Ministry of higher education and scientific research
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Organic Chemistry

Lecture 4

Alkynes

By

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Alkynes

1. Alkyne group have a triple bond between two carbon atoms.
2. Two hydrogen atoms have been removed from each of two adjacent carbon atoms, thereby allowing the two adjacent carbon atoms to form a triple bond.
3. General formula is: CnH2n-2
4. Begins with ethyne (acetylene)
5. For Example: C2H2

H—C≡C—H

Ethyne (acetylene)

Classification of Alkyne

Alkyne are further classified as terminal or non-terminal alkynes according as the triple bond is present at the carbon chain or within the carbon chain.

Terminal alkynes

$CH_3\ C \equiv CH$ (Propyne) $CH_3\ CH_2\ C \equiv CH$ (1-Butyne)

Non-Terminal alkynes

$CH_3\ C \equiv C\ CH_3$ (2-Butyne), $CH_3\ C \equiv CCH_2\ CH_3$ (2-Pentyne)

IUPAC Rules for Alkyne Nomenclature

The IUPAC rules for naming alkynes are:

1) The same as those for alkenes except that the ending is (-yne).

2) The (yne) suffix (ending) indicates an alkyne or cycloalkyne.

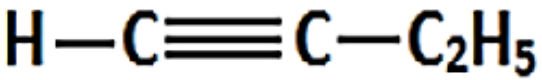
3) The longest chain chosen for the root name must include both carbon atoms of the triple bond.

4) The root chain must be numbered form the end nearest a triple bond carbon atom. If the triple bond is in the center of the chain the nearest substituent rule is used to determine the end where numbering starts.

5) The smaller of the two numbers designating the carbon atoms of the triple bond is used as the triple bond locator.

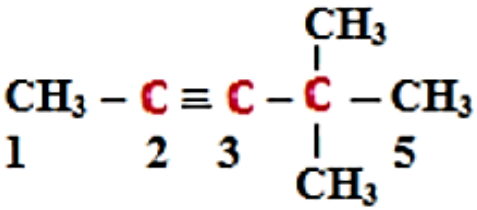
6) If several multiple bonds are present, each must be assigned a locator number.

The following examples illustrate the rules:



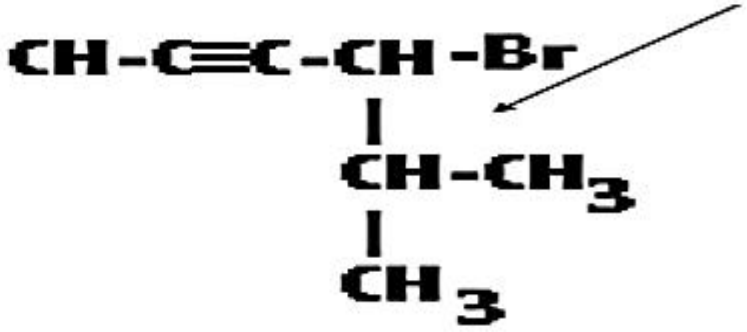
1-butyne

2- butyne



4,4-dimethy l-2-pentyne

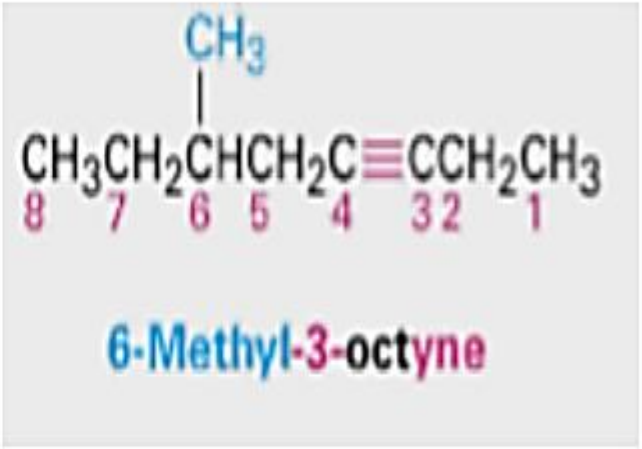
$CH_3C{\equiv}CH$ methylacetylene (propyne)



4bromo-5-methyl-2-hexyne

$$HC{\equiv}CCHCH_2CH_3$$
$$|$$
$$CH_3$$

3-methyl-1-pentyne



Reaction

Most of the reactions of a Hornes are similar to those of alkenes. The same reagents that add to carbon-carbon double bond also add to carbon-carbon triple bond . But it is possible to add two molecules of reagent to each alkyne.

1-Addition of Halogens (Halogenation)

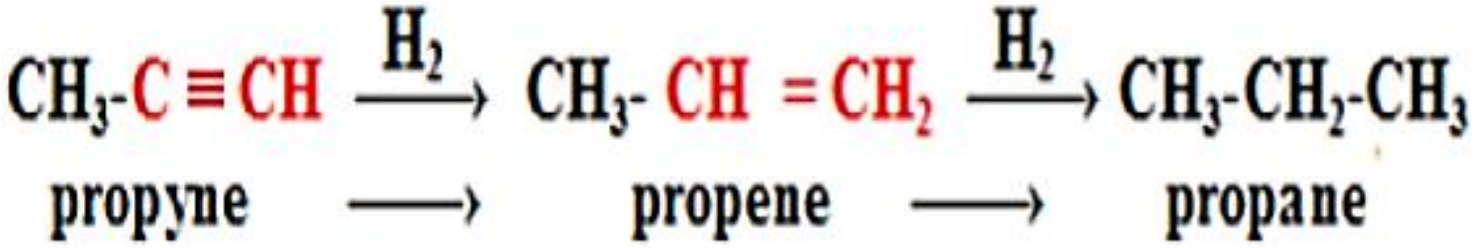
$$CH_3\text{-}CH_2\text{-}C{\equiv}CH + Br_2 \longrightarrow CH_3\text{-}CH_2\text{-}CBr = CHBr$$

$$CH_3\text{-}CH_2\text{-}CBr = CHBr + Br_2 \longrightarrow CH_3\text{-}CH_2\text{-}CBr_2\text{-}CHBr_2$$

1-butyne ⟶ 1,2-dibromo-1-butyne ⟶ 1,1,2,2-tetrabromobutane

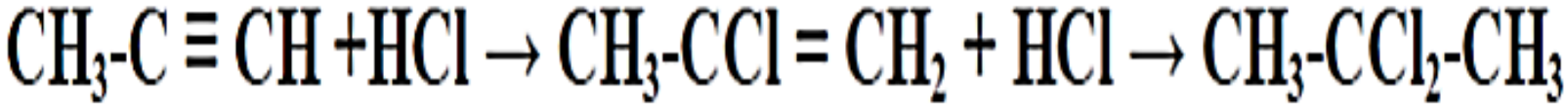
2- Addition of Dihydrogen (Hydrogenation)

The addition of H2 to alkyne is obtain by add the hydrogen gas to alkyne with uses the metal (Ni ,Pd , ...) catalysis to give alkene in first step an alkane in the second step



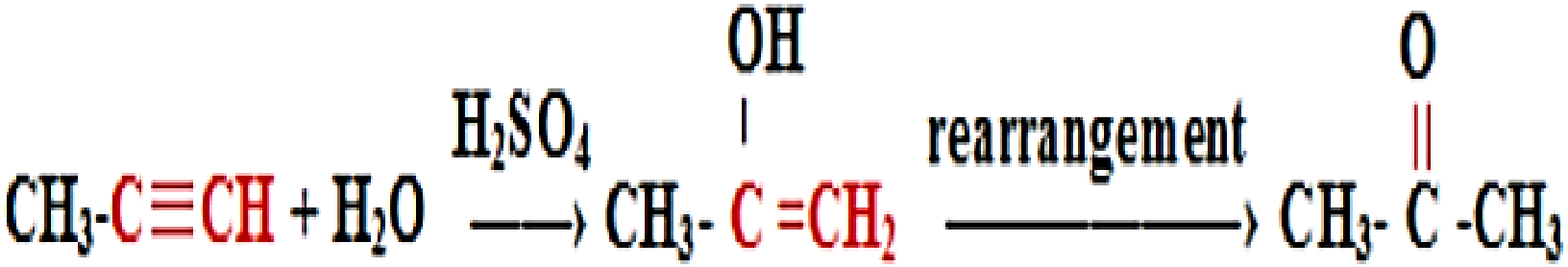
3- Addition of Halogen halide (Hydrohalogenation)

The addition of HX is obtain according to Markovnikov Rule the acid hydrogen (H) gets attached to the carbon with more hydrogen substituents, and the halide (X) group gets attached to the carbon with more alkyl substituents) (Markovnikov[1] s Rule)



4- Addition of water (Hydration)

One difference between the acid catalyzed hydration of alkenes and that of alkynes. Alkynes form alcohol Alkynes form compounds containing C=O bond.



Thank you