Chemistry — Carbon and its compounds

Carbon and Its Compounds

Key Definitions

- **Carbon**: A non-metal element with the atomic number 6, known for its ability to form a vast number of compounds.
- **Allotropes of Carbon**: Different structural forms of carbon, including:
- **Diamond**: Each carbon atom is tetrahedrally bonded to four other carbon atoms.
- **Graphite**: Carbon atoms are arranged in layers of hexagonal lattices, with weak forces between layers.
- **Fullerenes**: Molecules composed entirely of carbon, taking the form of hollow spheres, ellipsoids, or tubes.
- **Graphene**: A single layer of carbon atoms arranged in a two-dimensional honeycomb lattice.
- **Hydrocarbons**: Compounds consisting solely of carbon and hydrogen. They can be classified as:
- **Aliphatic Hydrocarbons**: Straight or branched chains (e.g., alkanes, alkenes, alkynes).
- **Aromatic Hydrocarbons**: Compounds containing benzene rings.
- **Functional Groups**: Specific groups of atoms that impart characteristic properties to organic compounds. Examples include:
- **Alcohol (-OH)**
- **Carboxylic Acid (-COOH)**
- **Aldehyde (-CHO)**
- **Ketone (C=O)**

Important Formulas

- General formula for alkanes:

$$C_nH_{2n+2}$$

- General formula for alkenes:

$$C_nH_{2n}$$

- General formula for alkynes:

$$C_nH_{2n-2}$$

- Molecular formula for alcohols:

$$C_nH_{2n+1}OH$$

- Molecular formula for carboxylic acids:

$$C_nH_{2n+1}COOH$$

Diagrams

Structure of Diamond

- Each carbon atom forms four strong covalent bonds in a tetrahedral arrangement, resulting in a rigid three-dimensional structure.

Structure of Graphite

- Layers of carbon atoms are bonded in a planar hexagonal arrangement, with weak van der Waals forces between layers allowing them to slide over each other.

Functional Group Examples

- **Alcohol**: `R-OH`
- **Carboxylic Acid**: `R-COOH`

Summary Tables

Type of Hydrocarbon	General Formula	Example
Alkane	C_nH_{2n+2}	Methane (CH_4)
Alkene	C_nH_{2n}	Ethene (C_2H_4)
Alkyne	C_nH_{2n-2}	Ethyne (C_2H_2)

Functional Group	Structure	Example
Alcohol	R-OH	Ethanol (C_2H_5OH)
Carboxylic Acid	R-COOH	Acetic Acid (CH_3COOH)
Aldehyde	R-CHO	Formaldehyde (HCHO)
Ketone	R-C(=O)-R'	Acetone (C_3H_6O)

Key Takeaways

- Carbon is unique due to its ability to form stable bonds with many elements, leading to a vast array of compounds.
- Understanding the structure and properties of carbon compounds is essential for studying organic chemistry.
- Functional groups determine the chemical behavior of organic molecules.
- Hydrocarbons serve as the foundation for many organic compounds, with distinct properties based on their structure.