M.Sc. 3rd Semester Examination, 2023

CHEMISTRY

PAPER—CEM-303

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

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

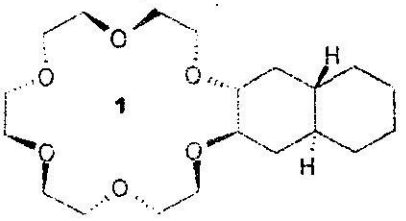
(*Organic Special*)

GROUP – A

Answer any **four** questions : 2×4

1. What are major groove and minor groove in DNA double helix ?

2. How DNA replication is semi-conservative ?



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 : 4×4

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 occuring ionophore having similar selectivity.

GROUP – C

Answer any **two** questions from the following : 8×2

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*) What is a 'supramolecular gel' and how is it formed ?

(*b*) What are the major 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

15. (*a*) Define self-assembly.

(*b*) What are the types of interactions involved in the self-assembly process ?

(*c*) Write the different types of supramolecular structures that can be formed by self-assembly.

(*d*) Give examples of two triterpenoids that spontaneously self-assemble in liquids. 2×4

16. (*a*) What is aromatic-aromatic (π-π) interaction ?

(*b*) Show schematically the potential energy diagram for two integrating π-atoms as a function of their orientation.

(*c*) Charge transfer transitions observed for EDA complexes are a consequence not a cause of the more general (π-π) interaction. Explain.

(*d*) Give an example of Host-Guest complexation utilization aromatic-aromatic interaction. 2×4

[**Internal Assessment – 10 Marks**]

(*Inorganic Special*)

GROUP – A

Answer any four questions : 2 × 4

1. "The role of Zn is primarily structural in ZnSOD." Explain.

2. How DMSO reductase help to nucleate cloud formation ?

3. Why Catalase is called a haeme protein ?

4. Why ATP is needed for the reduction of nitrogen by Nitrogenase ?

5. Write down the equation of Resonance energy transfer between donor and acceptor molecules.

6. What do you mean by radiation less transition ?

GROUP – B

Answer any **four** questions : 4×4

7. Write down the enzymatic activity and reaction mechanism of formate dehydrogenase enzyme.

8. Write down the enzymatic activity and reaction mechanism of amino peptidase enzyme.

9. Write down the enzymatic activity and reaction mechanism of alcohol dehydrogenase enzyme.

10. Write down the synthesis of active site of the galactose oxidase.

11. Discuss the selection rules of the radiative process.

12. Write down the differences between thermal reaction and chemical reaction.

GROUP – C

Answer any **two** questions : 8×2

13. Which enzymes are involved in the reduction of nitrate ? Draw and discuss the about their active site structure. Clearly indicate reduction mechanism of the nitrate by these enzyme. $1 + 3 + 4$

14. Draw and discuss about the environment around the active site structure of enzyme peroxidase. Explain the enzymatic activity and reaction mechanism of this enzyme. $4 + 4$

15. What is photosynthetic electron transport chain ? Explain the photo synthetic electron transfer chain with diagramme in photosynthesis. $2 + 6$

16. Derive the Sten-Volmer equation for a bimolecular fluorescence quenching. Write about two properties of Thexi states. 5 + 3

[Internal Assessment – 10 Marks]

(Physical Chemistry Special)

GROUP – A

Answer any **four** questions : 2 × 4

1. What is an Exciton ?

2. The surface number density of Schottky defect is lower than Frenkel defect. Explain.

3. The quantum yield of the reaction $2F \rightarrow F'$ decreases as the time of irradiation increases– Explain.

4. Define spectral energy density of a black body radiation.

5. Explain what is meant by phenomenological co-efficient.

6. Write down the relations which correlate an osmotic effect to a streaming effect.

GROUP – B

Answer any **four** questions from the following : 4×4

7. How does mercury (Hg) become superconductor below 4.2 K ?

8. Define quantities α and β for exchanges between suitable ensembles and derive relation between these.

9. Derive the concentration of Schottky defect in a crystal.

10. Explain the working principle of a transistor.

11. Derive an expression for the rate of entropy production for a system which is composed of two parts, both enclosed in the same adiabatic enclosure at a uniform temperature T_1 and T_2 respectively ($T_2 > T_1$). How would you identify force and its flux ?

12. Calculate the characteristic rotational temperature for Hydrogen gas at 2727°C. Give moment of inertia of hydrogen gas molecule at this temperature = 4.60×10^{-48} kg m^2.
(Given $h = 6.626 \times 10^{-34}$ Js, K = 1.38×10^{-23} JK^{-1})

GROUP – C

Answer any **two** questions from the following : 8×2

13. Derive the expression for ideal gas equation given by Einstein. 8

14. (*a*) What is an F centre ? Why LiF shows pink colour when it is heated in excess Li metal ?

(*b*) Potassium crystalizes as bcc lattice and the length of the unit cell is 533.3 pm. Given that the density of Potassium is 0.8560 b,cm^{-3}, calculate Avogadro constant. (1 + 4) + 3

15. Derive the equations showing inter relationship between two thermoelectric effects followed automatically as a conseuences of Onsager's reciprocal relation. 8

16. Define Grand Partition Function. Obtain an expression for the Grand Partition Function for a system of Bose particles and hence derive the Bose-Einstein distribution law. 8

[Internal Assessment — 10 Marks]

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