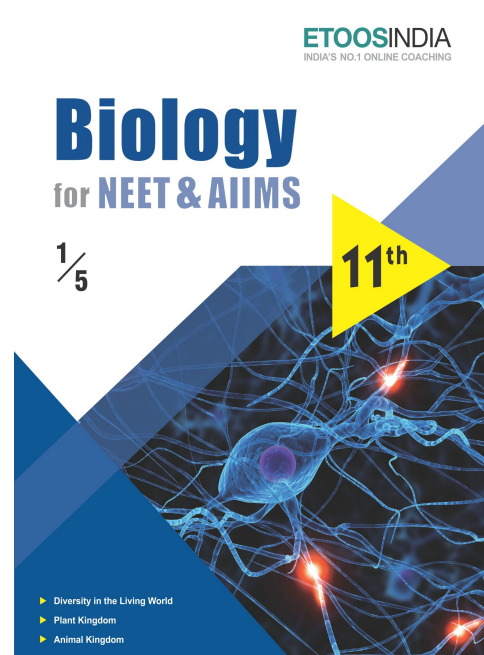
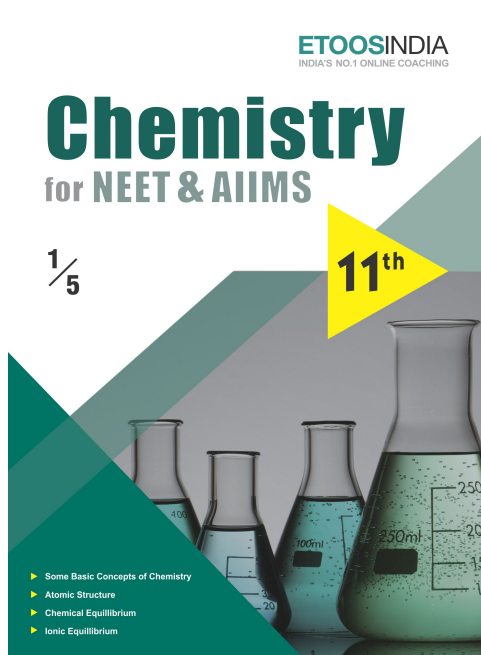
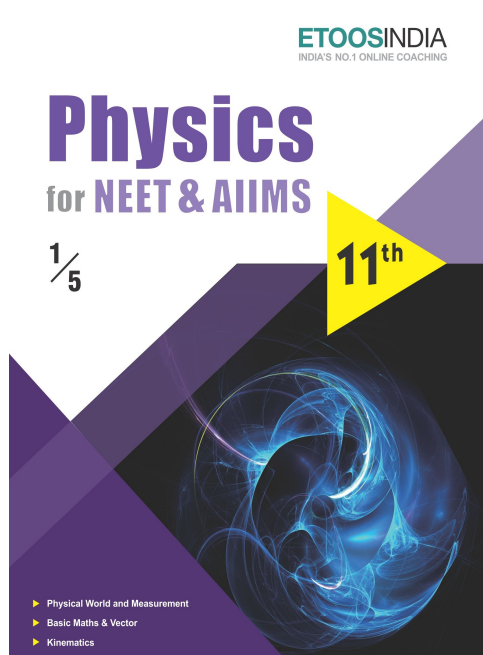


This PDF is the Sample PDF taken from our Comprehensive Study Material for NEET & AIIMS

To purchase the books, go through the link below-
<http://www.etoosindia.com/smartmall/bookList.do>



**ETOOS Comprehensive Study Material
For NEET & AIIMS**

COORDINATION COMPOUNDS

Coordination is critical to any large scale event. That's the lesson we are learning.

"LYNETTEMILLER"

INTRODUCTION

Compounds formed due to combination of two or more simple stable salts, which retain their identity in solid as well as in dissolved state, are called coordination compounds. These are backbone of modern inorganic and bio-inorganic chemistry and chemical industry. The concept of co-ordination compounds arises from the complex formation tendency of transition elements. These compounds play a vital role in our lives, as chlorophyll of plants, vitamin B₁₂ and haemoglobin of animal blood are the co-ordination compounds of Mg, Co and Fe respectively. The co-ordination compounds play important role in analytical chemistry, polymerisation reactions, metallurgy and refining of metals, photography, water purification etc. Co-ordination compounds also find many applications in electroplating, textile dyeing and medicinal chemistry.



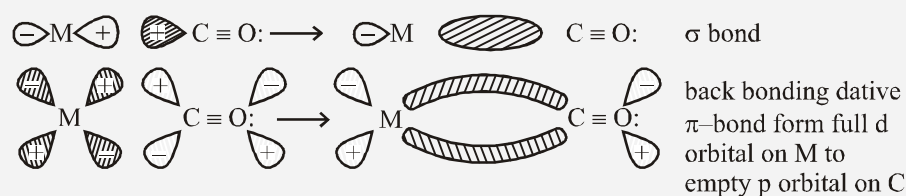
ETOOS KEY POINTS

(1) Synergic Bonding :

Ligand which donate electron pair to central metal ion & form coordinate σ bond but simultaneously they accept electron pair from central metal ion through back bonding or synergic bonding.

CO, NO⁺, CN⁻, R₃P, R₃As etc.

The electronic configuration of CO molecule shows that it has lone pair of electrons on carbon and oxygen atom each. Carbon atom can donate its electron pair to a transition metal atom (M), forming OC \rightarrow M coordinate bond. Since the metal atom in metal carbonyl is in zero oxidation state, the formation of M \rightarrow CO σ bond accumulates a negative charge on the metal atom. The accumulation of negative charge on the metal atom can be counter balanced by transferring some negative charge from the metal atom to CO molecule (ligand). This transfer can be done by making a M \rightarrow CO π bond by the overlap between an appropriate filled orbital on the metal atom and empty π_y^* or π_z^* molecular orbital on CO molecule. This type of bonding between M and CO is called synergic bonding.



[Schematic of orbital overlaps in metal carbonyls]

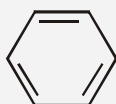
Conclusion of synergic bonding : due to synergic bonding


- (a) M-C bond strength increases; M-C bond length decreases; because double bond character increases
- (b) C-O bond strength decreases; C-O bond length increases; because bond order of C-O decreases, electron density in ABMO of CO increases.

(2) π -donor and π -acceptor ligands :

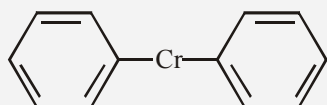
ligands which donate π electron to central metal ion & also accept electron density from central metal ion through synergic bonding.

(i) H₂C=CH₂ (η^2 - ethylene) : it is a 2π electron donor

(ii)  (η^6 - benzene) : it is a 6π electron donor

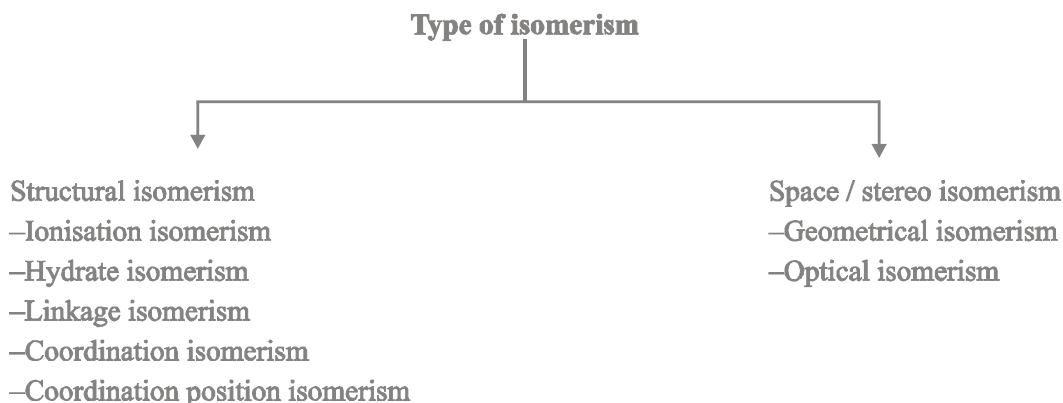
(iii)  / [C₅H₅]⁻ (η^5 - cyclopentadienyl) : it is a 6π electron donor

For Example

- (a) [Cr(η^6 -C₆H₆)₂] 
sandwich compound
- (b) [Fe(η^5 -C₅H₅)₂] ferrocene (sandwich compound)
- (c) K[PtCl₃(η^2 -C₂H₄)] (Zeise salt)

ISOMERISM IN COMPLEXES

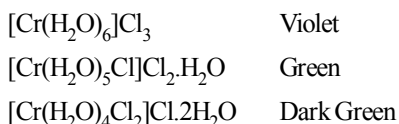
Complex compounds that have the same molecular formula but have different structural /spacial arrangements of ligands are called isomers. These are of two types, namely structural and stereo isomers.



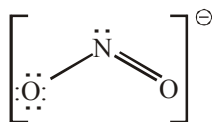
STRUCTURAL ISOMERISM

(i) **Ionisation Isomerism** : This type of isomerism is due to the exchange of groups between the complex ion and ions outside it. $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ is red-violet. An aqueous solution of it gives a white precipitate of BaSO_4 with BaCl_2 solution, thus confirming the presence of free SO_4^{2-} ions. In contrast $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ is red. A solution of this complex does not give a positive sulphate test with BaCl_2 . It does give a cream coloured precipitate of AgBr with AgNO_3 , thus confirming the presence of free Br^- ions. Other examples of ionisation isomerism are $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$ and $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$ and $[\text{Co}(\text{en})_2\text{NO}_2.\text{Cl}]\text{SCN}$, $[\text{Co}(\text{en})_2\text{NO}_2.\text{SCN}]\text{Cl}$ and $[\text{Co}(\text{en})_2\text{Cl}.\text{SCN}]\text{NO}_2$.

(ii) **Hydrate isomerism** : These isomers arise by the exchange of groups in the complex ion with water. Three isomers of $\text{CrCl}_3.6\text{H}_2\text{O}$ are known. From conductivity measurements and quantitative precipitation of the ionised Cl^- , they have been given the following



(iii) **Linkage Isomerism** : This type of isomerism arises when the ligand attached to the central metal ion of a complex in different ways. Such ligands are called ambident ligands. Nitrite ion has electron pairs available for co-ordination both on N and O atoms.

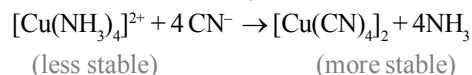


Ex.

- | | | |
|---|-----|--|
| <p>(a) $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$
pentaamminenitrito-o-cobalt(III) chloride
(red)</p> | and | <p>$[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
pentaamminenitrito-N-cobalt-(III)-chloride
(yellow)</p> |
| <p>(b) $[\text{Mn}(\text{CO})_5.\text{SCN}]^+$
pentacarbonylthiocyanato
-S-manganese (II) ion</p> | and | <p>$[\text{Mn}(\text{CO})_5(\text{NCS})]^+$
pentacarbonylthiocyanato
-N-manganese (II) ion</p> |

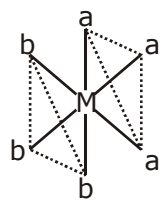
Etoos Tips & Formulas

1. $\text{CH}_3\text{B}(\text{OCH}_3)$ is an organometallic compound but $\text{B}(\text{OCH}_3)$ is not.
2. The closed ring complexes formed by polydentate ligands are called Chelates. Chelation leads to stability.
3. Estimation of nickel (II) is done by complexing with dimethyl glyoxime (DMG) whereas that of Ca^{+2} and Mg^{2+} ions is done by titrating against EDTA.
4. Complex in which ligands can be substituted by other ligands are called labile complexes. For example $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is a labile complex because NH_3 ligands can be substituted by CN^- ligands.

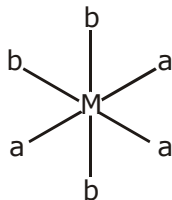


5. Another type of geometrical isomerism is also shown by octahedral complexes of the type Ma_3b_3 .

if each trio of donor atoms occupy adjacent positions at the corner of an octahedral face, then it is called facial (fac) isomer and when the position are around the meridian of the octahedron, then it is called meridional (mer) isomer.



fac-form



Mer-form

6. Haemoglobin is a complex of Fe, chlorophyll is a complex of Mg, vitamin B_{12} is a complex of Co.
7. σ -bond organometallic compounds generally contains a non-transition metal linked to carbon atom of alkyl group by σ bond. For example eg. R-MgX .
8. p-bonded organometallics are formed by donation of p-electrons of double bond to the metal atom. For example Zeise's salt $\text{K}[\text{PtCl}_3\eta^2\text{C}_2\text{H}_4]$ and Ferrocene $\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2$
9. Grignard's reagent is one of the most useful organometallic compounds. Due to the high polarity of ($\text{C}^\delta\text{-Mg}^{\delta+}$) bond, it can be used to synthesise many organic compounds.

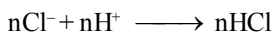
SOLVED EXAMPLE

Ex. 1 A solution containing 0.319 gm of complex $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ was passed through cation exchanger and the solution given out was neutralised by 28.5 ml of 0.125 M NaOH. The correct formula of the complex will be: [molecular weight of complex = 266.5]

- (A) $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2 \cdot \text{H}_2\text{O}$
 (B) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
 (C) $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$
 (D) All are correct

Ans. (B)

Sol. $\text{Cl}^- = \text{HCl} = \text{NaOH}$



Thus 1 mol of complex will form n mol of HCl

1 mole of complex = n mol of HCl = n mole of NaOH

$$\text{mole of complex} = \frac{0.319}{266.5} = 0.0012; \text{ mole of NaOH}$$

$$\text{used} = \frac{28.5 \times 0.125}{1000} = 0.0036$$

So 0.0012 mole of complex = 0.0036 mole of NaOH = 0.0036 mole of HCl

$$1 \text{ mole of complex} = \frac{0.0036}{0.0012} = 3 \text{ mole of HCl}$$

$$\therefore n = 3$$

So complex is $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$.

Ex. 2 Calculate the effective atomic number of the metal atoms in the following complexes / complex ions.

- (A) $[\text{Cr}(\text{CO})_6]$ (B) $[\text{Fe}(\text{CN})_6]^{3-}$
 (C) $[\text{Co}(\text{CN})_6]^{4-}$ (D) $[\text{Ni}(\text{NH}_3)_6]^{2+}$

[Cr = 24 ; Fe = 26; Co = 27 and Ni = 28 as atomic numbers]

- Ans.** (A) 36 (B) 35
 (C) 37 (D) 38

Sol. EAN = Number of electrons in metal atom or ion + Number of electrons donated by ligands to metal.

- (A) $[\text{Cr}^0(\text{CO})_6]$; EAN = 24 + 12 = 36 ;
 (B) $[\text{Fe}^{\text{III}}(\text{CN})_6]^{3-}$; EAN = 23 + 12 = 35
 (C) $[\text{Co}^{\text{III}}(\text{CN})_6]^{4-}$; EAN = 25 + 12 = 37 ;
 (D) $[\text{Ni}^{\text{II}}(\text{NH}_3)_6]^{2+}$; EAN = 26 + 12 = 38

Ex. 3 Consider the following complexes :

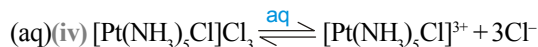
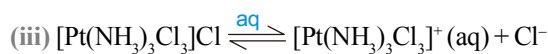
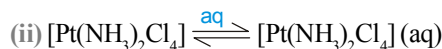
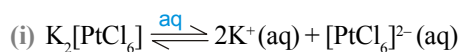
- (i) K_2PtCl_6 (ii) $\text{PtCl}_4 \cdot 2\text{NH}_3$
 (iii) $\text{PtCl}_4 \cdot 3\text{NH}_3$ (iv) $\text{PtCl}_4 \cdot 5\text{NH}_3$

their electrical conductance in aqueous solutions are :

- (A) 256, 0, 97, 404 (B) 404, 0, 97, 256
 (C) 256, 97, 0, 404 (D) 404, 97, 256, 0

Ans. (A)

Sol. The electrical conductance of the complexes depend upon the number of ions given by them in the aqueous solutions.



Complex	Number of ions	Expected electrical conductance
(i) $\text{K}_2[\text{PtCl}_6]$	3	256
(ii) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_4]$	0	0
(iii) $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]\text{Cl}$	2	97
(iv) $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$	4	404

- (i) $\text{K}_2[\text{PtCl}_6]$ 3 256
 (ii) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_4]$ 0 0
 (iii) $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]\text{Cl}$ 2 97
 (iv) $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$ 4 404

So, the correct option is (A).

Ex. 4 Give the order of chelating effect of following ligands.

- (i) $\text{C}_2\text{O}_4^{2-}$ (ii) EDTA
 (iii) dien

- (A) iii > ii > i (B) i > ii > iii
 (C) ii > iii > i (D) i > iii > ii

Ans. (C)

Sol. As number of donor atoms increases the number of bonds increase. So the chelating effect of ligands increase as oxalato, dien and EDTA has two, three and six donor atoms respectively.

Ex. 5 Write the structural formula corresponding to each of the following IUPAC names :

- (A) potassium tetracyanidozincate (II)
 (B) tetracarbonyl nickel (0)
 (C) potassium tetracyanonickelate (0)
 (D) potassium tris(oxalato)aluminate (III)

- Ans.** (A) $\text{K}_2[\text{Zn}^{\text{II}}(\text{CN})_4]$ (B) $[\text{Ni}^0(\text{CO})_4]$
 (C) $\text{K}_4[\text{Ni}^0(\text{CN})_4]$ (D) $\text{K}_3[\text{Al}^{\text{III}}(\text{C}_2\text{O}_4)_3]$

Sol. Refer IUPAC rule.

Exercise # 1

SINGLE OBJECTIVE

NEET LEVEL

- In $K_4Fe(CN)_6$
 (A) (CN) are linked with primary valency
 (B) (CN) are linked with secondary valency
 (C) K are linked with secondary valency
 (D) K are linked with non-ionic valency
- The co-ordination number of copper in cuprammonium sulphate is
 (A) 2 (B) 6
 (C) 4 (D) -4
- Which of the following acts as a bidentate ligand in complex formation
 (A) Acetate (B) Oxalate
 (C) Thiocyanate (D) EDTA
- The co-ordination number of cobalt in the complex $[Co(en)_2Br_2]Cl_2$ is
 (A) 2 (B) 6
 (C) 5 (D) 4
- Which of the following ligands forms a chelate
 (A) Acetate (B) Oxalate
 (C) Cyanide (D) Ammonia
- According to Werner's theory
 (A) Primary valency can be ionized
 (B) Secondary valency can be ionized
 (C) Primary and secondary valencies both cannot be ionized
 (D) Only primary valency cannot be ionized
- Which of the following is not true for ligand-metal complex
 (A) Larger the ligand, the more stable is the metal-ligand bond
 (B) Highly charged ligand forms strong bond
 (C) Larger the permanent dipole moment of ligand, the more stable is the bond
 (D) Greater the ionization potential of central metal, the stronger is the bond
- What is the co-ordination number of the metal in $[Co(en)_2Cl_2]^+$
 (A) 4 (B) 5
 (C) 6 (D) 3
- Bidentate ligand is
 (A) CN^-
 (B) Ethylene diammine (en)
 (C) SCN^-
 (D) EDTA
- The coordination number of Pt in $[Pt(NH_3)_4Cl_2]^+$ ion is
 (A) 2 (B) 4
 (C) 6 (D) 8
- Which is the example of hexadentate ligand
 (A) 2, 2-dipyridyl
 (B) Dimethyl glyoxime
 (C) Aminodiacetate ion
 (D) Ethylene diammine tetra acetate ion [EDTA]
- The coordination number of a metal in coordination compounds is
 (A) Same as primary valency
 (B) Sum of primary and secondary valencies
 (C) Same as secondary valency
 (D) None of these
- Ligand in a complex salt are
 (A) Anions linked by coordinate bonds to a central metal atom or ion
 (B) Cations linked by coordinate bonds to a central metal atom or ion
 (C) Molecules linked by coordinate bonds to a central metal atom or ion
 (D) Ions or molecules linked by coordinate bonds to a central metal atom or ion
- A group of atoms can function as a ligand only when
 (A) It is a small molecule
 (B) It has an unshared electron pair
 (C) It is a negatively charged ion
 (D) It is a positively charged ion
- Which of the following complexes show six coordination number
 (A) $[Zn(CN)_4]^{2-}$ (B) $[Cr(H_2O)_6]^{3+}$
 (C) $[Cu(CN)_4]^{2-}$ (D) $[Ni((NH_3)_4)]^{2+}$
- How many ions are produced in aqueous solution of $[Co(H_2O)_6]Cl_2$
 (A) 2 (B) 3
 (C) 4 (D) 6
- IUPAC name of $[Pt(NH_3)_3(Br)(NO_2)Cl]Cl$ is
 (A) Triamminechlorobromonitroplatinum (IV) chloride
 (B) Triamminebromonitrochloroplatinum (IV) chloride
 (C) Triamminebromochloronitroplatinum (IV) chloride
 (D) Triamminenitrochlorobromoplatinum (IV) chloride

Exercise # 2

SINGLE OBJECTIVE

AIIMS LEVEL

- Which of the following is not correctly matched ?
 - $[\text{Fe}(\text{en})_3]^{3+}$ - sp^3d^2 and paramagnetic
 - $[\text{FeCl}_4]^{2-}$ - sp^3 and paramagnetic
 - $[\text{Fe}(\text{CN})_6]^{3-}$ - d^2sp^3 and paramagnetic
 - $[\text{Fe}(\text{CO})_2(\text{NO}^+)_2]$ - sp^3 and diamagnetic
- Which of the following isomers of $[\text{M}(\text{NH}_3)_2\text{Cl}_2]$ would react with silver oxalate ($\text{Ag}_2\text{C}_2\text{O}_4$) to give a coordination compound ?

(A)

(B)

 - Both
 - None
- The complex $\text{K}_4[\text{Zn}(\text{CN})_4(\text{O}_2)_2]$ is oxidised into $\text{K}_2[\text{Zn}(\text{CN})_4(\text{O}_2)_2]$, then which of the following is correct ?
 - Zn (II) is oxidised into Zn (IV)
 - Paramagnetic moment decreases
 - O – O bond length increases
 - Paramagnetic moment increases
- The hybridisation of $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ are :
 - both sp^3d^2
 - both d^2sp^3
 - sp^3d^2 and d^2sp^3 respectively
 - d^2sp^3 and sp^3d^2 respectively
- Consider the following statements ;

S1 : The $[\text{Co}(\text{ox})_3]^{3-}$ complex is diamagnetic and gains stability through chelation.

S2 : The $[\text{Co}(\text{NO}_2)_6]^{4-}$ is inner orbital complex involving d^2sp^3 hybridisation and is paramagnetic.

S3 : The complex $[\text{PtCl}_4]^{2-}$ is square planar and diamagnetic.

and arrange in the order of true / false

 - T T T
 - F F T
 - T F T
 - T T F
- Select the correct statement ;
 - Potassium ferrocyanide and potassium ferricyanide can be differentiated by measuring the solid state magnetic moment.
 - The complex $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ can be differentiated by adding aqueous solution of barium chloride
 - The complex $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Br}$ and $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{Cl}$ can be differentiated by adding aqueous solution of silver nitrate.
 - All of these
- All the following complexes show decrease in their weights when placed in a magnetic balance then the group of complexes having tetrahedral geometry is :

I	$\text{Ni}(\text{CO})_4$
II	$\text{K}[\text{AgF}_4]$
III	$\text{Na}_2[\text{Zn}(\text{CN})_4]$
IV	$\text{K}_2[\text{PtCl}_4]$
V	$[\text{RhCl}(\text{PPh}_3)_3]$

 - II, III, V
 - I, II, III
 - I, III, IV
 - none of these
- The complex $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$ is formed in the brown ring test for nitrates when freshly prepared FeSO_4 solution is added to aqueous solution of NO_3^- ions followed by addition of conc. H_2SO_4 . Select correct statement about this complex.
 - Hybridisation of iron is sp^3d^2 .
 - Iron has +1 oxidation state.
 - It has magnetic moment of 3.87 B. M. confirming three unpaired electrons in Fe.
 - All the above are correct statements.
- Which of the following has dsp^2 hybridisation and is diamagnetic in nature ?

(I) $\text{Na}_4[\text{Cr}(\text{CO})_4]$	(II) $[\text{Ni}(\text{DMGH})_2]$
(III) $[\text{PtHBr}(\text{PEt}_3)_2]$	(IV) $[\text{Ag}(\text{SCN})_4]^{3-}$
(V) $[\text{AuBr}_4]^-$	

 - I, II, IV only
 - I, III, IV, V only
 - II, III, V only
 - III, V only
- Of the following complex ions, one exhibits isomerism. That is :

(A) $[\text{Ag}(\text{NH}_3)_2]^+$	(B) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{2+}$
(C) $[\text{Pt}(\text{en})\text{Cl}_2]$	(D) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

Exercise # 3

PART - 1

MATRIX MATCH COLUMN

1. Match the complexes given in column-I and the characteristic(s) given in column-II.

Column – I

(Complexes)

- (A) $[\text{Ni}(\text{CO})_4]$
 (B) $[\text{AgF}_4]^-$
 (C) $[\text{Zn}(\text{CN})_4]^{2-}$
 (D) $[\text{RhCl}(\text{PPh}_3)_3]$

Column – II

(characteristics)

- (p) sp^3 hybridisation
 (q) Diamagnetic
 (r) dsp^2
 (s) Unidentate ligand.
 (t) + 3 oxidation state of metal ion

2. Match the complexes given in column-I and the magnetic properties given in column-II.

Column I

(Complexes)

- (A) $[\text{NiCl}_2(\text{PPh}_3)_2]$
 (B) $\text{V}(\text{CO})_6$
 (C) $[\text{Cr}(\text{CN})_6]^{4-}$
 (D) $\text{Ni}(\text{CO})_4$

Column II

(Magnetic properties)

- (p) Paramagnetic with 1 unpaired electrons
 (q) Paramagnetic with 2 unpaired electrons
 (r) Paramagnetic with 3 unpaired electrons
 (s) Diamagnetic

3. Match the complexes listed in column-I with type of hybridisation listed in column-II.

Column I

- (A) $[\text{AuF}_4]^-$
 (B) $[\text{Cu}(\text{CN})_4]^{3-}$
 (C) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (D) $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$

Column II

- (p) dsp^2 hybridisation
 (q) sp^3 hybridisation
 (r) sp^3d^2 hybridisation
 (s) d^2sp^3 hybridisation

4. Match the pair of complexes given in column-I and the characteristic(s) given in column-II.

Column - I

- (A) $(\text{NH}_4)_2[\text{NiCl}_4]$ and $(\text{NH}_4)_2[\text{Ni}(\text{CN})_4]$
 (B) $\text{CoCl}_3 \cdot 6\text{NH}_3$ and $\text{PtCl}_4 \cdot 5\text{NH}_3$
 (C) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ and $(\text{NH}_4)_2[\text{PtCl}_4]$
 (D) $\text{K}_2[\text{Fe}(\text{H}_2\text{O})_6]$ and $\text{K}_4[\text{FeCl}_6]$

Column- II

- (p) Both show same electrical conductance.
 (q) Both show same effective atomic number.
 (r) Both show same primary valencies.
 (s) Both gives white precipitate with AgNO_3 solution.

5. Match the complexes given in column-I and the characteristic(s) given in column-II.

Column – I

(Complexes)

- (A) $[\text{Ni}(\text{CO})_4]$
 (B) $[\text{Fe}(\text{NO})_2(\text{CO})_2]$
 (C) $[\text{Ni}(\text{PF}_3)_4]$
 (D) $[\text{PtCl}_3(\text{C}_2\text{H}_4)]^-$

Column – II

(characteristics)

- (p) Tetrahedral
 (q) π back bonding
 (r) diamagnetic
 (s) One of the ligand is three electron donor.

6. Match the complexes given in column-I and the characteristic(s) given in column-II.

Column – I

(Complexes)

- (A) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
 (B) $[\text{CoF}_6]^{3-}$
 (C) $[\text{Co}(\text{NO}_2)_6]^{3-}$
 (D) $[\text{Co}(\text{ox})_3]^{3-}$

Column – II

(characteristics)

- (p) d^2sp^3
 (q) sp^3d^2
 (r) diamagnetic
 (s) paramagnetic

Exercise # 4

PART - 1

PREVIOUS YEAR (NEET/AIPMT)

1. Shape of $\text{Fe}(\text{CO})_5$ is [CBSE AIPMT 2000]

(A) Octahedral (B) square planar
(C) trigonal bipyramidal (D) square pyramidal
2. In the separation of Cu^{2+} and Cd^{2+} of IInd group in qualitative analysis of cations, tetrammine copper (II) sulphate and tetrammine copper (II) sulphate and tetrammine cadmium (II) sulphate react with KCN to form the corresponding cyano complexes, which one of the following pairs of the complexes and their relative stability enables the separation of Cu^{2+} and Cd^{2+} ? [CBSE AIPMT 2001]

(A) $\text{K}_3[\text{Cu}(\text{CN})_4]$: less stable and $\text{K}_2[\text{Cd}(\text{CN})_4]$: more stable
(B) $\text{K}_3[\text{Cu}(\text{CN})_4]$: more stable and $\text{K}_2[\text{Cd}(\text{CN})_4]$: less stable
(C) $\text{K}_2[\text{Cu}(\text{CN})_4]$: less stable and $\text{K}_2[\text{Cd}(\text{CN})_4]$: more stable
(D) $\text{K}_2[\text{Cu}(\text{CN})_4]$: more stable and $\text{K}_2[\text{Cd}(\text{CN})_4]$: less stable
3. Which one of the following complexes will have four isomers [CBSE AIPMT 2001]

(A) $[\text{Co}(\text{en})_3]\text{Cl}_3$
(B) $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
(C) $[\text{Co}(\text{PPh}_3)_2(\text{NH}_3)\text{Cl}_2]\text{Cl}$
(D) $[\text{Co}(\text{PPh}_3)_3\text{Cl}]\text{Cl}_2$
4. Which of the following will exhibit maximum ionic conductivity? [CBSE AIPMT 2001]

(A) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (B) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
(C) $[\text{Cu}(\text{NH}_3)_4]\text{Cl}_2$ (D) $[\text{Ni}(\text{CO})_4]$
5. Which statement is incorrect? [CBSE AIPMT 2001]

(A) $\text{Ni}(\text{CO})_4$ - tetrahedral, paramagnetic
(B) $[\text{Ni}(\text{CN})_4]^{2-}$ square planar, diamagnetic
(C) $\text{Ni}(\text{CO})_4$ - tetrahedral, diamagnetic
(D) $[\text{Ni}(\text{Cl})_4]^{2-}$ tetrahedral, paramagnetic
6. Coordination number of Ni in $[\text{Ni}(\text{C}_2\text{O}_4)_3]^{4-}$ is [CBSE AIPMT 2000]

(A) 3 (B) 6
(C) 4 (D) 2
7. Which of the following organometallic compounds is σ and π - bonded? [CBSE AIPMT 2001]

(A) $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2]$ (B) $\text{K}[\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4)]$
(C) $[\text{Co}(\text{CO})_5\text{NH}_3]^{2+}$ (D) $\text{Fe}(\text{CH}_3)_3$
8. Which of the following will give maximum number of isomers?

(A) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$ (B) $[\text{Ni}(\text{en})(\text{NH}_3)_4]^{2+}$
(C) $[\text{Ni}(\text{C}_2\text{O}_4)(\text{en})_2]^{2-}$ (D) $[\text{Cr}(\text{SCN})_2(\text{NH}_3)_4]^+$
9. Atomic number of Cr and Fe are respectively 24 and 26, which of the following is paramagnetic with the spin of electron? [CBSE AIPMT 2002]

(A) $[\text{Cr}(\text{CO})_6]$ (B) $[\text{Fe}(\text{CO})_5]$
(C) $[\text{Fe}(\text{CN})_6]^{4-}$ (D) $[\text{Cr}(\text{NH}_3)_6]^{3+}$
10. The hypothetical complex chloro diaquatrimmine cobalt (III) chloride can be represented as [CBSE AIPMT 2002]

(A) $[\text{CoCl}(\text{NH}_3)_3(\text{H}_2\text{O})_2]\text{Cl}_2$
(B) $[\text{Co}(\text{NH}_3)_3(\text{H}_2\text{O})_2]\text{Cl}_2$
(C) $[\text{Co}(\text{NH}_2)_3(\text{H}_2\text{O})_2]\text{Cl}$
(D) $[\text{Co}(\text{NH}_3)_3(\text{H}_2\text{O})_3]\text{Cl}_3$
11. Which one of the following octahedral complexes will not show geometrical isomerism? (A and B are monodentate ligands) [CBSE AIPMT 2003]

(A) $[\text{MA}_4\text{B}_2]$ (B) $[\text{MA}_5\text{B}]$
(C) $[\text{MA}_2\text{B}_4]$ (D) $[\text{MA}_3\text{B}_3]$
12. According to IUPAC nomenclature sodium nitroprusside is named as [CBSE AIPMT 2003]

(A) sodium pentacyanonitrosyl ferrate (II)
(B) sodium pentacyanonitrosyl ferrate (III)
(C) sodium nitoferricyanide
(D) sodium nitroferrocyanide
13. The number of unpaired electrons in the complex ion $[\text{CoF}_6]^{3-}$ is (At.no.of Co=27) [CBSE AIPMT 2003]

(A) 3 (B) 2
(C) 2 (D) 0
14. Among the following which is not the π -bonded organometallic compound? [CBSE AIPMT 2003]

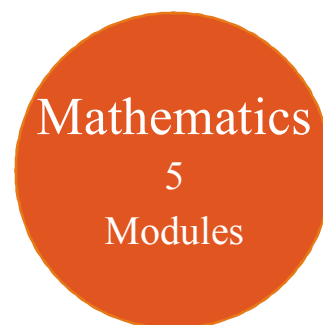
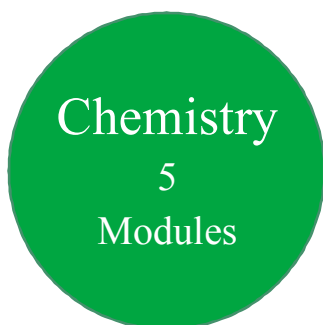
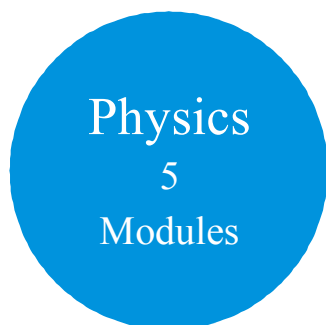
(A) $\text{K}[\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4)]$ (B) $\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2$
(C) $\text{Cr}(\eta^6\text{-C}_6\text{H}_6)_2$ (D) $(\text{CH}_3)_4\text{Sn}$
15. Which of the following coordination compounds would exhibit optical isomerism?

(A) Pentaamminenitrocobalt (III) iodide
(B) Diamminedichloroplatinum (II)
(C) Trans-Dicyanobis (ethylenediamine) chromium (III) chloride
(D) Tris- (ethylenediamine) cobalt (III) bromide

STRAIGHT OBJECTIVE TYPE

- All the following complex ions are found to be paramagnetic
 $P: [FeF_6]^{3-}$; $Q: [CoF_6]^{3-}$; $R: [V(H_2O)_6]^{3+}$; $S: [Ti(H_2O)_6]^{3+}$
 The correct order of their paramagnetic moment (spin only) is
 (A) $P > Q > R > S$ (B) $P < Q < R < S$ (C) $P = Q = R = S$ (D) $P > R > Q > S$
- Which of the following statement(s) most likely to be incorrect?
 (A) $Ti(NO_3)_4$ is a colourless compound (B) $[Cu(NCCH_3)_4]^+ BF_4^-$ is a colourless compound
 (C) $[Cr(NH_3)_6]^{3+} 3Cl^-$ is a colourless compound (D) $K_3[VF_6]$ is colourless compound
- Amongst the following, the species with tetrahedral geometry is :
 (A) $[Pd(CN)_4]^{2-}$ (B) $[Ni(CN)_4]^{2-}$ (C) $[PdCl_4]^{2-}$ (D) $[NiCl_4]^{2-}$
- Which of the following statements is correct?
 (A) Potassium ferrocyanide is diamagnetic where as potassium ferricyanide is paramagnetic.
 (B) Crystal field splitting in ferrocyanide ion is greater than that of ferricyanide ion.
 (C) The geometry of $Ni(CO)_4$ and $[NiCl_2(PPh_3)_2]$ are tetrahedral.
 (D) (A) & (C) both
- Amongst $[Co(ox)_3]^{3-}$, $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$:
 (A) $[Co(ox)_3]^{3-}$ and $[CoF_6]^{3-}$ are paramagnetic and $[Co(NH_3)_6]^{3+}$ is diamagnetic.
 (B) $[Co(ox)_3]^{3-}$ and $[Co(NH_3)_6]^{3+}$ are paramagnetic and $[CoF_6]^{3-}$ is diamagnetic.
 (C) $[Co(ox)_3]^{3-}$ and $[Co(NH_3)_6]^{3+}$ are diamagnetic and $[CoF_6]^{3-}$ is paramagnetic.
 (D) $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ are paramagnetic and $[Co(ox)_3]^{3-}$ is diamagnetic.
- All the following complex show decreases in their weights when placed in a magnetic balance then the group of complexes having tetrahedral geometry is :
 (i) $Ni(CO)_4$ (ii) $K[AgF_4]$ (iii) $Na_2[Zn(CN)_4]$ (iv) $K_2[PtCl_4]$
 (v) $[RhCl(PPh_3)_3]$
 (A) (ii), (iii), (v) (B) (i), (ii), (iii) (C) (i), (iii), (iv) (D) None of these
- $[Fe(en)_2(H_2O)_2]^{2+} + en \rightarrow$ complex(X). The correct statement about the complex (X) is :
 (A) It is a low spin complex (B) It is diamagnetic
 (C) It shows geometrical isomerism (D) (A) and (B) both
- On treatment of $[Ni(NH_3)_4]^{2+}$ with concentrated HCl, two compounds I and II having the same formula, $[Ni(NH_3)_2Cl_2]$, are obtained, I can be converted into II by boiling with dilute HCl. A solution of I reacts with oxalic acid to form $[Ni(NH_3)_2(C_2O_4)]$ where as II does not react. Point out the correct statement from the following.
 (A) I cis, II trans; both tetrahedral (B) I cis, II trans; both square planar
 (C) I trans, II cis; both tetrahedral (D) I trans, II cis; both square planar
- The total number of isomers shown by $[Co(NH_3)_4(NO_2)_2](NO_3)$ complex is :
 (A) 10 (B) 6 (C) 4 (D) 12
- In which of the following complex ion, the metal ion will never have t_{2g}^6, e_g^0 configuration according to CFT?
 (A) $[FeF_6]^{3-}$ (B) $[Fe(CN)_6]^{3-}$ (C) $[Fe(CN)_6]^{4-}$ (D) None of these
- Which of the following polymerisation isomers of the compound having empirical formula $[Cr(NH_3)_3(NO_2)_3]$ has the lowest molecular mass?
 (A) $[Cr(NH_3)_4(NO_2)_2]^+ [Cr(NH_3)_2(NO_2)_4]^-$ (B) $[Cr(NH_3)_6]^{3+} [Cr(NO_2)_6]^{3-}$
 (C) $[Cr(NH_3)_5(NO_2)]^{2+} [Cr(NH_3)(NO_2)_5]^{2-}$ (D) All

11th Class Modules Chapter Details



PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics <p>Module-2</p> <ol style="list-style-type: none"> 1. Law of Motion & Friction 2. Work, Energy & Power <p>Module-3</p> <ol style="list-style-type: none"> 1. Motion of system of particles & Rigid Body 2. Gravitation <p>Module-4</p> <ol style="list-style-type: none"> 1. Mechanical Properties of Matter 2. Thermal Properties of Matter <p>Module-5</p> <ol style="list-style-type: none"> 1. Oscillations 2. Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Some Basic Concepts of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom <p>Module-2</p> <ol style="list-style-type: none"> 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals <p>Module-3</p> <ol style="list-style-type: none"> 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition <p>Module-4</p> <ol style="list-style-type: none"> 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases <p>Module-5</p> <ol style="list-style-type: none"> 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

To purchase the books, go through the link below-
<http://www.etoosindia.com/smartmall/bookList.do>

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Electrostatics 2. Capacitance <p>Module-2</p> <ol style="list-style-type: none"> 1. Current Electricity 2. Magnetic Effect of Current and Magnetism <p>Module-3</p> <ol style="list-style-type: none"> 1. Electromagnetic Induction 2. Alternating Current <p>Module-4</p> <ol style="list-style-type: none"> 1. Geometrical Optics 2. Wave Optics <p>Module-5</p> <ol style="list-style-type: none"> 1. Modern Physics 2. Nuclear Physics 3. Solids & Semiconductor Devices 4. Electromagnetic Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Solid State 2. Chemical Kinetics 3. Solutions and Colligative Properties <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Electrochemistry 2. Surface Chemistry <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. P-Block Elements 2. Transition Elements (d & f block) 3. Co-ordination Compound 4. Metallurgy <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. HaloAlkanes & HaloArenes 2. Alcohol, Phenol & Ether 3. Aldehyde, Ketone & Carboxylic Acid <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Nitrogen & Its Derivatives 2. Biomolecules & Polymers 3. Chemistry in Everyday Life 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Reproduction in Organisms 2. Sexual Reproduction in Flowering Plants 3. Human Reproduction 4. Reproductive Health <p>Module-2</p> <ol style="list-style-type: none"> 1. Principles of Inheritance and Variation 2. Molecular Basis of Inheritance 3. Evolution <p>Module-3</p> <ol style="list-style-type: none"> 1. Human Health and Disease 2. Strategies for Enhancement in Food Production 3. Microbes in Human Welfare <p>Module-4</p> <ol style="list-style-type: none"> 1. Biotechnology: Principles and Processes 2. Biotechnology and Its Applications 3. Organisms and Populations <p>Module-5</p> <ol style="list-style-type: none"> 1. Ecosystem 2. Biodiversity and Conservation 3. Environmental Issues

To purchase the books, go through the link below-
<http://www.etoosindia.com/smartmall/bookList.do>