Chapter 8 Organic Chemistry

8.1 Simple Hydrocarbons and Isomerism

(p. 402) Warm Up:

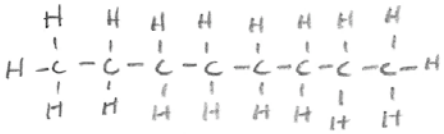
1. 

2. 4 valence electrons

3. a) ionic - inorganic
   b) covalent - organic
   c) covalent - inorganic
   d) ionic - inorganic
   e) covalent - organic

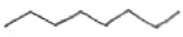
(p. 404) Practice Problems

1. structural:

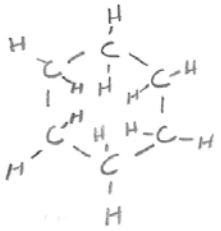


condensed structural: $CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$

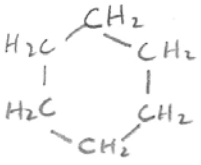
carbon skeletal:



2.



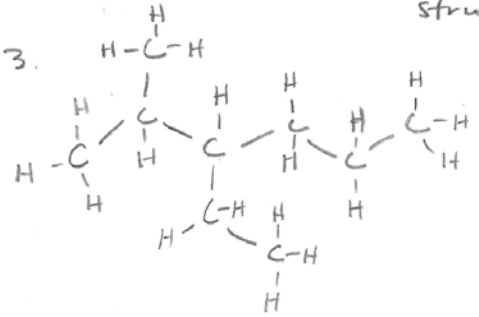
structural

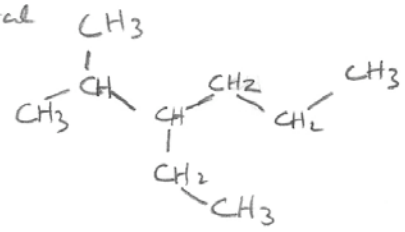


condensed structural

carbon skeletal

3.



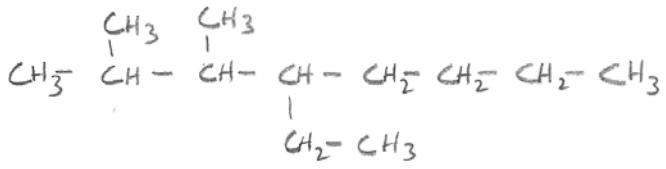


(p. 407) Practice Problems - Naming a Simple Alkane

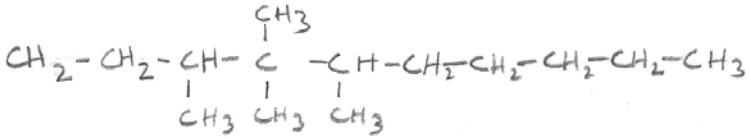
1 a) 2,3,4 - trimethylpentane

b) 2,2,4- trimethyl pentane

2.



3.

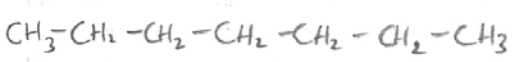


(p. 409) Quick check

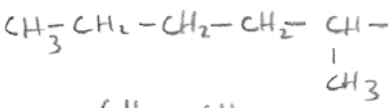
1. $C_{12}H_{26}$
2. Because the carbon atoms can be arranged in many different ways; in chains, branches and rings.

3,4(many answers possible)

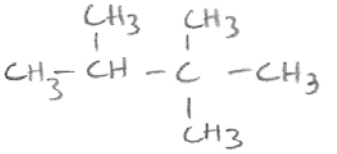
For example:



heptane

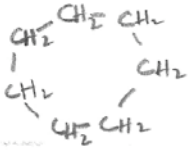


2-methylhexane



2,2,3 - trimethylbutane

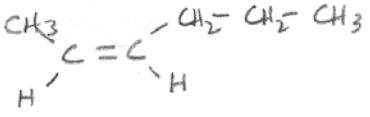
(p. 411) Quick check

1. C_7H_{14}
2.  C_7H_{14}
3. 1-methyl-2-ethyl cyclo hexan
4. (See next page)

Quick Check (cont).

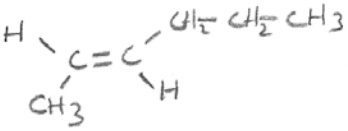
4.

C_6H_{12}



C_6H_{12}

cis-2-hexene



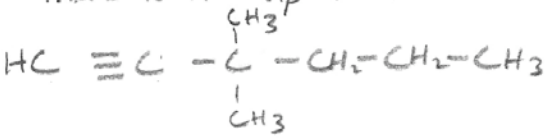
C_6H_{12}

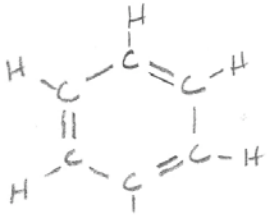
trans-2-hexene

(p. 413) Quick Check

1. C_8H_{14}

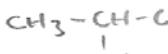
2. No - there is no up or down side on a triple bond.

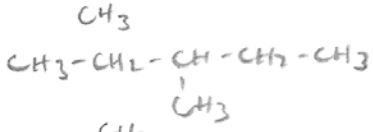
3. 

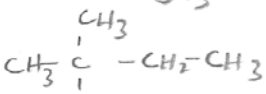
4. 

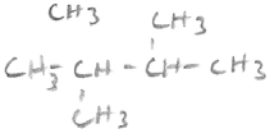
(p. 414) Activity - Building and Naming Structural Isomers

1. $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$

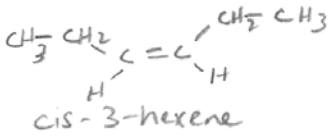
3.  2-methylpentane

 3-methylpentane

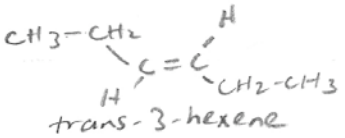
 2,2-dimethylbutane

 2,3-dimethylbutane

4. 5

5. 

cis-3-hexene

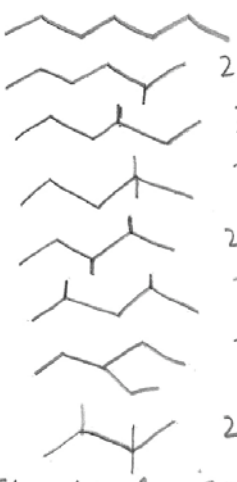


trans-3-hexene

(p. 415) 8.1 Review Questions

1. A condensed structural formula shows H atoms. A carbon skeleton formula does not.

ex. $CH_3-CH_2-CH_3$ 

2. 

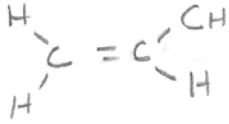
heptane
2-methylhexane
3-methylhexane
2,2-dimethylpentane
2,3-dimethylpentane
2,4-dimethylpentane
3-ethylpentane
2,2,3-trimethylbutane

3. Structural isomers - organic molecules with the same chemical formula but a different placement of atoms.
geometric isomer - organic molecules with the same structure but different orientation across the double bond.

ex. C_6H_{12}

structural isomers: 2-methylhexene and 3-methylhexene

geometric isomers: cis-3-hexene and trans-3-hexene

4. 

no - because of the 2 H atoms on the first C atom

5. a) cis b) trans c) cis

6. Saturated - molecules that don't contain any double or triple bonds.

7. unsaturated - molecules that contain double or triple bonds. Alkenes, alkynes and aromatics are unsaturated.

8 a) cycloalkane or alkene

b) alkane

c) alkyne

d) aromatic

9 a) trans-3-heptene

b) 1,3,5-trimethylcyclohexane

c) 3,4,4,5-tetraethylheptane

d) 4-methyl-1-cyclopentyne

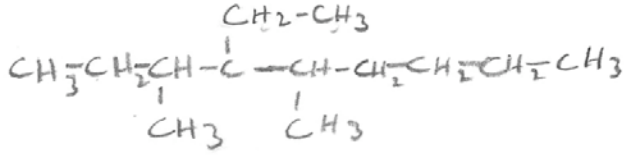
e) 1,4-diethyl-2-methylbenzene

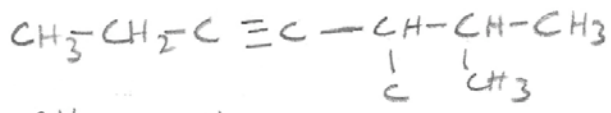
f) 4-ethyl-2,6-dimethylheptane

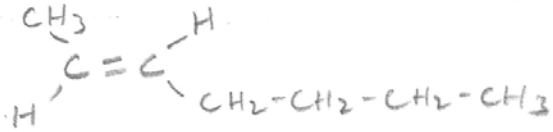
g) 3-methyl-2-hexene

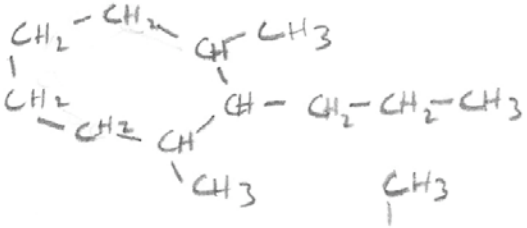
h) 3-ethyl-4-methyl-1-hexyne

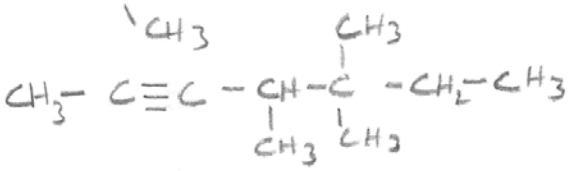
10.

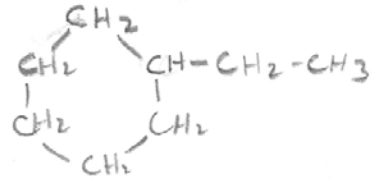
a) 

b) 

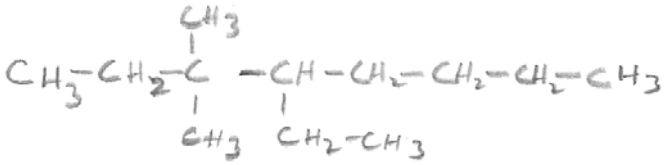
c) 

d) 

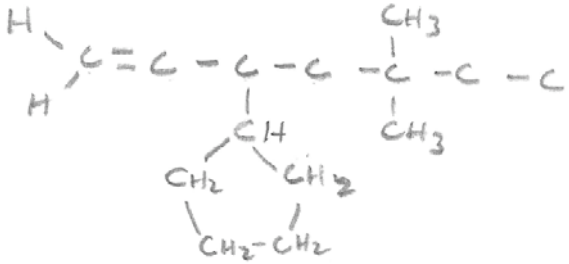
e) 

f) 

g)



h)

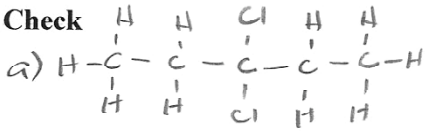


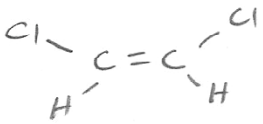
Continued…

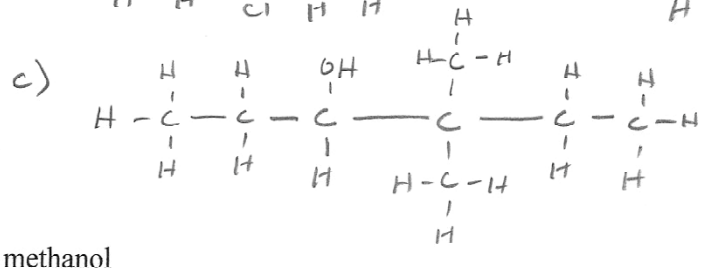
8.2 Functional Groups

(p. 417) **Warm Up** (answers will vary according to student. Most of these products are common household products)

(p. 419) **Quick Check**

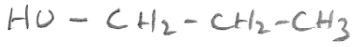
1. a) 

b) 

c) 

2. a) methanol

b) 1-bromobutane

3. 1-propanol 

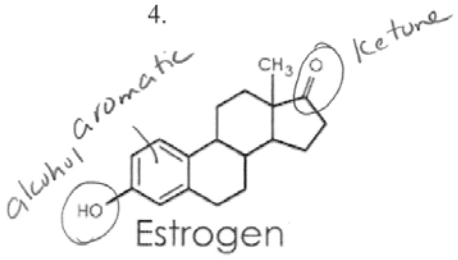
4. Alcoholic drinks such as beer, wine and hard liquor may lead to ethanol poisoning.

(p. 421) **Quick Check**

1. A carbonyl group contains a carbon atom double bonded to an oxygen atom.
2. Aldehydes and ketones contain a carbonyl group.
3. a) An ether and a ketone both contain an oygen atom. They are different in that an ethers oxygen atom joins two carbon atoms to each other using a single bond, whereas in a ketone, the oxygen atom is only bonded to one carbonatom with a double bond.

   b) An aldehyde and ketone are similar in that they both contain a double bonded oxygen atom to a carbon atom. They are different in that the aldehyde oxygen atom is at the end of the carbon chain, whereas the oxygen atom in the ketone is bonded to a carbon atom not at the end of a chain.

4.



(p. 423) **Quick Check**

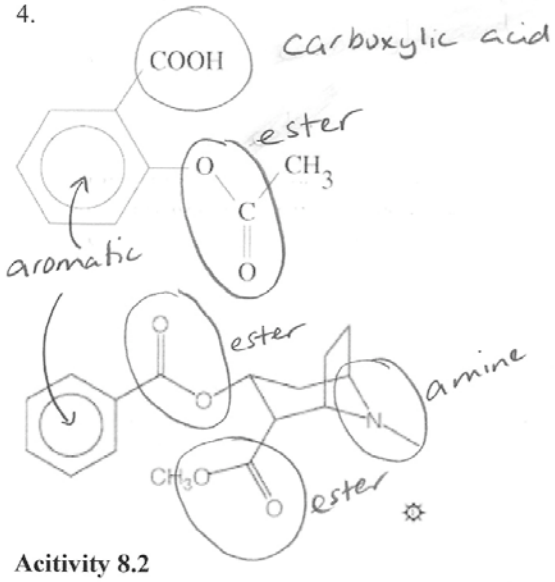
1. A carboxyl group is a –COOH group. $-C(=O)OH$

2. Both a carboxylic acid and ester contain a –COO group. They are different in that a carboxylic acid ends with a H atom bonded to the oxygen atom, whereas in an ester, the oxygen atom is bonded to another carbon atom or R group:

   Carboxylic acid: -COOH Ester: -COOR ex. $-C(=O)OH$ and $-C(=O)O-R$

3. Both an amide and amine contain a nitrogen atom. They are different in that an amine contains only single bonds and a nitrogen atom bonded to a carbon atom. An amide contains a nitrogen atom bonded to a carbonyl group.

4.



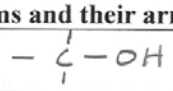
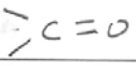
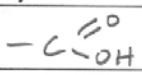
(p. 425) **Acitivity 8.2**

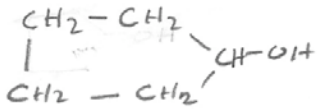
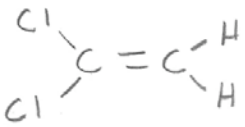
1. ester
2. alkyl halide, aromatic 1,3-dichloro-5-methylbenzene
3. alkyne propyne

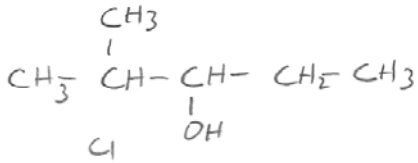
4. aldehyde
5. alcohol 2-methyl-1-propanol
6. amine
7. alkene 4-methyl-3-heptene
8. ether
9. amide
10. ketone

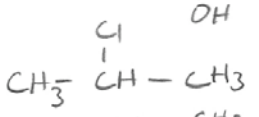
(p. 427) **8.2 Review Questions**

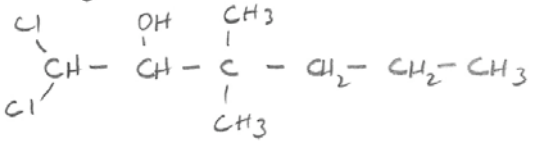
1. oxygen and nitrogen are also common in organic compounds.
2. A functional group is an atom, group of atoms or organization of bonds in an organic molecule that reacts in a characteristic manner. Examples include alkenes, alkynes, alcohols, ethers, esters etc.
3. Halogens.
4. Complete the following table:

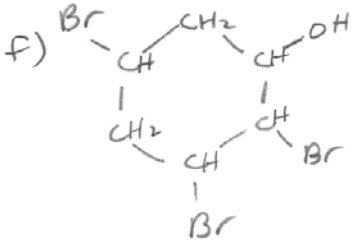
Name of group	Atoms and their arrangement
hydroxyl	
carbonyl	
carboxyl	

5. a) 2,2-dichloropropane
   b) 2-bromo-3-chloro-3-methyl-1-pentanol
   c) 1,2,3,4-tetrachlorocyclobutane
   d) 4-bromo-2-hexene
   e) pentanoic acid
   f) 1,3,5-trifluorobenzene
6. a) 
   b) 

c) 

d) 

e) 

f) 

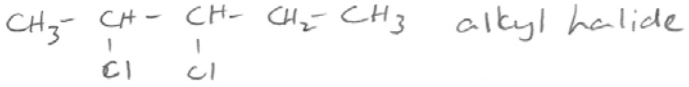
7. In an ionic compound, the –OH group is a hydroxide group. In an organic compound, the –OH group is a hydroxyl group or an alcohol group.

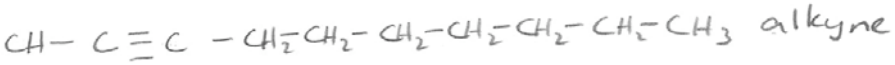
8a) alcohols, ethers

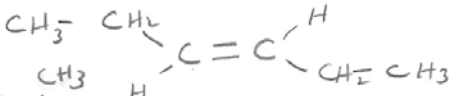
b) aldehydes, ketones, carboxylic acids, esters, amides

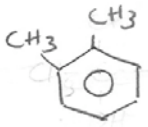
c) carboxylic acids, and esters

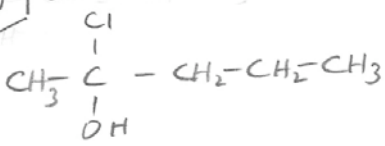
9. An amide contains a nitrogen atom bonded to a carbon that is double bonded to an oxygen atom. A carboxylic acid does not contain a nitrogen atom. Both amides and carboxylic acids contain a carbon atom that is double bonded to an oxygen atom.

10. a)  alkyl halide

b)  alkyne

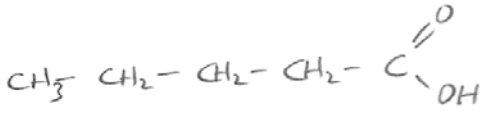
c)  alkene

d)  aromatic

e)  alkyl halide and alcohol

f) amide

g) aldehyde

h) 

11. a) aldehyde

b) aromatic, carboxylic acid

c) ketone

d) alkyl halide

e) alcohol

f) ester

g) amine

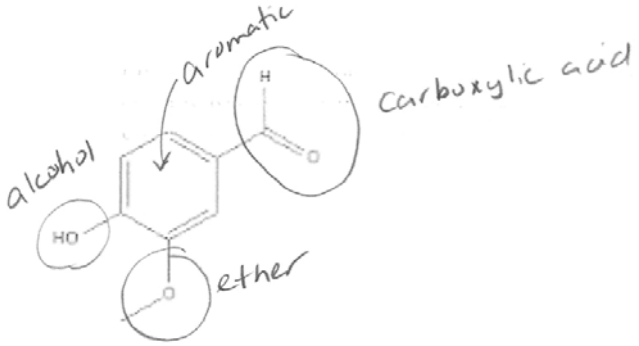
h) amide

i) alkene

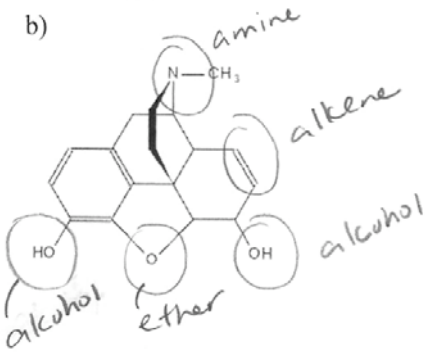
j) ether

12.

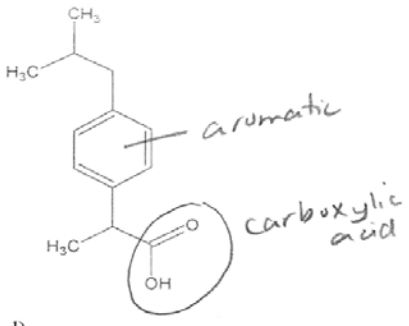
a) Vanillin – a food flavoring



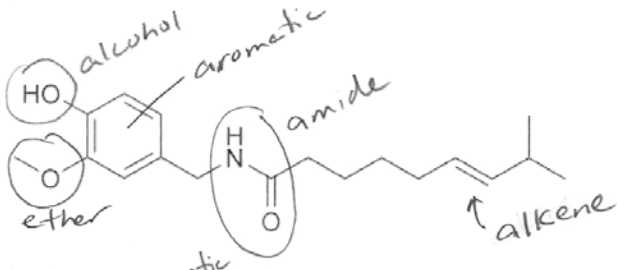
b)



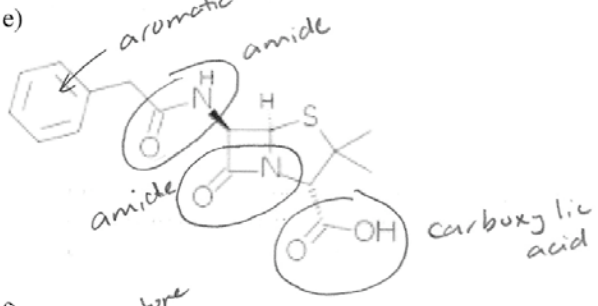
c)



d)

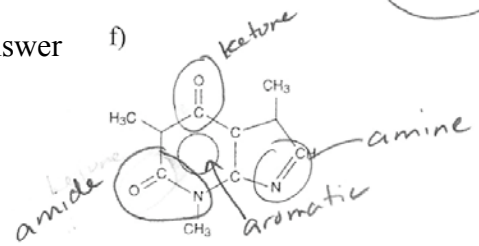


e)

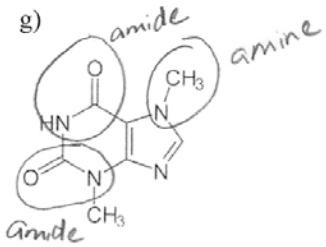


1st edition answer

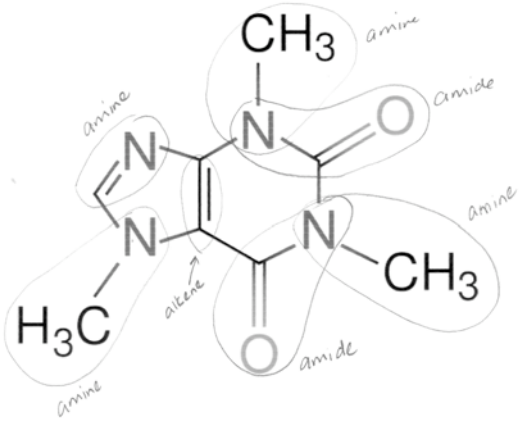
f)



g)



(f) 2nd edition answer



8.3 Reactions of Organic Molecules

(p. 430)

Warm Up

1. Unsaturated molecules contain double or triple bonds. Saturated molecules contain only single bonds.
2. The products of combustion are water and carbon dioxide.
3. 1c, 2f, 3a, 4b, 5d, 6e

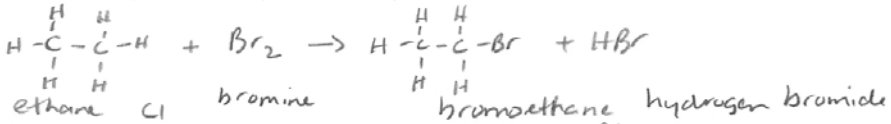
(p. 431)

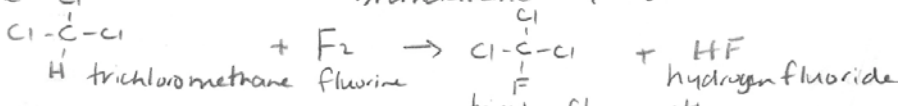
Quick check:

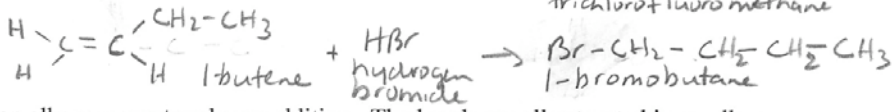
1. $C_3H_8 + 5\ O_2 \rightarrow 4\ H_2O + 3\ CO_2$
2. A carbon monoxide detector is valuable because it can detect the odorless and very poisonous gas CO that may be produced from a malfunctioning furnace or car engine.
3. $C_3H_8 + 2\ O_2 \rightarrow 4\ H_2O + 3\ C$ or $C_3H_8 + 7/2\ O_2 \rightarrow 4\ H_2O + 3\ CO$

(p. 434)

Quick Check:

1. In a substitution reaction, the number of atoms that the central carbon atom is bonded to does not change. In an addition reaction, the number of atoms each carbon atom is bonded increases.
2. a) substitution b) addition c) addition d) substitution
3. a) 

   b) 

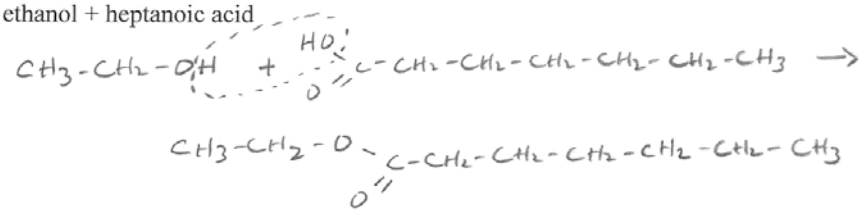
   c) 

4. No, an alkane cannot undergo addition. The bonds are all saturated in an alkane, so the carbon atoms cannot bond to more atoms.

(p. 437)

Practice Problems

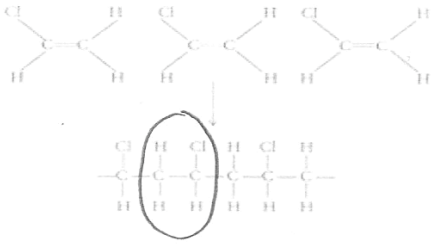
1. methyl salicylate
2. ethanol + heptanoic acid



3. Methane + chlorine. These are substitution reactions.

(p. 440) **Quick Check:**

1. Homopolymer. The repeat unit is $-CF_2-$.
2. Addition polymerization.



3. HDPE is made of polymer chains with few branches. LDPE is made of polymers with many branches off the parent chain.
4. Many answers possible: HDPE: milk jugs, plastic garbage cans, water pipes.

   LDPE: food wrap, sandwich plastic bags, grocery bags

(p. 442) **8.3 Activity: Organic Molecules In Every Day Life**

Many products in everyday life are organic compounds that are produced industrially. Students may use textbooks, the internet and other resources to research these products.

(p. 443) **8.3 Review Questions**

1. Complete combustion produces only CO_2 and H_2O. Incomplete combustion may produce C or CO as well. Complete combustion occurs when there is an excess of oxygen. Incomplete combustion occurs when there is a limited amount of oxygen.

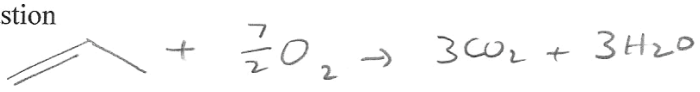
2. Alkanes typically undergo substitution reactions. Alkenes and alkynes undergo addition reactions.

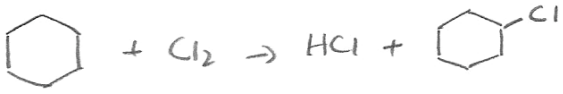
3. Water or a hydrogen halide are commonly eliminated.

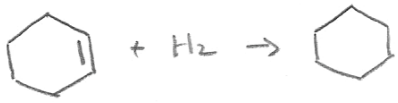
4. In an addition reaction, the number of atoms bonded to the carbon atoms in the skeleton increases. In a substitution reaction, the number of atoms bonded to the carbon skeleton remains the same.

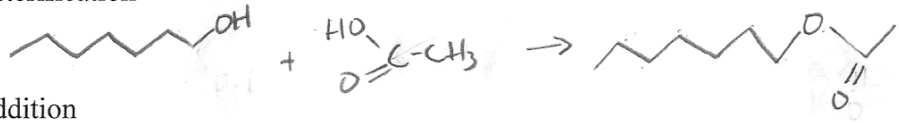
5. A hydrogenation reaction is an addition reaction where hydrogen atoms are added at the site of a double or triple bond. A condensation or dehydration reaction is an elimination reaction where water is eliminated.

6. a) combustion

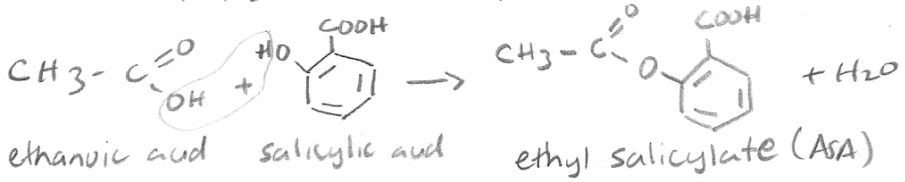


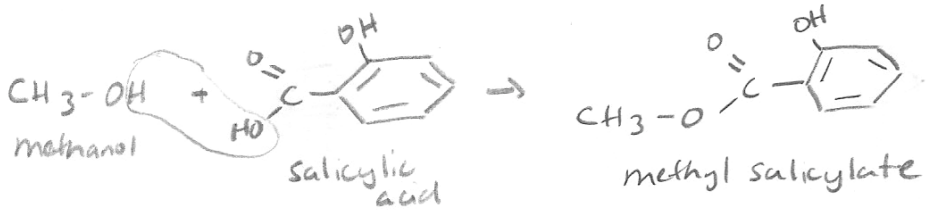
b) substitution 

c) addition or hydrogenation 

d) esterification 

e) addition 

7. a) 

b) 

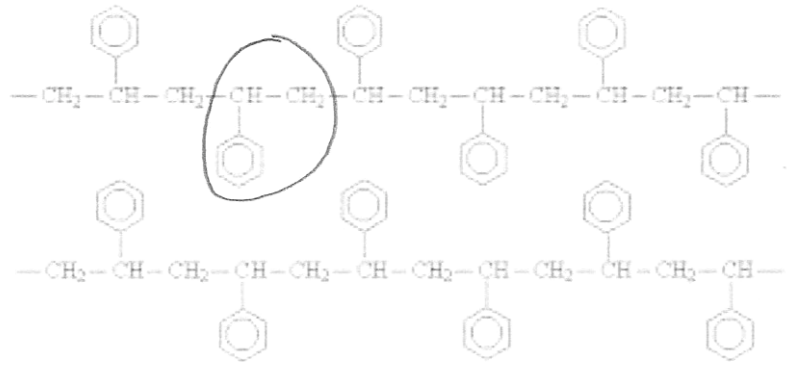
8. A monomer is a repeat unit in a polymer. When many monomers are linked together, they form a polymer.

9. In addition polymerization, double or triple bonds are broken in a monomer to link together to form long polymer chains. An example is ethene that polymerizes to polyethylene.

10. In condensation polymerization, smaller molecules are linked together when a molecule is eliminated. An example of this is the production of nylon 6,6.

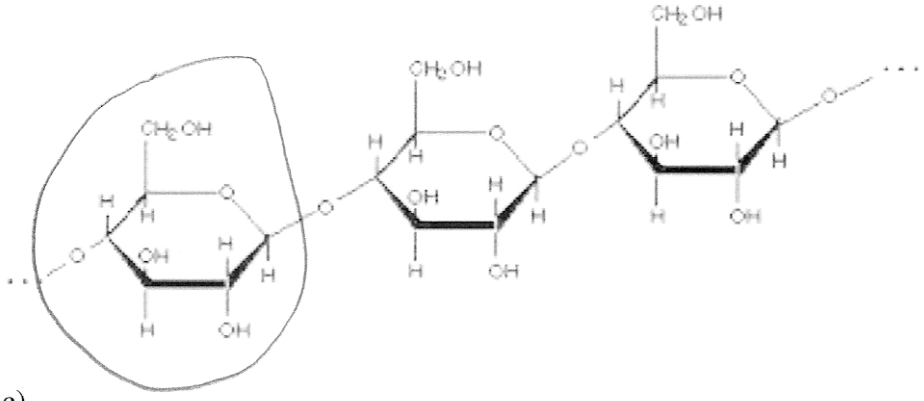
11. Proteins, DNA and cellulose.

12. a)

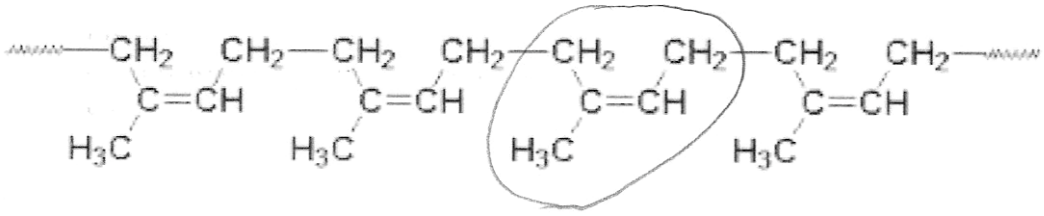


Syndiotactic Polystyrene (two chains shown)

b)



c)



d)