CHAPTER 13 Review

Reflecting on Chapter 13

Summarize this chapter in the format of your choice. Here are a few ideas to use as guidelines:

- Identify the origins and sources of hydrocarbons and other organic compounds.
- Describe the characteristics that enable carbon to form so many, varied compounds.
- Distinguish among complete, condensed, and line structural diagrams.
- Identify, draw, and name at least two examples of each kind of hydrocarbon you studied: alkanes, alkenes, alkynes, and cyclic hydrocarbons.
- Demonstrate, using suitable examples, true isomers of a hydrocarbon.
- Compare physical properties, such as boiling point, of aliphatic compounds.
- Describe the processes and techniques that the petrochemical industry depends on. Identify at least ten products of this industry.

Reviewing Key Terms

For each of the following terms, write a sentence that shows your understanding of its meaning.

aliphatic hydrocarbons	alkanes
alkenes	alkynes
cis-trans isomer	cracking
cyclic hydrocarbons	expanded molecular formula
fractional distillation	geometric isomer
homologous series	isomers
hydrocarbons	organic compound
petrochemicals	petroleum
reforming	saturated hydrocarbons
structural diagram	structural model
unsaturated hydrocarbons	

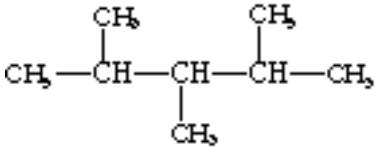
Knowledge/Understanding

1. **(a)** What are the origins of most hydrocarbons and other organic compounds?
   (b) List three sources of hydrocarbons.
   (c) What is the main source of hydrocarbons used for fuels?
2. List three factors that are required to change biological matter into petroleum.
3. What are the key properties of the carbon atom that allow it to form such diverse compounds?
4. Define the following terms: fractional distillation, petrochemical.
5. What are isomers? Give one example of a set of isomers for a molecular formula.
6. Describe how the boiling point changes as the chain length of an aliphatic compound increases. Explain why this happens.
7. Briefly compare alkanes, alkenes, and alkynes. (Give both similarities and differences.)
8. Describe the difference between structural isomers and cis-trans isomers.
9. Name each compound.

(a) $CH_3—CH_2—CH_2—CH_3$

(b) $CH_3—CH_3$

(c)



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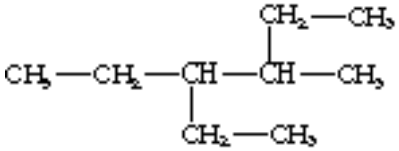
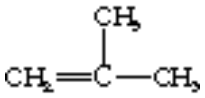


10. For each structural diagram, write the IUPAC name and identify the type of aliphatic compound.

(a)



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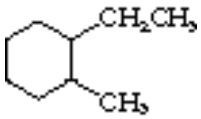

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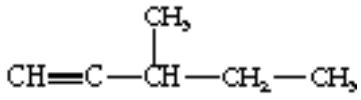

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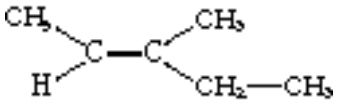

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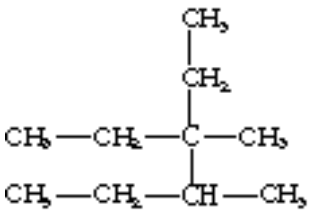
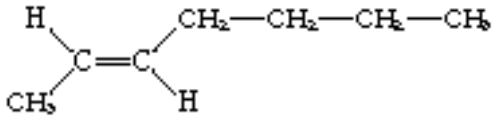
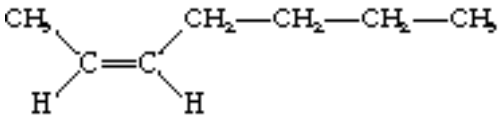


11. Name the following isomers of 2-heptene.

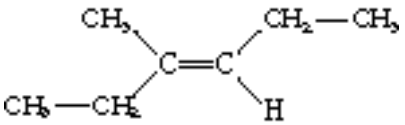




12. Match the following names and structural diagrams. Note that only four of the six names match.

(a) cis-3-methyl-3-hexene
(b) trans-3-hexene
(c) trans-3-methyl-2-hexene
(d) trans-3-methyl-3-hexene
(e) cis-3-methyl-2-hexene
(f) cis-3-hexene

(A)



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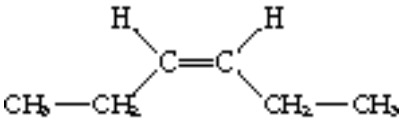

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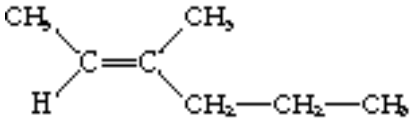

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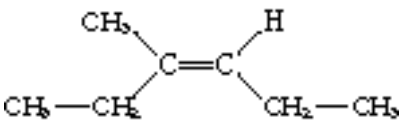


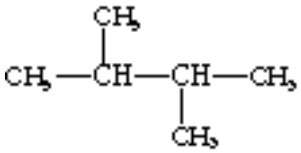
13. Is 1-methyl-2-cyclobutene the correct name for a compound? Draw the structural diagram for the compound, and rename it if necessary.

14. Explain why the rule "like dissolves like" is very useful when cleaning up an oil spill on a body of water.

15. Why is it impossible for the correct name of a linear alkane to begin with 1-methyl?

16. Which combinations of the following structural diagrams represent true isomers of ? Which structural diagrams represent the same isomer?

(a)



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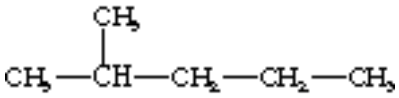

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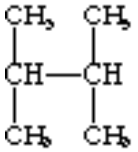

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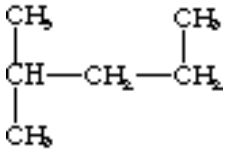

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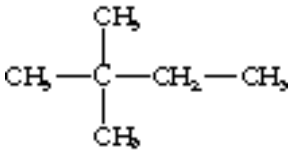

Inquiry

17. Someone has left two colourless liquids, each in an unlabelled beaker, on the lab bench. You know that one liquid is an alkane, and one is an alkene. Describe a simple test that you can use to determine which liquid is which.

18. Suppose that you were given a liquid in a beaker labelled "." Discuss how you would determine whether the substance was an alkane, a cycloalkane, an alkene, or an alkyne.

19. In Investigation 13-C, you constructed cyclobutane. In order to construct this isomer, you had to use springs for bonds.

(a) Why did you have to use springs?
(b) What do you think the bulging springs tell you about the stability of cyclobutane in real life?

Communication

20. Draw a complete structural diagram for each of these compounds.

(a) 3-ethylhexane
(b) 1-butene
(c) 2,3-dimethylpentane

21. Draw a condensed structural diagram for each of these compounds.
(a) methylpropane
(b) 1-ethyl-3-propylcyclopentane
(c) cis-3-methyl-3-heptene
(d) 3-butyl-4-methyl-1-octyne
(e) 4-ethyl-1-cyclooctene

22. (a) Draw four structural isomers of .
(b) Draw four cis-trans isomers of

23. In a fractionation tower, the gaseous fractions are removed from the top and the solid residues are removed from the bottom.
(a) Explain why the fractions separate like this.
(b) A sample of crude oil was tested and found to contain mostly smaller hydrocarbon molecules, less than 15 carbon atoms long. From what part of the tower would most of the fractions of this sample be removed? Why?

24. Use a diagram to describe the steps involved in refining petroleum to obtain gasoline.

25. Draw a concept map to illustrate how hydrocarbon molecules can start as crude oil and end up as synthetic rubber.

26. Imagine that you are the owner of an oil refinery. Your main supply of crude oil contains a high percent of longer-chain hydrocarbons (greater than 15 carbon atoms per molecule). A new customer is looking for a large supply of gasoline, which contains 7- and 8-carbon molecules. How will you meet your customer's needs?

27. Place the following alkanes in order from lowest to highest boiling point. Explain your reasoning.

(a) $CH_3—CH_2—CH_2—CH_2—CH_3$

(b) $CH_3—CH_2—CH_3$

(c) $CH_3—\underset{\displaystyle CH_3}{\underset{|}{CH}}—CH_3$

(d) $CH_3—CH_2—CH_2—CH_3$

28. Draw the complete, condensed, and line structural diagrams for 2,3,4-trimethylpentane. Discuss the main advantange of each type of structural diagram.

Making Connections

29. List two ways in which ethene is important in everyday life.

30. Research the similarities and differences in drilling for oil offshore versus onshore. Write a report of your findings.

31. The National Energy Board has estimated that Canada's original petroleum resources included (430 billion cubic metres) of oil and bitumen (a tar-like substance) and (170 trillion cubic metres) of natural gas. Canada's petroleum-producing companies have used only a small fraction of these resources. Why, then, do you think many people are so concerned about exhausting them?

Answers to Practice Problems and Short Answers to Section Review Questions:

Practice Problems: **1.** **2.** **3.** 10 **4.** 25
5.(a) 2-methylbutane **(b)** 2,2-dimethylpropane **(c)** 3-ethyl-2,5-dimethylheptane **(d)** 2,2,4,4-tetramethylhexane **(e)** 2,2,4-trimethyl-4-propyloctane **7.(a)** 2,4-dimethylhexane **(b)** 2,3-dimethylhexane **(c)** 3-ethyl-3-methylhexane **8.(a)** 3-hexene **(b)** 3-propyl-2-heptene **(c)** 4-ethyl-2,3-dimethyl-4-octene **10.** 2-butene, 1-butene, 2-methyl-1-propene **11.** cis-2-pentene, trans-2-pentene **14.** cis-2-hexene, trans-2-hexene; cis-3-hexene, trans-3-hexene; 3-methyl-cis-2-pentene, 3-methyl-trans-2-pentene; 4-methyl-cis-2-pentene, 4-methyl-trans-2-pentene **15.(a)** 4,4-dimethyl-2-pentyne **(b)** 3-ethyl-5-methyl-3-propyl-1-hexyne **17.(a)** 1-ethyl-3-methylcyclopentane **(b)** 1,2,3,4-tetramethylcyclohexane **(c)** methylcyclobutane **(d)** 3-methyl-5-propyl-1-cyclopentene **(e)** 4-methyl-1-cyclooctene **(f)** 5-ethyl-3,4-dimethyl-1-cyclononene **(g)** 3,5-diethyl-1-cyclohexene **(h)** 1-methyl-2-pentylcyclopentane **13.1:** **5.(a)** organic **(b)** organic **(c)** inorganic **(d)** inorganic **(e)** organic **(f)** inorganic **(g)** organic **(h)** inorganic
13.3: **1.(a)** alkane, alkene, alkyne **2.** meth (1), eth (2), prop (3), but (4), pent (5), hex (6), hept (7), oct (8), non (9), dec (10) **4.(a)** 3-ethyl-2,4-dimethylhexane **(b)** 2,4,4-trimethyl-1-pentene **(c)** 4-ethyl-3-propyl-1-hexyne **(d)** 2-ethyl-3,4,5,6-tetramethyl-1-cycloheptene **6.(a)** propyne, cyclopropene **(b)** pentane, 2-methylbutane, 2,2-dimethylpropane **(c)** 1-pentene, cis-2-pentene, trans-2-pentene, 2-methyl-2-butene, 2-methyl-1-butene, cyclopentane **13.4:** **1.(a)** boiling point **(b)** fractional distillation