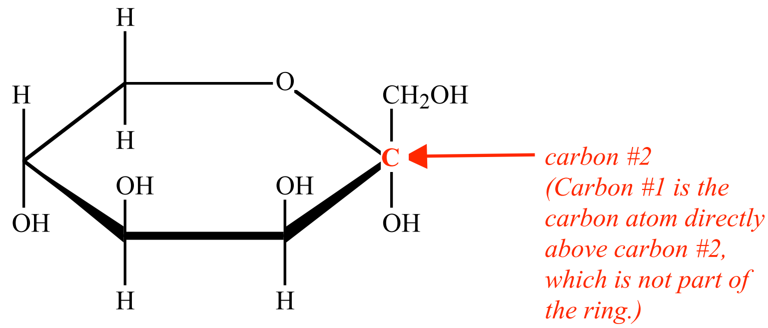
CHAPTER 14: ANSWERS TO SELECTED PROBLEMS

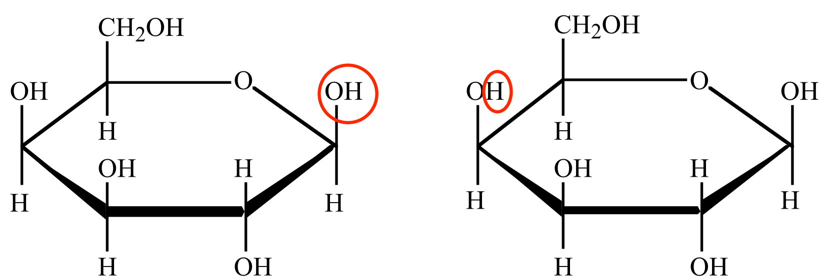
SAMPLE PROBLEMS ("Try it yourself")

14.1 Tagatose contains six carbon atoms, so it is a hexose. Carbon atom #2 is shown below.

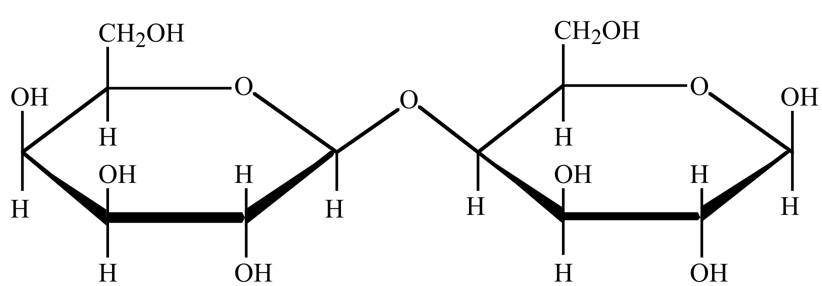


14.2 This is the β anomer. The hydroxyl group on the anomeric carbon atom (the right-hand carbon atom) is above the ring.

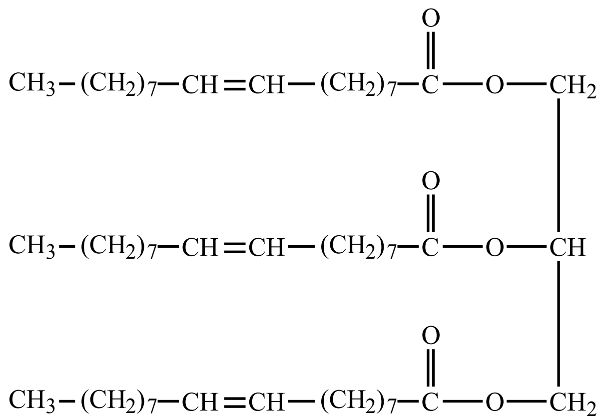
14.3 Start by putting two molecules of β-D-galactose side by side. (The structure of β-D-galactose is the same as α-D-galactose, except that the OH and the H on the #1 carbon are switched.)



Now carry out the condensation reaction, using the OH and H groups that are circled above. The product is:



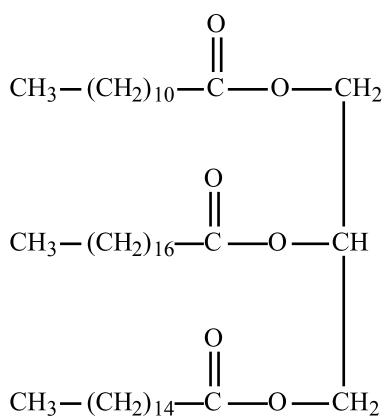
14.4



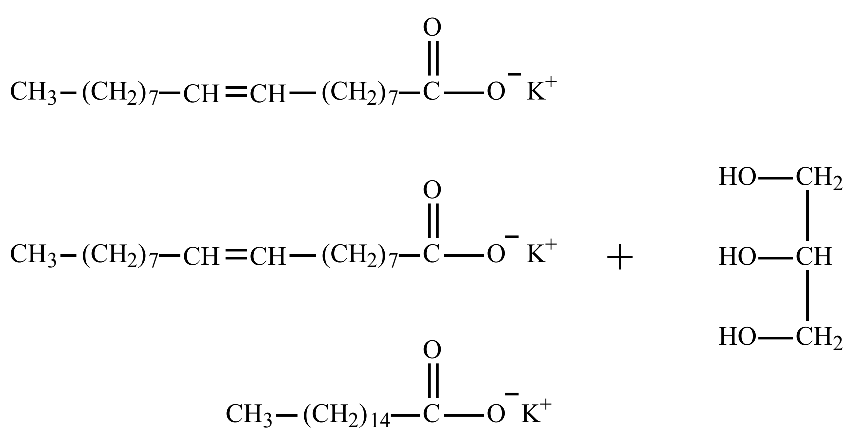
14.5 Palmitoleic acid is an omega-7 fatty acid.

14.6 Triglyceride #1 has the higher melting point, because it contains fewer double bonds.

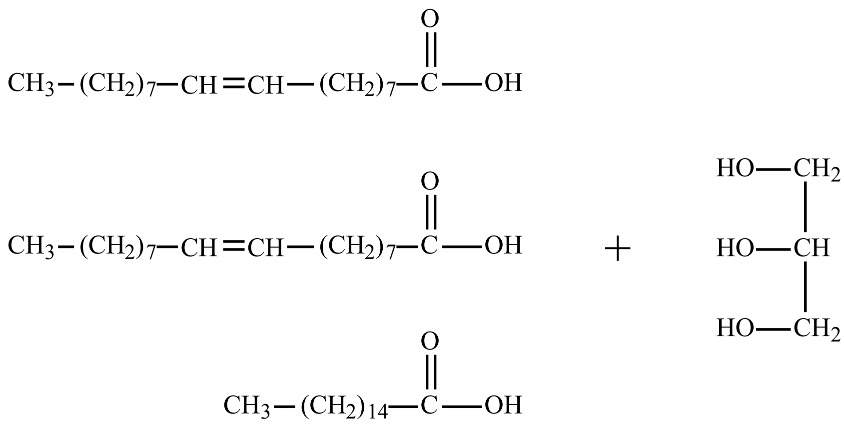
14.7



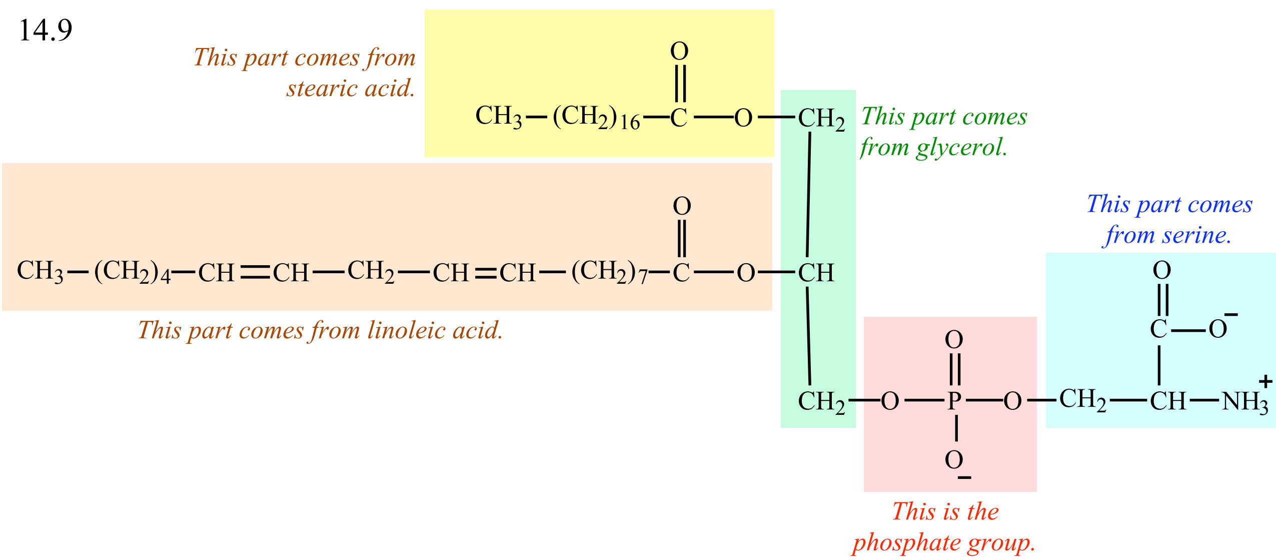
14.8 a) When we use aqueous KOH to hydrolyze a triglyceride, we form glycerol and the potassium salts of the three fatty acids. Therefore, the structures of the products are:



b) When we use aqueous H_2SO_4 to hydrolyze a triglyceride, we form glycerol and the three fatty acids in their unionized forms. The structures of the products under these conditions are:



14.9



14.10 This is passive transport, because the calcium ions are flowing in the normal direction (from high concentration to low concentration).

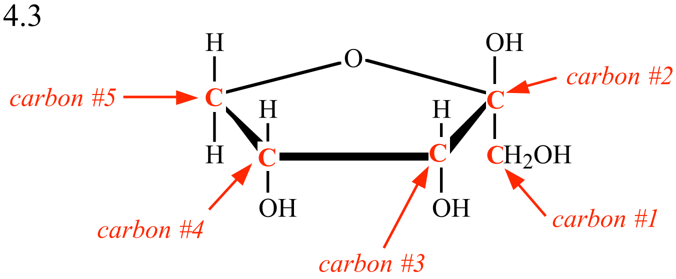
END OF SECTION PROBLEMS

Section 14.1

14.1 The molecular formula of tagatose is $C_6H_{12}O_6$. Monosaccharides always have a 1:2:1 ratio of carbon to hydrogen to oxygen. The problem tells us that tagatose has six carbon atoms, so it must have twelve hydrogen atoms (2 x 6 = 12) and it must have six oxygen atoms.

14.2 Threose is a tetrose, because it contains four carbon atoms.

14.3



14.4 Glucose is the most common hexose in living organisms.

14.5 Galactose and mannose differ in the positions of the H and OH around carbon atoms numbers 2 and 4.

14.6 a) Glucose has a much higher solubility than cyclohexane, because glucose contains several functional groups that can form hydrogen bonds, while cyclohexane does not contain any hydrogen-bonding groups. Therefore, glucose is strongly attracted to water, while cyclohexane is not.

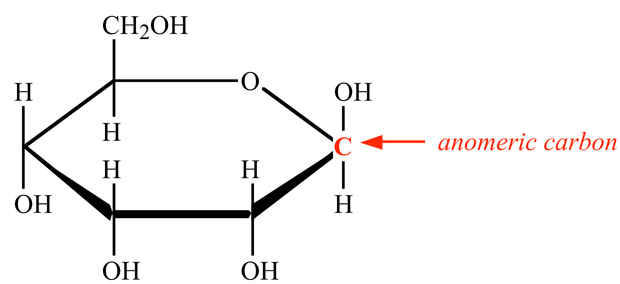
b) Glucose has a higher melting point than cyclohexane, because the hydrogen-bonding groups in glucose are attracted to one another. It takes a good deal of energy to pull glucose molecules away from one another (breaking the hydrogen bonds).

Section 14.2

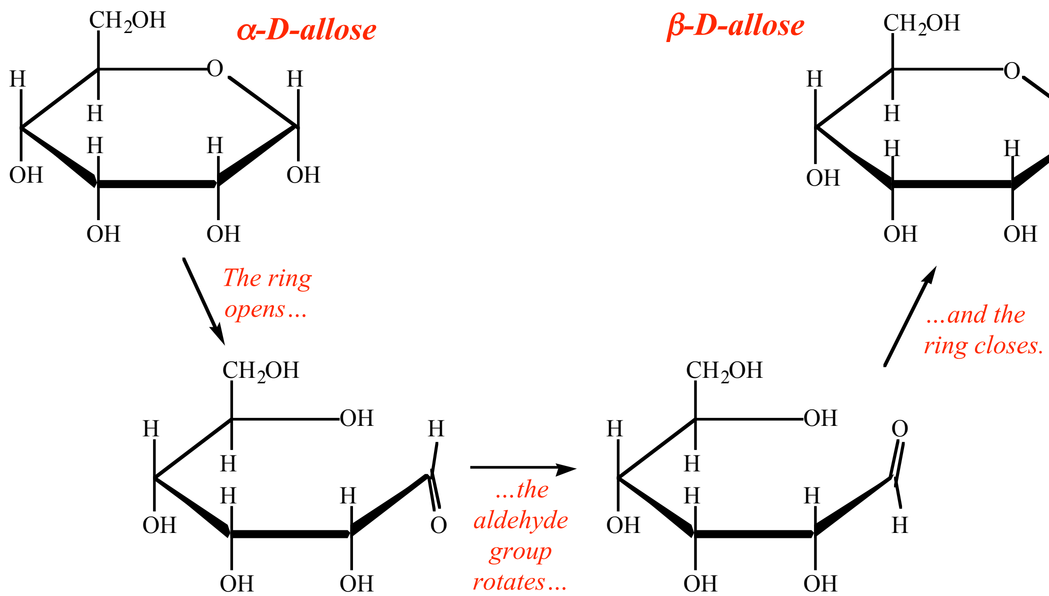
14.7 β-D-ribulose is a reducing sugar, because it has a hydroxyl group attached to the anomeric carbon atom (the right-hand carbon atom in the ring.)

14.8 a) The right-hand carbon atom (carbon #1) is the anomeric carbon. (See below.)

b) The OH group that is attached to the anomeric carbon is above the ring, so this is β-D-allose.



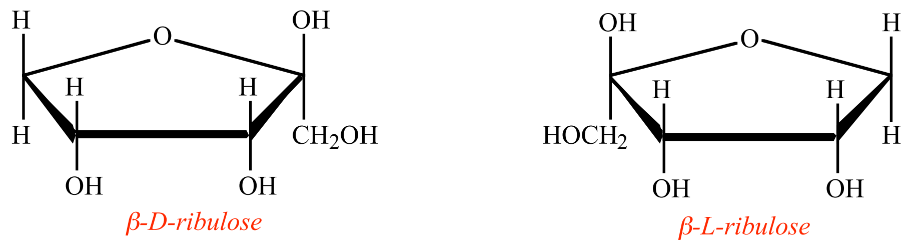
14.9



14.10 The enantiomer of α-D-fructose is α-L-fructose. The D and L forms of a sugar are mirror images.

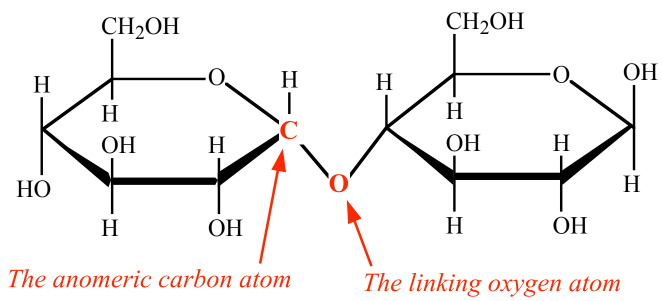
14.11 The enzymes that convert glucose into other compounds are themselves chiral, so only one form (the D form) of glucose can fit into their active sites.

14.12 To draw β-L-ribulose, start with β-D-allose, then turn it completely around.

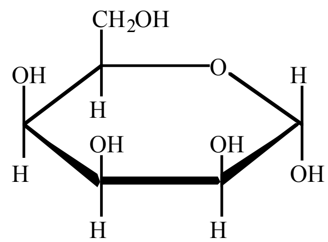


Section 14.3

14.13 The linking oxygen atom is <u>below</u> the #1 carbon (the anomeric carbon) in the left-hand ring. Therefore, the glycosidic linkage is α(1→4).

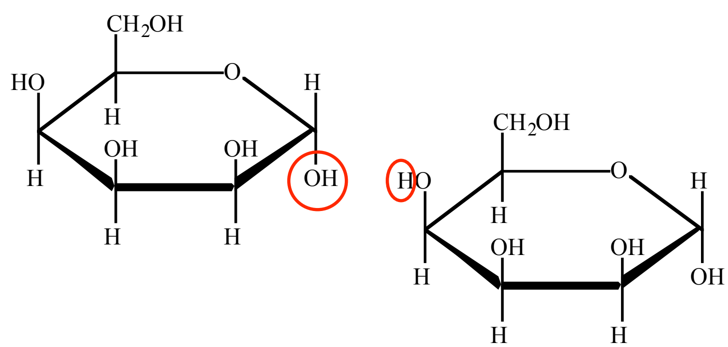


14.14 a)

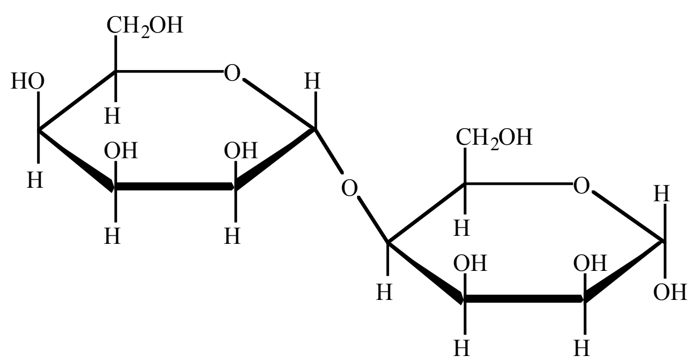


In the α anomer, the OH group is below the anomeric carbon atom.

b) First position the two molecules so they "shake hands" (the OH groups are facing one another), then carry out the condensation reaction.



The molecules are "shaking hands"



The structure of the disaccharide

14.15 Both linkages are α(1→4), but they are structurally different, because the OH group on the #4 carbon points up in allose, but down in glucose. This is easy to see if you compare the structure of the disaccharide above with the structure of maltose (on page 14-16). Therefore, this disaccharide does not fit into the active site of the enzyme that hydrolyzes maltose.

Section 14.4

14.16 The disaccharide is a reducing sugar, because the right-hand ring contains a hemiacetal group (a hydroxyl group bonded to the anomeric carbon atom).

14.17 a) glucose and fructose b) glucose and galactose

14.18 Sucrose does not have two anomeric forms, because the glycosidic bond in sucrose connects the anomeric carbon atoms of both glucose and fructose. This locks the glucose and fructose rings into the α and β forms, respectively.

14.19 The storage polysaccharides are a fuel source for an organism. The organism breaks them down into glucose when needed, and the organism then burns the glucose to obtain energy. The structural polysaccharides give strength and rigidity to an organism, and they are not used as fuel.

14.20 The most common building block of polysaccharides is glucose.

14.21 a) Cellulose is the main structural material of plants.
b) Amylopectin is one of the two forms of starch, and serves as a fuel source for plants.
c) Glycogen serves as a fuel source for animals.

14.22 Chitin is built from N-acetylglucosamine, rather than glucose.

14.23 The storage polysaccharides in plants are amylose and amylopectin. They differ in that amylose is an unbranched chain of glucose molecules, whereas amylopectin is a branched chain. Because of the branches, amylopectin contains both $\alpha(1\rightarrow4)$ and $\alpha(1\rightarrow6)$ glycosidic bonds, while amylose contains only $\alpha(1\rightarrow4)$ glycosidic bonds.

14.24 Glycogen is the storage polysaccharide in animals. Glycogen is similar to amylopectin, but the branches in glycogen are closer together than they are in amylopectin. (The differences between glycogen and amylose are the same as the differences between amylopectin and amylose, and are described in the answer to question 14.24.)

14.25 In starch, the glucose molecules are linked by $\alpha(1\rightarrow4)$ glycosidic bonds (and $\alpha(1\rightarrow6)$ glycosidic bonds in amylopectin). The chains of glucose molecules form a loose coil (a helix) in amylose, but adopt an irregular shape in amylopectin.

In cellulose, the glucose molecules are linked by $\beta(1\rightarrow4)$ glycosidic bonds. The chains of glucose molecules in cellulose line up in parallel chains, held next to one another by hydrogen bonds.

14.26 Dextrins are short chains of glucose molecules, formed when starch or glycogen is partially broken down.

Section 14.5

14.27 a) This fatty acid is saturated, because the hydrocarbon chain does not contain a double bond.

b) This fatty acid is unsaturated, because the hydrocarbon chain contains at least one double bond.

14.28 a) This fatty acid is polyunsaturated, because it contains more than one C=C bond.

b) This is an omega-6 fatty acid, because the first double bond (counting from the left) is the sixth carbon-carbon bond.

14.29 a) The melting point of fatty acid “a” is higher than room temperature, because it is saturated. The melting point of fatty acid “b” is lower than room temperature, because it is unsaturated.

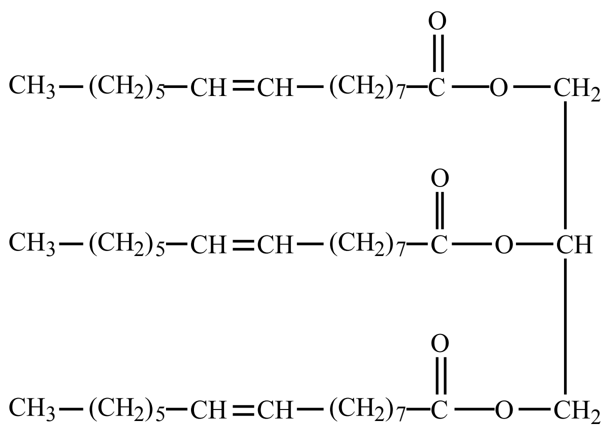
b) Fatty acid “a” is a solid and fatty acid “b” is a liquid at room temperature.

14.30 a) This fatty acid is insoluble in water (in fact all fatty acids are insoluble in water), because of its long hydrocarbon chain.

b) This fatty acid is soluble in ethanol. Fatty acids generally dissolve well in organic solvents.

14.31 a) $CH_3–(CH_2)_{12}–COOH$ b) $CH_3–(CH_2)_4–CH=CH–CH_2–CH=CH–(CH_2)_7–COOH$

14.32

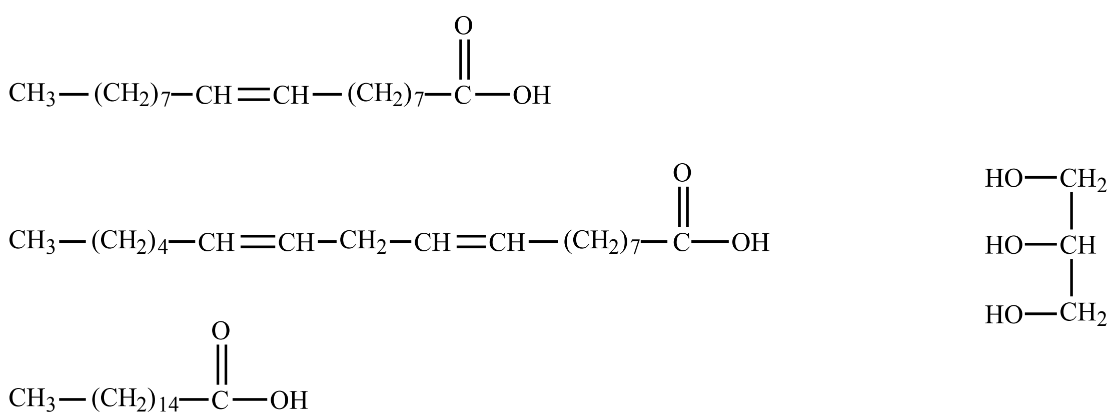


14.33 a) This mixture is a liquid at room temperature, because most of the fatty acids that make up these triglycerides are unsaturated.

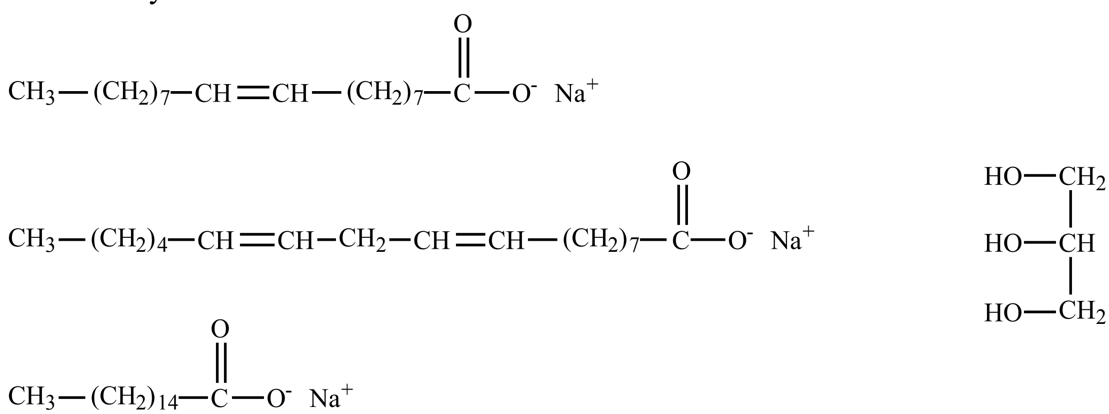
b) This mixture is an oil. All liquid mixtures of triglycerides are called oils. (The term “fat” is only used for solid mixture of triglycerides that come from an animal tissue.)

Section 14.6

14.35 a) H_2SO_4 is a strong acid. When we hydrolyze a triglyceride using an aqueous solution of a strong acid, the products are the three fatty acids (in their unionized forms) and glycerol.

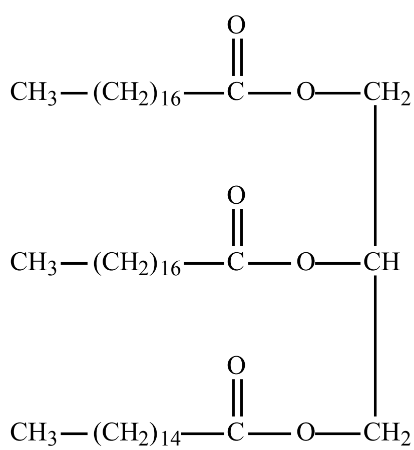


b) NaOH is a strong base. In this solution, the products are glycerol and the sodium salts of the three fatty acids.

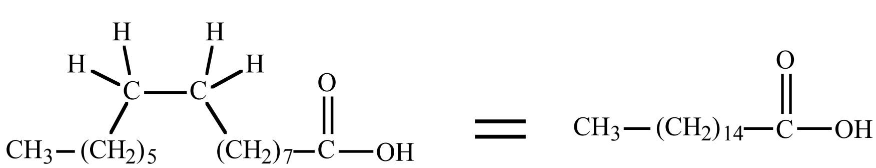


14.35 The three fatty acids (from top to bottom) are oleic acid, linoleic acid, and palmitic acid.

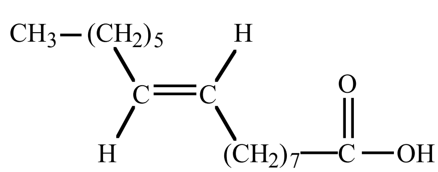
14.36 Hydrogenation converts all of the –CH=CH– groups into $–CH_2–CH_2–$ groups. As a result, the upper and middle hydrocarbon chains contain 16 CH_2 groups between the CH_3 and the carbonyl group. The lower chain is not affected, since it is already saturated. Here is the structure of the product.



14.37 Some of the molecules are hydrogenated, producing a saturated fatty acid:



The rest of the molecules change into the *trans* isomer of the original fatty acid:



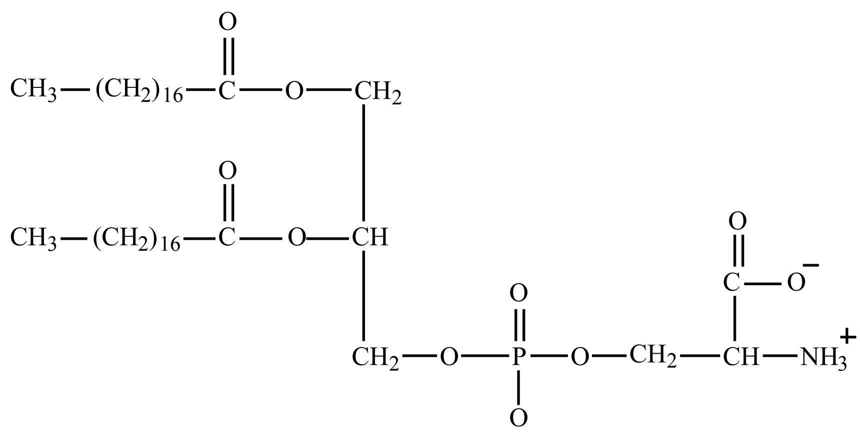
14.38 When a triglyceride is hydrolyzed in the digestive tract, the products are the conjugate bases of two of the fatty acids, plus a monoglyceride that is made from glycerol and the third fatty acid.

14.39 Triglycerides do not dissolve in water, so digestive enzymes cannot break them down effectively. Bile salts break up the large clusters of triglyceride molecules into much smaller clusters, allowing the triglycerides to mix with the digestive fluids. This in turn allows the digestive enzymes to break down the triglycerides rapidly.

Section 14.7

14.40 Glycerophospholipids are made from two fatty acids, glycerol, a phosphate ion, and an amino alcohol. The phosphate ion and the amino alcohol are ionized at pH 7 (phosphate is negatively charged and the amino group is positively charged).

14.41



14.42 The ionized "heads" of the lipids are strongly attracted to water, but the nonpolar "tails" of the lipids are not. Therefore, the lipids form a bilayer, with the tails of each layer facing the tails of the other layer. The heads face outward, in contact with the water on either side of the bilayer.

14.43 CO_2 is a nonpolar molecule and is not strongly attracted to water, so it can pass from the surrounding solution into (and through) the nonpolar interior of the lipid bilayer. On the other hand, HCO_3^- is an ion and is strongly attracted to water, so it cannot leave the surrounding solution and enter the nonpolar interior of the bilayer.

14.44 Cell membranes contain glycerophospholipids, various other lipids such as cerebrosides and sphingomyelins, and cholesterol.

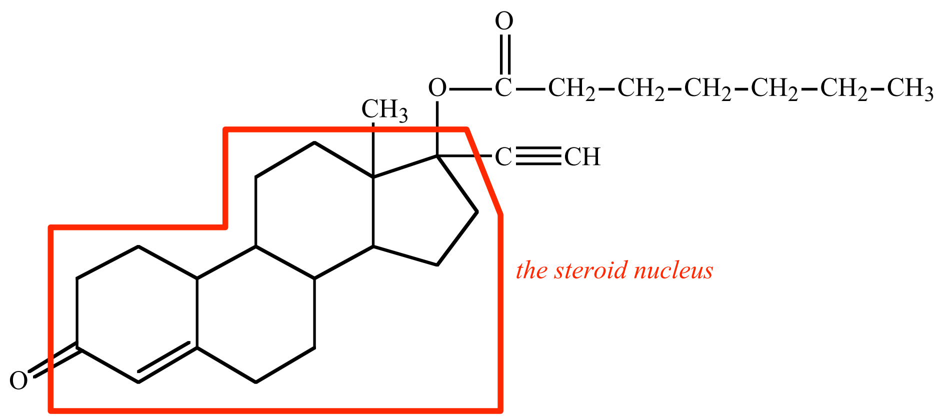
14.45 Transport proteins provide passageways for polar and ionic solutes to pass through membranes. Cells need transport proteins because they need a variety of ions and polar molecules to survive, but these substances cannot pass through a lipid bilayer.

14.46 In passive transport, solute molecules move from high concentration to low concentration, while in active transport, solute molecules move from low concentration to high concentration. Active transport requires an energy source, because it cannot occur on its own (the normal direction of diffusion is from high to low concentration).

14.47 A concentration gradient is a situation where the concentration of a particular solute is higher on one side of a membrane than it is on the other side. Concentration gradients contain potential energy, which cells harness to drive processes that require energy (such as active transport).

Section 14.8

14.48



14.49 a) Cholesterol is one of the essential components of cell membranes, and the body uses it to make other steroids.

b) Bile salts assist in the digestion of triglycerides (see the answer to Problem 14.40 for more details).

c) Steroid hormones are chemicals that regulate a wide range of body activities, including sexual maturation and function, pregnancy, and electrolyte and nutrient concentrations in blood.

14.50 a) mineralocorticoid b) estrogen

14.51 The primary carriers of cholesterol are LDL (low density lipoprotein) and HDL (high density lipoprotein). LDL carries cholesterol from the liver to other tissues, where it is used to build cell membranes. HDL carries cholesterol from the tissues to the liver for excretion.

14.52 The primary carrier of triglycerides in blood is the chylomicrons.

14.53 Steroid hormones are carried in the blood by two types of proteins, SHBG (sex hormone binding globulin) and CBG (corticosteroid binding globulin).

Section 14.9

14.54 a) This diet provides 1970 Calories per day (it's reasonable to round this to 2000 Calories).

135 g protein x 4 Cal/g = 540 Calories
110 g carbohydrate x 4 Cal/g = 440 Calories
110 g fat x 4 Cal/g = 990 Calories
} Total = 1970 Calories

b) 22% of the Calories are provided by carbohydrate (the calculator answer is 22.335025%).

$$\frac{440 \text{ Cal from carbs}}{1970 \text{ Cal total}} \times 100\% = 22\%$$

c) This is far below the recommendations of the National Academy of Sciences (45% to 65% of Calories from carbohydrates).

14.55 Humans can convert starch into glucose, and they can convert some of the amino acids in proteins into glucose. We cannot convert fats into glucose (although we can convert glycerol into glucose).

14.56 Polyunsaturated fatty acids are classified as essential, because our bodies cannot make them from other nutrients. Our diets must contain these fatty acids.

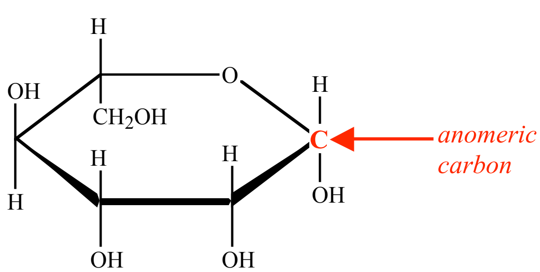
14.57 The starting materials in photosynthesis are water and carbon dioxide, and the products are glucose and oxygen (O_2).

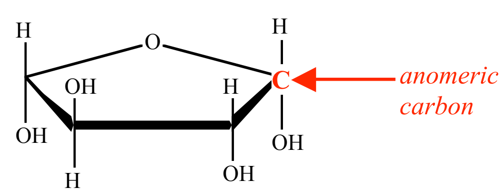
14.58 Photosynthesis and respiration are essentially the opposite of one another. In photosynthesis, an organism converts CO_2 and H_2O into an organic molecule (glucose) and O_2, consuming energy in the process. In respiration, an organism reacts an organic molecule with O_2, producing CO_2, H_2O, and energy.

CUMULATIVE PROBLEMS (Odd-numbered problems only)

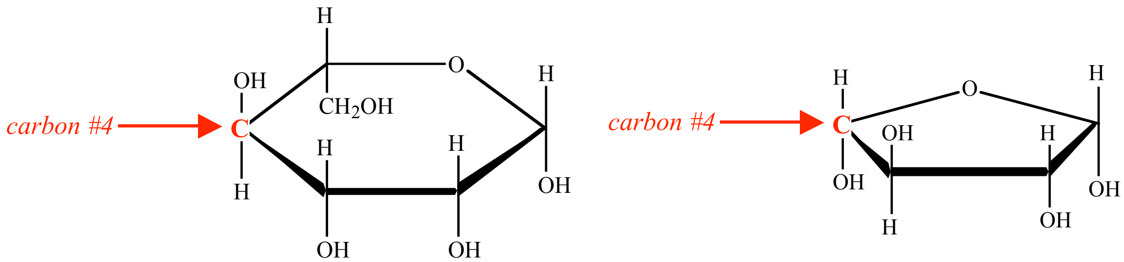
14.59 Molecule "a" is a hexose, because it contains a total of six carbon atoms (including the one that is attached to the ring). Molecule "b" is a tetrose, because it contains a total of four carbon atoms.

14.61





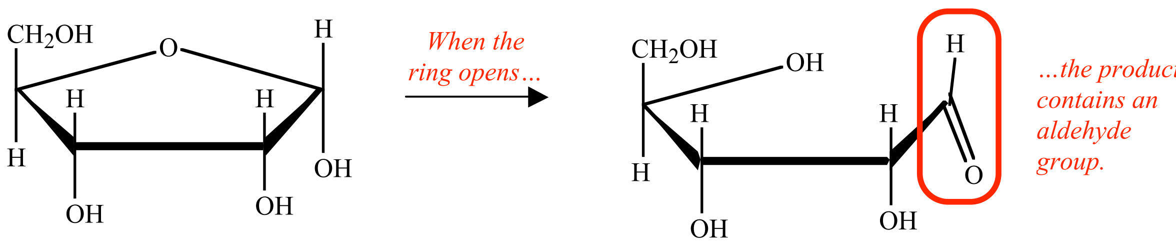
14.63



14.65 The OH and H groups attached to the #3 carbon atom are reversed in allose (as compared to glucose).

14.67 Glucose contains six hydrogen-bonding groups, one per carbon atom, so it dissolves best in solvents that can form hydrogen bonds very well. Both methanol and 1-pentanol contain an alcohol group, but 1-pentanol has a substantially longer hydrocarbon chain, so it does not form hydrogen bonds as well as methanol does. Therefore, glucose dissolves better in methanol.

14.69



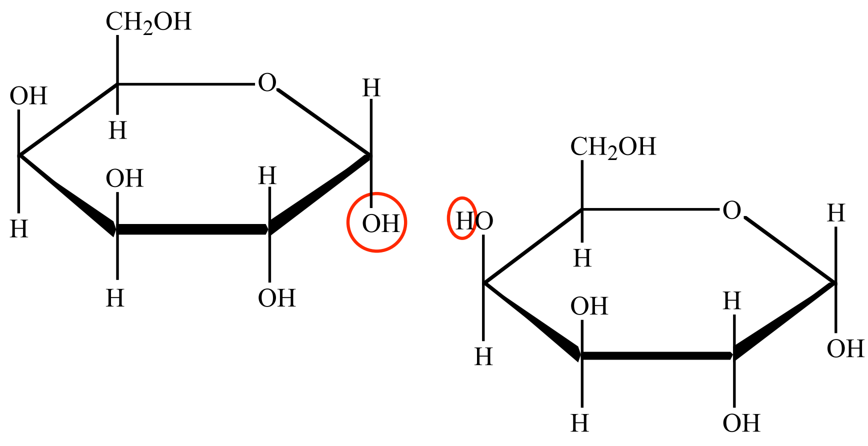
α-D-ribose

14.71 D-monosaccharides are more common than L-monosaccharides in living organisms. (L-monosaccharides are very rare.)

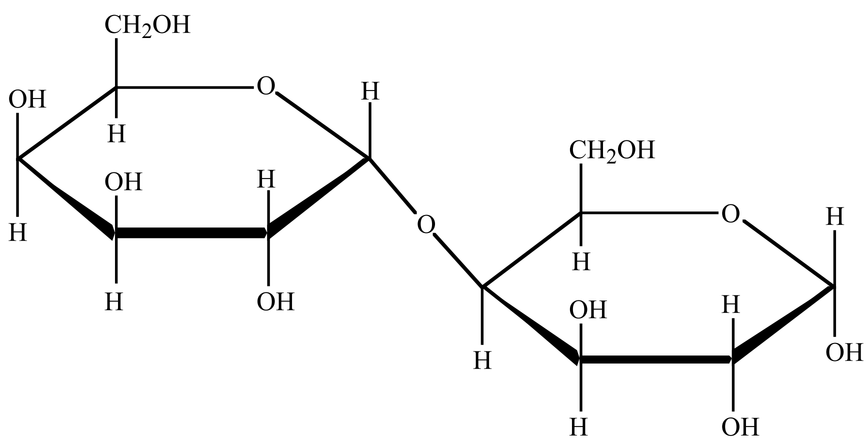
14.73 Galactose and mannose do not normally occur as monosaccharides. These two sugars are usually found as components of disaccharides and polysaccharides.

14.75 This compound does not give a positive Benedict's test (i.e. it is not a reducing sugar), because it does not contain a hemiacetal group. The anomeric carbon (the left-most carbon in the ring) is not attached to an OH group.

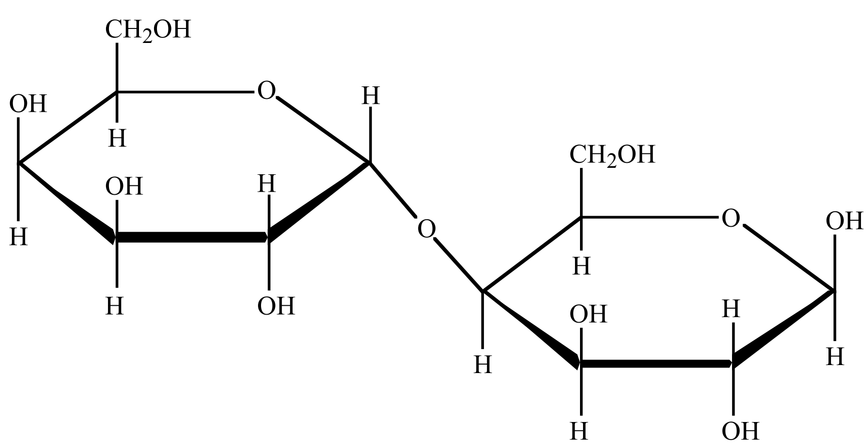
14.77 The left-hand galactose molecule must be the α anomer (because the linkage is α(1→4)), but the right-hand galactose molecule can be either anomer. This gives us two possible products. Here is how one of the possible disaccharides is formed, using two molecules of α-D-galactose:



Two molecules of α-D-galactose "shaking hands"

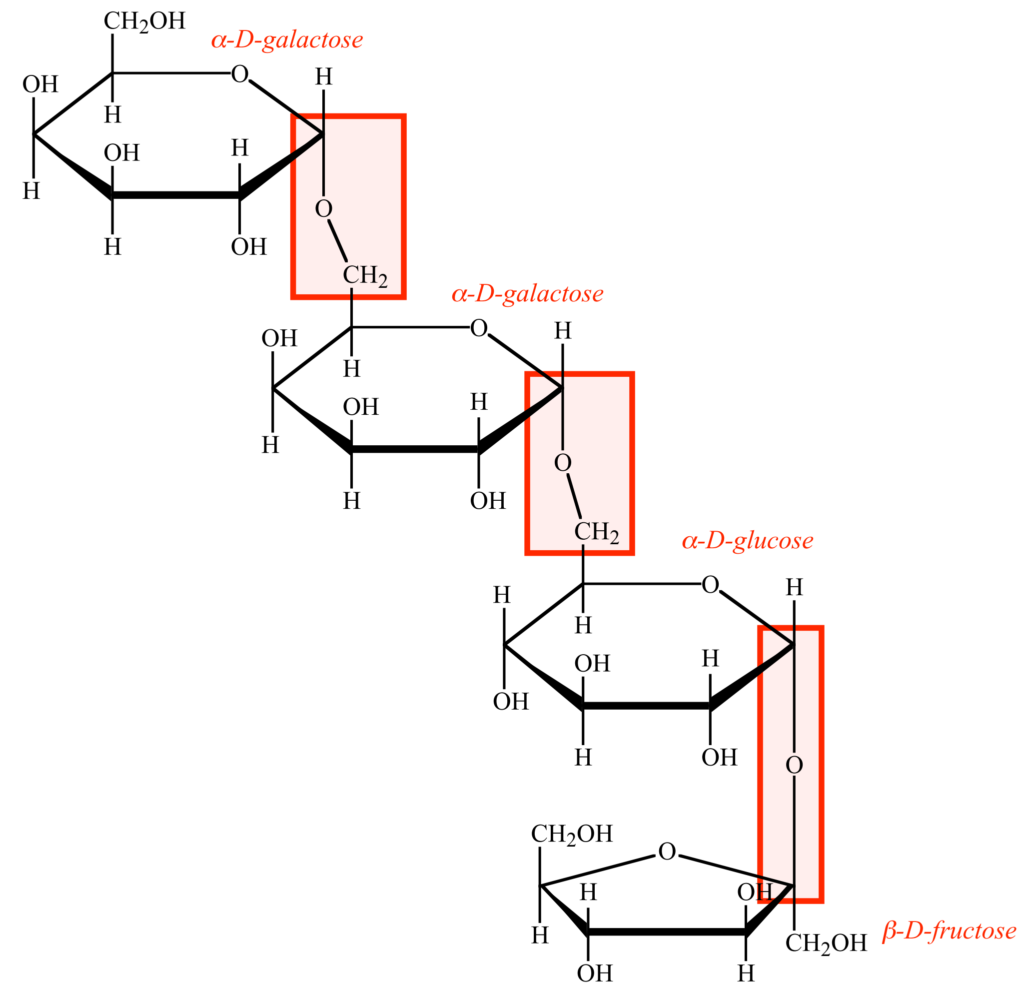


If we turn the right-hand galactose into the β anomer and make the glycosidic bond, we get the other possible disaccharide:



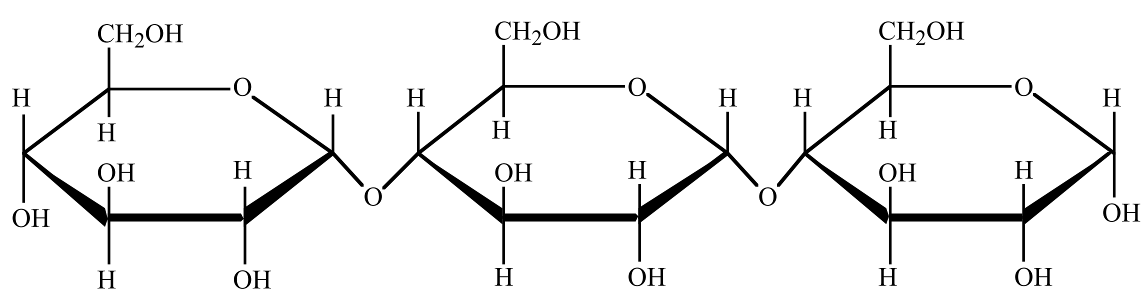
14.79 Sucrose is not a reducing sugar because neither ring can open up to the open-chain form. The glycosidic bond in sucrose joins both anomeric carbon atoms.

14.81 a) The three linkages are circled below.
b) The four simple sugars are labeled below.



14.83 Many people lose the ability to make lactase (the enzyme that hydrolyzes the glycosidic bond in lactose) in late childhood or early adulthood. However, virtually everyone is able to make sucrase (the enzyme that hydrolyzes the glycosidic bond in sucrose) throughout their lives.

14.85



14.87 a) glycogen or amylopectin b) glycogen c) amylose

14.89 To hydrolyze starch (including amylopectin), we need amylase and a debranching enzyme. Our digestive tract makes both of these enzymes (that's why we can digest starch!).

14.91 Both cellulose and chitin are structural polysaccharides, providing strength and rigidity to an organism. However, cellulose is made by plants, while chitin is made by arthropods (animals such as insects, lobsters, shrimp, crabs, spiders, scorpions, and so forth).

14.93 Immediately after a meal, the liver removes excess glucose from the blood and converts into glycogen. Later, when the glucose level in the blood starts to drop, the liver breaks glycogen down into glucose and releases the glucose into the blood.

14.95 Our bodies cannot digest cellulose, so we cannot use cellulose as an energy source. (If you ignite a piece of cellulose with a match, you'll get 4 Calories of heat per gram of cellulose, but that heat is of no use to our bodies.)

14.97 Only plants and certain specialized microorganisms can make carbohydrates from the inorganic compounds CO_2 and H_2O. This process is called photosynthesis.

14.99 The molecular formula of lactose is $C_{12}H_{22}O_{11}$. This formula does not fit the 1:2:1 ratio, because we lose two hydrogen atoms and one oxygen atom when we condense glucose and galactose to make lactose.

14.101 a) $\frac{44 \text{ g sugars}}{355 \text{ mL}} \times 100\% = 12.3943662\%$ (calculator answer)

Rounding this answer to two significant figures and attaching the label gives us **12% (w/v)**.

b) The formula weight of either sugar is 180.156 (using the molecular formula $C_6H_{12}O_6$), so 1 mole of either sugar weighs 180.156 grams. We can use this relationship to convert 44 g of sugar into moles:

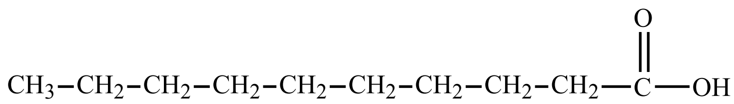
$$44 \text{ g} \times \frac{1 \text{ mole}}{180.156 \text{ g}} = 0.244232776 \text{ moles}$$

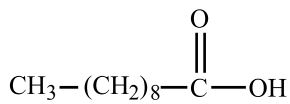
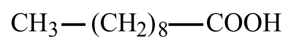
To get the molar concentration, we must divide the number of moles of sugar by the number of liters of solution. The volume of the soft drink is 355 mL, which equals 0.355 L.

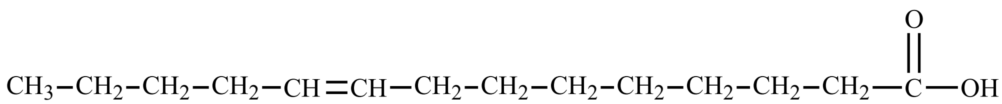
$$\frac{0.244232776 \text{ moles}}{0.355 \text{ L}} = 0.687979651 \text{ mol/L} \quad \text{(calculator answer)}$$

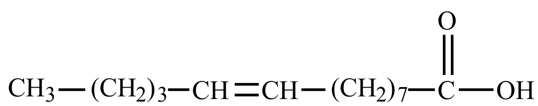
Rounding this answer to two significant figures and using our normal abbreviation for molarity gives us **0.69 M**.

c) The soft drink is hypertonic, because the solute concentration is higher than 0.28 M.

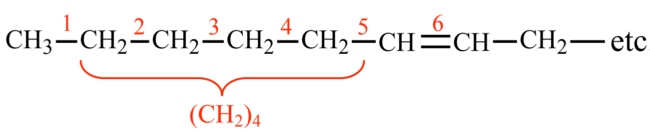
14.103 Capric acid is 

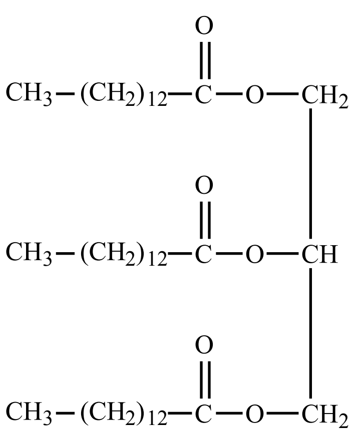
This can be abbreviated as  or 

14.105 

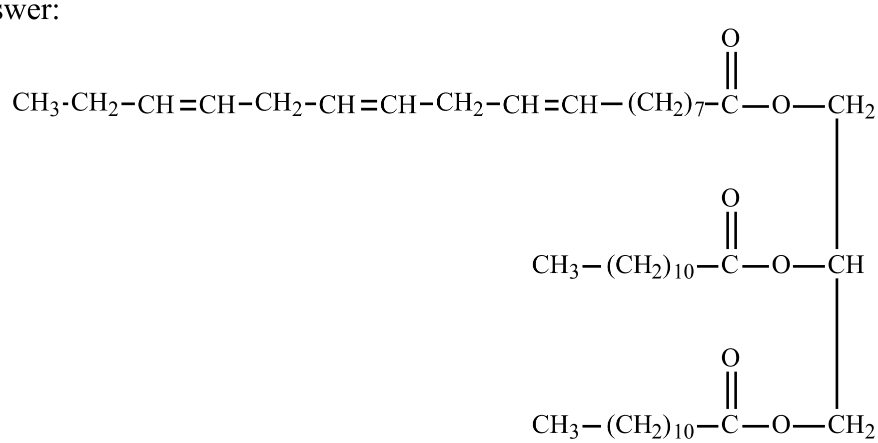
This can be abbreviated as 

14.107 Gamma-linolenic acid is an omega-6 fatty acid. When we count from the left side (the side opposite the carboxylic acid group, the first carbon-carbon double bond we reach is the sixth bond in the carbon chain.



14.109 a) 

b) You can attach the linolenic acid to any of the three carbon atoms of glycerol. The two lauric acid molecules are attached to the other two carbon atoms of glycerol. Here is one possible answer:



14.111 Triglyceride #2 has the highest melting point, because it is made from three saturated fatty acids. Triglyceride #3 is next, because it is made from one saturated and two unsaturated fatty acids. Triglyceride #1 has the lowest melting point, because it is made from three unsaturated fatty acids.

14.113 "High in polyunsaturates" means that many of the triglycerides in the oil are made from fatty acids that contain two or more double bonds in their hydrocarbon chains.

14.115 The hydrocarbon chains in a collection of saturated fatty acid molecules can be stacked on top of one another. This increases the attraction between the molecules, which depends on the amount of contact area (among other things). Unsaturated fatty acids have an abrupt bend in the chain, so they do not stack well and have less contact area. Therefore, unsaturated fatty acid molecules are not as strongly attracted to one another, making it easier to melt an unsaturated fatty acid.

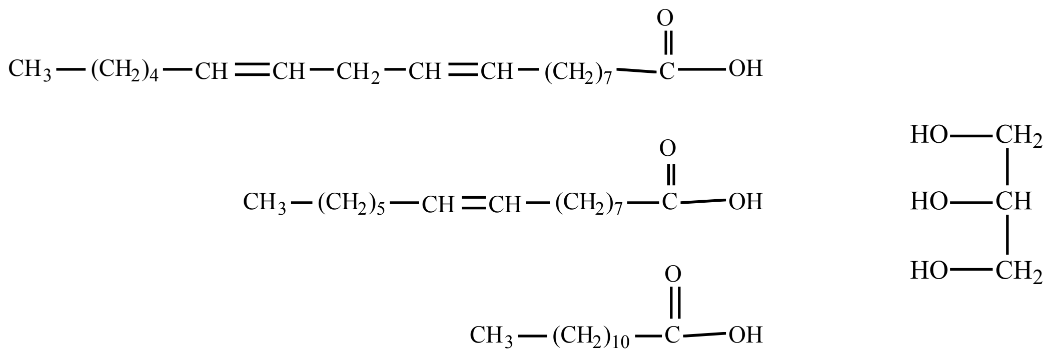
14.117 The advantages are that partial hydrogenation produces a soft solid (complete hydrogenation produces a hard solid), and that the product resists spoiling. The disadvantage is that partial hydrogenation produces *trans* fatty acids and saturated fatty acids, which are believed to increase the risk of heart disease.

14.119 a) The mixture is a solid at room temperature, because its melting point is 33ºC, which is above room temperature. (Room temperature is roughly 20ºC to 25ºC.)

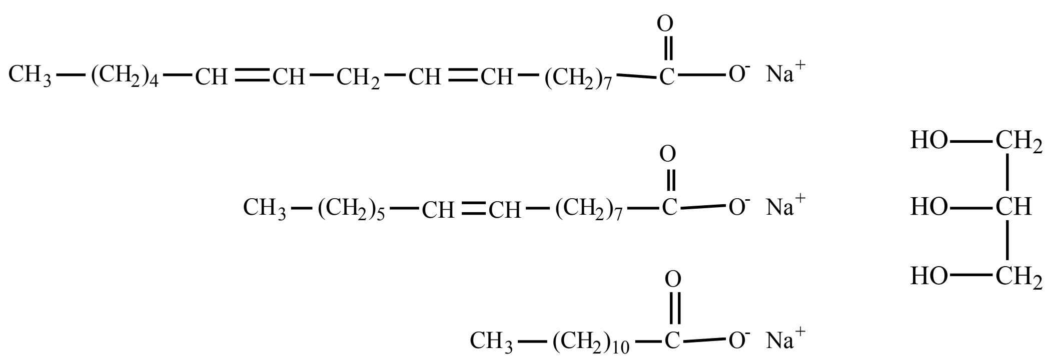
b) This mixture is classified as a fat, because it is a solid and it comes from an animal source.

14.121 This triglyceride was made from linoleic acid, palmitoleic acid, and lauric acid (from top to bottom).

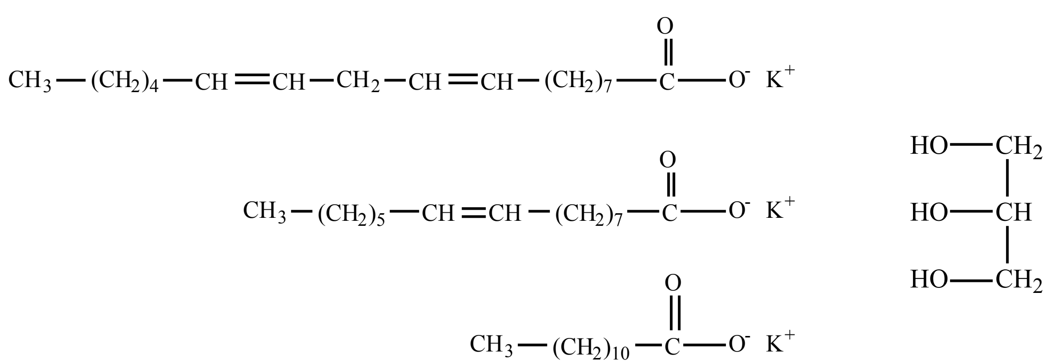
14.123 a) In 2 M H_2SO_4 (a strongly acidic solution), the products will be glycerol and the fatty acids.



b) In 2 M NaOH (a strongly basic solution), the products will be glycerol and the sodium salts of the fatty acids.

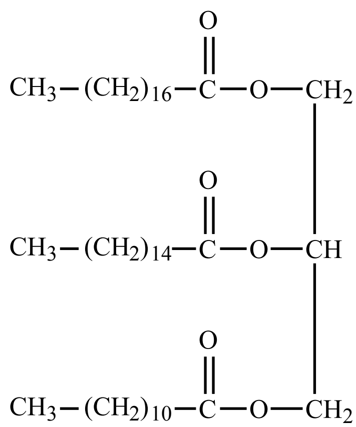


c) In 2 M KOH (another strongly basic solution), the products will be glycerol and the potassium salts of the fatty acids.



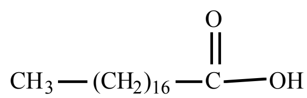
14.125 The sodium salts in the answer to part “b” and the potassium salts in the answer to part “c” of Problem 14.127 are soaps.

14.127 a)



b) This product is still a triglyceride, because it still contains three fatty acids combined with glycerol.

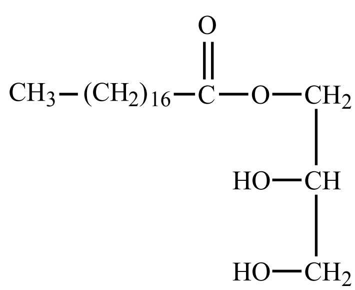
c) If this product is hydrolyzed, the product fatty acids will be stearic acid, palmitic acid, and lauric acid (top to bottom).

14.129 The product is stearic acid, 

14.131 The lipase is an enzyme that hydrolyzes triglycerides, breaking them down into glycerol (or a monoglyceride) and fatty acids.

14.133 The sodium salts are more soluble than the fatty acids because the sodium salts are ionic compounds. The attraction between an ion and water is stronger than the attraction between a polar molecule and water, because the charges on ions are larger than the charges on the atoms in a polar molecule.

14.135



14.137 The chylomicrons are the lipoproteins that transport most of the triglycerides.

14.139 Our bodies can make saturated fatty acids from other nutrients, particularly carbohydrates. They are “nonessential” only in the sense that we do not need a dietary source of them.

14.141 The fatty acids are connected to glycerol by an ester functional group.

14.143 Ethanol is not as polar as water, so it does not attract the ionized “heads” of the glycerophospholipids as strongly as water does. In addition, the nonpolar “tails” of the glycerophospholipids can readily mix with ethanol and do not need to segregate themselves from the solvent. Therefore, glycerophospholipids simply dissolve in ethanol, rather than forming a bilayer.

14.145 The carbohydrate portion of these lipids protrudes from the cell surface, allowing other cells to recognize the cell as being part of the organism.

14.147 Glucose contains several hydrogen-bonding groups, so it is strongly attracted to water. As a result, glucose molecules will not leave the aqueous solution and enter the nonpolar interior of the membrane.

14.149 O_2 and methanol can pass through lipid bilayers. In general, nonpolar substances (such as O_2) cross the membrane freely. Also, small molecules like methanol can cross the membrane as long as they are not ionized. However, ions (like Ca^{2+} and acetate) cannot cross the membrane, nor can large, highly polar molecules like sucrose.

14.151 a) This is an example of active transport, because the valine is moving out of the solution that has the lower concentration, and into the solution that has the higher concentration (against the normal direction of diffusion).

b) Active transport always requires a source of energy.

c) The concentration of sodium ions is higher outside the cell than it is inside the cell. This concentration gradient is a source of energy. Moving sodium ions into the cell produces energy (because sodium is moving in the normal direction of diffusion), and the cell harnesses this energy to carry out the active transport of valine.

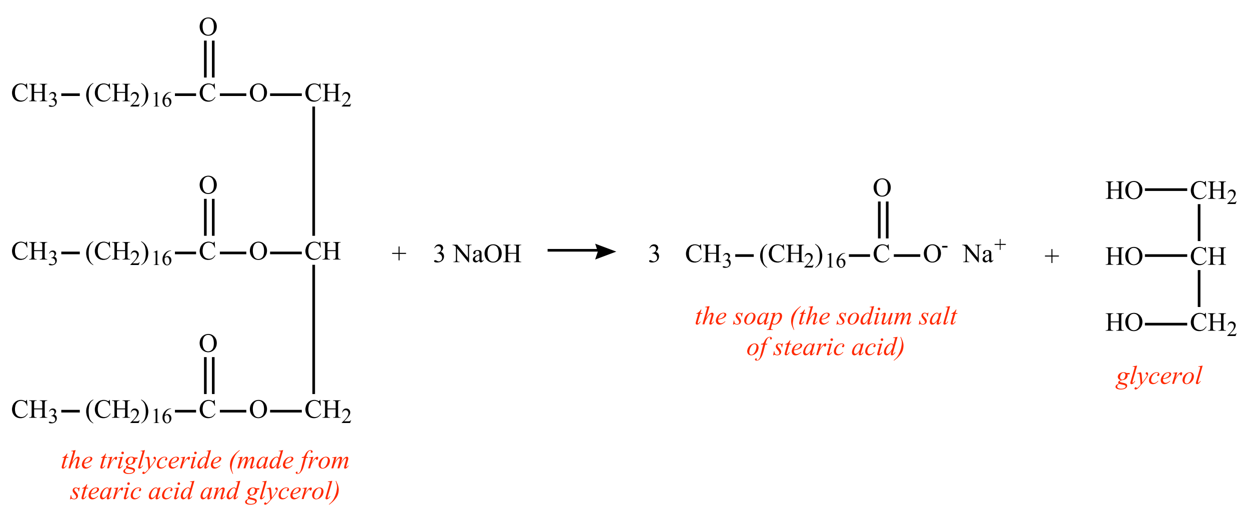
14.153 The steroid nucleus is a large hydrocarbon framework and is strongly hydrophobic. Steroids do not contain enough hydrophilic groups to compensate for this large hydrophobic framework and allow the molecules to dissolve in water.

14.155 a) bile salts b) estrogens and progestins

14.157 This is a reduction. A ketone group in androstendione is being converted into an alcohol group in testosterone. (The structure of testosterone is on page 14-53.)

14.159 SHBG is soluble in blood. It binds to estradiol and testosterone, allowing these two steroid to be transported by the blood.

14.161 The overall reaction is:



When we write this reaction as a chemical equation using molecular formulas, we get:

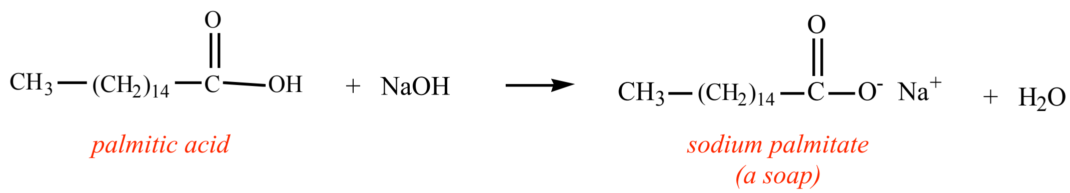
$$C_{57}H_{110}O_6 + 3\ NaOH \rightarrow 3\ NaC_{18}H_{35}O_2 + C_3H_8O_3$$

The formula weight of the triglyceride ($C_{57}H_{110}O_6$) is 891.45 amu, and the formula weight of the soap ($NaC_{18}H_{35}O_2$) is 306.45 amu. The balanced equation calls for three molecules of soap, so the relative mass of the soap is 3 x 306.45 amu = 919.35 amu. Therefore, you make 919.35 g of soap when you break down 891.45 g of triglyceride.

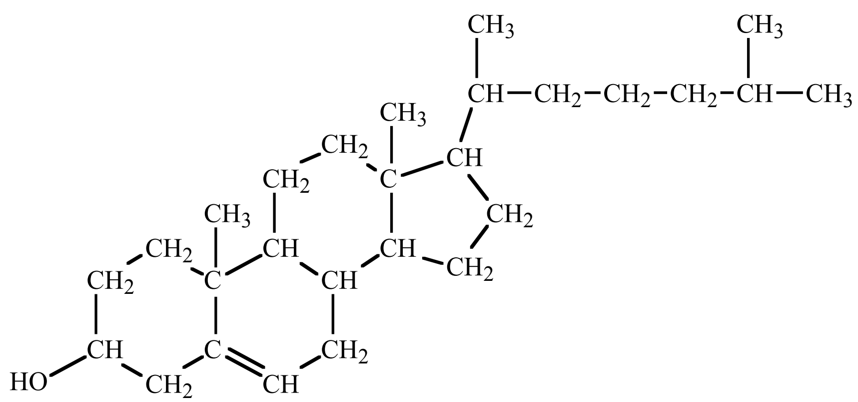
$$10.0\text{ g triglyceride} \times \frac{919.35\text{ g soap}}{891.45\text{ g triglyceride}} = 10.31297325\text{ g soap} \quad \text{(calculator answer)}$$

Rounding this answer to three significant figures gives us **10.3 g of soap**.

14.163 Any fatty acid reacts with NaOH to make its sodium salt, which will be a soap. Using palmitic acid as an example:



14.165 The hardest part of this problem is working out the molecular formula of cholesterol. The structure of cholesterol is shown on page 14-52, but you need to work out the numbers of hydrogen atoms on each carbon in the steroid nucleus. Here is a condensed structure that shows all of the hydrogen atoms.



Using this structure (and counting carefully!), we find that the molecular formula of cholesterol is $C_{27}H_{46}O$. From this, we can calculate that the formula weight of cholesterol is 386.638 amu, and this tells us that 1 mole of cholesterol weighs 386.638 grams. Now we can convert the actual mass of cholesterol in our solution from grams to moles.

$$1.25\text{ g} \times \frac{1\text{ mole}}{386.638\text{ g}} = 0.003232998\text{ moles}$$

The volume of the solution is 250 mL, which equals 0.25 liters. Therefore, the molarity is:

$$\frac{0.003232998\text{ moles}}{0.25\text{ L}} = 0.012931993\text{ mol/L} \quad \text{(calculator answer)}$$

Rounding this to three significant figures and using our normal abbreviation for molarity gives us **0.0129 M.**