QB365 Question Bank Software Study Materials

Coordination Chemistry Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

Chemistry

Total Marks : 40

2 Marks

20 x 2= 40

1) Write the IUPAC names for the following complexes.

Answer : i) $Na_2[Ni(EDTA)]$ - Sodium 2, 2', 2",2'" - (ethane-1,2 diyldinitrilo tetraacetatonickelate)(II)

ii) $[Ag(CN)_2]^-$ - Dicyanido-kC-argentate (I) ion

iii) $[CO(en)_3]_2(SO_4)_3$ - Tris (ethane 1, 2 diamine)cobalt (III) sulphate

iv) $[CO(ONO)(NH_3)_5]^{2+}$ - Pentaamminenitrito - KO cobalt (III) ion

v) $[Pt(NH_3)_2Cl(NO_2)]$ - Diammainechloridonitro - kN - platinum (II)

2) Arrange the following in order of increasing molar conductivity

(i) $Mg[Cr(NH_3)(Cl)_5]$

(ii) $Cr(NH_3)_5Cl]_3[CoF_6]_2$

(iii) $[Cr(NH_3)_3Cl_3]$

Answer : (i) $Mg[Cr(NH_3)Cl_5]^{2-} \rightleftharpoons Mg^{2+} + [Cr(NH_3)Cl_5]^{2-} (2 ions)$

(ii) $[Cr(NH_3)_5Cl_3[CoF_6]_2 \rightleftharpoons \underset{(5\text{ ions})}{3[Cr(NH_3)_5Cl]^{2+}} + 2[CoF_6]^{3-}$

(iii) $[Cr(NH_3)_3Cl_3] =$ No ions

If no of ions increases, molar conductivity increases molar conductivity of the complex also INCREASES.

∴ The order of the given compound is

$[Cr(NH_3)_3Cl_3]$< $Mg[Cr(NH_3)_3Cl_3]$ < $[Cr(NH_3)_5Cl_3]$ $[CoF_6]_2$

(No ion) (2 ions) (5 ions)

3) $[Ti(H_2O)_6]^{3+}$ is coloured, while $[Sc(H_2O)_6]^{3+}$ is colourless- explain.

Answer : $_{22}Ti - _{18}[Ar]4s^2 3d^2 /_{21}Sc - _{18}[Ar]4\ s^2 3\ d$

$_{22}Ti^{3+} - _{18}[Ar]3\ d^1 /_{18}Sc^{3+}\ _{18}[Ar]3\ d^0$

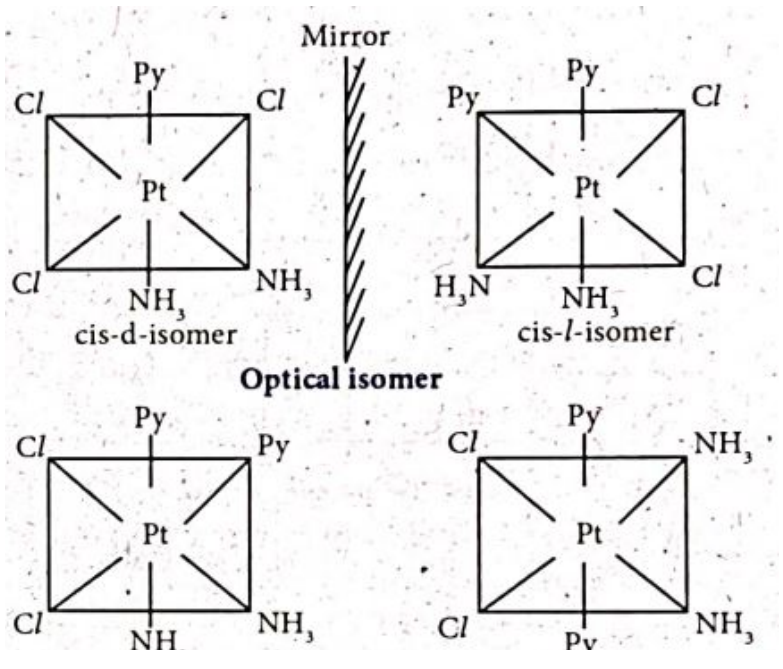
(i) In this complex the central metal ion is Ti^{3+}, which has d^1 configuration. This single electron occupies one of the t_{2g} orbitals in the octahedral aqua ligand field. When white light falls on this complex the electron absorbs light and promotes itself to e_g level. The spectral data show the absorption maximum is at 20000 cm^{-1} corresponding to the crystal field splitting energy (Δ_o) 239.7 $kJmol^{-1}$. The transmitted colour associated with this absorption is purple and hence the complex appears purple in colour.

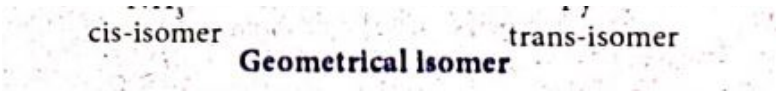
(ii) Thus in $[Ti(H_2O)_6]^{3+}$ $d - d$ transition takes place.

(iii) But in $[Sc(H_2O)_6]^{3+}$ Sc^{3+} has the outer electronic configuration of $3d^0$ where d-d transition is not possible and it is colourless.

4) Give an example for complex of the type $[Ma_2b_2c_2]$ where a, b, c are monodentate ligands and give the possible isomers.

Answer : $[Ma_2b_2C_2]^{\pm n}$ where a, b, c are monodentate ligands.





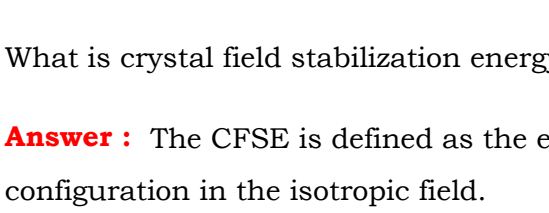
$[Pt(py_2)(NH_3)_2Cl_2]^{2+}$. It exhibits both optical and geometrical isomerism. cis iomer exhibis optical isomerism also. While trans isomer exhibits geometrical isomerism only.

5) What is linkage isomerism? Explain with an example.

Answer : (i) This is also called as salt isomerism.

(ii) This type of isomers arises when an ambidentate ligand is bonded to the central metal atom/ion through either of its two different donor atoms. In the below mentioned examples, the nitrite ion is bound to the central metal ion Co^{3+} through a nitrogen atom in one complex and through oxygen atom in other complex.

$[Co(NH_3)_5(NO_2)]^{2+}$



6) Classify the following ligands based on the number of donor atoms.

a) NH_3

b) en

c) ox^{2-}

d) pyridine

Answer :

Ligand	Type of Ligand	Number of donor atoms
NH_3	monodentate ligand	1
en	bidentate ligand	2
ox^{2-}	bidentate ligand	2
pyridine	monodentate ligand	1

7) Why tetrahedral complexes do not exhibit geometrical isomerism.

Answer : Tetrahedral complexes do not exhibit geometrical isomerism. Because the relative position of donor atoms of ligand the unidentate ligands (donor atom) attached to the central atom are same with respect to each other.

8) What is crystal field stabilization energy (CFSE)?

Answer : The CFSE is defined as the energy of the electronic configuration in the ligand field minus the energy of the electronic configuration in the isotropic field.

CFSE (ΔE_o) = $\{E_{Lf}\}$-$\{E_{iso}\}$

=$\{[n_{t2g}(-0.4) + n_{eg}(0.6)]\Delta_o + n_pP\} - \{n'_pP\}$

Here, n_{t2g} is the number of electrons in t_{2g} orbitals;

n_{eg} is number of electrons in e_g orbitals;

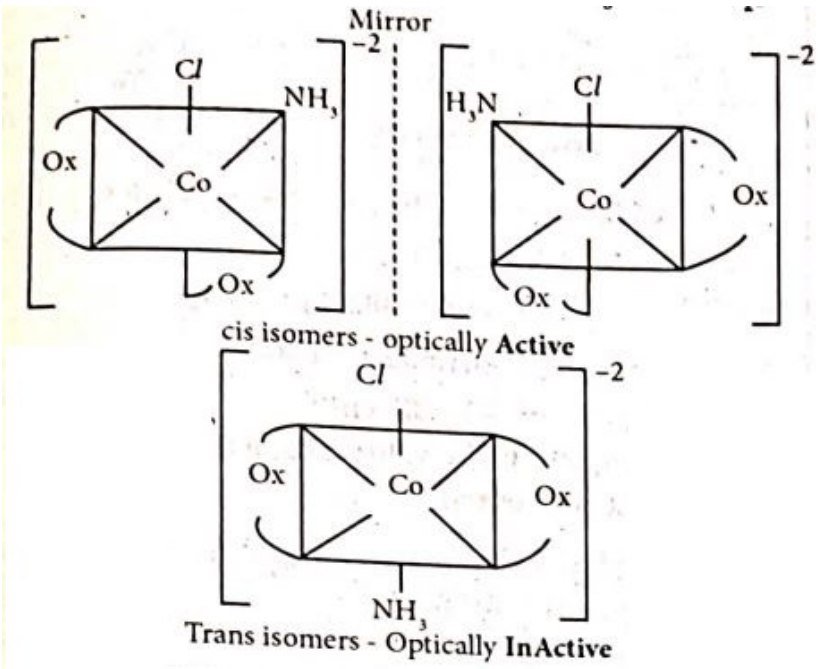
n_p is number of electron pairs in the ligand field; &

n'_p is the number of electron pairs in the isotropic field (barycentre).

P - pairing energy

9) Draw all possible stereo isomers of a complex $Ca[Co(NH_3)Cl(Ox)_2]$

Answer : $Ca[Co(NH_3)Cl(Ox)_2] \rightleftharpoons Ca^{2+} + [Co(NH_3)Cl(Ox)_2]^{2-}$



Hybridisation of Co = sp^3d^2

No of cis isomer = 2

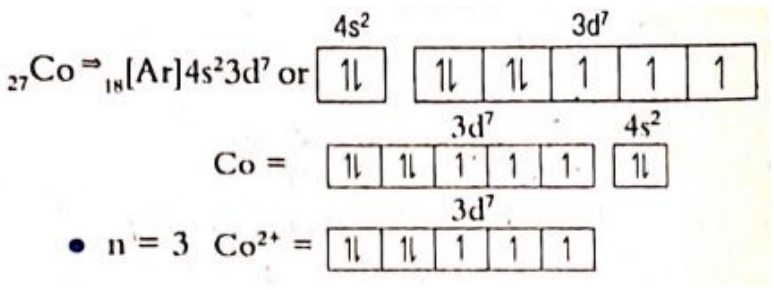
No of transisomer = 1

Total isomer = 3

Three isomers are possible for the given complex.

10) Predict the number of unpaired electrons in $[CoCl_4]^{2-}$ ion on the basic of VBT.

Answer :



It has three **unpaired electrons**.

The magnetic moment of $[CoCl_4]^{2-}$ is

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

$= \sqrt{3(3+2)} = \sqrt{15}$ = 3.87 BM

11) Calculate the magnetic moment of $[Fe(H_2O)_6]^{2+}$, if atomic number of Fe is 26.

Answer : Magnetic moment (μ) = $\sqrt{n(n+2)}$ BM

Fe (z = 26) = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

Fe^{2+} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^0$

$\therefore \mu = \sqrt{n(n+2)} = \sqrt{4(4+2)} = \sqrt{24}$

= 4. 89 BM

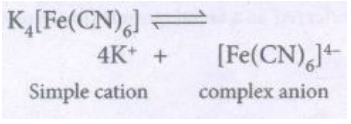
12) What are ligands?

Answer : (i) The ligands are the atoms or groups of atoms bound to the central atom/ion. The atom in a ligand that is bound directly to the central metal atom is known as a donor atom.

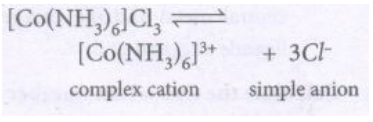
(ii) For example, in $K_4[Fe(CN)_6]$, the ligand is CN^- ion, but the donor atom is carbon.

13) What are anionic & cationic complex? Give an example.

Answer : (i) An anionic complex compound contains a complex anion and simple cation.



(ii) A cationic complex contains complex cation and simple anion



14) Name the metal present in

(i) Chlorophyll

(ii) Haemoglobin

(iii) Vitamin B_{12}

(iv) Cis - platin

Answer : (i) Mg

(ii) Fe

(iii) Co

(iv) Pt

15) $[Fe(CN)_6]^4$ and $[Fe(H_2O)_6]^{2+}$ are different colours in dilute solutions. Why?

Answer : $[Fe(CN)_6]^4$ and $[Fe(H_2O)_6]^{2+}$ show different colours in dilute solution because

i) CN^- is a strong field ligand and H_2O is a weak ligand hence magnitude of CFSE is different.

ii) Both CN^- and H_2O absorb same wavelength of energy.

iii) Complexes of weak field ligands are generally colourless.

iv) The sizes of CN^- and H_2O are different hence their colours are also different.

16) $[CuCl]_4]^{2-}$ exists while $[CuI_4]^{2-}$ does not exist. Why?

Answer : (i) Cu^{2+} is reduced to Cu^+ by I^-, hence cupric iodide is converted into cuprous iodide. So $[CuI]^{2-}$ does not exists.

(ii) Cl^- cannot effect this change so $[CuCl]_4]^{2-}$ exists.

17) What do you meant by co-ordination isomers?

Answer : (i) This type of isomers arises in the coordination compounds having both the cation and anion as complex ions.

(ii) The interchange of one or more ligands between the cationic and the anionic coordination entities result in different isomers.

Example: $[Co(NH_3)_6]\,[Cr(CN)_6]$ and $[Cr(NH_3)_6]\,[Co(CN)_6]$

18) Mention the different types of geometrical isomers.

Answer : (i) This type of isomerism exists in square planar and octahedral complex.

(ii) Square planar complexes: cis and trans form of

1. $[MA_2\,B_2]^{n\pm}$
2. $[MA_2BC]^{n\pm}$
3. $[M(xy)_2]^{n\pm}$
4. $[MABCD]^{n\pm}$

Octahedral complexes:

1. $[MA_2\,B_4]^{n\pm}$
2. $[M(xx)_2\,B_2]^{n\pm}$

Shows cis-trans isomerism.

$[MA_3\,B_3]^{n\pm}$ shows facial and meridonal isomerism.

19) What are strong field ligands? Give examples.

Answer : Ligands such as CO, CN^-, en and NH_3 present in the complexes cause pairing of electrons present in the central metal atom. Such ligands are called strong field ligands.

20) Write the IUPAC names for the following complexes $[Pt(NH_3)_2Cl(NO_2)]$

Answer : Diammainechloridonitro - kN - platinum (II)