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[This question paper contains 4 printed pages]

Your Roll No.

:2019.....

Sl. No. of Q. Paper

: **7396** **J**

Unique Paper Code

: 32171501

Name of the Course

: **B.Sc.(Hons.) Chemistry**

Name of the Paper

: Organic Chemistry - IV

Semester

: V

Time : 3 Hours

Maximum Marks : 75

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Question No. **1** is compulsory.
- (b) Attempt **six** questions in all.

1. Answer any **five** of the following : 3×5=15

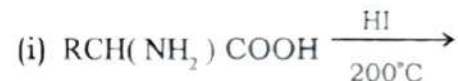
- (a) The sequence ACGTGC (reading in the 5' → 3' direction) appears on a portion of one strand of DNA. What is the corresponding sequence on the complementary strand of the DNA double helix? Show the polarity of this complementary strand.
- (b) (i) Show which nitrogen atom of histidine heterocycle is basic and which is not.
(ii) Show the structure that results when histidine accepts a proton on the basic nitrogen and then is deprotonated on the other heterocyclic nitrogen.

P.T.O.

- (c) Explain the term "anabolism" and give an example.
- (d) For lysine, the pK_a values of α -carboxyl, the α -amino, and the side chain amino group are 2.2, 9.1 and 10.5 respectively. Write down the structure of lysine at its pI and calculate its pI value.
- (e) Explain the following terms and give an example :
- (i) Bactericide (ii) Bacteriostatic
- (f) What is "iodine number" ? What is its significance ?
2. (a) Convert : 4
- (i) Cytosine \rightarrow 5-Nitrocytosine
- (ii) Urea \rightarrow Uracil
- (b) Give synthesis of Cytosine from malondialdehyde acetal. 4
- (c) Write down the systematic name and structures of : 4
- (i) Cytidine (ii) Guanosine
3. (a) Write the structure and name of coenzyme formed from vitamin Riboflavin .
- (b) Classify the following enzymes according to the type of reaction that they catalyze. Give the first digit of E.C.number.
- (i) Phosphotriose isomerise
- (ii) Phosphofructo kinase
- (c) Differentiate between competitive and noncompetitive inhibition. 4 \times 3=12

4. (a) Give synthesis of Chloramphenicol from p-Nitroacetophenone. Write the name of compound used for resolution.
- (b) (i) Is chloramphenicol bactericide or bacteriostatic ? Explain it through its mode of action.
- (ii) What are antipyretics ? Give an example.
- (c) Vitamine C is required for synthesis of structural protein of skin, connective tissue. Name the protein. Give the name of disease caused by severe deficiency of Vitamine C. 4 \times 3=12

5. (a) Complete the following reactions :



- (b) Treatment of a protein with trypsin gave a peptide 'A' which on complete hydrolysis produced :

Ser, Ala, Gly, Phe, Val, Lys, Asp

Partial hydrolysis of 'A' with Chymotrypsin gave a dipeptide and a pentapeptide. On treatment with sanger's reagent followed by hydrolysis, the dipeptide gave DNP-Asp. The pentapeptide was cycled through Edman's degradation three times. The composition of the peptide remaining after each cycle was as follows :

Cycle 1 : Ala, Lys, Ser, Gly

Cycle 2 : Ala, Lys, Gly

Cycle 3 : Ala , Lys

What is the sequence of amino acids in the heptapeptide ? Explain all the reactions.
4,8

6. (a) Write down two irreversible steps of citric acid cycle .Write all the structures and name of enzymes.
- (b) How is pyruvate converted into lactate under anaerobic conditions ? Write down all the reactions involved .Give the name of enzymes also.
- (c) Give Solid phase synthesis of the tripeptide :
Gly, Ala, Val 4×3=12
7. (a) Explain the term "Rancidity" of oils .How can it be prevented.
- (b) What is acid value of an oil ? What is its significance ?
- (c) How many grams of KOH would be required to neutralise a suspension in water of 250g of fat whose acid value is 40.
4×3=12
8. Write down short notes on any **three** of the following : 4×3=12
- (i) Allosteric enzymes
 - (ii) Factors affecting enzyme action
 - (iii) Secondary structure of proteins
 - (iv) Electrophoresis

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[This question paper contains 8 printed pages]

Your Roll No. :2019.....

Sl. No. of Q. Paper : 7397 J

Unique Paper Code : 32171502

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

Name of the Paper : Physical Chemistry - V :
Quantum Chemistry and Spectroscopy

Semester : V

Time : 3 Hours **Maximum Marks : 75**

Instructions for Candidates :

- (i) Write your Roll No. on the top immediately on receipt of this question paper.
- (ii) Attempt any **six** questions in all.
- (iii) Question No. **1** is compulsory. Each part of Question No. **1** carries **3** marks.
- (iv) Each part of the rest of the questions carries **4** marks.
- (v) Attempt all parts of a question together.
- (vi) Use of scientific calculators is allowed but they cannot be shared.
- (vii) Logarithmic tables can be provided if required.

P.T.O.

Physical Constants

Planck's constant	$6.626 \times 10^{-34} \text{ Js}$
Velocity of light	$3 \times 10^8 \text{ ms}^{-1}$
Avogadro's number	6.023×10^{23}
Mass of electron	$9.1 \times 10^{-31} \text{ kg}$
Nuclear Magneton	$5.05 \times 10^{-27} \text{ JT}^{-1}$
Bohr Magneton	$9.27 \times 10^{-24} \text{ JT}^{-1}$
Boltzmann Constant	$1.38 \times 10^{-23} \text{ JK}^{-1}$

1. Attempt any **five** of the following :

- (a) How will the rotational spectra change when ^{12}C in $^{12}\text{C}^{16}\text{O}$ is replaced by ^{13}C ?
- (b) Write the Hamiltonian for H_2 molecule and explain each term.
- (c) The term 'state' and 'energy level' are not synonymous in wave-mechanics. Explain. How many states and energy levels lie in the energy range of $E < 10h^2/8ml^2$?
- (d) The function given below are defined in the interval $x=-a$ and $x=+a$ as follows :
 $f(x) = N(a^2 - x^2)$
 Assuming the value of the function to be zero for $x < -a$ and $x > +a$, calculate the Normalization constant N .
- (e) Show that the Morse Potential :
 $V = D[1 - \exp\{a(r_{eq} - r)\}]^2$
 is reducible to harmonic potential for the lower vibrational levels. Also show that the force constant is given as $k = 2Da^2$.

- (f) What are the essential conditions for a molecule to show IR Spectra. Which of the following will be IR active : O_2 , CO_2 , CO and SO_2 .
- (g) Homonuclear diatomic molecule, Br_2 , is microwave inactive but is rotational Raman active. Why ?
2. (a) Show that the probability of finding the particle in a one-dimensional box in the region $L/4$ and $3L/4$ is $1/2$ if n is even, and

$$\frac{1}{2} + \frac{(-1)^k}{n\pi} \text{ if } n \text{ is odd.}$$

- (b) A particle of mass m moves in a three-dimensional box of sides a , b , c . If the potential is zero inside and infinity outside the box, give the expressions for the energy eigenvalues and wavefunctions for a particle in a 3-D box. What is the zero point energy of the system ? What is the degeneracy of the first and second excited states ?
- (c) Evaluate the expectation values of $\langle x \rangle$ and $\langle p \rangle$ for the ground state of the harmonic oscillator.

Given : Normalized wavefunction :

$$\Psi \left(\sqrt{\frac{a}{\pi}} \right)^{1/2} e^{-ax^2/2};$$

Standard integral : $\int_{-\infty}^{\infty} x^2 e^{-ax^2} \cdot dx = \left(\frac{1}{2a} \right) \left(\frac{\pi}{a} \right)^{1/2}$

3. (a) For a one-electron homonuclear diatomic molecule the values of some relevant integrals are given below :

$$\int \Phi_A \hat{H} \Phi_A d\tau = -3 \text{ a.u.} \quad \int \Phi_B \hat{H} \Phi_B d\tau = -3 \text{ a.u.}$$

$$\int \Phi_A \hat{H} \Phi_B d\tau = -3/2 \text{ a.u.} \quad \int \Phi_A \Phi_B d\tau = 1/2$$

where Φ_A and Φ_B are the normalized set of basis functions for an LCAO wavefunction. Find the energy of the bonding molecular orbital and find the normalized wavefunction.

- (b) Calculate the average distance of the electron from the nucleus of H atom in the 2s state.

$$\Psi_{200} = \left(\frac{1}{\sqrt{32\pi}} \right) \left(\frac{1}{a_0} \right)^{3/2} \left(2 - \frac{r}{a_0} \right) e^{-r/2a_0}$$

$$\left(\text{Given: } \int_0^\infty r^n e^{-ar} \cdot dr = \frac{n!}{(a)^{n+1}} \right)$$

- (c) What do you understand by the term transition probability? Depict the energy levels and probability densities for the first four levels of a harmonic oscillator with the help of a diagram.

4. (a) Show that if two operators \hat{A} and \hat{C} are Hermitian, then their product ($\hat{A} \hat{C}$) is also Hermitian if and only if \hat{A} and \hat{C} commute.
- (b) Write down the normalized Valence Bond wavefunction and Molecular Orbital wavefunction for H_2 molecule. Compare the expressions obtained and explain configuration interaction.
- (c) Arrive at the following expression for H_2^+ :

$$E_+ = \frac{\alpha + \beta}{1 + S}$$

(where α is the coulomb integral, β is the resonance integral and S is the overlap integral) using LCAO-MO treatment.

5. (a) The pi electrons of a conjugated molecule can be regarded as moving in a particle in a box, where the box length is somewhat more than the length of the conjugated chain. For butadiene, take this length as 7.0 Å and estimate the wavelength of the light absorbed when a pi-electron is excited from the highest occupied to the lowest vacant level. The experimental value is 217 pm.

- (b) Find the commutator of position and momentum operator and give its physical significance, giving the name of the principle it verifies.
- (c) Gilliam et al. (1950) measured the first line in the rotational spectrum of CO as 3.84235 cm^{-1} . Calculate the rotational constant, moment of inertia and find out which rotational state of CO would be most populated at 300 K?
6. (a) What are the selection rules for observing IR spectra of an anharmonic oscillator? Derive the expressions for energy required for fundamental transition and first overtone.
- (b) Dissociation energy of $^{12}\text{C}^{16}\text{O}$ is $1.107 \times 10^6 \text{ Jmol}^{-1}$. The anharmonicity constant of the molecule is 5.860×10^{-3} . Find :
- equilibrium frequency of vibration
 - force constant of the molecule
- (c) The line spacing (on each side of the band origin ω_0) in PR spectrum of CO_2 is $4B$ instead of the usual $2B$ as observed in case of HCN. Briefly explain.

7. (a) A molecule A_2B_2 shows IR and Raman spectra as tabulated below :

cm^{-1}	IR	Raman
3374	-	strong, polarized
1974	-	strong, polarized
3287	Active (PR)	-
612	-	weak, polarized
729	Active (PQR)	-

Predict the shape of the molecule and assign the various observed lines to the appropriate normal modes of vibrations.

- (b) Show that the separation between the maximum in P and R branches of a vibration rotation spectrum of a heteronuclear diatomic molecule is approximately given as :

$$\Delta\nu = \sqrt{\frac{8kTB}{hc}}$$

where the symbols have their usual meanings.

- (c) Distinguish between Fluorescence and Phosphorescence.

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8. (a) r_{eq}'' and r_{eq}' are internuclear distance of a diatomic molecule in the ground and excited states respectively. Three cases arise :

$$r_{eq}'' = r_{eq}', \quad r_{eq}'' > r_{eq}', \quad \text{and} \quad r_{eq}'' \gg r_{eq}'.$$

Discuss the intensity distribution in absorption spectra of any **two** cases using Franck Condon principle along with potential energy diagrams.

- (b) Of the two molecules, N_2 and O_2 , which will show an ESR spectrum and why? Show the hyperfine structure of Methyl radical ($\cdot CH_3$) in ESR spectrum, giving the intensities of the peaks.
- (c) (i) In a spectrometer operating at 1 T, the NMR frequency of ^{19}F is 40.06 MHz. Calculate its magnetogyric ratio/gyromagnetic ratio.
- (ii) Show the low and high resolution NMR spectrum of acidified ethanol.
9. Write short notes on (any **three**) :
- Born Oppenheimer Approximation
 - Variation Principle
 - Dissociation and Predissociation
 - Larmor Precession

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[This question paper contains 6 printed pages.]

Your Roll No. 2019

Sr. No. of Question Paper : 7638

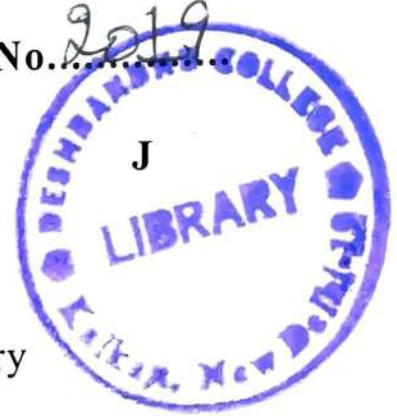
Unique Paper Code : 32177908

Name of the Paper : Green Chemistry

Name of the Course : B.Sc. (H) Chemistry / B.Sc.
(Prog.) : DSE-1/1A

Semester : V

Duration : 3 Hours Maximum Marks : 75



Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions.
3. Each question carries **15** marks.
4. Attempt all parts of a question together.

1. (a) Give any one example in each of the following cases, stating the green chemistry principle involved : **(Any six)**

(i) Ultrasonic reaction (Chemical equation)

(ii) Rightfit pigment (structure)

P.T.O.

- (iii) Ionic liquid (formula)
- (iv) Aqueous phase reaction (Chemical equation)
- (v) Microwave-assisted reaction (Chemical equation)
- (vi) Analytical technique for real analysis for pollution prevention
- (vii) Green solvent

(b) Which is better: A reaction that uses a stoichiometric amount of a reagent or the one that uses a catalytic amount of the same reagent? Justify your answer. (2×6,3)

2. Attempt any **three** of the following :

- (a) Give the greener route to replace the conventional synthesis of the Carbaryl insecticide (once produced in Union Carbide India Ltd., M.P., India). Why the route is considered greener?
- (b) What is cradle to cradle approach? Elaborate using the Ecoworx® carpet tiles that won US Presidential Green Chemistry Challenge Award in 2003.

- (c) Draw the pyramid that represents waste management hierarchy indicating the options to manage waste. Which is the most preferred option?
- (d) Give the principle of inherent safer design (ISD)? How does it work for designing the green processes in industries? (5×3)

3. (a) Do the following conversions considering the greener route :

- (i) Glucose to adipic acid
- (ii) Corn to polylactic acid

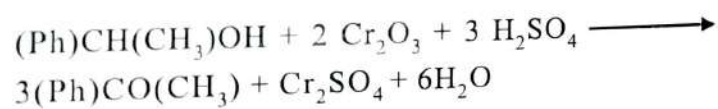
(b) Highlight the importance of asymmetric catalysts illustrating the thalidomide babies' case.

OR

What is biocatalysis? Give two relevant advantages and two limitations of biocatalysts used in the chemical reactions. (5×2,5)

- 4. (a) Write short notes (with emphasis on description, one example and two benefits wherever applicable) on any **three** of the following :
 - (i) Twelve principles of green chemistry

- (ii) Solvent less reactions
 - (iii) Combinatorial green chemistry
 - (iv) Green chemistry in sustainable development
 - (v) Enzymatic interesterification for the production of healthier fats and oils
- (b) How the pollution prevention act of 1990 by US environmental Protection Agency (EPA) relating risk, exposure and hazard leads to a paradigm shift to green chemistry? (4×3,3)
5. (a) Giving the formula for % atom economy, calculate the % atom economy of the following reaction :



OR

The conventional synthesis of the drug, Ibuprofen, involves six steps with the % atom economy of 40%. The synthesis was replaced with a three step process and having % atom economy of 77%. Explain the role of % atom economy and number of steps involved in the adoption of the replaced

- synthesis of the drug. Also state the green chemistry principle(s) involved in reinforcing the above two factors while considering any synthesis of the chemical compounds.
- (b) Suggest one green solvent that can replace perchloroethylene (PERC) in the dry cleaning of garments. Give any two drawbacks of PERC that provides a rationale for its replacement. Also give two greener relevance of the replaced solvent.
- (c) In 1980, US Environmental Protection Agency (EPA) and chemical industry focused mainly on Pollution Remediation while the scientists' concern was Pollution Prevention in first place. Give the explanation to this statement. How can one design a greener chemical synthesis? (5,5,5)
6. (a) Explain the following terms giving one example in each case (**any two**) :
- (i) VOC
 - (ii) Toxic chemical
 - (iii) Auxiliary substance in a chemical reaction
 - (iv) Depleting feedstock

- (b) What are antifoulants? Why the marine antifoulant tributyl tin oxide (TBTO) has been replaced by Sea Nine 211? Which green chemistry principle is being followed in this case?
- (c) Give (name or draw) the worldwide accepted symbol for toxicity. The chemical substance X causes blindness to human beings on its exposure to the concentration of more than 10 parts per billion, while the substance Y affects in the similar way but on its exposure to the concentration more than 1 million parts per billion. Then which out of the two, X or Y, should be chosen for the chemical synthesis as per green chemistry rules? Give reasons for your answer. (5,5,5)

Sr. No. of Question Paper: 8778

17



11/12

Unique Paper Code: 217365

2019

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

J

Name of the Paper: CHHT-514: Biochemistry and Environmental Chemistry

Semester: V / (ii)

Duration: 3 Hours

Maximum Marks: 75

Instructions for candidates

1. Write your Roll No. on top immediately on receipt of this question paper.
2. Attempt all **four** questions in Section A.
3. ^{Attempt four questions in Section B} **Question 5** in Section B is compulsory.
4. Attempt any **three** other questions from Section B (~~four~~ questions per section, ~~eight~~ questions in all).
5. Clearly mention Section A and Section B in the heading before starting the respective sections.

SECTION A

Biochemistry

Attempt **all four** questions in this Section.

Maximum Marks: 38

1. (a) Explain the biological role of messenger RNA and transfer RNA.
(b) Enzymes exhibit a spectrum of specificity in action. Elaborate with examples.
(c) Differentiate between secondary and tertiary structure of proteins. Draw partial segments to illustrate. (3, 3, 4)
2. (a) Outline the sequence of reactions involved in the anaerobic conversion of glucose to pyruvate. Which enzyme in the sequence belongs to the Oxido-reductase class of enzymes?
(b) The drug action of sulphonamides is known to involve enzyme inhibition. Illustrate this with the help of structures, mentioning the type of inhibition. Which kinetic parameters are distinctive?
(c) What are ribozymes? (5, 3, 1)
3. (a) What are the salient features of the double helix model of DNA? Draw a segment to show these features.
(b) Draw the structure of **any three** of the following and give their chief biological functions:
 - (i) A sphingolipid
 - (ii) An omega-3 fatty acid
 - (iii) A liposome
 - (iv) A bile salt(4, 2X3)
4. (a) Outline the mechanism of any one enzyme catalysed reaction at the active site.
(b) Write a concise account of any two of the following:
 - (i) Genetic code
 - (ii) Regulation of enzyme activity
 - (iii) Induced fit model of enzyme action
(c) Choosing a suitable example, explain the role of a cofactor in an enzyme catalysed reaction. (3, 4, 2)

SECTION B

Environmental Chemistry

Question 5 is compulsory. Attempt any **three other** questions from this Section.

Maximum Marks: 37

5. (a) Fill in the blanks:
 - (i) is the boundary of separation between the troposphere and the stratosphere.
 - (ii) The sun, the wind and water falling from a height are sources of energy.

- (iii) builders, commonly used in detergents, cause eutrophication of water bodies.
- (iv) organisms inhabit the bottom sediments of the ocean.

(b) Give a neat, labelled, self-explanatory diagram of a thermally stratified tropical lake.

(c) Give one word/phrase for the following (any four):

- (i) The rate of decrease in atmospheric temperature with altitude
(ii) Energy obtained from the interior of the earth
(iii) The phenomenon by which vegetation adds to the atmospheric moisture
(iv) Autotrophic organisms at the bottom of the marine food chain
(v) The type of coal which causes the least air pollution

6. (a) Distinguish between the following (any two):

(4, 2, 4)

- (i) LAS and ABS surfactants
(ii) Primary and secondary air pollutants
(iii) Nuclear fission and nuclear fusion

(b) Briefly explain the biogeochemical Carbon OR Sulphur Cycle with a neat, labelled diagram.

(c) Name three major atmospheric pollutants. What are the sources of SO_x in the atmosphere?

(1½ X2, 3, 3)

7. (a) Discuss the troposphere as a major region of the atmosphere and explain the phenomenon of temperature inversion.

(b) Explain briefly what is meant by the secondary stage of water treatment and describe one method of secondary treatment in detail.

OR

What are the consequences of a marine oil spill? How can its effects be mitigated?

(c) Mention the methods of safe disposal of nuclear waste and briefly discuss the problems faced during such disposal.

OR

What are the different forms of coal and how are they graded in terms of energy generation and environmental pollution?

(3, 3, 3)

8. (a) Discuss the catalytic role of NO and Cl in stratospheric ozone depletion.

OR

Discuss briefly the anthropogenic greenhouse effect, its consequences and control measures.

(b) Name three sources of renewable energy and discuss any one source in detail.
(c) Define BOD and COD of a water sample. Why is the value of COD always greater than BOD for a sample?

(3, 3, 3)

9. (a) What are the major constituents of photochemical smog? Discuss with reactions.
(b) Give the classification of aquatic ecosystems. Discuss briefly the ecologically harmful effects of the presence of pesticides in a water body.

(c) What are the sources of acidity and salinity of water in a water body? Discuss briefly their consequences and control measures.

OR

What do you understand by 'water quality parameters' and 'water quality standards'? Which is the body responsible for setting water quality standards in India?

(3, 3, 3)

Chem/09 10-124

Sl. No. 07 Q.P. 8848

18



30/11/19

Unique Paper Code : 217501

Name of the Paper : CHHT 511: Inorganic Chemistry -IV

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

Semester : V

Duration : 3 hours

Maximum Marks: 75

Instructions for Candidates

1. Write your roll no. on the top immediately on receipt of this question paper.
2. Attempt any **five** questions.
3. All questions carry equal marks.

1. (a) Give the IUPAC names of the following complexes (any 5):

- (i) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
- (ii) $\left[\begin{array}{c} \text{NH}_2 \\ \diagup \quad \diagdown \\ (\text{en})_2\text{Co} \quad \text{Co}(\text{en})_2 \\ \diagdown \quad \diagup \\ \text{OH} \end{array} \right] \text{Cl}_2$
- (iii) $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
- (iv) $[\text{Pt}(\text{NH}_3)_3\text{Cl}]\text{Cl}$
- (v) $[\text{Co}(\text{C}_2\text{O}_4)(\text{en})_2]^+$
- (vi) $\text{Na}_3[\text{Fe}(\text{CN})_5\text{Cl}]$

5

(b) Give the formula of the following complexes (any 5):

- (i) Potassium pentachloridonitridoosmate(VI)
- (ii) Hexaamminechromium(III) hexanitrochromate(III)
- (iii) Sodium amminebromidochloridonitrito-N-platinate(II)
- (iv) Diaquabis(ethylenediamine)cobalt(III) nitrate
- (v) Tetraamminecobalt(III)-μ-amido-μ-hydroxidobis(ethylenediamine)cobalt(III)chloride
- (vi) Potassium dicyanidodioxalatonickelate(II)

5

(c) The complex $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic but $[\text{NiCl}_4]^{2-}$ is paramagnetic and has two unpaired electrons. Explain these observations and deduce the structures of the two complexes.

3

(d) Draw the geometric isomers of the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$.

2

2. (a) State Jahn-Teller theorem and explain its application to copper(II) complexes.

3

(b) Draw the optical isomers of the trioxalatochromate(III) ion.

2

(c) What happens when (any 5):

(i) Potassium permanganate and ferrous sulphate react in acidic medium

(ii) Sulphur dioxide is passed through acidified potassium dichromate

(iii) $\text{K}_4[\text{Fe}(\text{CN})_6]$ is heated with conc. H_2SO_4

(iv) Sodium nitroprusside reacts with sodium sulphide

(v) Cl_2 gas is passed over heated TiO_2 in the presence of carbon

(vi) $\text{Mn}(\text{II})$ reacts with sodium bismuthate in acidic medium

5

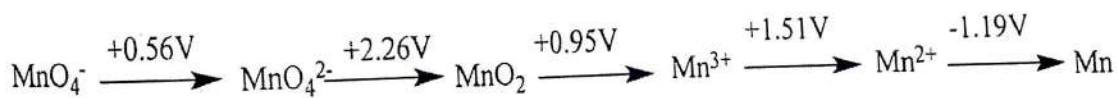
(d) What is lanthanide contraction? Explain its consequences.

5

3. (a) Calculate CFSE for the complex $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ both in high spin and low spin state when mean pairing energy P is $23,500\text{cm}^{-1}$ and value of Δ_0 is $13,900\text{cm}^{-1}$

3

(b) Consider the Latimer diagram for Manganese in acidic medium



Answer the following questions

(i) Is there any tendency of Mn^{2+} to reduce to Mn ? Justify.

(ii) Calculate skip EMF for MnO_4^{2-} to Mn^{2+}

(iii) Which oxidation state of Mn will disproportionate?

4

(c) Which of the following pairs of complexes will have a higher value of Δ_0 and why?

(i) $\text{Fe}(\text{H}_2\text{O})_6^{2+}$ and $[\text{Fe}(\text{CN})_6]^{4-}$

(ii) $\text{Fe}(\text{H}_2\text{O})_6^{2+}$ and $[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$

(iii) $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{Co}(\text{NH}_3)_6]^{2+}$

3

(d) Explain 'crystal field splitting' and 'crystal field stabilization energy'. Draw the crystal field splitting pattern for the following configurations:

(i) d^6 octahedral high spin and low spin (ii) d^8 square planar

5

4. (a) Explain the following in brief (any 6):

(i) Ce^{4+} act as oxidizing while Eu^{2+} as reducing agent.

(ii) Low spin tetrahedral complexes are not known.

(iii) Compounds of Ti^{4+} and Zn^{2+} are typically white.

- (iv) Lanthanides exhibit sharp bands in the absorption spectra while transition metals show broad bands
- (v) Cobalt (II) is easily oxidized to cobalt (III) in the presence of strong field ligands.
- (vi) Potassium dichromate is highly coloured.
- (vii) Radii of elements of 3rd transition series are similar to those of 2nd transition series
- (viii) Transition metals form a large number of complexes.

6x2

(b) Explain the separation of lanthanides by ion exchange method.

3

5. (a) An orange compound A on heating gives a green compound B and oxygen. On acidification of B, a compound C is formed which on treatment with zinc in the presence of dilute HCl gives a blue compound D. Compound D on treatment with sodium acetate gives a red compound E. Identify A, B, C, D and E. Discuss the structure and magnetic behavior of Compound E.

6

(b) Using VBT predict the geometry and magnetic moment for the following complexes:

- (i) $[\text{Ni}(\text{CO})_4]$
- (ii) $[\text{MnF}_6]^{3-}$
- (iii) $[\text{Cr}(\text{CN})_6]^{3-}$

6

(c) Name the type of isomerism for the following complexes

- (i) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{C}_2\text{O}_4)_3]$ and $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{C}_2\text{O}_4)_3]$
- (ii) $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$
- (iii) $\text{K}_3[\text{Co}(\text{NO}_2)_6]$ and $\text{K}_3[\text{Co}(\text{ONO})_6]$

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6. (a) Actinoids have a greater tendency to form complexes than lanthanoids. Explain

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(b) Giving reasons, explain which of the following pairs show higher value of the property mentioned.

- (i) Stability: $[\text{Co}(\text{NH}_3)_6]^{3+}$ or $[\text{Co}(\text{en})_3]^{3+}$.
- (ii) Lability: $[\text{Cr}(\text{CN})_6]^{3-}$ or $[\text{Hg}(\text{CN})_4]^{2-}$
- (iii) Paramagnetism: $[\text{FeF}_6]^{4-}$ or $[\text{Fe}(\text{CN})_6]^{4-}$

2x3

(c) What are the chief postulates of Werner's Coordination Theory? Explain with examples.

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(d) Discuss in brief the reasons for the deep colour of potassium permanganate.

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