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## CHAPTER 22 CHAPTER ASSESSMENT

## Hydrocarbons

## Reviewing Vocabulary

In the space at the left, write the word or phrase in parentheses that correctly completes the statement.

- alkyne \_\_\_\_\_
- saturated \_\_\_\_\_
- structural isomers \_\_\_\_\_
- Optical \_\_\_\_\_
- Branched-chain \_\_\_\_\_
- aromatic \_\_\_\_\_
1. A hydrocarbon that has one or more triple covalent bonds between carbon atoms is called an (alkene, alkyne).
  2. All the carbon atoms are connected to each other by single bonds in (saturated, unsaturated) hydrocarbons.
  3. Isomers in which the atoms are bonded in different orders are known as (structural isomers, stereoisomers).
  4. (Geometric, Optical) isomers result from different arrangements of four different groups about the same carbon atom.
  5. (Straight-chain, Branched-chain) alkanes contain carbon atoms that are bonded to more than two other carbon atoms.
  6. Organic compounds that contain benzene rings are called (aromatic, aliphatic) compounds.
  7. All organic compounds contain the element *nitrogen*.
  8. Butane, pentane, and hexane are members of one *homologous series*.
  9. A *molecular* formula shows the structure of a hydrocarbon but saves space by not showing how the hydrogen atoms branch off the carbon atoms.
  10. A carcinogen is a substance that causes *cancer*.
  11. Compounds that exist in right and left forms have a property called *chirality*.
  12. In the process called cracking, *lighter* fractions of petroleum are converted into gasoline.
  13. Isomers have the same molecular formula but different *molecular structures*.

In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.

- carbon \_\_\_\_\_
- true \_\_\_\_\_
- condensed structural \_\_\_\_\_
- true \_\_\_\_\_
- true \_\_\_\_\_
- heavier \_\_\_\_\_
- true \_\_\_\_\_

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## CHAPTER 22 CHAPTER ASSESSMENT

## Understanding Main Ideas (Part A)

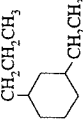

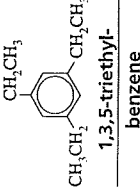
Circle the letter of the choice that best completes the statement.

1. Hydrocarbons contain only
  - a. carbon.
  - b.** carbon and hydrogen.
  - c. carbon, hydrogen, and oxygen.
  - d. hydrogen and oxygen.
2. In a branched alkane, each branch attached to the main chain is called a(n)
  - a. asymmetric carbon.
  - b. cycloalkane.
  - c.** acetylene group.
  - d.** substituent group.
3. Cyclohexane is an example of
  - a. a straight-chain alkane.
  - b. a parent chain.
  - c.** a cyclic hydrocarbon.
  - d. an alkene.
4. In polarized light, the light waves vibrate in
  - a.** one plane.
  - b. two planes.
  - c. three planes.
  - d. all possible planes.
5. The boiling of petroleum to separate components is called
  - a. cracking.
  - b. knocking.
  - c.** fractional distillation.
  - d. optical rotation.

Circle the letter of the correct name for each of the following structures.

6.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ 
  - a. propane
  - b.** pentane
  - c. hexane
7.  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$ 
  - a.** 2-pentene
  - b. 3-pentene
  - c. 4-pentene
8.  $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CCH}_3$ 
  - a. 4-pentyne
  - b. 3-pentene
  - c.** 2-pentyne

Use the IUPAC rules to name the following structures.

9.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$   
3-methylheptane
10.  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$   
4-ethyl-2-octene
11.   
1-ethylcyclohexane
12.   
1,2-dimethylcyclohexane
13.   
1,3,5-triethylbenzene

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### Understanding Main Ideas (Part B)

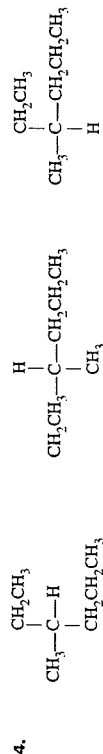
Answer the following questions.

- Why are there so many different organic compounds?  
Organic compounds contain carbon, and each carbon atom can form four covalent bonds with carbon or other elements. As a result, carbon atoms can form long chains and an unlimited number of complex, branched structures.
- How does the sharing of electrons between carbon atoms in hexane differ from that in benzene?  
In hexane, each carbon atom shares a pair of electrons with the carbon atom or atoms it is bonded to. In benzene, electrons are delocalized, or shared by all six carbon atoms in the ring.

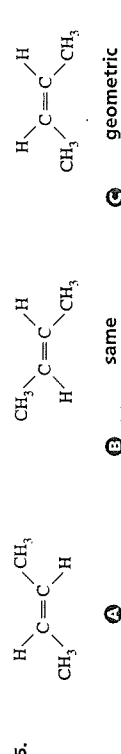
Compare structures A, B, and C in each of the following groups. If B represents the same compound as A, write *same*. If B is an isomer of A, write the type of isomer (geometric, optical, or structural). Do the same for C.



**A**  **B**  structural  **C**  same



**A**  **B**  same  **C**  optical



**A**  **B**  same  **C**  geometric

### Thinking Critically

Suppose a fractional distillation tower is set up to separate petroleum into four fractions. The boiling ranges of these fractions are shown in Table 1. The boiling points of several straight-chain alkanes are shown in Table 2. Use the information in these tables to answer questions 1 and 2.

Table 1

Fraction	Boiling Range (°C)
1	below 40
2	40–100
3	101–275
4	above 275

Table 2

Name	Molecular Formula	Boiling Point (°C)
Methane	CH <sub>4</sub>	-162
Propane	C <sub>3</sub> H <sub>8</sub>	-42
Pentane	C <sub>5</sub> H <sub>12</sub>	36
Hexane	C <sub>6</sub> H <sub>14</sub>	69
Heptane	C <sub>7</sub> H <sub>16</sub>	98
Octane	C <sub>8</sub> H <sub>18</sub>	126
Decane	C <sub>10</sub> H <sub>22</sub>	174
Pentadecane	C <sub>15</sub> H <sub>32</sub>	266
Hexadecane	C <sub>16</sub> H <sub>34</sub>	280

1. Which of the alkanes listed in Table 2 would you expect to find in each fraction?

Fraction 1: **methane, propane, pentane** Fraction 3: **octane, decane, pentadecane**

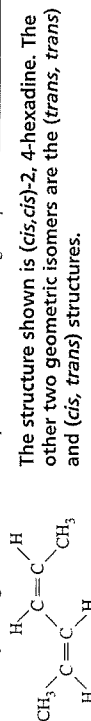
Fraction 2: **hexane, heptane** Fraction 4: **hexadecane**

2. In which fraction would you expect to find each of the following straight-chain alkanes, which are not listed in Table 2?

nonane **Fraction 3** ethane **Fraction 1** icosane (C<sub>20</sub>H<sub>42</sub>) **Fraction 4**

Answer the following questions.

3. How many other geometric isomers are possible for the following compound? **2**



4. Would it be more difficult to distinguish between samples of two structural isomers or samples of two optical isomers? Explain.

It would be more difficult to distinguish between two optical isomers. Structural isomers differ in many chemical and physical properties. Optical isomers differ only in their rotation of polarized light and in chemical reactions where chirality is important.