

M.Sc. 3rd Semester Examination, 2022

CHEMISTRY

*(Physical Chemistry Special /Organic Chemistry
Special/Inorganic Special)*

PAPER – CHEM-303

Full Marks : 40

Time : 2 hours

Answer any one Paper as per your Specialization

The figures in the right hand margin indicate marks

*Candidates are required to give their answers in their
own words as far as practicable*

(Physical Chemistry Special)

A. Answer any four of the following : 2 × 4

1. What do you mean by entropy production ?

(Turn Over)

2. Define the term 'The spectral emissive power'.
3. Why does the conductivity of a semiconductor increase exponentially with increasing temperature ?
4. Does 'Phonon' have momentum ?
5. What is Hall mobility ?
6. Write down the statement of postulate of local equilibrium and principle of microscopic reversibility.

B. Answer any *four* questions of the following : 4×4

7. Iron (II) oxide FeO , crystal has a cubic structure and each edge of unit cell is 5.0 \AA . Taking density of the oxide as 4.0 g cm^{-3} , calculate the number of Fe^{2+} and O^{2-} ions present in each unit cell.

8. Explain what is meant by phenomenological co-efficient and discuss the significance of the cross co-efficient L_{ij} .

9. Considering suitable ensembles derive a relation between Lagrangian multipliers α and β in terms of chemical potential.

10. Why the resistivity value of Aluminium becomes nearly equal to zero below 1.18 K.

11. 'Both Wien's Law and Rayleigh's Law are simply particular cases of Planck's Law of Radiation'. Explain.

12. Define Grand partition function for a system of (a) Bosons (b) Fermions. 2 + 2

C. Answer any *two* questions of the following : 8 × 2

13. What is n-type and p-type semiconductor ?
Explain the fabrication of transistors. 1 + 1 + 6

14. (a) What is 'V₂' Centre ? Discuss the mechanism of formation of 'V₂' Centre with a suitable example.
- (b) Calculate the transitional partition function for hydrogen atom at 3000 K confined to move in a box of volume of $2.494 \times 10^5 \text{ cm}^3$. Also determine the thermal de Broglie wavelength. 4 + (3 + 1)
15. 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
16. Obtain the expression for the rate of entropy production for the transfer of material when an applied electric field causes a pressure difference at equilibrium and hence obtain an expression for electro-osmotic pressure in terms of appropriate phenomenological coefficients. 6 + 2

(*Organic Chemistry Special*)

A. Answer any *four* questions : 2 × 4

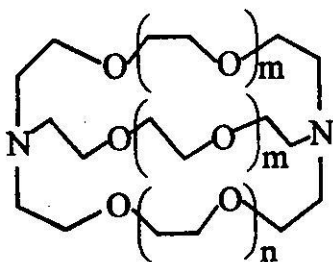
1. Define template effect during macrocyclization.
2. Show how 18-crown-6 can bind K^+ -ion selectively.
3. Show schematically the structure of collagen protein.
4. What is DNA melting ?
5. Write the significance of multiple recognition sites in a polytopic host.
6. Why is Proline known as helix breaker ?

B. Answer any *four* questions of the following : 4 × 4

7. (a) Design a molecular receptor for the complexation of adepic acid.

- (b) Synthesize the molecular receptor.
- (c) How can one study the complexation of adipic acid ?
8. How can one use cryptands as a Light Conversion Device ? Give an example.
9. Design a receptor for mono-potassium salt of maleic acid, synthesize it and show the mode of its complexation.
10. Briefly sketch the 'U'-tube transport experiment and write the principle of it. Write its usefulness.
11. (a) What is role of a protease enzyme ?
- (b) Design a protease enzyme mimic, synthesize it and show how it can function as a protease enzyme mimic ?

12. Propose a synthetic route for the synthesis of the following cryptand. Discuss how the selectivity of the cryptands to monovalent cation change with change in the arm length.



C. Answer any *two* questions of the following : 8×2

13. (a) Define hydrophobic effect.

(b) How can water act as a better solvent than common organic solvents for a simple Diels-Alder reaction? Illustrate with examples.

(c) What are 'salting in' and 'salting out' agents? $2 + 3 + 3$

14. (a) Write four principles of green chemistry.

(b) Give an example of a green synthesis of metal nanoparticles with plausible mechanism.

(c) Give an example of a green synthesis of organic compounds. 2 + 3 + 3

15. Define the following secondary structural elements : α -helix, β -pleated sheet, β -turn, 3.10 helix. 4 + 4

16. (a) What is self-replication ?

(b) Write briefly the significance of such studies.

(c) Propose a self-replicating scheme based on a model compound and explain how a simple template molecule can amplify without enzymes. 2 + 2 + 4

(*Inorganic Special*)

A. Answer any *four* of the following : 2 × 4

1. Write down the name of two metalloproteins which are excellent Catalysts for the disproportionation of super oxide. Where they are found ?
2. Write down effects the of Alcohol dehydrogenase isoenzyme on living organisms.
3. Mention the names of various types of aminopeptidases.
4. What are the differences between assimilatory and dissimilatory nitrate reductase ?
5. What do you mean by DOSENCO state ?
6. What is meant by static and dynamic quenching of fluorescence ?

B. Answer any *four* questions : 4 × 4

7. Draw and discuss the active site structure of Nitrogenase.
8. Describe the active site structure of catalase with its active site.
9. Explain active site structure of cytochrome-P450.
10. Give mechanism of reduction of xanthene to uric acid by xanthene oxidase.
11. How THEXI state can be prepared ? Write down the properties of this state.
12. Derive the an expression for the quantum yield of fluorescence in terms of life time (τ).

C. Answer any *two* questions : 8 × 2

13. Why Galactose oxidase is called a free radical enzyme ? Draw the active site structure of galactose oxidase. Give enzymatic activity and reaction mechanism of its reaction. 1 + 3 + 4

14. What are the main sources of sulphite in life forms? Draw and discuss the active site structure of sulphite oxidase. Give mechanism of its action. 1 + 3 + 4
15. Discuss how the photochemical reduction and oxidation of H_2O molecules can be achieved using $[Ru(bpy)_3]^{2+}$ as photosensitizer. 8
16. Write down the equation of efficiency (η) of resonance energy transfer. Discuss the condition of Förster theory of resonance energy transfer. Discuss about the bimolecular quenching. 2 + 3 + 3
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