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(b) Macrocyclic Effect

(c) Werner's theory of Coordination Compounds

(d) Factors affecting stability of the complexes

(5,5,5)

(1500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5526

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Unique Paper Code : 2172012401

Name of the Paper : DSC 10: Coordination Chemistry
and Reaction Mechanism

Name of the Course : B.Sc. (Hons) Chemistry
(NEP-UGCF-2022)

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt six questions in all.
3. Question 1 is mandatory.
4. All questions carry equal marks.

P.T.O.

1. Explain the following giving appropriate reasoning :

(a) 4d and 5d elements form low spin octahedral complexes.

(b) Square planar complexes do not exhibit optical isomerism.

(c) $[\text{PtF}_6]$ is stable, whereas NiF_6 does not exist.

(d) Fe(II) and Fe(III) form complexes with CN^- but not with NH_3 .

(e) The crystal field splitting in tetrahedral complexes is smaller than in octahedral complexes.

(3,3,3,3,3)

2. (a) Name the following complexes according to the IUPAC system of nomenclature.

(i) $[\text{Pt}(\text{NH}_3)_4]$ $[\text{PtCl}_4]$

(c) The formation of $[\text{CdBr}_4]^{2-}$ from $[\text{Cd}(\text{H}_2\text{O})_6]^{2+}$ exhibits the successive equilibrium constants K_1 , K_2 , K_3 and K_4 as 1.56, 0.54, 0.06 and 0.37, respectively. Explain why K_4 is larger than K_3 .

(5,5,5)

7. (a) Cr(II) fluoride and Mn(II) fluoride, both have a central metal ion surrounded by six F-ions. The Mn-F bond lengths are equidistant but four of the Cr-F distances are long and two are short. Explain.

(b) What are labile and inert complexes? Explain giving one example each, on the basis of CFT.

(c) Differentiate between inner orbital and outer orbital octahedral complexes.

(5,5,5)

8. Write short notes on (Any three) :

(a) Crystal Field theory and its limitations

(b) Describe the factors responsible for strong distortion in the octahedral complexes. Square planar complexes are a special case of octahedral geometry. Justify your answer.

(c) (i) I^- and CO have higher trans effects than Cl^- . Explain.

(ii) Predict the products when $[\text{PtCl}_4]^{2-}$ is treated with NH_3 followed by C_2H_4 . (5,5,5)

6. (a) On the basis of VBT, account for the magnetic properties of $[\text{Ni}(\text{NH}_3)_6]^{2+}$ and $[\text{Cr}(\text{CN})_6]^{3-}$.

(b) Determine the CFSE of a d^6 octahedral complex having $10Dq = 25000 \text{ cm}^{-1}$ and $P = 15000 \text{ cm}^{-1}$ (mean pairing energy).

(ii) $\text{K}_3[\text{Fe}(\text{CN})_6]$

(iii) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$

(iv) $[(\text{H}_3\text{N})_5\text{Co}-\text{NH}_2-\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})]\text{Cl}_5$

(v) $[\text{Co}(\text{en})_3]\text{Cl}_3$

(b) What is the chelate effect? Chelate effect is predominantly due to entropy change. Explain.

(c) Which of the following have higher Δ_0 value and why?

(i) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ or $[\text{Fe}(\text{CN})_6]^{3-}$

(ii) $[\text{Cr}(\text{NH}_3)_6]^{2+}$ or $[\text{Cr}(\text{NH}_3)_4]^{2+}$ (5,5,5)

3. (a) Write the formulae of the following complexes according to the IUPAC system of nomenclature :

(i) pentaamminenitrito-O cobalt(III) sulphate

(ii) potassium amminedicyanidodioxidoperoxidochromate(VI)

(iii) μ -amido - μ -hydroxido bis[tetraamminecobalt(III)]

(iv) tetrapyridineplatinum(II) tetrachloridoplatinate(II)

(v) Potassium tetrafluoridoargentate(I)

(b) Define the terms transition state and intermediate state using reaction pathways.

(c) What is the effect of π acceptor ligand and π donor ligands on Δ_0 ? Explain on the basis of ligand field theory. (5,5,5)

4. (a) Explain why square planar complexes of Pt(II) often undergo associative substitution mechanisms, while octahedral complexes of Cr(III) typically undergo dissociative mechanisms.

(b) Draw and explain Crystal Field Splitting diagram for octahedral complexes.

(c) How will you distinguish between the following pairs of isomers?

(i) cis and trans $[\text{Pt}(\text{NH}_3)\text{Cl}_2]$

(ii) $[\text{Co}(\text{NH}_3)_5\text{SO}_4]$ I and $[\text{Co}(\text{NH}_3)_5\text{I}] \text{SO}_4$
(5,5,5)

5. (a) Predict and sketch all the possible isomers of $[\text{Cr}(\text{gly})_3]$.