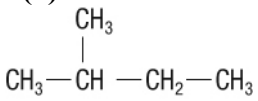
Unit 1 Review, pages 120–127

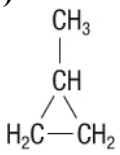
Knowledge

1. (d)
2. (c)
3. (b)
4. (d)
5. (c)
6. (b)
7. (a)
8. (a)
9. (b)
10. (d)
11. (a)
12. (c)
13. (c)
14. (c)
15. (d)
16. True
17. False. Alkanes are *saturated* hydrocarbons.
18. False. In methane, each carbon atom is connected to *4* hydrogen atoms.
19. False. Butane molecules contain *4* carbon atoms.
20. True
21. False. Alkyl groups are named by replacing the *-ane* ending of the parent alkane with *-yl*.
22. False. In the *cis* isomer, the two matching alkyl groups are on the same side of the double bond.
23. False. *Alkynes* have at least one triple bond between adjacent carbon atoms.
24. False. The compound illustrated in **Figure 1** is a *secondary* alcohol.
25. True
26. True
27. False. A *carboxyl* group consists of a carbon atom double-bonded to an oxygen atom and single-bonded to a hydroxyl group.
28. False. Most carboxylic acids are *weak* acids.
29. True
30. True
31. True
32. True
33. False. To undergo condensation polymerization a compound must have at least *two* functional group*s*.
34. True
35. True
36. False. The repeating units in nucleic acids are called nucleotides.

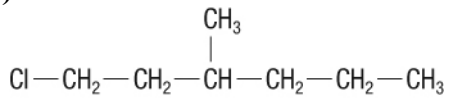
37. (a) (iv)
(b) (vii)
(c) (x)
(d) (v)
(e) (iii)
(f) (xi)
(g) (viii)
(h) (ii)
(i) (ix)
(j) (i)
(k) (vi)
38. (a) (ii)
(b) (iv)
(c) (iii)
(d) (i)
39. (a) 2,2,4-trimethylhexane
(b) 5-methylnonane
(c) 2,2,4,4-tetramethylpentane
(d) 3-ethyl-3-methyloctane
(e) 1,3-dichlorobutane
(f) 1,1,1-trichlorobutane
(g) 2,3-dichloro-2,4-dimethylhexane
(h) 1,2-difluoroethane
40. (a)



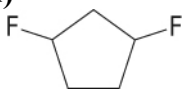
(b)



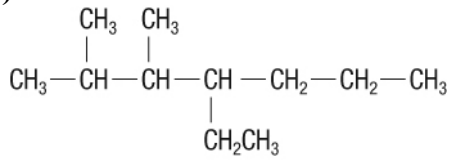
(c)



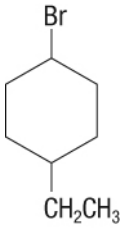
(d)



(e)



(f)

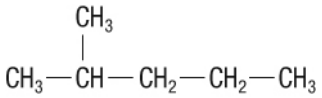


41. chloromethane, CH_3Cl; dichloromethane, CH_2Cl_2; trichloromethane, $CHCl_3$; tetrachloromethane, CCl_4

42. The name of this alkane is decane.

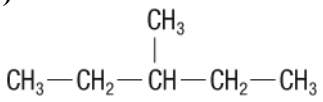
43.

(i)



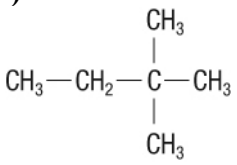
2-methylpentane

(ii)



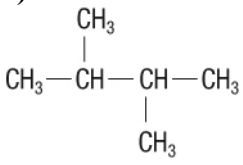
3-methylpentane

(iii)



2,2-dimethylbutane

(iv)



2,3-dimethylbutane

(v) $CH_3{-}CH_2{-}CH_2{-}CH_2{-}CH_2{-}CH_3$

hexane

44. As the length of the carbon chain of an alkane increases, the boiling point of the alkane increases.

45. (a) An alkyl group is a hydrocarbon branch attached to the main structure of a hydrocarbon molecule.

(b) Answers will vary. Sample answer:
Two compounds that contain alkyl groups are methylpropane and ethylcyclopentane.

46. (a) A molecule of butane has 10 hydrogen atoms.

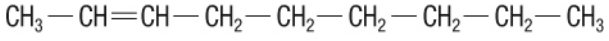
(b) A molecule of the straight-chain alkane with 6 carbon atoms has 14 hydrogen atoms.

(c) A molecule of 2-chloropentane has 11 hydrogen atoms.

47. (a) The general chemical formula for a straight-chain alkane is C_nH_{2n+2}.

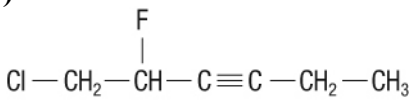
(b) The general chemical formula for a cyclic alkane is C_nH_{2n}.

48. (a) There are 5 carbon atoms in a molecule of cyclopentane.
(b) There are 4 carbon atoms in a molecule of but-1-yne.
49. A saturated hydrocarbon consists of carbon−carbon single bonds only. An unsaturated hydrocarbon has at least one double or triple bond between carbon atoms.
50. (a) but-1-ene
(b) 4-methylhex-2-ene
(c) 2,5-dimethylhept-3-ene
51. (a)



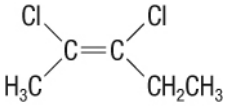
non-2-ene

(b)



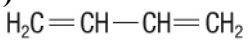
1-chloro-2-fluorohex-3-yne

(c)



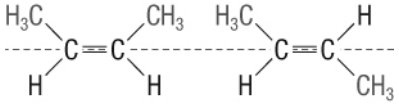
cis-2,3-dichloropent-2-ene

(d)



butane-1,3-diene

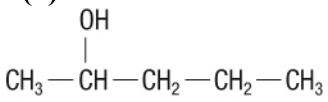
52. In addition reactions, atoms from one molecule are added to an alkene by breaking double bonds. Addition reactions include hydrogenation, halogenation, hydrohalogenation, and hydration. In a substitution reaction, an alkyl group replaces a hydrogen atom in an organic molecule. In alkenes, adding substituents does not require breaking double bonds.
53. Markovnikov's rule is used to determine the results of the addition of a hydrogen halide to an alkene.
54. (a) The correct name for 2-methylhex-4-ene is 5-methylhex-2-ene.
(b) The correct name for 2,5-hexadiene is hexa-1,4-diene.
(c) The correct name for 1,2-dimethylcyclohex-3-ene is 3,4-dimethylcyclohexene.
55. A *cis* isomer has matching alkyl groups located on the same side of the double bond. The *trans* isomer has the groups located on opposite sides of the double bond.



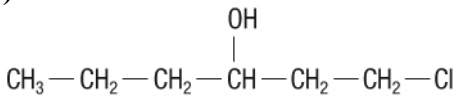
cis-but-2-ene *trans*-but-2-ene

56. Alkenes, alkynes, and aromatic compounds are classified as unsaturated compounds because they contain carbon−carbon double or triple bonds.
57. Benzene, C_6H_6, is a flat 6-carbon ring with a hydrogen atom bonded to each carbon atom. Even though its structural diagram is drawn as three double bonds alternating with three single bonds between carbon atoms, bond length measurements show that all six bond lengths are equal. To indicate that all six bonds are identical, the structure is shown as alternating between two arrangements of double bonds or as a hexagon with a circle inside, implying that electrons are shared equally between all 6 carbon atoms.

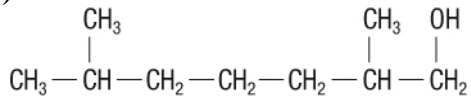
58. (a) pentan-1-ol, primary alcohol
(b) 3-chlorobutan-1-ol, primary alcohol
(c) 3-methylhexan-3-ol, tertiary alcohol
(d) 2-methylcyclopentanol, secondary alcohol
59. (a)



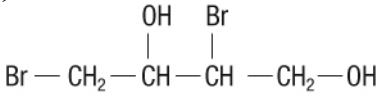
pentan-2-ol
(b)



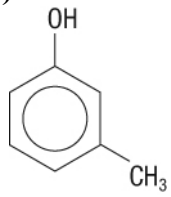
1-chlorohexan-3-ol
(c)



2,6-dimethylheptan-1-ol
(d)

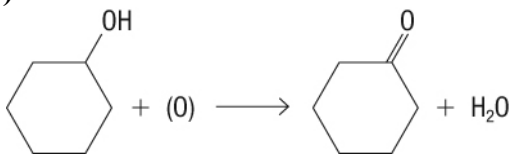


2,4-dibromobutane-1,3-diol
(e)

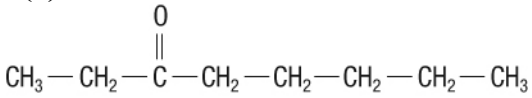


3-methylphenol
60. Alcohols are polar compounds because of the presence of the electronegative oxygen atom in the –OH group. The bond between oxygen and hydrogen is polar. Also, the C–O bond is significantly more polar than the C–H bond because the electronegativity difference between carbon and oxygen is greater than that between carbon and hydrogen.
61. The product of the oxidation of a secondary alcohol is a ketone.
62. butan-1-ol, primary alcohol; butan-2-ol, secondary alcohol; 2-methylpropan-1-ol, primary alcohol; 2-methylpropan-2-ol, tertiary alcohol
63. (a) The product of the oxidation of a secondary alcohol is a ketone.
(b) The product of the hydrogenation of an aldehyde is a primary alcohol.
64. (a) pentanal
(b) 3-ethylhexan-2-ol
(c) 3-methylpentan-2-one
(d) 2-methylcyclohexanol
(e) phenol, or hydroxybenzene

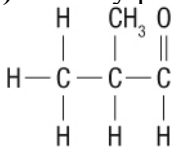
65. (a) The product of the oxidation of cyclohexanol is cyclohexanone.
(b)



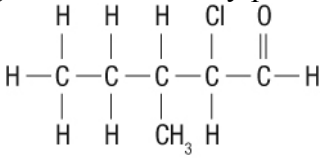
66. (a) ketone: pentan-2-one
(b) aldehyde: butanal
(c) ketone: 4,5-dichlorohexan-3-one
(d) aldehyde: 2,3-dimethylpentanal
67. Aldehydes and ketones both contain carbonyl groups. In an aldehyde, the carbonyl group is located at the end of the parent chain of the molecule. In a ketone, the carbonyl group is bonded to 2 carbon atoms in the carbon chain.
68. (a) octan-3-one: ketone



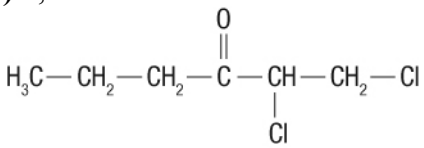
(b) 2-methylpropanal: aldehyde



(c) 2-chloro-3-methylpentanal: aldehyde

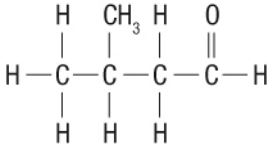


(d) 1,2-dichlorohexan-3-one: ketone

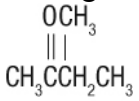


69. This compound is not a ketone but an aldehyde. The correct name is hexanal.
70. (a) methanoic acid
(b) 2-methylpropanoic acid
(c) 3-ethyl-2-methylhexanoic acid
(d) 4-chlorobenzoic acid

71. (a) (i) The structure of the product resulting from the oxidation of 3-methylbutan-1-ol is the following:

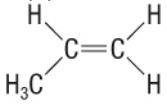


(ii) The structure of the product resulting from the oxidation of 3-methylbutan-2-ol is the following:



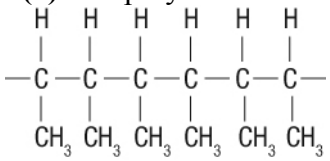
(iii) There would be no reaction.
(b) The product in (i), 3-methylbutanal, could undergo further oxidation to form 3-methylbutanoic acid.
72. The two compounds that react to produce ethyl butanoate are ethanol and butanoic acid.
73. Triglycerides are esters.
74. The compounds produced by the hydrolysis of ethyl benzoate are ethanol and benzoic acid.
75. (a) CH_3CH_2CHO is an aldehyde.
(b) CH_3COCH_3 is a ketone.
(c) $CH_3CH_2CH_2NH_2$ is an amine.
(d) $CH_3CH_2CH_2COOH$ is a carboxylic acid.
(e) This compound is a ketone.
(f) This compound is an aldehyde.
(g) This compound is a carboxylic acid.
(h) This compound is an amine.
76. An amine is a derivative of ammonia in which one or more hydrogen atoms is replaced by an alkyl group. Its functional group is a nitrogen atom with a lone pair of electrons.
77. Answers will vary. Sample answer:
Natural polymers, such as silk and DNA, are made by living things. Synthetic polymers, such as polyester and nylon, are manufactured from monomers that often come from plants or petrochemicals.
78. (a) A homopolymer is made from only one type of monomer. A copolymer is made from at least two different monomers.
(b) You can you tell from looking at the structure of a polymer whether it is a homopolymer or a copolymer by looking at the monomers that make it up. A homopolymer has the same repeating unit throughout its chain, whereas a copolymer has two distinct parts to its repeating unit.
79. (a) A compound that can undergo addition polymerization reactions must have carbon−carbon double bonds.
(b) During addition polymerization, the carbon−carbon double bonds within monomers are broken, and carbon−carbon single bonds form between monomers.

80. (a) The monomer of polypropene is:

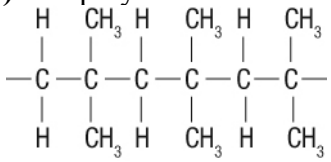


(b) The monomer of polyethene is:

81. (a) The polymer formed from but-2-ene is:

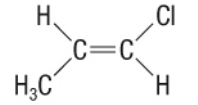


(b) The polymer formed from methylpropene is:



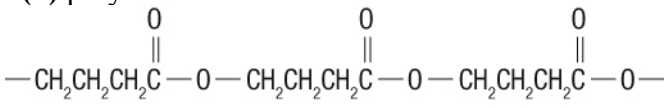
82. (a) Polymers can be both natural and synthetic. A protein molecule is an example of a natural polymer. Plastics are synthetic polymers that retain their shape after being molded, such as polystyrene. All plastics are polymers, but not all polymers are plastic.
(b) Thermoplastics do not contain many cross-links, so they melt or soften when heated, hold their shape when cooled, and can be molded. An example is HDPE. Thermoset polymers are highly cross-linked, so they do not soften at high temperatures. An example is vulcanized rubber.
(c) Plasticizers are additives that increase flexibility of plastics, making them easier to produce and shape into useful objects. Plasticizer molecules are inserted between polymer chains to keep the chains spaced apart. Phthalates are a type of plasticizer. Elastomers are polymers with a limited amount of cross-linking, which allows them to stretch and then snap back to their original shape. Rubber is an elastomer.
83. (a) Bonds that hold polymer chains together are called cross-links.
(b) Cross-linking occurs when functional groups attached to monomers can form chemical bonds between separate polymer strands. For example, dienes form cross-links.
(c) Cross-links bind polymer chains more tightly; so the polymer is more rigid and inflexible.
84. Health Canada placed restrictions on the use of some phthalates in children's products because phthalates may disrupt the human reproductive system, especially if the exposure occurs during childhood.
85. A condensation polymer can only be made from just one type of monomer if the monomer has two reactive functional groups involved in the polymerization reaction.
86. Water is often a byproduct because most of the functional groups that react in a condensation reaction contain oxygen and hydrogen. For example, one condensation polymerization reaction results when a carboxylic acid reacts with an alcohol, resulting in an ester linkage, which releases a water molecule.

87. The monomer that reacts to form the addition polymer shown is:

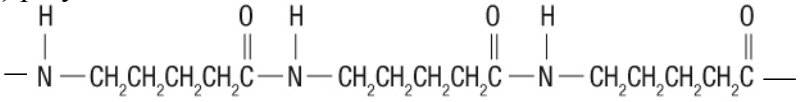


1-chloroprop-1-ene

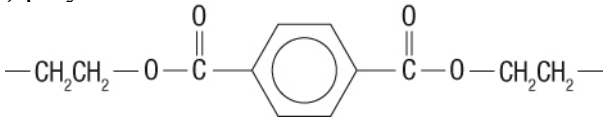
88. (a) polyester



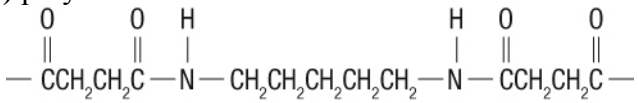
(b) polyamide



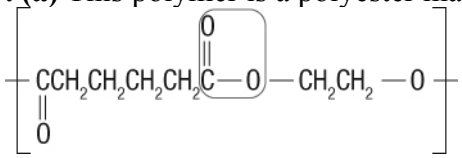
(c) polyester



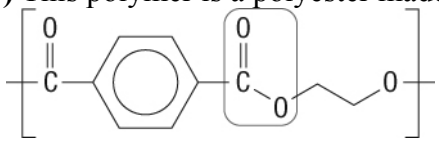
(d) polyamide



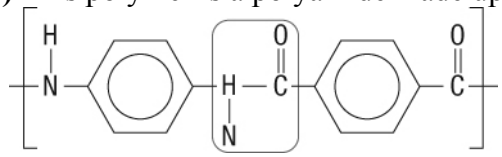
89. (a) This polymer is a polyester made up of carboxylic acid and alcohol monomers.



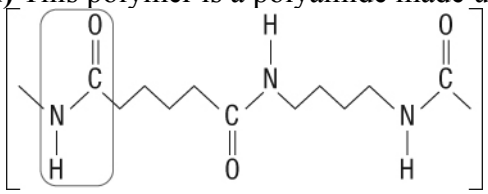
(b) This polymer is a polyester made up of carboxylic acid and alcohol monomers.



(c) This polymer is a polyamide made up of amine and carboxylic acid monomers.



(d) This polymer is a polyamide made up of amine and carboxylic acid monomers.

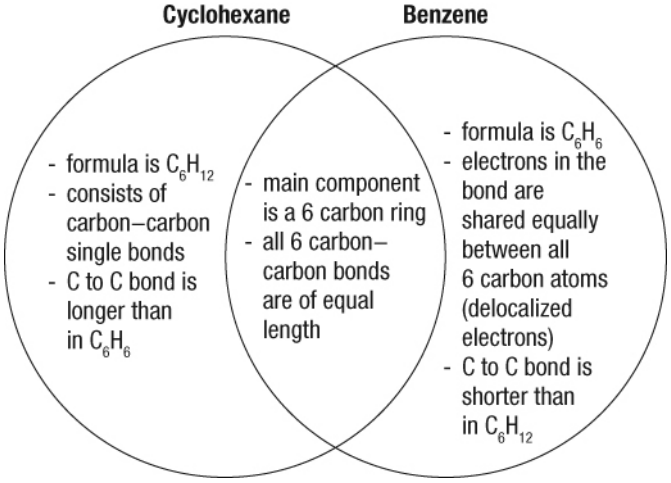


90. Polymers do not degrade and may remain unchanged for centuries, especially polyethene and polystyrene packaging materials. Some plastics also contain toxic ingredients, such as phthalates, which are harmful to humans and animals.

91. (a) Neoprene was designed to replace rubber.
(b) The polymer was called nylon-6,6 and it was a polyamide.
(c) The two types of organic compounds that were combined to make nylon-6,6 were a carboxylic acid and amine. Specifically, the compounds hexane-1,6-diamine and hexanedioic acid were used
92. Cellulose is found in the cell walls of plants. Glycogen stores energy in animal cells. Starch stores energy in plant cells.
93. (a) All amino acids contain a carboxyl group (–COOH) and an amino group ($–NH_2$).
(b) The main product of the polymerization of amino acids is a peptide. The by-product is water.
(c) Nylon is a synthetic polymer that is formed from a similar reaction.
94. The term "peptide bond" is appropriate to use in reference to the amide linkage between amino acids.

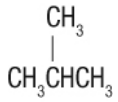
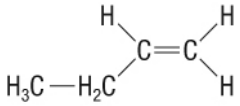
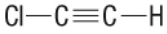
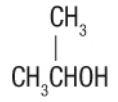
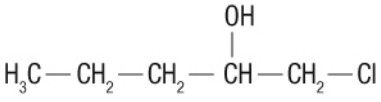
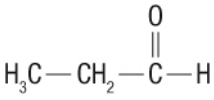
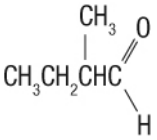
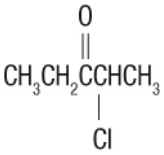
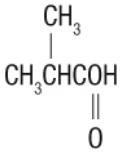
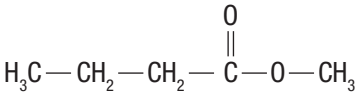
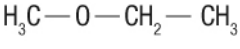
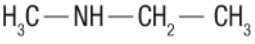
Understanding

95. Ethane is insoluble in water because it is a non-polar molecule; whereas water molecules are polar.
96. Alkanes are relatively stable, compared to alkenes and alkynes, because they are saturated, and hence cannot undergo reactions to break double or triple bonds.
97. Alkenes have carbon−carbon double bonds, which are strong bonds that do not allow the carbon atoms to rotate about the bond axis. Therefore, the groups on different sides of a double bond are in a fixed position relative to each other, which allows *cis–trans* isomerism to occur.
98. Functional groups are double or triple bonds and specific groups of atoms within a molecule that affect the properties of the compound, such as solubility, melting point, boiling point, and chemical reactivity. Organic molecules are classified according to their functional groups.
99. Methene is not an appropriate name for a compound because the prefix *meth-* indicates a single carbon atom in the molecule. Thus, it cannot form a double bond with another carbon atom. The suffix *–ene* signifies a double bond and therefore requires two carbon atoms.
100.



101. The first naming convention for aromatic compounds is used when there are non-carbon substituents or small alkyl groups on the benzene ring. In this case, the benzene ring is considered to be the parent molecule, and the attached functional groups are named as substituents to benzene, such as in 2-ethyl-1,4-dimethylbenzene. In the second naming convention, the benzene ring is considered to be a substituent on a hydrocarbon chain, such as in 4-phenylheptane.
102. Ethanol has a higher boiling point than chloroethane because the hydroxyl group can form hydrogen bonds with other ethanol molecules.
103. The boiling points of aldehydes and ketones are lower than those of similar alcohols because they do not contain hydroxyl groups and therefore cannot form hydrogen bonds between molecules.
104. The product of the oxidation of butanal is butanoic acid, $CH_3CH_2CH_2COOH$.
105. The boiling points of carboxylic acids are higher than those of alkanes of similar size because carboxylic acids have two polar functional groups—a carbonyl group and a hydroxyl group—located close together, which makes their molecules very polar. In contrast, alkanes are non-polar molecules. The hydroxyl groups can undergo hydrogen bonding with other molecules, which also raises the boiling points of carboxylic acids.

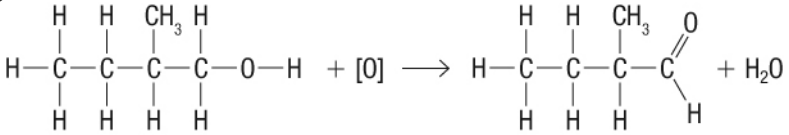
106.

Name	Type of compound	Condensed structural formula
2-methylpropane	alkane	
but-1-ene	alkene	
chloroethyne	alkyne	
propan-2-ol	alcohol	
1-chlorobutan-2-ol	alcohol	
propanal	aldehyde	
2-methylbutanal	aldehyde	
2-chloropentan-3-one	ketone	
methylpropanoic acid	carboxylic acid	
methyl butanoate	ester	
methoxyethane	ether	
N-methylethanamine	amine	

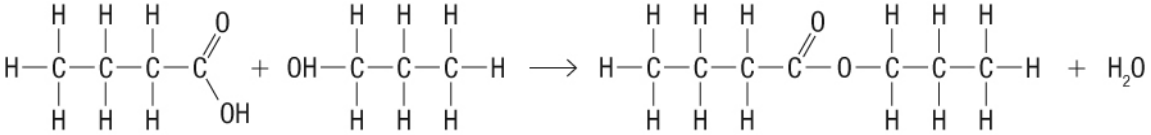
107. (a) $CH_3OH + HOCH_2CH_2CH_3 \rightarrow CH_3{-}O{-}CH_2CH_2CH_3 + H_2O$

(b) $CH_3CH{=}CH_2 + Cl_2 \rightarrow CH_3CHClCH_2Cl$

(c)

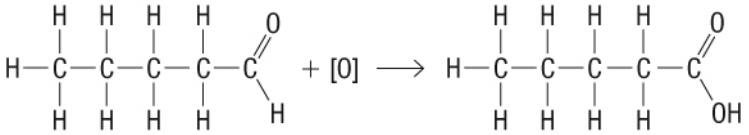


(d)



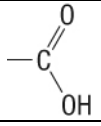
(e) $CH_3CH_2C{\equiv}CCH_2CH_3 + 2\ H_2 \rightarrow CH_3CH_2CH_2CH_2CH_2CH_3$

(f)



108. Propan-1-ol has the highest boiling point because each molecule can form hydrogen bonds with its neighbors. Propanamine has the second-highest boiling point. Its molecules can also form hydrogen bonds with neighboring molecules. However, the N–H bond in propanamine is less polar than the O–H bond in propanamine. Consequently, the attraction between propanamine molecules is not as strong. Propane has the lowest boiling point because it is non-polar.

109. Answers may vary. Sample answer:

Type	**Functional group**	**Solubility**	**Boiling point**
alcohol	−OH	soluble in water but not in a non-polar solvent	higher than boiling point of an alkane of similar size
amine	$-NH_2$		
carboxylic acid			

110. Answers will vary. Sample answer:

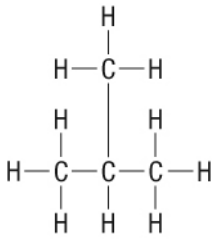
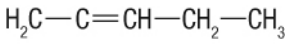
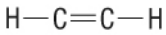
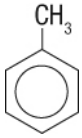
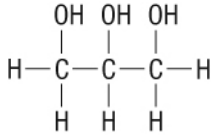
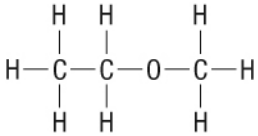
Addition polymers	**Condensation polymers**
- created when carbon−carbon double bonds are broken - no byproducts formed in addition reactions - mainly synthetic polymers	- created when monomers with two reactive functional groups react - byproduct (usually water) formed during condensation reactions - natural and synthetic polymers

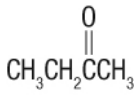
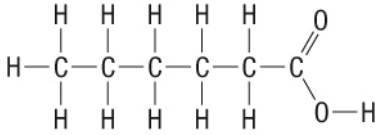
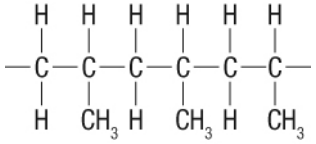
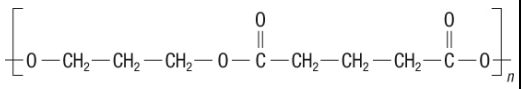
111. Hydrogen bonds hold together the two strands that make up DNA by binding the bases: cytosine and guanine, and thymine and adenine.

112. Answers will vary. Sample answer:

Polymerization of amino acids	Polymerization of monosaccharides
- formed by condensation reactions - monomers linked by peptide bonds - reactive functional groups: carboxylic acids and amines - form straight-chain polymers that can be long and narrow, sheet-like, or globular depending on other forces and bonds involved in creating the three-dimensional shape of the protein	- formed by condensation reactions - monomers linked by glycosidic bonds - reactive functional groups: hydroxyl groups - can form straight-chain or branched-chain polymers

113. Answers will vary. Sample answer:

Type of compound	Functional group	Sample structure	Sample name
Alkane	single bonds between carbon atoms		methylpropane
Alkene	one or more double bonds between carbon atoms		but-1-ene
alkyne	one or more triple bonds between carbon atoms		ethyne
aromatic	benzene ring		toluene
alcohol	hydroxyl group		propane-1,2,3-triol
ether	oxygen atom bonded between 2 carbon atoms		methoxyethane

ketone	carbonyl group attached to 2 other carbon atoms		butanone
carboxylic acid	carboxyl group		hexanoic acid
addition polymer	double bonds between carbon atoms of monomers		polypropene
condensation polymer	2 reactive functional groups on each monomer		polyester

Analysis and Application

114. Answers may vary but could include:

1) Most fuels are alkanes, which release greenhouse gases, in particular carbon dioxide, when burned. Greenhouse gases contribute to climate change and smog, which causes health problems such as breathing difficulties and cancer.

2) Alkyl halides such as chlorofluorocarbons are used as coolant fluids in refrigerators and air conditioners. Because they are chemically inert, they remain in the atmosphere until they reach the stratosphere, where they react with ozone and damage the ozone layer.

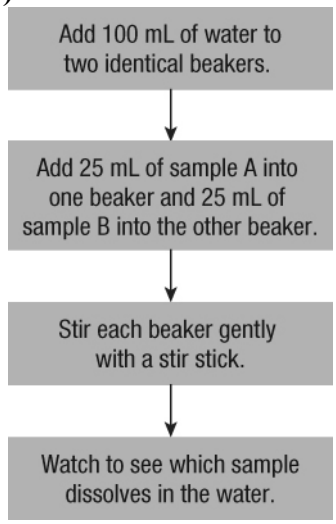
3) Benzene is now a known carcinogen, so its commercial use has in large part been discontinued.

4) Ethanol has serious health effects and is toxic when consumed in large quantities.

5) *Trans* fats are widely manufactured and used because they have properties that increase stability and enhance flavours in some foods. Unfortunately, the human digestive system cannot digest these fats in the same way as saturated fats, which can lead to health problems due to buildup of fats and their by-products in blood vessels and internal organs. Health Canada advises choosing foods that contain little or no *trans* fat.

115. Answers may vary. Sample answer:

(a)



(b) Necessary equipment: 2 beakers of equal size, measuring equipment, 2 stir sticks.
Necessary materials: water, small volume of each sample

(c) Cyclohexane is a non-polar molecule, and 2-methylpropan-2-ol is polar due to the presence of the hydroxyl group. Therefore, cyclohexane should not dissolve in water, and 2-methylpropan-2-ol should be soluble in water.

(d) When handling cyclohexene, avoid skin and eye contact, keep away from ignition sources, and avoid inhalation. Use 2-methylpropan-2-ol in a well-ventilated area and keep away from ignition sources.

116. Answers may vary. Sample answer:

(a) Three organic compounds that are (or used to be) widely used as industrial solvents are benzene, short-chain alcohols, and ketones.

(b) Polar compounds will dissolve in these solvents.

(c) Benzene is a known carcinogen and short-chain alcohols are poisonous. Simple ketones are generally less toxic than other solvents.

(d) Industrial solvents damage the environment by entering the water supply and poisoning marine wildlife. The poisons can then enter the food chain and bioaccumulate.

117. Answers may vary. Sample answer:

(a) A procedure that could be used to separate these compounds is to boil them. Pentane has the lowest boiling point because it is non-polar, and thus would evaporate first. Pentan-1-ol would evaporate second, followed by pentanoic acid. Both of these compounds can form hydrogen bonds, which is why they have higher boiling points.

(b) Pentane is flammable. To reduce the hazard, keep it away from ignition sources and static discharges; do not pour down drains.

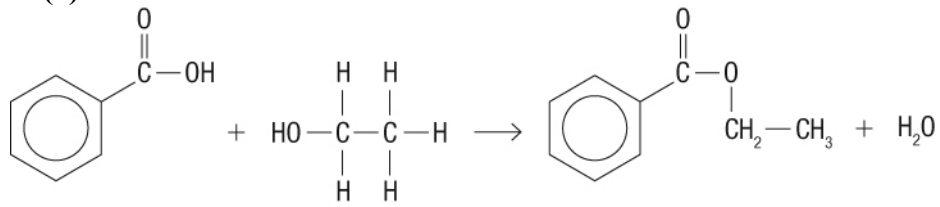
Pentan-1-ol is toxic. Do not swallow.

Pentanoic acid is corrosive. Avoid contact with eyes, wear protective clothing, and do not pour down drains without diluting the acidic solution first.

118.

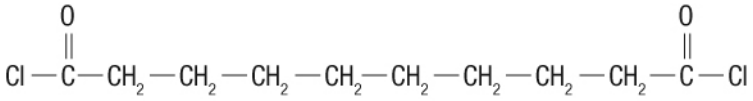
	WHMIS	Safety precautions
(a) propan-2-ol		• Wear eye protection and protective clothing. • Do not inhale or ingest. • Keep away from ignition sources.
(b) propane		• Keep container in a well-ventilated place. • Keep away from sources of ignition.
(c) concentrated ethanoic acid		• Keep away from ignition sources. • Wear protective clothing and gloves.
(d) methanal (formaldehyde)		• Keep away from sources of ignition. • In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. • Wear suitable protective clothing, gloves, and eye or face protection. • In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Use only in well-ventilated areas.

119. (a) Lipids are not water soluble because the long fatty acid chains in triglyceride molecules are non-polar. Fats are usually solid at room temperature because they have long fatty acid chains and are saturated. Saturated hydrocarbon chains rotate freely around the single carbon–carbon bonds. Each long hydrocarbon chain is flexible, allowing optimal packing, which maximizes their van der Waals forces. More thermal energy is required to overcome the attractive forces and separate the molecules, which causes lipids made from saturated fatty acids to have a relatively high melting point. Unsaturated hydrocarbon chains contain double bonds, which limit rotation around the carbon–carbon bonds. *Cis* formations produce kinks that prevent fatty acid chains from packing together tightly, causing weaker van der Waals interactions; so it takes less thermal energy to separate the fatty acid chains. Therefore, the melting points of unsaturated compounds are lower. Triglycerides made from unsaturated fatty acid chains with *cis* double bonds are liquids at room temperature.
(b) Margarine manufacturers have created *trans* fatty acids, which have a much smaller bend in the chain, and therefore a melting point closer to those of unsaturated fats. They are thus more stable and enhance flavours in some foods.
(c) Hydrogenation makes unsaturated fats more saturated, which makes them less reactive because they have fewer multiple bonds.
120. (a)

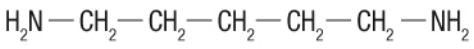


The products of this reaction are ethyl benzoate and water.
(b) Adding (cold) water will have little effect because benzoic acid is only slightly soluble in water due to its large non-polar benzene ring. Adding hot water may
121. Lemon juice can be used to remove fish odour from a person's hands because lemon juice is acidic. The amines responsible for the fish odour are bases. The acidity of lemon juice neutralizes the amines which converts them into an ammonium salt which is less volatile and hence, less smelly.
122. (a) Plastics are non-biodegradable, are made from petrochemicals, a non-renewable resource, and can be toxic to humans and wildlife when they break down.
(b) Answers may vary. Sample answer:
I could reduce the effects of these problems by minimizing the plastics I purchase, reusing plastic food containers as much as possible, and recycling the plastic containers I cannot reuse.
123. (a) Plastic is inert, lasts a very long time, and is flexible.
(b) Answers may vary. Sample answer:
Plastics are smooth, and can be slippery when in a moist environment; so they may slide out of place, which can be deadly. The substances used to make plastics flexible can be toxic and could poison the host. Constant exposure to fluid motion (blood) could cause some of the toxic substances in plastic to leach into the bloodstream, also poisoning the host.

124.



decanedioyl dichloride



pentane-1,5-diamine

Evaluation

125. Answers may vary. Sample answer: The most important functional group in the body is the amine group because it participates in the formation of peptide bonds, which bind amino acids together to form proteins. Proteins are essential in the human body because they regulate many vital functions. The least important functional group in the body is the double bond because it is very reactive and can lead to the formation of free radicals, which are damaging to the body.

126. These compounds are used as preservatives in foods that contain unsaturated fats because they are highly fat-soluble. A negative aspect of these preservatives is that they may be carcinogenic.

127. Answers may vary. Sample answer: The manufacture of ethanol from the sugars in corn is not a good idea because growing corn for fuel is using up valuable land that could be used to grow food instead. The amount of ethanol added to gasoline is only about 10 %, which does not significantly reduce greenhouse gas emissions from vehicles to justify adding it to gasoline.

128. Answers may vary. Sample answer: Nylon and neoprene are examples of synthetic compounds that were invented to replace natural compounds, silk and rubber, respectively. It is more environmentally responsible to use natural polymers because they are biodegradable and also come from renewable sources.

Reflect on Your Learning

129. Answers may vary. Concept maps should show the relationships among organic compounds such as alkanes, alkenes, alkynes; esters, aromatic hydrocarbons, and lipids; monomers (organic compounds such as amino acids and monosaccharides); functional groups such as alcohols and carboxylic acids; polymers; and the process of addition polymerization and condensation polymerization.

130. Answers will vary. Sample answer: The concepts that are most relevant and important to my future education and career goals are synthetic polymers because they are ubiquitous and pose a problem for disposal. This problem will only grow more serious as these non-biodegradable substances continue to be produced.

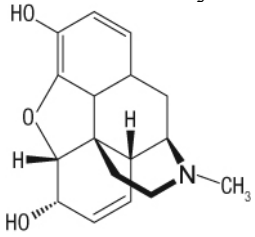
131. Answers will vary. Sample answer: The concept that I found most confusing was how to determine the monomers given condensation polymers. It was difficult for me to figure out where a monomer ended and the next one began. I would help another student understand this concept by helping him or her locate and identify the ester or amide linkages and determine the full functional groups of the monomers involved.

Research

132. Answers may vary. Sample answer:

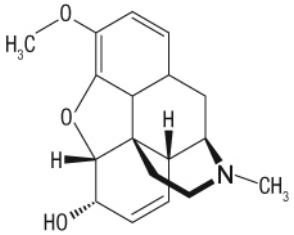
Gasohol is a mixture of 90 % gasoline and 10 % ethanol, or 97 % gasoline and 3 % methanol. Benefits of gasohol include a higher octane (antiknock) content than regular gasoline, and slower, cooler, and more complete combustion; so pollutant emission is reduced. However, gasohol vaporizes more easily, which may worsen ozone layer degradation in summer. Gasohol with ethanol is made from corn, which is expensive and requires a lot of energy to produce. It can also damage rubber seals and finishes in cars if there is a higher concentration of ethanol. Gasohol containing methanol is corrosive, toxic, and expensive to produce. Formaldehyde, a carcinogen, is one of its emissions. I don't think gasohol should be used because growing corn to produce it expends more energy than the resultant gasohol provides and also uses land that could otherwise be used to grow food.

133. Answers may vary. Sample answer: Morphine has the following structure:



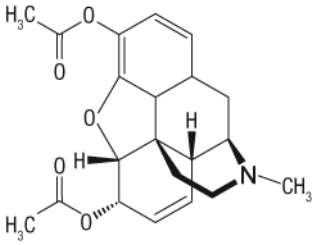
Morphine is a strong analgesic used to alleviate severe pain. It is derived from opium and works by directly affecting the central nervous system. Its drawback is that it is highly addictive, like heroin. Its main side effect is constipation.

Codeine has the following structure:



Codeine is an opiate used to relieve mild to moderate pain, cough, and diarrhea. It too is extracted from poppies, but is not as abundant in opium as morphine. Adverse effects of condeine include drowsiness, dry mouth, euphoria, itching, nausea, vomiting, urinary retention, constipation, coughing, and depression. It can also induce respiratory depression. Like morphine, it is addictive if used for a long time.

Heroin has the following structure:



Heroin is made from morphine. It can be used as an analgesic but is also a well-known highly addictive recreational drug. It is preferred as an analgesic to morphine in the UK because it has less severe side effects.

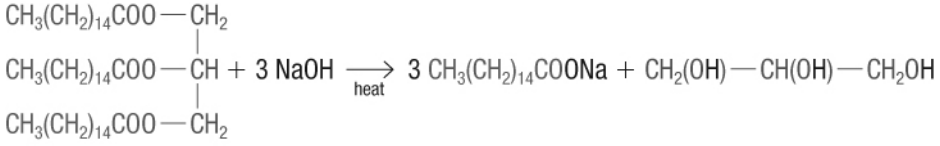
134. Answers may vary. Car parts that are made of plastic include dashboards, lights, seats, engine parts, and bumpers. Plastic parts reduce a car's weight and thereby improve its fuel economy. They can be molded into any shape, and so they are easy and inexpensive to manufacture to any specification. The drawback is that plastic is less durable than traditional materials, i.e., steel.

135. Answers may vary. Sample answer:

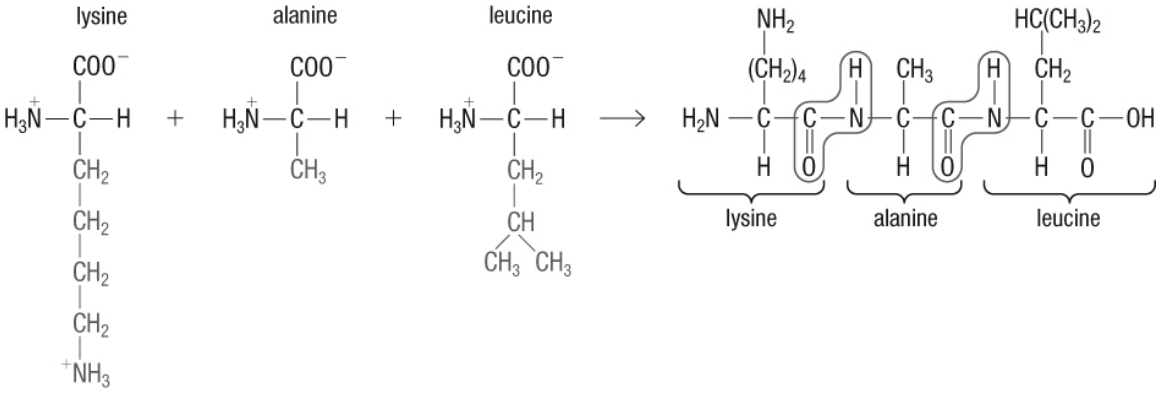
-Combustion reactions are involved when anything is burned, such as fuel. The purpose of burning fuel is to produce energy to do useful work. An example of a complete combustion reaction is

$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g) + \text{energy}$

–A saponification reaction is the reaction used to make soap, which is used for cleaning. Soap is a sodium salt produced when sodium hydroxide and a triglyceride are combined and heated:



–Condensation reactions are responsible for the formation of condensation polymers, both natural and synthetic. Protein synthesis from amino acids is an example of a natural condensation reaction that occurs constantly in living cells. For example,



–Substitution reactions are used to make alkyl halides such as chlorofluorocarbons (CFCs). In these reactions, halogen atoms replace hydrogen atoms in alkanes. One such reaction is given by the following equation:

$CHCl_3(g) + Cl_2(g) \rightarrow CCl_4(g) + HCl(g)$

CFCs are used as coolants in refrigerators and air conditioners. However, because they are chemically inert, they remain unchanged in the atmosphere until they reach the stratosphere, where they damage the ozone layer. For this reason, they are being phased out.