

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMC
BRANCH: CHEMISTRY

SEMESTER : V
SESSION : MO/18

SUBJECT: IMC5009 INORGANIC CHEMISTRY II

TIME: 3 HOURS

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
 2. Candidates may attempt any 5 questions maximum of 60 marks.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Which one of the following coordination compounds would you expect to be paramagnetic? [2]
i) $Zn(NH_3)_4Cl_2$
ii) $K[FeCl_4]$ (low spin, tetrahedral)
- Q.1(b) For each of the following, sketch the d-orbital energy levels and the distribution of d electrons among them, state the geometry, list the number of d-electrons, list the number of lone electrons, and label whether they are paramagnetic or diamagnetic: [4]
i. $[Ti(H_2O)_6]^{2+}$
ii. $[NiCl_4]^{2-}$
- Q.1(c) Discuss different types of Structural isomers in Coordination chemistry. [6]
- Q.2(a) Palladium(II) tends to form complexes with coordination number 4. A compound has the composition $PdCl_2 \cdot 3NH_3$. (a) Write the formula for this compound that best shows the coordination structure. (b) When an aqueous solution of the compound is treated with excess $AgNO_3(aq)$, how many moles of $AgCl(s)$ are formed per mole of $PdCl_2 \cdot 3NH_3$? [2]
- Q.2(b) For the complex ion $[Fe(Cl)_6]^{3-}$ determine the number of d electrons for Fe, sketch the d-orbital energy levels and the distribution of d electrons among them, list the number of lone electrons, and label whether the complex is paramagnetic or diamagnetic. [4]
- Q.2(c) The octahedral complex $[Ti(H_2O)_6]^{3+}$ has a single d electron. To excite this electron from the ground state t_{2g} orbital to the e_g orbital, this complex absorbs light from 450 to 600 nm. The maximum absorbance corresponds to Δ_{oct} and occurs at 499 nm. Calculate the value of Δ_{oct} in Joules and predict what color the solution will appear. [6]
- Q.3(a) Explain why tetrahedral low spin complexes are rare? [2]
Q.3(b) Explain why $MgAl_2O_4$ is a normal spinel structure while $NiFe_2O_4$ is an inverted spinel structure. [4]
Q.3(c) Consider Ti^{3+} and Cr^{3+} in an octahedral environment, of the two, which one is in an electronically degenerate state, and explain what types of distortion may occur in non linear molecules that exist in electronically degenerate state. [6]
- Q.4(a) Give the range of UV-vis and IR spectroscopy. [2]
Q.4(b) If the transition is between one set of d-orbital to another set of d-orbital, only one color should be there for a complex. However, different colors are seen for different complexes. Why? [4]
Q.4(c) Why d-d transitions are weak compared to CT transitions? What do you understand by Nephelauxetic effect? [6]
- Q.5(a) Why borazines are called inorganic benzene? [2]
Q.5(b) Draw the structure of B_5H_9 , B_4H_{10} , P_4S_{10} , P_4S_7 [4]
Q.5(c) Discuss Wades rule with examples. [6]
- Q.6(a) Discuss the Structure and application of diborane. [2]
Q.6(b) $[C_2B_9H_{11}]^{2-}$ anion could be considered isoelectronic with $C_5H_5^-$. Justify. Draw the structure of $[C_2B_9H_{11}]^{2-}$ anion [4]
Q.6(c) Discuss the following (i) cyclosilicates (ii) phyllosilicates (iii) tectosilicates [6]
- Q.7(a) The exchange in the $Fe(H_2O)_6]^{3+}$ and $Fe(H_2O)_6]^{2+}$ is very much slower than in $Fe(CN)_6]^{3-}$ and $Fe(CN)_6]^{4-}$ system. Explain. [3]
Q.7(b) What is trans effect? Discuss trans effect by polarization theory. [5]
Q.7(c) Explain outer sphere mechanism. [4]