

B.Sc.(Honours) Examination, 2019

Chemistry (Honours)

(Inorganic Chemistry)

Full Marks: 40

Answer *any four* questions.

1. a) Derive the following relations: 2

i) $\mu_1 = \frac{e \omega r^2}{2c}$ [Where, μ_1 = the orbital magnetic moment, r = the average radius vector, c = the velocity of light]

ii) $\mu_l = g \sqrt{l(l+1)} \beta$ [Where, l = orbital angular momentum quantum number]

- b) What do you mean by β ? Why the 2nd relationship is advantageous over the 1st one? 2

- c) What is g ? Mention its value for orbital magnetic moment and spin magnetic moment. 2

- d) Give the significance of the following equation:

$$\chi_{\text{m(dia)}} = -\frac{\text{Ne}^2}{6mc^2} \Sigma \text{r}^2 \quad 2$$

- e) Calculate $\chi_{m(\text{dia})}$ for pyridine. 2

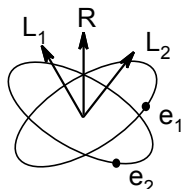
Given χ_m for $H = -2.93 \times 10^{-6}$ (C.G.S)

$$C = -6.00 \times 10^{-6} \text{ (C.G.S)}$$

$$N(\text{ring}) = -4.61 \times 10^{-6} \text{ (C.G.S)}$$

$$\lambda = -0.24 \times 10^{-6} \text{ (for ring C) (C.G.S.)}.$$

2.



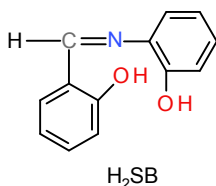
- a) Two electrons e_1 and e_2 are moving in two different 'd' orbitals. The directions of their respective angular orbital momentum vectors are shown in the figure. What will be the directions of the motion of both the electrons in ground state? Give reasons. 2

- b) Write down the Hund's first and second rules to characterize the ground state of the d^2_2 system.

- c) Show the following states for the d^2 system (in the diagram):

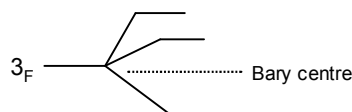
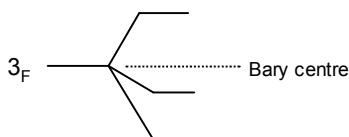
- i) spin-spin coupling
- ii) orbital-orbital coupling
- iii) spin-orbital coupling (for ground state only)
- iv) The M_l levels

3. a) Vanadium form compound [VO(SB)] and found magnetic moments at 298 K was 1.08 BM – explain. (The ligand provided below; answer should require specific justification including structure etc.). 4



P.T.O.

- b) Sc, Y and La belongs to Transition and/or Non-Transition Series Elements – Comment (Ans. Should require justification as well as specific examples including properties etc.). 3
- c) Justify the status of high-spin and low-spin of the compounds: $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Mn}(\text{acac})_3]$ (acac = acetylacetonate anion). 3
4. a) Lanthanides shows predominantly trivalent oxidation state, but oxidation states of actinides are numerous – Explain. 4
- b) Comment on the nature of electronic spectral behavior of d- and f-transition (both lanthanides and actinides) metal compounds. 3
- c) Give four examples of higher (>6) coordinated compounds involving actinide elements. 3
5. Attempt **any four**: 4x2.5
- a) Stabilization of tetravalent manganese or nickel – explain with strategy as well as taking specific ligand(s).
- b) Arrange $\text{K}_2\text{Cr}_2\text{O}_7$, NaBiO_3 and KMnO_4 according to increasing oxidizing power. Justify your answer.
- c) Define ‘Flexidentate’ ligand taking example(s) and show it’s different coordination modes.
- d) Distinguish ferrous and ferric irons in the light of chemical tests. Write the involved chemical reactions.
- e) Specify the d^n -configuration for the following two states and assign the states:



- f) Specify the J states for above states. Give the energy difference between the J states and calculate the energy of each ‘J’ states.
6. Attempt **any four**: 4x2.5
- a) Calculate the maximum concentration of Cd^{2+} and Mn^{2+} ions which will remain in solution after precipitation by excess of H_2S in 0.25 M HCl. Comment on the results. Given: K_1 and K_2 of H_2S are 9.1×10^{-8} and 1.2×10^{-15} respectively. Solubility products of CdS and MnS are 5.5×10^{-25} and 1.4×10^{-15} respectively.
- b) What do you mean by group reagent in analytical Chemistry? Select the group reagents of all the analytical groups with corresponding justification(s).
- c) Why do you consider phosphate is an interfering anion? Mention a method by which you remove the interference? Write a chemical test to identify the anion.
- d) How do you identify Ni^{2+} qualitatively in you laboratory? Justify the reaction condition? Comment on the magnetic properties of the involved complex.
- e) Discuss briefly the principle involved in the qualitative analysis of Cu^{2+} and Cd^{2+} in a binary mixture.