

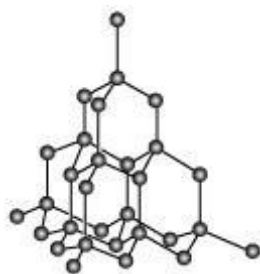
13. Carbon An Important Element

- **Covalent bonds**

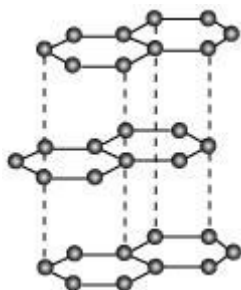
- The bonds formed by the sharing of electrons are known as covalent bonds.
- In covalent bonding, both the atoms (that are participating in the bonding) share electrons, i.e., the shared electrons belong to both the atoms.
- Carbon contains four electrons in its valence shell. It always forms covalent bonds as it is difficult for it to lose or gain four electrons in order to complete its octet.

- Allotropes of Carbon

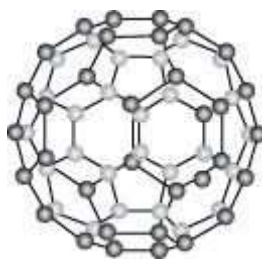
- Allotropes have different appearances and physical properties, but chemically they are the same.
- There are three allotropes of carbon: diamond, graphite, and buckminsterfullerene.



Diamond



Graphite



Buckminsterfullerene

Amorphous Solid:

- An amorphous solid is a non-crystalline solid with no well-defined ordered structure.
- Amorphous forms of carbon are: Charcoal, Lampblack or soot; Coal; Coke

Catenation

- Catenation is the ability of an element to combine with itself through covalent bonds.
- Carbon shows extensive catenation, giving rise to large number of compounds.
- It can form strong single, double, and triple bonds with other atoms of carbons. Carbon can combine with itself to form chain, branched, and ring structures.

- **Hydrocarbons**

- The compounds made up of only carbon and hydrogen are called hydrocarbons.
- The compounds of carbon that contain only single bonds among carbon atoms are called saturated compounds
- Compounds containing double and triple bonds among carbon atoms are called unsaturated compounds.
- If the hydrocarbons are saturated (like methane and ethane), then they are called alkanes; if they are unsaturated, then they are alkenes (containing double bonds) and alkynes (containing triple bonds).

Occurrence of carbon dioxide:



- Carbon dioxide occurs in free as well as in combined state.
- It is found in air in free state. A large amount of carbon dioxide is found dissolved in water bodies such as oceans, lakes, etc.

Preparation of carbon dioxide:

- Carbon dioxide is also formed when charcoal or hydrocarbons are burned in the air.
- It is also formed when metallic carbonates or metallic hydrogen carbonates are treated with dilute acids.
- It is formed by treating any metallic carbonate with dilute mineral acids.

Some physical properties of carbon dioxide:

- Colourless
- Odourless
- Have sour taste
- Almost water soluble gas
- Non-poisonous in nature

Chemical properties of carbon dioxide:

- It dissolves in water to form carbonic acid (H_2CO_3).
- It combines with alkali to form metal carbonates.
- Carbon reacts with carbon dioxide to form carbon monoxide.
- Carbon dioxide reacts with calcium oxide, i.e. quick lime, to form calcium carbonate.

Uses of carbon dioxide:

- Preservation of food stuff from insects
- Fire extinguishers, especially those designed for electrical fires; use liquid carbon dioxide kept under pressure to extinguish flames
- Solid carbon dioxide is called "dry ice".

1. Methane is the first and smallest compound of the homologous series of alkanes.
2. A molecule of methane has a three-dimensional tetrahedral structure.
3. Methane is known as 'Marsh Gas', because it is naturally present in marshy areas.

Preparation of methane



1. Methane is produced by heating a mixture of carbon monoxide and hydrogen to 300 degree Celsius in the presence of the nickel metal as catalyst.
2. Methane is produced by destructive distillation of acetic acid in the presence of sodalime ($\text{NaOH} + \text{CaO}$).
3. In a biogas plant, methane gas is produced anaerobically from plants and animals waste.

Chemical properties of methane

1. Methane is highly flammable and burns with blue flame in air to give carbon monoxide.
2. Methane gas reacts with chlorine in the presence of ultraviolet light to form methyl chloride and hydrogen chloride.

Uses of methane gas: Methane is extensively used

1. as a gaseous fuel in the industrial, automobile and domestic sectors
2. in the manufacture of a large number of organic compounds, such as methyl alcohol and formaldehyde
3. as a major constituent of compressed natural gas
4. for the preparation of 'Syn Gas'.
 - **Biomass** refers to those living and non living organic materials that can be used as sources of energy in the form of fuel.
 - Some examples of biomass fuels are wood, crops, and organic garbage.
 - Biomass fuel is a renewable source of energy.
 - Gas made from the anaerobic digestion of agricultural and animal waste is called **biogas**.
 - **Biodegradation** is the process of biological degradation of organic matter by bacteria and fungi.

