



CHEMISTRY

BOOKS - CHEMISTRY

COORDINATION COMPOUNDS

Coordination Compounds

1. Which of the following complexes formed by Cu^{2+} ions is most stable ?

A.
$$Cu^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+}, \log K = 11.6$$

B. $Cu^{2+} + 4CN^- \rightarrow [Cu(CN)_4]^{2-}, \log K = 27.3$
C. $Cu^{2+} + 2en^- \rightarrow [Cu(en)_2]^{2+}, \log K = 15.4$
D. $Cu^{2+} + 4H_2O \rightarrow [Cu(H_2O)_4]^{2+}, \log K = 8.9$

Answer: B

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2. The colour of the coordination compounds depends on the crystal field splitting . What will be the correct order of obsorption of wavelength of light in the visible region, for the comolexes, $[Co(NH_3)_6]^{3+}$ m and $[Co(H_2O)_6^{3+}$?

$$\begin{split} &\mathsf{A}. \left[Co(CN)_{6} \right]^{3-} > \left[Co(NH_{3})_{6} \right]^{3+} > \left[Co(H_{2}O)_{6} \right]^{3+} \\ &\mathsf{B}. \left[Co(NH_{3})_{6} \right]^{3+} > \left[Co(H_{2}O)_{6} \right]^{3+} > \left[Co(CN)_{6} \right]^{3-} \\ &\mathsf{C}. \left[Co(H_{2}O)_{6} \right]^{3+} > \left[Co(NH_{3})_{6} \right]^{3+} > \left[Co(CN)_{6} \right]^{3-} \\ &\mathsf{D}. \left[Co(CN)_{6} \right]^{3-} > \left[Co(NH_{3})_{6} \right]^{3+} > \left[Co(H_{2}O)_{6} \right]^{3+} \end{split}$$

Answer: C

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3. When 0.1 mol $CoCl_3(NH_3)_5$ is treated with excess of $AgNO_3$, 0.2 mole of AgCl are obtained. The conductivity of solution will correspond to

A.1:3 electrolyte

B.1:2 electrolyte

C.1:1 electrolyte

D. 3 : 1 electrolyte

Answer: B

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4. When 1 mol $CrCl_3.6H_2O$ is treated with excess of $AgNO_3$, 3 mol of

AgCl are obtained. The formula of the coplex is

A. $\left[CrCl_3(H_2O)_3
ight]$. $3H_2O$

B. $\left[CrCl_2(H_2O)_4 \right] Cl.2H_2O$

 $\mathsf{C}.\left[CrCl(H_2O)_5 \right] Cl_2. \ H_2O$

D. $\left[Cr(H_2O)_6 \right] Cl_3$

Answer: D

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5. The correct IUPAC name of $\left[Pt(NH_3)_2 Cl_2
ight]$ is

A. Diamminedichloridoplatinum (II)

B. Diamminedichloridoplatinum (IV)

C. Diamminedichloridoplatinum (0)

D. Dichloridodiammineplatinum (IV)

Answer: A

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6. The stabilization of coordination compound due to chelation is called the chelate effect. Which of the following is the most stable complex species?

- A. $[Fe(CO)_5]$
- $\mathsf{B.}\left[Fe(CN)_6\right]^{3-}$
- C. $[Fe(C_2O_4)_3]^{3-}$
- D. $\left[Fe(H_2O)_6
 ight]^{3\,+}$

Answer: C

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7. Indicate the complex ion which shows geometrical isomerism.

A.
$$\left[Cr(H_2O)_4 Cl_2
ight]^+$$

 $\mathsf{B.}\left[Pt(NH_3)_3Cl\right]$

$$\mathsf{C.}\left[\mathit{Co}(\mathit{NH}_3)_6\right]^{3+}$$

D.
$$\left[Co(CN)_5(NC)\right]^3$$

Answer: A

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8. The CFSE for octahedral $[CoCl_6]^{4-}$ is $18,000cm^{-1}$. The CFSE for tetrahedral $[CoCl_4]^{2-}$ will be

A. 18, $000 cm^{-1}$

B. 16, $000 cm^{-1}$

C. 8, $000 cm^{-1}$

D. 20, $000 cm^{-1}$

Answer: C

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9. Due to the presence of ambidenate ligands coordination compounds show isomerism. Palladium complexes of the type $\left[Pd(C_6H_5)_2(SCN)_2\right] \& \left[Pd(C_6H_5)_2(NCS)_2\right]$ are

A. linkage isomers

B. Coordination isomers

C. ionisation isomers

D. geometrical isomers

Answer: A



C. Coordination isomerism

D. no isomerism

Answer: D

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11. Which of the following is not chelating agent

- (a) Thiosulphate
- (b) Oxalato
- (c) Glycinato
- (d) Ethylene diamine .
 - A. Thiosulphato
 - B. Oxalato
 - C. Glycinato
 - D. Ethane-1, 2-diamine

Answer: A • Watch Video Solution 12. Which of the following species is not expected to be a ligand? A. NO B. NH_4^+

Answer: B

D.CO

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C. $NH_2CH_2CH_2NH_2$

13. What kind of isomerism exists between $ig[Cr(H_2O)_6 ig] Cl_3$ (violet) and

 $\left[Cr(H_2O)_5 Cl
ight]$. H_2O (greyish-green)?

A. Linkage isomersim

B. Solvate isomerism

C. Ionisation isomerism

D. Coordination isomerism

Answer: C

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14. IUPAC name of $\left[Pt(NH_3)_2 Cl(NO_2)
ight]$ is

A. Platinum diaminechloronitrite

B. Chloronitrito-N-ammineplatinum (II)

C. Diamminechloridonitrito-N-platinum (II)

D. Diamminechloronitrito-N-platinate (II)

Answer: C

15. Atomic number of Mn. Fe and Co are 25, 26 and 27 respectively. Which of the following inner orbital octahedral complex ions are diamagnetic ?

- A. $[Co(NH_3)_6]^{3+}$ B. $[Mn(CN)_6]^{3-}$ C. $[Fe(CN)_6]^{4-}$
- D. $\left[Fe(CN)_6\right]^{3-}$

Answer: A::C

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16. Atomic number of Mn, Fe, Co and Ni are 25, 26, 27 and 28 respectively. Which of the following outer orbital octahedral complexes have same number of unpaired electrons ?

A.
$$[MnCl_6]^{3-}$$

B. $[FeF_6]^{3-}$
C. $[CoF_6]^{3-}$
D. $[Ni(NH_3)_6]^{2+}$

Answer: A::C

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17. Which of the following options are correct for $\left[Fe(CN)_6\right]^{3-}$ complex ?

A. $d^2 s p^3$ hybridisation

B. sp^3d^2 hybridisation

C. Paramagnetic

D. Diamagnetic

Answer: A::C

18. An aqueous pink solution of cobalt (II) chloride changes to deep blue on addition of excess of HCl. This is because

A.
$$\left[Co(H_2O_6]^{2+} ext{ is transformed into } \left[CoCl_6
ight]^{4-}
ight.$$

B.
$$ig[{\it Co(H_2O)}_6ig]^{2+}$$
 is transformed into $ig[{\it CoCl}_4ig]^{2-}$

C. tetrahedral complexes have smaller crystal field splitting than

octahedral complexes

D. Tetrahedral complexes have larger crystal field splitting than

octahedral complex

Answer: B::C



19. Which of the following complexes are homoleptic ?

- A. $\left[Co(NH_3)_6
 ight]^{3\,+}$
- $\mathsf{B.}\left[Co(NH_3)_4 Cl_2 \right]^+$
- $\mathsf{C.}\left[Ni(CN)_4\right]^{2-}$
- D. $\left[Ni(NH_3)_4Cl_2
 ight]$

Answer: A::C

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20. Which of the following complexes are heteroleptic ?

A.
$$\left[Cr(NH_3)_6
ight]^{3\,+}$$

- $\mathsf{B.}\left[Fe(NH_3)_4Cl_2\right]^+$
- $\mathsf{C.}\left[Mn(CN)_6\right]^{4\,-}$
- D. $\left[Co(NH_3)_4 Cl_2 \right]$

Answer: B::D

21. Identify the optically active compounds from the following

A.
$$[Co(en)_3]^{3+}$$

B. trans $-[Co(en)_2Cl_2]^+$
C. cis $-[Co(en)_2Cl_2]^+$
D. $[Cr(NH_3)_5Cl]$

Answer: A::C

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22. Identify the correct statements for the behaviour of ethane-1, 2-diamine as a ligand.

A. It is a neutral ligand

B. It is a didentate ligand

C. It is a chelating ligand

D. It is a unidentate ligand

Answer: A::B::C

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23. Which of the following complexes show linkage isomerism ?

A.
$$\left[Co(NH_3)_5(NO_2)
ight]^{2\,+}$$

- $\mathsf{B.}\left[Co(H_2O)_5CO \right]^{3\,+}$
- C. $\left[Cr(NH_3)_5 \right] SCN^{2+}$

D. $\left[Fe(en)_2 C l_2\right]^+$

Answer: A::C

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24. Arrange the following complexes in the increasing order of conductivity of their solution

 $\left[Co(NH_3)_3Cl_3\right], \left[Co(NH_3)_4Cl_2\right]Cl, \left[Co(NH_3)_6\right]Cl_3, \left[Cr(NH_3)_5Cl\right]Cl_2$



25. A coordination compound $CrCI_3.4H_2O$ precipitates AgCI when treated with $AgNO_3$ The molar conductance of its solution corresponds to a total of two ions Write the structural formula of the compound and name it .

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26. A complex of the type $[M(AA)_2X_2]$ is known to the optically active. What does this indicate about the structure of the complex? Give one example of such complex . **27.** Magnetic moment of $[MnCl_4]^{2-}$ is 5.92 BM. Explain giving reason present.



28. On the basis of crystal field theory explain why Co(III) Forms paramagnetic octahedral complex with weak field ligands whereas it forms diamagnetic octahedral complex with strong field ligands.

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29. Why are low spin tetrahedral complexes not formed ?



30. Give the electronic configuration of the following complexes on the basis of crystal field splitting theory. $[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$ and $[Cu(NH_3)_6]^{2+}$.

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31. Explain why $[Fe(H_2O)_6]^{3+}$ has magnetic moment value of 5.92 BM where as $[Fe(CN)_6]^{3-}$ has a value of only 1.74 BM ?

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32. Arrange following complex ions in increasing order of crystal field splitting energy (Δ_0) .



33. Why do compounds having similar geometry have different magnetic

moment?



34. $CuSO_4.5H_2O$ is blue in colour while $CuSO_4$ is colourless. Why ?

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35. Name the type of isomerism when ambidentate ligands are attched

to central metal ion. Give two examples of ambidentate ligands.



36. Match the complex ions given in column I with the colours given in column II and assign the correct code.

Column l (Complex ion)		Column II (Colour)		
A.	$[Co(NH_3)_6]^{3+}$	1.	Violet	
B.	$[\text{Tr}(H, O)_{o}]^{3+1}$	2.	Green	
C.	[Ni(H ₂ O) ₆] ²⁺	3.	Pale blue	
D.	$[Ni(H_2O)_4 (en)]^{2+} (aq)$	4.	Yellowish orange	

^	A	B	C	D
А.	1	2	4	5
-	A	B	C	D
ь.	4	3	2	1
~	Δ	\boldsymbol{R}	C	ת
c	Л	D	\mathbf{U}	$\boldsymbol{\nu}$
C.	л 3	$\frac{D}{2}$	4	$\frac{D}{1}$
C.	А 3 А	$\frac{D}{2}$	$\frac{C}{4}$	1 D

Answer: A::B::C::D



37. Match the coordination compounds given in column I with the central metal atoms given in column II and assign the correct code.

	Column I (Coordination compound)		Column II (Central metal atom)
A.	Chlorophyll	1.	Rhodium
В.	Blood pigment	2.	Cobalt
C.	Wilkinson catalyst	3.	Magnesium
D.	Vitamin B ₁₂	4.	Iron



Answer: A::B::C::D

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38. Match the complex ions given in column I with the hybridisation and number of unpaired electrons given in column II and assign the correct

code

	Column I (Complex ion)	Column II (Hybridisation, number of unpaired electrons)
A.	$[Cr(H_2O)_6]^{3+}$	1. dsp^2 , 1
В.	$[Co(CN)_{4}]^{2-}$	2. $sp^3 d^2$, 5
C.	$[Ni(NH_3)_6]^{2+}$	3. $d^2 s p^3$, 3
D.	$[MnF_{6}]^{4-}$	4. $sp^3 d^2$,2
A	$B \ C \ D$	
A. 3	1 4 2	
_B A	$B \ C \ D$	
^{в.} 4	$3 \ 2 \ 1$	
c^{A}	$B \ C \ D$	
^{ر.} ۲	9 1 1	

Answer: A::B::C::D



39. Match the complex species given in column I with the possible isomerism given in Column II and assign the correct code.

Column I (Complex species)		Column II (Isomerism)		
Α.	[Co(NH ₃) ₄ Cl ₂] ⁺	1.	Optical	
В.	$cis - [Co(en), Cl_2]^+$	2.	Ionisation	
C.	$[Co(NH_3)_{5}(NO_2)]Cl_2$	3.	Coordination	
D.	[Co(NH ₃) ₆][Cr(CN) ₆]	4.	Geometrical	

^	A	B	C	D
А.	1	2	4	3
В.	A	B	C	D
	4	3	2	1
C.	A	B	C	D
	4	2	1	3
D.	A	B	C	D
	4	1	2	3

Answer: A::B::C::D

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40. Match the compounds given In column I with oxidation state of cabalt present in it (given in column II) and assign the correct code.

	Column I (Compound)		Column II (Oxidation state of Co)		
Ą	[Co(NCS)(NH,)_](SO;)	1.	+4		
B.	$[Co(NH_3)_4 Cl_2]SO_4$	2.	0		
C.	$Na_{4}[Co(S_{2}O_{3})_{3}]$	3.	+2		
D.	$[Co_2(CO)_8]$	4.	+3		

^	A	B	C	D
А.	1	2	4	3
В.	A	B	C	D
	4	3	2	1
C.	A	B	C	D
	3	1	4	2
D.	A	B	C	D
	4	1	3	2

Answer: A::B::C::D

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41. Assertion (A) Toxic metal ions are removed by the chelating ligands.

Reason (R) Chelate complexes tend to be more stable.

A. Assertion and reason both are true, reason is correct explanation

of assertion.

B. Assertion and reason both are true but reason is not the correct

explanation of assertion.

C. Assertion is true, reason is false.

D. Assertion is false, reason is true.

Answer: A

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42. Assertion (A) $[Cr(H_2O_6)]Cl_2$ and $[Fe(H_2O)_6]Cl_2$ are reducing in

nature.

Reason (R) Unpaired electrons are present in their d-orbitals.

A. Assertion and reason both are true, reason is correct explanation

of assertion.

B. Assertion and reason both are true but reason is not the correct

explanation of assertion.

C. Assertion is true, reason is false.

D. Assertion is false, reason is true.

Answer: B

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43. Assertion (A) Linkage isomerism arises in coordination compounds containing ambidnetate ligand.

Reason (R) Ambidentate ligand has two different donor atoms.

A. Assertion and reason both are true, reason is correct explanation

of assertion.

B. Assertion and reason both are true but reason is not the correct

explanation of assertion.

C. Assertion is true, reason is false.

D. Assertion is false, reason is true.

Answer: A

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44. Assertion (A) Complexes of MX_6 and MX_5L type (X and L are unidentate) do not show geometrical isomerism.

Reason (R) Geometrical isomerism is not shown by complexes of coordination number 6.

A. Assertion and reason both are true, reason is correct explanation

of assertion.

B. Assertion and reason both are true but reason is not the correct

explanation of assertion.

C. Assertion is true, reason is false.

D. Assertion is false, reason is true.

Answer: B



45. Assertion (A) $[Fe(CN)_6]^{3-}$ ion shows magnetic moment corresponding to two unpaired electrons.

Reason (R) Because it has d^2sp^3 type hybridisation.

A. Assertion and reason both are true, reason is correct explanation

of assertion.

B. Assertion and reason both are true but reason is not the correct

explanation of assertion.

C. Assertion is true, reason is false.

D. Assertion is false, reason is true.

Answer: D

46. Using crystal field theory, draw energy level diagram, write electronic configuration of the central metal atom/ion and determine the magnetic moment value in the following

(a)
$$\left[CoF_{6}
ight]^{3-}, \left[Co(H_{2}O)_{6}
ight]^{2+}, \left[Co(CN)_{6}
ight]^{3-}$$

(b) $FeF_{6}^{3-}, \left[Fe(H_{2}O)_{6}
ight]^{2+}, \left[Fe(CN)_{6}
ight]^{4-}$

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47. Using valence bond theory, explain the following in relation to the

complexes given below

$$\left[Mn(CN)_{6} \right]^{3-}, \left[Co(NH_{3})_{6} \right]^{3+}, \left[Cr(H_{2}O)_{6} \right]^{3+}, \left[FeCl_{6} \right]^{4-}$$

- (a) type of hybridisation
- (b) Inner or outer orbital complex
- (c) Magnetic behaviour
- (d) Spin only magnetic moment value.



48. $CoSO_4Cl.5NH_3$ exists in two isomeric forms 'A' and 'B'. Isomer 'A' reacts with $AgNO_3$ to give 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.

- (a) Identify 'A' and 'B' and write their structural formulae.
- (b) Name the type of isomerism involved.
- (c) Give the IUPAC name of 'A' and 'B'.



49. what is the relationsphip between observed colour of the complex

and the wavelength of light absorbed by the complex ?



50. Why are different colours observed in octahedral and tetrahedral

complexes for the same metal and same ligands ?

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