M.Sc. 3rd Semester Examination, 2022

CHEMISTRY

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

PAPER — CEM-303 (CCAE)

Full Marks : 40

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

(*Inorganic Special*)

GROUP – A

Answer any **four** questions : 2×4

1. How you can prove that in CuZnSOD, the role of Zn is primarily structural ?

2. "Galactose oxidase does not contain any conventional redox factors but can perform hydrogen transfer". Explain.

3. Where DMSO reductases are found ? Give example.

4. What do you understand by the name P450 of the enzyme cytochrome P450 ?

5. What do you mean by stimulated absorption ?

6. What is static quenching of fluorescence ?

GROUP – B

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

7. Catalase is a heme protein, why it is called so ? Draw and discuss its active site structure a.

8. Draw and talk over the active site structure of electron carrier protein cytochrome P-450.

9. There are two type of carboxy peptidase, what are they ? Show the mechanism of hydrolysis of the peptide bond by this enzyme.

(*Continued*)

10. Which enzyme is responsible for the uric acid synthesis ? Outline mechanism involved in this conversion.

11. Write the expression for calculating fluorescence quantum yield. Mention each terms involved in this expression.

12. Write down the differences between fluorescence and phosphorescence.

GROUP – C

Answer any **two** questions : 8×2

13. "Poisonous superoxide requires an enzyme to convert O_2 and H_2O_2" mention the name of the enzyme and draw its active site structure. Explain the mechanism involves on the oxidation of organic molecules by peroxidase.

14. Outline the active site structure of Vit-B12 Coenzyme. Discuss the reaction mechanism involved in cobalamin catalyzed reaction.

15. Write short notes on :

    (*i*) Resonance energy transfer

    (*ii*) Stimulated absorption.

16. Discuss about the properties of Thexi states, Derive the expression of Stern-Volmer equation of fluorescence quenching.
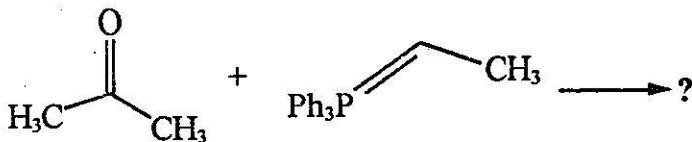
(*Organic Special*)

GROUP – A

Answer any **four** questions : 2×4

1. What is aromatic-aromatic interaction ?

2. Define hydrophobic effects.

3. Write down the product(s) of the following reaction and calculate the atom economy

4. What is the vertical distance of separation between adjacent base pairs in DNA double helix ?

5. What is denaturation of proteins.

6. Show the biodegradation steps of Poly(hydroxy-alkanoates) [PHAs].

GROUP – B

Answer any **four** questions : 4 × 4

7. How can water act as a better solvent than common organic solvent for a simple Diels-Alder reaction, illustrate with an example ?

8. Design a receptor for urea, synthesize and show the mode of their complexation.

9. How would you synthesize the following compounds ?

   (*i*) Biodisel from plant oil

   (*ii*) Citral from isobutene (BASF process).

(*Turn Over*)

10. How can one study the morphology of a supramo-lecular gel ?

11. Elaborate the structural features of 18-Crown-6. How does 18-Crown-6 binds the monovalent cation.

12. Compare the green and classical route for the preparation of following compounds.

    (*i*) Hydroquinone

    (*ii*) Ibuprofen.

GROUP – C

Answer any **two** questions : 8×2

13. (*a*) Biocatalytic procedure is more superior than classical chemical procedure for the preparation of 6-aminopenicillanic acid from penicillin G-Explain.

    (*b*) Write down the examples of low molecular weight organic gelators based on

    (*i*) amino acids (*ii*) lipids (*iii*) carbohydrates.

(*c*) Give the use of cyclodextrins derivative as ribonuclease enzyme mimic. $2 + 3 + 3$

14. (*a*) What is green chemistry ? How unconventional energy sources used in green synthesis ?

(*b*) Give examples (Green synthesis) :

   (*i*) Mannich reaction (Under Solvent free)

   (*ii*) Knovenagel Reaction (Under Aqueous solvent)

   (*iii*) Suzuki coupling (Using ionic liquid).

(*c*) Write down the different types of amphiphiles based on hydrophilic head and hydrophobic tail with proper examples. $(1 + 2) + 3 + 2$

15. (*a*) What is the definition of gel ?

(*b*) p-chlorination of anisole is preferred in water in presence of b-cyclodextrins with rate acceleration. How does explain this observation ?

(*Turn Over*)

(c) Write down the application of gels. $2 + 3 + 3$

16. (a) Discuss briefly Ramachandran plot.

(b) Locate the following secondary structural elements of proteins in Ramachandran plot : α-helix, parallel β-pleated sheet, antiparallel β-pleated sheet, 3.10 helix.

(c) Compare the structural features of protein α-helix and DNA double helix. $2 + 3 + 3$

(*Physical Special*)

GROUP – A

Answer any **four** questions : 2×4

1. Define Hall angle with its mathematical expression.

2. Phonon has no momentum.-Justify.

3. What is fermion ?

(*Continued*)

4. Write the equations for heat transfer and mass transfer and identify the flux and the force.

5. Show that $A = Nk_B T \ln Z$ (where the symbols indicate usual meaning).

6. Write down Debye T^3 law.

GROUP — B

Answer any **four** questions : 4×4

7. How would you identify NaCl crystal by calculating geometrical structure factor ?

8. Why does presence of excess of lithium makes LiCl crystals pink ?

9. The quantum yield of the reaction

$$2F \rightarrow F$$
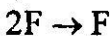
decreases when

(*i*) The crystal is heated with a temperature less than 140K

(*ii*) The time of irradiation increases. Explain. $2 + 2$

10. Using the expression for molecular partition function f, derive an expression of internal energy E.

11. Derive an expression for molecular rotational partition function for rigid rotor model.

12. Establish Prigogine's principle of minimum entropy production.

GROUP – C

Answer any two questions : 8×2

13. Derive the equations for occurring maximum diffraction according to the theory of von Laue.

14. Derive an expression for equilibrium constant of a reaction in terms of partition function.

15. (a) Crystalline KF has the NaCl type of structure. Given that the density of KF(s) is 2.481 gcm⁻³ at 20°C, calculate the unit cell length and the nearest neighbor distance in KF(s).

(b) Assuming the expression for thermodynamic probability of distribution of fermions obtain the Fermi-Dirac distribution law.   3 + 5

16. Consider a process where a difference of electrical potential causes a pressure difference. Obtain the expression for the rate of entropy production for the process and obtain the expression for electroosmotic pressure in term of the phenomenological coefficients.

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