PG/IS/CEM/103/23

M.Sc. 1st Semester Examination, 2023

CHEMISTRY

PAPER–CEM-103

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

GROUP – A

Answer any **four** questions : 2×4

1. If x-rays of wave length 0.5 Å are diffracted at an angle at 50° in the first order. What is the spacing between the adjacent planes of the crystal ?

2. Derive the relation between interplanar distance and Miller Indices.

3. Write the sub-groups present in D_{3h} group.

4. By which species iron is transported in lower organisms ? Mention their types and cite one example for each type.

5. Draw the active site structure of the urease and state the geometry around the metal centres.

6. Derive Bragg's expression in terms of reciprocal lattice.

GROUP – B

Answer any **four** questions : 4×4

7. At 278 K, iron (Fe) is found to show bcc structure with a lattice parameter of 0.2866 nm. Obtain the density of iron from this information. (The atomic weight of Fe is 55.845). 4

8. Beryllium (Be) mineral is expressed by a chemical formula ($3BeO.Al_2O_3.6SiO_2$), and it is revealed that the structure is hexagonal with the lattice parameters $a = 0.9215$ nm and $c = 0.9169$ nm, and density 2.68×10^6 g/m^3. Obtain the numbers of molecules contained in a unit cell. 4

9. Schematically represent and discuss the coordination environment around the metal ion in carbonic anhydrase. How is the nucleophile generated at the active site of the enzyme ? 1 + 3

10. Write the steps involved in the irreversible oxidation of haemoglobin. Discuss the role of glu-270 amino acid residue in the enzymatic activity of carboxypeptidase-A. 2 + 2

11. What do you mean by 'abelian group" ? Find out whether C_{3v} is an "abelian group" or a 'non-abelian group". 1 + 3

12. Derive the matrix form of $S_n(x)$ symmetry operation. 4

GROUP – C

Answer any **two** questions : 8×2

13. State the meaning and draw stereographic projections of the following point groups.

(*i*) 622
(*ii*) m3
(*iii*) 4 mm
(*iv*) 32
(*v*) mmm
(*vi*) 222
(*vii*) 6mm
(*viii*) 422

14. (*a*) Write the matrix form of all symmetry operations possesses by *trans*-N_2F_2 molecule. Show that these symmetry operations form a group. Determine the classes present in this group. 2 + 2 + 2

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

(*i*) $[ZnCl_4]^{2-}$

(*ii*) Staggered ferrocene

(*iii*) CO_3^{2-}

(*iv*) $[Cr(ox)_3]^{3-}$

15. (*a*) Using "Great Orthogonality Theorem" verify that the vectors whose components are the characters of two different irreducible representations are orthogonal. 3

(*b*) Derive the matrix form of all symmetry operations present in $POCl_3$ molecule. 5

16. Discuss the structure of ferritin. What is the ferroxidase activity of ceruloplasmin ? Schematically represent the steps involved in the transportation mechanism of iron. What are ionophores ? Classify ionophores and state examples for each case. 2+2+2+1+1

[Internal Assessment – 10 Marks]
