

Maximum Mark: 75

Note: Please write the roll number at the top the answer sheets. It should be noted that 40 min extra time will be provided for uploading the answer sheet in a single pdf file.

4 x 1 = 4 marks

- Q1 B. Attempt all fill in the blank.**

5 x 1 = 5 marks

- Q1 C. Short answer type.**

6 x 1 = 6 marks

- i. Draw the energy level of d^9 -orbital in elongation and compression Jahn-Teller distortion.
- ii. Calculate the total number of microstates: (A) s^1d^3 (B) $4F_3$ (C) $3T_{1g}$.
- iii. Calculate Dissociation energy of D(A-B) molecule having $X_A-X_B = 0.208$ for (i) diatomic molecule and (ii) metal complex, if $D(A-A) = D(B-B) = a$ kJ/mol
- iv. Write the general formula for Closo-, Nido and arachno-borane
- v. Explain the statement given below:
 - (a) BH_3 exists in dimeric form whereas BF_3 exists as monomer.
 - (b) Similarly, BF_3 forms stable adduct with ether whereas former forms less stable adduct.
- vi. Discuss the structure of I_3^+ and I_3^-

Question 2. Attempt ANY THREE of the following:

3 x 5 = 15 marks

- A Discuss the Bent's rule and explain few exceptions?
B Explain briefly of the following:
(i) Different types of radii (ii) Walsh rule (iii) Fajan's rule
(iv) Apicophilicity (v) the geometries of I_3^- and SbF_4^-
C Describe the Diagonal relationships? Discuss with examples.
D Discuss the effect of chemical forces on physical properties like melting and boiling points.
E Discuss the process of experimental determination of molecular structure?

Question 3. Attempt ANY THREE of the following:

3 x 5 = 15 marks

- A. Arrange the following acids/or bases in order of their increasing acidity (any four):
I. (a) BCl_3 , (b) BI_3 , (c) BBr_3 , (d) BF_3
II. (a) CH_4 , (b) AsH_3 , (c) NH_3 , (d) PH_3
III. (a) $HBrO_4$, (b) $HClO_4$, (c) HIO_4
IV. (a) Fe_2O_3 , (b) FeO , (c) Fe_3O_4 ,
V. (a) Cu_2O , (b) CuO , (c) ZnO
Also, Explain the reasons for their acidity trend.
B. Explain the reactivity of the reactants and stability of products A and B in the following reactions:
$$RMgBr + Me_2O \longrightarrow A$$
$$BF_3 + NH_3 \longrightarrow B$$
$$SbF_5 + XeF_4 \longrightarrow C$$

C. Justify that all types boranes are electron-deficient compounds with the help of Lipscomb rule.
(a) Explain the Structure of B_4H_{10} using Lipscomb rule
(b) Explain the Structure of B_5H_{11} using Wade's rule
D. Explain the following with suitable theory (any four):
(a) The basic character of urea and thiourea in NH_3 (liq) and HF
(b) The basic character of $LiAlH_4$ and $NaBH_4$ in NH_3 (liq) and Et_2O
(c) The acidic strength of NH_3Cl and NH_4F in NH_3 (liq) and H_2O
(d) The acidic strength of H_2O in NH_3 (liq), H_2SO_4 , SO_2 (liq) and HF
(e) The acidic strength of BH_3 , BF_3 , B_2H_6 in Et_2O

Question 4. Attempt ANY THREE of the following:

3 x 5 = 15 marks

- A. Calculate the ground term symbol of given configuration: p^2, d^6 strong field, p^3d^2 .
OR
Draw the splitting diagram of square planar complex- d^8 configuration.
B. Explain the mechanism of given reaction: outer/inner sphere mechanism
$$[Fe(CN)_6]^{4-} + [Fe^*(CN)_6]^{3-} \longrightarrow [Fe(CN)_6]^{3-} + [Fe^*(CN)_6]^{4-}$$

OR
Draw Orgel diagram of d^2 -configuration and explain all possible transition with Mulliken term symbol.
C. The electronic spectrum of $[CrF_6]^{4-}$ show three bands at $14,900\text{ cm}^{-1}$; $22,400\text{ cm}^{-1}$ and $34,800\text{ cm}^{-1}$. Calculate the value of Δ_o .
OR
Draw the molecular orbital (MO) diagram of $[Co(NH_3)_6]^{3+}$.
D. Explain the difference between Orgel and Tanabe-Sugano diagram and draw Tanabe-Sugano diagram of d^1 and d^2 -configuration.
E. Write the mechanism of Anation reaction of $[Co(NH_3)_5H_2O]^{3+}$.

Question 5. Attempt ANY THREE of the following:

3 x 5 = 15 marks

- A. What factors affect oxygen binding to hemoglobin?
- B. What are the differences between Lanthanides and Actinides? Explain why most of the actinide are colorless?
- C. What is the role of carboxy peptidase A? Write their mechanism of action.
- D. How lanthanides can be separated by ion-exchange chromatography method? Explain.
- E. Write the synthesis of *cis*-platin from potassium tetrachloroplatinate (II)? Briefly explain the mode of action of *cis*-platin as an anti-cancer drug.

