CBSE Class 12 Chemistry Notes Chapter 9: CBSE Class 12 Chemistry notes for Chapter 9 on Coordination Compounds are designed to make understanding this topic easier. These notes cover important concepts like the formation of coordination compounds, the role of ligands, coordination number, and the bonding in these compounds.

By focusing on key topics such as Werner's theory, isomerism in coordination compounds, and their applications, these notes help students build a strong foundation. Studying these notes will help in better exam preparation and improve the chances of scoring higher marks in Chemistry.

CBSE Class 12 Chemistry Notes Chapter 9 Coordination Compounds Overview

These CBSE Class 12 Chemistry notes for Chapter 9 Coordination Compounds have been prepared by subject experts of Physics Wallah. The notes provide a clear and detailed overview of key concepts, including the formation, structure, and properties of coordination compounds.

These notes are designed to help students grasp complex ideas like ligands, coordination numbers, and isomerism, these notes simplify the subject for easier understanding. With a focus on exam preparation they provide concise explanations and examples ensuring students can effectively learn and perform well in their Chemistry exams.

CBSE Class 12 Chemistry Notes Chapter 9 Coordination Compounds PDF

CBSE Class 12 Chemistry Notes for Chapter 9 Coordination Compounds provide a detailed understanding of this important topic.

For your convenience the detailed notes are available in PDF format. The PDF link is provided below for easy access to all the important concepts and explanations needed for your studies.

CBSE Class 12 Chemistry Notes Chapter 9 Coordination Compounds PDF

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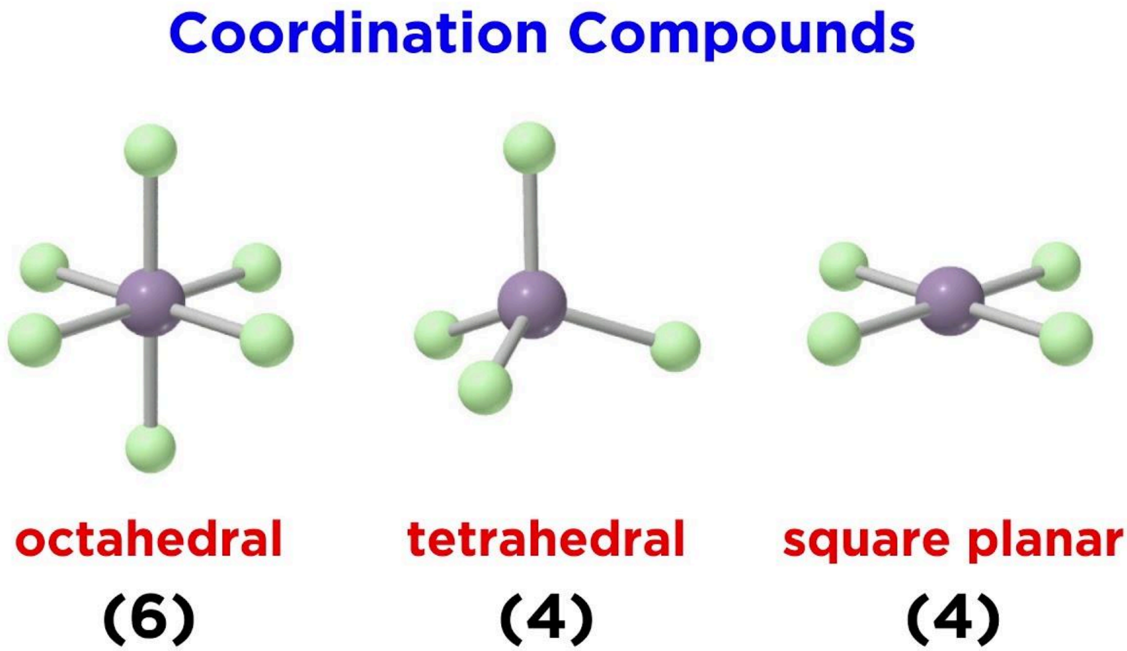
Here we have provided CBSE Class 12 Chemistry Notes Chapter 9 Coordination Compounds-

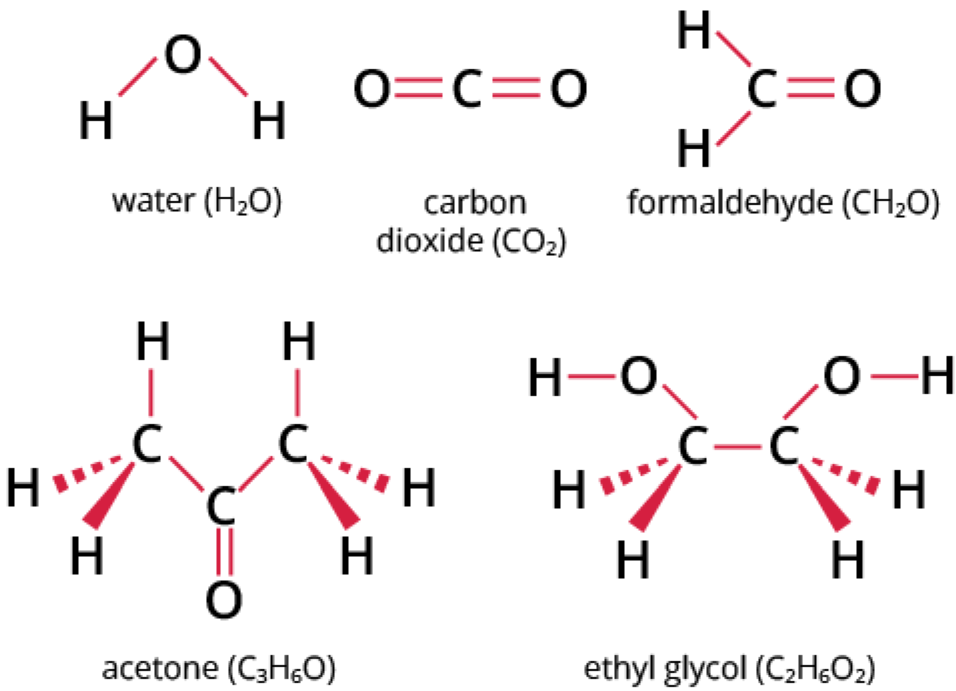
Introduction



Coordination compounds play a important role in both nature and chemistry. Without compounds like chlorophyll (a magnesium complex) in plants and hemoglobin (an iron complex) in human blood, life as we know it would not be possible.

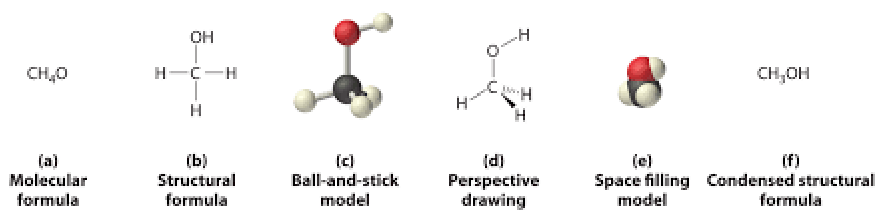
Studying coordination compounds helps us better understand chemical bonding and reveals important physical properties, such as their magnetic behavior. This knowledge is essential for appreciating the significance of these compounds in biological systems and various chemical applications.

Molecular or Addition Compounds



Molecular or addition compounds are formed when a solution containing two or more simple stable compounds in molecular proportions is allowed to evaporate. This process results in the formation of crystals of new substances. These compounds represent a combination of two different molecules or ions, often showing properties different from those of the original substances. They play a significant role in various chemical reactions and are commonly seen in coordination chemistry.

Types of Molecular Compounds



Molecular compounds can be classified into different types based on their formation and properties. One significant type is the double salt.

Double Salt

A double salt is created by combining two different salts that crystallize together as a single substance. However, when dissolved in water, these double salts ionize as two distinct salts and lose their identity. This means that in solution, they produce ions of both original salts, which can be detected separately. Common examples of double salts include Mohr's salt and potash alum. These compounds are important in various industrial and laboratory applications.

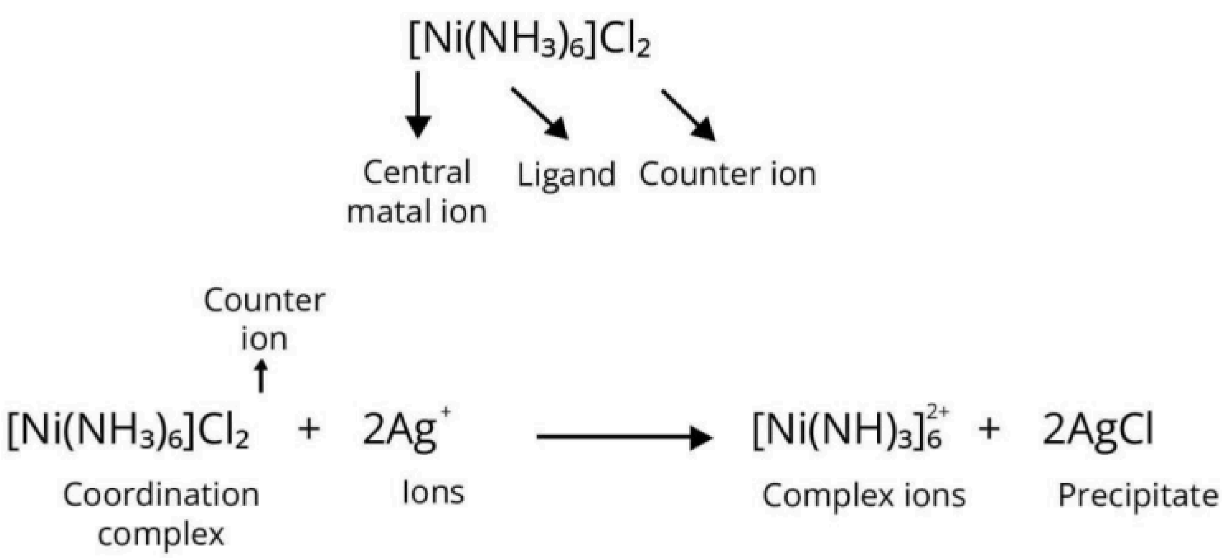
Coordination Compounds

A coordination compound is a molecular compound formed by the combination of two or more simple molecular entities. Unlike double salts, coordination compounds retain their identity both in solid form and when dissolved in water or other solvents. These compounds consist of a central metal atom or ion bonded to a group of surrounding molecules or ions called ligands. Their stability and unique properties make them important in biological systems, catalysis, and industrial applications.

A coordination compound consists of a central atom or ion, ligands, and a complex ion, with either a cation or an anion associated with it. The complex ion is enclosed in square brackets, while the cation or anion is written outside

Coordination Sphere

The coordination sphere refers to the central metal atom or ion along with the ligands directly attached to it, all enclosed within square brackets. This arrangement is also known as the first sphere of attraction. The ligands are tightly bonded to the metal ion within this sphere, making it behave as a single, cohesive unit. This close-knit structure is crucial for the stability and properties of the coordination compound.



Oxidation Number of Central Metal Atom

The oxidation number of the central metal atom in a coordination compound is defined as the charge the metal would have if all the ligands and their associated electron pairs were removed. It is calculated using the charge of the complex ion and the known charges of the ligands.

Nomenclature of Coordination Compounds

The nomenclature of coordination compounds follows specific rules to ensure clarity and consistency in naming:

Order of Naming: The cation (positive part) is named before the anion (negative part).

Oxidation State: The oxidation state of the central metal ion is indicated in parentheses using Roman numerals.

Ligand Naming: Ligands are named before the central metal ion. Ligands are named using specific prefixes and rules.

Ligand Name Modifications:

Anionic ligands ending in 'ide' change to 'o' (e.g., chloride to chloro).

Anionic ligands ending in 'ite' change to 'ito' (e.g., sulfite to sulfito).

Anionic ligands ending in 'ate' change to 'ato' (e.g., sulfate to sulfato).

Unmodified Ligand Names: Neutral ligands are often named as they are, such as "water" or "ammonia".

Positive Group Termination: Positive groups are typically named with the suffix '-ium' (e.g., hydrazinium).

Multiple Ligands: Use prefixes like di-, tri-, tetra-, penta-, and hexa- to indicate multiple ligands. For ligands with names containing numbers, use bis-, tris-, and tetrakis- to avoid confusion. These names are enclosed in parentheses, e.g., "bis(ethylenediamine)".

Naming Complex Anions: If the anion of the complex is a complex itself, the metal's name is modified with '-ate'.

Special Metal Names: Some metals have specific names when part of a complex anion:

- Lead: plumbate
- Gold: aurate
- Zinc: zincate
- Tin: stannate
- Silver: argentate
- Cobalt: cobaltate

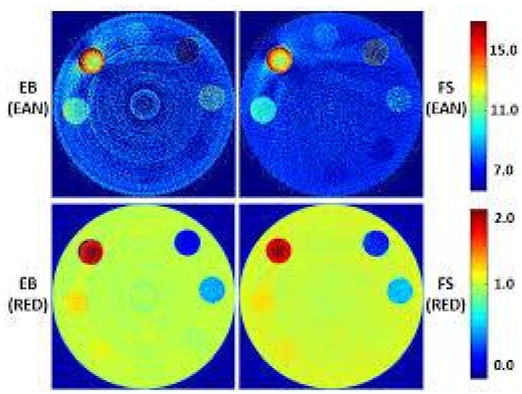
- Iron: ferrate
- Aluminium: aluminate
- Manganese: manganate
- Copper: cuprate
- Chromium: chromate
- Platinum: platinate

Polynuclear Complexes: Complexes containing more than one metal atom are called polynuclear. The prefix 'μ' is used to denote bridging ligands that connect metal atoms.

Ambidentate Ligands: Some ligands can bind to the metal via different atoms. For example, nitrite can bind through nitrogen or oxygen.

Writing Formulas: In the formula, the complex ion is enclosed in square brackets. Ligands are listed alphabetically, with negative ligands first, followed by neutral and then positive ligands.

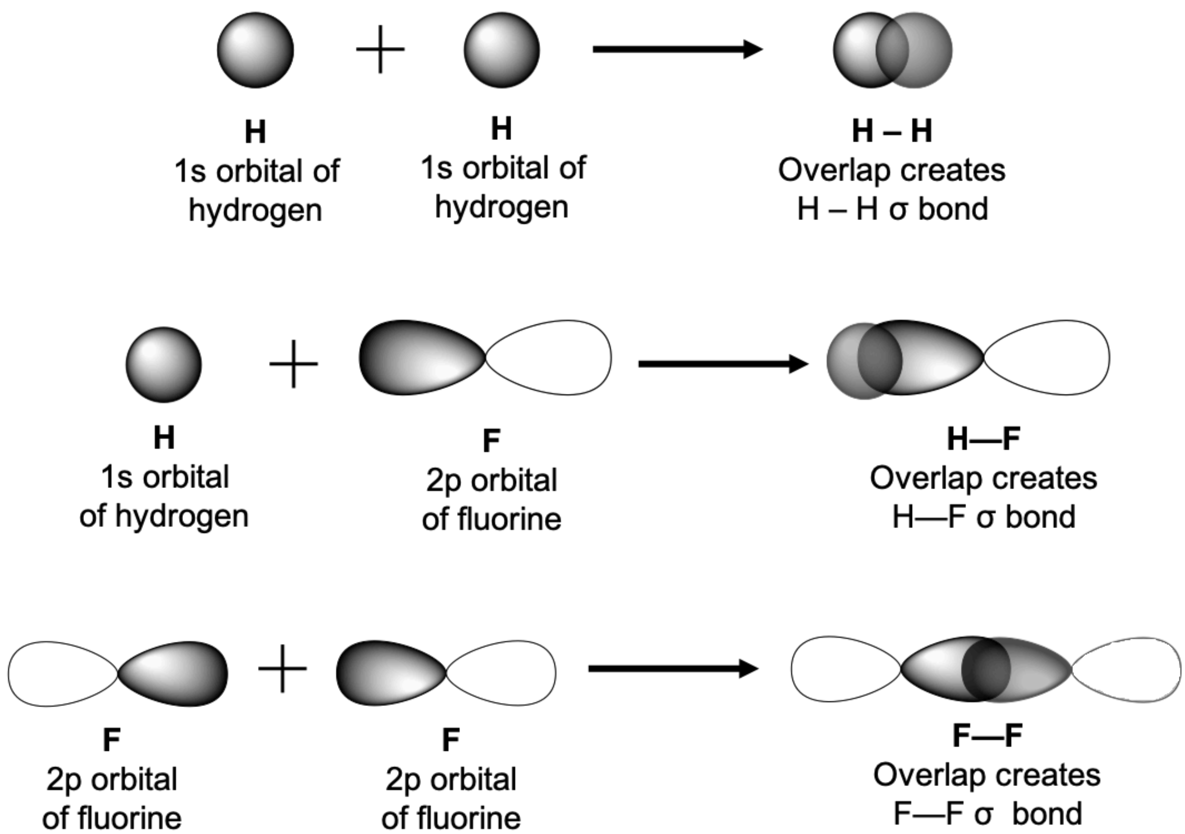
Effective Atomic Number (EAN)



The concept of Effective Atomic Number (EAN), introduced by Sidgwick, helps in understanding the stability and electronic structure of coordination compounds.

EAN is defined as the total number of electrons surrounding the central metal atom or ion, accounting for both the electrons originally present in the metal and those donated by the ligands. This concept can be particularly useful in predicting the stability of metal complexes and understanding their electronic configuration.

Valence Bond Theory (VBT)



Valence Bond Theory (VBT) is used to explain the bonding in coordination compounds, especially those involving transition metals. Here are the key points and assumptions of VBT:

Orbital Hybridization:

- VBT considers that the d orbitals of transition metals can participate in bonding due to their proximity in energy to s and p orbitals. This leads to various types of hybridization.
- For coordination compounds, hybridization of orbitals helps explain the geometry and bonding in these complexes.

Empty Orbitals:

- The central metal ion has empty orbitals that can accept electron pairs donated by ligands. The number of empty orbitals determines the coordination number of the metal ion in the complex.
- For example, a metal with a coordination number of 6 will have six empty orbitals that can hybridize.

Orbital Overlap:

- Strong bonds are formed when metal orbitals overlap with the orbitals of the ligands. Greater overlap results in more stable complexes.

- Hybrid orbitals are formed through the mixing of s, p, and sometimes d orbitals. These hybrid orbitals are equivalent and participate in bonding with ligands.

Ligand Electron Donation:

- Each ligand donates a pair of electrons to the central metal ion or atom. This forms a coordinate covalent bond between the metal and the ligand.

Non-bonding Electrons:

- Electrons in the inner orbitals of the metal that do not participate in bonding are considered non-bonding and do not affect the bonding interactions.

Magnetism:

- A complex is **paramagnetic** if it contains unpaired electrons, leading to attraction to a magnetic field.
- A complex is **diamagnetic** if all electrons are paired, resulting in no attraction to a magnetic field.

Effect of Strong Ligands:

- In the presence of strong field ligands (e.g., cyanide, carbon monoxide), electrons can pair up in the metal's orbitals, which can lead to a violation of Hund's rule. This pairing affects the magnetic properties and overall stability of the complex.

Limitations of Valence Bond Theory (VBT)

Ligand and Metal Ion Properties:

- VBT does not account for variations in the properties of different ligands and metal ions. It does not explain why the same metal ion can form different complexes with different ligands.

Complex Lability:

- The theory does not address why some complexes are more labile (i.e., react more readily) than others. Lability refers to the rate at which a complex undergoes ligand substitution reactions, and VBT does not provide a clear explanation for this phenomenon.

Inner and Outer Orbital Complexes:

- VBT does not satisfactorily explain the concept of inner and outer orbital complexes. Inner orbital complexes involve the use of d-orbitals from the inner shell, while outer orbital complexes use d-orbitals from the outer shell. The theory lacks a clear explanation for the formation of these different types of complexes.

Color of Complexes:

- The theory fails to explain why coordination complexes exhibit colors. The color of a complex is related to the absorption of specific wavelengths of light, which is not adequately addressed by VBT. This aspect is better explained by Crystal Field Theory (CFT) or Ligand Field Theory (LFT).

Crystal Field Theory (CFT)

Crystal Field Theory (CFT) offers a different perspective compared to Valence Bond Theory (VBT) by focusing on the electrostatic interactions between the central metal ion and the ligands. This theory is widely accepted for explaining the bonding and properties of coordination compounds. The main assumptions of CFT are:

Ligands as Point Charges:

- Ligands are treated as point charges that create an electrostatic field around the central metal ion. This assumption simplifies the analysis by focusing on the electrostatic interactions between the metal and the ligands.

No Interaction Between Metal and Ligand Orbitals:

- CFT assumes that there is no direct interaction between the orbitals of the metal ion and the orbitals of the ligands. Instead, the theory considers only the electrostatic repulsion between the negatively charged ligands and the electrons in the metal ion's orbitals.

Degeneracy of d Orbitals:

- In a free metal atom, the five d orbitals are degenerate, meaning they all have the same energy. However, when a complex is formed, the presence of ligands distorts this degeneracy. The electrostatic field created by the ligands splits the d orbitals into different energy levels, creating a crystal field splitting pattern.

Benefits of CBSE Class 12 Chemistry Notes Chapter 9 Coordination Compounds

- **Comprehensive Coverage**: The notes provide a detailed explanation of coordination compounds, including essential concepts like ligands, coordination entities and complex ions, ensuring students have a thorough understanding of the topic.

- **Clear Definitions and Examples**: Key terms and definitions are explained clearly with examples illustrating complex concepts. This helps students grasp the intricacies of nomenclature, oxidation numbers, and coordination spheres.
- **Simplified Concepts**: The notes break down complex topics such as Valence Bond Theory and Crystal Field Theory into simpler terms making it easier for students to understand and apply these theories to various problems.
- **Boosts Confidence**: Detailed notes prepare students for a range of questions boosting their confidence and readiness for exams.