[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. What is symmetry element? Discuss the following symmetry elements with one example each i) Plane of symmetry ii) Proper rotation axis **5**

B. Discuss the point group assign to following molecules **5**
i) trans- dichloro ethylene
ii) NH_3

C. Draw molecular orbital diagram for CO molecule. Discuss its bond order and magnetic behaviour. **5**

D. Explain the triangular structure of H_3^+ ion on the basis of molecular orbital theory. **5**

E. Discuss the structure of BeH_2 molecule on the basis of molecular orbital theory and draw molecular orbital diagram showing the distributions of electrons in various molecular orbitals. **5**

F. Write the comparison between homomononuclear and heteronuclear diatomic molecule. **5**

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

A. Define unit cell. Express the relationship between density of unit cell and lattice parameters. **5**

B. What is atomic packing factor. Show that packing density of face centered cubic crystal [fcc] is 74%. **5**

C. An element having atomic mass 27 g mol^{-1} crystallises in cubic unit cell with edge length 405 pm and has density 2.7 g cm^{-3}. Determine the type of cell. (Avogadro's constant is 6.023 x 10^{23}). **5**

D. Explain Schottky and Frenkel defects in solids with suitable example. **5**

E. Write a note on fullerenes and alkali metal fullerides as a superconductor. **5**

F. Give any five applications of superconductor. **5**

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

A. Define f-block elements. Name and give the electronic configuration of elements of second transition elements. **5**

B. What do you mean by lanthanide contraction? Discuss the effects of lanthanide contraction with respect to: **5**
i] Decreasing basicity. ii] Variation in the properties of Lanthanides.

C. Explain the following**:**
i] Magnetic moments of lanthanides are high. **3**
ii] Lanthanides. preferably exhibit 3+ Oxidation states **2**

D. Write a short note on spectral properties of lanthanides. **5**

E. Discuss the principles involved in the separation of lanthanides by ion exchange method. **5**

F. Discuss in brief commercial and nuclear applications of lanthanides. **5**

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

A. With reference to liquid dinitrogen tetraoxide as a solvent give two balanced equations for each of the following type of reactions. **5**
(i)acid-base (ii) reaction with metals

B. Explain anomalous behaviour of Oxygen with reference to elements of group 16. **5**

C. With the help of schematic diagram discuss the manufacture of sulphuric acid by contact process. **5**

D. Based on electronic configuration of elements of Group 17, explain their oxidation states and oxidizing power. **5**

E. Give any two methods of preparation of interhalogen compounds and discuss the structures of (i) XY_3 and (ii) XY_5 type interhalogen compounds. **5**

F. Explain (1) Protonic (ii) aprotic and (iii) amphiprotic solvents with suitable examples. **5**

5. Answer the following:

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

a. Centre of symmetry is denoted by symbol 'i'.
b. The rotational axis C_n for water molecule is 2
c. The axis with the lowest order of symmetry operations is called principal axis.
d. Total number of electrons in NO is 14
e. Operation of doing nothing is called identity operation.
f. Molecular orbitals are regarded as monocentric.
g. Molecular orbitals with lowest energy give rise to antibonding molecular orbitals.
h. In triangular ion, nondegenerate orbitals are labelled as 'a'.

B. Fill in the blank with appropriate words given in the bracket **(Any five)** **5**
[zero, above, Schottky, unit cell, two, 0.52, fcc]

a. ….. is the fundamental building unit of the crystal.
b. Atomic packing factor in simple cubic cell is…….
c. Number of atoms per unit cell in body centered cubic crystal [bcc] is …….
d. ABC-ABC. Type packing results in ……. unit cell.
e. Defects occurs in crystal due to cation and anion vacancy is ……
f. Superconductors has practically …… electrical resistance.
g. Superconductors whose critical temperature is ……. 77 K are high temperature superconductors.

C. Select and write the appropriate answer . **(Any five)** **5**

a. The elements of actinide series are characterized by the preferential filling of ---------- .
a. 5f orbitals. b. 4s orbitals. c. 5p orbitals. d. 5s orbitals.

b. The ideal electronic configuration of lanthanum is ---------- .
a. [Xe] $4f^7\ 5d^1\ 6s^2$. b. [Rn] $4f^0\ 5d^1\ 6s^2$.
c. [Xe] $4f^0\ 5d^1\ 6s^2$. d. [Ar] $4f^0\ 5d^0\ 6s^2$.

c. Decreasing basicity is one of the important consequences of ----------.
a. Lanthanide contraction b. Cracking
c. Concentration d. Extraction.

d. Cerium by exhibiting +4 oxidation state attains a stable configuration of ---------- .
a.$4f^0$ b.$4f^5$ c. $4f^{10}$ $4f^1$

e. The method which involves the adsorption of Ln^{3+} ions on a cation exchange resin followed by preferential elution is ----------.
a. spectrophotometric method. b. potentiometric method.
c. ion exchange method. d. colorimetric method.

f. An average separation factor reported for the adjacent lanthanides in 15.8 M nitric acid-100% TBP system is ----------.
a. 0.5. b.1.2**.** c.1.5. d.2.5

g. The lanthanide compound used as catalysts in hydrogenation, dehydrogenation and oxidation reactions is----------**.**
a. Lanthanum oxides. b. Promethium nitrate.
c. Samarium oxalate. d. Neodymium sulphate.

h. The tripositive lanthanide ion that is colourless is ---------- .
a. Erbium b. Lutecium. c. Holmium d. Promethium.

D. Match the column (Any five). **5**

a.	Acidic solvent	**i.**	levels of acids
b.	Rhombic sulphur	**ii.**	V_2O_5
c.	Contact process	**iii.**	m + n
d.	Steric number of AB_mE_n	**iv.**	trigonal bipyramid
e.	XY_5 interhalogens	**v.**	Protonic solvents.
f.	Metal-ammonia solution	**vi.**	Square pyramidal
g.	Liquid HF	**vii.**	S8 rings
		viii.	levels of bases
		ix.	blue
