(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. Give an account of the following with suitable examples: **5**
(i) Inversion centre (ii) Identity

B. Discuss the point group assigned to diatomic linear molecules **.** **5**

C. Compare homonuclear and heteronuclear diatomic molecules **5**

D. Discuss using Walsh diagram, H_3^+ion is triangular **.** **5**

E. Draw the molecular orbital energy level diagram for H_2O molecule. Comment on its magnetic property. **5**

F. (i) Write in short the importance of symmetry in chemistry.(2 points) **2**

(ii) Explain in HCl molecule, the 3pz orbital of chlorine is involved in bonding with 1s of hydrogen **3**

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

A. What are lattice parameters. Derive a relationship between lattice constant (a) of a cubic crystal and density of the crystal material. **5**

B. Show that packing factor for body centered cubic (bcc) lattice is 0.68. **5**

C. For a simple cubic (sc) unit cell - **5**
(i) Calculate the number of atoms per unit cell (sc).
(ii) Find the atomic radii (r) of a metal which crystallises in sc structure with length of unit cell 326 pm.

D. With suitable example, explain Frenkel defect in ionic solids. **5**

E. Write a short note on conventional superconductor . **5**

F. Explain the terms: **5**
(i) Superconducting Transition Temperature (T_c)
(ii) Ideal and hard superconductors.

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

A. (i) What are inner transition elements? **2**
(ii) Give reason, lanthanide shows +3 as their common oxidation states. **3**

B. Explain magnetic properties of lanthanides ions are different from those of transition metal ions. **5**

C. Give the factors affecting the rate of ion exchange and explain the role of complexing agent in elution of lanthanide ions, by ion exchange method. **5**

D. Give reasons:
(i) Yttrium occurs invariably with some lanthanides. **2**
(ii) Post lanthanides have abnormal high densities. **3**

E. On the basis of electronic configuration of lanthanides, explain the colour of lanthanide ions in solution or their compounds. **5**

F. Give the commercial and nuclear applications of lanthanides. **5**

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

A. What are acid, basic and amphiprotic solvents? Explain with suitable examples. **5**

B. Name the oxyacids of chlorine. Discuss their acid strength in detail. **5**

C. Write a short note on metal-ammonia solutions. **5**

D. Discuss the structure of XY_7 type of interhalogens with suitable examples. **5**

E. Give the three steps involved in the formation of Sulphuric acid. Explain the effect of pressure on the formation of SO_3. **5**

F. Discuss the allotropic forms of Oxygen. **5**

5. Answer the following :

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

a. Hydrogen molecule belongs to C∞vpoint group.

b. Centre of inversion is absent in C_6H_6 molecule.

c. NO forms NO^+ ,the single electron is lost from antibonding orbital.

d. Bond order of CO molecule is 3.

e. Trans-dichloroethylene belongs to C_{2h} point group .

f. C∞v is the higher symmetry point group.

g. Photoelectron spectrum of water shows two bands.

h. Though BeH_2 and H_2O molecule have same number of peripheral atoms their structures are different.

B. Select and write the appropriate answer (**any five**): **5**

a. AB AB --- type of arrangement of spheres is found in _____ close packing.
(i) Simple cubic (sc) (ii) face-centered cubic (fcc) (iii) Hexagonal.

b. The number of atoms in face-centered cubic unit cell is _____.
(i) 2 (ii) 4 (iii) 6

c. In Schottky defect of ionic solids, _____ is missing.
(i) a cation (ii) an anion (iii) both cation and anion.

d. The effect of ejecting out the flux lines of magnetic field by a superconductor is known as _____ effect.
(i) Meissner (ii) Doppler (iii) Steric

e. In C_{60} Fullerene there are ____ five membered rings.
(i) 10 (ii) 12 (iii) 20

f. Presence of foreign atoms in ionic crystals leads to _____ defect.
(i) impurity (ii) vacancy (iii) interstitial (self)

g. Coordination number in face centered cubic lattice is:
(i) 6 (ii) 8 (iii) 12

h. A point in crystal lattice signifies _____ of particles.
(i) size (ii) volume (iii) position of the centre

C. Fill in the blank by choosing the appropriate answer from below**(any five)**:- **5**
(most, least,hydrolysis, Gadolinite, Dy^{3+}, Gd^{3+},similar, Os, partition, different,)

a. Solvent extraction is based on _____ law.
b. Nb – Ta shows _____ chemical properties.
c. bis(2-ethylhexyl) phosphoric acid is less susceptible to _____ as compared to TBP.
d. _____ is less reactive (noble) because of lanthanide contraction.
e. _____ is a silicate of lanthanides.
f. La^{3+} ion is _____ hydrated.
g. _____ ion shows highest experimental magnetic moment.

D. Match the Columns: (**any five**) **5**

A		B	
a	Protonic solvent	1	Chlorine
b	Rhombic sulphur	2	NO^+
c	Maximum electron affinity	3	V_2O_5
d	Bromine Triflouride	4	-2
e	Autoionisation of N_2O_4	5	Flourine
f	Catalyst in manufacture of H_2SO_4	6	HCl
g	Oxidation state of Group-16 elements	7	Bent T-shape
		8	NO^-
		9	Puckered ring
		10	-6
		11	Triangular