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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

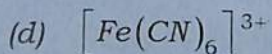
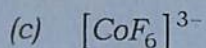
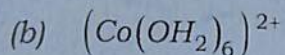
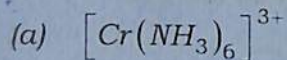
(Choose the correct answer)

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(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 :

$2 \times 4 = 8$

(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 planar 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 Δ_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. $[\text{Co}(\text{NH}_3)_6]^{3+}$ 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
