



WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-III Examination, 2022

CHEMISTRY

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.*

CEMAT-35-IA

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

UNIT-I

1. (a) Of the two isomers of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$, one isomer 'A' reacts with thiourea (tu) to produce $[\text{Pt}(\text{tu})_4]^{2+}$, whereas the other isomer 'B' produces $[\text{Pt}(\text{NH}_3)_2(\text{tu})_2]^{2+}$. Predict the isomers 'A' and 'B'. Justify your answer. 2+1
- (b) Calculate CFSE of $\text{Mn}(\text{H}_2\text{O})_6^{2+}$, $\text{Fe}(\text{H}_2\text{O})_6^{2+}$, $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ and predict most stable complex ion. 2
- (c) Explain the nature of Jahn-Teller distortion expected for an octahedral complex of Cu(II) ion. 3
- (d) Observed magnetic moment value of Co(II) complexes in octahedral field is higher than spin only moment. Explain. 3
- (e) $[\text{NiCl}_4]^{2-}$ is paramagnetic, whereas $[\text{PtCl}_4]^{2-}$ is diamagnetic although both Ni(II) and Pt(II) are d^8 ions. Explain. 2
2. (a) Construct the qualitative Orgel diagram associated with $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ and explain its electronic spectrum. 3
- (b) For the $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ ion, the mean pairing energy (p) is $23,500 \text{ cm}^{-1}$. The magnitude of Δ_0 is $13,900 \text{ cm}^{-1}$. Calculate CFSE for the complex in the high spin and low spin states. Which state is more stable? 3
- (c) Using CFSE indicate whether MnCr_2O_4 is a normal or inverse spinel. 2
- (d) VO_4^{3-} is white, CrO_4^{2-} is yellow and MnO_4^- is purple — Explain the trend of colour in these complexes. 2
- (e) Give the preparative pathway of all possible stereoisomers of $[\text{Pt}(\text{Cl})(\text{NH}_3)(\text{Py})(\text{Br})]$ from PtCl_4^{2-} using trans effect phenomenon. 3

UNIT-II

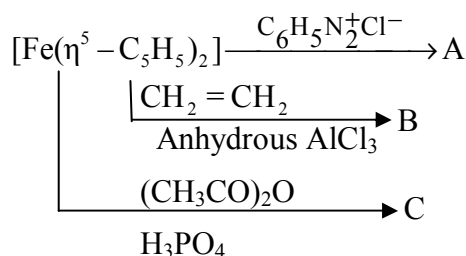
3. (a) How will you prepare $K_2[Ni(CN)_4]$? On calculating its magnetic moment, explain the structure of the complex. 3
- (b) Explain why (any *one*): 2
- (i) Actinides have greater tendency to form complexes than that of lanthanides.
- (ii) Nobelium(II) is more stable and non-reducing while Yb^{2+} is a stronger reducing agent.
- (c) Although lanthanides usually exhibit +3 oxidation state, Eu^{2+} and Yb^{2+} have special stability. Explain. 3
- (d) What is lanthanide contraction and what is its influence on the chemistry of post lanthanide elements? 2+2
4. (a) How will you prepare sodium nitroprusside? State one of its application. 3
- (b) Actinides show a wider range of oxidation states than lanthanides. — Explain. 2
- (c) Explain the variation of the ionic radii of the lanthanide ions in their +3 oxidation state. 2
- (d) Actinides have the greater tendency to form complexes than lanthanides. — Explain. 2
- (e) Which lanthanides show different oxidation state than the usual +3 oxidation state and why? 3

CEMAT-35-IB

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

UNIT-I

5. (a) Define hapticity of non-Werner type complexes. What will be hapticity of ligand in $[Ni(C_5H_5)_2]$? Draw the structure of the complex. 3
- (b) Write short notes on Hydrogenation of Olefins (Including mechanism). 4
- (c) How is Zeigler Natta Catalyst prepared? 2
- (d) Identify the species A, B and C in the following reaction: 3



- (e) Using EAN rule determine number of M–M bond(s) in $Mn_2(CO)_{10}$. 1
6. (a) Applying 18-electron rule find the number of metal-metal bonds in the following molecules: 2
- $Rh_6(CO)_{16}$ and $Os_4(CO)_{14}$
- (b) What is hapticity? Give examples of η^1 , η^3 and η^5 -cyclopentadienyl complexes. 1+3 = 4

- (c) Explain with examples the different coordination modes of NO. 3
- (d) How is ferrocene prepared? What is the magnetic moment value of ferrocene? 1+1+2=4
How can you chemically prove that the two cyclopentadiene rings in ferrocene rotate freely with respect to one another?

UNIT-II

7. (a) What is Zeimermann-Reinhardt reagent? Explain the function of its constituents in permanganometric estimation of Fe^{3+} ion. $1\frac{1}{2}+1\frac{1}{2}$
- (b) What are co-precipitation and post-precipitation? How is post-precipitation avoided during gravimetric analysis? 1+1+1
- (c) Write the principle of estimation of Cu^{2+} ion iodometrically. How is thiosulphate solution standardized? What is the function of thiocyanate in this titration? 2+1+1
- (d) What are masking and demasking agents? Give examples. 2
8. (a) Give the principle of argentometric estimation of chloride using adsorption indicator. 3
- (b) Find the oxidimetric equivalent weight of KBrO_3 . 2
- (c) Why in iodometric titration addition of starch indicator is suggested near the end point of titration? 2
- (d) Briefly describe the dissolution process of chalcopyrites and hence write the principle for estimation of copper in the solution. $2\frac{1}{2}+2\frac{1}{2}$

CEMAT-35-AA

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

UNIT-I

9. (a) Show the mechanism of the catalytic hydration of CO_2 by carbonic anhydrase. 3
- (b) Give example of a toxic metal ion and write its effect on human body. Give example of its removal by chelation therapy. 3
- (c) What is the function of cytochrome-c? 1
- (d) Mention the major role of Ca^{2+} ion in human body. 1
- (e) Write the light and dark phase reactions related to photosynthesis. 3
- (f) Indicate the metal ions present in nitrogen fixing enzymes. 2
- 10.(a) Write short notes on "Carbonate-bicarbonate biological buffer". 3
- (b) Mention harmful effects of As^{3+} in human system. Mention how it can be removed by chelation therapy. 3
- (c) Give the mechanism of O_2 transportation from Lungs to mitochondrial cell mentioning the active site structure of Hb. 3
- (d) Write structures of two Pt-complexes approved clinically for treatment of human cancer. Mention the role of *cis*-Platin as anticancer drug. 4

UNIT-II

- 11.(a) Briefly discuss the viscosity method for determination of molecular weight of polymers. 3
- (b) Mention *two* differences between: 2+2
- (i) Step growth polymerization and chain polymerization.
- (ii) Carbon nanotubes and graphene.
- (c) Find the value of n assuming the validity of the 18 electron rule in the following compounds: 2+2
- (i) $\text{Ru}_3(\text{CO})_n$ (ii) $\text{Fe}_4(\eta^5\text{-Cp})(\eta^1\text{-Cp})(\text{CO})_n$
- (d) Give an example of a metal surface catalysis reaction. 1
- 12.(a) Explain the structure of fullerene- C_{60} . Reduced fullerene has many practical applications. – Comment. 3
- (b) Zeolites play an important role in heterogeneous catalysis. Explain with an example. 3
- (c) A sample of polymer contains 5, 25, 40 and 30 per cent molecules of the polymer with molecular weights 10,000; 12,000; 13,000 and 15,000. Determine the weight average and number average molecular weights of the polymer sample. 3
- (d) Describe in detail any chemical method for the synthesis of Au nanoparticles. Explain the role of the different chemicals used in the synthetic process. 3

CEMAT-35-AB

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

UNIT-I

- 13.(a) What are nucleosides and nucleotides? Show the structure of nucleotide containing the base which occurs only in RNA, but not in DNA. 4
- (b) Explain the differences between secondary and tertiary structures of protein. What types of bonding interaction are present in each case? 5
- (c) What do you mean by protein renaturation? 2
- (d) Name one amino acid residue which is rarely found in alpha helix. Give reason. 2
- 14.(a) Describe the salient features of Watson and Cricks double helical model of DNA. 4
- (b) What forces stabilize α helices? Which amino acids have highest propensity to form α helices? 2+2
- (c) How are enzymes classified? Name the different classes of enzymes. 3
- (d) A sample of DNA contains 30% cytosine (C) as a base. Calculate the % of other bases present in the sample. 2

UNIT-II

- 15.(a) Explain qualitatively the role of electrical double layer in the stability of colloids. 3
(b) What is an autocatalytic reaction? Give an example. 2
(c) What is Lineweaver-Burk plot? What is the importance of this plot? 3
(d) State the factors influencing the migration of species in gel electrophoresis. 2
(e) Explain the effect of pH on enzyme activity. 2
- 16.(a) Write down the Michaelis-Menten equation mentioning the meaning of each term involved, for enzyme-catalysed reaction. Find the condition for which the reaction rate is half its maximum value. 2+2
(b) What are turn-over number and inhibition of an enzymetic reaction? 3
(c) How do lyophilic colloids differ from lyophobic colloids? Which between lyophilic and lyophobic sols is more stable? — Explain. 2+2
(d) What is isoelectric focussing? 1

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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