

# Nature of Carbon and Hydrocarbons

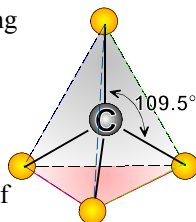
## Aim

- to describe bonding in carbon and the type of compounds it typically forms

## Notes

### Nature of Carbon

- ★ Family - Group 14
  - ☆ Metalloid - can bond with metals and nonmetals
  - ☆ Most active member of family
  - ☆ Electron configuration
    - ★ 4 valence electrons
    - ★ can bond with up to four elements at once
- ★ Bonding
  - ☆ forms compounds by covalent bonding
    - ★ single bond - one shared pair of electrons  $\text{-C-}$
    - ★ forms a regular tetrahedron
    - ★ double bond - two shared pairs of electrons  $\text{C=C}$
    - ★ triple bond - three shared pairs of electrons  $\text{-C}\equiv\text{C-}$
  - ☆ forms bonds with other elements or with other carbons
  - ☆ can form chains of carbon of unlimited length
    - ★ chains can be straight
    - ★ chains can be branched
    - ★ chains can be closed to form rings
- ★ The variety and complexity of carbon compounds is unlimited



### Characteristics of organic compounds

- ★ Formed as a result almost exclusively of covalent bonding
- ★ Generally nonpolar
- ★ Generally insoluble in water
  - ☆ usually soluble in nonpolar solvents (other organic compounds)
- ★ Nonelectrolytes except organic acids which are weak electrolytes

- ★ Have low melting points (due to weak intermolecular forces that hold them together)
- ★ Have slower reaction rates than inorganic compounds
  - ☆ covalent bonds within organic molecules are strong
  - ★ activation energies are high
  - ★ catalysts are often used to increase reaction rates

### Hydrocarbons

- ★ Definition - compounds composed of only hydrogen and carbon
- ★ Homologous series - group of organic compounds with similar properties and related structures (differ from each other by  $\text{CH}_2$ )
  - ☆ Aliphatic - hydrocarbon chains
    - ★ Saturated
      - ★ Definition - has no bonds that can be broken to add extra hydrogens
      - ★ called **Alkanes**
        - family of hydrocarbons with all single bonds
        - general formula  $\text{C}_n\text{H}_{2n+1}$
        - named with suffix "**ANE**"
    - ★ Unsaturated - has double or triple bonds that can be broken to add more hydrogens
      - ★ **Alkenes**
        - family of hydrocarbons with one double bond
        - general formula  $\text{C}_n\text{H}_{2n}$
        - named with suffix "**ENE**"
      - ★ **Alkynes**
        - family of hydrocarbons with one triple bond
        - general formula  $\text{C}_n\text{H}_{2n-2}$
        - named with suffix "**YNE**"

**Answer the questions below by circling the number of the correct response**

- Which formula may represent an unsaturated hydrocarbon?  
(1)  $C_2H_6$  (2)  $C_3H_6$  (3)  $C_4H_{10}$  (4)  $C_5H_{12}$
- In an homologous series, the second member has the formula  $C_3H_6$ . What is the formula of the fourth member of this series.  
(1)  $C_4H_8$  (2)  $C_4H_{10}$  (3)  $C_5H_{10}$  (4)  $C_5H_{12}$
- As the molecular mass of the compounds of the alkane series increases, their boiling point (1) decreases (2) increases (3) remains the same
- Which represents an unsaturated hydrocarbon? (1)  $C_2H_4$  (2)  $C_2H_6$  (3)  $C_3H_8$  (4)  $C_4H_{10}$
- Which is a saturated hydrocarbon? (1)  $C_3H_8$  (2)  $C_6H_6$  (3)  $C_2H_5OH$  (4)  $C_2H_4O_2$
- Which compound is a hydrocarbon? (1)  $R-CH_3$  (2)  $R-OH$  (3)  $R-COOH$  (4)  $R-Cl$
- Which molecule contains a triple covalent bond? (1)  $C_2H_2$  (2)  $C_2H_4$  (3)  $C_3H_6$  (4)  $C_3H_8$
- Which compound is a member of the alkane series? (1)  $C_2H_6$  (2)  $C_3H_6$  (3)  $C_4H_6$  (4)  $C_6H_6$
- The general formula for the alkyne series is (1)  $C_nH_n$  (2)  $C_nH_{n-2}$  (3)  $C_nH_{2n}$  (4)  $C_nH_{2n-2}$
- Which is the formula of a saturated hydrocarbon? (1)  $C_2H_2$  (2)  $C_2H_4$  (3)  $C_5H_8$  (4)  $C_5H_{12}$
- Which formula represents an unsaturated hydrocarbon? (1)  $C_3H_8$  (2)  $C_3H_7Cl$  (3)  $C_3H_6$  (4)  $CCl_4$
- The compound  $CH_3CH_2CH_2CH_3$  belongs to the series that has the general formula (1)  $C_nH_{2n-2}$ , (2)  $C_nH_{2n+2}$ , (3)  $C_nH_{n-6}$ , (4)  $C_nH_{n+6}$
- Which molecule contains a triple covalent bond between adjacent carbon atoms? (1)  $C_2H_4$  (2)  $C_2H_2$  (3)  $C_3H_6$  (4)  $C_3H_8$
- Each member of the alkane series differs from the preceding member by one additional carbon atom and (1) 1 hydrogen atom (2) 2 hydrogen atoms (3) 3 hydrogen atoms (4) 4 hydrogen atoms
- Which formula represents a saturated hydrocarbon? (1)  $C_2H_2$  (2)  $C_2H_4$  (3)  $C_3H_6$  (4)  $C_3H_8$
- Which formula represents a hydrocarbon with a double covalent bond? (1)  $CH_3Cl$  (2)  $C_2H_3Cl$  (3)  $C_2H_2$  (4)  $C_2H_4$
- Organic compounds differ from inorganic compounds in that organic compounds generally have (1) high melting points and are electrolytes, (2) high melting points and are nonelectrolytes, (3) low melting points and are electrolytes, (4) low melting points and are nonelectrolytes
- The compound  $C_2H_2$  belongs to the series of hydrocarbons with the general formula (1)  $C_nH_n$  (2)  $C_{2n}H_{2n}$  (3)  $C_nH_{2n-2}$  (4)  $C_{2n}H_{2n-2}$
- Which normal alkane has the highest boiling point at 1 atmosphere? (1)  $C_2H_4$  (2)  $C_3H_6$  (3)  $C_4H_8$  (4)  $C_5H_{10}$
- Which element is composed of atoms that can form more than one covalent bond with each other? (1) hydrogen (2) helium (3) carbon (4) calcium