

Get Ready to Crack CSIR-NET 2021

(Study Notes on
Organometallic Compounds)



Organometallic Compounds

Organometallic Compounds are chemical compounds having at least one bond between a metallic element and a carbon atom which belongs to an organic molecule.

The bonding is ionic or covalent or delocalised between organic groups and a metal atom.

Organometallic compounds of Li, Mg (Grignard reagents) are the most important organic reagents. Some metalloid elements such as silicon, tin, and boron also form organometallic compounds which are used in some industrial chemical reactions.

Hapticity

The no. of carbon atoms through which an organic ligand is attached to the central metal atom" is known as "Hapticity" of the ligand.

This is represented by the symbol " η "

EAN Rule

The sum of the electrons on the central metal atom or ion and the electrons donated from the ligands in a complex compound is called the effective atomic number (EAN) of the metal. For a compound to be stable, EAN should be equal to the atomic number of the next incoming noble gas.

18-Electron Rule

If the central metal ion or atom of a complex compound acquires noble gas electronic configuration i.e, 18 electrons in the valence orbitals (or valence shell) then the electronic configuration will be closed and stable." It is known as the 18-electron rule. The total number of

electrons is equal to the sum of d-electrons + electrons donated by the

ligands.

18 electrons = coordinatively saturated

< 18 electrons = coordinatively unsaturated

Metal Carbonyls

Those metal Complexes in which Carbon monoxide acts as a ligand are called metal carbonyls. For example:Cr (CO)₆, Fe (CO)₅.

There are two types of metal carbonyls:

a) Mononuclear metal carbonyls: These complexes contain only one metal atom per molecule. For example : [Ni(CO)₄], [Fe(CO)₅], etc.

b) Polynuclear metal carbonyls: These complexes contain more than one metal atom per molecule. For example: Mn₂(CO)₁₀ ,Fe₂(CO)₉ , Co₄(CO)₁₂etc.

Bonding in metal carbonyls:

The nature of M-C bond is as follows :

Formation of σ -bond:

It is the overlap of filled carbon σ -orbital with the vacant metal orbital.

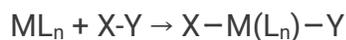
Formation of π -bond:

It is the overlap of filled d-orbital of metal with the vacant π^* orbital of CO.

Common Reactions:

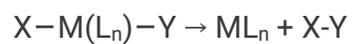
Oxidative Addition:

This is the reaction in which a neutral ligand adds to the metal centre and oxidises it generally by two electrons.



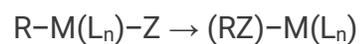
Reductive Elimination:

This is the reaction in which two cisoidal anionic ligands couple together on metal centre.



Migratory Insertion:

This is the reaction in which a cisoidal anionic and neutral ligand couple together to generate a new coordinated anionic ligand.



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