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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

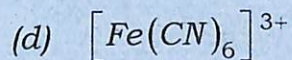
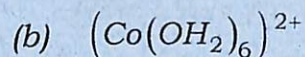
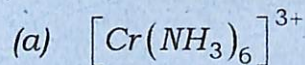
(Choose the correct answer)

Contd.



(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 ?



*(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 :

2×4=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:
- The  $Mn^{2+}$  compounds are more stable than  $Fe^{2+}$  towards oxidation to their +3 state. 2
  - In the 3d series, the enthalpy of atomization of  $Zn^{2+}$  is the lowest. 2
  - $Sc^{3+}$  is colourless in aqueous solution whereas  $Ti^{3+}$  is coloured. 2



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  $\text{Na/K}$  pump? Discuss the functioning of  $\text{Na/K}$  pump. 5

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