Q1 - 24 January - Shift 1

The primary and secondary valencies of cobalt respectively in $[Co(NH_3)_5Cl]Cl_2$ are :

(1) 3 and 5

(2) 2 and 6

(3) 2 and 8

(4) 3 and 6

Space for your notes:

Q2 - 24 January - Shift 1

The d-electronic configuration of $[CoCl_4]^{2-}$ in tetrahedral crystal field is $e^m t_2^n$. Sum of 'm' and 'number of unpaired electrons is _____.

Space for your notes:

Q3 - 24 January - Shift 2

Which of the following cannot be explained by crystal field theory?

(1) The order of spectrochemical series

(2) Magnetic properties of transition metal complexes

(3) Colour of metal complexes

(4) Stability of metal complexes

Space for your notes:

Q4 - 24 January - Shift 2

All the alkali metal hydrides are ionic solid (True). The hybridization and magnetic behaviour of cobalt ion in $[Co(NH_3)_6]^{3+}$ complex, respectively is

(1) sp^3d^2 and diamagnetic

(2) d^2sp^3 and paramagnetic

(3) d^2sp^3 and diamagnetic

(4) sp^3d^2 and paramagnetic

Space for your notes:

Q5 - 25 January - Shift 1

The number of paramagnetic species from the following is_____.

$[Ni(CN)_4]^{2-}$, $[Ni(CO)_4]$, $[NiCl_4]^{2-}$

$[Fe(CN)_6]^{4-}$, $[Cu(NH_3)_4]^{2+}$

$[Fe(CN)_6]^{3-}$ and $[Fe(H_2O)_6]^{2+}$

Space for your notes:

Q6 - 25 January - Shift 2

Match List I with List II

	List I Coordination entity		List II Wavelength of light absorbed in nm
A.	$[CoCl(NH_3)_5]^{2+}$	I.	310
B.	$[Co(NH_3)_6]^{3+}$	II.	475
C.	$[Co(CN)_6]^{3-}$	III.	535
D.	$[Cu(H_2O)_4]^{2+}$	IV.	600

Choose the correct answer from the options given below :-

(1) A-IV, B-I, C-III, D-II
(2) A-III, B-II, C-I, D-IV
(3) A-III, B-I, C-II, D-IV
(4) A- II, B-III, C-IV, D-I

Space for your notes:

Q7 - 25 January - Shift 2

Total number of moles of AgCl precipitated on addition of excess of $AgNO_3$ to one mole each of the following complexes $[Co(NH_3)_4Cl_2]Cl$, $[Ni(H_2O)_6]Cl_2$, $[Pt(NH_3)_2Cl_2]$ and $[Pd(NH_3)_4]Cl_2$ is

Space for your notes:

Q8 - 29 January - Shift 1

Chiral complex from the following is

Here en = ethylene diamine

(1) cis – $[PtCl_2(en)_2]^{2+}$

(2) trans – $[PtCl_2(en)_2]^{2+}$

(3) cis – $[PtCl_2(NH_3)_2]$

(4) trans – $[Co(NH_3)_4Cl_2]^{+}$

Space for your notes:

Q9 - 29 January - Shift 1

The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is _____ .

Space for your notes:

Q10 - 29 January - Shift 2

Correct order of spin only magnetic moment of the following complex ions is:

(Given At. No. Fe: 26, Co:27)

(1) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Co(C_2O_4)_3]^{3-}$

(2) $[Co(C_2O_4)_3]^{3-} > [CoF_6]^{3-} > [FeF_6]^{3-}$

(3) $[FeF_6]^{3-} > [Co(C_2O_4)_3]^{3-} > [CoF_6]^{3-}$

(4) $[CoF_6]^{3-} > [FeF_6]^{3-} > [Co(C_2O_4)_3]^{3-}$

Space for your notes:

Q11 - 29 January - Shift 2

The denticity of the ligand present in the Fehling's reagent is _____ .

Space for your notes:

Q12 - 30 January - Shift 1

Which of the following is correct order of ligand field strength?

(1) $CO < en < NH_3 < C_2O_4^{2-} < S^{2-}$

(2) $S^{2-} < C_2O_4^{2-} < NH_3 < en < CO$

(3) $NH_3 < en < CO < S^{2-} < C_2O_4^{2-}$

(4) $S^{2-} < NH_3 < en < CO < C_2O_4^{2}$

Space for your notes:

Q13 - 30 January - Shift 1

To inhibit the growth of tumours, identify the compounds used from the following:

(A) EDTA

(B) Coordination Compounds of Pt

(C) D – Penicillamine

(D) Cis – Platin

Choose the correct answer from the option given below:

(1) B and D Only

(2) C and D Only

(3) A and B Only

(4) A and C Only

Space for your notes:

Q14 - 30 January - Shift 2

1 L, 0.02 M solution of $[Co(NH_3)_5SO_4]Br$ is mixed with 1L, 0.02 M solution of $[Co(NH_3)_5Br]SO_4$. The resulting solution is divided into two equal parts (X) and treated with excess $AgNO_3$ solution and $BaCl_2$ solution respectively as shown below:

1 L Solution (X) + $AgNO_3$ solution (excess)$\rightarrow$Y

1 L Solution (X) + $BaCl_2$ solution (excess)$\rightarrow$Z

The number of moles of Y and Z respectively are

(1) 0.02, 0.02

(2) 0.01, 0.01

(3) 0.02, 0.01

(4) 0.01, 0.02

Space for your notes:

Q15 - 30 January - Shift 2

The Cl – Co – Cl bond angle values in a fac-$[Co(NH_3)_3Cl_3]$ complex is/are:

(1) 90° & 180°

(2) 90°

(3) 180°

(4) 90° & 120°

Space for your notes:

Q16 - 31 January - Shift 1

Cobalt chloride when dissolved in water forms pink colored complex X which has octahedral geometry. This solution on treating with cone HCl forms deep blue complex, Y which has a Z geometry. X, Y and Z, respectively, are

(1) X=$[Co(H_2O)_6]^{2+}$, Y=$[CoCl_4]^{2-}$, Z=Tetrahedral

(2) X=$[Co(H_2O_6)]^{2+}$, Y=$[CoCl_6]^{3-}$, Z=Octahedral

(3) X=$[Co(H_2O)_6]^{3+}$, Y=$[CoCl_6]^{3-}$, Z=Octahedral

(4)X=$[Co(H_2O)_4Cl_2]^{+}$, Y=$[CoCl_4]^{2-}$, Z=Tetrahedral

Space for your notes:

Q17 - 31 January - Shift 2

If the CFSE of $\left[Ti(H_2O)_6\right]^{3+}$ is $-96.0\ kJ/mol$, this complex will absorb maximum at wavelength ___ nm. (nearest integer)

Assume Planck's constant $(h) = 6.4 \times 10^{-34}$ Js Speed of light $(c) = 3.0 \times 10^8 m/s$ and Avogadro's constant $(N_A) = 6 \times 10^{23}/mol$.

Space for your notes:

Q18 - 01 February - Shift 1

Which of the following complex will show largest splitting of d-orbitals?

(1) $[Fe(C_2O_4)_3]^{3-}$

(2) $[FeF_6]^{3-}$

(3) $[Fe(CN)_6]^{3-}$

(4) $[Fe(NH_3)_6]^{3+}$

Space for your notes:

Q19 - 01 February - Shift 2

The complex cation which has two isomers is

(1) $[Co(H_2O)_6]^{3+}$ (2) $[Co(NH_3)_5Cl]^{2+}$

(3) $[Co(NH_3)_5NO_2]^{2+}$ (4) $[Co(NH_3)_5Cl]^{+}$

Space for your notes:

Q20 - 01 February - Shift 2

The spin only magnetic moment of $[Mn(H_2O)_6]^{2+}$ complexes is _____B.M. (Nearest integer)

Space for your notes:

Answer Key

(As per Official NTA Key released on 2 Feb)

Q1 (4)	**Q2** (7)	**Q3** (4)	**Q4** (3)
Q5 (4)	**Q6** (2)	**Q7** (5)	**Q8** (1)
Q9 (0)	**Q10** (1)	**Q11** (4)	**Q12** (2)
Q13 (1)	**Q14** (2)	**Q15** (2)	**Q16** (1)
Q17 (480)	**Q18** (3)	**Q19** (3)	**Q20** (6)

Q1 (4)

$[Co(NH_3)_5Cl]Cl_2$

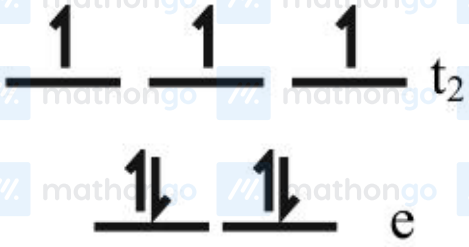
Oxidation number of Co is +3.

So primary valency is 3.

It is an octahedral complex so secondary valency 6 or Co-ordination number 6.

Q2 (7)

$Co^{2+} : 3d^7\ 4s^0, Cl^- : WFL$



Configuration $e^4\ t_2^3 : m = 4$

Number of unpaired electrons = 3

So, answer = 7

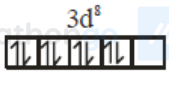
Q3 (4)

Crystal field theory introduce spectrochemical series based upon the experimental values of Δ but can't explain it's order. While other three points are explained by CFT. Specially when the CFSE increases thermodynamic stability of the complex increases.

Q4 (3)

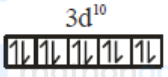
$[Co(NH_3)_6]^{+3} - d^2sp^3$, diamagnetic

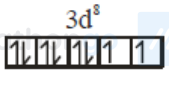
Q5 (4)

$\left[Ni(CN)_4\right]^{2-}$: Ni^{+2} =  :

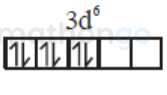
diamagnetic

^-CN : strong field ligand

$\left[Ni(CO)_4\right]$: Ni =  : diamagnetic

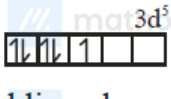
$[NiCl_4]^{2-}$: Ni^{2+} =  : paramagnetic

Cl^- : weak field ligand

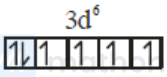
$\left[Fe(CN)_6\right]^{4-}$: Fe^{2+}  : diamagnetic

^-CN : strong field ligand

$[Cu(NH_3)_4]^{+2}$: Cu^{+2} $\Rightarrow$ one unpaired electron : paramagnetic

$[Fe(CN)_6]^{3-}$: Fe^{+3} :  :

paramagnetic, ^-CN : strong field ligand

$[Fe(H_2O)_6]^{2+}$: Fe^{2+} :  :

paramagnetic H_2O : Weak field ligand

Q6 (2)

	List I Coordination entity		List II Wavelength of light absorbed in nm
A.	$[CoCl(NH_3)_5]^{2+}$	I.	535
B.	$[Co(NH_3)_6]^{3+}$	II.	475
C.	$[Co(CN)_6]^{3-}$	III.	310
D.	$[Cu(H_2O)_4]^{2+}$	IV.	600

$$E = \frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda}$$

$$\Rightarrow \Delta(CFSE) \propto \frac{1}{\lambda_{absorb}} \propto \text{strength of ligand.}$$

Q7 (5)

$[Co(NH_3)_4Cl_2]Cl \Rightarrow$ Gives 1 mole AgCl

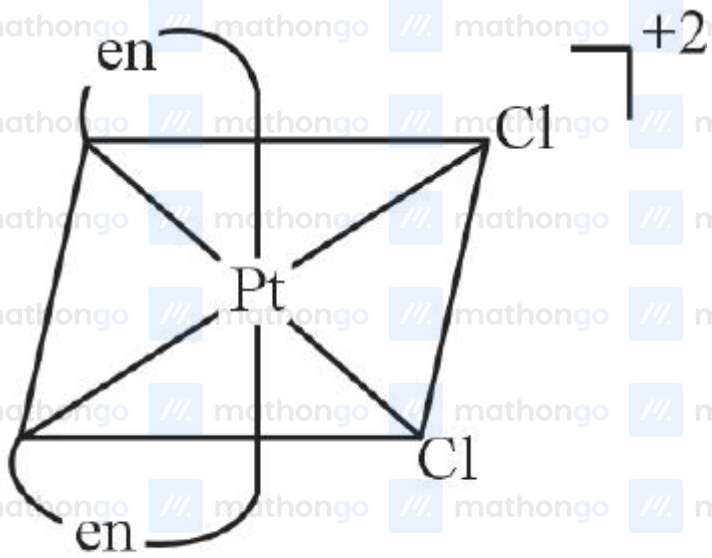
$[Ni(H_2O)_6]Cl_2 \Rightarrow$ Gives 2 moles AgCl

$[Pt(NH_3)_2Cl_2] \Rightarrow$ Gives No AgCl

$[Pd(NH_3)_4]Cl_2 \Rightarrow$ Gives 2 moles AgCl

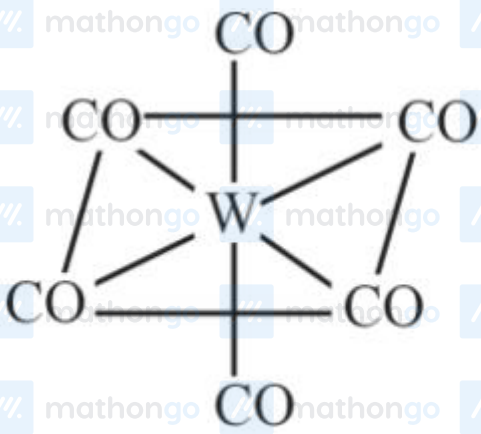
Total number of moles of AgCl = 5 mole

Q8 (1)



this is chiral complex form

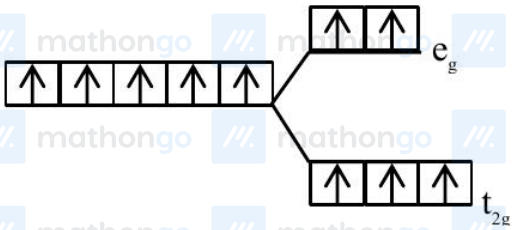
Q9 (0)



$[(CO)_5Mn-Mn(CO)_5]$

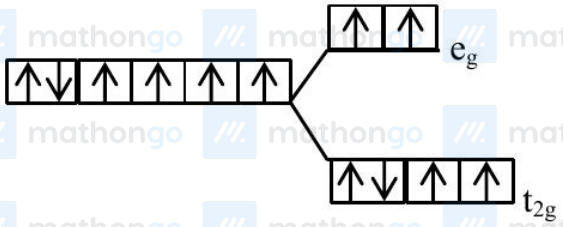
Q10 (1)

$[FeF_6]^{3-}$: $Fe^{3+} = 3d^5$ Δ_O<P



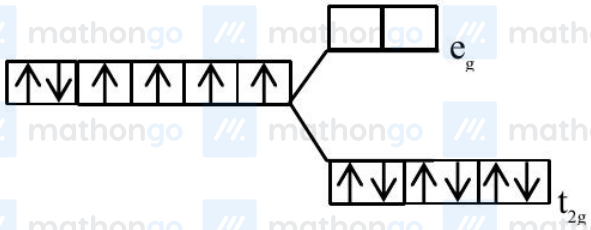
Number of unpaired $e^- = 5$ $\therefore$ $\mu = \sqrt{35}$ BM

$[CoF_6]^{3-}$: $Co^{3+} = 3d^6$ $(\Delta_O < P)$



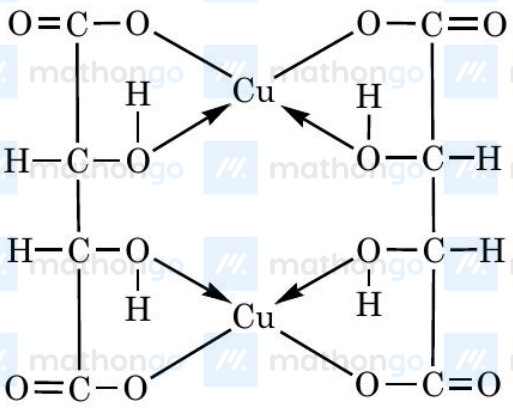
Number of unpaired $e^- = 4$ $\therefore$ $\mu = \sqrt{24}$ BM

$[Co(C_2O_4)_3]^{3-}$: $Co^{3+} = 3d^6$ $(\Delta_O > P)$



Number of unpaired $e^- = 0$ $\therefore$ $\mu = 0$ BM

Q11 (4)



Copper tartarate complex

Denticity = 2

Q12 (2)

The increasing order of field strength of ligands (according to spectrochemical series)

$S^{2-} < C_2O_4^{2-} < NH_3 < en < CO$

Q13 (1)

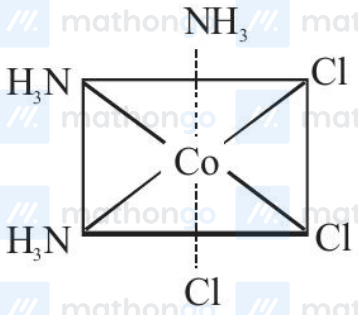
Cis – Platin is used in chemotherapy to inhibits the growth of tumors. ($cis[Pt(NH_3)_2Cl_2]$)

Q14 (2)

$$\underset{0.01\ mol}{\left[Co(NH_3)_5SO_4\right]Br} + \underset{excess}{AgNO_3} \rightarrow \underset{0.01\ Mol}{AgBr}\downarrow$$

$$\underset{0.01\ mol}{\left[Co(NH_3)_5Br\right]SO_4} + \underset{excess}{BaCl_2} \rightarrow \underset{0.01\ Mol}{BaSO_4}\downarrow$$

Q15 (2)



The Cl – Co – Cl bond angle in above octahedral complex is 90°

Q16 (1)

$$CoCl_2 + 6H_2O \longrightarrow [Co(H_2O)_6]Cl_2$$

Pink(X)

octahedral

$\downarrow$ +HCl(conc.)

$[CoCl_4]^{2-}$

(Y)Blue solution

(Z)Tetrahedral

Q17 (480)

$\left(Ti^{+3}\left(H_2O\right)_6\right)^{3+}$

Ti^{+3} : 3d'

C.F.S.E. $= -0.4 \times \Delta_0$

$$= -\frac{96\times10^3}{N_0}\,J$$

$$\Delta_0 = \frac{96\times10^3}{0.4\times6\times10^{23}}$$

$$\Rightarrow \quad \frac{hc}{\lambda} = \frac{96\times10^3}{0.4\times6\times10^{23}}$$

$$\lambda = \frac{0.4\times6\times10^{23}\times6.4\times10^{-34}\times3\times10^8}{96\times10^3}$$

$= 0.48 \times 10^{-6}$m

$= 480 \times 10^{-9}$m

$= 480$ nm

Q18 (3)

$\bar{C}N$ is a strong field ligand so maximum splitting in d orbitals take place.

Q19 (3)

$([Co(NH_3)_5NO_2]^{2+}$

Two linkage isomers possible

Q20 (6)

(Given : Atomic no. of Mn is 25)

$([Mn(H_2O)_6]^{2+}$

$Mn^{2+} = 3d^5$

$\mu = \sqrt{5(5+2)} = 5.91BM$