(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   **5**
     elements associated with them.

  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.   **5**
     Give its structure,magnetic property and molecular configuration.

  D. Describe the molecular orbital energy level diagram of CO with respect to   **5**
     bond order and magnetic property (Hybridisation not required).

  E. Explain the geometry of H_3^+ ion on the basis of Walsh diagram and molecular   **5**
     orbital theory.

  F. a. Explain why covalent bond energy in heteronuclear diatomic molecule is reduced.   **3**
    b. Define: (i) Symmetry Operation   (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 fullerides.   **5**

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

  A. What are *f*-block elements? Give the ideal and observed electronic   **5**
     configurations of actinides.

  B. Explain the spectral properties of lanthanides.   **5**

  C. Explain the method of separation of lanthanides from each other by ion   **5**
     exchange method.

  D. Give reasons:
     (i) Post lanthanide elements have abnormal high densities.   **3**
     (ii) Cerium can forms compounds with +4 oxidation state.   **2**

E. Explain the oxidation states of lanthanides on the basis there 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

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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**

   a. Colour of lanthanide ions is mainly because of charge transfer transitions.

   b. Outer electronic configuration of Dy^{4+} is $[Xe]\ 4f^{8}$

   c. Gd^{3+} is colourless.

   d. Nobel character of Ir may be attributed to lanthanide contraction.

   e. An average separation factor of 1.5 is achieved for adjacent lanthanides in 10.8M nitric acid.

   f. Compounds of Ce^{4+} are oxidising agents.

   g. 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)

   a. Among the following _____ is an aprotic solvent.

   b. BrF_3 molecule has a _____ structure.

   c. One of the products of autoionisation of liquid NH_3 is _____.

   d. Elements of Group-17 need only ___ electrons to complete their octet.

   e. _____ does not form an oxyacid.

   f. An allotropic form of oxygen is _____.

   g. _____ is used to absorb Sulphur trioxide in Contact Process.

_____