Time : 2 ½ Hours **Total marks :75**

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 Three** of the following

A. What is point group? Elaborate on the symmetry elements in trans dichloro ethylene molecule with suitable diagram and give point group. **5**

B. Discuss the following symmetry elements with suitable example. **5**
i) Axis of symmetry ii) Identity

C. Draw a labelled M.O diagram for CO molecule. Comment on its magnetic property and bond order. **5**

D. Explain the structure of BeH_2 molecule on the basis of M.O theory. **5**

E. Write a note on Walsh correlation diagram. **5**

2. Attempt **Any Three** of the following

A. Define Atomic Packing factor. Derive the atomic packing factor for body centred cubic lattice. **5**

B. What is point defect? Explain Frenkel defect with suitable example. **5**

C. Explain Crystal lattice and Lattice Constants with suitable diagrams. **5**

D. Calculate the number of atoms per unit cell of a metal with lattice parameter of 3.61 Å. Density of the metal is $8.98 \times 10^3 kg/m^3$, atomic weight of the metal is 63.5 and Avogadro's number is 6.022×10^{23} atoms/mol **5**

E. Write a note on Meissner's effect in superconductors. **5**

3. Attempt **Any Three** of the following

A. What are inner transition elements? Name and give the electronic configuration of actinide series. **5**

B. Discuss the spectral properties of lanthanide. **5**

C. Explain the separation of lanthanides by tributyl phosphate (TBP) extraction method. **5**

D. What is lanthanide contraction? Write a note on following consequences of lanthanide contraction **5**
i) Basicity of lanthanides ions decreases from lanthanum to lutecium
ii) Similarities between zirconium and hafnium

E. Discuss the commercial and catalytic applications of lanthanides. **5**

4. Attempt **Any Three** of the following

A. What are the protic and aprotic solvents? Explain with suitable example. **5**

B. What are non-aqueous solvents? Give any two balance equations for each of the following reactions of liquid ammonia. **5**
i) Complex formation ii) Solvolysis

C. Write a note on allotropes of sulphur. **5**

D. Explain anomalous behaviour of Fluorine. **5**

E. On the basis of VSEPR theory, explain structure and bonding in BrF_3 interhalogen compound. **5**

5. Answer the following:

A. Select whether the following statements are **true or false (Any five)** **5**

a. NH_3 has two mirror planes.
b. The molecules having two atoms of the same element are known as homonuclear diatomic molecules.
c. Schottky defect is one dimensional defect.
d. Ceramic superconductors are high temperature superconductors.
e. Misch metal is an alloy of lanthanides.
f. Magnetic moments of lanthanide ions are very low.
g. From oxygen to polonium, electropositive character increases.
h. Oxygen mostly exhibits positive oxidation states.

B. **Select the correct option and complete the following statements. (Any five)** **5**

a. H_2O molecule is ----------
a) linear b) angular c) tetrahedral d) octahedral
b. The combinations of the atomic orbitals of the central atom and group orbitals of the peripheral atoms in polyatomic molecules are as per ---------- in molecular orbital theory.
a) SALCs b) LCAO c) Hybridisation d) Electron spin
c. Schottky defect is generally found in an ionic solid with ----------
a) High coordination number b) Low coordination number
c) Zero Coordination number d) Smallest coordination number
d. Superconductivity was first observed in liquid ----------
a) He b) Hg c) Br_2 d) N_2
e. Lanthanides are characterised by preferential filling of ---------- orbitals.
a) 6d b) 4f c) 5f d) 4d
f. The absorption spectra of lanthanide ions are due to …….. transitions.
a) d-d b) d-f c) f-f d) p-d
g. --------is the most electropositive element.
a) sulphur b) oxygen c) selenium d) polonium
h. The oxidation state of oxygen in OF_2 is-----
a) +2 b) -2 c) +1 d) +4

C. **Match the column: (Any five)** **5**

Column A	Column B
a. Sign of wave function	i. Mineral of lanthanons
b. Improper rotation axis is also called	ii. BCC
c. ABABAB… packing	iii. Colourless lanthanide
d. Alkali metal fullerides	iv ψ
e. Monazite	v. FCC
f. La^{3+} ion	vi. σ
g. Radioactive element	vii. Rotation reflection axis
h. XY_7 interhalogen	viii. Polonium
	ix. Superconductors
	x. IF_7
