



petroleum chemistry
Chemical engineering department
Al-Mustaqbal-college
First class
second semester
Lecture five
By
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2021-2022

Lecture one

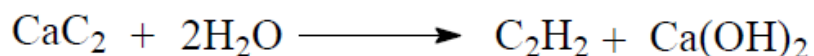
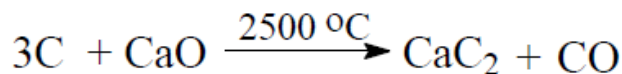
Alkynes

In organic chemistry, an alkyne is **an unsaturated hydrocarbon containing at least one carbon—carbon triple bond**. The simplest acyclic alkynes with only one triple bond and no other functional groups form a homologous series with the general chemical formula $C_{2n}H_{2n-2}$.

known formally as [ethyne](#) using [IUPAC nomenclature](#). Like other hydrocarbons, alkynes are generally hydrophobic.

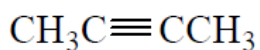
The simplest known alkene is acetylene gas C_2H_2 , and the geometry of the molecule is linear due to the use of the two carbon atoms for the sp^3 hybrid orbitals, meaning that the two carbon and hydrogen atoms are all located on a straight line. Acetylene gas burns with oxygen to give a flame with a very high temperature of 3000 degrees Celsius and for this reason acetylene gas is used in welding work.

Acetylene is prepared industrially by heating coke with calcium oxide CaO in an electric furnace and then treating the resulting calcium carbide CaC_2 with water.



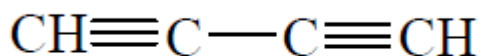
EXAMPLES :

1-

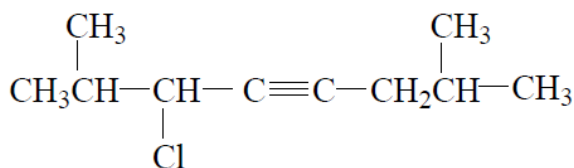


2-Butyne

2-



1,3-Butadiyne



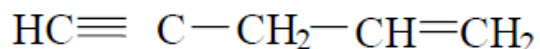
3-

3-Chloro-2,7-dimethyl-4-octyne

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Examples of the naming system IUPAC

In the event that there are two bonds, one double and the other triple in the compound on two equal dimensions, then the double bond takes numbers and the end remains the same as it is preceded by the number signifying the location of the triple bond and this comes preceded by the name indicating the presence of the alkene.



1-Penten-4-yne

In the event that there are two bonds, one double and the other triple in the compound on two equal dimensions, then the double bond takes numbers and the end remains the same as it is preceded by the number signifying the location of the triple bond, and this comes preceded by the name indicating the existence always of the -yne.

Physical properties of alkyne

Alkynes are non-polar compounds that do not dissolve in water, but are highly soluble in organic solvents such as benzene and carbon tetrachloride. They are similar to alkanes in their boiling point. For example, you find that compounds from the C_2 to C_4 atom are gases, and compounds from the C_4 to C_{16} are liquids, which are higher than C_{17} be solid materials.

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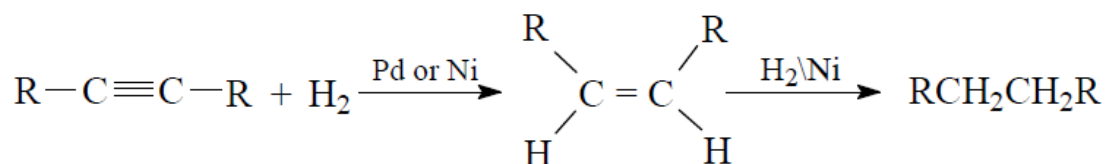
Chemical properties of alkynes

The addition reactions on the triple bond take place in two stages:

In the first stage, alkenes are formed, and in the second stage, saturated compounds are formed, namely alkanes. Alkynes are oxidized by various oxidizing agents, as shown by the following reactions:

1- Addition hydrogen

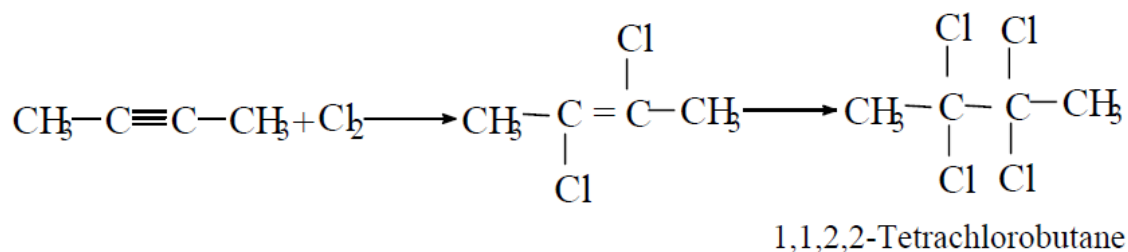
When 2 moles of hydrogen are passed over alkynes in the presence of a catalyst such as platinum, palladium, or nickel, the corresponding alkane is formed.



To obtain alkene only, it is necessary to use a catalyst designed for the reaction, such as nickel boride - Ni, B₂ or palladium with lead acetate Pd + Pb(AOAc)₄ or Linder catalyst (Pd/CaCO₃).

2- Addition halogen

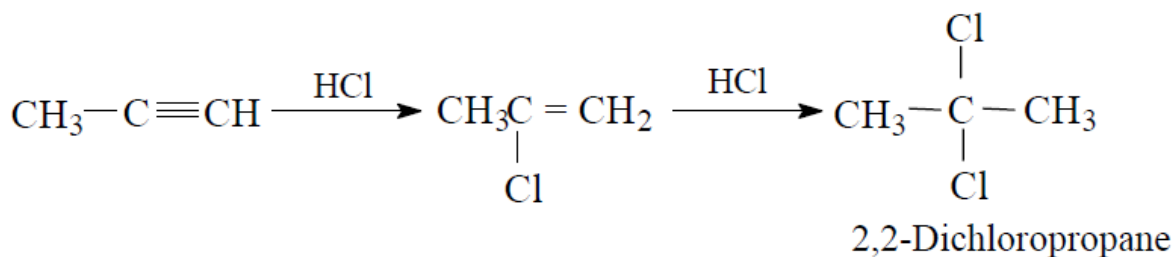
Alkynes react with halogens easily, initially giving the di-alkenes, and by continuing the reaction, it produces tetra halide alkanes:



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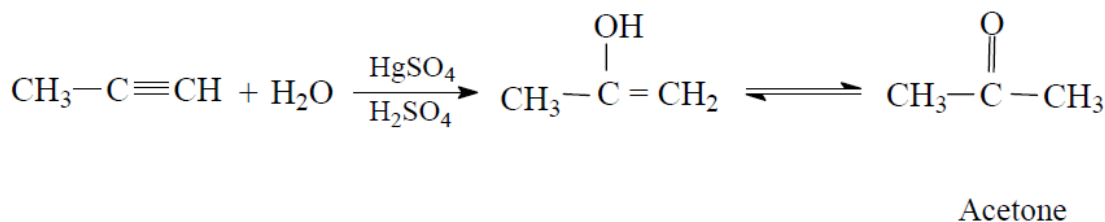
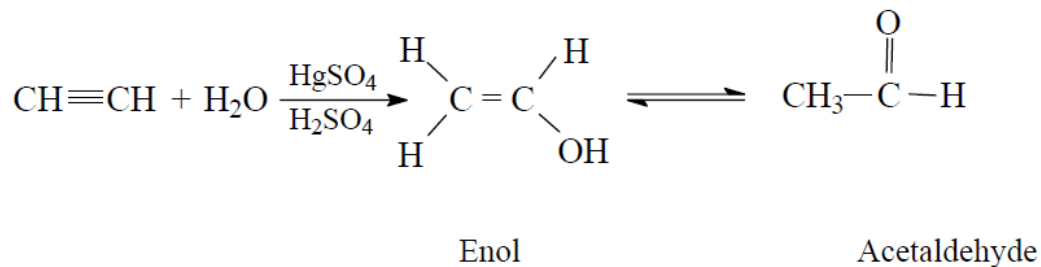
3- Addition of hydrogen halides

Alkynes react with hydrogen halides by addition reactions, and the addition in this case follows the Markovnikov rule. For example, when 2 mole of alkene halides reacts with an alkyne, an alkene halide is initially formed, and as the reaction continues, an alkane is formed that contains two hydrogen atoms located on one carbon atom.



4- Addition of water

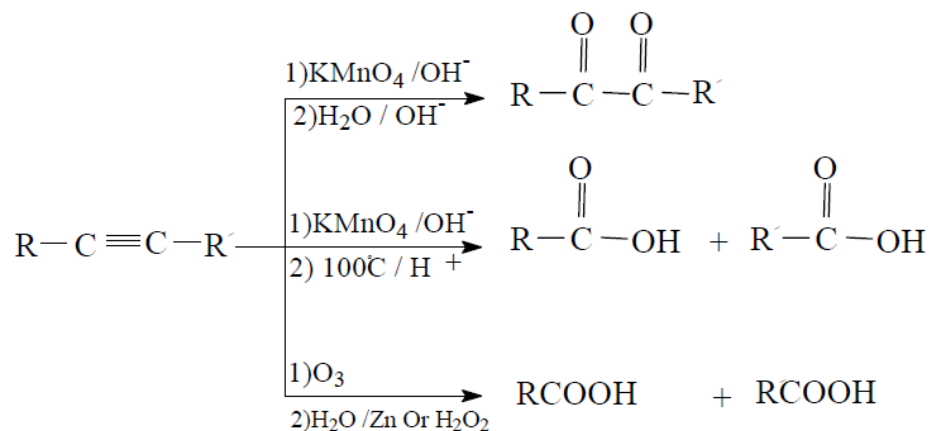
Adding a molecule of water to an alkene according to Markovnikov's rule, dilute sulfuric acid and mercury sulfate are used as a catalyst. When added, an unstable enol is formed that quickly turns into a stable compound, a ketone or an aldehyde.



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5- Oxidation of alkynes

Alkynes are oxidized by potassium permanganate or ozone or other strong oxidants to give different compounds as shown by the following equations:

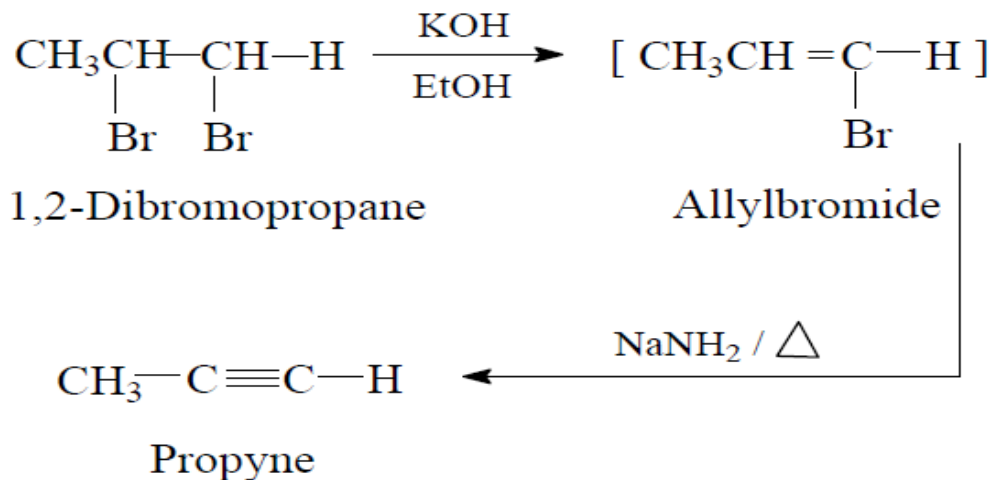


Preparation of Alkynes

a- It prepared in laboratory from :

1- Dehydrogenation and halogenation of alkyl di-halide

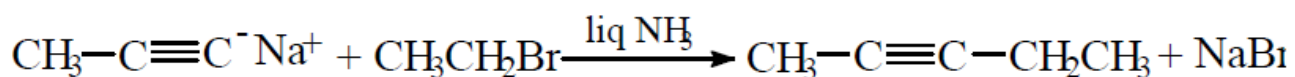
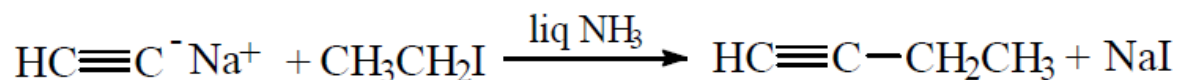
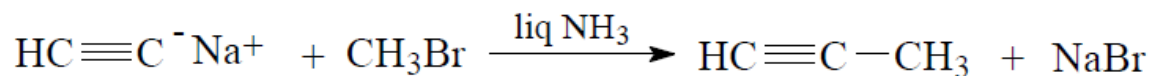
Two hydrogen atoms and two halogens are removed from two adjacent carbon atoms in two stages as follows:



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2- from sodium acetylides and its derivatives:

Sodium acetylide reacts with primary alkyl halides to build long hydrocarbon chains.



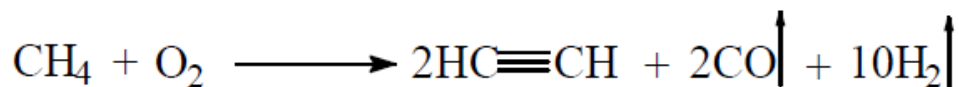
Sodium propynide

This method is not suitable with secondary or tertiary alkyl halides, because acetylide acts as a strong base that reacts with secondary and tertiary halides, producing unsaturated hydrocarbons.

b- Preparation of alkenes in industry :

1- Thermal cracking method of methane

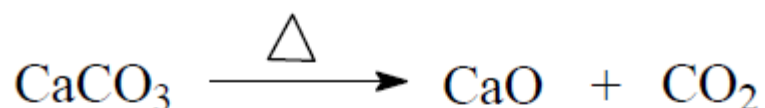
Methane is heated at a very high temperature, and it produces acetylene, mixed with other materials, as in the following equation:



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2- From coliseum carbonate CaCO_3

In this method, calcium carbonate is heated and quicklime is produced, followed by heating the resulting quicklime with coal (coke) in an electric furnace where calcium carbide is formed, then water is added to calcium carbide and acetylene is produced according to the following equations:



Calcium carbonate

