

2026

CHEMISTRY — HONOURS

Paper : DSCC-8

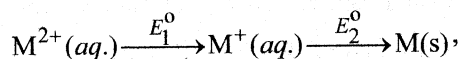
(Inorganic Chemistry - II)

Full Marks : 75

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer **question nos. 1, 2, 3 & 4 (Compulsory)** and **any four** questions from the rest.1. Answer **any ten** questions :

2×10

- Assign the geometries for $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CN})_4]^{2-}$.
- Write down the primary and secondary valencies of the metal in $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$.
- Identify the spin-allowed and spin-forbidden transition between
 - $t_{2g}^3 e_g^2 \rightarrow t_{2g}^2 e_g^3$
 - $t_{2g}^2 e_g^0 \rightarrow t_{2g}^1 e_g^1$.
- $\text{Cr}_2\text{O}_7^{2-}$ is reduced to Cr^{3+} in acid medium. Write down the half-cell equation and the corresponding Nernst equation.
- Write down the full name and formula of one redox indicator.
- Write down the IUPAC names of the compounds : $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$, $[\text{Co}(\text{NH}_3)_5\text{N}_3]\text{Cl}_2$.
- Which of the following complexes are expected to show Jahn-Teller distortion?
 $[\text{CrCl}_6]^{4-}$, $[\text{Co}(\text{CN})_6]^{3-}$, $[\text{Fe}(\text{CN})_6]^{3-}$, $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$.
- Write any two roles of sulphur-pi interaction in supramolecular chemistry.
- From the following Latimer diagram, identify the higher E° -value between E_1° and E_2°

The reaction : $2\text{M}^+(\text{aq.}) \rightarrow \text{M}(\text{s}) + \text{M}^{2+}(\text{aq.})$. Name the type of reaction.

- Give one example each of $\pi - \pi$ interaction and $\pi - \pi$ stacking interaction.
- Calculate the spin-only magnetic moment value of $[\text{FeBr}_4]^-$.
- Give one example of ambidentate ligand and draw the structures of its complexes showing ambidentate nature.

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2. (a) Write short note on : Crystal Field Stabilization Energy (CFSE) based on the following points :

- (i) Difference between CFSE and Crystal Field Splitting Energy.
- (ii) Calculation of CFSE for low spin and high spin Fe^{2+} complexes.
- (iii) Explanation of the fact that $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ has greater crystal field splitting energy than $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$. 2+2+1

Or

(b) Write short note on spectrochemical series based on the following points :

- (i) Definition
- (ii) Explanation of the fact that position of H_2O in the series is higher compared to OH^- .
- (iii) Arrangement of the following ions in increasing order of ligand field strength in the series : CN^- , NH_3 , CO , F^- . 2+2+1

3. (a) Write short note on hydrogen bonding based on the following points :

- (i) Definition of symmetrical and unsymmetrical hydrogen bonding.
- (ii) Factors controlling hydrogen bond energy.
- (iii) Comparison of boiling points of HF and H_2O . 1+2+2

Or

(b) Write short note on formal potential based on the following points :

- (i) Definition.
- (ii) Difference between standard electrode potential and formal potential.
- (iii) Calculation of formal potential of $\text{MnO}_4^-/\text{Mn}^{2+}$ system at $\text{pH} = 3$ and $\text{pH} = 6$. 1+1+3

4. (a) Write short note on octahedral site stabilisation energy (OSSE) based on the following points :

- (i) Definition.
- (ii) Calculation of the values for $\text{Co}^{2+}(\text{H.S.})$ and Ni^{2+} . 1+4

Or

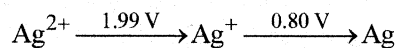
(b) Write short note on Orgel diagram based on the following points :

- (i) Construction of the diagram for Ni^{2+} (Oct. and Td complexes).
- (ii) Assignments of electronic transitions.
- (iii) Limitation. (1+1)+(1+1)+1

5. (a) Define optical isomerism. Draw all possible stereoisomers of $[\text{Pt}(\text{en})\text{Cl}_2\text{Br}_2]$. Among them, identify the optical isomers.

(b) Define halogen bonding. " CF_3I is better candidate for halogen bonding compared to CH_3I " — Explain.

- (c) Latimer diagram of silver in acid medium is



Construct a Frost diagram of silver.

What does the diagram suggest?

4+3+3

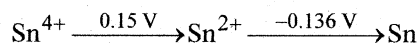
6. (a) μ_{eff} value of $\text{Co}^{2+}(\text{H.S. oct.})$ is higher than $\text{Co}^{2+}(\text{Td})$ while that of $\text{Ni}^{2+}(\text{oct.})$ is lower than $\text{Ni}^{2+}(\text{Td})$. Justify.
- (b) In 1(N) H_2SO_4 medium, calculate the redox potential values at the following three stages of titration of 0.1(N) Fe^{2+} with 0.1(N) KMnO_4
- 25 ml Fe^{2+} + 24.95 ml KMnO_4
 - 25 ml Fe^{2+} + 25 ml KMnO_4
 - 25 ml Fe^{2+} + 25.05 ml KMnO_4 .

[Given : $E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ volt}$, $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ volt}$]

- (c) “Pd(II) and Pt(II) form square-planar complexes exclusively but Ni(II) forms square-planar complexes under certain conditions”— Explain.

4+3+3

7. (a) Based on the following Latimer diagram



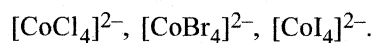
answer the following :

- Calculate $E^\circ_{\text{Sn}^{4+}/\text{Sn}}$ value.
 - Comment on the ease of reduction of $\text{Sn}^{2+} \rightarrow \text{Sn}$ and $\text{Sn}^{4+} \rightarrow \text{Sn}$.
- (b) Explain which one of each pair is comparatively more intense coloured :
- cis*- and *trans*- $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]^+$
 - $[\text{CoCl}_4]^{2-}$ and $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$

- (c) What is Chelate effect? Explain.

4+3+3

8. (a) What do you mean by non-covalent interactions? Mention their different types with one example in each case.
- (b) Write down three limitations of valence bond theory in coordination chemistry.
- (c) Arrange the following in increasing order of energy for ligand to metal charge transfer bands and explain :



4+3+3

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9. (a) "Metal ions having d^9 configuration preferably forms octahedral complexes, whereas d^{10} configuration preferably forms tetrahedral complexes." Why?
 (b) " KHF_2 exists but KCl_2 does not." —Explain.
 (c) "A solution of potassium ferricyanide cannot oxidise iodide to iodine but it can do so in presence of zinc ion"— Explain.

[Given : $E^\circ_{[\text{Fe}(\text{CN})_6]^{3-}/[\text{Fe}(\text{CN})_6]^{4-}} = 0.36 \text{ volt}$, $E^\circ_{\text{I}_2/\text{I}^-} = 0.54 \text{ volt at } 25^\circ\text{C}$]. 4+3+3

10. (a) Both the metal ions in $\text{K}_3[\text{CuF}_6]$ and $\text{K}[\text{AgF}_4]$ possess d^8 electronic configuration, but one is paramagnetic and the other is diamagnetic. Identify them with justification.
 (b) $10 Dq$ for $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ is known from electronic spectrum as 21000 cm^{-1} . The pairing energy of $\text{Mn}(\text{II})$ is 28000 cm^{-1} . Predict whether the complex is high-spin or low-spin and also calculate the CFSE value.
 (c) Cu^{2+} will oxidise I^- to I_2 during iodometric estimation of Cu^{2+} . Justify the statement from the relevant redox potential and solubility product values given below :

$E^\circ_{\text{Cu}^{2+}/\text{Cu}^+} = 0.15 \text{ volt}$, $E^\circ_{\text{I}_2/2\text{I}^-} = 0.54 \text{ volt}$, $K_{\text{sp}}(\text{CuI}) \sim 1 \times 10^{-12}$ at 25°C . 4+3+3