# INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Spring Semester 2012   Dept. Chemistry   Time: 2 Hrs.   Full Marks: 50   No. of Students: 15

2nd Yr. M.Sc. Sub. Name: Inorganic Chemistry II Sub.No. CY20106

Answer all Questions

1. (a) Find the number and identity of all the isomers of $[Ma_2b_2cd]$.

   (b) Draw the structures of all possible isomers of $[Ru(NH_3)_5(NO_2)]Cl$ and $[Co(en)_2NH_3Cl]^+$ and label them according to the isomerism. (c) Sketch the isomers of $[Cr(trien)_3]Cl_3$ and assign the absolute configuration (Δ or Λ). (10)

2. Draw the molecular structure of (a) tetraminecobalt(III)-μ-amido- μ-hydroxobis(ethylenediamine)cobalt(III) chloride (b) diamminedioxalatoplatinate(-2) (2)

3. (a) Explain the sigma bonding in $[Co(NH_3)_6]^{3+}$ complex. (b) 'CO' is a strong field ligand – Justify with suitable diagram. (4+4)

4. The spin-only magnetic moment for $[FeO_4]^{4-}$ is 2.83 BM. Predict the geometry of the complex based on the magnetic moment. The X-ray study shows that O-Fe-O bond angle is >125°- Rationalize the observed bond angle? (3)

5. Explain the electronic effects in the linkage isomerism with suitable example. (3)

6. (i) What chemical test can be used to distinguish the following pairs of compounds? (a) $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5 SO_4]Br$ (b) $[CrCl_2(H_2O)_4]Cl \cdot 2H_2O$ and $[CrCl(H_2O)_5]Cl_2 \cdot H_2O$ (ii) What is the relationship between these pairs of compounds. (iii) Why the following complex is chiral? (4)
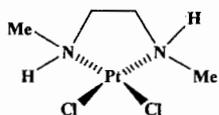
7. Identify the species M^{2+}, M^+, XX and YY in the following reactions. (hint: M^{2+} is a transition metal cation; M^+: alkali metal cation; XX: brick red; YY: dark green) Explain the conversion of XX to YY. (4)

$$M^{2+} + M^+ + [Cr(CN)_6]^{3-} \longrightarrow XX$$

$$XX \xrightarrow{100\,°C} YY$$
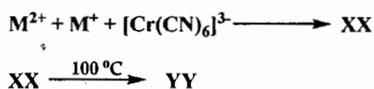
8. Identify A to E, catalyst, 'aa' and 'bb' and write the corresponding balanced chemical equations. (*hint: A is a first row transition steely-gray metal; C is an oxidizing agent with no d electrons; E is a dimer*) (10)
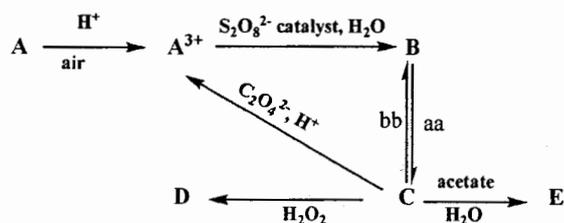
9. Give an example of ML_5 transition metal complex and explain *Berry* pseudo rotation. (3)

10. The following complex shows temperature-dependent interconversion between two geometries. Identify the geometries and calculate the magnetic moment and CFSE of both the complexes. (3)