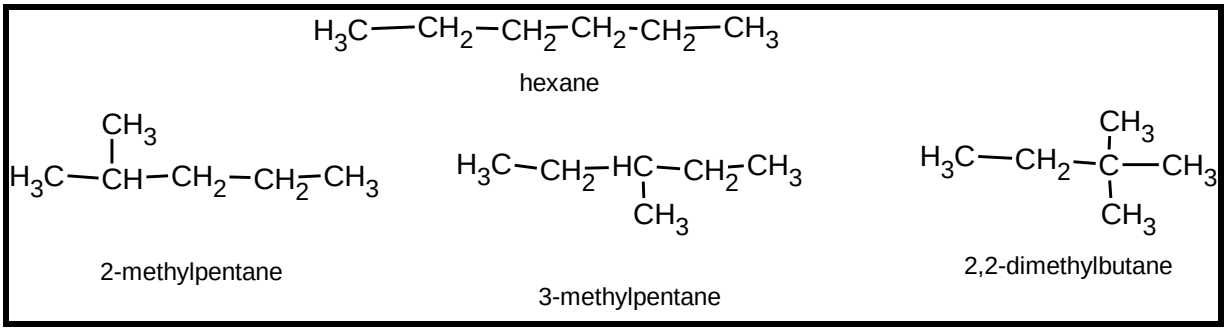
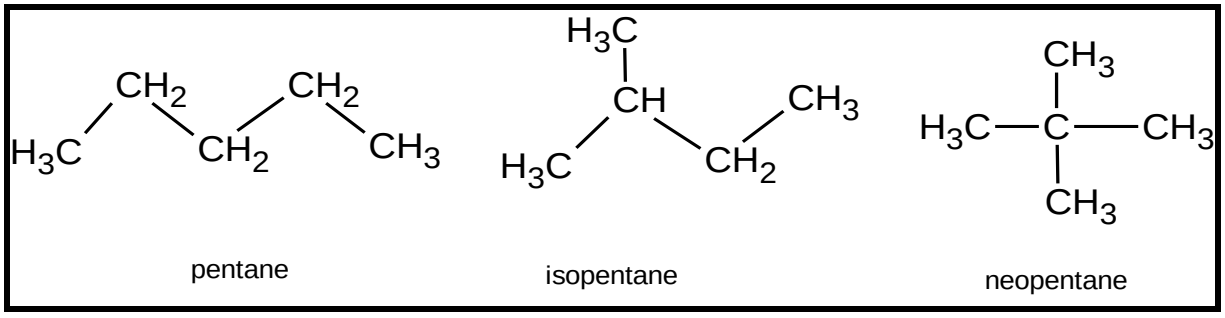
Isomers:

When two or more molecules have the same chemical formula but different structures they are called ***isomers*** *or* Compounds have the same molecular formula with different atom arrangements " Different compounds means that they have different physical properties (melting point, boiling point etc.). They may also have very different chemical properties depending on the type of isomerism present.

1- Structural Isomers : Differences in shape of molecule due to straight chain and a branched chain .(i.e. 2-methylpentane and 3-methylpentane 2,2-dimethybutam) because the have the same molecular formula (C_6H_{14}).





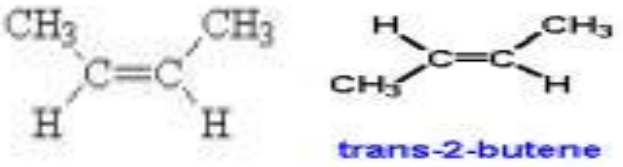
2-Geometric Isomers: Geometric isomers differ in the position of groups attached to either side of a carbon-carbon double bond. Geometric isomerism occurs because double bonds are rigid and cannot rotate like single bonds. Geometric isomers have slightly different physical and chemical properties, for example some ***cis*** isomers are polar, while their ***trans*** isomer is non-polar.

General Rules:

1- To have a cis-trans (geometric) isomer, each carbon in the C=C double bond must be attached to two different groups.

2- In a cis isomer, the two larger groups are attached to each C=C double bond on the same side.

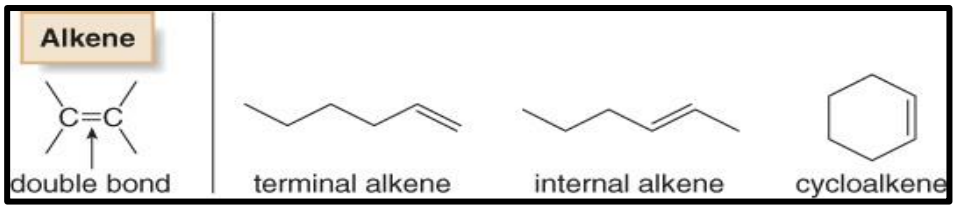
3- In trans isomer, the two larger groups are attached to each C=C double bond on opposite sides.



Alkenes:

are **also called olefins** unsaturated hydrocarbons with general formula **CnH2n .**

Unsaturated = contain a double C=C bond



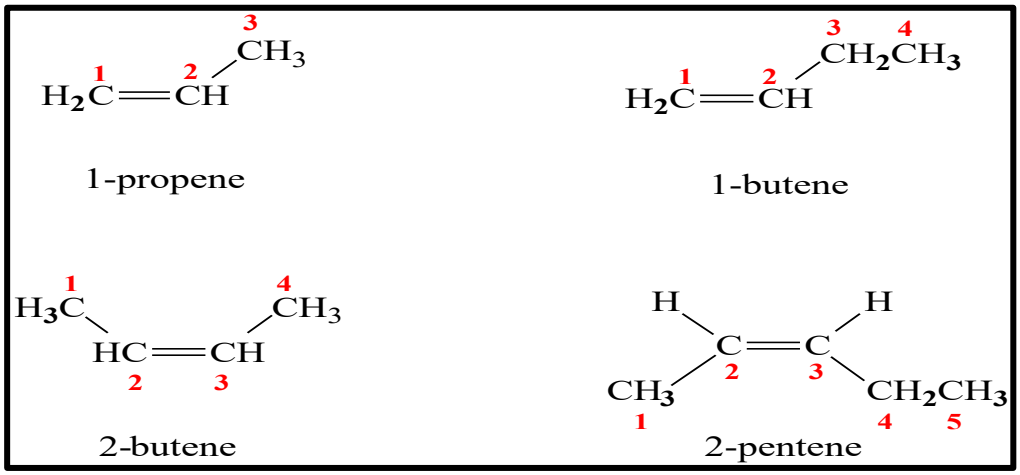
Nomenclature of Alkenes

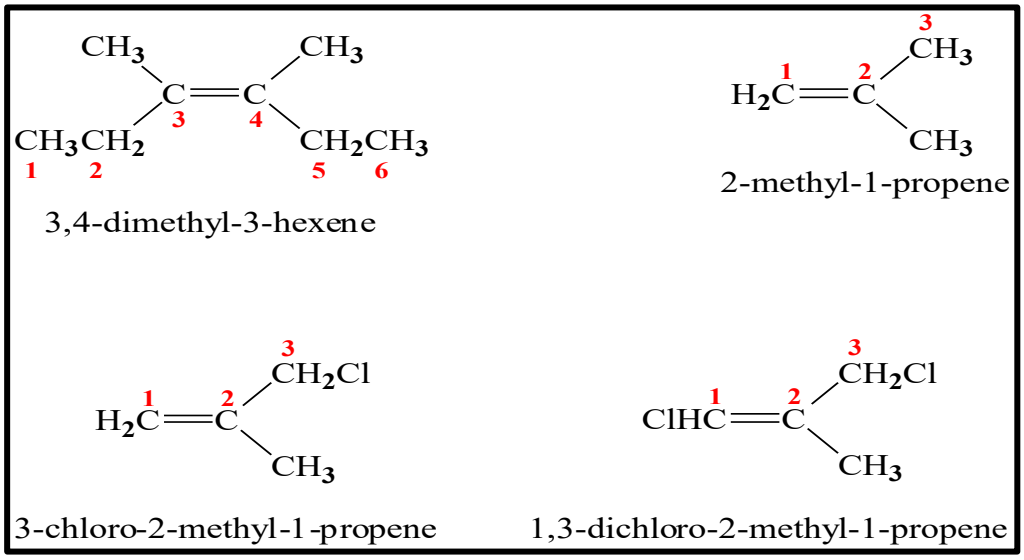
(The systematic rules for naming alkenes IUPC Name)

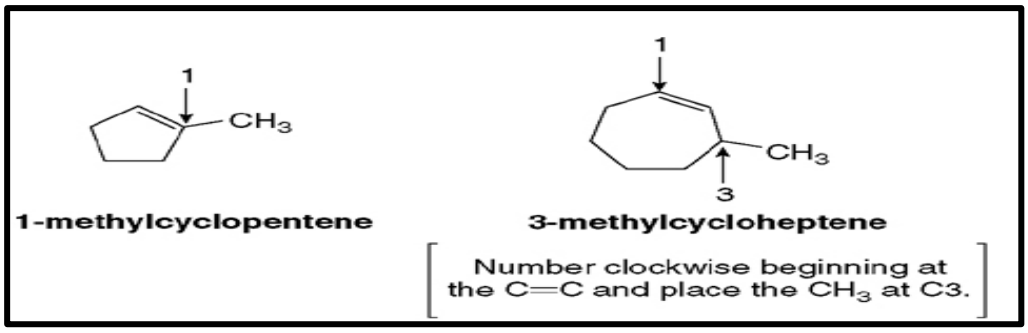
1- Find the longest chain of carbon atoms that includes the double bond then name as for the corresponding saturated hydrocarbon (alkane) (use the meth, eth, prop… root word) but use the termination **-ene** rather than **-ane.**

2- To determine which carbon is the first carbon, make the double bond the lowest number possible.

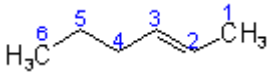
3- The number of the carbon where the double bond is located is written before the root word.

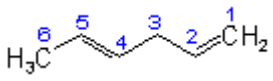




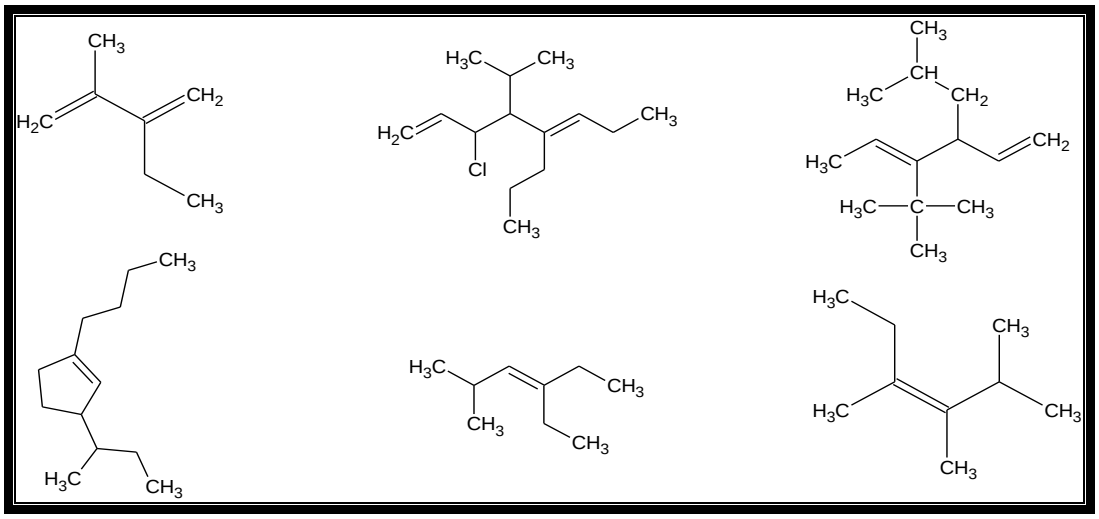


4- If there are more than one double bond each bond position is noted with a number preceding the root name and a prefix; **di, tri**… is inserted before the –ene suffix, -**diene or –triene** are examples.

2-Hexene 

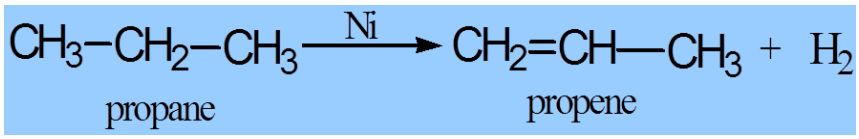
1,4-Hexadiene 

Examples: Give IUPC names of the following structure.

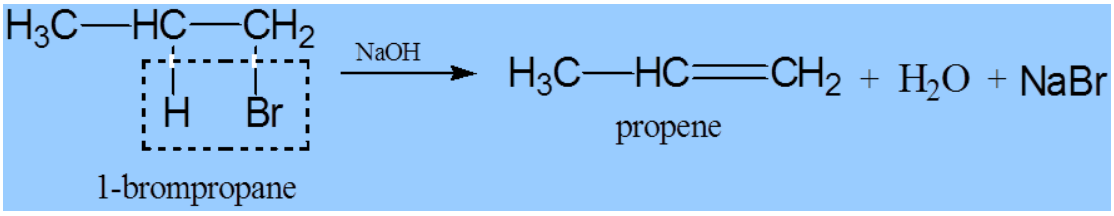


Synthesis of alkenes

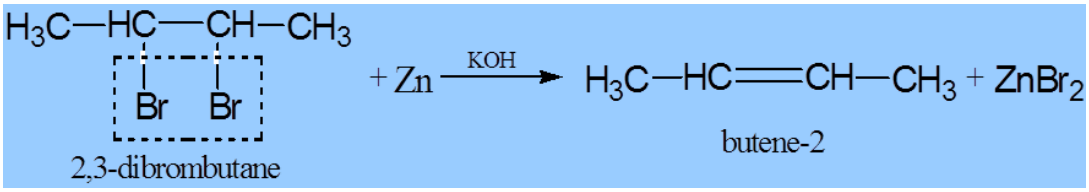
1 - Dehydrogenation of alkanes :



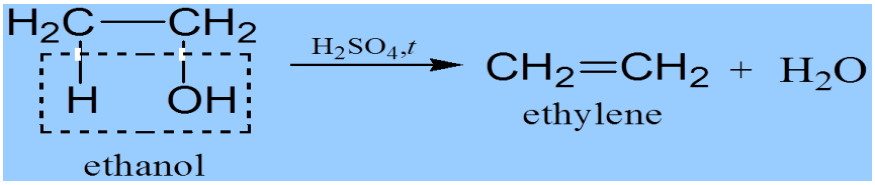
2- Dehydrohalogenation of alkyl halides :



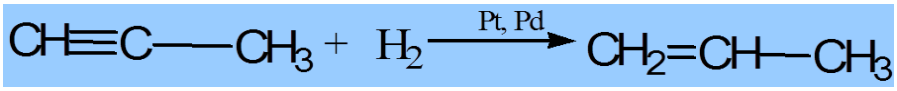
3-Dehalogenation of vicinal bromides :



4-Dehydration of alcohols :



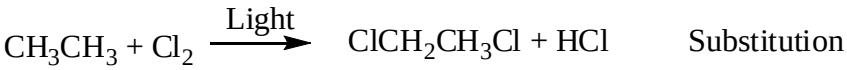
5-Reduction of alkynes :

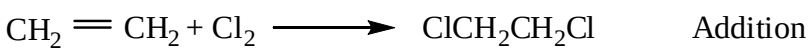


Reaction of Alkenes :

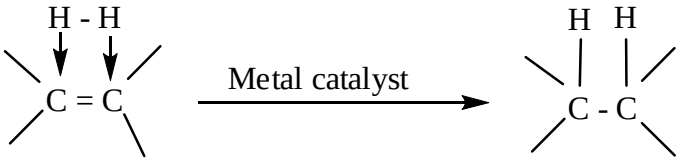
Addition reaction of alkenes :

Alkenes and alkanes undergo different types of reactions. Alkanes react by substitution, whereas addition to the double bond is the reaction of alkenes.

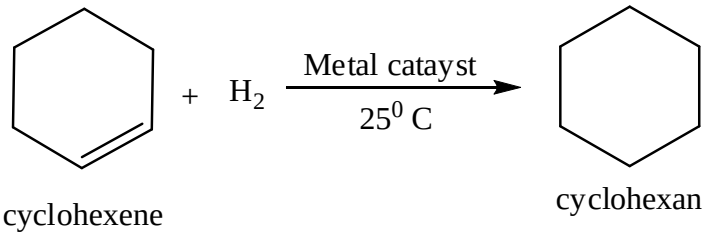


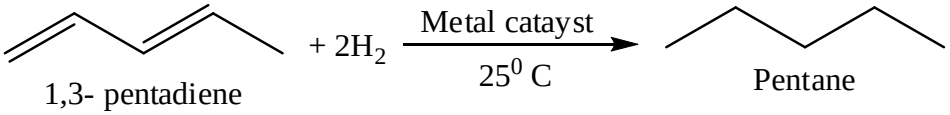


1- Addition of hydrogen : Reduction of the carbon - carbon double bond , the addition of H_2 to alkenes in the presence of a metal catalyst converts them to alkanes.



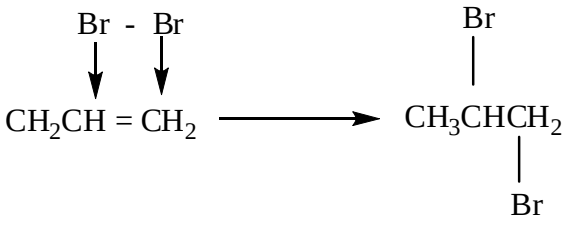
Some specific examples :





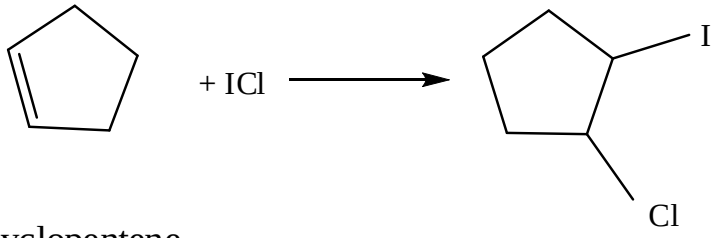
2- Addition of Halogens :

The addition of bromine and chlorine to alkenes occurs readily.



propane 1,2 - Dibromopropane

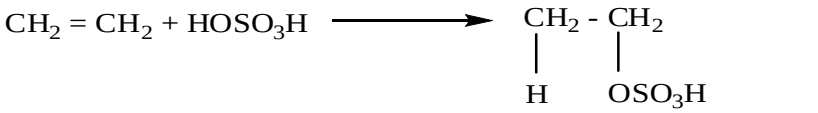
Iodine usually does not react with alkenes but the inter halogens iodine mono chloride (ICI) and iodine mono bromide (IBr) are added readily.



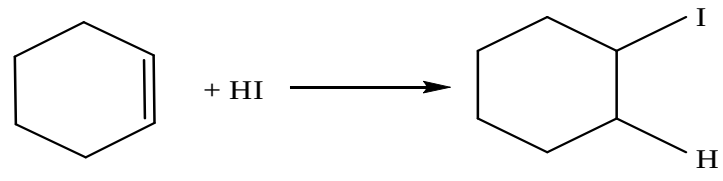
Cyclopentene 1- Chloro -2- iodocyclopentane

3- Addition of Acids :

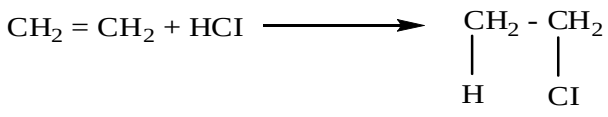
Acid such as sulfuric acid and the hydrogen halides are readily added to alkenes.



Ethylene Sulfuric acid Ethyl hydrogen sulfate

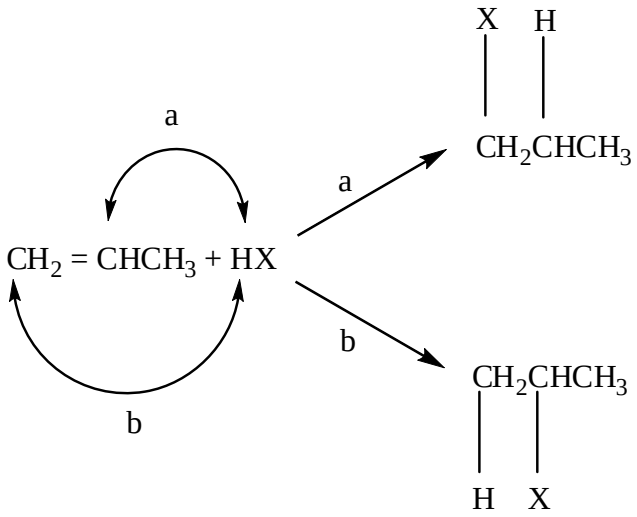


cyclohexene Iodocyclohexane

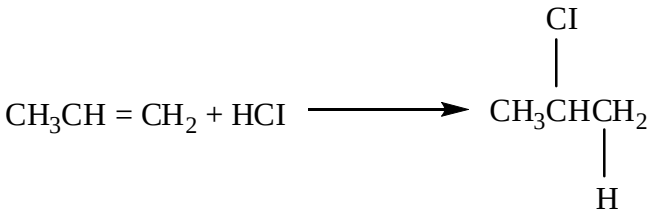


Ethylene Chloroethane

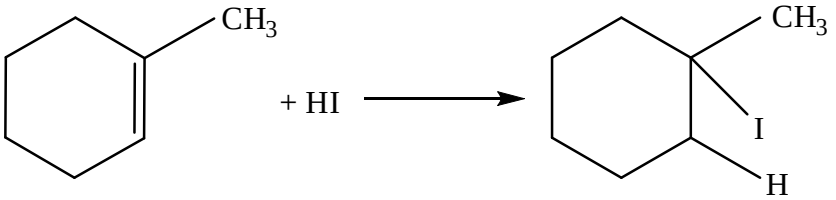
The addition of an unsymmetrical reagent such as HX to an unsymmetrical alkene can from two isometric products :



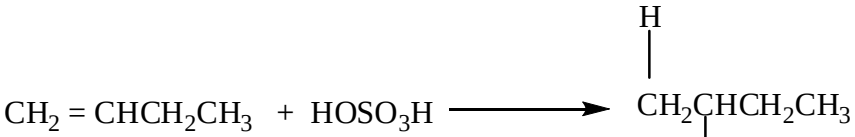
Actually, only one product is obtained, the one formed when the hydrogen of the acid is added to the carbon of the double bond containing the greatest number of hydrogens. This rule is called the **Markonikoff rule.**



Propene — 2 - Chloropropane



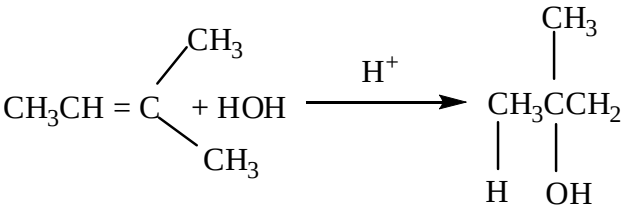
1- Methylcyclohexene — 1- Iodo - 1- methylcyclohexane



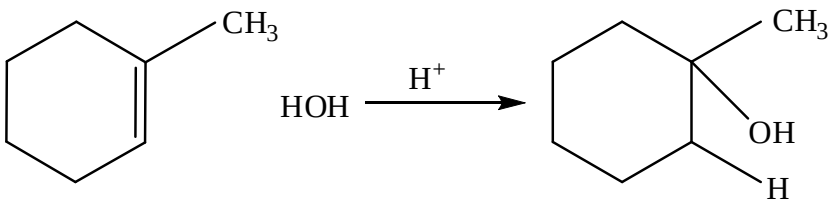
1- Butene — Sulfuric acid — Butyl hydrogen sulfate

4- Addition of water :

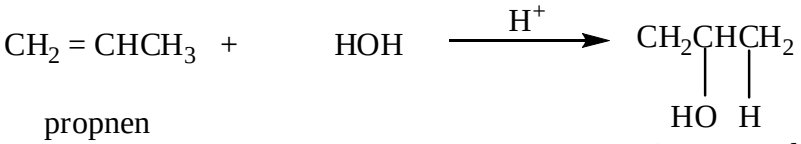
The addition of water to alkenes, called hydration, requires the presence of a strong acid catalyst such as sulfuric or phosphoric acid.



Methylpropene — Methyl -2- propanol

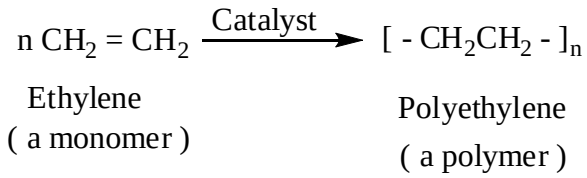


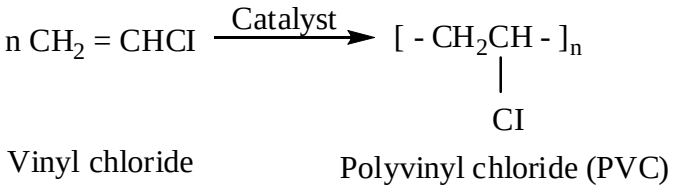
1- Methylcyclohexene — 1- methylcyclohexanol

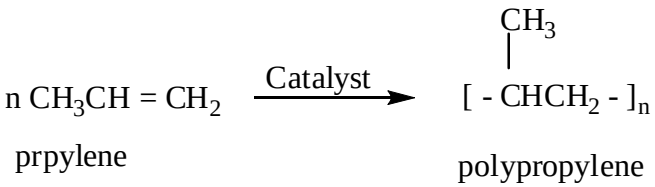


propnen — 2- propanol

Polymerization : One alkene adding to another.
Polymer : A hung molecule with a high molecular weight formed by combining a large number of monomers (monomer : one molecule of an alkene), for example, ethylene polymerize to form polyethylene with the a catalyst.

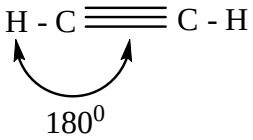






Alkynes :

These compounds all contain at least one carbon - carbon triple bond. like acetylene (C_2H_2).



The reactions of alkynes are similar to those of alkenes.
Example :