Oct '19

[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 suitable example. **5**
     i) Proper rotational axis of symmetry
     ii) Centre of symmetry
   - **B.** Describe the point group assigned to following molecules; **5**
     i) H_2O
     ii) HCl
   - **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 water molecule. **5**
   - **E.** Discuss the correlation between bond angles and molecular orbitals with suitable example. **5**
   - **F.** On the basis of molecular orbital theory, prove the triangular structure of trihydrogen ion. Why it is not linear? **5**

2. Attempt **any four** of the following:
   - **A.** Define and explain crystal lattice and unit cell. **5**
   - **B.** Write a note on conventional superconductors. **5**
   - **C.** Define atomic packing factor. Show that packing factor for bcc lattice is 68%. **5**
   - **D.** Give the applications of superconducting materials. **5**
   - **E.** Explain Schottky defect in ionic solid. **5**
   - **F.** What are fullerenes? Give a brief account of fullerenes. **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.** What is lanthanide contraction? Discuss any two consequences of lanthanide contraction. **5**
   - **C.** Describe spectral properties of lanthanides. **5**
   - **D.** Discuss
     i) ion exchange equilibria in lanthanide separation. **2**
     ii) significance of the complexing agent for separation of lanthanides. **3**
   - **E.** Explain the extraction process of lanthanides with respect to i) concentration ii) cracking of the minerals. **5**
   - **F.** Give the separation of lanthanides by Tributyl phosphate (TBP) extraction method. **5**

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

A. What are non-aqueous solvents? give any two balance equations for each of the following reactions of liquid Dinitrogen tetroxide; **5**

a) Reactions with metals

b) Solvate formation

B. Explain levelling effect of water on strong acids and strong bases. **5**

C. Write a note on allotropic forms of sulphur atom. **5**

D. Describe the process involve in manufacture of sulphuric acid by contact process. **5**

E. Discuss anomalous behaviour of fluorine. **5**

F. On the basis of VSEPR theory, explain the bonding and structure of IF_5 interhalogen compound. **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 σ

a) Centre b) Axis c) Plane d) Angle

b. The axis with the _____order of symmetry operations is called subsidiary axis.

a) random b) moderate c) lowest d) highest

c. The rotation axis Cn 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 molecules.

a) heteronuclear b) homonuclear c) thermonuclear d) isonuclear

e. _____ are regarded as polycentric.

a) atomic orbitals b) molecular orbitals

c) wave functions d) angular momentum

f. Total number of electrons in _____ molecule is 15.

a) CO b) H_2O c) NO d) HCl

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. Niobium tin (Nb_3Sn) is conventional superconductor.

b. In tetragonal crystal system $a = b \neq c$ and $\alpha = \beta = \gamma = 90^0$.

c. The effect of ejecting out the flux lines of magnetic field is known as Meissner effect.

d. The positions occupied by particles in the crystal lattice are called lattice point.

e. The presence of frenkel defect in a crystal decreases the density of crystal.

f. Coordination number in simple cubic lattice is 4.

g. Bravais shows that there can only be 14 different ways in which similar point can be arranged in three dimensional space.

h The lattice vectors and interfacial angles collectively are known as lattice constant.

C. **Fill in the blanks with correct alternatives given in the bracket: (any five)** 5
(spin and orbital moment , misch, thorium, chelates, ultraviolet, increases Pt, Gadolinite)

a. Magnetic properties of lanthanides are due to the contribution of .....
b. The cracking of mineral in extraction of lanthanides from monazite ore involves removal of .....
c. ..... metal is used as good scavenger of oxygen and sulphur in several metallurgical operations.
d. Cerium glass is used in glare reducing spectacles due to absorption of ..... radiations.
e. ..... is less reactive because of lanthanide contraction.
f. ..... with more number of rings are generally more stable.
g. . ..... is a silicate of lanthanides.
h In lanthanide solvent extraction process, it is observed that the extent of separation ..... with the decrease in ionic radius.

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

Column A	Column B
a. Aprotic solvents	i. Allotrope of carbon
b. Rhombic sulphur	ii. ns^2np^5
c. Acetic acid	iii. Catalyst used in manufacturing of H_2SO_4
d. Ozone	iv. m + n
e. BrF	v. Protic solvent
f. Group 17 elements	vi. Puckered ring
g. Platinised asbestos	vii. Benzene
h. Steric number of ABmEn	viii. Allotrope of Oxygen
	ix. Interhalogen compound
	x. 6

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