تم تحميل هذا الملف من موقع المناهج الإماراتية

*للحصول على أوراق عمل لجميع الصفوف وجميع المواد اضغط هنا

https://almanahj.com/ae

* للحصول على أوراق عمل لجميع مواد الصف الثاني عشر العام اضغط هنا 12/ae/com.almanahj//:https

* للحصول على جميع أوراق الصف الثاني عشر العام في مادة كيمياء ولجميع الفصول, اضغط هنا

https://almanahj.com/ae/12chemistry

* للحصول على أوراق عمل لجميع مواد الصف الثاني عشر العام في مادة كيمياء الخاصة بـ الفصل الأول اضغط هنا

https://almanahj.com/ae/12chemistry1

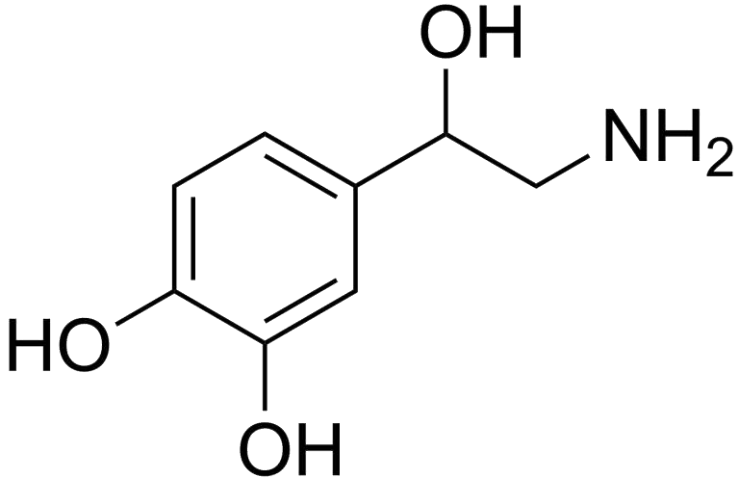
* لتحميل كتب جميع المواد في جميع الفصول للـ الصف الثاني عشر العام اضغط هنا grade12/ae/com.almanahj//:https

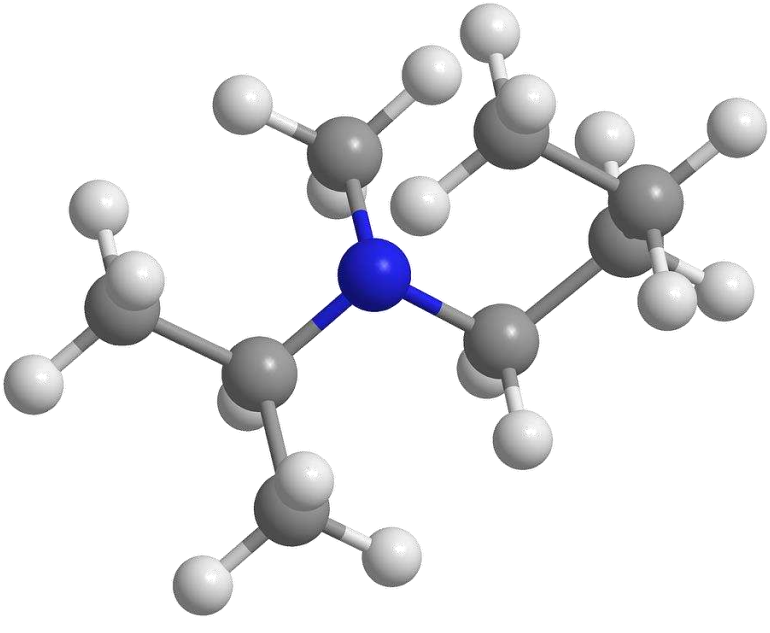
للتحدث إلى بوت المناهج على تلغرام: اضغط هنا bot_almanahj/me.t//:https

G. 12 general Chemistry

Student name: .....

Class: 12/.





Section:1 Simple organic compounds

Examples for organic compounds; gasoline, vanilla flavor, natural rubber, and human body.

Organic compounds:

They are compounds that contain carbon element except carbon oxides and carbonates (inorganic compounds).

Of the millions of carbon compounds more than 90% are organic compounds

Why scientists give organic compounds this name?

Because they thought that organic compounds only formed in living organisms' bodies. But in 1830 organic compounds have been prepared in the laboratory.

Classify the compounds to organic or inorganic compounds? C_4H_{10}, H_2O, FeO , CH_3COOH , CaS ,CH_4 CO_2 .

Organic compounds: …….

Inorganic compounds: ……

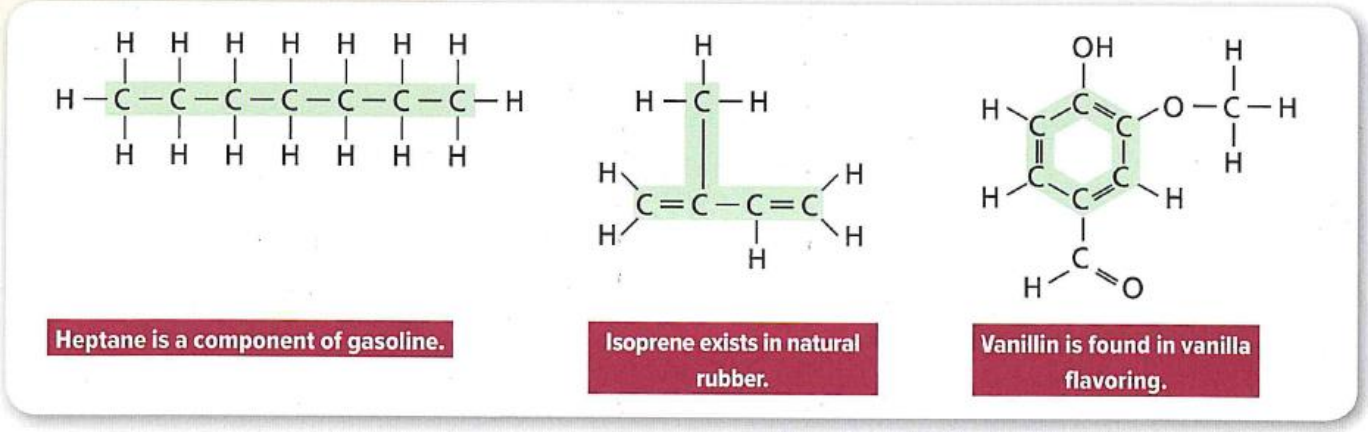
Why carbon forms so many different compounds?

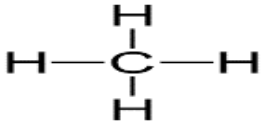
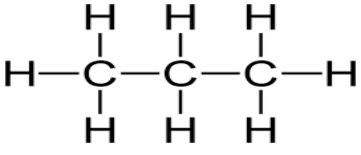
Carbon atom has 4 electrons in the outer energy level, so it can form 4 covalent bonds with another carbon atom or any other different atoms. And it can form single, double, or triple covalent bonds. It can form straight chains, branched chains, or cycle chains.

Covalent bond can be formed when bonding atoms sharing one pair of electrons or more

Carbon can form straight chains, branched, or cycle chains. Short chain can be used as fuel, when long chains can be used to making plastic

Short chain can be used as fuel, when long chains can be used to making plastic.



examples	Chemical formula	Structural formula	Space filling model
	Simplest way	Uses lines (each line represents single covalent bond) to show bonds between atoms.	Shows more realistic picture of the relative size and arrangement of atoms in the molecule.
methane	CH_4		
propane	C_3H_8		

Chemists usually use chemical and structural formula to show chemical reactions.

Hydrocarbons

Hydrocarbons are made up of **carbon and hydrogen only.**

Natural methane gas **CH4** is one of the main components of the natural gas used at homes, propane gas **C3H8** is a fuel for stoves, outdoors grills, and hot air balloons. Hydrocarbons produce more than 90% of the energy we use, and hydrocarbons are important for medicine, clothes, and foods.

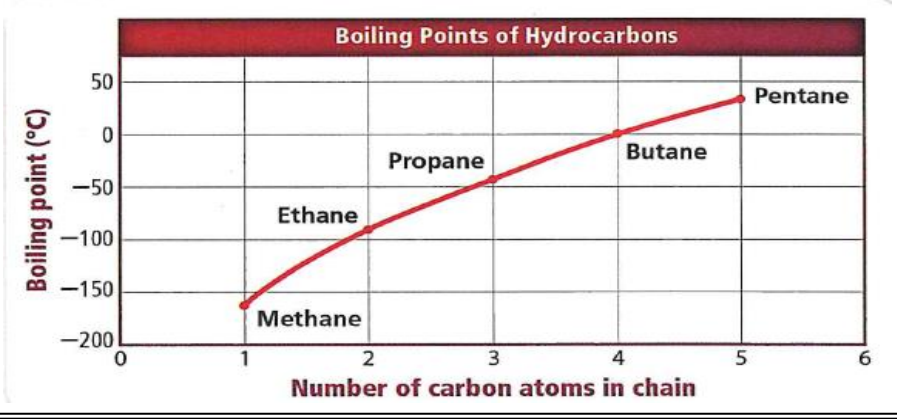


Table 1 Roots for Hydrocarbons

Root	Number of Carbon Atoms
Meth–	1
Eth–	2
Prop–	3
But–	4
Pent–	5
Hex–	6
Hept–	7
Oct–	8

Worksheet

Which compound is the main component of natural gas?

Pentane- hexane- iso-octane- methane

From the graph, what is the relation between boiling points and the number of carbon atoms in the chain?

……
……

Which compound has the highest boiling point.?

a- Methane b- propane c- ethane d- butane

Which compound has the lowest boiling point.?

a- Butane b- pentane c- hexane d- methane

Covalent bond between carbon atoms	1	2	3
type	single	double	triple
show	C–C	C=C	C≡C
Name end with	ane	ene	yne
example	Ethan C2H6	Ethene C2H4	Ethyne C2H2

Exercise: write the compound that match the type of bond in the coming table?

Ethane- ethene- ethyne- propyne- pentene- octane- hexene

Have single covalent bond	Have double covalent bond	Have triple covalent bond

What is the bond type between carbon atoms in pentene?

a- Single covalent bond and one double covalent bond b- Single covalent bond only

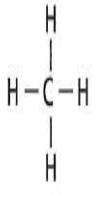
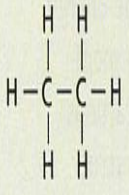
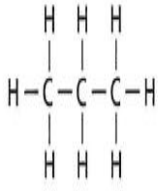
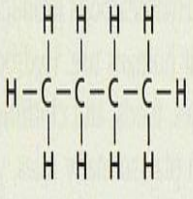
c- Single covalent bond and one triple covalent bond d- Triple covalent bond only

saturation: is the state when the hydrocarbon contains the maximum number of hydrogen atoms.

Hydrocarbons can be classified into tow types:

a- Saturated hydrocarbons: are hydrocarbons that **contain only single covalent bonds** between carbon atoms.
b- Unsaturated hydrocarbons: are hydrocarbons that **contain at least one double or triple covalent bond** between carbon atoms.

Table 2 Some Saturated Hydrocarbons

Name	Methane	Ethane	Propane	Butane
Chemical Formula	CH_4	C_2H_6	C_3H_8	C_4H_{10}
Structural Formula				

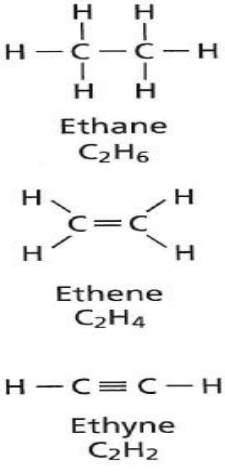
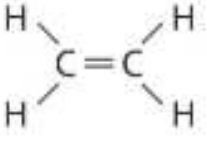
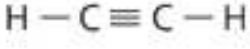
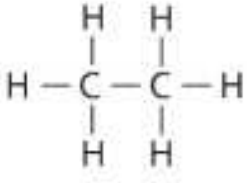


Figure 4 Saturated hydrocarbons, such as ethane, have only single bonds. Unsaturated hydrocarbons, such as ethene and ethyne, have double or triple bonds between carbon atoms.

Ethene is sometimes called Ethelene. Ethelene gas aids ripening fruits. Ethyne is used in some welding torches.

Exercise: classify the hydrocarbons into **saturated(S)** or **unsaturated(U)** hydrocarbons?

C_4H_6 - C_5H_{12} - C_3H_6 - butyne - pentene - propane

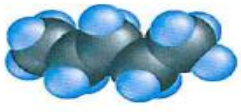




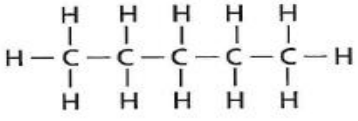
Hydrocarbons are saturated when the have the maximum number of ……. Atoms.

a- Oxygen b- hydrogen c- nitrogen d- carbon

Isomers: are compounds that have identical chemical formulas but different molecular structures and shapes.

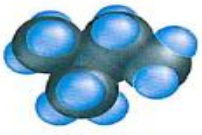
Pentane

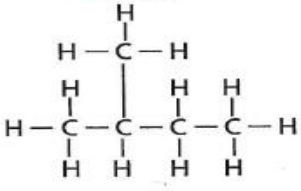




boiling point: 36°C
melting point: −130°C
density: 0.626 g/cm³

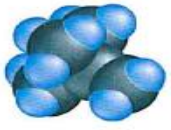
Isopentane

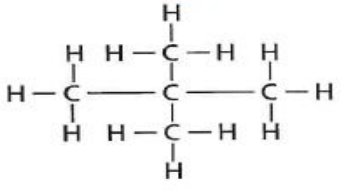




boiling point: 28°C
melting point: −160°C
density: 0.620 g/cm³

Neopentane



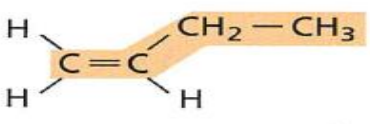


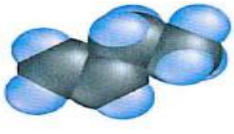
boiling point: 9.5°C
melting point: −17°C
density: 0.614 g/cm³

Properties of isomers: the arrangement of carbon atoms in each compound change the shape of the molecule, which affects its physical properties.

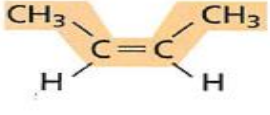
Melting and boiling points lower as the amount of branching in an isomer increases.

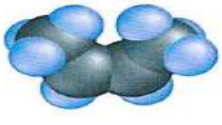
Neopentane's high melting point results from the symmetry of molecule and its globular shape.



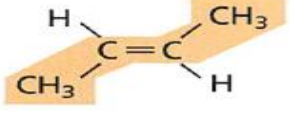


1-butene





cis-2-butene



trans-2-butene

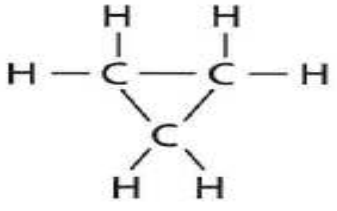
Other isomers: in the non-branched isomers of butene, notice that the double bond can located in different places on the chain and that the chain bend in different ways.

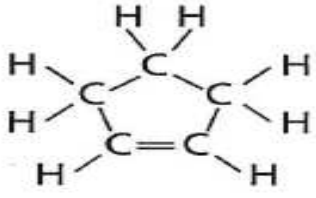
Another type of isomer differs in how the atoms are arranged in space. Such isomers form what are often called right-hand and left-hand molecules and look like mirror images. Two such isomers may have identical physical and chemical properties.

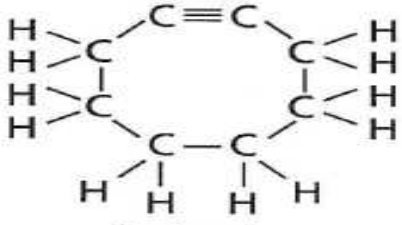
Carbon rings

Recall that carbon can also form rings. For example, cyclopropane has three carbon atoms joined into a ring by single covalent bonds. **Cyclo- means circular**.

Cyclic chains can have double and triple bonds. For example, cyclopentene C_5H_8 has a double bond, and cyclooctyne C_8H_{12} has a triple bond.


Cyclopropane
C_3H_6


Cyclopentene
C_5H_8


Cyclooctyne
C_8H_{12}

Q: explain why propane C_3H_8 and cyclopropane C_3H_6 are **not** isomers?

……
……

Q: write down the chemical formulas of butane and cyclobutene? Are the isomers? Explain?

……
……

Benzene: is a cyclic hydrocarbon with carbon atoms that are joined with alternating single and double bonds. The electrons in the double bonds are shared by all the six carbon atoms in the ring.

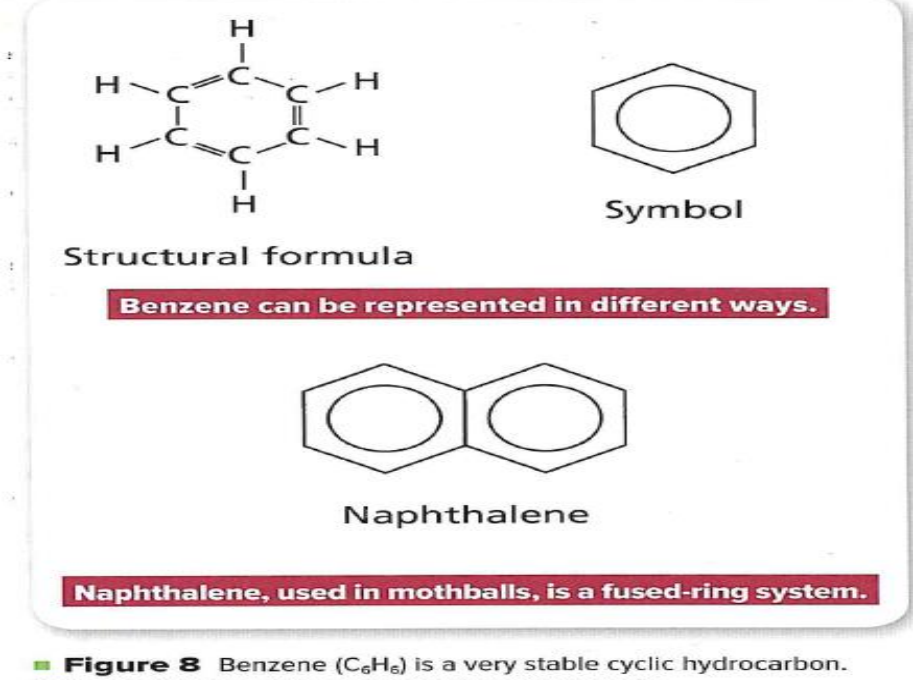


Figure 8 Benzene (C_6H_6) is a very stable cyclic hydrocarbon. Benzene rings can fuse to make other compounds.

Benzene is very stable because all carbon atoms share the electrons of the double bonds in the ring. And the carbon atoms are bonded in a rigid flat structure.

Fused rings:

Benzene ring can fuse together, like in naphthalene molecule. Naphthalene is used in mothball, which have a distinct odor.

Tetracycline antibiotics are based on fused ring system containing four fused rings.

SECTION 1 REVIEW

Section Summary

- Carbon can form many compounds because it has four electrons in its outer energy level.
- Hydrocarbons can be saturated or unsaturated.
- Isomers are compounds that have identical chemical formulas but different molecular structures.
- Benzene contains six carbon atoms bonded into a ring with alternating double and single bonds.

1. **MAIN**IDEA **Define** the term *organic compounds* and explain how they got this name.
2. **Classify** each of the following compounds as organic or inorganic: C_4H_{10}, H_2O, FeO, CH_3COOH, and CaS.
3. **Compare and contrast** ethane, ethene, and ethyne.
4. **Explain** the term saturated in relation to hydrocarbons. What are these compounds saturated with?
5. **Describe** how boiling and melting points generally vary as branching in hydrocarbon isomers increases.
6. **Think Critically** Cyclobutane is a cyclic, saturated hydrocarbon containing four carbon atoms. Draw its structural formula. Are cyclobutane and butane isomers? Explain.

Apply Math

7. **Identify Trends** Adding one double bond to octane (C_8H_{18}) makes the hydrocarbon octene (C_8H_{16}). Write the formulas for adding one, two, and three more double bonds to octane. What is the decrease in the number of hydrogen atoms for each double bond added?

Section 2: substituted hydrocarbons

Replacing hydrogen

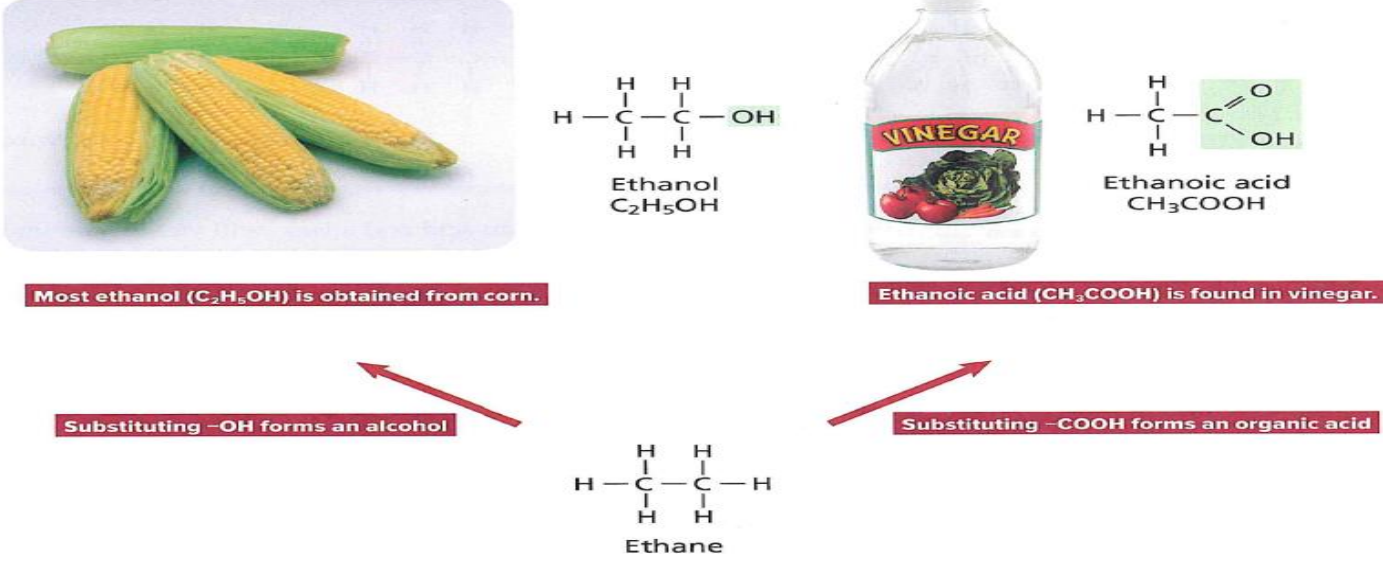
Chemists often change hydrocarbons into other compounds having different physical and chemical properties. They may include a double or triple bond or add different atoms or groups of atoms to a hydrocarbon. Some of these changed compounds are substituted hydrocarbons.

A substituted hydrocarbon has one or more of its hydrogen atoms replaced by atoms, or groups of atoms, of other elements (functional groups). Depending on what properties are needed, chemists decide what functional groups to add.

1- Substitution oxygen groups:

Many compounds only have carbon, hydrogen, and oxygen atoms as in **alcohols, organic acids, and esters**.

Oxygen atom can form single or double bonds with carbon atom, and it can form only single bonds with hydrogen atom.



a- **Alcohols** form when (-**OH**) groups replace one or more H atoms in a hydrocarbon. They often serve as solvents and disinfectants (مطهرات) and can be used as pieces to assemble larger molecules. Ethanol is an alcohol produced by the fermentation of sugar in grains and in fruit.

b- Organic acids form when a carboxyl group (-COOH) is substituted for one of the hydrogen atoms in a hydrocarbon. Ethanoic acid also known as acetic acid, is an organic found in vinegar.

Citric acid found in citrus fruits, such as oranges and lemons, and lactic acid found in sour milk.

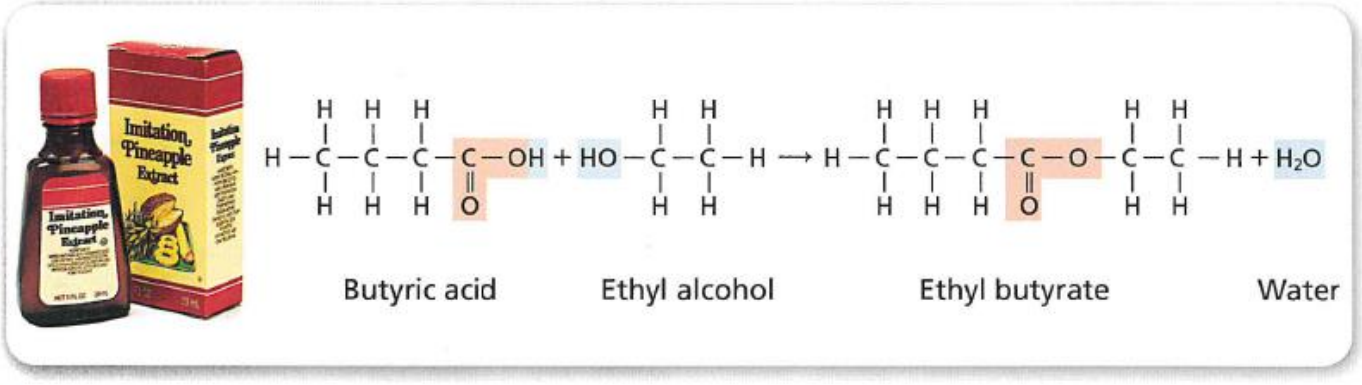
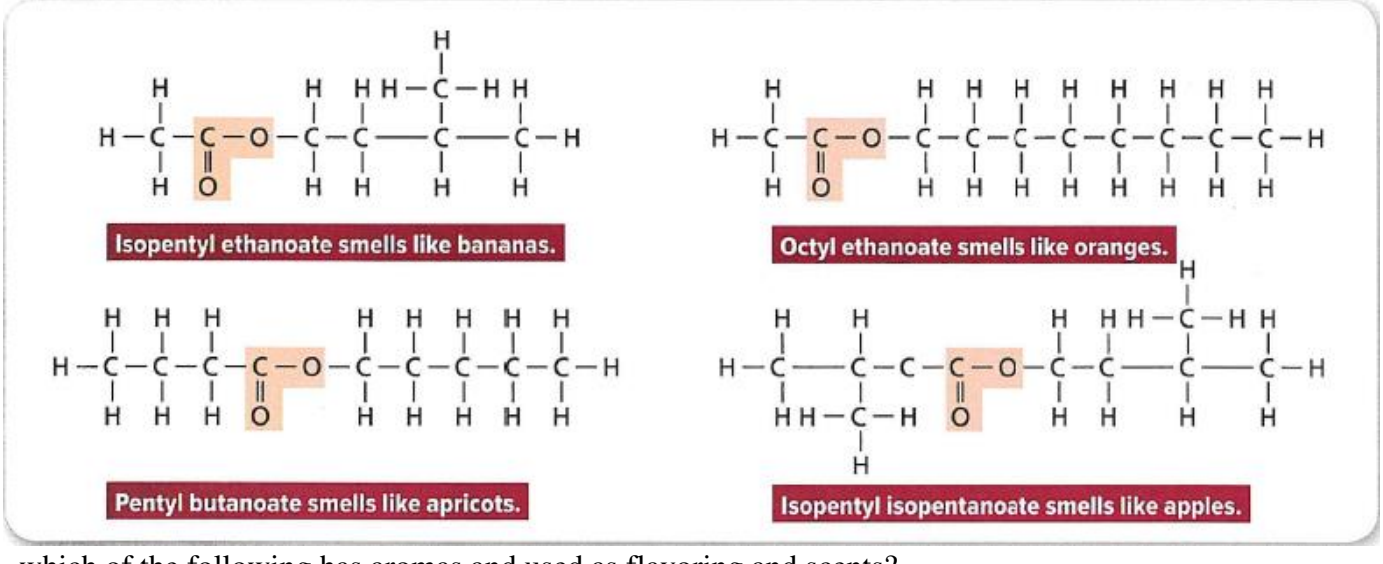


Figure 11 Butyric acid and ethyl alcohol combine to form the ester ethyl butyrate and water. Ethyl butyrate tastes like pineapple.

c- Ester is a substituted hydrocarbon with a (-COOC-) group produced from the reaction between alcohol and organic acid.

The reaction of butyric acid and ethyl alcohol to produce water and ester ethyl butyrate which is a component in pineapple flavor. Esters have many different applications. Esters of the alcohol glycerin are used to make commercial soaps. Other esters can be made into fibers for clothing, and still others are used in flavor and perfumes.

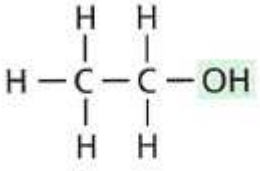
Figure 12 Because of their strong, fruity aromas, esters are used as flavoring and scents.



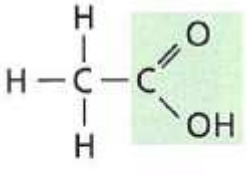
which of the following has aromas and used as flavoring and scents?

a- Alcohol
b- Organic acid
c- Hydrocarbon
d- ester

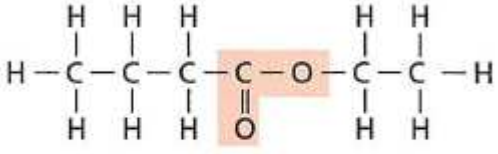
Classify the organic compounds according to their names (functional groups) in the table



Ethanol
C_2H_5OH



Ethanoic acid
CH_3COOH



Ethyl butyrate

Citric acid. - Lactic acid. - Octyl ethanoate.

Alcohols	**Organic acids**	**Ester**

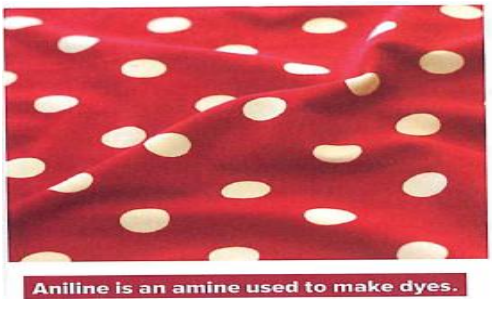
Write the letter that matches the ester use in the space?

	ester		The use of the ester
1	Isopentyl ethanoate + butyl ethanoate	……..	a- Apples odor
2	Octyl ethanoate	……	b- commercial soaps
3	Isopentyl isopentanoate	……	c- Pineapples odor
4	Pentyl butanoate	……	d- Apricots odor
5	Ethyl butanoate	……	e- Bananas odor
6	Glycerin alcohol ester	……	f- Oranges odor

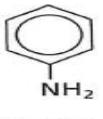
2- Substitution other elements

a- **Amines:** an amine forms when an amine group (**-NH_2**) replaces a hydrogen atom in the hydrocarbon. for example, aniline is formed when **-NH_2** group replaces a hydrogen atom in benzene ring. It is used to make dyes. Amines are also essential for life.

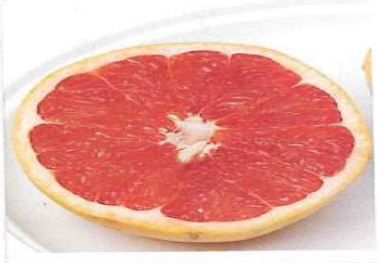
b- **Thiols:** when a group -SH replaces hydrogen atom in a hydrocarbon, the resulting compound is a thiol. Most thiols have unpleasant odors. This can be useful to animals such as skunks. The odor of grapefruits is due to the thiol. You can smell the skunk spray in concentration as law as 0.5parts per million. Natural gas has no odor of its own, so it is impossible to smell a gas leak. For this reason, gas companies add small amounts of a thiol to the gas to make people aware of leaks.

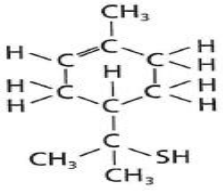


Aniline is an amine used to make dyes.



Aniline



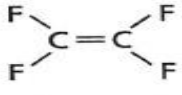


Grapefruit thiol

A thiol gives grapefruit its unique smell and taste.

c- **Halocarbons:** a substituted hydrocarbon with a halogen, such as fluorine, chlorine or bromine, in place of hydrogen atom in a hydrocarbon is called a **halocarbon**. For example, when four chlorine atoms replace four hydrogen atoms in ethene, the result is tetrachloroethene a solvent used in dry-cleaning. Adding four fluorine atoms to ethene makes a compound that is a starting material for making nonstick coating on cookware.

Figure 14 Tetrafluoroethene is a halocarbon used to make non-stick coatings on pans.



Tetrafluoroethene

Section:3 Petroleum—A Source of Carbon Compounds

What is petroleum?

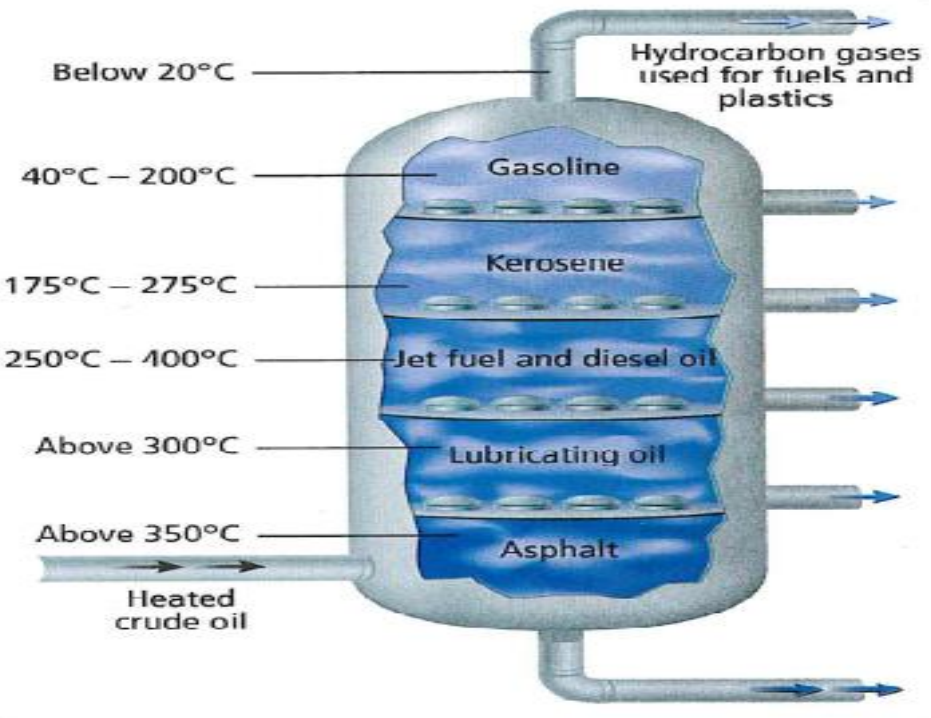
- Petroleum is a mixture of thousands of carbon compounds. To make items such as combs, the first step is to extract the crude oil from its underground source. Then, chemists and engineers separate the crude oil into fractions containing compounds with similar boiling points.
- The separation process is known as **fractional distillation**.

What is petroleum?

- If you have ever driven past a refinery, you may have seen big, metal towers called **fractionating towers**. They often rise as high as 35 m and can be 18 m wide and have pipes and metal scaffolding attached to the outside.

The Tower

- Inside the tower is a series of metal plates arranged like the floors of a building. These plates have small holes so that vapors can pass through.
- The tower separates crude oil into fractions containing compounds having a range of boiling points.
- Within a fraction, boiling points may range more than 100°C.



How It Happens

- The crude petroleum at the base of the tower is heated to more than 350°C. At this temperature most hydrocarbons in the mixture become vapor and start to rise. The higher boiling fractions reach only the lower plates before they condense, forming shallow pools that drain off through pipes on the sides of the tower and are collected.
- Fractions with lower boiling points may climb higher to the middle plates before condensing. Finally, those with the lowest boiling points condense on the top most plates or never condense at all and are collected as gasses at the top of the tower.

Why don't the condensed liquids fall back through the holes?

- The reason is that pressure from the rising vapors prevents this. The separation of the fractions is improved by the interaction of rising vapors with condensed liquid.

Uses for Petroleum Compounds

- The fractions that condense on the upper plates and contain from five to ten carbons are used for gasoline and solvents. Below these are fractions with 12 to 18 carbons that are used for kerosene and jet fuel. The bottom fractions go into lubricating oil, and the residue is used for paving asphalt.

Polymers

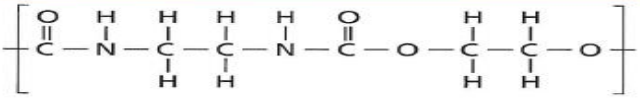
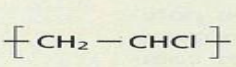
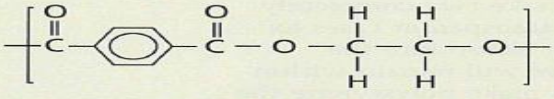
Did you ever loop together strips of paper to make paper chains for decorations?

- A paper chain can represent the structure of a polymer. Some of the smaller molecules from petroleum can act like links in a chain. When these links are hooked together, they make new, extremely large molecules known as **polymers**. The small molecule, which forms a link in the polymer chain, is called a **monomer**.

Table 3 Hydrocarbon Polymers

Polymer	Monomer	Uses
Polyethylene	$+CH_2-CH_2+$	 - plastic bags - plastic bottles
Polypropylene	$+CH_2-\underset{CH_3}{CH}+$	 - glues - carpets - high-performance outdoor clothing
Polystyrene	$+CH-CH_2+$ (C$_6$H$_5$)	 - foam packing - disposable food containers - CD cases

Table 4 Substituted Hydrocarbon Polymers

Polymer	Monomer	Uses
Polyurethane		 • foam • waterproof coatings • shoe parts
Polyvinyl chloride		 • pipes • hoses • house siding
Polyester		 • fabric • rope

Common Polymers

One **common polymer** or plastic is made from the **monomer** ethene or ethylene. Under standard room-temperature conditions, this small hydrocarbon is a gas. However, when ethylene combines with itself repeatedly, it forms **a polymer** called **polyethylene**. Polyethylene is used widely in shopping bags and plastic bottles.

Often two or more different monomers, known as **copolymers**, combine to make one polymer molecule. Polymers can be made light and flexible or so strong that they can be used to make plastic pipes, boats, and even some auto bodies. Because so many things used today are made of synthetic polymers, some people call this "The Age of Plastics."

Designing Polymers

The properties of polymers depend mostly on which monomers are used to make them. Like hydrocarbons, polymers can have **branches** in their chains. The **amount of branching** and **the shape** of the polymer greatly **affects its properties**.

Versatile polystyrene: Sometimes the same polymer can take two completely different forms. For example, **polystyrene** that is made from **styrene**, forms brittle, transparent cases for CDs and lightweight, opaque foam cups and packing materials.

To make this transformation, a gas such as carbon dioxide is blown into melted polystyrene as it is molded. Bubbles remain within the polymer when it cools, making polystyrene foam an efficient insulator.

Other polymers can be spun into threads, which are used to make clothing or items such as suitcases and backpacks. Bulletproof vests are made of tightly woven, synthetic polymer. Some polymers remain rigid when heated, but others become soft and pliable when heated and harden again when cooled.

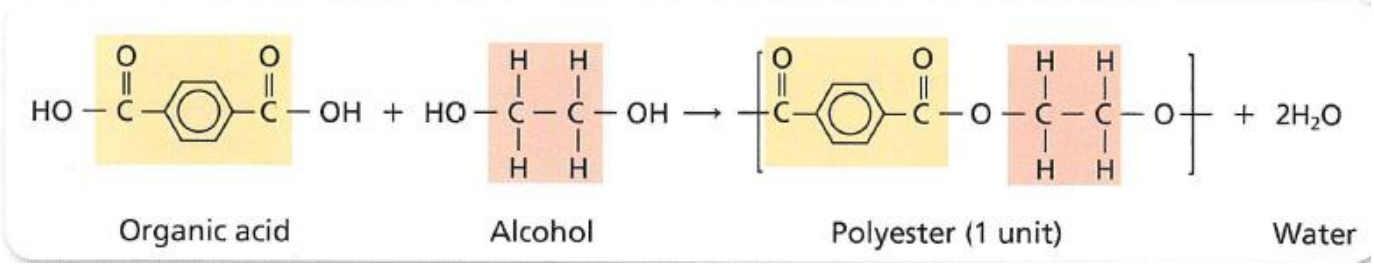
Substituted hydrocarbon polymers:

polymers can contain element other than carbon and hydrogen. **Polyurethane** has functional groups that contain oxygen and nitrogen. The **monomers** of **polyvinyl chloride (PVC)** are **ethene monomers** with **chlorine** substituted from one **hydrogen atom**. So, the **PVC** becomes harder and more heat resistant than polyethylene.

Polyesters: synthetic fibers called polyesters are made from an organic acid that has two -COOOH groups. **Polyester is strong** because two **-OH groups**, and **the chains** are closely packed together.

Many varieties of polyesters can be made depending on what alcohols and acids are used. Polyesters can be woven or knitted into durable fabrics.

Figure 20 Polyesters are formed when an organic acid with two –COOH groups combines with an alcohol that has two –OH groups.



Other Petroleum Products: Aromatic dyes from petroleum have replaced natural dyes, such as **indigo** and **alizarin**, almost completely. The **first synthetic dye** was a bright purple called mauve that was **discovered accidentally** in coal tar compounds.

Depolymerization: Many polymers **do not decompose**. One way to combat this is by **recycling**, which recovers clean plastics **for reuse in new products**. Another approach involves a process called **depolymerization**, which **uses heat** or **chemicals** to break the long polymer chain into its monomer fragments. These **monomers can then be reused**. Each polymer requires a different process, and much research is needed to make this type of recycling economical.

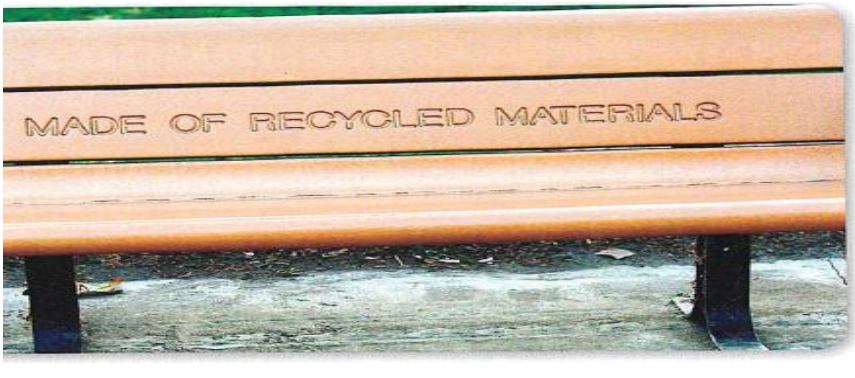


Figure 21 Plastics can be recycled into many structures, such as decks, gazebos, and this bench.

SECTION 3 REVIEW

Section Summary

- Crude oil is a dark, flammable liquid formed from fossilized materials.
- Organic compounds in crude oil can be separated using fractional distillation.
- Polymers are long chains of repeating chemical units called monomers.
- Polymers can be designed with specific properties.
- Depolymerization is the process of breaking a polymer into its components.

14. **MAIN IDEA Identify** several items around your home that are made from organic compounds obtained from crude oil.
15. **Name** some of the fuels obtained from crude oil by fractional distillation.
16. **Describe** the process of fractional distillation.
17. **Explain** why polymers made from the same monomer can have physical properties that vary greatly.
18. **Describe** why depolymerization can be an expensive process.
19. **Think Critically** Based on the names of the polymers in this section, what do you think the polymer made from the monomer terpene is called?

Apply Math

20. **Calculate** If the mass of a monomer is 105 atomic mass units, find the mass of a polymer containing 122 monomers.

Question1: Petroleum is a mixture of thousands of _____ compounds.

A. iron B. hydrogen C. carbon D. nitrogen

Answer: The answer is C. Petroleum is a flammable liquid often called crude oil.

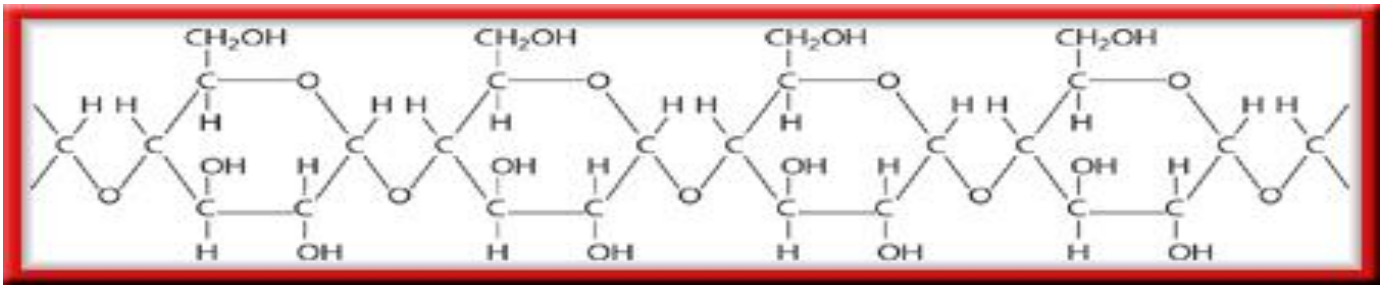
Question 2: What process is used to separate crude oil into useable compounds?

Answer: Fractional distillation is used to separate crude oil into fractions containing compounds with similar boiling points. This process takes place in petroleum refineries.

Question 3: Which is not obtained from petroleum?

A. propane B. gasoline C. paving asphalt D. glycogen

Answer: The answer is D. Glycogen is a glucose polymer that stores energy from starch in the liver and muscles.



Section:4 Biological Polymers

Biological Polymers:

Biological polymers are huge molecules. They are made of many smaller monomers that are linked together. The monomers of biological polymers are usually larger and more complex in structure.

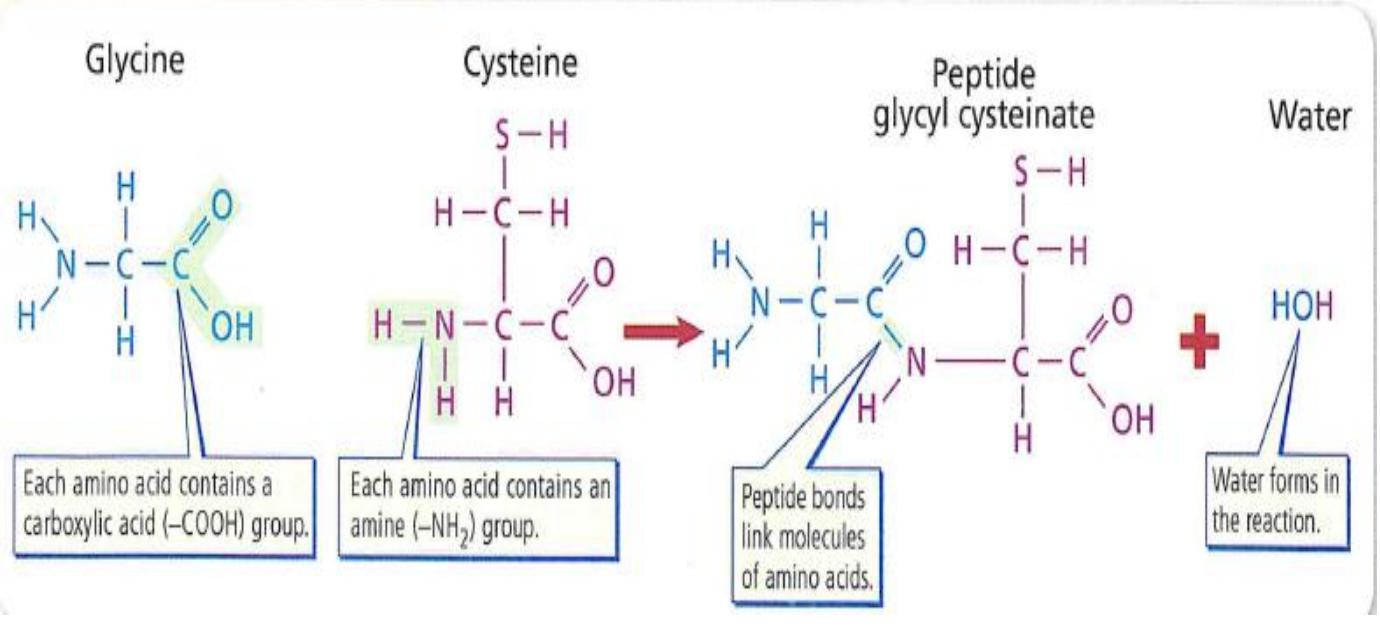
Many of the important biological compounds in your body are polymers. Among them are the proteins, which often contain hundreds of units.

Proteins:

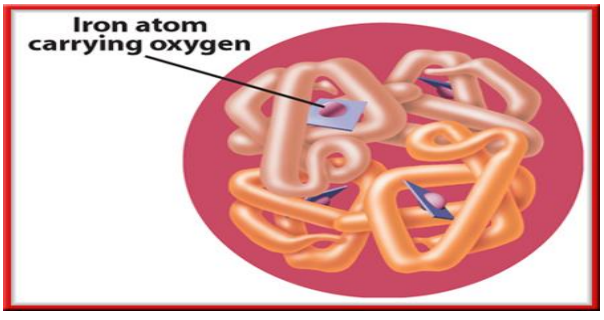
Proteins are large organic polymers formed from organic monomers called amino acids. Even though only 20 amino acids are commonly found in nature, they can be arranged in so many ways that millions of different proteins exist. Proteins come in numerous forms and make up many of the tissues in your body, such as muscles and tendons, as well as your hair and fingernails. In fact, proteins account for 15 percent of your total body weight.

Protein Monomers

Amine groups-$\mathbf{NH_2}$ of one amino acid can combine with the carboxylic acid group **-COOH** of another amino acid, linking them together to form a compound called a peptide. The bond joining them is known as peptide bond. When a peptide contains a large number of amino acids—about 50 or more—the molecule is called a protein.



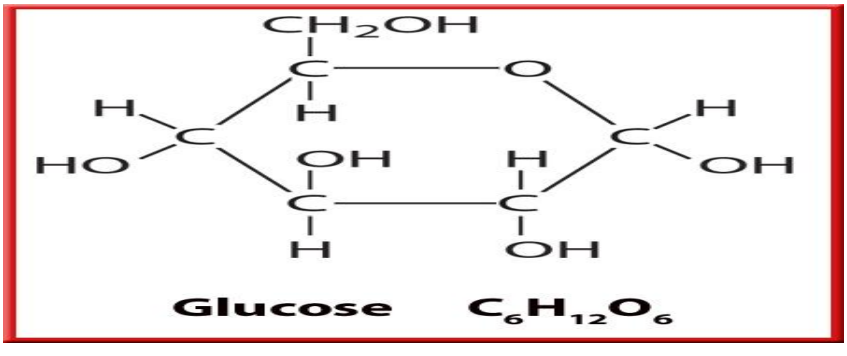
Protein Structure: Long protein molecules tend to twist and coil in a manner unique to each protein. For example, hemoglobin, which carries oxygen in your blood, has four chains that coil around each other.



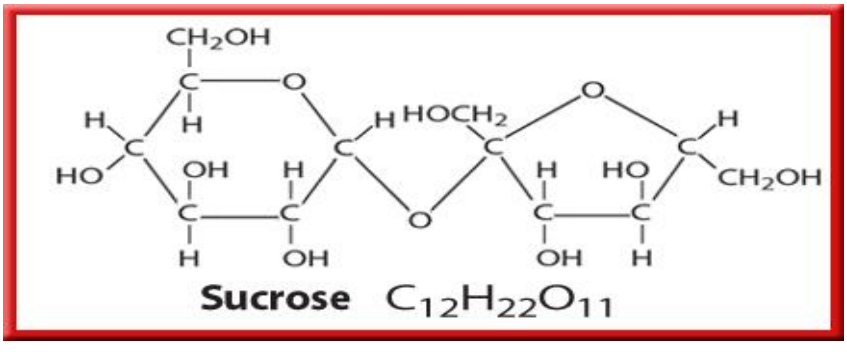
When you eat foods that contain proteins, your body breaks down the proteins into their amino acid monomers. Then your body uses these amino acids to make new proteins that form muscles, blood, and other body tissues.

Carbohydrates: **Carbohydrates** are compounds containing carbon, hydrogen, and oxygen, which have twice as many hydrogen atoms as oxygen atoms. Carbohydrates include the sugars and starches.

Sugars: Sugars are a major group of carbohydrates. The sugar glucose is found in your blood and also in many sweet foods such as grapes and honey.



Common table sugar, known as sucrose, is broken down by digestion into two simpler sugars—fructose, often called fruit sugar, and glucose. Unlike starches, sugars provide quick energy soon after eating.

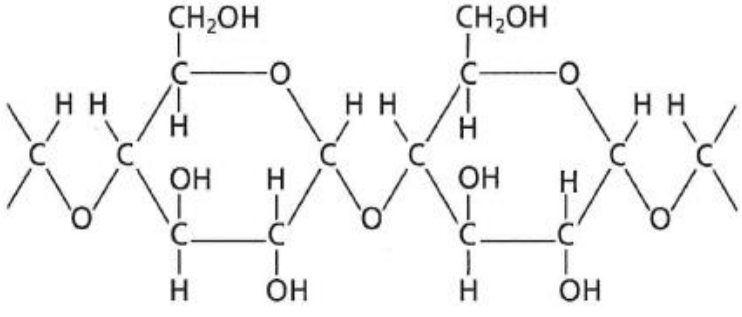


Starches:

The energy from starches can be stored in liver and muscle cells in the form of a compound called glycogen. During a long race, this stored energy is released, giving the athlete a fresh burst of power.

Figure 25 Starch, the major component of pasta, is a polymer made of glucose monomers.

READING CHECK **Describe** the difference between sugars and starches.



Starch

Lipids:

Fats, oils, and related compounds make up a group of organic compounds known as **lipids**. Lipids contain the same elements as carbohydrates but in different proportions. Lipids have fewer oxygen atoms and contain carboxylic acid groups .

Fats and Oils:

These substances are similar in structure to hydrocarbons. They can be classified as saturated or unsaturated, according to the types of bonds in their carbon chains. Saturated fats contain only single bonds between carbon atoms. Unsaturated fats having one double bond are called monounsaturated, and those having two or more double bonds are called polyunsaturated.

Animal lipids or fats tend to be saturated and are solids at room temperature. Plant lipids called oils are unsaturated and are usually liquids. Evidence shows that too much saturated fat and cholesterol in the diet may contribute to some heart disease and that unsaturated fats may help to prevent heart disease.

A balanced diet includes some fats, just as it includes proteins and carbohydrates.

Apply Science

Which foods should you choose?

What do you like to eat? You probably choose your foods by how good they taste. A better way might be to look at their nutritional values. Your body needs nutrients, such as proteins, carbohydrates, and fats, to give it energy and to help it build cells. Almost every food has some of these nutrients in it. The trick is to choose your foods so you do not get too much of one thing and not enough of another.

Identify the Problem

The table shows some basic nutrients for a variety of foods. The amount of the protein, carbohydrate, and fat is recorded as the number of grams in 100 g of the food. By examining these data, select the foods that best provide each nutrient.

Nutritional Values for Some Common Foods

Food (100 g)	Protein (g)	Carbohydrate (g)	Fat (g)
Cheddar cheese	25	1	33
Hamburger	17	23	17
Soybeans	13	11	7
Wheat	15	68	2
Potato chips	7	53	35

Solve the Problem

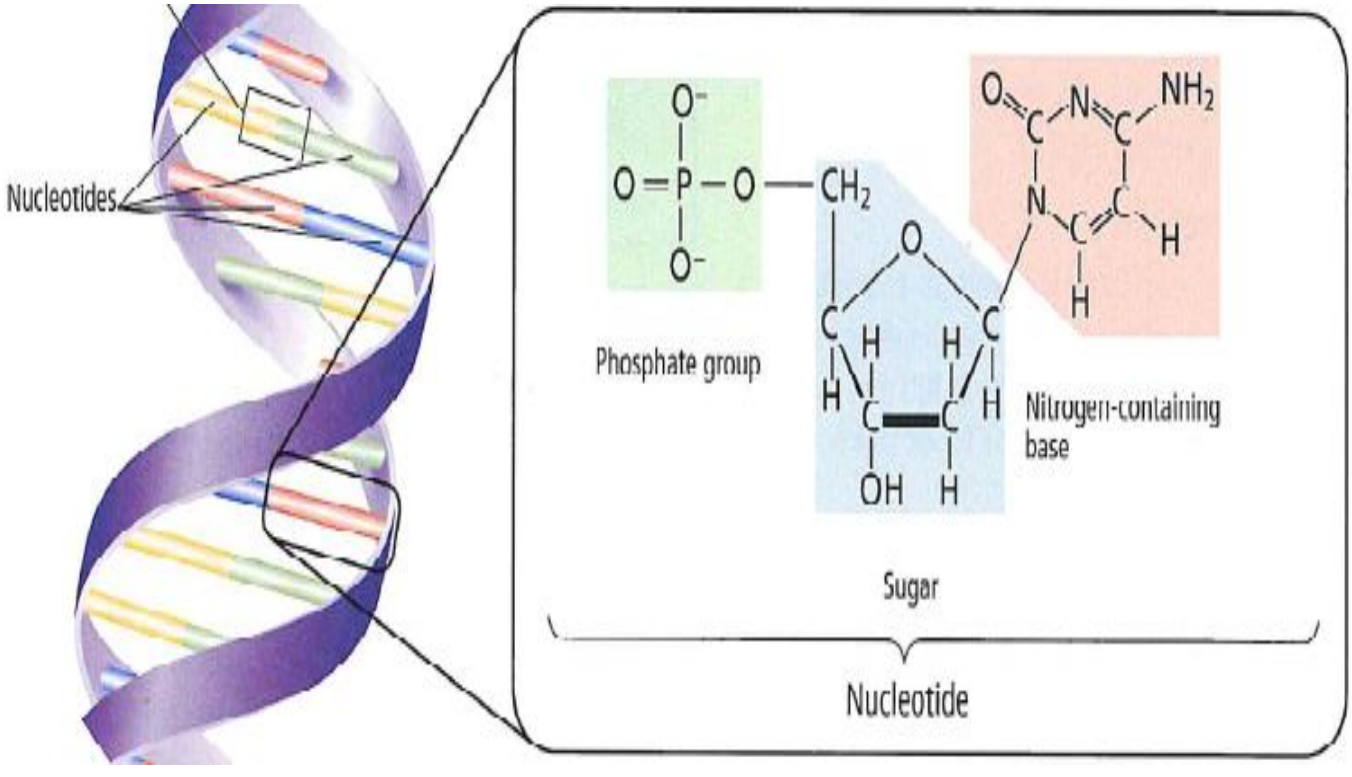
1. Using the table, list the foods that supply the most protein and carbohydrates. What might be the problem with eating too many potato chips?
2. In countries where meat and dairy products are not plentiful, people eat a lot of food made from soybeans. Give several reasons why people might wish to substitute meat and dairy products with soybean-based products.

***Nucleic Acids:**

One kind of nucleic acid, called **deoxyribonucleic acid** or DNA, is found in the nuclei of cells where it codes and stores genetic information. This is known as the genetic code.

***Nucleic Acid Monomers:**

The monomers that make up DNA are called nucleotides. Nucleotides are complex molecules containing an organic base, a sugar, and a phosphoric acid unit. In DNA two nucleotide chains twist around each other forming what resembles a twisted ladder or what is called the double helix. Human DNA contains only four different organic bases, but they can form millions of combinations. The bases on one side of the ladder pair with bases on the other side.



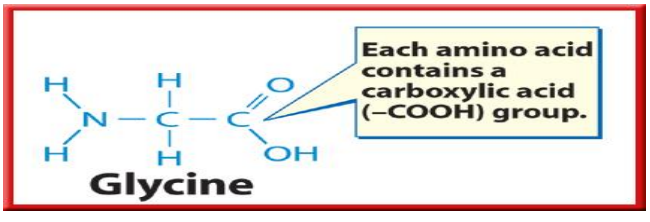
***DNA Fingerprinting:**

The DNA of each person differs in some way from that of everyone else, except for identical twins, who share the same DNA sequence. The unique nature of DNA offers crime investigators a way to identify criminals from hair or fluids left at a crime scene. Chemists can break up the DNA into its nucleotide components and use radioactive and X-ray methods to obtain a picture of the nucleotide pattern. Comparing this pattern to one made from the DNA of a suspect can link that suspect to the crime scene.

Question 1: Proteins are large organic polymers formed from._____

A. glucose B. amino acids C. carboxylic acids D. nucleic acids

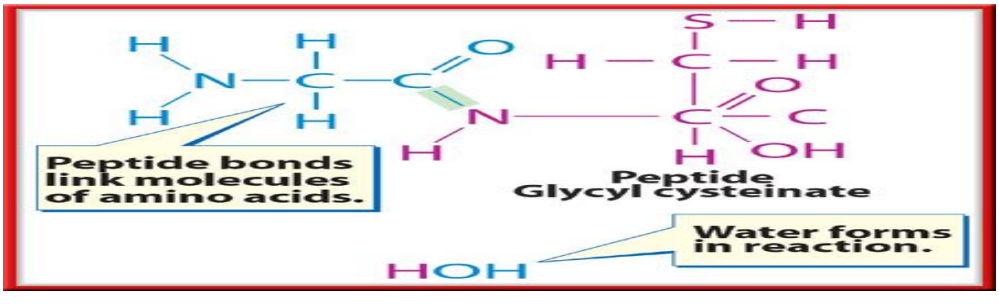
Answer: The answer is B, amino acids. Every amino acid contains a carboxylic acid group, as well as an amine group.



Question 2: Which of the following refers specifically to the bond linking amino acids?

A. ionic B. covalent C. metallic D. peptide

Answer: The answer is D. Peptides are compounds formed by the linking together of amino acids



Question 3: What part of a nucleic acid monomer forms the "rungs" of a DNA ladder?

Answer: The four different organic bases in DNA form hydrogen bonds and make up the "rungs" of the ladder. The sugar and phosphate groups make up the backbone, or sides of the ladder.

SECTION 4 REVIEW

Section Summary

- Proteins are large, organic polymers that form muscles, blood, and other body tissues.
- Carbohydrates contain carbon, hydrogen, and oxygen.
- Sugars and starches are carbohydrates that provide energy to your body.
- Lipids include fats and oils.
- DNA is a nucleic acid that is found in the cell nucleus.

21. MAINIDEA **Name** the monomers that make up the following biological polymers: proteins, nucleic acids, and starches.
22. **Identify** where your body gets the compounds that it needs to build proteins.
23. **Describe** the function of DNA.
24. **Explain** the difference between saturated and unsaturated fats and oils.
25. **Think Critically** Whole milk contains about 4 percent butterfat. Explain why you might choose to drink milk containing 2 percent fat.

Apply Math

26. **Use Percentages** You have read that your body is about 15 percent protein. Calculate the mass of protein in your body in kilograms.

CHAPTER 1 ASSESSMENT

Use Vocabulary

Complete each statement with the correct term from the Study Guide.

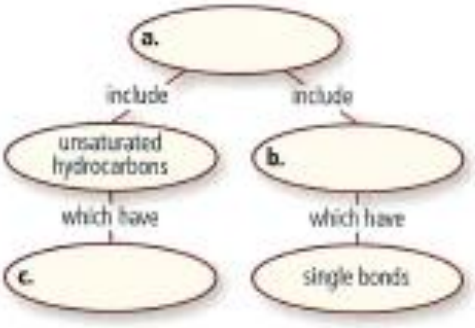
27. **BIG IDEA** ___ are most compounds that contain the element carbon.
28. Amino acids combine to form large organic polymers known as ___.
29. ___ is the nucleic acid that contains your genetic information.
30. A(n) ___ is a compound containing the benzene-ring structure.
31. Sugars and starches are part of the group of organic compounds called ___.
32. Fats and oils are part of the group of organic compounds called ___.
33. ___ are compounds with identical chemical formulas but different structures.

Check Concepts

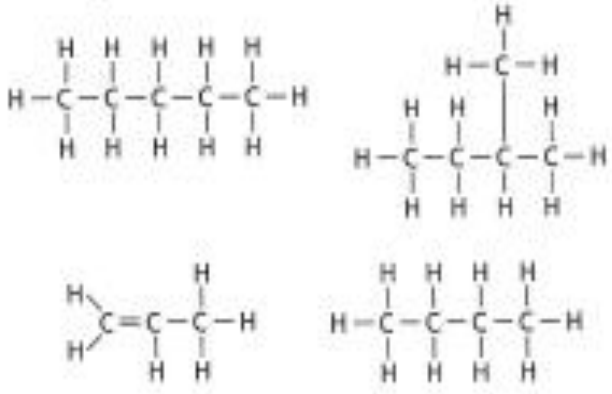
34. How would you describe a benzene ring?
    A rare
    B stable
    C unstable
    D saturated
35. What are the small units that make up polymers called?
    A monomers
    B isomers
    C plastics
    D carbohydrates
36. What type of compound is hemoglobin?
    A carbohydrate
    B lipid
    C nucleic acid
    D protein
37. What type of compounds form the DNA molecule?
    A amino acids
    B nucleotides
    C polymers
    D carbohydrates
38. Glucose and fructose both have the formula $C_6H_{12}O_6$. What are such compounds called?
    A amino acids
    B alcohols
    C isomers
    D polymers
39. If a carbohydrate has 16 oxygen atoms, how many hydrogen atoms does it have?
    A 4
    B 8
    C 16
    D 32
40. **Theme Focus** Which crude oil fractions are collected at the top of a fractionating tower?
    A high boiling point, few carbon atoms
    B high boiling point, many carbon atoms
    C low boiling point, few carbon atoms
    D low boiling point, many carbon atoms

Interpret Graphics

41. Copy and complete the following concept map about types of hydrocarbons.



Use the figure below to answer question 42.



42. Write the chemical formula of each of these hydrocarbons, and identify which two are isomers.

43. Look at the fiber content of ten items of your clothing. Note the percentages of synthetic or natural fibers. Make a circle graph to compare the average percentages of natural and synthetic fibers. (*Hint: cotton, linen, wool, and silk are natural fibers.*)

Think Critically

44. Infer A healthy diet contains a variety of nutrients, including fats. However, saturated fats have some drawbacks. Based on this knowledge, how would you modify your diet to make it healthier? What general rule would you apply in making your choices?

45. Classify the following compounds as saturated, unsaturated, or substituted hydrocarbons: hexane (C_6H_{14}), isopropyl alcohol (C_3H_7OH), 2-chlorobutane (C_4H_9Cl), pentene (C_5H_{10}), and butyric acid (C_3H_7COOH).

46. Explain why the toughness and durability of many plastic polymers can be both an asset and a liability.

47. Describe how the structures of propyl alcohol and isopropyl alcohol might differ, although both have the formula C_3H_8O.

48. Draw a substituted hydrocarbon that has the following: six carbon atoms; single, double, and triple bonds; a hydroxyl group; and an amine group.

Apply Math

49. Solve One-Step Equations Although physicians disagree about what is a healthy level of blood cholesterol, many feel that levels above 200 mg/dL are harmful. A patient's blood cholesterol level measured 228 mg/dL. After two months on a low-fat diet, it dropped to 210 mg/mL. By what percent did the patient's cholesterol level decrease?

50. Use Percentages The label on a 500-mL bottle of vinegar states that it contains 6 percent acid by volume. How many milliliters of acid does this bottle contain?

Use the table below to answer question 51.

Nutritional Values for Some Common Foods

Food (100 g)	Protein (g)	Carbohydrate (g)	Fat (g)
Cheddar cheese	25	1	33
beefburger	17	23	17
Soybeans	13	11	7
Wheat	15	68	2
Potato chips	7	53	35

51. Calculate Percent The Food and Drug Administration recommends a maximum intake of 65 g of fat per day. What percent of the daily fat allowance is a 30 g serving of potato chips?

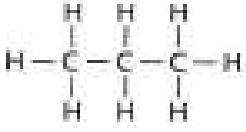
CUMULATIVE STANDARDIZED TEST PRACTICE

MULTIPLE CHOICE

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

1. What atoms make up a hydrocarbon molecule?
   A. oxygen, carbon, and hydrogen
   B. nitrogen and carbon
   C. carbon and hydrogen
   D. oxygen and hydrogen

Use the figure below to answer questions 2 and 3.



2. What is the chemical formula of the compound shown above?
   A. C_3H_8
   B. CH_4
   C. C_4H_8
   D. C_3H_8

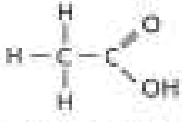
3. What is the name of this compound?
   A. propane
   B. heptane
   C. isoprene
   D. methane

4. Which of these contains carbon, hydrogen, and oxygen, and has twice as many hydrogen atoms as oxygen atoms?
   A. hydrocarbon
   B. carbohydrate
   C. alcohol
   D. isomer

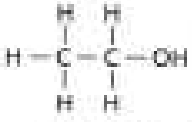
5. Which of the following is not a polymer derived from petroleum?
   A. polypropylene
   B. acetylene
   C. polyethylene
   D. polystyrene

6. Which of the following is a type of recycling that breaks up the polymers into their original monomers?
   A. fractionation
   B. depolymerization
   C. isomerization
   D. saturation

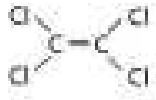
Use the figure below to answer question 7.



Ethanoic acid
CH_3COOH



Ethanol
C_2H_5OH



Tetrachloroethene
C_2Cl_4

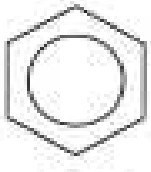
7. What is true of all three of these compounds?
   A. Their basic structural unit is a benzene ring.
   B. They are inorganic compounds.
   C. They are substituted hydrocarbons.
   D. They are polymers.

8. Which of these compounds is an alcohol that is often obtained from corn?
   A. ethanol
   B. acetic acid
   C. tetrachloroethene
   D. ethane

9. Which of these best shows the shape of the nucleic acid DNA?

A.

C.



B.

D.

SHORT RESPONSE

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

10. Describe the bonds between carbon atoms found in an organic compound.

Use the figure below to answer question 11.

11. These hydrocarbons are isomers. Write their chemical formulas.

12. Describe the general relationship between melting point, boiling point, and the amount of branching in an isomer.

13. Describe some properties and uses of alcohols.

14. Diagram the process used to separate petroleum compounds. On what physical property is this process based?

15. How are alcohols and organic acids similar? How are they different?

EXTENDED RESPONSE

Record your answers on a sheet of paper.

16. Describe useful properties of polymers. Name several objects made of polymer material that would likely have been made of wood or metal in the past.

17. Identify the polymer material used to make CD cases and foam drinking cups. Explain the processes used to make these two different products.

Use the figure below to answer question 18.

18. How is this a good representation of a protein? Describe the importance of proteins in the human body.

19. When you read or hear about cholesterol in the news, it is usually associated with negative effects on the heart and blood vessels. Why does the body make a substance that can potentially damage the circulatory system?

20. Plastic polymers are inexpensive, but they do not decompose readily in landfills. Describe two ways to solve this problem.

Objectives

Safety Precautions

ChemLAB

Esters

Objectives

- **Prepare** an ester from an alcohol and an acid.
- **Detect** the results of the reaction by the odor of the product.

Background: **Organic compounds known as acids and alcohols react to form another type of organic compound called an ester. Esters frequently produce a recognizable and often pleasant fragrance. Esters are responsible for many fruit flavors, such as apple, pineapple, pear, and banana. However, esters are not always aromatic in the chemical sense—they might not contain a benzene ring.**

Question: *How do an acid and an alcohol react to produce a compound with different characteristics? Can the presence of the new compound formed be detected by its odor?*

Safety Precautions

Procedure

1. Identify the safety concerns of tis lab before work begins.
2. Add about 150 mL of water to the beaker, and heat it on the hot plate to 70°C.
3. Place approximately 1 g of salicylic acid in a test tube. Does this material have an odor? See the warning and illustration below for the proper way to detect odors in the laboratory.

   WARNING: ***To detect an aroma safely, hold the container about 10 cm in front of your face and wave your hand over the opening to direct air currents to your nose.***

Preparation

Materials

medium-size test tube
test-tube holder
250mL beaker
10mL graduated cylinder
water
hot plate
ring stand
thermometer
salicylic acid (1.0 g)
amyl alcohol (2 mL)
concentrated sulfuric acid (1 mL to be added by teacher)

4. Check to see if amyl alcohol has an odor. If so, try to remember what it smells like.
5. Add 2 mL of amyl alcohol to the test tube.
6. Ask your teacher to carefully add 1 mL of concentrated sulfuric acid. **WARNING:** ***Sulfuric acid is caustic. Avoid all contact. Do not inhale fumes***
7. Place the test tube in the hot water, and leave it untouched for about 12 to 15 minutes.
8. Remove the tube from the hot water using a test tube holder, and allow it to cool. Check to see if you can detect a new aroma.

Analyze Your Data

1. **Identify** What did you smell after the reaction was complete?
2. **Infer** Look closely at the surface of the liquid in the test tube. Do you see any small droplets of an oily substance? What do you think it is?

Conclude and Apply

1. **Predict** This reaction formed the ester amyl salicylate. What esters would form if amyl alcohol were replaced by the following alcohols: methyl, ethyl, propyl, and isobutyl?
2. **Predict** Look at the equation for the reaction at the bottom of the page. One product is given. What do you think is the second product formed in this reaction? Explain.
3. **Design an Experiment** How might you modify the experiment to produce a different ester?

COMMUNICATE YOUR DATA

Poster Make a poster showing the reaction that took place. Use the poster to explain the formation of esters to students from another class.