

Total No. of Questions :6]

SEAT No. :

P2606

[5023]-11

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 110: Physical Chemistry - I

(2008 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic table / calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any three of the following: **[15]**

- a) State the second law of thermodynamics in three different ways. Explain any one of these statements.
- b) Using chemical potential derive the expression for entropy change in mixing of two ideal gases.
- c) Write a note on photoelectric effect. How does it support Planck's quantum theory?
- d) What is partial molar volume? Explain any one method to determine it.
- e) Write a note on Heisenberg's uncertainty principle give different forms of uncertainty relations.

Q2) Attempt any three of the following: **[15]**

- a) Sketch and explain the phase diagram of water.
- b) Write a note on black body radiation. what is meant by UV catastrophe?
- c) Derive Clapeyron -Clausius equation and give its significance.
- d) Explain the Zeroth and third law of thermodynamics give their applications.
- e) What is wave particle duality? Derive the expression for de-Broglie's wave length in terms of kinetic energy of a particle.

Q3) Attempt any two of the following: **[10]**

- a) Estimate the molar solubility of oxygen in water at 25°C and partial pressure of 160 torr. (Henry's constant $K = 3.3 \times 10^7$ torr).
- b) Find the degeneracy of the levels for which total energy of a particle in 3 d box is $\frac{86h^2}{8ma^2}$.
- c) What is the uncertainty in the velocity of an electron if the uncertainty in its position is 1\AA ?

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) Derive the expression for concentration of final product in the following reaction $A \rightarrow B \rightarrow C$.
- b) What is meant by steady state approximation? Apply steady state approximation to obtain Michaelis - Menten equation.
- c) Write a note on flash photolysis to study fast reactions.
- d) Obtain the expression for the second order rate constant assuming unequal reactant concentration.
- e) Discuss diffusion controlled and activation controlled reactions.

Q5) Attempt any three of the following: **[15]**

- a) Derive the Eyring's equation on the basis of transition state theory.
- b) Discuss in brief Bose-Einstein statistics.
- c) What is meant by explosive reactions? Discuss reaction between O_2 and H_2 with suitable diagram.
- d) Derive the expression for translational partition function.
- e) Derive the expression for Fermi -Dirac statistics.

Q6) Solve any two of the following: **[10]**

- a) Calculate vibrational partition function at 300 K and 500 K, if the fundamental vibrational frequency for a molecule is centred at 1600 cm^{-1} .
- b) Specific reaction rate of a reaction increases three times of original if the temperature is increased from 25°C to 35°C . Calculate energy of activation of this reaction if the pre-exponential factor is $6.25 \times 10^{13}\text{ s}^{-1}$.
- c) Calculate the collision frequency when 1g of O_2 is mixed with 0.1g H_2 in one litre container at 27°C [Given: collision cross - section = 0.227 nm^2 , $k = 1.38 \times 10^{-6}\text{ erg. k}^{-1}$, at wts $O = 16$, $H = 1$].

EEE

Total No. of Questions :6]

SEAT No. :

P2607

[5023]-12

[Total No. of Pages :5

M.Sc. (Part - I)

CH - 130: INORGANIC CHEMISTRY - I

(2008 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Neat and labelled diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*

SECTION -I

Q1) Attempt any three of the following:

[15]

- a) Discuss the symmetry operations in the following point groups.
 - i) C_{3h}
 - ii) C_{3v}
 - iii) D_{2h}
- b) What are the conditions of mathematical group and explain them considering an example of $SOCl_2$ molecule.
- c) Give the stereographic projection of D_{5d} and C_{5h} point groups. Justify your answer.
- d) Write matrices for i and $C_2^{(y)}$ symmetry operations and show by matrix multiplication. $C_2^{(x)} \times C_2^{(y)} = C_2^{(z)}$.
- e) Draw possible isomers of $[Ma_3b_3]$ complex. Explain on the basis of symmetry which isomer is optically active.

P.T.O.

Q2) Attempt any three of the following:

[15]

- a) Using similarity transformation and multiplication table given below, group the symmetry operations in the appropriate classes.

C_2h	E	C_2	i	σ_h
E	E	C_2	i	σ_h
C_2	C_2	E	σ_h	i
i	i	σ_h	E	C_2
σ_h	σ_h	i	C_2	E

- b) Write out the characters of the representations of the following direct product and determine the set of irreducible representations which comprise them for the point group Td.

Direct product $E \times T_2$

Td	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$		
A_1	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	1	1	-1	-1		
E	2	-1	2	0	0		$zz^2-x^2-y^2, x^2-y^2$
T_1	3	0	-1	1	-1	R_x, R_y, R_z	
T_2	3	0	-1	-1	1	(x, y, z)	(xy, xz, yz)

- c) Sketch and describe all the symmetry operations in $B_3N_3H_6$ molecule and classify it into appropriate point group.
- d) Define the following terms with examples.
- Unit cell
 - Crystal lattice
 - Space lattice
 - Miller indices
 - Weiss indices

- e) Fill in the missing entries X, Y and Z in the following character table. Label the irreducible representations with appropriate Mulliken symbols.

	E	C_2^z	C_2^y	C_2^x
T_1	1	1	1	1
T_2	1	X	-1	-1
T_3	1	-1	Y	-1
T_4	1	-1	-1	Z

Q3) Attempt any two of the following: **[10]**

- a) Find out normalized SALC using projection operator of B_{1g} irreducible representation which operates on 61 orbital of XeF_4 molecule belonging to D_{4h} point group.

D_4	E	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$
B_{1g}	1	-1	1	1	-1	1	-1	1	1	-1

- b) By schematic representation give the products of following symmetry operations in BrF_5 molecule.
- $\sigma_{v_1} \times \sigma_{d_1}$
 - $C_2' \times \sigma_{v_2}$
- c) For $[NiCl_4]^{2-}$ complex ion find the reducible representation for which sigma bond form the basis and find out which orbitals from central ion will be offered for sigma bonding.

Given: the character table for T_d in question no. 2(b).

SECTION -II

Q4) Answer any three of the following: **[15]**

- a) Explain with suitable examples following reactions of organometallic compounds.
- β hydrogen elimination
 - Lewis acidity
 - Oxidation reaction

- b) Give an account of carbides of Boron.
- c) Give characteristic reactions of COCl_2 .
- d) Give an brief account of nitrogen activation.
- e) Mention the position and relative abundance of noble gases in earth crust. Why is helium present in low concentration in atmosphere. Give applications of noble gases.

Q5) Write notes on any three of the following: **[15]**

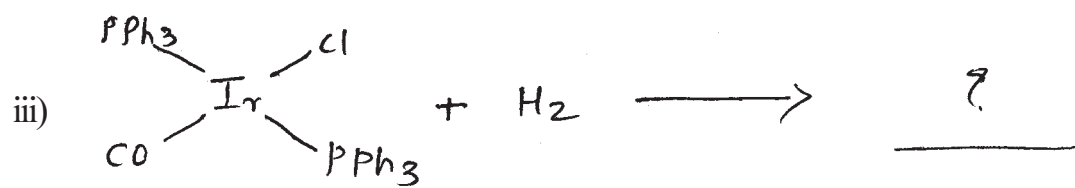
- a) Oscillating reactions.
- b) Oxyacids of sulphur.
- c) Lead acid battery.
- d) Electron rich compounds.
- e) Metal compounds of fullerenes.

Q6) a) Draw any five structures: **[5]**

- i) P_4O_{10}
- ii) $\text{B}_3\text{N}_3\text{H}_6$
- iii) Ge_6R_6
- iv) $\text{Mn}_2(\text{CO})_{10}$
- v) B_6H_{10}
- vi) $\text{Li}_4(\text{CH}_3)_4$.

b) Complete any five reactions: **[5]**

- i) $\text{LiAlH}_4 + \text{SiCl}_4 \rightarrow \underline{\quad ? \quad}$
- ii) $\text{PCl}_5 + \text{KF} \rightarrow \underline{\quad ? \quad}$



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Total No. of Questions :6]

SEAT No. :

P2608

[5023]-13

[Total No. of Pages :4

M.Sc.-I

ORGANIC CHEMISTRY

CH - 150: Organic Reaction Mechanism and Stereo Chemistry

(2008 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to right indicates full marks.*
- 3) Answers to the two sections should be written in separate answer books.*

SECTION -I

Q1) Attempt any four of the following:

[16]

- a) Methyl cinnamate undergoes electrophilic substitution predominantly at meta position. Explain.
- b) Bromination of phenanthrene give s g, 10-dibromo product. Why?



- d) Why 4-methylbenzyl chloride reacts faster than 4-nitrobenzyl chloride with NaOH.
- e) Elimination of HCl from neomenthyl chloride gives two olefins, while menthyl chloride gives only one olefin.

P.T.O.

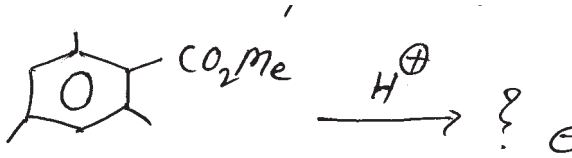
Q2) Write short notes on any three of the following:

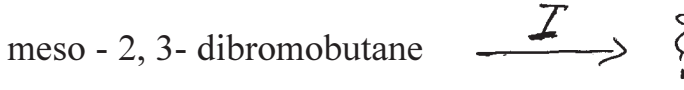
[12]

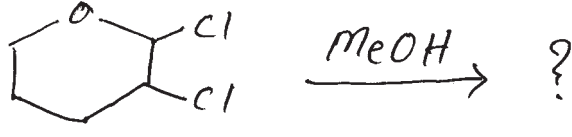
- SET mechanism.
- Alternant and nonalternant hydrocarbons.
- Factors affecting strength of bases.
- Phase transfer catalyst.

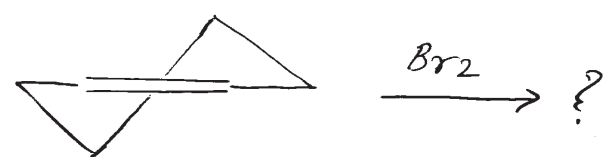
Q3) Predict the products with mechanism (any three):

[12]

- 

Reaction of methyl acrylate with H^+ to form a carbocation intermediate.
- 

Reaction of meso-2,3-dibromobutane with I_2 to form a product.
- 


Reaction of 1,2-dichlorocyclohexane with $MeOH$ to form a product.
- 

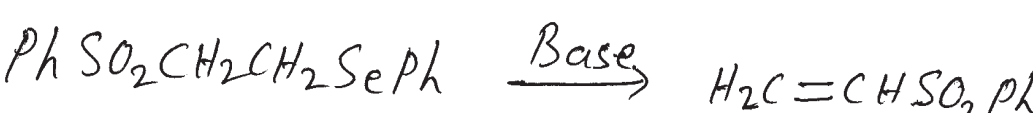
Reaction of norbornene with Br_2 to form a product.

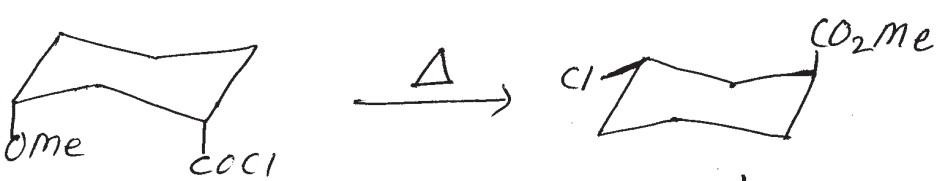
SECTION -II

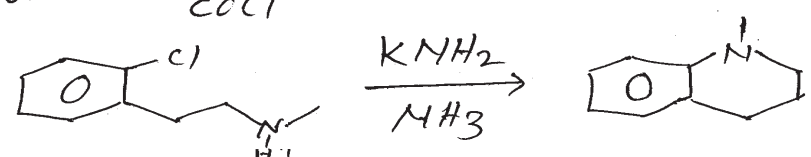
Q4) Suggest mechanism for any four:

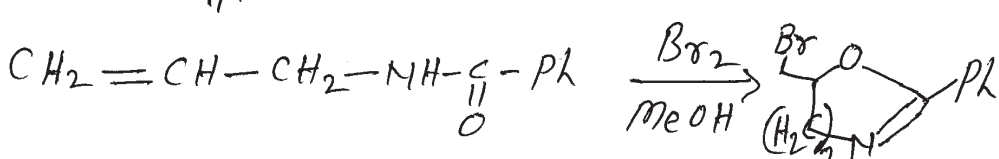
[12]

- 

Reaction of 1-methylcyclopentene with C_6H_6 and H^+ to form 1-phenylcyclohexane.
- 

Reaction of $PhSO_2CH_2CH_2SePh$ with $Base$ to form $H_2C=CHSO_2Ph$.
- 

Reaction of a bicyclic chloroester with Δ to form a rearranged product.
- 

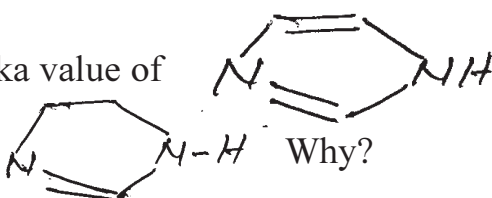
Reaction of a chloroalkyl aniline derivative with KNH_2 and NH_3 to form a bicyclic amine.
- 

Reaction of $CH_2=CH-CH_2-NH-C(=O)-Ph$ with Br_2 and $MeOH$ to form a brominated cyclic product.

Q5) Attempt any four of the following:

[12]

- a) How will you prove that ethylene glycol and 1, 2-dibromoethane exist in different conformations.

- b) pka value of  is much lower than that of . Why?

- c) The trans isomer of ethyl - 4 - butylcyclohexane carboxylate is hydrolyse with aqueous base about 20 times faster than cis isomer. Explain.

- d) Which of the following is stronger acid.

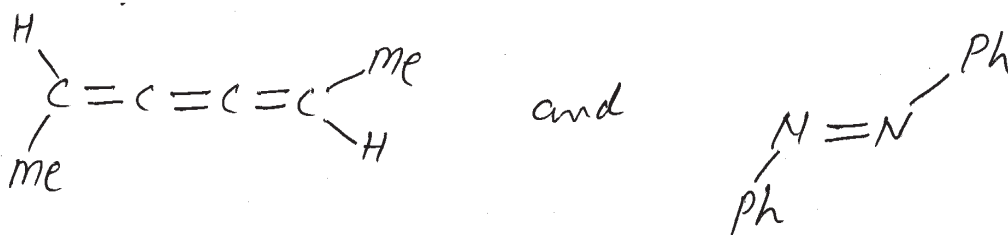


- e) Compound $\text{PhCH} = \text{CH}_2$ on reaction with $\text{HBr} / \text{H}_2\text{O}_2$ and $\text{HCl} / \text{H}_2\text{O}_2$ gives different products. Explain.

Q6) Attempt any eight of the following:

[16]

- a) Assign E/Z to the following compounds.



- b) Assign R/S to the chiral centre.



- c) Explain hydrogen bonding.

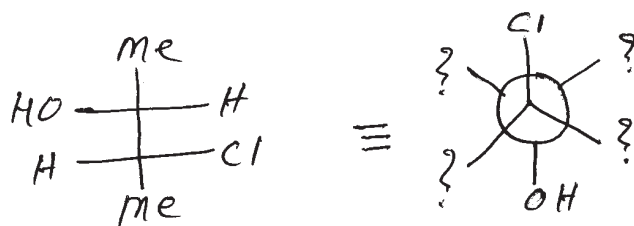
- d) Propynoic acid is stronger acid than propenoic acid. Explain.

e) Assign Re/Si faces to the following . Acetophenone and 4-nitrobenzaldehyde.

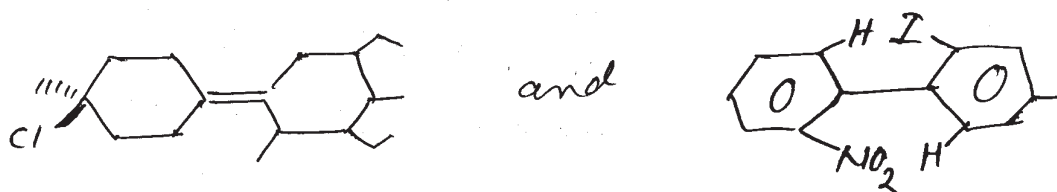
f) Draw resonance structures for the following.



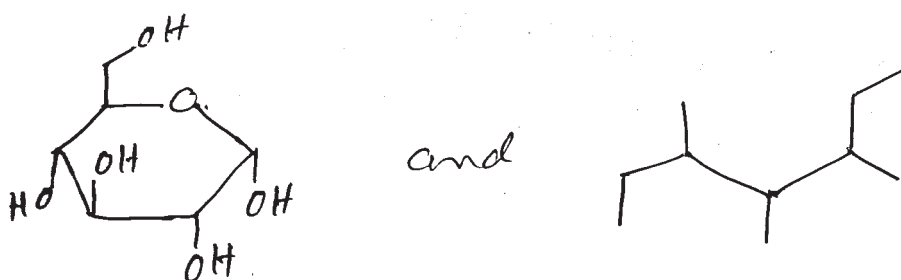
g) Draw the equivalent structure



h) Which of the following is optically active? Justify.



i) Identify chiral carbon atoms and find total number of stereoisomers in the following compounds.



EEE

Total No. of Questions :6]

SEAT No. :

P2609

[5023]-21

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 210: Physical Chemistry - II

(2008 Pattern) (Old) (Semester - II)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
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4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
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8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
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12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Answer any three of the following: **[15]**

- a) Explain the vibrational coarse structure in electronic spectroscopy.
- b) Discuss the breakdown of the Born-Oppenheimer approximation.
- c) Explain the classical theory of Raman spectroscopy.
- d) Write a note on applications of Mossbauer spectroscopy.
- e) Explain the factors governing width of spectra.

Q2) Answer any three of the following: **[15]**

- a) Write a note on predissociation spectra.
- b) Discuss the limits of resolution in spectroscopy.
- c) State and explain the advantages of FTIRS.
- d) Write a note on the principle of NMR spectroscopy.
- e) Explain hyperfine structure in ESR spectroscopy.

Q3) Solve any two of the following: **[10]**

- a) The rotational constant for a molecule is 6 cm^{-1} . Find the most populated level at 1000 K.
- b) Sketch the rotational Raman spectra for a molecule having $B = 10 \text{ cm}^{-1}$. The exciting frequency is 2970 mm^{-1} .
- c) Calculate the force constant for HCl which shows absorption band at 289 mm^{-1} . [At. wt. of Cl = 35.5, H = 1]

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) Explain the construction and working of scintillation counter.
- b) What is G value? Give the mechanism of radiolysis of Fricke solution and hence show that G value for Fricke solution is 15.5.
- c) Discuss four factor formula used in reactor technology.
- d) Give an account of nuclear waste management.
- e) Give an account of the two models suggested for the interaction of secondary electrons with solvent molecules in radiolysis.

Q5) Attempt any three of the following: **[15]**

- a) Discuss the principles of using a radiotracer. Describe how the thickness of a moving sheet is determined using a radiation gauge.
- b) Discuss the use of radiotracer in estimating friction and wear out of machine parts.
- c) Explain the technique of radiometric titration with suitable example. Draw and explain the corresponding curves of any two cases.
- d) Explain the separation of isotopes by gaseous diffusion method.
- e) What is diffusion? Discuss different types of diffusion processes and give one example of each.

Q6) Solve any two of the following: **[10]**

- a) The half life period of radon is 3.8 days. After how many days will one twentieth of radon sample be left over?
- b) Find the molecular and mass absorption coefficient of propanol [Atomic weights - H = 1, C = 12, O = 16, and $\mu = 0.211$ b/electron].
- c) To assess the volume of blood in a patient, 1.0cm^3 was withdrawn from the body of a patient and labelled with ^{32}P . The labelled blood gave 1,35,000 cpm per 1.0cm^3 , 1.0cm^3 labelled blood was re-injected and an equal volume was withdrawn after 15 minutes. It gave 240 counts for 10 minutes. Find the total volume of blood in the body of the patient.

EEE

Total No. of Questions : 6]

SEAT No. :

P2610

[5023]-22

[Total No. of Pages : 6

M.Sc. -I

**CH-230 : INORGANIC CHEMISTRY-II
(2008 Pattern) (Semester-II)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Neat and labelled diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and calculator is allowed.*
- 6) *Given: Atomic number Cu = 29, Mn = 25, Cr = 24, Fe = 26, Ni = 28.*

SECTION-I

Q1) Attempt any three of the following:

[15]

- a) Determine the spin multiplicities of states arising from eg^2 configuration when infinitely strong octahedral field is relaxed to strong field, using Bethe's method of descending symmetry, correlation table and direct product table.
- b) Work out possible number of microstates for the following systems.
 - i) d^3
 - ii) d^7
 - iii) p^1d^1
 - iv) t_2g^3
 - v) eg^2
- c) Explain for which of the following ions shows orbital contribution to magnetic moment. Justify your answer.
 - i) $[CuCl_4]^{-2}$
 - ii) $[Mn(H_2O)_6]^{+3}$
- d) Calculate the effective magnetic moment of an $[Cr(ox)_3]^{-3}$ complex ion using the following data
 - i) $\lambda = + 92 \text{ cm}^{-1}$
 - ii) $10Dq = 17,000 \text{ cm}^{-1}$

P.T.O.

Q2) Answer any three of the following: [15]

- a) Prepare the microstate table for np^2 configuration and hence derive the allowed R.S. terms for the same.
- b) Predict the expected transition in the following complexes
 - i) $[\text{Fe}(\text{SCN})_6]^{-3}$
 - ii) $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$
- c) Explain Hund's Rules to determine the ground state term symbols. Also arrange the following R.S. Terms with increasing order of energy.
 ${}^3\text{F}, {}^1\text{P}, {}^1\text{G}, {}^6\text{H}, {}^3\text{I}$ and ${}^6\text{D}$
- d) A complex $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ records three spin allowed transitions at 17400cm^{-1} , 24600cm^{-1} and 37800cm^{-1} . Calculate nephelauxetic ratio β and comment on nature of M-L bond. If $B = 918\text{cm}^{-1}$.

Q3) Write notes on (any two): [10]

- a) Orgel diagrams.
- b) Charge transfer spectra.
- c) Nephelauxetic effect and Nephelauxetic series.

SECTION-II

Q4) Attempt any three of the following: [15]

- a) Give an account of transferrin.
- b) Give an account of metallointercalators.
- c) Explain the voltage gated sodium channel.
- d) Give an account of dioxygen transport.

Q5) Write short notes (any three):

[15]

- a) Communication roles for metals in biology.
- b) Electron transfer reactions in biomolecules.
- c) Kinetic analysis of enzyme reactions.
- d) Siderophores.

Q6) Draw the structures of (any five) of the following:

[10]

- a) Corrin ring.
- b) Fe_2S_4 .
- c) Auranofin.
- d) Uracil.
- e) Serine.
- f) Imidazole.

Character Table for O rotational group

O	E	6C ₄	3C ₂ (=C ₄ ²)	8C ₃	6C ₂	
A ₁	1	1	1	1	1	(R _x , R _y , R _z); (x, y, z)
A ₂	1	-1	1	1	-1	
E	2	0	2	-1	0	
T ₁	3	1	-1	0	-1	(xy, xz, yz)
T ₂	3	-1	-1	0	1	

Correlation Table for the Group O_h

O _h	O	T _d	D _{4h}	D _{2d}	C _{4v}	C _{2v}	D _{2h}	D _{3h}	C _{2h}
A _{1g}	A ₁	A ₁	A _{1g}	A ₁	A ₁	A ₁	A _{1g}	A ₁	A _g
A _{2g}	A ₂	A ₂	B _{1g}	B ₁	B ₁	A ₂	A _{2g}	A ₂	B _g
E _g	E	E	A _{1g} +B _{1g}	A ₁ +B ₁	A ₁ +B ₁	A ₁ +A ₂	E _g	E	A _g +B _g
T _{2g}	T ₂	T ₂	A _{2g} +E _g	A ₁ +E	A ₂ +E	A ₁ +B ₁ +B ₂	A ₂ +E _g	A ₂ +E	A _g +2B _g
T _{1g}	T ₁	T ₁	B _{2g} +E _g	B ₂ +E	B ₂ +E	A ₁ +B ₁ +B ₂	A ₁ +E _g	A ₁ +E	2A _g +B _g
A _{1u}	A ₁	A ₁	A _{1u}	B ₁	A ₂	A ₂	A _{1u}	A ₁	A _u
A _{2u}	A ₂	A ₂	B _{2u}	A ₁	B ₂	A ₂	A _{2u}	A ₂	B _u
E _u	E	E	A _{1u} +B _{1u}	A ₁ +B ₁	A ₂ +B ₂	A ₁ +A ₂	E _u	E	A _u +B _u
T _{1u}	T ₁	T ₂	A _{1u} +E _u	B ₂ +E	A ₁ +E	A ₁ +B ₁ +B ₂	A _{1u} +E _u	A ₁ +E	A _u +2B _u
T _{2u}	T ₂	T ₁	B _{2u} +E _u	A ₂ +E	B ₁ +E	A ₁ +B ₁ +B ₂	A _{2u} +E _u	A ₂ +E	2A _u +B _u

DIRECT PRODUCTS

1. Groups of the form $G \times I$ or $G \times \sigma_1$:
 The g, u or $'$, $''$ additions to the IR symbols in these groups satisfy
 $g \times g = u \times u = g, g \times u = u, 'x' = 'x'', ''x'' = ''x''$.
2. Products of the form $A \times A, B \times B, A \times B$:
 For all groups:
 Letter symbols: $A \times A = A, B \times B = A, A \times B = B$.
 Subscripts: $1 \times 1 = 1, 2 \times 2 = 1, 1 \times 2 = 2$
 except for the B representations of D_2 and D_{2h} where
 $B \times B = B$ and $1 \times 2 = 3, 2 \times 3 = 1, 3 \times 1 = 2$.
3. Products of the form $A \times E, B \times E$:
 - (a) For all groups: $A \times E_k = E_k$ irrespective of the suffix on A.
 - (b) For all groups except D_{4h}, D_{6h}, S_8 :
 $B \times E_1 = E_2, B \times E_2 = E_1$
 (irrespective of the suffix on B. (If the group has only one B representative put $E_1 = E_2 = E$.)
 - (c) For D_{4h} :
 $B \times E_1 = E_2, B \times E_2 = E_4, B \times E_3 = E_3, B \times E_4 = E_2, B \times E_5 = E_1$
 irrespective of the suffix on B.
 - (d) For D_{6h}, S_8 :
 $B \times E_1 = E_3, B \times E_2 = E_2, B \times E_3 = E_1$
 irrespective of the suffix on B.
4. Products of the form $E \times E$:
 (For groups which have A, B or E symbols without suffixes put $A_1 = A_2 = A$, etc. in the equations below)
 - (a) For $O_h, O, T_d, D_{2d}, D_2, C_{4v}, C_{2v}, C_{3v}, S_6, D_{3d}, D_{3h}, D_3, C_{3v}, C_{2v}, C_2$:
 $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2; E_1 \times E_2 = E_1 + E_2 + E_4$.
 - (b) For $D_{4h}, D_4, C_{2v}, C_{4h}, C_4, S_8, D_{2d}$:
 $B \times E = A_1 + A_2 + B_1 + E_2$.
 - (c) For D_{4h} :
 $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2$
 $E_3 \times E_3 = E_4 \times E_4 = A_1 + A_2 + E_4$
 $E_5 \times E_5 = A_1 + A_2 + B_1 + E_2$
 $E_1 \times E_2 = E_3 \times E_3 = E_1 + E_2, E_1 \times E_3 = E_2 \times E_3 = E_2 + E_4$
 $E_1 \times E_4 = E_2 \times E_3 = E_2 + E_3, E_2 \times E_3 = E_2 \times E_4 = E_1 + E_2$
 $E_1 \times E_5 = B_1 + B_2 + E_2, E_2 \times E_4 = B_1 + B_2 + E_2$.

(d) $D_{5d}, D_{3h}, D_3, C_{3v}, C_{2h}, C_s$

$$E_1 \times E_1 = A_1 + A_2 + E_2, E_2 \times E_2 = A_1 + A_2 + E_1,$$

$$E_1 \times E_2 = E_1 + E_2.$$

(e) For D_{4d}, S_8 .

$$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2,$$

$$E_2 \times E_2 = A_1 + A_2 + B_1 + B_2$$

$$E_1 \times E_2 = E_2 \times E_3 = E_1 + E_3, E_1 \times E_3 = B_1 + B_2 + E_2.$$

5. Products involving the T (or F) representations of O_h, O and T_d

$$A_1 \times T_1 = T_1, A_1 \times T_2 = T_2, A_2 \times T_1 = T_2, A_2 \times T_2 = T_1,$$

$$E \times T_1 = E \times T_2 = T_1 + T_2.$$

$$T_1 \times T_1 = T_2 \times T_2 = A_1 + E + T_1 + T_2,$$

$$T_1 \times T_2 = A_2 + E + T_1 + T_2.$$

6. The complete results for O are :

O	A_1	A_2	E	T_1	T_2
A_1	A_1	A_2	E	T_1	T_2
A_2	A_2	A_1	E	T_2	T_1
E	E	E	$A_1 + A_2 + E$	$T_1 + T_2$	$T_1 + T_2$
T_1	T_1	T_2	$T_1 + T_2$	$A_1 + E + T_1 + T_2$	$A_2 + E + T_1 + T_2$
T_2	T_2	T_1	$T_1 + T_2$	$A_2 + E + T_1 + T_2$	$A_1 + E + T_1 + T_2$

EEE

Total No. of Questions : 6]

SEAT No. :

P2611

[5023]-23

[Total No. of Pages : 4

M.Sc. -I

ORGANIC CHEMISTRY

**CH-250 : Synthetic Organic Chemistry and Spectroscopy
(2008 Pattern) (Semester-II)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

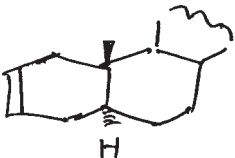
- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Answers to the two sections to be written in separate answer books.*

SECTION-I

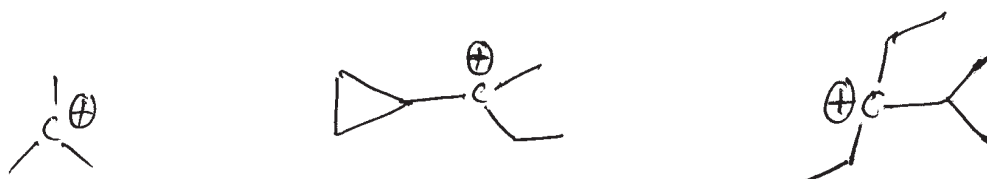
Q1) Explain any four of the following:

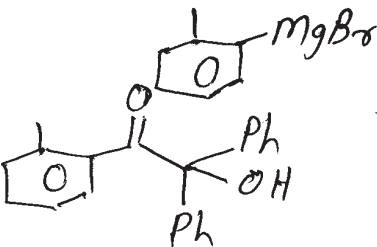
[16]

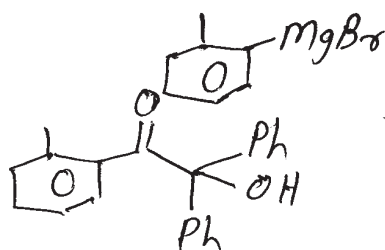
- a) Outline the details of Reformatsky reaction.

- b) Steroid  gives different products on treatment with $I_2/AgOAc$, H_3O^+ and OSO_4/H_2O .

- c) Arrange the following cations as per their stability order and justify your answer.



- d) Reaction of  gives.



with benzophenone exclusively

- e) Neomenthyl and menthyl chloride on reaction with base gives different products.

P.T.O.

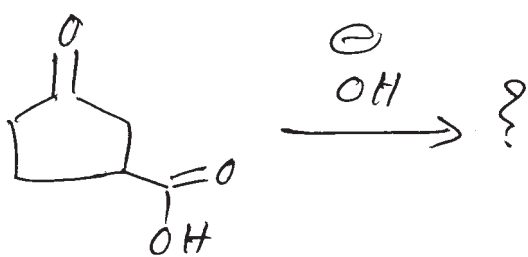
Q2) Write short notes on any three of the following:

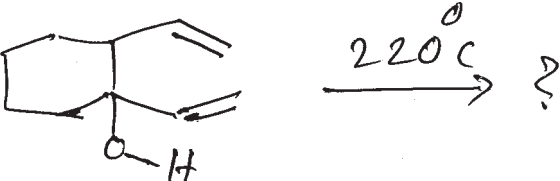
[12]

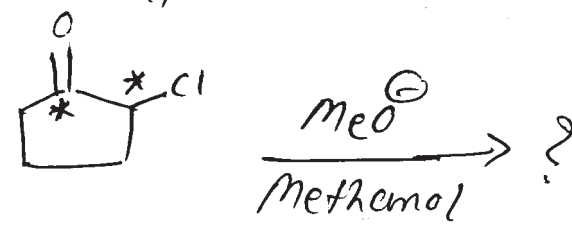
- Swern oxidation.
- Wolf rearrangement.
- Synthetic applications of diazomethane.
- Factors affecting chemical shifts in PMR.

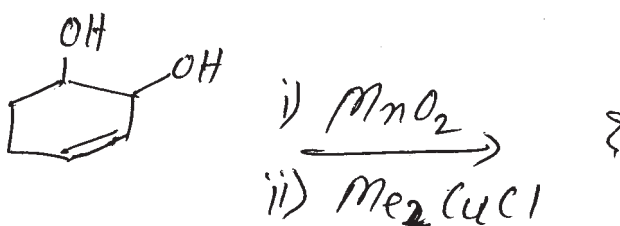
Q3) Predict the products and suggest the mechanism for any four of the following:

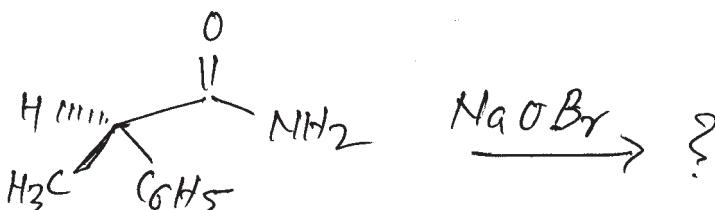
[12]

- 

Reaction of 2-oxocyclopentanecarboxylic acid with hydroxide ion (OH^-) leading to a question mark.
- 

Reaction of bicyclo[2.2.1]hept-2-ene-2-ol at 220°C leading to a question mark.
- 

Reaction of 2-chlorocyclopentanone with methoxide ion (MeO^-) in methanol leading to a question mark.
- 

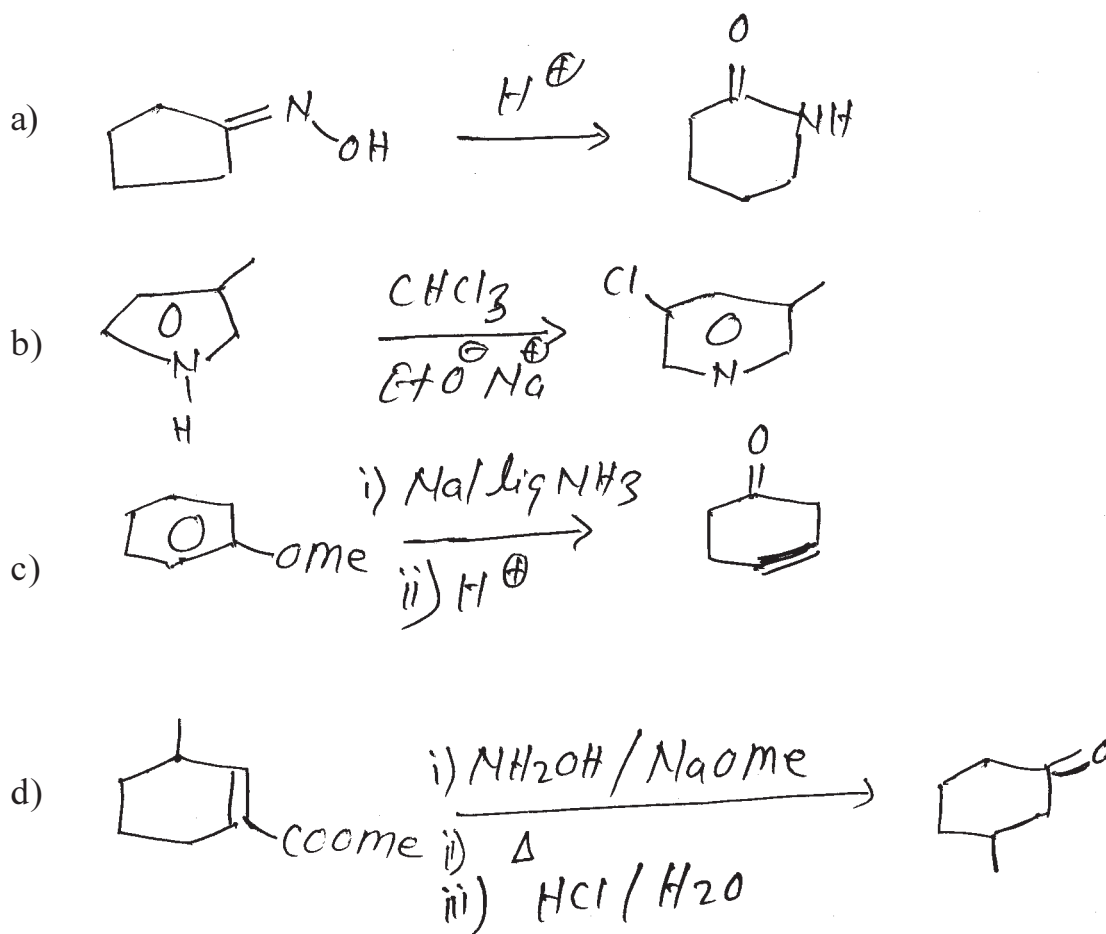
Reaction of 1,2-cyclohexadiene-1,2-diol with MnO_2 followed by Me_2CuCl leading to a question mark.
- 

Reaction of N-phenylethylamine with NaOBr leading to a question mark.

SECTION-II

Q4) Suggest the mechanism for Any Four of the following:

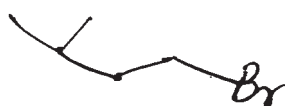
[12]



Q5) Answer any four of the following:

[16]

- a) α -chloroacetone shows two bands in $\bar{\nu}$ region at 1725 and 1748 cm^{-1} while acetone shows only one band for same group at 1720 cm^{-1} .
- b) Explain diamagnetic anisotropy and hypsochromic shift.
- c) Assign the chemical shifts for the following



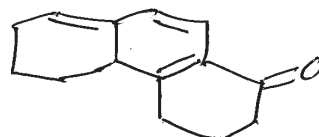
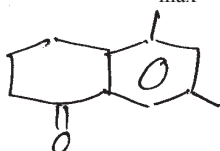
1.02 δ (d, $J = 6$ Hz, 24 mm)

1.65 δ (m, 4 mm)

1.85 δ (m, 8.3 mm)

3.4 δ (t, $J = 6$ Hz, 8.2 mm)

d) Calculate λ_{\max} for the following compounds.



e) Esters of O-chlorobenzoic acid shows two carbonyl stretching frequencies. Why?

Q6) Deduce the structures of Any Three of the following using spectral data and justify your answer: **[12]**

a) $C_7H_{14}O$

U.V. : 295 nm

I.R. : 1710 cm^{-1}

PMR : $1.05\ \delta(\text{d}, J = 6.5\text{ Hz}, 36\text{ mm})$

$2.70\ \delta(\text{septet}, J = 6.5\text{ Hz}, 6\text{ mm})$

b) $C_8H_{15}NO$

U.V. : Featureless

I.R. : 1715 cm^{-1}

PMR : $1.08\ \delta(\text{d}, J = 7\text{ Hz}, 6\text{ H})$

$2.45\ \delta(\text{t}, J = 5\text{ Hz}, 4\text{ H})$

$2.8\ \delta(\text{t}, J = 5\text{ Hz}, 4\text{ H})$

$2.93\ \delta(\text{septet}, J = 7\text{ Hz}, 1\text{ H})$

c) $C_{12}H_{14}O_4$

U.V. : $\lambda_{\max} 220\text{ nm } \epsilon = 11000$

I.R. : $1730, 1600, 750\text{ cm}^{-1}$

PMR : $1.25\ \delta(\text{t}, J = 6\text{ Hz}, 30\text{ mm})$

$4.28\ \delta(\text{q}, J = 6\text{ Hz}, 20\text{ mm})$

$7.45\ \delta(\text{dd}, J = 2\text{ and } 8\text{ Hzs}, 10\text{ mm})$

$7.68\ \delta(\text{dd}, J = 2\text{ and } 8\text{ Hz}, 10\text{ mm})$

d) $C_9H_6O_2$

U.V. : $250\text{ nm } \epsilon = 14000$

I.R. : $3200\text{-}2500, (\text{Broad}) 2200,$

$1680, 1600, 1480, 920, 750, 680\text{ cm}^{-1}$

PMR : $7.4\ \delta(\text{m}, 18\text{ mm})$

$7.7\ \delta(\text{dd}, J = 2\text{ Hz}, \text{ and } 8\text{ Hz}, 12\text{ mm})$

$11.2\ \delta(\text{s}, 6\text{ mm})$

EEE

Total No. of Questions :5]

SEAT No. :

P2612

[5023]-31

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 310:Quantum Chemistry and Solid State Chemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any four of the following: **[20]**

- a) Explain the properties of operators.
- b) Derive an expression for linear momentum operator.
- c) Construct the energy operators for
 - i) Be^{+2} ion and
 - ii) H_2^+ ion, Explain the terms involved in it.
- d) Show that 'a' is eigen value of \hat{L} , then a^n is eigen value of $[\hat{L}]^n$.
- e) State the principle of variation method and derive the equation $\int \phi^* \hat{H} \phi d\tau \geq E_1$.
- f) Derive the expression for the first order correction to the wave function for non-degenerate perturbation method.

Q2) Attempt any four of the following: **[20]**

- a) Sketch the molecular orbitals for butadiene on the basis of the HMO theory.
- b) Explain how a compound may be classified as aromatic, antiaromatic and non-aromatic on the basis of REPE values.
- c) Evaluate delocalization energy for benzene on the basis of Hückels approximation.
- d) Explain Hückels $(4m+2)$ rule of annulenes.
- e) Discuss how Hess and Schaad modified Hückels theory.
- f) Explain why cyclo octatetraene is unstable but its dianion is stable and planar.

SECTION -II

Q3) Attempt any three of the following: **[15]**

- a) What is defect? Describe the various types of defects found in crystalline solids.
- b) Explain the mechanism of crystal growth from vapour phase.
- c) Distinguish between extrinsic and intrinsic semiconductors.
- d) Derive the expression for the number of Frenkel defects present in a crystal at a given temperature.
- e) Write a note on Brillouin zones.

Q4) Attempt any three of the following: **[15]**

- a) Sketch and explain the hysteresis loop observed for magnetization of an insulator crystal.
- b) Stating the types, explain the origin of colour centres in an ionic crystal.
- c) Draw and describe the various types of ' α -t ' plots for the decomposition of a single solid.
- d) Discuss the various rate laws for gas-solid reactions.
- e) Write a note on transistors.

Q5) Solve any two of the following: **[10]**

- a) Calculate the mean free time for an electron in a semiconductor crystal having drift mobility $626 \text{ cm}^2/\text{volt sec}$.
- b) Calculate fermi energy in eV for monovalent crystal having number of free electron 10^{19} per cm^3 at 27°C .
- c) Calculate the drift mobility of a charge carrier for a semiconductor having doner concentration of 10^{22} per m^3 and conductivity 100 mhos /m .

EEE

Total No. of Questions :6]

SEAT No. :

P2613

[5023]-32

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 311: Nuclear and Radiation Chemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table / calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any three of the following: **[15]**

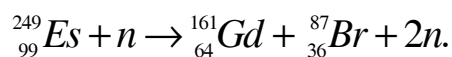
- a) Discuss various types of fission.
- b) Give classification of Nuclear reactors.
- c) Write the salient features of collective model.
- d) Discuss the role of moderator and coolant in nuclear reactors.
- e) How Rutherford's back scattering technique is used for surface analysis?

Q2) Attempt any three of the following: **[15]**

- a) Discuss compound Nucleus theory.
- b) Write a note on Vande Graff generator.
- c) Discuss the working of ceric sulphate dosimetry
- d) Distinguish between somatic and genetic effect of radiation.
- e) Write a note on personal dosimetry.

Q3) Solve any two of the following: **[10]**

- a) ${}^7\text{Li}$ target is bombarded by protons of energy 5MeV. Calculate
 - i) the energy of protons scattered through an angle of 90° and
 - ii) the energy of protons observed at 90° after they have excited the lithium to a level of 0.48 MeV.
- b) Compute the energy released in the following fission.



given the following atomic masses.

$${}_{99}^{249}\text{Es} = 249.0762 \text{ amu} \quad {}_{64}^{161}\text{Gd} = 160.928 \text{ amu}$$

$${}_{36}^{87}\text{Br} = 86.9220 \text{ amu} \quad n = 1.0087 \text{ amu}$$

- c) Find out the dose due to $800 \mu\text{Ci}$ ${}^{60}\text{Co}$ source at a distance of 5 meters.
Given $E_{\gamma} = 1170$ and 1330 keV .

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) Explain the term quenching, scavenger, G-value and spur.
- b) Discuss the mechanism of air saturated ferrous sulphate solution. Enlist the factors affecting $G(\text{Fe}^{3+})$ in it.
- c) Explain the working of Li drifted germanium detector.
- d) Describe the mechanism of radiation annealing.
- e) What are various radiolytical products of water? Discuss the free radical theory briefly.

Q5) Attempt any three of the following: **[15]**

- a) Discuss the Samuel-Magee model of water radiolysis.
- b) Define RBE and rem. Discuss the factors on which relative hazards of a given nuclide depend.
- c) Write a note on critical size of nuclear reactor.
- d) Discuss the ICRP recommendation for maximum permissible dose
- e) Describe estimated short term effects of various single dose whole body radiation exposure in man.

Q6) Solve any two of the following: **[10]**

- a) Find out the recoil energy of an atom with mass no.80 in K cal/mole for a 5 MeV photon.
- b) Find thickness of lead to reduce a dose due to gamma rays from 3.82 rad/min to 0.1 rad/min.
Given $\mu_{\text{pb}} = 0.57 \text{ cm}^{-1}$
- c) Calculate the activity of Na.22 which gives a dose rate of 4 rem/h at a distance of 2 meters. It emits gamma radiations of energy 1.28 MeV.



Total No. of Questions :6]

SEAT No. :

P2614

[5023]-33

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 312: Advanced Instrumental Methods of Analysis

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables / calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any three of the following: **[15]**

- a) How x-rays are generated? Describe x-ray tube with neat labelled diagram.
- b) What are the parameters considered while selecting an optimum nuclear reaction in NAA?
- c) What is Bremsstrahlung? Discuss the factors affecting short-wavelength cut-off and intensity of x-rays.
- d) Discuss the applications of NAA.
- e) Enlist the applications of mass spectrometry.

Q2) Attempt any three of the following: **[15]**

- a) Discuss the spherical electrostatic field analyzer in ESCA.
- b) Describe briefly electron bombardment ionization method.
- c) Describe the energy level diagram for sample and spectrometer in the ESCA technique.
- d) Define soft method of ionization. Describe any one soft method of ionization used in mass spectrometry.
- e) Write a short note on electron microprobe technique.

Q3) Solve any two of the following: **[10]**

- a) Estimate the thickness of foil of the alloy having absorption coefficient $631.75 \text{ cm}^2/\text{g}$ at 0.436 nm . If the detector recorded 10,848 counts per min of transmitted x-rays when foil was not in the path of x-rays and 1023 counts/min when foil was placed in the path. The density of alloy is 8.01 g/cm^3 .

- b) 0.5 g of steel sample containing vanadium was irradiated for 7 minutes in a neutron flux of $10^7 \text{ n cm}^{-2}\text{s}^{-1}$. Activity at the end of irradiation was found to be 2460 dpm. Find the percentage of vanadium in steel.
- c) Calculate the magnetic flux density required to focus an ion with M/Z equal to 215 on the exit slit of a magnetic analyzer in which the accelerating potential is 6490 V and the radius of curvature of the ionic beam at the exit slit is 23.0 cm.

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) With neat diagram explain sample introduction in ICP spectrometer.
- b) Compare TGA and DTA methods. Give their merits and demerits.
- c) What is photoluminescence? Describe the apparatus for it.
- d) Describe in brief components of TGA apparatus?
- e) Discuss briefly applications of ICP-AES technique.

Q5) Attempt any three of the following: **[15]**

- a) Explain the terms binding energy, work function and kinetic energy of electron with suitable energy level diagram.
- b) What is polarizable electrode? Describe different electrodes used in voltammetry.
- c) Discuss current-voltage relationship in coulometric technique.
- d) Write a short note on cyclic voltammetry.
- e) Describe controlled-potential coulometry.

Q6) Solve any two of the following: **[10]**

- a) Calculate the time required for constant current of 0.75 A to deposit 0.27 g of Co(II) as an element on cathode assuming 100% current efficiency.
- b) The work function of a spectrometer is 50 eV. The binding energy of the emitted electron is 1070 eV. If the kinetic energy of the electron is 1.77 eV. Find wavelength of incident x-ray.
- c) The thermal curve of a 125.5 mg sample that contained a mixture of $\text{MgC}_2\text{O}_4\text{H}_2\text{O}$ and thermally stable salt had mass loss of 6.98 mg at an onset temperature of about 140°C corresponding to vaporization of water. Determine percentage of $\text{MgC}_2\text{O}_4\text{H}_2\text{O}$ in sample [Atomic weight- Mg=24.3, O=16, C=12, H=1.08]



Total No. of Questions :6]

SEAT No. :

P2615

[5023]-34

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 314: Polymer Chemistry

(2008 Course) (Semester-III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables / calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any three of the following: **[15]**

- a) Discuss the phenomenon of rheological behaviour of polymer
- b) Explain polydispersity index. Derive co-polymer equation.
- c) Write a note on glass transition temperature.
- d) Discuss flory-krigbaum theory of polymer- solutions.
- e) Explain homochain heterochain polymers with examples.

Q2) Attempt any three of the following: **[15]**

- a) Write a note on conducting polymers.
- b) Explain the WLF equation and its application.
- c) Describe secondary bond.
- d) Distinguish between step and chain polymerization.
- e) Explain the effect of radiation on polymers.

Q3) Solve any two of the following: **[10]**

- a) A polymer melt comprises of equal number of molecules with molecular weight 15000. Find \bar{M}_w and \bar{M}_n for particles with molecular weight 15500
- b) Find the viscosity of a polymer of 0.4 g/dl concentration [$k=1.12 \times 10^{-2}$; $\alpha = 0.7$; Huggin constant = 0.30]
- c) A condensation polymerization reaction is 99% complete. Find \bar{M}_n , \bar{M}_w , PI and weight fraction of the monomers

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) Describe the sedimentation equilibrium method of determination of molecular weight of polymer.
- b) Write a note on vulcanization
- c) Define fibre, crimp, denier and tenacity.
- d) Discuss the effect of radiation on polymers.
- e) Explain the synthesis and properties of conducting polymers.

Q5) Attempt any three of the following: **[15]**

- a) Explain the use of XRD in polymer analysis.
- b) What are vinyl polymer? Discuss types of addition reactions
- c) Write a note on free radical chain polymerization.
- d) Discuss the principle of membrane osmometry.
- e) Discuss the use of carbon black as a filler for rubber.

Q6) Attempt any two of the following: **[10]**

- a) Describe the process of calendering.
- b) Explain cold and hot blow molding.
- c) Newtonian and non-newtonian behaviour of polymers.



Total No. of Questions :4]

SEAT No. :

P2616

[5023]-35

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 315: Special Topics in Physical Chemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables / calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

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6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
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9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any four of the following: **[20]**

- a) Write a note on conductometric sensors.
- b) Calculate the pH and concentration of all ionic species for 0.01M CH_3COON_a [$K_a=1.8\times 10^{-5}$ for acetic acid]
- c) Define adsorption isotherm. Draw different types of adsorption isotherms and explain the isotherm of type IV.
- d) Explain catalytic cycle for acetal hydrolysis in aqueous acid solution.
- e) Define the terms, poison Michaelis-Menten kinetics, the Hammett acidity function and specific acid catalysis.
- f) Define the sensor according to the International Electrotechnical committee. Draw a block diagram of a sensor system and explain it.

Q2) Attempt any four of the following: **[20]**

- a) Discuss the catalysis in concentrated strong acid solution.
- b) Write proton condition for H_2CO_3 and CH_3COOH .
- c) Draw and discuss the mechanism of the phenolacetone condensation reaction to give bisphenol A.
- d) Write proton condition for H_2Se and NaHSe .
- e) Find the concentration of H_2CO_3 , HCO_3^- and CO_3^{2-}
[Given $\text{pH}=5$, $K_{a1}=4.1\times 10^{-7}$, and $K_{a2}=5.6\times 10^{-11}$]
- f) Explain catalysis in gas phase with suitable example.

SECTION -II

Q3) Attempt any four of the following: **[20]**

- a) What are intelligent gels? Explain.
- b) What do you mean by biomimetics? How is it used in under water actuation?
- c) Write a note on carbon nanotubes
- d) Describe the phase rule with respect to the sulphur system.
- e) Describe the different forms of smart composite.
- f) Calculate the wavelength of an electron emitted in cathode ray tube operating at 10,000V.

Q4) Attempt any four of the following: **[20]**

- a) Derive phase rule.
- b) What is smart car? Explain the basic principles involved in it.
- c) Write a note on 'azeotropic mixture'.
- d) Write a note on the Pachinko machine.
- e) Explain the function of smart closes and smart windows.
- f) What are the applications of nanogels?



Total No. of Questions :4]

SEAT No. :

P2617

[5023]-36

[Total No. of Pages :3

M.Sc. -II

INORGANIC CHEMISTRY

CH - 326: Organometallic Compounds of Transition Metals and

Homogeneous catalysis

(2008 Pattern) (Semester - III) (New)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *All questions are compulsory and carry equal marks.*
- 2) *Figures to the right side indicates full marks.*
- 3) *Use of log. table / calculators are allowed.*
- 4) *At.No: Mn=25, Fe=26, W=74, Ti=22*

Q1) Attempt any four of the following: **[20]**

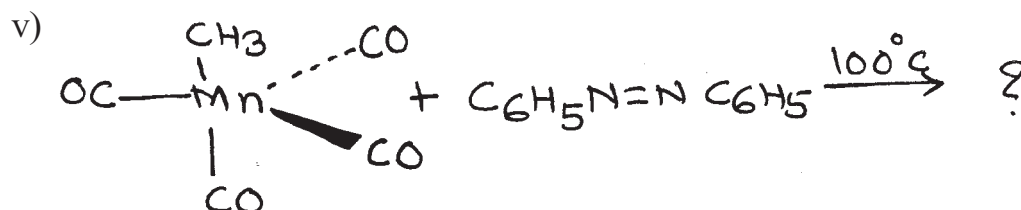
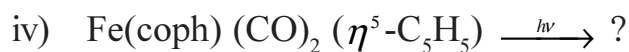
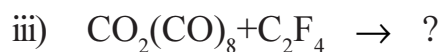
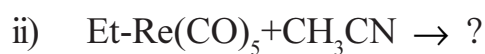
- a) "Co-ordinated alkenes are susceptible to nucleophilic attack". Justify the statement with suitable reactions.
- b) Explain the typical reactions of $\text{Fe}(\text{CO})_5$.
- c) Give a brief account of preparative routes and bonding description of metallocenes.
- d) Give a brief account of different methods for the synthesis of metal-arene compounds.
- e) Draw the structure of zeises salt. What are the structural features of zeises salt.

Q2) Attempt any four of the following: **[20]**

- a) What is EAN rule? which of the following obey EAN rule?
 - i) $[\text{Mn}(\text{CO})_4\text{NO}]^+$
 - ii) $\text{Fe}_3(\text{CO})_{12}$
 - iii) $\text{Cp}(\text{NO})_2\text{W}^{\bar{\text{H}}}$
 - iv) $(\eta^5\text{-c}_5\text{H}_5)(\eta^1\text{-c}_5\text{H}_5)\text{Fe}(\text{CO})_2$
 - v) $[(\eta^5\text{-cp})_2\text{Tl}(\text{co})_2(\eta^2\text{-c}_2\text{ph}_2)]$

P.T.O.

b) Complete the following reactions & state which reactions are cyclometallation reactions elimination reactions oxidative addition reactions and which are insertion reactions



c) Discuss the $^1\text{HNMR}$ of $\text{Fe}(\text{CO})_3 (\eta^4\text{-C}_8\text{H}_8)$ at R.T and -145°C .

d) What is catalysis? Why do transition metals act as catalyst? Give two examples of homogeneous catalysts.

e) Give an account of typical reactions MCP_2^*

Q3) Attempt any four of the following: [20]

a) What is the role of carbene complex in the metathesis reaction?

b) What do you mean by hydrocyanation reaction? which catalyst is used? Explain with suitable example.

c) Explain the interdependence of Inorganic and organometallic materials in the environment.

d) What are the similarities and difference between Suzuki and Heck coupling.

e) Draw the structures-

i) Tropyliumiron tricarbonyl cation

ii) 1,4,7 cyclononatriene molybdenum tricarbonyl

iii) Azaferrocene

iv) Dibenzene chromium

v) Bis- π cyclopentadienyl allyl titanium(III)

Q4) Write notes on any four:

[20]

- a) Repee reaction
- b) Wacker's process
- c) OMC'S as protecting agents.
- d) d-block organometallics in organic synthesis.
- e) Fluxional behaviour of organometallic compounds.



Total No. of Questions :4]

SEAT No. :

P2618

[5023]-37

[Total No. of Pages :2

M.Sc.

INORGANIC CHEMISTRY

**CH - 330: Coordination Chemistry, Magnetism and Inorganic
Reaction Mechanism**

(2008 Pattern) (Semester - III) (New Course)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) All questions are compulsory and carry equal marks.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Use of logarithmic tables and calculator is allowed.*

Q1) Attempt any four of the following:

[20]

- a) Explain the magnetic properties in dimeric copper(II) acetate monohydrate.
- b) Predict the type of Magnetic exchange which occurs via the 90° exchange pathway in the systems d^1-d^1 , d^3-d^3 , d^8-d^8 , d^9-d^9 .
- c) Give the nomenclature for the following molecules.
 - i) $\text{Li}[\text{Co}(\text{NCCH}_3)_4]$
 - ii) $\text{Fac-}[\text{Rh}(\text{PR}_3)_3\text{Cl}_3]$
 - iii) $[\text{Co}(\text{en})_3]^{3+}$
 - iv) $[\text{Ca}(\text{H}_2\text{O})_2(\text{en})_2]^{2+}$
 - v) $\text{Mo}_2(\text{CO})_8$
- d) Explain why $\text{Mn}_2(\text{CO})_{10}$ is diamagnetic.
- e) Write a note on Magnetic domain

Q2) Attempt any four of the following:

[20]

- a) Account for the difference in the room temperature magnetic moment of copper(II) acetate dihydrate (1.4 B.M.) and cupric acetylacetonate (1.84B.M)

P.T.O.

- b) Explain the terms (any two):
- Ferromagnetic material
 - Canting
 - Potential energy for high-spin, cross-over complexes
- c) Draw the crystal field splitting of 'd' orbitals of central metal ion in symmetric octahedral, and tetrahedral complexes.
- d) Draw the structures of following molecules.
- Fac-[Co(NO₂)₃(dien)]
 - [Co(NH₃)₅Cl]Cl₂
 - Fe₂(CO)₉
 - [Rh(pph₃)₂Cl₂]
 - K₃[Fe(OX)₃]
- e) Explain magnetically dilute and concentrated system.

Q3) Attempt any four of the following: **[20]**

- Discuss the relationship between the 'd' electron configuration of the metal and the lability of a complexes.
- Write a note on Acid Hydrolysis.
- Give in a brief about the two electron transfer reaction.
- Explain the various steps involved in photographic process.
- Write a note on Base Hydrolysis.

Q4) Attempt any four of the following: **[20]**

- What is trans effect? How would you synthesize all three isomers of square planar Pt(NH₃)(CH₃NH₂)(NO₂)Cl From [PtCl₄]²⁻
- Discuss in brief racemization of trischelate complexes.
- Explain kinetically inert complexes are thermodynamically unstable and vice-versa with suitable examples.
- Write a note on polarisation theory.
- Discuss in brief about oxidative addition reactions.



Total No. of Questions :4]

SEAT No. :

P2619

[5023]-38

[Total No. of Pages :3

M.Sc.-II

INORGANIC CHEMISTRY

CH - 331: Structural Methods in Inorganic Chemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *All questions carry equal marks.*
- 2) *All questions are compulsory.*

Q1) Attempt any four:

[20]

- a) Explain the principle of NMR spectroscopy and enumerate the difference between ^1H and ^{19}F nmr.
- b) 0.4012 g of sample was dissolved in acid and the Ba^{+2} and Ca^{+2} ions were precipitated as oxalates. The oxalates were then heated in a T.G. apparatus to get a residue weighing 0.3444g in the temperature range $320-440^\circ\text{C}$ and 0.3111 g in the $580-620^\circ\text{C}$ range. Calculate the percentage of Barium and calcium in the sample. (At. wts, $\text{Ba}=137.3$, $\text{Ca}=40$, $\text{C}=12$, $\text{O}=16$, $\text{H}=1$)
- c) How many lines would you expect in the ESR spectrum of
 - i) Hydrogen atom
 - ii) Benzene anion
- d) With the help of suitable examples explain the effect of various factors on a TG curve.
- e) Define isomer shift parameter in Mössbauer spectroscopy and explain its significance.

P.T.O.

Q2) Answer the following (any four): **[20]**

- a) “ESR is a technique which can be effectively used for studying biological systems”. Justify the statement
- b) Explain how ^{31}P nmr can be used to detect facial and meridional isomers of $\text{C}_r(\text{CO})_3[\text{P}(\text{OCH}_3)_3]$ can be detected from their equilibrium mixture in deuteriated toluene.
- c) Derive Bragg’s Law using the simple case of incident x-ray beam being diffracted by parallel planes in a crystal.
- d) Give a comparative account of DTA and DSC.
- e) How is NQR used for studying the nature of chemical bonds.

Q3) Attempt the following (any four): **[20]**

- a) What are the conditions for Mössbauer spectroscopy. Explain
- b) Calculate the magnetic field at which resonance occurs if the g value for the benzene radical anion is 2.0025 and the spectrometer is operating at 9302 MHz.
- c) Define the following terms
 - i) Bravais lattice
 - ii) Screw axis
 - iii) zero field splitting
 - iv) Quadrupole splitting
 - v) ‘g’ value in ESR.
- d) What structural information can be obtained for Group III halides from NQR.
- e) What is chemical shift in NMR? which are factors affecting the chemical shift of a proton?

Q4) Answer the following (any four):

[20]

- a) A sample of $\text{Fe C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ when heated in air decomposed to form Fe_2O_3 in two steps. Calculate the weight Loss involved in each step. Write the decomposition reaction for each step. What will be the effect of CO_2 atmosphere on the thermogram?
- b) ESR of copper salicylaldehyde complex shows eleven peaks while that for $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ shows only 4 peaks. Explain
- c) Calculate the percentage of KO_3 in a sample, if in a TGA analysis the sample underwent the following transformation



0.2546g of sample when heated at 70°C for 60 minutes weighed 0.213 g

- d) From the following Mössbauer data for I_2Cl_6 & $\text{I}_2\text{Br}_2\text{Cl}_4$ predict the structure of $\text{I}_2\text{Br}_2\text{Cl}_4$.

	δ mms ⁻¹	e^2q Q/MHz
I_2Cl_6	3.5 ± 0.02	$+3060 \pm 10$
$\text{I}_2\text{Br}_2\text{Cl}_4$	I_A 2.82 ± 0.02	$+ 2916 \pm 10$
	I_B 3.48 ± 0.02	$+ 3040 \pm 10$

- e) Explain the basic experiment of cyclic voltametry write the help of CV parameters.



Total No. of Questions :4]

SEAT No. :

P2620

[5023]-39

[Total No. of Pages :2

M.Sc.-II

INORGANIC CHEMISTRY

**CH - 332: Bioinorganic Chemistry: Inorganic Elements in the
Chemistry of Life**

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *All questions carry equal marks.*
- 2) *All questions are compulsory.*

Q1) Answer the following(any four):

[20]

- a) Give an account of role of Ni in different enzymes.
- b) Discuss the Fenton reaction and it's implications towards DNA cleavage activity.
- c) Explain the important reactions catalysed by methyl cobalamine cofactor.
- d) What are the functions of cytochrome oxidase?
- e) Explain what do you mean by "Radiolabelling". Discuss how it is used for antibiotics.

Q2) Attempt any four of the following:

[20]

- a) Explain the role of metal cluster in water oxidation
- b) Compare the therapeutic and diagnostic applications of radiopharmaceuticals.
- c) Explain the role of -iron-sulphur clusters in biological processes.
- d) Discuss different types of copper-proteins.
- e) "Nature uses metal-nucleic acid interactions for different functions such as protein folding". Explain this statement with suitable examples.

P.T.O.

Q3) Write short notes on (any four): **[20]**

- a) Pertechnate generator
- b) Carboxypeptidase
- c) Chemical nucleases
- d) Reactions of superoxide dismutase
- e) Hydrogenase

Q4) a) Draw the structures of (any five) **[5]**

- i) Carboplatin
- ii) Qzurin
- iii) Zinc finger
- iv) $[\text{Tc}(\text{PR}_2)_4\text{X}_2]$
- v) Spirogermanium
- vi) F-430

b) Answer in short any five of the following **[10]**

- i) What do you mean by “intercalation”?
- ii) What are the steps involved in Drug development?
- iii) Why transition metals are involved in enzymatic reactions?
- iv) Role of Gadolinium complexes as contrast agent in MRI.
- v) Describe the reaction of oxygen with deoxy hemocyanin.
- vi) What do you mean by model compounds? Explain with any one example.

c) Match the following **[5]**

A	B
Manganese	$\text{Fe}_4 \text{S}_4$
Ferridoxin	Bone scanning
Tc-MDP	Catalase
Urease	Alcohol & Dehydrogenase
Zn	Nickel



Total No. of Questions :6]

SEAT No. :

P2621

[5023]-40

[Total No. of Pages :4

M.Sc.-II

ORGANIC CHEMISTRY

CH - 350: Organic Reaction Mechanism

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

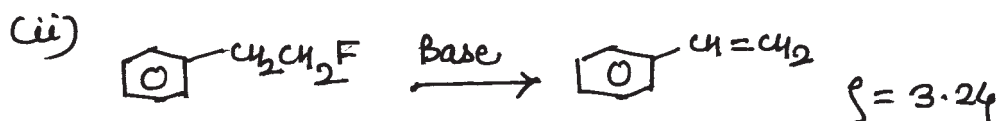
SECTION-I

Q1) Attempt any four of the following: [12]

- a) Halogenation of EMK in acid and base catalysed conditions give different products Explain.
- b) Discuss the generation of carbenes with suitable examples
- c) Write note on BAc² pathway.
- d) Discuss the use of isotopes in determination of reaction mechanism.
- e) What is pyridoxal mediated transamination?

Q2) Attempt any four of the following: [12]

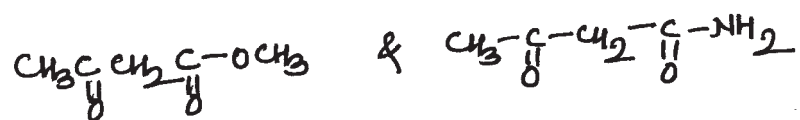
- a) Hydrolysis of Ph SCH₂CH₂Cl is considerably slower than that of Et SCH₂CH₂Cl
- b) Explain the sign and magnitude of ρ (rho) in the following reactions.



P.T.O.

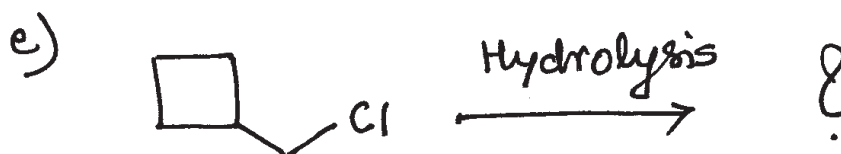
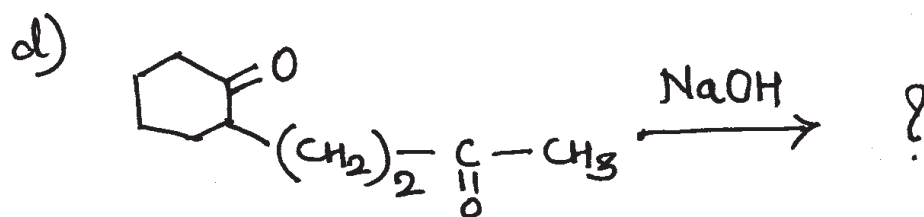
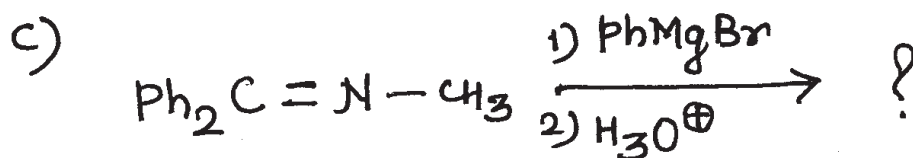
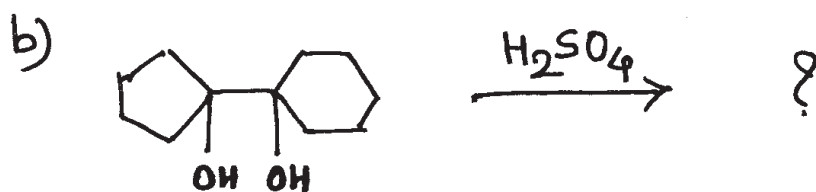
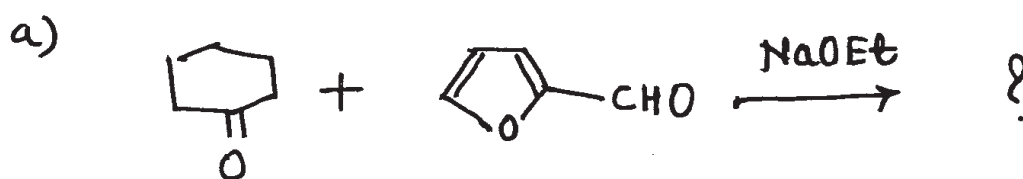
c) Write note on Dickman Cyclization.

d) Which is more acidic?



e) Prove that Hammett equation is a linear free energy relation

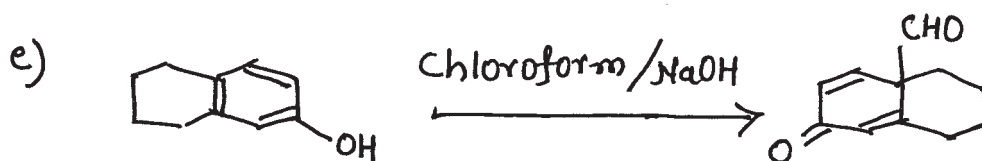
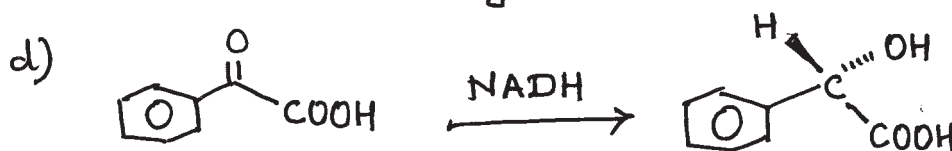
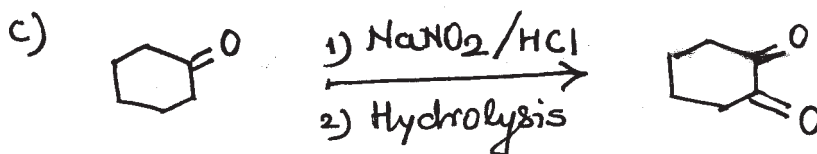
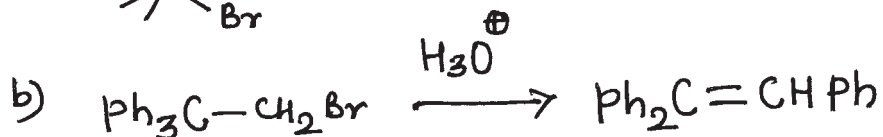
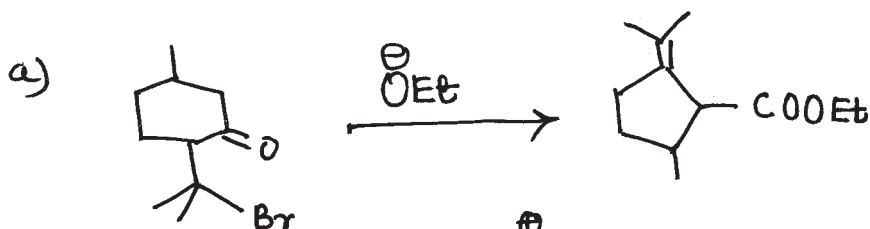
Q3) Predict the products with mechanism for any four of the following [16]



SECTION-II

Q4) Suggest the mechanism any four of the following:

[16]

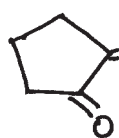


Q5) Explain any four of the following:

[12]

a) 4-N,N-dimethyl amino benzaldehyde fails to undergo intermolecular Benzoin condensation.

b) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ exists exclusively in keto form where as

 is almost 100% in enol form. Explain.

c) Discuss carboxylation with Biotin in biological chemistry.

d) Stork enamine approach is more selective than enolate ion approach in alkylation of ketones. Explain.

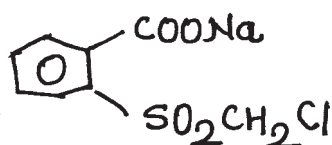
e) Which of the following compound is more acidic?



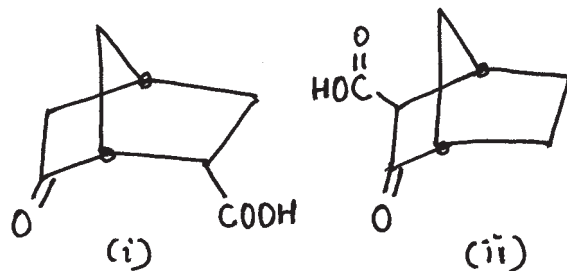
Q6) Attempt any four of the following:

[12]

- Discuss effect of solvent on ρ (rho) of the reaction.
- Explain the mechanism of racemization of α -amino acid using pyridoxal phosphate.
- Write full structure of NADH.
- Hydrolysis of following compound takes place easily in boiling water. Justify



- Which one of the following undergoes decarboxylation at faster rate?



Total No. of Questions :6]

SEAT No. :

P2622

[5023]-41

[Total No. of Pages :5

M.Sc-II

ORGANIC CHEMISTRY

CH - 351: Spectroscopic Methods in Structure Determination

(2008 Pattern) (Semester - III)

Time : 3 Hours]

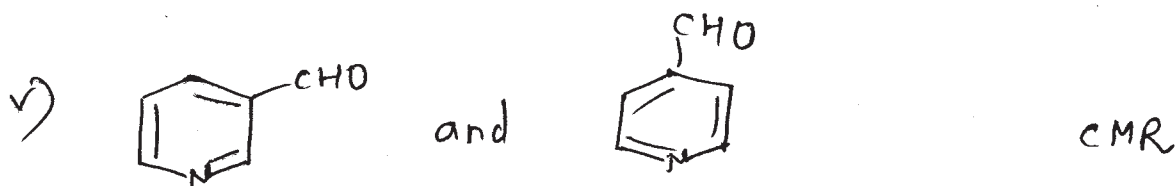
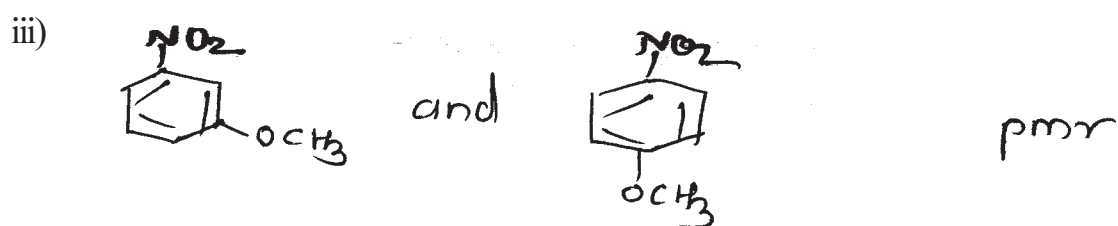
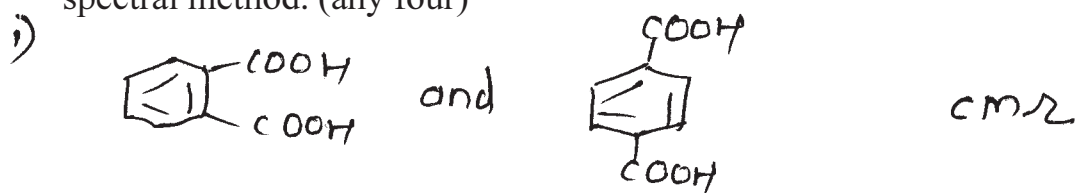
[Max. Marks :80

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right side indicate full marks.
- 3) Answers to the two sections to be written in separate answer sheets.

SECTION-I

Q1) a) Distinguish between the compounds shown below by using the indicated spectral method. (any four) [8]



P.T.O.

- b) Explain any four of the following: [8]
- i) Double focusing instrument gives better idea about the molecular formula than that of single focusing.
 - ii) The size of cyclic olefin can be estimated from J-vicinal.
 - iii) Unlike PMR, integration of signals is not used in CMR.
 - iv) CMR can be used to distinguish ketones and aldehydes from other carbonyl derivatives.
 - v) DMF shows two signals for methyls group at room temperature whereas it shows one signal at 130°C.

Q2) Answer any three of the following: [12]

- a) Compounds with following molecular formulae show only one signal in their PMR spectra. Suggest their structures.
 - i) C_2H_6O
 - ii) C_5H_{10}
 - iii) C_3H_6
 - iv) $C_2H_4Br_2$

- b) An organic compound C_7H_8 undergo catalytic hydrogenation to give compound C_7H_{12} whose CMR spectra exhibits the following signals. Find the structure and assign the signals.
 CMR (PND): 143, 75 and 50
 DEPT(135): 143 & 50 up, 75 down

- c) A compound with molecular formula $C_5H_8O_2$ exhibits following spectral data. Deduce the structure from the data.
 IR: 3300-2700(b), 1720, 1640 cm^{-1}
 PMR: 2.5(m, 16mm), 5.1(dd, J=10 & 1.5 Hz; 4 mm)
 5.2 (dd, J=16 & 1.5 Hz, 4mm), 5.85 (m, 4mm), 11.4 (s, exchangeable, 4mm)

- d) Deduce the structure from spectral data given.
 MF: $C_6H_8Cl_2O_2$
 PMR : 1.45 (d, J=12Hz, 1H), 1.60 (s, 3H),
 2.29 (d, J= 12Hz, 1H), 3.77(s, 3H).
 CMR : 18, 31, 35, 53, 63, 170.
 DEPT 90 : No peak
 DEPT 135 : 18 & 53 \uparrow ; 31 \downarrow

Q3) Write short notes on any three of the following:

[12]

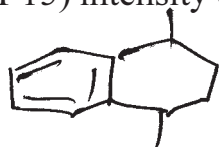
- Diamagnetic anisotropy
- Use of 2D-NMR
- Long-range coupling
- Rearrangement mechanisms in MS.

SECTION-II

Q4) a) Answer any four of the following:

[8]

- A compound with three chlorine atoms give M, M+2, M+4, M+6 intensities in the ratio of 27: 27: 9: 1. Explain.
- HO-CH₂-CH₂-NH₂ shows m/e 30 ten times intense than m/e 31. Explain.
- (M-15) intensity of I and II are 28.2% and 4% respectively.

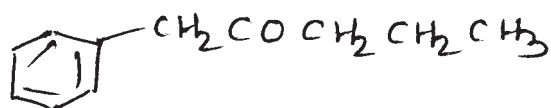


I



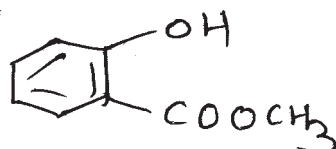
II

- Explain the ions obtained in MS of



120, 91, 71, 43

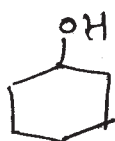
- Explain the genesis of the ions of



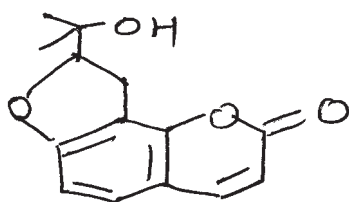
152, 120, 64

- Using the mass peaks given below, assign the correct structure from those shown below. [4]

m/e 15(50), 41(50), 59(8), 69(100), 85(22), 100(18). What will be the base peaks of the remaining compounds.



- Q5) a) Assign with reasoning the PMR signals to the protons of the compound shown below. Explain the decoupling experiment. [8]



1.2 (s, 9 mm), 1.3 (s, 9 mm),

2.0 (s, 3mm, exchangeable),

3.3(d, J= 7Hz, 6mm), 4.82

(t, J=7Hz, 3 mm), 6.25 (d,

J= 10 Hz, 3mm), 6.77 (d, J= 8Hz, 3mm), 7.23 (d, J=8Hz, 3mm), 7.72(d, J=10Hz, 3mm)

Decoupling Expt: Irradiated observed

3.3 4.82 t → s

6.25 7.72 d → s

- b) Answer any two of the following. [8]

- i) Deduce the structure of the compound from CMR data

MF : $C_5H_{10}O$

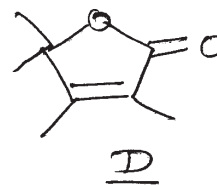
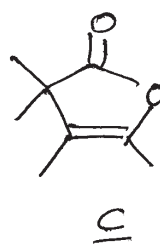
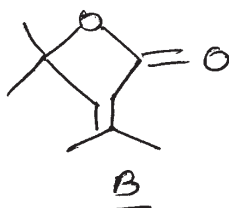
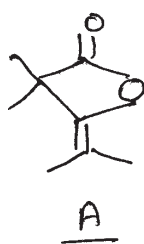
CMR : 18, 41, 67, 116 and 141

DEPT 1: 18, 41, 141, all up; 67 & 116 down

DEPT 2 : 41 and 141 up

- ii) Identify with justification which of the four structures given below is consistent with the given CMR data of a compound.

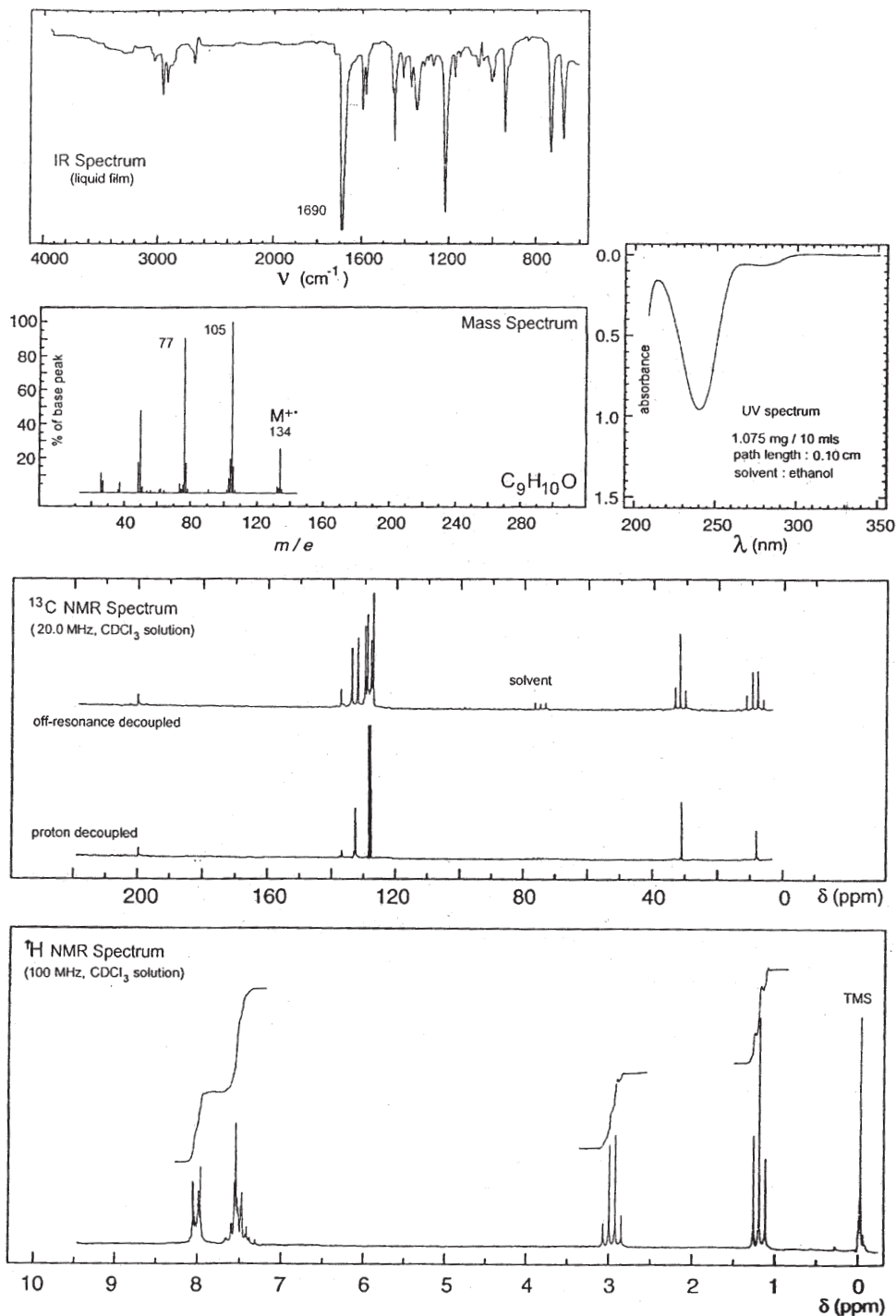
CMR : 15.2 (q, mod), 15.4 (q, mod), 20 (q, str) 54 (s, weak), 104 (s, weak), 142 (s, weak) & 173 (s, weak),



- iii) Deduce the structure of the compound based on the CMR data given below. Assign the CMR signals.

MF: C_6H_8O CMR: δ 30(t), 41 (t), 46(t), 129(d), 145 (d), 198(s)

Q6) You are provided with the spectra of a compound on the opposite page. Analyze these spectra and arrive at a structure consistent with the data. Justify your structure. **[12]**



Total No. of Questions :6]

SEAT No. :

P2623

[5023]-42

[Total No. of Pages :5

M.Sc. -II

ORGANIC CHEMISTRY

CH - 352: Organic Stereochemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right side indicate full marks.*
- 3) Answers to the two sections should be written in separate answer books.*

SECTION -I

Q1) Attempt any four of the following:

[16]

- a) Neomenthylchloride undergoes base catalysed elimination about 200 times faster than menthyl chloride. Explain.
- b) Draw the conformations of trans-anti-trans and cis-anti-trans perhydroanthracene. Calculate their energies and state which is more stable?
- c) Describe the concept of I-strain with suitable examples.
- d) "One of the isomers of hexachlorocyclohexane reacts very slowly with a base". Explain.
- e) Cis - 4 - hydroxycyclohexane carboxylic acid can undergo lactonization while trans isomer doesnot. Explain.

P.T.O.

- b) Give the reaction of diazomethane with Enhydrin. How this reaction help to deduce the lactone ring fusion with Enhydrin.
- c) Find the relative configuration at C_5 and C_6 in dihydrocodeine.
- d) How relative configuration in quinine at C_8 and C_9 is deduced by comparison with ephidrine.

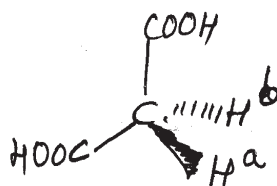
Q5) Answer the following questions (Any Four):

[12]

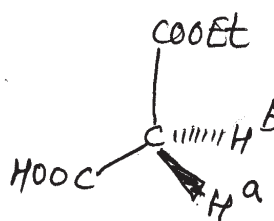
- a) In the structure A, B, C state with reasons, whether the hydrogens marked H^a and H^b are homotopic, enantiotopic or diastereotopic.



(A)

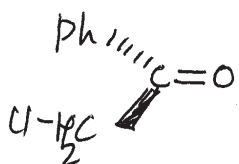


(B)

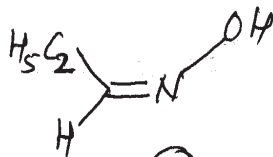


(C)

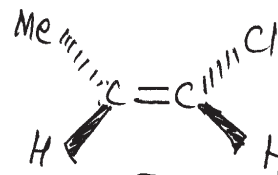
- b) Assign Re/Si configuration to the top face, as drawn of each sp^2 hybridized carbon and nitrogen in compound D, E, F.



(D)

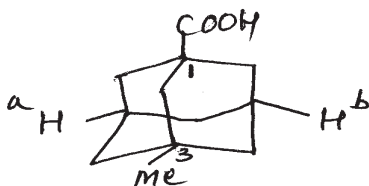


(E)

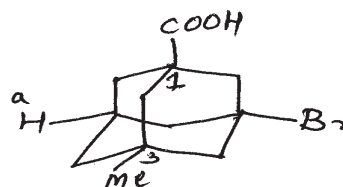


(F)

- c) Would you expect the proton H^a and H^b in following compounds to be enantiotopic. Comment on chirality.

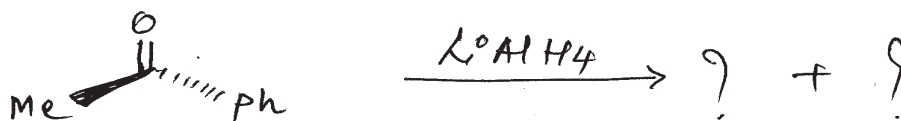


(I)



(II)

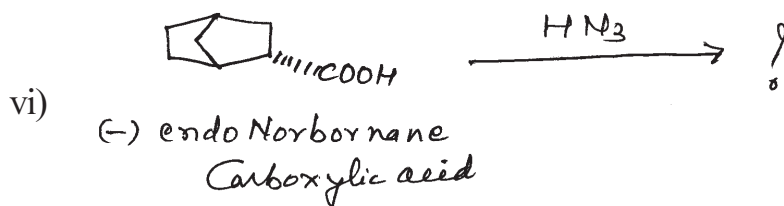
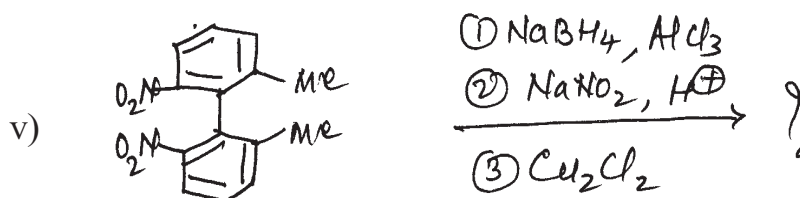
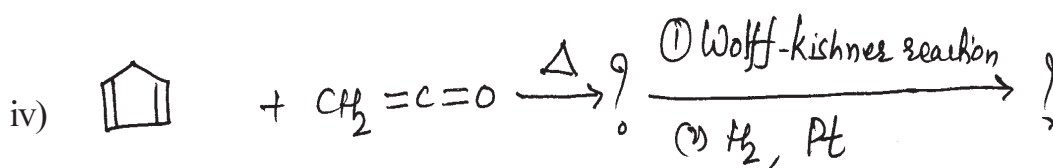
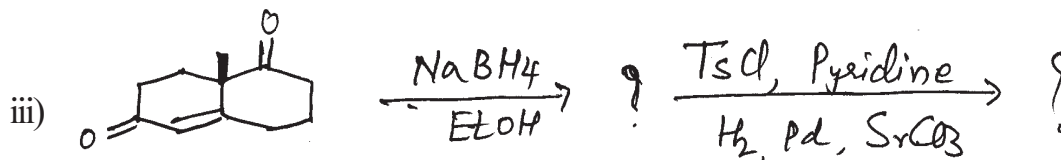
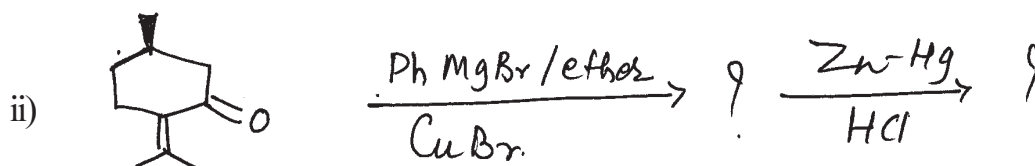
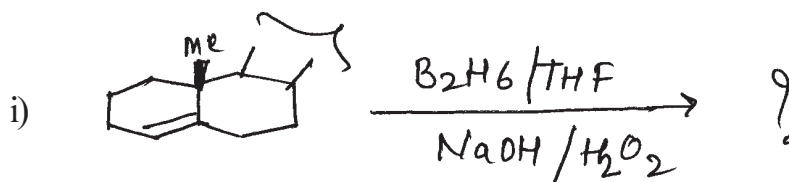
- d) Write the products by reaction with LiAlH_4 from Re and Si faces on following compound comment on optical activity of the products.



- e) Oxidation of maleic acid with OsO_4 gives mesotartaric acid. Where as similar oxidation of fumaric acid gives (\pm) tartaric acid. Explain.

$\text{HOOC}-(\text{CH}=\text{CH})-\text{COOH}$ cis or trans isomer.

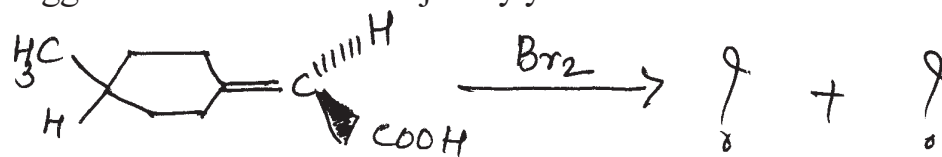
- Q6) a) Predict the product/s in the following reactions. Explain the stereochemical principle and mechanism in details (any five): [10]



b) Solve any two of the following:

[6]

- i) Calculate the ee and specific rotation of a mixture containing 6 gm of (+) 2-butanol and 4 gm of (-) 2-butanol. The specific rotation of enantiomerically pure (+) 2-butanol is +13.5°.
- ii) Explain, how Felkin Ahn model differs from Cram model.
- iii) Active compound 4-methyl cyclohexylideneacetic acid (A) on Bromine addition reaction gives a mixture of two active dibromide suggest the mechanism and justify your answer.



Active compound.

(A)

EEE

Total No. of Questions :6]

SEAT No. :

P2624

[5023]-43

[Total No. of Pages :5

M.Sc. -II

ORGANIC CHEMISTRY

**CH - 353: Free Radicals, Photochemistry and Pericyclic Reactions
and their Applications**

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right side indicate full marks.*
- 3) Answers to the two sections should be written in separate answer books.*

SECTION -I

Q1) a) Write short notes on any two of the following: [8]

- i) Photosensitisation
- ii) Use of tributyl tin hydride in organic synthesis
- iii) Dimerisation of olefins

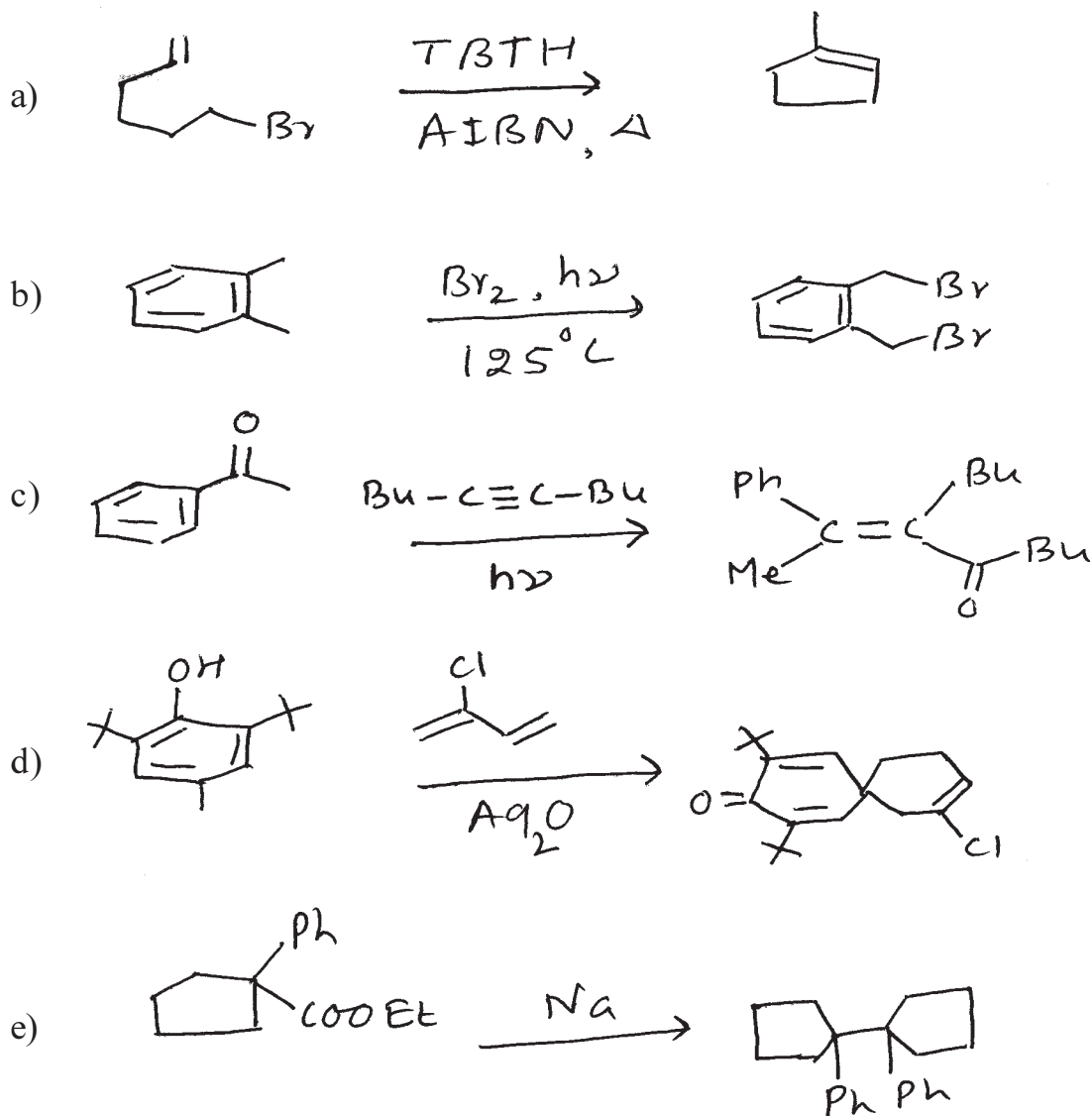
b) Explain any two of the following: [8]

- i) Photo oxidation of alkenes and polyenes by singlet oxygen.
- ii) Paterno - Büchi reaction with suitable examples.
- iii) Intermolecular hydrogen abstraction.

P.T.O.

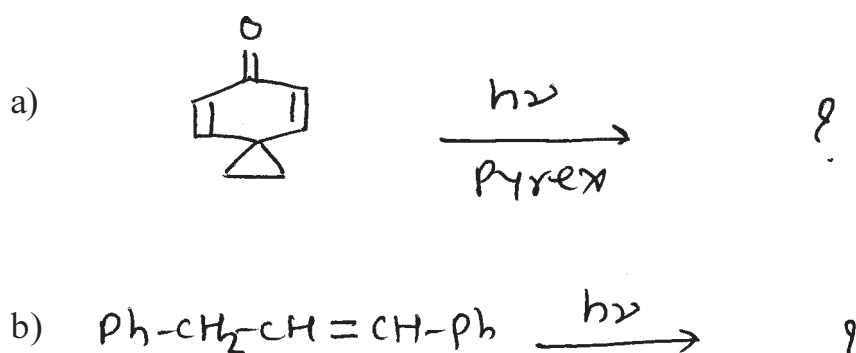
Q2) Suggest the mechanism for any four of the following:

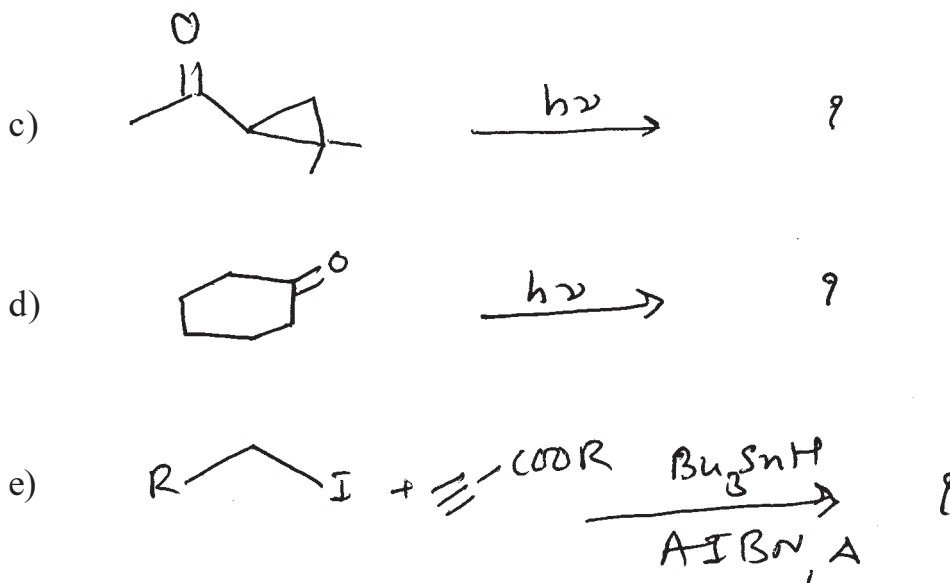
[12]



Q3) Predict the product/s for any four of the following:

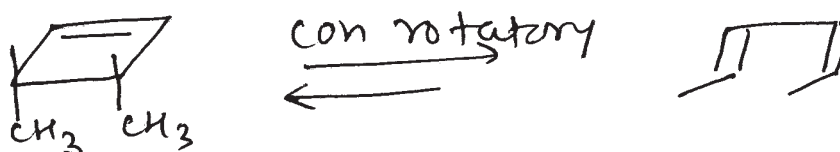
[12]



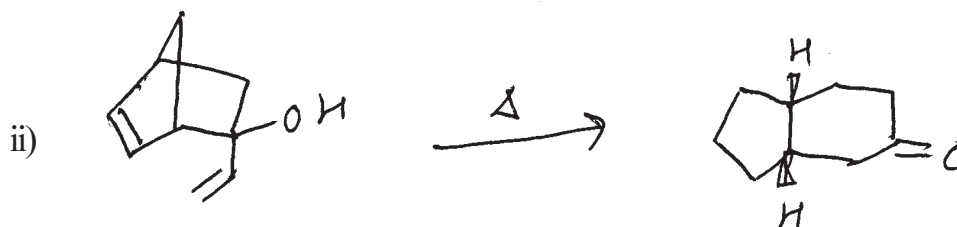


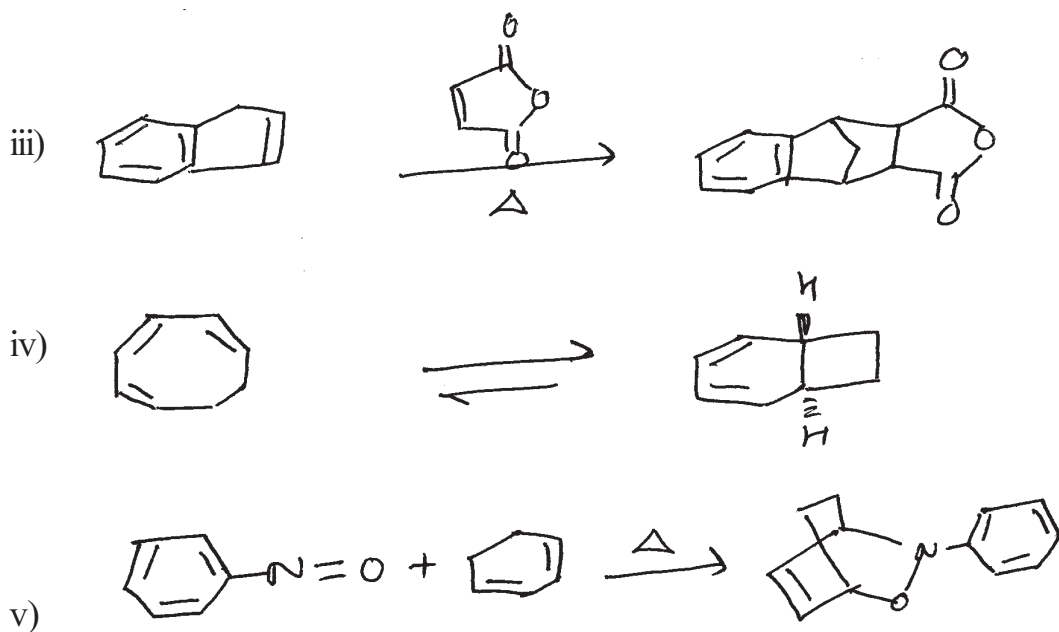
SECTION -II

Q4) a) Construct a correlation diagram for the following transformation. [4]



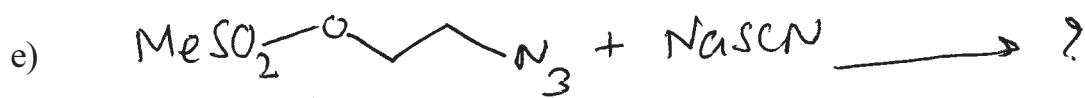
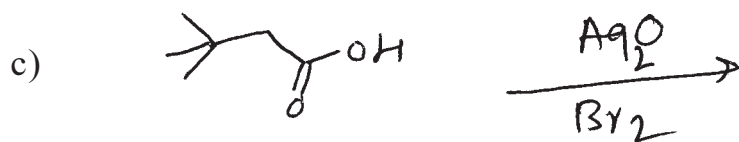
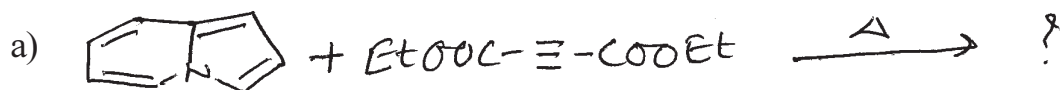
b) Suggest the mechanism for any four of the following: [12]





Q5) Predict the products in any four of the following:

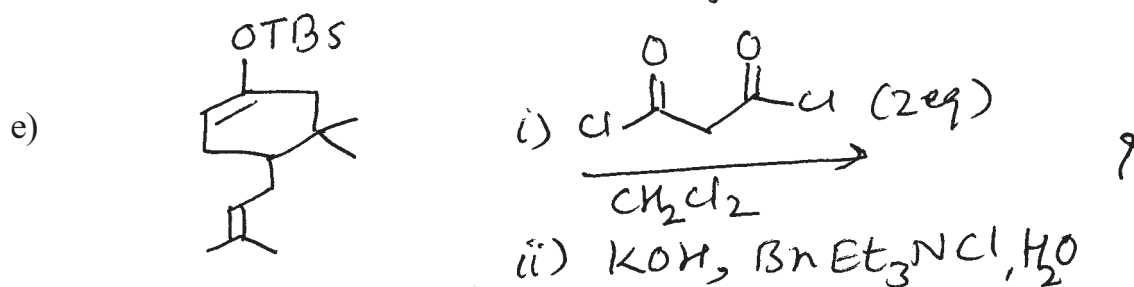
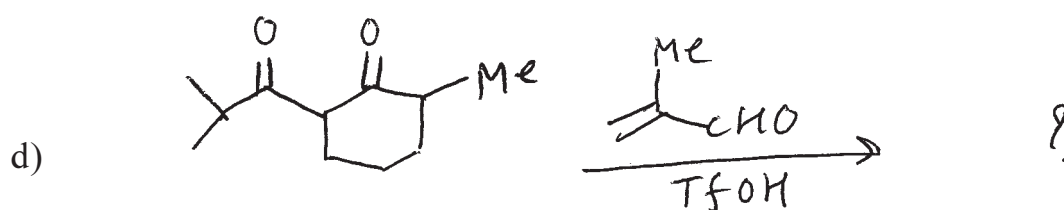
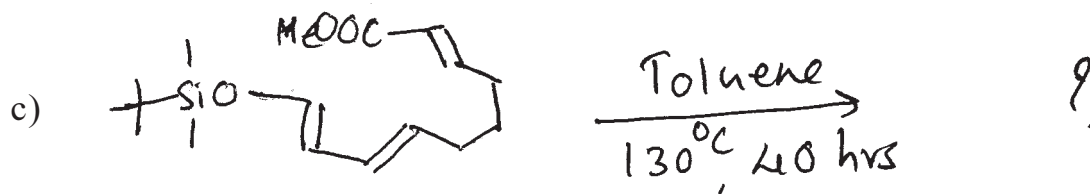
[12]



Q6) Answer any four of the following:

[12]

- a) Predict the structure 2,4 heptadiene produced by the thermal ring opening of cis - 3 - ethyl - 4 - methyl cyclobutene.
- b) With the help of co-relation diagram show that the Diels - Alder reaction is thermally allowed process.



EEE

Total No. of Questions :4]

SEAT No. :

P2625

[5023]-44

[Total No. of Pages :3

M.Sc. - II

ANALYTICAL CHEMISTRY

**CH - 390: Electroanalytical and Current Analytical Methods in Industries
(2008 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.*
- 2) All questions are compulsory and carry equal marks.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Use of logarithmic tables / calculator (non-programmable) is allowed.*

SECTION -I

Q1) Attempt any four of the following:

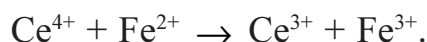
[20]

- a) Explain the construction and working of rotating platinum microelectrode.
- b) Describe the analytical applications of stripping voltametry.
- c) Define limiting current. Discuss the factors affecting on limiting current.
- d) A constant current of 0.853 A is passed through a copper chploride solution for 10 min. Calculate the weight of copper metal deposited on the cathode. [Given: At.wt. of Cu = 63.54]
- e) Determine half-wave potential of Ag/AgCl electrode having electrode potential - 2.240 volt at 27°C, the current generated by the rate of mass transport by diffusion is 2.82 μA . [Given: cathodic diffustion current = 15.24 μA]

P.T.O.

Q2) Attempt any four of the following: **[20]**

- a) Describe the potential ramp used in square wave polarography. Distinguish between pulse polarography and square wave polarography.
- b) Write a critical note on chrono-amperometry.
- c) State the principle of amperometric titrations. Discuss the nature of amperometric titration curve when an electroactive reagent added into an electro inactive solution.
- d) What are nanomaterials? Give it's general applications.
- e) A 25 ml aqueous sample of Fe(II) was assayed in a 0.20 M ce (III) solution by controlled-potential coulometry. At the end point, area under the current-time curve was 20.0 mA min. Determine the concentration of Fe (II) in the sample. The overall electrode reaction was



SECTION -II

Q3) Attempt any four of the following: **[20]**

- a) State and explain the principle of neutron activation analysis. Discuss the steps involved in neutron activation analysis.
- b) State and explain the principle of radiometric titration with suitable example.
- c) Discuss the principle and technique of direct isotope dilution analysis.
- d) Calculate the concentration of chloride in unknown solution having transmittance of 80.0% in the cell of path length 1.0 cm. The turbidity coefficient of the unknown sample is $5.0 \times 10^{-3} \text{ lit mg}^{-1} \text{ cm}^{-1}$.
- e) A 1 mg of labelled selenium having activity 8550 counts for 10 min, was mixed with 100 cm^3 of human blood serum. After through mixing 5 mg of selenium was extracted gave an activity 2500 counts for 5 min. Calculate the amount of selenium present in the human blood serum, if the background activity is 100 counts for 10 min.

Q4) Attempt any four of the following:

[20]

- a) State the principle of DTA. Discuss with neat labelled diagram, the working of differential thermal analysis.
- b) Explain, the characteristics of thermometric titrations. How it differs from conventional titrations?
- c) State and explain the principle of nephelometry with suitable schematic diagram.
- d) Discuss the applications of turbidimetry.
- e) An impure sample of calcium oxalate monohydrate was analysed using TGA technique. TG curve of the sample indicates total mass change from 90 mg to 45 mg, when sample was heated upto 900°C. Calculate the percentage purity of the sample.

[Given: At.wt. of Ca = 40, C = 12, O = 16 and H = 1].

EEE

Total No. of Questions :4]

SEAT No. :

P2626

[5023]-45

[Total No. of Pages :3

M.Sc. - II

ANALYTICAL CHEMISTRY

CH - 391: Environmental and Analysis of Industrial Materials

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.*
- 2) All questions are compulsory and carry equal marks.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Use of logarithmic tables, non-programmable calculator is allowed.*

SECTION - I

Q1) Attempt any four of the following:

[20]

- a) What is compound fertilizer? Explain Na-tetraphenyl borate method used for determination of Potassium from mixed fertilizers.
- b) Explain the method for determination of CaO in the sample of cobalt glass.
- c) Explain the procedure for estimation of zinc by using 8 - hydroxyquinoline from deodorants and antiperspirants.
- d) Explain the term explosive. How is heat of explosion measured by adiabatic calorimeter?
- e) 10 ml of 0.01 M ZnSO₄ solution required 9.5 ml of EDTA solution for complete reaction. 0.250 gm of sample containing magnesium was dissolved in 100 ml of acid. An aliquot of 10 ml of same solution required 11 ml EDTA solution. Calculate percentage of magnesium in the sample. [Given: At.wts. Mg = 24.31]

P.T.O.

Q2) Attempt any four of the following:

[20]

- a) Describe importance of pigment volume concentration in surface coating industries.
- b) What is sampling? Mention the methods of sampling. Explain the method used for sampling of explosive.
- c) Outline the procedure for determination of chromium from pigments.
- d) A sample of detergent weighing 7.550 g was dissolved in water and solution was diluted to 100 ml in a volumetric flask, 10 ml of an aliquot of this solution required 11 ml of 0.005 N CETAB solution for complete reaction. Calculate percentage of combined SO_3 present in the sample. [Given: At. wts. O = 16, S = 32]
- e) 0.135 g. of nitrogen fertilizer was dissolved in acid and made strongly alkaline with NaOH. The solution was heated and liberated ammonia was absorbed in exactly 50 ml of 0.050 N M_2SO_4 . The unused H_2SO_4 was back titrated with 0.05 N NaOH and burette reading was 20 ml. Calculate the percentage of nitrogen in the sample. [Given: At wts. N = 14]

SECTION -II

Q3) Attempt any four of the following:

[20]

- a) Explain the analytical procedure for estimation of calcium from Dolomite ore.
- b) Outline the analytical procedure for the determination of any one of the following:
 - i) Chromium from steel.
 - ii) Iron from bauxite ore.
- c) Give the constituents of Ilmenite. Explain the analysis of Titanium from Ilmenite ore.

- d) 0.150 gm of bauxite ore was disintegrated by suitable method. After removal of impurities the filtrate containing Al^{+3} ions was diluted to 100 ml. An aliquot of 25 ml required 26 ml of 0.0098 M EDTA solution for complete reaction. Calculate percentage of Al_2O_3 .
- e) 0.25 gm of yellow-chrome pigment was disintegrated and soluble chromate was extracted with H_2SO_4 . The solution was diluted to 100 ml. An aliquot of 10 ml required 11.0 ml of 0.05 N $\text{Na}_2\text{S}_2\text{O}_3$ solution in iodometric titration. Calculate the percentage of chromium and CrO_3 in the given sample. [Given: At. wts, Cr = 52, O = 16]

Q4) Attempt any four of the following: **[20]**

- a) Explain the analytical method for estimation of arsenic from waste water.
- b) Write a note on catalytic converter.
- c) How NO_x is generated? Explain its hazardous effect on material. How is it controlled?
- d) What is sludge? give the any two methods used for disposal of sludge.
- e) Explain principle and construction of cyclone separator.

EEE

Total No. of Questions :4]

SEAT No. :

P2627

[5023]-46

[Total No. of Pages :3

M.Sc. - II

ANALYTICAL CHEMISTRY

CH - 392: Advanced Analytical Techniques

(2008 Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.*
- 2) All questions are compulsory and carry equal marks.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Use of logarithmic tables/ calculator (non-programmable) is allowed.*
- 5) Use of graph paper is allowed.*

SECTION -I

Q1) Attempt any four of the following:

[20]

- a) State the Kirchoff's law. State its significance in relation with conservation of mass and energy.
- b) Explain the terms:
 - i) Transformer
 - ii) Capacitors
 - iii) Conductance
 - iv) Inductors
 - v) Resistor
- c) Explain the difference between metallic conductor, insulator and semiconductors on the basis of band theory.
- d) Draw a block diagram of digital computer and explain the function of each component.
- e) Calculate the binary equivalent of 7497 and decimal equivalent of 1110001011.

P.T.O.

Q2) Attempt any four of the following:

[20]

- a) Write a note on centrifugal force analyzers.
- b) Draw the outline of microprocessor control in liquid chromatography.
- c) Write a critical note on discrete sample analyzer.
- d) Explain the scope of the microprocessor control of atomic absorption spectroscopy in analytical laboratories.
- e) Calculate the reactance of $0.02 \mu\text{F}$ capacitor at a frequency 3 kHz and 3 MHz .

SECTION -II

Q3) Attempt any four of the following:

[20]

- a) Explain the following terms with respect to A.A.S.
 - i) Spectral interference
 - ii) Chemical interference
 - iii) Ionisation interference
 - iv) Releasing agent
 - v) Protective agent
- b) Mention the elements required in micronutrients for the growth of crop. Describe any one suitable method for the determination of molybdenum from soil sample.
- c) Compare the ICPS and direct current plasma emission spectroscopic techniques of analysis with respect to principle, and method of analysis.
- d) Write a note on Resonance ionization spectroscopy.

- e) The determination of copper in an industrial waste stirring is carried out by using A.A.S. A calibration curve is prepared with copper standard solution as given below from calibration curve and the sample absorbance of 0.175. Calculate copper solvent in the waste.

Copper in PPM	Absorbance ($\lambda=325$ nm)
0.60	0.134
1.20	0.269
1.80	0.397
sample	0.175

Q4) Attempt any four of the following: **[20]**

- a) Give a brief account of radioimmuno assay with special reference to principle and application.
- b) Explain ELISA with respect to principle, aspects and applications.
- c) Explain clinical application of the radioimmuno assay of insulin.
- d) Discuss the working of Hollow cathode lamp.
- e) A solution of sample of plant ash gave a meter reading 37. To the solution B and C containing the same quantity of unknown solution 40 and 80 mg/ml of added potassium were meter reading of 65 and 93. Calculate the concentration of potassium in the sample.

EEE

Total No. of Questions :4]

SEAT No. :

P2628

[5023]-47

[Total No. of Pages :3

M.Sc. - II

ANALYTICAL CHEMISTRY

CH - 380: Pharmaceutical Analysis

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.*
- 2) All questions are compulsory and carry equal marks.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Use of non-programmable calculator / logarithmic table is allowed.*

SECTION -I

Q1) Answer any four of the following:

[20]

- a) What are emulsions? How are they prepared? Mention their advantages.
- b) What are atmospheric and microbial contaminants associated with pharmaceutical chemicals?
- c) How is sampling of vegetable drug carried out?
- d) How proteolytic activity of an enzyme is determined?
- e) 50 ml saline sample was diluted to 250 ml with distilled water. 25 ml of diluted solution was titrated with 0.05 N AgNO₃ solution using K₂CrO₄ as an indicator. The burette reading was 12 ml. Calculate amount of NaCl present in given sample. [At. Wt. Na =23, Cl = 35.45].

P.T.O.

Q2) Answer any four of the following:

[20]

- a) What is aromatic water? How is it prepared?
- b) Define aerosols. Explain quality control test for aerosols.
- c) What are capsules? Explain any two methods of preparation of capsules.
- d) Outline an analytical procedure for determination of haemoglobin.
- e) 0.55 gm sample containing calcium lactate ($C_9H_{10}O_6Ca \cdot 5H_2O$) was dissolved in 100 ml of water containing 3 ml HCl. After dissolution, solution was neutralised with NaOH. This solution was titrated with 0.05 M EDTA using murexide and naphthogreen indicator and gave burette reading 28.2 ml. Calculate the percentage of calcium lactate in given sample. [At. Wt. C = 12, H = 1, O = 16, Ca = 40.08]

SECTION -II

Q3) Attempt any four of the following:

[20]

- a) Explain tube assay method for microbial assay of antibiotics.
- b) What is the difference between tablet and capsules? Explain in detail Additives in Tablet preparation.
- c) Explain different phases of new drug development.
- d) Explain in detail types of Tablet preparations.
- e) 0.29 gm sample of oxyphenbutazene ($C_{19}H_{21}ON_2O_3 \cdot H_2O$) was dissolved in 25 ml of acetone. This solution was titrated with 0.1 N NaOH using bromothymol blue indicator and gave burette reading 8.2 ml. Calculate percentage of oxyphenbutazene in given sample. [Given: mol. wt. of oxyphenbutazene = 342]

Q4) Attempt any four of the following:

[20]

- a) Give biological assay on titanus antitoxin.
- b) What is Karl fischer reagent? How is it standardized using water - methanol reagent?
- c) Explain selection area for new drug development.
- d) Write a note on GMP.
- e) A pharmaceutical sample containing 0.15 gm of β - naphthol was dissolved in 25 ml of ethylene diammine and was titrated with 0.1 N potassium methoxide using O-nitroaniline as an indicator. The Burette reading was 8.5 ml. Determine the percentage of β - naphthol in the sample.
[At. wt. C = 12, O = 16, H = 1.008]

EEE

Total No. of Questions :4]

SEAT No. :

P2629

[5023]-48

[Total No. of Pages :2

M.Sc. - II

ANALYTICAL CHEMISTRY

CH-381: Medicinal Chemistry

(2008 Pattern) (Semester - III) (Optional)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.*
- 2) All questions are compulsory and carry equal marks.*
- 3) Neat diagrams must be drawn wherever necessary.*

SECTION -I

Q1) Attempt any four of the following:

[20]

- a) What is drug? Give systematic classification of drugs.
- b) Write a short note on biological assay.
- c) Mention the uses of pharma cokinetics in drug development process.
- d) Explain drug receptor interaction.
- e) Write short note on 'free Wilson analysis'.

Q2) Attempt any four of the following:

[20]

- a) Give a brief account of new procedures followed in drug design.
- b) Write a short note on 'Immunological assay'.
- c) Write a brief account of different physicochemical parameters affecting drug action.

P.T.O.

- d) Define and explain:
 - i) Soft - drug
 - ii) Drug receptors
 - iii) ED 50
 - iv) Isosterism
- e) Give the synthesis of chloroquin.

SECTION -II

Q3) Attempt any four of the following: **[20]**

- a) Explain the term antiinfective agents. Give their general mode of action.
- b) Give an account of cardiovascular diseases.
- c) Give the process of synthesis of :
 - i) Penicillin G
 - ii) Streptomycin
- d) What are sulphonamides? Explain the general mode of action.
- e) Write a short note on 'Novel Drug Delivery system'.

Q4) Attempt any four of the following: **[20]**

- a) Give the role of Hormones and natural products in chemotherapy.
- b) Write a brief account of benzodiazapines.
- c) Write a note on 'Applications of chiral drugs in medicines'.
- d) Define:
 - i) Drug inhibitor
 - ii) Mitotic inhibitor
 - iii) Neuroleptic drug.
- e) Give the structure and detailed mode of action of chloramphenicol.

EEE

Total No. of Questions :6]

SEAT No. :

P2630

[5023]-51

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 410: Molecular Structure and Spectroscopy

(2008 Pattern) (Semester - IV) (Old)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables, calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any three of the following: **[15]**

- a) Discuss the quantum mechanical theory of nmr.
- b) What is the need of reference for recording high resolution nmr? Explain the advantages of TMS.
- c) Describe the instrumentation used in nqr spectroscopy with suitable diagram.
- d) Explain the theory of spin-spin interaction for A_2 type systems. Why two protons in a CH_2 group do not cause splitting of each others signal.
- e) Write a note on: FT nmr.

Q2) Attempt any three of the following: **[15]**

- a) Explain isotropic and an isotropic hyperfine coupling constant.
- b) Define the terms: Zero field splitting, spin polarization, unpaired spin density and hyperfine coupling constant.
- c) What is Mc Connell relationship? Explain the terms involved their in. Discuss its applications.
- d) Describe the instrumentation used in esr spectroscopy and explain the working of a klystron.
- e) With the help of a schematic diagram, explain the technique of photo acoustic spectroscopy.

Q3) Solve any two of the following: **[10]**

- a) Predict the intensity distribution in hyperfine lines of esr spectrum by the radicals $\cdot CH_3$ and $\cdot CD_3$.
- b) Calculate the frequency required to excite proton from $m_1 = \frac{1}{2}$ and $m_1 = -\frac{1}{2}$ (Given: $g_N = 5.585$, $H = 1.4$ T)
- c) The benzene radical anion has $g = 2.0025$. At what field should one search for resonance in a spectrometer operating at 9.503 GHz?

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) Discuss the advantages and disadvantages of XRD method as an analytical tool.
- b) Describe the rotating crystal method with suitable diagram in XRD analysis.
- c) State the phase problem and outline the techniques for over coming it.
- d) Describe the experimental arrangement for the study of electron diffraction of gases.
- e) How is the Fourier synthesis used to determine a unit cell?

Q5) Attempt any three of the following: **[15]**

- a) Derive the Van-Velck equation for magnetic susceptibility.
- b) Explain the terms: Pole strength, Magnetic field and intensity of magnetization.
- c) Describe with a suitable diagram the working of Gouy balance.
- d) How will you determine the crystalline dimension by the broadening of diffraction lines?
- e) What is 'spin only' magnetic moment? Find it for a metal complex with three unpaired electrons.

Q6) Solve any two of the following: **[10]**

- a) Calculate the atomic radius of copper atom having mass 63.5 and density 8.949 cm^{-3} ; it has FCC structure.
- b) Calculate a glancing angle.
(Given: $\lambda = 153.9 \text{ pm}$, $d = 400 \text{ pm}$, $n = 1$)
- c) The gram susceptibility of $\text{Ni(en)}_3 \text{ S}_2\text{O}_3$ is 11.03×10^{-6} cgs units at 17°C find the susceptibility at 30°C .

EEE

Total No. of Questions :6]

SEAT No. :

P2631

[5023]-52

[Total No. of Pages :4

M.Sc.

PHYSICAL CHEMISTRY

CH - 411: Surface Chemistry and Electro-Chemistry

(2008 Pattern) (Semester - IV) (Old)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables, calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
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12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Answer any three of the following: **[15]**

- a) Differentiate between physical adsorption and chemisorption.
- b) Write BET equation and explain the terms involved in it. How it is used for determination of surface area of solid adsorbent.
- c) Write Gibbs equation for adsorption on liquid surface and discuss the experimental methods for its verification.
- d) Explain the terms:
 - i) turnover number
 - ii) functionality
 - iii) catalyst selectivity
- e) Describe gravimetric method for studying adsorption of gas on solid.

Q2) Answer any three of the following: **[15]**

- a) What are Zeolites? Discuss in brief their applications.
- b) Discuss the adsorption of on porous solids.
- c) Derive two dimensional ideal gas law for film on liquid surface.
- d) Discuss the factors affecting detergent action.

Q3) Solve any two of the following: **[10]**

- a) To retard the evaporation of water, Hexadecanol $C_{16}H_{33}OH$ has been used to produce monomolecular film on water reservoirs. If the cross section area of alcohol in close packed layer is 0.20 nm^2 , how many grams of the alcohol are required to cover 5 acre ($20,000 \text{ m}^2$) lake?
- b) The volume of oxygen gas at 0°C and 101 kPa adsorbed on the surface of 1.00 g of sample of silica at 0°C was 0.29 cm^3 at 142.5 Torr and 1.45 cm^3 at 760 Torr . Determine the value of monolayer capacity (V_m).
- c) At 20°C the surface tension (γ) of solution of butyric acid in water can be represented by the equation $\gamma = \gamma_0 - a \ln(1 + bc)$ where γ_0 is surface tension of water, $a = 13.1$ and $b = 19.60$ as constants. Calculate the excess concentration of 0.2m solution.

SECTION -II

Q4) Answer any three of the following: **[15]**

- a) Derive the expression for thickness of ionic atmosphere.
- b) Explain the terms:
 - i) Galvani potential
 - ii) Volta potential
 - iii) Surface potential
 - iv) Outer potential
- c) Explain the term ionic strength. How does it affect
 - i) thickness of ionic atmosphere
 - ii) mean activity coefficient of an electrolyte
- d) Write an equation for heat of hydration for positive ion having coordination number four based on ion-dipole model.
- e) Derive the equations for specific conductivity and equivalent conductivity in terms of mobility of ion.

Q5) Answer any three of the following: **[15]**

- a) What is exchange current density? How is the concept understood using Butler-Volmer equation.
- b) What is passivation of metals? Explain its general mechanism.
- c) With neat diagram describe $H_2 - O_2$ fuel cell.
- d) Discuss the methods of preventing corrosion.

Q6) Solve any two of the following:

[10]

- a) The drift velocity of an univalent ion is $3 \times 10^{-5} \text{ cms}^{-1}$ under a potential gradient of 0.075 V cm^{-1} . Calculate the absolute ionic mobility and conventional ionic mobility.
- b) Calculate the value of thickness of ionic atmosphere at 20°C in 0.1 molar solution of NaBr. Dielectric constant of water is 78.54.
- c) When dilute KOH solution was electrolysed using a nickel cathode, the overpotential was found to be 0.45 V to maintain a current density 0.01 A/m^2 and 0.20 to maintain current density 0.0001 A/m^2 calculate the transfer coefficient and exchange current density for the hydrogen / hydrogen ion equilibrium at nickel cathode in the given medium at 298 K.

EEE

Total No. of Questions :4]

SEAT No. :

P2632

[5023]-53

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 414: Biophysical Chemistry and Related Techniques

(2008 Pattern) (Semester - IV) (Old) (Optional)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table, calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any four of the following: **[20]**

- a) Discuss Corey concept of the structure of proteins.
- b) Write a note on Chaperones.
- c) Explain folding of proteins.
- d) Discuss ATP synthesis in cell metabolism.
- e) Explain reverse osmosis.
- f) Discuss Donnan equilibrium.

Q2) Attempt any four of the following: **[20]**

- a) Discuss the role of carbonic acid in blood buffering.
- b) Calculate R_{rms} for a polymer having 1250 units and 1400 nm long.
- c) Write a note on the role of nucleic acids in cell biology.
- d) Deduce the relation $\bar{R} = \sqrt{\frac{8N}{3\pi}} \cdot l$ in a polymer macromolecular chain.
- e) Write an account of H bond directionality.
- f) Explain the use of Henderson's equation in preparing buffer solutions.

SECTION -II

Q3) Answer any four of the following: **[20]**

- a) Enlist five important functions of a cell membrane.
- b) What is enzyme inhibition? Explain competitive inhibition.

- c) Draw and explain the graph showing various events of action potential.
- d) Give the classification of biopolymer particles based on shape. What are fibrous and globular proteins?
- e) Discuss briefly electron diffraction method for determining shape and size of biopolymer particles.
- f) Discuss the mechanism of ion transport through the cell membrane.

Q4) Answer any four of the following: **[20]**

- a) Explain the light scattering method for determining the molecular weight of biopolymers.
- b) What are the major applications of optical rotatory dispersion?
- c) Write a note on Helix - coil transitions.
- d) What are micelles and bilayers? Differentiate between these.
- e) What is electrophoresis? State its types. Explain any one.
- f) Describe the instrumentation for measuring optical rotatory dispersion.

EEE

Total No. of Questions : 4]

SEAT No. :

P2633

[5023]-54

[Total No. of Pages : 2

M.Sc.

PHYSICAL CHEMISTRY

**CH-415: Special Topics in Nuclear Radiation Chemistry
(Old 2008 Pattern) (Semester-IV)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *Answers to the TWO sections should be written in SEPARATE answer books.*
- 2) *ALL questions are COMPULSORY.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of logarithmic tables, calculator is ALLOWED.*
- 5) *Neat diagrams must be drawn WHEREVER necessary.*

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION-I

Q1) Attempt any four of the following. **[20]**

- a) Discuss the general aspects of use of radiopharmaceuticals in diagnosis and therapy of various diseases.
- b) Explain the terms: MPD, REM, G-value, μ_e and dosimetry.
- c) Outline the procedure for ${}^6\text{Li}$ isotope separation.
- d) Discuss the principle of radio-immuno-assay with suitable example. Explain, how is it used in disease diagnosis?
- e) Explain how are uranium isotopes separated.

Q2) Attempt any four of the following. **[20]**

- a) Write the PP I, PP II and PP III process reactions.
- b) Discuss the properties of plank era, inflation era and electroweak era.
- c) Discuss p,r and s processes in nucleosynthesis.
- d) Write a note on CNO bicycle.
- e) Write the reactions for He, C and Ne burning.

SECTION-II

Q3) Attempt any four of the following. **[20]**

- a) Discuss the chemical problems in purification and isolation of radioactive species during their production.
- b) Write a note on radiolysis of ethanol.
- c) What is necessity of thin targets? How are they prepared?
- d) Write a note on carriers used in nuclear reactions.
- e) Discuss the neutralization radiometric titration with a neat labelled diagram.

Q4) Attempt any four of the following. **[20]**

- a) Discuss competition kinetics with suitable example.
- b) Discuss applications of radiometric titrations.
- c) Define a chain reaction. Discuss its types.
- d) Discuss the effect of solute concentration on the molecular yields of H_2 and H_2O_2 .
- e) Define radical scavenging. Explain it with suitable example.



Total No. of Questions : 4]

SEAT No. :

P2634

[5023]-55

[Total No. of Pages : 2

M.Sc.-II

INORGANIC CHEMISTRY

CH-430: Inorganic Solids & Heterogeneous Catalysis.

(2008 Pattern) (Semester -IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*

Q1) Answer any four of the following:

- a) Draw the structures of following compounds: **[20]**
- i) $B_3 N_3 H_6$
 - ii) $C_2 B_{10} H_{12}$
 - iii) $B_5 H_g (PMe_3)_2$
 - iv) $Ir_4 (CO)_{12}$
 - v) $Ru_3 (CO)_{12}$
- b) Sketch the potential energy diagram for the adsorption of H_2 on nickel and give the pictorial representation of the adsorbate states.
- c) What are molecular sieves? Give their classification and important applications.
- d) Give an account of surface characterization methods used for the characterization of supported metal catalysts.
- e) Give an account of use of nano catalysts in organic synthesis.

Q2) Attempt the following (any Four):

[20]

- a) What are phosphazenes? Give an account of their synthesis and draw their structures.
- b) Give an account of different parameters which influence during zeolite synthesis.

P.T.O.

- c) Explain the catalytic hydrogenation of alkenes, which is the best suited metal used as a catalysts for the reaction?
- d) Discuss the use of MCM-41 as a heterogeneous catalyst.
- e) What do you mean by deactivation of the catalyst? Discuss any one method of deactivation in detail.

Q3) Answer any four of the following. **[20]**

- a) Give an overview of silicon polymers.
- b) Comment on effect of size, polarizability, and stability of product in the formation of polyoxoanions.
- c) Give an account of use of zeolite as a catalyst in petroleum industry.
- d) What do you mean by monolayer and multi layer adsorptions? Sketch and draw the various types of Langmuir adsorption Isotherms.
- e) Explain any two methods of preparation of heterogeneous catalysts with suitable example.

Q4) Write short notes on (any four) **[20]**

- a) Heteropolyacids.
- b) ZSM-5
- c) Chemical reactors.
- d) Semiconducting oxides as a catalysts.
- e) Immobilization of metal nanoparticles.



Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 2

P2635

[5023]-56

M.Sc.-II

INORGANIC CHEMISTRY
CH-431: Materials Science
(Semester-IV) (2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn Wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logtables & calculators is allowed.*

Q1) Answer any four.

[20]

- a) Explain Fick's First law of Diffusion.
- b) Write an account on Oxide based superconductors.
- c) What do you understand by Meissner effect?
- d) Explain the phenomenon of "Magnetic Exchange" in insulators.
- e) Describe the BCS theory for superconductivity.

Q2) Attempt any four.

[20]

- a) X - rays with a wavelength of 1.54 \AA are used to calculate the spacings of (200) planes in Aluminium. The Bragg angle for this reflection is 22.4° . What is the unit cell of the Al crystal?
- b) Explain the two important types of defects observed in alkali halide crystals.
- c) Explain: Point defects; Line defects; Plane defects.
- d) Describe a method for obtaining a single crystal of semiconductors.
- e) Explain how the high T_c oxides are useful in microelectronic and electronic devices.

Q3) Answer any four

[20]

- a) Discuss the interstitial and Chevrel compounds.
- b) i) Draw (101) crystallographic plane in a Cubic cell.
ii) Tungsten has structure with lattice constant 0.316 nm . Calculate the value of atomic radius of tungsten in nm.

P.T.O.

- c) Find the drift velocity of an electron in silver wire of radius 1 mm and carrying a current 2 A. Density of Silver is 10.5 gm/cm^3 ($N=6.025 \times 10^{23}/\text{gm mole}$).
- d) What are compound semiconductors? Write an account on their preparation and applications.
- e) Explain the use of bubble memory in Magnetic Recording.

Q4) a) Match the following: [10]

- | | |
|---|----------------------------|
| i) Wood | Extrinsic semiconductor |
| ii) Positive +
negative holes | True compound conductivity |
| iii) P doped Si | Bioactive ceramic |
| iv) Pervoskite | Intrinsic semiconductor |
| v) LED | Natural composite |
| vi) Ba TiO ₃ | Soft magnetic material |
| vii) Ni-Zn ferrite | Piezo electric material |
| viii) La ₂ Cu O ₄ | Hard magnetic material |
| ix) Ba ferrite | Cuprate super conductor |
| x) Hydroxyapetite | Junction device |

b) Write notes on (any two). [10]

- i) Super conductors
- ii) Peltier- Seebeck effect
- iii) Imperfections in solids



Total No. of Questions : 9]

SEAT No. :

P2636

[5023]-57

[Total No. of Pages : 3

M.Sc.II

INORGANIC CHEMISTRY

**CH-445:Inorganic Applications in Industry,
Biotechnology and Environmental Chemistry
(2008 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *Attempt any two sections from the following.*
- 2) *Both sections should be written in the same answer book.*
- 3) *All questions are compulsory.*
- 4) *Figures to the right indicate full marks.*
- 5) *Neat diagrams must be drawn wherever necessary.*
- 6) *Use of logarithmic table / calculator is allowed.*

SECTION-I

Inorganic Applications in Industry

Q1) Attempt any three of the following. **[15]**

- a) What are formazans? How are they classified as ligands? Give at least two examples of each and draw the structure of metal complexes they form.
- b) Which types of isomerism are seen in chromium and Cobalt complexes of tridentate AZO compounds? Explain any one type of isomerism.
- c) Explain the microstructure of hardwood.
- d) Explain the production and properties of glass fibers for reinforcing plastic resin.

Q2) Attempt any three of the following. **[15]**

- a) Give in details production of Portland cement.
- b) Discuss the different processes available for electrodeposition of zinc.
- c) What are the general properties of pigment ? Explain any one of them.
- d) Explain the role of co-ordination in electroplating.

P.T.O.

Q3) Write short notes on any two. **[10]**

- a) Natural earth colour pigment
- b) Phthalocyanins.
- c) O-hydroxynitroso compounds.

SECTION-II

Environmental Chemistry

Q4) Attempt any three of the following. **[15]**

- a) What does primary and secondary treatment in a sewage treatment plant remove from the waste stream?
- b) Draw a schematic diagram of an alkaline fuel cell (AFC). Write the reactions that occur at the cathode and anode. Show overall reaction. What is the electrolyte used in the AFC?
- c) What is meant by point and non-point sources of pollution? Give an example of each.
- d) Determine pE for waste water that contains $5.0 \times 10^{-7} \text{ M cd}^{+2}$. Does this waste water favour oxidation or reduction? ($pE^\circ = -6.81$).

Q5) Attempt any three of the following. **[15]**

- a) List the five provisions of the Clean Water Act (CWA). Which of these are considered the most important?
- b) Explain how the detergent and pesticides are responsible for water pollution.
- c) What are the best options for energy source for 21st century? Explain in short.
- d) Name the instrumental method for the determination of metals such as Hg, Cd, As and Pb. Explain cold-vapour atomic absorption method for the determination of Hg from polluted water.

Q6) Write short notes any two. **[10]**

- a) Reverse Osmosis.
- b) High strength waste.
- c) Energy from biomass.

SECTION-III
Biotechnology

Q7) Attempt any three of the following. **[15]**

- a) What is the “Germ theory of diseases”?
- b) Which principles of Genetics are used in biotechnology?
- c) How can fungi be used for production of Food?
- d) What do you understand by term antibiotics? How are they used to cure diseases?

Q8) Attempt any three of the following. **[15]**

- a) Explain the use of clones for the synthesis of antigens.
- b) Write an account on production of lactic acid.
- c) Discuss the commercial applications of tissue culture.
- d) “Algae can be used as food as well as fuel”. Explain.

Q9) Write notes on any two. **[10]**

- a) Biocatalysts.
- b) DNA mapping.
- c) Solid state fermentations.



ORGANIC CHEMISTRY

CH-450: Chemistry of Natural Products

(2008 Pattern) (Semester-IV)

Time : 3 Hours]

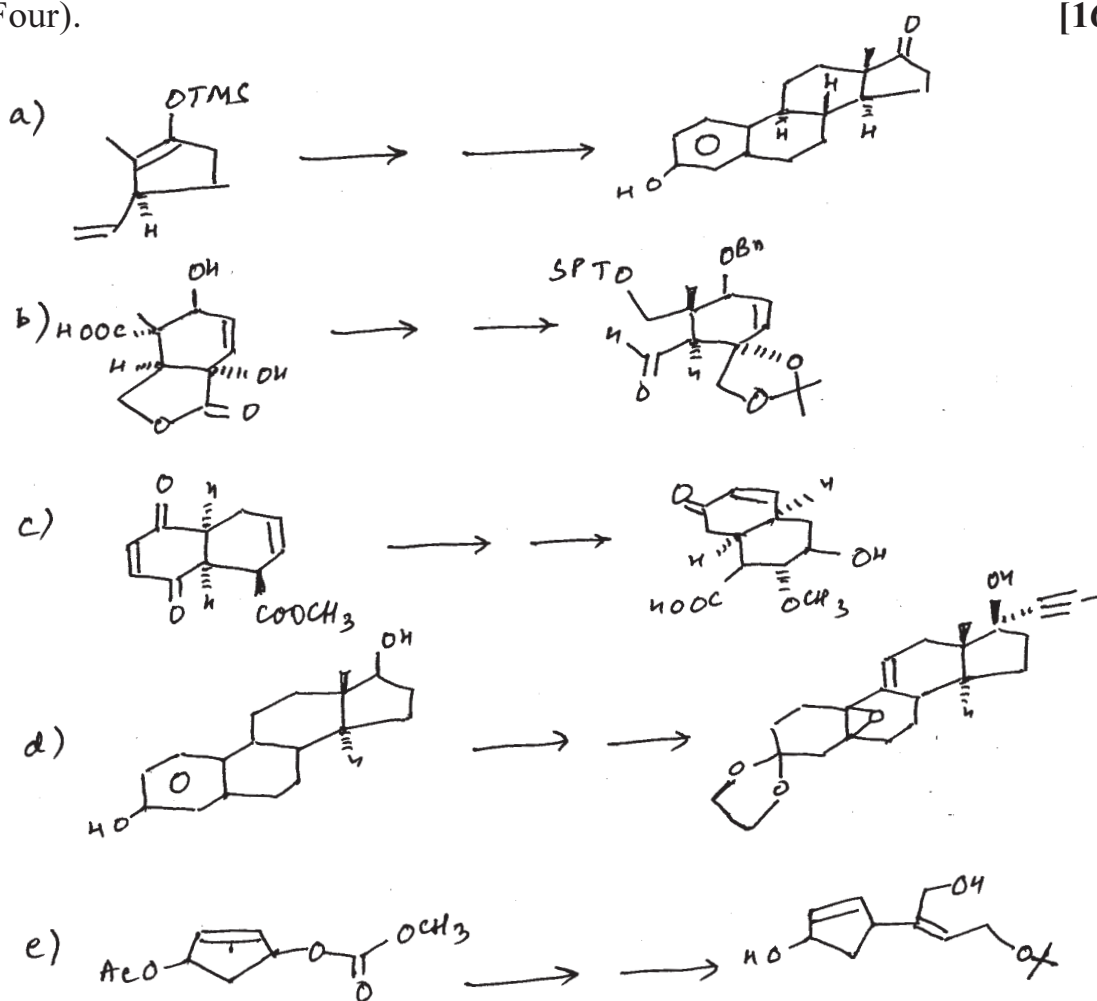
[Max. Marks : 80

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answers books.

SECTION-I

Q1) Outline the steps involved in the following synthetic sequences. Indicate the reagents used and discuss the mechanism and stereochemistry involved (Any Four). [16]

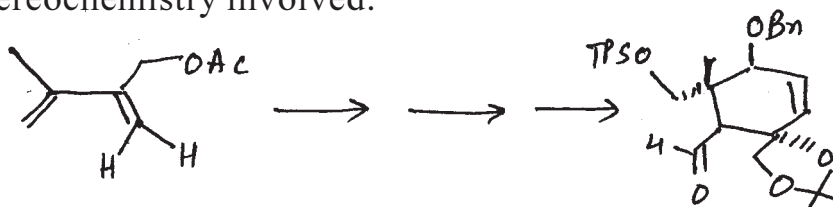


Q2) Answer the following (any three):

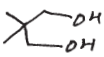
[12]

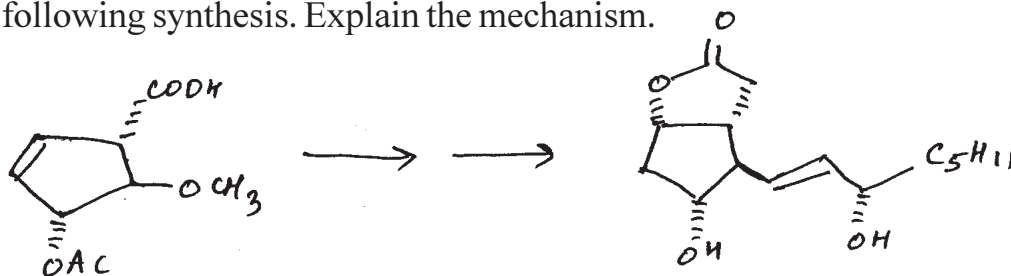
- Give chemical evidences to establish relative stereochemistry between podophyllotoxin and Picropodophyllin.
- Prove that hydroxy camptothecin is a hydroxy derivative of camptothecin.
- Discuss chemical and spectral evidences for the presence of β -substituted furan ring in Hardwickiic acid.
- Describe tertiary - OH group and sites of unsaturation in camptothecin.

Q3) a) Arrange the reagents given below in correct order to complete following synthetic steps. Explain the mechanism and stereochemistry involved. [6]



Reagents:

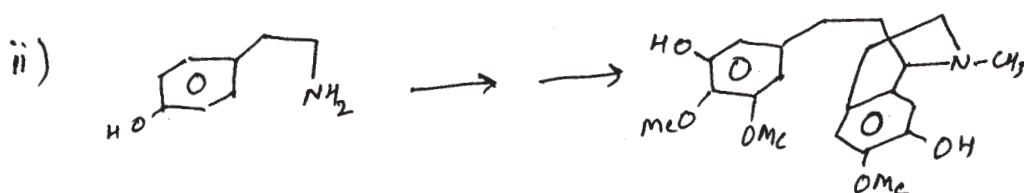
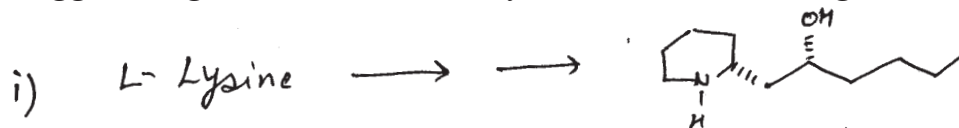
- KH, Bu_4NI , BnBr, Et_2O
 - TPSCl, imidazole, DMF
 - LAH, Et_2O
 - phB(OH)₂, Benzene, 
 - H_2 , NNHSO₂ Ar, THF
 - TBSCl, imidazole, DCM.
 - KOH tBuOH.
- b) Use iodolactonisation and Wittig olefination reactions to complete following synthesis. Explain the mechanism. [6]



SECTION-II

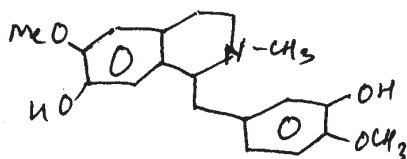
Q4) a) Give the steps in the formation of DMAPP and Δ^3 IPP by mevalonate path way. [4]

b) Suggest biogenetic scheme for any three of the following: [12]

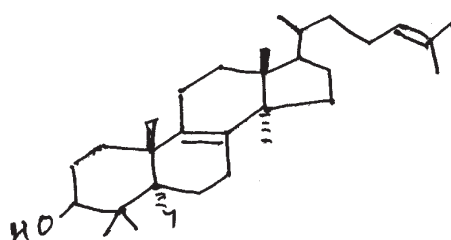


Q5) Answer any two of the following: [12]

a) Suggest the biogenesis for the given compound starting from 2-¹⁴C-Tyrosine. Indicate the position of label in the compound.



b) How will the method of folding of squalene monoepoxide be derived in case of following compound? What are the alkyl(R) shifts in this compound. Complete its biogenesis

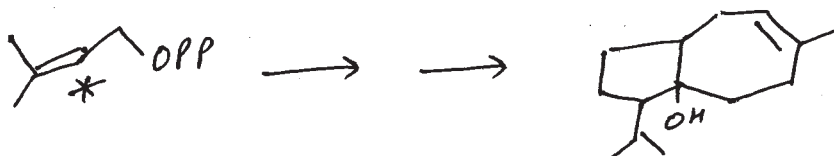


- c) Give the biogenesis of shikimic acid from D- erythrose 4- phosphate and phosphoenol pyruvate. Explain with an example how shikimic acid is converted into amino acid.

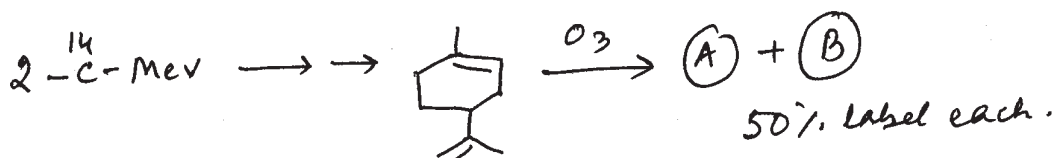
Q6) a) Answer any one:

[6]

- i) Complete the following biogenetic steps and indicate the position of label in final compound.



- ii) Suggest the biogenesis for the following terpene. Indicate the position of label in product. Justify.



- b) Complete the following biogenesis.

[6]



Total No. of Questions : 6]

SEAT No. :

P2638

[5023]-59

[Total No. of Pages : 3

M.Sc.-II

ORGANIC CHEMISTRY

CH-451:Synthetic Methods in Organic Chemistry

(2008 Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Figures to the right indicate full marks.*

SECTION-I

Q1) Explain any three of the following: **[12]**

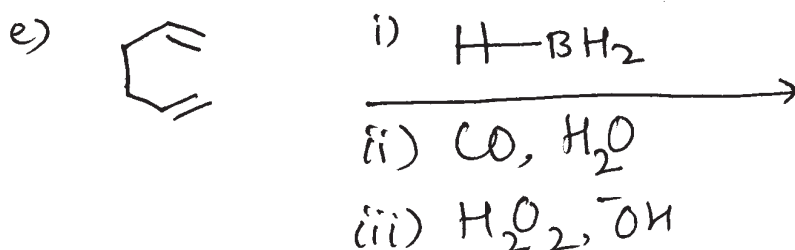
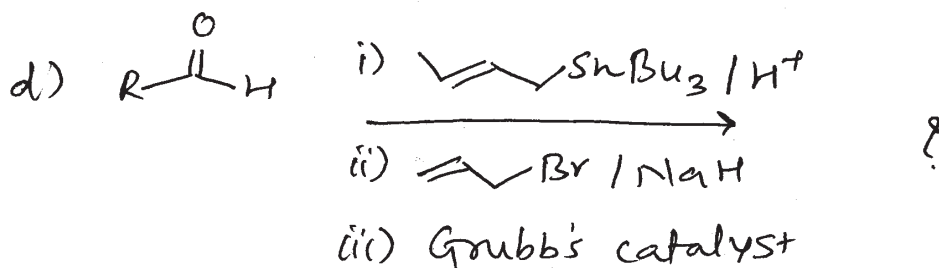
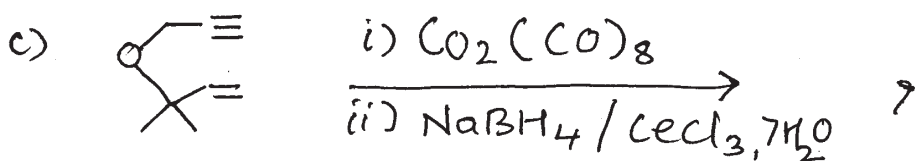
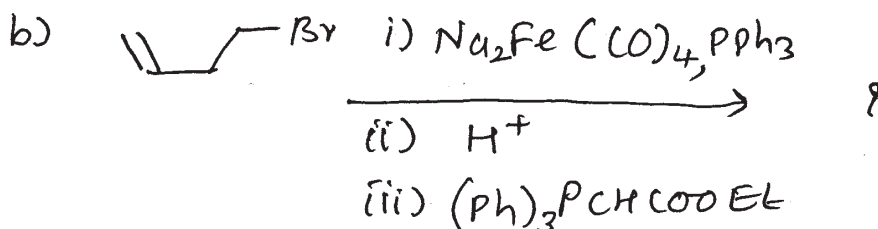
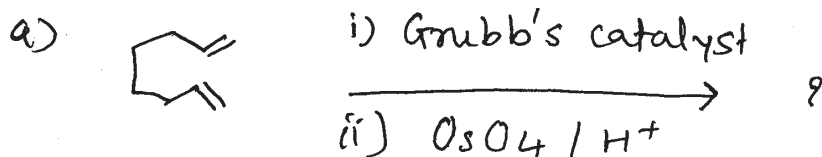
- a) Synthesis of optically active alcohol by using IPC_2BH .
- b) Dithiol ethers could be used for the generation of reagent having umpolnng reactivity.
- c) Role of copper (II) chloride in the wacker process
- d) Give synthesis and synthetic application of colman's reagent.

Q2) Write short notes on any three of the following: **[12]**

- a) Stille coupling
- b) Ziegler Natta catalyst
- c) Peterson olefination
- d) Wilkinson's catalyst in hydro formylation.

P.T.O.

Q3) Predict the products and suggest the mechanism any four of the following. [16]

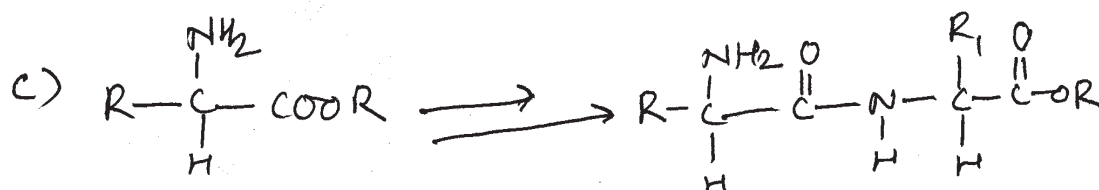


SECTION-II

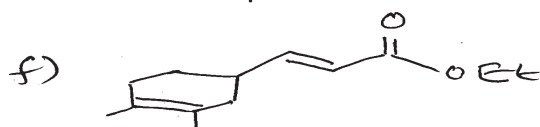
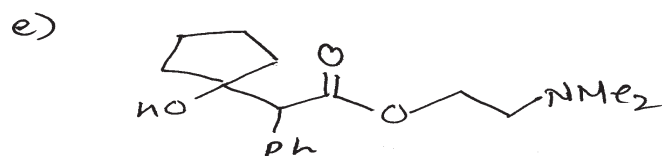
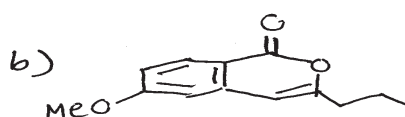
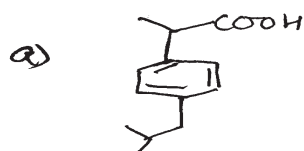
Q4) Explain any three of the following : [12]

- Trityl chloride could be used for selective protection of primary hydroxy group in glucosides.
- Protection and deprotection of amines.
- Activation of $-\text{COOH}$ group is essential in peptide synthesis
- Linear and convergent synthesis.

Q5) How will you effect the following conversions using suitable reagents.(any three). [12]



Q6) Using retrosynthetic analysis suggest a suitable synthetic strategy for synthesis of any four of the following compounds. [16]



Total No. of Questions : 6]

SEAT No. :

P2639

[5023]-60

[Total No. of Pages : 4

M.Sc.II

ORGANIC CHEMISTRY

**CH-452:Heterocyclic Chemistry Chiron Approach and Medicinal Chemistry
(2008 Pattern) (Semester-IV)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Answers to the two sections should be written in separate answer books.*

SECTION-I

Q1) a) Explain any three of the following. **[9]**

- i) Oxazole is less basic than imidazole.
- ii) Thiophene is resistant to ring opening than furan and pyrrole.
- iii) Quinoline is used as a solvent in decarboxylation reactions.
- iv) Describe two different reactions of pyrrole indicating its aromatic nature.

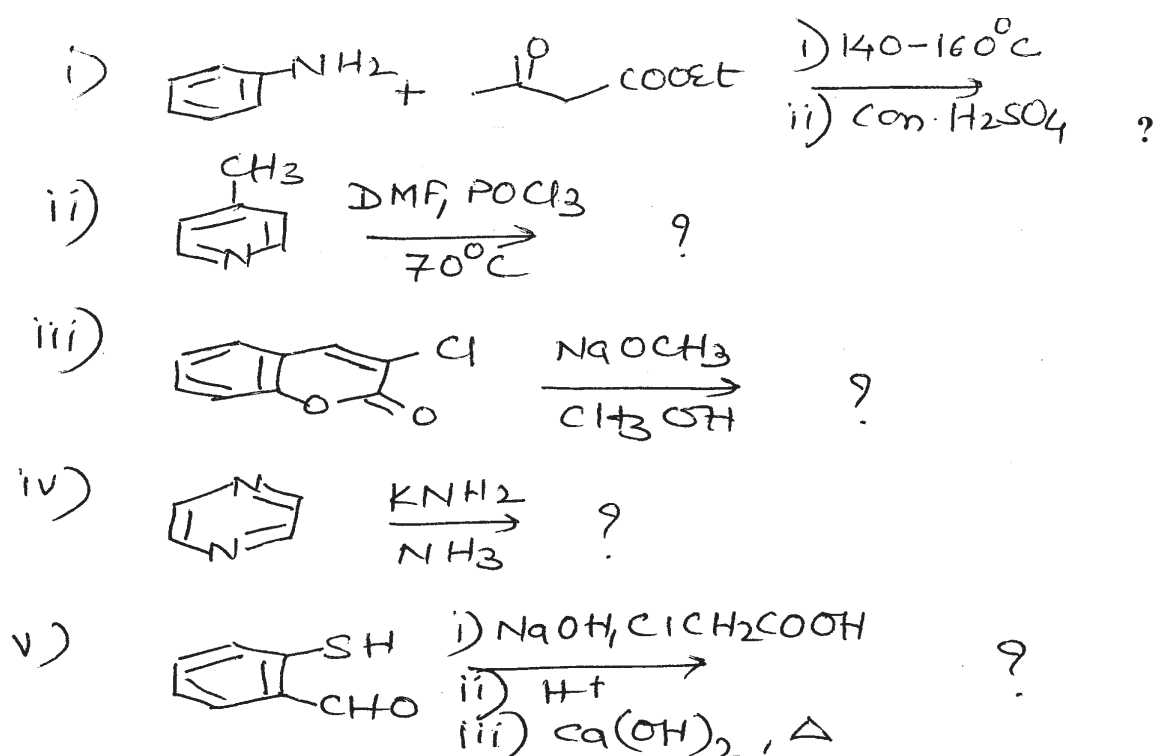
b) Write application of supramolecular chemistry in medicine and data storage. **[3]**

Q2) a) Give the reactions of following reagents with thiophene. **[4]**

- i) HCHO, CHCl₃, 0°C.
- ii) ClSO₃H, PCl₅, R-T.
- iii) HNO₃, AC₂O, ACOH, 0°C.
- iv) I₂, HNO_{3(aq)}, 90°C.

P.T.O.

b) Predict the product/s in any four of the following. [8]



c) Give the use of any two of the following reagents in heterocyclic synthesis. Write mechanism. [4]

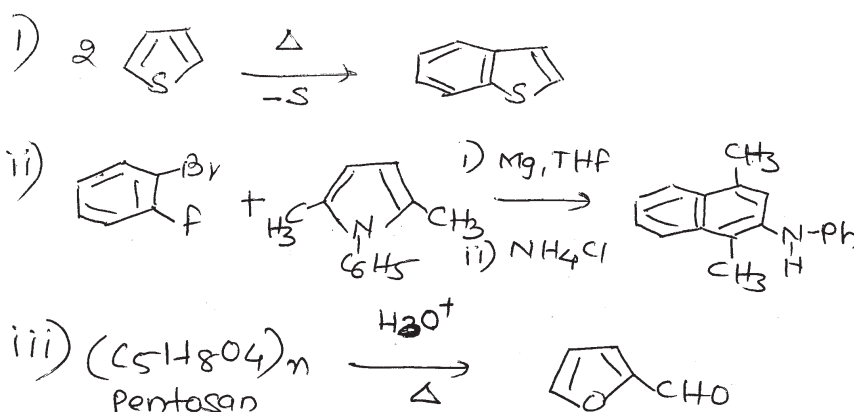
- n-BuLi in formylation of furan
- Phenylhydrazine in synthesis of indoline
- $\text{Pd}(\text{Ph}_3)_4$ in arylation of pyridine.

Q3) a) Write notes on any two of the following. [6]

- Hantzsch pyridine synthesis.
- Paal knorr thiophene synthesis
- Feist- Benary synthesis.

b) Suggest suitable mechanism for any two of the following.

[6]



SECTION-II

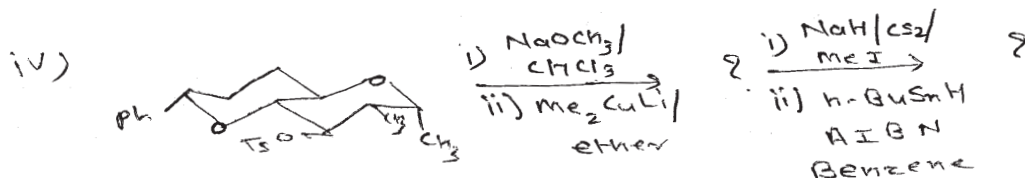
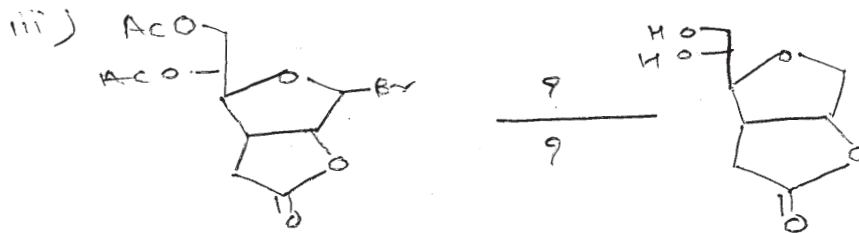
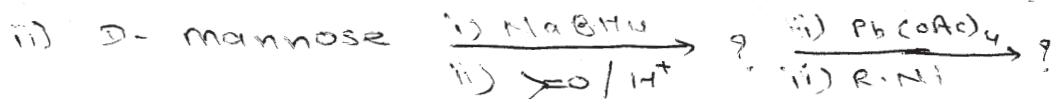
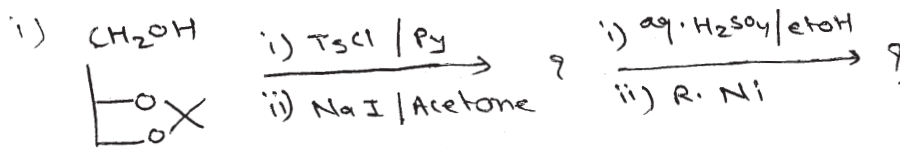
Q4) Answer any Four of the following

[16]

- Draw $1C_4$ and $4C_1$ conformation of D- mannose and L- mannose.
- Give various types of targets derived from carbohydrate precursors by synthesis.
- Two isomeric compounds A and B having molecular formula $C_5H_{10}O_5$ gives following reactions.
 - Both A and B Forms tetra acetate derivative.
 - Both A and B Forms phenyl hydrazone derivative.
 - A can form both furanose as well as pyranose ring while B can form only furanose ring.
Determine the structure A and B .
- Write the synthesis of R- Epichlorohydrin.
- Give the evidences for ring structure of D- Glucose.

Q5) Complete the following reaction sequence [any three].

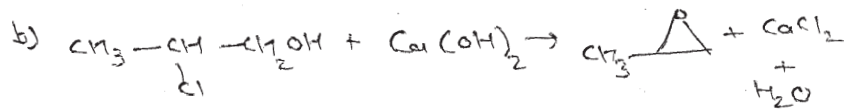
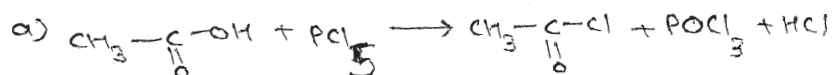
[12]



Q6) a) Solve any two of the following

[8]

- Write the short note on elimination of drug from body.
- Calculate the atom economy for the following reactions



- Give the theoretical aspects of drug design.

b) Answer the following.

[4]

- Retrosynthetic analysis of shikimic acid.
- Concept of chiron



Total No. of Questions : 4]

SEAT No. :

P2640

[5023]-61

[Total No. of Pages : 2

M.Sc.-II

ANALYTICAL CHEMISTRY

CH-481: Bioanalytical and Forensic Science

(2008 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory and carry equal marks.*
- 2) *Answer to the two sections should be written in separate answer books.*
- 3) *Use of logarithmic table / non-programmable calculator is allowed.*

SECTION-I

Q1) Attempt any four of the following. **[20]**

- a) Explain the procedure for isolation and identification of barbiturates from stomach content.
- b) Give requirement of bonded laboratory.
- c) How are benzodiazepines detected? Explain with suitable examples.
- d) Discuss the procedure for license, required for manufacture of preparations containing alcohol as per medical and toilet preparation Act.
- e) It a nitrogen retained, nitrogen absorbed, and nitrogen intake from proteins by rat was 1.85 mg, 1.12 mg 7.26 mg respectively. Calculate NPU, D and B.V.

Q2) Attempt any four of the following. **[20]**

- a) Outline method for estimation of V.T.C.
- b) Discuss micro- kjeldal's method for estimation of proteins.
- c) How starch is determined from flour.
- d) Write a note on food additives.
- e) A sample of cocoa weighing 3 gm was subjected to theobromine determination and value obtained with 0.081 N NaOH was 2.80 ml; Calculate the % of theobromine in the sample.
(Given: Mol. wt theobromine=180

P.T.O.

SECTION-II

Q3) Attempt any four of the following. **[20]**

- a) How is pasteurisation of milk varified?
- b) What are food preservatives? Give classification of food preservatives.
- c) What are carbohydrates? Explain method for estimation of glucose.
- d) Discuss the chemistry of thiamine with respect to structure, source and biological function.
- e) A sample of butter weighting 5g was dissolved in chloroform and treated with KI solution. It was filtrated against 0.01m sodium thiosulphate, gave B.R 8.8 ml. Calculate peroxide valve.

Q4) Attempt any four of the following. **[20]**

- a) Explain a method for estimation of tannin from tea sample.
- b) How is amylase estimated?
- c) Explain the term LSD. Describe the method for it's determination.
- d) Explain the method for estimation of saccharin from softdrink.
- e) Calculate the ammount of lactic acid in milk sample, when 10.0 ml of milk required 4.2 ml of 0.1 N NaoH for neutralisation.
(Given: mol ut of lactic acid=90)



Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 2

P2641

[5023]-62

M.Sc.-II

ANALYTICAL CHEMISTRY
CH-490: Analytical Spectroscopy
(2008 Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) All questions are compulsory and carry equal marks.*
- 2) Answers to the two sections should be written in separate answer books.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Use of logarithmic table / non-programmable calculator is allowed.*

SECTION-I

Q1) Attempt any four of the following. **[20]**

- a) Enlist the electromagnetic spectral regions that are useful for chemical analysis with electromagnetic radiation spectrum.
- b) Mention the properties of an ideal detector. Give its classification. Explain the working of scintillation detector.
- c) Explain the origin of chemical shift in ESCA lines. Describe the use of chemical shift in quantitative analysis.
- d) State the limiting law. Explain its causes for deviation from limiting law.
- e) The percentage transmittance of 250 ppm solution is 45 at 480 nm. Calculate the molar absorptivity of the substance in a 1.00 cm cell. [Given: molecular weight of substance is 250 g mole⁻¹]

Q2) Attempt any four of the following. **[20]**

- a) Explain the principle of x-ray fluorescence . Describe the wavelength dispersive x-ray fluorometer with schematic diagram.
- b) What is the electro-chemiluminescence? Explain 's' route and 'J' route mechanisms in electro-chemiluminescence.
- c) What is absorptive edge method? State and explain the principle of x-ray absorption method.

P.T.O.

- d) Calculate 2 's' electron binding energy of sulphur ion from the incident x-ray photon was used to create the inner-shell vacancy had a wavelength of 952 pm. The work function of spectrometer was 7.2 eV and the kinetic energy of measured electron was 890 eV. [Given: plancks constant= 6.625×10^{-34} Js, Velocity of light= 3×10^8 m/s].
- e) A crystal of magnesium fluoride was exposed to $k\alpha$ line of copper at 154.2pm, diffracted at an angle of 25.2° relative to the crystalline surface for first order diffraction . Calculate the spacing between adjacent layers of nuclei in the magnesium fluoride crystal.

SECTION-II

Q3) Attempt any four of the following. **[20]**

- a) Write a critical note on magnetic resonance imaging.
- b) What is Larmor precession? Explain the principle of NMR spectroscopy based on classical theory.
- c) Explain the following terms:
- i) g-factor
 - ii) Gyromagnetic ratio
- d) A compound shows NMR at 330 Hz downfield from TMS peak in spectrometer operating at 60 MHz. Calculate the Values of chemical shifts in ppm relative to TMS peak.
- e) Calculate magnetic field strength required to observe the NMR frequency for ^{19}F at 60 MHz. [Given: $g_{\text{N}}=5.257$, $\beta_{\text{N}}=5.05 \times 10^{-27}$ JT $^{-1}$]

Q4) Attempt any four of the following. **[20]**

- a) State and explain the principle of ESR spectroscopy. Discuss one application of the technique in inorganic chemistry.
- b) Explain with suitable examples, the use of spin label technique in ESR.
- c) Explain the working of SEM with schematic diagram.
- d) Explain the following terms:
- i) Spin- spin coupling
 - ii) double resonance.
- e) If an unpaired electron in a particular environment has a g-factor 2.017, calculate the magnetic flux density required to cause the electron to resonate at a frequency 35 GHz. [Given: $\mu_{\text{e}}=9.285 \times 10^{-24}$ JT $^{-1}$]



Total No. of Questions : 4]

SEAT No. :

P2642

[5023]-63

[Total No. of Pages : 2

M.Sc.II

ANALYTICAL CHEMISTRY

CH-491:Polymer Technology

(2008 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory and carry equal marks.*
- 2) *Answers to two sections should be written in separate answer books.*
- 3) *Draw neat diagrams wherever necessary.*

SECTION-I

Q1) Attempt any four of the following. **[20]**

- a) Give the salient features of bulk polymerization.
- b) Discuss the Kinetics of anionic polymerization.
- c) Describe the mechanism of free radical chain polymerization.
- d) Describe photodegradation of polymer with suitable examples.
- e) Derive kinetic rate equation for living chain polymerization.

Q2) Attempt any four of the followings. **[20]**

- a) Write a short note on 'cross-linking reactions in polymerization'.
- b) Give method of preparation & uses of:
 - i) Polyethylene
 - ii) Polyesters
- c) What is antioxidant? Describe the role of antioxidant in the stability of polymer. Explain it with a suitable example.
- d) Differentiate between the following:
 - i) Natural polymer and synthetic polymer.
 - ii) Addition polymer and condensation polymer.
- e) 8.0 moles of acrylamide ($r_1=1.38$) are mixed with 6.0 moles of acrylic acid ($r_2=0.36$). Find the composition of polymer formed instantaneously.

P.T.O.

SECTION-II

Q3) Attempt any four of the following. **[20]**

- a) Give the role of X-ray diffraction in polymer analysis.
- b) Describe the characterisation of polymer by differential scanning calorimetry.
- c) Give types of Fibers. Explain wet spinning process of Fibers.
- d) Explain the terms:
 - i) Impact test
 - ii) Abrasion resistance
 - iii) Haze
 - iv) Vapour permiability
 - v) Resistivity
- e) 1.4210 gram of carboxy terminated and hydroxy terminated. Polybutandine dissolve in mixture of ethanol and toluene. It was titrated against 0.1638 N alcoholic KOH the burette reading was 8.65 ml. Calculated average molecular weight of polymer.

Q4) Attempt any four of the following. **[20]**

- a) Explain the term sol-gel and gelation. Describe the steps involved in the preparation of sol-gel.
- b) What is polymer processing ? Describe the foaming process.
- c) Describe the ebulliometry method used for the determination of number average molecular weight of polymer.
- d) What is reinforcing? Explain hand- lay-up technique.
- e) A suspension containing equal masses of particles of molecular weights 30,000 and 50,000 respectivity. Calculate the number average molecular weight (\bar{M}_n) → and weight average molecular weight (\bar{M}_w)

