



M Sc. (1st Semester) (Mid term)

Course Title: Metal Complexes and Reaction Mechanism (PCH-CC-101)

Rollno:

Max. Marks: 30

Time: 40min

- Q1. The transition metal complex shows a magnetic dipole moment of 5.20 BM at room temperature. The number of unpaired electrons on the metal is
- 3
 - 4
 - 5
 - 2
- Q2. Which statement most correctly describes crystal field theory for a d-block complex of unspecified geometry?
- The theory considers covalent interactions between a metal centre and the surrounding ligands
 - The theory considers electrostatic interactions between a metal centre and the surrounding ligands which are taken to be point charge
 - The theory rationalizes the non degeneracy of the metal d-orbitals for considering the electrostatic repulsions between point charge ligand and electrons in the metal d-orbitals
 - The theory rationalizes why the metal d orbitals are split into two levels.
- Q3. Which metal complex ion is expected to have a Jahn Teller distortion?
- $[\text{Cr}(\text{H}_2\text{O})_6]^{+3}$
 - $[\text{Cr}(\text{NH}_3)_6]^{+2}$
 - $[\text{Cr}(\text{CN})_6]^{-3}$
 - $[\text{Cr}(\text{bpy})_3]^{+3}$
- Q4. For which pair of complexes is the order of values of Δ_o correct?
- $[\text{Rh}(\text{NH}_3)_6]^{+3} > [\text{Co}(\text{NH}_3)_6]^{+3}$
 - $[\text{Fe}(\text{CN})_6]^{-4} > [\text{Fe}(\text{CN})_6]^{-3}$
 - $[\text{Cr}(\text{H}_2\text{O})_6]^{+2} > [\text{Cr}(\text{H}_2\text{O})_6]^{+3}$
 - $[\text{CrF}_6]^{-3} > [\text{Cr}(\text{CN})_6]^{-3}$
- Q5. The d-d transition in octahedral $[\text{NiX}_6]^{-2}$ complexes are:
- Laporte forbidden but spin allowed
 - Laporte forbidden and spin forbidden
 - Laporte allowed and spin allowed
 - Laporte allowed but spin forbidden
- Q6. The compound which shows MLCT is
- $\text{Ni}(\text{CO})_4$
 - $\text{K}_2\text{Cr}_2\text{O}_7$
 - HgO
 - $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$
- Q7. $[\text{Ni}(\text{CN})_4]^{-2}$ and $[\text{NiCl}_4]^{-2}$ complex ions are
- Both diamagnetic
 - Both paramagnetic
 - Diamagnetic and paramagnetic respectively
 - Antiferromagnetic and diamagnetic respectively
- Q8. The pair of compounds having metals in their highest oxidation is
- $\text{MnO}_2, \text{FeCl}_3$
 - $[\text{NiCl}_4]^{-2}, \text{CoCl}_4^{-4}$
 - $\text{MnO}^{-4}, \text{CrO}_2\text{Cl}_2$
 - $[\text{Fe}(\text{CN})_6]^{-3}, \text{Co}(\text{CN})_3$
- Q9. The correct statement for Mn-O bond length in $[\text{Mn}(\text{H}_2\text{O})_6]^{+2}$ is
- All bonds are equal
 - Four bonds are longer than two bonds
 - Two bonds are longer than four bonds
 - They are shorter than Mn-O bond in $[\text{MnO}_4]^{-2}$
- Q10. The hybridization of the metal orbitals in $[\text{Co}(\text{H}_2\text{O})_6]^{+2}$ is
- sp^3
 - sp^3d
 - dsp^2
 - sp^3d^2
- Q11. Which ion is kinetically inert?
- Cr^{2+}
 - Co^{3+}
 - Co^{2+}
 - Fe^{3+}

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Q12. Which statement is correct?

- A dissociative mechanism is a 2-step mechanism with the leaving group departing in the second step
- An associative mechanism is a 2-step mechanism; the intermediate has a lower coordination number than the starting complex
- In a dissociative interchange mechanism, bond breaking dominates over bond formation
- In an associative interchange mechanism, the entering group associates with the substrate after the leaving group has departed

Q13. In the base-catalysed substitution of Cl^- by $[\text{OH}]^-$ in $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$ under strongly basic conditions, the first step in the mechanism is:

- conversion of an ammine to amido ligand
- substitution of Cl^- by $[\text{OH}]^-$
- dissociation of Cl^- to give a 5-coordinate intermediate
- association of $[\text{OH}]^-$ to give a 7-coordinate intermediate

Q14. Anation is:

- the substitution of an uncharged ligand by an anionic ligand
- the substitution of an uncharged ligand by another uncharged ligand
- the substitution of an anionic ligand by another anionic ligand
- the substitution of an anionic ligand by an uncharged ligand

Q15. Three of the following ions are kinetically inert, one is labile. Which ion is labile?

- Rh^{3+}
- Ti^{3+}
- Ru^{2+}
- Cr^{3+}

Q16. Which one the following electronic configuration gives kinetically inert octahedral complexes

- $t_{2g}^6 e_g^0$
- $t_{2g}^3 e_g^1$
- $t_{2g}^5 e_g^0$
- $t_{2g}^6 e_g^4$

Q17. The correct order of lability is as

- $[\text{AlF}_6]^{3-} > [\text{SiF}_6]^{2-} > [\text{PF}_6]^- > [\text{SF}_6]$
- $[\text{AlF}_6]^{3-} < [\text{SiF}_6]^{2-} < [\text{PF}_6]^- < [\text{SF}_6]$
- $[\text{SiF}_6]^{2-} > [\text{AlF}_6]^{3-} > [\text{PF}_6]^- > [\text{SF}_6]$
- $[\text{SF}_6] > [\text{AlF}_6]^{3-} > [\text{SiF}_6]^{2-} > [\text{PF}_6]^-$

Q18. The substitutionally inert complex among the following complex according to VBT is:

- $[\text{V}(\text{NH}_3)_6]^{3+}$
- $[\text{MnCl}_6]^{3-}$
- $[\text{Cr}(\text{CN})_6]^{3-}$
- None of the above

Q19. The rate of exchange of OH_2 present in the coordination sphere by 18OH_2 of, (i) $[\text{Cu}(\text{OH}_2)_6]^{2+}$, (ii) $[\text{Mn}(\text{OH}_2)_6]^{2+}$, (iii) $[\text{Fe}(\text{OH}_2)_6]^{2+}$, (iv) $[\text{Ni}(\text{OH}_2)_6]^{2+}$, follows an order

- (i) > (ii) > (iii) > (iv)
- (i) > (iv) > (iii) > (ii)
- (ii) > (iii) > (iv) > (i)
- (iii) > (i) > (iv) > (ii)

Q20. Base hydrolysis of $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ is an overall second order reaction, whereas that of $[\text{Co}(\text{CN})_6]^{3-}$ is of first order. The rates depend in both cases solely on the concentrations of the cobalt complex. This may be due to

- Presence of ionizable proton in $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ but not in $[\text{Co}(\text{CN})_6]^{3-}$
- $\text{S N}^1\text{CB}$ mechanism in the case of $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ only
- $\text{S N}^1\text{CB}$ mechanism in the case of $[\text{Co}(\text{CN})_6]^{3-}$ only
- $\text{S N}^1\text{CB}$ mechanism in both the complexes

Correct explanation(s) is/are

- A and B
- A and C
- B only
- A and D

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