

Organometallic Reactions :-

- * organometallic reactions are chemical reactions that involve the interaction between an organometallic compound and another compound (Non-organic organic compound).
- * organometallic compounds are chemical compounds that contain at least one Carbon-metal bond, and they are used as catalysts or reagents.

Some common organometallic reactions include :-

(i) Grignard reactions :-

These reactions involve the use of organomagnesium compounds to form Carbon-Carbon bonds with electrophiles.

(ii) Heck reactions :-

These reactions involve the coupling of an aryl or vinyl halide with an unsaturated hydrocarbon.

Uses :- The organometallic reactions are used in organic synthesis, Pharmaceutical and development of new drugs and materials.

Ligand Association and Dissociation :-

These are compounds that contain a central metal ion or atom surrounded by one or more ligands.

(i) Ligand Association :- It is the process by which a ligand binds to a metal ion or atom to form a coordinate compound.

(ii) This process occurs when a ligand donates a pair of electrons to a metal ion to form a covalent coordinate bond.

Ligand Dissociation

- (i) It is the process by which a ligand is released from a coordinate compound to form a coordination free ligand and a metal ion or atom.
- (ii) This process can occur through a number of different mechanisms, such as substitution reactions.

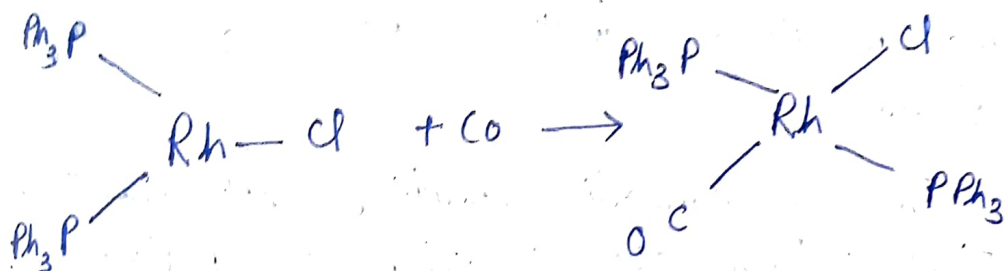
oxidative addition

- (i) It is the reaction in which a metal center undergoes an increase in its oxidation state by accepting a ligand that is already bound to another atom or molecule.
- (ii) This process involves the breaking of a sigma bond between the ligand and the other atom or molecule, followed by the formation of new sigma and pi bonds between metal center and the ligand.

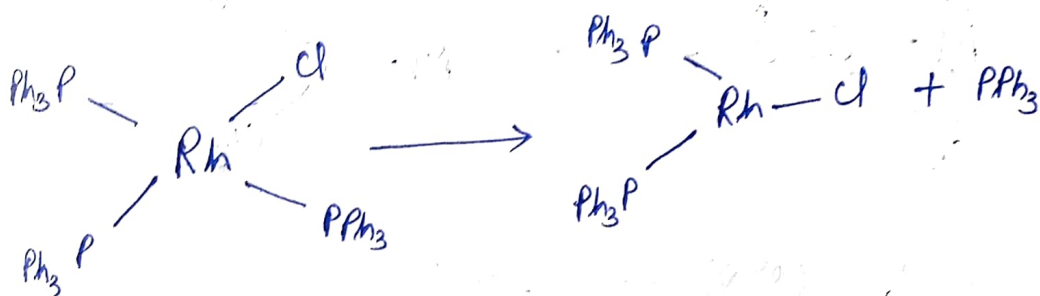
Reductive Elimination :-

- (i) The reaction in which a metal undergoes a decrease in its oxidation state by releasing a ligand as a neutral molecule or ion.
- (ii) This process involves the breaking of sigma or pi bonds between the metal center and the ligand, followed by the formation of a new sigma bond between the ligand and the other atom or molecule.

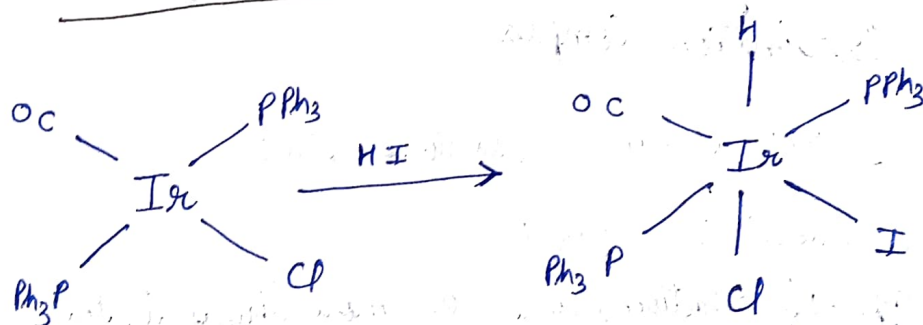
Examples Ligand Association



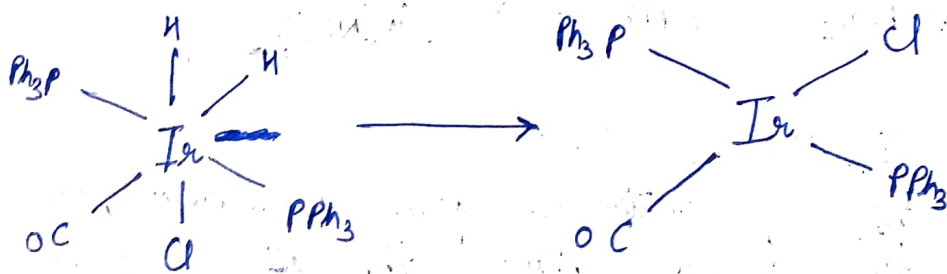
Ligand Dissociation



oxidative addition



Reductive Elimination



Insertion Reaction

(i) It is the insertion of a chemical species (small molecules) into a bond of a larger molecule.

(ii) In organometallic chemistry, the insertion reactions involve the insertion of a Metal-Carbon bond into a Carbon-Hydrogen or Carbon-Carbon bond of an organic molecule.

Example:-



Reactions of Coordinated ligands:-

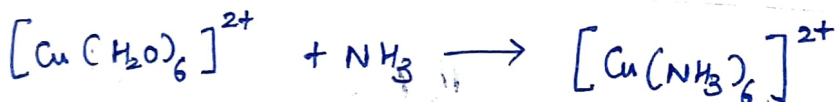
The coordinate ligands can undergo various reactions that can change the structure and properties of the coordination complex.

Some of the common reactions are:-

(i) Ligand Substitution reactions:-

In this type of reaction, one or more ligands in the coordination complex are replaced by another ligand.

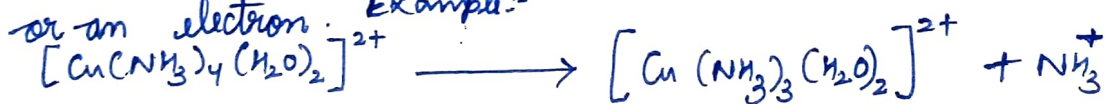
Example:-



(ii) Ligand dissociation reactions:-

In this type of reaction, a ligand is released from a coordination complex, through the loss of a proton or an electron.

Example:-

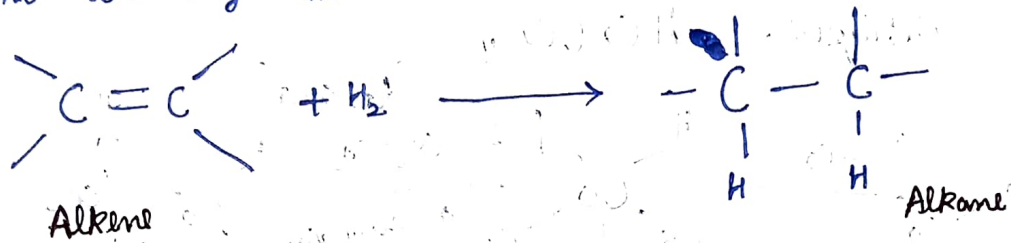


Ligand oxidation/Reduction reactions

In this reaction a ligand undergoes a change in its oxidation state, through transfer of electrons between the ligand and metal.

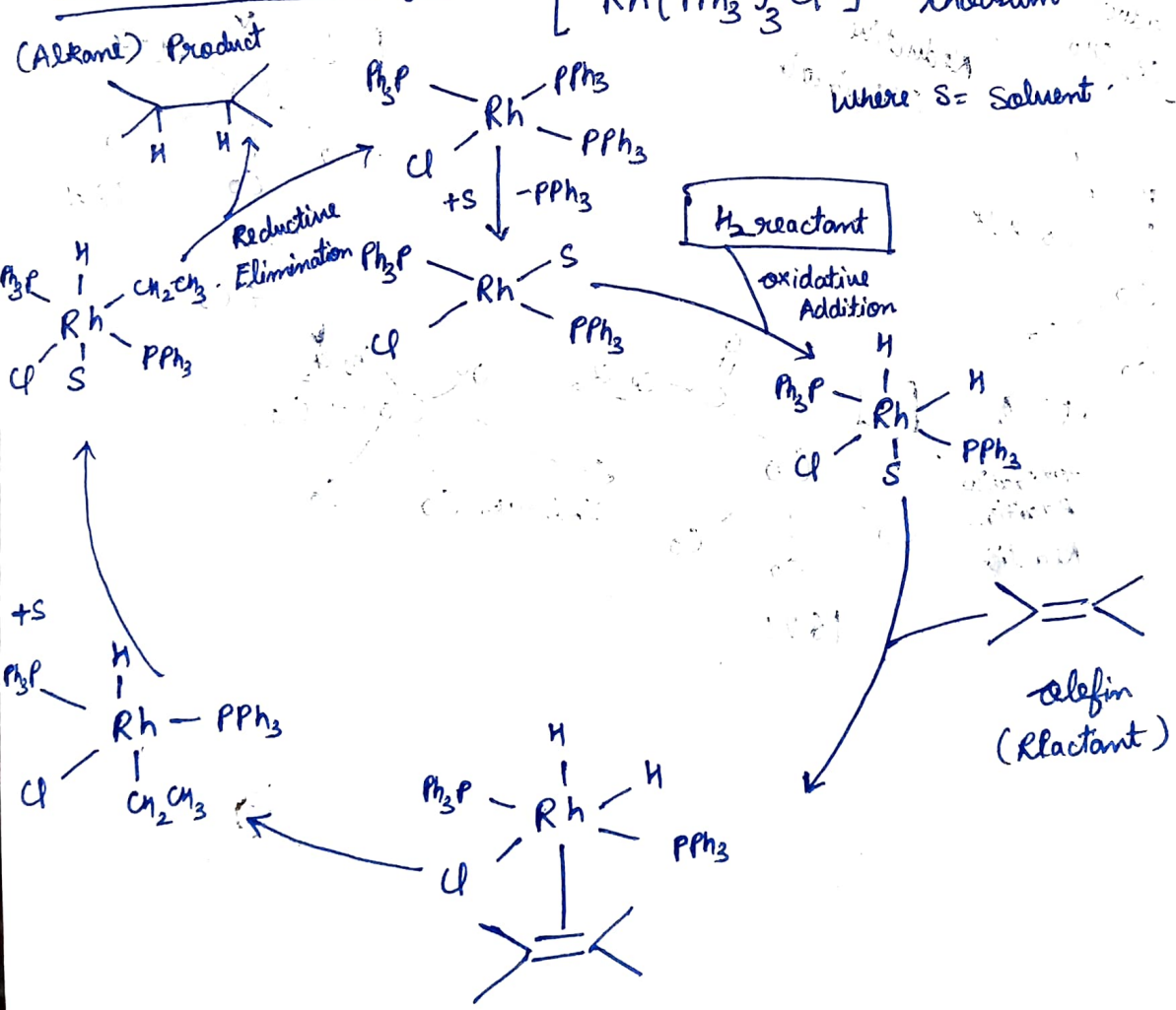
Hydrogenation of olefins (Wilkinson's Catalyst):-

Hydrogenation of olefins is a common reaction in organic chemistry in which



This reaction is catalyzed by metal complexes with Wilkinson's Catalyst:- $[Rh(PPh_3)_3Cl]$ chlorido(triphenylphosphine)rhodium

where S = Solvent

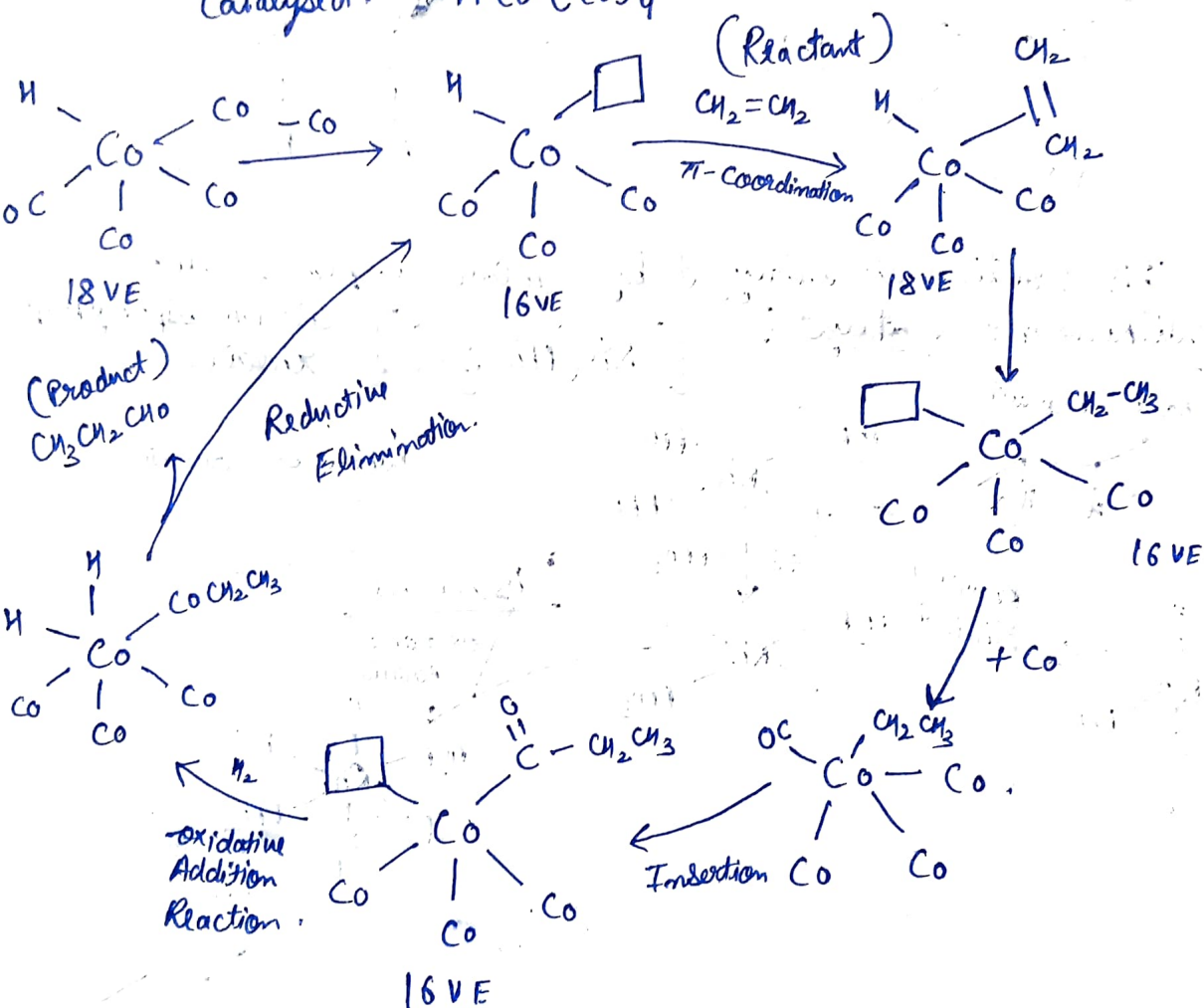


⑥

$$R-\text{CH}=\text{CH}_2 + \text{H}_2 + \text{CO} \xrightarrow{\text{Catalyst}} R-\text{CH}_2-\text{CH}_2-\text{CHO} + R-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{CHO}$$

(Linear) (Branched)

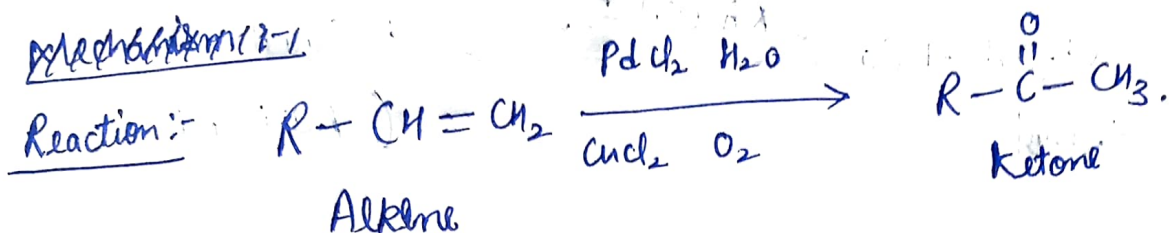
Catalysed. $\text{HCo}(\text{CO})_4$



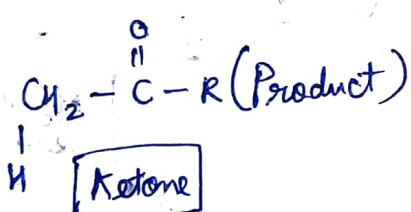
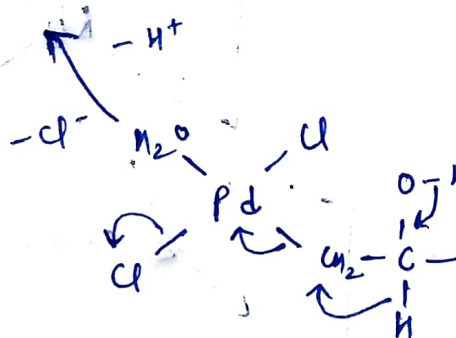
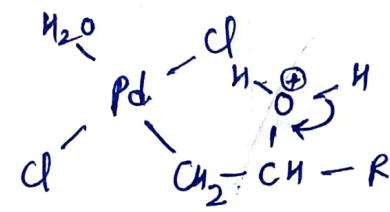
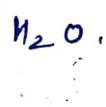
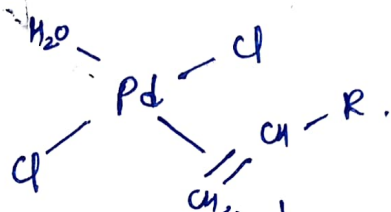
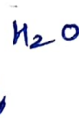
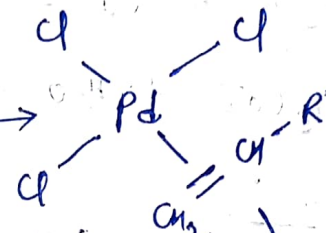
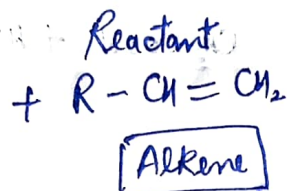
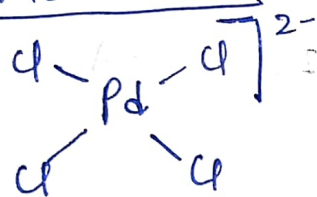
Olefin oxidation (Wacker Process)

In this process convert alkenes (olefins) to Carbonyl compounds such as ketones with the help of Catalyst PdCl_2 , CuCl_2 , H_2O and O_2

Reaction



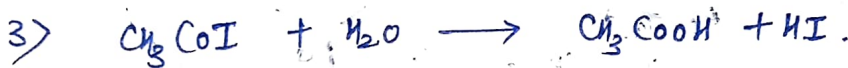
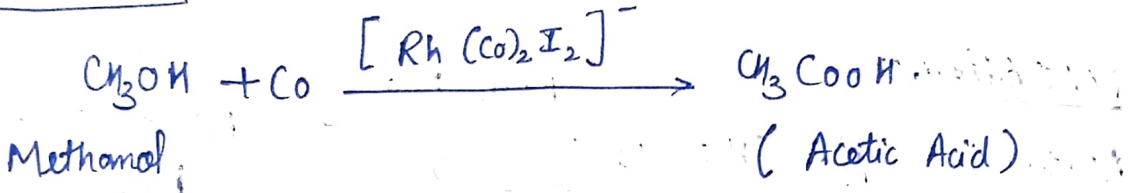
Mechanism



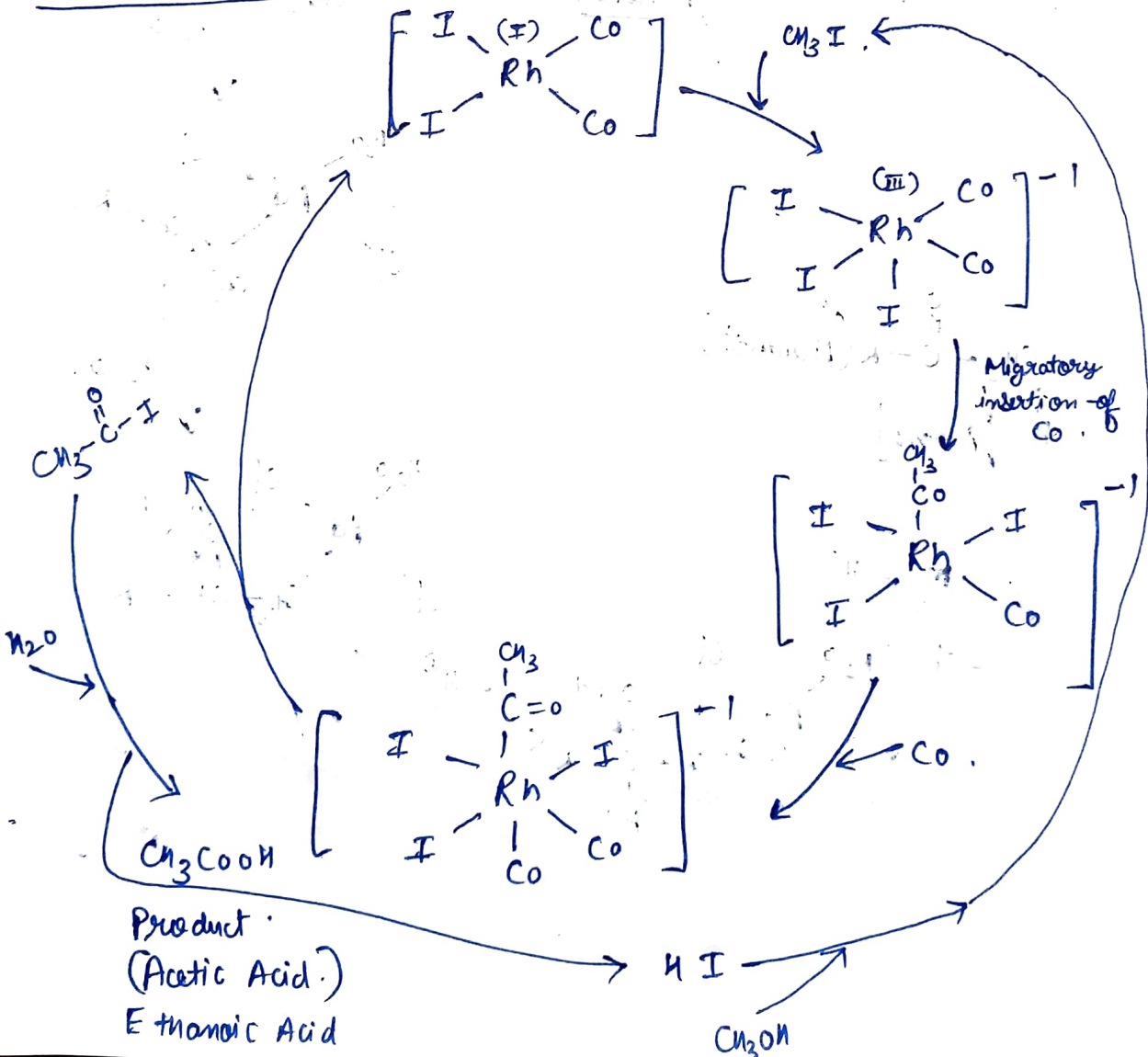
Carbonylation of Methanol (Acetic Acid Synthesis) ⁽⁸⁾ :-

In this Process, methanol is reacted with Carbon monoxide (CO) in the presence of a catalyst to produce Acetic Acid.

Reactions :-



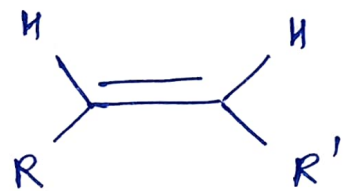
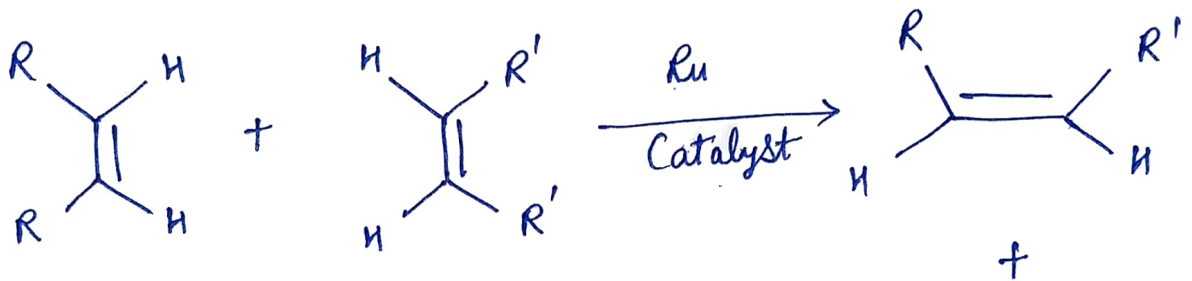
Mechanism :-



olefin metathesis :-

(i) It involves the exchange of alkene (olefin) between two molecules with the transition metal catalyst.

Reaction:



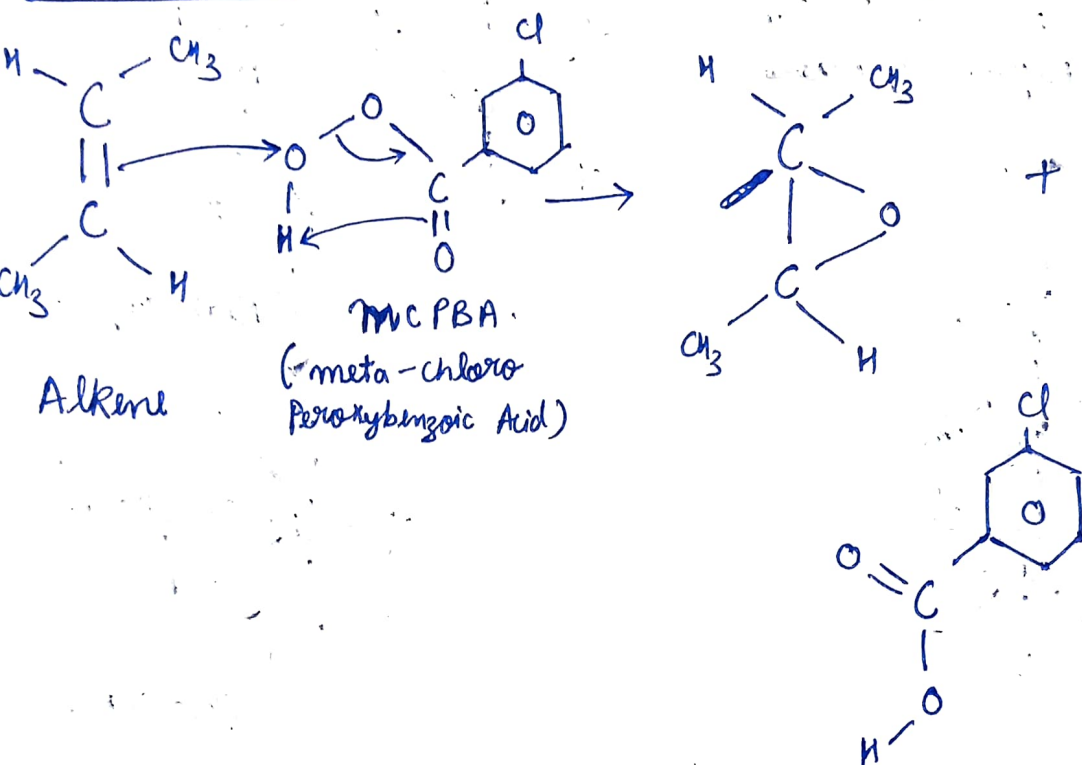
New Alkenes
formed.

(9)

Epoxidation of olefin :-

- (i) Epoxidation of olefins is a reaction that converts alkenes (olefins) into epoxides (which are three-membered cyclic ethers).
- (ii) It takes place in the presence of peroxyacids such as MCPBA (m-chloroperoxybenzoic Acid).

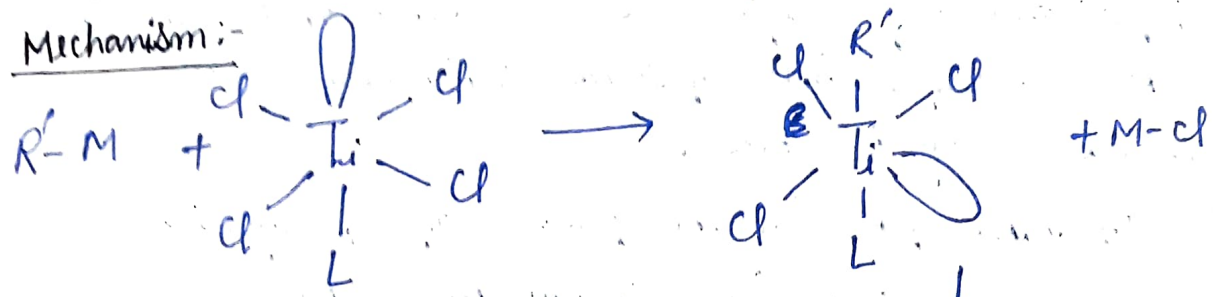
Mechanism :-



Polymerization of olefins (Ziegler Natta Catalyst).

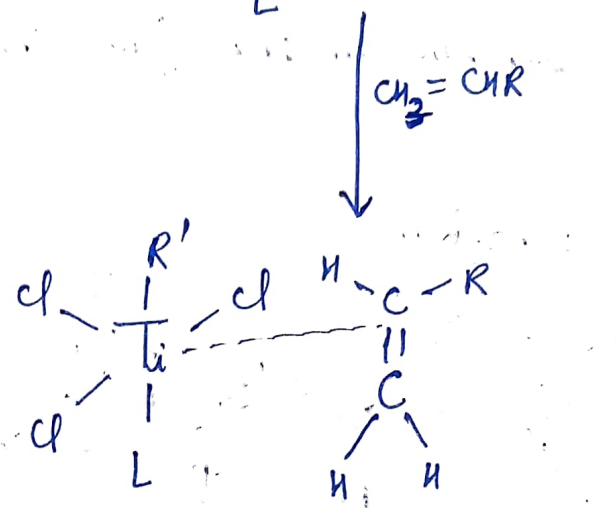
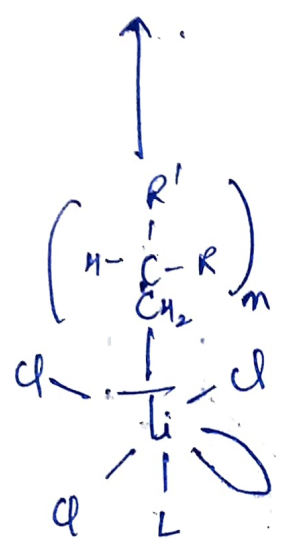
- (i) It is a ~~can~~ process that converts monomers such as ethylene or propylene into polymers.
- (ii) The most common method for the polymerization of olefins involves the use of Ziegler-Natta Catalyst.

Mechanism:-

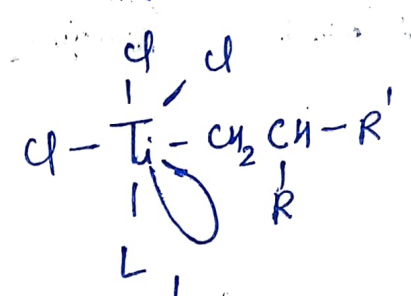


Active Catalyst

$CH_2=CH-CH_2-CH_2 \dots R$
 Polymer of Alkene

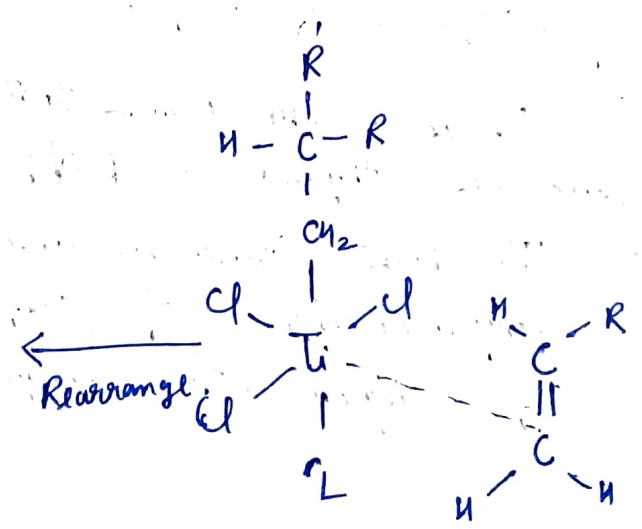
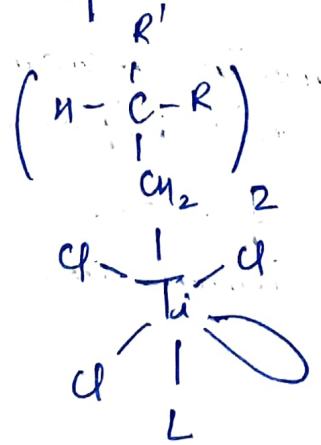


Rearrange.



$CH_2=CHR$

Repeat many times



olefin metathesis :-

(i) It involves the exchange of alkene (olefin) between two molecules with the transition metal catalyst.

Reaction:

