



**WEST BENGAL STATE UNIVERSITY**  
B.Sc. Honours 5th Semester Examination, 2022-23

**CEMACOR11T-CHEMISTRY (CC11)**

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.  
Candidates should answer in their own words and adhere to the word limit as practicable.  
All symbols are of usual significance.*

**UNIT-I**

**Answer any two questions from the following**

12×2 = 24

1. (a) Find CFSE for  $d^6$  systems in terms of  $Dq$  and pairing energy for high spin complexes. 2
- (b)  $CrF_6^{3-}$  shows absorption bands at 14900, 22700 and 34400  $cm^{-1}$  respectively. Assign the bands. Find  $10Dq$  value. 2+2
- (c) Give reasonable explanations to the following facts.
  - (i)  $FeF_6^{3-}$  ion is colorless, whereas,  $[Fe(CN)_6]^{3-}$  ion is colored. 2
  - (ii) Room temperature magnetic moment of Copper(II) sulfate pentahydrate is almost equal to the spin only moment of Cu(II) whereas that of Cu(II) acetate monohydrate is usually lower. 2
- (d) What is Nephelauxetic effect? 2
2. (a) 'Octahedral Cu(II) complexes are distorted' — Explain in the light of CFT using approximate energy diagram. 3
- (b)  $OH^-$  ion is in lower position than  $H_2O$  in spectrochemical series. Explain. 3
- (c) Explain with examples, how super-exchange and anti-ferromagnetic interactions influence the magnetic behaviour of co-ordination complexes. 3
- (d) Between cis- and trans-  $[Co(en)_2 Cl_2]^+$ . Which one will give more intense d-d transition? Why? 3
3. (a) Diamagnetic complexes of cobalt(III) such as  $[Co(NH_3)_6]^{3+}$  and  $[Co(NO_2)_6]^{3-}$  are yellow orange. In contrast paramagnetic complexes  $[CoF_6]^{3-}$  and  $[Co(OH_2)_3F_3]$  are blue. Explain qualitatively the difference in color. 3
- (b) Which of the following complexes would you expect to suffer from a Jahn-Teller distortion:  $[CrI_6]^{4-}$ ,  $[Cr(CN)_6]^{4-}$ ,  $[CoF_6]^{3-}$  and  $[Mn(ox)_3]^{3-}$ ? Give reasons for your answers. 2
- (c) Which of the following pairs of complexes has higher  $Dq$  value and why? 3
  - (i)  $[Co(NH_3)_6]^{3+}$  and  $[Rh(NH_3)_6]^{3+}$
  - (ii)  $[Fe(C_2O_4)_3]^{4-}$  and  $[Fe(C_2O_4)_3]^{3-}$
  - (iii)  $[Cr(en)_3]^{3+}$  and  $[Cr(C_2O_4)_3]^{3-}$

- (d) How does pi bonding in metal ligand complexes influence the stability of oxidation states of transition metals? Give two examples with explanations. 2+2
4. (a) Pick up the ions which will undergo tetragonal distortion in octahedral field. Give reason of your choice. 3  
 $Fe^{+3}$  (High Spin),  $Co^{+2}$  (Low Spin) and  $Ni^{+2}$
- (b) Chromium(II) acetate mono-hydrate is diamagnetic at room temperature. Explain. 3
- (c) Using an approximate Orgel diagram, explain the electronic spectrum of  $Ni^{2+}(aq)$  ion. 3
- (d) The observed magnetic moment for  $K_3[TiF_6]$  is  $1.70\mu_B$ . Calculate  $\mu$  (spin-only) for this complex. Why is there a difference between calculated and observed values? 1+2

## UNIT-II

Answer any *one* question from the following

16×1 = 16

5. (a) What is Lanthanide contraction? How does it influence the chemical behaviour of lanthanides? 3
- (b) Discuss the trend of variation of two important chemical properties in passing from 3d through 4d to 5d transition elements. 3
- (c) Actinides have a greater tendency to form complexes than lanthanides — Explain. 3
- (d) Why are the ionisation energies of 5d elements greater than those of 3d and 4d elements? 3
- (e) Although lanthanides usually exhibit +3 oxidation states,  $Eu^{2+}$  and  $Ce^{4+}$  have special stability. Give reason. 2
- (f) Bands from f-f transitions are sharp but those from d-d transitions are broad. Explain why. 2
6. (a) What are the basis of lanthanide separation? Give a brief outline of the separation of the lanthanide elements by the ion-exchange method. 1+3
- (b) Make critical comments on common and stable oxidation states of Cu, Ag and Au. 3
- (c) Oxo-cations are common with the actinides, but not with the lanthanides. Why? 3
- (d) ' $La^{3+}$  and  $Lu^{3+}$  are diamagnetic while  $Sm^{3+}$  shows low magnetic moment' — Comment. 3
- (e) (+3) oxidation state is common for lanthanides in general while actinides can show variable oxidation states — Explain. 3

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