

[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. Discuss the following symmetry elements with one example each 5
 - i) Axis of symmetry
 - ii) Plane of symmetry
- B. Discuss the point group assign to following molecules; 5
 - i) BCl_3
 - ii) NH_3
- C. Draw molecular orbital diagram for NO molecule. Discuss its bond order and magnetic behaviour. 5
- D. What is SALCs of atomic orbitals? Explain the formation of molecular orbitals in Beryllium dihydride molecule. 5
- E. Write a note on structure of H_3^+ ion on the basis of molecular orbital theory 5
- F. Discuss the correlation between bond angles and molecular orbitals with suitable example. 5

2. Attempt any four of the following:

- A. Explain following terms; 5
 - a) lattice point
 - b) Unit cell
- B. Prove that number of atoms per unit cell (n) for, 5
 - a) simple cubic lattice (sc) is 01
 - b) face centered cubic lattice (fcc) is 04
- C. Show that the atomic packing factor for bcc lattice is 68%. 5
- D. Explain Schottky defect by giving a suitable example 5
- E. What are superconductors? Explain concept of superconductivity with the help of suitable example. 5
- F. Explain the following terms; 5
 - a) Meissner effect
 - b) conventional superconductor

3. Attempt any four of the following:

- A. What are inner transition elements? Give the names and observed electronic configuration of lanthanide elements. 05
- B. Write a short note on ability of lanthanide elements to form complexes. 05
- C. Explain Ion Exchange Equilibria. Discuss the significance of complexing agent for separation of lanthanides by Ion Exchange Method. 05
- D. i) Why Cerium and Europium show +4 and +2 oxidation state respectively? 02
ii) Explain the binodal curve of magnetic moments of lanthanide ions. 03
- E. Discuss spectral properties of lanthanides. 05
- F. i) Explain, why the post-lanthanide elements have high densities? 03
ii) Explain any two important mineral of lanthanides. 02

4. Attempt any four of the following:

- A. Explain ionizing and non-ionizing solvents with suitable examples. 5
- B. i. What are non-aqueous solvents? give two examples. 2
ii. write any three balance equations of liquid Dinitrogen tetroxide (Liq. N_2O_4) with metals 3
- C. Explain in detail allotropic forms of sulphur atom in group-16 elements. 5
- D. Discuss the use of Platinised asbestos and vanadium pentoxide in the oxidation of sulphur dioxide to sulphur trioxide. 5
- E. Explain anomalous behaviour of fluorine. 5
- F. On the basis of VSEPR theory, discuss the bonding and structure of XY_5 type interhalogen compound with any one suitable example 5

5. Answer the following:

A. Select the correct option and complete the following statements: (any five) 5

- a. _____ of symmetry is denoted by symbol i
~~a) Centre~~ b) Axis c) Plane d) Angle
- b. The axis with the _____ order of symmetry operations is called principal axis.
a) lesser ~~b) moderate~~ c) lowest d) highest
- c. The rotation axis C_n for ammonia molecule is _____
a) C_4 ~~b) C_3~~ c) C_2 d) C_0
- d. The molecules having two atoms of the same elements are known as _____ diatomic.
a) heteronuclear ~~b) homonuclear~~ c) thermonuclear d) isonuclear
- e. Atomic orbitals are regarded as _____
a) monocentric b) polycentric c) multicentric d) dientric
- f. Molecular orbitals are denoted by wave function _____
a) ψ b) α c) σ d) ϵ
- g. Molecular orbitals with higher energy give rise to _____ molecular orbitals.
a) non-bonding b) antibonding c) bonding d) cross
- h. In triangular ion, triply degenerate orbitals are labelled as _____
a) a b) e c) t d) f

B. State whether true or false: (any five) 5

- ☒ a. The temperature at which superconductivity occurs is called critical temperature.
- b. Atomic packing factor of simple cubic lattice is 74%
- c. Volume of all the atoms in face centered cubic cell (fcc) is $2 \times \frac{4}{3} \pi r^3$
- d. At ordinary temperature a metal has a measurable resistivity but as the temperature decreases resistivity decreases and conductivity increases
- ☒ e. The presence of Frenkel defect in a crystal does not change the density of crystal
- f. Magnetic permeability of Superconductor is one.
- ☒ g. Bravais shows that there can only be 14 different ways in which similar point can be arranged in three-dimensional space

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

(hydrogenation, $4f^{n+1} 5d^0 6s^2$, Lu^{3+} , ultra-violet, Gd^{3+} , spin and orbital moment, misch, group 3 and 6th period)

- a. Magnetic properties of lanthanides are due to contribution of -----
- b. Cerium glass is used in glare reducing spectacles due to absorption of ----- radiation.
- c. ----- is colourless lanthanide ion.
- d. ----- is diamagnetic lanthanide ion.
- e. Lanthanide oxides are used as catalyst in ----- reactions.
- f. ----- metal is used as a good scavenger of oxygen and sulphur in several metallurgical operations.
- g. Position of lanthanide elements in periodic table is -----
- h. The observed electronic configuration of lanthanide elements may be represented as -----

D. Match the column: (Any five) 5

Column A

Column B

- | | |
|--|---|
| a. Water | i. Tetrahedral geometry 6 |
| b. Dipole moment | ii. $[He]2s^2 2p^4$ 4 |
| c. Platinised asbestos | iii. $m+n$ |
| d. Electronic configuration of Oxygen atom | iv. Debye 2 |
| e. Contact Process | v. $[Ar]5s^2 4p^5$ |
| f. Perchlorate ion | vi. Catalyst used in manufacture of H_2SO_4 3 |
| g. Steric number of AB_mE_n molecule | vii. Nonaqueous solvent 1 |
| | viii. Universal solvent 1 |
| | ix. Manufacturing of H_2SO_4 5 |