Sem 5 TYBSC Chemistry Nov 2022

[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 one example each   i) Axis of symmetry   5
   ii) Improper rotation axis

   B. What is point group? Discuss the point groups $C_{\infty v}$ and $D_{\infty h}$ with suitable example in each.   5

   C. Draw molecular orbital diagram for CO 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. Explain the triangular structure of H_3^+ ion on the basis of molecular orbital theory   5

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

2. Attempt any four of the following:

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

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

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

   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 superconductor.   5

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 5
    oxidation of SO_2 to SO_3

E. Give one method of preparation of IF_5 and explain the bonding and 5
    structure of IF_5

F. Describe the bonding and structure of hypochlorite ion (ClO^-) on the basis 5
    of VSEPR theory

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 σ.
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 ψ.
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.3rd group and 7th Period.   b. 3rd group and 3rd Period.
c.7th group and 3rd Period.   d. 8th group and 5th 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_4E_2	vi.	Plastic sulphur
g.	Soft rubber like mass	vii.	Poor solvent for ionic compound
		viii.	Bent 'T' shape