

SET I

Sem IV – PG Chemistry (EC 4)

Full Marks: 70

Time: 3 hours

The figures in the margin indicate full marks

Candidates are required to give their answer in their own words as far as practicable.

Answer five questions in which Q. No.1 is compulsory

1. Answer the following questions:

1 x 10

- i) What type of guest would crown ether be able to bind?
 - a) Zwitterions
 - b) Anions
 - c) Cations
 - d) Neutral species
- ii) Calcium ion binds to extracellular binding proteins to
 - a) Stabilize the protein structure
 - b) Destabilize the protein structure
 - c) Bond rupture
 - d) Calcium accumulation
- iii) Name of cytochrome P- 450 was given because of its
 - a) Molecular Weight
 - b) Decomposition temperature
 - c) Activation energy
 - d) Absorption peak position
- iv) Vitamin B12 deficiency cause
 - a) Nervous disorder
 - b) Pernicious anemia
 - c) Fatty Liver
 - d) Goiter
- v) Example of supramolecule is
 - a) EDTA
 - b) DMG
 - c) Crown ether
 - d) Schiff base
- vi) Which of the following may be considered as Supramolecular interaction
 - a) Covalent Bond

- b) Ionic Bond
 - c) Agostic Interaction**
 - d) Coordinate Bond
 - vii) Metal Organic framework (MOF) can be used for gas storage.
 - a) True**
 - b) False
 - viii) Copperiedus is a case of excess copper accumulation in body.
 - a) True**
 - b) False
 - ix) Cis-platin and trans-platin both can be used as anticancer drug.
 - a) True
 - b) False**
 - x) π - π stacking which helps in stabilizing large molecules is not supramolecular interaction.
 - a) True
 - b) False**
2. Discuss the structure and biological functions of ferritin, transferrin and siderophore. 15
 3. Discuss the role of Ca^{+2} in (a) muscle contraction and (b) blood clotting process. 15
 4. Formation of $\text{Zn}^{\text{II}}\text{-OH}$ at the biological pH is the crucial step in explaining the activity of carbonic anhydrase – justify the statement. Comment on the role of protein portion and ligating sites to monitor the Lewis acidity of Zn (II) in the said enzyme. 15
 5. Discuss the mechanism of drug action of cis- platin as an anticancer drug. What are the major side effects of cis platin as an anticancer drug? Suggest the possible ways to mitigate these side effects. 15
 6. Discuss the term supramolecular chemistry. What are the forces/interactions operate in such case? Illustrate with few examples. 15
 7. Discuss the mechanism of function of cytochrome P-450. Discuss its structural properties? 15
 8. What are the possible ways of noncovalent interactions of inert metal complexes with the DNA helix? 15

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Answer any five questions in which Q. No.1 is compulsory

1. Write true or false -

1 x 10

- i) Supramolecular interaction may be considered as non-covalent interaction. (True / False)
 - ii) Supramolecules can exhibit host – guest properties. (True / False)
 - iii) Siderophores transport calcium across the cell membrane. (True / False)
 - iv) Catalase and peroxidase destroy peroxides in living cell. (True / False)
 - v) Uric acid may be generated by the action of xanthine oxidase. (True / False)
 - vi) Vanadium can be used in anticancer drug. (True / False)
 - vii) Active site structure of carbonic anhydrase is octahedral. (True / False)
 - viii) Carboxypeptidase is an enzyme that hydrolyzes a peptide bond. (True / False)
 - ix) Cytochrome P-450 was named after its molecular weight. (True / False)
 - x) Biomineralization can be considered as a process of mineral production by living organism. (True / False)
2. Justify whether clathrates, cryptands, calixpyrroles will fall in the class of supramolecules. How such molecules interact with transition and non-transition metals.

3. Discuss the chemistry of the drugs used in cancer chemotherapy. What are the conditions a molecule to behave as a medicine? Give few examples. 15
4. What is the role of xanthine oxidase? Show reaction and catalytic mechanism. Discuss clinical significance. 15
5. Illustrate how metal ions interact with nucleic acid. What are the consequences? 15
6. Discuss in detail the role of calcium in human body. Mention effects of Ca deficiency. 15
7. Discuss in detail the chemistry of ferritin and transferrin. What is apotransferrin? 15
8. How do you justify the nature's selection of cobalt in vitamin B₁₂? Explain the answer in terms of the thermodynamics and kinetic properties of cobalamin. 15

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Answer five questions in which Q. No.1 is compulsory

1. Answer the following questions:

1 x 10

- xi) The formation of skeleton, shells and teeth are the examples of _____ process

Ans. Biomineralization

- xii) The uptake of iron by transferrin needs oxidation of Fe (II) by O_2 to Fe (III) and this process is catalysed by a copper containing protein, known as _____

Ans. Ceruloplasmin

- xiii) Iron containing Siderophores look _____ in colour and this is why the siderophores are also named as siderochromes.

Ans. Red - brown

- xiv) The Menkes disease due to genetic disorder arises from the wide spread defect in intracellular _____

Ans. Copper transport

- xv) The enzyme _____ catalyses the disproportionation of O_2^{2-} while _____ catalyses the disproportionation of O_2^- .

Ans. Catalase, superoxide dismutase

- xvi) _____ Disease is an acute Cu poisoning.

Ans. Wilson's

- xvii) _____ is the only vitamin that contains a metal i.e. Co.

Ans. Cobalamin

- xviii) Carboxypeptidase cleaves peptide bond in _____ terminus of the Protein.

Ans. C terminus

- xix) Vitamin B12 has _____ ring in its structure.

Ans. Corrin

- xx) Desferrioxamine is used to cure _____ overdose.

Ans. Iron

2. Discuss supramolecular catalysis with specific examples. Compare with conventional catalysis.

3. What do you mean by hypocalcemia and hypercalcemia? Discuss the role of Calcium in bone metabolism. 15
4. Some metal ions are required to stabilize the DNA structure but some metal ions can destroy the DNA structure – illustrate with suitable examples. 15
5. What do you mean by ferritin micelle? Why is it called micelle? What is apotransferrin? 15
6. Discuss the structural properties of catalase and peroxidase? How do they function? How do you establish the participation of higher valent iron in their enzymatic activity? 15
7. Give the clinical symptoms due to deficiency and excess of the metals (i) Zn, (ii) Cu, (iii) Fe and (iv) Cr. Discuss the utility of HSAB principle in selecting the chelating antidotes. 15
8. Discuss in detail the various forces acting on Supramolecules with respect to hydrogen bonding, π - π stacking, hydrophobic interactions, anion- π interactions, ion-dipole interactions and van der Waals interactions with few examples. 15