

(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 lanthanide 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:**
- Yttrium occurs invariably with some lanthanides. 2
 - 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:**
- What are acid, basic and amphiprotic solvents? Explain with suitable examples. 5
 - Name the oxyacids of chlorine. Discuss their acid strength in detail. 5
 - Write a short note on metal-ammonia solutions. 5
 - Discuss the structure of XY_7 type of interhalogens with suitable examples. 5
 - Give the three steps involved in the formation of Sulphuric acid. Explain the effect of pressure on the formation of SO_3 . 5
 - Discuss the allotropic forms of Oxygen. 5
- 5. Answer the following :**
- State whether the following statements are true or false: **(Any five)** 5
 - Hydrogen molecule belongs to $C_{\infty v}$ point group.
 - Centre of inversion is absent in C_6H_6 molecule.
 - NO forms NO^+ , the single electron is lost from antibonding orbital.
 - Bond order of CO molecule is 3.
 - Trans-dichloroethylene belongs to C_{2h} point group.
 - $C_{\infty v}$ is the higher symmetry point group.
 - Photoelectron spectrum of water shows two bands.
 - Though BeH_2 and H_2O molecule have same number of peripheral atoms their structures are different.
 - Select and write the appropriate answer **(any five):** 5
 - AB AB --- type of arrangement of spheres is found in _____ close packing.
 - Simple cubic (sc)
 - face-centered cubic (fcc)
 - Hexagonal.
 - The number of atoms in face-centered cubic unit cell is _____.
 - 2
 - 4
 - 6
 - In Schottky defect of ionic solids, _____ is missing.
 - a cation
 - an anion
 - both cation and anion.
 - The effect of ejecting out the flux lines of magnetic field by a superconductor is known as _____ effect.
 - Meissner
 - Doppler
 - Steric
 - In C_{60} Fullerene there are _____ five membered rings.
 - 10
 - 12
 - 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 Trifluoride | 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 |