Sr. No: 751206

May-2026

M.Sc. Chemistry - II SEMESTER

Inorganic Chemistry General II (CH-201B)

Time: 3 Hours **Max. Marks:75**

Instructions:
1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Any other specific instructions*

PART -A

Q1 (a) Derive the ground state term symbol for a d^2 free ion using Hund's rules. (1.5)

(b) Why do high-spin and low-spin octahedral complexes show different magnetic moments? (1.5)

(c) What is the physical significance of the Racah parameter B? (1.5)

(d) Discuss the concept of relaxation in Laporte's selection rule. (1.5)

(e) Differentiate between charge transfer spectra and d-d spectra. (1.5)

(f) What is meant by spin crossover in coordination compounds? Give one example (1.5)

(g) The absorption spectrum of $[Ti(H_2O)_6]^{3+}$ shows one band as broad and unsymmetrical explain. (1.5)

(h) Write the structure type and electron count of B_6H_{10} according to Wade's rules. (1.5)

(i) What is meant by isolobal analogy? (1.5)

(j) The magnetic moment of a complex is found to be 4.90 BM. Predict the number of unpaired electrons present. (1.5)

PART -B

Q2 (a) Construct the possible spectroscopic terms for a d^2 electronic configuration. Draw the orgel diagrams for d^2 octahedral and tetrahedral complexes. (10)

(b) The three absorption bands for $[CrF_6]^{3-}$ are observed in an electronic spectrum at 14900 $^{cm-1}$, 22700 $^{cm-1}$, and 34400 $^{cm-1}$. Determine the value of B' and Δ_o. (5)

Q3 (a) Explain the principle of Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD). Discuss the Cotton effect in optically active metal complexes. (8)

(b) What change in magnetic properties can be expected when $[NO_2]^-$ in $[Co(NO_2)_6]^{3-}$ are replaced by Cl^- ligands? (7)

Q4 Explain the existence of $Co_2(CO)_8$ in both terminal and bridging carbonyl forms. Discuss its structural features, the role of the Co–Co bond, the synergistic bonding concept of CO, the difference in bonding between terminal and bridging CO groups. How IR spectroscopy can be used to distinguish these carbonyl environments through their IR spectroscopy stretching frequencies. (15)

Q5 (a) State the selection rules governing electronic transitions in transition metal (10)

complexes. Justify whether MnO^{4-}, $[Ni(NH_3)_6]^{2+}$, and $[Mn(H_2O)_6]^{2+}$ are Laporte and spin allowed or forbidden?

(b) Discuss the structure prediction of boranes using Wade-Mingo's rules and Styx numbers of B_5H_9, $B_6H_6^{2}$ and $B_{10}H_{14}$. (5)

Q6 (a) What are Tanabe–Sugano diagrams? Explain their applications in interpretation of electronic spectra. Draw Tanabe Sugano diagram for d^3 or d^8 complexes. (10)

(b) Explain spin crossover phenomenon and why it is common in octahedral complexes but rare in tetrahedral systems. (5)

Q7 Using Wade's rules, classify and explain the structures of $B_6H_6^{2-}$, B_5H_9, and B_4H_{10}. For each species, calculate the skeletal electron pairs and identify whether it belongs to the closo, nido, or arachno type. Further, classify $C_2B_{10}H_{12}$, $CpCoC_2B_9H_{11}$, and $Co_2(CO)_8$ as carborane, metalloborane/metallocarborane, or metal carbonyl cluster, respectively. (15)

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