B.Sc. (Honours) Examination, 2019

Semester-VI

Chemistry (Honours)

Course: BCHC-61

(Inorganic Chemistry)

Time: Three Hours **Full Marks: 30**

Questions are of value as indicated in the margin.

Answer ***any three*** questions.

1. a) What do you mean by ^{2S+1}L and give its significance.
   b) Arrange all the ^{2S+1}L terms in order of energy for d^2 system.
   c) Mention and arrange all the $^{2S+1}L_j$ terms in order of energy that arises from the ground state ^{2S+1}L terms for both d^2 and d^8. Give justifications for each case of energy ordering (b and c). 2+2+3×2=10

2. a) What is spin-orbit coupling? Derive an expression for spin-orbit coupling constant λ. (When an electron is moving in an orbit of a nuclear charge of Ze).
   b) Give the energy separations between "J" states of d^2 and d^8 systems.
   c) Compute the energy of all the "J" states of d^2 and d^8 systems.
   d) Give the equations for magnetic moment computation for μ_j, μ_{s+L} and μ for large multiplet, small multiplet and comparable multiplet in comparison to kT respectively.(1+2)+2+2+3=10

3. a) Write down the different '**J**' states for Pm^{3+} (f^4), Sm^{3+} (f^5), Eu^{3+} (f^6) and Tb^{3+} (f^8) and explain the magnetic behaviour they posses.
   b) Characterize the spectral lines for d^2 configuration. 6+4=10

4. Attempt **any four**: 4×2.5=10
   a) What is isolobal analogy? Among CH, BH, P, $Mn(CO)_5$, NC_p, $Fe(CO)_4$, CH_2, $SiCH_3$ which components are isolobal to $Co(CO)_3$, when $Co(CO)_3$ is a fragment of $Co_4(CO)_{12}$.
   [Where, Cp = pentahapto cyclopentadienyl anion]
   b) Mention the four major experimental evidences of synergistic effect observed in Zeise's salt? Arrange according to increasing order of C-C bond length with justification in the given molecule $[PtCl_3(C_2H_4)]^-$, $[Pt(PPh_3)_2(C_2H_4)]$, $[Pt(PPh_3)_2(C_2F_4)]$.
   c) Predict and draw the structure of $Fe_2(CO)_9$ and $Fe_3(CO)_{12}$. Give an example of semi-briding CO.
   d) In metal carbonyls metal generally binds with the carbon centre, not with the oxygen centre – explain.
   e) What is 18 electron rule? Mention its success and failure.

5. Attempt **any four**: 4×2.5=10
   a) Analyze the reaction product with justification: $MeMn(CO)_4(C^*O) + CO \rightarrow ?$ Write the name of the reaction.
   b) What is Collman's reagent? How do you synthesize it? Mention its utility in organic synthesis.
   c) The complex $[Ir(trihapto\text{-}C_3H_5((NO)(PPh_3)_2]^+$ shows prominent linear-bent inter conversion. Draw the structure in each case and count electron. Comment on the order of NO stretching frequency in linear and bent NO. Give justification.
   d) Calculate the metal carbon bond order in $Ni(CO)_4$ and $Cr(CO)_6$.
   e) What do you mean by fluxional molecule? The proton NMR spectrum of $(C_2H_5)_4Ti$ exhibits four peaks, two peaks and one peak at –80, –30 and 62°C respectively. Explain the observation.

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