



petroleum chemistry
Chemical engineering department
Al-Mustaqbal-college
First class
second semester
Lecture four
By
Asst. lect. Ban Ali Hassan

2021-2022


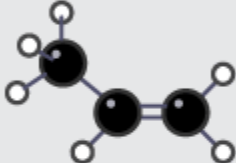
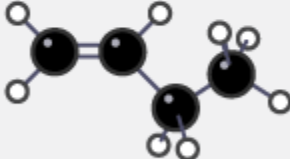

Lecture one

Alkenes

Alkenes are a homologous series of hydrocarbons that contain a carbon-carbon double bond. The number of hydrogen atoms in an alkene is double the number of carbon atoms, so they have the **general formula C_nH_{2n}**

For example, the molecular formula of ethene is C_2H_4 , while for propene it is C_3H_6

Here are the names and structures of four alkenes:

Alkene	Molecular formula	Structural formula	Ball-and-stick model
Ethene	C_2H_4	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	
Propene	C_3H_6	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H} - \text{C} - \text{C} = \text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array}$	
But-1-ene	C_4H_8	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{C} - \text{H} \\ \quad \quad \quad \quad \\ \quad \quad \quad \text{H} \quad \text{H} \end{array}$	
But-2-ene	C_4H_8	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H} - \text{C} - \text{C} = \text{C} - \text{C} - \text{H} \\ \quad \quad \quad \\ \text{H} \quad \quad \quad \text{H} \end{array}$	

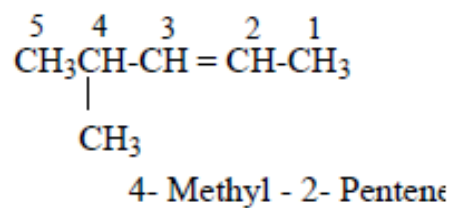
Alkenes are **unsaturated**, meaning they contain a double bond.

This bond is why the alkenes are more reactive than the alkanes.

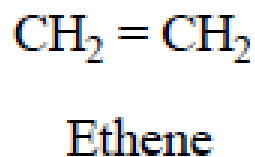
Lecture one

Examples :

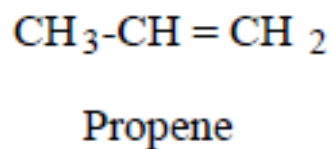
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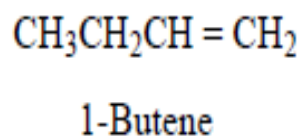
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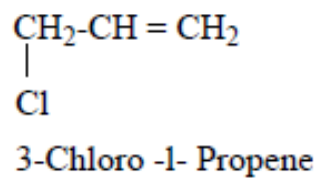
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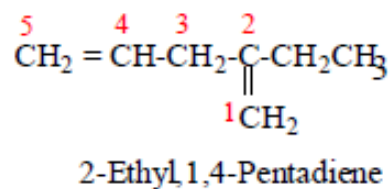
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6-

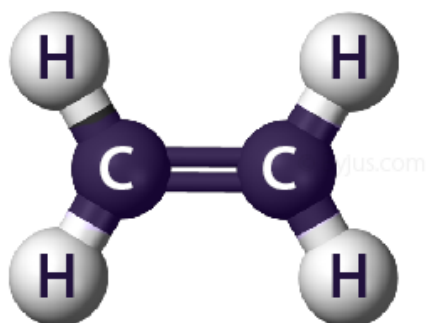


Lecture one

physical properties of alkene

Alkenes do not differ much from alkanes in their physical properties. They are similar to alkanes close to them in molecular weight, in their boiling points and solubility. They are insoluble in water, but they are soluble in non-polar solvents such as benzene, ether and carbon tetrachloride. Since alkenes are soluble in concentrated sulfuric acid, while alkanes do not dissolve in concentrated sulfuric acid.

PHYSICAL PROPERTIES OF ALKENES



- Insoluble in water and soluble in polar solvents
- Densities is less than wates
- The boiling and melting points of an alkene is usually lower than that of an alkane with same number of carbon atoms
- Alkenes with 2 to 4 carbon atoms are gases at room temperature
- Unsubstituted alkenes with 5 to 17 carbon atoms are liquids
- Alkenes with >17 C atoms are solid

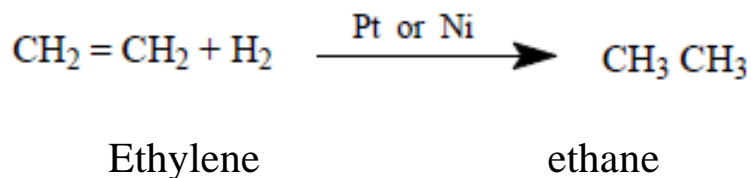
Lecture one

Chemical properties of alkane

Alkanes are the least reactive type of organic compound. Alkanes are not absolutely unreactive. Two important reactions that they undergo are combustion, which is the reaction with oxygen and halogenation, which is the reaction with halogens.

1- Hydrogenation:

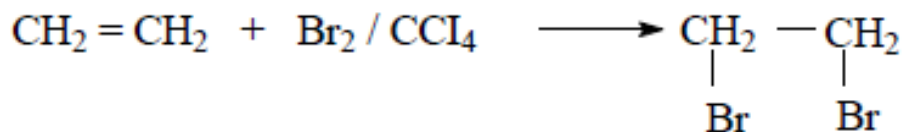
Hydrogen is added to the alkene in the presence of a catalyst (Pd , Ni, Pt) to give the alkane.



In this reaction, a hydrogen atom is added to one of the two atoms of the double bond, and another hydrogen atom is added to the other end of the double bond.

2- Halogenation

Chlorine or bromine dissolved in an inert solvent is added to the alkene to give dichloroalkanes or dibromoalkanes.



The reaction of bromine with alkene is used to detect the presence of the double bond (and the triple bond), the red color of bromine disappears when it is added to the alkene.

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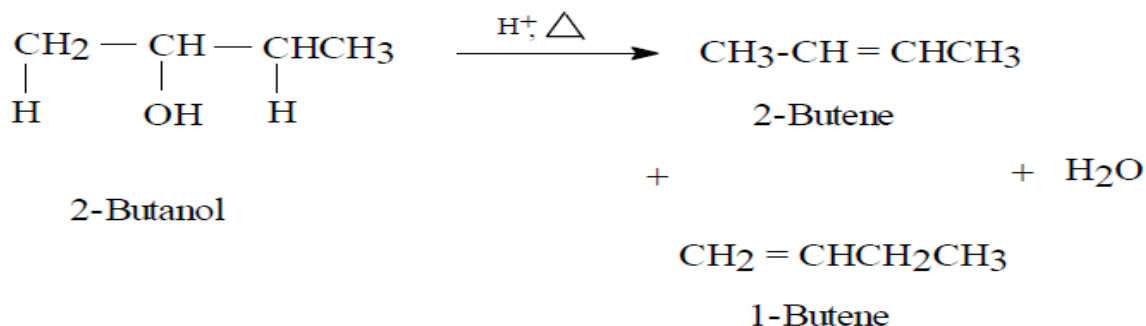
Preparation of Alkanes

a-It prepared in laboratory from :

1- Dehydration of Alcohols

Alkenes are obtained by the dehydration of alcohols. The dehydration of alcohols can be affected by two common methods.

1. By heating an alcohol with concentrated mineral acid, such as concentrated H_2SO_4 or concentrated H_3PO_4 . Anhydrous zinc chloride can also be used as a dehydrating agent.



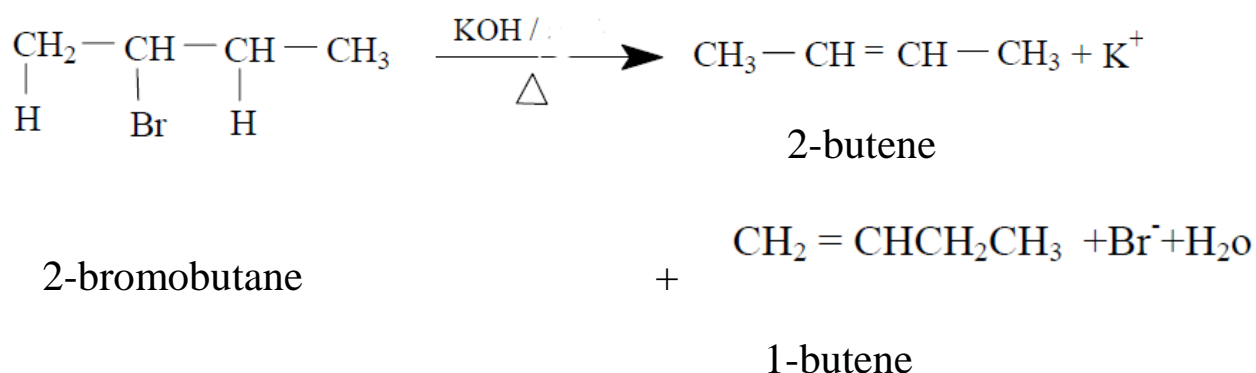
When alcohol is heated with a small amount of acid, for example sulfuric acid H_2SO_4 and phosphorous acid H_3PO_4 . When dehydration leads to the formation of two products, the most substituted alkene (the alkene in which the two carbon atoms of the double bond carry the largest number of the alkyl group) is the main product.

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2- Extracting hydrogen halide from alkyl halide

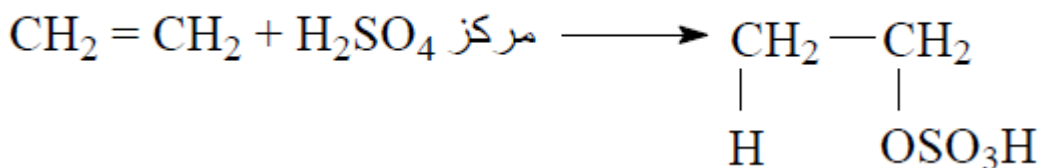
The alkyl halide is removed when heated with alcohol in the presence of potassium hydroxide KOH.

Where the extraction of hydrogen halide leads to the formation of two products, the alkene most replaced by alkyl groups is the main product, as in alcohols, as in the following example:



3- Add cold concentrated sulfuric acid H₂SO₄

Sulfuric acid is added to give alkyl hydrogen sulfate, while alkanes do not react with this acid. This reaction is used to differentiate between alkanes and alkenes and the addition follows Markovnikov's rule.



Lecture one

b- Preparation of alkenes in industry :

Ethylene is prepared in industry in Western Europe from the naphtha fraction obtained from the distillation of petroleum. This fraction contains straight-chain alkanes containing 4-10 carbon atoms. This is passed by steam in tubes heated to 700-900°C. The resulting ethylene is purified by fractional distillation.

Ethylene is prepared in factories in the United States by converting ethane from wet natural gas at a high temperature.

Propane is prepared from propane by high temperature and the presence of ($\text{Cr}_2\text{O}_3 + \text{Al}_2\text{O}_3$) as a catalyst, as well as from petroleum distillation.

