

M.Sc. CHEMISTRY
First Semester (Repeat)
INORGANIC CHEMISTRY-I
(MSC - 102)

Duration: 3Hrs.

Full Marks: 70

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins.

Marks: 50

Answer any four from Question no. 2 to 8
Question no. 1 is compulsory.

1. What are bonding and antibonding molecular orbitals? Draw molecular orbital energy level diagram for oxygen molecule and discuss its properties. What is the type of highest occupied molecular orbital of HF? (3+5+2=10)
2. What is CFSE? Calculate CFSE for a high spin d^4 case. Why the crystal field splitting in a T_d field is smaller than in an O_h field? Briefly state the factors that affect the extent to which metal d orbitals are split by surrounding ligands. (2+2+2+4=10)
3. (a) Define electronegativity. Explain different electronegativity scale for determination electronegativity value.
(b) Explain on the basis of molecular orbital theory for hetero nuclear diatomic molecule CO and NO. (5×2=10)
4. State selection rules for electronic transitions. Why dilute solutions of Mn(II) are colourless? What is an Orgel diagram? How Orgel diagram is different from correlation diagram? What is the atomic term symbol for He atom ($1s^2$)? (2+2+2+2+2=10)

5. (a) Discuss about synthesis, structure and bonding involved in diborane.
 (b) What are oxo-acids of halogen? Write the general properties and trends of oxoacids.
 (c) What are pseudohalides and pseudohalogens? (5+3+2=10)
6. Write short notes on: (any 2) (5×2=10)
 a) Green house effect
 b) Acid Rain
 c) Ozone layer depletion
7. (a) The electronic spectrum of $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ exhibits two absorption bands at 17,800 (γ_1) and 25,700 (γ_2) cm^{-1} . Find out the correct assignments for these transitions. (5)
 (b) Explain why Co_3O_4 exists as normal spinel structure but Fe_3O_4 as inverse spinel structure on the basis of CFT. (5)
8. Following are the conclusion of observation of electronic spectra of $[\text{Co}(\text{en})_3]^{3+}$, *cis*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ and *trans*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ solutions. Make assignments of the bands and explain the observations-
 (i) Spectra of $[\text{Co}(\text{en})_3]^{3+}$ and *cis*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ shows two bands only but *trans*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ shows three bands.
 (ii) *cis*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ and *trans*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ shows bands at lower energy.
 (iii) Intensity of the peak of *trans*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ is less than *cis*- $[\text{Co}(\text{en})_2\text{F}_2]^+$ complex. (4+3+3=10)

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Duration: 20 minutes

Marks – 20

(PART A - Objective Type)

I. Choose the correct answer:

1×10=10

- According to VSEPR theory to predict molecular shape, which of the following we do not need to take into account?
 - Valence electrons occupying sigma bonding orbitals.
 - Valence electrons occupying pi bonding orbitals.
 - Valence electrons occupying non-bonding orbitals.
 - All of above.
- The kind of geometry adopted by atoms in a molecule of water is?
 - Tetrahedral
 - Octahedral
 - Linear
 - V-shaped
- The number of molecular orbitals that may be constructed from the valence shell orbitals of the constituent atoms in CH₄ are?
 - 2
 - 4
 - 6
 - 8
- The symmetry of the antibonding molecular orbital formed by a linear combination of the p_x or p_y atomic orbitals in a homonuclear diatomic molecule is?
 - π_g
 - σ_g
 - π_u
 - σ_u
- Which of the following *correctly* places the ligands in their order in the spectrochemical series?
 - F⁻ < Cl⁻ < NH₃ < H₂O
 - Br⁻ < Cl⁻ < H₂O < NH₃
 - CO < I⁻ < en < py
 - ox < urea < H₂O < OH
- Which metal complex ion is expected to be subject to a Jahn-Teller distortion?
 - [Cr(NH₃)₆]²⁺
 - [Cr(bpy)₃]²⁺
 - [Cr(H₂O)₆]³⁺
 - [Cr(CN)₆]³⁻
- A d¹ electron configuration corresponds to which of the following terms?
 - ³D
 - ⁴D
 - ⁵D
 - ²D
- How many microstates are possible for a d² configuration, including both weak and strong field limits?
 - 2
 - 15
 - 30
 - 45

9. $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{NiCl}_4]^{2-}$ complex ions are
- diamagnetic and paramagnetic respectively
 - paramagnetic and diamagnetic respectively
 - both diamagnetic
 - both paramagnetic

10. Zeise's salt is

- | | |
|--|---------------------------|
| a) H_2PtCl_6 | b) $[\text{PtCl}_4]^{2-}$ |
| c) $[\text{PtCl}_3(\text{C}_2\text{O}_4)]^-$ | d) $[\text{ZnCl}_4]^{2-}$ |

II. State true or false:

1×5=5

- Orthoboric acid is also called as "boric acid."
- Interhalogens are less reactive than halogens.
- ICl_7 does not exist.
- Like halogens, pseudohalogens are oxidizing agents.
- The intense colour of KMnO_4 is due to *d-d* transition.

III. Fill in the blanks:

1×5=5

- The Bhopal Gas Tragedy was due to emission of.....
- The second most influential green house gas is.....
- PAN stands for.....
- CO acts as a poison for human due to formation of.....
- Unit for noise pollution level is.....
