



## UNIT. NO 12

## HYDROCARBONS

### Hydrocarbons:

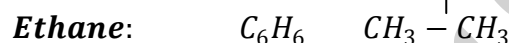
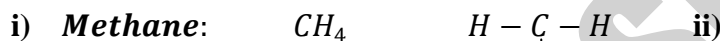
Those organic compounds which contain only two elements carbon and hydrogen are called hydrocarbons. There are three basic types of hydrocarbons.

- i) Alkanes (C – C)                      ii) Alkenes (C = C)                      iii) Alkynes  
(C ≡ C)

### 1. Alkanes (C – C):-

Those hydrocarbons that contain carbon-carbon single bond are called alkanes. They are also called saturated hydrocarbons. Their general formula is “ $C_nH_{2n+2}$ ”, where “n” is number of carbon atoms.

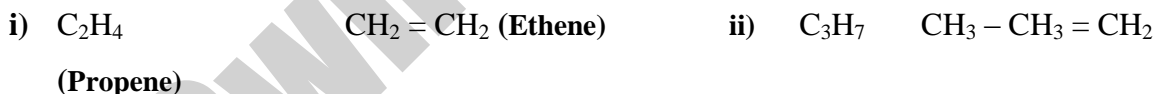
#### Example:



### 2. Alkenes (C = C):-

Those hydrocarbons that contain carbon-carbon double bond (=) are called alkenes. They are also called un-saturated hydrocarbons. Their general formula is “ $C_nH_{2n}$ ”, where “n” is number of carbon atoms.

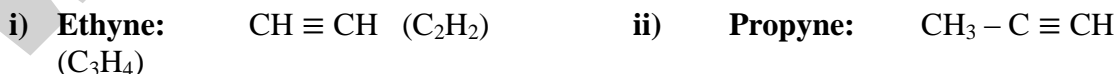
#### Example:



### 3. Alkynes (C ≡ C):-

Those hydrocarbons that contain carbon-carbon triple bond (≡) are called alkynes. They are also called un-saturated hydrocarbons. Their general formula is “ $C_nH_{2n-2}$ ”, where “n” is number of carbon atoms.

#### Example:



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## GENERAL METHODS OF PREPARATION OF ALKANES

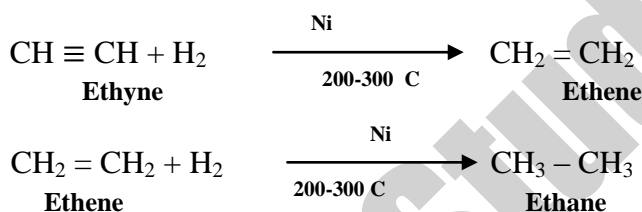


## First Method:

### 1. By Hydrogenation of Alkenes and Alkynes:

The process in which hydrogen molecule is added

in an alkene or alkyne is called hydrogenation. This process takes place in the presence of finely divided nickel at 200 – 300°C and under high pressure. By the hydrogenation of alkene or alkyne alkanes are produced.



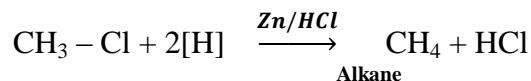
## SECOND METHOD

### By the Reduction of Alkyl Halides:

Alkyl halides are those organic compounds in which one hydrogen atom of an alkane is replaced by one halogen atom.

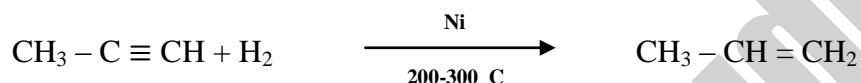
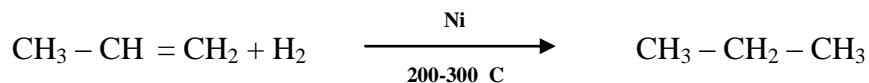
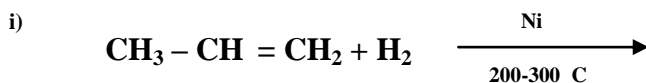
When an alkyl halide is treated with Zinc (Zn) in the presence of an aqueous acid then an alkane is

produced. In this reaction Zinc (Zn) reacts with aqueous acid (HCl) and as a result atomic hydrogen is produced. This atomic hydrogen is called nascent hydrogen and this nascent hydrogen reduces alkyl halide.



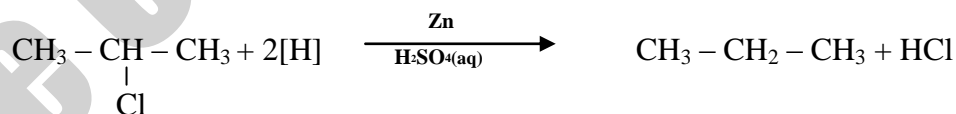
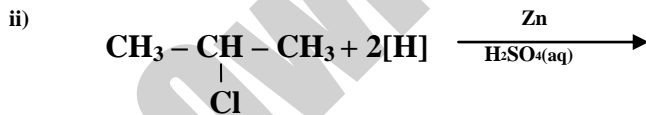
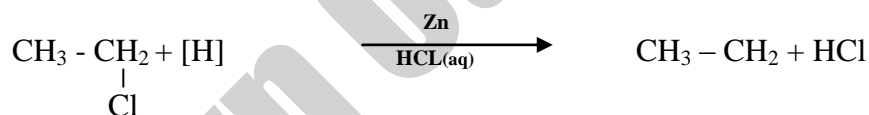
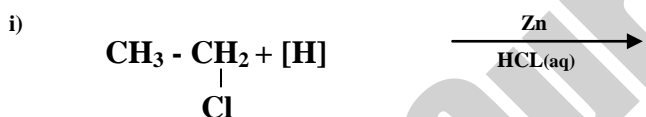
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**Complete the following reactions.**



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**Self Assessment Exercise No -12.4**

Complete the following reactions.



**Properties of Alkanes:-**

1. Alkane molecules are non-polar in nature.
2. Alkane molecules are less dense than water and they are soluble in water.
3. Chemically alkanes are un-reactive towards most of the ionic compounds.



- Hexane is a special alkane and it is used to extract vegetables oils from corn, soya beans, cotton seed etc.
- Alkanes containing four carbon atoms are colour less, odourless gases.
- Alkanes containing five to seventeen carbon atoms are colourless, odourless liquids.
- Alkanes containing carbon atoms greater than seventeen are colourless , odourless solids.

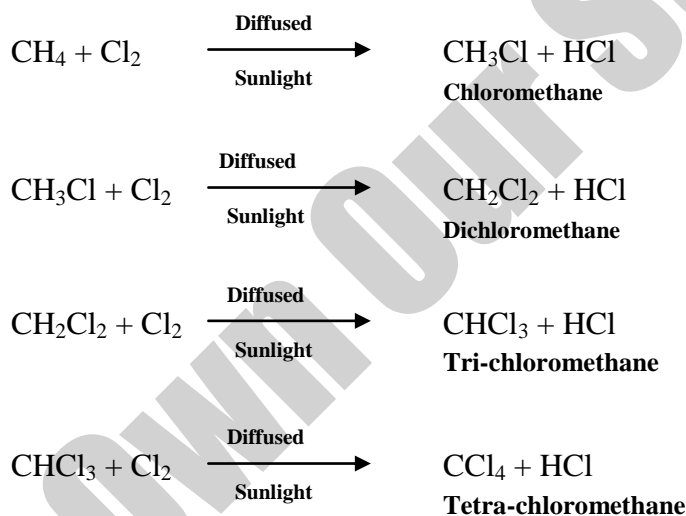
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## Halogenation:-

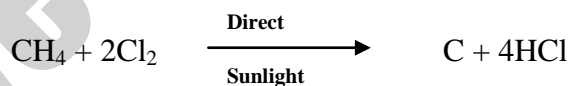
The reaction of an alkane in which one hydrogen atom of an alkane is replaced by one halogen atom is called halogenation.

### **Example:**

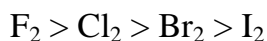
The reaction of methane and chlorine in diffused in sunlight is an example of halogenation.



In direct sunlight the reaction of methane with chlorine is explosive and forms carbon and HCl.



The trend in reactivity of halogen with an alkane is as follows:



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## Combustion:-



A reaction of a substance with oxygen or air that causes rapid release of heat and the appearance of a flame is called combustion.

Complete combustion of an alkane produces carbon dioxide, water and heat. Most of the alkane burn with blue flame.



### Incomplete Combustion:-

Incomplete combustion of methane occurs in the presence of limited supply of oxygen and as a result carbon monoxide, carbon and water are produced.



### Question:- Why lighter alkanes are widely used as fuel?

**Ans:** The lighter alkanes are widely used as fuel because:

1. Their combustion can be controlled.
2. They produced large amount of heat per gram.
3. They are cheap and readily available.

### Uses of Methane:-

1. Methane is used as domestic fuel (sui gas)
  2. Methane is used as a fuel for automobiles(CNG)
  3. Methane is used to manufacture urea fertilizer.
- .....
- .....

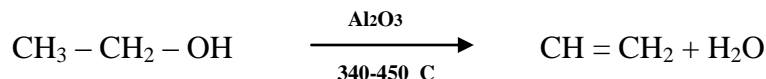
## GENERAL METHODS OF PREPARATION OF ALKENES:

### 1<sup>st</sup> Method

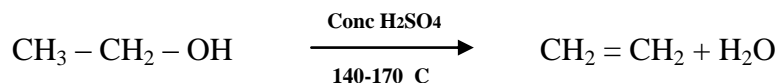
#### By Dehydration of Alcohols:

Dehydration is a process in which water is removed from a substance.

Alcohols dehydrate when their vapour are passed over heated alumina.



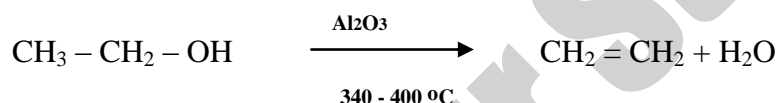
Concentrated sulphuric acid is also used for dehydration.



### Elimination Reaction:

In dehydration reaction “- OH” group is removed from one carbon atom and “H” atom is removed from adjacent carbon atom. These adjacent carbon atoms form double bond. Such a reaction is called elimination reaction.

**Example:**

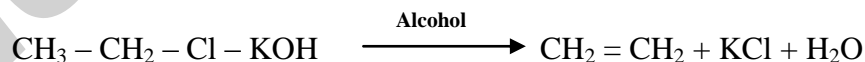


### 2<sup>nd</sup> Method

### By Dehydrohalogenation of Alkyl Halides:

Dehydrohalogenation is a process in which one hydrogen atom and one halogen atom (hydrogen halide) is removed from a substance. When alkyl halides are heated with alcoholic potassium hydroxide then by the process of dehydrohalogenation alkenes are produced.

**Example:**



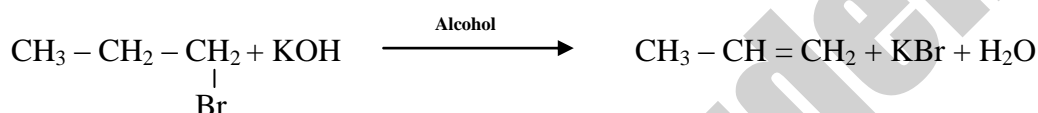
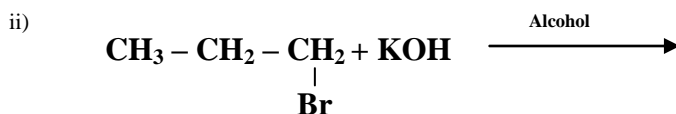
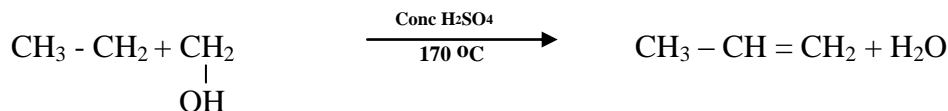
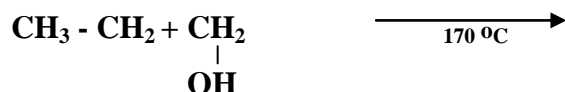
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### Page. No. 80 Self Assessment Exercise No -12.6

Complete the following reactions.

i)

Conc H<sub>2</sub>SO<sub>4</sub>



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**Question:-** Removal of “H” and halogen takes place from two adjacent carbon atoms. Is dehydrohalogenation an elimination reaction?

**Ans:** Yes, dehydrohalogenation is an elimination reaction because we know that an elimination reaction is a type of organic reaction in which two substituent's [“H” and “Cl”] are removed from two adjacent carbon atoms.

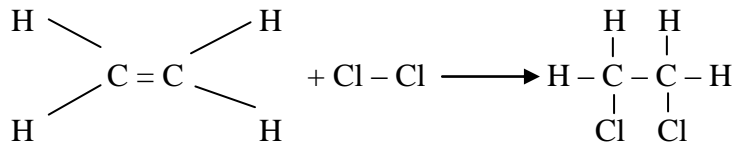
### Properties of Alkenes:-

1. Alkenes are un-saturated hydrocarbons.
2. First three members of alkenes are gases.
3. Alkenes containing five to fifteen carbon atoms are liquids.
4. Alkenes containing carbon atoms more than fifteen are solids.
5. Alkenes are insoluble in water but soluble in organic solvents such as alcohols.

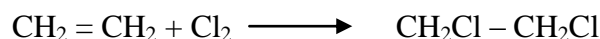
### Reaction with Halogens:-

Chlorine and bromine both react with double bond of alkenes. When chlorine react with double bond of alkene then one chlorine atom becomes attached with

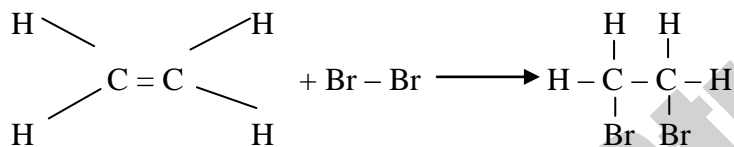
one carbon atom and other chlorine atom is attached with other carbon atom. This type of reaction is called addition reaction.



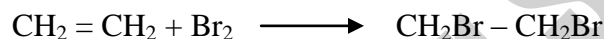
OR



Similarly bromine reacts with double bond of alkene in the same way



OR

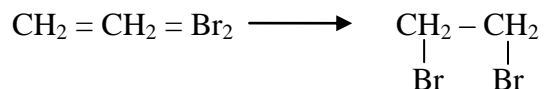


**Question:** How can you differentiate ethane from ethene?

OR

How can you identify the un-saturation in a molecule?

**Ans:** We can differentiate ethane and ethene by using a bromine test. In this test we add a small amount of bromine water in two different jars containing ethane or ethene. The bromine reacts with ethene and convert its double bond into single bond. As a result the colour of bromine water is discharged. Whereas in case of ethane there is already single bond is present. Therefore the colour of bromine water remain the same in case of ethane. The decolourization of bromine solution indicates the presence of double bond (un-saturation) in a molecule.

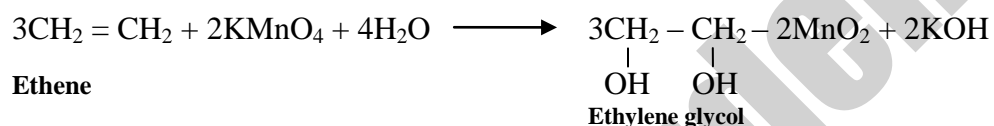




**Question:** How can you convert ethene into glycol? OR Explain Baeyer's test.

**Ans:** When an alkene is treated with dilute aqueous solution of "KMnO<sub>4</sub>" then 1% addition of two hydroxyl groups occurs across the double bond of alkene. The pink colour "KMnO<sub>4</sub>" solution is

discharged during the reaction. This reaction used as a test for the presence of alkene and it is known as Baeyer's test. As a result of this reaction ethene is converted into ethylene glycol.



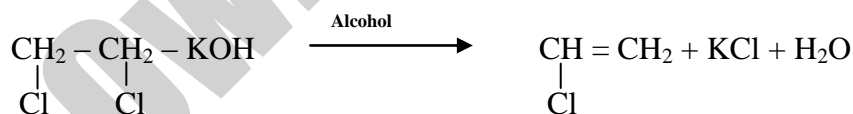
## GENERAL METHODS OF PREPARATION OF ALKYNES

### 1<sup>st</sup> Method

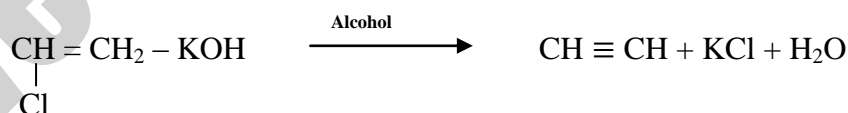
#### By Dehydrohalogenation of Vicinal Dihalides:

Vicinal dihalides are those organic compounds in which two halogen atoms are attached with two adjacent carbon atoms. When vicinal dihalides are treated with alcoholic potassium hydroxide then it removes two halogen atoms and two hydrogen atoms from two adjacent carbon atoms. As a result a triple bond is formed between two carbon atoms. This reaction completes in two steps.

#### Step – 1:



#### Step – 2:



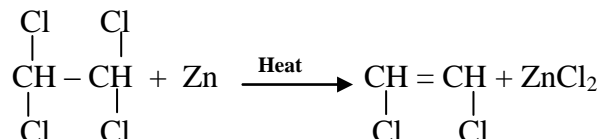
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### 2<sup>nd</sup> Method

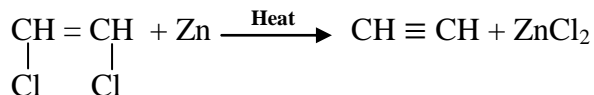
#### By Dehalogenation of Tetrahalides:

Tetrahalides are those organic compounds in which four halogens atoms are attached with two adjacent carbon atoms. When tetra halides are treated with Zinc dust then dehalogenation of tetrahalides takes place and as a result alkyne is produced. This reaction completes in two steps.

### Step – 1:



### Step – 2:



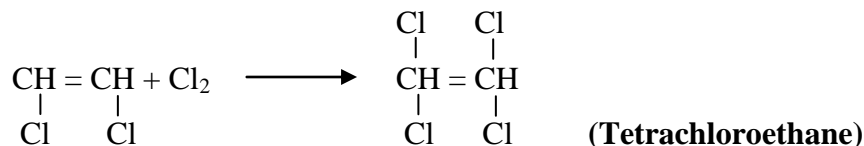
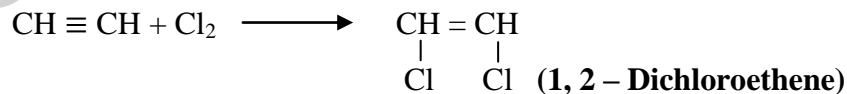
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### Properties of Alkynes:

1. Alkynes are un-saturated hydrocarbons & they contain triple bond.
2. The first three members of alkynes are gases, the next eight members are liquids and higher members are solids.
3. Alkynes are non polar compounds and they are readily dissolve in organic solvent such as alcohols.
4. Alkyne has garlic like odour.
5. Due to presence of triple bond alkynes are reactive compounds.

### Addition of Halogens in Alkynes:

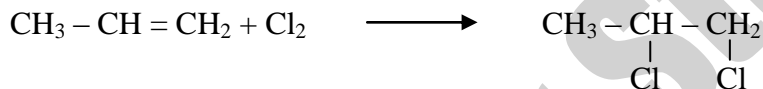
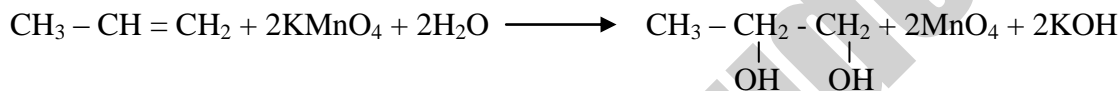
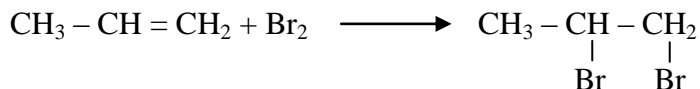
Alkynes easily react with halogens. As a result of this reaction alkynes add two molecules of halogens.





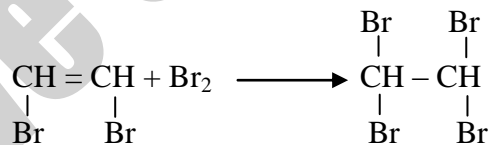
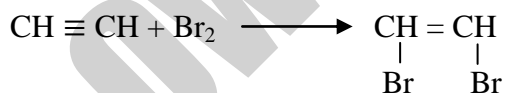
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Page.NO.81: Self Assessment Exercise 12.7:-

Q. Complete the following reactions.



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Page. NO.84: Self Assessment Exercise 12.8:-

Q. Write chemical reaction of ethyne and bromine, why this is used to identify the unsaturation in a molecules.





## Identification of the Un-Saturation in a Molecule:

Bromine is reddish brown liquid. When it reacts with ethyne then reddish brown colour disappears. This decolourization of bromine solution indicates the presence of un-saturation (triple bond).

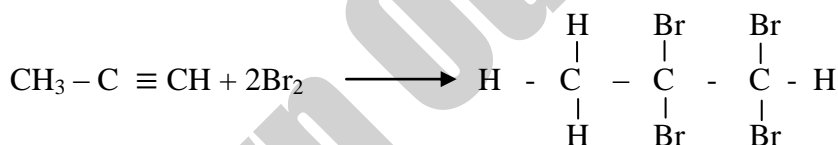
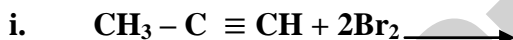
## Uses of Ethyne:

1. Ethyne is used in oxy-acetylene torch for welding and cutting metals.
2. Ethyne is used for ripening of fruits.
3. Ethyne is used for the manufacture of polyvinyl acetate (PVA), polyvinyl chloride (PVC), polyvinyl ethers and rubber.

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### Page.NO.85: Self Assessment Exercise 12.9:-

Q. Complete the following reactions.



Q. Which organic compound is used as antifreeze in automobile radiators?

Ans. Ethylene (ethene) is a most important commercial organic chemical. It is used in the manufacture



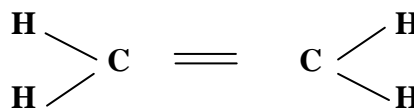
of polythene (plastic). It is also converted into ethylene glycol. This ethylene glycol is used as antifreeze in automobile radiators.

## EXERCISE QUESTIONS

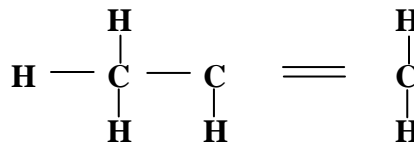
Page # 88 Q- No-2(i) Give three examples of un-saturated hydrocarbons:

Ans:- Three example of un-saturated hydrocarbons are given as,

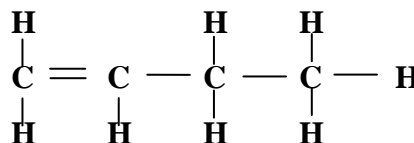
i. Ethene :  $\text{CH}_2 = \text{CH}_2$



ii. Propene :  $\text{CH}_3 - \text{CH} = \text{CH}_2$



iii. Butene :  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_3$





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**Q-No- 2(ii) Draw electron dot and cross structure for ethene.**

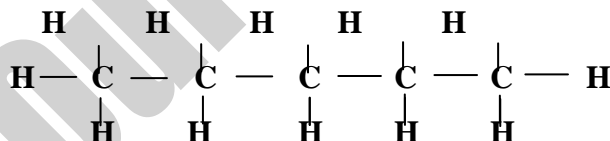
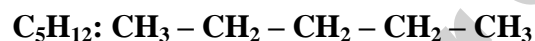
**Ans:-** The electron dot and cross structure for ethene is,



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**Q-No-2(iii): draw structural formulas of an alkane, an alkene and and alkyne containing five carbon atoms.**

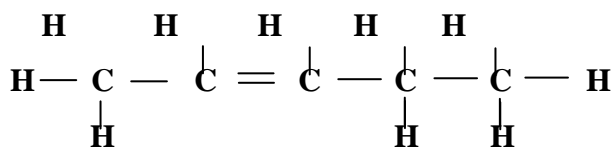
**Ans: - ALKANE:-**

Alkane containing five carbon atoms is pentane its structural formula is.



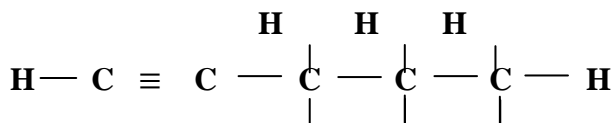
**ALKENE:-**

Alkene containing five carbon atoms is called pentene. Its structural formula is.



**ALKYNE:-**

Alkyne containing five carbon atoms is called pentyne. Its structural formula is.





H H H

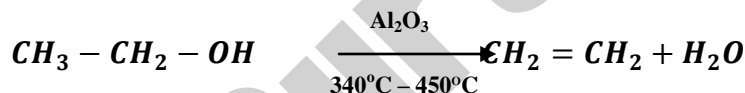
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**Q-No-2(iv): How can you differentiate ethane from ethene?**

**Ans:** - we can differentiate ethane and ethene by using a bromine test. In this test we add a small amount of bromine water in two different jars containing ethane and ethene. The bromine reacts with ethene and convert its double bond into single bond. As a result the colour of bromine water is discharged. Whereas in case of ethane there is already single bond is present therefore colour of bromine water remains the same.

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**Q-No-2(v): What do you mean by dehydration reaction?**

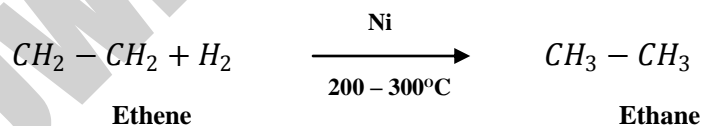
**Ans:** - Dehydration is a process in which water is removed from a substance.

**Example:** - Alcohols dehydrate when their vapors are passed over heated alumina.



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**Q-No-3(i): How can you convert ethene into ethane?**

**Ans:-** By addition reaction of ethene with hydrogen in the presence of finely divided nickel at 200 – 300 °C converts ethene into ethane

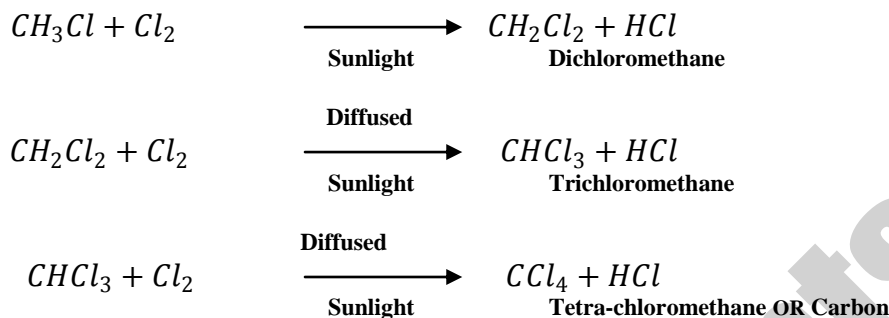


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**Q-No-3(ii): How can you convert methane into carbon tetrachloride?**

**Ans:-** A substitution reaction of methane with halogen (Chlorine) atom in which a halogen atom substitutes one or more hydrogen atoms of methane produces carbon tetrachloride. Diffused sunlight is used for this purpose.



Diffused



tetrachloride

**Q-No-3(iii):** How can you convert ethene into glycol?

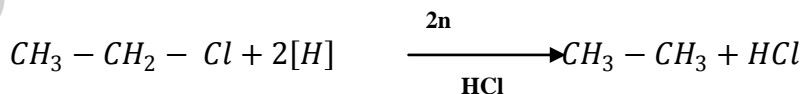
**Ans:-** When an alkene (ethene  $CH_2 = CH_2$ ) is treated with dilute alkaline aqueous solution of  $KMnO_4$  then 1% addition of two hydroxyl groups occur across the double bond. The pink colour of  $KMnO_4$  solution is discharged during the reaction. This reaction is used as a test for the presence of an alkene (ethene) and it is known as Baeyer's test.



**Q-No-3(iv):** How can you convert ethyl chloride into ethane?

**Ans:-** When ethyl chloride is treated with Zn in the presence of an aqueous acid (HCl) then ethane ( $C_2H_6 = CH_3 - CH_3$ ) is produced.

In this reaction Zn reacts with aqueous acids (HCl) and as a result atomic hydrogen is produced. This atomic hydrogen is called nascent hydrogen. This nascent hydrogen is used to convert ethyl chloride into ethane.

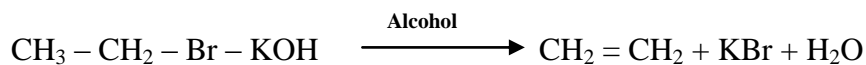


**Q-No-3(v):** How can you convert ethyl bromide into ethene?





**Ans:-** Dehydrohalogenation is a process in which one hydrogen atom and halogen atom is removed from an organic compound. Dehydrohalogenation of ethyl bromide in the presence of alcoholic potassium hydroxide converts it into ethene.



**Q-No-9: Explain why a systematic method of naming chemical compounds is necessary.**

**Ans:-** Million of organic compounds exist in nature. To understand, recognize and classify these compounds a systematic naming of organic compounds is necessary. An international body, “The **International Union of Pure and applied Chemistry (IUPAC)**” defines the rules for naming organic compounds.

“Each different organic compound should have a different name.

## Exercise Questions

**Page-No-188**

**Q-No-2(i)**

List the Impurities present in rain water.

**Ans:-** There are a large number of substances present in the atmosphere. For example, smoke particles, insects and bacteria, some harmful gases such as  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{NO}$ ,  $\text{NO}_2$ . These gases either react with rain water or get dissolved in it.

All these above mentioned substances or materials are the impurities present in rain water.

**Q-No-2(ii)**

List toxic substances present in household waste.

Ans:- Household wastes include soaps and detergents, paints and oil, food and vegetable waste and garbage etc.

### Q-No-2(iii)

In what ways, industrial wastes pollute water?

Ans:- The wastes from the industries may contain highly toxic compounds and heavy metals such as Pd, Cd, Hg, As, Sb, etc. All these compounds pollute the water. Industrial wastes may also contain large quantities of chromium salts. These salts dissolve in water and cause cancer.

### Q-No-2(iv)

What is water pollution? How water can be contaminated?

Ans:- Contamination of water sources like lakes, rivers, oceans and ground water by human activities such as oil leakage, agricultural pesticides, industrial wastes etc is called water pollution.

### Q-No-2(v)

List some water born diseases.

Ans:- Some water born diseases are:

- i. Cholera
- ii. Typhoid
- iii. Hepatitis
- iv. Jaundice

### Q-No-2(vi)

What are pathogenic microorganisms?

Ans:- The study of the causes and effects of diseases is called pathology and the microorganisms such as bacteria or viruses that causes such diseases are called pathogenic microorganisms.

### Q-No-3

What is hard water? Why is it sometimes undesirable?

Ans:- water that gives little lather with soap or forms scum with soap is called hard water are water has a large number of minerals dissolves in it. Usually it contains calcium and



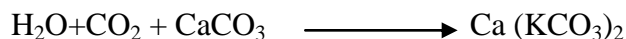
magnesium which does not work with soap and detergents. As a result large quantity of soap and detergents is used. Also these Ca and Mg ions can damage the water pipes and industrial boilers.

Q-No-5

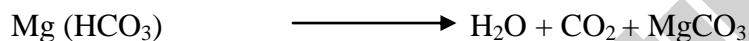
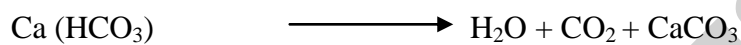
- a) Reaction of slaked lime with alum



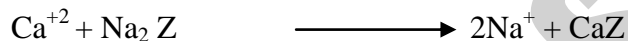
- b) Carbonated rain water with lime stone



- c) Reaction that occurs when temporary hard water is boiled



- d)  $\text{Ca}^{+2}$  ions interact with sodium zeolite



Q-No-6

How can buildings made of lime stone are affected by acid rain.

Ans:- acid rain has a corrosive effect on lime stone or marble buildings. Acid rain contains  $\text{SO}_2$  and whenever  $\text{SO}_2$  comes in contact with lime stone then corrosion occurs. As a result the building made of lime stone badly affected by this corrosion.

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