1. Differentiate between organic and inorganic compounds with examples.

Answer:

Organic compounds are primarily carbon-based and contain carbon-hydrogen (C–H) bonds, such as methane (CH_4) and ethanoic acid (CH_3COOH). Inorganic compounds, on the other hand, do not necessarily contain carbon or C–H bonds, like sodium chloride (NaCl) and water (H_2O). Organic compounds are generally associated with living organisms, while inorganic compounds are found in minerals and non-living sources. For example, glucose is organic, while calcium carbonate is inorganic. This distinction helps classify compounds and understand their origin, bonding, and chemical behavior.

2. What are allotropes of carbon? Explain with crystalline and amorphous forms.

Answer:

Allotropes are different structural forms of the same element in the same physical state. Carbon exists in both crystalline and amorphous allotropes. Crystalline forms include diamond (hard, non-conductive) and graphite (soft, conductive), where atoms are arranged in a definite pattern. Amorphous carbon lacks a regular structure and includes coal, charcoal, and lampblack. The properties of these allotropes differ due to bonding and structure. For example, diamond has strong tetrahedral bonds, making it extremely hard, while graphite has layers with weak interlayer forces, making it slippery.

3. Classify organic compounds based on structure and bonds.

Answer:

Organic compounds can be classified into open-chain (acyclic) and closed-chain (cyclic) compounds. Open-chain compounds include straight or branched structures, such as alkanes and alkenes. Closed-chain compounds may be alicyclic (like cyclohexane) or aromatic (like benzene). Based on bonds, they are divided into saturated compounds (only single bonds – alkanes) and unsaturated compounds (double/triple bonds – alkenes and alkynes). This classification helps predict reactivity and physical properties. For example, alkanes are less reactive, while alkenes undergo addition reactions due to double bonds.

4. What is the degree of carbon and how is it classified?

Answer:
The degree of carbon refers to the number of other carbon atoms attached to a carbon atom in an organic molecule. It is classified as:

- Primary (1°): attached to one carbon (e.g., $–CH_3$ group)
- Secondary (2°): attached to two carbons
- Tertiary (3°): attached to three carbons
- Quaternary (4°): attached to four carbons

For example, in isobutane, the central carbon is tertiary. Degree of carbon affects the compound's reactivity, especially in substitution and elimination reactions, which is important in organic reaction mechanisms.

5. What is a functional group? How does it help in classification of organic compounds?

Answer:
A functional group is an atom or group of atoms that determines the characteristic chemical reactions of a compound. Examples include –OH (alcohol), –COOH (carboxylic acid), –CHO (aldehyde), and $–NH_2$ (amine). Functional groups classify organic compounds into categories like alcohols, ketones, acids, etc. They also affect the compound's physical and chemical properties. For instance, alcohols have hydrogen bonding due to –OH, making them more soluble in water. Identification of functional groups is crucial in naming, predicting reactivity, and understanding biological and industrial uses.

6. Explain homologous series with an example.

Answer:
A homologous series is a group of organic compounds having the same functional group and general formula, differing by a CH_2 unit. Each member shows similar chemical properties and a gradual change in physical properties like boiling point. For example, the alkane series: methane (CH_4), ethane (C_2H_6), propane (C_3H_8) differ by CH_2 but show similar

reactions like combustion. Homologous series helps in organizing organic compounds systematically and predicting the properties of unknown members in the series.

7. Write IUPAC naming rules for organic compounds with an example.

Answer:
IUPAC naming involves:

1. Identifying the longest carbon chain.
2. Numbering the chain from the end nearest to the functional group.
3. Naming and locating substituents.
4. Using prefixes and suffixes accordingly.

Example: $CH_3–CH_2–OH$ → Ethanol

- 2 carbon atoms = "eth"
- Saturated = "ane"
- –OH group = "ol" → hence "ethanol"

These rules provide a unique, systematic name for each compound, making chemical communication clearer across languages and disciplines.

8. Define isomerism in organic compounds with an example.

Answer:
Isomerism occurs when compounds have the same molecular formula but different structures or arrangements. Structural isomerism includes chain, position, and functional group isomerism. For example, C_4H_{10} can be butane (straight chain) or isobutane (branched chain), showing chain isomerism. Isomerism affects physical and chemical properties, such as boiling point or reactivity. It's vital in organic chemistry because many isomers can exist for the same formula, each with different applications and behaviors.

9. Compare physical and chemical properties of ethanol and ethanoic acid.

Answer:

Ethanol (CH_3CH_2OH) is a colorless, volatile liquid with a pleasant odor, soluble in water, and has a boiling point of 78.5°C. It undergoes combustion and can be oxidized to ethanoic acid.

Ethanoic acid (CH_3COOH) is a sour-smelling liquid (acetic acid), soluble in water, with a higher boiling point (~118°C) due to stronger hydrogen bonding. It reacts with bases and metals to form salts and releases hydrogen. Both have –OH groups but ethanoic acid also has a carbonyl group, making it acidic and more reactive in acid-base reactions.

10. What are soaps and detergents? How do they differ in their chemical nature?

Answer:

Soaps are sodium or potassium salts of long-chain fatty acids, made by saponification of fats/oils with alkali. They are biodegradable but ineffective in hard water.

Detergents are synthetic surfactants made from petroleum derivatives and work well in hard water. They have a sulfate or sulfonate group instead of carboxylate in soaps.

While both remove grease by emulsifying oils, detergents are preferred for laundry and industrial cleaning due to their efficiency in all water types. Soaps are better environmentally but less suitable in hard water conditions.