বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2021
(Under CBCS Pattern)
Semester - V
Subject: CHEMISTRY
Paper: C 11-T & P
(Inorganic Chemistry - IV)

Full Marks : 60 (Theory-40 + Practical-20)
Time : 3 Hours

Candiates are required to give their answer in their own words as far as practicable.
The figures in the margin indicate full marks.

(Theory : Marks - 40)

Group - A

Answer any *three* questions : 12×3=36

1. (a) Write the limitations of CFT that needs the development of LFT.

   (b) Explain why and how the structure of $[MCl_4]^{2-}$ ion change from M = Ni to Pt in their structure.

   (c) 'Mn^{3+} and Cr^{2+} are isoelectronic but Mn^{3+} is an oxidant and Cr^{2+} is reductant.' — Explain.

   (d) Cu(II) acetate monohydrate shows subnormal magnetic moment' — Discuss.

(e) Cu, Ag and Au have the oxidation states +2, +1 and +3 respectively — Why? 3+2+3+2+2

2. (a) 'Electronic absorption spectra of 4f metal ions consist of sharp lines while 3d ions display broad bands' — Explain.

(b) Co(II) octahedral complexes with high spin state show magnetic moment 4.8-5.2 BM, while in tetrahedral geometry it is 4.0-4.4 BM' — Explain.

(c) Draw the Orgel diagram of a d^3 metal ion in octahedral geometry and predict how many transitions are possible.

(d) What are the factors necessary to breakdown the spin distribution principle (high spin vs low spin) in the transition metal complexes.

(e) Why majority of Lanthanides show +3 oxidation state while Actinides show higher oxidation states? 2+3+3+2+2

3. (a) Write down the difference between spectrochemical series and nephelauxatic series.

(b) An octahedral d^8 complex shows d-d absorption bands at 10739 cm^{-1}, 17489 cm^{-1} and 28217 cm^{-1}. Assign the bands from the Orgel diagram and calculate the 10 Dq.

(c) How the orbital moment is quenched in most of the first row transitional metal complexes? Why the quenching is not perfect in Ni(II) octahedral and Co(II) tetrahedral complexes?

(d) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic — explain in the light of CFT.

(e) What is lanthanide contraction? 2+4+3+2+1

4. (a) Account the reason for the smaller value of crystal field splitting in tetrahedral than octahedral complexes.

(b) What is spinal? Co_3O_4 is normal spinal while Fe_3O_4 is inverse spinal — Explain.

(c) Why $La(OH)_3$ is more basic than $Lu(OH)_3$?

(d) OH^- is strong nucleophile than H_2O but in spectrochemical series H_2O is in upper end than OH^- — Explain.

(e) Write the relation between molar magnetic susceptibility (χ_M) with magnetic moment (μ). 2+(1+3)+2+3+1

5. (a) In CrF_2 the Cr-F bonds are unequal but in MnF_2 the Mn-F bonds are equal in lengths — Why?

(b) Cr(II) acetate complex is diamagnetic yet it is a d^4 system — Explain.

(c) Show the variation of ionic radii of M^{2+} ion of the 3d block elements.

(d) Aq. $MnSO_4$ is colourless though Mn^{2+} has five d electrons, while $KMnO_4$ is deeply coloured though it has no 'd electron'. — Discuss.

(e) The Lanthanides are electropositive metals that commonly occurs as Ln(III) although Eu^{2+} and Yb^{2+} are stable — Explain. 2+2+3+3+2

6. (a) CoF_6^{3-} and NiF_6^{2-} both have weak field ligand F^-, yet CoF_6^{3-} is paramagnetic and NiF_6^{2-} is diamagnetic — Explain.

(b) Room temperature magnetic moment of $\left[Fe(H_2O)_5 NO\right]^{2+}$ is 3.9 BM — Comment on the oxidation state of Fe atom in this complex ion.

(c) Why does Co(II) form tetrahedral complexes more readily than Ni(II) ion?

(d) Write notes on (any two)

(i) Antiferromagnetism

(ii) L-S coupling

(iii) Jahn-Teller distortion

Group - B

Answer any ***two*** questions : 2×2=4

7. Give one example of high spin Co(III) complex and calculate its spin only magnetic moment.

8. 'All tetrahedral complexes are high spin' — Explain.

9. 'Geometry of Cu(II) complexes are distorted' — Comment.

10. There is no d-d transition in $\left[Mn(OH_2)_6\right]^{2+}$ $\left(d^5 - \text{system}\right)$, but it shows colour in visible region — Why?

(Practical : Marks - 20)

Group - A

Answer any ***one*** question : 15×1=15

1. Describe the principle and method of gravimetric estimation of Ni(II) using Dimethyl Glyoxime (DMG)

2. Describe the principle and method of separation of Fe(III) and Al(III) using paper chromatography.

3. Discuss the principle and spectroscopic measurement of the λ_{max} value for $\left[Fe(acac)_3\right]^{3+}$ complex.

Group - B

Answer any ***one*** question : 5×1=5

4. Write down the principle involved in the chromatographic separation of Ni(II) and Co(II) metal ions.

5. Write down the methodology of the gravimetric estimation of copper as Cu(SCN).

6. Write down the methodology of determining 10 Dq by spectrophotometric method.