

Five Year Integrated M. Sc. Examination 2023

Semester-VII

Course: CH-4-7-1 (2016)

(Chemistry)

Time: Four Hours

Full Marks: 80

Questions are of value as indicated in the margin

Group-A

(Answer *any ten* questions)

1. (a) Find the spin ground state S value of the $[\text{Mn}_{12}\text{O}_{12}(\text{AcO})_{16}(\text{H}_2\text{O})_4] \cdot 2\text{AcOH}$ $[\text{Mn}_{12}]$ cluster.
(b) What do you understand by metamagnetism? Explain with a suitable example.
(c) What will be the energy separation between the ground state and the first excited state of f^3 system in terms of spin-orbit coupling constant?
(d) A transition metal complex shows a magnetic moment of around 5.20 B.M. at room temperature. Find the number of unpaired electrons in the metal.
(e) What is the intermediate of Schimdt reaction? What is the final product?
(f) Why Birch reduction is not possible for simple alkene?
(g) What is regioselective reaction? Explain with example?
(h) What is crossover experiment?
(i) Define the sedimentation potential.
(j) Define the primary salvation number.
(k) What is polarizable electrode?
(l) What is zeta potential?

2 x 10

Group-B

(Answer *any four* questions)

2. (a) Write a note on single molecule magnet.
(b) Explain which of the following complexes will have orbital contribution towards magnetic moment:
(i) CoCl_4^{2-} , (ii) $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and (iii) $\text{Co}(\text{CN})_6^{4-}$
(2+3)
3. (a) Calculate the diamagnetic correction for pyridine.
Given: Pascal's constant for H = -2.93×10^{-6} , C = -6.00×10^{-6} , N (open chain) = -5.57×10^{-6} , N (ring) = -4.61×10^{-6} and Pascal's constitutive corrections for C (in ring) = -0.24×10^{-6} , C (shared by two rings) = -3.07×10^{-6}
(b) Write a characteristic of ferromagnetic materials. Draw the unit cells of α -Fe, Ni and Co. Comment on their magnetostriction behavior.
(2+3)
4. (a) Why the magnetic moment of Eu^{3+} cannot be obtained from the equation used for the calculation of magnetic moment of Tb^{3+} ?
(b) Calculate the μ_s and μ_{eff} for the complex ion, CoCl_4^{2-} .
Given: $\lambda = -172 \text{ cm}^{-1}$ and $10 Dq = 3100 \text{ cm}^{-1}$
(2+3)
5. (a) Comment on the magnetic property of $[\text{Re}_2\text{Cl}_8]^{2-}$.
(b) Find out the spin-only magnetic moments of the square planar and square pyramidal complexes of Co(II) and discuss about the possibility of orbital contribution in both the geometries.
(2+3)
6. (a) What is the preference for high spin/low spin complex formation in Mn(III), Fe(III) and Co(III)? Explain in the light of Tanabe Sugano diagram
(b) What is the ground state term for f^9 system? Find out the μ_J and μ_S values for this electronic configuration.
(2+3)

(Answer *any four* questions)

- 3+2

- 3+2

- $$1+1+1+1+1$$

- $2+3$

- $$1+1+1+1+1$$

(Answer *any four* questions)

12. (a) Draw a schematic diagram that shows a layer of ions stuck to the electrode surface and the remaining ions are scattered in the cloud fashion. Show the variation of potential from electrode surface to the bulk of the solution according to this model and also mention the corresponding total differential capacitance of the interface.

Assume that the electrode surface is positively charged.

- (b) What is heat of solvation of an electrolyte? How it can be measured experimentally? (1+2)+2
13. (a) Describe the formation of an electrified interface with and without one of the phases connected to an external source of charge.
(b) Draw and explain the electrocapillary surface tension vs. potential curve, electrode charge density vs. potential curve and differential capacitance vs. potential curve. 2.5+2.5
14. (a) A metal in contact with an electrolytic solution is a sphere of large radius. Now what will happen if the radius of the particle becomes smaller and smaller?
(b) Draw the different models of ionic solvation and describe each model. 2+3
15. (a) What are colloids? Classify colloids in terms of interaction with the solvent molecules with suitable examples.
(b) Under what conditions are colloids stable? Explain qualitatively (with schematic diagrams) the forces that operate between the colloidal particles. 1+4
16. (a) A water molecule is considered to be electrically equivalent to a dipole. Explain how?
(b) What is water structure? Discuss with a suitable diagram. How does the presence of ions affect the structure of neighboring water molecules and what are the necessary energy changes when ions enter mentally to the water structure? 1+4