3 (Sem–4/CBCS) CHE HC 1

2025

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 as directed : 1×7=7

(i) What is ambidentate ligand ? Give example.

(ii) The number of heme groups present per haemoglobin molecule is

(a) 4

(b) 3

(c) 6

(d) 2

(Choose the correct answer)

(iii) Of the five d-orbitals of a Transition metal ion in a square planer complex, the orbital with highest energy will be

(a) d_{xy}

(b) $d_{x^2-y^2}$

(c) d_{z^2}

(d) d_{yz}

(Choose the correct answer)

(iv) Wilson diseases is caused by the deficiency of

(a) *Cu*

(b) *Hg*

(c) *Pb*

(d) *Fe*

(Choose the correct answer)

(v) Give an example of Macrocyclic ligand.

(vi) Which one of the following has the largest atomic radius ?

(a) *Fe*

(b) *Co*

(c) *Cr*

(d) *Zn*

(Choose the correct answer)

(vii) Carbonyl ligand is also known as π-acid ligand because

(a) it has filled hybrid orbital

(b) it has vacant π antibonding orbital

(c) it has vacant π bonding molecular orbital

(d) it has vacant hybrid orbital

(Choose the correct answer)

2. Answer the following : 2×4=8

(i) Hydrated copper sulphate is blue in colour but anhydrous copper sulphate is colourless. Explain.

(ii) Draw geometrical isomers of the complex $[Co(NH_3)_3Cl_3]$. Are the isomers optically active ?

(iii) What is disproportionation reaction ? Explain with example.

(iv) Transition elements have high atomization energy. Explain.

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

(i) Describe separation of lanthanides by ion-exchange method.

(ii) Explain John-Teller distortion by crystal field theory. What are the conditions of John-Teller distortion is an octahedral complex ? How can you predict *Z*-out and *Z*-in distribution is an octahedral complex ? 2+2+1=5

(iii) Define Transition element. Write their general electronic configuration. "*Zn*, *Cd* and *Hg* are not considered as true Transition element." Explain why ? Write electronic configuration of Cr^{3+}. 1+1+2+1=5

(iv) What is Latimer diagram ? Latimer diagram for irons is given as

$$FeO_4^{2-} \xrightarrow{+2\cdot20V} Fe^{3+} \xrightarrow{0\cdot77V} Fe^{2+} \xrightarrow{-0\cdot445V} Fe^{0}$$

Determine the value of $E^0_{FeO_4^{2-}/Fe^{2+}}$ 1+4=5

(v) What is crystal field stabilization energy ? Which one of the given pairs of complexes has largest CFSE ? 1+4=5

(a) $\left[Cr(H_2O)_6\right]^{2+}$ or $\left[Mn(H_2O)_6\right]^{2+}$

(b) $\left[Fe(CN)_6\right]^{3-}$ or $\left[Ru(CN)_6\right]^{3-}$

4. Answer ***any three*** from the following questions : 10×3=30

(i) (a) Explain magnetic property and colour of transition metal complexes with the help of crystal field theory. 2+2=4

(b) Discuss about the oxidation states of first row Transition elements. 3

(c) Write consequences of lanthanide contraction. 3

(ii) (a) Write applications of Frost diagram. 6

(b) Write application of potassium permanganate in quantitative analysis. 4

(iii) Discuss the synthesis, structures and bonding in $Fe(Co)_5$, $Fe_2(Co)_9$, and $Fe_3(Co)_{12}$. Compare the Γ- and π-bonding ability of *Co* and No^+ as ligands. 6+4=10

(iv) (a) Write IUPAC name of the following compounds : 1×2=2

(i) $[Hg\ I_3]^-$

(ii) $[Ag\ (NH_3)_2]OH$

(b) What type of isomerism are exhibited by the following complexes ? 1×2=2

(i) $[Co\ (NH_3)_5\ Br]SO_4$

(ii) $\left[Co\ (NH_3)_5\ NO_2\right]^{2+}$

(c) Define the terms 'labile' and 'inert' of the coordination compounds. Compare these aspects with stability of compounds with appropriate examples. 2+4=6

(v) (a) Discuss the function of Haemoglobin and Myoglobin. Explain the terms 'cooperative effect' and 'Bohr effect'. 6

(b) Give an account of Storage and Transport of iron in human body. 4

(vi) (a) Write toxic effect of *Hg* and *As* in biological system. 2+2=4

(b) What important roles iron and zinc play in biological system ? 2+2=4

(c) Write about use of *Pt* or *Au* complexes in medicine. 2

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