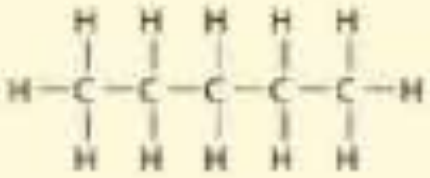
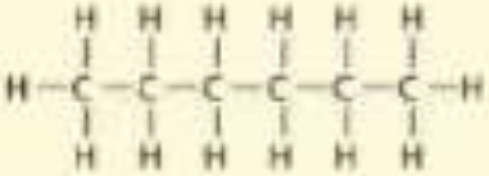
Sample Problems

1.



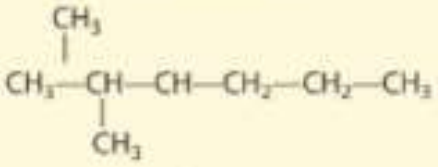


2. 10 single bonds

3. **a.** 3-ethylhexane **b.** 2-methylbutane

4. 4-ethyl-2-methylheptane

5.



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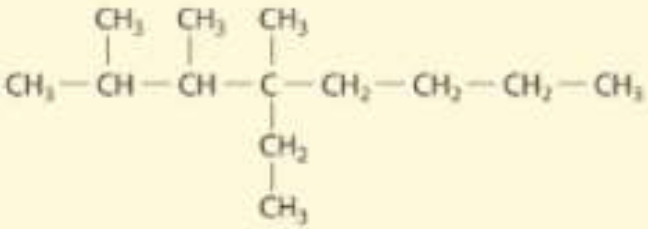


7. because a carbon atom contains four valence electrons

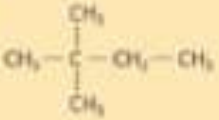
8. in a straight chain or in a chain with branches

9. The nonpolar hydrocarbons in mineral oil will not form a solution with a polar compound such as water.

10. **a.**

b.

11.



12. **a.** propane

b. 2,3-dimethylpentane

13. **BIG IDEA** Alkanes are nonpolar.

14. At least one carbon-carbon bond in an alkene is a double bond. Other bonds may be single C–C bonds or C–H bonds.

15. An alkyne contains at least one carbon-carbon triple bond. Other bonds may be single or double C–C bonds or C–H bonds.

16. Saturated hydrocarbons have the maximum number of hydrogen atoms per carbon. Unsaturated hydrocarbons have fewer hydrogen atoms per carbon

17. The boiling points are similar for hydrocarbons with the same number of carbon atoms.

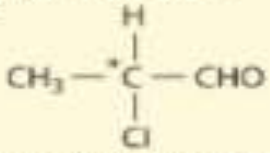
18.

ethene ethyne

Ethene is planar. Ethyne is linear.

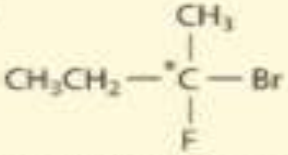
FIGURE 22.9 The groups are on opposite sides of the double bond in the *trans* configuration; the groups are on the same side of the bond in the *cis* configuration.

19. a.



b. no asymmetric carbon

20. a.

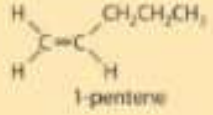


b. no asymmetric carbon

21. Constitutional isomers are different compounds with different physical properties.

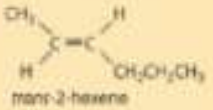
22. *cis-trans* isomers and enantiomers

23. a.

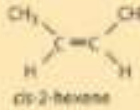


1-pentene

b.

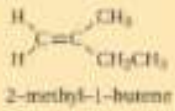


trans-2-hexene



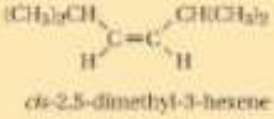
cis-2-hexene

c.

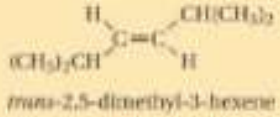


2-methyl-1-butene

d.



cis-2,5-dimethyl-3-hexene



trans-2,5-dimethyl-3-hexene

24. Both types of isomers have the same molecular formula but different molecular structures. Constitutional isomers differ in the order the atoms are joined; stereoisomers differ in the way the atoms are arranged in space.

25. It has four different substituents.

26. Answers will vary.

27. Isomers
    Constitutional isomers
    Stereoisomers (cis-trans isomers & enatiomers)

28. In a cyclic hydrocarbon, the carbon chain is in the form of a ring.

29. In benzene, the bonding electrons between carbon atoms are shared evenly around the ring.

30. a. ethylbenzene
b. 1-ethyl-3-propylbenzene
c. phenylbenzene

31. The suffix -ene indicates the presence of a double bond, but the bonds in the rings in aromatic compounds are hybrid bonds, not alternating single and double bonds.

32. **BIG**IDEA Hexane is a straight-chain, aliphatic, saturated hydrocarbon. 1-hexene is a straight-chain, aliphatic, unsaturated hydrocarbon. Cyclohexane is a cyclic, aliphatic, saturated hydrocarbon. Benzene is an aromatic hydrocarbon, which is unsaturated, by definition.

33. alkanes of low molar mass

34. The refining process starts with the distillation of petroleum into fractions according to boiling point.

35. hardness and carbon content

36. For complete combustion, the products are carbon dioxide and water. For incomplete combustion, carbon monoxide and soot form in addition to carbon dioxide and water.

37. Amounts of products obtained by fractional distillation don't match demands. Cracking breaks down hydrocarbons into smaller, more useful components.

38. sample answers: petroleum: paints and plastics; coal: ammonia fertilizer

39. Heat, pressure, and bacteria changed marine organisms buried in ocean sediments into petroleum and natural gas. Heat and pressure changed buried layers of vegetation into coal.

40. Natural gas largely consists of lighter alkanes such as methane, ethane, propane, and butane. Coal consists largely of aromatic compounds of extremely high molar mass. Petroleum consists largely of hydrocarbons that fall between those of natural gas and coal.