



WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 5th Semester Examination, 2021-22

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

- Explain the nature of Jahn-Teller distortion expected for an octahedral complex of Cu(II) ion. 3
 - $[\text{NiCl}_4]^{2-}$ is paramagnetic, whereas $[\text{PtCl}_4]^{2-}$ is diamagnetic, although both Ni(II) and Pt(II) are d^8 ions. — Explain. 3
 - With the help of approximate Orgel diagram explain the electronic spectrum of $[\text{V}(\text{H}_2\text{O})_6]^{3+}$. 3
 - Crystal field splitting of the d -orbital is more pronounced in the octahedral field than that in the tetrahedral field. — Explain. 3
- Between the two redox couple, $[\text{Co}(\text{OH}_2)_6]^{3+}/[\text{Co}(\text{OH}_2)_6]^{2+}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}/[\text{Co}(\text{NH}_3)_6]^{2+}$ which one is more oxidizing and why? 3
 - $\text{K}_2\text{Ca}[\text{Cu}(\text{NO}_2)_6]$ and $\text{K}_2\text{Ba}[\text{Cu}(\text{NO}_2)_6]$ exhibit static Jahn-Teller distortion while $\text{Tl}_2\text{Pb}[\text{Cu}(\text{NO}_2)_6]$ shows dynamic Jahn-Teller distortion. — Explain. 3
 - Ni(II) is smaller in size in the square planar environment as compared to that in tetrahedral environment, but reverse is the case with Ag(I). — Explain. 3
 - Mn^{2+} (aq) is pale in colour whereas aqueous solution of MnO_4^- is intense in colour. — Explain. 3
- Account for the following order of lattice enthalpies of the octahedral fluorides of $3d$ (M^{2+}) ions: 3

$$\text{Mn}^{2+} < \text{Fe}^{2+} < \text{Co}^{2+} < \text{Ni}^{2+} < \text{Cu}^{2+} > \text{Zn}^{2+}$$
 - Explain why $\text{Ni}(\text{CO})_4$ is tetrahedral while $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar. 2
 - Electronic spectrum of $[\text{CoF}_6]^{3-}$ shows two maxima in the visible region. — Explain. 3
 - Co^{2+} (d^7 , high spin) has a magnetic moment in the range 4.8-5.2 BM in octahedral field, while in tetrahedral environment the value is in the range 4.0-4.4 BM. The reverse type of observation is true for Ni^{2+} ion. — Explain. 2+2

4. (a) Use Jahn-Teller theorem to decide if $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ will have an un-distorted octahedral structure. 3
- (b) State the selection rules for electronic transition in the spectra of metal complexes. 2
- (c) Fe_3O_4 has an inverse spinel structure whereas Mn_3O_4 has a normal spinel structure. — Explain the observation from CFT. 3
- (d) Find out the ground state term for V^{3+} ion. 2
- (e) Calculate the spin-only magnetic moment in Bohr Magneton for $\text{K}_3[\text{CuF}_6]$. 2

UNIT-II

Answer any *one* question from the following

16×1 = 16

5. (a) What is the common oxidation state of lanthanide elements? Why is it so? 1+2
- (b) Give the general electronic configuration of lanthanides and explain the trends in ionic radii of M^{3+} ion of this class. 1+2
- (c) 4s orbitals are filled before the 3d orbitals but during ionization 4s electrons are removed before 3d electrons. — Comment. 2
- (d) Discuss how the stability of the oxidation states changes from 3d to 4d to 5d transition metals. 3
- (e) Lanthanides have more or less identical chemical properties while d-block elements differ widely in this respect. — Explain. 3
- (f) The electronic absorption spectra of tri-positive lanthanide ions give rise to multiple sharp peaks. — Explain. 2
6. (a) What are the common oxidation states of Cu, Ag and Au? — Explain. 3
- (b) Why do actinides show larger number of oxidation states compared to lanthanides? 3
- (c) Which one of the following are diamagnetic and which are paramagnetic? 3
 Yb^{2+} , Ce^{4+} and Sm^{3+}
- (d) Cu^{2+} ions are coloured and paramagnetic whereas Zn^{2+} ions are colourless and diamagnetic. — Explain. 3
- (e) Compare the properties of lanthanides and actinides with respect to the following properties: 4
 (i) colour and (ii) absorption spectra.

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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