Organic Chemistry

Chapter 4

Alkynes

4.1 Introduction

Molecules of alkyne series of hydrocarbon are characterized by having two adjacent carbon atoms joined to one another by a triple bond. The carbon-carbon triple bond is unsaturated and highly reactive toward the reagents that double bonds react with.

The general formula is $\mathbf{C_nH_{2n-2}}$.

$HC \equiv CH$	Ethyne (acetylene)
$HC \equiv CCH_3$	Propyne
$HC \equiv CCH_2CH_3$	1-Butyne
$HC \equiv C(CH_2)_2CH_3$	1-Pentyne
$HC \equiv C(CH_2)_3CH_3$	1-Hexyne
$HC \equiv C(CH_2)_4CH_3$	1-Heptyne
$HC \equiv C(CH_2)_5CH_3$	1-Octyne
$HC \equiv C(CH_2)_6CH_3$	1-Nonyne
$HC \equiv C(CH_2)_7CH_3$	1-Decyne

4.2 Nomenclature

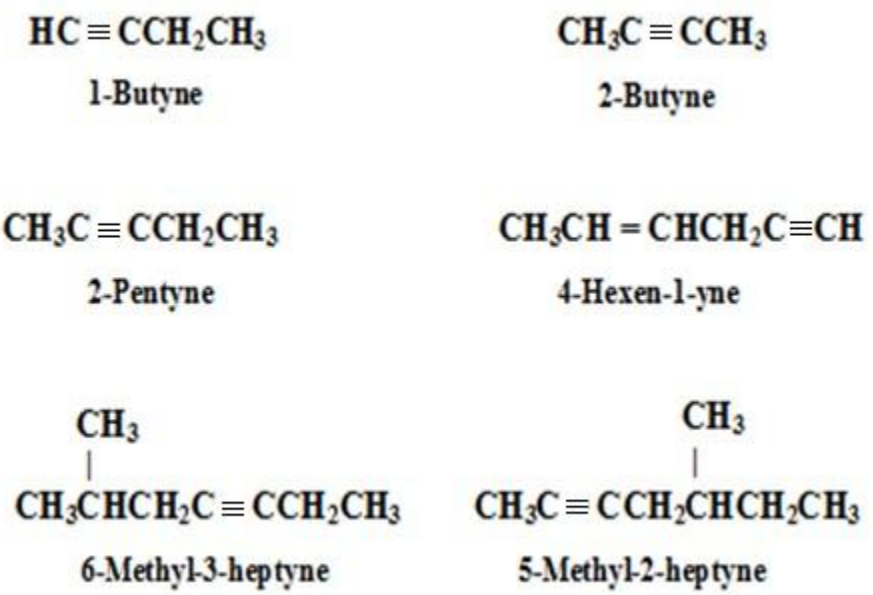
The alkynes are named according to two systems. In one, they are considered to be derived from acetylene by replacement of one or both hydrogen atoms by alkyl group.

$H - C \equiv C - C_2H_5$ **(Ethylacetylene) 1-Butyne**

$CH_3 - C \equiv C - CH_3$ **(Dimethylacetylene) 2-Butyne**

$CH_3 - C \equiv C - CH(CH_3)_2$ **(Isopropyl methylacetylene) 4-Methyl-2-pentyne**

For more complicated alkyne the IUPAC names are used. The rules are exactly as for the alkenes, except that the ending **-yne** is used in place of **–ene**.



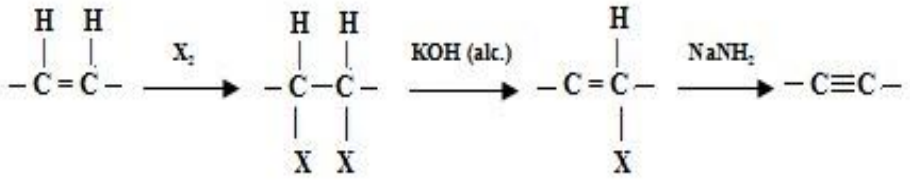
4.3 Physical Properties of Alkynes

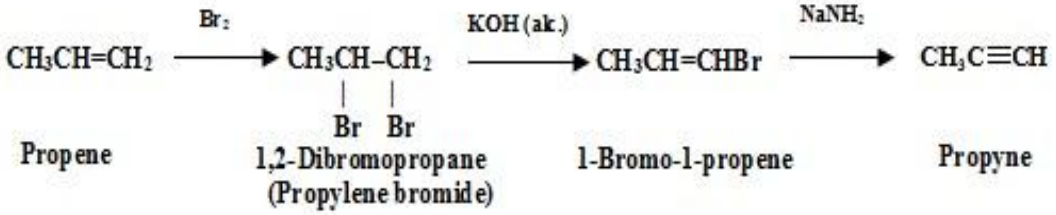
Being compounds of low polarity, the alkynes have physical properties that are essentially the same as those of the alkanes and alkenes. They are insoluble in water but quite soluble in the usual organic solvents of low polarity: ether, benzene, and carbon tetrachloride. They are less dense than water. Their boiling points show the usual increase with increasing carbon number, and the usual effects of chain branching; they are very nearly the same as the boiling points of alkanes and alkenes with the same carbon skeletons.

4.4 Preparation of Alkynes:

1- Dehydrohalogenation of alkyl halides

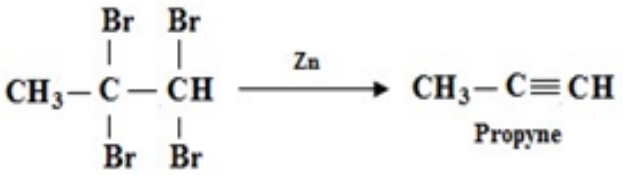
A carbon-carbon triple bond is formed in the same way as a double bond: elimination of atoms or groups from two adjacent carbons.





2- Dehalogenation of tetrahalides

Alkynes can be prepared by dehalogenation of trtrahalides.

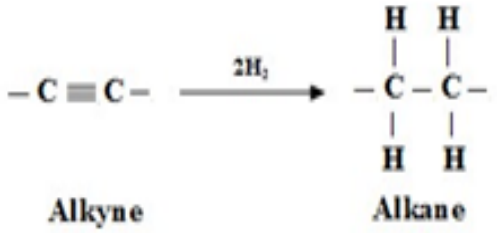


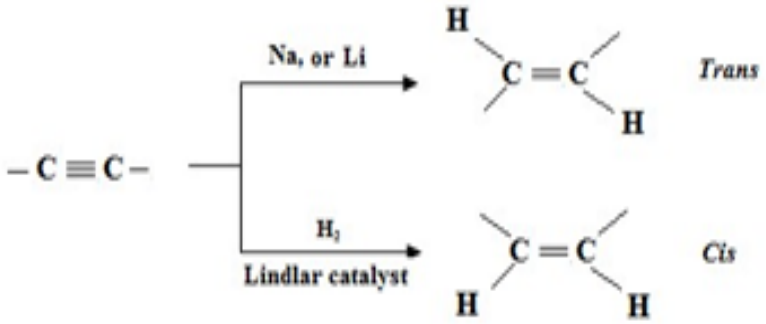
4.5 Reactions of Alkynes:

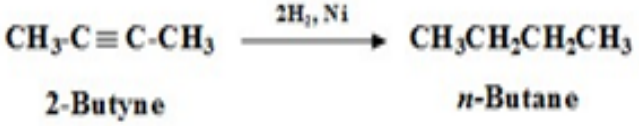
(Addition Reactions)

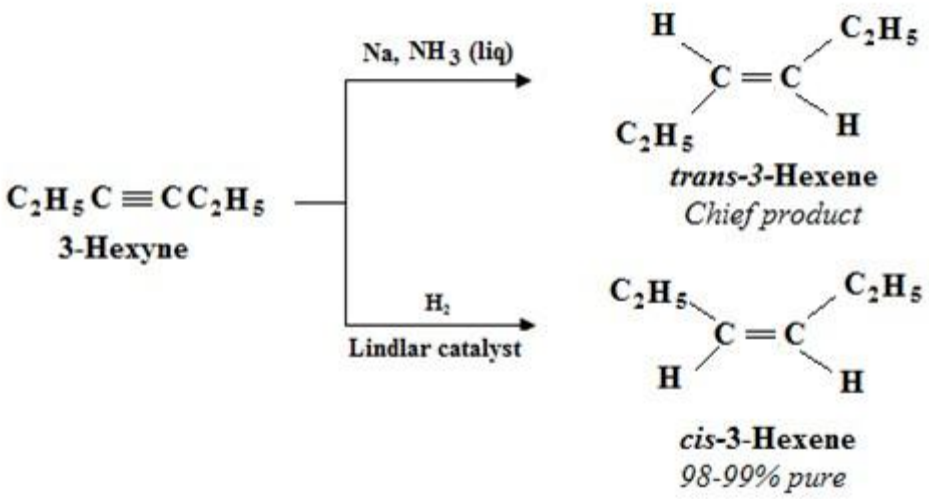
1- Addition of hydrogen

As would be expected, alkynes can be hydrogenated catalytically, taking up 2 mol of hydrogen per mol of alkyne to form the corresponding saturated molecule. Careful control of the hydrogenation can stop the reaction at the alkene stage.



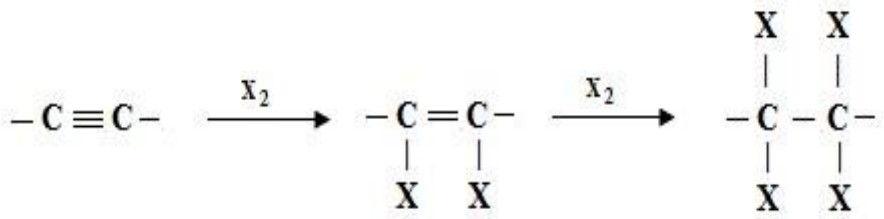


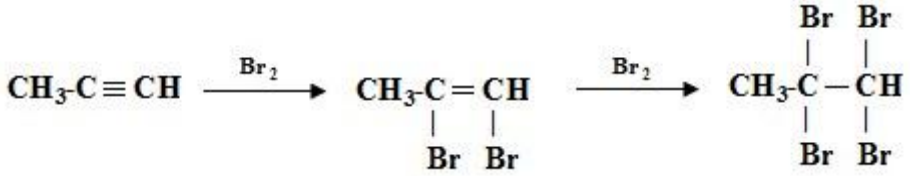




2- Addition of halogen

Alkynes can react with chlorine and bromine to yield tetrahaloalkanes. A dihaloalkene is an intermediate.





With best wishes