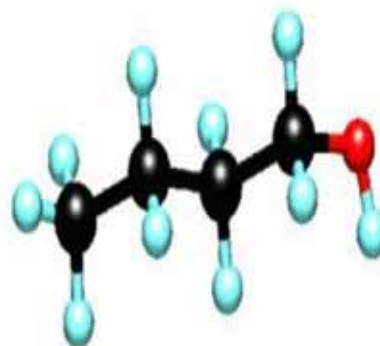
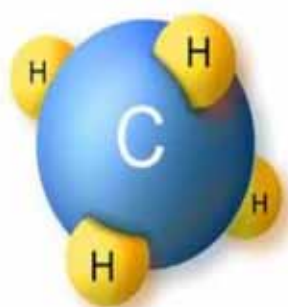
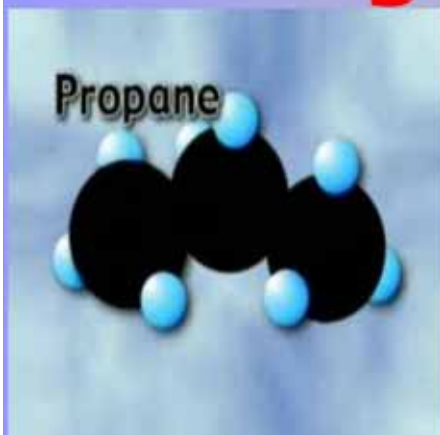


# Hydrocarbons - Alkanes and Alkyl Radicals



## **Learning Outcomes:**

### **Students will be able to:**

- 1. define Hydrocarbons with examples;**
- 2. differentiate between saturated and unsaturated Hydrocarbons;**
- 3. differentiate between saturated and unsaturated compounds using Iodine, Bromine and Potassium permanganate solution;**
- 4. name the Alkanes up to decane;**
- 5. convert Alkanes into Alkyl groups;**
- 6. differentiate between Alkanes and Alkyl groups.**

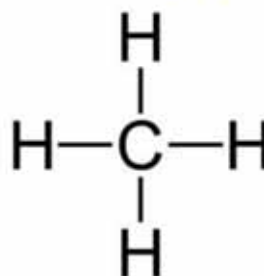
## Hydrocarbons:

*"Those organic compounds which contain only carbon and hydrogen are called Hydrocarbons."*

For example:

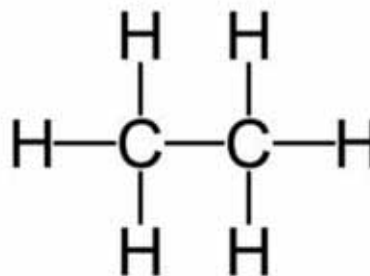
Methane

CH<sub>4</sub>



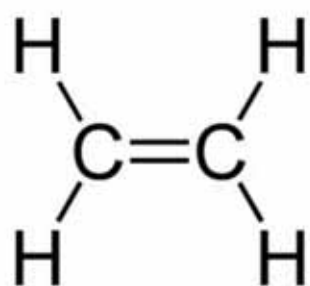
Ethane

C<sub>2</sub>H<sub>6</sub>



Ethene

C<sub>2</sub>H<sub>4</sub>

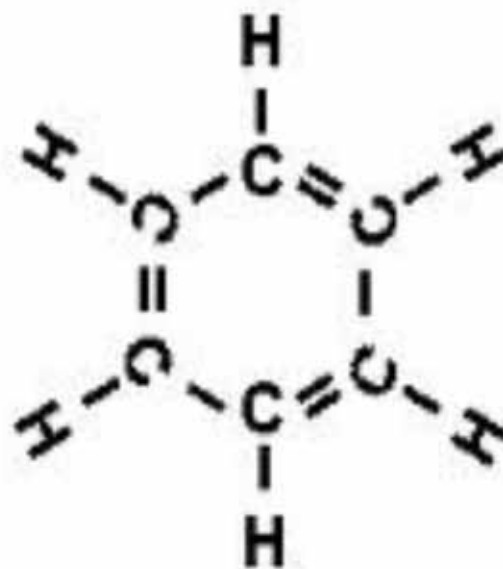


Ethyne

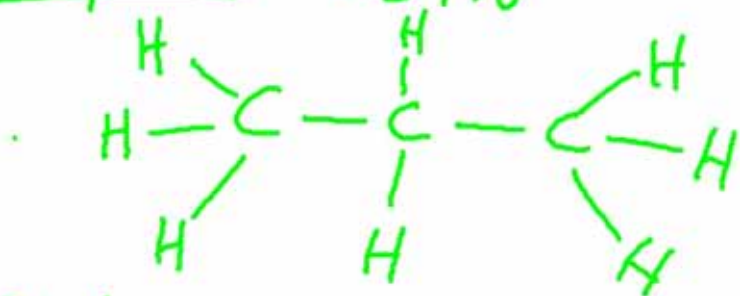
C<sub>2</sub>H<sub>2</sub>



Benzene C<sub>6</sub>H<sub>6</sub>



Propane  $C_3H_8$



Butene  $C_4H_8$

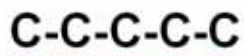


## Differentiation between Saturated and Unsaturated Hydrocarbons:

Following are some of the major differences between saturated and unsaturated hydrocarbons.

### Saturated Hydrocarbons

1. These organic compounds contain single carbon-carbon covalent bond.



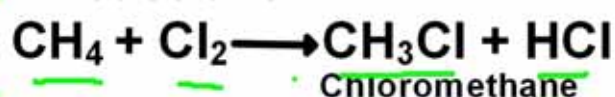
### Unsaturated Hydrocarbons

1. These organic compounds contain at least one double or triple covalent bond.



2. Due to the presence of all single covalent bonds, these compounds are less reactive.

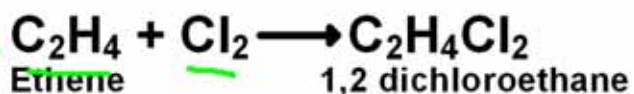
3. Saturated compounds undergo substitution reactions.



4. The number of hydrogen atoms is more when compared to its corresponding unsaturated hydrocarbon.

2. Due to the presence of double and triple bonds, these compounds are more reactive.

3. Unsaturated compounds under go addition reactions.



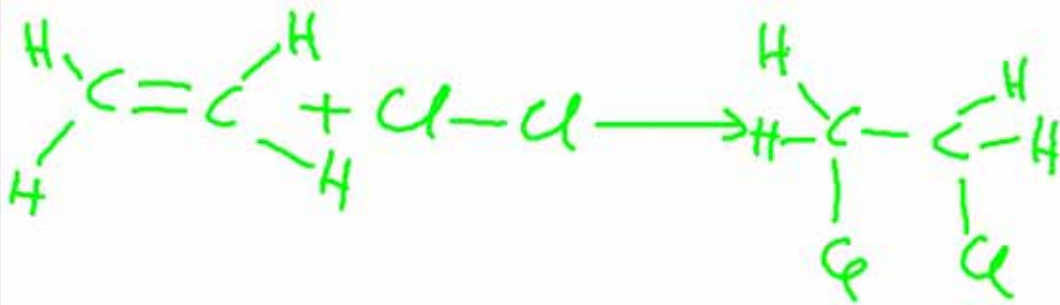
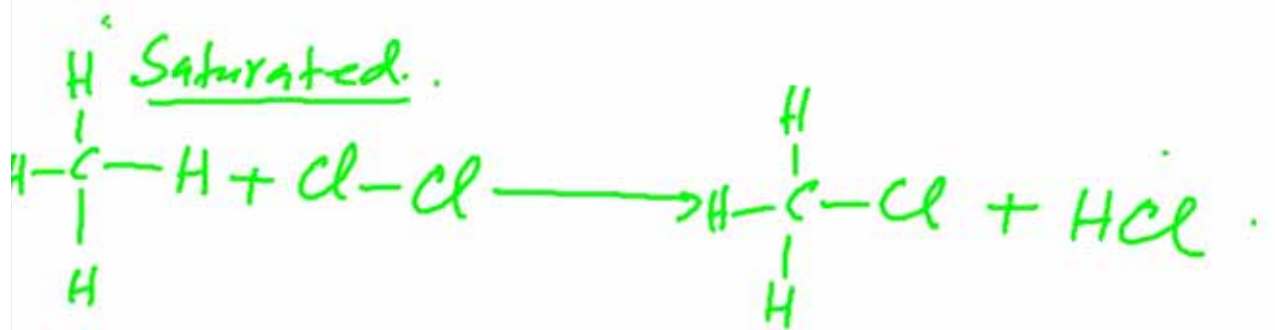
4. The number of hydrogen atoms is less when compared to its corresponding saturated hydrocarbon.

C<sub>2</sub>H<sub>6</sub> Ethane Saturated.

C<sub>2</sub>H<sub>4</sub> Ethene ]

C<sub>2</sub>H<sub>2</sub> Ethyne ]





## Differentiation between saturated and unsaturated compounds using Iodine, Bromine and Potassium permanganate solution:

Following tests can differentiate saturated and unsaturated compounds.

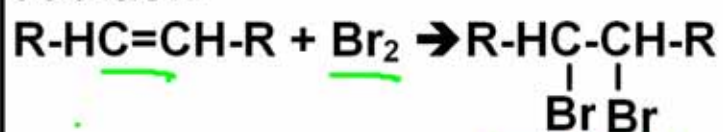
Test	Saturated	Unsaturated
1. Reaction with Iodine.	Violet colour of iodine is not discharged.	Violet colour of iodine is discharged. $\text{R}-\text{HC}=\text{CH}-\text{R} + \text{I}_2 \rightarrow \text{R}-\text{HC}-\text{CH}-\text{R}$ <p style="text-align: center;">              </p>

2. Reaction with Bromine

Animation

Orange colour of bromine water is not discharged

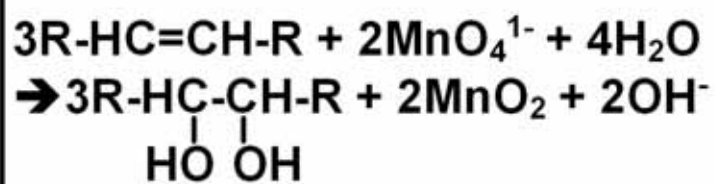
Orange colour of bromine water is discharged due to addition.



3. Reaction with Potassium permanganate

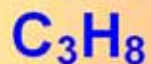
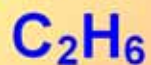
Purple colour of  $\text{KMnO}_4$  is not discharged

Purple colour of  $\text{KMnO}_4$  is discharged



## **Names of first ten Alkanes:**

### **Formula**



### **Name**

Methane

Ethane

Propane

Butane

Pentane

Hexane

Heptane

Octane

Nonane

Decane

## Conversion of Alkanes into Alkyl groups:

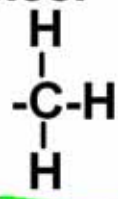
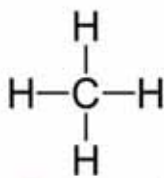
### Definition of alkyl group:

*"When one hydrogen is removed from the molecule of an alkane, the remaining group of atoms is called alkyl group."*

### For example:

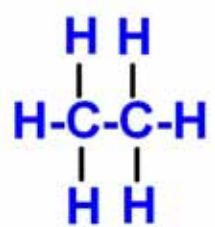
Methane has one carbon and four hydrogens. The methyl group also has one carbon but only three hydrogens. In place of the fourth hydrogen, there is a bond to a different substance.

**Methane**

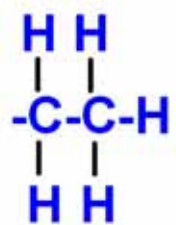


**Methyl group**

Ethane



Ethyl group



## **Names and Formula of some Alkyl Groups:**

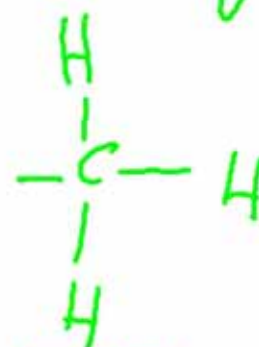
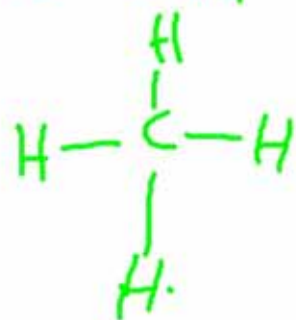
<b>Alkyl Group</b>	<b>Name</b>
<b>CH<sub>3</sub>-</b>	<b>Methyl</b>
<b>C<sub>2</sub>H<sub>5</sub>-</b>	<b>Ethyl</b>
<b>C<sub>3</sub>H<sub>7</sub>-</b>	<b>Propyl</b>
<b>C<sub>4</sub>H<sub>9</sub>-</b>	<b>Butyl</b>
<b>C<sub>5</sub>H<sub>11</sub>-</b>	<b>Pentyl</b>
<b>C<sub>6</sub>H<sub>13</sub>-</b>	<b>Hexyl</b>
<b>C<sub>7</sub>H<sub>15</sub>-</b>	<b>Heptyl</b>
<b>C<sub>8</sub>H<sub>17</sub>-</b>	<b>Octyl</b>
<b>C<sub>9</sub>H<sub>19</sub>-</b>	<b>Nonyl</b>
<b>C<sub>10</sub>H<sub>21</sub>-</b>	<b>Decyl</b>

## Differentiation between Alkanes and Alkyl groups:

Alkane	Alkyl group
<p>1. A hydrocarbon compound with four valencies of carbon fully satisfied by single covalent bonds.</p> <p>2. These satisfy the general formula</p> $\text{C}_n\text{H}_{2n+2}$	<p>1. A hydrocarbon radical with three valencies of carbon satisfied by single covalent bonds but fourth unused valency to bond with a different substance.</p> <p>2. These satisfy the general formula</p> $\text{C}_n\text{H}_{2n+1}$



Methane CH<sub>4</sub>



Methyl

R = Alkyl groups.

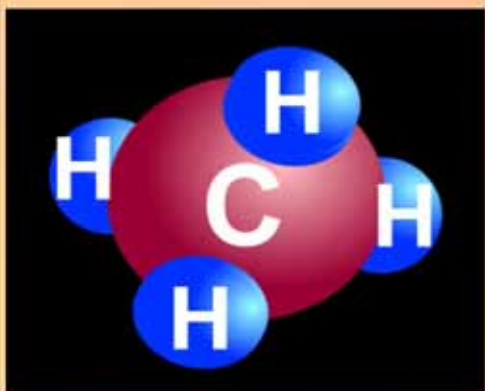
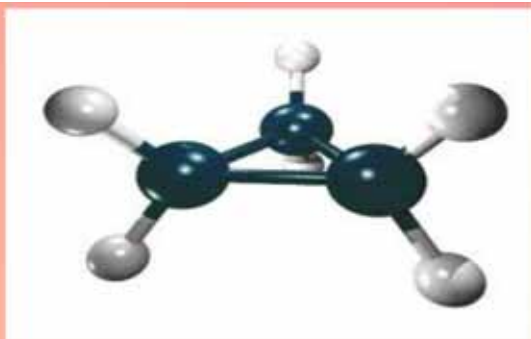
3. These are organic compounds and exists on their own.

4. For example  
Methane      $\text{CH}_4$   
Ethane      $\text{C}_2\text{H}_6$   
etc.

3. These are organic radicals and cannot exist on their own, but act as substituents to replace a hydrogen atom on a chain or ring of carbon atoms.

4. For example  
Methyl      $-\text{CH}_3$   
Ethyl      $-\text{C}_2\text{H}_5$   
etc.

# Multiple Choice Questions



1. Which of the following is expected to be an alkyl group?

- A.  $\text{CH}_4$
- B.  $\text{C}_2\text{H}_6$
- C.  $\text{C}_3\text{H}_8$
- D.  $\text{C}_4\text{H}_9$

**2. Which of the following test is used to detect unsaturation in a molecule?**

- A. Fehling's test**
- B. Baeyer's test**
- C. Tollen's test**
- D. Lucas test**

**3. Which of the following is an unsaturated hydrocarbon?**



