**QP Code : 76969**

(2 ½ Hours) [ **Total Marks : 75**]

**N.B. :** (1) **All** Questions are **compulsory.**
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of log table/ non-programmable calculator is allowed.

1. Attempt **any three** of the following :-
   (A) Identify the symmetry elements and assign point groups to HCl and $H_2O$ molecules. 5
   (B) Give an account of the following with suitable examples. 5
      (i) Plane of symmetry
      (ii) Identity.
   (C) Explain symmetry elements and assign a point group in $BCl_3$ molecule with proper diagrams. 5
   (D) Draw a neat labelled M O diagram for $BeH_2$ molecule. Give its structure and magnetic property. 5
   (E) Write the wave equations for the formation of molecular orbitals in $H_2O$ molecule (MO diagram not expected) 5
   (F) Explain the term extrinsic semiconductors. Discuss n-type semiconductors with suitable examples. 5

2. Attempt **any three** of the following :-
   (A) What is Atomic Paking Factor (APF)? Show that packing factor for simple cubic (sc) lattice is 0.52. 5
   (B) For a body centred cubic (bcc) unit cell - 5
      (i) Calculate the number of atoms per unit cell (bcc).
      (ii) Find the atomic radii (r) of a metal which crytallises in bcc structure with length of unit cell 286 pm.
   (C) A metal crystallises out in face centered cubic structure (fcc). Calculate the molar mass (M) and atomic radii (r) if the length of unit cell (a) is 404 pm and density of metal is 2.7 $g/cm^3$. Avagadro's no. (N) is $6.023 \times 10^{23}$ $mol^{-1}$ and 1 pm= $10^{-10}$ cm. 5
   (D) Define Point defect. 5
   Describe various types of point defects observed in the crystal.
   (E) Explain with the help of a diagram 5
      (i) Crystal Lattice and Lattice Points.
      (ii) Meissner's Effect 5
   (F) Give a brief account of Alkali metal fullerides.

3. Attempt **any three** of the following :-

(A) What are inner transition elements? Name the elements of second inner transition series and write their electronic configuation. 5

(B) What is lanthanide contraction? Discuss it's effect on post lanthanons. 5

(C) (i) Discuss the position of 4f and 5f block elements in the periodic table. 2

(ii) Discuss the applications of lanthanides. 3

(D) Explain : 5

(i) absorption spectra of lanthanide ions are not affected by complexing agents.

(ii) $Ce^{4+}$ and $Eu^{2+}$ are very stable ions.

(E) Discuss the TBP solvent extraction method for the separation of lanthanides. 5

(F) Give the dissimilarities between the elements of lanthanide and actinide series. 5

4. Attempt **any three** of the following :-

(A) Distinguish between the following. 5

(i) Protonic and aprotic Solvents.

(ii) Ionizing and non ionizing solvents.

(B) Explain the following : 5

(i) Supercritical $CO_2$ liquid is the most suitable non aqueous solvents for analytical purposes.

(ii) Applications of ionic liquids.

(C) Discuss the preparation and bonding of interhalogen of the type XY with suitable example. 5

(D) What are pseudohalogens? Discuss the methods of preparation and structure of selenocyanogen. 5

(E) Discuss the methods of preparation, properties and bonding of Xenon oxotetrafluoride ($XeOF_4$). 5

(F) (i) Explain with equation, $XeF_6$ cannot be store in glass vessels. 3

(ii) Explain ammonia is 'Water like' solvent. 2

5. Answer the following :- 4

(A) Select and write the most appropriate answer.

(a) $H_2$ molecule belongs to _____point group.

(i) $C\infty v$ (ii) $D\infty h$ (iii) $D_3h$

(b) The molecule having centre of symmetry is _____.

(i) $CH_4$ (ii) $NH_3$ (iii) $C_6H_6$.

(c) $H_3^+$ ion molecule has _____ valence electrons.
(i) 3 (ii) 2 (iii) 1

(d) The collection of very closely spaced energy levels is called_____.
(i) energy band (ii) energy gap (iii) valence band

**OR**

5. (A) State whether the following statements are **true** or **false**. 4

(p) The point group associated with $NH_3$ molecule is $C_2v$.

(q) According to symmetry rules label 'e' denotes doubly degenerate orbitals.

(r) Photoelectron spectrum of water shows two bands.

(s) p-type semiconductor is obtained when silicon is doped with arsenic.

5. (B) Select and write the most appropriate answer. 4

(a) AB AB --- type of arrangement of spheres is found in_____ close packing.
(i) simple cubic (sc)
(ii) face-centered cubic
(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) Conventional superconductors require _____for cooling.
(i) liquid Helium
(ii) liquid Hydrogen
(iii) liquid Nitrogen

**OR**

5. (B) State whether the following statements are **true** or **false**. 4

(p) Packing density for face centred cubic (fcc) lattice is 0.68.

(q) Nearest neighbour distance in hexagonal close pack lattice is $a = 2r$.

(r) Ionic crystals with low coordination number show Frenkel defect.

(s) $YBa_2 Cu_3 0_7$ is an example of Organic superconductor.

5 (C) Select and write the most appropriate answer. 4

(a) The lanthanide ion that is colourless is _____.
(i) $Ce^{3+}$ (ii) $Tm^{3+}$ (iii) $Ho^{3+}$

(b) Compared to lanthanides, actinides show_____tendency to form complexes.
(i) stronger (ii) weaker (iii) similar

(c) The electronic configuation of Lutecium is _____.
(i) [Xe] $4f^{14}$, $5d^1$,$6s^2$
(ii) [Xe] $4f^{14}$, $5d^0$,$6s^2$
(iii) [Xe] $4f^{14}$, $5d^1$,$6s^1$

(d) Uranium is powerful_____.
(i) oxidising agent
(ii) reducing agent
(iii) both (i) & (ii)

**OR**

5. (C) State whether the following statements are **true** or **false**. 4
(p) The lanthanide ion that is diamagnetic is $Ho^{3+}$.
(q) Most of the tripositive lanthanide ions are characterized by well defined sharp line like Spectra.
(r) In actinides the additional electron enters in 4f orbital.
(s) The series starting with Lawrencium and ending with Thorium is called as actinide series.

5 (D) Select and write the most appropriate answer . 3
(a) Ionic liquids are non-aqueous_____solvents, capable of dissolving a wide range of compounds.
(i) neutral (ii) polar (iii) non-polar

(b) In interhalogen compounds, the less electronegative halogen exhibits_____ oxidation state.
(i) positive (ii) neutral (iii) negative

(c) The halogenoids are also called as _____
(i) halides
(ii) pseudohalogens
(iii) pseudohalides

**OR**

5. (D) State whether the following statements are **true** or **false**. 3
(p) Iodine heptafluoride is the only one interhalogen compound of $XY_7$ type.
(q) Chemical formula for selenocyanogen is $(SeCN)_2$.
(r) The electronic configuration of xenon is [Kr] $4d^{10}$, $5s^2$ , $5p^6$.

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