



Our country, our future

## Chapter 3: Alkynes

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### Alkynes

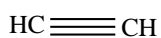
Alkynes

General formula  $C_nH_{2n-2}$  where  $n \geq 2$

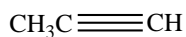
T

hey contain a triple bond

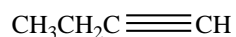
Examples



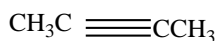
Ethyne



Propyne



But-1-yne



But-2-yne

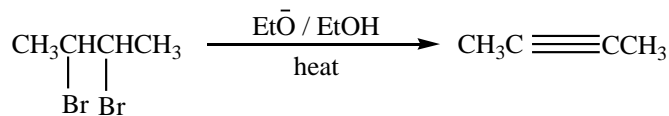
### Preparation

#### 1. From vicinal dihalides.

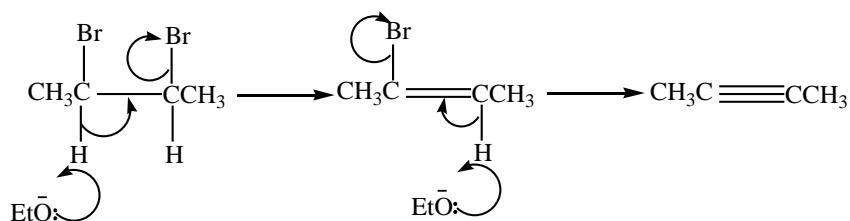
Vicinal dihalides are halides with two halogen atoms on adjacent carbon atoms

The reaction is carried out by refluxing vicinal dihalides with a mixture of an alcohol with its sodium or potassium salt.

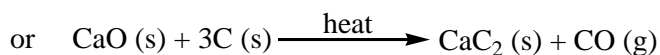
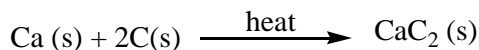
Example



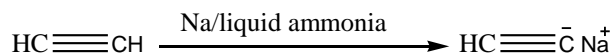
Mechanism



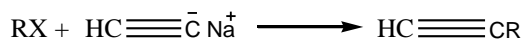
## 2. Preparation of alkyne from carbon



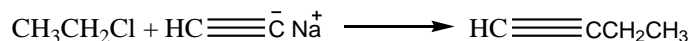
## 3. Preparation of long chain alkyne from ethyne



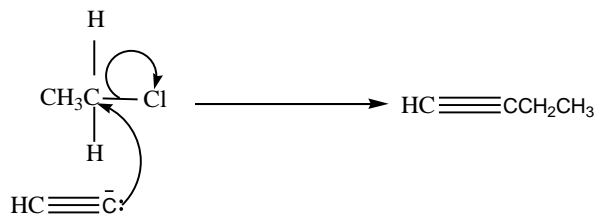
Then



Example



Mechanism



## Exercise

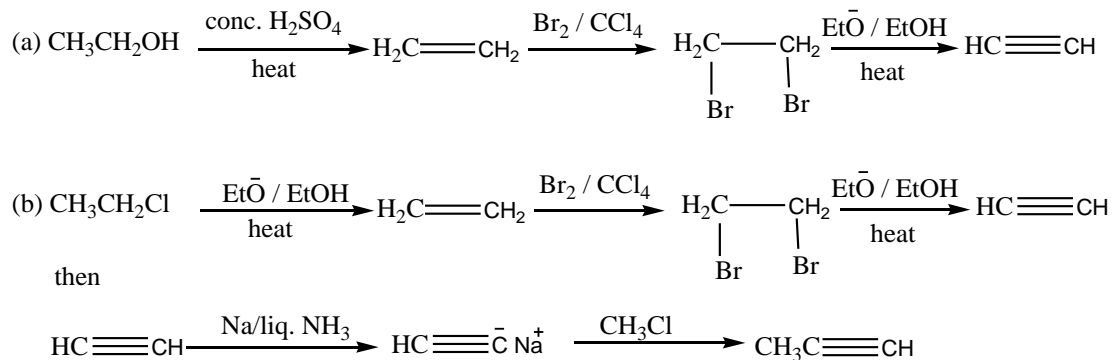
### 4. Synthesize



Questions involving synthesis requires a student to write a series of reactions leading the formation of products from the reactant(s). Most time more than one equation is required because reactions of organic compounds are specific that we may need to convert the reactants into intermediate compounds before a product can be obtained.

For instance, before baking bread, wheat flour is first converted to dough. Usually think of the intermediates to enable you to complete a synthesis equation.

### Solution



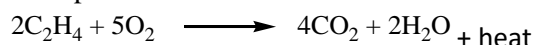
### Physical properties

1. They range from gases to liquids to solids
2. They are insoluble in water but soluble in organic solvents

### Chemical properties.

1. They burn in oxygen to give carbon dioxide, water and heat.

Example

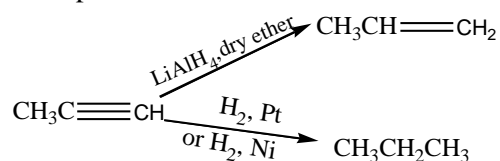


They are used as fuel because they produce heat

2. Reduction

Depending on conditions, alkyne may be reduced to alkenes or alkanes

Example



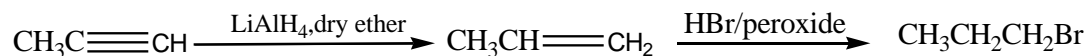
Note that reduction of alkyne to alkene has synthetic value because alkenes are more reactive than alkanes.

### Example

Synthesize



### Solution



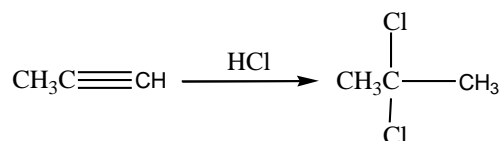
Not that the first part of the synthesis involves **reduction alkynes** to alkene.

### 3. Addition reactions

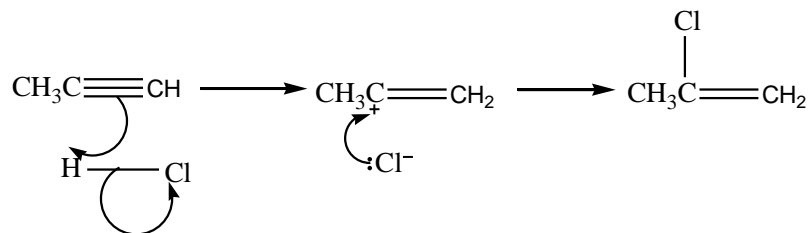
Alkyne undergo addition reactions like alkenes except that the addition occurs twice.

(a) Addition of HX (X= Cl, Br, and I)

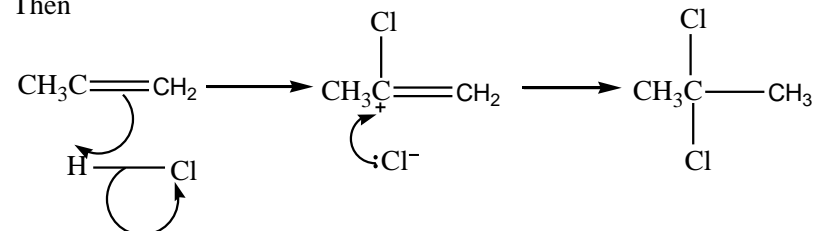
Example



Mechanism



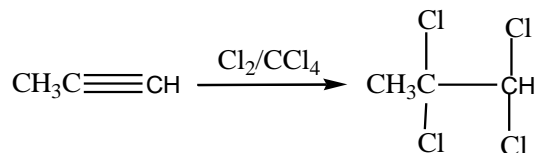
Then



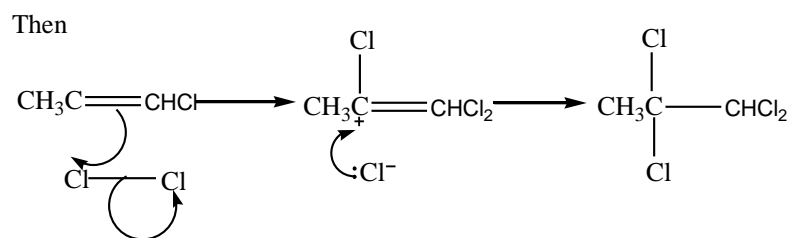
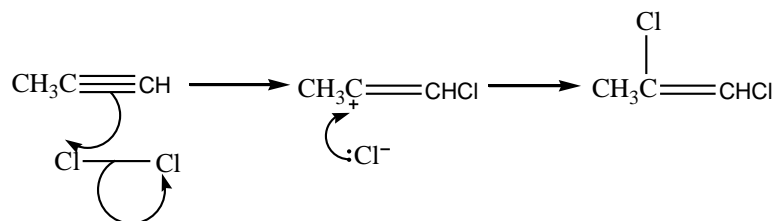
(b) Addition of halogens

The halogen is diluted with carbon tetrachloromethane (to prevent explosion)

Example

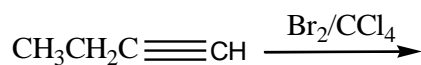


### Mechanism

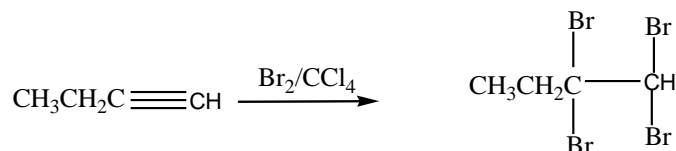


### Exercise

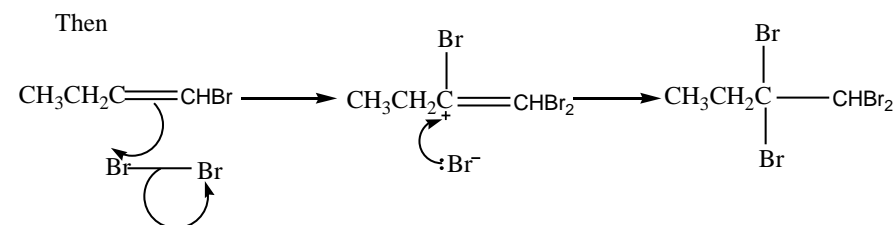
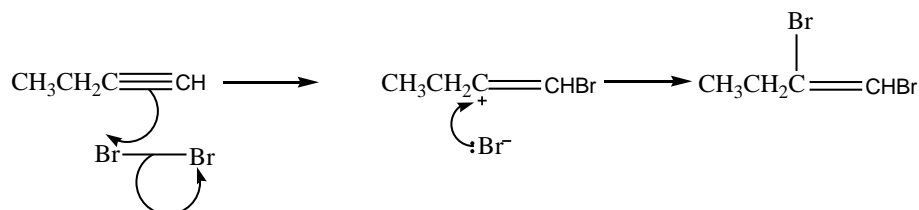
Complete and write a mechanism



### Solution



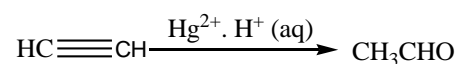
### Mechanism



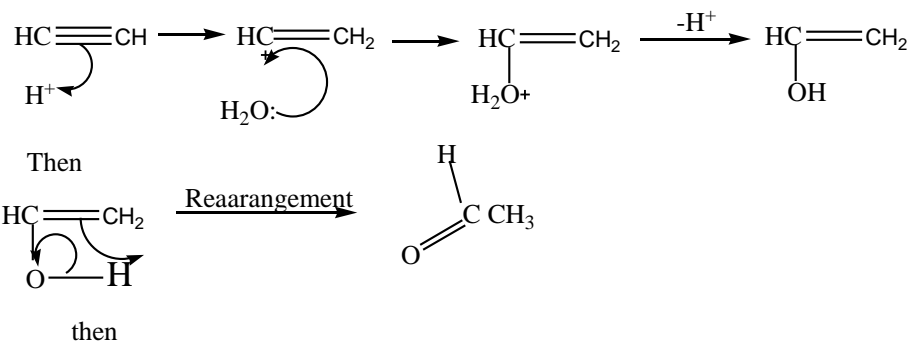
(c) Addition of water.

The reaction is catalyzed by mercury (II) sulphate and dilute sulphuric acid. Carbonyl compounds are formed.

### Example

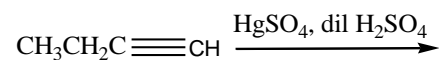


### Mechanism

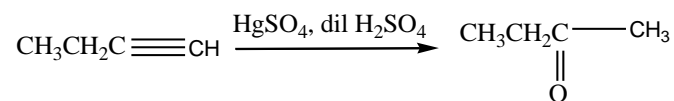


### Exercise

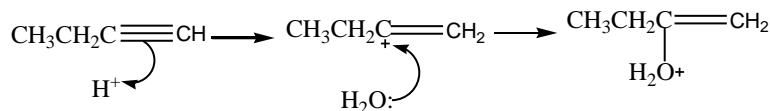
Complete and write a mechanism



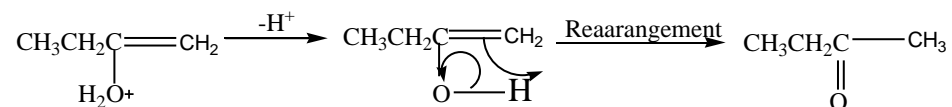
### Solution



### Mechanism



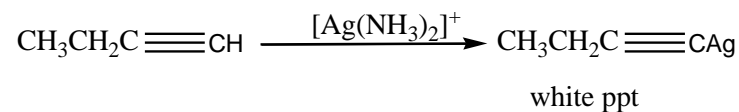
Then



### (d) Reaction of terminal alkyne

Alkynes with a triple bond at the end of the chain react with ammoniacal silver nitrate or ammoniacal copper I chloride to form white precipitate or red precipitate respectively.

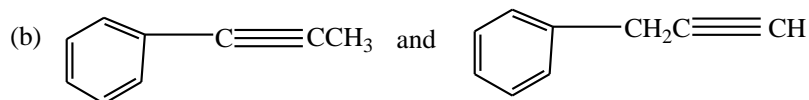
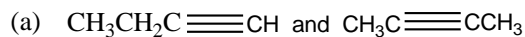
Example



This reaction is used to distinguish alkynes with a triple bond at the end from those with a triple bond in the middle of the chain.

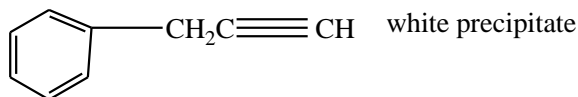
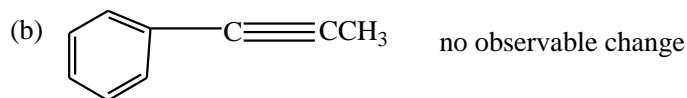
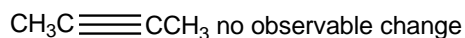
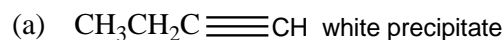
### Exercise

Name one reagent that can be used to distinguish between the following pairs of compounds. In each case state what will be observed when the reagent is treated with each of the compounds of the pair.



Reagent: ammoniacal silver nitrate

Observation



### Revision questions

1.  $10\text{cm}^3$  of a hydrocarbon X was exploded with  $70\text{cm}^3$  of Oxygen and cooled, the final volume was  $55\text{cm}^3$ . The volume of the mixture reduced to  $15\text{cm}^3$  when shaken with concentrated potassium hydroxide solution.

  - Determine the molecular formula of X.
  - Write and name all isomers of X.
  - X formed a red precipitate with ammoniacal copper(I) chloride,
    - Identify X.
    - Write equations and suggest mechanism for the reaction between X and acidified water, hydrogen in presence of palladium catalyst and hydrogen peroxide.
  - Write equations and conditions to show how X can be prepared from a named
    - Alcohol
    - Alkyl halide.