

2025

M.Sc. 3rd Semester Examination
CHEMISTRY

Paper : CEM - 303

Full Marks : 50

Time : Two Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.*

(Advanced Inorganic Chemistry-II)

Group - A

Answer any *four* questions : 2×4=8

1. How it can be concluded that zinc plays a primarily structural role in ZnSOD?
2. Describe how DMSO reductase contributes to cloud formation in the atmosphere.
3. Why are catalase and peroxidase classified as haemoprotein?
4. What are the main differences between porphyrin ring and corrin ring?
5. Write the mathematical expression for resonance energy transfer between donor and acceptor molecules.

P.T.O.

(2)

6. What is meant by a radiationless transition in photochemical processes?

Group - B

Answer any *four* questions : $4 \times 4 = 16$

7. Discuss the enzymatic activity and reaction mechanism of formate dehydrogenase.
8. Explain the catalytic activity and mechanism of aminopeptidase.
9. Discuss the enzymatic activity and mechanism of alcohol dehydrogenase.
10. Outline the synthesis and structural features of the active site of galactose oxidase.
11. Explain the selection rules governing radiative transitions in photochemical reactions.
12. Differentiate between thermal and chemical reactions.

Group - C

Answer any *two* questions : $8 \times 2 = 16$

13. Cite the enzymes involved in nitrate reduction process. Draw and describe the active site structures, and explain the mechanism of nitrate reduction catalyzed by these enzymes. $1+3+4$
14. Illustrate and describe the environment surrounding the active site of the enzyme catalase. Explain its catalytic activity and reaction mechanism in presence of high concentration of H_2O_2 . $4+4$

(3)

15. What is the photosynthetic electron transport chain? Describe the sequence of electron transfer steps in photosynthesis with a detailed diagram. 2+6
16. Derive the Stern-Volmer equation for biomolecular fluorescence quenching. Mention three major characteristic properties of THEXI states. 5+3

Internal Assessment : 10 marks

P.T.O.

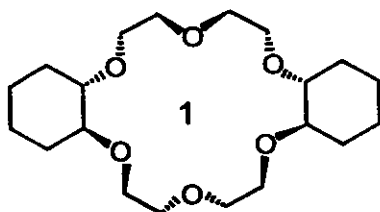
(4)

(Advanced Organic Chemistry-II)

Group - A

Answer any *four* questions : $2 \times 4 = 8$

1. What is Ramachandran map?
2. What is DNA melting?
3. Write the IUPAC name of compound 1 and propose a synthetic route.



4. How proteins play a role in the bone morphology?
5. How can one use cryptands as a Light Conversion Device?
6. (a) What is the 'principle of preorganization'?
(b) Define 'peak selectivity'.

Group - B

Answer any *four* questions : $4 \times 4 = 16$

7. Write the applications of crown-ethers/cryptands.
8. (a) Briefly sketch the 'U'-tube transport experiment and write the principle of it.
(b) Write its usefulness.

9. (a) Define template effect.
(b) How does macrocyclization work even though it is an entropically disfavorable process?
10. Give an example of a green synthesis of metal nanoparticles with plausible mechanism.
11. Why proline is known as helix breaker?
12. (a) Elaborate the structural features of 18-crown-6.
(b) How does 18-crown-6 bind a monovalent cation?
(c) Name a naturally occurring ionophore having similar selectivity.

Group - C

Answer any *two* questions : $8 \times 2 = 16$

13. (a) Define molecular recognition.
(b) Write the principal forces involved in this process.
(c) Design a suitable receptor for adipic acid, synthesize it and show the mode of its complexation. $2+2+4$
14. (a) Design, synthesize and explain the mode of complexation of barbital.
(b) How can one modify the above receptor for the design of a protease enzyme mimic? $4+4$

P.T.O.

15. Design receptors for the following guests, synthesize those and show the mode of their complexation :

(a) urea,

(b) mono-potassium salt maleic acid. 4+4

16. (a) What is a 'supramolecular gel' and how is it formed?

(b) What are major the differences between a 'supramolecular' and a 'polymeric' gel?

(c) Give a few examples of Low Molecular Mass Organogelators.

(d) How can one study the morphology of a supramolecular gel? 2×4

Internal Assessment : 10 marks

(7)

(Advanced Physical Chemistry-II)

Group - A

Answer any *four* questions : $2 \times 4 = 8$

1. "The quantum yield of the reaction $2F \rightarrow F_2$ decreases when the crystals containing 'F' centres are heated below 140 K". — Explain.
2. Define 'spectral emissive power' of a black body radiation.
3. Write down the statements of (a) postulate of local equilibrium and (b) principle of microscopic reversibility.
4. Define 'Hall potential' and 'Hall mobility' with their mathematical expressions.
5. 'Phonon has no momentum.' — Criticize.
6. Write down the relation which correlates two thermoelectric effects (Seebeck effect and Peltier effect).

Group - B

Answer any *four* questions : $4 \times 4 = 16$

7. Obtain the expression for the entropy production due to flow of matter.
8. Discuss the BCS theory of superconductivity.

P.T.O.

9. What is a 'V' centre? Discuss the mechanism of formation of 'V' centre with a suitable example.
10. Derive the expression for surface number density for a crystal containing Frenkel defect.
11. Given that the density of KBr is 2.75 gcm^{-3} and that the length of an edge of a cubic unit cell is 654 pm. Determine how many formula units of KBr there are in a unit cell. Does the unit cell have a NaCl or CsCl structure? 3+1
12. Derive the expression for the Rayleigh-Jeans law for black body radiation.

Group - C

Answer any *two* questions : $8 \times 2 = 16$

13. Define Grand Partition Function. Obtain expressions of Grand Partition Functions for systems of bosons and fermions and hence derive the Bose-Einstein distribution law. 2+2+4
14. What is meant by Bose-Einstein condensation? Derive the expression for the temperature at which such a process may occur for a boson. 1+7
15. Obtain the expression for the rate of entropy production for a process where the application of an electric field $\Delta\phi$ causes a pressure difference Δp . Utilising this expression define streaming potential and streaming current in terms of phenomenological co-efficients. 5+3

(9)

16. Define Geometrical Structure Factor. Distinguish between CsCl lattice and NaCl lattice with the help of Geometrical Structure Factor. 2+6

Internal Assessment : 10 marks
