Chemistry Of Alkanes

Learning Outcomes:

Studentds will be able to:

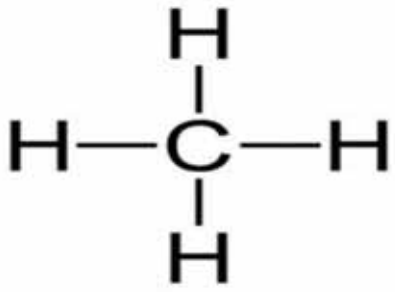
1. describe Alkanes as saturated hydrocarbons.
2. recall that in Alkanes, the four bonds of each carbon atom are directed to the corners of a tetrahedron.
3. draw electron cross and dot structures of simple first five Alkanes.
4. describe that the combustion of alkanes provide energy.
5. write a chemical equation to show the preparation of alkanes.

Alkanes as Saturated Hydrocarbons:

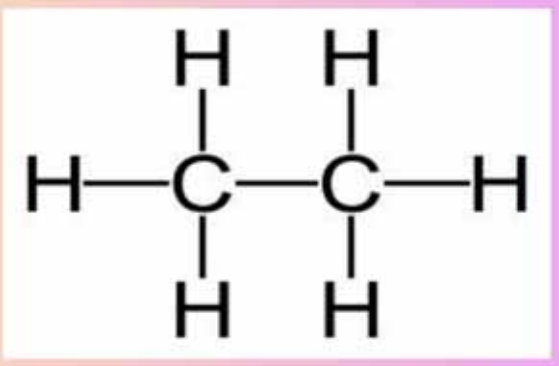
'Saturated' means, the compounds that don't have multiple bonds. Alkanes, therefore, are saturated hydrocarbons because all their bonds are single bonds. These are compounds of hydrogen and carbon in which the tetravalency of carbon is fully satisfied with single bonds and hence no further atom or group can be attached to the carbon atom.

For example

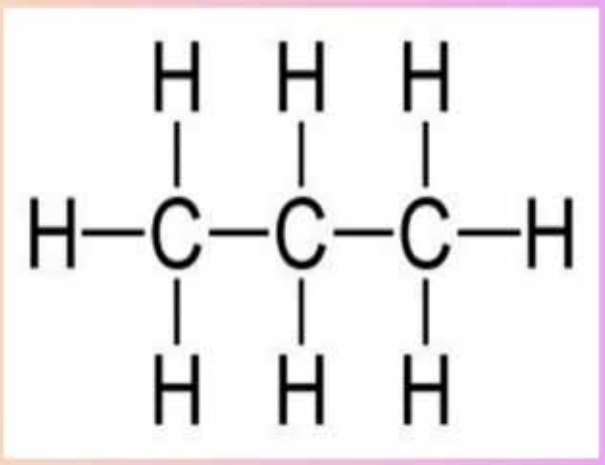
Methane



Ethane

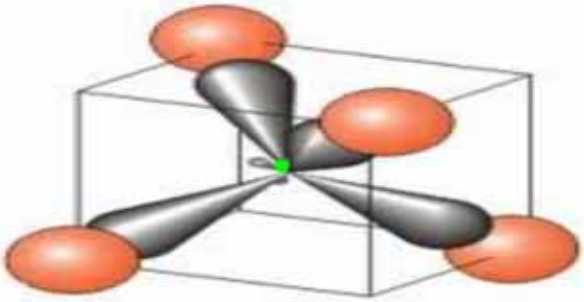


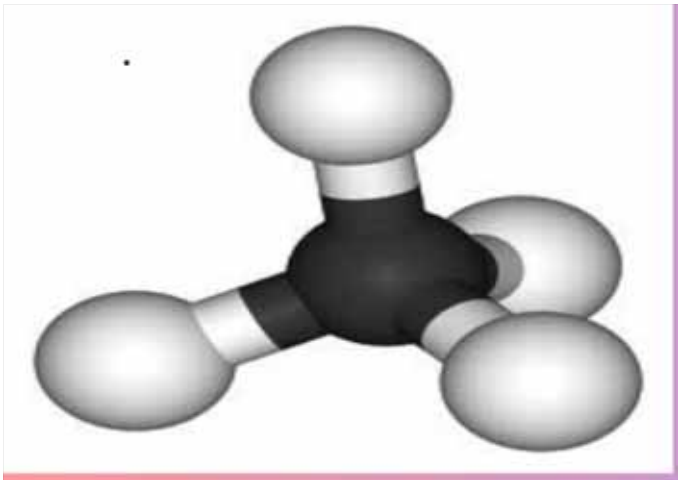
Propane



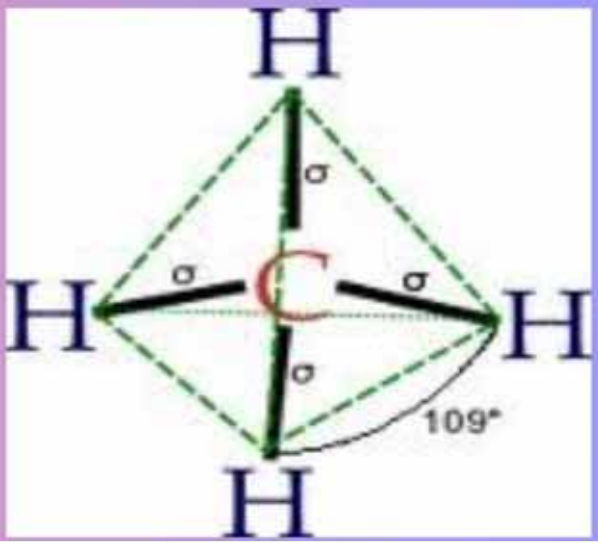
Tetrahedral Stucture of Alkanes:

The shape of the alkanes shows that all bonds on the carbon atoms are identical and that the bond angles are close to 109 degrees. Thus, each carbon atom is at the center of a tetrahedral structure,with either carbon atoms or hydrogen atoms at the corners of the tetrahedron.






R
C
R
R
R

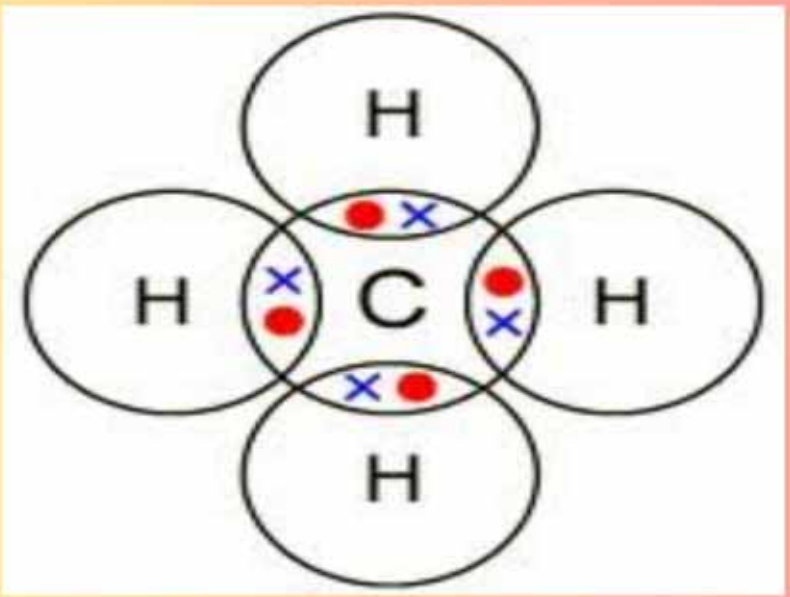

H
σ
H
σ
C
σ
H
σ
109°
H

HCl

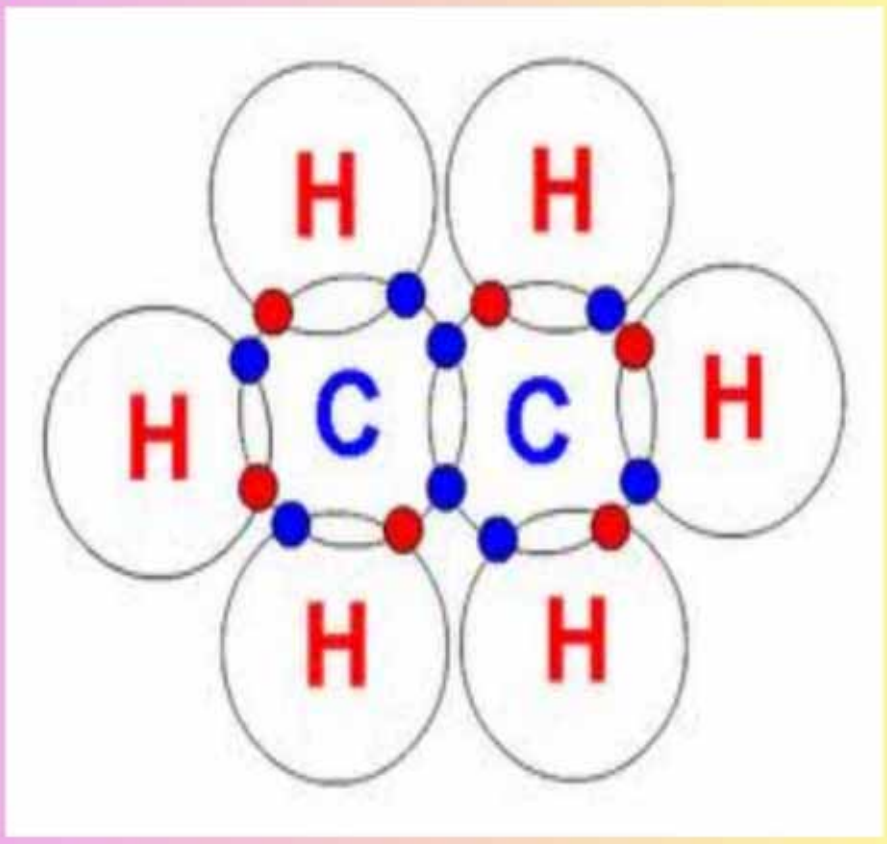
$_1H$ $_{17}Cl$

1 = x 17 = •

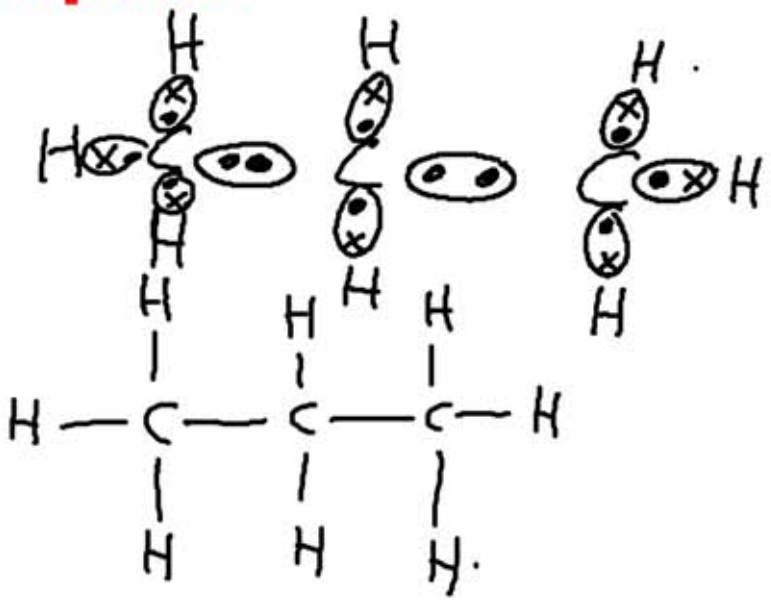
Electron Cross and Dot Structures for First Five Alkanes:



Ethane



Propane



Combustion of Alkanes Provide Energy:

Alkanes are combustible. When burned, they produce carbon dioxide, water, and large quantities of heat. This energy is used to heat homes and other buildings and to generate electricity. When heating a home, for example, oil or natural gas is burned and the energy released is used to heat water or air. The hot water or air is then circulated around the building.

What makes alkanes the best fuel is their combustion reaction, in which they react with oxygen to form water, carbon dioxide and a large amount of heat. Following reactions illustrate the combustion reaction.

Methane burns in air to produce energy which we utilize in our homes and in industry.

$$CH_4 + 2\ O_2 \rightarrow 2\ H_2O + CO_2 + Energy$$

Another example is combustion of propane:

$$C_3H_8 + 5\ O_2 \rightarrow 4\ H_2O + 3\ CO_2 + Energy$$

In general all alkanes react as:

$$C_nH_{2n+2} + (3n+1)/2\ O_2 \rightarrow (n+1)\ H_2O + n\ CO_2 + Energy$$

Preparation of Alkanes:

Following are some of the general methods for the preparation of Alkanes.

1. Hydrogenation of unsaturated Hydrocarbons:

When alkenes or alkynes are reacted with hydrogen in the presence of Nickel at 200°C to 300°C, they produce alkanes.

$$R\text{-}CH{=}CH_2 + H_2 \xrightarrow[200\text{-}300^\circ C]{Ni} R\text{-}CH_2\text{-}CH_3$$

Alkane

$$R\text{-}C{\equiv}CH + 2H_2 \xrightarrow[200\text{-}300^\circ C]{Ni} R\text{-}CH_2\text{-}CH_3$$

Alkanes

From Alkyl Halides:

An alkane is produced when an alkyl halide reacts with zinc in the presence of an aqueous acid such as HCl or CH_3COOH.

$$R\text{-}X + 2[H] \xrightarrow{Zn/HCl} R\text{-}H + HX$$

Alkane.

$$Zn + 2HCl \longrightarrow ZnCl_2 + 2H$$

Multiple Choice Questions

1. In a molecule of alkane, the hydrogen atoms are directed towards the centers of a regular

A. square.
B. pyramid.
C. tetrahedron.
D. trigon.

2. The reaction $H_2CCH_2 + H_2 \rightarrow H_3CCH_3$, is an example of

A. polymerization.
B. addition.
C. substitution.
D. decomposition.

3. Which of the following is expected to be the major product, when ethyl chloride is reduced in the presence of Zn/HCl?

A. Methane
B. Ethane
C. Ethene
D. Ethyne