Name KEY Date _____ Class _____

CHAPTER 22 STUDY GUIDE FOR CONTENT MASTERY

Hydrocarbons

Section 22.1 Alkanes

In your textbook, read about organic chemistry, hydrocarbons, and straight-chain alkanes.

Use each of the terms below just once to complete the passage.

hydrocarbons	homologous series	organic compounds	straight-chain alkanes

Most compounds that contain carbon are known as **(1)** organic compounds. The simplest group of such compounds are **(2)** hydrocarbons, which contain only carbon and hydrogen. If all of the carbon atoms are linked by single covalent bonds and there are no branches, the compounds are called **(3)** straight-chain alkanes. Ethane, propane, and butane are three examples. They are members of one **(4)** homologous series because they differ from each other by a repeating unit (— CH_2 —).

In your textbook, read about branched-chain alkanes and naming them.

For each statement below, write *true* or *false*.

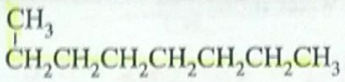
True **5.** The ability of carbon atoms to bond to two, three, or four other carbon atoms makes possible a variety of branched-chain alkanes.

True **6.** A carbon atom or group of carbon atoms that branch off the main hydrocarbon chain of an alkane is a substituent group.

False **7.** A skeletal formula is a way of representing an organic compound by showing only the ~~hydrogen~~ carbon atoms.

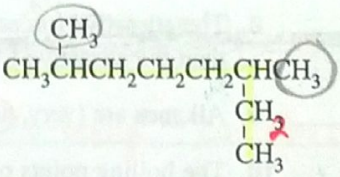
Use the IUPAC rules to name the following structures.

8.



octane

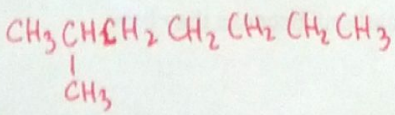
9.



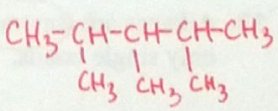
2,6-dimethyl octane

Draw the structure of each of the following alkanes.

10. 2-methylheptane



11. 2,3,4-trimethylpentane



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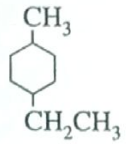
Section 22.2 Cyclic Alkanes and Alkane Properties

In your textbook, read about cycloalkanes.

For each item in Column A, write the letter of the matching item in Column B.

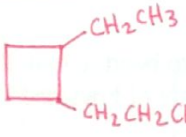
Column A	Column B
b 1. A simplified way of representing an organic compound by showing only the carbon-carbon bonds	a. *cyclo-*
c 2. A way of representing an organic compound that saves space by not showing how the hydrogen atoms branch off the carbon atoms	b. condensed structural formula
a 3. Indicates that a hydrocarbon has a ring structure	c. line structure
d 4. A hydrocarbon that has a ring of carbon atoms in its structure	d. cyclic hydrocarbon

Use the IUPAC rules to name the following structure.

5. 

1-ethyl-4-methyl cyclohexane

Draw the structure of the following cycloalkane.

6. 1-ethyl, 2-propylcyclobutane 

In your textbook, read about the properties of alkanes and multiple carbon-carbon bonds.

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

C–C
C–H

_____ 7. All the bonds in an alkane are (polar, nonpolar).

_____ 8. The attractive forces between alkane molecules are (stronger, weaker) than the attractive forces between alkane and water molecules.

_____ 9. Alkanes are (very, not very) soluble in water.

_____ 10. The boiling points of alkanes (increase, decrease) with increasing molecular mass.

_____ 11. The chief chemical property of alkanes is their (low, high) reactivity.

_____ 12. Alkanes are often used as (solvents, fuels) because they readily undergo combustion in oxygen.

_____ 13. Alkanes are (saturated, unsaturated) hydrocarbons because they have only single bonds.

Section 22.3 Alkenes and Alkynes

In your textbook, read about alkenes, alkynes, and naming alkynes.

Use the following words to complete the statements.

alkene	alkyne	electron density	ethene	ethyne

1. An alkyne is a hydrocarbon that has one or more triple covalent bonds between carbon atoms.
2. The unsaturated hydrocarbon ethene is the starting material for the synthesis of the plastic polyethylene.
3. An alkene is a hydrocarbon that has one or more double covalent bonds between carbon atoms.
4. Torches used in welding burn ethyne, which is commonly called acetylene.
5. Alkenes and alkynes are more reactive than alkanes because double and triple bonds have greater electron density than single bonds have.

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

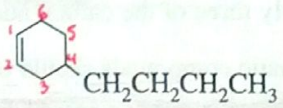
6. $CH_3CH_2CH{=}CHCH_2CH_2CH{=}CH_2$
   - **a.** 1,5-octadiene
   - **b.** 3,7-octadiene
   - **c.** 4,8-dioctene

7. $CH_3CH_2C{\equiv}CCH_2CH_3$
   - **a.** 3-hexene
   - **b.** 3-hexyne
   - **c.** 3-pentyne

Use the IUPAC rules to name the following structures.

8. $CH_3CH{=}C(CH_3)CHCH_3$ (CH₃ on C3; CH₃ on C4)

   4,4-dimethyl-2-pentene

9. 

   4-butyl-cyclohexene

10. $CH_3CH_2CH_2CH(CH_2CH_3)CH_2C{\equiv}CCH(CH_2CH_3)CH_2CH_3$

    3,7-diethyl-4-decyne

11. $CH_3CH(CH_3)CH_2CH(CH_2CH_2CH_3)CH_2CH_2CH{=}CHCH_3$ (CH₂CH₃ on C6)

    6-ethyl-8-methyl-5-propyl-2-nonene

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Section 22.5 Aromatic Hydrocarbons and Petroleum

In your textbook, read about the structure of benzene and aromatic compounds.

Use the following words to complete the statements.

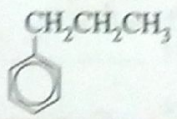
aliphatic compounds	aromatic compounds	carcinogens

1. Substances that cause cancer are called carcinogens.
2. Alkanes, alkenes, and alkynes are examples of aliphatic compounds
3. All aromatic compounds contain benzene rings as part of their structure.

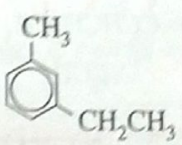
Circle the letter of the choice that best completes the statement or answers the question.

4. What is the molecular formula of benzene?
   a. C_6H_6 b. C_6H_{12} c. C_6H_{14} d. $C_{12}H_{12}$
5. Which of the following is the best way to represent the structure of benzene?
   a.  b.  c.  d. 
6. Compared to alkenes and alkynes of similar size, benzene is
   a. less reactive.
   b. about as reactive.
   c. slightly more reactive.
   d. much more reactive.
7. The electrons in the ring of an aromatic compound are
   a. held tightly by one carbon nucleus.
   b. localized between specific carbon nuclei.
   c. shared equally by all of the carbon nuclei.
   d. shared by only three of the carbon nuclei.
8. The use of aromatic compounds should be limited because many of them
   a. produce chimney soot.
   b. can cause health problems.
   c. have pleasant smells.
   d. cannot be synthesized.

Use the IUPAC rules to name the following structures.

9. 

propyl benzene

10. 

1-ethyl-3-methyl benzene

Section 22.5 *continued*

In your textbook, read about natural sources of hydrocarbons and rating gasolines.

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

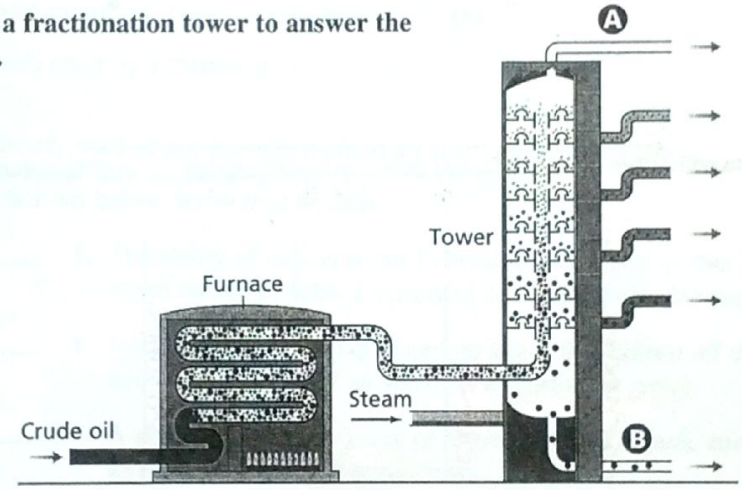
_____ **11.** (Petroleum, Natural gas) is a mixture of alkanes, aromatic hydrocarbons, and organic compounds containing sulfur or nitrogen atoms.

_____ **12.** The boiling of petroleum and collection of its components is called (sedimentation, fractional distillation).

_____ **13.** In the process known as (cracking, knocking), heavier petroleum fractions are converted to gasoline by breaking their large molecules into smaller ones.

_____ **14.** A gasoline's ability to burn evenly and prevent knocking is expressed by its (hexane, octane) rating.

Use the diagram of a fractionation tower to answer the following questions.



15. How does the temperature inside the tower vary from bottom to top?

Temperature is hottest at the bottom and coolest at the top.

16. In what physical state is the material collected from pipe A? gas

17. What is the material collected from pipe A used for?

gases for fuel (methane, propane, butane) and raw material for plastics manufacture (ethane)

18. What is the material collected from pipe B used for?

Tar, asphalt, paraffin

19. Which pipe, A or B, collects hydrocarbons with higher boiling points? B

20. Which pipe, A or B, collects smaller hydrocarbons? A