

3. Persistent organic pollutants can be classified into three different groups:

- Industrial chemical products like PCBs
- Combustion byproducts such as dioxins
- Pesticides like DDT

Some examples include:

- PCBs, hexabromobiphenyl
- PAHs, dioxins, furans
- hexachlorobenzene
- Toxaphene
- Chlordane
- Aldrin
- DDT
- Mirex
- Dieldrin
- pentachlorophenol
- Endrin

For links to web sites related to persistent organic pollutants, visit the McGraw-Hill Ryerson web site at www.mcgrawhill.ca/books/chemistry12. Go to Teacher Resources and follow the links.

4. Student risk-benefit analyses will vary. Some additional points for students to research and consider could include:

- design and manufacture
- chemical and physical properties
- uses
- cost and availability
- health risks from manufacture or use
- environmental pollution from manufacture or disposal

5. Student answers will vary. Work with the class to produce a list of specific criteria and a rubric for assessment. Some criteria could include:

- Is it accurate and interesting?
- Is it convincing to the reader?
- Does the student provide proofs for his/her arguments?
- Is it relevant to consumers?

Chapter 2 Review Answers

Student Textbook pages 105–109

Answers to Knowledge/ Understanding Questions

- (a) In an addition reaction, atoms are added to a double or triple bond.

(b) In a substitution reaction, a hydrogen atom or functional group is replaced by a different atom or functional group.

(c) In an elimination reaction, atoms are removed from a molecule and a double bond is formed.

(d) In the oxidation of an organic compound, a carbon atom forms more bonds to oxygen and less bonds to hydrogen.

(e) In the reduction of an organic compound, a carbon atom forms fewer bonds to oxygen and more bonds to hydrogen.

(f) In a condensation reaction, two organic molecules combine to form a single organic molecule.

(g) In a hydrolysis reaction, water adds to a bond and splits it in two.
- An esterification reaction is one type of condensation reaction.
- Addition and elimination reactions are the reverse of each other. In an addition reaction, atoms add to a double bond, while in an elimination reaction, atoms are taken away from a molecule to produce a double bond.
- (a) An esterification reaction produces an ester from a condensation reaction between a carboxylic acid and an alcohol. Water is a second product of this reaction. A hydrolysis reaction produces two organic molecules by splitting a larger organic molecule, often at an ester or amide bond. Water is the second reactant.

(b) These two reactions are the reverse of each other. Esterification joins an alcohol and carboxylic acid to form an ester; hydrolysis splits an ester to produce an alcohol and a carboxylic acid.
- (a) addition

(b) substitution

(c) elimination

(d) substitution

(e) addition

(f) addition

(g) substitution
- (a) oxidation

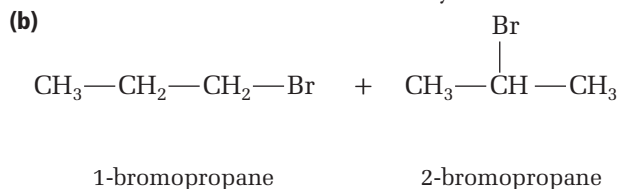
(b) reduction

(c) oxidation
- (a) Addition polymerization is a reaction in which monomers with double bonds are joined together through multiple addition reactions to form a polymer.

(b) Condensation polymerization is a reaction in which monomers are joined together by the formation of an ester or amide bonds. Water is usually the second product.
- A nylon is a condensation polymer that contains amide bonds, while a polyester is a condensation polymer that contains ester bonds. They are similar in that they are both formed by condensation polymerization, and water is a byproduct of both reactions.

9. This is an addition reaction because hydrogen is being added to a double bond. It is also reduction because more carbon-hydrogen bonds are formed.

10. (a) Markovnikov's rule states that the halide atom or OH group in an addition reaction is usually added to the more substituted carbon atom. It applies to the following situation because both reactants are asymmetrical.



(c) 2-bromopropane

11. This is an elimination reaction because two hydrogen atoms are eliminated from the molecule to form a double bond (the C=O bond).

12. This is a reduction because the product has fewer carbon-oxygen bonds and more carbon-hydrogen bonds than the reactant.

13. (a) propene, $\text{CH}_2=\text{CH—CH}_3$

(b) Polypropene is an addition polymer. The polymer contains a continuous chain of carbon-carbon bonds, with no ester or amide bonds. In addition, the monomer has a double bond which is lost in the polymer.

(c) polypropylene

14. (a) A protein is a natural polymer made up of amino acids. Amino acids are the building blocks, or monomers, for proteins.

(b) Much of the body's structure is made from proteins. Proteins are also responsible for many of the biological functions in the body. Insulin is an example of a protein that helps regulate sugar levels in the body.

15. (a) Lipids are biological molecules that are not soluble in water, but are soluble in non-polar solvents.

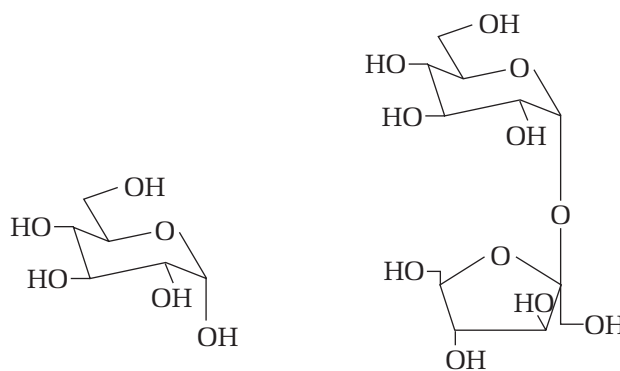
(b) glycerol trioleate, cholesterol, testosterone

(c) meat, milk, peanut butter, cheese (any food that contains fat or oil)

(d) Lipids are important for the long-term storage of energy in the body. They make up cell membranes and act as hormones (e.g., testosterone). Lipids also make up some of the fat-soluble vitamins, such as vitamins A, D, and E.

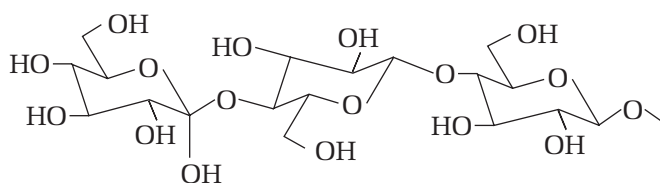
16. (a) A monosaccharide is a simple sugar made of one saccharide unit. A disaccharide contains two saccharide units. A polysaccharide is a polymer unit that contains many saccharide units.

(b) monosaccharide—glucose; disaccharide—sucrose; polysaccharide—cellulose



glucose

sucrose



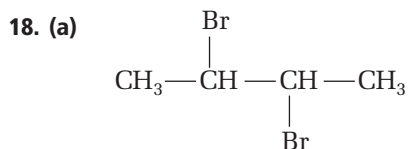
cellulose

(c) Carbohydrates are the primary source of energy for the body.

17. (a) a saccharide unit, or monosaccharide

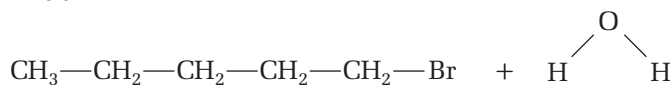
(b) glucose

Answers to Inquiry Questions



2,3-dibromobutane

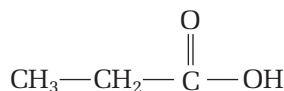
(b)



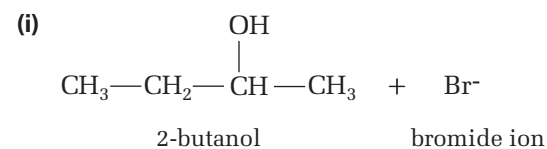
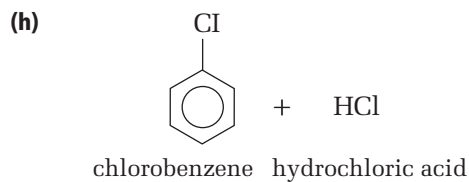
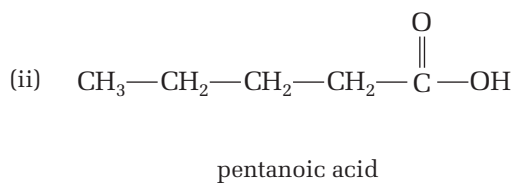
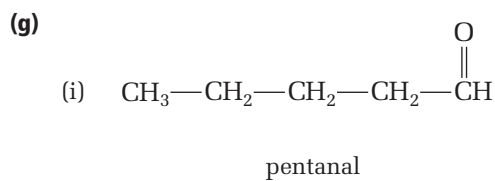
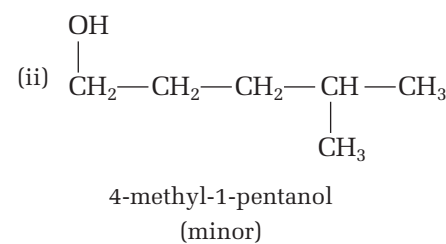
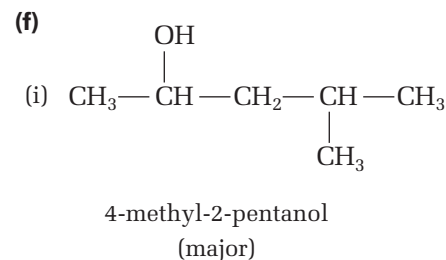
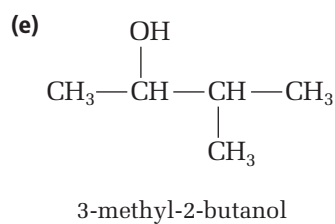
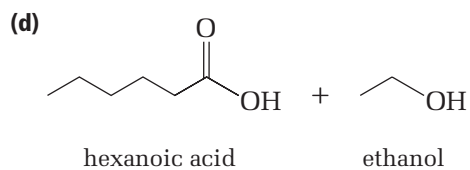
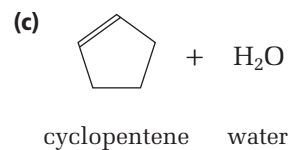
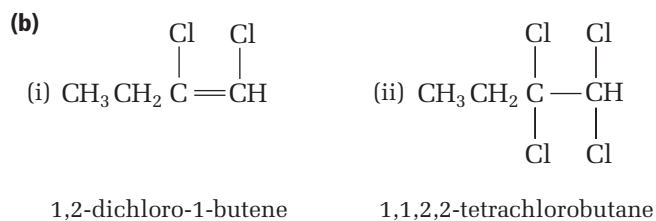
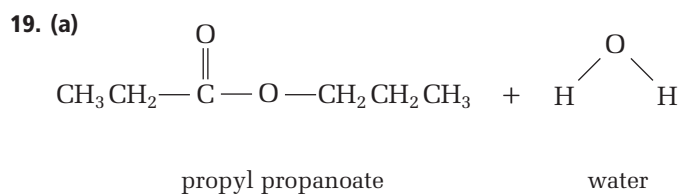
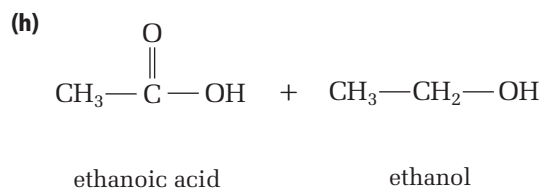
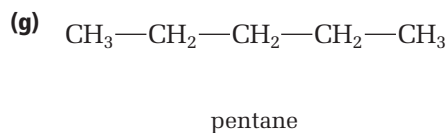
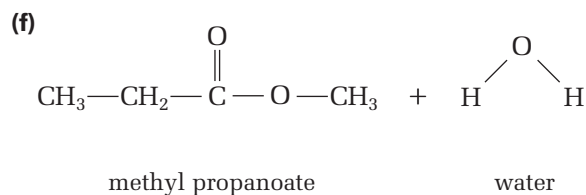
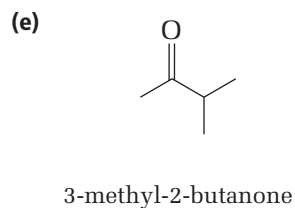
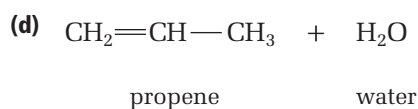
1-bromopentane

water

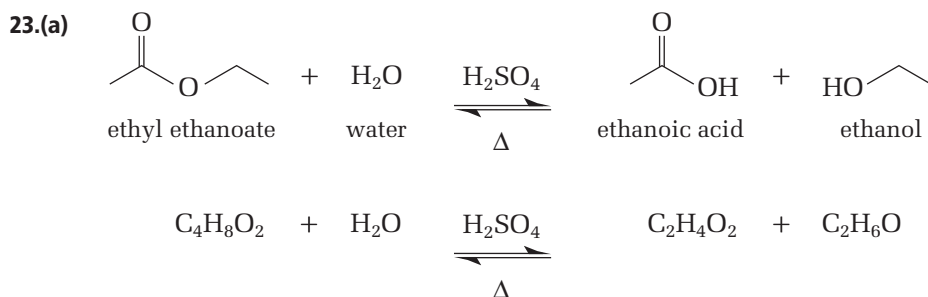
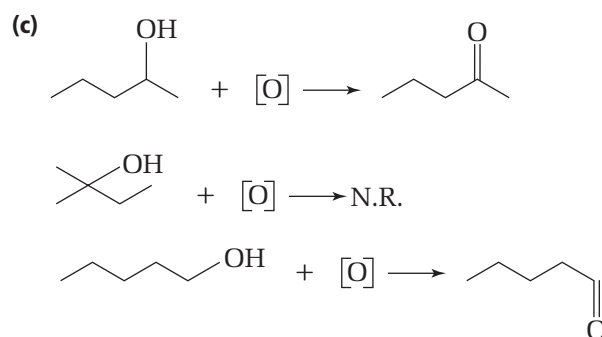
(c)



propanoic acid



(b) 1-pentanol will react vigorously, and the purple permanganate colour will disappear quickly. 2-pentanol will react slower, and the purple permanganate colour will disappear after a few seconds. 2-methyl-2-butanol will not react, and the purple permanganate colour will not disappear. (Tertiary alcohols do not oxidize.)



(b) Student answers will vary, but should include distilled water, heating in a hot water bath (note that no open flame should be used, since esters are flammable!), and the presence of sulfuric acid. A possible procedure is given below.

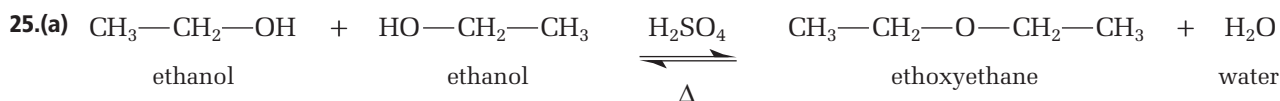
1. Place 5 mL ethyl ethanoate in a clean and dry test tube.
2. Place the test tube in a water bath at approximately 50°C.
3. Add 5 mL of distilled water and two drops of concentrated H₂SO₄.
4. Leave the test tube in the water bath for approximately 10–15 min to allow the reaction to occur.

(c) Materials would include:

- hot plate
- 500 mL beaker for the hot water bath

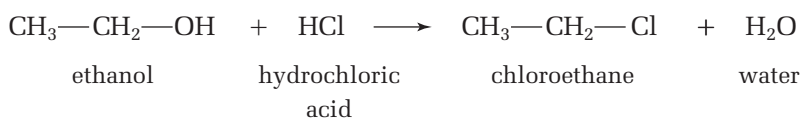
- test tubes (20 mL)
- water for water bath
- distilled water
- ethyl ethanoate
- concentrated H₂SO₄
- medicine dropper
- fume hood for use and storage of sulfuric acid

24. Tollen's reagent consists of a dilute ammonia solution of silver oxide, Ag₂O. When the reagent reacts with an aldehyde, a shiny mirror of metallic silver is deposited on the walls of the flask. Tollen's reagent acts as an oxidizing agent. Aldehydes will oxidize to carboxylic acids, but ketones will not react. Therefore, if a reaction takes place, and silver metal is deposited on the walls of the test tube, the unknown compound must be an aldehyde, not a ketone.



(b) This reaction is a substitution reaction, because the OH group on one alcohol molecule is replaced with an ethoxy group formed from the other alcohol molecule.

(c) This reaction is a different kind of substitution reaction, in which the OH group on the alcohol is replaced with a chlorine atom.



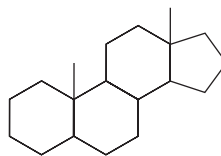
Answers to Communication Questions

26. Students will find it challenging to build a nucleotide using a molecular model kit, and it will take some time. If time is limited, or if you do not have sufficient molecular model kits, you may want to have students draw DNA nucleotides on paper instead, and then join the papers to produce a “strand” of DNA. If students have studied DNA further, and understand base pairing, they could prepare a second, matching strand of DNA and join the two to produce a short segment of DNA.
27. Student answers will vary. Some examples include vegetable oil, acetaminophen, gasoline, plastic, nylon, etc. You may also choose to use this question as a discussion topic. Students can discuss the different organic products they use, in terms of:
- use
 - cost
 - benefits and disadvantages
 - possible alternatives
28. (a) Leaded gasoline caused environmental pollution. Lead fuel additives have now been replaced with less harmful organic fuel additives.
- (b) CFCs cause ozone depletion. Organic compounds such as hydrofluorocarbons and hydrocarbons are now used as substitutes.

Answers to Making Connections Questions

29. Student answers will vary.
30. Polystyrene is not biodegradable, produces toxic fumes when burned, and accumulates in waste-disposal sites. Although it is possible to recycle this product, most cities do not, due to the high cost of transporting the bulky but lightweight substance. The manufacture of polystyrene and polystyrene foams such as Styrofoam™ produces hazardous wastes such as benzene.
31. Student answers will vary.

- 32.(a) The structure of a steroid contains four rings, as shown below.



- (b) Common examples of steroids include testosterone, progesterone, aldosterone, estrogen, and cortisone. Cortisone is a steroid used to help offset the effects of inflammation in the joints. The synthetic estrogen ethinylestradiol and the synthetic progestin norethindrone are steroids used in the birth control pill.
- (c) Anabolic steroids such as stanozolol are synthetic androgens that mimic the muscle-building effects of natural testosterone. They were detected in several athletes during the 1988 summer Olympics. Steroids are still used by some athletes to increase muscle mass, and thus improve performance. However, this type of steroid use is illegal, and may contribute to serious health problems such as heart disease, cancer, and stroke, as well as leading to lesser health problems including impotence, acne, nausea, and headaches.
33. (a) Muscles need proteins to grow. Amino acid beverages contain readily available amino acids that can and may be used to build protein for muscle growth in athletes.
- (b) While amino acids and protein are a necessary part of a healthy diet, and important to muscle production, these substances can be obtained from a balanced diet. Athletes should not depend on high-protein and high-calorie drinks and neglect their diets.
34. (a) You would expect lye to be either an acid or a base, since it acts to hydrolyze ester bonds.
- (b) Lye is actually sodium hydroxide, NaOH.
- (c) Students should be able to find early soap recipes in history books and books on the lives of pioneers. These recipes will include heating, and the use of wood ash (containing lye, NaOH), water, and animal fats.
- (d) Student procedures should include the necessary conditions for basic hydrolysis, including water, heat, the presence of a strong base, and a fat or oil.