

**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 :  $2 \times 4$

1. If x-rays of wave length  $0.5 \text{ \AA}$  are diffracted at an angle at  $50^\circ$  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  $(3\text{BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2)$ , and it is revealed that the structure is hexagonal with the lattice parameters  $a = 0.9215 \text{ nm}$  and  $c = 0.9169 \text{ nm}$ , and density  $2.68 \times 10^3 \text{ g/m}^3$ . 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 :  $8 \times 2$

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

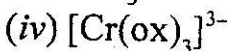
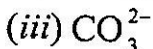
- (i) 622
- (ii)  $m\bar{3}$
- (iii) 4 mm
- (iv) 32
- (v) mmm
- (vi) 222
- (vii) 6mm
- (viii) 422

14. (a) Write the matrix form of all symmetry operations possessed 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 :



(ii) Staggered ferrocene



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

(b) Derive the matrix form of all symmetry operations present in  $\text{POCl}_3$  molecule.

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.

[ Internal Assessment – 10 Marks ]