



**WEST BENGAL STATE UNIVERSITY**

B.Sc. Honours PART-III Examinations, 2017

**CHEMISTRY-HONOURS**

**PAPER-CEMA-V**

Time Allotted: 4 Hours

Full Marks: 100

*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.*

Use separate answer scripts for [CEMAT-35-IA & CEMAT-35-IB] and for [CEMAT-35-AA & CEMAT-35-AB ]

**CEMAT-35-IA**

**Answer any two questions taking one from each unit.**

**UNIT-I**

1. (a) How will you prepare *cis* and *trans* isomers of  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  starting from  $[\text{PtCl}_4]^{2-}$  and  $[\text{Pt}(\text{NH}_3)_4]^{2+}$  ions respectively. 3
- (b) Draw the structures of all possible isomers of  $[\text{CoCl}_2(\text{NH}_3)_2(\text{en})]^+$ . 3
- (c) Between  $\text{Co}_3\text{O}_4$  and  $\text{Fe}_3\text{O}_4$  which has normal and which has inverse spinel structure. Give reasons. 2
- (d) Why  $\text{HgCl}_2$  is colorless whereas  $\text{HgI}_2$  is red solid? 2
- (e) Employing appropriate method how can you separate the enantiomers of  $[\text{Co}(\text{NH}_2\text{CH}_2\text{COO})_3]$ ? 3
2. (a) Explain why  $\text{H}_2\text{O}$  is stronger field ligand than  $\text{OH}^-$ ? 4



- (b) How can you explain the magnetic properties of high and low spin Co(III) octahedral complexes using VBT? 4
- (c) Construct the qualitative Orgel diagram associated with  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$  and hence predict the nature of d-d transitions. 4
- (d) Why  $\text{Cu}(\text{OAc})_2$  exhibit magnetic moment lower than the expected spin-only moment? 1

### UNIT-II

3. (a) Why Lanthanides exhibit, primarily +3 oxidation state whereas d-block transition metals show variable oxidation states? 3
- (b) What do you mean by 'lanthanide contraction'? 2
- (c) Compare and contrast the oxidation states and coordination behavior of Ni, Pd and Pt. 3
- (d) How  $\text{K}_4[\text{Fe}(\text{CN})_6]$  is prepared? State one of its analytical applications. Give the required chemical equations. 1.5+1.5
- (e) Why Th is present in most of the ores of Lanthanides. 1
4. (a) Write a short note on magnetic properties of Lanthanides. 3
- (b) Actinides show wider range of oxidation states than the Lanthanides. Explain. 3
- (c) Explain the principle of separation of Lanthanides by ion-exchange method. 3
- (d) How will you prepare sodium nitroprusside? Discuss its analytical use with relevant chemical equations. 3

### CEMAT-35-IB

Answer any two questions taking one from each unit.

### UNIT-I

5. (a) Apply 18 electron rule to draw the structures of  $\text{Fe}_3(\text{CO})_{12}$  and  $(\text{C}_6\text{H}_6)\text{Co}_4(\text{CO})_9$ . 1.5+1.5



- (b) To a dry THF solution of  $\text{Fe}(\text{CO})_5$ , metallic Na is added and refluxed.  $\text{CH}_3\text{Br}$  is added to the cooled reaction mixture. Predict the product with chemical equations. 3
- (c) Write short note on Ziegler-Natta catalyst. 3
- (d) Identify A, B, C and D of the following reactions 4×0.5
- $$\text{Fe}(\eta^5 - \text{C}_5\text{H}_5)_2 \xrightarrow{n\text{-BuLi}} \text{A} \xrightarrow{\text{N}_2\text{O}_4} \text{B} \xrightarrow{\text{Fe}/\text{HCl}} \text{C} \xrightarrow{\text{CO}_2/\text{H}_2\text{O}} \text{D}$$
- (e) Give examples of metal complexes where Cyclopentadiene is coordinated in monohapto and dihapto fashion. 2
6. (a) How can you identify the presence of terminal and bridging carbonyls taking  $\text{Fe}_2(\text{CO})_9$  as the reference. 2
- (b) Discuss metal-metal bonding in  $[\text{Re}_2\text{Cl}_8]^{2-}$ . 2
- (c) Two forms of  $(\eta^5 - \text{Cp})_2\text{Fe}_2(\text{CO})_4$  exist in equilibrium in solution at room temperature. Draw the structures and state how the interconversion occurs? 3
- (d) What do you mean by 'oxidative addition' reaction? Give example with chemical equation. 1.5+1.5
- (e) Draw the structure of 'Wilkinson's catalyst' and give one of its application with appropriate catalytic cycle. 3

### UNIT-II

7. (a) (i) In the complexometric determination of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  in a mixture, mention the reagents, indicators and reaction conditions (pH, temperature) explaining their roles. Draw the structure of the complex formed during the reaction. 5+2
- (ii) What is the role of  $\text{Mg}^{2+}$  in the determination of  $\text{Ca}^{2+}$  by complexometric method?
- (b) Write notes on (i)  $\text{KH}(\text{IO}_3)_2$  (ii) Basic slag. 2.5×2
8. (a) What do you mean by 'precipitation form' and 'weight form' of a metal ion, with example, in connection with its gravimetric estimation? 3



- (b) Give the approximate composition of steel. State the principle of estimation of Cr and Mn in steel. 1+(2×2)
- (c) Give an outline of the procedure for the estimation of Fe and Al in a mixture. 4

CEMAT-35-AA

Answer any *two* questions taking *one* from each unit.

UNIT-I

9. (a) Explain the functioning of carbonate-bicarbonate buffering system, stating its biological importance. 3
- (b) Describe biological functions of the following metalloproteins: 2+2  
(i) Hemoglobin (ii) Cytochrome.
- (c) What is meant by essential metals in living systems? Give representative examples. 3
- (d) What is *cis*-platin? State its medicinal use. Why is *trans*-platin not active as a drug? 3
- 10.(a) What is biological nitrogen fixation? Explain. 3
- (b) Write the light phase and dark phase reactions related to photosynthesis. 3
- (c) Name two toxic metal ions of your choice and mention how they are removed from the body by the help of Chelation therapy. 5
- (d) Explain the role of  $Ca^{2+}$  ion in human body. 2

UNIT-II

- 11.(a) Differentiate between 'bottom up' and 'top down' approach for the synthesis of nanomaterials. Give representative examples. 4
- (b) Why does Surface Plasmon Resonance of Au nanoparticle originate? Explain the variation of the SPR band with change in particle morphology. 4



- (c) Comment on the CO stretching frequencies given below. 4
- |                        |  |                             |                          |                              |      |
|------------------------|--|-----------------------------|--------------------------|------------------------------|------|
| CO                     | $[\text{Ti}(\text{H}_2\text{O})_6]^{2-}$ | $[\text{V}(\text{CO})_6]^-$ | $\text{Cr}(\text{CO})_6$ | $[\text{Mn}(\text{CO})_6]^+$ |      |
| (in $\text{cm}^{-1}$ ) | 2143                                     | 1750                        | 1860                     | 2000                         | 2090 |
- 12.(a) Using 18-electron rule as a guide find the number of metal-metal bonds in 3
- (i)  $\text{Co}_4(\text{CO})_{12}$  (ii)  $\text{Os}_3(\text{CO})_{12}$  (iii)  $\text{Rh}_6(\text{CO})_{16}$
- (b) (i) What is  $\bar{M}_w$  (weight average molecular weight) and  $\bar{M}_n$  (number average molecular weight) of a polymer sample? 5
- (ii) What is polydispersity index?
- (iii) Determine the number average and weight average molecular weight of an equal weight mixture of two polymers of molar masses 20000 and 30000 g/mol respectively.
- (c) State one important application of (i) quartz (ii) zeolite. 2
- (d) What are quantum dots? Name a technique to identify such materials. 2

CEMAT-35-AB

Answer any two questions taking one from each unit.

UNIT-I

- 13.(a) Explain quaternary structure of protein. Name a protein that has quaternary structure. 3+1 = 4
- (b) What are the similarities and differences between nucleotides of DNA and RNA? Explain with their structures. 4
- (c) Define enzyme and co-enzyme with example(s). What are their functions in biological processes? 3+2 = 5
- 14.(a) Comment on hydrophobicity and hydrophilicity of nucleic acids. 2
- (b) What is reversible denaturation of protein? Cite one example of chemical reagent which can denature protein. 2+1 = 3



- (c) What is irreversible denaturation of protein? Explain with an example. 2
- (d) What are the main classes of enzymes? 2
- (e) How many amino acids are involved in ten complete turn of  $\alpha$ -helix? 1
- (f) Write the amino acid sequence in the mRNA molecule synthesized from a DNA template strand having the sequence: 5'-ATCGTACCGTTA-3'. 3

UNIT-II

- 15.(a) Discuss briefly the basic principle for the separation of a mixture of proteins by isoelectric focusing technique. 4
- (b) State the role of SDS in SDS-PAGE used for protein separation. 2
- (c) One microgram of pure enzyme (Mw) catalysed a reaction at a rate  $0.5 \mu \text{ mole min}^{-1}$  under optimum condition. Calculate the specific activity in units/mg of protein and the turnover number of the enzyme. 2+2
- (d) Explain the statement: "Gold number of potato starch is 25". 2
  
- 16.(a) Define isoelectric point (pI). Show how pI of an amino acid can be determined. 1+3
- (b) What is catalytic efficiency? Write down its significance. 2
- (c) How could a lyophobic colloid be prepared? 2
- (d) Write short notes on: 2+2
  - (i) Zeta potential
  - (ii) pH-dependence of enzymatic activity.