**[Time: 3Hours]**                                                            **[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        **5**
            one example each    i) Axis of symmetry
                              ii) Improper rotation axis

   **B.**    What is point group? Discuss the point groups C∞v and D∞h with suitable        **5**
            example in each.

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

   **D.**    What is SALCs of atomic orbitals? Explain the formation of molecular        **5**
            orbitals in Beryllium dihydride molecule.

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

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

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

   **A.**    Explain the term Lattice parameter. Derive relation between density and        **5**
            lattice parameter.

   **B.**    Define Atomic Packing factor. Show that the atomic packing factor for FCC        **5**
            unit cell is 74%.

   **C.**    Calculate the number of atoms per unit cell of a metal having the lattice        **5**
            parameter 2.9 Å and density is 7.87 g/cm3. Atomic weight of metal is 55.85
            and Avogadro constant is $6.023 \times 10^{23}$.

   **D.**    Define point defect. Differentiate between Schottky and Frenkel defect.        **5**

   **E.**    Explain the following:        **5**
                  i)        Critical temperature.
                  ii)       Meissner effect.

   **F.**    Write  short  note  on  Fullerenes  and  Alkali  metal  fullerides  as  a        **5**
            superconductor.

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

   **A.**    What are f-block elements?        **5**

            Give its ideal and observed electronic configurations of lanthanides,

   **B.**    Discuss the spectral properties of lanthanides.        **5**

   **C.**    Give reasons :        **5**
            i] Similarities between Zirconium and Hafnium.
            ii] Variation in the properties of lanthanides.

84066                              Page **1** of **3**

| | | |
|---|---|---|
| **D.** | i.Explain the binodal curve of magnetic moments of $Ln^{3+}$ ions. | **3** |
| | ii. Explain the extraction process of lanthanides with respect to - | |
| | a]Concentration         b]   Cracking of the mineral | **2** |
| **E.** | Write a short note on Solvent extraction method. | **5** |
| **F.** | How do lanthanides occur in nature? | **2** |
| | Give any three applications of Lanthanides. | **3** |

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

| | | |
|---|---|---|
| **A.** | Distinguish between : | **5** |
| | (i) protic and aprotic solvent (ii) Ionising and non-ionising solvents | |
| **B.** | With reference to $N_2O_4$ explain following | **5** |
| | (i) acid-base reaction (ii) Solvate formation | |
| **C.** | Write a short note on allotropes of sulphur | **5** |
| **D.** | Describe the use of platinized asbestos and vanadium pentoxide in the oxidation of $SO_2$ to $SO_3$ | **5** |
| **E.** | Give one method of preparation of $IF_5$ and explain the bonding and structure of $IF_5$ | **5** |
| **F.** | Describe the bonding and structure of hypochlorite ion ($ClO^-$) on the basis of VSEPR theory | **5** |

**5.**     **Answer the following:**

**A.**     Select whether the following statements are **true** or **false (Any five)**     **5**
- **a.** $BF_3$ molecule belongs to the $C_3V$ point group.
- **b.** The symmetry element identity is obtained by rotation of $360^0$
- **c.** Centre of symmetry is denoted by $\sigma$.
- **d.** The molecules having more than two atoms of the same or different elements are known as polyatomic species.
- **e.** Total number of electrons in CO is 15
- **f.** Molecular orbital are denoted by wave function is $\psi$.
- **g.** Molecular orbitals with lower energy give rise to antibonding molecular orbitals.
- **h.** In triangular ion, triply degenerate orbitals are labelled as 't'.

**B.**     Fill in the blank with appropriate words given in the bracket **(Any five )**     **5**
     [two, vacancy defect, Frenkel defect, 0.52, Meissner effect, conventional, lattice point]
- **a.** Number of atoms per unit cell in bcc structure is _____.
- **b.** Atomic packing factor in simple cubic cell is _____.
- **c.** Schottky defect in the crystal is _____.
- **d.** When atom is missing from its lattice site and occupy interstitial space between lattice site results in _____.
- **e.** The positions occupied by particles in the crystal lattice are called _____.
- **f.** $Nb_3Sn$ is an example of _____ superconductor.
- **g.** The effect of ejecting out the flux lines of magnetic field is known as _____.

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

**a.**      The position of actinides in periodic table is      ------------------

a.3$^{rd}$ group and 7$^{th}$ Period.                              b. 3$^{rd}$ group and 3$^{rd}$ Period.
c.7$^{th}$ group and 3$^{rd}$ Period.                              d.  8$^{th}$ group and 5$^{th}$ Period

**b.**   The electronic configuration of lutetium [atomic number =71] is-------------

a.[Xe] $4f^7 5d^1 6s^2$ .                              b. [Rn] $4f^0 5d^1 6s^2$ .

c. [Xe] $4f^{14} 5d^1 6s^2$ .                          d.[Ar] $4f^0 5d^0 6s^2$ .

**c.**   The anomalous oxidation states of lanthanides are -----------------

   a.   1+, 2+.          b. 1+, 3+.          c. 4+, 5+.                    d. 2+, 4+.

**d.**   The colourless lanthanide ion among the following is ------------------

   a. $La^{3+}$.          b. $Pr^{3+}$.                    c.$Nd^{3+}$.                    d.$Sm^{3+}$.

**e.**   The cracking of mineral in extraction of lanthanides from monazite ore involves removal of    -----------------
a. thoria (ThO$_2$).      b.aluminium.          c.potassium.          d.chromium.

**f.**      The main ores of Lanthanides are -----------------.

   a.   Bauxite          b.Alumina          c.Monazite          d. Cryolite

**g.**   An average separation factor achieved for adjacent lanthanides in 15.8 M nitric acid is -----------------.
   a.   2.0                b.1.5                c. 2.0                    d. 3.5

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

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

| | | | |
|---|---|---|---|
| **a.** | Group 17 | **i.** | Strong oxidising agent |
| **b.** | HOCl | **ii.** | $ns^1, np^6$ |
| **c.** | Liquid NH$_3$ | **iii.** | Octahedral |
| **d.** | BF$_3$ | **iv.** | Base |
| **e.** | Amide in liq. NH$_3$ | **v.** | $ns^2, np^5$ |
| **f.** | AB$_4$E$_2$ | **vi.** | Plastic sulphur |
| **g.** | Soft rubber like mass | **vii.** | Poor solvent for ionic compound |
| | | **viii.** | Bent 'T' shape |

----------------