M. Sc. 1st Semester Examination, 2024

CHEMISTRY

(Inorganic)

PAPER — CEM-103

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

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

·GROUP—A

Answer any **four** questions : 2 × 4

1. (a) What is meant by met-hemoglobin ?

   (b) What is the component subunit in foetal hemoglobin (HbF) ?

2. (a) How is iron in ferritin deposited with various amounts of phosphate ?

(b) Which enzyme catalyses the Fe(II) to Fe(III) oxidation during ferroxidase activity ?

3. In a crystal, a lattice plane cuts intercepts of 2a, 3b and 6c along the axes, where a, b and c are primitive vectors of the unit cell. Determine the Miller indices of the given plane.

4. Calculate interplanar spacing for a (3 2 1) plane in a simple cubic lattice whose lattice constant is 4.2×10^{-10} m.

5. Show that no two classes of a group can share a common element.

6. Write all the symmetry operations present in $[FeF_6]^{3-}$ anion.

(*Continued*)

(**3**)

GROUP—B

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

7. Discuss the O_2 and CO binding in myoglobin/ hemoglobin.   4

8. Explain the role of Zn(II) and Arg-127 residue in carboxypeptidase-A activity.   4

9. (*a*) Write a note on 'Membrane transport'.

    (*b*) Discuss the pH dependence of carbonic anhydrase activity.   2 + 2

10. Water (H_2O) crystallizes to form ice, when cooled below 273K (0 ^{0}C) under 1 atmospheric pressure. Ice has a hexagonal crystal structure with the lattice parameters of a = 453 nm and c = 741 nm. The density of ice at 1 atmospheric pressure at 273K is 0.917×106 g/m^3. Estimate the number of water molecules (H_2O) in a unit ice crystal cell.   4

11. (a) Prove that if a C_4 axis and one plane containing this axis exist in a molecule, then there must be a second plane which also contains this C_4 axis and at an angle of $45°$ to the first plane.

   (b) Prove that if P is conjugate with Q and R, then Q and R also conjugate to each other. $3 + 1$

12. Derive the matrix form of the $Sn(y)$ symmetry operation.   4

GROUP – C

Answer any **two** questions : 8×2

13. (a) Draw the active site structure of hemocyanin. Comment on the magnetic property of hemocyanin. $2 + 2$

   (b) Discuss the structure (details coordination environment around Zn^{II}) and function of carbonic anhydrase enzyme.   4

(*Continued*)

14. (*a*) What do you mean by "subgroup" of a group ? Write the conditions which must obey to form a "Subgroup" of a "group". Determine the sub-groups of D_{3h} and D_{4h} groups. $1 + 1 + 2 + 2$

(*b*) Find out the point group of the following molecules/ions :   2

   (*i*) *trans*-N_2F_2

   (*ii*) $[Co(NH_3)_5Cl]^{2+}$

   (*iii*) *mer*-$[Co(NH_3)_3Cl_3]$

   (*iv*) $[Ni(CO)_4]$

15. State the meaning and draw stereographic projections of the following point groups :   8

(*i*) 6mm, (*ii*) 3, (*iii*) 2mm, (*iv*) 3m, (*v*) m, (*vi*) 2mm, (*vii*) 6/mmm, (*viii*) 4mm

16. (*a*) Using "Great Orthogonality Theorem" prove that the sum of the squares of the characters in any irreducible representation equals to the order of the group.   4

(*b*) At 278 K, iron (Fe) shows a bcc structure with a lattice parameter of 0.2866 nm. Obtain the density of iron from this information.　　4

[Internal Assessment — 10 Marks]

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