Ch. 4 Assessment

Due: 8:30am on Monday, September 9, 2024

To understand how points are awarded, read the Grading Policy for this assignment.

Carbon Bonding and Functional Groups

Hydrocarbons are molecules consisting of only carbon atoms and hydrogen atoms. Hydrocarbons form the basis of many types of organic molecules.
In addition to carbon atoms and hydrogen atoms, many organic molecules also have groups of atoms called functional groups. These functional groups may be substituted for one or more of the hydrogen atoms of a hydrocarbon. The functional groups present in an organic molecule determine the chemical behavior of that molecule.

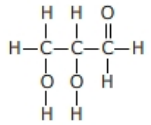
Part A - Carbon bonding

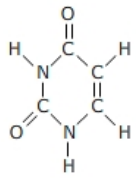
Which molecules show an appropriate number of bonds around each carbon atom?

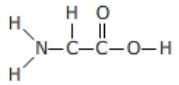
Select the *three* that apply.

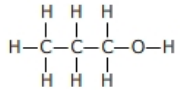
You did not open hints for this part.

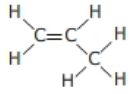
ANSWER:











Part B - Identifying functional groups in a molecule

The molecule shown here contains four functional groups.

Highlight all the atoms of the *four* functional groups, but do *not* highlight any bonds. When you click on each atom, it will change color. To deselect an atom, click on it again. Before you submit, check that you have *not* selected any bonds.

Hint 1. Definition of functional group

A functional group is a specific configuration of atoms commonly attached to the carbon skeleton of an organic molecule. Functional groups confer specific chemical properties to the molecules of which they are a part. Atoms typically found in functional groups include oxygen, nitrogen, sulfur, and phosphorus.

Hint 2. Chemical structures of functional groups

The table below shows the formulas of six biologically important functional groups.

Functional group	Formula
hydroxyl	–OH
carbonyl	>CO
carboxyl	–COOH
amino	$-NH_2$

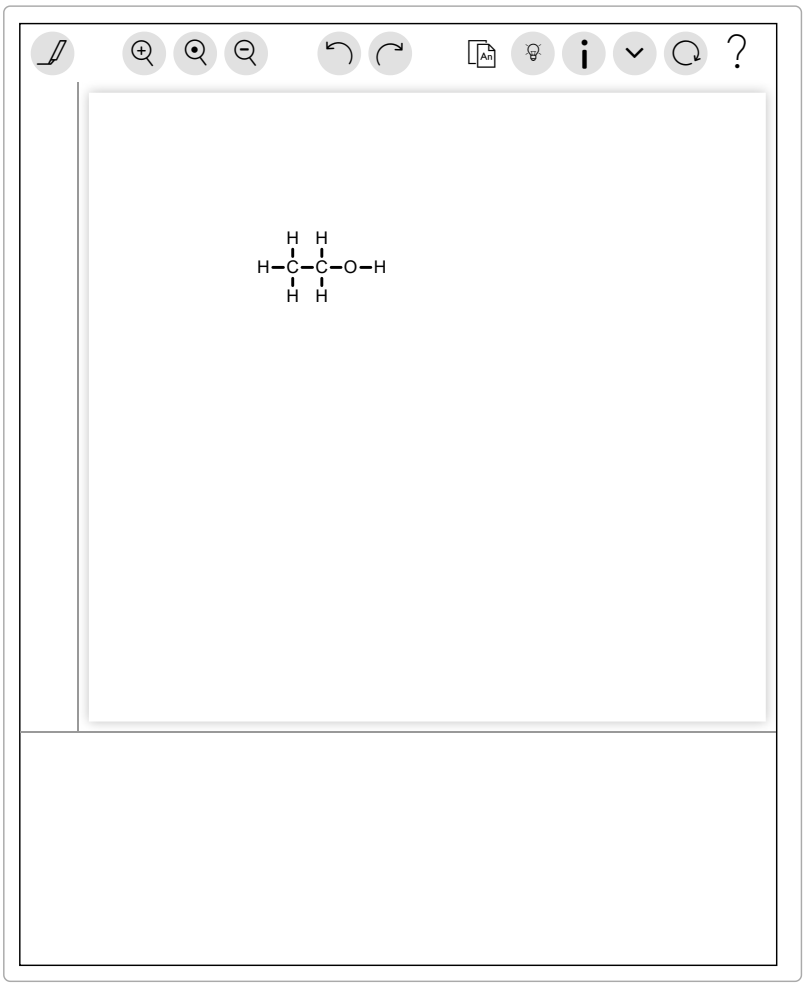
sulfhydryl	–SH
phosphate	$-OPO_3^{2-}$

Hint 3. Can you highlight the functional group of a molecule?

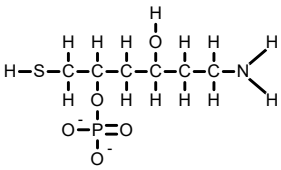
The molecule shown here contains a hydroxyl functional group.

Highlight the atoms of the hydroxyl group (–OH) by clicking on them. When you click on each atom, it will change color. To deselect an atom, click on it again. Do *not* highlight any bonds.

ANSWER:



ANSWER:



Part C - Classifying molecules by their functional groups

Functional groups confer specific chemical properties to the molecules of which they are a part. In this activity, you will identify which compounds exhibit certain chemical properties as well as examples of those six different compounds.

Drag one molecule and one chemical property to each bin. If one property can apply to more than one functional group, choose the *best* answer for each functional group.

Hint 1. Organic compounds and their functional groups

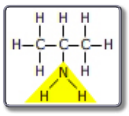
The table below shows the formulas of six biologically important functional groups and the compounds in which they are found. In aldehydes, the carbonyl group is at the end of the carbon skeleton, whereas in ketones, it is within the carbon skeleton.

Compound	Functional group	Formula
alcohol	hydroxyl	–OH
aldehyde or ketone	carbonyl	>CO
carboxylic acid	carboxyl	–COOH
amine	amino	$-NH_2$
thiol	sulfhydryl	–SH
organic phosphate	phosphate	$-OPO_3^{2-}$

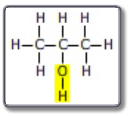
ANSWER:

Reset Help

forms disulfide bonds



contributes negative charge

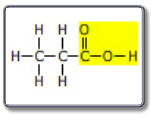


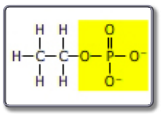
may be a structural isomer of a ketone

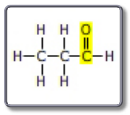
acts as a base

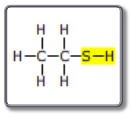
acts as an acid

is polar and makes compounds more soluble in water









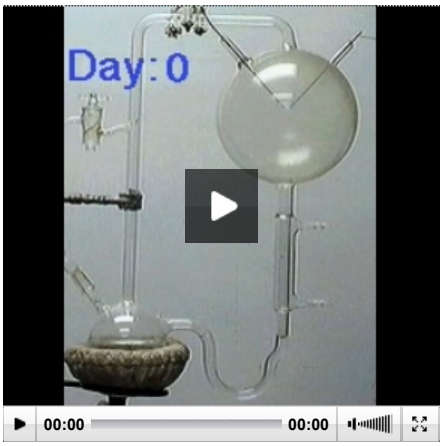
alcohol	carboxylic acid	aldehyde	thiol	amine	organic phosphate

Scientific Skills Exercise: Working with Moles and Molar Ratios

Could the first biological molecules have formed near volcanoes on early Earth?

In 2007, Jeffrey Bada, a former graduate student of Stanley Miller's, discovered some vials of samples that had never been analyzed from an experiment about abiotic synthesis of organic molecules performed by Miller in 1958. In this experiment, Miller used hydrogen sulfide gas (H_2S) as one of the gases in the reactant mixture. Since H_2S is released by volcanoes, the H_2S experiment was designed to mimic conditions near volcanoes on early Earth. In 2011, Bada and colleagues published the results of their analysis of these "lost" samples. In this exercise, you will make calculations using the molar ratios of reactants and products from the H_2S experiment.

According to his laboratory notebook, Miller used the same apparatus as in his original experiment, but the mixture of gaseous reactants included methane (CH_4), carbon dioxide (CO_2), hydrogen sulfide (H_2S), and ammonia (NH_3). Watch the video below to see a simulation of Miller's experiment.



Video courtesy of Jeffrey Bada, Scripps Institution of Oceanography, University of California San Diego

After three days of simulated volcanic activity, he collected samples of the liquid, partially purified the chemicals, and sealed the samples in sterile vials. In 2011, Bada's research team used modern analytical methods to analyze the products in the vials for the presence of amino acids, the building blocks of proteins.

The table shows 4 of the 23 amino acids detected in the samples from Miller's 1958 H_2S experiment.

Product Compound	Molecular Formula	Molar Ratio
Glycine	$C_2H_5NO_2$	1.0
Serine	$C_3H_7NO_3$	3.0×10^{-2}
Methionine	$C_5H_{11}NO_2S$	1.8×10^{-3}
Alanine	$C_3H_7NO_2$	1.1

Data from E. T. Parker et al., Primordial synthesis of amines and amino acids in a 1958 Miller H_2S-rich spark discharge experiment, *Proceedings of the National Academy of Sciences USA* 108:5526-5531 (2011). www.pnas.org/cgi/doi/10.1073/pnas.1019191108.

Part A - Identifying molar ratios

A *mole* (abbreviated *mol*) is defined as an exact number of objects: 6.02×10^{23} (Avogadro's number). You can have 1 mole of an atom, a molecule, or any other object, such as eggs or books. One mole of an object equals 6.02×10^{23} of that object.

The table shows the "molar ratios" of some of the products from the Miller H_2S experiment.

In a molar ratio, each unitless value is expressed relative to a standard for that experiment. Here, the standard is the number of moles of the amino acid glycine, which is set to a value of 1.0. For instance, serine has a molar ratio of 3.0×10^{-2}, meaning that for every mole of glycine, there is 3.0×10^{-2} mole of serine present in the sample.

What is the molar ratio of methionine to glycine in the samples?

ANSWER:

- 1.8×10^{-3} mole of methionine per mole of glycine
- 1.0 mole of methionine per 1.8×10^{-3} mole of glycine
- 1.8×10^{-3} moles of glycine per mole of methionine
- 3.0×10^{-2} mole of methionine per mole of glycine

Part B - Working with moles

How many molecules of glycine are present in 1.0 mole of glycine?

ANSWER:

- 1.8×10^{-3} molecules
- 3.0×10^{-2} molecules
- 1.0 molecule
- 6.02×10^{23} molecules

Part C

For every 1.0 mole of glycine in the sample, how many molecules of methionine are present? (For help performing calculations with numbers expressed in scientific notation, try this exercise.)

ANSWER:

- 1.08×10^{-70} molecules of methionine
- 1.8×10^{-3} molecules of methionine
- 1.08×10^{21} molecules of methionine
- 6.02×10^{23} molecules of methionine

Part D - Using data from the table

Which amino acid is present in higher amounts than glycine in the samples?

ANSWER:

- lysine
- serine
- methionine
- alanine

Part E

If there is 1.0 mole of glycine present in the sample, how many *more* molecules of alanine are present?

ANSWER:

- 0.1
- 6.02×10^{22}
- 6.62×10^{23}

Part F

The synthesis of products is limited by the amount of reactants added to the reaction flask.

If one mole each of CH_4, NH_3, H_2S, and CO_2 is added to 1 liter of water in a flask (1 liter of water = 55.5 moles of H_2O), how many moles of hydrogen, carbon, oxygen, nitrogen, and sulfur are in the flask? *Round your answers to the nearest whole number*.

Hint 1. Calculating the number of moles of each element

To determine the number of moles of each element, it helps to make a table like this. The first row has been filled in for you.

	H	C	O	N	S
1 mole CH_4	4	1	--	--	--
1 mole NH_3					
1 mole H_2S					
1 mole CO_2					
55.5 moles H_2O					
Total					

For each molecule, the number of moles of each element is indicated by the subscript numbers after it. Therefore, you multiply only that element by that number. For example, 1 mole of CH_4 has 1 mole of carbon and 4 moles of hydrogen. When you fill in the row for H_2O, make sure to multiply by 55.5.

ANSWER:

How many moles of hydrogen?	mole(s)
How many moles of carbon?	mole(s)
How many moles of oxygen?	mole(s)
How many moles of nitrogen?	mole(s)
How many moles of sulfur?	mole(s)

Part G

Glycine's molecular formula is $C_2H_5NO_2$. How many moles of each element would be needed to make 1.0 mole of glycine?

ANSWER:

- 2 moles carbon, 5 moles hydrogen, 1 mole nitrogen, and 2 moles oxygen
- 1 mole each of carbon, hydrogen, nitrogen, and oxygen
- 5 moles each of carbon, hydrogen, nitrogen, and oxygen
- 1.2×10^{24} moles of carbon, 3.0×10^{24} moles of hydrogen, 6.02×10^{23} moles of nitrogen, and 1.2×10^{24} moles of oxygen

Part H

Select

	H	C	O	N	S
1 mole CH_4	4	1	--	--	--
1 mole NH_3	3	--	--	1	--
1 mole H_2S	2	--	--	--	1
1 mole CO_2	--	1	2	--	--
55.5 moles H_2O	111	--	55.5	--	--
Total	**120**	**2**	**58**	**1**	**1**

from the dropdown menu above the table to review the number of moles of each element in the flask containing one mole each of CH_4, NH_3, H_2S, and CO_2 added to 55.5 moles of water.

What is the maximum number of moles of glycine ($C_2H_5NO_2$) that could be made in the flask if no other molecules were made?

ANSWER:

- 1 mole of glycine
- 2 moles of glycine
- 5 moles of glycine
- 120 moles of glycine

Part I

If only serine ($C_3H_7NO_3$) was made, which element would be used up first in the flask?

ANSWER:

- nitrogen
- oxygen
- carbon
- sulfur

Part J

What is the maximum number of moles of serine that could be made in the flask if no other molecules were made?

ANSWER:

- 2/3 (0.67) of a mole of serine
- 1 mole of serine
- 3.0×10^{-2} mole of serine
- 2 moles of serine

Part K

If only methionine ($C_5H_{11}NO_2S$) was made, which element would be used up first?

ANSWER:

- oxygen
- sulfur
- nitrogen
- carbon

Part L

What is the maximum number of moles of methionine that could be made in the flask if no other molecules were made?

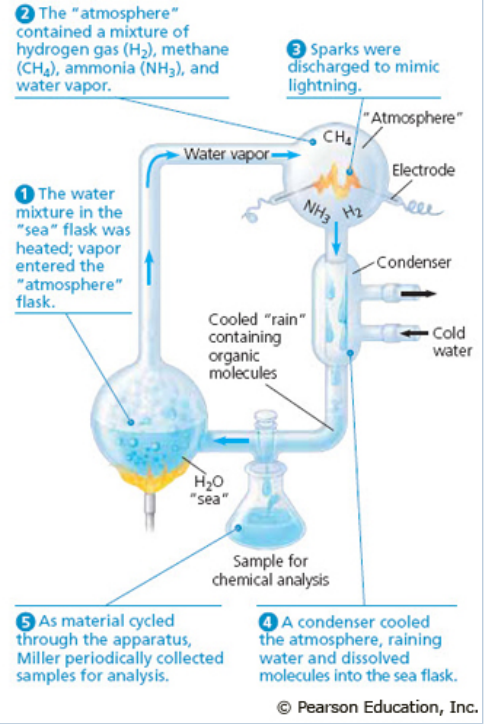
ANSWER:

- 1.8×10^{-3} mole of methionine
- 1 mole of methionine
- 2 moles of methionine
- 2/5 (0.4) of a mole of methionine

Part M

The earlier published experiment carried out by Miller did not include H_2S in the reactants. Select from the dropdown menu above the table to review Miller's earlier experiment.

Which of the compounds shown in the data table in Figure 1 could be made in the H_2S experiment but could *not* be made in the earlier experiment (Figure 3)?



ANSWER:

- methionine
- serine
- glycine
- alanine

In this chapter, you will learn how carbon functions as the basis of life's molecules. You will also learn about some common small molecules and chemical groups. Before beginning this chapter, you should be able to describe in general the structure of atoms and the meaning of atomic number and atomic mass (see Concept 2.2). The following question provides a quick check of your basic knowledge in this area.

Part A

An atom of iron has the atomic number 26. This means that

ANSWER:

- it has 13 neutrons, 13 protons, and 13 electrons.
- it has 13 electrons, 26 protons, and 26 neutrons.
- it has 52 protons and 52 electrons.
- it has 26 protons and 26 electrons.

Get Ready for This Chapter: Chapter 4 Question 2

In this chapter, you will learn how carbon functions as the basis of life's molecules. You will also learn about some common small molecules and chemical groups. Before beginning this chapter, you should be able to explain how electrons are distributed in an atom's electron shells and how the electron distribution determines the chemical behavior of an atom (see Concept 2.2, section entitled "Electron Distribution and Chemical Properties"). The following question provides a quick check of your basic knowledge in this area.

Part A

Based on the electron configuration of the elements below, which would exhibit a chemical behavior most like that of oxygen?

${}^{12}_{6}\mathrm{C}$ ${}^{16}_{8}\mathrm{O}$ ${}^{1}_{1}\mathrm{H}$ ${}^{14}_{7}\mathrm{N}$ ${}^{32}_{16}\mathrm{S}$ ${}^{31}_{15}\mathrm{P}$, where the upper index is atomic mass and the lower index is atomic number.

ANSWER:

- nitrogen
- sulfur
- carbon
- phosphorus

Get Ready for This Chapter: Chapter 4 Question 3

In this chapter, you will learn how carbon functions as the basis of life's molecules. You will also learn about some common small molecules and chemical groups. Before beginning this chapter, you should be able to explain what covalent bonds are and how they are formed (see Concept 2.3). The following question provides a quick check of your basic knowledge in this area.

Part A

An atom has four electrons in its valence shell. What type(s) of covalent bonds is it capable of forming with oxygen?

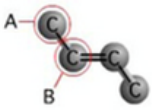
ANSWER:

- double bonds only
- single and double bonds
- single bonds only
- it cannot form covalent bonds with oxygen

Get Ready for This Chapter: Chapter 4 Question 4

Part A

How many hydrogen atoms can be attached to carbon A?



ANSWER:

- 1
- 4
- 3
- 2

Chapter 4 Question 1

Part A

Organic chemistry is currently defined as

ANSWER:

- the study of natural (as opposed to synthetic) compounds.
- the study of carbon compounds.
- the study of compounds made only by living cells.
- the study of hydrocarbons.

Chapter 4 Pre-Test Question 2

Part A

Which complex organic molecules were synthesized in Miller's experiment?

You did not open hints for this part.

ANSWER:

- formaldehyde, ammonia, amino acids, hydrocarbons
- ammonia, methane, amino acids, hydrocarbons
- ammonia, hydrogen cyanide, amino acids, hydrocarbons
- formaldehyde, hydrogen cyanide, amino acids, hydrocarbons
- formaldehyde, methane, amino acids, hydrocarbons

Chapter 4 Question 4

Part A

The results from Stanley Miller's 1953 experiments can best be used to support which of the following hypotheses?

ANSWER:

- life on Earth arose from simple inorganic molecules
- organic molecules can be synthesized abiotically under conditions that may have existed on early Earth
- the conditions on early Earth were conducive to the origin of life
- life on Earth arose from simple organic molecules, with energy from lightning and volcanoes

Chapter 4 Question 5

Part A

Miller's classic experiment demonstrated that a discharge of sparks through a mixture of gases could result in the formation of a large variety of organic compounds. Miller did not use which one of the following gases in his experiment?

ANSWER:

- oxygen
- ammonia
- water
- methane

Chapter 4 Question 3

Part A

Differences in which of the following chemical characteristics are responsible for the uniqueness of individuals organisms?

ANSWER:

- types of inorganic compounds present in each organism
- types and relative amounts of organic molecules synthesized by each organism
- sizes of the organic molecules in each organism
- elemental composition from organism to organism

Chapter 4 Question 2

Part A

Which of the following characteristics is responsible for the complexity and variety of organic molecules?

ANSWER:

- the variety of rare elements in organic molecules
- the chemical versatility of carbon atoms
- the diverse bonding patterns of nitrogen
- their interaction with water

Chapter 4 Question 1

Part A

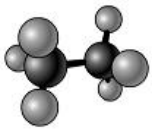
Which of the following molecules has the fewest characteristics of an organic molecule?

ANSWER:

- water
- methane
- keratin–fibrous protein forming the main structure of hair
- hemoglobin–iron-containing oxygen transport metalloprotein

Activity: Isomers

Isomers



Watch the animation and answer the questions.

Part A

L-dopa is used to treat _____.

ANSWER:

- muscle sprains
- Marfan's syndrome
- laryngitis
- Alzheimer's disease
- Parkinson's disease

Part B

What kind of effect does R-dopa have on Parkinson's disease?

ANSWER:

- It makes the symptoms of Parkinson's disease worse.
- At first it alleviates the symptoms but over the long term it makes the symptoms worse.
- At first it makes the symptoms worse but over the long term it alleviates the symptoms.
- None.
- It alleviates the symptoms.

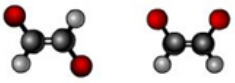
Part C

These molecules are _____.

ANSWER:

- thiols
- enantiomers
- amines
- cis-trans isomers (geometric isomers)
- structural isomers

Part D

These molecules are _____. 

ANSWER:

- cis-trans isomers (geometric isomers)
- ATP and ADP
- thiols
- enantiomers
- structural isomers

Part E

These molecules are _____.

ANSWER:

- thiols
- structural isomers
- cis-trans isomers (geometric isomers)
- enantiomers
- R-dopa and L-dopa

Part F

Enantiomers are molecules that _____.

ANSWER:

- differ in the arrangement of their molecules about a double bond
- contain an –OH group
- are isomers that differ in the covalent partnerships between their atoms
- are mirror images
- contain a carboxyl group

Part G

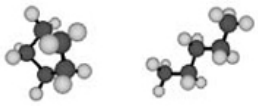
Cis-trans isomers (geometric isomers) are molecules that _____.

ANSWER:

- are isomers in which one of the molecules contains an amino group and the other contains a phosphate group
- are isomers that differ in the covalent partnerships between their atoms
- are mirror images
- differ in the arrangement of their atoms about a double bond
- differ in their molecular formulas

Part H

This pair of molecules are _____.



ANSWER:

- structural isomers
- cis-trans isomers (geometric isomers)
- enantiomers
- identical
- not isomers

Misconception Question 17

Part A

Which statement about isomers is correct?

ANSWER:

- Structural isomers differ in the position of double bonds within the molecule.
- Enantiomers differ in biological activity.
- *Cis-trans* isomers are mirror image isomers.

Misconception Question 16

Part A

How do isomers differ from one another?

ANSWER:

- Isomers differ in molecular formulas.
- Isomers differ in the arrangement or bonding of atoms.
- Isomers differ in charge.

Chapter 4 Question 4

Part A

Visualize the structural formula of each of the following hydrocarbons. Which hydrocarbon has a double bond in its carbon skeleton?

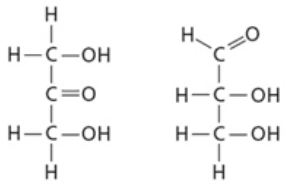
ANSWER:

- C_2H_6
- C_2H_2
- C_2H_4
- C_3H_8

Chapter 4 Question 5

Part A

Choose the term that correctly describes the relationship between these two sugar molecules.



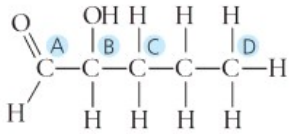
ANSWER:

- structural isomers
- *cis-trans* isomers
- enantiomers
- isotopes

Chapter 4 Question 6

Part A

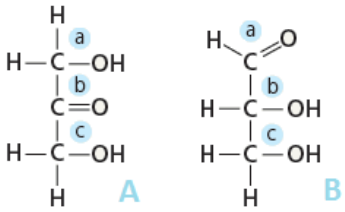
Identify the asymmetric carbon in this molecule.



ANSWER:

- A
- B
- C
- D

Chapter 4 Question 8



Part A

Which of the molecules in the figure above has an asymmetric carbon?

ANSWER:

- A
- B
- none of the molecules
- both molecules

Part B

Which carbon is asymmetric?

ANSWER:

- a
- b
- c

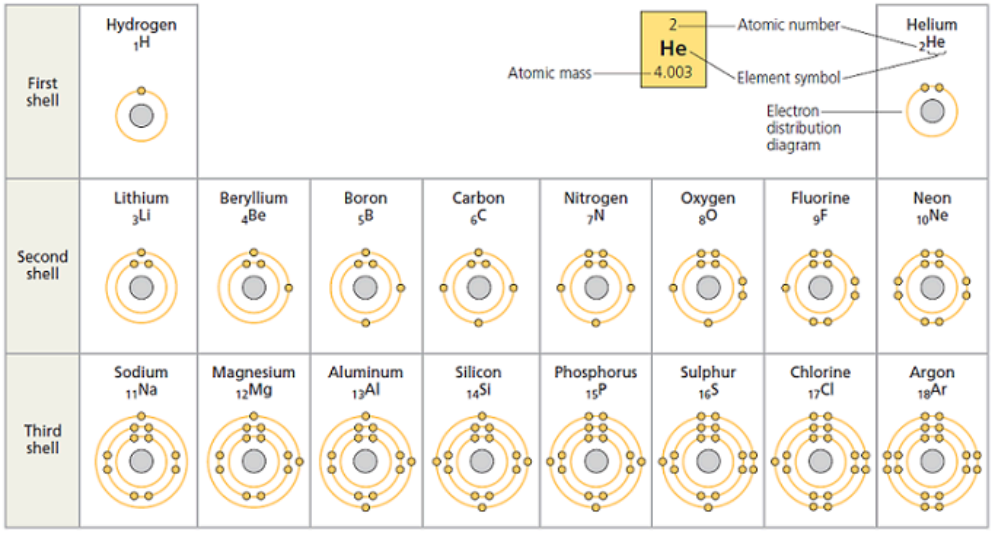
Chapter 4 Question 9

EVOLUTION CONNECTION

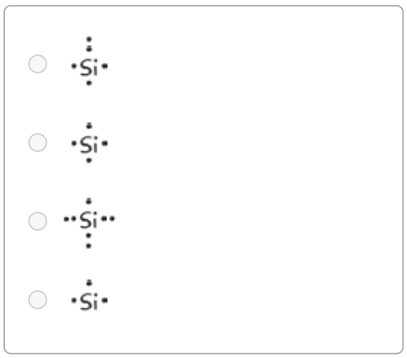
Some scientists think that life elsewhere in the universe might be based on the element silicon, rather than on carbon, as on Earth.

Part A

Look at the electron distribution diagram for silicon in the figure below and choose the Lewis dot structure for silicon.



ANSWER:



Part B

What properties does silicon share with carbon that would make silicon-based life more likely than, say, neon-based life or aluminum-based life?

Match the terms in the left column to the appropriate blanks in the sentences on the right. Not all terms will be used.

ANSWER:

Reset Help

2
no
long
the same number as
3
smaller
less than
more than
short
1
larger

Si has 4 valence electrons, [ ] carbon. Therefore, silicon would be able to form [ ] chains, including branches that could act as skeletons for [ ] molecules. It would clearly do this much better than neon (with [ ] valence electrons) or aluminum (with [ ] valence electrons), both of which cannot form branched molecules.

Chapter 4 Pre-Test Question 1

Part A

Most organic compounds contain which atoms?

You did not open hints for this part.

ANSWER:

- carbon, oxygen, nitrogen, phosphorus
- hydrogen, oxygen, nitrogen, phosphorus
- carbon, hydrogen, nitrogen, phosphorus
- carbon, hydrogen, oxygen, sulfur
- carbon, hydrogen, oxygen, nitrogen

Chapter 4 Pre-Test Question 3

Part A

Variation in carbon chains is an important source of molecular complexity. How can carbon skeletons vary?

You did not open hints for this part.

ANSWER:

- Carbon skeletons can vary in length and exhibit different branching structures
- Carbon skeletons only vary in length
- Carbon skeletons can vary in length and contain double bonds at different positions
- Carbon skeletons can vary in length and contain rings of carbon atoms
- Carbon skeletons can vary in length, exhibit different branching structures, contain double bonds at different positions, and contain rings of carbon atoms

Chapter 4 Pre-Test Question 4

Part A

The large diversity of shapes of biological molecules is possible because of the extensive presence of _____ in the molecules.

You did not open hints for this part.

ANSWER:

- nitrogen
- sulfur
- hydrogen
- oxygen
- carbon

Chapter 4 Pre-Test Question 5

Part A

Which of the following is a hydrocarbon?

You did not open hints for this part.

ANSWER:

- CO_2
- C_3H_8
- CCl_2F_2
- H_2CO_3
- $C_6H_{12}O_6$

Chapter 4 Pre-Test Question 7

Part A

Which of the following best describes *cis-trans* isomers?

You did not open hints for this part.

ANSWER:

- they differ in the arrangement of covalent bonds and in covalent partners
- they are long chains of hydrogen and carbon atoms
- they have the same number of atoms of the same elements, but different structures
- they differ in their spatial arrangement around inflexible double bonds
- they are mirror images of each other

Chapter 4 Question 11

In 1918, an epidemic of sleeping sickness caused an unusual rigid paralysis in some survivors, similar to symptoms of advanced Parkinson's disease. Years later, L-dopa (below, left), a chemical used to treat Parkinson's disease, was given to some of these patients. L-dopa was remarkably effective at eliminating the paralysis, at least temporarily. However, its enantiomer, D-dopa (right), was subsequently shown to have no effect at all, as is the case for Parkinson's disease.

L-dopa D-dopa

Part A

How does the effectiveness of one enantiomer and not the other illustrate the theme of structure and function?

Match the terms in the left column to the appropriate blanks in the sentences on the right. Not all terms will be used.

ANSWER:

Reset Help

three-dimensional
two-dimensional
covalent
four
noncovalent
symmetric
two
asymmetric
differ in structure and function
have identical structure but different function

A specific [ ] shape of molecule results from the geometry of the bonds between its atoms. Enantiomers are isomers that [ ] because of the arrangement of atoms or groups of atoms around a(n) [ ] carbon. Because of the [ ] bonds formed by carbon, the [ ] different atoms or groups can occur in [ ] non-superimposable arrangements. L-dopa is effective because its structure allows it to interact with a receptor molecule. D-dopa is ineffective because its structure does not fit the receptor molecule.

Chapter 4 Question 12

Part A

How does the chemical structure of the carbon atom account for the differences between the male and female lions seen in the photo?

Match the terms in the left column to the appropriate blanks in the sentences on the right. Not all terms will be used.

ANSWER:

Reset Help

female

shapes and chemical characteristics

the number of double bonds

effects

male

proteins

four covalent

steroids

2

4

two covalent

chemical groups

Because carbon has a valence of [ ], it can form [ ] bonds with other atoms. Such versatility of carbon allows for building the skeletons of organic molecules, including important biomolecules.

For example, carbon skeletons in the shape of four fused rings make up [ ], some of which are sex hormones. Estradiol, a [ ] sex hormone, and testosterone, a [ ] sex hormone, are very similar in structure, differing only in two [ ]. It leads to different [ ], allowing them to bind to molecules on the surface of different target cells and result in different [ ], such as the differences between the lions in the photo.

Chapter 4 Question 10

SCIENTIFIC INQUIRY

Fifty years ago, pregnant women who were prescribed thalidomide for morning sickness gave birth to children with birth defects. Thalidomide is a mixture of two enantiomers; one reduces morning sickness, but the other causes severe birth defects. Today, the FDA has approved this drug for non-pregnant individuals with Hansen's disease (leprosy) or newly diagnosed multiple myeloma, a blood and bone marrow cancer. The beneficial enantiomer can be synthesized and given to patients, but over time, both the beneficial and the harmful enantiomer can be detected in the body.

Part A

What is the possible explanation for the presence of the harmful enantiomer?

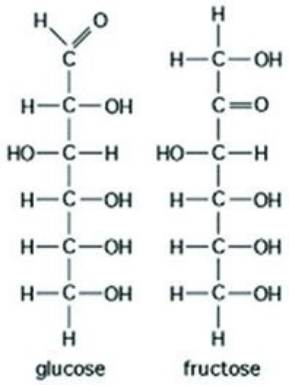
ANSWER:

- Food intake must influence thalidomide to dissolve into the harmful enantiomer.
- The molecule of the beneficial thalidomide enantiomer might not be stable enough to be transported unchanged in the organism.
- The body must have an enzyme that is able to convert the beneficial thalidomide enantiomer into the harmful enantiomer.
- It might be that the beneficial thalidomide enantiomer is influenced by the pH of the stomach, which causes conversion to the harmful enantiomer.

Chapter 4 Question 23

Part A

Use the following figure to answer the following question.



The figure shows the structures of glucose and fructose. Which of the following describes a difference between the two molecules?

ANSWER:

- number of oxygen atoms joined to carbon atoms by double covalent bonds
- number of carbon, hydrogen, and oxygen atoms
- types of carbon, hydrogen, and oxygen atoms
- arrangement of carbon, hydrogen, and oxygen atoms

Chapter 4 Question 8

Part A

Which of the following unique feature of carbon allows it to support life on Earth?

ANSWER:

- Carbon is hydrophobic in nature.
- Carbon is the most abundant element on earth.
- Carbon is the most electronegative element in the periodic table.
- Carbon can form a variety of bonds in nature.

Chapter 4 Question 7

Part A

Which of the following characteristics of an atom determines the number and kind of bonds it can form?

ANSWER:

- the number of particles in its nucleus
- its atomic number
- its atomic mass
- the number of particles in its valence shell

Chapter 4 Question 6

Part A

Which of the following is true of carbon?

ANSWER:

- It is highly electronegative.
- It can form a maximum of three covalent bonds with other elements.
- It forms only polar molecules.
- It can form both polar and nonpolar bonds.

Chapter 4 Question 9

Part A

How many electrons must one carbon atom share with other atom or atoms to complete its valence shell?

ANSWER:

- three
- eight
- two
- four

Chapter 4 Question 20

Part A

Which of the following statements is correct for organic molecules with only hydrogens and five carbon atoms?

ANSWER:

- different positions of double bonds between carbon atoms is not possible
- only a linear carbon skeleton is possible for the molecule
- only carbon number 1 and 2 can form a double bond between them
- the molecule cannot have enantiomers

Chapter 4 Question 18

Part A

Which of the following factors determines whether a carbon atom's covalent bonds with other atoms are in a tetrahedral configuration or a planar configuration?

ANSWER:

- temperature of the solvent
- polarity of the covalent bonds
- solvent in which the organic molecule is dissolved
- double bonds between the carbon atom and other atoms

Chapter 4 Question 14

Part A

All of the following statements accurately describe isomers EXCEPT:

ANSWER:

- Isomers have same molecular formula.
- Isomers are not structurally different.
- Isomers differ in both physical and chemical properties.
- Geometric and Optical isomerism are two types of stereoisomerism.

Chapter 4 Question 24

Part A

Which of the following identifies the chemical relationship between glucose and fructose?

ANSWER:

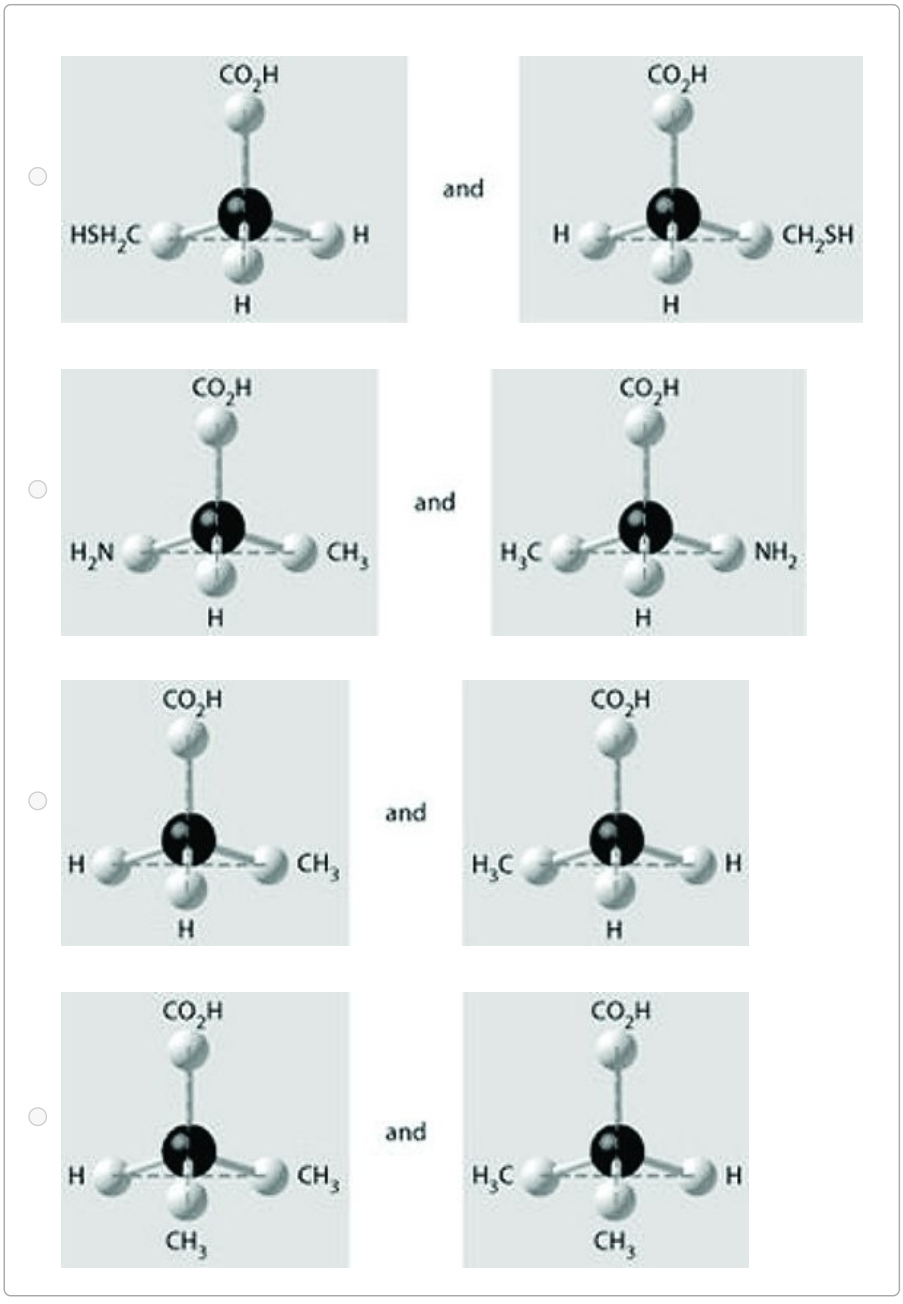
- They are enantiomers.
- They are isotopes.
- They are *cis-trans* isomers.
- They are structural isomers.

Chapter 4 Question 26

Part A

Which of the pairs of molecular structures shown depict enantiomers (enantiomeric forms) of the same molecule?

ANSWER:



Chapter 4 Question 13

Part A

A carbon atom is most likely to form what kind of bond(s) with other atoms?

ANSWER:

- hydrogen
- carbon is an inert element
- covalent
- ionic

Chapter 4 Question 11

Part A

The maximum number of hydrogen atoms in an alkane with six carbons is _____.

ANSWER:

- 6
- 12
- 14
- 10

Chapter 4 Question 16

Part A

Research indicates that ibuprofen, a drug used to relieve inflammation and pain, is a mixture of two enantiomers; what are enantiomers?

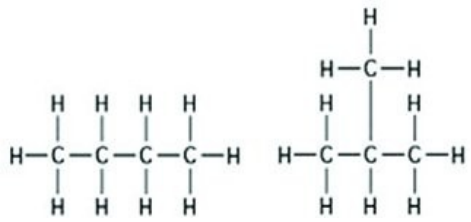
ANSWER:

- Molecules that have identical chemical formulas but differ in the branching of their carbon skeletons.
- Molecules that differ in the arrangement of atoms around their double bonds.
- Molecules that are mirror images of each other.
- Molecules that differ in the location of their double bonds.

Chapter 4 Question 22

Part A

Use the following figure to answer the question.



The two molecules shown in the figures are best described as _____.

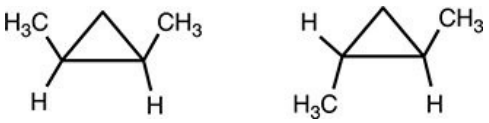
ANSWER:

- chain length isomers
- *cis-trans* isomers
- structural isomers
- enantiomers

Chapter 4 Question 21

Part A

What is the relationship between the following two molecules?



ANSWER:

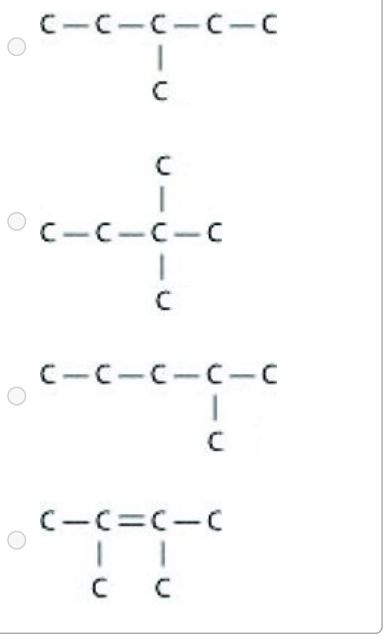
- They are not isomers.
- They are enantiomers.
- They are the same molecule.
- They are geometrical isomers.

Chapter 4 Question 25

Part A

Which of the following illustrations is *not* a structural isomer of an organic compound with the molecular formula C_6H_{14}? For clarity, only the carbon skeletons are shown; hydrogen atoms that would be attached to the carbons have been omitted.

ANSWER:



Chapter 4 Question 19

Part A

Compared to a hydrocarbon chain where all the carbon atoms are linked by single bonds, which of the following statements best describe a hydrocarbon chain with the same number of carbon atoms but with one or more double bonds?

ANSWER:

- It will be more flexible in structure.
- It will contain more hydrogen atoms.
- It will be more constrained in structure.
- It will be more polar.

Chapter 4 Question 10

Part A

Which of the following explains why the valency of carbon is 4 even though it has 6 electrons?

ANSWER:

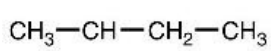
- has 4 electrons in its first shell and 2 in the second shell
- donates its 2 electrons to another atom
- has 2 electrons in its first shell and 4 in the second shell
- shares its 2 electrons and bonds with another atom

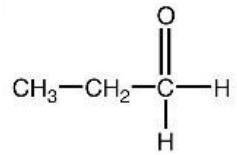
Chapter 4 Question 12

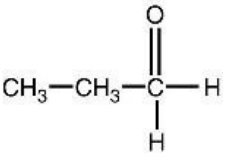
Part A

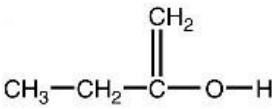
Which of the following structures is a correct representation of an alcohol?

ANSWER:





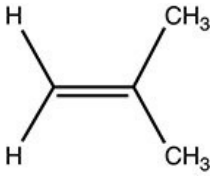




Chapter 4 Question 15

Part A

Which statement is true about the following molecule?



ANSWER:

- It is a *cis* isomer.
- It is a *trans* isomer.
- It is *cis* in its vapor form and *trans* in its fluid form.
- It is not an isomer.

Chapter 4 Question 17

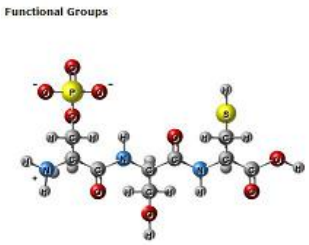
Part A

Thalidomide was sold as "racemic mixture" to pregnant women to treat morning sickness during pregnancy but the drug was found to harm fetus in the womb. It was banned in 1962. Which of the following reasons is the best explanation of the harmful effects of the drug?

ANSWER:

- Thalidomide was under dosed.
- Racemic mixture of any compound is always toxic and should be avoided.
- (+)(R)-thalidomide is a sedative, but (-)(S)-thalidomide is a teratogen (a drug that is toxic in nature).
- Thalidomide is not isomeric in nature thus causes adverse events.

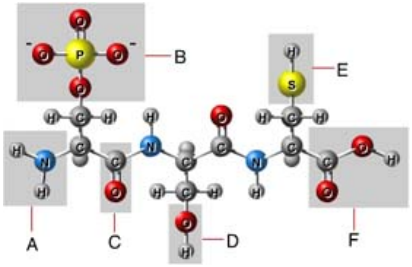
Activity: Functional Groups



Watch the animation and answer the questions.

Part A

Which one of these is an amino group?

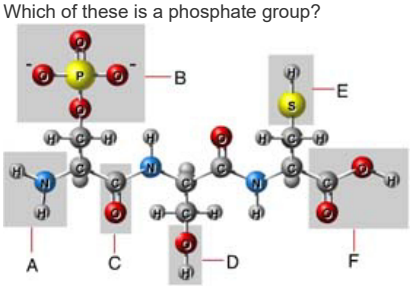


ANSWER:

- D
- B
- E
- C
- A

Part B

Which of these is a phosphate group?

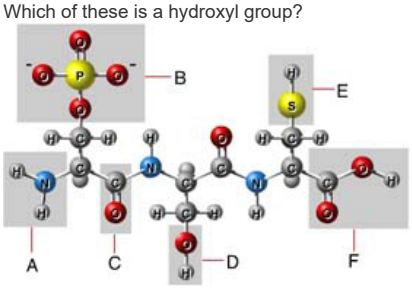


ANSWER:

- C
- F
- E
- A
- B

Part C

Which of these is a hydroxyl group?

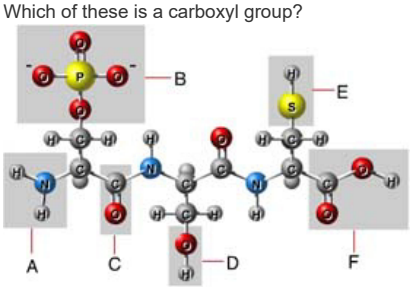


ANSWER:

- C
- F
- E
- A
- D

Part D

Which of these is a carboxyl group?

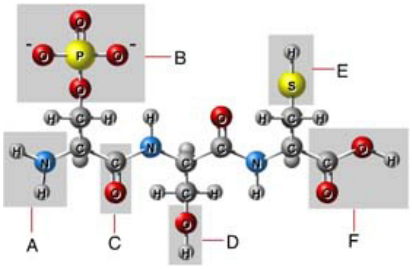


ANSWER:

- C
- E
- B
- A
- F

Part E

Which of these functional groups is characteristic of alcohol?

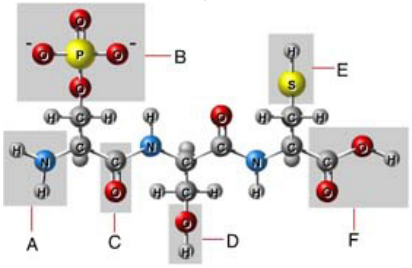


ANSWER:

- C
- D
- A
- E
- B

Part F

Which of the functional groups behaves as a base?

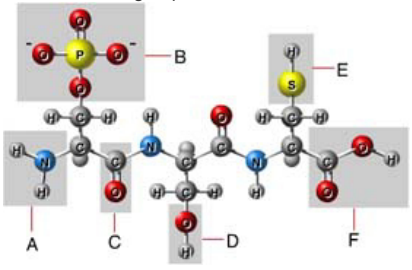


ANSWER:

- F
- C
- B
- A
- E

Part G

Which of these groups is characteristic of thiols?

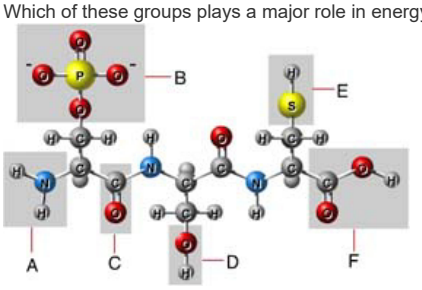


ANSWER:

- A
- D
- B
- F
- E

Part H

Which of these groups plays a major role in energy transfer?

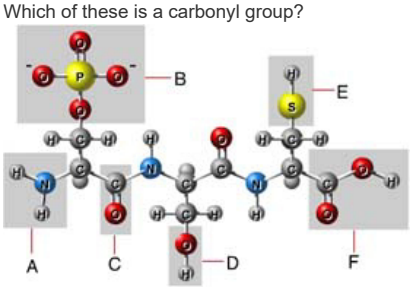


ANSWER:

- C
- B
- E
- D
- A

Part I

Which of these is a carbonyl group?

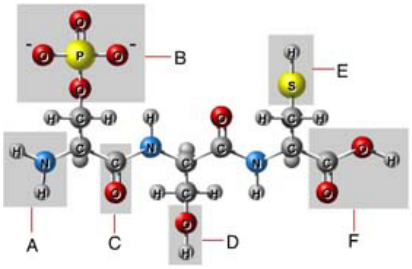


ANSWER:

- C
- A
- B
- F
- E

Part J

Which of functional groups listed below behaves as an acid?



ANSWER:

- E
- D
- A
- C
- F

Misconception Question 19

Part A

Which statement about a methyl functional group is correct?

ANSWER:

- A methyl group may be negatively charged.
- A methyl group consists of a carbon bonded to three hydrogen atoms.
- A methyl group is polar.

Misconception Question 18

Part A

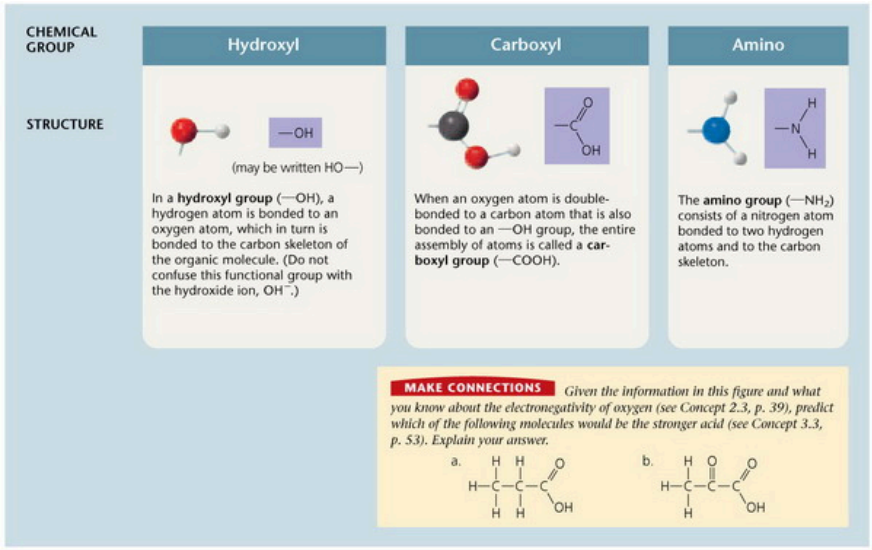
Which of the following statements about functional groups is **TRUE**?

ANSWER:

- Amino and carboxyl are functional groups.
- DNA and RNA are functional groups.
- Lipids and proteins are functional groups.

Misconception Question 20

Part A



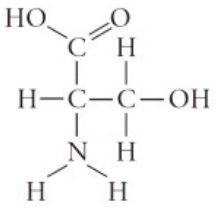
Which of the functional groups shown above is most likely to gain a proton and become positively charged?

ANSWER:

- The carboxyl group is most likely to gain a proton.
- The amino group is most likely to gain a proton.
- The hydroxyl group is most likely to gain a proton.

Chapter 4 Question 2

Part A



Which functional group is present in this molecule?

ANSWER:

- sulfhydryl
- carboxyl
- methyl
- phosphate

Chapter 4 Question 3

Part A

Which chemical group is most likely to be responsible for an organic molecule behaving as a base?

ANSWER:

- carbonyl
- phosphate
- hydroxyl
- amino

Chapter 4 Question 7

Part A

Which action could produce a carbonyl group?

ANSWER:

- the replacement of the nitrogen of an amine with oxygen
- the addition of a thiol to a hydroxyl
- the addition of a hydroxyl to a phosphate
- the replacement of the $-\mathrm{OH}$ of a carboxyl group with a methyl group

Chapter 4 Pre-Test Question 8

Part A

Citric acid makes lemons taste sour. Which of the following is a functional group that would cause a molecule such as citric acid to be acidic? See Concept 4.3 (Page)

You did not open hints for this part.

ANSWER:

- carbonyl
- hydrocarbon
- carboxyl
- amino
- hydroxyl

Chapter 4 Pre-Test Question 6

Part A

Molecules that have the same chemical formula (same numbers of each type of atom) but different three-dimensional shapes are called _____.

You did not open hints for this part.

ANSWER:

- enantiomers
- isomers
- isotopes
- functional groups
- hydrocarbons

Chapter 4 Pre-Test Question 9

Part A

Variations in the reactive properties of different organic molecules are most closely associated with _____.

You did not open hints for this part.

ANSWER:

- the number of carbon atoms comprising the molecule's skeleton
- the number of asymmetric carbon atoms present
- the presence or absence of double bonds
- the nature of the carbon skeleton (either ringed or linear)
- the presence or absence of functional groups

Chapter 4 Pre-Test Question 10

Part A

What functional group is commonly used in cells to transfer energy from one organic molecule to another?

You did not open hints for this part.

ANSWER:

- amino
- sulfhydryl
- phosphate
- hydroxyl
- carboxyl

Chapter 4 Question 29

Part A

Which of the following functional groups is hydrophobic in nature?

ANSWER:

- sulfhydryl
- amino
- hydroxyl
- methyl

Chapter 4 Question 45

Part A

Which chemical change will convert ADP to ATP?

ANSWER:

- by adding energy and a phosphate
- by adding two phosphates
- by removing energy and a phosphate
- by adding a phosphate, energy and oxygen

Chapter 4 Question 44

Part A

Which of the following statements about ADP/ATP is true?

ANSWER:

- ADP can have two *positive* charges.
- ATP can have four negative charges.
- ADP contains more energy than ATP.
- Following hydrolysis, ATP can release one phosphate, whereas ADP cannot.

Chapter 4 Question 46

Part A

Hydrolysis of ADP produces which of the following products?

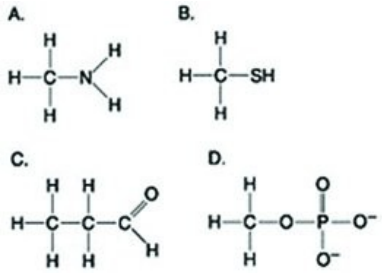
ANSWER:

- AMP + Pi + energy
- ATP + Pi
- ATP + energy
- Pi + Pi + water

Chapter 4 Question 41

Part A

Use the figures to answer the following question.



Which molecule shown can be a result of mercaptoethanol reduction of a disulfide bridge?

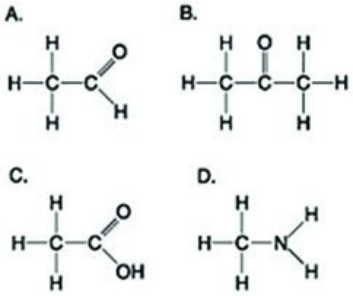
ANSWER:

- A
- B
- C
- D

Chapter 4 Question 40

Part A

Use the figures to answer the following question.



Which molecule shown can increase the concentration of hydrogen ions in a solution and is therefore an organic acid?

ANSWER:

- A
- B
- C
- D

Chapter 4 Question 43

Part A

ATP is necessary for life because _____.

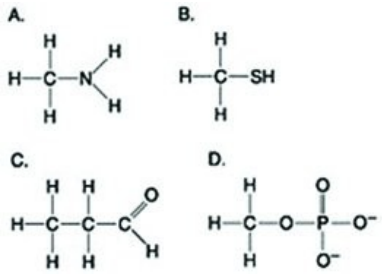
ANSWER:

- it speeds up the biological processes
- it is the principle energy carrying molecule in a cell
- it is soluble in water
- it tastes good

Chapter 4 Question 42

Part A

Use the figures to answer the question.



Which molecule shown above contains a functional group that is a part of the principal molecule that stores and transfers energy in cells?

ANSWER:

- A
- B
- C
- D

Chapter 4 Question 35

Part A

Use the schemes to answer the question.

A. –OH

B. –C(=O)–O–H

C. $-NH_2$

D. –SH

Which of the functional groups shown in the figure is present in hexanol but not in hexane?

ANSWER:

- A
- B
- C
- D

Chapter 4 Question 34

Part A

Use the schemes to answer the question.

A. –OH

C. $-NH_2$

B. $-\overset{\overset{O}{\|}}{C}-O-H$

D. –SH

Which functional group shown in the figure can accept protons and raise the pH of the surrounding solution?

ANSWER:

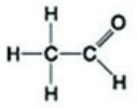
- A
- B
- C
- D

Chapter 4 Question 37

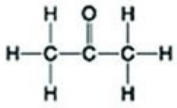
Part A

Use the figures to answer the following question.

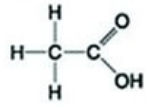
A.



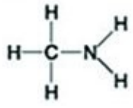
B.



C.



D.



Which molecule(s) shown is (are) ionized in a cell?

ANSWER:

- A
- B and D
- C and D
- D

Chapter 4 Question 33

Part A

Which of the following functional groups is present in acetic acid?

ANSWER:

- carboxyl group
- sulfhydryl group
- hydroxyl group
- carbonyl group

Chapter 4 Question 32

Part A

Testosterone and estradiol are male and female sex hormones, respectively, in many vertebrates. In which of the following ways do these molecules differ from each other?

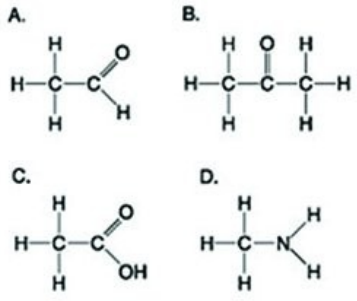
ANSWER:

- They are structural isomers but have the same molecular formula.
- They are enantiomers of the same organic molecule.
- They have different functional groups attached to the same carbon skeleton.
- They are *cis-trans* isomers but have the same molecular formula.

Chapter 4 Question 38

Part A

Use the figures to answer the following question.



Which molecule shown has at least one carbon atom attached to three different chemical groups?

ANSWER:

- A
- B
- C
- A and B

Chapter 4 Question 36

Part A

Which of the following compounds is found in vinegar?

ANSWER:

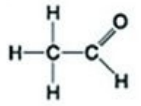
- nitric acid
- acetic acid
- amino acid
- propionic acid

Chapter 4 Question 39

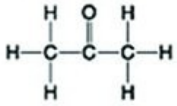
Part A

Use the figures to answer the following question.

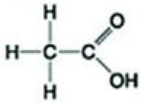
A.



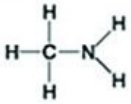
B.



C.



D.



Which molecule shown has a carbonyl functional group in the form of a ketone?

ANSWER:

- A
- B
- C
- D

Chapter 4 Question 31

Part A

Which of the following functional groups gives amino acids their acidic character?

ANSWER:

- phosphate
- carbonyl
- amino
- carboxyl

Chapter 4 Question 30

Part A

Which two functional groups are *always* found in amino acids?

ANSWER:

- hydroxyl and carboxyl groups
- amino and sulfhydryl groups
- carbonyl and amino groups
- carboxyl and amino groups

Chapter 4 Question 28

Part A

A compound contains hydroxyl groups as its predominant functional group. Which of the following properties of the molecule can be predicted with the information provided?

ANSWER:

- It should dissolve in water.
- It should dissolve in a nonpolar solvent.
- It will not form hydrogen bonds with water.
- It lacks an asymmetric carbon and is probably a fat or lipid.

Chapter 4 Question 27

Part A

Which of the following functional groups is unreactive but when added to bases of DNA can alter gene expression?

ANSWER:

- methyl
- amino
- hydroxyl
- carboxyl