UNIT-9: COORDINATION COMPOUNDS

One mark questions:	
1. What is a coordination entity?	K
2. Identify the Lewis acid in : $[CoCl(NH_3)_5]^{2+}$.	U
3. Give an example for didentate ligand.	K
4. Which type of ligands form chelates?	U
5. Give an example for homoleptic complex.	U
6. Write the IUPAC name of the following (1 mark each)	K

Sl.No	Co-ordination compound
1	$K[Au(CN)_2]$
2	$[Fe(en)_3]Cl_3$
3	$[Co(NH_3)_6]Cl_3$
4	$[Co(NO_2)_3(NH_3)_3]$
5	$[Ag(CN)_2]^-$
6	$K_3[Fe(CN)_5(CO)]$
7	$K_3[Co(C_2O_4)_2Cl_2]$
8	$[Cr(NH_3)_3(H_2O)_3]Br_3$
9	$[Cr(C_2O_4)_3]^{3-}$
10	$[Ag(NH_3)_2]$ $[Ag(CN)_2]$

7. Using IUPAC names write the formulae for the following: (1 mark each)	
i) Tetrahydroxidozincate (II)	
ii) Tris(ethane-1,2-diamine)platinum(II) nitrate	
iii) Potassium trioxalatochromate (III)	
iv) Dichloridobis(ethane -1,2-diamine)platinum (IV) nitrate.	
v) Potassium tetracyanatonickelate (II)	
vi) Pentaamminenitrito-O-cobalt (III)	K
8. What type of ligand can give rise to linkage isomerism?	U
9. How many isomers can the complex $[CoCl_2 (NH_3)_4]$ Cl form?	U
10. Which isomer of $[CoCl_2 (en)_2]^+$ cannot show optical isomerism?	U
11. What is linkage isomerism?	K
12. Indicate the type of isomerism in the following set of complex compound $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]$ Cl	U
13. What is the geometry of a complex if the hybridisation of the central metal is dsp^2.	U
14. What is crystal field splitting?	K

15. How is the energy separation Δ_t and Δ_0 related when the metal, ligand and metal ligand distances are the same?	U
16. What is spectrochemical series?	K
17. Is $[Co(NH_3)_6]^{3+}$ an inner orbital or outer orbital octahedral complex?	U
18. Why are different colours observed in octahedral and tetrahedral complexes when the metal and ligands are same?	U
19. Many tetrahedral complexes are high spin complexes. Why?	U
20. A six coordinated high spin complex is bonded to weak ligands. What would be the hybridisation of the central metal?	U
21. Complete the following definition: The dissociation constant of a coordination compound is defined as _____________	K
22. Which coordination complex is used in treatment of lead poisoning?	A
Two mark questions:	
1. What is a double salt? Give an example.	K
2. What is ambidentate ligand? Give an example.	K
3. What are heteroleptic complexes? Give an example.	K
4. What are primary and secondary valencies?	K
5. What type of isomerism is exhibited by the following pairs of complexes? i) $[Co(NH_3)_6]\,[Cr(CN)_6]$ and $[Co(CN)_6]\,[Cr(NH_3)_6]$ ii) $[Cr(H_2O)_6]\,Cl_3$ and $[Cr(H_2O)_5\,Cl]\,Cl_2\,H_2O$	A
6. Draw the structures of cis -trans isomers for $[Pt(NH_3)_2\,Cl_2]$	S
7. Draw Fac-mer isomers of $[Co(NH_3)_3Cl_3]$	S
8. Explain geometrical isomerism in coordination compounds with an example.	K
9. Explain optical isomerism in a coordination compounds with a suitable example?	K
10. Write d and l isomers of cis $[Pt(en)_2\,Cl_2]^{2+}$	S
11. Which is the most stable complex among the following and why? $[Fe(H_2O)_6]^{3+}$, $[Fe(NH_3)_6]^{3+}$, $[Fe(C_2O_4)_3]^{3-}$, $[FeCl_6]^{3-}$	A
12. $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.	A
13. Mention the two factors on which the magnitude of crystal field splitting Δ_0 depends on?	K
14. Give any two differences between crystal filed splitting in tetrahedral and octahedral field.	U

15. Explain why $[Co(NH_3)_6]^{3+}$ is an inner orbital complex where as $[CoF_6]^{3-}$ is an outer orbital complex?	A
16. Write the energy level diagram for the crystal field splitting in octahedral complex.	K
17. Explain crystal field splitting in tetrahedral co-ordination entities with a neat labelled diagram.	K
18. Give the limitations of crystal field theory.	K
19. How are M-C σ and M-C π bond formed in metal carbonyls ?	U
Three mark questions:	
1. Give the postulates of Werner theory of coordination compounds.	K
2. Match the coordination compounds given in column I with type of isomerism exhibited by them in column II:	U

Column I (Coordination compound)	Column II (Isomerism)
A) $[Co(en)_3]\,Cl_3$	1. Linkage isomerism
B) $[Co(NH_3)_6]\,[Cr(CN)_6]$	2. Optical isomerism
C) $[Co(NH_3)_5\,(SCN)]^{+2}$	3. Coordination isomerism

3. Using valence bond theory account for hybridization, geometry and magnetic property of $[Ni(CN)_4]^{2-}$.	K
4. Using valence bond theory account for hybridization, geometry and magnetic property of $[Co(NH_3)_6]^{3+}$.	K
5. Write the name, structure and magnetic behaviour of the complex $K_2[Ni(CN)_4]$, which is a low spin complex.	A
6. Applying VBT, predict the number of unpaired electrons in the square planar $[Pt(CN)_4]^{-2}$ ion. (Given outer EC of Pt = $5d^9 6s^1$)	A
7. The spin only magnetic moment of $[MnBr_4]^{-2}$ is 5.9 B.M. predict the geometry of the complex.	A
8. Compare the following high spin complexes with respect to the shape, hybridization and number of unpaired electrons: i) $[NiCl_4]^{-2}$ ii) $[CoF_6]^{-3}$	A
9. Give the oxidation state, hybridization and coordination number of the central metal ion in the complex: $(NH_4)_2\,[CoF_4]$	U
10. Mention any three limitations of VBT that can be accounted for in CFT.	K
11. Which d-orbitals form the e_g set in a tetrahedral field? Between t_{2g} and e_g which set has lower energy in octahedral complex? Give reason.	K

12. Explain colour in coordination compounds using CFT taking $[Ti(H_2O)_6]^{3+}$ as an example. K

13. Complex ions $[Co(NH_3)_5\ H_2O]^{3+}$, $[Co(NH_3)_6]^{3+}$ and $[Co(CN)_6]^{3-}$ in aqueous medium exhibit colour. Wavelengths of light absorbed was 475 nm, 310 nm and 500 nm. Match the complexes with their absorbing wavelengths correctly. U

14. Mention any three applications of co-ordination compounds A

15. Give one example each for the applications of coordination compounds in
    a) Extraction of metals b) Analytical chemistry c) Biological systems A

16. Match the coordination compounds given in column I with central metal atoms given in column II:

Column I (Coordination compound)	**Column II (Central metal atom)**
A. Chlorophyll	1. Rhodium
B. Blood	2. Cobalt
C. Wilkinson catalyst	3. Calcium
D. Vitamin B_{12}	4. Iron
	5. Magnesium

A

Five mark questions:

1. For the complex $[Fe(en)_2\ Cl_2]\ Cl$ (At.No. Fe : 26)
    i) What is the oxidation state of metal ion?
    ii) Mention the geometry of hybrid orbitals.
    iii) What is its magnetic behaviour?
    iv) Give the IUPAC name
    v) How many moles of $AgNO_3$ is required to react with one mole of the complex? A

2. a) A complex M_{XYAB} has square planar geometry. How many geometrical isomers are possible? Write their structures.
    b) Between $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$ in which one of these does the metal-carbon bond has both σ and π character? A

3. $CoSO_4Cl.5NH_3$ exists in two isomeric forms 'A' and 'B'. Isomer 'A' reacts with $AgNO_3$ to give a white precipitate, but does not react with $BaCl_2$. Isomer 'B' gives white precipitate with $BaCl_2$ but does not react with $AgNO_3$. Answer the following questions.
    i) Identify 'A' and 'B' and write their structural formulas.
    ii) Name the type of isomerism involved.
    iii) Give the IUPAC name of 'A' and 'B'. A

4.	a)	Differentiate $[Fe(CO)_5]$ and $K[Fe(NH_3)_2(CN)_4]$ with respect to i) oxidation state of metal ii) shape	
	b)	Assuming complete ionisation, how many ions per molecule are formed by $K_4[Mn(CN)_6]$ in its aqueous solution?	
	c)	Between $[Fe(C_2O_4)_3]^{3-}$ and $[Fe(NH_3)_6]^{3+}$ which one is more stable and why?	A
5.	a)	On basis of crystal field theory, write the electronic configuration of d^4 in terms of t_{2g} and e_g in octahedral complex when i) $\Delta_0 > P$ ii) $\Delta_0 < P$	
	b)	How many metal-metal bonds and bridged CO groups are in $[Co(CO)_8]$ complex?	
	c)	Geometrical isomerism is not possible in tetrahedral complexes. Give reason.	A