Roll No. .....

Exam Code : D-22

Subject Code—58383

B. Sc. EXAMINATION

(Main/Re-appear) (Batch 2018 Onwards)

(First Semester)

CHEMISTRY

CCL-104

Inorganic Chemistry-I

(Atomic Structure and Bonding)

Time : 3 Hours *Maximum Marks : 80*

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

Compulsory Question

1. (i) What is radial probability distribution function ? 2

(ii) What is Bond order of B_2 molecule ? 2

(iii) Explain the geometry of SF_4 molecule. 2

(iv) Explain the physical significance of Heisnberg uncertainty principle in daily life. 2

(v) What is electronic configuration of Pd ? 2

(vi) Arrange the orbitals in terms of $(n + l)$ rule $3s$, $4d$, $5p$. 2

(vii) What is Henry and Smith relationship ? Calculate % ionic character of HF molecule if electronegativity of H and F is 2.1 and 4.0 respectively. 2

(viii) Draw the plot of electron probability density (ψ^2) v/s intermolecular distance for bonding molecular orbitals. 2

Unit I

2. (a) What is Schrödinger's wave equation of H atom ? Explain the radial and angular wave function and also explain on which quantum no. radial and angular wave function depend. 6

(b) Explain why de-Broglie wave equation is significant only for microscopic particle but not for macroscopic particle. 4

(c) Explain the emission spectra of H atom (or Hydrogen spectra) in detail. 6

3. (a) What is de-Broglie wavelength ? Derive Schrödinger's wave equation by using it. 6

(b) Determine the wavelength of the photon in nm emitted during transition from $n = 5$ to $n = 2$, $R_H = 1.09 \times 10^5\ cm^{-1}$. 6

(c) What is radial wave function for $1s$ and $2s$ orbital. 4

Unit II

4. (a) Explain the shape of s, p and d-orbital. 6

(b) Calculate the number of nodes, maxima and angular nodes for $4d$, $5f$, $4p$, $4s$ orbital. 6

(c) Write the electronic configuration of Ni^{2+}, Pt^{2+}, V^{2+}, Cu^{2+}. 4

5. (a) Define radial probability distribution curve and draw the curve for $3d$ and $4s$ orbital. 6

(b) Explain :

(i) Hund's rule

(ii) Pauli's exclusion principle

(iii) Aufbau rule. 4

(c) (i) What is electronic configuration of Mn^{2+} and Co^{2+} ion ?

(ii) Explain, why half filled and fully filled orbital are stable. 6

Unit III

6. (a) What is Born Lande Equation ? Explain the factor on which Born Lande equation depends. 3

(b) Explain the application of polarization of Fazan rule. 4

(c) Explain the geometry and hybridisation of XeF_6 and SO_4^{2-}. 6

(d) Explain VSPER theory and its postulates. 3

7. (a) Explain the following characteristics of ionic solids : 4

(i) Solubility

(ii) Isomorphism

(iii) Conductivity

(iv) Hard and Brittle nature.

(b) Calculate lattice energy of KCl using Born Haber cycle from the following data : 4

Sublimation energy for K(S) = 89 kJ/mol

Ionization energy of K (IE) = 425 kJ/mol

Dissociation energy of Cl_2 (D) = 244 kJ/mol

Electron Gain Enthalpy of Cl (EGE) = –355 kJ/mol

Enthalpy of formation = –438 kJ/mol of KCl

(c) Bond angle of NH_3 is greater than NF_3 and Bond angle of PH_3 is less than PF_3. Why ? 4

(d) Explain the hybridization and geometry of molecules : 4

(i) $[Ni(CN)_4]^{2-}$

(ii) NO_3^-.

Unit IV

8. (a) Differentiate Bonding and Anti-bonding molecular orbital. 4

(b) What are rules for filling molecular orbital ? 3

(c) Explain the MOT diagram for NO, NO^+, NO^- molecule. 5

(d) Which have greater bond dissociation energy—N_2, N_2^+ and N_2^-. 4

9. (a) Give the condition for combination of atomic orbital according to LCAO. 4

(b) Why does N_2^+ have longer bond length than N_2 but O_2^+ is smaller than O_2 ? 6

(c) Explain, how MOT diagram determines the following properties of molecules ? 6

(i) Bond Order

(ii) Bond Dissociation Energy

(iii) Stability

(iv) Magnetic Property.

85

Roll No. ..... 18 Exam Code : D-22

Subject Code—58384

B.Sc. EXAMINATION

(Main/Reappear) (Batch 2018 Onwards)

(First Semester)

CHEMISTRY

CCL-105

Organic Chemistry-I

(General Organic Chemistry and Aliphatic Hydrocarbons)

Time : 3 *Hours* *Maximum Marks* : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory.

(Compulsory Question)

1. (a) Define electromeric effect with example. 2

(b) What are carbanions ? Give the orbital structure of simple carbanion. 2

(c) What are meso compounds ? Why are they optically inactive ? 2

(d) Rank the following groups in order of decreasing priority on the basis of sequence rules for R/S configuration : 2

(i) $-CH_2CH_3, -CH_3, -H, -CH(CH_3)_2$

(ii) $-H, -CH_2Br, -CH_3, -CH_2CH_2Br$.

(e) The alkanes, (i) C_6H_{12} and (ii) C_8H_{18} on treatment with chlorine give only one monochloride. Give the structures of each alkane and its chloride. 2

(f) Write a note on Birch reduction of alkynes to give *trans* alkenes. 2

(g) Acetylene is more acidic than ethane. Explain. 2

(h) Prepare ethyne from calcium carbide. 2

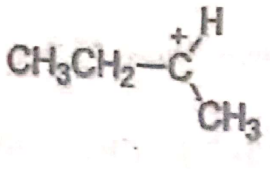
Unit I

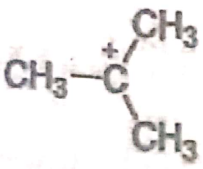
2. (a) How is hyperconjugative effect used to explain the relative stability of alkenes ? 4

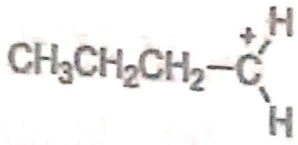
(b) Explain the stability order among the 1°, 2° and 3° carbanions. 4

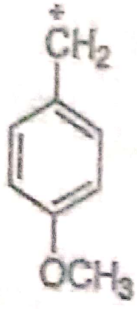
(c) What are aromatic, anti-aromatic and non-aromatic compounds ? Give *one* example of each. 4

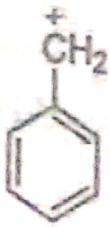
(d) List the carbocations in each set in decreasing order of stability : 4

(i) 



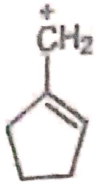


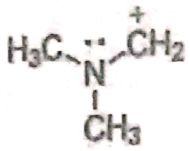
(ii) 



3. (a) Why are allyl and benzyl carbocation stable ? 4

(b) Write the important resonance structures for each of the following and also designate the one that would contribute most to the hybrid : 4

(i) 

(ii) 

(iii) $H_2\ddot{N}-C\equiv N$

(iv) $CH_3-\overset{+}{C}H-\ddot{S}-CH_3$

(v) $CH_3-CH_2-\overset{+}{C}=\ddot{O}:$

(c) Identify the stronger nucleophile in each pair : 4

(i) NH_3, NH_2^-

(ii) CH_3^-, HO^-

(iii) CH_3NH_2, CH_3OH

(iv) CH_3COO^-, $CH_3CH_2O^-$

(iv) $CH_3CH_2O^-$, $(CH_3)_3CO^-$

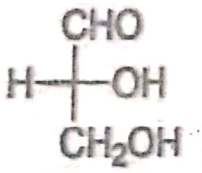
(d) Give the differences in between inductive effect and electrometric effect. 4

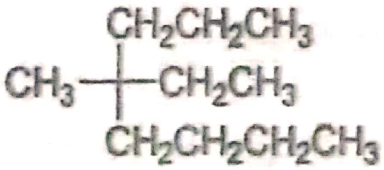
Unit II

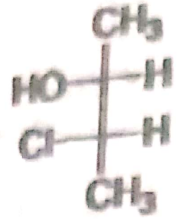
4. (a) What are sequence rules ? Discuss with suitable examples. 4

(b) Give the properties of enantiomers. 4

(c) Assign R and S configuration of the following compounds for each chiral carbon : 4

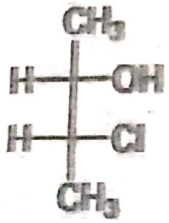
(i) 

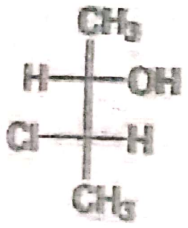
(ii) 

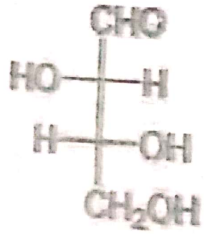
(iii) 

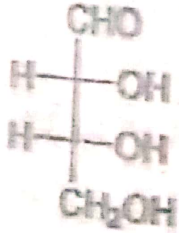
(d) Explain order among the stability of the different Newman conformations of propane. 4

5. (a) Assign *erythro* and *threo* to the following with reasoning : 4

(i) 

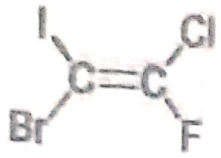
(ii) 

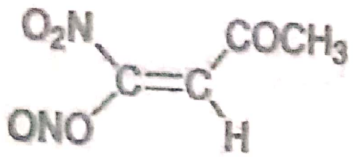
(iii) 

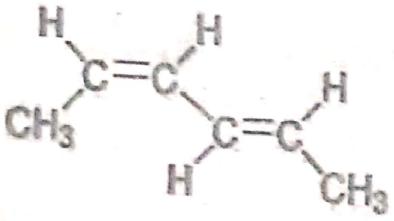
(iv) 

(b) Discuss the conformational analysis of *n*-butane with Newman formula and relative energies of various conformations. 4

(c) Assign E and Z configurations to the following : 4

(i) 

(ii) 

(iii) 

(d) Explain the following terms : 4

(i) Flagpole hydrogens

(ii) Axial hydrogens

(iii) Equatorial hydrogens

(iv) Torsional strain.

6. (a) Offer suitable explanation for the following statements : 4

(i) The boiling points of isomeric alkanes decreases with increase in the branching of the chain.

(ii) *n*-Alkanes with even number of carbon atoms melt at higher temperatures than those with odd number of carbon atoms.

(b) Explain mechanism of hydroboration-oxidation reaction of alkenes with suitable example. 4

(c) State Markovnikov's rule. Explain the addition of HCl to $CH_3CH = CH_2$ using this rule. 4

(d) Calculate percentage of products obtained by monobromination of 2-methylpropane. (Reactivity of 3°, 2°, 1° hydrogens in bromination is 1600 : 82 : 1). 4

7. (a) Discuss briefly the mechanism of chlorination of methane. Also cite three evidences in support of the mechanism. 4

(b) Discuss the mechanism of the Kolbe's electrolysis. 4

(c) Discuss the mechanism of anti-Markovnikov's addition of HBr to unsymmetrical alkenes. 4

(d) Discuss the mechanism of addition of halogens to alkenes. Also give evidences in support of proposed mechanism. 4

Unit IV

8. (a) Prepare an alkyne from : 4

(i) A dihalogen derivative

(ii) A tetrahalogen derivative.

(b) How can you convert propyne into 2-butyne ? 4

(c) Complete the following reactions : 4

(i) $H-C\equiv C-H + 2\,Br_2 \xrightarrow{CCl_4}$

(ii) $CH_3-C\equiv CH \xrightarrow{O_3} A \xrightarrow{Zn\,/\,H_2O} B$

(iii) $CH_3CH_2-C\equiv C-H \xrightarrow[(ii)\ H_2O]{(i)\ O_3}$

(d) A terminal alkyne was treated with $NaNH_2$ followed by propyl iodide. the resulting internal alkyne was treated with ozone followed by water, giving only one type of carboxylic acid. Give the structures of terminal and internal alkynes and also write the reactions involved. 4

9. (a) Give the structures of three isomeric dichlorides that could be used as starting materials for the preparation of 3,3-dimethyl-1-butyne. 4

(b) Predict the products formed when ethyne, propyne and 2-butyne are treated with dilute cold, neutral $KMnO_4$ solution. 4

(c) Write all the possible structures for the compounds having molecular formula C_5H_8 which upon treatment with ammoniacal $AgNO_3$ solution gives a white precipitate. 4

(d) Propose a plausible mechanism for the following transformation : 4