Library Set
HC-1, 2, 3
(4016, 4026, 4036)

2022

CHEMISTRY

(Honours)

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 ***any seven*** questions from the following as directed : 1×7=7

   (i) Which one of the following complex ions is tetrahedral ?

   (a) $[PtCl_4]^{2-}$

   (b) $[PdCl_4]^{2-}$

   (c) $[NiCl_4]^{2-}$

   (d) $[AuCl_4]^{2-}$

   (Choose the correct option)

(ii) $[Cr(CN)_6]^{3-}$ is expected to be _____.
(diamagnetic/paramagnetic)

(Fill in the blank)

(iii) What happens when ammonium metavanadate is heated?

(iv) What is the oxidation number of *Fe* in $[Fe(H_2O)_5(NO)]^{2+}$?

(v) Which one of the following solutions will undergo higher depression of freezing point?

(a) 1*M* aqueous solution of $[Co(NH_3)_5Cl]Cl_2$

(b) 1*M* aqueous solution of $[Co(NH_3)_5Cl_2]Cl$

(vi) Number of possible isomers for the octahedral complex $[Co(en)Cl_2Br_2]^-$ is

(a) 2

(b) 4

(c) 6

(d) 8

(Choose the correct option)

(vii) Among the lanthanide hydroxides, $La(OH)_3$ is _____basic and $Lu(OH)_3$ is _____ basic. *(Fill in the blanks)*

(viii) Which metal play important role in glucose metabolism?

(ix) Name the metal that is present in cytochrome.

(x) Which one of the following oxides does not give rise to polyacids and polyanions?

(a) *V(V)oxide*

(b) *Cr(VI)oxide*

(c) *W(VI)oxide*

(d) *Mo(VI)oxide*

(Choose the correct option)

2. Answer ***any four*** questions from the following: 2×4=8

(i) Explain why actinides form oxocation while lanthanides don't.

(ii) Why is ORS given to patients suffering from diarrhoea?

(iii) Transition elements and their compounds are good catalysts. Explain.

(iv) Write the IUPAC name of $[(NH_3)_5Co—O_2—Co(NH_3)_5](NO_3)_4$ and the formula of diamminediaquadicyanidocobalt(III) chloride.

(v) Tetrahedral complexes are high spin. Explain.

(vi) Weak field ligands form high spin complexes and strong field ligands form low spin complexes. Why ?

(vii) For a metal ion having d^6 configuration in an octahedral complex, the magnitude of crystal field splitting is 32,200 cm^{-1} and the electron pairing energy is 17,600 cm^{-1}. Predict whether the complex will be high spin or low spin. Calculate the crystal field stabilization energy for the predictable spin state.

(viii) Why do transition elements show variable oxidation state ?

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

(i) The magnetic moment of $[Fe(CN)_6]^{3-}$ was found to be 1.9 BM and of $[Fe(H_2O)^{3+}$ is 5.9 BM. Account for this observation with the help of valence bond theory.

(ii) Draw and justify the crystal field splitting diagram for $[CoCl_4]^{2-}$ and calculate CFSE.

(iii) Discuss about the stability of +2 oxidation state of the elements of the first transition series.

(iv) Most spinels involving Fe^{3+} have the inverse structure, whereas those of Mn^{2+} have normal arrangements. Why ?

(v) In what ways magnetic properties of lanthanides are different than transition elements ?

(vi) Write the structure and function of ferritin.

(vii) Name *two* chelating ligands used in chelate therapy and sketch their ligating sites and uses.

(viii) Write the chemistry of the well-known 'volcano' experiment. Explain the following observation :

CrO is basic, Cr_2O_3 is amphoteric while CrO_3 is fully acidic.

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

(i) What is the effect of π-donor and π-acceptor ligands on Δ_0? Explain on the basis of ligand field theory. 5+5=10

(ii) State Jahn-Teller theorem. Which d^n configuration leads to (i) weak, and (ii) strong Jahn-Teller distortion in octahedral complexes ? Explain why all six $Cu\text{-}OH_2$ distances in $[Cu(H_2O)_6]^{2+}$ are not equal. 2+2+6=10

(iii) Octahedral complexes are generally more stable and more common than tetrahedral complexes. Despite this, some tetrahedral complexes are formed and are stable. What are the reasons behind this ?

(iv) Discuss the +IV oxidation state of cerium. Explain, why *Ce*(III) can be easily oxidized to *Ce* (IV) ? 8+2=10

(v) Write the structure and function of haemoglobin. What change occurs in the heme group of haemoglobin in going from deoxy to oxy form ? 5+5=10

(vi) Write the structure, function and mechanism of carbonic anhydrase. 3+3+4=10

(vii) Compare the chemistry of the transition elements of the second and third series with that of the first series considering the following features : 2+2+2+2+2=10

(a) Atomic and ionic radii

(b) Oxidation state

(c) Aqueous chemistry

(d) Metal-metal bonding

(e) Magnetic property

(viii) Given below is the Latimer diagram of *Fe* in acidic medium :

$$FeO_4^{2-} \xrightarrow{+2.20} Fe^{3+} \xrightarrow{+0.77} Fe^{2+} \xrightarrow{-0.47} Fe$$

On the basis of this diagram answer the following questions : 2+2+1+2+3=10

(a) Predict the strongest oxidising agent and the strongest reducing agent.

(b) Is there *any* thermodynamic tendency of Fe^{2+} to reduce to *Fe* ? Give reason.

(c) Write the half reaction for the conversion of FeO_4^{2-} to Fe^{3+}.

(d) What is a disproportionation reaction? Is there *any* oxidation state of iron which undergoes disproportionation? Explain.

(e) Calculate the skip-step *emf* for $Fe^{3+} \rightarrow Fe$.
