CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examinations, Aug-Sept. 2022

Programme: M.Sc. Chemistry **Session: 2021-2022**

Semester: II **Max. Time: 2 hours**

Course Title: Analytical Techniques in Chemistry **Max. Marks: 35**

Course Code: SBS CH 010202 DCS 2002

Instructions

1. Question no. 1 has four subparts and students need to answer any two. Each subpart carries 3.5 Marks.
2. Question no. 2 to 5 have three subparts and students need to answer any two subparts of each question. Each subpart carries 3.5 Marks.

Question 1

a) Describe the principle and instrumentation of DSC.

b) Write down a short note on applications of biosensors in environmental pollutant detection.

c) Explain the phenomenon of electron optics.

d) Write in brief about Tafel plots. (3.5 X 4)

Question 2

a) Illustrate the TGA curve for $CuSO_4.5H_2O$.

b) Write down a short note on applications of DSC.

c) Describe the factors affecting the TGA curve of an analyte. (3.5 X 3)

Question 3

a) Write down the principle of cyclic voltametry. How it helps in metal analysis?

b) Write down theory and Principle of chronoamperometry.

c) How do electrochemical techniques help in analyzing the fertilizers? (3.5 X 3)

Question 4

a) Write a note the introduction of microscopy.

b) Write a note on electron beam lithography.

c) Describe the principle and working of SEM. (3.5 X 3)

Question 5

d) What you mean by anodic and cathodic polarization?

e) Write a short note on Impedance spectroscopy.

f) Describe the terms Nyquest plots and Bod plots in brief. (3.5 X 3)

CENTRAL UNIVERSITY OF HARYANA

Second Semester Term End Examinations September 2022

Programme: M.Sc. Chemistry **Session: 2021-22**
Semester: Semester-II **Max. Time: 2 Hours**
Course Title: Computational Chemistry **Max. Marks: 35**
Course Code: SBS CH 010201 DCSC 2002

Instructions:

1. Question no. 1 has four parts and students need to answer any two. Each part carries three and half Marks.
2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries three and half marks.

Question No. 1. **(2X3.5=7)**

a) Briefly discuss theoretical and computational chemistry?
b) What is semi empirical method?
c) Why is basis set choice critical?
d) Write a note on transition structure modeling.

Question No. 2. **(2X3.5=7)**

a) Write a short note on Born-Oppenheimer approximation.
b) Discuss restricted and unrestricted Hartree–Fock methods in detail with suitable transition metals.
c) What do you mean by self-consistent field theory?

Question No. 3. **(2X3.5=7)**

a) What are exchange-correlation functionals?
b) Briefly describe higher order gradient approximation.
c) Write a note on hybrid density functional methods.

Question No. 4. **(2X3.5=7)**

a) Why are typical basis sets not good for transition metal complexes, and why is the LANL2DZ basis set used so often for transition metals?
b) How important to use split basis set? Discuss with examples.
c) What are correlation-consistent basis sets?

Question No. 5. **(2X3.5=7)**

a) What do you mean by stationary point, saddle point, local and global minima?

b) What do you observe during optimization of a molecule? Discuss in detail.

c) Briefly discuss steepest descent and Newton–Raphson methods.

CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examinations, Aug-Sept. 2022

Programme: Int. B.Sc.-M.Sc. Chemistry **Session: 2021-2022**

Semester: II **Max. Time: 3h**

Course Title: Organic Chemistry-I: Basics & Hydrocarbons **Max. Marks: 70**

Course Code: SBS CH020201 C 4004

Instructions

1. Question no. 1 has seven subparts and students need to answer any four. Each subpart carries 3.5 Marks.
2. Question no. 2 to 5 have three subparts and students need to answer any two subparts of each question.

Question 1

a) What is hyperconjugation? How does it differ from resonance?

b) Explain the effect of hybridization of carbon on acidity of hydrocarbons.

c) What is optical activity? Write down the necessary condition for a molecule to be optically active.

d) Describe Wurtz reaction for the synthesis of butane and hexane.

e) Write a short note on Diels-Alder reaction by taking a suitable example.

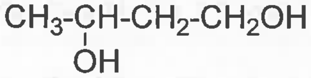
f) Explain Markonikov's rule in addition reactions of alkene with example.

g) Out of the following, select the aromatic compounds with justification

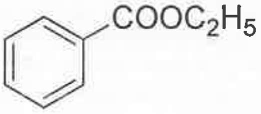
- i) Cyclopropyl cation
- ii) Cyclopentadienyl anion
- iii) Pyridine
- iv) Indole (3.5 X 7)

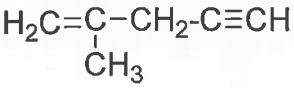
Question 2

a) i) Write the IUPAC name for each compound

(i) 

$CH_3\text{-}\underset{OH}{CH}\text{-}CH_2\text{-}CH_2OH$

(ii) 

(iii) 

$H_2C{=}\underset{CH_3}{C}\text{-}CH_2\text{-}C{\equiv}CH$

(3)

ii) What are carbenes? Discuss the structure of carbene. (4)

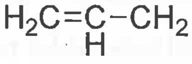
b) i) Explain the decreasing order of stability of given carbanion. (4)

$HC{\equiv}\overset{-}{C}$ $H_3C\text{-}C{\equiv}\overset{-}{C}$ $H_2C{=}\overset{-}{C}H$ $CH_3\text{-}\overset{-}{C}H_2$

ii) *p*-Nitrophenol is more acidic than phenol. Give reason. (3)

c) i) Write down the differences between SN^1 and SN^2 reactions. (3)

ii) Give reason

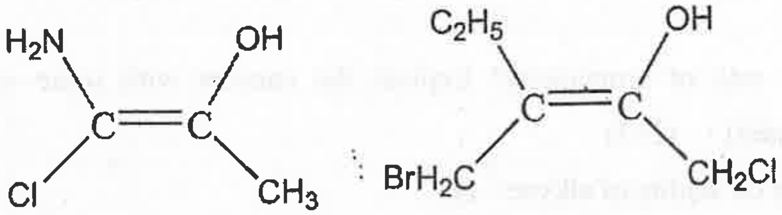
(a) Why $CH_3\text{-}\overset{+}{C}H_2\text{-}CH_3$ is less stable than  $H_2C{=}\underset{H}{C}\text{-}\overset{+}{C}H_2$. (2)

(b) Why *tert*-butyl carbocation is more stable than *iso*propyl carbocation?

Question 3

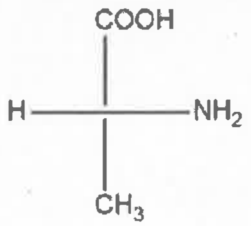
a) i) Draw all possible conformation (Newman) of n-butane and relate their energies. Also, give reason for their stability. (5)

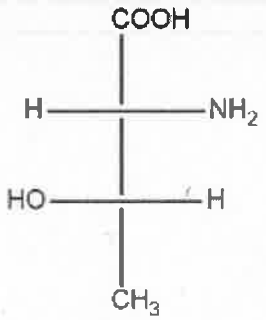
(ii) Assign E or Z notations to the following compounds (2)



b) i)Why chair form of cyclohexane is more stable than boat form? (2)

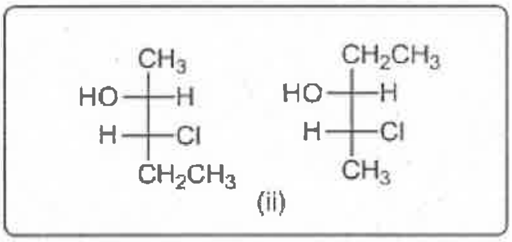
ii) Assign R/S configuration to the stereogenic centers (2)





iii) Write difference between enantiomers and diastereomers. (3)

c) i) Assign R/S configuration to the stereogenic centers and give relation between the following compounds. (3)



ii) Write a short note on

(i) threo and erythro

(ii) D and L nomenclature. (4)

Question No. 4

a) i) Describe the Diels Alder reaction with suitable example. (3.5)

ii) What is E_1 elimination reaction? Write down the factors affecting E_1. (3.5)

b) Describe Hydroboration-oxidation reaction by taking propene as a substrate. Illustrate the mechanism for the reaction.(7)

c) i) Write down the Ozonolysis product of the o-xylene and p-xylene. (3.5)

ii) Explain the mechanism of allylic bromination. (3.5)

Question No. 5

a) i) What is Huckle rule of aromaticity? Explain the concept with some suitable examples (at least three). (2+3)

ii) Write a short note on acidity of alkyne. (2)

b) i) Describe any two methods for alkylation of terminal alkyne. (4)

ii) Describe the alkylation, nitration and sulphonation of benzene. (3)

c) Describe any two nucleophilic addition reactions of alkynes. (3.5 + 3.5)

CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examinations, August-September 2022

Programme: Int. B.Sc.-M.Sc. Chemistry **Session: 2021-2022**

Semester: II **Max. Time: 3 hours**

Course Title: GE Chemistry: Chemical Energetics, Equlibria & Functional Organic Chemistry-I **Max. Marks: 70**

Course Code: SBS CH 020201 GE 4004

Instructions

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1. Question no. 1 has seven subparts and students need to answer any four. Each subpart carries 3.5 Marks.
2. Question no. 2 to 5 have three subparts and students need to answer any two subparts of each question.

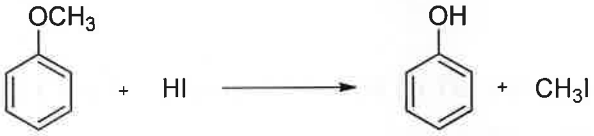
Question No. 1. (3.5 X 7)

(a) Write down a short note on extensive and intensive Properties.

(b) Differentiate the terms, State function and Path function.

(c) How primary, secondary and tertiary alcohols can be differentiated on the basis of Lucas Reagent.

(d) Write down the mechanism for the following conversion



(e) Why solubility of AgCl decreases if some $AgNO_3$ is added to its saturated solution.

(f) Salt of strong acid and strong base does not undergo hydrolysis. Why?

(g) Alkyl halides are more reactive towards nucleophilic substitution reaction than aryl halides. Give reason.

Question No. 2.

a) i) Write down a short note on Thermodynamic Processes. (4)

ii) Calculate the resonance energy of nitrous oxide from the following data

ΔH°_f of N_2O = 82 KJ/mol (3)

Bond energies

$N \equiv N$	946 KJ/mol
$N=N$	418 KJ/mol
$O=O$	498 KJ/mol
$N=O$	607 KJ/mol

b) Derive an expression for variation of enthalpy of a reaction with temperature. (7)

c) i)The molar heat of combustion of C_2H_2(g), C (graphite) and H_2 (g) are 310.62, 94.05 and 68.32 Kcal respectively. Calculate heat of formation of C_2H_2. (3.5)

ii)The heat evolved on combustion of 1g of starch $(C_6H_{10}O_5)_n$ into CO_2 and H_2O is 17.49 KJ/g. Compute the enthalpy of formation of 1g of starch. Given ΔH_f of H_2O (l) = -285.85 KJ/mol and ΔH_f of CO_2 = -293.7 KJ/mol. (3.5)

Question No. 3.

a) (i) What are buffer solutions? How a solution of weak base and its salt behaves as a buffer? Derive Henderson equation for a buffer mixture of weak base and its salt.

(ii) A buffer solution contains 0.20 mole of NH_4OH per litre. Calculate the pH of the solution. Dissociation constant of NH_4OH at room temperature is 1.81×10^{-5} (4, 3)

b) (i) Derive an expression for hydrolysis constant and degree of hydrolysis for salt of strong acid and weak base. Also derive expression for calculation of pH of hydrolysed solution.

(ii) What would be the pH of 0.01 M solution of NH_4Cl in water at 25 °C? (Kb for $NH_4OH = 1.81 \times 10^{-5}$) (5, 2)

c) (i) What is solubility product of a substance? Discuss the application of solubility product principle to inorganic analysis. (3)

(ii) Derive the relation between K_p, K_c and K_x. Under what conditions $K_p=K_c=K_x$ (4)

Question No. 4

a) i) What are the products obtained when 2-chloro-1-phenylpropene undergoes hydrohalogenation? Which one is the major product and why? (3)

ii) Why does propene react with HBr in presence of peroxide to give 1-Bomopropane whereas in absence of peroxide it gives 2-Bromopropane. (4)

b) i) What is Friedel-Craft alkylation reaction? Give mechanism of the reaction. (3)

ii) Write difference between nucleophilic substitution reactions SN^1 and SN^2. (4)

c) i) Write short note on the following:

(a) Williamson's ether synthesis

(b) Sandmeyer reaction.(4)

ii) The presence of nitro group at ortho/para postions increase the reactivity of haloarenes towards nucleophilic substitution reactions Comment. (3)

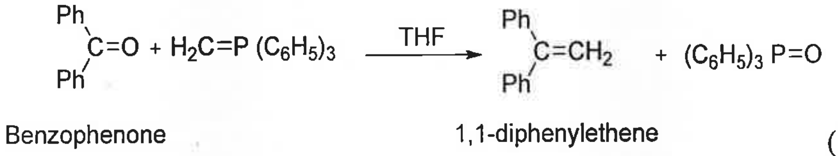
Question No. 5.

a) Illustrate the mechanism of Pinacol-Pinacolone rearrangement with suitable example. (7)

b) What is Reimer-Tiemann reaction? Explain the mechanism of reaction by taking Phenol as a substrate. (7)

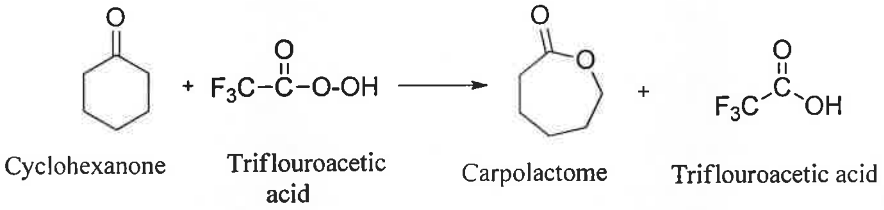
c) Write down the suitable mechanism for the following conversion

i)



(3.5 marks)

ii)



(3.5 marks)

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations Aug-Sept. 2022

Programme: M.Sc. Chemistry **Session: 2021-22**
Semester: Second **Max. Time: 3 Hours**
Course Title: Physical Chemistry-II (Quantum Chemistry & Group Theory)
Course Code: SBS CH 010209 C 4004 **Max. Marks: 70**

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and a half Marks.
2. Questions no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries seven marks.

Q 1. (4 × 3.5 = 14)

a) Define symmetry and symmetry elements.
b) Define the terms: i) Class and ii) Subgroup.
c) Differentiate between competitive and non-competitive inhibition.
d) Write a short note on Associated Legendre polynomials.
e) Differentiate between reversible and irreversible thermodynamics.
f) Write down the limitations of Lindemann's theory of unimolecular reactions.
g) Find the value of x in terms of spherical coordinates in the case of a rigid diatomic rotator.

Q 2. (2 × 7 = 14)

a) Derive Recursion formula for rigid diatomic rotator.
b) Solve Radial Wave Function in case of a Hydrogen atom.
c) Solve spherical Eigen function in the case of a rigid diatomic rotator.

Q3. (2 × 7 = 14)

(a) i) Describe the Lindemann's theory of unimolecular reactions. Show that it leads to the
rate expression. (5)

$$r = \frac{k_3 k_1 [A]^2}{k_2 [A] \div k_3}$$

ii) Under what conditions does the order of the reaction become 1 and 2 ? (2)

(b) i) The Michaelis-Menten mechanism of an enzyme-catalyzed reaction is

$$\mathbf{E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} E + P}$$

Find out the rate of formation of the product. (4)

ii) Show that the enzyme reaction is first-order and zero-order w.r.t. S at low and high concentrations of S, respectively. (3)

(c) i) Explain how the Lineweaver-Burk and Eadie-Hofestee plots help in deriving the value of V_{max} and K_M (Michaelis-Menten constant). (4)

ii) For an enzyme-substrate reaction, the K_M for the reaction is 0.05 mol dm^{-3} and the rate of the reaction is 2.5×10^{-5} mol dm^{-3}. If substrate concentration is 0.9 mol dm^{-3}, find V_{max}. (3)

Q 4. (2 × 7 = 14)

a) (i) List all possible symmetry elements present in Allene and H_2O_2. (4)

(ii) Determine and explain the point group of staggered and eclipsed Ferrocene. (3)

b) (i) Explain the consequences of the Orthogonality Theorem. (3)

(ii) $C_n^n = E$ but $S_n^n \neq E$ (when n is odd). Why? (2)

(iii) State and explain Mullikan's notation for irreducible representation in the character table. (2)

c) (i) Construct the character table for point group C_2V. (4)

(ii) The characters of a reducible representation of a C_2V group are

C_2V	E	$C_2(z)$	σ_{xz}	σ_{yz}
	9	-1	3	1

Find how many times each irreducible representation of a C_2V group is present in reducible representation? (3)

Q 5. (2 × 7 = 14)

a) Derive an equation for entropy production due to heat from the box I to box II.

b) Derive four relations of Electro-kinetic effects of irreversible thermodynamics.

c) Write a short note on Thermomechanical Pressure Difference (TPD) and Thermo-mechanical effect in irreversible thermodynamics.

CENTRAL UNIVERSITY OF HARYANA

Second Semester Term End Examinations August-September 2022

Programme: M.Sc. Chemistry	**Session: 2021-22**
Semester: II	**Max. Time: 3 Hours**
Course Title: Inorganic Chemistry-II	**Max. Marks: 70**
Course Code: SBS CH 010207 C 4004	

Instructions:

1. Question no. 1 has seven parts and students are required to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and student are required to answer any two parts of each question. Each part carries seven marks.

Q 1. (4X3.5=14)

a) What is the difference between "spectroscopic terms" and "orbitals"? Write down the advantages of spectroscopic terms in analyzing properties of inorganic complexes.

b) Determine the ground state term symbols of $2p^1$ and $3d^2$ electronic configurations.

c) Discuss the effect of the spin orbit coupling on the effective magnetic moment-explain with examples and relevant formula.

d) What is superexchange phenomenon between two paramagnetic centers? Based on superexchange, what would the exchange interaction between two d^5-d^5 metal ions through oxide ion?

e) What are inert and labile complexes? Explain with examples.

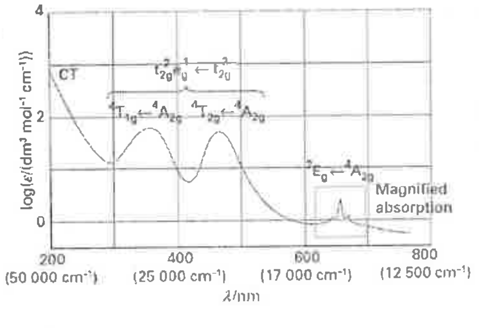
f) What is chelate effect? Discuss with example.

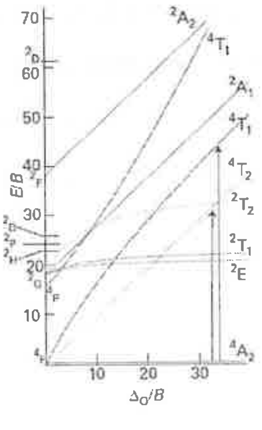
g) Write a short note on the determination of formation constant by pH-metry.

Q 2. (2X7=14)

a) Draw the Orgel diagram of tetrahedral and octahedral d^2, d^3, d^7 and d^8 configurations together in a single plot with proper labeling. Discuss the mixing of T_1 and A_2 states and repulsion of T_1 states in the diagram. **(7 marks)**

b) (i) From the two figures given below, deduce the values of Δ_O and B for $[Cr(NH_3)_6]^{3-}$. The complex exhibits two low-energy transitions at 21,550 and 28,500 cm^{-1}. **(4 marks)**





(ii) What are charge transfer complexes? **(3 marks)**

c) (i) What is positive (+) and negative (–) Cotton effect? How the CD and ORD curves are helpful for assigning the configurations of optically active complexes? **(5 marks)**

(ii) Write down the absolute configurations of the following two complexes from information given in below table. **(2 marks)**

Formula of complexes	ν (cm^{-1})	ε_l-ε_r	Absolute configurations
(-)589-$[Co(en)_3]^{3+}$	20,280	-2.18	?
(+)589-$[Co(R\text{-}pn)_3]^{3+}$	18,500	+1.13	?

Q3. (2X7=14)

a) Explain spin-crossover in coordination compounds taking one example. Discuss the effect of temperature on the spin-crossover behavior **(3½ + 3½ marks)**

b) (i) Write a short note on orbital contribution to the magnetic moment mentioning the conditions for orbital contribution to magnetic moment. **(4 marks)**

(ii) Arrange the μ_{eff} values for the four CoX_4^{2-} complexes where X = SCN^-, Cl^-, Br^- and I^-. Explain the order. **(3 marks)**

c) (i) Write a short note on spin canting and spin frustration **(2+2 marks)**

(ii) Why diamagnetic character is shown by all the substances? If a substance has both dia- and paramagnetic character, which one would prevail? **(3 marks)**

Q 4. (2X7=14)

a) (i) What is the difference between transition state and intermediate? Explain by drawing energy profile diagram. **(4 marks)**

(ii) Explain thermodynamic and kinetic stability with examples of metal cyanide compounds. **(3 marks)**

b) Write a note on substitution reactions in octahedral complexes. Discuss the mechanism in details with examples and derive rate law for dissociative mechanism. **(7 marks)**

c) (i) Write short notes on inner sphere and outer sphere reactions. **(2½ + 2½ marks)**

(ii) Explain *trans* effect with an example. **(2 marks)**

Q 5. (2X7=14)

a) (i) Explain the term stepwise formation constant? Discuss in brief how the nature of metal ion and ligands determine the stability of the complexes. **(5 marks)**

(ii) What is macrocyclic effect? **(2 marks)**

b) (i) The stepwise stability constants (log *K*) for successive replacement of H_2O with NH_3 in $[Ni(H_2O)_6]^{3+}$ are: 2.79, 2.26, 1.69, 1.25, 0.74 and 0.03 in 2M NH_4NO_3 at 30 °C. What do you observe from this? Explain with proper explanation. **(3 marks)**

(ii) Which types of rings (e.g. 3, 4, 5, 6, 7-membered) give rise to high stability of metal complexes? Discuss chelate effect by taking suitable example. **(4 marks)**

c) (i) The formation constants for the following reactions is as follows:

$[Fe(OH_2)_6]^{2+}(aq) + bpy(aq) \Leftrightarrow [Fe(bpy)(OH_2)_4]^{2+}(aq) + 2H_2O(l)$ $\log K_1 = 4.2$

$[Fe(bpy)(OH_2)_4]^{2+}(aq) + bpy(aq) \Leftrightarrow [Fe(bpy)_2(OH_2)_2]^{2+}(aq) + 2H_2O(l)$ $\log K_2 = 3.7$

$[Fe(bpy)_2(OH_2)_2]^{2+}(aq) + bpy(aq) \Leftrightarrow [Fe(bpy)_3]^{2+}(aq) + 2H_2O(l)$ $\log K_3 = 9.3$

Explain why log K_3 is much higher than log K_1 and log K_2. **(3 marks)**

(ii) Write a short note on determination of formation constant by spectrophotometry. **(4 marks)**

Or

Discuss the behavior of crown ethers towards different alkali metal ions. How the energy factor becomes important in addition to the entropy factor for stabilizing such crown ether metal complexes? **(4 marks)**

CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examinations, Aug-Sept. 2022

Programme: Int. B.Sc.-M.Sc. Chemistry **Session: 2021-2022**

Semester: II **Max. Time: 3 hours**

Course Title: Physical Chemistry-II: Thermodynamics & its applications

Course Code: SBS CH020202 C 4004 **Max. Marks: 70**

Instructions

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1. Question no. 1 has seven subparts and students need to answer any four. Each subpart carries 3.5 Marks.
2. Question no. 2 to 5 have three subparts and students need to answer any two subparts of each question. Each subpart carry the total 7.0 marks.

Question 1

a) Write down a short note on extensive and intensive properties.

b) Describe the following thermodynamic functions.
   i) Gibb's free energy
   ii) Internal Energy

c) Explain the work done during various kind of thermodynamic processes.

d) Define the term adiabatic flame temperature. Derive an expression for calculating it.

e) Gibbs free energy change **ΔG**, determines the spontaneity of a reaction. Comment.

f) The equilibrium constant Kp for a gaseous reaction is independent of pressure, Kx is not. Give reason.

g) Why the solution of the water and alcohol shows deviation from Raoult's law. (3.5 X 7)

Question 2

a) i) A carnot engine works between 120 ^{0}C and 30 ^{0}C. Calculate the efficiency. If the power produced by the engine is 400 watts, calculate the heat absorbed from the source and rejected to the sink every second. (3)

ii) Derive the expression for work done carried out during reversible isothermal expansion and reversible isothermal expansion. (4)

b) Derive an expression for integrated form of Clausius-Clapeyron equation. (7)

c) i) The heat evolved on combustion of 1g of starch $(C_6H_{10}O_5)_n$ into CO_2 and H_2O is 17.49 kJ/g. Compute the enthalpy of formation of 1g of starch. Given ΔH_f of H_2O (l) = -285.85 kJ/mol and ΔH_f of CO_2 = -293.7 KJ/mol. (3.5)

ii) What you mean by enthalpy? Define the terms enthalpy of formation, enthalpy of combustion and enthalpy of neutralization. 3.5)

Question 3

a) What you mean by spontaneous and non-spontaneous reactions? Describe the criteria for a reaction to be spontaneous in terms of Gibb's free energy, enthalpy, work function, internal energy and entropy. (7)

b) What you mean by Joule Thomson coefficient? Derive an expression for the calculating it. (7)

c) i) $\Delta S_{vap}$of acetone is 0.09 kJ/mol K. If boiling point of acetone is 56 ˚C, calculate the heat required for vaporization of 1g of acetone. (3)

ii) Derive an expression for calculating the entropy for reversible and irreversible process. (4)

Question No. 4

a) i) Derive the relation between K_p, K_c and K_x. Under what conditions $K_p = K_c = K_x$. (4)

ii) Explain with example the coupling of endergonic reactions with exergonic reactions. (3)

b) i) State Le Chatelier's principle. Explain the effect of change in temperature on equilibrium for an exothermic reaction. (3)

ii) For the ammonia formation reaction, the reference equation is

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ K_c is 2.4x10^{-3} at 1000 K. What are the values of K_c for the following balanced equations? (2)

$$\frac{1}{3}N_2(g) + H_2(g) \rightleftharpoons \frac{2}{3}NH_3(g)$$

$$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

iii) For the dissociation reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, derive the expression for the degree of dissociation (α) in terms of K_P and total equilibrium pressure P. (2)

c) i) The equilibrium constant of a reaction doubles on raising the temperature from 25° C to 35 °C. Calculate $\Delta H°$ for the reaction. (3)

ii) Calculate the standard free energy change for the formation of NO(g) from $N_2(g)$ and $O_2(g)$ at 298 K: $N_2(g) + O_2(g) \rightarrow 2\ NO(g)$, given that $\Delta H° = 180.7$ kJ and $\Delta S° = 24.7$ J/K. Is the reaction spontaneous under these circumstances? (4)

Question No. 5

a) i) State and explain the Raoult's law for vapour pressure of binary solutions of volatile liquids. (3)

ii) Derive the relation between the boiling point elevation of a solution and the mole fraction of the dissolved solute. How is the expression used for determining molar mass of a nonvolatile solute? (4)

b) i) Write a short note on abnormal colligative properties and Van't Hoff factor. (3)

ii) State and explain Henry's law. Under what conditions gases obey Henry's law. Also, mention the application of Henry's law. (4)

c) i) Give the reason for lowering of vapour pressure of pure liquid on adding a non-volatile solute to it. (2)

ii) Calculate the elevation in boiling point when 12.5 g of urea is dissolved in 170 g of water. Molecular mass of urea is 60 g mol^{-1} and the molal elevation constant of water is 0.52 K kg mol^{-1}. (2)

iii) Addition of 0.643 g of a compound to 50 ml of benzene (density = 0.879 g/ml) lowers the freezing point from 5.51 °C to 5.03 °C. If K_f for benzene is 5.12 K kg mol^{-1}, calculate the molecular weight of the compound. (3)

CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examinations, Sept. 2022

Programme: Int. B.Sc.-M.Sc. Chemistry **Session: 2021-2022**

Semester: II **Max. Time: 3h**

Course Title: Organic Chemistry-I: Basics & Hydrocarbons **Max. Marks: 70**

Course Code: SBS CH020201 C 4004

Instructions

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1. Question no. 1 has seven subparts and students need to answer any four. Each subpart carries 3.5 Marks.
2. Question no. 2 to 5 have three subparts and students need to answer any two subparts of each question.

Question 1

a) What is hyperconjugation? How does it differ from resonance?

b) Explain the effect of hybridization of carbon on acidity of hydrocarbons.

c) What is optical activity? Write down the necessary condition for a molecule to be optically active.

d) Describe Wurtz reaction for the synthesis of butane and hexane.

e) Write a short note on Diels-Alder reaction by taking a suitable example.

f) Explain Markonikov's rule in addition reactions of alkene with example.

g) Out of the following, select the aromatic compounds with justification

i) Cyclopropyl cation

ii) Cyclopentadienyl anion

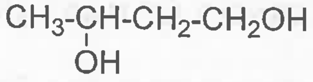
iii) Pyridine

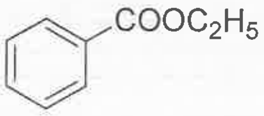
iv) Indole

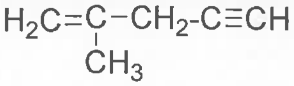
(3.5 X 7)

Question 2

a) i) Write the IUPAC name for each compound

(i) 
$CH_3\text{-}\underset{\substack{|\\OH}}{CH}\text{-}CH_2\text{-}CH_2OH$

(ii) 

(iii) 
$H_2C{=}\underset{\substack{|\\CH_3}}{C}{-}CH_2\text{-}C{\equiv}CH$

(3)

ii) What are carbenes? Discuss the structure of carbene. (4)

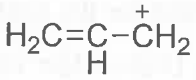
b) i) Explain the decreasing order of stability of given carbanion. (4)

$HC{\equiv}\overset{-}{C}$ $\quad H_3C{-}C{\equiv}\overset{-}{C}$ $\quad H_2C{=}\overset{-}{C}H$ $\quad CH_3\text{-}\overset{-}{C}H_2$

ii) *p*-nitrophenolis more acidic than phenol. Give reason. (3)

c) i) Write down the differences between SN^1 and SN^2 reactions. (3)

ii) Give reason

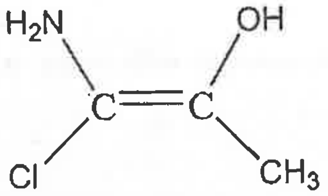
(a) Why $CH_3\text{-}\overset{+}{C}H_2\text{-}CH_3$ is less stable than 
$H_2C{=}\underset{H}{C}{-}\overset{+}{C}H_2$. (2)

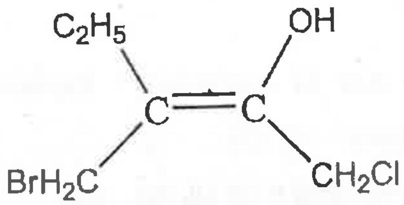
(b) Why *tert*-butyl carbocation is more stable than *iso*propyl carbocation?

Question 3

a) i) Draw all possible conformation (Newman) of n-butane and relate their energy. Also, give reason for their stability. (5)

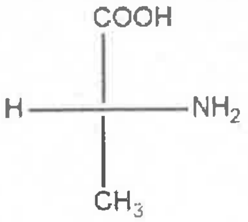
(ii) Assign E or Z notations to the following compounds (2)

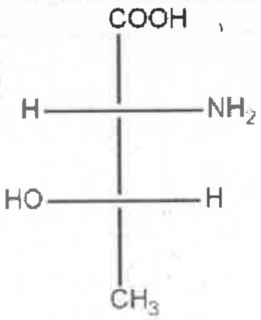




b) i)Why chair form of cyclohexane is more stable than boat form? (2)

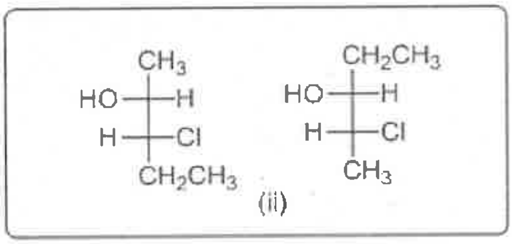
ii) Assign R/S configuration to the stereogenic centers (2)





iii) Write difference between enantiomers and diastereomers. (3)

c) i) Assign R/S configuration to the stereogenic centers and give relation between the following compounds. (3)



(ii)

ii) Write a short note on

(i) threo and erythro

(ii) D and L nomenclature. (4)

Question No. 4

a) i) Describe the Diels Alder reaction with suitable example. (3.5)

ii) What is E_1 elimination reaction? Write down the factors affecting E_1. (3.5)

b) Describe Hydroboration-oxidation reaction by taking propene as a substrate. Illustrate the mechanism for the reaction.(7)

c) i) Write down the Ozonolysis product of the o-xylene and p-xylene. (3.5)

ii) Explain the mechanism of allylic bromination. (3.5)

Question No. 5

a) i) What is Huckle rule of aromaticity? Explain the concept with some suitable examples (at least three). (2+3)

ii) Write a short note on acidity of alkyne. (2)

b) i) Describe any two methods for alkylation of terminal alkyne. (4)

ii) Describe the alkylation, nitration and sulphonation of benzene. (3)

c) Describe any two nucleophilic addition reactions of alkynes. (3.5 + 3.5)

CENTRAL UNIVERSITY OF HARYANA

Second Semester Term End Examinations September 2022

Programme: M.Sc. Chemistry **Session: 2021-22**
Semester: Semester-II **Max. Time: 2 Hours**
Course Title: Computational Chemistry **Max. Marks: 35**
Course Code: SBS CH 010201 DCSC 2002

Instructions:

1. Question no. 1 has four parts and students need to answer any two. Each part carries three and half Marks.
2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries three and half marks.

Question No. 1. **(2X3.5=7)**

a) Briefly discuss theoretical and computational chemistry?
b) What is semi empirical method?
c) Why is basis set choice critical?
d) Write a note on transition structure modeling.

Question No. 2. **(2X3.5=7)**

a) Write a short note on Born-Oppenheimer approximation.
b) Discuss restricted and unrestricted Hartree–Fock methods in detail with suitable transition metals.
c) What do you mean by self-consistent field theory?

Question No. 3. **(2X3.5=7)**

a) What are exchange-correlation functionals?
b) Briefly describe higher order gradient approximation.
c) Write a note on hybrid density functional methods.

Question No. 4. **(2X3.5=7)**

a) Why are typical basis sets not good for transition metal complexes, and why is the LANL2DZ basis set used so often for transition metals?
b) How important to use split basis set? Discuss with examples.
c) What are correlation-consistent basis sets?

Question No. 5. (2X3.5=7)

a) What do you mean by stationary point, saddle point, local and global minima?

b) What do you observe during optimization of a molecule? Discuss in detail.

c) Briefly discuss steepest descent and Newton–Raphson methods.

CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examinations, Sept. 2022

Programme: M.Sc. Chemistry **Session: 2021-2022**

Semester: II **Max. Time: 2 hours**

Course Title: Analytical Techniques in Chemistry **Max. Marks: 35**

Course Code: SBS CH 010202 DCS 2002

Instructions

1. Question no. 1 has four subparts and students need to answer any two. Each subpart carries 3.5 Marks.
2. Question no. 2 to 5 have three subparts and students need to answer any two subparts of each question. Each subpart carries 3.5 Marks.

Question 1

a) Explain the electron beam lithiography Technique.
b) Write down a short note on applications of chemicals in environmental pollutant detection.
c) Describe the principal and instrumentation of TGA.
d) Write in brief about electrochemical Polarization. (3.5 X 4)

Question 2

a) Illustrate the TGA curve for Calcium oxalate.
b) Describe the factors affecting the DTA curve of a analyte.
c) Explain the principle and working of DSC with suitable examples. (3.5 X 3)

Question 3

a) Write down the theory and Principal of cyclic voltammetry.
b) Write down the working of cyclic voltametry. How it helps in fertilizer analysis?
c) Explain the analysis of metals by using various electrochemical techniques. (3.5 X 3)

Question 4

a) Write down a note on electron optics.

b) Write down the introduction of transmission and Scanning electron Microscope in brief.

c) Describe the principal and working of TEM. (3.5 X 3)

Question 5

a) What you mean by Impedance spectroscopy. Write down its applications.

b) Describe the applications of anodic and cathodic polarization?

c) Write down a short note on Nyquest plots and Bod plots. (3.5 X 3)