Co-ordination Compounds

Question1

Yellow compound of lead chromate gets dissolved on treatment with hot NaOH solution. The product of lead formed is a :
[27-Jan-2024 Shift 1]

Options:

A. Tetraanionic complex with coordination number six

B. Neutral complex with coordination number four

C. Dianionic complex with coordination number six

D. Dianionic complex with coordination number four

Answer: D

Solution:

Solution:

Question2

Identity the incorrect pair from the following:
[27-Jan-2024 Shift 2]

Options:

A. Photography - AgBr

B. Polythene preparation $-TiCl_4$, $Al(CH_3)_3$

C. Haber process - Iron

D. Wacker process $-PtCl_2$

Answer: D

Solution:

Solution:

Question3

Identify from the following species in which $d^2 sp^3$ hybridization is shown by central atom:
[27-Jan-2024 Shift 2]

Options:

A. $[Co(NH_3)_6]^{3+}$

B. BrF_5

C. $[Pt(Cl)_4]^{2-}$

D. SF_6

Answer: A

Solution:

Solution:

Question4

The Spin only magnetic moment value of square planar complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is _____B.M. (Nearest integer)
(Given atomic number for Pt = 78)
[27-Jan-2024 Shift 2]

Answer: 0

Solution:

Solution:

Question5

In which one of the following metal carbonyls, CO forms a bridge between metal atoms?
[29-Jan-2024 Shift 1]

Options:

A. $[Co_2(CO)_8]$

B. $[Mn_2(CO)_{10}]$

C. $[Os_3(CO)_{12}]$

D. $[Ru_3(CO)_{12}]$

Answer: A

Solution:

Solution:

Question6

The correct IUPAC name of K_2MnO_4 is
[29-Jan-2024 Shift 2]

Options:

A. Potassium tetraoxopermanganate (VI)

B. Potassium tetraoxidomanganate (VI)

C. Dipotassium tetraoxidomanganate (VII)

D. Potassium tetraoxidomanganese (VI)

Answer: B

Solution:

Solution:

Question7

Aluminium chloride in acidified aqueous solution forms an ion having geometry
[30-Jan-2024 Shift 1]

Options:

A. Octahedral

B. Square Planar

C. Tetrahedral

D. Trigonal bipyramidal

Answer: A

Solution:

Question8

Choose the correct Statements from the following:
(A) Ethane-1 2-diamine is a chelating ligand.
(B) Metallic aluminium is produced by elecrtrolysis of aluminium oxide in presence of cryolite.
(C) Cyanide ion is used as ligand for leaching of silver.
(D) Phosphine act as a ligand in Wilkinson catalyst.
(E) The stability constants of Ca^{2+} and Mg^{2+} are similar with EDTA complexes.
Choose the correct answer from the options given below:
[30-Jan-2024 Shift 1]

Options:

A. (B), (C), (E) only

B. (C), (D), (E) only

C. (A), (B), (C) only

D. (A), (D), (E) only

Answer: C

Solution:

Solution:

Question9

The molecule/ion with square pyramidal shape is:
[30-Jan-2024 Shift 2]

Options:

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

B. PCl_5

C. BrF_5

D. PF_5

Answer: C

Solution:

Question10

The coordination geometry around the manganese in decacarbonyldimanganese(0)
[30-Jan-2024 Shift 2]

Options:

A. Octahedral

B. Trigonal bipyramidal

C. Square pyramidal

D. Square planar

Answer: A

Solution:

Solution:

Question11

Number of complexes which show optical isomerism among the following is
cis $-[Cr(ox)_2Cl_2]^{3-}$, $[Co(en)_3]^{3+}$
cis $-[Pt(en)_2Cl_2]^{2+}$, cis $-[Co(en)_2Cl_2]^{+}$
trans $-[Pt(en)_2Cl_2]^{2+}$, trans $-[Cr(ox)_2Cl_2]^{3-}$
[30-Jan-2024 Shift 2]

Answer: 4

Solution:

Question12

The correct statements from following are:
A. The strength of anionic ligands can be explained by crystal field theory.
B. Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.
C. The hybridization involved in formation of $[Ni(CN)_4]^{2-}$ complex is dsp^2.
D. The number of possible isomer(s) of cis- $[PtCl_2(en)_2]^{2+}$ is one
Choose the correct answer from the options given below:
[31-Jan-2024 Shift 1]

Options:

A. A, D only

B. A, C only

C. B, D only

D. B, C only

Answer: D

Solution:

Solution:

Question13

Select the option with correct property -
[31-Jan-2024 Shift 2]

Options:

A. $[Ni(CO)_4]$ and $[NiCl_4]^{2-}$ both diamagnetic

B. $[Ni(CO)_4]$ and $[NiCl_4]^{2-}$ both paramagnetic

C. $[NiCl_4]^{2-}$ diamagnetic, $[Ni(CO)_4]$ paramagnetic

D. $[Ni(CO)_4]$ diamagnetic, $[NiCl_4]^{2-}$ paramagnetic

Answer: D

Solution:

Solution:

Question14

Choose the correct answer from the options given below :

	LIST - I (Complex ion)		LIST - II Electronic Configuration
A.	$[Cr(H_2O)_6]^{3+}$	I.	$t_{2g}^2 e_g^0$
B.	$[Fe(H_2O)_6]^{3+}$	II.	$t_{2g}^3 e_g^0$
C.	$[Ni(H_2O)_6]^{2+}$	III.	$t_{2g}^3 e_g^2$
D.	$[V(H_2O)_6]^{3+}$	IV.	$t_{2g}^6 e_g^2$

[31-Jan-2024 Shift 2]

Options:

A. A-III, B-II, C-IV, D-I

B. A-IV, B-I, C-II, D-III

C. A-IV, B-III, C-I, D-II

D. A-II, B-III, C-IV, D-I

Answer: D

Solution:

Solution:

Question15

Which of the following complex is homoleptic?
[1-Feb-2024 Shift 1]

Options:

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

B. $[Ni(NH_3)_2 Cl_2]$

C. $[Fe(NH_3)_4 Cl_2]^+$

D. $[Co(NH_3)_4 Cl_2]^+$

Answer: A

Solution:

Question16

Given below are two statements:
Statement (I): A solution of $[Ni(H_2O)_6]^{2+}$ is green in colour.
Statement (II): A solution of $[Ni(CN)_4]^{2-}$ is colourless.
In the light of the above statements, choose the most appropriate answer from the options given below:
[1-Feb-2024 Shift 1]

Options:

A. Both Statement I and Statement II are incorrect

B. Both Statement I and Statement II are correct

C. Statement I is incorrect but Statement II is correct

D. Statement I is correct but Statement II is incorrect

Answer: B

Solution:

Solution:

Question17

Given below are two statements :
Statement (I) : Dimethyl glyoxime forms a sixmembered covalent chelate when treated with $NiCl_2$ solution in presence of NH_4OH.
Statement (II) : Prussian blue precipitate contains iron both in (+2) and (+3) oxidation states. In the light of the above statements, choose the most appropriate answer from the options given below:
[1-Feb-2024 Shift 2]

Options:

A. Statement I is false but Statement II is true

B. Both Statement I and Statement II are true

C. Both Statement I and Statement II are false

D. Statement I is true but Statement II is false

Answer: A

Solution:

Question18

$[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ are respectively known as:
[1-Feb-2024 Shift 2]

Options:

A. Spin free Complex, Spin paired Complex

B. Spin paired Complex, Spin free Complex

C. Outer orbital Complex, Inner orbital Complex

D. Inner orbital Complex, Spin paired Complex

Answer: B

Solution:

Solution:

Question19

1L, 0.02M solution of $[Co(NH_3)_5SO_4]Br$ is mixed with 1L, 0.02M 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:
1L Solution(X) + $AgNO_3$ solution (excess) →Y
1L Solution (X) + $BaCl_2$ solution (excess) →Z
The number of moles of Y and Z respectively are
[30-Jan-2023 Shift 2]

Options:

A. 0.02, 0.02

B. 0.01, 0.01

C. 0.02, 0.01

D. 0.01, 0.02

Answer: B

Solution:

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

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

Question20

The Cl − Co − Cl bond angle values in a fac$[Co(NH_3)_3Cl_3]$ complex is/are: [30-Jan-2023 Shift 2]

Options:

A. 90˚&180˚

B. 90˚

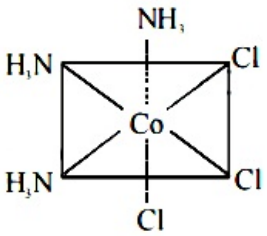
C. 180˚

D. 90˚&120˚

Answer: B

Solution:

Solution:



The Cl − Co − Cl bond angle in above octahedral complex is 90˚

Question21

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
[31-Jan-2023 Shift 1]

Options:

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

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

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

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

Answer: A

Solution:

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

Pink(X)

octahedral

$\downarrow$ +HCl(conc.)

$[CoCl_4]^{2-}$

(Y)Blue solution

(Z)Tetrahedral

Question22

If the CFSE of $[Ti(H_2O)_6]^{3+}$ is $-96.0\,kJ / mol$, this complex will absorb maximum at wavelength ____ nm. (nearest integer)
Assume Planck's constant (h) = 6.4×10^{-34} Js Speed of light (c) = 3.0×10^8 m / s and Avogadro's constant (N_A) = 6×10^{23} / mol
[31-Jan-2023 Shift 2]

Answer: 480

Solution:

$(Ti^{+3}(H_2O)_6)^{3+}$

$Ti^{+3} : 3d^1$

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

$$= -\frac{96 \times 10^3}{N_0} J$$

$$\Delta_0 = \frac{96 \times 10^3}{0.4 \times 6 \times 10^{23}}$$

$$\Rightarrow \frac{hc}{\lambda} = \frac{96 \times 10^3}{0.4 \times 6 \times 10^{23}}$$

$$\lambda = \frac{0.4 \times 6 \times 10^{23} \times 6.4 \times 10^{-34} \times 3 \times 10^8}{96 \times 10^3}$$

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

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

$= 480\,nm$

Question23

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 :-
[25-Jan-2023 Shift 2]

Options:

A. A-IV, B-I, C-III, D-II

B. A-III, B-II, C-I, D-IV

C. A-III, B-I, C-II, D-IV

D. A- II, B-III, C-IV, D-I

Answer: B

Solution:

Solution:

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) $\propto \frac{1}{\lambda_{absorb}} \propto$ strength of ligand.

Question24

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
[25-Jan-2023 Shift 2]

Answer: 5

Solution:

Solution:
$[Co(NH_3)_4Cl_2]Cl \Rightarrow$ 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.

Question25

Chiral complex from the following is:
Here en = ethylene diamine
[29-Jan-2023 Shift 1]

Options:

A. cis $-[PtCl_2(en)_2]^{2+}$

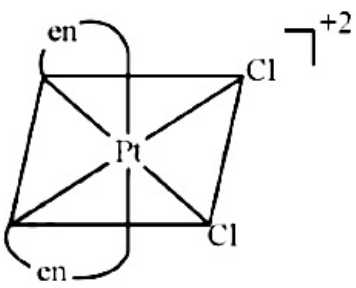
B. trans - $[PtCl_2(en)_2]^{2+}$

C. cis - $[PtCl_2(NH_3)_2]$

D. trans $-[Co(NH_3)_4Cl_2]^{+}$

Answer: D

Solution:



this is chiral complex form

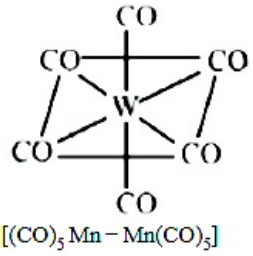
Question26

The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is _____.
[29-Jan-2023 Shift 1]

Answer: 0

Solution:

Solution:



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

Question27

Correct order of spin only magnetic moment of the following complex ions is:
(Given At. No. Fe: 26, Co:27)
[29-Jan-2023 Shift 2]

Correct order of spin only magnetic moment of the following complex ions is:
(Given At. No. Fe: 26, Co:27)
[29-Jan-2023 Shift 2]

Options:

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

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

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

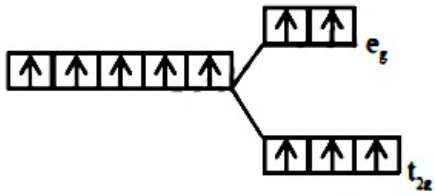
D. $[CoF_6]^{3-} > [FeF_6]^{3-} > [Co(C_2O_4)_3]^{3-}$

Answer: C

Solution:

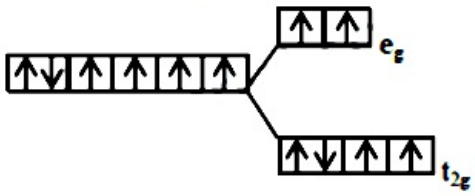
Solution:

$[FeF_6]^{3-}$: $Fe^{3+} = 3d^5 \Delta_0 < P$



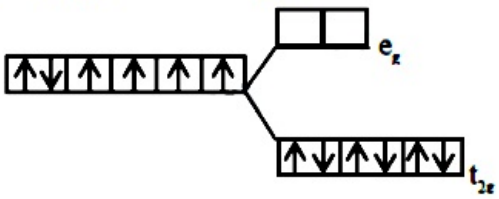
Number of unpaired $e^- = 5 \therefore \mu = \sqrt{35}$ BM

$[CoF_6]^{3-}$: $Co^{3-} = 3d^6 (\Delta_0 < P)$



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

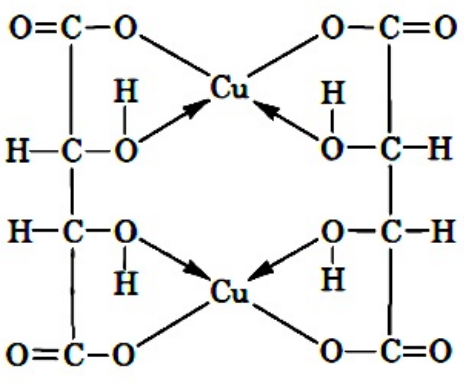
Question28

The denticity of the ligand present in the Fehling's reagent is _____.
Denticity = 2
[29-Jan-2023 Shift 2]

Answer: 4

Solution:

Solution:



Copper tartarate complex

Question29

Which of the following is correct order of ligand field strength? [30-Jan-2023 Shift 1]

Options:

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

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

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

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

Answer: A

Solution:

Solution:
The increasing order of field strength of ligands (according to spectrochemical series)
$S^{2-} < C_2O_4^{2-} < NH_3 < en < CO$

Question30

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: [30-Jan-2023 Shift 1]

Options:

A. B and D Only

B. C and D Only

C. A and B Only

D. A and C Only

Answer: B

Solution:

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

Question31

The primary and secondary valencies of cobalt respectively in $[Co(NH_3)_5Cl]Cl_2$ are :
[24-Jan-2023 Shift 1]

Options:

A. 3 and 5

B. 2 and 6

C. 2 and 8

D. 3 and 6

Answer: D

Solution:

Solution:
$[Co(NH_3)_5Cl]Cl_2$
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 .

Question32

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____
[24-Jan-2023 Shift 1]

Answer: 7

Solution:

Co^{2+} : $3d^7 4s^0$, Cl^-:
Configuration $e^4 t_2^3$: m = 4
Number of unpaired electrons = 3
So, answer = 7

Question33

Which of the following cannot be explained by crystal field theory?
[24-Jan-2023 Shift 2]

Options:

A. The order of spectrochemical series

B. Magnetic properties of transition metal complexes

C. Colour of metal complexes

D. Stability of metal complexes

Answer: A

Solution:

Solution:
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.

Question34

Identify the correct statements about alkali metals.
A. The order of standard reduction potential (M^+ | M) for alkali metal ions is Na > Rb > Li.
B. CsI is highly soluble in water.
C. Lithium carbonate is highly stable to heat.
D. Potassium dissolved in concentrated liquid ammonia is blue in colour and paramagnetic.
E. All the alkali metal hydrides are ionic solids.
Choose the correct answer from the options given below
[24-Jan-2023 Shift 2]

Options:

A. A, B, D only

B. C and E only

C. A and E only

D. A, B and E only

Answer: C

Solution:

Solution:
(1) Na > Cs > Li− true { If considered with sign } The low solubility of CsI is due to smaller hydration enthalpy of it's two ions
Li_2CO_3 is highly stable to heat - false
In Conc. NH_3, K formed blue solution - true
All the alkali metal hydrides are ionic solid (True).

Question35

The number of paramagnetic species from the following is _____.

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

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

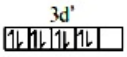
$[Fe(CN)_6]^{3-}$ and $[Fe(H_2O)_6]^{2+}$

[25-Jan-2023 Shift 1]

Answer: 4

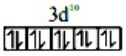
Solution:

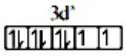
Solution:

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

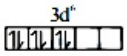
diamagnetic

^-CN : strong field ligand

$[Ni(CO)_4]$: Ni =  diamagnetic

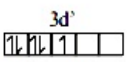
$[NiCl_4]^{2-}$: Ni^{2+} =  paramagnetic

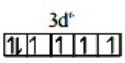
Cl^- : weak field ligand

$[Fe(CN)_6]^{4-}$: 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

Question36

Which of the following complex will show largest splitting of d-orbitals?
[1-Feb-2023 Shift 1]

Options:

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

B. $[FeF_6]^{3-}$

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

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

Answer: C

Solution:

Solution:
$\overline{CN}$ is a strong field ligand so maximum splitting in d orbitals take place.

Question37

The complex cation which has two isomers is : [1-Feb-2023 Shift 2]

Options:

A. $[Co(H_2O)_6]^{3+}$

B. $[Co(NH_3)_5Cl]^{2+}$

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

D. $[Co(NH_3)_5Cl]^{+}$

Answer: C

Solution:

Solution:
($[Co(NH_3)_5NO_2]^{2+}$.
Two linkage isomers possible
NO_2→ Ambidentate ligand

Question38

The spin only magnetic moment of $[Mn(H_2O)_6]^{2+}$ complexes is _____ B.M. (Nearest integer) (Given : Atomic no. of Mn is 25) [1-Feb-2023 Shift 2]

Answer: 6

Solution:

Solution:
$([Mn(H_2O)_6]^{2+}$.
$Mn^{2+} = 3d^5$
$\mu = \sqrt{5(5+2)} = 5.91\,BM$

Question39

Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: The spin only magnetic moment value for $[Fe(CN)_6]^{3-}$ is 1.74 BM, whereas for $[Fe(H_2O)_6]^{3+}$ is 5.92 BM.
Reason R : In both complexes, Fe is present in +3 oxidation state.
In the light of the above statements, choose the correct answer from the options given below:
[6-Apr-2023 shift 1]

Options:

A. Both A and R are true but R is NOT the correct explanation of A

B. A is false but R is true

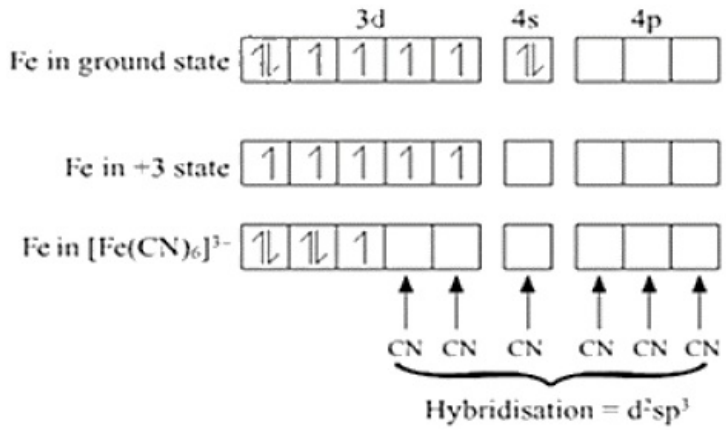
C. A is true but R is false

D. Both A and R are true and R is the correct explanation of A

Answer: A

Solution:

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



Unpaired electron $= 1$
$\mu = \sqrt{n(n+2)} = \sqrt{1 \times 3} = 1.74$ B.M.
$[Fe(H_2O)_6]^{3+}$ No pairing because H_2O is WFL
Number of unpaired electrons $= 5$, $\mu = 5.92\,BM$
Assertion is true, Reason is true but not correct explanation.

Question40

Number of ambidentate ligands in a representative metal complex $[M(en)(SCN)_4]$ is

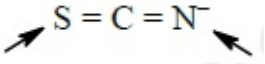
[en = ethylenediamine]

[6-Apr-2023 shift 1]

Answer: 4

Solution:

$[M(en)(SCN)_4]$



Ambidentate ligand means two ligand site, so ambidentate ligand is SCN^-.
Ans: 4

Question41

The IUPAC name of $K_3[Co(C_2O_4)_3]$ is :-

[6-Apr-2023 shift 2]

Options:

A. Potassium trioxalatocobaltate(III)

B. Potassium tris(oxalato)cobalt(III)

C. Potassium tris(oxalato)cobaltate(III)

D. Potassium trioxalatocobalt(III)

Answer: A

Solution:

Solution:
IUPAC name of $K_3[Co(C_2O_4)_3]$ is Potassium trioxalatocobaltate(III)

Question42

Given below are two statements : one is labelled as "Assertion A" and the other is labelled as "Reason R".
Assertion A : In the complex $Ni(CO)_4$ and $Fe(CO)_5$, the metals have zero

oxidation state.
Reason R : Low oxidation states are found when a complex has ligands capable of π-donor character in addition to the σ-bonding.
In the light of the above statements, choose the most appropriate answer from the option given below.
[6-Apr-2023 shift 2]

Options:

A. A is correct but R is not correct

B. A is not correct but R is correct

C. Both A and R are correct but R is NOT the correct explanation of A

D. Both A and R are correct and R is the correct explanation of A.

Answer: A

Solution:

Solution:

Question43

Element not present in Nessler's reagent is:-
[6-Apr-2023 shift 2]

Options:

A. Hg

B. I

C. K

D. N

Answer: D

Solution:

Solution:
Nessler reagent is $-K_2[HgI_4]$

Question44

Which of the following complex is octahedral, diamagnetic and the most stable?
[8-Apr-2023 shift 1]

Options:

A. $K_3[Co(CN)_6]$

B. $[Ni(NH_3)_6]Cl_2$

C. $[Co(H_2O)_6]Cl_2$

D. $Na_3[CoCl_6]$

Answer: A

Solution:

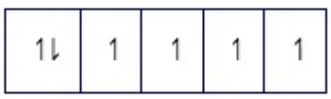
$K_3[Co(CN)_6]$

$+3+x-6=0$

$x=+3$

$\Downarrow$

$Co^{-3} \rightarrow 3d^6$



∵CN^- is SFL so pairing occur so

u-e $=0$

$\downarrow$

So diamagnetic

Question45

The correct order of spin only magnetic moments for the following complex ions is
[8-Apr-2023 shift 1]

Options:

A. $[CoF_6]^{3-} < [MnBr_4]^{2-} < [Fe(CN)_6]^{3-} < [Mn(CN)_6]^{3-}$

B. $[Fe(CN)_6]^{3-} < [CoF_6]^{3-} < [MnBr_4]^{2-} < [Mn(CN)_6]^{3-}$

C. $[MnBr_4]^{2-} < [CoF_6]^{3-} < [Fe(CN)_6]^{3-} < [Mn(CN)_6]^{3-}$

D. $[Fe(CN)_6]^{3-} < [Mn(CN)_6]^{3-} < [CoF_6]^{2-} < [MnBr_4]^{2-}$

Answer: D

Solution:

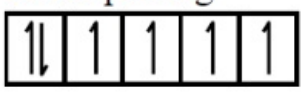
$[CoF_6]^{3-}$

↓

CO^{+3}

F^- WFL

So no pairing



u.e = 4

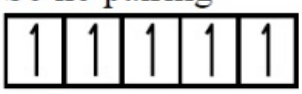
$[MnBr_4]^{2-}$

↓

Mn^{+2}

Br^- WFL

So no pairing



u.e = 5

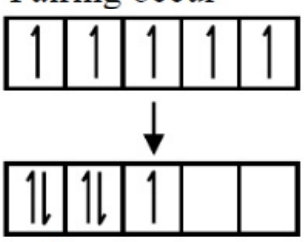
$[Fe(CN)_6]^{3-}$

↓

$3d^5$

CM^- SFL

Pairing occur



u.e = 1

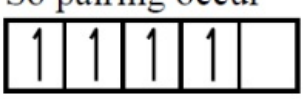
$[Mn(CN)_6]^{3-}$

↓

Mn^{+3}

CN^- is SFL

So pairing occur



u.e = 2

$[Fe(CN)_6]^{-3} < [Mn(CN)_6]^{-3} < [CoF_6]^{-3} < [MnBr_4]^{-2}$

Question46

Match list I with list II

LIST - I Coordination complex	LIST - II Number of unpaired electrons
A. $[Cr(CN)_6]^{3-}$	I. 0
B. $[Fe(H_2O)_6]^{2+}$	II. 3
C. $[Co(NH_3)_6]^{3+}$	III. 2
D. $[Ni(NH_3)_6]^{2+}$	IV. 4

Choose the correct answer from the options given below:
[8-Apr-2023 shift 2]

Options:

A. A-II, B-IV, C-I, D-III

B. A-IV, B-III, C-II, D-I

C. A-II, B-I, C-IV, D-III

D. A-III, B-IV, C-I, D-II

Answer: A

Solution:

Solution:
For option (A)
Cr^{+3} : $3d^3$
CN^- → SFL
⇒ No. of unpaired electrons = 3
For option (B)
Fe^{+2} : $3d^6$
H_2O : WFL
No. of unpaired electrons = 4
For option (C)
Co^{+3} : $3d^6$
NH_3 : SFL
No. of unpaired electrons = 0
For option (D)
Ni^{+2} : $3d^8$
NH_3 : SFL
No. of unpaired electrons = 2

Question47

The observed magnetic moment of the complex $[Mn(xNCS)_6]^{x-}$ is 6.06 BM. The numerical value of x is _____.
[8-Apr-2023 shift 2]

Answer: 4

Solution:

$[Mn(NCS)_6]^{x-}$
Number of unpaired electron = 5
So, Mn must be in +2 oxidation state (Mn^{+2})
$\Rightarrow 2 + (-6) = -x \Rightarrow -4 = -x \Rightarrow x = 4$

Question48

The sum of oxidation state of the metals in $Fe(CO)_5$, VO^{2+} and WO_3 is _____

[8-Apr-2023 shift 2]

Answer: 10

Solution:

Solution:
$\overset{(0)}{Fe}(CO)_5 \quad \overset{(+4)}{V}O^{2+} \quad \overset{(+6)}{W}O_3$
So, Sum of oxidation state = 0 + 4 + 6 = 10

Question49

The octahedral diamagnetic low spin complex among the following is [10-Apr-2023 shift 1]

Options:

A. $[CoF_6]^{3-}$

B. $[CoCl_6]^{3-}$

C. $[Co(NH_3)_6]^{3+}$

D. $[NiCl_4]^{2-}$

Answer: C

Solution:

Solution:
(1) Paramagnetic, High Spin & Tetrahedral
(2) Paramagnetic, High Spin & Octahedral
(3) Paramagnetic, High Spin & Octahedral
(4) Diamagnetic, Low Spin & Octahedral

$[Co(NH_3)_6]^{3+}$, CN = 6 CN = 6 (Octahedral)
NH_3 = SFL
Co^{+3} = $[Ar]3d^6$

Diamagnetic & Low spin complex

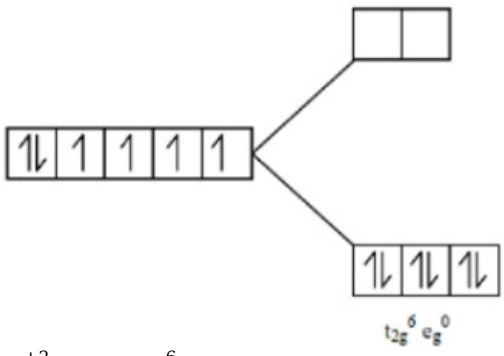
Question50

In potassium ferrocyanide, there are _____ pairs of electrons in the t_{2g} set of orbitals.
[10-Apr-2023 shift 1]

Answer: 3

Solution:

Solution:



Fe^{+2} = $[Ar]3d^6$
CN^- = SFL
t_{2g} contain 6 electron so it become 3 pairs

Question51

Match List I with List II

LIST I Complex	LIST II Crystal Field splitting energy (Δ_0)
A $[Ti(H_2O)_6]^{2+}$	I. -1.2
B $[V(H_2O)_6]^{2+}$	II. -0.8
C $[Mn(H_2O)_6]^{3-}$	III. 0
D $[Fe(H_2O)_6]^{3+}$	IV. -0.8

Choose the correct answer from the options given below:

[10-Apr-2023 shift 2]

Options:

A. A-IV, B-I, C-II, D-III

B. A-IV, B-I, C-III, D-II

C. A-II, B-IV, C-III, D-I

D. A-II, B-IV, C-I, D-III

Answer: A

Solution:

$[Ti(H_2O)_6]^{+2}$ $[V(H_2O)_6]^{+2}$ $[Mn(H_2O)_6]^{+3}$ $[Fe(H_2O)_6]^{3+}$

↓

Ti^{+2} V^{+2} Mn^{+3} Fe^{+3}

↓ ↓ ↓ ↓

$3d^2$ $3d^3$ $3d^4$ $3d^5$

CFSE $= -0.4 \times t_{2g} + 0.6 \times eg + xp$

$= -0.4 \times 2 + 0.6 \times 0 + xp$

(A) $= -0.8 \rightarrow Ti^{+2}$

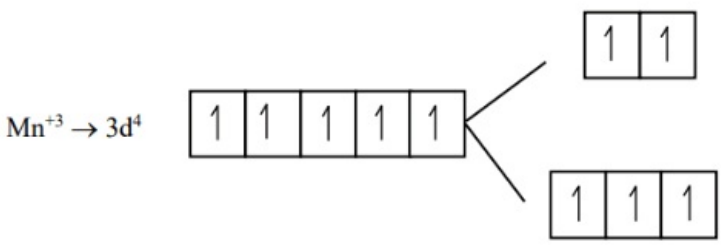
(B) $V^{+2} \rightarrow 3d^3$

CFSE $= -0.4 \times t_{2g} + 0.6 \times eg + xp$

$= -0.4 \times 3 + 0.6 \times 0 + xp$

$= -1.2$

(C)

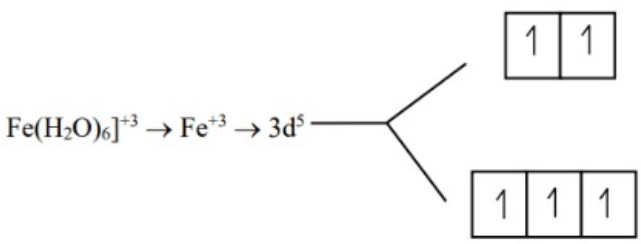


CFSE $= -0.4 \times t_{2g} + 0.6 \times eg + xp$

$-0.4 \times 3 + 0.6 \times 1 + xp$

$= -1.2 + 0.6 = 0.6$

(D)



CFSE $= -0.4 \times t_{2g} + 0.6 \times eg + xp$

$= -0.4 \times 3 + 0.6 \times 2$

$= -1.2 + 1.2$

$= 0$

Question52

The correct order of the number of unpaired electrons in the given complexes is

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

B. $[FeF_6]^{3-}$

C. $[CoF_6]^{3-}$

D. $[Cr(\ \text{oxalate}\ )_3]^{3-}$

E. $[Ni(CO)_4]$

Choose the correct answer from the options given below:
[10-Apr-2023 shift 2]

Options:

A. E < A < D < C < B

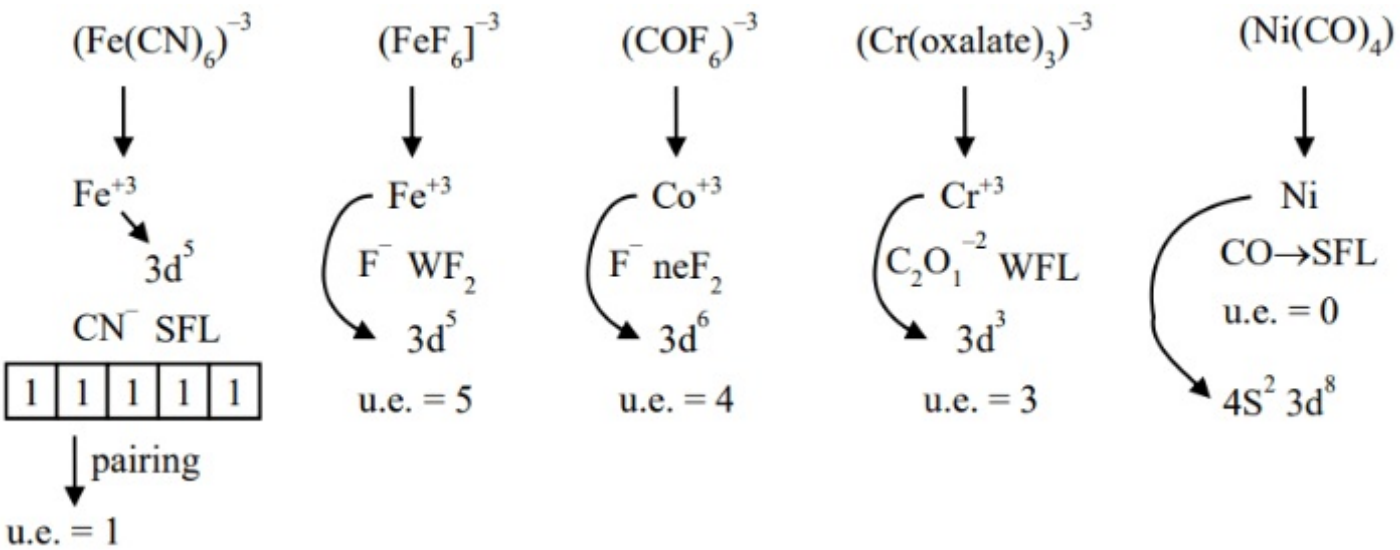
B. A < E < C < B < D

C. A < E < D < C < B

D. E < A < B < D < C

Answer: A

Solution:



Question53

The complex that dissolves in water is
[11-Apr-2023 shift 1]

Options:

A. $[Fe_3(OH)_2(OAc)_6]Cl$

B. $Fe_4[Fe(CN)_6]_3$

C. $K_3[Co(NO_2)_6]$

D. $(NH_4)_3[As(Mo_3O_{10})_4]$

Answer: A

Solution:

Solution:
$Fe_4[Fe(CN)_6]_3$ Prussian Blue-water insoluble
$K_3[Co(NO_2)_6]$ very poorly water soluble
$(NH_4)_3[As(MO_3O_{10})_4]$ water insoluble
ammonium arseno molybdate
$[Fe_3(OH)_2(OAc)_6]Cl$ is water soluble.

Question54

The set which does not have ambidentate ligand (s) is [11-Apr-2023 shift 1]

Options:

A. $C_2O_4^{2-}$, NO_2^-, NCS^-

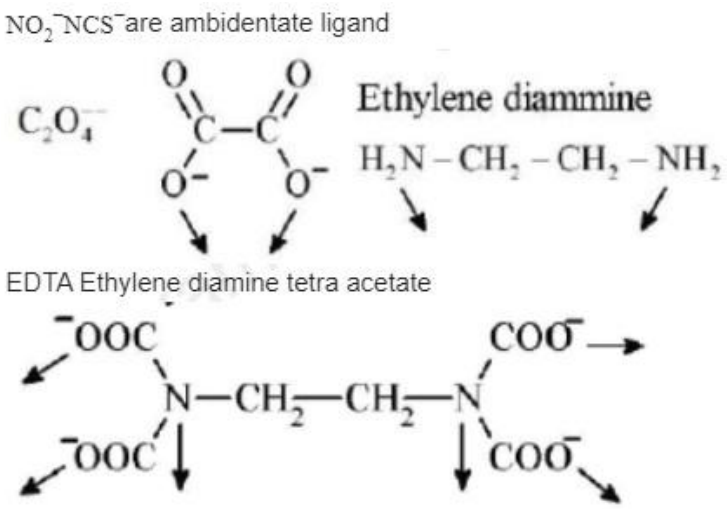
B. $EDTA^{4-}$, NCS^-, $C_2O_4^{2-}$

C. NO_2^-, $C_2O_4^{2-}$, $EDTA^{4-}$

D. $C_2O_4^{2-}$, ethylene diamine, H_2O

Answer: D

Solution:



Question55

Which of the following complex has a possibility to exist as meridional isomer?

[11-Apr-2023 shift 1]

Options:

A. $[Co(en)_2Cl_2]$

B. $[Pt(NH_3)_2Cl_2]$

C. $[Co(en)_3]$

D. $[Co(NH_3)_3(NO_2)_3]$

Answer: D

Solution:

Solution:
$[MA_3B_3]$ type of compound exists as facial and meridional isomer.

Question56

The ratio of spin-only magnetic moment values μ_{eff} $[Cr(CN)_6]^{3-}$ / μ_{eff} $[Cr(H_2O)_6]^{3+}$ is _____.
[11-Apr-2023 shift 1]

Answer: 1

Solution:

Solution:
Spin magnetic moment of $[Cr(CN)_6]^{3-}(t_{2g}^3 eg_g^0)$
$\mu_1 = \sqrt{3(3+2)} = \sqrt{15}$ BM
Spin magnetic moment of $[Cr(H_2O)_6]^{3+}(t_{2g}^3 eg_g^0)$
$\mu_2 = \sqrt{3(3+2)} = \sqrt{15}$ BM
$\frac{\mu_1}{\mu_2} = \frac{\sqrt{51}}{\sqrt{51}} = 1$

Question57

If Ni^{2+} is replaced by Pt^{2+} in the complex $[NiCl_2Br_2]2^-$, which of the

following properties are expected to get changed?
A. Geometry
B. Geometrical isomerism
C. Optical isomerism
D. Magnetic properties
[11-Apr-2023 shift 2]

Options:

A. A, B and C

B. A and D

C. B and C

D. A, B and D

Answer: D

Solution:

Solution:
$[NiBr_2Cl_2]^{2-}$→ This complex species is tetrahedral as Br^{Θ}&Cl^{Θ} are weak field ligands.
$[PtBr_2Cl_2]^{2-}$→ As Pt belongs to 5d series. This complex species is square planar.
Both the complex species are optically inactive.
$[NiBr_2Cl_2]^{2-}$, being tetrahedral does not show Geometrical Isomerism.
$[PtBr_2Cl_2]^{2-}$ shows two Geometrical Isomers.

Question58

Match List I with List II

List I Complex	List I Colour
A. $Mg(NH_4)PO_4$	I. Brown
B. $K_3[Co(NO_2)_6]$	II. White
C. $MnO(OH)_2$	III. Yellow
D. $Fe_4[Fe(CN)_6]_3$	IV. blue

Choose the correct answer from the options given below:
[11-Apr-2023 shift 2]

Options:

A. A-II, B-III, C-IV, D-I

B. A-II, B-IV, C-I, D-III

C. A-III, B-IV, C-II, D-I

D. A-II, B-III, C-I, D-IV

Answer: D

Solution:

$Mg(NH_4)PO_4 \Rightarrow$ White
$K_3[Co(NO_2)_6] \Rightarrow$ Yellow
$MnO(OH)_2 \Rightarrow$ Brown
$Fe_4[Fe(CN)_6]_3 \Rightarrow$ Blue

Question59

Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : $[CoCl(NH_3)_5]^{2+}$ absorbs at lower wavelength of light with respect to $[CoCl(NH_3)_5(H_2O)]^{3+}$
Reason R : It is because the wavelength of the light absorbed depends on the oxidation state of the metal ion.
In the light of the above statements, choose the correct answer from the options given below:
[11-Apr-2023 shift 2]

Options:

A. Both A and R are true but R is NOT the correct explanation of A

B. A is true but R is false

C. Both A and R are true and R is the correct explanation of A

D. A is false but R is true

Answer: D

Solution:

Solution:
Since H_2O is strong field ligand compared to chloride and Co^{3+} ion is present.
$\therefore$ CFSE is higher for $[Co(NH_3)_5H_2O]^{+3}$, hence it will absorb at lower wavelength.

Question60

The magnetic moment is measured in Bohr Magneton (BM). Spin only magnetic moment of Fe in $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3-}$ complexes respectively is:
[11-Apr-2023 shift 2]

Options:

A. 3.87 B. M. and 1.732 B.M.

B. 6.92 B.M. in both

C. 5.92 B.M. and 1.732 B.M.

D. 4.89 B.M. and 6.92 B.M.

Answer: C

Solution:

Solution:

$[Fe(H_2O)_6]^{3+}$

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

No pairing

1	1	1	1	1

$\therefore$ Unpaired $e^- = 5$

$\mu = \sqrt{n(n+2)}$

$= \sqrt{5(5+2)}$

$\mu = \sqrt{35} = 5.92$ B.M.

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

1↓	1↓	1	1	1

$\therefore$ Unpaired $e^- = 1$

$\mu = \sqrt{n(n+2)}$

$= \sqrt{1(1+2)} = \sqrt{3} = 1.732$ B.M.

Question61

Match List I with List II

LIST I Complex		LIST II CFSE (Delta(Δ_0)	
A.	$[Cu(NH_3)_6]^{2+}$	I.	−0.6
B.	$[Ti(H_2O)_6]^{3+}$	II.	-2.0
C.	$[Fe(CN)_6]^{3-}$	III.	-1.2
D.	$[NiF_6]^{4-}$	IV.	-0.4

Choose the correct answer from the options given below: [12-Apr-2023 shift 1]

Options:

A. A-III, B-IV, C-I, D-II

B. A-II, B-III, C-I, D-IV

C. A-I, B-IV, C-II, D-III

D. A-I, B-II, C-IV, D-III

Answer: C

Solution:

Solution:

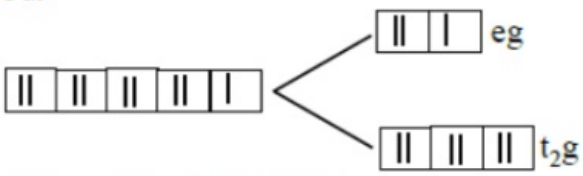
$(Cu(NH_3)_6)^{+2}$

↑

Cu+2

↑

3d9



$CSf: -0.4 \times 6 + 3 \times 0.6 + xp$

$-2.4 + 1.8$

$= -0.6$

$Ti(H_2O)_6^{+3}$

↓ , $CFse = -0.4$

$Ti^{+3} \rightarrow 3d^1$

$Ti(H_2O)_6^{+3}$

↓

$Ti^{+3} \rightarrow 3d^1$

Question62

The mismatched combinations are
A. Chlorophyll - Co
B. Water hardness - EDTA
C. Photography $-[Ag(CN)_2]^-$
D. Wilkinson catalyst - $[(Ph_3P)_3RhCl]$
E. Chelating ligand - D-Penicillamine
Choose the correct answer from the options given below :
[13-Apr-2023 shift 1]

Options:

A. A and C Only

B. D and E Only

C. A and E Only

D. A, C, and E Only

Answer: A

Solution:

Solution:
Mg is present in chlorophyll and in black and white photography the developed film is fixed by washing with hypo solution which dissolves the undecomposed AgBr to form a complex ion $[Ag(S_2O_3)_2]^{3-}$

Question63

The covalency and oxidation state respectively of boron in $[BF_4]^-$, are : [13-Apr-2023 shift 2]

Options:

A. 3 and 5

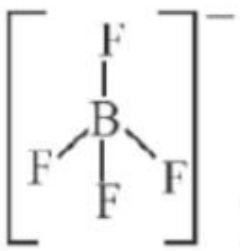
B. 4 and 3

C. 4 and 4

D. 3 and 4

Answer: B

Solution:



Number of covalent bond formed by Boron is 4
Oxidation number of fluorine is -1 ,
Oxidation number of $B + 4 \times (-1) = -1$,
Thus, Oxidation number of $B = +3$

Question64

Which of the following complexes will exhibit maximum attraction to an applied magnetic field? [13-Apr-2023 shift 2]

Options:

A. $[Zn(H_2O)_6]^{2+}$

B. $[Ni(H_2O)_6]^{2+}$

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

D. $[Co(H_2O)_6]^{2+}$

Answer: D

Solution:

Solution:
Complex with maximum number of unpaired electron will exhibit maximum attraction to an applied magnetic field
$[Zn(H_2O)_6]^{2+} \rightarrow d^{10}$ system $\rightarrow t_{2g}^{6}$ eg ^{4}, 0 unpaired e^-
$[Co(H_2O)_6]^{2+} \rightarrow d^{7}$ system $\rightarrow t_{2g}^{5}$ eg ^{2}, 3 unpaired e^-
$[Co(en)_3]^{3+} \rightarrow d^{6}$ system $\rightarrow t_{2g}^{6}eg^{0}$, 0 unpaired e^-
$[Ni(H_2O)_6]^{2+} \rightarrow d^{8}$ system $\rightarrow t_{2g}^{6}$ eg ^{2}, 2 unpaired e^-

---

Question65

The total number of stereoisomers for the complex $[Cr(ox)_2ClBr]^{3-}$(where ox = oxalate) is : [13-Apr-2023 shift 2]

Options:

A. 3

B. 1

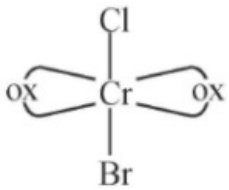
C. 4

D. 2

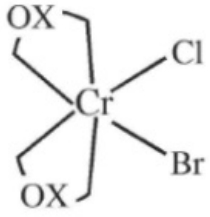
Answer: A

Solution:

Solution:
$[Cr(Ox)_2ClBr]^{-3}$
- No. of isomers-



- This structure has plane of symmetry, So no optical isomerism will be shown.



- This structure does not contain plane of symmetry, So two forms d as well as 1 will be shown.

Question66

The complex with highest magnitude of crystal field splitting energy (Δ_0) is
[15-Apr-2023 shift 1]

Options:

A. $[Mn(OH_2)_6]^{3+}$

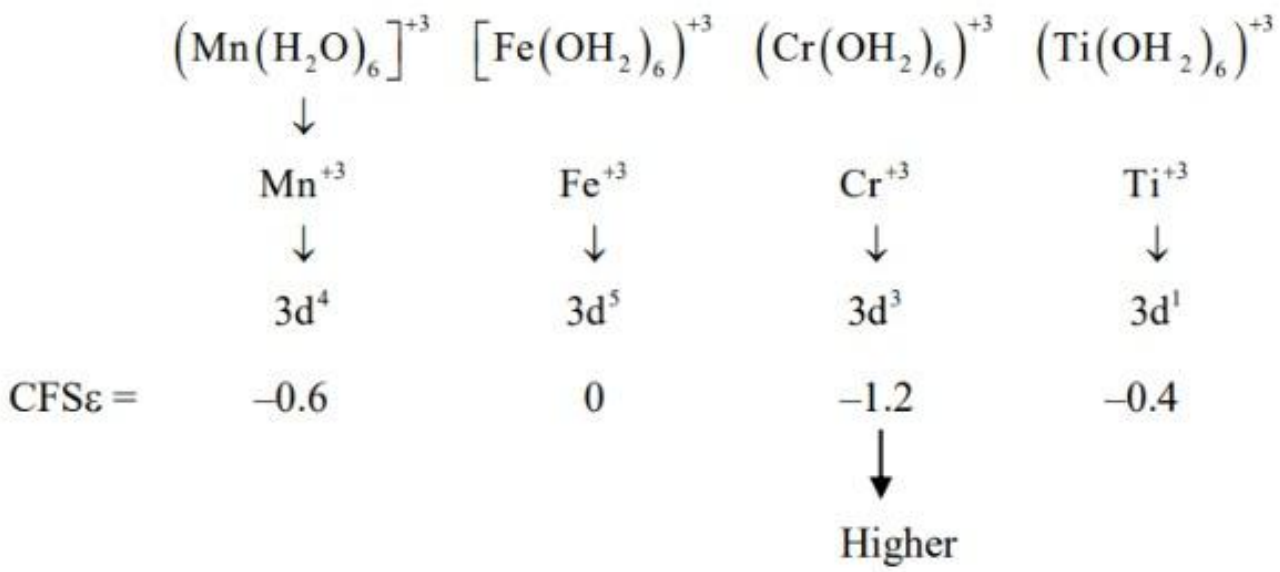
B. $[Fe(OH_2)_6]^{3+}$

C. $[Cr(OH_2)_6]^{3+}$

D. $[Ti(OH_2)_6]^{3+}$

Answer: C

Solution:



Question67

The volume (in mL) of 0.1M$AgNO_3$ required for complete precipitation of chloride ions present in 20 mL of 0.01M solution of $[Cr(H_2O)_5Cl]Cl_2$ as silver chloride is _____.
[15-Apr-2023 shift 1]

Answer: 4

Solution:

$[Cr(H_2O)_5Cl]Cl_2 + 2AgNO_3 \rightarrow$
0.01M, 20 mL 0.1M
For 0.2 milimole $AgNO_3$ required
= 0.4 milimole
0.4 = 0.1 × V(ml)
V = 4 mL

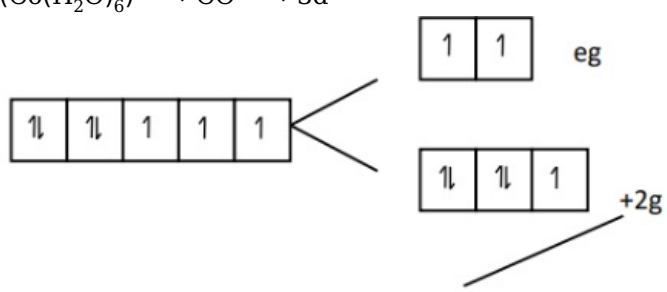
Question68

The homoleptic and octahedral complex of Co^{2+} and H_2O has _____ unparied electrons(s) in the t_{2g} set of orbitals.
[15-Apr-2023 shift 1]

Answer: 1

Solution:

Solution:
$(Co(H_2O)_6)^{+2} \rightarrow CO^{+2} \rightarrow 3d^7$



u.e. in t_2g is = (1)

Question69

List-1		List -II	
(A)	$[PtCl_4]^{2-}$	I	sp^3d
(B)	BrF_5	II	d^2sp^3
(C)	PCl_5	III	dsp^2
(D)	$[CoNH_{36}]^{3+}$	IV	sp^3d^2

Choose the most appropriate answer from the options given below :
[24-Jun-2022-Shift-1]

Options:

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

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

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

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

Answer: B

Solution:

Solution:

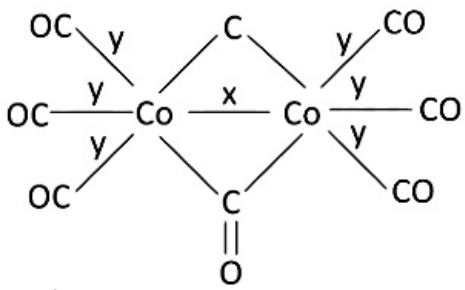
Question70

In the cobalt-carbonyl complex : $[CO_2(CO)_8]$, number of Co − Co bonds is "X" and terminal CO ligands is "Y". X + Y = [24-Jun-2022-Shift-1]

Answer: 7

Solution:

Solution:



x = 1
y = 6
∴x + y = 7

Question71

Transition metal complex with highest value of crystal field splitting (Δ_0) will be [24-Jun-2022-Shift-2]

Options:

A. $[Cr(H_2O)_6]^{3+}$

B. $[Mo(H_2O)_6]^{3+}$

C. $[Fe(H_2O)_6]^{3+}$

D. $[Os(H_2O)_6]^{3+}$

Answer: D

Solution:

Solution:
Crystal field splitting (Δ_0) for octahedral complexes depends on oxidation state of the metal as well as to which transition series the metal belongs. For the same oxidation state, the crystal field splitting (Δ_0) increases as we move from
$3d \rightarrow 4d \rightarrow 5d$
Cr^{3+} and Fe^{3+} belong to 3d series, Mo^{3+} belongs to 4d series and Os^{3+} belongs to 5d series.
Therefore crystal field splitting (Δ_0) is highest for $[Os(H_2O)_6]^{3+}$.

Question72

White precipitate of AgCl dissolves in aqueous ammonia solution due to formation of :
[25-Jun-2022-Shift-1]

Options:

A. $[Ag(NH_3)_4]Cl_2$

B. $[Ag(Cl)_2(NH_3)_2]$

C. $[Ag(NH_3)_2]Cl$

D. $[Ag(NH_3)Cl]Cl$

Answer: C

Solution:

Solution:
$AgCl + 2NH_3 \rightarrow \underset{\text{Soluble}}{[Ag(NH_3)_2]^+Cl^-}$

Question73

If $[Cu(H_2O)_4]^{2+}$ absorbs a light of wavelength 600 nm for d − d transition, then the value of octahedral crystal field splitting energy for $[Cu(H_2O)_6]^{2+}$ will be ____$\times 10^{-21}$J. [Nearest Integer]
(Given : h = 6.63×10^{-34} Js and c = $3.08 \times 10^{8} ms^{-1}$)
[25-Jun-2022-Shift-1]

Answer: 745

Solution:

$[Cu(H_2O)_4]^{2+}$ is tetrahedral
$[Cu(H_2O)_6]^{2+}$ is octahedral

$\because \Delta_t = \frac{4}{9} \times \Delta_0$

$$\Delta_t = \frac{6.63 \times 10^{-34} \times 3.08 \times 10^8}{600 \times 10^{-9}}$$

$$\Delta_0 = \frac{9}{4} \times \frac{6.63 \times 10^{-34} \times 3.08 \times 10^8}{600 \times 10^{-9}} \approx 765 \times 10^{-21} J$$

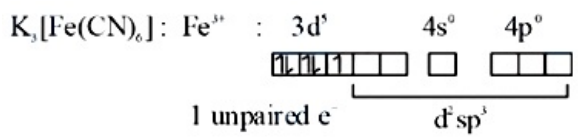
Question74

Amongst $FeCl_3 \cdot 3H_2O$, $K_3[Fe(CN)_6]$ and $[Co(NH_3)_6]Cl_3$, the spin-only magnetic moment value of the innerorbital complex that absorbs light at shortest wavelength is_____ B.M. [nearest integer] [25-Jun-2022-Shift-2]

Answer: 2

Solution:

Solution:
$[Fe(H_2O)_3Cl_3]$, $K_3[Fe(CN)_6]$, $[Co(NH_3)_6]Cl_3$
inner orbital complexes
$K_3[Fe(CN)_6]$ has more value of Δ_0 than that of $[Co(NH_3)_6]Cl_3$; as $\overline{C}N$ is stronger ligand.
More $\Delta_0 \Rightarrow$ smaller value of absorbed λ



Spin only magnetic moment (μ) = $\sqrt{3}$ BM = 1.732 BM
Rounding off $\Rightarrow$2

Question75

Which statement is not true with respect to nitrate ion test? [26-Jun-2022-Shift-1]

Options:

A. A dark brown ring is formed at the junction of two solutions.

B. Ring is formed due to nitroferrous sulphate complex.

C. The brown complex is $[Fe(H_2O)_5(NO)]SO_4$.

D. Heating the nitrate salt with conc. H_2SO_4, light brown fumes are evolved.

Answer: B

Solution:

Brown ring test

$NO_3^- + 3Fe^{+2} + 4H^+ \rightarrow NO + 3Fe^{+3} + 2H_2O$

$[Fe(H_2O)_6]^{2+} NO \rightarrow \underset{\text{Brown ring}}{[Fe(H_2O)_5 NO]^{2+}} H_2O$

Question76

The spin-only magnetic moment value of an octahedral complex among $CoCl_3 \cdot 4NH_3$, $NiCl_2 \cdot 6H_2O$ and $PtCl_4 \cdot 2\,HCl$, which upon reaction with excess of $AgNO_3$ gives 2 moles of AgCl is ___B.M. (Nearest integer)
[26-Jun-2022-Shift-1]

Answer: 3

Solution:

$CoCl_3 \cdot 4NH_3 \xrightarrow[\text{excess}]{AgNO_3} [Co(NH_3)_4 \cdot Cl_2] + AgCl$

$NiCl_2 \cdot 6H_2O \xrightarrow[\text{excess}]{AgNO_3} [Ni(H_2O)_6]^{2+} + 2\,AgCl$

$PtCl_4 \cdot 2\,HCl \longrightarrow [PtCl_6]^{4-} + \text{No AgCl ppt}$

$[Ni^{+2}(H_2O)_6] = d^8 = t2_g e_g^{\,2} = 2$ unpaired electrons

Magnetic moment $= \sqrt{2(2+2)}$

$2\sqrt{8} \approx 3$

Question77

Reaction of $[Co(H_2O)_6]^{2+}$ with excess ammonia and in the presence of oxygen results into a diamagnetic product. Number of electrons present in t_{2g}-orbitals of the product is__
[26-Jun-2022-Shift-2]

Answer: 6

Solution:

Solution:
$[Co(H_2O)_6]^{2+} + NH_3$ (excess) $\rightarrow [Co(NH_3)_6]^{3+} + 6H_2O$
Diamagnetic
↓
Low spin complex
$Co^{3+} \Rightarrow 3d^6 4s^0$
$\Rightarrow t_{2g}^6 e_g^0$
Total number electrons = 6

Question78

Which of the following will have maximum stabilization due to crystal field?
[27-Jun-2022-Shift-1]

Options:

A. $[Ti(H_2O)_6]^{3+}$

B. $[Co(H_2O)_6]^{2+}$

C. $[Co(CN)_6]^{3-}$

D. $[Cu(NH_3)_4]^{2+}$

Answer: C

Solution:

Solution:
The given complexes are:
$[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{2+}$, $[Co(CN)_6]^{-3}$, $[Cu(NH_3)_4]^{2+}$
CN^- is the strongest ligand among the given complexes CFSE value for the $[Co(CN)_6]^{-3}$ complex will be highest as it has d^6 configuration with a CFSE value of $-2.40\ \Delta_0 + 2P$, where P represents pairing energy and Δ_0 represents splitting energy in octahedral field.
The value of Δ_0 is high for cyanide complexes.

Question79

Arrange the following coordination compounds in the increasing order of magnetic moments. (Atomic numbers : Mn = 25; Fe = 26)
A. $[FeF_6]^{3-}$
B. $[Fe(CN)_6]^{3-}$
C. $[MnCl_6]^{3-}$ (high spin)

D. $[Mn(CN)_6]^{3-}$

Choose the correct answer from the options given below :
[27-Jun-2022-Shift-2]

Options:

A. A < B < D < C

B. B < D < C < A

C. A < C < D < B

D. B < D < A < C

Answer: B

Solution:

Solution:

Coordination Compound	Number of unpaired $e^-(n)$	Magnetic moment $(\mu)(B.M)$
A. $[FeF_6]^{3-} - d^5$	5	5.91
B. $[Fe(CN)_6]^{3-} - d^5$	1	1.73
C. $[MnCl]_6]^{3-} - d^4$	4	4.89
D. $[Mn(CN)_6]^{3-} - d^4$	2	2.82

Hence, correct order of magnetic moment is 2 < 4 < 3 < 1

Question80

Given below are two statements :
Statement I : $[Ni(CN)_4]^{2-}$ is square planar and diamagnetic complex, with dsp ^{2} hybridization for Ni but $[Ni(CO)_4]$ is tetrahedral, paramagnetic and with sp^3-hybridication for Ni.
Statement II : $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both have same d-electron configuration have same geometry and are paramagnetic.
In light the above statements, choose the correct answer from the options given below :
[28-Jun-2022-Shift-1]

Options:

A. Both Statement I and Statement II are true.

B. Both Statement I and Statement II are false.

C. Statement I is correct but Statement II is false.

D. Statement I is false but Statement II is correct.

Answer: B

Solution:

Solution:
$[Ni(CN)_4]^{2-}$: d^8 configuration, SFL, sq. planar splitting (dsp^2), diamagnetic.
$[Ni(CO)_4]$: d^{10} config (after excitation), SFL, tetrahedral splitting (sp^3), diamagnetic.
$[NiCl_4]^{2-}$: d^8 config, WFL, tetrahedral splitting (sp^3), paramagnetic (2. unpaired e^-).

Question81

Number of complexes which will exhibit synergic bonding amongst, $[Cr(CO)_6]$, $[Mn(CO)_5]$ and $[Mn_2(CO)_{10}]$ is___
[28-Jun-2022-Shift-1]

Answer: 3

Solution:

Solution:
Carbonyl complex compounds have tendency to show synergic bonding.

Question82

$[Fe(CN)_6]^{4-}$
$[Fe(CN)_6]^{3-}$
$[Ti(CN)_6]^{3-}$
$[Ni(CN)_4]^{2-}$
$[Co(CN)_6]^{3-}$
Among the given complexes, number of paramagnetic complexes is____
[28-Jun-2022-Shift-2]

Answer: 2

Solution:

$[Fe(CN)_6]^{4-}$ Diamagnetic
$[Fe(CN)_6]^{3-}$ Paramagnetic (1 unpaired electron)
$[Ti(CN)_6]^{3-}$ Paramagnetic (1 unpaired electron)
$[Ni(CN)_4]^{2-}$ Diamagnetic
$[Co(CN)_6]^{3-}$ Diamagnetic

Question83

(a) $CoCl_3 \cdot 4NH_3$,
(b) $CoCl_3.5NH_3$,
(c) $CoCl_3 \cdot 6NH_3$ and
(d) $CoCl(NO_3)_2 \cdot 5NH_3$.
Number of complex(es) which will exist in cis-trans form is/are_____
[28-Jun-2022-Shift-2]

Answer: 1

Solution:

Solution:
$CoCl_3 \cdot 4NH_3 \Rightarrow [Co(NH_3)_4Cl_2]Cl$
$CoCl_3 \cdot 5NH_3 \Rightarrow [Co(NH_3)_5Cl]Cl_2$
$CoCl_3 \cdot 6NH_3 \Rightarrow [Co(NH_3)_6]Cl_3$
Only $[Co(NH_3)_4Cl_2]$ can show geometrical isomerism. Hence can exist in cis-trans form.

Question84

Given below are two statements.
- Statement I : In $CuSO_4 \cdot 5H_2O$, Cu − O bonds are present.
- Statement II : In $CuSO_4 \cdot 5H_2O$, ligands coordinating with Cu(II) ion are O-and S-based ligands.
In the light of the above statements, choose the correct answer from the options given below.
[29-Jun-2022-Shift-2]

Options:

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are incorrect.

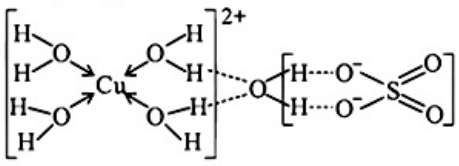
C. Statement I is correct but Statement II is incorrect.

D. Statement I is incorrect but Statement II is correct.

Answer: C

Solution:

Solution:
Statement I is true but statement II is false. Only oxygen atom forms a Co-ordinate bond with Cu^{+2} in $CuSO_4 \cdot 5H_2O$



Question85

Spin only magnetic moment of $[MnBr_6]^{4-}$ is _____ B.M. (round off to the closest integer)
[29-Jun-2022-Shift-2]

Answer: 6

Solution:

$Mn^{2+} \rightarrow t_{2g^{111}}e_{g^{11}}$

$\mu_s = \sqrt{35}$

$= 5.91$

$= 6$

Question86

Consider the following metal complexes:
$[Co(NH_3)_6]^{3+}$
$[CoCl(NH_3)_5]^{2+}$
$[Co(CN)_6]^{3-}$
$[Co(NH_3)_5(H_2O)]^{3+}$
The spin-only magnetic moment value of the complexthat absorbes light with shortest wavelength is
B. M. (Nearest integer)
[25-Jul-2022-Shift-1]

Answer: 0

Solution:

Solution:
$\Delta_0 \propto \frac{1}{\lambda}$
Here, CN^-being SFL will have maximum CFSE
So, $[Co(CN)_6]^{3-}$ will be $d^2 sp^3$, $\mu = 0$

Question87

The correct order of energy of absorption for the following metal complexes is
A : $[Ni(en)_3]^{2+}$, B : $[Ni(NH_3)_6]^{2+}$, C : $[Ni(H_2O)_6]^{2+}$
[25-Jul-2022-Shift-2]

Options:

A. C < B < A

B. B < C < A

C. C < A < B

D. A < C < B

Answer: A

Solution:

Solution:
Stronger is ligand attached to metal ion, greater will be the splitting between t_2g and eg (hence greater will be ΔU)
$\therefore$ greater will be absorption of energy.
Hence correct order
$[Ni(en)_3]^{2+} > [Ni(NH_3)_6]^{2+} > [Ni(H_2O)_6]^{2+}$

Question88

The difference between spin only magnetic moment values of $[Co(H_2O)_6]Cl_2$ and $[Cr(H_2O)_6]Cl_3$ is _____.
[26-Jul-2022-Shift-1]

Answer: 0

Solution:

Solution:
Co → $4s^2 3d^7$
H_2O is weak field ligand.
$Co^{+2} \rightarrow 3d^7$
n = 3 $\mu_1 = \sqrt{n(n+2)}$
$= \sqrt{15}$ B.M.
$Cr \rightarrow 4s^1 3d^5$
$Co^{+3} \rightarrow 3d^3$
n = 3 $\mu_2 = \sqrt{15}$ B.M.
$\mu_1 - \mu_2 = 0$

Question89

The metal complex that is diamagnetic is (Atomic number: Fe, 26; Cu, 29) [26-Jul-2022-Shift-2]

Options:

A. $K_3[Cu(CN)_4]$

B. $K_2[Cu(CN)_4]$

C. $K_3[Fe(CN)_4]$

D. $K_4[FeCl_6]$

Answer: A

Solution:

Solution:
$\Rightarrow K_3[Cu(CN)_4]$ is diamagnetic
Cu(I) $\Rightarrow d^{10}$ configuration $\Rightarrow$ No unpaired electrons.
$\Rightarrow K_2[Cu(CN)_4]$, $K_3[Fe(CN)_4]$ and $K_4[FeCl_6]$ are paramagnetic in nature

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Question90

The conductivity of a solution of complex with formula $CoCl_3(NH_3)_4$ corresponds to 1 : 1 electrolyte, then the primary valency of central metal ion is _____. [27-Jul-2022-Shift-1]

Answer: 3

Solution:

In 1: 1 type of electrolyte the ions have $+1$ and -1 charge on them
$\therefore$ Possible compound is $\rightarrow [Co(NH_3)_4 Cl_2]^+ Cl^-$
Oxidation state of central atom represents the total number of primary valency
$\therefore$ Primary valency will be 3 .

Question91

Low oxidation state of metals in their complexes are common when ligands:
[27-Jul-2022-Shift-2]

Options:

A. have good π-accepting character

B. have good σ-donor character

C. are having good π-donating ability

D. are having poor σ-donating ability

Answer: A

Solution:

Solution:
Ligands like :CO, are sigma donor and π-acceptor and they make stronger bond with lower oxidation state metal ion, in this case back bonding is more effective

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Question92

Fe^{3+} cation gives a prussian blue precipitate on addition of potassium ferrocyanide solution due to the formation of :
[27-Jul-2022-Shift-2]

Options:

A. $[Fe(H_2O)_6]_2[Fe(CN)_6]$

B. $Fe_2[Fe(CN)_6]_2$

C. $Fe_3[Fe(OH)_2(CN)_4]_2$

D. $Fe_4[Fe(CN)_6]_3$

Answer: D

Solution:

Solution:
$4Fe^{3+} + 3[Fe(CN)_6]^{-4} \longrightarrow Fe_4[Fe(CN)_6]_3$

Question93

The spin only magnetic moment of the complex present in Fehling's reagent is _____ B.M.
(Nearest integer).
[27-Jul-2022-Shift-2]

Answer: 2

Solution:

Fehling solution is a complex of Cu^{++}
$Cu^{++} = 3d^9$
No. of unpaired $e^- = 1$
$M.M = \sqrt{1(1+2)} = \sqrt{3} = 1.73\,BM$

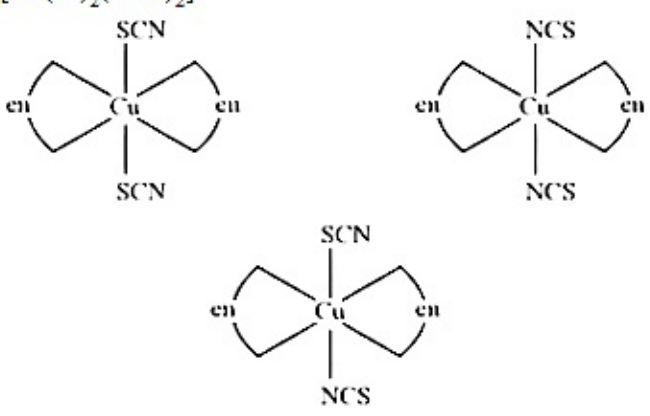
Question94

Total number of relatively more stable isomer(s) possible for octahedral complex $[Cu(en)_2(SCN)_2]$ will be _____.
[28-Jul-2022-Shift-1]

Answer: 3

Solution:

$[Cu(en)_2(SCN)_2]$



Question95

Match List I with List II

List - I (Complex)	List - II (Hybridization)
(A) $Ni(CO)_4$	(I) sp^3
(B) $[Ni(CN)_4]^{2-}$	(II) sp^3d^2
(C) $[Co(CN)_6]^{3-}$	(III) d^2sp^3
(D) $[CoF_6]^{3-}$	(IV) dsp^2

Choose the correct answer from the options given below: [28-Jul-2022-Shift-2]

Options:

A. A-IV, B-I, C-III, D-II

B. A-I, B-IV, C-III, D-II

C. A-I, B-IV, C-II, D-III

D. A-IV, B-I, C-II, D-III

Answer: B

Solution:

Solution:
$Ni(CO)_4$ Hybridisation sp^3
$[Ni(CN)_4]^{2-}$ Hybridisation dspe2
$[Co(CN)_6]^{3-}$ Hybridisation $d^2\ sp^3$
$[Co(F)_6]^{3-}$ Hybridisation sp^3d^2

Question96

$[Fe(CN)_6]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is (−) _____ Δ_0. (Nearest integer) [29-Jul-2022-Shift-1]

Answer: 2

Solution:

Solution:
In $[Fe(CN)^6]^{3-}$, Fe is present in (+3) oxidation state Fe(III)⇒ inner orbital complex ⇒d^5 (with pairing)
Configuration ⇒t_{2g}^5

$\text{CFSE} = 5 \times \frac{-2}{5}\Delta_0 = -2\Delta_0$

Question97

Octahedral complexes of copper(II) undergo structural distortion (Jahn-Teller). Which one of the given copper (II) complexes will show the maximum structural distortion? (en - ethylenediamine; $.H_2N\_CH_2 - CH_2 - NH_2$)

[29-Jul-2022-Shift-2]

Options:

A. $[Cu(H_2O)_6]SO_4$

B. $[Cu(en)(H_2O)_4]SO_4$

C. cis- $[Cu(en)_2\,Cl_2]$

D. trans$-[Cu(en)_2\,Cl_2]$

Answer: A

Solution:

Solution:
According to John teller any nonlinear molecular system in a degenerate electronic state will be unstable and will undergo some kind of distortion which will lower its symmetry and energy and split the degenerate state.
In case of octahedral d^9 configuration, the last electron may occupy either d^2 or $d_{x^2y^2}$ orbitals of e_g set.
If it occupies dz^2 orbital most of the electron density will be concentrated between the metal and the two ligands on the z axis. Thus there will be greater electrostatic repulsion associated with these ligands than with the other four on xy plane. The Jahn Teller effect is mostly observed in octahedral environments. The considerable distortions are usually observed in high spin d^4, low spin d^7 and d^9 configuration.

Question98

Sum of oxidation state (magnitude) and coordination number of cobalt in $Na \cdot [Co(bpy)\,Cl_4]$ is _____.

[29-Jul-2022-Shift-2]

Answer: 9

Solution:

$Na[Co(bpy)\,Cl_4]$
Oxidation state of cobalt $= +3$
Coordination number of cobalt $= 6$

[As bpy is bidentate]
So, sum = 9

Question99

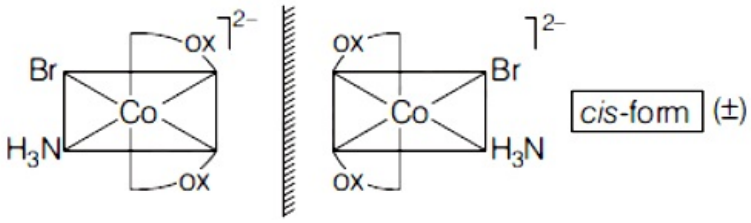
The number of stereoisomers possible for $[Co(OX)_2(Br)(NH_3)]^{2-}$ is ..... .[ox = Oxalate].
[26 Feb 2021 Shift 2]

Answer: 3

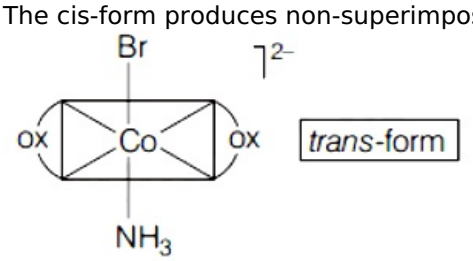
Solution:

Solution:

The coordination compound $[\overset{III}{Co}(ox)_2(Br)(NH_3)]^{2-}$ of general formula $[M(A-A)_2BC]$ can show both geometrical and optical isomerism (stereoisomerism).



The cis-form produces non-superimposable mirror images, i.e. enantiomeric pairs (optically active)



The trans-form is optically inactive.
So, total number of stereoisomers possible
= cis(±) + trans = 3

Question100

Given below are two statements.
Statement I The identification of Ni^{2+} is carried out by dimethyl glyoxime in the presence of NH_4OH.
Statement II The dimethyl glyoxime is a bidentate neutral ligand.
In the light of the above statements, choose the correct answer from the options given below.
[25 Feb 2021 Shift 2]

Options:

A. Both statements I and II are true.

B. Both statements I and II are false.

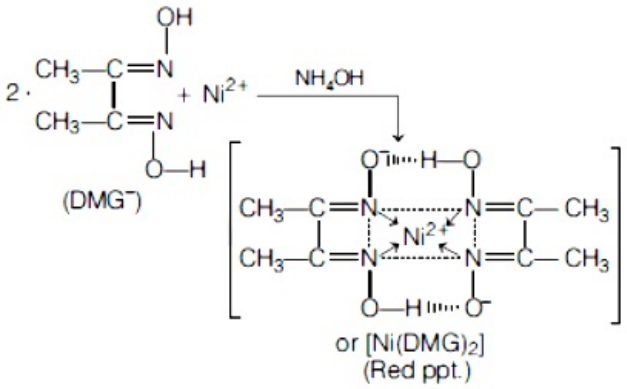
C. Statement I is true but statement II is false.

D. Statement I is false but statement II is true.

Answer: A

Solution:

Solution:
Both statements are true. Dimethyl glyoxime (DMG) is a neutral bidentate ligand (DMG^-).
Ni^{2+} ion is identified with DMG in presence of NH_4OH to give a red ppt. Its reaction is as follows.



Question101

The stepwise formation of $[Cu(NH_3)_4]^{2+}$ is given below

$$Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} [Cu(NH_3)_2]^{2+}$$

$$[Cu(NH_3)]^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} [Cu(NH_3)_2]^{2+}$$

$$[Cu(NH_3)_2]^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} [Cu(NH_3)_3]^{2+}$$

$$[Cu(NH_3)_3]^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$$

The value of stability constants K_1, K_2, K_3 and K_4 are 10^4, 1.58×10^3, 5×10^2 and 10^2 respectively. The overall equilibrium constants for dissociation of $[Cu(NH_3)_4]^{2+}$ is $x \times 10^{-12}$. The value of x is___ (Rounded off to the nearest integer)
[24 Feb 2021 Shift 1]

Answer: 1

Solution:

$Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} [Cu(NH_3)]^{2+}$

$[Cu(NH_3)]^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} [Cu(NH_3)_2]^{2+}$

$[Cu(NH_3)_2]^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} [Cu(NH_3)_3]^{2+}$

$[Cu(NH_3)_3]^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$

$Cu^{2+} + 4NH_3 \overset{K}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$

So, $K = K_1 \times K_2 \times K_3 \times K_4$

$= 10^4 \times 1.58 \times 10^3 \times 5 \times 10^2 \times 10^2$

$\therefore K = 7.9 \times 10^{11}$

Where K = Equilibrium constant for formation of $[Cu(NH_3)_4]^{2+}$

So, equilibrium constant (K') for dissociation

of $[Cu(NH_3)_4]^{2+}$ is $\frac{1}{K}$

$K' = \frac{1}{K}$

$K' = \frac{1}{7.9 \times 10^{11}} = 1.26 \times 10^{-12} = (x \times 10^{-12})$

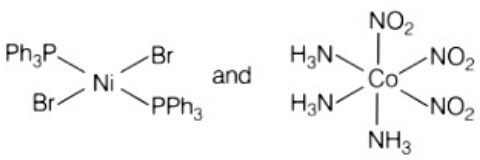
So, x = 1.26 ≈ 1.0.

Question102

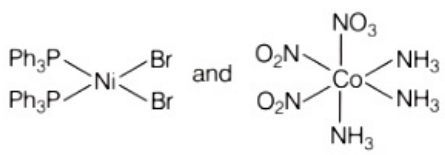
The correct structures of trans-$[NiBr(PPh_3)_2]$ and meridonial-$[Co(NH_3)_3(NO_2)_3]$, respectively are
[18 Mar 2021 Shift 1]

Options:

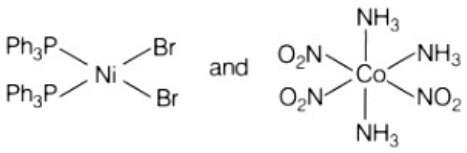
A.



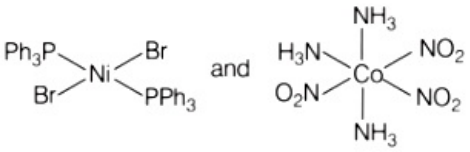
B.



C.



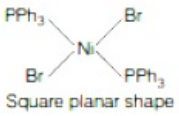
D.



Answer: D

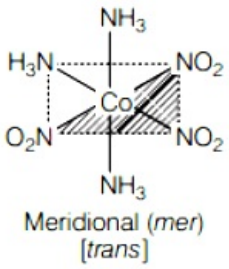
Solution:

Solution:
Trans $[N iBr_2(PPh_3)_2]$



Square planar shape

and meridional $[Co(N H_3)_3(N O_2)_3]$



Meridional (*mer*)
[*trans*]

Question103

Match List-I and List-II.

List I	List II
A. $[Co(NH_3)_6][Cr(CN)_6]$	1. Linkage isomerism
B. $[Co(NH_3)_3(NO_2)_3]$	2. Solvate isomerism
C. $[Cr(H_2O)_6]Cl_3$	3. Co-ordination isomerism
D. $cis-[CrCl_2(ox)_2]^{3-}$	4. Optical isomerism

[17 Mar 2021 Shift 2]

Options:

A. A-3 ,B-1 ,C-2 ,D-4

B. A-4 ,B-2 ,C-3 ,D-1

C. A-2 ,B-1 ,C-3 ,D-4

D. A-1 ,B-2 ,C-3 ,D-4

Answer: A

Solution:

A. Coordination isomerisms occurs in coordination salts in which there is an interchange of ligands between the metal in the cationic coordination spheres and the metal in the anionic coordination sphere.
$[Co(NH_3)_6][Cr(CN)_6] \Leftrightarrow [Co(CN)_6][Cr(NH_3)_6]$ (Coordinate isomerism)
B. Linkage isomerism occurs in coordination compounds that have the same composition but differ in the connectivity of the ligand to the metal. $[Co(NH_3)_3(NO_2)_3]$ shows linkage isomerism. NO_2 can connect through N and O donor sites.
C. Solvate isomerism is also known as 'hydrate isomerism' where water behaves as a ligand and water of crystallisation. e.g., The complex $[Cr(H_2O)_6]Cl_3$ (violet) contains water as a ligand and its solvate isomer $[Cr(H_2O)_5Cl]Cl_2H_2O$ (grey-green) contain water as a water of crystallisation.
D. Optical isomerism occurs mainly in compounds that are mirror images of each other. $cis[CrCl_2(ox)_2]^{3+}$ is chiral compound, hence shows optical isomerism.

Question104

The correct pair(s) of the ambident nucleophiles is(are)
A. $AgCN/KCN$
B. RCOOAg/RCOOK
C. $AgNO_2/KNO_2$
D. AgI/KI
[17 Mar 2021 Shift 2]

Options:

A. B and C

B. Only A

C. A and C

D. Only B

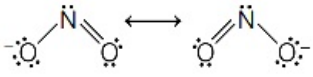
Answer: C

Solution:

Solution:
The correct pair(s) of ambident nucleophile are (A) KCN and $AgCN$ and (C) $AgNO_2$ and KNO_2.
Structure are as follows:
^-CN can bind through C and N atoms.

$:\overset{\ominus}{C} \equiv N: \leftrightarrow :C = \ddot{N}:^{\ominus}$

NO_2^- can bind through N and O.



Question105

The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $COCl_3 \cdot 4NH_3$ is (Round off to the nearest integer).
[16 Mar 2021 Shift 1]

Answer: 2

Solution:

$[Co(NH_3)_4Cl_2]Cl + 2en \longrightarrow [Co(en)_2Cl_2] + 4NH_3$
NH_3 is the neutral monodentate ligand. Ethylene diamine is a neutral didentate ligand.

$H_2\ddot{N} - CH_2 - CH_2 - \ddot{N}H_2$ (en)
So, two ethylene diamine are equivalent to four NH_3 ligand.

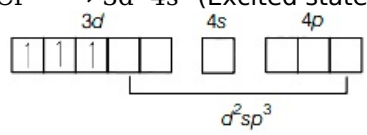
Question106

The total number of unpaired electrons present in the complex $K_3[Cr\ (oxalate\ )_3]$ is_____.
[18 Mar 2021 Shift 1]

Answer: 3

Solution:

Solution:
$K_3[Cr(ox)_3]$
Let, x be the oxidation state of Cr in $K_3[Cr(C_2O_4)_3]$. Since, the overall charge on the complex is 0 , the sum of oxidation states of all elements in it should be equal to 0 . Therefore,
$+3 + x + 3(-2) = 0$ (oxalate is bidentate ligand and having -2 charge)
or, $x = +3$.
Hence, chromium is in $+3$ oxidation state.
$Cr \longrightarrow 3d^5 4s^1$ (ground state electronic configuration)
$Cr^{3+} \longrightarrow 3d^3 4s^0$ (Excited state)



CN = 6
$\therefore$ oxalate is weak field ligand
$\therefore$3 unpaired electron in d -orbital. The hybridisation of chromium in the complex is d^2sp^3.

Question107

On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH , resulted in the formation of product A. The secondary valency of Fe in the product A is (Round off to the nearest integer).
[17 Mar 2021 Shift 2]

Answer: 6

Solution:

Secondary valency is equal to coordination number of central metal ion. In this reaction, central metal atom iron is attached with 3-oxalato ligand, and oxlaic acid it is a bidentate ligand i.e. have two donor sites. So, coordination number or secondary valency $= 3 \times 2 = 6$

$$FeCl_3 + 3H_2C_2O_4 + 6KOH \longrightarrow \underset{(A)}{K_3[Fe(C_2O_4)_3]} + 3KCl + 6H_2O$$

Hence, product A have iron with secondary valency $= 6$

Question108

What is the spin-only magnetic moment value (BM) of a divalent metal ion with atomic number 25 , in it's aqueous solution?
[17 Mar 2021 Shift 1]

Options:

A. 5.92

B. 5.0

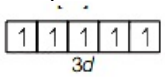
C. zero

D. 5.26

Answer: A

Solution:

Solution:
Atomic number 25 is for manganese (Mn).
Configuration of $Mn = [Ar]4s^2 3d^5$
In aqueous medium, $Mn^{2+} = [Ar]3d^5$



Total number of unpaired electrons $= 5$
μ (magnetic moment) $= \sqrt{n}(n+2)$ BM
where, $n =$ number of unpaired electron
$\therefore \mu = \sqrt{5(5+2)} = \sqrt{35}BM = 5.92BM$

Question109

3 moles of metal complex with formula $Co(en)_2Cl_3$ gives 3 moles of silver chloride on treatment with excess of silver nitrate. The secondary valency of Co in the complex is _____.
(Round off to the nearest integer)
[27 Jul 2021 Shift 2]

Answer: 6

Solution:

Solution:

$3[Co(en)_2Cl_2]Cl + AgNO_3 \underset{(excess)}{\rightarrow} 3AgCl \underset{(white\ ppt.)}{}$

Secondary valency of Co = 6

(C. N.)

Question110

Given below are two statements:

Statement I : $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.

Statement II : $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.

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

[27 Jul 2021 Shift 2]

Options:

A. Statement I is correct but statement II is false

B. Both statement I and statement II are false

C. Statement I is incorrect but statement II is true

D. Both statement I and statement II are are true

Answer: D

Solution:

Solution:

$[Mn(CN)_6]^{3-}$ $[Fe(CN)_6]^{3-}$ $[Co(C_2O_4)_3]^{3-}$

$\Downarrow$

$Mn^{3+}CN^-$ Fe^{3+},CN^- $Co^{3+},C_2O_4^{2-}$

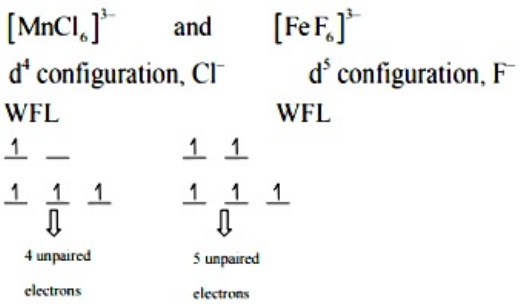
d^4 configuration, SFL d^5 configuration, SFL d^6 configuration, Chelating ligand

$\Rightarrow$ All will have larger splitting hence d^2sp^3 hybridisation

$[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$

d^4 configuration, Cl^- d^5 configuration, F^-

WFL WFL



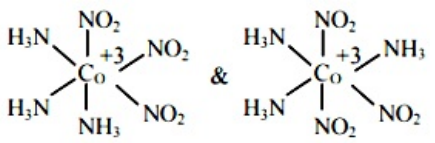
Question111

The number of geometrical isomers possible in triamminetrinitrocobalt (III) is X and in trioxalatochromate (III) is Y. Then the value of X + Y is _____.
[27 Jul 2021 Shift 1]

Answer: 2

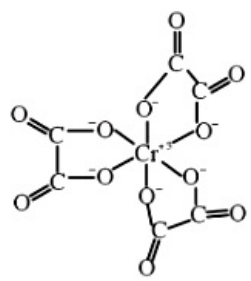
Solution:

Solution:
Triamminetrinitrocobalt(III) $\rightarrow [Co(NO_2)_3(NH_3)_3]$
trioxalatochromate(III) ion $\rightarrow [Cr(C_2O_4)_3]^{3-}$
$[Co(NO_2)_3(NH_3)_3]$



Two geometrical isomers (X)

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



Zero geometrical isomer (Y)

$X + Y = 2 + 0 = 2.0$

Question112

An organic compound is subjected to chlorination to get compound A using 5.0 g of chlorine. When 0.5 g of compound A is reacted with $AgNO_3$ [Carius Method], the percentage of chlorine in compound A is _____ when it forms 0.3849 g of AgCl. (Round off to the Nearest Integer)
(Atomic masses of Ag and Cl are 107.87 and 35.5 respectively)
[27 Jul 2021 Shift 1]

Answer: 19

Solution:

n_{cl} in compound $= n_{AgCl} = \frac{0.3849g}{(107.87 + 35.5)} g / mol$

$\Rightarrow$ mass of chlorine $= n_{Cl} \times 35.5 = 0.0953gm$

$\Rightarrow$ % wt of chlorine $= \frac{0.0953}{0.5} \times 100$

$= 19.06\%$

Question113

The number of geometrical isomers found in the metal complexes $[PtCl_2(NH_3)_2]$, $[Ni(CO)_4]$, $[Ru(H_2O)_3Cl_3]$ and $[CoCl_2(NH_3)_4]^+$ respectively, are :
[27 Jul 2021 Shift 1]

Options:

A. 1, 1, 1, 1

B. 2, 1, 2, 2

C. 2, 0, 2, 2

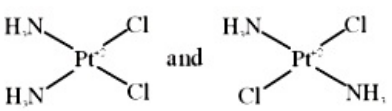
D. 2, 1, 2, 1

Answer: C

Solution:

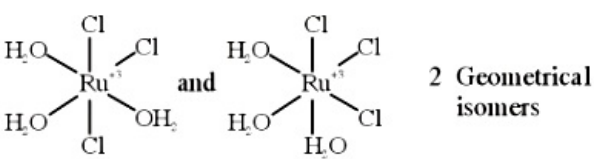
Solution:

$[PtCl_2(NH_3)_2]$

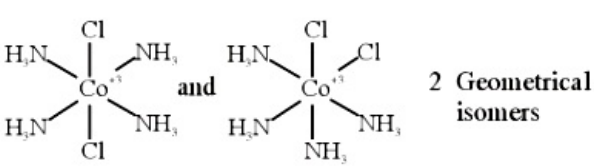


$[Ni(CO)_4]$ → All ligands are same — Zero Geometrical isomers

$[Ru(H_2O)_3Cl_3]$



$[CoCl_2(NH_3)_4]^+$



Question114

The type of hybridisation and magnetic property of the complex

$[M\,nCl_6]^{3-}$, respectively, are:
[27 Jul 2021 Shift 1]

Options:

A. sp^3d^2 and diamagnetic

B. d^2sp^3 and diamagnetic

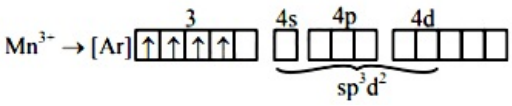
C. d^2sp^3 and paramagnetic

D. sp^3d^2 and paramagnetic

Answer: D

Solution:

Solution:
$[M\,nCl_6]^{3-}$



Paramagnetic and having 4 unpaired electrons.

Question115

Which one of the following metal complexes is most stable?
[25 Jul 2021 Shift 2]

Options:

A. $[Co(en)(NH_3)_4]Cl_2$

B. $[Co(en)_3]Cl_2$

C. $[Co(en)_2(NH_3)_2]Cl_2$

D. $[Co(NH_3)_6]Cl_2$

Answer: B

Solution:

Solution:
Complex $[Co(en)_3]Cl_2$ is most stable complex among the given complex compounds because more number of chelate rings are present in this complex as compare to others.

(1) $[Co(en)(NH_3)_4]Cl_2$	1 chelate ring
(2) $[Co(en)_3]Cl_2$	3 chelate ring
(3) $[Co(en)_2(NH_3)_2]Cl_2$	2 chelate ring
(4) $[Co(NH_3)_6]Cl_2$	0 chelate ring

Question116

Three moles of AgCl get precipitated when one mole of an octahedral co-ordination compound with empirical formula $CrCl_3.3NH_3.3H_2O$ reacts with excess of silver nitrate. The number of chloride ions satisfying the secondary valency of the metal ion is _____.
[25 Jul 2021 Shift 1]

Answer: 0

Solution:

Solution:
Mole of AgCl precipitated is equal the mole of Cl^- present in ionization sphere.

$$[Cr(H_2O)_3(NH_3)_3]Cl_3 \rightarrow [Cr(H_2O)_3(NH_3)_3]^{3+} + 3Cl^-$$

1 mole 1 mole 3 mole

$AgNO_3$ (Excess) ↓

AgCl (3mole)

Since none of Cl^- is present in the co-ordination sphere. Therefore answer is zero.

Question117

Which one of the following species responds to an external magnetic field?
[25 Jul 2021 Shift 1]

Options:

A. $[Fe(H_2O)_6]^{3+}$

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

C. $[Co(CN)_6]^{3-}$

D. $[Ni(CO)_4]$

Answer: A

Solution:

1. $[Fe(H_2O)_6]^{3+}$
Fe^{3+} : $[Ar]3d^5$
Hybridisation : sp^3d^2
Magnetic nature : Paramagnetic (so this complex response to external magnetic field)
2. $[Ni(CN)_4]^{2-}$
Ni^{2+} : $[Ar]3d^8$
Hybridisation: dsp^2
Magnetic nature : diamagnetic
3. $[Co(CN)_6]^{3-}$
Co^{3+} : $[Ar]3d^6$
Hybridisation: d^2sp^3
Magnetic nature : diamagnetic
4. $[Ni(CO)_4]$
Ni : $[Ar]3d^8 4s^2$
Hybridisation : sp^3
Magnetic nature : diamagnetic

Question118

The total number of unpaired electrons present in $[Co(NH_3)_6]Cl_2$ and $[Co(NH_3)_6]Cl_3$ is
[22 Jul 2021 Shift 2]

Answer: 1

Solution:

Solution:
$[Co(NH_3)_6]Cl_2$
Co^{2+} : $[Ar]3d^7 4s^0 4p^0$
For this complex Δ_0< P.E., so pairing of electron does not take place.
sp^3d^2 hybridisation
Total 3 unpaired electrons are present.
$[Co(NH_3)_6]Cl_3$
Co^{3+} : $[Ar]3d^6 4s^0 4p^0$
d^2sp^3 hybridisation
NH_3 acts as SFL because $\Delta_0 > P.E$
So here all electrons becomes paired.

Question119

The correct order of intensity of colors of the compounds is:
[20 Jul 2021 Shift 1]

Options:

A. $[Ni(CN)_4]^{2-} > [NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+}$

B. $[Ni(H_2O)_6]^{2+} > [NiCl_4]^{2-} > [Ni(CN)_4]^{2-}$

C. $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

D. $[NiCl_4]^{2-} > [Ni(CN)_4]^{2-} > [Ni(H_2O)_6]^{2+}$

Answer: C

Solution:

	$[NiCl_4]^{2-}$	>	$[Ni(H_2O)_6]^{2+}$	>	$[Ni(CN)_4]^{2-}$
Splitting energy order	Δ_t	<	Δ_0	<	Δ_{sq}
absorbed energy order	$[NiCl_4]^{2-}$	<	$[Ni(H_2O)_6]^{2+}$	<	$[Ni(CN)_4]^{2-}$
intensity of colour of compound	$[NiCl_4]^{2-}$	>	$[Ni(H_2O)_6]^{2+}$	>	$[Ni(CN)_4]^{2-}$

Question120

According to the valence bond theory the hybridization of central metal atom is dsp^2 for which one of the following compounds?
[20 Jul 2021 Shift 1]

Options:

A. $NiCl_2 . 6H_2O$

B. $K_2[Ni(CN)_4]$

C. $[Ni(CO)_4]$

D. $Na_2[NiCl_4]$

Answer: B

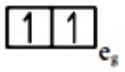
Solution:

1) $NiCl_2.6H_2O$

$Ni^{+2} \rightarrow [Ar]_{18}3d^8 4s^0$

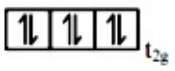
C.N. = 6 octahedral

splitting



e_g

Hybridisation sp^3d^2



t_{2g}

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

C.N. 4 $Ni^{-2} \rightarrow [Ar]_{18}3d^8 4s^0$

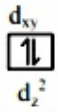
$CN^- \rightarrow$ Strong field ligand

$d_{x^2-y^2}$

Hybridisation dsp^2

Square planar splitting

d_{xy}



d_{z^2}

d_{yz} d_{xz}

3) $Ni(CO)_4$

CO - Strong field ligand

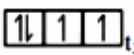
$Ni \rightarrow [Ar]_{18}$

$3d^{10}$ 4s sp^3 4p

Hybridisation

4) $Na_2[NiCl_4]$ $Ni \rightarrow [Ar]_{18}3d^8 4s^0$

$Cl^{\ominus} \rightarrow$ weak field ligand

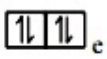


t_2 Hybridisation sp^3

C.N. 4

tetrahedral

splitting



e

Question121

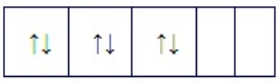
An aqueous solution of $NiCl_2$ was heated with excess sodium cyanide in presence of strong oxidizing agent to form $[Ni(CN)_6]^{2-}$. The total change in number of unpaired electrons on metal centre is _____.
[20 Jul 2021 Shift 2]

Answer: 2

Solution:

$[Ni(CN)_6]^{2-}$

$Ni^{+4} \rightarrow d^6$ strong field ligand



Pairing will be there zero unpaired electron

$NiCl_2 \rightarrow Ni^{2+} \rightarrow d^8$

$\rightarrow$ two unpaired e^-

Change = 2

Question122

Spin only magnetic moment in BM of $[Fe(CO)_4(C_2O_4)]^+$is [31 Aug 2021 Shift 2]

Options:

A. 5.92

B. 0

C. 1

D. 1.73

Answer: D

Solution:

Solution:
In $[Fe(CO)_4(C_2O_4)]^+$, oxidation number of Fe = +3
$\{x + 4 \times 0 + (-2) = 1\}$
$\therefore x = 3$
$Fe^{3+} = [Ar]3d^5 4s^0$
CO is a strong field ligand, so pairing is favoured
$Fe^{3+} = t_{2g}^{2,2,1}, e_g^{0,0}$
Number of unpaired electron (n) = 1
$\mu = \sqrt{n(n+2)}\,BM$
$= \sqrt{1(1+2)} = \sqrt{3} = 1.73\,BM$

Question123

The denticity of an organic ligand, biuret is [31 Aug 2021 Shift 1]

Options:

A. 2

B. 4

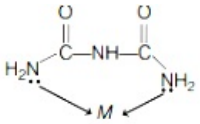
C. 3

D. 6

Answer: A

Solution:

Solution:
Biuret is bidentate ligand and denticity of this organic ligand is 2.



Hence, correct option is (a).

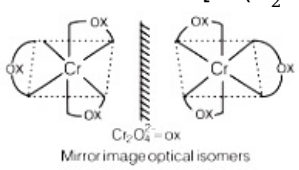
Question124

The number of optical isomers possible for $[Cr(C_2O_4)_3]^{3-}$ is ...
[27 Aug 2021 Shift 2]

Answer: 2

Solution:

Solution:
The structure of $[Cr(C_2O_4)_3]^{3-}$ is



Oxalate is bidentate symmetrical ligand. The complex does not possess any element of symmetry and are optically active. The two optical isomers are shown above.
∴ Answer is two (2).

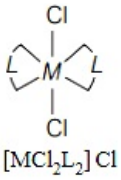
Question125

1 mol of an octahedral metal complex with formula $MCl_3.2L$ on reaction with excess of $AgNO_3$ gives 1 mol of AgCl. The denticity of ligand L is ..... .(Integer answer)
[27 Aug 2021 Shift 1]

Answer: 2

Solution:

Since, the compound is octahedral, the central metal M will form 6 bonds. On reaction with excess of $AgNO_3$, only 1 mol of AgCl is precipitated that means only $1Cl^-$ is present as counter ion and $2Cl^-$ ions are present in coordinate sphere. So 'L' should by bidentate to form an octahedral complex along with $2Cl^-$ions.



$[MCl_2L_2]Cl$

Question126

Indicate the complex/complex ion which did not show any geometrical isomerism.
[26 Aug 2021 Shift 2]

Options:

A. $[CoCl_2(en)_2]$

B. $[Co(CN)_5(NC)]^{3-}$

C. $[Co(NH_3)_3(NO_2)_3]$

D. $[Co(NH_3)_4 Cl_2]^+$

Answer: B

Solution:

(a) $[CoCl_2(en)_2]$ shows cis-trans isomerism.
(b) $[Co(CN)_5(NC)]^{3-}$ is of MA_5B type complex, which will not show any isomerism.
(c) $[Co(NH_3)_3(NO_2)_3]$ shows facial and meridonial isomerism.
(d) $[Co(NH_3)_4Cl_2]^+$ shows geometrical (cis-trans) isomerism. In cis isomer, two Cl ligands are adjacent to each other. In trans isomer two Cl ligands are opposite to each other.
∴ Option (b) is correct.

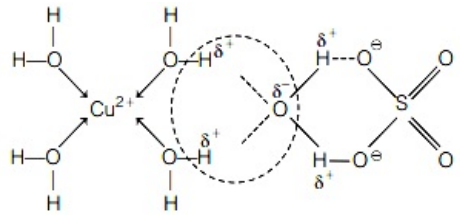
Question127

The number of hydrogen bonded water molecule(s) associated with stoichiometry $CuSO_4.5H_2O$ is/are.
[31 Aug 2021 Shift 1]

Answer: 1

Solution:

Solution:
The number of hydrogen bonded water molecule associated with stoichiometry $CuSO_4.5H_2O$ is 1.



Question128

In the structure of the dichromate ion, there is a [31 Aug 2021 Shift 1]

Options:

A. linear symmetrical Cr − O − Cr bond.

B. non-linear symmetrical Cr − O − Cr bond.

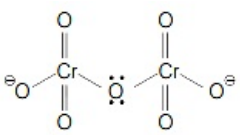
C. linear unsymmetrical Cr − O − Cr bond.

D. non-linear unsymmetrical Cr − O − Cr bond.

Answer: B

Solution:

Solution:
The structure of dichromate ion ($Cr_2O_7^{2-}$) contains a non-linear symmetrical Cr − O − Cr bond.



Hence, correct option is (b).

Question129

Acidic ferric chloride solution on treatment with excess of potassium ferrocyanide gives a prussian blue coloured colloidal species. It is [27 Aug 2021 Shift 1]

Options:

A. $Fe_4[Fe(CN)_6]_3$

B. $K_5\,Fe[Fe(CN)_6]_2$

C. $HFe[Fe(CN)_6]$

D. $KFe[Fe(CN)_6]$

Answer: A

Solution:

Solution:
When a solution of ferric chloride is treated with potassium ferrocyanide solution, a prussian blue precipitate of ferric ferrocyanide is obtained.

$$\underset{\text{Ferric chloride}}{4\,FeCl_3} + \underset{\text{Potassium ferrocyanide}}{3K_4[Fe(CN)_6]} \rightarrow \underset{\text{Ferric ferrocyanide}}{Fe_4[Fe(CN)_6]_3} + 12\,KCl$$

Question130

The overall stability constant of the complex ion $[Cu(NH_3)_4]^{2+}$ is 2.1×10^{13}. The overall dissociations constant is $y \times 10^{-14}$. Then, y is ..... . (Nearest integer)
[26 Aug 2021 Shift 2]

Answer: 5

Solution:

Solution:
Given, $K_f = 2.1 \times 10^{13}$

Dissociation constant $(K_d) = \frac{1}{K_f} = 4.7 \times 10^{-14}$

$\therefore y = 4.7 \simeq 5.$

Question131

Arrange the following cobalt complexes in the order of increasing crystal field stabilisation energy (CFSE) value.
Complexes $\underset{(A)}{[CoF_6]^{3-}}$, $\underset{(B)}{[CO(H_2O)_6]^{3+}}$, $\left[\underset{(C)}{Co(NH_3)_6}\right]^{3+}$ and $\left[\underset{(D)}{Co(en)_3}\right]^{3+}$
Choose the correct option.
[26 Aug 2021 Shift 2]

Options:

A. A < B < C < D

B. B < A < C < D

C. B < C < D < A

D. C < D < B < A

Answer: A

Solution:

For the same central metal ion, the CFSE increases with increase in strength of the ligand. The order of strength of ligand is given by the spectrochemical series:
$I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^-$
$< C_2O_4^{2-} < H_2O < NCS^- < EDTA^{4-} < NH_3 < en < CN^- < CO$
Thus, the order of CFSE of given complexes will be :
$\underset{(A)}{[CoF_6]^{3-}} < \underset{(B)}{[CO(H_2O)_6]^{3+}} < \underset{(C)}{\left[Co(NH_3)_6\right]^{3+}} < \underset{(D)}{\left[Co(en)_3\right]^{3+}}$.

Question132

Which one of the following complexes is violet in colour? [26 Aug 2021 Shift 1]

Options:

A. $[Fe(CN)_6]^{4-}$

B. $[Fe(SCN)_6]^{4-}$

C. $Fe_4[Fe(CN_6)]_3 \cdot H_2O$

D. $[Fe(CN)_5NOS]^{4-}$

Answer: D

Solution:

Solution:
The complex $[Fe(CN)_5NOS]^{4-}$ is violet in colour. It is formed when sodium nitroprusside reacts with sulphide ion to give violet colour as follows $S^{2-} + [Fe(CN)_5NO]^{2-} \rightarrow \underset{\text{(Violet colour)}}{[Fe(CN)_5NOS]^{4-}}$

Question133

The potassium ferrocyanide solution gives a prussian blue colour, when added to [1 Sep 2021 Shift 2]

Options:

A. $CoCl_3$

B. $FeCl_2$

C. $CoCl_2$

D. $FeCl_3$

Answer: D

Solution:

Solution:
Potassium ferrocyanide solution $\{K_4[Fe(CN)_6]\}$ will give prussian blue colour when added to ferric chloride ($FeCl_3$) due to formation of iron (III) hexacyanoferrate (II).
$FeCl_3 + K_4[Fe(CN)_6] \longrightarrow Fe_4[Fe(CN)_6]_3$ Iron (III) hexacyanido - ferrate (II) (Prussian blue colour)

Question134

The crystal field stabilisation energy (CFSE) and magnetic moment (spin - only) of an octahedral aqua complex of a metal ion (M^+) are $-0.8\Delta_0$ and 3.87 BM, respectively.

Identify (M^{2+}).
[1 Sep 2021 Shift 2]

Options:

A. V^{3+}

B. Cr^{3+}

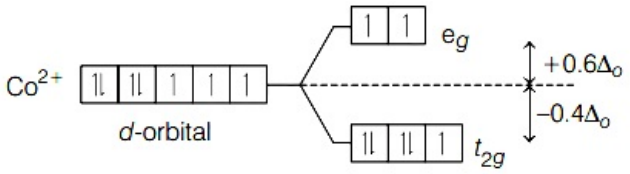
C. Mn^{4+}

D. Co^{2+}

Answer: D

Solution:

Solution:
The crystal field stabilisation energy (CFSE) and magnetic
moment (spin - only) of CO^{2+} octahedral aqua complex are $-0.8\Delta_0$ and 3.87 BM respectively.



CFSE $= [(e^- \text{in } t_{2g}) \times (-0.4) + (e^- \text{in } e_g) \times 0.6]\Delta_0$
$= [5\times -0.4 + 2 \times 0.6]\Delta_0$
$= -0.8\Delta_0$
Magnetic moment (spin only) can be calculated as:
$\mu = \sqrt{n(n+2)}$
(where, μ = spin only magnetic moment and
n = number of unpaired electrons = 3
$= \sqrt{3(3+2)} = \sqrt{15} = 3.87$ BM

Question135

The volume (in mL) of 0.125M $AgNO_3$ required to quantitatively precipitate chloride ions in 0.3g of $[Co(NH_3)_6]Cl_3$ is _____.
$M_{[Co(NH_3),Cl_3}$ = 267.46g / mol
M_{AgNO_3} = 169.87g / mol
[NV, Jan. 08 ,2020(I)]

Answer: 26.92

Solution:

Solution:
$\underset{0.3g}{[ML_6]Cl_3} + 3\ \underset{V\,ml\,0.125\,M}{AgNO_3} \longrightarrow 3AgCl$

Number of moles of the complex $= \frac{0.3}{267.46}$

Number of moles of $AgNO_3 = 0.125 \times V \times 10^{-3}$

$\frac{0.3}{267.46} \times 3 = 0.125 \times V \times 10^{-3}$

Or, $V = \frac{0.3 \times 3 \times 1000}{267.46 \times 0.125} = 26.92mL$

Question136

The correct order of the calculated spin-only magnetic moments of complexes (A) to (D) is:
(A) $Ni(CO)_4$
(B) $[Ni(H_2O)_6]Cl_2$
(C) $Na_2[Ni(CN)_4]$
(D) $PdCl_2(PPh_3)_2$
[Jan. 08, 2020(II)]

Options:

A. (A) ≈ (C) < (B) ≈ (D)

B. (C) < (D) < (B) < (A)

C. (C) ≈ (D) < (B) < (A)

D. (A) ≈ (C) ≈ (D) < (B)

Answer: D

Solution:

Solution:
(A) $Ni(CO)_4$
Ni = $3d^8 4s^2$
CO is strong field ligand. So pairing of elections happens.

$\therefore$ Number of unpaired electrons $= 0$
$\therefore \mu_{spin} = 0$

(B) $[Ni(H_2O)_6]Cl_2$
$Ni^{+2} = 3d^8 4s^0$
H_2O is weak field ligand. So no pairing of electrons happens.
Number of unpaired electron $= 2$
$\therefore \mu_{spin} = \sqrt{n(n+2)} = \sqrt{2(2+2)} = \sqrt{8}$ B.M

(C) $Na_2[Ni(CN)_4]$
$Ni^{+2} = 3d^8 4s^0$
CN^- is strong field ligand. So pairing of electrons happens.
Number of unpaired electron $= 0$
$\therefore \mu_{spin} = 0$

(D) $PdCl_2(PPh_3)_2$
$Pd^{2+} = 4d^8$
This is dsp^2 complex. And shape is square planar.
$\therefore \mu_{spin} = 0$

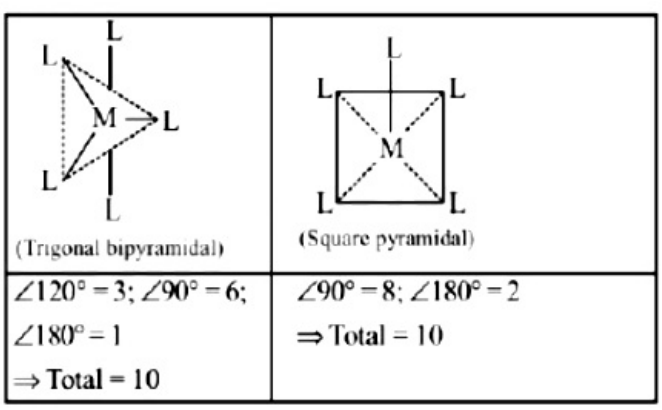
Question137

Complexes (ML_5) of metals Ni and Fe have ideal square pyramidal and trigonal bipyramidal geometries, respectively. The sum of the 90°, 120° and 180°L − M − L angles in the two complexes is _____. [NV, Jan. 08, 2020(II)]

Answer: 20

Solution:

Solution:



Total number of 180°, 90° and 120°L − M − L bond angles $= 10 + 10 = 20$

Question138

The theory that can completely\/properly explain the nature of bonding in $[Ni(CO)_4]$ is:

[Jan. 07,2020(I)]

Options:

A. Werner's theory

B. Molecular orbital theory

C. Crystal field theory

D. Valence bond theory

Answer: B

Solution:

Solution:
The covalant character of the bonding ($M-C\sigma$ and $M-C\pi$ bonding) which exists between the metal and the carbon atom of the CO can only be explained by the molecular orbital theory.

Question139

Complex X of composition $Cr(H_2O)_6Cl_n$ has a spin only magnetic moment of 3.83BM . It reacts with $AgNO_3$ and shows geometrical isomerism. The IUPAC nomenclature of X is:
[Jan. 09,2020 (I)]

Options:

A. Hexaaqua chromium (III) chloride

B. Tetraaquadichlorido chromium (IV) chloride dihydrate

C. Dichloridotetraaqua chromium (IV) chloride dihydrate

D. Tetraaquadichlorido chromium(III) chloride dihydrate

Answer: D

Solution:

Solution:
$\mu = \sqrt{n(n+2)}$ B.M. $= 3.83$ B.M.
$n = 3$($n =$ No. of unpaired e^-)
Therefore, oxidation number of Cr should be +3 .
Hence complex is $Cr(H_2O)_6Cl_3$
Complex shows geometrical isomerism therefore formula of complex is $[Cr(H_2O)_4Cl_2]Cl.2H_2O$
IUPAC Name: Tetraaquadichlorido chromium(III) Chloride dihydrate

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Question140

The isomer(s) of $[Co(NH_3)_4Cl_2]$ that has/have a $Cl - Co - Cl$ angle of 90°, is/are:
[Jan. 09,2020 (II)]

Options:

A. meridional and trans

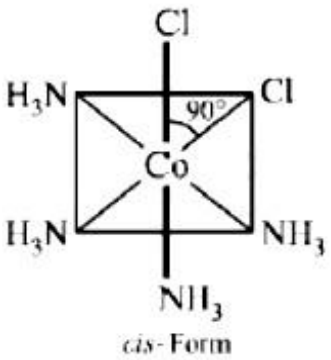
B. cis and trans

C. trans only

D. cis only

Answer: D

Solution:



Question141

The complex that can show f ac - and mer-isomers is:
[Jan. 08,2020 (I)]

Options:

A. $[Co(NH_3)_4Cl_2]^+$

B. $[Pt(NH_3)_2Cl_2]$

C. $[CoCl_2(en)_2]$

D. $[Co(NH_3)_3(NO_2)_3]$

Answer: D

Solution:

Solution:
$[Ma_3b_3]$ type complex shows facial and meridional isomerism.
So, the complex $[CO(NH_3)_3(NO_2)_3]$ will show fac-and merisomers.

Question142

Among (a) - (d) , the complexes that can display geometrical isomerism are:

(a) $[Pt(NH_3)_3Cl]^+$

(b) $[Pt(NH_3)_3Cl]^+$

(c) $[Pt(NH_3)_2Cl(NO_2)]$

(d)$[Pt(NH_3)_4ClBr]^{2+}$

[Jan. 08,2020 (II)]

Options:

A. (b) and (c)

B. (d) and (a)

C. (c) and (d)

D. (a) and (b)

Answer: C

Solution:

Solution:
$[Pt(NH_3)_2Cl(NO_2)]$ and $[Pt(NH_3)_4ClBr]^{2+}$ are the Ma_4bc and Ma_2bc type of complexes.
Each shows two geometrical isomers i.e., cis and trans isomers.

Question143

The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is:

[Jan. 07,2020 (I)]

Options:

A. Diamminechlorido(methanamine) platinum (II)chloride

B. Diammine (methanamine) chloridoplatinum(II)chloride

C. Diamminechlorido(aminomethane) platinum (II)chloride

D. Bisammine(methanamine) chlorido platinum(II)chloride

Answer: A

Solution:

Solution:
$[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$
Diamine chlorido (methanamine) platinum (II) chloride

Question144

The number of possible optical isomers for the complexes $M A_2B_2$ with sp^3 and $d sp^2$ hybridized metal atom, respectively, is:
Note: A and B are unidentate neutral and unidentate monoanionic ligands, respectively.
[Jan. 07,2020 (II)]

Options:

A. 0 and 2

B. 2 and 2

C. 0 and 0

D. 0 and 1

Answer: C

Solution:

Solution:
$[M A_2B_2]$ will not exhibit optical isomerism in both conditions.

Question145

Among the statements (A) − (D), the incorrect ones are:
(A) Octahedral Co(III) complexes with strong field ligands have very high magnetic moments.
(B) When $\Delta_0 < P$, the d -electron configuration of Co(III) in an octahedral complex is $t_{2g}^4 e_g^2$
(C) Wavelength of light absorbed by $[Co(en)_3]^{3+}$ is lower than that of $[CoF_6]^3$
(D) If the Δ_0 for an octahedral complex of Co(III) is 18,000 cm^{-1}, the Δ_i for its tetrahedral complex with the same ligand will be 16, 000cm^{-1}.
[Jan. 07,2020 (II)]

Options:

A. (A) and (D) only

B. (C) and (D) only

C. (A) and (B) only

D. (B) and (C) only

Answer: A

Solution:

Co^{3+} with strong field ligand forms complex of low magnetic moment.

$\Delta_t = \left(\frac{4}{9}\right)\Delta_0$

$\Rightarrow \Delta_1 = \frac{4}{9} \times 18000 = 8000 cm^{-1}$

Question146

[Pd (F)(Cl)(Br)(I)]^2 has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of [F e(CN)$_6$]$^{n-6}$, respectively, are: [Note : Ignore the pairing energy] [Jan. 09,2020(I)]

Options:

A. 2.84BM and $-1.6\Delta_0$

B. 5.92BM and 0

C. 1.73BM and $-2.0\Delta_0$

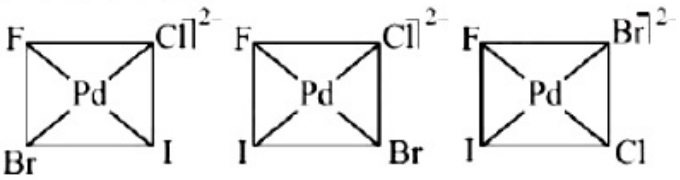
D. 0BM and $-2.4\Delta_0$

Answer: C

Solution:

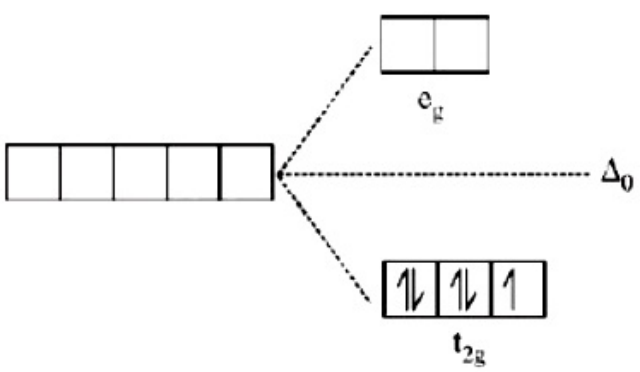
Number of Geometrical isomers (n) in square planar

$[Pd(F)(Cl)(Br)(I)]^{2-} = 3$



$[Fe(CN)_6]^{3-6} = [Fe(CN)_6]^{3-}$

$Fe^{3+} = 3d^5$



$\mu = \sqrt{n(n+2)} = 1.73B.M$

$CFSE = -0.4\,\Delta_0 \times nt_{2g} + 0.6\,\Delta_0 \times n_{2g}$

$= -0.4\,\Delta_0 \times 5 = -2.0\Delta_0$

Question147

The correct order of the spin-only magnetic moments of the following complexes is:
(A) $[Cr(H_2O)_6]Br_2$
(B) $Na_4[Fe(CN)_6]$
(C) $Na_3[Fe(C_2O_4)_3](\Delta_0 > P)$
(D) $(Et_4N)_2[CoCl_4]$
[Jan. 09,2020(II)]

Options:

A. (C) > (A) > (D) > (B)

B. (C) > (A) > (B) > (D)

C. (A) > (D) > (C) > (B)

D. (B) ≈ (A) > (D) > (C)

Answer: C

Solution:

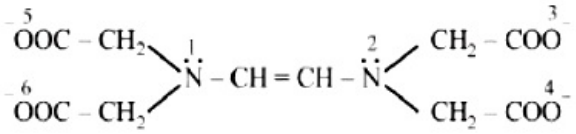
As, $\mu_s = \sqrt{n(n+2)}$
$Na_4[Fe(CN)_6] \rightarrow Fe^{2+}$
$\Rightarrow$ S.F.L. $\Rightarrow t_{2g}^6 e_g^0 \Rightarrow \mu_s = 0$
$[Cr(H_2O)_6]Br_2 \rightarrow Cr^{2+}$
$\Rightarrow$ W.F.L. $\Rightarrow t_{2g}^3 e_g^1 \Rightarrow \mu_s = \sqrt{24}$ B.M.
$(Et_4N)_2[CoCl_4] \rightarrow Co^{2+}$
$\Rightarrow$ W.F.L. $\Rightarrow e^4 t_2^3 \Rightarrow \mu_s = \sqrt{15}$ B . M
$Na_3[Fe(C_2O_4)_3] \rightarrow Fe^{3+}$
$\Rightarrow$ S.F.L. $\Rightarrow t_{2g}^5 e_g^0 \Rightarrow \mu_s = \sqrt{3}$ B.M

Question148

The total number of coordination sites in ethylenediaminetetraacetate ($EDTA^+$) is_____.
[NV, Sep. 05,2020 (I)]

Answer: 6

Solution:



EDTA $^{4-}$ is a hexadentate ligand, since hexa means six and the ligand attaches six times.

Question149

Consider the complex ions, trans-$[Co(en)_2Cl_2]^+$(A) and cis $-[Co(en)_2Cl_2]^+$(B). The correct statement regarding them is : [Sep. 05,2020 (II)]

Options:

A. both (A) and (B) cannot be optically active.

B. (A) can be optically active, but (B) cannot be optically active.

C. both (A) and (B) can be optically active.

D. (A) cannot be optically active, but (B) can be optically active.

Answer: D

Solution:

Solution:
trans-$[Co(en)_2Cl_2]^+$ (A) contains a plane of symmetry so (A) cannot be optically active, whereas, (B) cis $[Co(en)_2Cl_2]^-$ does not contain any plane of symmetry, so (B) will be optically active.

Question150

The number of isomers possible for $[Pt(en)(NO_2)_2]$ is [Sep. 04, 2020 (I)]

Options:

A. 2

B. 4

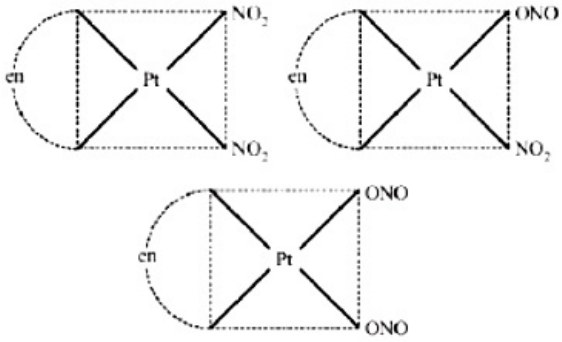
C. 1

D. 3

Answer: D

Solution:

Solution:
$[Pt(en)(NO_2)_2]$



So, total possible isomers are 3.

Question151

The complex that can show optical activity is: [Sep. 03,2020 (I)

Options:

A. trans $-[Cr(Cl_2)(ox)_2]^3$

B. trans-$[Fe(NH_3)_2(CN)_4]$

C. cis $-[Fe(NH_3)_2(CN)_4]$

D. cis $-[CrCl_2(ox)_2]^{3-}$(ox = oxalate)

Answer: D

Solution:

Solution:
Only cis- $[CrCl_2(ox)_2]^{3-}$ shows optical isomerism while its trans form do not show optical isomerism due to presence of plane of symmetry.

Question152

ComplexA has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc. H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is: [Given : atomic mass of Cr = 52 amu and Cl = 35 amu] [Sep. 03,2020 (II)

Options:

A. $[Cr(H_2O)_6]Cl_3$

B. $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$

C. $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

D. $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

Answer: D

Solution:

Solution:
Conc. H_2SO_4 acts as dehydrating agent. Molar mass of given complex $= 266.5 g / mol$ On treating with conc. H_2SO_4 the mass lost by the complex $= \frac{13.5}{100}(266.5) \approx 36g = 2mol$ esof H_2O
Formula of the complex $= [Cr(H_2O)_4Cl_2]Cl .2H_2O$

Question153

The one that is not expected to show isomerism is: [Sep. 02,2020 (II)]

Options:

A. $[Ni(NH_3)_4(H_2O)_2]^{2+}$

B. $[Ni(en)_3]^{2+}$

C. $[Ni(NH_3)_2Cl_2]$

D. $[Pt(NH_3)_2Cl_2]$

Answer: C

Solution:

Solution:
(a) $[Ni(NH_3)_4(H_2O)_2]^{2+}$ shows geometrical isomerism.
(b) $[Ni(en)_3]^{2+}$ shows optical isomerism.
(c) $[Ni^{2+}(NH_3)_2Cl_2] \Rightarrow Ni^{2+} \Rightarrow 3d^8 4s^0$
$\Rightarrow sp^3$ hybridisation
$\Rightarrow$ tetrahedral
So, $[Ni(NH_3)_2Cl_2]$ does not show isomerism.
(d) $[Pt(NH_3)_2Cl_2]$ shows geometrical isomerism.

Question154

The species that has a spin-only magnetic moment of 5.9 BM , is : T_d = tetrahedral) [Sep. 06, 2020 (I)]

Options:

A. $[Ni(CN)_4]^{2-}$ (square planar)

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

C. $Ni(CO)_4(T_d)$

D. $[MnBr_4]^{2-}(T_d)$

Answer: D

Solution:

Solution:
$[MnBr_4]^{2-} \Rightarrow Mn^{2+} \Rightarrow d^5(Td)$
[$\because$ Br is weak field ligand]
$d^5(Td)$ is high spin complex.
So, $\mu = \sqrt{5(5+2)} = 5.91B \cdot M$

Question155

For a d^4 metal ion in an octahedral field, the correct electronic configuration is : [Sep. 06, 2020 (II)]

Options:

A. $t_2^3 e_g^1$ when $\Delta_0 < P$

B. $t_{2g}^3 e_g^1$ when $\Delta_0 > P$

C. $t_{2g}^4 e_g^0$ when $\Delta_0 < P$

D. $e_g^2 t_{2g}^2$ when $\Delta_0 < P$

Answer: A

Solution:

Solution:
If $\Delta_0 > P$ then fot $d^4 \Rightarrow t_{2g}^4 e_g^0$
If $\Delta_0 < P$ then for $d^4 \Rightarrow t_{2g}^3 e_g^1$

Question156

The values of the crystal field stabilization energies for a high spin d^6 metal ion in octahedral and tetrahedral fields, respectively, are: [Sep. 05, 2020 (I)]

Options:

A. $-0.4\Delta_0$ and $-0.6\Delta_t$

B. $-2.4\Delta_o$ and $-0.6\Delta_t$

C. $-1.6\Delta_0$ and $-0.4\Delta_t$

D. $-0.4\Delta_0$ and $-0.27\Delta_t$

Answer: A

Solution:

Solution:
For d^6 configuration, high spin complex.
(i) In case of octahedral field, $t_{2g}^4 e_g^2$
CF SE $= [-0.4p + 0.6q]\ \Delta_0 + n(P)$
$= [-0.4 \times 4 + 0.6 \times 2]\ \Delta_0 + 0 = -0.4\Delta_0$
(ii) In case of tetrahedral field, e^3, t_2^3
CF SE $= [-0.6p + 0.4q]\ \Delta t$
$= [-0.6 \times 3 + 0.4 \times 3]\ \Delta t = -0.6\ \Delta t.$

Question157

Considering that $\Delta_0 > P$, the magnetic moment (in BM) of $[Ru(H_2O)_6]^{2+}$ would be _____.
[NV Sep. 05, 2020 (II)]

Answer: 0

Solution:

$Ru^{2+} = 4d^6 = t_{2g}^6 e_g^0$ since $\Delta_0 > P$
No. of unpaired electrons = 0
$\therefore$ Magnetic moment = 0B.M.

Question158

The pair in which both the species have the same magnetic moment (spin only) is:
[Sep. 04, 2020 (I)]

Options:

A. $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

B. $[Co(OH)_4]^{2-}$ and $[Fe(NH_3)_6]^{2+}$

C. $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)]^{2+}$

D. $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

Answer: A

Solution:

Solution:
$[Cr(H_2O)_6]^{2+} \Rightarrow Cr^{2+} \Rightarrow 3d^4 \Rightarrow t_{2g}^{1,1,1}, e_g^{1,0}$
No. of unpaired e : 4
$[Fe(H_2O)_6]^{2+} \Rightarrow Fe^{2+} \Rightarrow 3d^6 \Rightarrow t_{2g}^{2,1,1}, e_g^{1,1}$
No. of unpaired e : 4
$[Fe(NH_3)_6]^{2+} \Rightarrow Fe^{2+} \Rightarrow 3d^6 \Rightarrow t_{2g}^{2,1,1}, e_g^{1,1}$
No. of unpaired e : 4
$[Co(OH)_4]^{2-} \Rightarrow Co^{2+} \Rightarrow 3d^7 \Rightarrow e^{2,2}, t_2^{1,1,1}$
No. of unpaired e : 3
$[CoCl_4]^{2-} \Rightarrow Co^{2+} \Rightarrow 3d^7 \Rightarrow e^{2,2}, t_2^{1,1,1}$
No. of unpaired e : 3
$[Mn(H_2O)_6]^{2+} \Rightarrow Mn^{2+} \Rightarrow 3d^5 \Rightarrow t_{2g}^{1,1,1}, e_g^{1,1}$
No. of unpaired e : 5
So $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$ have same magnetic moment (spin only).

Question159

The Crystal Field Stabilization Energy (CFSE) of $[CoF_3(H_2O)_3](\Delta_0 < P)$ is :
[Sep. 04, 2020 (II)]

Options:

A. $-0.8\ \Delta_0 + 2P$

B. $-0.4\Delta_0$

C. $-0.8\Delta_0$

D. $-0.4\ \Delta_0 + P$

Answer: B

Solution:

Solution:
$[CoF_3(H_2O)_3] \Rightarrow Co^{3+} \Rightarrow d^6$ or $t_{2g}^4 e_g^2$
CF SE $= -[0.4p + 0.6q]\ \Delta_0 + n(P)$
$= [-4 \times 0.4 + 2 \times 0.6]\ \Delta_0 + 0 = -0.4\Delta_0$

Question160

The one that can exhibit highest paramagnetic behaviour among the following is :
gly = glycinato; bpy = 2, 2′ -bipyridine
[Sep. 04, 2020 (II)]

Options:

A. $[Pd(gly)_2]$

B. $[Fe(en)(bpy)(NH_2)_2]^{2+}$

C. $[Co(OX)_2(OH)_2](\Delta_0 > P)$

D. $[Ti(NH_3)_6]^{3+}$

Answer: C

Solution:

Solution:

	No, of unpaired electrons
$[Fe(en)(bpy)(NH_3)_2]^{2+}$	$Fe^{2+} - 3d^6 0$
$[Pd(gly)_2]$	$Pd^{2+} - 3d^8 0$
$[Co(OX)_2(OH)_2]$	$Cos^{5+} - 3d^4 2$
$[Ti(NH_3)_6]^3$	$Ti^{3+} - 3d^1 1$

Thus, $[Co(OX)_2(OH)_2]$ exhibits highest paramagnetic behaviour due to highest number of unpaired electrons.

Question161

The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at 20, 300cm^{-1}. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1}, is:

($kJ\ mol^{-1} = 83.7cm^{-1}$)

[Sep. 03, 2020 (I)]

Options:

A. 145.5

B. 242.5

C. 83.7

D. 97

Answer: D

Solution:

Solution:

$[Ti(H_2O)_6]^{3+} \Rightarrow Ti^{3+} = 3d^1 4s^\circ$

$\therefore$ Electronic configuration is $t_{2g}^1 e_g^0$

CPSE $= [-0.4n_{t\gamma_g} + 0.6n_{eg}]\ \Delta_0 + n(p)$
$= [(-0.4) \times 1 + 0]20300$
$= -8120 cm^{-1}$
$= \frac{-8120}{83.7} kJ\ /\ mol\ = -97 kJ\ /\ mol$

Question162

The d -electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are:
[Sep. 03, 2020 (II)]

Options:

A. $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$

B. $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$

C. $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$

D. $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$

Answer: C

Solution:

Solution:
$[Ru(en)_3]Cl_2 \Rightarrow Ru^{2+} = 4d^6 = t_{2g}^6, e_g^0$
$[Fe(H_2O)_6]^{2+} \Rightarrow Fe^{2+} = 3d^6 = t_{2g}^4, e_g^2$
So, correct answer is (c).

Question163

Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90BM . The geometry and the crystal field stabilization energy of the complex is:
[Sep. 02, 2020 (I)]

Options:

A. octahedral and $-2.4\ \Delta_0 + 2P$

B. tetrahedral and $-0.6\Delta_l$

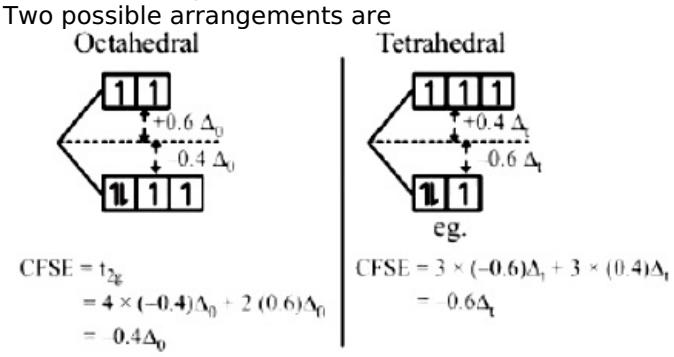
C. octahedral and $-1.6\Delta_0$

D. tetrahedral and $-1.6\ \Delta_t + 1P$

Answer: B

Solution:

Spin only magnetic moment $= 4 \cdot 9 = \sqrt{n(n+2)}$
$\therefore$ number of unpaired electrons $= 4$
Two possible arrangements are



So, option (b) is correct.

Question164

For octahedral M n(II) and tetrahedral Ni(II) complexes, consider the following statements:
(I) both the complexes can be high spin.
(II) N i(II) complex can veryrarely below spin.
(III) with strong field ligands, Mn(II) complexes can be low spin.
(IV) aqueous solution of M n(II) ions is yellow in color.
The correct statements are:
[Sep. 02, 2020 (I)]

Options:

A. (I) and (II) only

B. (I), (III) and (IV) only

C. (I), (II) and (III) only

D. (II), (III) and (IV) only

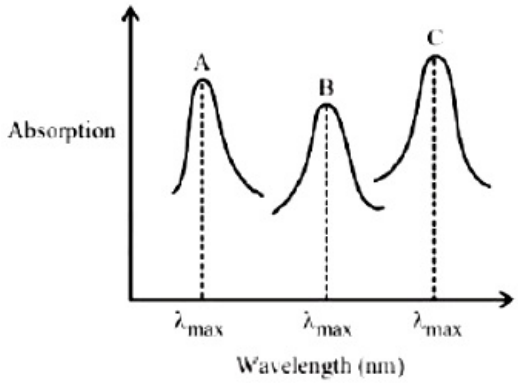
Answer: C

Solution:

Solution:
With weak field ligands Mn(II) will be of high spin and with strong field ligands it will be of low spin. Ni(II) tetrahedral complexes will be generally of high spin due to sp^3 hybridisation. M n(I I) is of light pink colour in aqueous solution.

Question165

Simplified absorption spectra of three complexes ((i), (ii) and (iii)) of M^{n+} ion are provided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is :



(i) $[M(NCS)_6]^{(-6+a)}$

(ii) $[MF_6]^{(-6+n)}$

(iii) $[M(NH_3)_6]^{n+}$

[Sep. 02, 2020 (II)]

Options:

A. A − (iii), B − (i), C − (ii)

B. A − (ii), B − (i), C -(iii)

C. A − (ii), B − (iii), C − (i)

D. A − (i), B − (ii), C − (iii)

Answer: A

Solution:

Solution:
Stronger the ligand greater is splitting of d orbitals and smaller will be wavelength of light absorbed. According to spectrochemical series, the splitting power of ligands is $NH_3 > NC\bar{S} > F^-$.
Thus, order of wavelength of light absorbed is
$\lambda_{NH_3} < \lambda_{NC\bar{S}} < \lambda_{F^-}$

Question166

The coordination number of Th in $K_4[Th(C_2O_4)_4(H_2O)_2]$ is: ($C_2O_4^{2-}$ = oxalato)
[Jan. 11,2019(II)]

Options:

A. 14

B. 6

C. 8

D. 10

Answer: D

Solution:

$K_4[Th(C_2O_4)_4(H_2O)_2]$
$C_2O_4^{2-}$ (oxalato): bidentate ligand
H_2O (aqua): monodentate
∴ Co-ordination no. of Th = 2 × 4 + 2 = 10

Question167

The total number of isomers for a square planar complex $[M(F)(Cl)(SCN)(NO_2)]$ is:
[Jan. 10, 2019(I)]

Options:

A. 16

B. 8

C. 4

D. 12

Answer: D

Solution:

Solution:
Possible complexes No. of isomers
$[M(F)(Cl)(SCN)(NO_2)] \rightarrow 3$
$[M(F)(Cl)(SCN)(ONO)] \rightarrow 3$
$[M(F)(Cl)(NCS)(NO_2)] \rightarrow 3$
$[M(F)(Cl)(NCS)(ONO)] \rightarrow 3$
Total = 12

Question168

A reaction of cobalt(III) chloride and ethylenediamine in a 1: 2 mole ratio generates two isomeric products A (violet coloured) and B (green coloured). A can show optical activity, but, B is optically inactive. What type of isomers does A and B represent?
[Jan. 10,2019(II)]

Options:

A. Geometrical isomers

B. Coordination isomers

C. Linkage isomers

D. Ionisation isomers

Answer: A

Solution:

Solution:
Reaction for the given condition can be written as:
$[CoCl_6]^3 + 2(en) \longrightarrow [CoCl_2(en)_2]^+$
(1 : 2 mole ratio) (cis-trans-isomer)
A = optically active (cis-isomer), violet
B = optically inactive (trans-isomer), green

Question169

The metal d -orbitals that are directly facing the ligands in $K_3[Co(CN)_6]$ are : [Jan.12, 2019(I)]

Options:

A. d_{xy} and $d_{x^2-y^2}$

B. $d_{x^2-y^2}$ and $d_{z}2$

C. d_{xz}, d_{yz} and $d_{2}2$

D. d_{xy}, d_{x} and d_{yz}

Answer: B

Solution:

Solution:
$K_3[Co(CN)_6]$ is an octahedral complex.
During splitting of d orbitals in octahederal complexes, $d_{x^2-y^2}$ and d_{z^2} orbitals point towards the direction of ligands (i.e. they experience more repulsion and will be raised in energy by $\frac{3}{5}\Delta_0$).

Question170

The magnetic moment of an octahedral homoleptic Mn(II) complex is 5.9BM . The suitable ligand for this complex is: [Jan.12, 2019(I)]

Options:

A. Ethylenediamine

B. CN

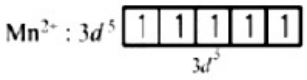
C. NCS

D. CO

Answer: C

Solution:

Solution:
Electronic configuration of Mn^{2+} is,



Presence of 5 unpaired e^- shows that the complex of Mn^{2+} has only weak field ligand (NCS^-).

Question171

Match the metals (column I) with the coordination compound(s)/enzyme(s) (column II) :

(column I)	(column II)
Metals	**Coordination compound(s)/enzyme(s)**
(A) Co	(i) Wilkinson catalyst
(B) Zn	(ii) Chlorophyll
(C) Rh	(iii) Vitamin B_{12}
(D) Mg	(iv) Carbonic anhydrase

[Jan.11, 2019(I)]

Options:

A. (A) − (iii); (B) − (iv); (C) − (i); (D) − (ii)

B. (A) − (i); (B) − (ii); (C) − (iii); (D) − (iv)

C. (A) − (ii); (B) − (i); (C) − (iv); (D) − (iii)

D. (A) − (iv); (B) − (iii); (C) − (i); (D) − (ii)

Answer: A

Solution:

Solution:
Wilkinson catalyst: $[Rh(PPh)_3Cl]$
Chlorophyll: $C_{55}H_{72}O_5N_4Mg$
Vitamin B_{12} contains Co.
Carbonic anhydrase contains a Zn ion.

Question172

The difference in the number of unpaired electrons of a metal ion in its high-spin and low-spin octahedral complexes is two. The metal ion is: [Jan.10, 2019(II)]

Options:

A. Ni^{2+}

B. Fe^{2+}

C. Co^{2+}

D. Mn^{2+}

Answer: C

Solution:

Solution:

Metal ion	High spin	Low spin	Difference in the unpaired electrons
$Ni^{2+}(3d^8)$	2	2	0
$Mn^{2+}(3d^5)$	5	1	4
$Fe^{2+}(3d^6)$	4	0	4
$Co^{2+}(3d^7)$	3	1	2

Question173

Two complexes $[Cr(H_2O)_6]Cl_3$ (A) and $[Cr(NH_3)_6]Cl_3$(B) are violet and yellow coloured, respectively. The incorrect statement regarding them is:
[Jan.9, 2019(I)]

Options:

A. Δ_0 values of (A) and (B) are calculated from the energies of violet and yellow light, respectively.

B. both are paramagnetic with three unpaired electrons.

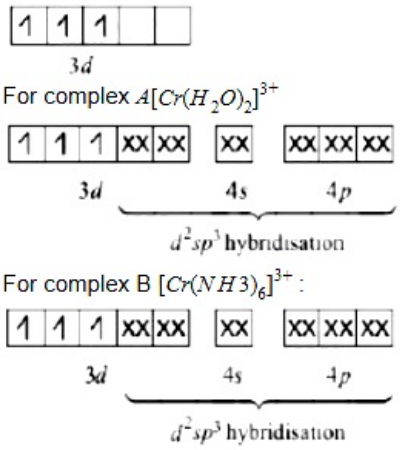
C. both absorb energies corresponding to their complementary colors.

D. Δ_0 value for (A) is less than that of (B).

Answer: A

Solution:

Solution:
E.C. of $Cr^{3+}(3d^3)$:



Here, both the complexes (A) and (B) are paramagnetic with 3 unpaired electrons each. H_2O is also a weak field ligand, which causes lesser splitting than NH_3, which is comparatively stronger field ligand. Hence, the (Δ_0) value of (A) and (B) are calculated from the wavelengths of light absorbed and not from the wavelengths of light emitted.

Question174

The complex that has highest crystal field splitting energy (Δ) is: [Jan.9, 2019(II)]

Options:

A. $[Co(NH_3)_5(H_2O)]Cl_3$

B. $K_2[CoCl_4]$

C. $[Co(NH_3)_5Cl]Cl_2$

D. $K_3[Co(CN)_6]$

Answer: D

Solution:

Solution:
In case of similar metal atom or ion, the value of coordination number and the strength of the ligands determine the value of crystal field splitting energy. Greater the co-ordination number and strength of value of the ligand, greater will be the value of CFSE. Strength of ligands: $CN^- > NH_3 > H_2O > Cl$
$\therefore K_3[Co(CN)_6]$ has the highest crystal field splitting energy.

Question175

Homoleptic octahedral complexes of a metal ion M^{3+1} with three monodentate ligands L_1, L_2 and L_3 absorb wavelengths in the region of green, blue and red respectively. The increasing order of the ligand strength is: [Jan.9, 2019(II)]

Options:

A. $L_3 < L_1 < L_2$

B. $L_3 < L_2 < L_1$

C. $L_1 < L_2 < L_3$

D. $L_2 < L_1 < L_3$

Answer: A

Solution:

Solution:
Lesser the wavelength of light absorbed (more ener- gy) greater will be ligand strength.
Energy : Blue > Green > Red
Ligand strength: L_2 > L_1 > L_3

Question176

$Mn_2(CO)_{10}$ is an organometallic compound due to the presence of : [Jan. 12,2019(I)]

Options:

A. $Mn - C$ bond

B. Mn-Mn bond

C. $Mn - O$ bond

D. C-O bond

Answer: A

Solution:

Solution:
Compounds having atleast one carbon metal ($M - C$) bond are known as organometallic compounds. It contains $Mn - C$ bond.

Question177

The number of bridging CO ligand(s) and Co-Co bond(s) in $Co_2(CO)_8$, respectively are: [Jan. 11,2019(I)]

Options:

A. 2 and 1

B. 2 and 0

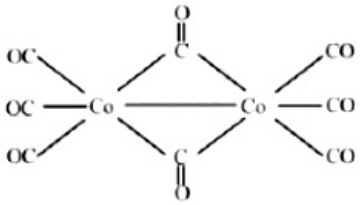
C. 0 and 2

D. 4 and 0

Answer: A

Solution:

Solution:
The structure of $Co_2(CO)_8$ is represented as



It contains two bridging CO ligands and one metal-metal (Co − Co) bond.

Question178

Wilkinson catalyst is:
[Jan. 10,2019(I)]

Options:

A. $[(Ph_3P)_3I\,rCl\,]$

B. $[(E\,t_3P)_3RhCl\,]$

C. $[(Ph_3P)_3RhCl\,]$

D. $[(E\,t_3P)_3I\,rCl\,]$

Answer: C

Solution:

Solution:
Wilkinson's catalyst is $[Rh(PPh_3)_3Cl\,]$

Question179

The coordination numbers of Co and Al in $[Co(Cl\,)(en)_2]Cl$ and $K_3[Al\,(C_2O_4)_3]$, respectively, are:
(en = ethane- 1,2 -diamine)
[April 12,2019 (II)]

Options:

A. 5 and 3

B. 3 and 3

C. 6 and 6

D. 5 and 6

Answer: D

Solution:

Solution:
$[Co(en)_2Cl\ ]Cl$
Cl^- - monodentate ligand
en - bidentate ligand
∴ Co-ordination Number of Co = (2 × 2) + 1 = 5
$K_3[Al\ (C_2O_4)_3]$
$C_2O_4^{2-}$ - bidentate ligand
∴ Co-ordination Number of Al = 2 × 3 = 6

Question180

The species that ean have a trans-isomer is: (en = ethane −1, 2− diamine, Ox = oxalate) [April 10,2019 (I)]

Options:

A. $[Z\,n(en)Cl_2]$

B. $[Pt(en)Cl_2]$

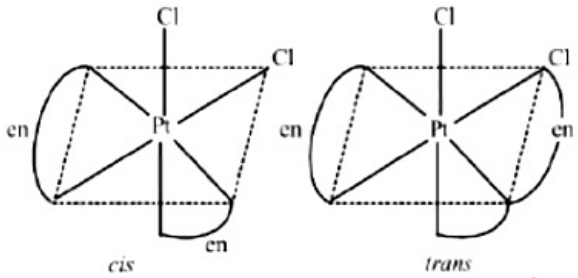
C. $[Cr(en)_2(Ox)]^+$

D. $[Pt(en)_2Cl_2]^{2+}$

Answer: D

Solution:

Solution:

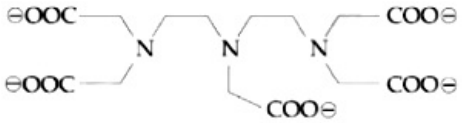


cis-trans Isomerism is possible with $[Pt(en)_2Cl_2]^{2+}$. $[Cr\ (en)_2Ox\ ]^+$ shows only optical isomerism. The other two complexes, i.e., $[Pt(en)Cl_2]$ and $[Z\,n(en)Cl_2]$ do not show stereoisomerism.

Question181

The maximum possible denticities of a ligand given below towards a

common transition and inner-transition metal ion, respectively, are:



[April 9,2019 (II)]

Options:

A. 8 and 6

B. 6 and 8

C. 6 and 6

D. 8 and 8

Answer: B

Solution:

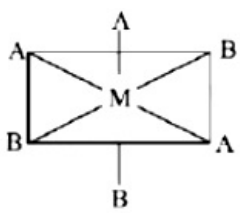
Solution:
The maximum possible denticites of the given ligand towards transition metal ion is 6 and towards inner transition metal ion (due to greater ionic radii and more atomic orbitals) is 8 .

Question182

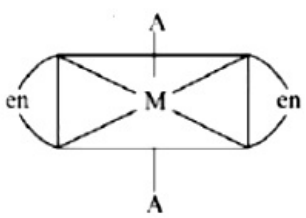
The one that will show optical activity is:
(en = ethane 1,2 -diamine)
[April 9,2019 (I)]

Options:

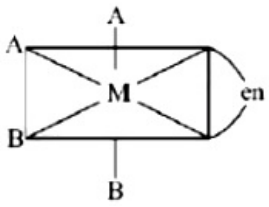
A.



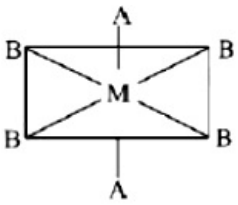
B.



C.



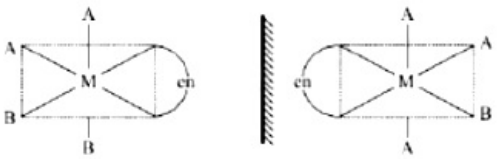
D.



Answer: C

Solution:

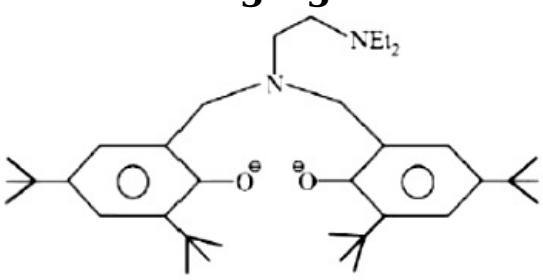
Solution:



No plane of symmetry or centre of symmetry is present. Hence, it will be optically active.

Question183

The following ligand is:



[April 8,2019 (I)]

Options:

A. hexadentate

B. tetradentate

C. bidentate

D. tridentate

Answer: B

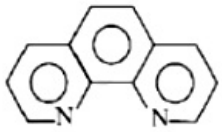
Solution:

Solution:
It has four atoms containing lone pair of e^-, therefore, it will be able to donate these lone pairs and acts as a tetradentate

ligand.

Question184

The complex ion that will lose its crystal field stabilization energy upon oxidation of its metal to +3 state is:

(Phen = 

and
ignore pairing energy)

[April 12, 2019 (I)]

Options:

A. $[Co(phen)_3]^{2^2}$

B. $[Ni(phen)_3]^2$

C. $[Zn(phen)_3]^{2+}$

D. $[Fe(phen)_3]^2$

Answer: D

Solution:

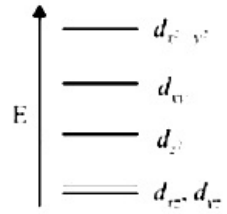
Solution:
$CFSE \Rightarrow [-0.4p + 0.6q]\Delta_0$
$Ni^{2+}(d^8) \longrightarrow Ni^{3+}(d^7)$
$t_{2g}^6 e_B^2 \qquad t_{2g}^6 e_B^1$
$CFSE \Rightarrow -1.2 \quad -1.8$
$Co^{2+}(d^7) \longrightarrow Co^{3+}(d^6)$
$t_{2g}^6 e_g^1 \qquad t_2^6 e^0 g$
$CFSE \Rightarrow -1.8 \quad -2.4$
$Zn^{2+}(d^{10}) \longrightarrow Zn^{3+}(d^9)$
$t_{2g}^6 e_g^4 \qquad t_{2g}^6 e^3$
$CFSE \Rightarrow 0.0 \quad -0.6$
$Fe^{2+}(d^6) \rightarrow Fe^{3+}(d^5)$
$t_{2g}^6 e_g^0 \qquad t_{2g} e_g^0$
$CFSE \Rightarrow -2.4 \quad -2.0$
So, only Fe^{2+} will lose crystal field stabilisation energy upon oxidation to +3 , others will gain crystal field stabilisation energy.

Question185

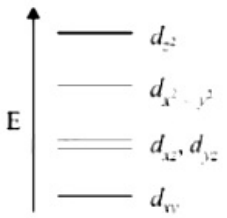
Complete removal of both the axial ligands (along the zaxis) from an octahedral complex leads to which of the following splitting patterns? (relative orbital energies not on scale)
[April 12, 2019 (I)]

Options:

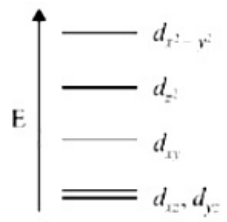
A.



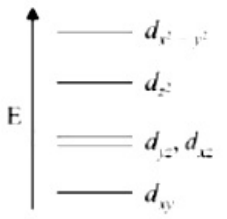
B.



C.



D.



Answer: A

Solution:

Solution:
(a) After removal of both axial ligands from octahedral complex the field becomes square planar and leads to following energy patterns.
$d_{x^2-y^2} > d_{xy} > d_{z^2} > d_{xz} = d_{yz}$

Question186

Three complexes, $[CoCl(NH_3)_5]^{2+}(I)$, $[Co(NH_3)_5H_2O]^{3+}(II)$ and $[Co(NH_3)_6]^{3+}$ (III) absorb light in the visible region. The correct order of the wavelength of light absorbed by them is :
[April 10, 2019 (I)]

Options:

A. (III) > (I) > (II)

B. (III) > (II) > (I)

C. (II) > (D) > (III)

D. (I) > (II) > (III)

Answer: D

Solution:

Solution:
Wavelength of the energy absorbed by the coordination compound is inversely proportional to ligand field strength of the given co-ordination compound. The strong field ligand causes higher splitting of the d -orbitals. The decreasing order of ligand field strength is $NH_3 > H_2O > Cl$. Therefore decreasing order of absorbed wavelength is (I) > (II) > (III)

Question187

The crystal field stabilization energy (CFSE) of $[Fe(H_2O)_6]Cl_2$ and $K_2[NiCl_4]$, respectively are: [April 10, 2019 (II)]

Options:

A. $-0.6\Delta_0$ and $-0.8\Delta_z$

B. $-0.4\Delta_o$ and $-0.8\Delta_\tau$

C. $-2.4\Delta_o$ and $-1.2\Delta_e$

D. $-0.4\Delta_o$ and $-1.2\Delta_r$

Answer: B

Solution:

$[Fe(H_2O)_6]^{2+} t_2^4 ge_g^2$
$CFSE = (-4 \times 0.4 + 2 \times 0.6)A_0 = -0.4\Delta_0$
$[NiCl_4]^{2-} e^4 t_2^4$ $CFSE = (-4 \times 0.6 + 4 \times 0.4)\Delta_1 = -0.8\Delta_1$

Question188

The degenerate orbitals of $[Cr(H_2O)_6]^{3+}$ are: [April 9, 2019 (I)]

Options:

A. d_{xz} and $d_{y=}$

B. d_{yz} and d_{z^2}

C. d_{z^2} and d_{xz}

D. $d_{x^2-y^2}$ and d_{xy}

Answer: A

Solution:

Solution:
Cr^{3+} has d^3 configuration and forms an octahedral inner orbitals complex, therefore the set of degenerate orbitals are (d_{xy}, d_{yz} and d_{xz}) and ($d_{x^2-y^2}$ and d_{z^2}).

Question189

The correct statements among I to III are:
(I) Valence bond theory cannot explain the color exhibited by transition metal complexes.
(II) Valence bond theory can predict quantitatively the magnetic properties of transition metal complexes.
(III) Valence bond theory cannot distinguish ligands as week and strong field ones.
[April 9, 2019 (I)]

Options:

A. (II) and (III) only

B. (I), (II) and (III)

C. (I) and (III) only

D. (I) and (II) only

Answer: C

Solution:

Solution:
Valence bond theory cannot distinguish between weak field ligands and strong field ligands. Therefore, it cannot predict quantitatively the magnetic properties of transition metal complexes.

Question190

The correct order of the spin-only magnetic moment of metal ions in the following low-spin complexes, $[V(CN)_6]^4$, $[Fe(CN)_6]^4$, $[Ru(NH_3)_6]^{3+}$, and $[Cr(NH_3)_6]^{2+}$, is
[April 8, 2019 (I)]

Options:

A. $Cr^{2+} > Ru^{3+} > Fe^{2+} > V^{2}$

B. $V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2}$

C. $V^{2+} > Ru^{3+} > Cr^{2+} > Fe^{2+}$

D. $Cr^{2+} > V^{2+} > Ru^{3+} > Fe^{2+}$

Answer: B

Solution:

Solution:

Complex	Metal ion electrons	No. of unpaired
$[V(CN)_6]^4$	V^{2+}	3
$[Ru(NH_3)_6]^{3+}$	Ru^{3+}	1
$[Fe(CN)_6]^+$	Fe^{2+}	0
$[Cr(NH_3)_6]^{2+}$	Cr^{2+}	2

∵ Spin magnetic moment ∝ no. of unpaired electrons. So the order of spin magnetic moment is:
$V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$

Question191

The calculated spin-only magnetic moments (BM) of the anionic and cationic species of $[Fe(H_2O)_6]_2$ and $[Fe(CN)_6]$, respectively, are: [April 8, 2019 (II)]

Options:

A. 0 and 4.9

B. 2.84 and 5.92

C. 4.9 and 0

D. 0 and 5.92

Answer: C

Solution:

Solution:
$[Fe(H_2O)_6]^{2+}$: cationic species of $[Fe(H_2O)_6]_2$
$[Fe(CN)_6]^{4-}$: anionic species of $[Fe(CN)_6]$
Magnetic Moment (μ) = $\sqrt{n(n+2)}$
Where n = no. of unpaired electrons
Now, $[Fe(H_2O)_6]^{2+}[Fe(CN)_6]^4$
n = 4 n = 0
$\therefore \mu = \sqrt{4(4+2)}$ $\mu = \sqrt{0(0+2)}$
$\mu = 4.9$ $\mu = 0$

Question192

The compound used in the treatment of lead poisoning is: [April 12, 2019 (II)]

Options:

A. D-penicillamine

B. desferrioxime B

C. Cis-platin

D. EDTA

Answer: D

Solution:

Solution:
EDTA is used in the treatment of lead poisoning.Deferrioxime B is used in treatment of iron poisoning and D-penicillamine is used in treatment of heavymetal poisoning, while cis -platin is used for treating cancer.

Question193

The compound that inhibits the growth of tumors is : [April 8, 2019 (II)]

Options:

A. trans-$[Pt(Cl)_2(NH_3)_2]$

B. cis $-[Pd(Cl)_2(NH_3)_2]$

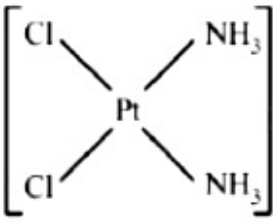
C. cis $-[Pt(Cl)_2(NH_3)_2]$

D. trans-$[Pd(Cl)_2(NH_3)_2]$

Answer: C

Solution:

cis-Platin is used as an anti-cancer drug.



cis-$[Pt(Cl)_2(NH_3)_2]$

Question194

Consider the following reaction and statements:
$[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$
(I) Two isomers are produced if the reactant complex ion is a cis-isomer.
(II) Two isomers are produced if the reactant complex ion is a trans - isomer
(III) Only one isomer is produced if the reactant complex ion is a trans-isomer
(IV) Only one isomer is produced if the reactant complex ion is a cis-isomer.
The correct statements are:
[2018]

Options:

A. (I) and (II)

B. (I) and (III)

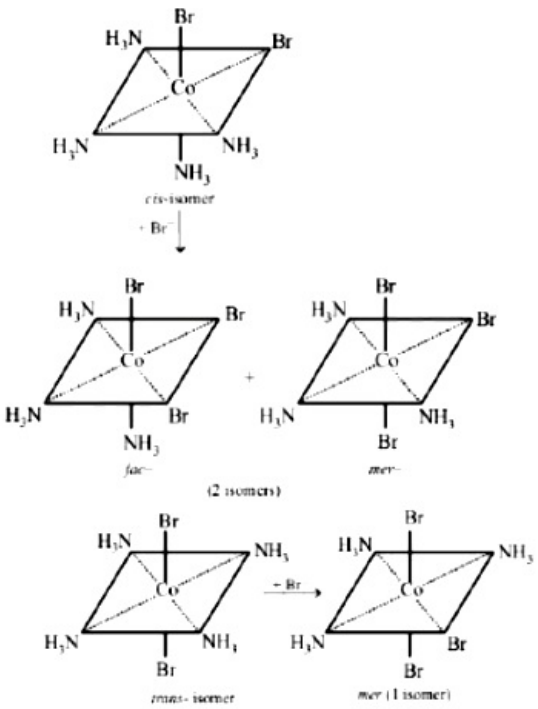
C. (III) and(IV)

D. (II) and (IV)

Answer: B

Solution:

Solution:



Question195

Which of the following complexes will show geometrical isomerism?

[Online April 16, 2018]

Options:

A. Potassium tris(oxalato) chromate (III)

B. Pentaaquachlorochromium (III) chloride

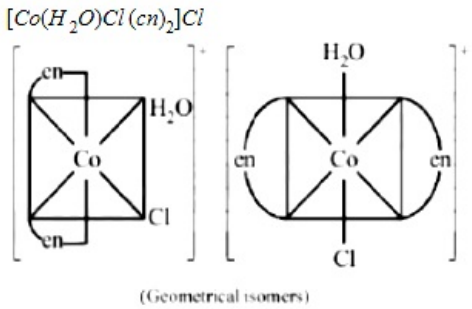
C. Aquachlorobis (ethylenediamine) cobalt(II) chloride

D. Potassium amminetrichloroplatinate (II)

Answer: C

Solution:

Solution:



Question196

The total number of possible isomers for square-planar $[Pt(Cl)(NO_2)(NO_3)(SCN)]^{2-}$ is:

[Online April 15, 2018(II)]

Options:

A. 16

B. 12

C. 8

D. 24

Answer: B

Solution:

Solution:
The square planar complex of the type [Mabed] $^{n+}$, where all four ligands are different, has 3 geometrical isomers. But if one of the ligands is ambidentate, then $2 \times 3 = 6$ geometrical isomers are possible. But if two ligands are ambidentate, then $4 \times 3 = 12$ geometrical isomers are possible.
In the given example, NO_2^- and SCN are ambidentate ligands

Question197

In Wilkinson's catalyst, the hybridisation of central metal ion and its shape are respectively:
[Online April 16, 2018]

Options:

A. sp^3d , trigonal bipyramidal

B. d^2sp^3, octahedral

C. $d\,sp^2$, squarc planar

D. sp^3, tetrahedral

Answer: C

Solution:

Solution:
Wilkinson catalyst is $[RhCl(PPh_3)_3]$.
Rh belongs to $4d$ series, so it terms square planar complexes and contains $d\,sp^2$ hybridisation.

Question198

The correct combination is:
[Online April 15, 2018(I)]

Options:

A. $[NiCl_4]^{2-}$ square-planar; $[Ni(CN)_4]^2$ -paramagnetic

B. $[Ni(CN)_4]^{2-}$ -tetrahedral; $[Ni(CO)_4]$ -paramagnetic

C. $[NiCl_4]^{2-}$ -paramagnetic; $[Ni(CO)_4]$ -tetrahedral

D. $[NiCl_4]^{2-}$ dimagnetic; $[Ni(CO)_4]$ -square-planar

Answer: C

Solution:

Solution:
$[Ni(CN)_4]^{2-}$ is square planar, diamagnetic (0 unpaired electrons) with $d\,sp^2$ hybridisation.
$[Ni(CO)_4]$ - is tetrahedral, diamagnetic (0 unpaired electrons) with sp^3 hybridisation.
$[NiCl_4]^2$ is tetrahedral, paramagnetic (2 unpaired electrons) with sp^3 hybridisation.
Hence, the option (c) is the correct answer.

Question199

The correct order of spin-only magnetic moments among the following is:
(Atomic number: M n = 25, Co = 27, N i = 28, Z n = 30)
[Online April 15, 2018(II)]

Options:

A. $[ZnCl_4]^{2-} > [NiCl_4]^{2-} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$

B. $[CoCl_4]^2 > [MnCl_4]^2 > [NiCl_4]^{2-} > [ZnCl_4]^2$

C. $[NiCl_4]^2 > [CoCl_4]^{2-} > [MnCl_4]^{2-} > [ZnCl_4]^2$

D. $[MnCl_4]^{2-} > [CoCl_4]^{2-} > [NiCl_4]^{2-} > [ZnCl_4]^{2-}$

Answer: D

Solution:

Solution:
The complex having highernumber of unpaired electrons will have higher value of spin only magnetic moment.
In all these complexes, the central metal ion is in +2 oxidation state.
Zn^{2+} has $3d^{10}$ outer electronic configuration with 0 unpaired electron.
Ni^{2+} has $3d^{t}$ outer electronic configuration with 2 unpaired electrons.
Co^{2+} has $3d^{7}$ outer electronic configuration with 3 unpaired electrons.
Mn^{2+} has $3d^{6}$ outer electronic configuration with 5 unpaired electrons
Hence the correct order of spin-only magnetic moments is $[MnCl_4]^{2-} > [CoCl_4]^{2-} > [NiCl_4]^{2-} > [ZnCl_4]^{2-}$

Question200

On treatment of 100mL of 0.1M solution of $CoCl_3.6H_2O$ with excess $AgNO_3$; 1.2×10^{22} ions are precipitated. The complex is:
[2017]

Options:

A. $[Co(H_2O)_4Cl_2]Cl.2H_2O$

B. $[Co(H_2O)_3Cl_3] \cdot 3H_2O$

C. $[Co(H_2O)_6]Cl_3$

D. $[Co(H_2O)_5Cl]Cl_2, H_2O$

Answer: D

Solution:

Solution:
Moles of complex $= \frac{\text{Molarity} \times \text{Volume(mL)}}{1000}$
$= \frac{100 \times 0.1}{1000} = 0.01 \text{mol e}$
Moles of ions precipitated with excess of

$AgNO_3 = \frac{1.2 \times 10^{22}}{6.02 \times 10^{23}} = 0.02 \text{mol es}$

$\therefore$ Number of Cl^- present in ionisation sphere

$= \frac{\text{Number of moles of ions precipitated}}{\text{Number of moles of complex}}$

$= \frac{0.02}{0.01} = 2$

It means 2Cl - ions present in ionization sphere.

Thus formula of the complex is

$[Co(H_2O)_5Cl]Cl_2H_2O$

Question201

The pair of compounds having metals in their highest oxidation state is :

[Online April 8, 2017]

Options:

A. MnO_2 and CrO_2Cl_2

B. $[NiCl_4]^{2-}$ and $[CoCl_4]^{2-}$

C. $[Fe(CN)_6]^{3-}$ and $[Cu(CN)_2]^{2-}$

D. $[FeCl_4]^-$ and Co_2O_3

Answer: A

Solution:

Solution:

$\overset{-1}{Cr}O_2\overset{2-}{Cl_2}$ Cr = +6; MnO_2^{2-} Mn = +4

(Highest oxidation state)

$[\overset{-1}{N}iCl_4]^{3-}$ Ni = +2; $[\overset{-1}{Co}Cl_4]^{2-}$ Co = +2

$[\overset{-1}{Fe}(CN)_6]^{-3}$ Fe = +3; $[Cu(\overset{-1}{CN})_4]^{2-}$ Cu = +2

(4) $[\overset{-1}{Fe}Cl_4]^-$ Fe = +3; $\overset{-2}{Co_2}O_3$ Co = +3

Question202

$[Co_2(CO)_8]$ displays:

[Online April 9,2017]

Options:

A. oneCo-Cobond, six terminal CO and two bridging CO

B. oneCo-Cobond, four terminal CO and four bridging CO

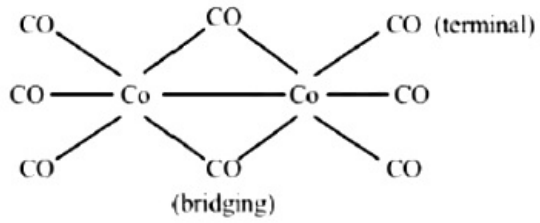
C. no Co-Co bond, six terminal CO and two bridging CO

D. noCo-Cobond, four terminal CO and four bridging CO

Answer: A

Solution:

Solution:



Question203

Which one of the following complexes shows optical isomerism? [2016]

Options:

A. trans$[Co(en)_2Cl_2]Cl$

B. $[Co(NH_3)_4Cl_2]Cl$

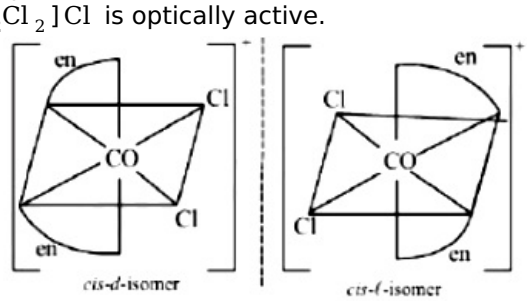
C. $[Co(NH_3)_3Cl_3]$

D. cis$[Co(en)_2Cl_2]Cl$ (en = ethylenediamine)

Answer: D

Solution:

Solution:
Optical isomerism occurs when a molecule is nonsuper imposable with its mirror image hence the complex cis-$[Co(en)_2Cl_2]Cl$ is optically active.



Question204

Which one of the following complexes will consume more equivalents of aqueous solution of $AgNO_3$? [Online April 9,2016]

Options:

A. $Na_2[CrCl_5(H_2O)]$

B. $Na_3[CrCl_6]$

C. $[Cr(H_2O)_5Cl]Cl_2$

D. $[Cr(H_2O)_6]Cl_3$

Answer: D

Solution:

Solution:
More equivalents of $AgNO_3$ aqueous solution will be consumed if complex will furnish more Cl^- ions in solution. Hence complex $[Cr(H_2O)_6]Cl_3$ will consume more equivalents of aqueous solution of $AgNO_3$.

Question205

Which of the following is an example of homoleptic complex? [Online April 10, 2016]

Options:

A. $[Co(NH_3)_6]Cl_3$

B. $[Pt(NH_3)_2Cl_2]$

C. $[Co(NH_3)_4Cl_2]$

D. $[Co(NH_3)_5Cl]Cl_2$

Answer: A

Solution:

Solution:
Complexes having only one type of ligands are examples of homoleptic complex.

Question206

The pair having the same magnetic moment is: [At. No.: Cr = 24, Mn = 25, Fe = 26, Co = 27] [2016]

Options:

A. $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{2+}$

B. $[CoCl_4]^{2-}$ and $[Fe(H_2O)_6]^{2+}$

C. $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2}$

D. $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

Answer: D

Solution:

Solution:

	Metal ion electron	Unpaired moment	Magnetic
(i)	Cr^{2+}	4	$\sqrt{24}$ B.M.
(ii)	Fe^{2}	4	$\sqrt{24}$ B.M.
(iii)	Co^{2+}	3	$\sqrt{15}$ B.M.
(iv)	Mn^{2+}	5	$\sqrt{35}$ B.M.

Since (i) and (ii), cach has 4 unpaired electron, so they will exhibit same magnetic moment. Thus option (d) is correct.

Question207

Identify the correct trend given below: (Atomic No. = Ti : 22, Cr : 24 and Mo : 42) [Online April 9, 2016]

Options:

A. Δ_o of $[Cr(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$ Δ_o of $[Ti(H_2O)_6]^{3+} > [Ti(H_2O)_6]^{2+}$

B. Δ_o of $[Cr(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$ and Δ_0 of $[Ti(H_2O)_6]^{3+} < [Ti(H_2O)_6]^{2+}$

C. Δ_0 of $[Cr(H_2O)_6]^{2+} < [Mo(H_2O)_6]^{2+}$ and Δ_0 of $[Ti(H_2O)_6]^{3+} > [Ti(H_2O)_6]^{2+}$

D. Δ_0 of $[Cr(H_2O)_6]^{2+} < [Mo(H_2O)_6]^{2+}$ and Δ_0 of $[Ti(H_2O)_6]^{3+} < [Ti(H_2O)_6]^{2+}$

Answer: D

Solution:

Solution:
The splitting is affected by the oxidation state of the central metal ion. A higher oxidation state leads to larger splitting, hence
Δ_o of $[Ti(H_2O)_6]^{3+} < \Delta_0$ of $[Ti(H_2O)_6]^{2+}$
Further Δ_o also depends of Z_{eff} and Z_{eff}. of 4d series is more than 3d series. Hence
Δ_0 of $[Cr(H_2O)_6]^{2+} < \Delta_o$ of $[Mo(H_2O)_6]^{2+}$

Question208

The number of geometric isomers that can exist for square planar

complex $[Pt(Cl)(py)(NH_3)(NH_2OH)]^+$ is (py = pyridine): [2015]

Options:

A. 4

B. 6

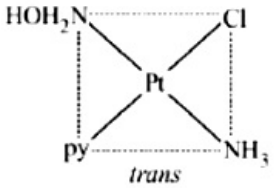
C. 2

D. 3

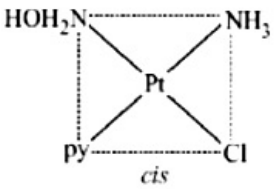
Answer: D

Solution:

Solution:
Square planar complexes of type M[ABCD] form three isomers. Their position may be obtained by fixing the position of one ligand and placing at the trans position any one of the remaining three ligands one by one.



trans



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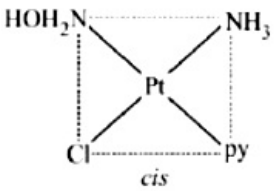

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Question209

The correct statement on the isomerism associated with the following complex ions,
(A) $[Ni(H_2O)_5NH_3]^{2+}$,
(B) $[Ni(H_2O)_4(NH_3)_2]^{2+}$
(C) $[Ni(H_2O)_3(NH_3)_3]^{2+}$ is :
[Online April 10,2015]

Options:

A. (A) and (B) show only geometrical isomerism

B. (A) and(B) show geometrical and optical isomerism

C. (B) and (C) show geometrical and optical isomerism

D. (B) and (C) show only geometrical isomerism

Answer: D

Solution:

Solution:
It does not show optical and geometrical isomerism (B) and (C) shows only geometrical isomerism.

Question210

Which of the following compounds is not colored yellow? [2015]

Options:

A. $(NH_4)_3[As(Mo_3O_{10})_4]$

B. $BaCrO_4$ [2015]

C. $Zn_2[Fe(CN)_6]$

D. $K_3[Co(NO_2)_6]$

Answer: C

Solution:

Solution:

Question211

The color of $KMnO_4$ is due to : [2015]

Options:

A. $L \rightarrow M$ charge transfer transition

B. $\sigma - \sigma^*$ transition

C. $M \rightarrow L$ charge transfer transition

D. $d - d$ transition

Answer: A

Solution:

Solution:
$L \rightarrow M$ charge transfer spectra. $KMnO_4$ is colored because it absorbs light in the visible range of electromagnetic

radiation. The permanganate ion is the source of color, as a ligand to metal ($L \rightarrow M$) charge transfer takes place between oxygen's p orbitals and the empty d orbitals on the metal. This charge transfer takes place when a photon of light is absorbed which leads to the purple color of the compound.

Question212

Which of the following complex ions has electrons that are symmetrically filled in both t_{2g} and e_g orbitals? [Online April 11, 2015]

Options:

A. $[FeF_6]^3$

B. $[Mn(CN)_6]^4$

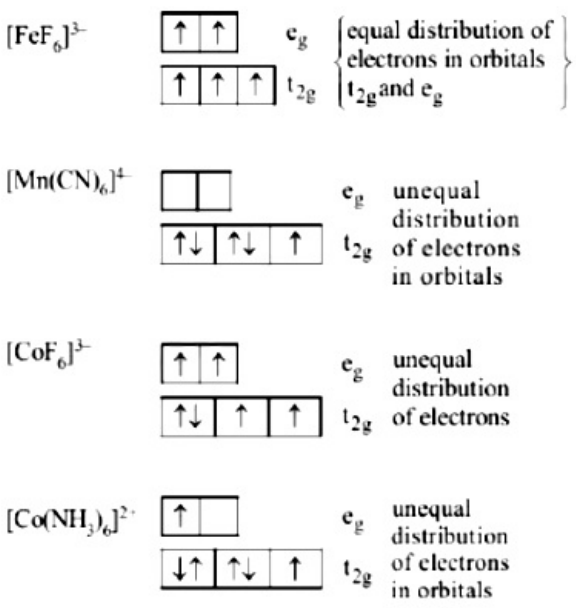
C. $[CoF_6]^3$

D. $[Co(NH_3)_6]^{2+}$

Answer: A

Solution:

Solution:
Symmetrically filled t_2 and e_g are those, which contain equal distribution of electrons.



Question213

Which molecule/ion among the following cannot act as a ligand in complex compounds? [Online April 10,2015]

Options:

A. CH_4

B. CO

C. CN

D. Br

Answer: A

Solution:

Solution:
The donor atoms, molecules or anions which donate a pair of electrons to the metal atom or ion and form a coordinate bond with it are called ligands. In methane there is no electrons for donation to central metal atom/ ion, it is stable with complete octet configuration.

Question214

Which of the following name formula combinations is not correct?

	Formula	
(1)	$K_2[Pt(CN)_4]$	Potassium tetracyanoplatinate (II)
(2)	$[Mn(CN)_5]^{2-}$	Pentacyanomagnate (II) ion
(3)	$K[Cr(NH_3)_2Cl_4]$	Potassium diammine tetrachlorochromate (III)
(4)	$[Co(NH_3)_4(H_2O)I]SO_4$	Tetraammine aquaioda cobalt (III) sulphate.

[Online April 11,2014]

Answer: 2

Solution:

Solution:
Pentacyanomangnate (III) is the correct IUPAC name of $[Mn(CN)_5]^2$.

Question215

An octahedral complex with molecular composition $M.5\,NH_3 \cdot Cl\ .\ SO_4$ has two isomers, A and B. The solution of A gives a white precipitate

with $AgNO_3$ solution and the solution of B gives white precipitate with $BaCl_2$ solution. The type of isomerism exhibited by the complex is: [Online April 19,2014]

Options:

A. Linkage isomerism

B. Ionisation isomerism

C. Coordinate isomerism

D. Geometrical isomerism

Answer: B

Solution:

Solution:
The two possible isomers for the given octahedral complex are $[M(NH_3)_5SO_4]Cl$ and $[M(NH_3)_5Cl]SO_4$. They respectively give chloride ion (indicated by precipitation with $BaCl_2$) and SO_4 ion (indicated by precipitation with $AgNO_3$). Hence the type of isomerism exhibited by the complex is ionisation isomerism.

Question216

The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is:
[2014]

Options:

A. $L_4 < L_3 < L_2 < L_1$

B. $L_1 < L_3 < L_2 < L_4$

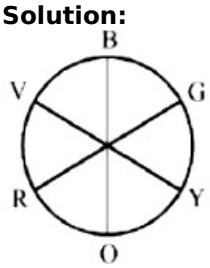
C. $L_3 < L_2 < L_4 < L_1$

D. $L_1 < L_2 < L_4 < L_3$

Answer: B

Solution:

Solution:



For a given metal ion, weak field ligands create a complex with smaller Δ, which will absorbs light of longer λ and thus

lower frequency. Conservely, stronger field ligands create a larger Δ, absorb light of shorter λ and thus higher vi.e. higher energy.
So order of ligand strength is
$L_1 < L_3 < L_2 < L_4$

Question217

An octahedral complex of Co^{3+} is diamagnetic. The hybridisation involved in the formation of the complex is: [Online April 9, 2014]

Options:

A. sp^3d^2

B. $d\,sp^2$

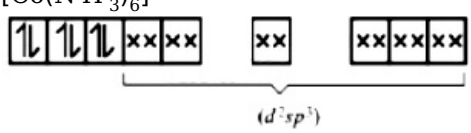
C. d^2sp^3

D. sp^3d

Answer: C

Solution:

Solution:
$[Co(NH_3)_6]^{3+}$



Octahedral and diamagnetic.

Question218

The correct statement about the magnetic properties of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ is (Z = 26): [Online April 9, 2014]

Options:

A. both are paramagnetic.

B. both are diamagnetic.

C. $[Fe(CN)_6]^{3-}$ is diamagnetic, $[FeF_6]^{3-}$ is paramagnetic.

D. $[Fe(CN)_6]^{3-}$ is paramagnetic, $[FeF_6]^{3-}$ is diamagnetic.

Answer: A

Solution:

Both are paramagnetic, the only difference is that CN is a strong field ligand whereas F^- is a weak field ligand.

Question219

Consider the coordination compound, $[Co(NH_3)_6]Cl_3$. In the formation of this complex, the species which acts as the Lewis acid is: [Online April 11, 2014]

Options:

A. $[Co(NH_3)_6]^{3+}$

B. Cl

C. Co^{3+}

D. NH_3

Answer: C

Solution:

Solution:

$\underset{\text{Lewis acid}}{Co^{3+}} + 6\ \underset{\text{Lewis base}}{NH_3} \longrightarrow \underset{\text{abduct}}{[Co(NH_3)_6]^{3+}}$

Question220

Among the following species the one which causes the highest CFSE, Δ_o as a ligand is: [Online April 12, 2014]

Options:

A. CN^-

B. NH_3

C. F^-

D. CO

Answer: D

Solution:

Solution:

Following is the order of increasing value of Δ_0 for the ligands

$I^- < Br^- < Cl^- < F^- < H_2O < Py = NH_3 < en < NO_2^- < < CN^{-<} < CO$

Question221

Which one of the following complexes will most likely absorb visible light?
(At nos. Sc = 21, Ti = 22, V = 23, Zn = 30)
[Online April 12, 2014]

Options:

A. $[Sc(H_2O)_6]^{3+}$

B. $[Ti(NH_3)_6]^{4+}$

C. $[V(NH_3)_6]^{3+}$

D. $[Zn(NH_3)_6]^{2+}$

Answer: C

Solution:

Solution:
The absorption of visible light is responsible for coloured nature of the transition metal cation due to the promotion of one or more unpaired $-d$ - electron from a lower to higher level within same d -subshell. Hence higher the number of unpaired electron higher will be the absorpion in visible light.
The electronic configuration of the given elements is $Sc^{3+}(18) = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^0 4s^0 -$ no unpaired e^-
$Ti^{4+}(18) = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^0 4s^0 -$ no unpaired e^-
$V^{3+}(20) = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^0 -$ Two unpaired e^-
$Zn^{2+}(28) = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^0 -$ no unpaired e.
hence $[V(NH_3)_6]^{3+}$ will most likely absorb visible light.

Question222

Nickel (Z = 28) combines with a uninegative monodentate ligand to form a diamagnetic complex $[NiL_4]^2$. The hybridisation involved and the number of unpaired electrons present in the complex are respectively:
[Online April 19, 2014]

Options:

A. sp^3, two

B. dsp^2, zero

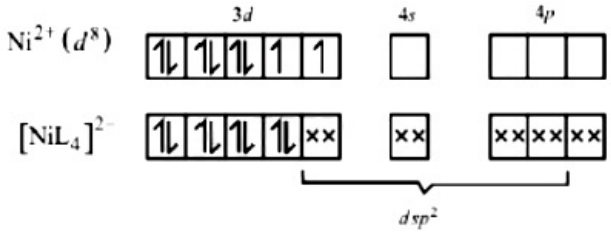
C. dsp^2, one

D. sp^3, zero

Answer: B

Solution:

$[N iL_4]^{2-}$ ⇒ Diamagnetic in nature (given)



So, no. of unpaired electron = 0
hybridisation $-d\,sp^2$

Question223

Which of the following complex species is not expected to exhibit optical isomerism?
[2013]

Options:

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

B. $[Co(en)_2Cl_2]^{+}$

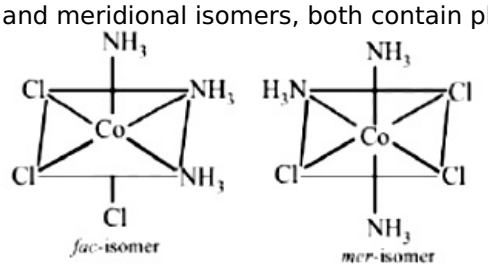
C. $[Co(NH_3)_3Cl_3]$

D. $[Co(en)(NH_3)_2Cl_2]^{+}$

Answer: C

Solution:

Solution:
Octahedral coordination entities of the type Ma_3b_3 exhibit geometrical isomerism. The compound exists both as facial and meridional isomers, both contain plane of symmetry



Question224

Type of isomerism which exists between $[Pd(C_6H_5)_2(SCN)_2]$ and $[Pd(C_6H_5)_2(NCS)_2]$ is:
[Online April 9,2013]

Options:

A. Linkage isomerism

B. Coordination isomerism

C. Ionisation isomerism

D. Solvate isomerism

Answer: A

Solution:

Solution:
The compound shows linkage isomerism because the ligand in the compound is an ambidenate ligand that can bond at more than one atomic site.
i.e., $:NCS^-$ and $:SCN^-$

Question225

Which of the following is diamagnetic? [Online April 22, 2013]

Options:

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

B. $[Co(ox)]^{3-}$

C. $[FeF_6]^{3-}$

D. $[Co(F_6)]^{3-}$

Answer: B

Solution:

Solution:
Among four ligands CN^- and OX^{2-} are strong field ligands. So pairing takes places in $[(FeCN)_6]^3$ and $[Co(OX)_3]^{3-}$ complexes. Fe^{3+} having one unpaired electron in its complex white Co^{3+} does not have unpaired electron in its complex. So option b is correct.

Question226

The magnetic moment of the complex anion $[Cr(NO)(NH_3)(CN)_4]^{2-}$ is: [Online April 23, 2013]

Options:

A. 5.91BM

B. 3.87BM

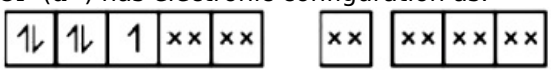
C. 1.73BM

D. 2.82BM

Answer: C

Solution:

Solution:
$In[Cr(NO)(NH_3)(CN)_4]^2$,
$Cr^+(d^5)$ has electronic configuration as:



So, 1 unpaired electron is present.
Thus, $\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.73BM$

Question227

In which of the following octahedral complex species the magnitude of Δ_0 will be maximum?
[Online April 25, 2013]

Options:

A. $[Co(H_2O)_6]^{2+}$

B. $[Co(CN)_6]^{3-}$

C. $[Co(C_2O_4)_3]^{3-}$

D. $[Co(NH_3)_6]^{3+}$

Answer: B

Solution:

Solution:
Crystal field splitting depends upon the nature of ligand. The nature of ligand decreases as shown below
$C_2O_4^{2-} < H_2O < NH_3 < CN^-$
Hence the crystal field splitting will be maximum for $[Co(CN)_6]^{3-}$

Question228

The structure of which of the following chloro species can be explained on the basis of dsp^2 hybridisation?
[Online April 25, 2013]

Options:

A. $PdCl_4^{2-}$

B. $FeCl_4^{2-}$

C. $CoCl_4^{2-}$

D. $NiCl_4^{2-}$

Answer: A

Solution:

Solution:
$[PdCl_4]^{2-}$ is dsp^2 hybridised and square planar in shape.

Question229

Which among the following will be named as dibromido bis (ethylenediamine) chromium (III) bromide? [2012]

Options:

A. $[Cr(en)_3]Br_3$

B. $[Cr(en)_2Br_2]Br$

C. $[Cr(en)Br_4]$

D. $[Cr(en)Br_2]Br$

Answer: B

Solution:

Solution:
$[Cr(en)_2Br_2]Br$
dibromido bis(ethylenediamine) chromium (III) Bromide.

Question230

Which of the following complex ions will exhibit optical isomerism? (en = 1, 2 -diamine ethane). [Online May 12,2012]

Options:

A. $[Cr(NH_3)_2Cl_2]^+$

B. $[Co(en)_2Cl_2]^+$

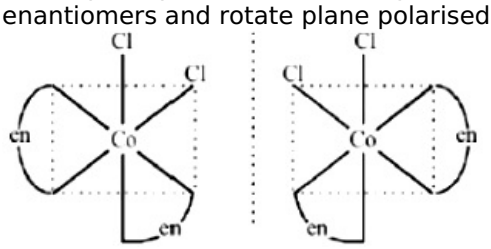
C. $[Co(NH_3)_4Cl_2]^+$

D. $[Zn(en)_2]^{2+}$

Answer: B

Solution:

Solution:
Non superimposable mirror images are called optical isomers and may be described as "chiral'. They are also called enantiomers and rotate plane polarised light in opposite directions.



Question231

The complex ion $[Pt(NO_2)(Py)(NH_3)(NH_2OH)]^+$ will give [Online May 26,2012]

Options:

A. 2 isomers (Geometrical)

B. 3 isomers (Geometrical)

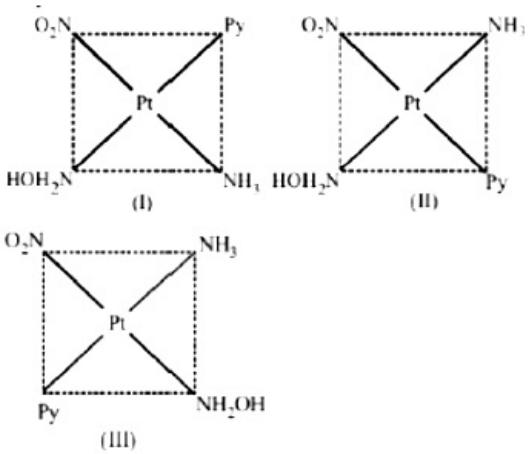
C. 6 isomers (Geometrical)

D. 4 isomers (Geometrical)

Answer: B

Solution:

Solution:
Complexes of the type M_{ABCD} may exist in three isomeric form. Similarly $[Pt(NO_2)(Py)(NH_3)(NH_2OH)^+]$ may exist in three isomeric form.



Question232

The d -electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and Co^{2+} are d^4, d^5, d^6 and d^7 respectively. Which one of the following will exhibit

the lowest paramagnetic behaviour?
(Atomic no. Cr = 24, M n = 25, F e = 26, Co = 27)
[Online May 7,2012]

Options:

A. $[Co(H_2O)_6]^{2+}$

B. $[Cr(H_2O)_6]^{2+}$

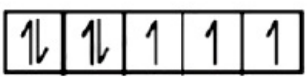
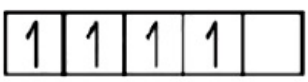
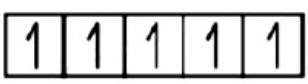
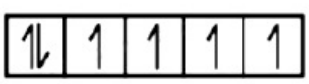
C. $[Mn(H_2O)_6]^{2+}$

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

Answer: A

Solution:

Solution:

	Electronic Configuration	No. of unpairedelectrons
Co^{2+}	d^7 	3
Cr^{2+}	d^4 	4
Mn^{2+}	d^5 	5
Fe^{2+}	d^6 	4

∴ Since Co^{3+} has lowest no. of unpaired electrons hence lowest paramagnetic behaviour is shown by $[Co(H_2O)_6]^{2+}$

Question233

The correct order of ligands in the spectrochemical series is
[Online May 19,2012]

Options:

A. $Cl^- > en > CN^- > NCS^-$

B. $CN^- > en > NCS^- > Cl^-$

C. $en > CN^- > Cl^- > NCS$

D. $NCS^- > CN^- > Cl^- > en$

Answer: B

Solution:

Solution:
Correct order is : CN^- > en > NCS^- > Cl

Question234

Which of the following paramagnetic ions would exhibit a magnetic moment (spin only) of the order of 5 BM? (At. Nos. Mn = 25, Cr = 24, V = 23, Ti = 22) [Online May 19,2012]

Options:

A. Mn^{2+}

B. Ti^{2+}

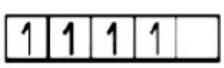
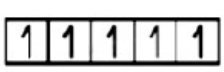
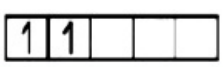
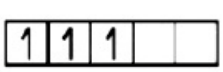
C. V^{2+}

D. Cr^{2+}

Answer: D

Solution:

Solution:

Ion	Electronic Configuration	Magnetic moment ($\sqrt{n(n+2)}$)
$Cr^{2+}d^4$		$\sqrt{4(4+2)} = 4.9$
$Mn^{2+}d^5$		$\sqrt{5(5+2)} = 5.8$
$Ti^{2+}d^2$		$\sqrt{2(2+2)} = 2.4$
$V^{2+}d^3$		$\sqrt{3(3+2)} = 3.8$

Hence Cr^{2+} has magnetic moment of the order of 5B . M .

Question235

Square-planar geometry is shown by [Online May 19,2012]

Options:

A. $[PtCl_2(NH_3)_2]$

B. $[NiCl_4]^{2-}$

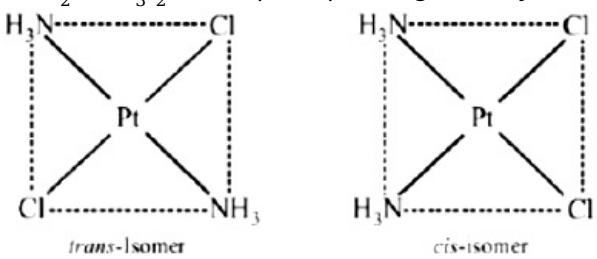
C. MnO_4^-

D. CrO_4^{2-}

Answer: A

Solution:

Solution:
$[PtCl_2(NH_3)_2]$ has square planar geometry.



Question236

Which one of the following complex ions has geometrical isomers? [2011]

Options:

A. $[Ni(NH_3)_5Br]$

B. $[Co(NH_3)_2(en)_2]^{3+}$

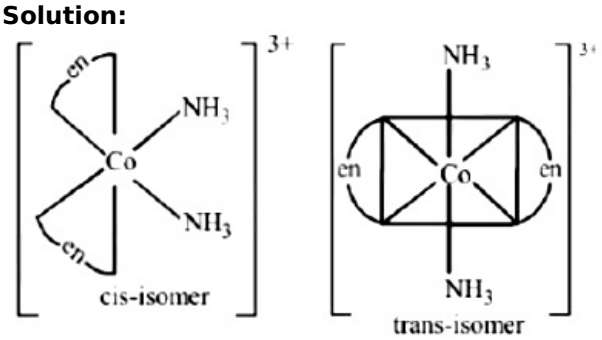
C. $[Cr(NH_3)_4(en)_2]^{3+}$

D. $[Co(en)_3]^{3+}$ (en-cthylenediamine)

Answer: B

Solution:

Solution:



Question237

A solution containing 2.675g of $CoCl_3.6NH_3$ (molar mass $= 267.5 g mol^{-1}$) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $AgNO_3$ to give 4.78g of AgCl (molar mass $= 143.5 g\ mol^{-1}$). The formula of the complex is
(At. mass of Ag = 108u)
[2010]

Options:

A. $[Co(NH_3)_6]Cl_3$

B. $[CoCl_2(NH_3)_4]Cl$

C. $[CoCl_3(NH_3)_3]$

D. $[CoCl(NH_3)_5]Cl_2$

Answer: A

Solution:

Solution:

$$\underset{2.675g}{CoCl_3 \cdot 6NH_3} \longrightarrow xCl^-$$

$$xCl^- + AgNO_3 \longrightarrow \underset{4.78g}{xAgCl} \downarrow$$

Number of moles of the complex

$= \frac{2.675}{267.5} = 0.01 mol$

Number of moles of AgCl obtained

$= \frac{4.78}{143.5} = 0.03 mol$

$\therefore$ No. of moles of AgCl obtained

$= 3\times$ No. of moles of complex

$\therefore\ n = \frac{0.03}{0.01} = 3$

Question238

Which one of the following has an optical isomer?
[2010]

Options:

A. $[Zn(en)(NH_3)_2]^{2+}$

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

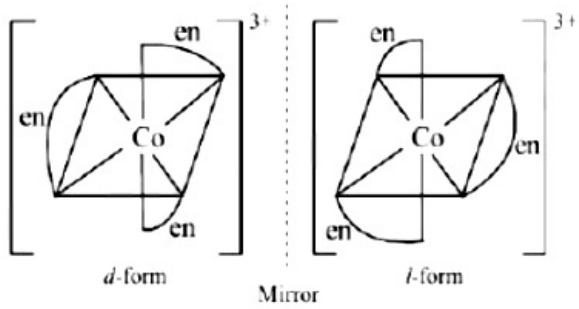
C. $[Co(H_2O)_4(en)]^{3+}$

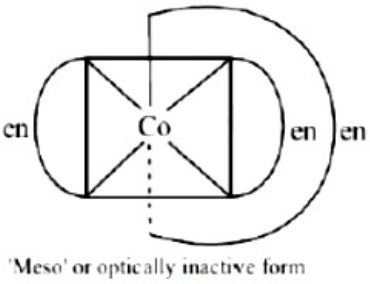
D. $[Zn(en)_2]^{2+}$ (en = ethylenediamine)

Answer: B

Solution:

Solution:
For a substance to be optical isomer following conditions should be fulfiled
(a) A coordination compound which can rotate the plan of polarised light is said to be optically active.
(b) When the coordination compounds have sam formula but differ in their abilities to rotate directions o the plane of polarised light are said to exhibit optica isomerism and the molecules are optical isomers. Th optical isomers are pair of molecules which are non superimposable mirror images of each other.
(c) This is due to the absence of elements of symmetry in the complex.
(d) Optica isomerism is expected in tetrahedral complex of the type Mabod.
Based an this only option (b) shows optical isomerism $[Co(en)_3]^{3+}$





Complexes of Zn^{2+} cannot show optical isomerism as they are tetrahedral complexes with plane of symmetry.
$[CO(H_2O)_4(en)]^{3+}$ has two planes of symmetry hence it is also optically inactive.

Question239

Which of the following shows optical isomerism [2009]

Options:

A. $[Co(en)(NH_3)_2]^{2+}$

B. $[Co(H_2O)_4(en)]^{3+}$

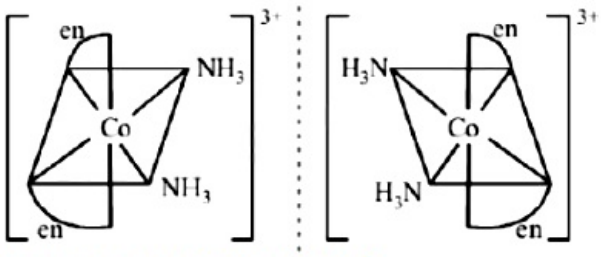
C. $[Co(en)_2(NH_3)_2]^{3+}$

D. $[Co(NH_3)_3Cl]^{+}$

Answer: C

Solution:

Solution:



Enantiomers of cis- $[Co(en)_2(NH_3)_2]^{3+}$

Question240

Which of the following pairs represent linkage isomers? [2009]

Options:

A. $[Pd(PPh_3)_2(NCS)_2]$ and $[Pd(PPh_3)_2(SCN)_2]$

B. $[Co(NH_3)_5NO_3]SO_4$ and $[Co(NH_3)_5SO_4]NO_3$

C. $[PtCl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$

D. $[Cu(NH_3)_4][PtCl_4]$ and $[Pt(NH_3)_4][CuCl_4]$

Answer: A

Solution:

Solution:
The SCN - ion can coordinate through S or N atom giving rise to linkage isomerism
M ← SCN thiocyanato
M ← NCS isothiocyanato.

Question241

The coordination number and the oxidation state of the element ' E ' in the complex $[E(en)_2(C_2O_4)]NO_2$(where (en) is ethylene diamine) are, respectively, [2008]

Options:

A. 6 and 2

B. 4 and 2

C. 4 and 3

D. 6 and 3

Answer: D

Solution:

In the given complex we have two bidentate ligands (i.e en and C_2O_4), so coordination number of E is 6
$(2 \times 2 + 1 \times 2 = 6)$
Let the oxidation state of E in complex be x, then
$[x + (-2) = 1]$ or $x - 2 = 1$ or $x = +3$, so its oxidation state is +3
Thus option (d) is correct.

Question242

In which of the following complexes of the Co(at. no. 27), will the magnitude of Δ_0 be the highest?
[2008]

Options:

A. $[Co(CN)_6]^3$

B. $[Co(C_2O_4)_3]^3$

C. $[Co(H_2O)_6]^{3+}$

D. $[Co(NH_3)_6]^{3+}$

Answer: A

Solution:

Solution:
In octahedral complex, the magnitude of Δ_0 will be highest in a complex having strongest ligand. Of the given ligands, CN^- is strongest, so Δ_0 will be highest for $[Co(CN)_6]^{3-}$. Thus option (a) is correct.

Question243

Which of the following has a square planar geometry?
(At. nos: Fe = 26, Co = 27, Ni = 28, Pt = 78)
[2007]

Options:

A. $[PtCl_4]^{2-}$

B. $[CoCl_4]^{2-}$

C. $[FeCl_4]^{2-}$

D. $[NiCl_4]^{2-}$

Answer: A

Solution:

Solution:
Complexes with dsp^2 hybridisation are square planar. All the complexes of Pt^{2+} are square planar including those with weak field ligand such as halide ions. Thus option (a) is correct.

Question244

The IUPAC name for the complex $[Co(NO_2)(NH_3)_5]Cl_2$ is : [2006]

Options:

A. pentaammine nitrito-N-cobalt(II) chloride [2006]

B. pentaammine nitrito-N-cobalt(III) chloride

C. nitrito-N-pentaamminecobalt(III) chloride

D. nitrito-N-pentaamminecobalt(II) chloride

Answer: B

Solution:

Solution:
$[Co(NO)_2(NH_3)_5]Cl_2$
Pentaamminenitrito-N-cobalt (III) chloride

Question245

Nickel (Z = 28) combines with a uninegative monodentate ligand X^- to form a paramagnetic complex $[NiX_4]^{2-}$. The number of unpaired electron(s) in the nickel and geometry of this complex ion are, respectively: [2006]

Options:

A. one, square planar

B. two, square planar

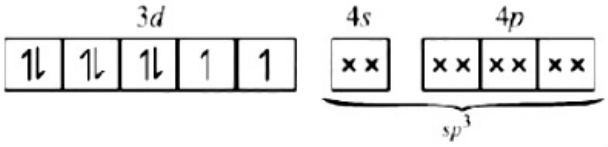
C. one, tetrahedral

D. two, tetrahedral

Answer: D

Solution:

Solution:
$[NiX_4]^{2-}$, the electronic configuration of Ni^{2+} is



It contains two unpaired electrons and the hybridisation is sp^3 (tetrahedral).

Question246

How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion? [2006]

Options:

A. One

B. Two

C. Six

D. Three

Answer: A

Solution:

Solution:
EDTA is hexadentate, four donor O atoms and 2 donor Natoms, and for the formation of octahedral complex one molecule is required.

Question247

In $Fe(CO)_5$, the $Fe-C$ bond possesses [2006]

Options:

A. ionic character

B. σ -character only

C. π -character

D. both σ and π characters

Answer: D

Solution:

Due to some backbonding by sideways overlapping between d -orbitals of metal and p -orbital of carbon, the $Fe-C$ bond in $Fe(CO)_5$ has both σ and π character.

Question248

The oxidation state Cr in $[Cr(NH_3)_4Cl_2]^+$ is [2005]

Options:

A. 0

B. +1

C. +2

D. +3

Answer: D

Solution:

Oxidation state of Cr in $[Cr(NH_3)_4Cl_2]^+$.
Let it be x, $1 \times x + 4 \times 0 + 2(-1) = 1$
Therefore $x = 3$.

Question249

The IUPAC name of the coordination compound $K_3[Fe(CN)_6]$ is [2005]

Options:

A. Tripotassium hexacyanoiron (II)

B. Potassium hexacyanoiron (II)

C. Potassium hexacyanoferrate(III)

D. Potassium hexacyanoferrate (II)

Answer: C

Solution:

Solution:
$K_3[Fe(CN)_6]$ is potassium hexacyanoferrate (III).

Question250

Which of the following compounds shows optical isomerism? [2005]

Options:

A. $[Co(CN)_6]^{3-}$

B. $[Cr(C_2O_4)_3]^{3-}$

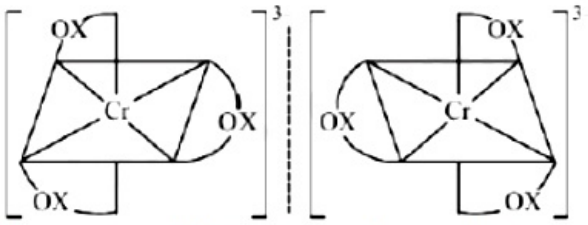
C. $[ZnCl_4]^{2-}$

D. $[Cu(NH_3)_4]^{2+}$

Answer: B

Solution:

Solution:



Non-superimposable mirror images, hence optical isomers.

Question251

Which one of the following cyano complexes would exhibit the lowest value of paramagnetic behaviour? (At. Nos: Cr = 24, Mn = 25, Fe = 26, Co = 27) [2005]

Options:

A. $[Co(CN)_6]^{3-}$

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

C. $[Mn(CN)_6]^{3-}$

D. $[Cr(CN)_6]^{3-}$

Answer: B

Solution:

		No. of unpaired electrons
(a)	Co^{3+}	4
(b)	Fe^{3+}	1
(c)	Mn^{3+}	4
(d)	Cr^{3+}	3

The effective magnetic moment is given by the number of unpaired electrons in a substance, the lesser the number of unpaired electrons lower is its magnetic moment in Bohr - Magneton and lower shall be its paramagnetic

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Question252

The coordination number of a central metal atom in a complex is determined by
[2004]

Options:

A. the number of ligands around a metal ion bonded by sigma and pi-bonds both

B. the number of ligands around a metal ion bonded by pi-bonds

C. the number of ligands around a metal ion bonded by sigma bonds

D. the number of only anionic ligands bonded to the metal ion.

Answer: C

Solution:

Solution:
The coordination number of central metal atom in a complex is equal to number of monovalent ligands, twice the number of bidentate ligands and so on, around the metal ion bonded by coordinate bonds.
Hence coordination number = No. of σ bonds formed by metals with ligands.

Question253

Coordination compounds have great importance in biological systems. In this context which of the following statements is incorrect?
[2004]

Options:

A. Cyanocobalamin is B_{12} and contains cobalt

B. Haemoglobin is the red pigment of blood and contains iron

C. Chlorophylls are green pigments in plants and contain calcium

D. Carboxypeptidase - A is an enzyme and contains zinc.

Answer: C

Solution:

Solution:
The chlorophyll molecule plays an important role in photosynthesis. It has porphyrin rings and the metal M g, not Ca.

Question254

Which one of the following has largest number of isomers? [2004]

Options:

A. $[I\ r(PR_3)_2H\ (CO)]^{2+}$

B. $[Co(N\ H_3)_5Cl\ ]^{2+}$[2004]

C. $[Ru(N\ H_3)_4Cl_2]^{+}$ (R = alkyl group, en = ethylenediamine)

D. $[Co(en)_2Cl_2]^{+}$

Answer: D

Solution:

Solution:
Isomers
$[Ru(N\ H_3)_4Cl_2]^{+}$, $[Co(N\ H_3)_5Cl\ ]^{2+}$,
cis and trans — none
$[I\ r(PR_3)_2H\ (CO)]^{2+}$, $[Co(en)_2Cl_2]^{+}$
cis and trans — cis and trans and optical isomers

Question255

Among the properties (a) reducing (b) oxidising (c) complexing, the set of properties shown by CN ion towards metal species is [2004]

Options:

A. c. a

B. b, c

C. a, b

D. a, b, c

Answer: A

Solution:

CN ion acts good complexing as well as reducing agent.

Question256

Which one of the following complexes is an outer orbital complex? (Atomic nos. : Mn = 25; Fe = 26; Co = 27, Ni = 28) [2004]

Options:

A. $[Co(NH_3)_6]^{3+}$

B. $[Mn(CN)_6]^4$

C. $[Fe(CN)_6]^4$

D. $[Ni(NH_3)_6]^{2+}$

Answer: D

Solution:

$\underset{d^2sp^3}{[Fe(CN)_6]^{4-}}$, $\underset{d^2sp^3}{[Mn(CN)_6]^{4-}}$, $\underset{d^2sp^3}{[Co(NH_3)_6;]^{3+}}$, $\underset{sp^3d^2}{[Ni(NH_3)_6]^{2+}}$

Hence $[Ni(NH_3)_6]^{2+}$ is outer orbital complex.

Question257

One mole of the complex compound $Co(NH_3)_5Cl_y$ gives 3 moles of ions on dissolution in water. One mole of the same complex reacts with two moles of $AgNO_3$ solution to yield two moles of AgCl (s). The structure of the complex is [2003]

Options:

A. $[Co(NH_3)_3Cl_3] \cdot 2NH_3$

B. $[Co(NH_3)_4Cl_2]Cl \ . NH_3$

C. $[Co(NH_3)_5Cl]Cl_2$

D. $[Co(NH_3)_4Cl]Cl_2, NH_3$

Answer: C

Solution:

$Co(NH_3)_5Cl_3 \rightleftharpoons [Co(NH_3)_5Cl]^{+2} + 2Cl^-$
$\therefore$ Structure is $[Co(NH_3)_5Cl]Cl_2$
Now $[Co(NH_3)_5Cl]Cl_2 + 2AgNO_3 \longrightarrow [Co(NH_3)_5Cl](NO_3)_2 + 2AgCl$

Question258

In the coordination compound, $K_4[Ni(CN)_4]$, the oxidation state of nickel is
[2003]

Options:

A. 0

B. +1

C. +2

D. -1

Answer: A

Solution:

Solution:
Let the O . N , of N in $K_4[Ni(CN)_4]$ be = x then
$4(+1) + x + (-1) \times 4 = 0$
$\Rightarrow 4 + x - 4 = 0$
$x = 0$

Question259

The type of isomerism present in nitropentammine chromium (III) chloride is
[2002]

Options:

A. optical

B. linkage

C. ionization

D. polymerisation.

Answer: B

Solution:

Solution:
The chemical formula of nitropentammine chromium (III) chloride is $[Cr(NH_3)_5NO_2]Cl_2$

It can exist in following two structures
$[Cr(NH_3)_5NO_2]Cl_2$ and
Nitropentamminechromium (III) chloride
$[Cr(NH_3)_5ONO]Cl_2$
Nitritopentamminechromium (III) chloride
Therefore the type of isomerism found in this compound is linkage isomerism as NO_2 group is linked through N as NO_2, or through O as $-ONO$.

Question260

A square planar complex is formed by hybridisation of which atomic orbitals?
[2002]

Options:

A. s, p_x, p_y, d_{yz}

B. s, p_x, p_y, $d_{x^2-y^2}$

C. s, p_x, p_y, d_{z^2}

D. s, p_y, p_z, d_{xy}

Answer: B

Solution:

A square planar complex is formed by hybridisation of s, p_x, p_y and $d_{x^2-y^2}$ atomic orbitals

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Question261

$CH_3-Mg-Br$ is an organo metallic compound due to
[2002]

Options:

A. $Mg-Br$ bond

B. $C-Mg$ bond

C. $C-Br$ bond

D. $C-H$ bond.

Answer: B

Solution:

Compounds that contain carbon-metal bond are known as organometallic compounds.
In $CH_3-Mg-Br$ (Grignard's reagent), a bond is present between carbon and Mg (metal), hence it is an organometallic compound.
