

2023

CHEMISTRY — HONOURS

Paper : CC-10

(Inorganic Chemistry - 4)

Full Marks : 50

*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 no. 1 and any eight questions from the rest.

1. Answer any ten questions :

1×10

(a) Justify whether the following transitions are spin allowed or spin forbidden.

(b) Between $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{Co}(\text{NH}_3)_5 \text{Cl}]^{2+}$, which one has intense colour?(c) Which lanthanide atom has ground state electronic configuration of $[\text{Xe}]4f^7 5d^1 6s^2$?

(d) Which ion(s) among the following will have highest tendency towards formation of tetrahedral complex— Ni(II), Co(II), Cr(III)?

(e) Arrange NO_2^- , H_2O , CO and Cl^- according to increasing *trans* effect shown by them.

(f) Give example of a transition metal complex which shows evidence of Jahn Teller distortion in its visible spectrum.

(g) Give example of a compound which shows superexchange phenomenon.

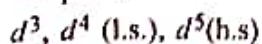
(h) What type of charge transfer spectra is observed in $\text{Fe}_4^{\text{III}}[\text{Fe}^{\text{II}}(\text{CN})_6]_3$?

(i) Cite an example of metal complex which shows spin state equilibrium.

(j) Give one example of superconducting lanthanide compound with its molecular formula.

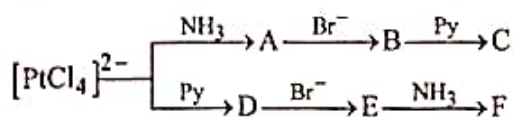
(k) Give two uses of actinide compounds.

(l) Which electronic configuration gives orbital contribution to the overall magnetic moment of the complex?



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2. (a) Stability of a distorted octahedral complex is greater than that of a perfectly octahedral complex. Explain with suitable example.
- (b) Explain why energy of ligand to metal charge-transfer bands follows the trend —
 $[\text{CoI}_4]^{2-} < [\text{CoBr}_4]^{2-} < [\text{CoCl}_4]^{2-}$. 3+2
3. (a) Show splitting pattern of d -orbitals in square planar complex. Explain why the complex $[\text{PdCl}_4]^{2-}$ adopts the square planar geometry.
- (b) Explain the fact : $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ has greater CFSE than $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ 3+2
4. (a) Metal ion having d^9 configuration preferably forms octahedral complexes whereas that with d^{10} configuration preferably forms tetrahedral complexes. Justify.
- (b) Predict the spinel nature of CuFe_2O_4 . 3+2
5. (a) Explain why *cis*-platin on reacting with excess thio urea (tu) produces $[\text{Pt}(\text{tu})_4]^{2+}$ while *trans*-platin produces *trans*- $[\text{Pt}(\text{tu})_2(\text{NH}_3)_2]^{2+}$ complex.
- (b) Explain the term 'Nephelauxetic effect' 3+2
6. (a) $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ absorbs $17,200\text{ cm}^{-1}$; $25,600\text{ cm}^{-1}$ and $38,500\text{ cm}^{-1}$ of light. Assign these absorptions with proper transitions involved with the help of Orgel diagram. Find out the 10 Dq value from the given data.
- (b) What do you mean by labile complex? Give an example. 3+2
7. (a) Identify the products A, B, C, D, E, F.



(Py = Pyridine)

- (b) $[\text{VO}_4]^{3-}$ is colourless while $[\text{CrO}_4]^{2-}$ is yellow, although both the metal ions have d^0 electronic configuration. 3+2
8. (a) Discuss the differences in spectral properties of transition metal compounds with lanthanide compounds.
- (b) In $[\text{CrF}_6]^{4-}$ four (Cr – F) bonds are long and two are short but in $[\text{MnF}_6]^{4-}$ all (Mn – F) bonds are equal in length. — Why? 3+2

9. (a) With the help of M.O. diagram, explain why halides show field strength order as —
 $I^- < Br^- < Cl^- < F^-$.
- (b) Explain why — EDTA forms a more stable complex with Lu(III) than La(III). 3+2
10. (a) Discuss the mechanistic steps involved in the base catalysed hydrolysis of $[CoCl(NH_3)_5]^{2+}$ complex.
- (b) Why tetrahedral complexes show much intense colour than octahedral complexes of same metal ion? 3+2
11. (a) Compare the magnetic moment of tetrahedral and octahedral complexes of Ni(II) with respect to spin only magnetic moment value.
- (b) Mention the lanthanide ions which are stable in +2 oxidation state. 3+2
12. (a) State the Jahn Teller theorem. Mention the electronic configurations in tetrahedral complexes which show Jahn Teller distortion.
- (b) Compare the stability of oxidation states of transition metal ions along a group. 3+2
13. (a) Show graphically how lattice energy of divalent halides, MX_2 ($M = Ca$ to Zn) vary and also provide a proper explanation.
- (b) Calculate the OSSE value for Ni(II) ion. 3+2
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