NAME\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ NOTES: UNIT 3: ICLS: COMPOUNDS & THEIR VOCABULARY

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Key Ideas:

* **Compounds** are made of species of **different elements** chemically bonded to each other, in **specific proportions,** resulting in a larger structure, with **different properties than the original elements**.
* The species bonded in a compound bond in specific proportions and lose their individual properties
* Metal atoms may bond with metal atoms to produce **metals**
* Nonmetal Atoms may bond with other Nonmetal Atoms to make **molecules**
* Positive Ions may bond with Negative Ions to make an **ionic compound**
* Electrons are gained / lost / shared based upon the ability of the ability of the nuclei to hold onto or attract electrons.
* Electronegativity of an atom helps us determine if electrons will be drawn towards its nucleus or away from its nucleus, when in a bond.
* Bonding leads to more stable compounds.
* Atoms bond to each other for a number of reasons:
  + - * + making bonds tends to lower energy (because bonding is an exothermic process),
        + making bonds tends to lead to a greater chemical stability (in part due to lower energy)
* Compounds may be described by adjectives such as: **ionic, molecular (covalent), organic, inorganic**
* Many ionic compounds are soluble (dissolve) in water, and produce electrolyte solutions.
* 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 |

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.

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

Noto Bene! The term, ***compound,*** is **not** used to describe the combination of a compound dissolved in water.

In the case of a compound dissolved in water, the overall system is described with a new term. That term is: ***solution mixture*** and we designate it with a symbol of (aq)

e.g. NaCl(aq) is a **solution mixture** made of the two compounds sodium chloride and water, physically combined. The aqueous solution mixture is NOT a new compound, but a physical combination of two compounds, that can be made in just about any proportion to each other. The mixture is called a mixture because there is no **definite ratio between the components.**

|  |  |  |
| --- | --- | --- |
| Elemental Atom or Ion | Symbol(s) | Positive Use(s) / Function(s) in the Human Body |
| oxygen | O-2 and O2 | * 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 *&* 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 | 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 |
| chlorine 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*** |

II) **Organic Compounds**: A compound which has Carbon as the *central atom*bonded with covalent bonds to

other atoms.

A) *Recognition Skill*, on a test/worksheet: \* Often, C is the first element of the formula.

B) Warning: Just because there is carbon (C) in the formula, does not make the compound an

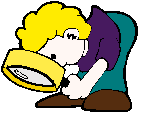
organic compound, automatically. Use the above recognition skill as a guide.

C) Can be described as molecules (nonmetal atoms bonded to nonmetal atoms)

III) **Inorganic Compound**: A compound which lacks carbon as a central atom.

A) The term molecule or ionic compound can be used to describe inorganic compounds

B) *Recognition Skill*: On a test / worksheet there C (carbon) **is not** the first symbol of the formula



|  |  |
| --- | --- |
| These ARE ORGANIC COMPOUNDS | These ARE NOT Organic Compounds |
| \*CH4(g) | \*(CO3)2- |
| \*C8H17OH(l) | \*Na2HCO3(s) |
| \*C4H10(g) | \*H2O(g) |
| \*C3H7NH2(l) | \*Li2CO3(s) |
| \*C25H52(s) | \*C(s) |
| \*CH3CH2CH2SH(g) | \*NaF(aq) |
| \* C6H12O6(s) | \* C6H12O6(aq) |
| \*CCl4(l) | \*HCN(g) |
| \*CH2CH2(g) | \*O2(g) |

Take a look….

IV) Subscripts: numbers indicating the number of each species in a compound, and ultimately the ratio

between the elements.

A) The subscripts of a compound are very specific. They indicate the exact relationship of the number

of species relative to each other.

B) Subscripts essentially express the Law of Definite Proportions …

H2O and H2O2 are very different compounds. One is water, the other, hydrogen peroxide.

NaCl exists …. NaCl2 does NOT exist … the subscripts must reflect the relationship between

the bonded species.

C) Also: Please note … The subscript DOES NOT indicate that the atoms are bonded… For instance,

H2O … The subscript just tells us there are 2 H for every 1 O. The hydrogen are NOT bonded

to each other!!!!

V) **Ionic Compound**: An inorganic compound existing due to an electrostatic attraction between oppositely

charged ions. Very often, an ionic compound is made from positive metal ions

(cations) bonded to negative nonmetal ion(s). The electrostatic attraction is called an

ionic bond.

 **Lets’s** **Spotlight a good Learning Skill: Concept map that definition.**

Use the descriptive terms and connect them using simple phrases or words

Ionic Compound

***Ionic Compounds… Continued…***

B) A Couple of Important Classes of Ionic Compounds

1) Salts (often categorized by the anion: chlorides, nitrates, sulfides, sulfates, phosphates)

2) Arrhenius Bases (positive metal ion bonded to a negative hydroxide ion [OH-1] )

C) Important Ideas Specific to Ionic Compounds

1) generally considered to be inorganic compounds

2) for many ionic compounds, water molecules can overwhelm and break the ionic bond,

causing the compound to dissociate and dissolve into water, creating an electrolyte solution

a) the electrolyte solution can conduct an electrical current

3) Generally:

1) very little odor

2) compared to molecular compounds, they have relatively high melting points

3) exist as solids at STP

Ionic Compound

VI) Molecular Compounds

A) Generally made of \*a nonmetallic atom bonded to another nonmetal atom via covalent bonding

B) A Few Important Classes of Molecular Compounds

1) Biomolecules: Proteins, Carbohydrates (sugars, starches), Lipids (fats, oils), Nucleic Acids

2) Neurotransmitters and Hormones

3) Acids

C) Important Ideas Specific To Molecules

1) May be inorganic or organic

2) *IF* soluble in water, most molecular compounds fail to ionize (They do NOT produce

electrolyte solutions

a) The acids are an exception

3) The covalent bond is a chemical bond produced by the unequal OR equal sharing of at least

1 pair of valence electrons

4) Molecular Compounds ≈ Covalent Compounds:

A few comments about our vocabulary:

* The terms are often used as synonyms of each other
* however, the term *covalent* best refers to a \* type of bond.
* Thus a covalent compound has covalent bonds, and that means the compound is probably a molecule (as opposed to an ionic compound).
* There is no such thing as a molecular bond however … This terminology is NOT

an acceptable descriptor of the bond type.

5) Generally:

1) if organic then the molecular substance is often fragrant / odiferous

2) compared to ionic compounds, molecular compounds have lower melting points

3) may exist in the solid, liquid, gas phase

4) may be described along a continuum of molecular polarity. Molecular polarity affects

physical and chemical activity.

DIRECTIONS: Take out your Periodic Table. Use it and your grasp of the definitions of a molecular compound and ionic compound to identify each of the following substances.

a) Molecular Compound (a substance, made of 2 or more different nonmetals bonded with covalent bonds)

b) Ionic Compound (a substance made of metal ion(s) and nonmetal ion(s) bonded with ionic bonds)

When asked for a Rationale, consider using ideas such as: *made from 2 nonmetal atoms*; *made from metal ion and nonmetal ion;*... or some sort of variation. Complete sentences are unnecessary.

\_\_\_1) N2O5 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_2) KCl Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_3) NaClO

\_\_\_4) NO2 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_5) NiCO3

\_\_\_6) Li2CO3 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_7) NH3

\_\_\_8) CH2FCl Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_9) Mg3(PO4)2 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_10) Fe2O3 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_11) H2O Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_12) ICl

\_\_\_13) Br2 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_14) CaO

\_\_\_15) BaSO4

\_\_\_16) CH2Cl2

\_\_\_17) LiF

\_\_\_18) HCl

\_\_\_19) N2O

\_\_\_20) TiO2 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_21) MnO

\_\_\_22) Mg(OH)2

\_\_\_23) AgCl Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_24) H2S

\_\_\_25) CCl4 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_26) MgF2

\_\_\_27) CuCl2

\_\_\_28) Ni2O3

\_\_\_29) PbO

\_\_\_30) PbO2

\_\_\_31) NaOH

\_\_\_32) C6H12O6 Rationale: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_33) C2H5OH

\_\_\_34) KNO3

Answers: 1) a 2) b 3) b 4) a 5) b 6) b 7) a

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

16) a 17) b 18) a 19) a 20) b 21) b 22) b 23) b

24) a 25) a 26) b 27) b 28) b 29) b 30) b 31) b

32) a 33) a 34) b