

M.Sc. Chemistry
First Semester
Inorganic Chemistry-I
(MSC-02)

Duration: 3Hrs.

Full Marks: 70

(Part-B: Descriptive)

Time: 2 hrs 40 minutes

Total marks: 50**1. Answer the following questions (any five):****2 × 5 = 10**

- i) Discuss the structure and bonding in diborane.
- ii) Discuss the bonding and properties of salt-like carbides.
- iii) Which of the two $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ or $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ has smaller Δ_o value?
- iv) Draw an Orgel diagram for d^9 configuration in octahedral field.
- v) How do you account for the solubility of Group II fluorides and hydroxides on descending down the group?
- vi) Why is the hydration energy of Group II metal ions far greater than that of Group I metal ions?
- vii) How is C_{60}O formed? What are the main products formed on bromination of C_{60} ?

2. Answer the following questions (any five):**3 × 5 = 15**

- i) What is meant by quenching of orbital angular momentum?
- ii) Which form is the most stable allotrope of sulphur? Write briefly about its structure and properties.
- iii) What is magnetic susceptibility? How does it vary with temperature?
- iv) Explain the Trans effect with an appropriate example.

- v) Why most of the Group I metals are highly explosive in nature? Explain in brief.
- vi) Why Cs^+ is more suitable to conduct electricity while Li^+ is less suitable for it? Explain in brief.
- vii) What is soil permeability? How soil permeability varies with other factors of soil?

3. Answer the following questions (any five):

$5 \times 5 = 25$

- i) What is meant by crystal field effect? Explain the crystal field effect on
 - (a) Ionic radii,
 - (b) hydration energy.
- ii) What are the salient features of Molecular Orbital Theory? Explain the Molecular Orbital treatment for a ML_4 (tetrahedral) complex.
- iii) Write briefly about the allotropes of phosphorus.
- iv) Write short notes on any two of the followings:
 - (a) Spin orbit coupling
 - (b) Temperature independent paramagnetism
 - (c) Spin Cross Over.
- v) Define hydrogen bonding? Distinguish between intramolecular and intermolecular H-bonding?
- vi) How are clathrates compounds formed? Why water molecules are not suitable to act as host molecules in the formation of clathrates compounds?
- vii) What do you understand by the term “host” and “guest” molecules in the context of clathrates compounds?

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PART A: Objective

Duration: 20 minutes

Marks – 20

Choose the correct answer:
(put '√' mark on the appropriate answer)

20 × 1 = 20

- The largest crystal field splitting will be for the ligand (same metal ion):
 - OX^{2-}
 - NO_2^-
 - NH_3
 - CN^-
- Which of the following has no CFSE in octahedral field?
 - Fe^{3+} (high spin)
 - Co^{2+} (low spin)
 - Fe^{3+} (low spin)
 - Cr^{3+} (high spin)
- The weakest trans directing ligands among the followings: I⁻, Cl⁻, NH₃, OH⁻:
 - OH⁻
 - I⁻
 - NH₃
 - Cl⁻
- Stability of a complex depends on:
 - Nature of the central metal ion
 - Number of chelate rings
 - Steric effects
 - Mass of the complex
- Which of the following configuration will not have orbital contribution in octahedral geometry:
 - d^2
 - d^4
 - d^8
 - d^9

6. In which of the following configuration the orbital contribution is quenched in octahedral field:

- (a) $t_{2g}^4 e_g^2$
- (b) $t_{2g}^6 e_g^1$
- (c) $t_{2g}^4 e_g^0$
- (d) $t_{2g}^5 e_g^2$

7. Ground state term of d^5 configuration is:

- (a) 6S
- (b) 4F
- (c) 2D
- (d) 3P

8. The CFSE for high spin d^4 octahedral complex is:

- (a) $-14Dq$
- (b) $-6 Dq$
- (c) $-12 Dq + P$
- (d) Zero

9. Ground state term symbol of He ($1s^2$) is :

- (a) $^1S_{1/2}$
- (b) 1S_0
- (c) $^0S_{1/2}$
- (d) None of the above

10. Reaction of $[PtCl_4]^{2-}$ with NH_3 followed by reaction with NO_2^- gives:

- (a) $trans - [PtCl_2(NO_2)(NH_3)]^-$
- (b) $cis - [PtCl_2(NO_2)(NH_3)]^-$
- (c) $trans - [PtCl_2(NO_2)_2]^{2-}$
- (d) $cis - [PtCl_2(NO_2)(NH_3)]^{2-}$

11. The number of terminal B-H bonds in B_4H_{10} is,

- (a) Six
- (b) Four
- (c) Two
- (d) Five.

12. The interatomic forces responsible for the hardness of the diamond crystal:

- (a) van der Waals forces
- (b) Molecular forces
- (c) Ionic interactions
- (d) Ion-dipole interactions.

13. The number of skeletal electrons in $C_4B_2H_6$,
- (a) 14 b) 16
 (c) 12 d) 18
14. Hydrolysis of CaC_2 is an exothermic reaction. It results $Ca(OH)_2$ and the following product,
- (a) C_2H_2 b) C_2H_4
 (c) CH_4 d) C_2H_6
15. The structural unit of asbestos minerals is,
- (a) $(Si_4O_{11})_n^{6n-}$
 (b) $(Si_2O_7)_n^{5n-}$
 (c) $(SiO_4)_n^{3n-}$
 (d) $(Si_3O_9)_n^{6n-}$
16. The products A and B of the following reaction,
- $$PCl_3 + C_6H_5N_3 \longrightarrow A + B \text{ are,}$$
- (a) $Cl_3PNC_6H_5$ and N_2
 (b) C_6H_6 and N_2
 (c) $Cl_2PNC_2H_5$ and N_2
 (d) $Cl_2PNC_3H_7$ and N_2
17. The crystallographic and spectroscopic studies suggested that there are:
- (a) Two main classes of H-bond
 (b) Three main classes of H-bond
 (c) Four main classes of H-bond
 (d) Six main classes of H-bond
18. The limiting ratio of quinol to trapped atom/molecule of clathrates compound is:
- (a) 2:1 b) 2:2
 (c) 3:1 d) 4:1
19. The solubility of Group II fluorides and hydroxides increases on descending down the group because
- (a) The hydration energy decreases more rapidly than the lattice energy
 (b) The hydration energy increases more rapidly than the lattice energy
 (c) The lattice energy decreases more rapidly than the hydration energy
 (d) The lattice energy increases more rapidly than the hydration energy
20. Soil P^H of 8.5-9.0 is considered as
- (a) Slightly alkaline b) Moderately alkaline
 (c) strongly alkaline d) very strongly alkaline.
