Carbon and Its Compounds
2. Alloïropes of carbon
3. Hydrocarbons
6. Ethanoic acid
Properties of carbon
Saponification
1. Carbon

**Bonding in Carbon**

Note: Usually, carbon does not form ionic bonds as losing or gaining electrons requires a large amount of energy.

Carbon bonding with other atoms of carbon
2. Allotropes of Carbon

Allotropes are different forms of a chemical element.

<table>
<thead>
<tr>
<th>Diamond</th>
<th>Graphite</th>
<th>Fullerene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trihedral arrangement of atoms</td>
<td>Hexagonal arrangement of atoms in a single plane (2D)</td>
<td>Molecules forming a closed cage or cylinder</td>
</tr>
<tr>
<td>Each carbon atom bonded to 6 other carbon atoms</td>
<td>Each carbon atom bonded to 3 other carbon atoms</td>
<td>Fullerene to be discovered</td>
</tr>
<tr>
<td>Extremely hard</td>
<td>Soft and slippery</td>
<td></td>
</tr>
<tr>
<td>Bad conductor of electricity</td>
<td>Good conductor of electricity</td>
<td></td>
</tr>
</tbody>
</table>

3. Hydrocarbons

- Saturated
  - Covalent bonds between carbon atoms

- Unsaturated
  - One carbon double bond
  - One carbon triple bond
### 3.1 Heteroatoms and Functional Groups

<table>
<thead>
<tr>
<th>Functional group</th>
<th>Alcohol</th>
<th>Aldehyde</th>
<th>Ketone</th>
<th>Carboxylic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroatom</td>
<td>- H</td>
<td>- CH - H</td>
<td>- CH -</td>
<td>- COO - H</td>
</tr>
</tbody>
</table>

**Identical molecular formula but different arrangement of atoms**

![Molecular structures](image)

### 3.3 Homologous Series

- **Functional group**
- Successive members differ by a methyl group.
- Different physical properties but similar chemical properties.

General formula for homologous series of:

- ![Chemical structures](image)
**Heteroatoms and Functional Groups**

<table>
<thead>
<tr>
<th>Functional group</th>
<th>Chloro</th>
<th>Peroxo</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th># Carbon atoms</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word root</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrocarbon</th>
<th></th>
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*If the secondary suffix starts with a vowel, delete.*
1. Chemical Properties of Carbon

4.1 Combustion Reaction
Carbon and most of carbon compounds burn in oxygen to give carbon dioxide along with the release of heat and light.

\[
\text{C} + \text{O}_2 \rightarrow \text{CO}_2 \text{ (Heat + Light)}
\]

\[
2\text{C} + \text{O}_2 \rightarrow 2\text{CO}_2 \text{ (Heat + Light)}
\]

4.2 Oxidation Reaction
In the presence of oxidising agents, alcohols can react to form carboxylic acid.

\[
\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{CH}_2\text{COOH}
\]

4.3 Addition Reaction
Hydrogen can be added to unsaturated hydrocarbons in the presence of catalysts to form saturated hydrocarbons.

4.4 Substitution Reaction
One atom or a group of atoms can be replaced by another atom or group of atoms.

\[
\text{H} - \text{H} + \text{C} \rightarrow \text{H} - \text{C} + \text{H} - \text{H}
\]
5. Important Reactions of Ethanol

\[
\text{Ethanol} + \text{O} \rightarrow \text{Ethoxide} + \text{H}_2\text{O}
\]

6. Important Reactions of Ethanoic Acid

**Esterification reaction:** Carboxylic acid reacts with an alcohol in the presence of an acid catalyst to form an ester and water.

\[
\text{Ethanoic acid} + \text{Alcohol} \rightarrow \text{Ester} + \text{Water}
\]

7. Saponification

\[
\text{Ester} + \text{NaOH} \rightarrow \text{Sodium salt} + \text{Water} + \text{Alcohol}
\]
7.1 Soaps and Detergents

- Sodium or potassium salts of
- Soap, hard water
- Hard water affects its cleansing action

Detergent

- Sodium salts of sulphonic acids or ammonium salts with chlorides or bromides
- Does not produce
- Hard water does not affect its cleansing action

7.2 Cleansing Action of Soap

Hydrophobic tail of soap molecule interacts with oil, the head interacts

Hydrophobic tail

- fearing

Hydrophilic head

Soap molecule

When dissolved in water, soap molecules form micelles which remove the oily dirt

Micelles

Polar head pointing towards water

Dirt trapped within soap micelle

Dirt free fabric

Non polar pointing towards dirt