

(Time: 3 Hours)

Total marks: 100

- N.B. (1) All questions are compulsory.
 (2) Figures to the right indicate full marks.
 (3) Use of logarithmic table/non-programmable calculator is allowed

1. Attempt **any four** of the following:

- A. Classify the symmetry operations with suitable examples. Give symmetry elements associated with them. **5**
- B. Discuss the symmetry operations and assign the point group to NH_3 molecule. **5**
- C. Draw a neat well labelled Molecular Orbital diagram of BeH_2 molecule. Give its structure, magnetic property and molecular configuration. **5**
- D. Describe the molecular orbital energy level diagram of CO with respect to bond order and magnetic property (Hybridisation not required). **5**
- E. Explain the geometry of H_3^+ ion on the basis of Walsh diagram and molecular orbital theory. **5**
- F. a. Explain why covalent bond energy in heteronuclear diatomic molecule is reduced. **3**
 b. Define: (i) Symmetry Operation **2** (ii) Order of group **2**

2. Attempt **any four** of the following:

- A. Explain with the help of a diagram: **5**
 (i) Unit Cell (ii) Lattice parameters.
- B. Define Packing density. Show that packing density for simple cubic lattice is 0.52 **5**
- C. For a face centered cubic (fcc) lattice, calculate: **5**
 (i) Number of atoms per unit cell (fcc)
 (ii) Lattice constant (a), if atomic radii (r) of a metal is 138 pm,
- D. With suitable example, explain Schottky defect in ionic solids. **5**
- E. Explain the terms: **5**
 (i) Superconducting Transition Temperature (T_c) (ii) Meissner's effect.
- F. Write a short note on Fullerenes and Alkali metal fullerenes. **5**

3. Answer **any four** of the following.

- A. What are f-block elements? Give the ideal and observed electronic configurations of actinides. **5**
- B. Explain the spectral properties of lanthanides. **5**
- C. Explain the method of separation of lanthanides from each other by ion exchange method. **5**
- D. Give reasons: **5**
 (i) Post lanthanide elements have abnormal high densities. **3**
 (ii) Cerium can form compounds with +4 oxidation state. **2**

- E. Explain the oxidation states of lanthanides on the basis their electronic configurations. **5**
- F. Give the applications of lanthanides. **5**
4. Attempt **any four** of the following:
- A. What are ionizing and nonionizing solvents? Explain with suitable examples. **5**
- B. With reference to liquid Dinitrogen tetroxide (N_2O_4) as a solvent, give balanced equations of (i) Acid base reactions (any two) **5**
(ii) Redox reaction with metals (any two)
- C. Name the oxyacids of Chlorine. Discuss the structure of any two on the basis of VSEPR theory. **5**
- D. Give any two preparations and any three properties of interhalogens. **5**
- E. With reference to the elements of Group-16, discuss the following: **5**
(i) Electronic configuration. (ii) Oxidation states.
- F. Discuss the role of V_2O_5 catalyst in the oxidation of SO_2 to SO_3 . **5**
5. Answer the following :
- A. Match the column : **(Any five)** **5**
- | A | B |
|----------------------------------|---------------------|
| a) Inversion centre | i) Td |
| b) Homonuclear diatomic molecule | ii) paramagnetic |
| c) Trans-dichloroethylene | iii) H_2 molecule |
| d) Higher symmetry point group | iv) linear |
| e) NO molecule | v) monocentric |
| f) Rotation – Reflection axis | vi) 3pz |
| g) Atomic orbitals | vii) C_{2h} |
| h) HCl | viii) i |
| | ix) C_{2v} |
| | x) Sn |
| | xi) polycentric |
- B. Select and write the appropriate answer. **5**
- a. AB – AB type of arrangement of spheres is found in _____ close packing.
(i) simple cubic (ii) face centered cubic (iii) hexagonal
- b. Voids in body centered cubic lattice is _____.
(i) 32% (ii) 48% (iii) 52%
- c. Due to Frenkel defect in ionic solids, density _____.
(i) increases (ii) decreases (iii) remains same
- d. Nb_3Sn is an example of _____ superconductor.
(i) conventional (ii) high temperature (iii) organic

- e. A point in crystal lattice signifies _____ of particles.
 (i) size (ii) volume (iii) position of centre.
- f. Frenkel defect occurs in _____.
 (i) Alkali halides (ii) Silver halides (iii) Alkali metal halides
- g. The coordination number in body centered cubic lattice is _____.
 (i) 6 (ii) 8 (iii) 12
- h. High temperature superconductors require _____ for cooling.
 (i) Liquid Helium (ii) Liquid Hydrogen (iii) Liquid Nitrogen

C. State whether the following statements are **true** or **false (any five)**:- **5**

- Colour of lanthanide ions is mainly because of charge transfer transitions.
- Outer electronic configuration of Dy^{4+} is $[Xe] 4f^8$
- Gd^{3+} is colourless.
- Nobel character of Ir may be attributed to lanthanide contraction.
- An average separation factor of 1.5 is achieved for adjacent lanthanides in 10.8M nitric acid.
- Compounds of Ce^{4+} are oxidising agents.
- La^{3+} has zero magnetic moment.

D. Fill in the blank with appropriate words given below (any five): **5**

(Water, O_2 , Liquid SO_2 , Trigonal, NH_2^- , two, Bent T shape, NH_2^+ , one, Flourine, O_4 , 98% H_2SO_4 , Iodine)

- Among the following _____ is an aprotic solvent.
- BrF_3 molecule has a _____ structure.
- One of the products of autoionisation of liquid NH_3 is _____.
- Elements of Group-17 need only _____ electrons to complete their octet.
- _____ does not form an oxyacid.
- An allotropic form of oxygen is _____.
- _____ is used to absorb Sulphur trioxide in Contact Process.