Inorganic chemistry

Atoms : defined as the smallest representative sample of an element. Only 106 different kinds of atoms are known to exist. Each element has a symbol and a name. the symbol is made up of one or two letters taken from the name of the element. The 106 elements can be listed in a number of ways. One way is to list them alphabetically. Another and more useful way is to arrange the elements in the ***periodic table***.

Periodic Table: Arrange the elements depending of chemical and physical properties. The periodic table consist of a number of columns called ***groups***. The horizontal rows are called ***periods***. The elements in each group have similar chemical and physical properties. For example, the elements in the far right of periodic table, called the noble gases.

The element in group **IA** are called the alkali metals. Those in group **IIA** are called the alkaline earth metals the transition metals are the elements located in groups **IIIB** to **IIB**. The halogens are the elements in group **VIIA**. All the nembers of a groups have similar physical and chemical properties.

The elements are divided into three classes depended on their physical properties. Element that show a metallic luster when polished, capable of being drawn out into wire, can be hammered into sheets, and are good condectors of heat and electricity are classed as ***metals***. elements that do not have these properties are classed as ***nonmetals***. A class between these two is called the ***metalloids elements***.

Only 90 of the 106 elements are found in nature. The others are prepared in the laboratory by instruments and techniques.

There are three particles that arranged in an atom, are ***electrons***, ***protons***, and ***neutrons***. Each of these particles are characteristic properties. The discovery of these particles was a major step toward determining the structure of atoms. But how are these particles arranged in an atom?

Three important subatomic particles

Name	Charge	Mass(amu)	Symbol
Electron	-1	1/1837	$\bar{e}$
Proton	+1	1.007	H^+, P^+, P
Neutron	0	1.004	n

Atomic numbers: all the atoms of an element have the same atomic number. The atomic number of an element is equal to the number of protons and in same time equal number of electrons in its nucleus. The importance of this statement became clear with the discovery of isotopes.

Mass number: the mas number of an atom is the sum of the number of protons and neutrons in its nucleus. For example; the mas number of hydrogen is 1, while in deuterium is 2.

Isotopes: Atoms whose nuclei have the same number of protons but different numbers of neutrons. For example; hydrogen atoms called **deuterium** atoms have nuclei that contain one proton and one neutron. The nuclei of hydrogen atoms called **tritium** atoms, when have one proton and two neutrons. Hydrogen is not the only element that has isotopes. Many other elements have two or more isotopes.

Atomic weight: The mass of an element is a weighted average of masses of all its isotopes. For example;

Average atomic mass of C = (0.9889)(12.00)+(0.0111)(13.00)

=12.01

Ions: there are two types of ions:

Positive ions; called cations, are formed when atoms lose electron. Such Na^+.

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Negative ions; called anions, are formed when atoms gain electrons. Such Cl^-.

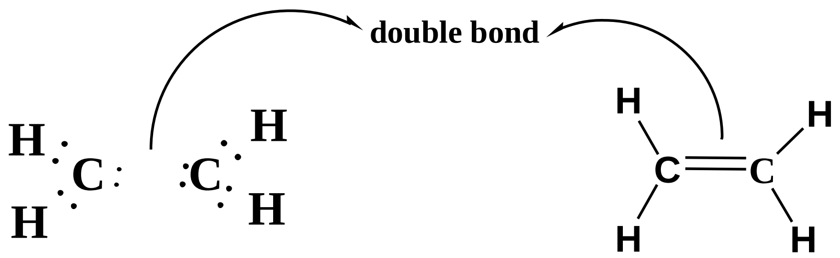
The charge on an ion is determined by the number of electrons it must gain or lose to achieve the electron arrangement of the nearest noble gas.

Chemical bonds:

Molecules are made up of atoms joined together. This join is called chemical bonds.

a. ionic bonds; formed by a strong attraction between negative and positive ions. Anion and cations are formed in many chemical reactions by the transfer of one or more electrons from one element to another. For example; NaCl.

b. Covalent bonds; formed by sharing electrons to achieve a noble gas electron arrangement for each atom. Meaning a pair of electrons shared between two atoms. For example: H_2, Cl_2, O_2 and $CH_2{=}CH_2$.



c. polar covalent bonds: The ability to attract electrons differs from atom to atom. Formed between two atoms of differents elements depends on the difference in their electronegativities. For example; in HCl (hydrogen chloride), the hydrogen and chlorine atoms share a pair of electrons. Because chlorine is more electronegative than hydrogen, the electron pair is drawn toward chlorine, giving it a partial negative charge and leaving a partial positive charge on the hydrogen.

$$\overset{\delta+}{H}\text{-----}\overset{\delta-}{Cl}$$

In a polar covalent bond, the more electronegative atom acquires a partial negative charge, and its less electronegative partner acquires a partial positive charge.

	$\delta+$ $\delta-$	$\delta+$ $\delta-$	$\delta+$ $\delta-$	$\delta+$ $\delta-$
EX:	C-----N	C-----F	H-----O	H-----N

Atoms of the elements H, C, N, O, S and halogens form polar covalent bonds with atoms of other elements.

Chemical reaction: the chemical reaction occur around us, the burning of fuel, the rusting of iron, and the growth of plants and animals are all examples of chemical reactions. We represent these and other chemical reactions on paper by *chemical equations*. A chemical equation is a concise way of giving information about a chemical reaction. The compounds that react in a chemical reaction are represented by their chemical formulas in the chemical equation.

AQUEOUS SOLUTIONS AND COLLOIDS

Solutions and colloids are essential to life. The solutions in living systems are aqueous, they are made with water. Therefore we must learn types of solutions and concentration of it, and used to explain their biologically important properties.

Solution: Homogenous mixture of molecules, atoms or ions of two or more different substance.

In the solution there are two substance which called components. One found in excess called the **Solvent**, and other is called **solute**. For example; solution of sugar in water, water is the solvent and sugar is the solute. The three states of matter can combine in nine different ways to form solution containing two components:

Taple ( ) Type of solutions

solvent	solute	Examples
liquid	liquid	Alcoholic beverages
Solid	liquid	An amalgam (mercury in silver)
Gas	liquid	-
Gas	solid	-
liquid	solid	Salt water
Solid	solid	metal alloys (brass or tin)
Gas	Gas	Air
liquid	Gas	carbonated beverages
Solid	Gas	hydrogen gas in palladium metal

-there is usually a limit to the amount of solute that can be dissolved in a solvent at particular temperature when this limit is reached, no more solute will dissolve in the solvent. When this happens we say that the solvent is saturated with solute, and called saturated solution.

Solubility: The amount of solute that dissolved in a given quantity of solvent to form the saturated solution. The solubility of a solute in a particular solvent depends on a

number of factors:
1-kind of solvent
2-kind of solute
3-The temperature of the solvent
4-The pressure above the solvent.

The results of our experiences in the world have led to the very general rule that (like dissolves like). By this we mean that a polar solvent such as water is a good solvent for ionic compounds such as sodium chloride. Gasoline, a mixture of nonpolar organic compounds, is a good solvent for other nonpolar organic compounds such as oils. The polar and nonpolar substances will not solutions such gasoline and water.

solubilities of several compounds in water

Compound	Solubility at 20^{O}C (g/100ml)	Solubility at 100^{O}C (g/100ml)
NaCl	36.2	39.1
NH_4Br	97.1	146.0
KBr	59.4	102.0
NH_3	47.5	6.9
KNO_3	37.8	247.0
O_2	0.00434	0.00080
Li_2CO_3	1.33	0.725
Ca SO_4	0.21	0.16

*Sometimes there is no limit to the amount of one substance that dissolve in another. This is particularly true for solution of a liquid in liquid.

1. Completely miscible: pair of liquids that are infinitely soluble in each other.

2. Partially miscible: other liquids are only slightly soluble in each other.

3. Immiscible: liquids that are insoluble in each other, ex. Gasoline immiscible water.

*Temperature of the solvent affect the solubility of the solute, in general solutes are more soluble in hot than cold solvents. Solubilities of several solids increasing greatly with increasing temperature, others increase only slightly. Other actually decrease. Above Table.

Gases are other compounds whose solubility in water decrease with increasing temperature. A familiar example is boiling water. The bubbles that form when water is heated are air escaping from solution because dissolved air is less soluble in water at higher temperatures.

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CONCENTRATION OF SOLUTIONS

We describe the relative amounts of solute and solvent in a solution by means of units of concentration. There are several such units, and we will examine the most commonly used ones.

A- Weight/ Weight percent:

One way to specify the concentration of a solute in a solution is as a *percent by weight*. The concentration of the solute is given by the following equation (8-1):

$$\text{percent by weight solute} = \frac{\text{weight of solute in g}}{\text{weight of solute in g} + \text{weight of solvent in g}} \times 100 \quad (8\text{-}1)$$

The following example shows how to express the concentration of a solute in the unit.

Example 8-1 : What is the percent by weight of sugar in a solution made by dissolving 10 gm of sugar in 90 gm of water?

Step 1. Relate the quantities in equation 8-1 to those given in the problem:

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