calculate the magnetic moment for ions of first transition series.

(ii) A M^{2+} ion of first transition series has been observed to have four unpaired electrons. Calculate its magnetic moment using spin-only formula,

(iii) What is the effect of curie temperature in ferromagnetism? (2.5×3=7.5)

5. (a) (i) Write a short note on borates.

(ii) Discuss the primary differences in the general properties of inorganic and organic polymers (any three). (2.5×2)

(b) (i) What is the structural difference between pyroxines and amphiboles?

(ii) Draw the structures of following ions :

$Si_2O_7^{2-}$, $Si_3O_9^{6-}$ (2+3)

(c) (i) Mention the criteria while selecting a wash solution in the gravimetric analysis.

(ii) Which is more effective for washing a precipitate in the gravimetric analysis: using two portions of 50 mL or ten portions of 10 mL of each? Justify your answer. (2+3)

6. (a) (i) What are silicones? What are the chain building and chain stopping units in silicones?

(ii) Identify the industries from the following which use silicones:

Rubber, Glass, Oil, Cement (5)

(b) Match the uses with the polymers

Gemstones	montmorillonites
Textiles	orthosilicates
Fertilizers	polyphosphazenes
Paints	phosphates
Corrosion protection	Borates (5)

(c) Write short note on **any one** of the following :

(i) Ion exchange method for separation of lanthanides

(ii) Lanthanide contraction and its consequences

(5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1151 **I**

Unique Paper Code : 2172012303

Name of the Paper : DSC: Chemical Equilibrium, Ionic Equilibrium, Conductance and Solid State

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : III

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **Six** questions in all.
3. Use of scientific calculator is permitted.

1. (a) State the Le Chatelier's principle. For the equilibrium reactions given below, discuss how the equilibrium will shift with the change in temperature and pressure :

(b) What are Miller Indices? Determine the Miller indices of the planes that intersect the crystallographic axes at the distance given below:

(i) (1a, 3b, -c)

(ii) (2a, 3b, 4c).

(c) A first-order reflection from the (111) planes of a cubic crystal were observed at a glancing angle of 11.2° when Cu (K_α) X-rays of wavelength 154 pm were used. What is the length of the side of the unit cell? Calculate the angle at which the same crystal will give a reflection from the (123) planes. (5,5,5)

4. (a) What is the effect of temperature change on the equilibrium constant? Derive a relation between K_p and T starting from the Gibbs Helmholtz equation.

(b) Explain the following :

(i) The molar conductivities of the alkali metal ions increase on going from Li^+ to Cs^+.

(ii) Acetate ions have lowerconductivity than chloride ions.

(c) State and explain Kohlrausch's law. Illustrate how this law is used for the calculation of molar ionic conductance at infinite dilution of weak electrolytes. (5,5,5)

5. (a) Describe the powder method to determine the crystal structure. Explain why it is not possible to deduce the position of hydrogen atoms from X-ray diffraction.

(b) Draw the planes for which the Miller indices are (112) and (200).

(c) What are Weiss indices? What are the corresponding Miller indices of the Weiss indices of crystal planes given below :

(i) (2a, 2b, 2c)

(ii) (a, b, ∞c) (5,5,5)

6. (a) Deduce the relation between K_h, K_a and K_w for a salt of a weak acid and a weak base. Also, find the pH of the hydrolyzed salt solution.

(b) What is pH scale? Calculate the pH of a solution obtained by mixing 25 mL of 0.2 M HCl with 50 mL of 0.25M NaOH. Take $K_w=10^{-14}$.

Concentration of HCl solution = 0.100 N

Mass of silver deposited in the coulometer = 0.1209 g

Movement of the boundary = 7.50 cm

Cross-section of the tube = 1.24 cm^2

(c) Define ionic mobility and show that, the ionic mobility of a solution (1:1 Electrolyte) at infinite dilution is given by

$$u_+^\circ + u_-^\circ = \frac{\lambda_+^\circ}{F} + \frac{\lambda_-^\circ}{F}$$

Where, u° is ionic mobility and λ° is molar ionic conductance. (5,5,5)

[This question paper contains 8 printed pages.]

Your. Roll No.....

Sr. No. of Question Paper : 5896 I

Unique Paper Code : 32171302

Name of the Paper : DSC (Organic Chemistry – II (Oxygen Containing Functional Groups)

Name of the Course : **B.Sc. (H) Chemistry**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **six** questions.
3. **All** questions carry equal marks.

P.T.O.

1. (i) An organic compound A ($C_9H_{10}O$) reacts with iodine and aqueous sodium hydroxide to give yellow precipitate of B and sodium salt of an acid C with molecular formula ($C_8H_8O_2$). Organic compound C on reaction with chlorine and red phosphorous forms compound D with molecular formula ($C_8H_7O_2Cl$). Identify the organic compounds A, B, C and D. Give the name reaction involved by which C is converted to D. Write the mechanism for conversion of A to B.

(ii) Self-condensation of benzaldehyde in the presence of CN^- ion as catalyst forms an organic compound X ($C_{14}H_{12}O_2$). Write down the structure of the organic compound and the name of the reaction involved. Write down the mechanism involved and discuss the role of CN^- ion in the above reaction. (6.5,6)

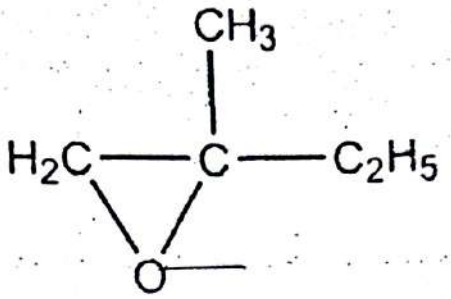
2. (i) Carry out the synthesis of the following compounds either from EAA or DEM :

(a) Adipic acid

(b) Butanoic acid

(c) Acetone

(ii) Write the product involved along with the mechanism in the ring opening reaction of the following with methanol in the acidic medium.



(9,3.5)

3. (i) Give reasons for the following :

(a) Ethyl chloride is more reactive than the vinyl chloride towards the nucleophilic substitution reactions.

(b) *0*-Bromoanisole and *m*-bromoanisole on treatment with sodamide in liquid ammonia give the same product.

(c) *0*-Nitrophenol is a weaker acid than *p*-nitrophenol.

(ii) Write down the mechanism of the alkaline hydrolysis of esters. Why is it irreversible in nature? (9,3.5)

4. (i) Differentiate between the following (give visible test only) and write down the reaction involved:

(a) Benzoic acid and benzyl alcohol

(b) Acetaldehyde and acetophenone

(c) Ethylchloride and chlorobenzene

(ii) Give and explain the relative reactivity order of the following carboxylic acid derivatives towards the nucleophilic substitution reaction :

CH_3COCl, $CH_3COOC_2H_5$, $(CH_3CO)_2O$, CH_3CONH_2 (9,3.5)

5. (i) Carry out the following conversions :

(a) Ethanal → Butanol

(b) Benzene → 1-Phenylpropane

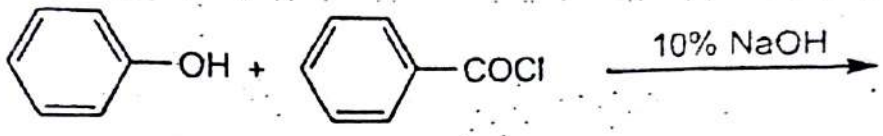
(c) Acetophenone → Benzoic acid

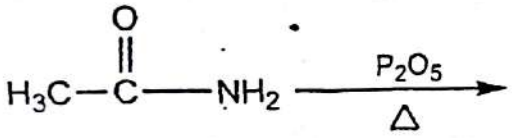
(ii) Write down the structure of the products formed on heating the following dicarboxylic acids :

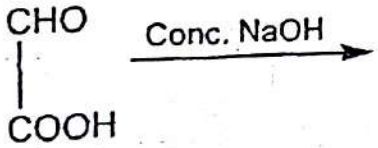
(a) Oxalic acid, (b) Malonic acid, (c) Succinic acid, (d) Glutaric acid, (e) Phthalic acid, (f) Hexanedioic acid, (g) Maleic acid (9,3.5)

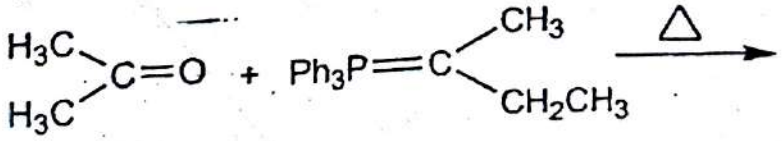
6. (a) Complete the following :

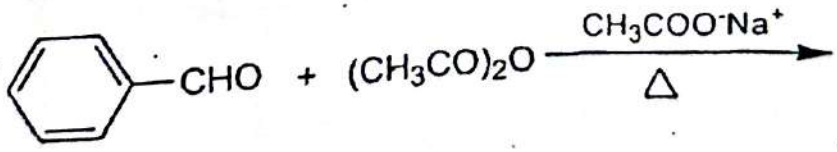
(i) $CH_3CH_2CH_2Br \xrightarrow{NaI/Acetone}$

(ii) 

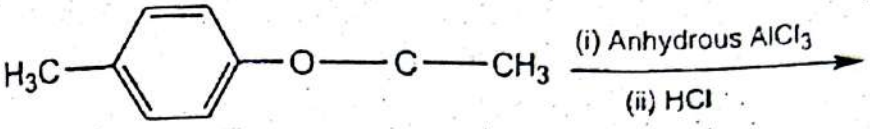
(iii) 

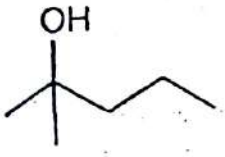
(iv) 

(v) 

(vi) 

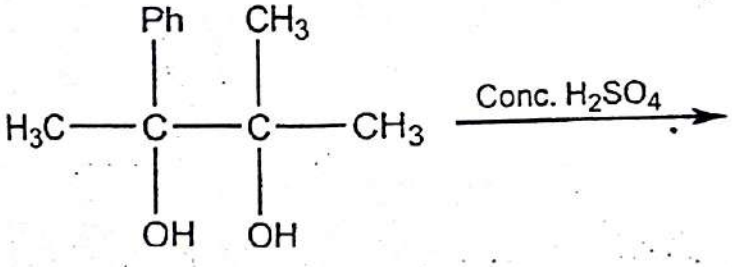
(vii) $Ph\text{-}CH_2\text{-}CH_2\text{-}COOEt \xrightarrow{LAH}$

(viii) 

(ix) 

$+ ZnCl_2 + Conc.\ HCl \longrightarrow$

(b) Write down the product formed along with the mechanism involved in the following reaction :



Which name reaction is involved in the above reaction? (9,3.5)

7. (i) Write short note on the following : **(any three)**

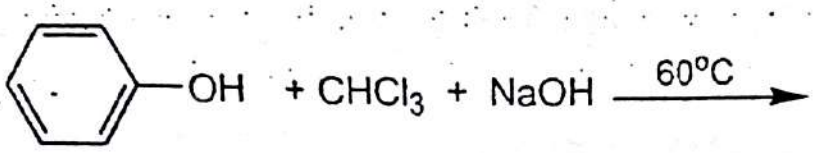
(a) Baeyer-Villiger oxidation

(b) Hofmann-bromamide degradation

(c) Michael addition

(d) Beckmann rearrangement

(ii) Write down the product for the following reaction, along with mechanism.



(9,3.5)

8. (i) (a) Give the products formed when *t*-butyl ether is heated with HI.

(b) Write down the products formed when α, β and γ-hydroxy acids are heated separately.

(c) In polar protic solvents, the rate of S_N2 reaction for halide ions as nucleophiles follows the order given below :

$I^- > Br^- > Cl^- > F^-$

However the order is just reversed in aprotic solvents. Explain.

[This question paper contains 8 printed pages.]

Your Roll No.....

I

Sr. No. of Question Paper : 1056

Unique Paper Code : 2172013501

Name of the Paper : DSC: Inorganic Chemistry V – Basics of Organometallic Chemistry

Name of the Course : B.Sc. (H) Chemistry

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions.
3. **All** questions carry equal marks.

P.T.O.

1. (a) Define the following with suitable example :

(i) Organometallic compounds and its application

(ii) Hapticity. Give examples of ligands with hapticities of 3, 4 and 5.

(b) What is meant by Synergic effect? How does it account for the formation of carbonyl complexes of transition metals in low oxidation states?

(c) Explain hydroformylation? Mention in detail the mechanism for the catalytic cycle of conversion of alkenes to aldehyde. (5,5,5)

2. (a) How are organometallic compounds classified on the bases of type of bonding. Explain giving example.

(b) (i) The V-C bond lengths in $[V(CO)_6]$ and $[V(CO)_6]^-$ are 200pm and 193pm respectively. Explain.

(ii) Give reason and arrange in order of Shortest C-O bond - Ni $(CO)_4$, $[Co(CO)_4]^-$, $[Fe(CO)_4]^{2-}$.

(c) Explain in details the Wacker Oxidation process for conversion of ethene to acetaldehyde. (5,5,5)

3. (a) The cyclopentadienyl rings in ferrocene have aromatic character but cyclopentadiene itself has no such character. Explain. Give two reactions of ferrocene which show it is more reactive than benzene.

(b) Give one method of preparation of Fischer Carbene. Differentiate between Fischer and Schrock Carbene (at least three).

(c) What is Ziegler Natta catalyst? Explain the active form of this catalyst which is involved in the polymerization of alkenes. (5,5,5)

4. (a) Give any two methods of preparation of Metal Carbonyls. What happens when $Fe(CO)_5$ react with :

(i) Bromine

(ii) PR_3 in presence of sunlight.

(b) Discuss in detail the Monsanto process for the production of acetic acid from methanol.

(c) Using the 18-electron rule as a guide, find the number of metal-metal bonds in $Fe_3(CO)_{12}$, and the charge on the species $[Co(CO)_4]^x$. (5,5,5)

5. (a) (i) Give reasons $Fe(CO)_5$ is known while $Fe(CO)_6$ is not.

(ii) Explain the structure and hybridization in Potassium risoxalatoferrate(III).

(b) Give a possible mechanism of conversion of synthesis gas to synthetic gasoline by Fischer Tropsch method.

(c) Which of the following are organometallic compounds and why :

(i) $(C_2H_5)_2Zn$

(ii) $Ti(OEt)_4$

(iii) CH_3MgBr

(iv) $(\eta^6\text{-}C_6H_6)(PPh_3)_2Cr$

(v) LiBr (5,5,5)

6. (a) Draw and explain the structure of the following metal carbonyls using VBT.

(i) $Co_2(CO)_8$

(ii) $Cr(CO)_6$

(b) Draw and explain the structure and bonding of metal with alkyl and allyl group.

(c) (i) Explain why direct nitration of ferrocene is not possible? How can you get nitro derivative of ferrocene?

(ii) Explain the following term used in a catalytic process: Catalyst Poison, Catalyst Promotor.

(5,5,5)

7. (a) Give any three methods of synthesis of metal alkene complexes. What happens when a metal alkene complex $[CpW(CO)_3(\pi\text{-}C_2H_4)]^+$ reacts with triphenylphosphine.

(b) Explain the following :

(i) Migratory insertion of Carbonyl.

(ii) The Carbonyls of 4d metals are less stable than the corresponding carbonyl of 3d metals.

(c) What is Wilkinson's Catalyst? Explain its structure and how it is an effective homogenous catalyst for hydrogenation of alkenes. (5,5,5)

8. (a) Give two methods of synthesis of ferrocene and how does it react with the following :

(i) Butyl Lithium,

(ii) Formaldehyde and secondary amine.

(b) Predict whether the following obey the EAN rule :

(i) $[Mn(\pi C_2H_4)(CO)_5]^+$

(ii) $Mn_2(CO)_{10}$

(iii) $[Fe(CO)_4]^{2-}$

(iv) $[Cr(CO)_3(NO)_2]$

(v) $[Co(\pi\text{-}C_3H_5)(CO)_3]$

*Calculate considering ligand (NO) as linear and bent both.

(c) How to synthesized Zeise's salt? Discuss the bonding in Zeise's salt on the basis of Dewar-Chatt-Duncanson model. — (5,5,5)

[This question paper contains 4 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

I

Sr. No. of Question Paper : 1094

Unique Paper Code : 2172013502

Name of the Paper : DSC: Nucleic acids, Amino acids, Proteins and Enzymes

Name of the Course : B.Sc. (Hons.) Chemistry

Semester : V

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt four questions in all.
3. All questions carry equal marks.

1. a) How would you differentiate between Gly-Ala and Ala-Gly by Edman's degradation method? Write down the reactions involved.

P.T.O.

b) How will you synthesize valine by Gabriels phthalimide method?

c) How will you differentiate between RNA and DNA by alkaline hydrolysis. Give mechanism of the reaction involved.

d) Write structure of NAD^+. Explain its role in an enzyme catalyzed reaction.

e) Discuss the effect of urea and heat on secondary structure of protein. (5x3)

2. a) The reaction of nonapeptide "A" with dansyl chloride gives dansyl derivative of Cysteine. Peptide "A" on reaction with cyanogen bromide gives tripeptide containing Cys, Met, Lys and hexapeptide containing Try, Gly, Ala, Phe, Leu and Asp. Partial hydrolysis of "A" yields Lys-Met-Leu, Ala-Gly-Try, Cys-Lys, Leu-Phe-Ala, Gly-Try-Asp and Met-Leu- Phe. Deduce the structure of "A".

Give all the reactions involved. Write down the products obtained when B is treated with Carboxypeptidase and Chymotrypsin.

b) What are the structures of lysine at pH = 1.5, 3.2, 9.74 and 12? To which electrode does lysine

migrate at each pH? Which of the structure will be present at isoelectric point? (10,5)

3. a) Name the monomers used in preparation of resin used in Solid Phase Merrifield method. How would you synthesize a tripeptide Leu-Ala-Lys by this method? Give its advantages over general method of synthesis.

b) Discuss the following about the Trypsin:

i. Specificity

ii. Catalytic Triad

iii. Pocket at the active site

c) Explain the various types of forces that are responsible for the stabilization of tertiary structures of proteins. (6,6,3)

4. a) Discuss the different types of reversible enzyme inhibition with examples.

b) Explain different classes of enzymes with one example each.

c) What do you understand by K_m in an enzymatic reaction? Discuss its significance. (6,6,3)

P.T.O.

5. a) Write the structures showing the hydrogen bonding between the following nucleotide base pairs:

   i. Thymine and Adenine

   ii Guanine and Cytosine

   b) Write short note on the types of RNA and their biological functions.

   c) Discuss the different steps involved in DNA Replication. (5,5,5)

6. Write down short notes on any three of the following:

   a) Electrophoresis

   b) Ninhydrin test

   c) Genetic code

   d) Factors affecting the enzyme activity (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

I

Sr. No. of Question Paper : 1113

Unique Paper Code : 2172013503

Name of the Paper : Quantum Chemistry and Covalent Bonding

Name of the Course : **B.Sc. (Honours) Chemistry**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt only **six** questions out of **eight**.
3. Use of scientific calculators and Logarithmic tables is allowed.
4. Attempt all parts of a question together.

Physical Constants

Planck 's constant	6.626×10^{-34} J s
Velocity of Light	3×10^{8} ms^{-1}
Avogadro's Number	6.022×10^{23} mol^{-1}
Mass of Electron	9.1×10^{-31} kg
Boltzmann Constant	1.38×10^{-23} J K^{-1}

1. (a) A particle of mass m, in a one-dimensional box of length a can be represented by the function, $\psi(x) = \sin\frac{n\pi x}{a}$ (n=1,2,3...). Normalize the given function $\psi(x)$ and find whether it is an eigen function of (i) p_x (ii) p_x^2.

(b) Write four properties of a function to make it acceptable as a solution of Schrodinger equation. Determine whether the following functions are acceptable or not acceptable as state functions over the interval indicated, giving appropriate reasons.

Function	Interval
$(1 - x^2)^{-1}$	$(-1, +1)$
$exp(-x)$	$(0, \infty)$

(c) Evaluate the commutator $[\widehat{L_x}, \widehat{L_y}]$ where $\widehat{L_x}$ and $\widehat{L_y}$, are the angular momentum operators along the x and y-direction respectively. (5,5,5)

2. (a) Are the following functions eigen functions of the operator $\frac{\widehat{d^2}}{dx^2}$? If so, give the eigen value.

(i) $f(x) = \exp\left(-\frac{x^2}{2}\right)$

(ii) $\cos 2x$

(b) Consider a particle of mass 'm' in a cubic box of edge length 'L'. What is the degeneracy of the level that has energy three times the lowest energy ? Write the mathematical expressions for the degenerate wavefunctions.

(c) If A and B are two atoms bonding along the z-axis predict, giving reasons, which of the following atomic orbitals can combine:

(i) φ_{2s}^{A} and $\varphi_{2p_z}^{B}$

(ii) φ_{1s}^{A} and φ_{2s}^{B}

(iii) $\varphi_{2p_x}^{A}$ and φ_{2s}^{B} (5,5,5)

3. (a) Write the expression for the Hamiltonian operator for the helium atom explaining briefly all the terms involved. Simplify this expression using the Bom Oppenheimer approximation. Write the expression for the corresponding Schrodinger's equation.

(b) Evaluate the expectation value of the radius, (r), at which the electron in the ground state of Hydrogen atom (Z=1) is found. Given the wave function for this state is

$\psi_{1,0,0} = \frac{1}{\sqrt{\pi}} \left(\frac{z}{a_0}\right)^{3/2} \exp\left(-\frac{zr}{a_0}\right)$ where a_0 is the Bohr radius and $\int_0^\infty r^n exp(-ar)\, dr = \frac{n!}{a^{(n+1)}}$.

(c) Write the electronic configuration of H_2, H_2^+ and hypothetical H_2^- species using molecular orbital theory. Explain why He_2^+ exist whereas He_2 does not. (5,5,5)

4. (a) A diatomic molecule can be treated as a simple quantum mechanical oscillator. How is the simple Schrodinger Wave Equation (SWE) modified for this system? Show that

(i) $\exp(-\beta x^2)$ is a solution to this SWE and

(ii) $E = \frac{1}{4\pi}\sqrt{\frac{k}{\mu}}$, here k is the force constant and μ is the reduced mass)

(b) What is the degeneracy of each of the following energy levels of H atom?

(i) $\frac{-e^2}{72\pi\epsilon_o a_o}$ (ii) $\frac{-e^2}{128\pi\epsilon_o a_o}$

(c) Explain and calculate zero point energy (ZPE) of an electron in a one dimensional box of infinite height and 1 Å length. State the Bohr's Correspondence principle. (5,5,5)

5. (a) Show that the wave functions describing the Is atomic orbital and the 2s atomic orbital for the hydrogen atom are orthogonal. Given that

$$\psi_{1s} = (\pi a_0^3)^{-1/2} \exp(-r/a_0) \text{ and}$$

$$\psi_{2s} = \frac{1}{4\sqrt{2\pi}} \left(\frac{1}{a_0}\right)^{3/2} \{2 - (r/a_0)\} exp\left(\frac{-r}{2a_0}\right)$$

where a_0 is Bohr's radius and

$$\int_0^\infty r^n exp(-ar)\, dr = n!/a^{(n+1)}.$$

(b) Set up the Hamiltonian operator for a particle oscillating about a mean position (a simple harmonic oscillator). Explain the significance of zero-point energy of a simple harmonic oscillator.

(c) Why the quantum number 'n' cannot be assigned a zero value while solving for the particle in a 1-D box? Give the units of ψ^2 for a particle in a 1-D box.

(5,5,5)

6. (a) A particle of mass m exists in a one-dimensional box of length L. Using the trial wave function $\psi_{trial} = Nx(L-x)$ evaluate the energy associated with the lowest energy level and comment on whether this trial wave function is an acceptable function according to the variation theorem.

(b) Show that operators corresponding to $\hat{x}$ and $\hat{p}_x$ do not commute. Give the physical significance of your result.

(c) What do you understand by Hermitian operators? Prove that all the eigen values of Hermitian operators are real numbers. (5,5,5)

7. (a) Write the LCAO-MO trial wave function of H_2^+, using Molecular Orbital approach. Derive the expressions for molecular orbital wave functions corresponding to the bonding and anti-bonding energy levels of H_2^+.

(b) Plot the radial probability distribution functions for an electron in hydrogen atom where $n = 1$ and $n = 2$. Explain the plots briefly.

(c) Explain the significance of orthonormality principle giving relevant mathematical expressions. (5,5,5)

8. Write short notes on **any three**:

(a) Postulates of Quantum Mechanics

(b) Pauli's Exclusion principle (quantum mechanical approach)

(c) Configuration Interaction

(d) Variation Theorem (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5878 **I**

Unique Paper Code : 32171502

Name of the Paper : DSC-Physical Chemistry V: Quantum Chemistry & Spectroscopy

Name of the Course : **B.Sc. (Hons) Chemistry**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.

2. Attempt 3 questions from Section A and 3 questions from SectionB. A total of 6 questions to be attempted.

3. Please indicate the section you are attempting at the appropriate place and do notintermixthesections. The questions should be number edinaccordance to the number in the question paper.

P.T.O.

4. Calculators and log tables may beused.

Physical Constants

Planck's constant 6.626×10^{-34} JS

Velocity of light 3×10^{8} m/s

Atomic mass unit 1.661×10^{-27}; kg

Avagadro's number 6.023×10^{23} mol^{-1}

Mass of electron 9.109×10^{-31} kg

SECTION A

Attempt **any 3** questions from this section

1. (a) Explain the following terms:

(i) Linear operator

(ii) Laplacian operator

(iii) Hamiltonain operator.

(b) Draw the Ψ and Ψ^2 patterns for various levels of the Simple Harmonic Oscillator. What conclusions can be drawn from these patterns?

(c) Write short notes on any two of the following:

(i) Bohr correspondence principle

(ii) Heisenberg Uncertainty Principle

(iii) Rigid rotator approximation (4.5,4,4)

2. (a) Indicate which of the following will lead to an eigen value equation. Report the eigen value, if any.

(i) $\frac{d}{dx}\exp(i\omega x)$

(ii) $\frac{d^2}{dx^2}(\sin 3x)$

(iii) $\frac{d^2}{dx^2}(5x^2)$

(b) Giving reason, state which of the following are acceptable wave functions in the indicated interval:

(i) sin x $(0,2\pi)$

(ii) e^{-x} $(-\infty, \infty)$

(c) Calculate the wavelength in nm, for the transition from HOMO to LUMO in 1, 3 butadiene molecule. The C-C and C = C bond lengths are 154pm and 135pm respectively. (4.5,4,4)

3. (a) For a particle of mass 'm' in a cube of edge length 'a', the energy of a quantum level is found to be $17\ h^2/(8ma^2)$. What are the quantum numbers and the degeneracy of the level?

(b) Show that two eigen functions of a Hermitian operator having different eigen values are orthogonal to each other.

(c) A particle of mass 'm' is confined to a one-dimensional box with the origin at centre of the box. The box extends from -a/2 to +a/2. The potential energy function V(x) is V(x) = 0 (inside) and $V(x) = \infty$ (outside). (4.5,4,4)

Write the Schrodinger equation for the system showing separate equation inside and outside the box. (4.5,4,4)

4. (a) Write the Schrodinger wave equation for hydrogen atom in polar coordinates while giving the significance of the terms involved.

(b) What do you understand by the commutation between two operators?

Show that position and linear momentum operator do not commute with each other.

(c) Why do we need to employ approximate methods to determine solution for multi- electron atoms? Explain Variation principle as an approximate method to determine approximate wave function.

(4.5,4,4)

SECTION B

Attempt any 3 questions from this section

5. (a) Briefly explain Rule of Mutual exclusion and its role in structure elucidation.

(b) Explain the different modes of vibration in the following two polyatomic molecules:water and carbon dioxide. Are they both IR and Raman active? Explain your answer.

(c) The rotational spectrum of $^{79}Br\ ^{19}F$ shows a series of equidistant lines 0.71433 cm^{-1} apart. Calculate the rotational constant B; the moment of inertia and bond length of the molecule. (4.5,4,4)

6. (a) What is Raman effect? Explain the origin of Stokes and Anti-Stokes line.

(b) Which of the following molecules will give rise to observable rotational and vibrational spectra HCl, N_2, CO, H_2O? Explain giving reasons.

(c) The $^1H^{35}Cl$ molecule shows pure rotational lines at the following frequencies (cm^{-1}) 20.7, 41.5, 62.0, 83.0, 103.8.

(i) Assign the lines to the rotational transitions, $J \rightarrow J+1$.

(ii) Calculate the bond distance of HCl.

(m_H =1.673 × 10^{-27}kg, m_{Cl} =58.06 × 10^{-27}kg)

(4.5,4,4)

7. (a) What is the effect on the microwave spectrum of $C^{16}O$ if $^{16}0$ is substituted by ^{18}O?

(b) Calculate the number of translational, rotational and vibrational degrees of freedom for

(i) CO_2

(ii) H_2O

(iii) Benzene

(iv) CH_4

(c) The force constant for $'H'^{9}F$ is 966 N^{-1}. Calculate:

(i) The zero-point vibrational energy of this molecule when it follows harmonic motion.

(ii) The frequency of the electromagnetic radiation

to excite this molecule from the ground state to the first excited state. (4.5,4,4)

8. (a) Indicate with the help of the Jablonski diagram, the various processes by which the excited electronic states get deactivated. What is the difference between fluorescence and phosphorescence?

(b) Arrange the following groups in increasing order of their absorption frequencies: Give justification

(i) CF, CCI, CBr, CH

(ii) C-C, C=C, C≡C

(c) What are the characteristics of TMS which make it useful as a reference in NMR spectrum? (4.5,4,4)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1557 **I**

Unique Paper Code : 2172511101

Name of the Paper : DSC-A1 (Basic Concepts of Organic Chemistry)

Name of the Course : **B.Sc. Program Physical Sciences**

Semester : I

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions.
3. **All** questions carry equal marks.

P.T.O.

1. (a) What is hyperconjugation effect? Explain the order of stability of primary, secondary and tertiary carbocations on the basis of this effect.

(b) Give the hybridization state and shape of CH_3^- anion.

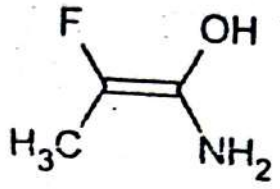
(c) Arrange the following in increasing order of acidity and justify your answer: Phenol, Benzoic acid, Acetic acid and Ethanol.

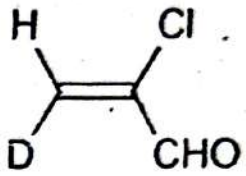
(d) What is electromeric effect? Explain with the help of a suitable example.

(e) Distinguish between inductive effect and resonance effect. (Give atleast three points of difference).

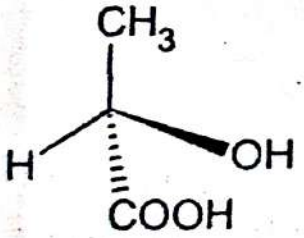
(3,3,3,3,3)

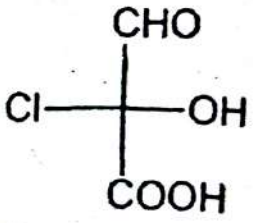
2. (a) Assign the priority sequence and designate E/Z configuration to the following :



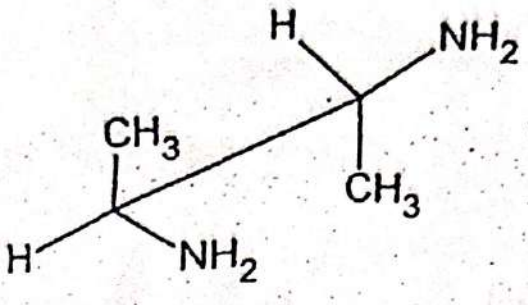


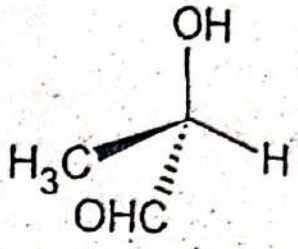
(b) Assign the priority sequence and designate R/S configuration to the following :





(c) Convert the following projection formulae to Fischer projection :





(d) Draw energy profile diagram for conformations of n-butane and label the energy gaps between significant conformations. (4,4,4,3)

3. (a) Name a reaction which involves carbene as an intermediate. Give the steps for generation of carbene in this reaction.

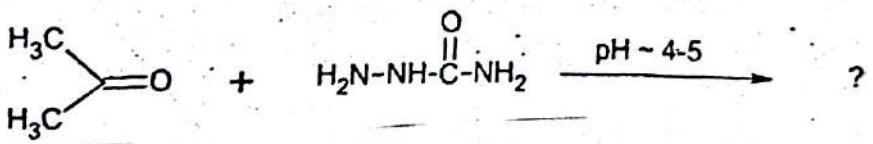
(b) What is Kharasch effect? Explain the stereochemical aspect of this effect. Name the major product obtained when 1-butene is subjected to reaction with HBr in presence of benzoyl peroxide.

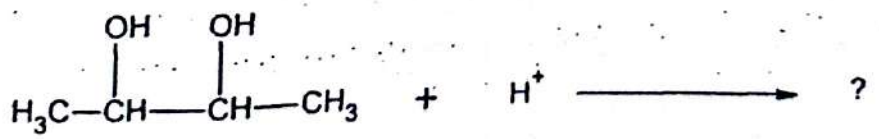
(c) Explain why nitrobenzene directs the incoming electrophile to meta position?

(d) Give the reaction and mechanism for bromination of phenol.

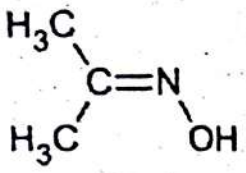
(e) What is an ambidentate nucleophile? Give two examples. (3,3,3,3,3)

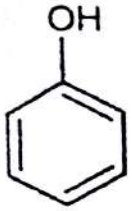
4. (a) Complete the following reactions **(Do any six)** :

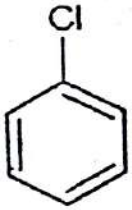
(i) 

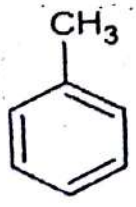
(ii) 

(iii) $H_3C-CH_2-CH_2-Cl + AgCN \longrightarrow ?$

(iv)  $+ H_2SO_4 \longrightarrow ?$

(v)  $+ CHCl_3 + 3\,KOH \longrightarrow ?$

(vi)  $+ NaNH_2 \longrightarrow ?$

(vii)  $+$ liq. $NH_3 \xrightarrow{Na\ /\ Ethanol} ?$

(b) Compare basicity order of primary secondary and tertiary amines in gaseous medium and aqueous medium. Justify the basicity order in each case. (2,2,2,2,2,2,3)

5. (a) Draw all possible stereoisomers of tartaric acid and identify which of them are optically active. Also identify the pair of enantiomers and diastereomers among them.

(b) Give the mechanism of Michael addition reaction.

(c) Predict the products and mention the type of reaction mechanism in the following reactions:

(i) CH_3-CH_2-CH_2-Cl + aq. KOH $\longrightarrow$?

(ii) CH_3-CH_2-CH_2-Cl + KOt-Bu $\longrightarrow$?

(d) Give the reaction and specify the major product when propene is subjected to hydroboration-oxidation reaction. (4,4,4,3)

6. Write short notes on the following name reactions (Do any **three**) :

(i) Benzoin Condensation

(ii) Williamson's Ether Synthesis

(iii) Aldol Condensation

(iv) Wagner-Meerwein Rearrangement (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6296 **I**

Unique Paper Code : 42174304

Name of the Paper : Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II

Name of the Course : **B.Sc. (Prog.)**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. Attempt Six questions in all, three questions from each Sections.
3. Questions no 1 is compulsory.
4. All Questions carry equal marks.
5. Use of the scientific calculator allowed.

P.T.O.

SECTION A

1. **Answer any five questions:**

(a) Explain why H^+ ion has very high ionic conductance.

(b) The resistance of 0.01N NaCl solution at 25°C is 100 Ohms. Cell constant of conductivity cell is unity. Calculate the equivalent conductance.

(c) What are azeotropes? Explain why azeotropic mixtures cannot be separated into pure components by simple distillation.

(d) Addition of NaCl increases, while addition of sodium benzoate decreases the CST of the Phenol-Water system at constant pressure. Explain.

(e) Give and justify the number of components in the

system

$$CaCO_3\,(s) \rightleftharpoons CaO\,(s) + CO_2\,(g)$$

(f) Explain the role of Salt Bridge in electrochemical cell.

(g) What are conditions of an ideal solution.

(5x2.5)

2. (a) Derive the integrated form of Clausius-Clapeyron equation for liquid-gas equilibria.

(b) Draw and explain the significant features of phase diagram of Sulphur.

(c) What is critical solution temperature? What is UCST and LCST? Explain CST with reference to phenol-water System. (4, 4, 4.5)

P.T.O.

3. (a) What are reference electrodes? Describe calomel electrode.

(b) List the various applications of Nernst distribution law and explain the process of solvent extraction.

(c) Calculate the standard emf and equilibrium constant for the cell reaction at 25 °C.

$$Cd(s) + Cu^{2+} \rightleftharpoons Cd^{2+}(s) + Cu(s)$$

Given $E^{\circ}_{Cu^{2+}/Cu} = 0.3394$ V; $E^{\circ}_{Cd^{2+}/Cd} = -0.4022$ V

(4, 4, 4.5)

4. (a) The specific conductance of saturated solution of $BaSO_4$ is 3.48×10^{-4} S/m and the specific conductance of pure water is 0.5×10^{-4} S/m at

298 K. Calculate the solubility product of $BaSO_4$. Limiting molar conductance of $BaSO_4$ is 287.3×10^{-4} Sm^2 mol^{-1}.

(b) Derive the relationship of ΔG, ΔH, ΔS with EMF of the cell.

(c) Explain briefly the principle underlying potentiometric titration and its advantage over volumetric titrations. Draw the potentiometric titration curve involving a strong acid and strong base. (4, 4, 4.5)

Section B: Organic Chemistry

5. (a) Discuss the Hinsberg test used for the identification of 1°, 2°, 3° amines. Outline the chemistry involved.

(b) Sucrose and lactose both are disaccharide but sucrose is a non-reducing sugar while lactose is a reducing sugar. Explain on the basis of their structures.

(c) Explain the mechanism of alkaline hydrolysis of ester. Why alkaline hydrolysis is generally preferred over acidic hydrolysis? (4.5, 4, 4)

6. (a) An aliphatic amine with molecular formula C_2H_7N exists in two isomeric forms 'A' and 'B'. When warmed with chloroform and KOH only 'A' reacts resulting into foul smell. What are the structures and names of 'A' and 'B'? Give name of the reaction and chemical equation involved in it.

(b) Explain why D-fructose reduces Fehling's solution although it is a ketose.

(c) Giving suitable explanation arrange the acid derivatives (ester, acid chloride, acid anhydride and amide) in decreasing order of reactivity towards nucleophilic acyl substitution reaction

(4.5, 4, 4)

7. Convert (any five)

(a) Aniline to p-nitro aniline

(b) D-Glucose to D-Fructose

(c) Phenylacetic acid to benzylamine

(d) Benzaldehyde to Benzamide

(e) Ethyl acetate to Acetic acid

(f) o-Toluidine to o-Cresol (5×2.5)

P.T.O.

8. (a) Deabbreviate: t-BOC and DCC. Using these, write all the steps involve for the synthesis of ala-val dipeptide. Give the name and structure of protecting and activating groups

(b) How will you convert D-arabinose to D-glucose and D-mannose by Killiani-fisher synthesis?

(c) Write short notes on:

(i) Hell-Volhard-Zelinsky reaction.

(ii) Secondary structures of proteins (4.5, 4, 4)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1459 **I**

Unique Paper Code : 2172512302

Name of the Paper : DSC: Chemical Energetics and Equilibria

Name of the Course : **B.Sc. Prog.**

Semester : III

Duration : 2 Hours — Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any **four** questions in all. Question No. **1** is compulsory.

3. Use of scientific calculator/log table is permitted.

NOTE : $R = 8.314\ JK^{-1}mol^{-1} = 0.0821\ dm^3atm\ mol^{-1}K^{-1}$

P.T.O.

1. Answer any five questions. Each question carry equal marks (3×5)

(a) Comment: All natural processes are irreversible in nature.

(b) Entropy favors melting and energy favors freezing of water. Discuss.

(c) Differentiate between residual entropy and third law entropy.

(d) The equilibrium constant for the reaction SO_3 (g) $\rightleftharpoons$ SO_2 (g) + 1/2 O_2 (g) is 0.18 at 900 K. What will be the equilibrium constant for the reaction $2SO_2$ (g) + O_2 (g) $\rightleftharpoons$ $2SO_3$ (g) at 900 K.

(e) Arrange the following in increasing order of pH. KNO_3 (aq), $C_6H_5COONH_4$ (aq), NH_4Cl (aq), CH_3COONa (aq)

(f) Explain any two limitations of the first law of thermodynamics which led to the formulation of the second law.

2. (a) Five moles of an ideal gas at 293 K are expanded are expanded isothermally from an initial pressure of 0.4053 MPa to a final pressure of 0.1013 MPa against a constant external pressure of 0.1013 MPa. Calculate q, w, ΔU and ΔH. (5)

(b) What is the effect of increasing pressure on the equilibrium?

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

What are the conditions for getting maximum yield of NH_3 by Haber's process? (5)

(c) At 298 K, the solubility product of $Bi(OH)_3$ is 4.0×10^{-31}. Calculate its solubility. (5)

3. (a) State Kelvin – Planck statement of second law of thermodynamics. Express the following rate of change in terms of state functions :

(i) H with respect to temperature in a system held at constant pressure.

(ii) S with respect to temperature in a system held at constant pressure. (5)

(b) Calculate the enthalpy change of the following reaction :

$$3C_2H_{2(g)} \rightarrow C_6H_{6(g)}$$

Given: Enthalpy of combustion of $C_2H_{2(g)} = -1.30$ $MJmol^{-1}$

Enthalpy of combustion of $C_6H_{6(g)} = -3.302$ MJ mol^{-1}

Write the reaction involved too. (5)

(c) What are buffer solutions? When a small quantity of acid is added to an aqueous solution of ammonium acetate, the pH of the solution remains unchanged, whereas when the same acid is added to an aqueous solution of sodium chloride, the pH of the solution changes enormously. Explain. (5)

4. (a) Prove that change in Gibbs free energy is non-PV work at constant temperature and pressure. (5)

(b) Show that the degree of dissociation (α) for the dissociation PCl_5 into PCl_3 & Cl_2 at pressure P is given by :

$$\alpha^2 = \left[\frac{K_p}{p + K_p}\right] \quad (5)$$

(c) 25 mL of 4×10^{-5} M solution of $Ba(NO_3)_2$ is mixed with 500 mL of 5×10^{-5} M solution of Na_2SO_4. Will a precipitate of $BaSO_4$ be formed? K_{sp} $(BaSO_4) = 1.08 \times 10^{-10}$ M^2. (5)

5. (a) Endothermic reactions are entropy driven processes. Explain. (5)

(b) The following reaction has attained equilibrium

$$CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)} \qquad \Delta H^\circ = -92.0 \text{ kJmol}^{-1}$$

What will happen if

(i) Volume of the reaction vessel is suddenly reduced to half.

(ii) The partial pressure of hydrogen is suddenly doubles. (5)

(c) Calculate the pH of an aqueous solution obtained by mixing 25 mL of 0.2 M HCl with 50 mL of 0.25 M NaOH. $K_w = 10^{-14}$ mol^2 dm^{-6} at 25°C. (5)

6. (a) Derive the relation between the pH of the solution and the relative amounts of the acid and salt present in it. (5)

(b) Calculate the bond enthalpy of C—H from the following data at 298 K:

Enthalpy of combustion of methane

$\Delta_c H = -890.36$ kJ mol^{-1}

Enthalpy of combustion of C (graphite)

$\Delta_c H = -393.51$ kJ mol^{-1}

$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(g)$

$\Delta_r H = -285.85$ kJ mol^{-1}

Enthalpy of dissociation of $H_2(g)$

$$\Delta_{diss}H = 435.93 \text{ kJ mol}^{-1}$$

Enthalpy of sublimation of C (graphite)

$$\Delta_{sub}H = 716.68 \text{ kJ mol}^{-1}$$

(5)

(c) Define the Joule-Thomson coefficient. Show that it is zero for an ideal gas. (5)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1547 I

Unique Paper Code : 2173522006

Name of the Paper : DSE : Biomolecules – I

Name of the Course : B.Sc. Prog.

Semester : III/V

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any FOUR questions out of SIX. All parts of a question should be attempted together.
3. Each question carries 15 marks.

P.T.O.

1. (a) Name the monomer used in the preparation of sucrose. Discuss the linkage in sucrose and draw the structure.

(b) Essential and non-essential fatty acids with suitable examples.

(c) DNA Translation. (5,5,5)

2. (a) Write the structure of Maltose and Lactose along with its uses? –

(b) Draw the structure of polynucleotide and explain its advantages.

(c) Explain hydrogenation of lipids with suitable example. (5,5,5)

3. (a) (i) How will you prepare Fructosazone ?

(ii) Write the reaction and name of the product when glucose is treated with hydrogen iodide in presence of red phosphorus.

(b) Draw and name the adenine containing nucleotides and explain its advantages.

(c) What are lipids and explain how they are useful for lipoproteins. (5,5,5)

4. (a) Discuss saponification and find out the saponification value of glyceryl tripalmitate (Given, Molecular weight = 806).

(b) Explain the differences between DNA and RNA.

(c) What are Epimers and Anomers? Give an example of each. (5,5,5)

5. (a) Explain ω-fatty acids with suitable examples.

(b) Draw the structures of five nucleic acid bases with their names.

(c) Discuss reducing and non-reducing sugars with suitable examples. (5,5,5)

P.T.O.

6. Write short note of any three of the following :

(a) Rancidity

(b) Mutarotation

(c) Genetic code

(d) Phospholipids (5,5,5)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1499 **I**

Unique Paper Code : 2173522009

Name of the Paper : DSE : Biomolecules II

Name of the Course : **B.Sc. (Prog)**

Semester : V

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions in all.
3. **All** questions carry equal marks.

P.T.O.

1. (a) How ninhydrin is used for the identification of amino acids? Write its chemical reaction.

(b) Write short notes on any two of the following :

(i) Fibrous and Globular protein

(ii) Essential and Non essential amino acids

(iii) Secondary structure of protein

(c) Give the Edman's method for determination of N-terminal residue analysis of a peptide. (5,5,5)

2. (a) Explain the drug action-receptor theory ?

(b) What is the difference between Catabolism and anabolism ?

(c) Write down the structure activity relationships (SAR) of Drug Molecules ? Explain the Binding Role of –OH, –NH2 groups. (5,5,5)

3. (a) Define the caloric value of food, and how it is determined ? Explain its significance in human nutrition.

(b) What is the purpose of con version of glucose into lactic acid and alcohol under anaerobic conditions ? Explain the various steps involved in alcoholic fermentation of glucose.

(c) What are ketone bodies, and why are they produced in the body ? Describe the significance of ketone bodies. (5,5,5)

4. (a) How do you synthesize a dipeptide Gly-Val?

(b) Explain the role of DCC, in the formation of peptide linkage with one example.

(c) Give the classification of amino acids based on their chemical structure. (5,5,5)

5. (a) Describe the role of NAD+ and FAD in biological redox systems.

(b) Calculate the amount of energy from the metabolism of per glucose molecule in cellular respiration in kilocalorie (kcal). Write the three major roles of enzymes in metabolism.

(c) What are the differences between Cofactors and Coenzymes? (5,5,5)

6. (a) Explain and write the reaction of the following ?

(i) Transferases.

(ii) Hydrolases

(b) Write short note on following

(i) Turnover number *vs* Catalytic efficiency

(ii) Specificity of enzyme

(c) What is allosteric inhibition? Give its mechanism. (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6329 **I**

Unique Paper Code : 42177925

Name of the Paper : DSE- Chemistry of d-block Elements, Quantum Chemistry and Spectroscopy

Name of the Course : **B.Sc. (Program)**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Six** questions in total with **three** from **Section A** and three from **Section B**.
3. Attempt **Section A** and **Section B** on separate sheets. Do not mix the questions of **Section A** and **Section B**.
4. Use of scientific calculator and Log table is allowed.

P.T.O.

Section A

(Inorganic Chemistry)

Attempt any **three** *questions.*

1. (a) Give reasons for **any three** of the following :

(i) The common oxidation of the first transition series elements increases up to manganese and then decreases.

(ii) $[NiCl_4]^{2-}$ is paramagnetic while $Ni(CO)_4$ is diamagnetic though both are tetrahedral.

(iii) Actinoids have greater tendency to form complexes as compared to lanthanoids.

(iv) Ti^{3+} complex compounds are coloured but Ti^{4+} complex compounds are colourless.

(b) What are the postulates of Valence Bond Theory (VBT). Discuss the geometry of $[Co(NH_3)_6]^{3+}$.

(c) What is Jahn Teller effect? Why distortion is found in octahedral complexes? Explain with examples. (6,3,3.5)

2. (a) Give the IUPAC names of **any three** of the following complexes :

(i) $[PtCl(NO_2)(NH_3)_4]SO_4$

(ii) $Na_3[Co(NO_2)_6]$

(iii) $[PtCl_2(NH_3)_4]$ $[PtCl_4]$

(iv) $[Co(en)_3](SO_4)_3$

(b) Indicate the type of isomerism in the following pairs :

(i) $[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$

(ii) $[Co(en)_2(H_2O)Cl]Cl_2$ and $[Co(en)_2Cl_2]Cl.H_2O$

(c) Draw the crystal field splitting diagram for Tetrahedral complex. (6,3,3.5)

3. (a) Explain the following :

(i) $[Fe(H_2O)_6]^{3+}$ shows magnetic moment is 5.9 BM but magnetic moment of $[Fe(CN)_6]^{3+}$ is 1.82 BM.

(ii) Octahedral complexes may be high spin or low spin but tetrahedral complexes are always low spin.

(b) What is the effect of nature of ligand on Δ_o.

(c) Calculate CFSE for a metal ion having d^6 configuration in an octahedral complex having $\Delta_o = 32{,}200\ cm^{-1}$ and the electron pairing energy (P) = $17{,}600\ cm^{-1}$. (6,3,3.5)

4. (a) Write short notes on **any two** of the following :

(i) Ion exchange method for separation of lanthanides

(ii) Transition metals have a strong tendency to form complex compounds.

(iii) Inner orbital and Outer orbital complexes with suitable examples in each case.

(b) The Latimer diagram of Mn in acidic medium is given as follow :

$$MnO_4^- \xrightarrow{0.56} MnO_4^{2-} \xrightarrow{2.27} MnO_2 \xrightarrow{0.96} Mn^{3+} \xrightarrow{1.51} Mn^{2+} \xrightarrow{-1.18} Mn$$

(i) Calculate the skip step emf for the $MnO_4^- \longrightarrow Mn^{2+}$ change

(ii) Name the best species as an oxidizing agent and a reducing agent under the above conditions.

(iii) Which species of Mn are unstable with respect to disproportionation.

(c) Explain the catalytic properties of 3d metals and their compounds. (6,3,3.5)

P.T.O.

Section B

(Physical Chemistry)

Planck's constant $h = 6.626 \times 10^{-34} Js$,

Velocity of light, $c = 3 \times 10^{8} ms^{-1}$

Mass of an electron, $m_e = 9.1 \times 10^{-31}$ kg

Attempt any **three** *questions.*

1. (a) What is quantum yield? Give the causes of high and low quantum yield of photochemical reactions.

   (b) Define the second law of photochemistry. A solution absorbs 3×10^{6} quanta of light per second. After 40 minutes of irradiation, 3.2×10^{6} moles of reactant were found to have remained out of 1 mole. Calculate the quantum yield for the process.

   (c) What are photosensitized reactions? Explain with the suitable example.

   (4,4.5,4)

2. (a) Define an eign value equation? Show which of the following mathematical functions are eign functions of operator d^2/dx^2 and give the corresponding eign values :

(i) Sin6x

(ii) exp(ikx)

(b) Write a short notes on degeracy.

(c) Write the short note on postulates of quantum mechanics. (4,4,4.5)

3. (i) The force constant of $^{12}C^{16}O$ is $1840 Nm^{-1}$. Calculate the vibrational frequency in cm^{-1} and the spacing between the vibrational energy levels in eV. ($1eV = 8066 cm^{-1}$)

(ii) State the essential condition for obtaining IR spectrum. Which of the following molecules will be IR active: H_2, HCl, NH_3, CO_2.

(iii) On what factors does the vibrational frequency of a molecule depend? Arrange the following functional groups in the order of their increasing vibrational frequency: H-Cl, H-I, H-F, H-Br. (4,4.5,4)

4. (i) Discuss the mechanism of photosensitization using suitable examples?

(ii) Calculate the average value of x for a particle in a 1D box of width a and infinite height.

(iii) Draw Jablonski diagram depicting various processes occurring in excited state.

(4,4,4.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

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Sr. No. of Question Paper : 6432

Unique Paper Code : 42177925

Name of the Paper : DSE – Chemistry of d-block Elements, Quantum Chemistry and Spectroscopy

Name of the Course : **B.Sc. (Program)**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Six** questions in total with three from **Section A** and **three** from **Section B**.
3. Attempt **Section A** and **Section B** on separate sheets. Do not mix the questions of **Section A** and **Section B**.
4. Use of scientific calculator and Log table is allowed.

P.T.O.

Section A

(Inorganic Chemistry)

Attempt any **three** *questions.*

1. (a) Give reasons for any **three** of the following :

(i) Transition metals and their compounds are good catalysts.

(ii) Zn and Cd are not considered as transition metals

(iii) Actinoids have greater tendency to form complexes as compared to lanthanoids

(iv) A solution of $[Ni(H_2O)_6]^{2+}$ is green, but a solution of $[Ni(CN)_4]^{2-}$ is colourless.

(b) Draw the crystal field splitting diagram for $[Fe(CN)_6]^{3+}$ and calculate CFSE.

(c) $[CoF_6]^{3-}$ is paramagnetic while $[Co(NH^3)_6]^{3+}$ is diamagnetic. Explain. (6,3,3.5)

2. (a) Give the IUPAC names of **any three** complexes of the following :

(i) $K_4[Ni(CN)_4]$

(ii) $[Co(N_3)(NH_3)_5]SO_4$

(iii) $[Co(NH_3)_5ONO]Cl_2$

(iv) $Fe(H_2O)_5(NO)]^{2+}$

(b) Indicate the type of isomerism in the following pairs :

(i) $[Pt(NH_3)_4\ Cl_2]Br_2$ and $[Pt(NH_3)_4Br_2]Cl_2$

(ii) $[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$

(c) For the $[Cr(H_2O)_6]^{2+}$ ion, the electron pairing energy(P) is 23,500 cm^{-1} and Δ_0 is 13,900 cm^{-1}. Calculate the CFSE for this complex ion corresponding to high spin and low spin state.

(6,3,3.5)

3. (a) Explain the following :

(i) Geometrical Isomerism in complexes of coordination number 4.

(ii) $[CoF_6]^{3-}$ ion is a high spin complex ion whereas $[Co(CN)_6]^{3-}$ is a low spin complex ion.

(b) Write the IUPAC formulae of **any two** of the following :

(i) Triamminetrinitrito-Ncobalt(III)ion

(ii) Caesium tetrafluorooxochromate(III)

(iii) di-μ-chlorido *bis* [diammineplatinum(II)] Chloride

(c) Discuss in detail the valence bond theory to explain metal-ligand bonding in coordination compounds.

(6,3,3.5)

4. (a) Write short notes on **any two** of the following :

(i) Lanthanides contraction and its consequences

(ii) Transition metals have a strong tendency

to form complex compounds.

(iii) Crystal field theory

(b) Given below is the Latimer diagram for Fe in acidic medium :

$$FeO_4^{2-} \xrightarrow{+2.20} Fe^{3+} \xrightarrow{+0.77} Fe^{2+} \xrightarrow{-0.47} Fe$$

Answer the following questions :

(i) Why is FeO_4^{2-} a strong oxidizing agent?

(ii) Is there any state which undergoes disproportionation? Explain

(iii) What is the most stable oxidation state?

(c) The magnetic moment value of $[Mn(CN)_6]^{3-}$ ion is 2.8 BM. Predict the type of hybridisation and geometry of the complex ion. (6,3,3.5)

Section B

(Physical Chemistry)

Planck's constant $h = 6.626 \times 10^{-34} Js$.

Velocity of light, $c = 3 \times 10^{8} ms^{-1}$

Mass of an electron, $m_e = 9.1 \times 10^{-31}$ kg

Attempt any three questions.

1. (a) Explain Lambert Beer laws and its limitation.

(b) Define quantum yield for a reaction. The quantum yield of the photochemical reactions:

$H_2(g) + Br(g) \rightarrow 2HBr\ (g)$ is low (0.01) while that of the reaction

$H_2(g) + Cl_2(g) \rightarrow 2HCl\ (g)$ is high (10^3). Explain why?

(c) Write a short note on Quenching of fluorescence.

(4,4.5,4)

2. (a) Define an eign-value equation? Show which of the following mathematical functions are eign functions of operator d^2/dx^2 and give the corresponding eign values :

(i) $4e^x$

(ii) $5\text{Sin}4x$

(b) Give the expression for the quantum mechanical operator p_x and also find whether the momentum operator p_x and position operator x commute with each other.

(c) Write the energy equation for a particle in a cubic box. Determine the quantum numbers and corresponding degeneracy of the quantum level having energy three times the energy of lowest level for a particle in a three-dimensional box of length a. (4,4,4.5)

3. (i) The pure rotational spectrum of a molecule AB consists of a series of equally spaced lines separated by 40.64 cm^{-1}. Calculate the moment of inertia and internuclear distance of the molecule.

P.T.O.

The atomic masses are : $A = 1.673 \times 10^{-27}$ kg

$B = 58.06 \times 10^{-27}$ kg

(ii) Derive formula for energy gap between two consecutive energy levels and also calculate the energy for two energy levels that 4 to 5.

(iii) What is the general selection rule for a molecule to be microwave active? In the light of the above rule, explain the microwave activity of the following molecules with reason:

(i) CO_2

(ii) HF

(iii) O_2

(iv) H_2S (4,4.5,4)

4. (i) Draw the Jablonski diagram and explain briefly the various transitions depicting different photophysical processes.

(ii) Explain the photophysical and photochemical reactions with examples.

(iii) Write a short note on Accidental degeracy? (4,4,4.5)