

[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 5
 - i) Mirror plane
 - ii) Centre of symmetry
 - B. Discuss the point group assigned to following molecules 5
 - i) H_2
 - ii) trans- dichloro ethylene
 - C. Draw molecular orbital diagram for CO molecule. Discuss its bond order and magnetic behaviour. 5
 - D. Discuss triangular structure of tri-hydrogen ion on the basis of Molecular orbital theory. 5
 - E. Explain formation of H_2O molecule with the help of molecular orbital diagram. Discuss its magnetic behaviour. 5
 - F. Discuss on the basis of Walsh diagram, correlation between bond angles and molecular orbitals with suitable example. 5
2. Attempt **any four** of the following:
- A. With the help of diagram, define and explain unit cell and lattice parameters. 5
 - B. Define coordination number. Calculate number of atoms per unit cell (n) for, 5
 - a) body centered cube (bcc),
 - b) Simple cube (sc).
 - C. What is atomic packing factor? Show that the packing factor for fcc lattice is 74%. 5
 - D. With the help of diagram, explain the superconducting transition temperature (T_c). 5
 - E. Differentiate between Schottky and Frenkel defect in ionic solid. 5
 - F. Write a note on conventional superconductors. 5
3. Attempt **any four** of the following:
- A. What are f block elements? Give the ideal and observed electronic configuration of actinides. 5
 - B. Write a short note on the ability of the lanthanide elements to form complexes. 5
 - C. Explain the extraction process of lanthanides with respect to 5
 - i) concentration ii) cracking of the minerals
 - D. On the basis of electronic configuration of lanthanides, explain the colour of lanthanide ions in solutions of their compounds. 5
 - E. Give the commercial and nuclear applications for lanthanide. 5

- d. AB ABtypes of arrangement is called hexagonal close packing (hcp).
- e. When atom is missing from its lattice site and occupy interstitial sites, it results in Frenkel defect.
- f. Fullerene is an allotrope of carbon.
- g. In cubic crystal system $a = b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$.
- h. Magnetic permeability below T_c in Superconductor is zero.

C. Fill in the blanks with correct alternatives given in the bracket (any five) 5

(Lu^{3+} , spin and orbital moment, group 3 and 6 period, hydrolysis, $3+$, Pt, Gadolinite, cracking)

- a. Magnetic properties of lanthanides are due to the contribution of
- b. Bis(2-ethylhexyl) phosphoric acid is less susceptible to as compared to TBP.
- c. is a colourless lanthanide ions.
- d. The process in which concentrated minerals are subjected to chemical treatment is known as
- e. is less reactive because of lanthanide contraction.
- f. is a silicate of lanthanides.
- g. Position of lanthanide elements in the periodic table is
- h. The common oxidation state of lanthanides is

D. Match the column: (Any five) 5

Column A

Column B

- | | |
|--|--|
| a. Ionizing solvents | i. $m + n$ |
| b. ClO_2^- ion | ii. Oxygen family |
| c. Contact process | iii. $[\text{Kr}]4d^{10}5s^25p^5$ |
| d. Steric number of AB_mE_n molecule | iv. IF_7 |
| e. Group 16 elements | v. Angular Geometry |
| f. Electronic configuration of Iodine | vi. Manufacturing of H_2SO_4 |
| g. XY_7 interhalogen | vii. Nitrogen family |
| h. Rhombic sulphur | viii. Polar |
| | ix. Crown shape |
| | x. IF_5 |
