Q1 - 2024 (04 Apr Shift 1)

Number of complexes from the following with even number of unpaired " d " electrons is

$\left[V(H_2O)_6\right]^{3+}, \left[Cr(H_2O)_6\right]^{2+}, \left[Fe(H_2O)_6\right]^{3+}, \left[Ni(H_2O)_6\right]^{3+}, \left[Cu(H_2O)_6\right]^{2+}$

[Given atomic numbers : $V = 23, Cr = 24, Fe = 26, Ni = 28 Cu = 29$]

(1) 2

(2) 1

(3) 4

(4) 5

Q2 - 2024 (04 Apr Shift 1)

The correct sequence of ligands in the order of decreasing field strength is :

(1) $NCS^- > EDTA^{4-} > CN^- > CO$

(2) $CO > H_2O > F^- > S^{2-}$

(3) $S^{2-} > -OH > EDTA^{4-} > CO$

(4) $^-OH > F^- > NH_3 > CN^-$

Q3 - 2024 (04 Apr Shift 2)

If an iron (III) complex with the formula $\left[Fe(NH_3)_x(CN)_y\right]^-$ has no electron in its e_g orbital, then the value of $x + y$ is

(1) 4

(2) 5

(3) 6

(4) 3

Q4 - 2024 (04 Apr Shift 2)

The number of unpaired d-electrons in $\left[Co(H_2O)_6\right]^{3+}$ is

(1) 2

(2) 1

(3) 0

(4) 4

Q5 - 2024 (05 Apr Shift 1)

Which one of the following complexes will exhibit the least paramagnetic behaviour?

[Atomic number, $\mathrm{Cr}=24, \mathrm{Mn}=25, \mathrm{Fe}=26, \mathrm{Co}=27$]

(1) $\left[\mathrm{Cr}(\mathrm{H_2O})_6\right]^{2+}$

(2) $\left[\mathrm{Fe}(\mathrm{H_2O})_6\right]^{2+}$

(3) $\left[\mathrm{Co}(\mathrm{H_2O})_6\right]^{2+}$

(4) $\left[\mathrm{Mn}(\mathrm{H_2O})_6\right]^{2+}$

Q6 - 2024 (05 Apr Shift 1)

The correct order of ligands arranged in increasing field strength.

(1) $\mathrm{F^-} < \mathrm{Br^-} < \mathrm{I^-} < \mathrm{NH_3}$

(2) $\mathrm{Br^-} < \mathrm{F^-} < \mathrm{H_2O} < \mathrm{NH_3}$

(3) $\mathrm{H_2O} < -\mathrm{OH} < \mathrm{CN^-} < \mathrm{NH_3}$

(4) $\mathrm{Cl^-} < -\mathrm{OH} < \mathrm{Br^-} < \mathrm{CN^-}$

Q7 - 2024 (05 Apr Shift 2)

The number of complexes from the following with no electrons in the t_2 orbital is

$\mathrm{TiCl_4}, [\mathrm{MnO_4}]^-, [\mathrm{FeO_4}]^{2-}, [\mathrm{FeCl_4}]^-, [\mathrm{CoCl_4}]^{2-}$

(1) 1

(2) 4

(3) 3

(4) 2

Q8 - 2024 (05 Apr Shift 2)

The metal atom present in the complex MABXL (where A, B, X and L are unidentate ligands and M is metal) involves sp^3 hybridization. The number of geometrical isomers exhibited by the complex is:

(1) 2

(2) 0

(3) 4

(4) 3

Q9 - 2024 (06 Apr Shift 1)

Match List I with List II

	List - I (Compound)		List - II (Uses)
A.	Iodoform	I.	Fire extinguisher
B.	Carbon tetrachloride	II.	Insecticide
C.	CFC	III.	Antiseptic
D.	DDT	IV.	Refrigerants

Choose the correct answer from the options given below:

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

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

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

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

Q10 - 2024 (06 Apr Shift 1)

he following complexes

$\underset{(A)}{\left[CoCl(NH_3)_5\right]^{2+}}, \underset{(B)}{\left[Co(CN)_6\right]^{3-}}, \underset{(C)}{\left[Co(NH_3)_5(H_2O)\right]^{3+}}, \underset{(D)}{\left[Cu(H_2O)_4\right]^{2+}}$

The correct order of A, B, C and D in terms of wavenumber of light absorbed is :

(1) $C < D < A < B$

(2) $B < C < A < D$

(3) $A < C < B < D$

(4) $D < A < C < B$

Q11 - 2024 (06 Apr Shift 2)

The correct IUPAC name of $\left[PtBr_2(PMe_3)_2\right]$ is :

(1) dibromodi(trimethylphosphine)platinum(II)

(2) bis(trimethylphosphine)dibromoplatinum(II)

(3) dibromobis(trimethylphosphine)platinum(II)

(4) bis[bromo(trimethylphosphine)]platinum(II)

Q12 - 2024 (06 Apr Shift 2)

Given below are two statements :

Statement I : PF_5 and BrF_5 both exhibit $sp^3\ d$ hybridisation.

Statement II : Both SF_6 and $\left[Co(NH_3)_6\right]^{3+}$ exhibit $sp^3\ d^2$ hybridisation.

In the light of the above statements, choose the correct answer from the options given below :

(1) Statement I is true but Statement II is false

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

Q13 - 2024 (06 Apr Shift 2)

Match List - I with List - II.

List - I Reaction	List - II Type of redox reaction
(A) $TiCl_4$	(I) e^2, t_2^0
(B) $[FeO_4]^{2-}$	(II) e^4, t_2^3
(C) $[FeCl_4]^{-}$	(III) e^0, t_2^0
(D) $[CoCl_4]^{2-}$	(IV) e^2, t_2^3

Choose the correct answer from the options given below :

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

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

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

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

Q14 - 2024 (08 Apr Shift 1)

Number of Complexes with even number of electrons in t_{2g} orbitals is -

$\left[Fe(H_2O)_6\right]^{2+}$, $\left[Co(H_2O)_6\right]^{2+}$, $\left[Co(H_2O)_6\right]^{3+}$, $\left[Cu(H_2O)_6\right]^{2+}$, $\left[Cr(H_2O)_6\right]^{2+}$

(1) 2

(2) 3

(3) 1

(4) 5

Q15 - 2024 (08 Apr Shift 1)

An octahedral complex with the formula $CoCl_3 \cdot nNH_3$ upon reaction with excess of $AgNO_3$ solution gives 2 moles of AgCl. Consider the oxidation state of Co in the complex is ' x '. The value of " $x + n$ " is _____

(1) 6

(2) 8

(3) 3

(4) 5

Q16 - 2024 (08 Apr Shift 2)

Match List - I with List - II.

List - I (Complex ion)	List - II (Spin only magnetic moment in B.M.)
(A) $\left[Cr(NH_3)_6\right]^{3+}$	(I) 4.90
(B) $[NiCl_4]^{2-}$	(II) 3.87
(C) $[CoF_6]^{3-}$	(III) 0.0
(D) $[Ni(CN)_4]^{2-}$	(IV) 2.83

Choose the correct answer from the options given below :

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

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

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

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

Q17 - 2024 (08 Apr Shift 2)

Total number of unpaired electrons in the complex ions $\left[Co(NH_3)_6\right]^{3+}$ and $[NiCl_4]^{2-}$ is

Q18 - 2024 (09 Apr Shift 1)

The F^- ions make the enamel on teeth much harder by converting hydroxyapatite (the enamel on the surface of teeth) into much harder fluoroapatite having the formula.

(1) $\left[3\left(Ca_3(PO_4)_2\right)\cdot Ca(OH)_2\right]$

(2) $\left[3\left(Ca_3(PO_4)_3\right)\cdot CaF_2\right]$

(3) $\left[3\left(Ca_2(PO_4)_2\right)\cdot Ca(OH)_2\right]$

(4) $\left[3\left(Ca_3(PO_4)_2\right)\cdot CaF_2\right]$

Q19 - 2024 (09 Apr Shift 1)

Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The total number of geometrical isomers shown by $[Co(en)_2Cl_2]^+$ complex ion is three.

Reason (R): $[Co(en)_2Cl_2]^+$ complex ion has an octahedral geometry.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(2) (A) is not correct but (R) is correct

(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(4) (A) is correct but (R) is not correct

Q20 - 2024 (09 Apr Shift 1)

Number of ambidentate ligands among the following is _____

$NO_2^-, SCN^-, C_2O_4^{2-}, NH_3, CN^-, SO_4^{2-}, H_2O$.

Q21 - 2024 (09 Apr Shift 2)

Match List I with List II

	List - I		List - II
A.	$K_2[Ni(CN)_4]$	I.	sp^3
B.	$[Ni(CO)_4]$	II.	$sp^3 d^2$
C.	$[Co(NH_3)_6]Cl_3$	III.	dsp^2
D.	$Na_3[CoF_6]$	IV.	d^2sp^3

Choose the correct answer from the options given below:

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

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

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

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

Q22 - 2024 (09 Apr Shift 2)

The coordination environment of Ca^{2+} ion in its complex with $EDTA^{4-}$ is :

(1) tetrahedral

(2) trigonal prismatic

(3) octahedral

(4) square planar

Answer Key

Q1 (1)	**Q2** (2)	**Q3** (3)	**Q4** (3)
Q5 (3)	**Q6** (2)	**Q7** (3)	**Q8** (2)
Q9 (2)	**Q10** (4)	**Q11** (3)	**Q12** (4)
Q13 (3)	**Q14** (2)	**Q15** (2)	**Q16** (2)
Q17 (2)	**Q18** (4)	**Q19** (2)	**Q20** (3)
Q21 (1)	**Q22** (3)		

Q1

$\left[V(H_2O)_6\right]^{3+} \rightarrow d^2sp^3$

$_{23}\,V : -[Ar]3\,d^3 4\,s^2$

$V^{+3} : -[Ar]3\,d^2, n = 2\,(\text{even number of unpaired } e^-)$

$\left[Cr(H_2O)_6\right]^{2+} \rightarrow sp^3\,d^2$

$_{24}Cr : -[Ar]3\,d^5 4\,s^1$

$Cr^{+2} : -[Ar]3\,d^4, n = 4\,(\text{even number of unpaired } e^-)$

e_g | 1 | |

t_{2g} | 1 | 1 | 1 |

$\left[Fe(H_2O)_6\right]^{3+} \rightarrow sp^3\,d^2$

$Fe^{3+} : -[Ar]3\,d^5 4\,s^0$

$n = 5\,(\text{odd number of unpaired } e^-)$

$\left[Ni(H_2O)_6\right]^{3+} \rightarrow sp^3\,d^2$

$Ni : -[Ar]3\,d^8 4\,s^2$

$Ni^{+3} : -[Ar]3\,d^7, n = 3\,(\text{odd number of unpaired } e^-)$

$\left[Cu(H_2O)_6\right]^{2+} \rightarrow sp^3\,d^2$

$Cu : -[Ar]3\,d^9 4\,s^0$

$n = 1\,(\text{odd number of unpaired } e^-)$

Q2

According to spectrochemical series ligand field strength is $CO > H_2O > F^- > S^{2-}$

Q3

Complex is $[\overset{III}{Fe}(NH_3)_2(CN)_4]^{\oplus}$

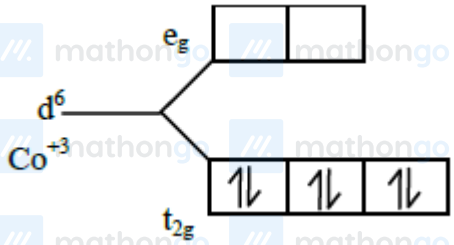
$x = 2$

$y = 4$

so $x + y = 6$

Q4

$\Rightarrow \left[Co(H_2O)_6\right]^{+3}$



No unpaired electrons

Q5

	Number of unpaired e	$\mu = \sqrt{n(n+2)}B.M.$
$\left[Co(H_2O)_6\right]^{2+}$	3	3.87
$\left[Fe(H_2O)_6\right]^{2+}$	4	4.89
$\left[Mn(H_2O)_6\right]^{2+}$	5	5.92
$\left[Cr(H_2O)_6\right]^{2+}$	4	4.89

Least paramagnetic behaviour $= \left[Co(H_2O)_6\right]^{2+}$

Q6

Experimental order $Br^- < F^- < H_2O < NH_3$

Q7

$TiCl_4 \Rightarrow Ti^{+4}$ $e^0t_2^0$

$MnO_4^- \Rightarrow Mn^{+7}$ $e^0t_2^0$

$FeO_4^{2-} \Rightarrow Fe^{+6}$ $e^2t_2^0$

$FeCl_4^{2-} \Rightarrow Fe^{+2}$ $e^3t_2^3$

$CoCl_4^{2-} \Rightarrow Co^{+2}$ $e^4t_2^3$

Q8

Tetrahedral complex does not show geometrical isomerism.

Q9

Iodoform - Antiseptic

CCl_4 - Fire extinguishe

CFC– Refrigerants

DDT - Insecticide

Q10

As ligand field increases, light of more energy is absorbed

Energy $\propto$ wave number $(\bar{v})$

Q11

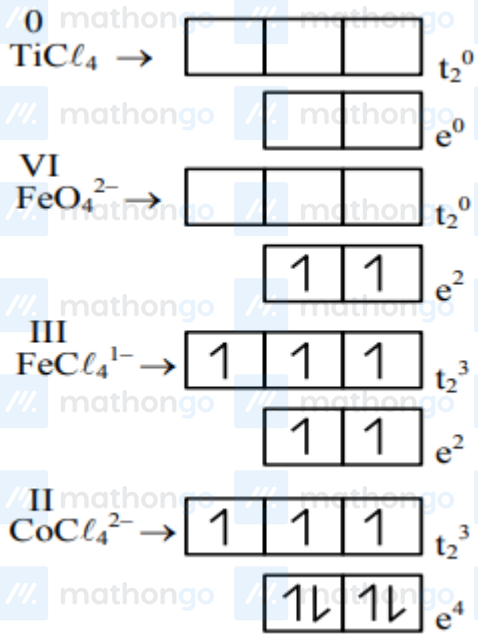
Dibromo bis(trimethylphosphine) platinum (II)

Q12

	Hybridisation		Hybridisation
PF_5	sp^3d	SF_6	sp^3d^2
BrF_5	sp^3d^2	$[Co(NH_3)_6]^{+3}$	d^2sp^3

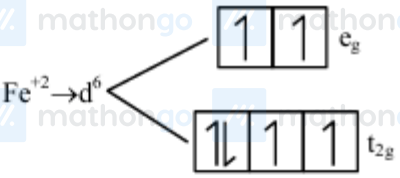
Both Statement (1) and (2) are false.

Q13



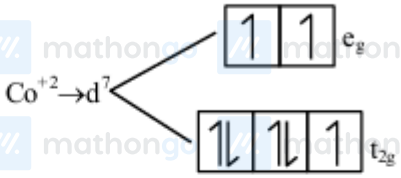
Q14

$[Fe(H_2O)_6]^{2+}$ $Fe^{+2} \rightarrow d^6$



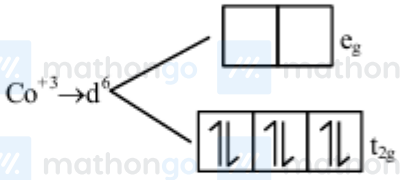
Electron in $t_{2g} = 4$(even)

$[Co(H_2O)_6]^{2+}$ $Co^{+2} \rightarrow d^7$



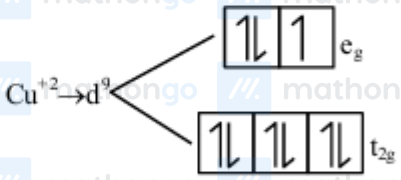
Electron in $t_{2g} = 5$(odd)

$[Co(H_2O)_6]^{3+}$ $Co^{+3} \rightarrow d^6$



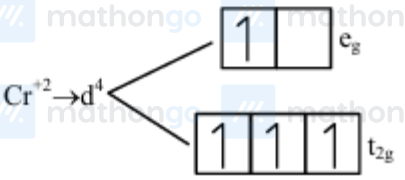
Electron in $t_{2g} = 6$(even)

$[Cu(H_2O)_6]^{2+}$ $Cu^{+2} \rightarrow d^9$



Electron in $t_{2g} = 6$(even)

$[Cr(H_2O)_6]^{2+}$ $Cr^{+2} \rightarrow d^4$



Electron in $t_{2g} = 3$(odd)

Q15

$$[\overset{+3}{Co}(NH_3)_5Cl]Cl_2 + \text{excess } AgNO_3 \longrightarrow \underset{\text{(2 moles)}}{2AgCl}$$

$x + 0 - 1 - 2 = 0$

$x = +3$

$n = 5$

$\therefore x + n = 8$

Q16

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

$Cr^{3+}: 3\,d^3$

$n = 3$ (unpaired electrons)

$\mu \simeq 3.87$ B.M. (II)

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

$Ni^{2+}: 3\,d^8$

$n = 2$

$\mu \simeq 2.83$ B.M. (IV)

(C) $[CoF_6]^{3-}$

$Co^{3+}: 3\,d^6$

$n = 4$

$\mu \simeq 4.90$ B.M. (I)

(D) $[Ni(CN)_4]^{2-}$

$Ni^{2+}: 3\,d^8$

$n = 0$

$\mu = 0$ B.M. (III)

SECTION -B

Q17

$Co^{+3}: 3\,d^6 \quad t_{2\,g}^{2,2,2} e_g^{0,0}$

Unpaired e $e^- = 0$

$Ni^{+2}: 3\,d^8 \quad e^{2,2} t_2^{2,1,1}$

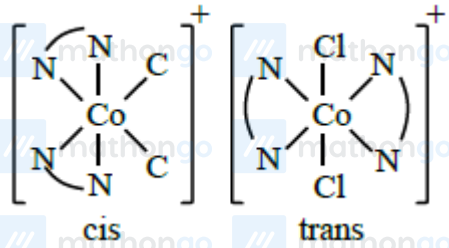
Unpaired $e^- = 2$

Q18

Fluoroapatite $\Rightarrow \left[3Ca_3(PO_4)_2 \cdot CaF_2\right]$

Q19

$[Co(en)_2Cl_2]^+$ has octahedral geometry with two geometrical isomers.



Q20

Ligands which have two different donor sites but at a time connects with only one donor site to central metal are ambidentate ligands.

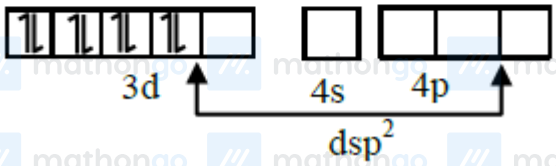
Ambidentate ligands are $NO_2^-; SCN^-; CN^-$

Q21

(A) $K_2[Ni(CN)_4]$

$Ni^{2+}: [Ar]3d^8\ 4s^o$,(CN^- is S.F.L)

Pre hybridization state of Ni^{+2}



Q22

$EDTA^{4-} \rightarrow$ Hexadentate ligand

$[Ca(EDTA)]^{2-}$

So Coordination environment is octahedral