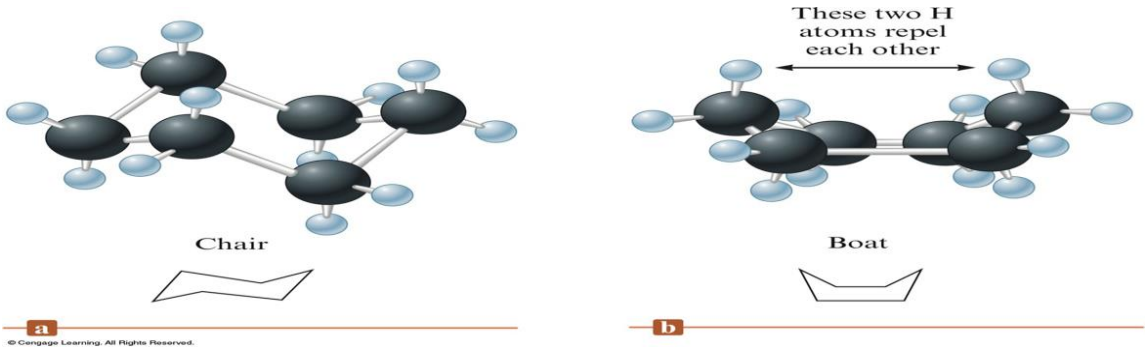


Alkenes:

Unsaturated hydrocarbons that contain a C=C double bond **,C_nH_{2n}**

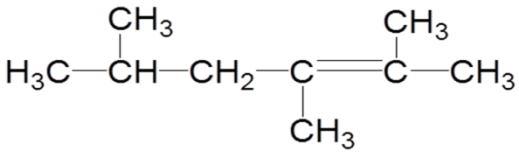
alkenes have a **double bond** between two or more of the carbons

NOMENCLATURE OF ORGANIC COMPOUNDS

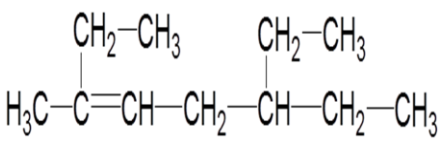
Organic chemistry deals with millions of compounds. In order to clearly identify them, a systematic method of naming has been developed and is known as the **IUPAC (International Union of Pure and Applied Chemistry)** system of nomenclature. In this systematic nomenclature, the names are correlated with the structure such that the reader or listener can deduce the structure from the name.

Alkene Nomenclature:

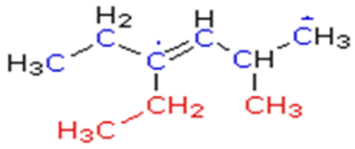
Names of alkenes are based on the longest continuous chain of carbon atoms that contains the double bond.

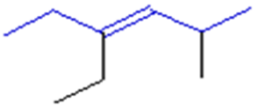


2,3,5-trimethyl-2-hexene



6-ethyl-3-methyl-3-octene



≡

≡ $(CH_3CH_2)_2C=CHCH(CH_3)_2$
4-ethyl-2-methyl-3-hexene

Alkenes: Preparations

These compounds are obtained from the thermal cracking of petroleum products, also it can be obtained from the partial distillation of crude oil.
The main methods in preparing alkenes are:

1.Elimination of HX molecule from an alkyl halide:

It can be carried out by elimination of halide attached with carbon atom neighboring to carbon atom bearing hydrogen by using alcoholic potassium hydroxide.

$$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-X \xrightarrow[\text{Alcohol}]{\text{KOH}} -C=C- + KX + H_2O$$

$$CH_3CH_2CH_2Cl \xrightarrow[\text{Alcohol}]{\text{KOH}} CH_3CH_2{=}CH_2 + KCL + H_2O \xleftarrow[\text{Alcohol}]{\text{KOH}} CH_3\underset{|}{\underset{Cl}{CH}}CH_3$$

n-propyl chloride — Propene — Isoprochloride

$$CH_3CH_2CH_2CH_2Cl \xrightarrow[\text{Alcohol}]{\text{KOH}} CH_3CH_2CH{=}CH_2$$

n- Butyl chloride — 1- Butene

$$CH_3CH_2\underset{|}{\underset{Cl}{CH}}CH_3 \xrightarrow[\text{Alcohol}]{\text{KOH}} CH_3CH{=}CHCH_3 + CH_3CH_2CH{=}CH_2$$

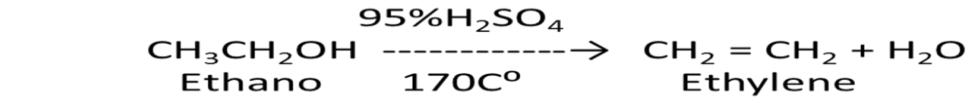
iso- Butyl chloride — 2- Butene — 1- Butene

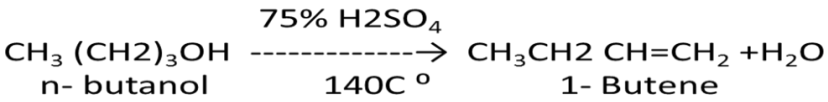
In some cases the product is of one type, but in other cases the product is a mixture of alkenes as it is seen, n- butyl chloride produces one product while isobutyl chloride produces two types products.

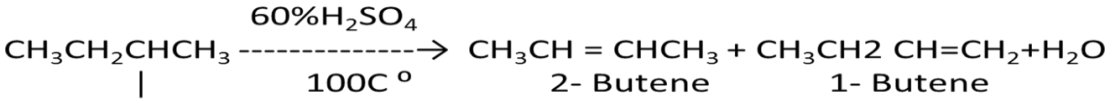
2.Preparation of alkenes by elimination of water molecule from alcohols:

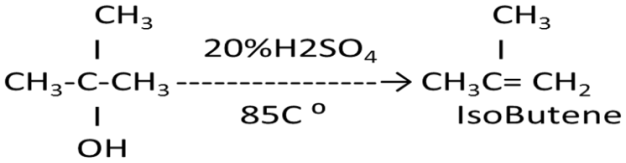
This process is carried out by using mineral acid and heat to form the double bond. This is done by one of the following methods:

heating the alcohol with sulphuric acid to high temperature Passing of alcohol vapor on aluminum chloride. Different alcohols yielding different alkenes and they are differs also by the simplicity of giving the product (3˚ > 2˚ > 1˚):



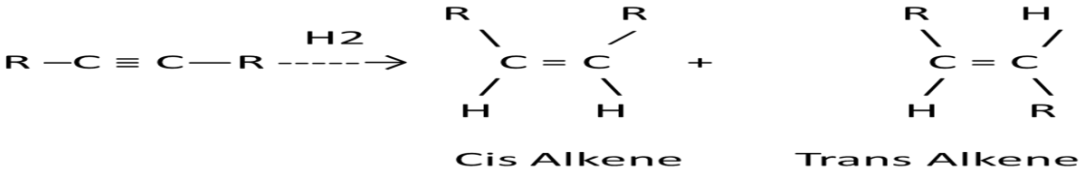


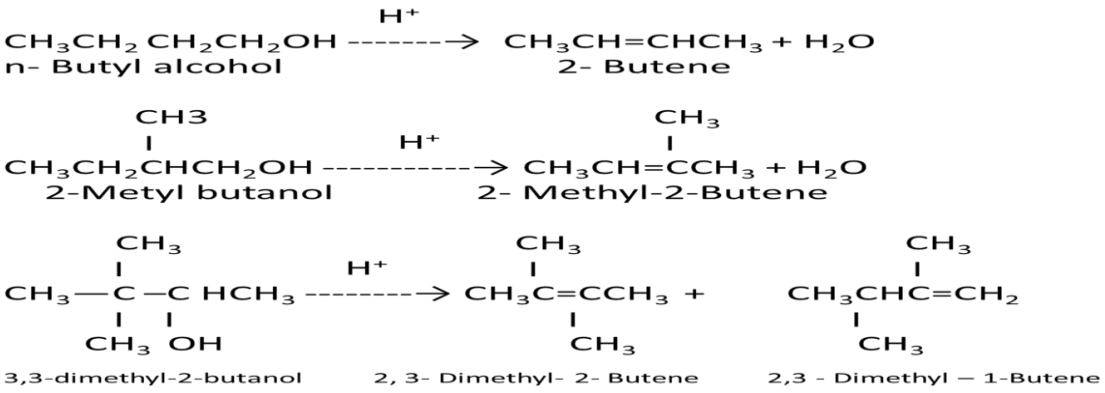




3-

Preparation of Alkenes from reduction of alkynes:





Alkene reactions

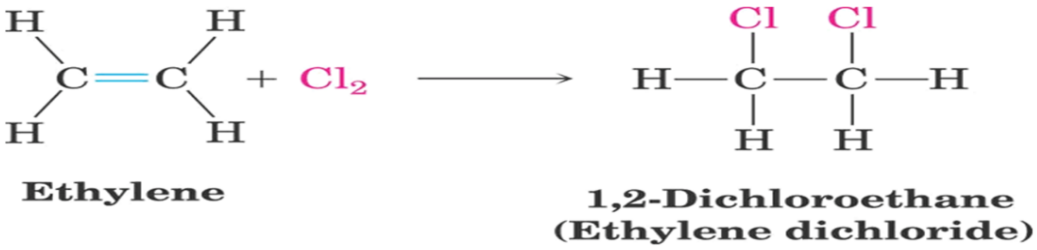
1- Addition reaction

Because of the double bond present in alkenes, this family of hydrocarbons is very reactive. The high concentration of electrons between the two atoms in the C=C bond makes this bond vulnerable to attack by a number of other molecules which are attracted to the charge.

Species which are attracted to a region of high negative charge in a molecule are called **ELECTROPHILES**

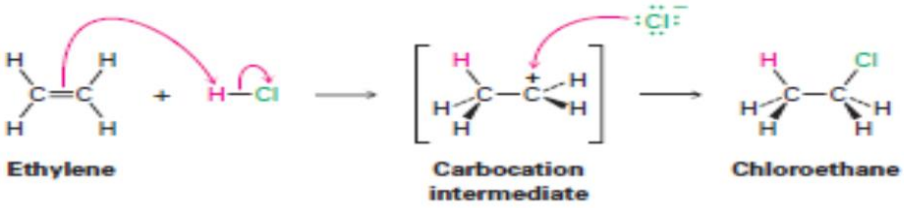
The incoming molecule has added to the alkene at the place where the double bond was located this reaction called ADDITION **REACTION.**

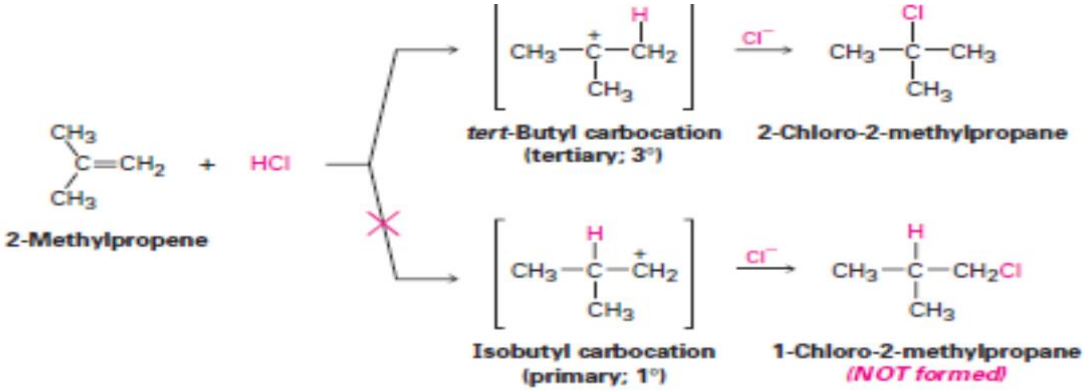
For example, halogens such as chlorine react to form a compound where the C=C bond is converted to a C-C bond and each of the two C atoms forms a bond to a halogen atom. This is illustrated by the following equation for the reaction of ethane (ethylene) with chlorine.



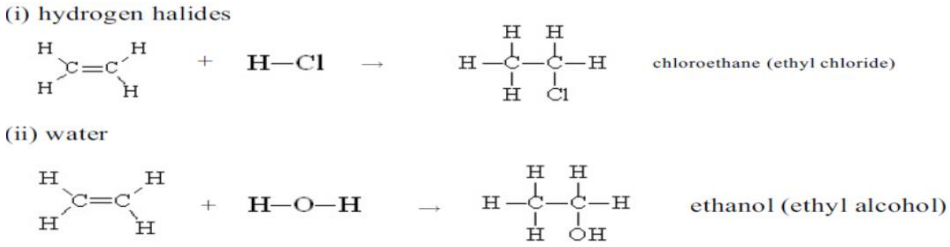
2-Markovnikov's rule (addition of HX) :-

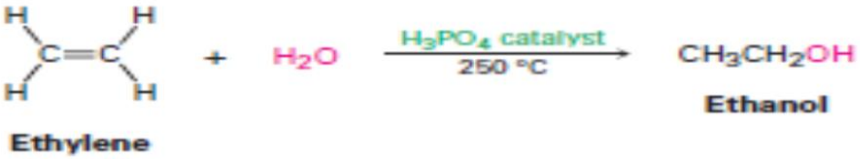
In the addition of HX to an alkene, the H attaches to the carbon with fewer alkyl substituents and the X attaches to the carbon with more alkyl substituents. Because carbocations are involved as intermediates in these reactions .





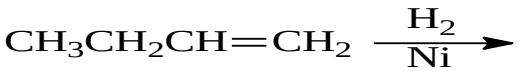
3- Examples of other molecules that undergo similar electrophilic addition reactions with the double bond of an alkene include:

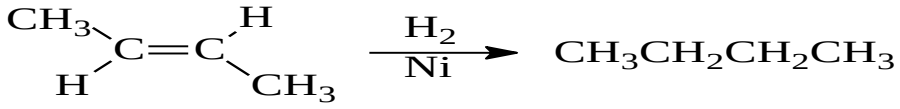


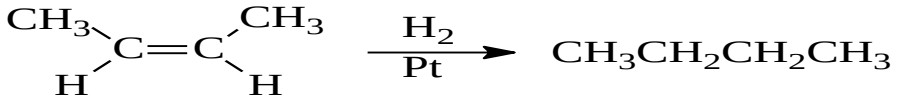


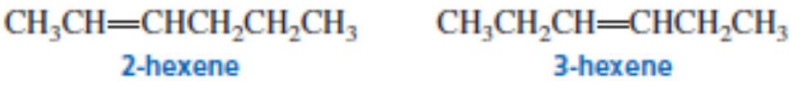
1- Addition of hydrogen : ethene (ethylene) reduced to ethane by mixing with hydrogen in the presence of a palladium catalyst.

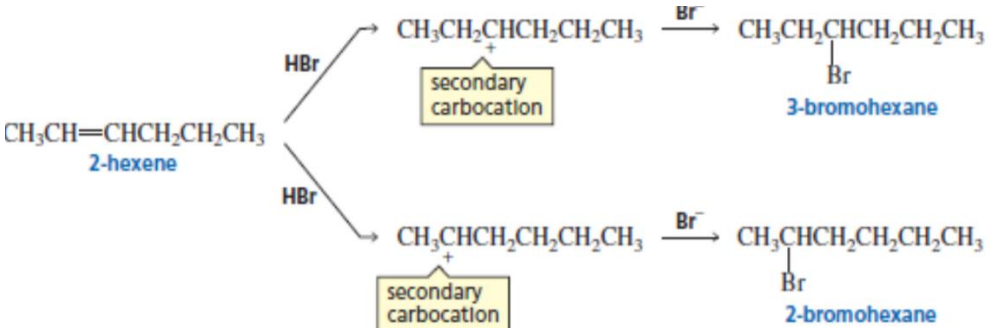
M = Pt, Pd, or Ni

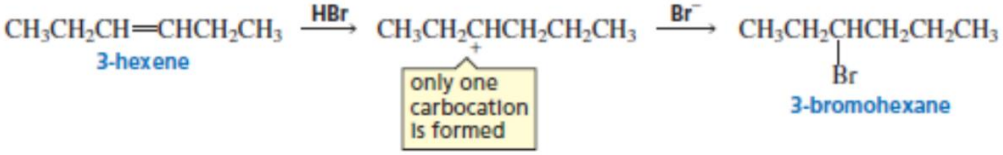












Alkynes

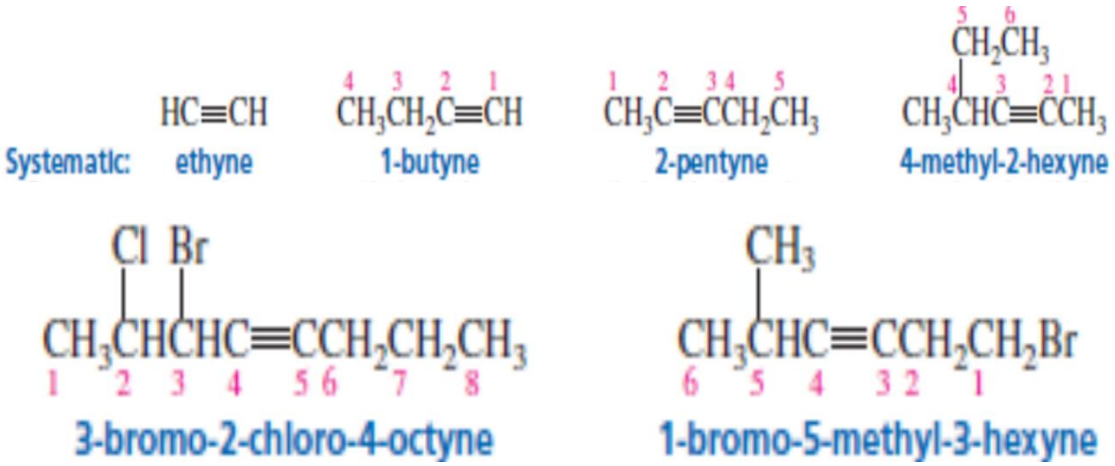
Are hydrocarbons that contain a carbon–carbon triple bond. Because of its triple bond, an alkyne has four fewer hydrogens than the corresponding alkane. Therefore, the general molecular formula for an alkyne is CnH2n-2. There are only a few naturally occurring alkynes. Examples include capelin, which has fungicidal activity .

Alkynes: hydrocarbons containing at least one carbon–carbon triple bond [CnHn-2] .

$$CH_3–CH_2–C\equiv C–CH_3$$

Nomenclature of Alkynes

The systematic name of an alkyne is obtained by replacing the “ane” ending of the alkane name with “yne.” the longest continuous chain containing the carbon–carbon triple bond is numbered in the direction that gives the alkyne functional group suffix as low a number as possible.



Physical Properties of Unsaturated Hydrocarbons

1-All hydrocarbons have similar physical properties. Alkenes and alkynes have physical properties similar to those of alkane .

2-All are insoluble in water.

3-All are soluble in solvents with low polarity such as benzene and ether. They are less dense than water.

4-like other homologous series, have boiling points that increase with

increasing molecular weight .

5-Alkynes are more linear than alkenes, and a triple bond is more polarizable

than a double bond . These two features cause alkynes to have stronger van

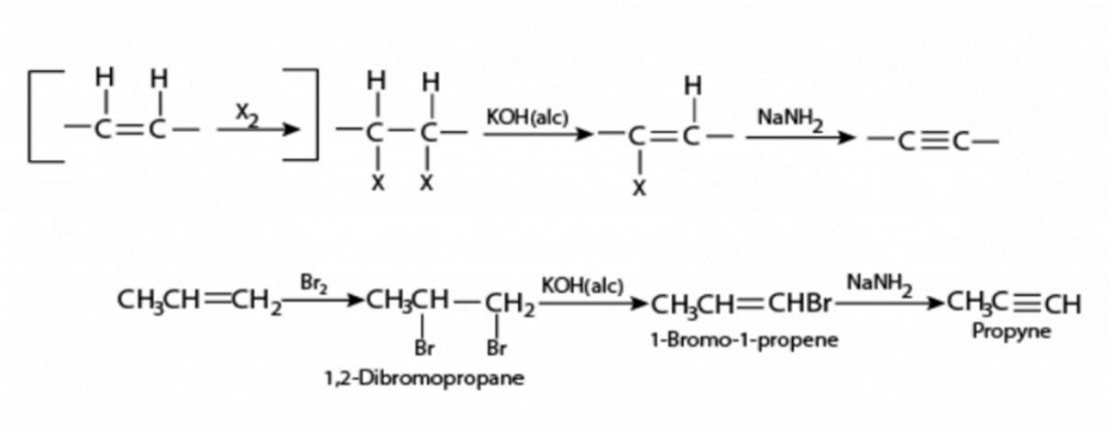
der Waals interactions. As a result, an alkyne has a higher boiling point

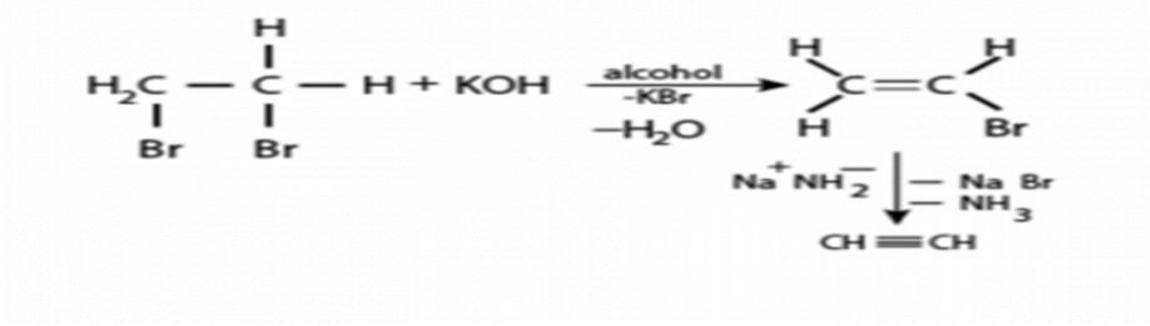
than an alkene containing the same number of carbon atoms.

6-Internal alkenes have higher boiling points than terminal alkenes.

Preparation of Alkynes

Alkynes are prepared by elimination reactions. • A strong base removes two equivalents of HX from a vicinal or geminal Dihalide to yield an alkyne through two successive E2 elimination reactions





Industrial Method for preparation of alkynes

Acetylene is prepared on large scale by the reaction of water on calcium carbide. Calcium carbide is prepared by heating quicklime with coke

$$\underset{\text{Quick lime}}{CaO} + \underset{\text{coke}}{3C} \xrightarrow{2300\,K} \underset{\text{Calcium carbide}}{CaC_2} + CO$$

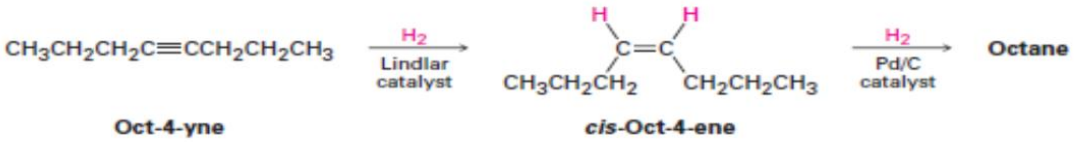
$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + \underset{\text{Acetylene}}{C_2H_2}$$

Acetylene can also be prepared on industrial scale by pyrolysis of methane at very high temperature of about 1800 K.

$$\underset{\text{methane}}{2CH_4} \xrightarrow{1800\,K} \underset{\text{Acetylene}}{HC \equiv CH} + 2H_2$$

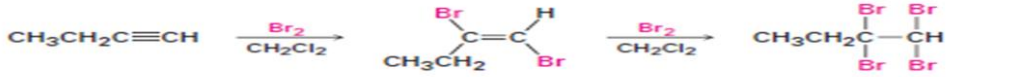
Alkyne Reactions

1-Addition of H2



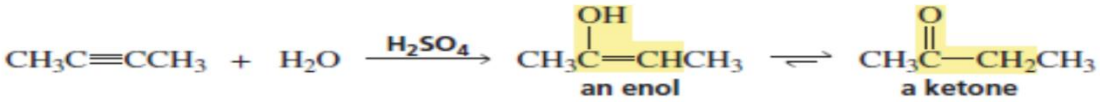
Oct-4-yne — *cis*-Oct-4-ene

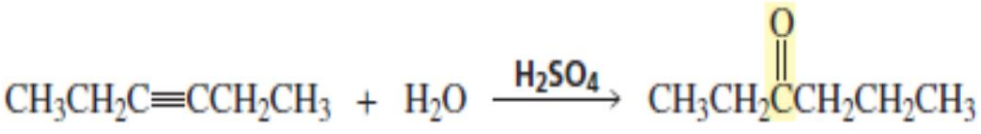
2- Addition of X_2

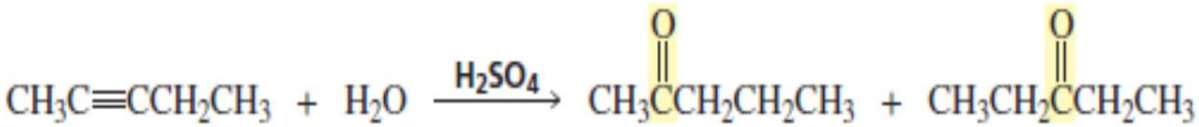


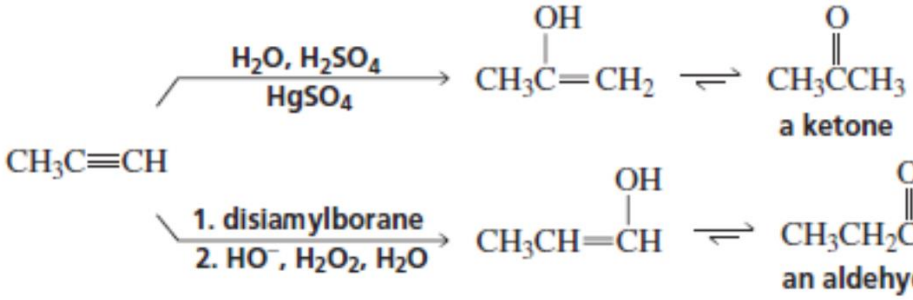
But-1-yne — (*E*)-1,2-Dibromobut-1-ene — 1,1,2,2-Tetrabromobutane

3-Addition of H_2O

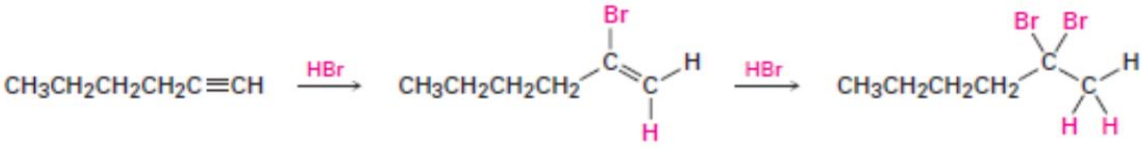






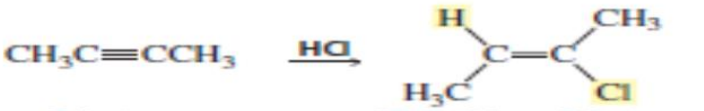


4-**Addition of HX**



Hex-1-yne **2-Bromohex-1-ene** **2,2-Dibromohexane**

2,2-dichloropentane 3,3-dichloropentane



2-butyne (Z)-2-chloro-2-butene