



## WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-III Examination, 2020

### CHEMISTRY

#### PAPER-CEMA-V

Time Allotted: 2 Hours

Full Marks: 50

*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 *one* question taking from**

1. (a) The complex  $[\text{Pt}(\text{NH}_3)_2(\text{SCN})_2]$  forms two stereo isomers, whereas the complex  $[\text{Pt}(\text{en})(\text{SCN})_2]$  forms only one. Sketch and name all the three isomers with proper explanation. 3
- (b) Predict the sites of  $\text{SCN}^-$  ligand suitable for complexing with  $\text{Fe}^{3+}$  and  $\text{Ag}^+$  respectively. Justify your answer. 2
- (c) Explain with reason (Any *two*): 5
  - (i)  $\text{NiAl}_2\text{O}_4$  is an inverse spinel.
  - (ii)  $\text{HgCl}_2$  is colourless while  $\text{HgI}_2$  is red solid.
  - (iii)  $\text{KMnO}_4$  is intensely purple coloured while  $\text{KClO}_4$  salt is colourless.
- (d) Explain why  $\text{K}_2[\text{NiCl}_4]$  is paramagnetic, whereas  $\text{K}_2[\text{PtCl}_4]$  is diamagnetic, although both  $\text{Ni}^{2+}$  and  $\text{Pt}^{2+}$  are  $d^8$  ions. 2
2. (a)  $[\text{Cr}(\text{en})_2\text{Cl}_2]\text{Cl}$  may be found in two forms, one violet and other green. On reaction with oxalate ion the violet species produces corresponding oxalate derivative while the green one does not react. Explain the result and write the actual name of the oxalate derivative. 2
- (b)  $\text{H}_2\text{O}$  is stronger field ligand than  $\text{OH}^-$  — Justify. 2
- (c) With the help of Orgel diagram explain the spectral transition for a  $3d^2$  ion. 3
- (d) Both  $\text{Ni}(\text{IV})$  and  $\text{Co}(\text{III})$  are  $d^6$  systems but  $\text{K}_3[\text{CoF}_6]$  is paramagnetic while  $\text{K}_2[\text{NiF}_6]$  is diamagnetic. — Explain. 3
- (e)  $[\text{VO}(\text{acac})_2]$  has magnetic moment 1.7 BM while  $[\text{V}(\text{acac})_3]$  shows 2.8 BM as magnetic moment. How do you reconcile? 2
3. (a) What is lanthanide contraction? Explain the impact of lanthanide contraction on the chemical behaviour of the lanthanides. 2+2
- (b) Explain why Au can form  $\text{Au}^-$  but not Cu and Ag. 3
- (c)  $\text{K}_3[\text{W}_2\text{Cl}_9]$  is diamagnetic whereas  $\text{K}_3[\text{Cr}_2\text{Cl}_9]$  is paramagnetic. — Why? 2
- (d) How are the magnetic properties of the lanthanides fundamentally different from those of the transition elements? 3
4. (a) Lanthanides exhibit primarily +3 oxidation state but  $d$ -block transition elements show variable oxidation state — Explain. 3
- (b) Giving equations outline the method of preparation of  $\text{KMnO}_4$  from pyrolusite. 2+2  
Explain with reasons the oxidising property of  $\text{KMnO}_4$  in acid and alkali medium.

- (c) Discuss the colour and spectral behaviour of actinides. 3
- (d)  $\text{La}(\text{OH})_3$  is most basic and  $\text{Lu}(\text{OH})_3$  is least basic among lanthanide(III) hydroxide. 2  
— Explain.

**CEMAT-35-IB****Answer any one question taking from**

5. (a) 'The C-C bond distance in ethylene molecule is shorter than the ethylene ligand in Zeise's salt.' — Explain. 3
- (b) Which one of the following has greater Cr-CO bond strength  $[\text{Cr}(\text{CO})_3(\text{NH}_3)_3]$  and  $[\text{Cr}(\text{CO})_3(\text{PPh}_3)_3]$  and why? 3
- (c) NO is linear in  $[\text{Co}(\text{diars})_2(\text{NO})]^{2+}$ , while is bent in  $[\text{IrCl}_2(\text{NO})(\text{PPh}_3)_2]$  — Explain. 3  
(diars = *o*-phenylenebisdimethylarsine)
- (d) Find out  $x$  and  $y$  in case of  $\text{Mn}(\text{CO})_x(\text{NO})_y$  following EAN rule. 2
- (e) How will you chemically show that the two cyclopentadiene rings in ferrocene freely rotate around the metal-ligand axis? 2
6. (a) "NO<sup>+</sup> is a bad donor but good acceptor while NO<sup>-</sup> is a good donor and bad acceptor" — Explain. 3
- (b) Describe a method of preparation of vanadium hexacarbonyl. Does it obey the 18-electron rule? Give reason for your answer. 3
- (c) Discuss the metal-metal bonding in  $[\text{Re}_2\text{Cl}_8]^{2-}$ . 3
- (d) How would you prepare Zeise's salt? Discuss its structure in detail. 1+3
7. (a) What is adsorption indicator? Explain its reactivity in precipitation titration taking one example. 4
- (b) Explain 'Co-precipitation' and 'Post precipitation' with example. 4
- (c) What are 'masking and demasking agents' in complexometric titration? Explain with suitable examples. 3
- (d) Give outlines of the analytical procedure for the estimation of calcium and magnesium in dolomite. 2
8. (a) What is metal-ion indicator? What are the characteristics of the metal ion indicator? 3
- (b) State at least three conditions of precipitations for gravimetric analysis. 2
- (c) Why sodium thiosulphate is not used as primary standard substance? 2
- (d) Give the principle of estimation of  $\text{Zn}^{2+}$  in  $\text{Zn}^{2+}$ - $\text{Cu}^{2+}$  mixture by complexometry. 3
- (e) Give outlines of the analytical procedures of the estimation of Sn metal in brass. 3

**CEMAT-35-AA****Answer any one question taking from**

9. (a) Explain the biological functions of the following: 4  
(i) Myoglobin (ii) Ferredoxin
- (b) What is an ionophore? Explain with an example. 3
- (c) Explain one role of  $\text{Zn}^{2+}$  ion in human body. 2
- (d) What are essential and ultra-trace elements? Give example in each case. 4
- 10.(a) What is sodium ion pump? Explain its function. 3
- (b) Discuss the significance of 'co-operative effect' with respect to oxygen transport by hemoglobin. 3

- (c) Write a short note on biological nitrogen fixation. 3
- (d) Name one gold-complex used as drug and state its therapeutic application. 2
- (e) Mention two diseases that are caused by metals mentioning their names. 2
- 11.(a) Discuss two consequences of nanosize effects. 3
- (b) What are carbon nano-tubes? State one of its uses. 2
- (c) With the help of 18-electron rule, establish the number of metal-metal bonds in  $\text{Fe}_3(\text{CO})_{12}$ ,  $\text{Rh}_6(\text{CO})_{16}$ . 3
- (d) How does zeolite accommodate guest ions? Mention its significance in everyday life. 3
- (e) State one important application of quartz. 2
- 12.(a) Briefly discuss the viscosity technique for determination of molecular weight of polymers. 4
- (b) What is block copolymer? Give one example of it. 2
- (c) Write down a short note on metal cluster(s) of oxide. 3
- (d) What is meant by gold nano-particles? Give a method of its preparation. Mention one of its uses. 4

**CEMAT-35-AB****Answer any *one* question taking from**

- 13.(a) What are the constituent units present in nucleoside? How is it different from nucleotide? 3
- (b) What are secondary and tertiary structures of proteins? Do all the proteins have both the structures? Answer with reason. 3
- (c) What is complementary base pairings in the structure of DNA? — Explain. 3
- (d) Mention two classes of coenzyme with one example of each of them. 3
- 14.(a) What is naturation of protein? 2
- (b) How are enzymes classified? Mention three classes of enzymes. 4
- (c) What is Hong-Steen model of adenine? 2
- (d) Write the structural and functional differences between DNA and RNA. 3
- (e) How many amino acids are involved in the ten complete turns of  $\alpha$ -helix? 1
- 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

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