

IV.  $\text{CrO}$  is basic,  $\text{Cr}_2\text{O}_3$  is amphoteric and  $\text{CrO}_3$  is acidic in nature. 2

V.  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is more stable than  $[\text{Co}(\text{NH}_3)_6]^{2+}$ . 2

Or

(b) How are essential metals in biological system classified? Mention each class with definition and write the name of each element present in it. 5

(c) What is Na/K pump? Discuss the functioning of Na/K pump. 5

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2024

**CHEMISTRY**

(Honours Core)

Paper : CHE-HC-4016

**(Inorganic Chemistry-III)**

Full Marks : 60

Time : Three hours

**The figures in the margin indicate full marks for the questions.**

1. Answer the following : 1×7=7

(i) In transitional metal complexes the metal acts as

- (a) Lewis acids
  - (b) Lewis bases
  - (c) Neutral compounds
  - (d) Amphoteric compounds
- (Choose the correct answer)

Contd.

(ii) Which oxidation state of Arsenic is most toxic?

(iii) In which one of the following species does the transition metal ion have  $d^3$  electronic configuration?

- (a)  $[\text{Cr}(\text{NH}_3)_6]^{3+}$
- (b)  $[\text{Co}(\text{OH}_2)_6]^{2+}$
- (c)  $[\text{CoF}_6]^{3-}$
- (d)  $[\text{Fe}(\text{CN})_6]^{3+}$

(Choose the correct answer)

(iv) What are macrocyclic ligands? Give one example.

(v) Write the general valence shell electronic configuration of group 6 elements of the periodic table.

(vi) In EDTA, total number of chelating rings are

- (a) 5
- (b) 3
- (c) 4
- (d) 6

(Choose the correct answer)

(vii) Carbonic anhydrase is a zinc enzyme that catalyses the

- (a) hydrolysis of the terminal peptide bond of a peptide chain
  - (b) hydration of  $\text{CO}_2$  and dehydration of carbonic acid
  - (c) binding of dioxygen to haemoglobin
  - (d) None of the above processes
- (Choose the correct answer)

2. Answer the following : 2×4=8

(i) " $\text{Cu}^{2+}$  ions are coloured and paramagnetic, whereas  $\text{Zn}^{2+}$  ions are colourless and diamagnetic." Explain why.

(ii) Draw the geometrical isomers of  $[\text{CrCl}_2(\text{en})_2]^{2+}$  and state whether they are optically active or not.

(iii) Write the full name and formula of the ligands whose abbreviations are given below :

dmg, acac, phen, edta

Contd.



(iv) How does Latimer diagram help to examine the thermodynamic feasibility of a species for disproportionation ?

3. Answer **any three** questions from the following :  
5×3=15

- (i) "Transition metals act as good catalysts". Explain with proper reasons. Write the name of the transition metal which is used as catalyst in the Haber's process for synthesis of ammonia. 4+1=5
- (ii) Discuss the mechanism of dioxygen binding and release by haemoglobin.
- (iii) "Octahedral complexes are more stable and more common than tetrahedral complexes." Explain.
- (iv) What is lanthanide contraction ? What causes lanthanide contraction ? Why the lanthanides do not form oxocations ?
- (v) Discuss the magnetic character of square planar  $d^8$  complexes with the help of crystal field theory.

3 (Sem-4/CBCS) CHE HC 1/G 4

3 (Sem-4/CBCS) CHE HC 1/G 5

Contd.

4. Answer the following questions : 10×3=30

(i) Either

(a) The pairing energy for  $Mn^{3+}$  is  $28,000\text{ cm}^{-1}$ . The  $\Delta_0$  for the complexes  $[Mn(H_2O)_6]^{3+}$  and  $[Mn(CN)_6]^{3-}$  are  $15,800\text{ cm}^{-1}$  and  $38,500\text{ cm}^{-1}$  respectively. From these values identify the high-spin and low-spin complexes and write the electronic configuration. 3

(b) Describe the preparation of  $KMnO_4$  from pyrolusite ore. How does acidified permanganate solution react with the following species ? Write the ionic equation for the reactions. 2+3=5

(i)  $Fe^{2+}$  ions

(ii) Oxalic acid

(c) "The third ionization enthalpy of manganese is very high." Explain why. 2

3 (Sem-4/CBCS) CHE HC 1/G 5

Contd.

Or

(d) Why is the separation of lanthanides difficult ? Discuss the ion exchange method for the separation of lanthanides. 2+4=6

(e) "Actinides have greater tendency to form complexes than lanthanides." Explain why. 4

(ii) Either

(a) Explain the origin of Jahn-Teller distortion by crystal field theory. What are the conditions for Jahn-Teller distortion in the tetrahedral and octahedral complexes ? 4+1+1=6

(b) Compare the Jahn-Teller distortions in  $Ni(II)$  and  $Cu(II)$ . 2

(c) Explain why  $trans-[Cu(en)_2(H_2O)_2]^{2+}$  is more stable than  $cis-[Cu(en)_2(H_2O)_2]^{2+}$ . 2

3 (Sem-4/CBCS) CHE HC 1/G 6

Or

(d) Write the general mechanisms by which a toxic metal can attack the human body. Give an account of the toxicity due to lead and mercury. 3+2+2=7

(e) "Excess as well deficiency of an essential metal is harmful to human body." Justify the statement with an example. 3

(iii) Either

(a) Assign suitable reasons for the following :

I. The  $Mn^{2+}$  compounds are more stable than  $Fe^{2+}$  towards oxidation to their +3 state. 2

II. In the 3d series, the enthalpy of atomization of  $Zn^{2+}$  is the lowest. 2

III.  $Sc^{3+}$  is colourless in aqueous solution whereas  $Ti^{3+}$  is coloured. 2

3 (Sem-4/CBCS) CHE HC 1/G 7

Contd.