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3 (Sem-4/CBCS) CHE HC 1

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

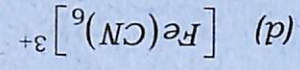
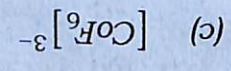
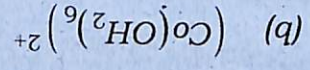
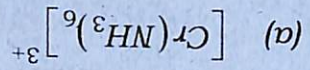
(d) Amphoteric compounds

*(Choose the correct answer)*

Contd.

(iii) 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 ?



(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  $CO_2$  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 :  $2 \times 4 = 8$

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

(ii) Draw the geometrical isomers of  $[CrCl_2(en)_2]^{2+}$  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

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

3. Answer **any three** questions from the following :  $5 \times 3 = 15$

(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 planer  $d^8$  complexes with the help of crystal field theory.

4. Answer the following questions :  $10 \times 3 = 30$

(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

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

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

IV.  $CrO$  is basic,  $Cr_2O_3$  is amphoteric and  $CrO_3$  is acidic in nature. 2

V.  $[Co(NH_3)_6]^{3+}$  is more stable than  $[Co(NH_3)_6]^{2+}$ . 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