



**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

1. (a) Explain the nature of Jahn-Teller distortion expected for an octahedral complex of Cu(II) ion. 3
- (b)  $[\text{NiCl}_4]^{2-}$  is paramagnetic, whereas  $[\text{PtCl}_4]^{2-}$  is diamagnetic, although both Ni(II) and Pt(II) are  $d^8$  ions. — Explain. 3
- (c) With the help of approximate Orgel diagram explain the electronic spectrum of  $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ . 3
- (d) Crystal field splitting of the  $d$ -orbital is more pronounced in the octahedral field than that in the tetrahedral field. — Explain. 3
  
2. (a) 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
- (b)  $\text{K}_2\text{Ca}[\text{Cu}(\text{NO}_2)_6]$  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
- (c) 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
- (d)  $\text{Mn}^{2+}$  (aq) is pale in colour whereas aqueous solution of  $\text{MnO}_4^-$  is intense in colour. — Explain. 3
  
3. (a) Account for the following order of lattice enthalpies of the octahedral fluorides of  $3d$  ( $M^{2+}$ ) ions: 3
 

$\text{Mn}^{2+} < \text{Fe}^{2+} < \text{Co}^{2+} < \text{Ni}^{2+} < \text{Cu}^{2+} > \text{Zn}^{2+}$
- (b) Explain why  $\text{Ni}(\text{CO})_4$  is tetrahedral while  $[\text{Ni}(\text{CN})_4]^{2-}$  is square planar. 2
- (c) Electronic spectrum of  $[\text{CoF}_6]^{3-}$  shows two maxima in the visible region. — Explain. 3
- (d)  $\text{Co}^{2+}$  ( $d^7$ , 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  $\text{Ni}^{2+}$  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)  $\text{Fe}_3\text{O}_4$  has an inverse spinel structure whereas  $\text{Mn}_3\text{O}_4$  has a normal spinel structure. — Explain the observation from CFT. 3
- (d) Find out the ground state term for  $\text{V}^{3+}$  ion. 2
- (e) Calculate the spin-only magnetic moment in Bohr Magnetons 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  $\text{M}^{3+}$  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  
 $\text{Yb}^{2+}$ ,  $\text{Ce}^{4+}$  and  $\text{Sm}^{3+}$
- (d)  $\text{Cu}^{2+}$  ions are coloured and paramagnetic whereas  $\text{Zn}^{2+}$  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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