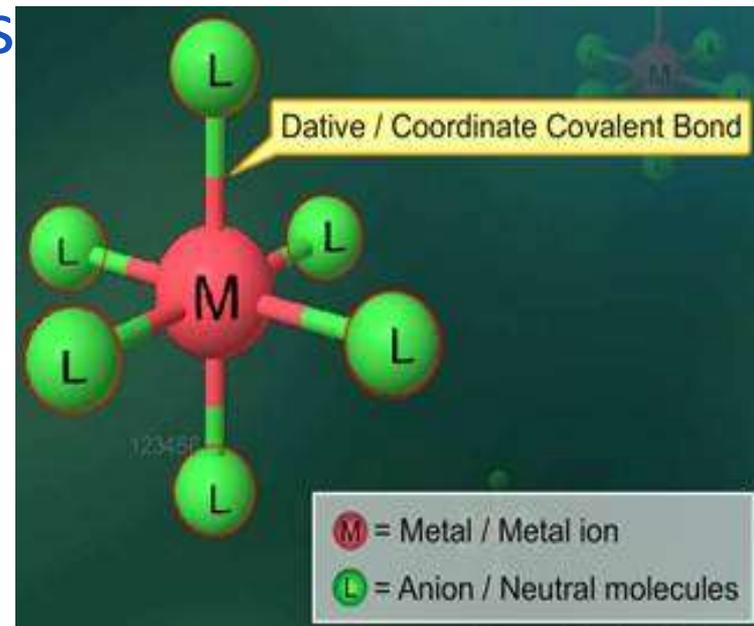


Coordination compound

- **Complex compounds are a special class of** compounds in which the metal atoms (or) ions are bound to a number of **anions (or) neutral molecules**.
- In modern terminology, these compounds are called **coordination compounds**
- Coordination compounds (or) complex compounds are a type of addition compounds.



On the basis of nature, addition (or) molecular compounds are divided into two categories. They are double salts and coordination (or) complex compounds.

differences between double salt and co-ordination compound.

<i>Double Salt</i>	<i>Co-ordination compound</i>
<ol style="list-style-type: none">1. These exist only in solid state and dissociate into constituent species in their solution.2. They lose their identity in dissolved state.3. Their properties are essentially the same as those of constituent species.4. In double salts the metal atom/ion exhibit normal valency.	<ol style="list-style-type: none">1. They retain their identity in solid as well as in solution state.2. They do not lose their identity in dissolved state.3. Their properties are different from those of their constituents. For example $K_4[Fe(CN)_6]$ does not show the test of Fe^{2+} and CN^- ions.4. In co-ordination compounds, the number negative ions or molecules surrounding the central metal atom is beyond its normal valency.

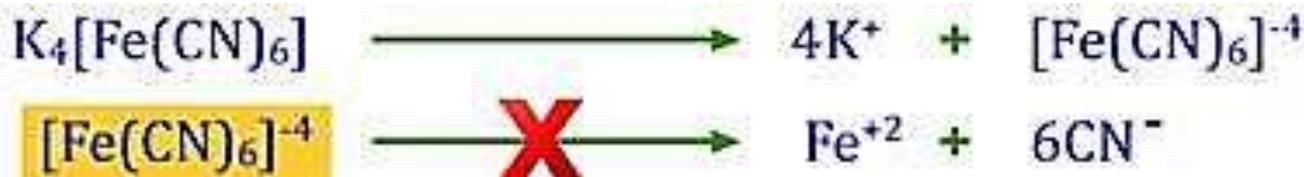
Mohr's salt: $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ double salt.

Double salt and coordination compound

- Ex: An **aqueous solution** of potash alum will give the tests for K^+ , Al^{+3} , and SO_4^{-2}

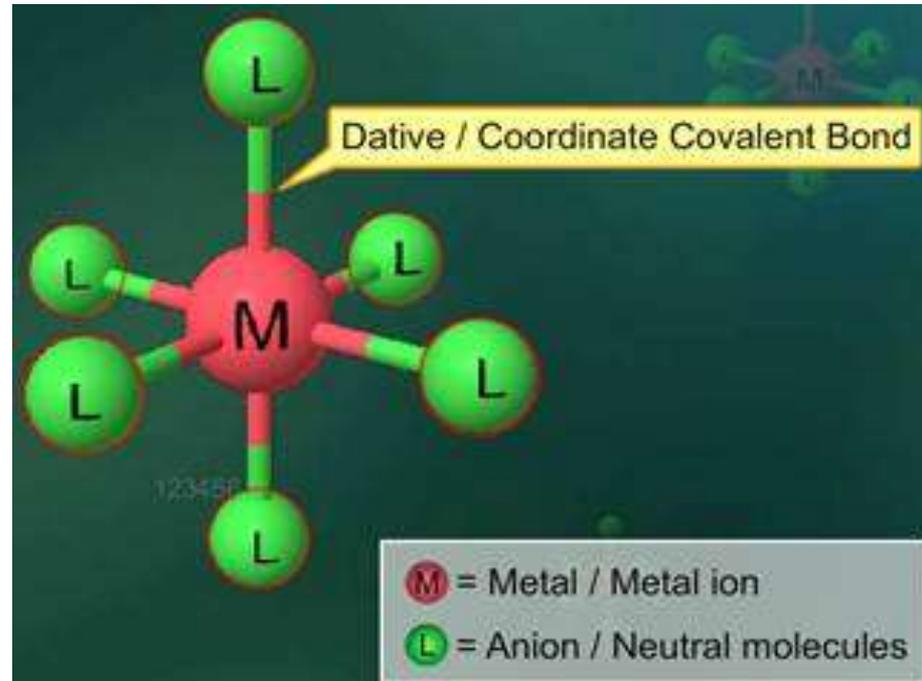


- **On the other hand**, coordination compounds are molecular compounds that retain their identity even when **dissolved in water**.
- Ex: When **potassium ferrocyanide** is **dissolved in water**, it does not give **the usual tests for Fe^{+2}** and **CN^{-1}** , indicating that, $[Fe(CN)_6]^{-4}$ does not dissociate into Fe^{+2} and CN^{-1} .



Complexes compound

- Compounds that have complex ions are called **complex compounds**.
- As the central metal ion in the complex ion forms dative (or) coordinate covalent bonds with the species surrounding it, complex ions are also known as **coordinate ions** and hence the corresponding compounds are known as **coordinate compounds**.



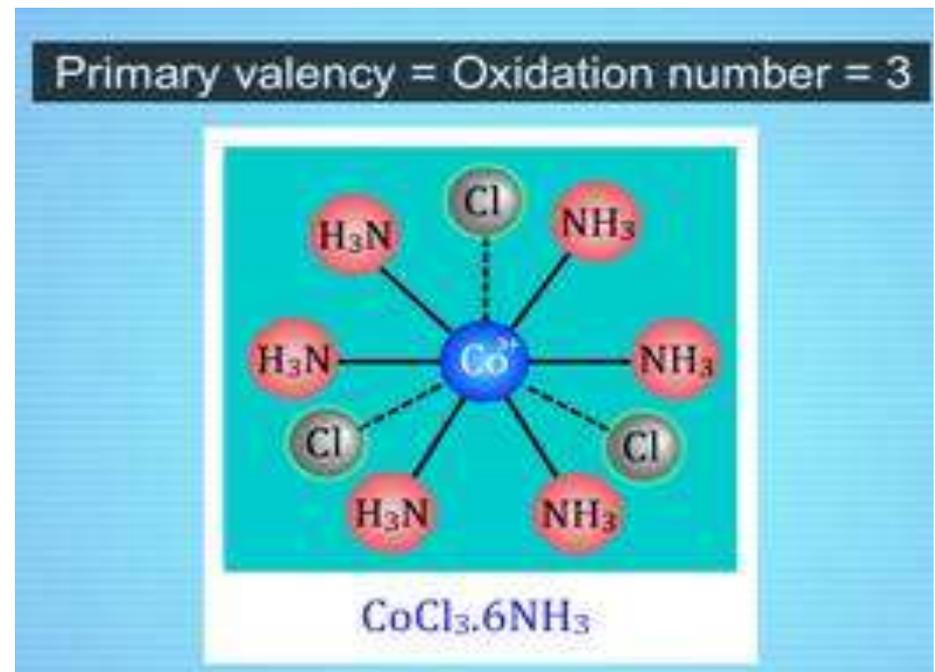
Werner's Theory:

- Alfred Werner a Swiss chemist put forward a **theory to explain the formation of complex compounds**.
- It was the first successful explanation, became famous as the **coordination theory of complex compounds**, which is also known as **Werner's theory**.

Postulates:

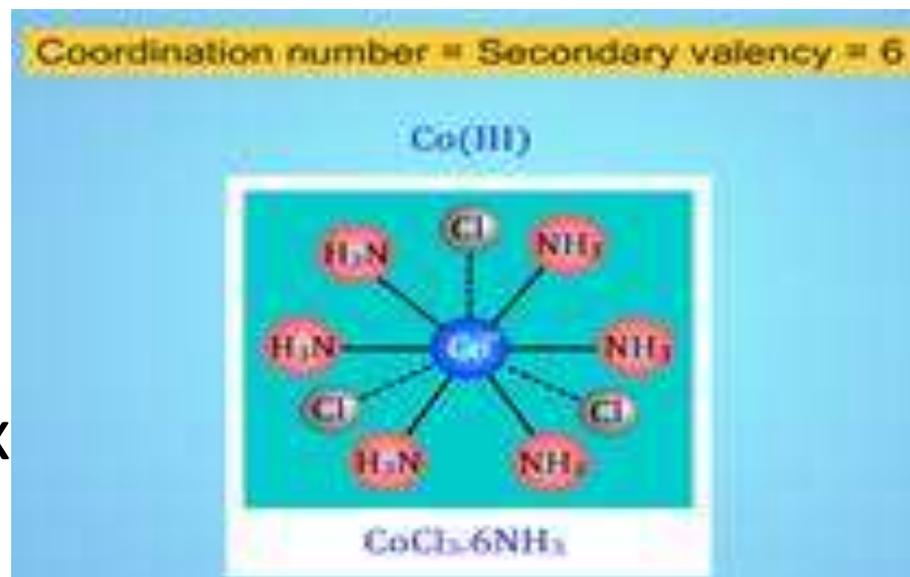
- The **central metal atom** (or) ion in a coordination compound exhibits **two types** of **valencies** - **primary** and **secondary**.
- **Primary** valencies are **ionisable** and correspond to the **number of charges** on the complex ion.

Primary valencies **apply equally** well to simple salts and to complexes and are **satisfied** by negative ions.



Postulates:

- **Secondary valencies** correspond to the valencies that a **metal atom (or) ion** towards neutral molecules (or) negative ions in the **formation** of its **complex ions**.
- Secondary valencies **are directional** and so a complex has a **particular shape**. The number and arrangement of **ligands** in space **determines** the **stereochemistry** of a complex



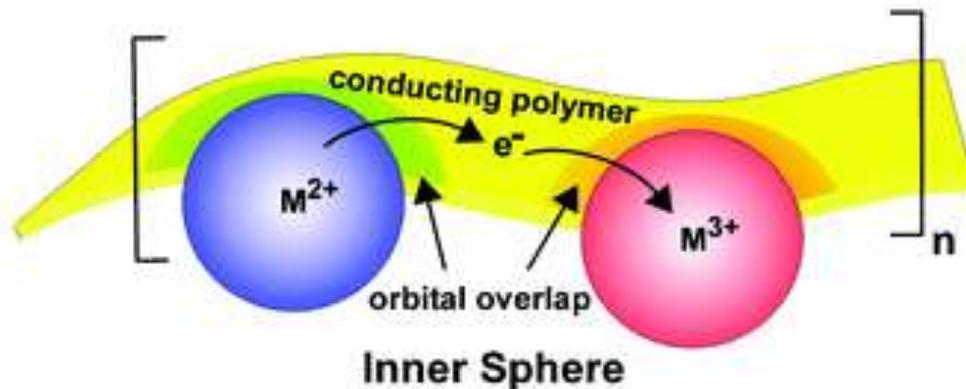
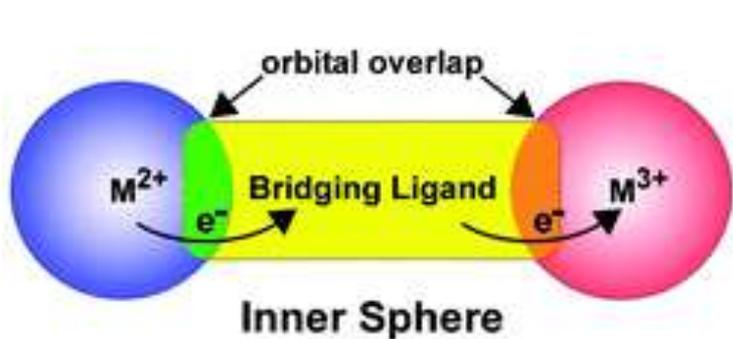
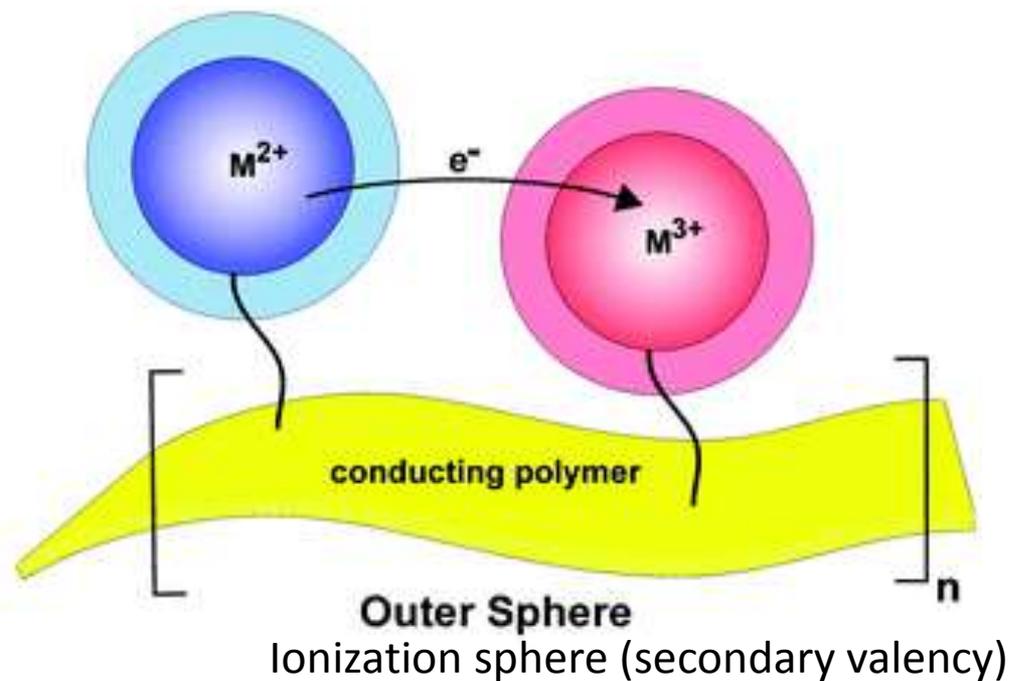
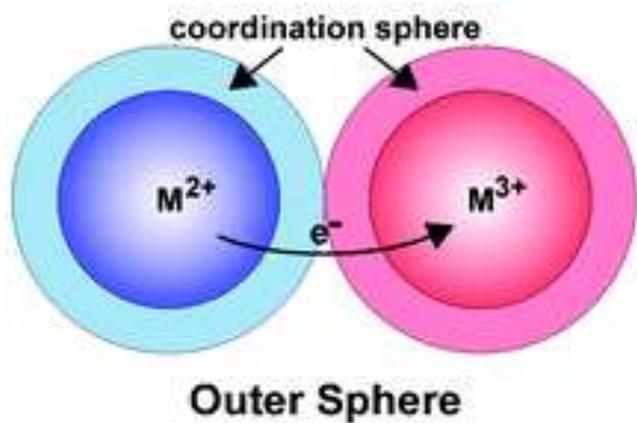
Werner's Theory:

- The postulates of Werner's coordination theory were actually based on **experimental evidence** rather than **theoretical**.
- Although Werner's theory **successfully explains** the bonding **features in coordination compounds**, it has **drawbacks**.

Drawbacks:

- It **doesn't explain** why only **certain elements** form **coordination compounds**.
- It **does not explain** why the bonds in coordination compounds **have directional properties**.
- It does not explain the **colour**, and **the magnetic and optical properties** of complexes.

Warners modern electronic theory of valance



Application of werner theory to

Co[III] amines



- On **heating with** HCl at 373k, **cobalt amines** doesnot **evlove NH3**.
- **Primary valence** of **Co is 3** and **secondary is 6**.
- All the **compound differ in their reactivity**.

Werner's Theory

Werner proposed putting all molecules and ions within the sphere in brackets and those "free" anions (that dissociate from the complex ion when dissolved in water) outside the brackets.

TABLE 24.1 Properties of Some Ammonia Complexes of Cobalt(III)

Original Formulation	Color	Ions per Formula Unit	"Free" Cl ⁻ Ions per Formula Unit	Modern Formulation
CoCl ₃ ·6 NH ₃	Orange	4	3	[Co(NH ₃) ₆]Cl ₃
CoCl ₃ ·5 NH ₃	Purple	3	2	[Co(NH ₃) ₅ Cl]Cl ₂
CoCl ₃ ·4 NH ₃	Green	2	1	<i>trans</i> -[Co(NH ₃) ₄ Cl ₂]Cl
CoCl ₃ ·4 NH ₃	Violet	2	1	<i>cis</i> -[Co(NH ₃) ₄ Cl ₂]Cl