NAME\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ NOTES: UNIT 3 COMPOUNDS

LEARNING GOALS: By the end of this unit, you should be able to identify:

* compounds as: Inorganic or Organic
* molecular compound (made with covalent bonding) or ionic compound (made with ionic bonding)
* the general properties of a molecular compound
* the general properties of an ionic compound

I) For our coursework we shall look at INORGANIC and ORGANIC compounds.

 A) There are a variety of other types of classifications for compounds … such as; organometallic

 compounds, ceramics, coordination compounds, metalorganic compounds….etc… However, very

 broadly we may study compounds by classifying them as either inorganic or organic.

 COMPOUND(S)

**can be classified as:**

**can be classified as:**

Inorganic

Compound(s)

Organic

Compound(s)

could be described as an:

could be described as a:

described as a:

 ***or***

Molecule or as

 Molecular

Molecule or as

 Molecular

Ionic compound

made from atoms bonded with

made from atoms bonded with

made from **ions** bonded with

Covalent bonds

(atoms sharing electrons)

Covalent bonds

(atoms sharing electrons)

Ionic bonds (oppositely charged ions attracting each other [electrostatic]

**Definition**

An overall neutral (in charge) chemical substance made from 2 or more different species bonded in a specific (definite) ratio.

II) New Term:  **Molecule (or Molecular Compound)**

 A) Broadly, a molecule is the smallest species made of \*two or more nonmetal atoms bonded together,

 via covalent bonding.

 1) Very often, molecular compound and covalent compound are interchangeable. However, I

 wish to stress that the term, molecule refers to the fact that the chemical species is made of

 nonmetals, while the term, covalent refers to a type of bond. It’s picky – but … I’m picky.

 2) So, using your grasp of the 11 nonmental elements: H, C, N, O, F, P, S, Cl, Se, Br, I

 work to understand that chemical unions of these elements allow us to use the term(s)

 \*molecule or molecular compound

 a) The adjective “molecule”, will apply to organic compounds and *may* apply to

 inorganic compounds as well. The term molecule informs us that we are discussing

 a chemical substance made of \*nonmetal atoms

 b) Now there are molecular elements … O2, P4, S8, Cl2, N2, O3 are a number of

 molecular elements which come to mind, but this section of notes is about compounds

c) The chemical behavior of a **molecular substance** is dependent upon a number of

 factors:

 These factors and their effects are summarized, briefly in the table.

|  |  |
| --- | --- |
| Factors Affecting The Chemical Behavior Of A Molecular Substance | Examples Of Issues That Are Affected |
| **Shape of the molecule** | * Lock and Key Theory of Enzyme Activity
* Solubility in solvents like water, or CCl4
* Phase (solid, liquid, gas)
 |
| **Composition of the molecule** | * Solubility
* Acid/Base Properties
* Combustibility
 |
| **Strength of the secondary attractive forces****between one molecule & surrounding molecules** | * Solubility
* Phase
* Melting Point
 |

B) Most acids are considered to be molecular compounds. In their purest state, acids are made up

 of nonmetals, bonded to each other via covalent bonding, and exist as separate entities.

 1) e.g.) HCl. H2SO4, CH3COOH (an example of a carboxylic acid with that last H as the

 “acidic Hydrogen”.

C) Molecule or Molecular may be used to describe inorganic or organic compounds.

 The key is to grasp that generally they are made of nonmetal atoms covalently bonded to

 other nonmetal atoms.



III) Ionic Bond

 For our course, if the bond is not a covalent bond, it will be an ionic bond.

 A) Ionic bond: \*an electrostatic attraction between a positive ion and a negative ion

 B) Generally, an ionic bond is found between a metal ion and a nonmetal atom, in which an electron

 has been completely transferred from the metal to the nonmetal. This transference creates

 a charge imbalance in both species (ions). One becomes + and the other becomes -. The

 two oppositely charged species become attracted to each other.

bonded to negative nonmetal ion(s



<https://thechemistrynotes.com/ionic-bond/>

 i) NaCl, LiF, NaF, MgCl2

 ii) there are organic salts (e.g. acetates, oxalates, citrates…) but these

 are not the focus of our class.

IV) Inorganic Compounds: This is a general descriptive term given to any compound \* which generally lacks

 carbon all together or lacks carbon - hydrogen bonds. (There are exceptions)

A) The above is not the best quality definition but it will work for our work and the vast majority of

 compounds dealt with in an everyday situation.

 1) Consider HCl. Written pieces may identify HCl as an *inorganic molecule* or an *inorganic*

 *compound* or an *inorganic molecular compound* or acid

 There is a total lack of C – H bonds. (⸫inorganic)

 The species are classified as nonmetals (⸫molecule or molecular)

 There are at least two different chemical species (H & Cl). (⸫compound)

2) Consider SO2 I would identify this as an inorganic molecule or

 an inorganic molecular compound

 There is a total lack of C – H bonding (⸫inorganic)

 The species are nonmetal species (⸫molecular)

 There are at least two different species (S & O) (⸫compound)

3) Consider KBr. I would identify this as an inorganic compound or more specifically, as an inorganic ionic compound

 There is a total lack of C – H bonding (⸫ inorganic)

 There are at least two different elemental species (K & Br) (⸫ compound)

 There is a metal species bonded to a nonmetal species (⸫ ionic / ionic bonds)

4) However, now consider Na2CO3

 a) Technically, this is an inorganic ionic compound .

 Yes, there is C but there is a lack of C – H bonding (⸫inorganic)

 There are two or more different elemental species (⸫compound)

 There is a metal species somehow bonded to nonmetal species (⸫ionic / ionic

 bonding)

5) In conclusion: Inorganic compounds may have \***ionic bonds or covalent bonds.**

 a) Thus, depending upon composition, other terms which may be applied to an inorganic

 compound are **ionic compound or molecular compound**

 **Take Home Messages**: What makes something a compound? \*It has at least two different elements

 bonded together in a specific ration.

 What makes something inorganic? \*It lacks C or C-H bonds or C is not the

 central atom.

 What makes something molecular or a molecule? \*It is generally two

 nonmetal species bonded to each other with covalent bonds.

 What makes something an ionic compound? \* an ionic bond between

**TRY THIS!**  For questions in this section, one or more of the responses given are correct. Using your notes and understanding of the periodic table, decide which of the responses is (are) correct. Then choose :

 a) when only choice I is correct

 b) when only choice II is correct

 c) when only choices I and II are both correct

 d) when only choices II and III are both correct

 e) when I, II, and III are each correct

\_\_\_\_\_ 1) Which of the following is (are) best described by the terms: **inorganic, molecular, and compound**?

 I) O2 II) H2O III) KOH

 a) when only choice I is correct

 b) when only choice II is correct

 c) when only choices I and II are both correct

 d) when only choices II and III are both correct

 e) when I, II, and III are each correct

\_\_\_\_\_2) Which of the following is (are) best described by the terms: **inorganic, ionic, and compound**?

 I) NaCl II) Fe2O3 III) CaCO3

\_\_\_\_\_3) Which of the following may be described by the term, **inorganic compound**?

 I) NaF II) C3H8 III) CH3OH

\_\_\_\_\_4) Which of the following may be described by the term **molecular**?

 I) NO2 II) C6H12O6 III) NaClO

 Answers: 1) b 2) e 3) a 4) c

V) Organic Compounds

 A) While there are approximately one half million inorganic compounds …. it is estimated that there

 are at least upwards of **20 million organic compounds**!!!!!!!!!!!

 B) Organic compounds tend to have C bonded to H covalently, at the very least. Other atoms, such as

 O, N, Cl, Br and even metals (organometallic chemistry) can be found in organic compounds. But

 key is a “backbone” made predominately of carbon atoms and covalent bonding. Carbon and

 hydrogen are usually present in an organic compound. (Of course, there are exceptions, but we shall

 not worry about them.

 1) Recall that the covalent bond is represented by a line ( ) which symbolized 2 (or 1 pair)

 of shared electrons.

 2) Nonmetal atoms have different electronegativity values, but they tend to be close in value.

 The covalent bond is formed as a “sharing” bond of electrons because neither nonmetal atom

 of the bond has a sufficiently large value to gain the electron completely.

 a) Electronegativity is a value assigned to an atom which describes the likelihood that

 it can attract the electrons of a bond to itself . A higher value indicates a greater

 likelihood of attraction.

 b) The Pauling Scale tends to run from a low of 0.79 to a high of 3.98 (or more

 generally as; 0.7 to 4)



<https://free-printable-paper.com/electronegativity-chart/>

 3) Organic compounds tend to be ONLY MOLECULAR compounds … That is, they *tend*

 to be

* made of nonmetal atoms,
* bonded to each other with covalent bonds.
* Electrons of the bond are being **shared**. Electrons are not fully lost, nor fully gained as indicated by closer electronegativity values.

 a) C6H12O6, CH4, CH3OH, CH3COOH, CH3CH2NH2, CH3CH2SH,

 4) Let’s look at the anti-malarial drug **hydroxychloroquine**. It was pushed as a possible

 treatment for the SARS CoV2 … Why? It was believed that the drug has some ability to

 inhibit the virus, as the drug may affect certain pH dependent reactions. The chemical is a

 very weak base. It appears to have no effect and it is not recommended for treatment, due

 to complications in older patients and those with comorbidities.

 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8381625/>



 This picture is from Wikipedia …

 At every vertex, unless noted, there is a

 carbon atom, bonded to at least 1 hydrogen

 atom for a total of 4 covalent bonds.

 So, you will notice the predominance

 of carbon (thus it is organic). There

 is more than one element (thus it is

 a compound) and the bonding (all

 those dashes or lines) indicate covalent

 bonds between nonmetals …Thus hydroxychloroquine is an **organic molecular compound**

 **made from covalent bonds (electrons are being shared so all atoms get 8 valence e-)**

C

 5) Look at Lactic Acid:



A varied set of uses and issues:

* Topical Exfoliant (alpha - hydroxy acid: AHA). In comparison, Salicylic acid is a BHA
* Found in dairy products (peaches & cream complexion)
* A good cleaner (e.g. CLR, Method)
* Tanning leather(!)
* Intravenous fluids
* Tooth decay

- H

C

H -

 - H

 |

H

C

 <https://pubchem.ncbi.nlm.nih.gov/compound/Lactic-acid>

 6) Ethylene (also called ethene)

* a powerful plant hormone which stimulates ripening.
* it breaks dormancy in seeds
* it is produced from methionine found in plant tissues (leaves, stems)
* may play a role in gravitropism, in both roots and stems!

[This Photo](https://www.homeworklib.com/questions/806114/2-what-two-atomic-orbitals-or-hybrid-atomic) by Unknown Author is licensed under [CC BY-SA-NC](https://creativecommons.org/licenses/by-nc-sa/3.0/)

* Check out: Ethene sensitive fruits at <https://ucsdcommunityhealth.org/wp-content/uploads/2017/09/ethylene.pdf>

 7) Messenger RNA (mRNA) is a polymer AND an organic compound.

 b) mRNA is a polymer … a repeating chain of monomers making up a large molecule.

 In the case of mRNA, the molecules are Guanine, Uracil, Adenine and Cytosine

 These molecules are organic compounds made of the elements: C, H, O, N, and P



 c)

 By Narayanese, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=3481560>

**Important Atoms and Ions that make biological compounds (HONC and a few more…)**

|  |  |  |
| --- | --- | --- |
| Elemental Atom or Ion | Symbol(s) | Positive Use(s) / Function(s) in the Human Body |
| Oxygen and Oxide ion |  O2 and O-2 | * structure / function of molecules in the 4 major bio-molecule categories: of proteins, lipids carbohydrates and nucleic acids
* final electron acceptor in the production of ATP in the Electron Transport System (ETS). This is oxygen’s association with *breathing*
* antiseptic agent in its role as a powerful reducing agent
 |
| Carbon | C | * structure / function of molecules in the 4 major bio-molecule categories: of proteins, lipids carbohydrates and nucleic acids
 |
| Hydrogen atom *&* Hydrogen ion | H and H+1 | * structure / function of molecules in the 4 major bio-molecule categories: of proteins, lipids carbohydrates and nucleic acids
* primarily responsible for pH
 |
| Nitrogen(as an atom or molecule) | N and N2 | * necessary for the structure / function of proteins
* N2 is a gas dissolved in blood tissue.
 |
| calcium ion | Ca+2 | * important in the structure / function of bones, teeth
* plays an important role in the fertilization of an ovum, by sperm.
* important secondary transducer in that the ion amplifies the signals of hormones bound to cell membranes, passing the signal onto molecules in the cell, changing cellular activity.
* used in muscle contraction and relaxation throughout the body, including the smooth muscle surrounding blood vessels.
 |
| Phosphorus | P | * structure / function of energy molecules (ATP) and energy transfer molecules
 |
| Potassium ion | K+1 | * proper functioning of nervous system transmission
* major cation inside nerve cells
* found in all living organisms … especially high in plant tissues such as fruits
 |
| Sulfur | S | * structure / function of the amino acids of protein molecules
* structure / function of nucleic acids
* may play a role in treating conditions such a fibromyalgia, depression, arthritis, diabetes, athletic injuries <http://www.ncbi.nlm.nih.gov/pubmed/11896744>
 |
| Sodium ion | Na+1 | * proper functioning of nervous system transmission
 |
| Chloride ion | Cl-1 | * proper functioning of nervous system transmission, especially in the GABA system
 |
| Magnesium ion | Mg+2 | * necessary for the structure / function of proteins
* necessary for the activation of ATP
* the function of over 300 enzymes require the activity of magnesium ion
* deficiency in the ion has been associated with muscle spasm, diabetes, high blood pressure, anxiety disorders, migraines, osteoporosis, and cardiovascular disease.
 |
| Trace Elements: Ions of: boron, chromium, cobalt, copper, fluorine, iodine, iron, manganese, molybdenum, selenium silicon, tin, vanadium, zinc  |  | * sometimes referred to as ***essential minerals***
 |

C) Every carbon atom in an organic molecule will have \* 4 covalent bonds.

 1) We can symbolize organic compounds with **molecular**, **condensed** & structural formulae

 Study the diagram. The carbon atoms really form a jagged backbone, each carbon bonded to

 another and then to hydrogen atoms to complete the need for 4 covalent bonds.

eg) H H H

 | | | Molecular Formula= **C3H8** (Just count up the atoms in the structure)

 H⎯C⎯C⎯C⎯ H

 | | |

 H H H

 | | |

H⎯C⎯C⎯C⎯H

 | | |

 H H H

 H H H

 Condensed Formula = \* CH3CH2CH3

 Study the diagram. Every C atom has \* 4 covalent bonds. Recall that each solid dash (⎯)

 represents \* 1 pair of shared e-.

 eg) H H H H O Condensed Formula=\* CH3CH2OCH2CH2COOH

 | | | | //

 H⎯C⎯C⎯O⎯C⎯C⎯C⎯O⎯H Molecular Formula = \*C5H10O3

 | | | |

 H H H H

 How many covalent bonds does the molecule represented above, have? \* 18

 eg) Study the diagram. The bonds between carbon atoms can be single bonds,

 \* double bonds (2 pair of shared e-) or even \* triple bonds

 H H H Condensed Formula = \*CH3CHCH2

 | | |

 H⎯C⎯C = C⎯H Molecular Formula =\* C3H6

 |

 H



eg) Consider the structures:

 which are often or

 written as:

2) There are many different ways to discuss organic compounds. We could discuss the

* families of organic compounds, based on various special groups of atoms called

functional groups

* alcohols
* ketones
* organic acids
* amines
* ethers
* esters
* large groups based upon shared structure or shared function:
* polyphenols
* alkaloids
* terpenoids
* flavones
* neurotransmitters
* hormones
* neurotoxins

Just don’t let the nomenclature or terms throw you. When you want to know something,

just google; *definition: polyphenol* or google *what the role of a polyphenol*.

D) Saturated vs Unsaturated Molecules

Take another 5 minutes please, to go to the next level… That level deals with how the *organization / orientation, or number of C to C covalent bonds affects the molecule, its chemistry, our lives.*

1) Saturated Organic Molecule versus ***UN***saturated Organic Molecule

 2) \* Saturated : A broad descriptive term, which tells you that every

the term "organic molecule" may apply to hydrocarbons and their derivatives

 **Carbon to Carbon** bond is \* a single covalent bond

 a) if a \* double bond or a \* triple bond exist between any **pair of carbon**

 **atoms** anywhere in the molecule, that molecule is considered to be \* unsaturated.

 H H H H H

 | | | | |

 H−C−C−C−C−C−H *This is an example of a C-C single bond*

 | | | | |

 H H H H H

 H H H H O The bonds between C atoms are \* single

 | | | | // Even though there is the double bond between C and O

 H−C−C−O−C−C−C−O−H this molecule is still classified as \* saturated.

 | | | |

 H H H H

 H H H Note the double bond between two of the carbon atoms | | | This molecule is considered to be \* an **UNsaturated molecule**

 H−C−C = C−H

 |

 H

 **Question**: Which of one of these two structural formulae represents a **saturated** molecule?

 H H H H O

 | | | | //

 a) H−C=C−C−H b) H−C−C−C−C−H

 | | | | | |

 H H H H H H

 NOW, Have you ever heard the terms: ***Poly***unsaturated Fat, ***Mono***unsaturated Fat, & Hydrogenated Oils?

 3) **Relevance to us:** Saturated fats (as opposed to unsaturated fats) tend to lead to the

 development of cholesterol.





**Relevance To Us: Cholesterol**



As cholesterol is not water-soluble it must bind

to special proteins before it can be carried in the bloodstream, known as apoproteins. Once coated they form a package called lipoproteins,

there are 2 main types of lipoproteins:

**Low density lipoproteins** (LDL), commonly known as bad cholesterol. LDL is the major cholesterol carrier in the blood. If there is too much LDL in the blood it can build up on artery walls. A high level of LDL cholesterol may give you an increased risk of coronary [heart disease](http://www.homehealth-uk.com/medical/heartdisease.htm).

**High density lipoproteins** (HDL), is commonly known, as good cholesterol. HDL is actually good for maintaining the health of the heart and preventing the narrowing of the arteries (atherosclerosis) because it appears to carry cholesterol away from the arteries and back to the liver for disposal.

This is why the ratio between LDL and HDL cholesterol is important. Usually the body maintains a balance of cholesterol, making more if it needs it and getting rid of any excess. But sometimes this balance goes wrong. LDL levels can be lowered by eating a low fat diet and HDL levels can be raised by exercising.

 **You can tell when a foodstuff, like butter or animal fat or cheese has saturated fats when**

**it is a solid at room temperature! Good to know!**

Check Out: <https://www.health.harvard.edu/staying-healthy/the-truth-about-fats-bad-and-good>

READING: FINDING MEANING IN A STRUCTURAL / CONDENSED OR SKELETAL FORMULA

The next few pages are designed to help you as you do your own research … Organic molecular compounds can be a bit challenging….

Structural formulas are insanely helpful, as they show you the number, type and position of each atom of a molecule.



 e.g.) With a little care, you can get the formula for Vitamin C from the

 structural formula: There are 6 Carbons, 6 Oxygen, and 8 H

 for: C6H8O6. Go ahead. Analyze the structure and count…

 <https://www.clutchprep.com/organic-chemistry/practice-problems/13578/draw-the-bond-line-structure-160-for-vitamin-c>

Your research and reading will lead you to other formats to describe molecules, and they are not always so clear … For instance, look at a skeletal formula for **lycopene**. Lycopene is a powerful antioxidant which may help with heart health and providing protection against certain cancers. It is found in tomatoes, watermelon, and pink grapefruit. Its skeletal structure is:

 <https://www.chemspider.com/Chemical-Structure.394156.html>

If you go “Huh?”, you would not be alone. The following pages will hopefully help you make sense of the variety of ways, organic molecules (in particular), are written.

**1) Covalent bonds are often symbolized with some sort of wedge-shape or straight line.**

 a straight means the bond is in the plane of the paper. Each dash represents

 1 pair of shared electrons (or simply just 2 electrons).

Most commonly, you shall see solid lines between two atoms or points on a molecule which represent (a)

 covalent bond(s).

[https://chem.libretexts.org/Bookshelves/Organic\_Chemistry/Book%3A\_Basic\_Principles\_of\_Organic\_Chemistry\_(Roberts\_and\_Caserio)/02%3A\_Structural\_Organic\_Chemistry.\_The\_Shapes\_of\_Molecules\_and\_Functional\_Group/2.1%3A\_Structural\_Formulas](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_%28Roberts_and_Caserio%29/02%3A_Structural_Organic_Chemistry._The_Shapes_of_Molecules_and_Functional_Group/2.1%3A_Structural_Formulas)

Wedges are sometimes used in structural formulae.



 <http://www.chem.ucalgary.ca/courses/350/Carey5th/Ch03/ch3-0-2.html>



For example; Drinking yourself blind comes from

 methanol poisoning. Methanol

 (wood alcohol) destroys the myelin

 sheath of the optic nerve causing

 permanent blindness. Ethanol (grain

 alcohol) is the alcohol of beer, wine,

 and liquor. It is a drug which affects

 behavior, and can be poisonous in its

 Methanol (Methyl alcohol) own right … but it does not affect the

<https://www.thoughtco.com/wedge-and-dash-projection-definition-602137> myelin sheath of the optic nerve.

If you drink methanol, you are in a real meth (mess…)

You can’t eat wood, so you can’t drink its alcohol … Think!

 <https://images.wisegeek.com/nerve-cell-with-labels.jpg>

Here’s a comparison of two slightly different views (top and side) of methanal (also called: ***formaldehyde***)



 <https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/2-2-hybrid-orbitals/>

**2) The carbon atoms of an organic compound are always included in a structural formula … but they**

 **may or may NOT be included, as a “C”.** **A favorite shorthand is the use of a vertex.**

 A vertex is any angular point … and where these “points” exist, a chemistry student may assume that there

 is a carbon atom, **AS WELL AS** the hydrogen atoms, required to complete the 4-bonds every carbon will

 make.

 A great example of this, is seen with what chemists call a **benzene ring**. Benzene is a hexagonally shaped

 ring structure and it is very special (and common!!!) A 6-sided diagram is often used to represent a

 benzene ring or some variation of a benzene ring.

 Each line intersection (vertex) represents a carbon atom, as well as the hydrogen atoms required to complete

 the 4-bond requirement for each C atom are assumed, unless otherwise indicated. Notice the double bonds

 between carbon atoms (indicated by the circle in diagram 3)



 This is a benzene molecule (C6H6) and, so is this one …. and this one too!

 <https://classnotes.org.in/class11/chemistry/organic-chemistry-some-basic-principles-techniques/nomenclature-of-simple-aromatic-compounds/>

 Here are two applications of a benzene ring (or some derivative) in molecules….



 Aspirin (acetylsalicylic acid)

 <https://www.sigmaaldrich.com/catalog/product/sigma/a5376?lang=en&region=US>

 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5613902/>

 A variation of delphinidin, called, delphinidin 3-glucoside is the

 basis of the blue pigment in hydrangea and blueberries.

**3) While benzene has a backbone of just carbon atoms, it isn’t that unusual to find ring structures**

 **with oxygen atoms (e.g. cyclic ethers, or cyclic esters) or nitrogen atoms (e.g. pyridine compounds)**

 You may see wedge-shaped bonds. The author is simply trying to indicate the 3-dimensional position of

 the bond and group of atoms.



 Also Vitamin C …They depict the same molecule, really

<https://www.clutchprep.com/organic-chemistry/practice-problems/13578/draw-the-bond-line-structure-160-for-vitamin-c> & [https://commons.wikimedia.org/wiki/File:Ascorbic\_acid\_structure.png](https://commons.wikimedia.org/wiki/File%3AAscorbic_acid_structure.png)

A pyridine ring is not the same as a benzene ring … but there are similarities… You will note the big difference is the inclusion of a N atom, in the ring (substituting for a C atom)



 <https://courses.lumenlearning.com/chemistryformajors/chapter/amines-and-amides/>

 Some molecules built off the pyridine ring are important vitamins.



 <http://www.softschools.com/formulas/chemistry/folic_acid_formula/483/>

 Vitamin B-6 (Pyridoxine) Vitamin B-9 (Folic Acid)

 This is a perfect example of a pyridine This shows a variation called a diazine … but it is

 <https://www.sigmaaldrich.com/catalog/product/sigma/p5669?lang=en&region=US> closely related to a pyridine …This has 2 Nitrogen

 in two rings. Note the benzene ring towards the

 middle of the molecule. Folic Acid is necessary to

 prevent a certain birth defect, and is so important, it

 is added to most foods, like breads….

**4) The most off-putting for many students are what are called, Skeletal Formula or Structures**

Often, you just see polygon shapes and/or crooked lines. Sometimes, the polygon shape has an oxygen or nitrogen in it. Well, remember, chemists are moving fast and they use a shorthand.

Again, where two lines intersect, (a vertex) we may assume there is a carbon atom, bonded to enough (unseen) hydrogen atoms, so as to complete carbon’s required 4 bonds.

Take a look at the following formulae for a molecule of ethanol (ethyl alcohol). This is a good time to show you the condensed formula, while on our way to study skeletal formulae.



 <https://study.com/academy/lesson/structural-formula-definition-examples.html>

Skeletal formulae are often, what you get on those pharmaceutical inserts describing the active drug.

Here is a look at the steroid, prednisone, from <https://en.wikipedia.org/wiki/Prednisone>



Here is a look at a very simple hydrocarbon, pentane and all forms (isomers) of it. A hydrocarbon is an organic molecule made of ONLY carbon and hydrogen. Pentane has a formula of C5H12. It has only single covalent bonds between the carbon atoms. The skeletal formula can look downright weird … but by now, I am hoping you are feeling a little more comfortable…. formulae from: <https://sites.google.com/site/ellesmerealevelchemistry/module-4-core-organic-chemistry/4-1-basic-concepts-and-hydrocarbons/4-1-1-basic-concepts-in-organic-chemistry/4-1-1-e-structural-isomers>



 CH3CH2CH2CH2CH3 CH3CH2CHCH3CH3 CH3CCH3CH3CH3

 Wherever there is a vertex, or at the end of the molecule chain, there is a C atom, and enough H to

give that C four covalent bonds.

Azetidine… fakes out other plants, which believe it is proline

A favorite story of mine, is about Lily of the Valley

Proline: a necessary amino acid for proteins

A Little Chemical Warfare!

From Chemistry In The Garden by J.R. Hanson

(Royal Society of Chemistry 2009 p. 63)

The rhizomes (primitive root structures) of the plant, lily-of-the-valley produce azetidine-2-carboxylic acid (figure 6.17) which diffuses out into the adjacent soil and facilitates the dominance of this plant. Other plants absorb this unusual amino acid and mistake it for proline (figure 6.18).

However, the resultant proteins cannot function correctly and the

plant dies, allowing the rhizomes of the lily-of-the-valley which

can tolerate this amino acid, to spread.



**PRACTICE: Use choices 1-5. A choice may be used once, more than once, or not at all**.

 1) O2 2) NaCl 3) saltwater (NaCl(aq)) 4) HBr 5) CH3OH

1) Which formula is best described by the terms; inorganic molecular compound? … careful….

2) Which formula is best described by the terms; organic, molecular, compound?

3) Which formula represents a mixture? (not a compound or element) … Another way of asking this is to

 write; Technically, which of the above is made with substances, but is NOT a *single* substance?

4) Which formula represents a **molecular element**  made with nonpolar covalent bonding?

5) Which formula represents a molecular **inorganic** compound made with **covalent bonding**?

6) Which formula is best described by the terms: inorganic, ionic bonding, compound?

7) In which choice is EVERY example, representative of an organic compound?

 1) KCl(s), C3H8(g), CaCO3(s), C6H12O6(s), CH3NH2(g)

 2) H2O(𝓁), C3H8(g), C6H12O6(s), CH3NH2(g), HCl(g)

 3) CH3NH2(g), CH3OH(𝓁), C(s), C6H12O6(aq), C12H22O11(s)

 4) C12H22O11(s), C8H18(𝓁), CH3OH(𝓁), CH3(CH2)4Cl2 (𝓁), CH4(g)

8) What is the primary type of bond that exists between the atoms of an organic compound?

9) A student claimed that Na2SO3(s) could be described by the terms; organic & compound. You tell them that

 they are half-right.

 What do you tell them they are okay with … and why … With respect to what do you correct them

 …and why?

10) You are studying with a friend … and they are confused about saturated organic compounds. For what do

 you tell them to look?

11) How might you be able to identify whether a foodstuff you hope to use is a saturated or unsaturated fat

Answers:

1) 4 **inorganic**: no C-H… **molecular**: made of nonmetals (H and Br) with covalent bonds (generally found as the bond between

 nonmetals), **compound**: at least 2 different elements bonded to each other

2) 5 **organic**: has C-H …. **molecular:** made of nonmetals with covalent bonds … **compound**: at least 2 different elements

 bonded to each other

3) 3 it is an aqueous solution made of water and sodium chloride

4) 1 **element**: atoms of the same atomic number, **molecular**: made of nonmetals via covalent bonds

5) 4 **inorganic**: no C-H … **polar covalent bonding**: 2 different nonmetals …very similar to question #1, just a slightly different

 way of asking.

6) 2 **inorganic:** no C-H … **ionic bonding:** bondbetween a metal and nonmetal, … **compound** at least 2 different elements

 bonded to each other

7) 4 3 is close, but just C is an element … not a compound….

8) Covalent bonding

9) They are right … it is a compound, a chemical made with two or more different elements, bonded in a specific ratio … but it is not organic. There

 is no carbon, and the presence of the metal suggests pretty strongly, at our level that this is ionic…..

10) Check to see if the formula begins with C … Check to see if the elements of the compound are nonmetals ….

11) If it is a solid at room temperature, there is a good chance it is saturated … see the reading.

**Practice: Molecules vs Ionic Compounds**. Use your periodic table to learn metals vs nonmetals and answer the following questions.

**Note: You may pretty much assume that:**

* Molecules tend to be made from nonmetal atoms bonded to other nonmetal atoms via covalent bond(s)
* Covalent compounds are a synonym for the term molecular compound (molecules)
* Not all molecules are compounds – some may be elements (e.g. S8, P4, F2)
* Ionic compounds are made with ionic bonds (electrostatic charge attraction)
* Ionic compounds, in their simplest form, are metal cations bonded to nonmetal anions. We may assume that

if a *FAIRLY SIMPLE* compound has a METAL the compound exhibits primarily ionic compound traits.

Questions: Use your periodic table and identify the following as either

a) molecules (either molecular compounds or molecular elements) or

b) ionic compounds.

answers: 1) b 2) b 3) a 4) b 5) a 6) a

7) a 8) a 9) b 10) a 11) a 12) a 13) b 14) b 15) b

1) \_\_\_ MgO

2) \_\_\_ CaCl2

3) \_\_\_ NH3

4) \_\_\_ LiF

5) \_\_\_ CCl4

6) \_\_\_ SO2

7) \_\_\_ Br2

8) \_\_\_ O3

9) \_\_\_ Na2S

10) \_\_\_ COCl2

11) \_\_\_ CO2

12) \_\_\_ C6H12O6

13) \_\_\_ KF

14) \_\_\_ NaOH

15) \_\_\_ CaCO3