

**M.Sc. (Chemistry) Sem-II
QUESTION BANK**

CHI- 4202 – Coordination chemistry and bioinorganic chemistry

SECTION I

1. Objective type questions

- 1) Which of the following complex show Jahn-Teller distortion?
i) $[\text{CuCl}_6]^{4-}$ ii) $[\text{Cr}(\text{acac})_3]$ iii) $[\text{Co}(\text{CN})_6]^{4-}$ iv) i and iii
- 2) The number of stereoisomers of trans- $[\text{CoCl}_2(\text{triene})]\text{Br}$ is-
i) one ii) two iii) three iv) four
- 3) An aqueous solution of $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ complex is pale pink in colour.
The probable reasons for it are-
i) Presence of ${}^6\text{A}_{1g}$ ground state
ii) Allowed transition by spin selection rule.
iii) Presence of ${}^2\text{T}_{2g}$ ground state
iv) charge transfer transition
- 4) The term symbol is not allowed for the np^2 configuration is-
i) ${}^1\text{D}$ ii) ${}^3\text{P}$ iii) ${}^1\text{S}$ iv) ${}^3\text{D}$
- 5) No. of microstates for P^2 configuration are,
i) 10 ii) 15 iii) 0 iv) 45
- 6) The term symbol for d^6 configuration is –
i) ${}^5\text{D}_4$ ii) ${}^5\text{D}_0$ iii) ${}^5\text{D}_1$ iv) ${}^5\text{D}_3$
- 7) The total number of orbitals associated with the principal quantum no=3 are,
i) 1 ii) 4 iii) 9 iv) 18
- 8) The octet rule is based on-
i) The lewis theory
ii) Sidwick- Powell theory
iii) VSEPR theory
iv) None of these
- 9) Aufbau principle is not satisfied by-
i) Cr & Cl ii) Cr & Mg iii) Cu & Ag iv) Cu & Na
- 10) The splitting of the lines of the spectrum in strong magnetic field is called:
i) Stark effect
ii) Zeeman effect
iii) Larmor precession
iv) Hyperfine splitting

2. Answer in one sentence.

- 1) What is Zeeman effect?
- 2) Calculate the total no. of microstates in P^3 configuration.
- 3) What do you mean by diamagnetism?
- 4) Define Curie point and Neel point.

- 5) Define orbital angular momentum.
- 6) What is Hund's rule?
- 7) Calculate the spin multiplicity for d^5 configuration.
- 8) What do you mean by Racah parameter?
- 9) Draw the Orgel diagram of d^5 system
- 10) Explain tetrahedral complexes are more intense than octahedral complexes

3 Short answer questions

- 1) Calculate the degeneracy for the following terms/ states/ configurations
 - i) $(s^1 p^1)$
 - ii) ${}^3T_{2g}$
- 2) Explain how would you justify the magnetic moment for the complex $[\text{Fe}(\text{CN})_6]^{3-}$
 $\mu_{\text{obs}} = 2.40 \text{ B.M.}$
- 3) Determine the ground state term for $[\text{Ni}(\text{NH}_3)_6]\text{S}_2\text{O}_3$ complex.
- 4) Explain the term ferrimagnetism and paramagnetism
- 5) Predict the electronic transitions in complex $[\text{Fe}(\text{CN})_6]^{3-}$
- 6) Classify the following transitions as orbitally allowed and forbidden in octahedral complex. Justify your answer
 - i) $E_g \rightarrow E_g$
 - ii) $T_{1g} \rightarrow T_{2g}$
- 7) Arrange the following in increasing order of energy and justify your answer ${}^4F, {}^2P, {}^3G, {}^6H, {}^3I$.
- 8) Give ground state term symbol for the following ions:
 - i) V^{3+}
 - ii) Ce^{3+}
- 9) Prepare a microstate table for the $1S^1$ configuration and find out the R-S term symbol
- 10) Which one of the following complex is more intense? Why? $\text{Cis}[\text{Cu}(\text{NH}_3)_4\text{Cl}_2]$ and $\text{Trans}[\text{Cu}(\text{NH}_3)_4\text{Cl}_2]$

4 short notes

- 1) Write a short note on quenching of orbital angular momentum.
- 2) Write short note on nephelauxetic effect.
- 3) Write a short note on charge transfer spectra in complexes.
- 4) Write short note on luminescence in TM complexes
- 5) Write short note on nephelauxetic series .
- 6) Write short note on Tanabe-Sugano diagram.
- 7) Write short note on Orgel diagram.
- 8) Write short note on phosphorescence and fluorescence.
- 9) Write short note on types of magnetism
- 10) Write short note on electronic transitions in TM compounds
- 11) Write short note on Zeeman effect.

5. Long answer type questions

- 1) Prepare a table of microstates and hence derive the allowed R-S term for ns^1nd^1 configuration
- 2) Discuss selection rules in d-d transitions with relaxation
- 3) Assign spin multiplicities to the states arising from eg^2 configuration using Bethe's method and direct product table
- 4) For Ni^{2+} octahedral complex three absorption bands are observed at 10850 cm^{-1} , 17600 cm^{-1} and 28300 cm^{-1} determine Racah parameter. Comment on the nature of M-L bond.
- 5) Explain the factors affecting the band broadening in electronic spectra.
- 6) Prepare microstate table for s^1p^1 configuration and hence derive the allowed R-S term for the same
- 7) For hexa aquo Co(II) complex ion two absorption bands are observed at 16050 cm^{-1} & 19400 cm^{-1} determine the third absorption band, crystal field parameters and interionic repulsion parameter comment on the nephelauxetic ratio
- 8) Describe the allowed R-S terms and hence prepare a table of microstates for nitrogen atom. Find out ground state R-S term
- 9) Describe in brief Orgel diagram for D&F ground state term
- 10) Calculate the effective magnetic moment of $[Ni(H_2O)_6]^{2+}$ using following data
 - i) $\lambda = -350\text{ cm}^{-1}$
 - ii) $10Dq = 8500\text{ cm}^{-1}$
- 11) Draw the Orgel diagram of d^2 , d^3 , d^8 , d^7 for octahedral complexes.
- 12) Assign the spin multiplicities to the 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.
- 13) Prepare the microstate table for np^3 configuration and hence derive the allowed R-S term for the same.
- 14) The electronic spectrum of $KMnO_4$ shows a broad band at 18000 cm^{-1} , while in K_2CrO_4 the band is observed at a higher frequency 26000 cm^{-1} . Assign the bands and explain the trend.
- 15) Why we find broad bands in electronic spectra of metal complexes?

SECTION II

1. Objective questions

- 1) In Vitamin B₁₂ the ligand system is _____
 - a) Porphyrin
 - b) Corrine
 - c) Pyrrol
 - d) Phthalocyanine
- 2) Myoglobin is _____
 - a) Tetramer
 - b) Trimer
 - c) Dimer
 - d) Monomer
- 3) Deoxyhaemoglobin is _____
 - a) Five coordinated complex
 - b) High spin complex
 - c) Fe²⁺ coordinated with four N atom
 - d) All the above
- 4) The metal involved in nitrogenase are _____
 - a) Fe and Mg
 - b) Mo and K
 - c) Mo and Fe
 - d) Mo and Zn
- 5) Ferritin and Transferritin are _____
 - a) Hydrolyses
 - b) Electron Carriers
 - c) Metal storage and structural proteins
 - d) Metal sensor
- 6) What is not true about Ferridoxin?
 - a) Involved in the oxidation of NH₃
 - b) Generate H₂ from acid solution
 - c) Reduction potential is from acid solution
 - d) It is a Fe-S protein
- 7) In Biological system, the metal ions involved in electron transport are _____
 - a) Zn²⁺ and Mg²⁺
 - b) Na²⁺ and K²⁺
 - c) Ca²⁺ and Mg²⁺
 - d) Cu²⁺ and Fe²⁺
- 8) The metal ion present in Haemerythrin is _____
 - a) Zn²⁺
 - b) Fe²⁺

- c) Cu^{2+}
 - d) Mg^{2+}
- 9) Efficiency of Iron causes_____
- a) Sickle cell anemia
 - b) Bone deformities
 - c) Hypogonadism
 - d) Skeletal deformities
- 10) Superoxide dismutase contains the metal ion_____
- a) Zn (II) and Ni (II)
 - b) Cu (II) and Zn (II)
 - c) Ni (II) and Co (II)
 - d) Cu (II) and Fe (II)

2. Answer in one sentence

- 1) Explain the role of Iron in Biological system
- 2) Difference between Hemoglobin and Myoglobin.
- 3) Explain the structure of Calmoduline
- 4) Draw the structure of DNA.
- 5) Explain the role of Calcium in Biological system.
- 6) Define Bioinorganic Chemistry.
- 7) What are Metalloenzymes?
- 8) Explain the functions of Metalloenzymes.
- 9) Give the Biological functions of Ca and Mg
- 10) Explain importance of Porphyrin

3. Short note

- 1) Transferrin
- 2) Vitamin B₁₂
- 3) Zinc Finger
- 4) Calmoduline
- 5) Sickle cell anemia
- 6) Cis-platin as anticancer drug
- 7) Bioinorganic Chips
- 8) Na/K pump
- 9) The Hard-soft Acid-Base concept
- 10) Structure of DNA

4. Short answer questions

- 1) Explain the role of Sodium in Biological system

- 2) Explain about Rubredoxin as Iron-Sulphur protein.
- 3) Write a note on RNA.
- 4) What is Bioinorganic Chemistry?
- 5) List the bioessential elements and Discuss their functions in Biosystem.
- 6) Draw structure of Vitamin B₁₂
- 7) Define Cytochrome C oxidase
- 8) What is Sickle cell anemia?
- 9) Define factors responsible for uptake of element.
- 10) Draw the structure of Corrine and Porphyrin.
- 11) Why zinc is so valuable in biology relative to other metals?

5. Long answer questions

- 1) What are the major iron proteins in a normal adult? List them with their characteristics and functions.
- 2) What are Iron-Sulphur proteins? Draw the active site structure Of Rubredoxin and ferredoxin.
- 3) Explain the mechanism of Detoxification of mercury.
- 4) Give the classification of Metallobiomolecules.
- 5) How does the ligand exchange rate effects the rate of Biological reactions?
- 6) Draw the structure of any five of the following,
 - a) Vit. B₁₂
 - b) Deoxyhaemoglobin
 - c) Rubredoxin
 - d) Gaunin
 - e) Uracil
 - f) 4Fe-4S
- 7) Explain the importance of Porphyrin and Corrine as ligand.
- 8) Draw the structure of Chlorophyll and give its significance In photosynthesis.
- 9) Define metal storage and transport proteins.
- 10) Match the followings,

a) Zn	a) Nitrogenase
b) Cu	b) Peroxidase
c) Fe	c) Carboxypeptidase
	d) Haemocyanin

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