# Alkanes

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**Solution 1:**

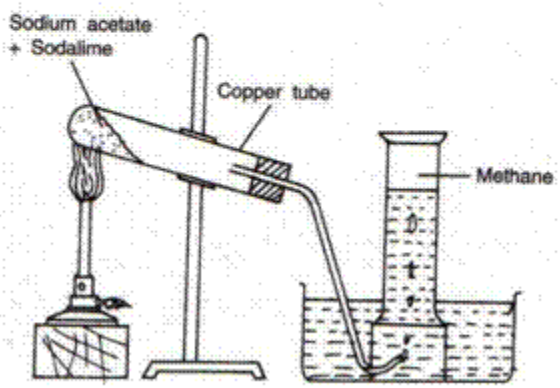
Methane is indicated by marsh gas and fire damp.

**Solution 2:**

(a) Mixture of sodium ethanoate and soda lime is heated in a hard glass tube.

$$CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$$

(b) Gas is collected by the downward displacement of water, since it is only slightly soluble in water and lighter than air.




(c) Soda lime is used as it is not deliquescent and does not attack glass.

**Solution 3:**

(a) When methyl bromide or methyl iodide and sodium are heated in presence of dry ether, ethane is formed.

$$CH_3I + 2Na + ICH_3 \xrightarrow{Dryether} CH_3 - CH_3 + 2NaI$$

(b) By reduction of Ethyl iodide using Zn +Cu couple in alcohol, ethane is formed.

$$CH_3CH_2I + 2[H] \rightarrow C_2H_6 + HI$$

**Solution 4:**

(a) The products obtained when methane reacts with chlorine in diffused sunlight are Chloromethane, Dichloromethane, Trichloromethane and Tetrachloromethane.

(b)

$$CH_4 + Cl_2 \xrightarrow[\text{or } \triangle]{\text{UV light}} CH_3Cl + HCl$$

$$CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$$

$$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$$

(c) The above reaction is substitution reaction. Here the substitution of alkanes with chlorine takes place hence it is called chlorination.

The reactions in which the hydrogen of the alkane molecule is replaced by another atom or group of atoms resulting in the formation of the derivative of that hydrocarbon are called substitution reactions.

Substitution by halogen atom is called halogenations.

**Solution 5:**

(i) Uses of Methane

- As a domestic fuel in the form of natural gas
- In the manufacture of methanol and hydrogen.

(ii) Uses of Ethane

- As a fuel, it has high calorific value than methane. Liquefied ethane is also used as a fuel.
- In the preparation of ethanol, acetaldehyde and acetic acid which find use in paints, varnishes, adhesive, plastic etc.

**Solution 6:**

$$C_2H_6 + Cl_2 \xrightarrow{UV\,light} C_2H_5Cl + HCl$$
$$C_2H_5Cl + Cl_2 \rightarrow C_2H_4Cl_2 + HCl$$
$$C_2H_4Cl_2 + Cl_2 \rightarrow C_2H_3Cl_3 + HCl$$
$$C_2H_3Cl_3 + Cl_2 \rightarrow C_2H_2Cl_4 + HCl$$
$$C_2H_2Cl_4 + Cl_2 \rightarrow C_2HCl_5 + HCl$$
$$C_2HCl_5 + Cl_2 \rightarrow C_2Cl_6 + HCl$$

**Solution 7:**

(a) Methane to methanol:

$$2CH_4 + O_2 \xrightarrow[200^\circ C]{Cu} 2CH_3OH$$

(b) Ethane to ethanal(acetaldehyde):

$$2C_2H_6 + O_2 \xrightarrow[200^\circ C]{Cu} 2C_2H_5OH$$

$$C_2H_5OH \xrightarrow[acidic]{K_2Cr_2O_7} CH_3CHO$$

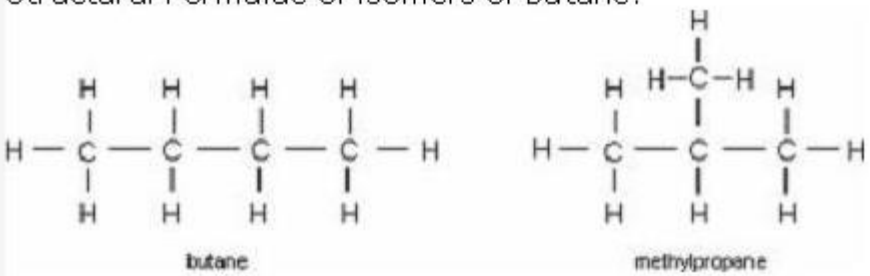
(c) Methane to methanoic acid:

$$2CH_4 + O_2 \xrightarrow[200^\circ C]{Cu} 2CH_3OH$$

$$CH_3OH \xrightarrow[acidic]{K_2Cr_2O_7} HCHO \xrightarrow[acidic]{K_2Cr_2O_7} HCOOH$$

**Solution 8:**

Structural Formulae of isomers of butane:



## Solution 9:

(a) Ethane is mixed with oxygen and is passed through hot copper tube; it gets oxidized to ethyl alcohol.

$$2C_2H_6 + O_2 \xrightarrow[200°C]{Cu} 2C_2H_5OH$$

(b) Ethane is first converted into ethyl alcohol by passing over hot copper tube, then further oxidation with acidified potassium dichromate yield aldehyde and carboxylic acids.

$$2C_2H_6 + O_2 \xrightarrow[200^\circ C]{Cu} 2C_2H_5OH$$

$$C_2H_5OH \xrightarrow[acidic]{K_2Cr_2O_7} CH_3CHO \xrightarrow[acidic]{K_2Cr_2O_7} CH_3COOH$$

## Solution 10:

The main sources of alkanes are natural gas and petroleum.

Alkanes are known as saturated hydrocarbons because the carbon atoms in their molecules are bonded to each other by single covalent bond. Each carbon atom is again bonded to hydrogen atom.

## Solution 11:

When methane and chlorine are exposed to direct sunlight they give carbon and HCl.

$$CH_4 + 2Cl_2 \xrightarrow[sunlight]{Direct} C + 4HCl$$

**Solution 12:**

(a) Ethane reacts in excess of air to give carbon dioxide and water.

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O + \text{Heat}$$

(b) Ethane reacts in absence of air to give carbon black.

$$C_2H_6 + O_2 \rightarrow 2C + 3H_2O$$

( c) Ethane reacts in presence of copper and 120atm pressure to give ethanol

$$2C_2H_6 + O_2 \xrightarrow[200^{\circ}C]{Cu} 2C_2H_5OH$$

(d) Ethane reacts with molybdenum oxide at 100 atm pressure to give ethanal.

$$C_2H_6 + O_2 \xrightarrow[\Delta]{MoO} CH_3CHO + H_2O$$

**Solution 13:**

Seven covalent bonds are present in Ethane.