Physical Science 2020

(This fourth quarter is an Intro to Chemistry)

LEWISBURG HIGH SCHOOL

Week 14 Chapter 16 (Spring Semister 2020)

April 13 – April 17, 2020

Please Only Take ONE Packet Per Student

Elements, Compounds, and Mixtures

Elements

A **chemical element** is a pure chemical substance consisting of a single type of atom distinguished by its atomic number, which is the number of protons in its atomic nucleus. Elements are divided into metals, metalloids, and nonmetals.

The lightest chemical elements, including hydrogen, helium and smaller amounts of lithium, beryllium and boron, are thought to have been produced by various cosmic processes during the Big Bang and cosmic ray spallation. Production of heavier elements, from carbon to the very heaviest elements, proceeded by stellar nucleosynthesis in certain planetary nebulae and supernovae, which blast these elements into space where they are available for later planetary formation in solar systems such as our own.[1] The high abundance of oxygen, silicon, and iron on Earth reflects their common production in such stars.

The history of the discovery and use of the elements began with primitive human societies that found native elements like copper and gold and extracted (smelted) iron and a few other metals from their ores. Alchemists and chemists subsequently identified many more, with nearly all of the naturally-occurring elements becoming known by 1900. The properties of the chemical elements are often summarized using the periodic table, which organizes the elements by increasing atomic number into rows ("periods") in which the columns ("groups") share recurring ("periodic") physical and chemical properties. Save for unstable radioactive elements with short half lives, all of the elements are available industrially, most of them in high degrees of purity.

Hydrogen and helium are by far the most abundant elements in the universe. However, iron is the most abundant element (by mass) making up the Earth, and oxygen is the most common element in Earth's crust.[2] Although all known chemical matter is composed of elements, chemical matter itself is hypothesized to constitute only about 15% of the matter in the universe. The remainder is believed to be dark matter, whose composition is largely unknown and most of which cannot be composed of chemical elements, since it lacksprotons, neutrons or electrons.[3]

When two or more distinct elements are chemically combined, with the atoms held together by chemical bonds, the result is termed achemical compound. Two thirds of the chemical elements occur naturally on Earth only as compounds, and in the remaining third, often the compound forms of the element are most common.[*citation needed*] Chemical compounds may be composed of elements combined in exact whole-number ratios of atoms, as in water, table salt, and minerals such as quartz, calcite, and some ores. However, chemical bonding of many types of elements results in crystalline solids and metallic alloys for which exact chemical formulas do not exist. Relatively pure samples of isolated elements are uncommon in nature. While 98 naturally-occurring elements (1 to 98, up to californium) have been identified in mineral samples from Earth's crust,[4] only a small minority of elements are found as recognizable, relatively pure minerals. Among the more common of such "native elements" are copper, silver, gold, carbon (as coal, graphite, or diamonds), sulfur, and mercury. All but a few of the most inert elements, such as noble gases and noble metals, are usually found on Earth in chemically combined form, as chemical compounds. While about 32 of the chemical elements occur on Earth in native uncombined forms, most of these occur as mixtures. For example, atmospheric air is primarily a mixture of nitrogen, oxygen, and argon, and native solid elements occur in alloys, such as that of iron and nickel.

As of November 2011, 118 elements have been identified, the latest being ununseptium in 2010.[5] Of these, only the first 98 are known to occur naturally on Earth; 80 elements are stable, while the others are radioactive, decaying into lighter elements over various timescales from fractions of a second to billions of years. The 18 radioactive elements that occur naturally are either very long-lived primordial isotopes (such as uranium and thorium) or radioactive decay daughters or nuclear reaction products formed from these elements combining with naturally occurring neutrons. Those elements that do not occur naturally on Earth have been produced artificially as the synthetic products of nuclear reactions.

Compounds

A **chemical compound** is a pure chemical substance consisting of two or more different chemical elements[1][2][3] that can be separated into simpler substances by chemical reactions.[4] Chemical compounds have a unique and defined chemical structure; they consist of a fixed ratio of atoms[3] that are held together in a defined spatial arrangement by chemical bonds. Chemical compounds can be molecular compounds held together by covalent bonds, salts held together by ionic bonds, intermetallic compounds held together by metallic bonds, or complexes held together by coordinate covalent bonds. Pure chemical elements are not considered chemical compounds, even if they consist of molecules that contain only multiple atoms of a single element (such as H_2, S_8, etc.),[5] which are called diatomic molecules or polyatomic molecules.

The physical and chemical properties of compounds differ from those of their constituent elements. This is one of the main criteria that distinguish a compound from a mixture of elements or other substances—in general, a mixture's properties are closely related to, and depend on, the properties of its constituents. Another criterion that distinguishes a compound from a mixture is that constituents of a mixture can usually be separated by simple mechanical means, such as filtering, evaporation, or magnetic force, but components of a compound can be separated only by a chemical reaction. However, mixtures can be created by mechanical means alone, but a compound can be created (either from elements or from other compounds, or a combination of the two) only by a chemical reaction.

Some mixtures are so intimately combined that they have some properties similar to compounds and may easily be mistaken for compounds. One example is alloys. Alloys are made mechanically, most commonly by heating the constituent metals to a liquid state, mixing them thoroughly, and then cooling the mixture quickly so that the constituents are trapped in the base metal. Other examples of compound-like mixtures include intermetallic compounds and solutions of alkali metals in a liquid form of ammonia.

Chemists describe compounds using formulas in various formats. For compounds that exist as molecules, the formula for the molecular unit is shown. For polymeric materials, such asminerals and many metal oxides, the empirical formula is normally given, e.g. NaCl for table salt.

The elements in a chemical formula are normally listed in a specific order, called the Hill system. In this system, the carbon atoms (if there are any) are usually listed first, any hydrogen atoms are listed next, and all other elements follow in alphabetical order. If the formula contains no carbon, then all of the elements, including hydrogen, are listed alphabetically. There are, however, several important exceptions to the normal rules. For ionic compounds, the positive ion is almost always listed first and the negative ion is listed second. For oxides, oxygen is usually listed last.

In general, organic acids follow the normal rules with C and H coming first in the formula. For example, the formula for trifluoroacetic acid is usually written as $C_2HF_3O_2$. More descriptive formulas can convey structural information, such as writing the formula for trifluoroacetic acid as CF_3CO_2H. On the other hand, the chemical formulas for most inorganic acids and bases are exceptions to the normal rules. They are written according to the rules for ionic compounds (positive first, negative second), but they also follow rules that emphasize their Arrhenius definitions. To be specific, the formula for most inorganic acids begins with hydrogen and the formula for most bases ends with the hydroxide ion (OH^-). Formulas for inorganic compoundsdo not often convey structural information, as illustrated by the common use of the formula H_2SO_4 for a molecule (sulfuric acid) that contains no H-S bonds. A more descriptive presentation would be $O_2S(OH)_2$, but it is almost never written this way.

Substance

In chemistry, a **chemical substance** is a form of matter that has constant chemical composition and characteristic properties.[1] It cannot be separated into components by physical separation methods, i.e. without breaking chemical bonds. It can be solid, liquid, gas, or plasma. Comparechemical compounds.

Chemical substances are often called 'pure' to set them apart from mixtures. A common example of a chemical substance is pure water; it has the same properties and the same ratio of hydrogen to oxygen whether it is isolated from a river or made in a laboratory. Other chemical substances commonly encountered in pure form are diamond (carbon), gold, table salt (sodium chloride) and refined sugar (sucrose). However, in practice, no substance is entirely pure, and chemical purity is specified according to the intended use of the chemical.

Chemical substances exist as solids, liquids, gases or plasma, and may change between these phases of matter with changes in temperature orpressure. Chemical reactions convert one chemical substance into another.

Forms of energy, such as light and heat, are not considered to be matter, and thus they are not "substances" in this regard.

Chemical substances (also called pure substances) may well be defined as "any material with a definite chemical composition" in an introductory general chemistry textbook.[2] According to this definition a chemical substance can either be a pure chemical element or a pure chemical compound. But, there are exceptions to this definition; a pure substance can also be defined as a form of matter that has both definite composition and distinct properties.[3] The chemical substance index published by CAS also includes several alloys of uncertain composition.[4] Non-stoichiometric compoundsare a special case (in inorganic chemistry) that violates the law of constant composition, and for them, it is sometimes difficult to draw the line between a mixture and a compound, as in the case of palladium hydride. Broader definitions of chemicals or chemical substances can be found, for example: "the term 'chemical substance' means any organic or inorganic substance of a particular molecular identity, including – (i) any combination of such substances occurring in whole or in part as a result of a chemical reaction or occurring in nature"[5]

In geology, substances of uniform composition are called minerals, while physical mixtures (aggregates) of several minerals (different substances) are defined as rocks. Many minerals, however, mutually dissolve into solid solutions, such that a single rock is a uniform substance despite being a mixture in stoichiometric terms. Feldspars are a common example: anorthoclase is an alkali aluminium silicate, where the alkali metal is interchangeably either sodium or potassium.

All matter consists of various elements and chemical compounds, but these are often intimately mixed together. Mixtures contain more than one chemical substance, and they do not have a fixed composition. In principle, they can be separated into the component substances by purelymechanical processes. Butter, soil and wood are common examples of mixtures.

Grey iron metal and yellow sulfur are both chemical elements, and they can be mixed together in any ratio to form a yellow-grey mixture. No chemical process occurs, and the material can be identified as a mixture by the fact that the sulfur and the iron can be separated by a mechanical process, such as using a magnet to attract the iron away from the sulfur.

In contrast, if iron and sulfur are heated together in a certain ratio (1 atom of iron for each atom of sulfur, or by weight, 56 grams (1 mol) of iron to 32 grams (1 mol) of sulfur), a chemical reaction takes place and a new substance is formed, the compound iron(II) sulfide, with chemical formula FeS. The resulting compound has all the properties of a chemical substance and is not a mixture. Iron(II) sulfide has its own distinct properties such asmelting point and solubility, and the two elements cannot be separated using normal mechanical processes; a magnet will be unable to recover the iron, since there is no metallic iron present in the compound.

Mixtures

In Chemistry, a **mixture** is a material system made up of two or more different substances which are mixed but are not combined chemically. A mixture refers to the physical combination of two or more substances on which the identities are retained and are mixed in the form of solutions, suspensions, and colloids.

Mixtures are the one product of a mechanical blending or mixing of chemical substances like elements and compounds, without chemical bonding or other chemical change, so that each ingredient substance retains its own chemical properties and makeup.[1] Despite that there are no chemical changes to its constituents, the physical properties of a mixture, such as itsmelting point, may differ from those of the components. Some mixtures can be separated into their components by physical (mechanical or thermal) means. Azeotropes are one kind of mixture that usually pose considerable difficulties regarding the separation processes required to obtain their constituents (physical or chemical processes or, even a blend of them).

Mixtures can be either homogeneous or heterogeneous. A homogeneous mixture is a type of mixture in which the composition is uniform and every part of the solution has the same properties. A heterogeneous mixture is a type of mixture in which the components can be seen, as there are two or more phases present. One example of a mixture is air. Air is a homogeneous mixture of the gaseous substances nitrogen, oxygen, and smaller amounts of other substances. Salt, sugar, and many other substances dissolve in water to form homogeneous mixtures. A homogeneous mixture in which there is both a solute and solvent present is also a solution. Mixtures can have any amounts of ingredients. Two or more liquids that can dissolve into each other are referred to as miscible. If them do not dissolve in each other they are immiscible.

Homogenous

A homogeneous mixture has an even mixture of compounds in the composition of it's matter.

Heterogeneous

A *heterogeneous mixture* is a mixture of two or more chemical substances (elements or compounds). Examples are: mixtures of sand and water or sand and iron filings, a conglomerate rock, water and oil, a portion salad, trail mix, and concrete (not cement). A mixture of powdered silver metal and powdered gold metal would represent a heterogeneous mixture of two elements.

Indicate the letter of the best answer. (Email the question number with the letter answer and 3 sentence essay to John Estes at the School Email Address)

(This is a open note assignment.)

1. What is the lightest element on Earth?
   a. Nitrogen b. Argon c. Hydrogen

2. What represents the columns, going up and down, on the Periodic table?
   a. Groups b. Periods c. Metals

3. What element is the most abundant on Earth?
   a. Nitrogen b. Iron c. Oxygen

4. Which one of the elements is "native"?
   a. Iron b. Gold c. Aluminum

5. In compounds the ratio of elements are?
   a. Fractionated b. Fixed c. Arbitrary

6. What is an example of a mixture of metals?
   a. Azeotrope b. Alloy c. Homogeneous

7. What are chemical substance often referred to as?
   a. Pure b. Heterogeneous c. Miscible

8. What is an example of a rock that is a uniform substance?
   a. Metamorphic b. Sedimentary c. Feldspar

9. A solution would be an example of what type of substance?
   a. Pure b. Chemical c. Mixture

10. Melting point would be an example of what type of property?
   a. Physical b. Chemical c. Extrinsic

After you finish the questions leave a three sentence or more essay on what you know, what you wanted to know, or what you learned. Thank you