CHAPTER 1 ORGANIC COMPOUNDS

Reflect on Your Learning

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1. (Sample response) Stain remover: nontoxic, soluble in water and fats and oils, not flammable, no unpleasant odours, liquid or solid at room temperatures, colourless, biodegradable.
2. (Sample response) They are similar in structure, similar in types of atoms, similar in size, similar in chemical reactivity.
3. • Solubility: "like dissolves like," compounds that have large nonpolar components tend to be soluble in nonpolar solvents, and compounds that have small nonpolar components and polar groups such as C=O, OH, or NH groups tend to be soluble in polar solvents.
   • Melting and boiling points: compounds with strong intermolecular attractions tend to have higher melting and boiling points as more energy is required to separate the molecules.
4. (Sample response) "Organic" means made by plants or animals; compounds that contain carbon atoms; grown without use of synthetic materials.

Try This Activity: How Do Fire-Eaters Do That?

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(a) A relatively cool-burning fuel is used, and the fire-eater takes care always to stay below the flame, as the photograph shows.

1.1 FUNCTIONAL GROUPS

PRACTICE

Understanding Concepts

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1. A functional group is a structural arrangement of atoms that, because of their electronegativity and bonding type, imparts particular characteristics to the molecule.
2. Yes, C=C and C=C bonds are more reactive than C—C bonds because the second and third bonds formed are weaker than the first single bond formed, and are thus more readily broken, making the multiple bonds more reactive.
3. A polar molecule would have a boiling point higher than that of a less polar molecule; polar molecules have stronger intermolecular attractions, requiring more energy (higher temperatures) to separate them.
4. Functional groups can contain:
   • carbon–carbon multiple bonds, which are more reactive than single C–C bonds;
   • single bonds between carbon and more electronegative atoms (e.g., O, N, or a halogen atom), which result in polar bonds and consequently, hydrogen bonding;
   • carbon double-bonded to oxygen, making a strongly polarized bond.

SECTION 1.1 QUESTIONS

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Understanding Concepts

1. (a) The functional group raises the melting and boiling points of a compound because increased polarity of the molecule increases the intermolecular forces of attraction, requiring more energy to separate the molecules.
   (b) The functional group increases the solubility in polar solvents because —OH and —NH groups allow increased hydrogen bonding with polar solvent.
2. (a) —OH group; high solubility in water
   (b) carbon–carbon double bond; low solubility in water
   (c) carbonyl group C=O; high solubility in water
   (d) —OH group and carbonyl group C=O; high solubility in water

3. (a) H_2O, NH_3, CH_4
   (b) Water and ammonia are mutually soluble, methane is not soluble in the other two; electronegativity values of O, N, C, and H are 3.5, 3.0, 2.5, and 2.1, respectively. Thus, the O–H and N–H bonds in water and in ammonia are more polar than C–H bonds in methane. The polar bonds in water and ammonia allow them to form hydrogen bonds; thus, they are soluble in each other.
   (c) All three compounds are produced by living organisms (e.g., water by animals and plants, ammonia and methane by bacteria) and may be considered "organic" by the definition that a substance is organic if produced by a living organism. By the chemical definition of "organic" being compounds of carbon, only methane is organic.

1.2 HYDROCARBONS

PRACTICE

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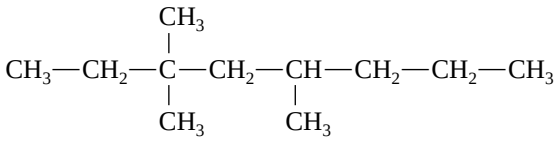
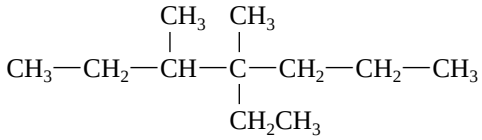
Understanding Concepts

1. (a) 4-ethyl-2,3,5-trimethylheptane
   (b) 3,7-dimethylnonane
   (c) 3,5,7-trimethyldecane
   (d) 1,4-dimethylcyclohexane
2. (a)



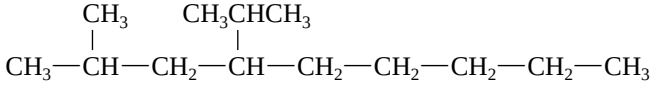
3,3,5-trimethyloctane

(b)



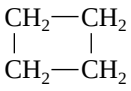
3,4-dimethyl-4-ethylheptane

(c)



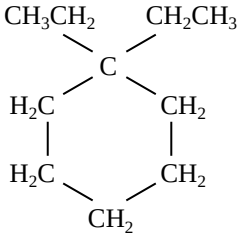
2-methyl-4-isopropylnonane

(d)



cyclobutane

(e)



1,1-diethylcyclohexane