CHEMISTRY FOUNDATIONS

Chemistry is the study of matter and its transformations. More specifically, it looks at how some materials interact with other materials.

Matter can be operationally defined as a substance that has:

- Mass
- Occupie [(e)-3(art)-3(h)2(w)-3(ill)11(s)-1(t)-3(ill h)2(a)11(v)-5(e)-3(a)11(m)5(as)-1(s)-1( )11(o)-7(f)]T

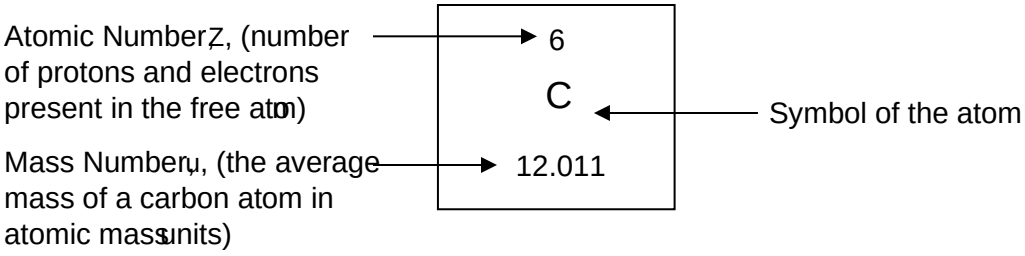
3. ELEMENTS

Elements are composed of chemical combinations of isotopes

For example, the group consisting of Hydrogen (H), Lithium (Li), Sodium (Na), Potassium (K), etc., is known as the alkali metals. Other metals such as Mg and Ca found in the earth also formed alkaline solutions with water, but not in nearly the same explosive fashion as Na and K. These metals were known as the alkaline-earth metals.

This arrangement of atoms according to their properties soon proved its value. Gaps in Mendeelev's Table soon began to appear, and he was able to predict the existence of as yet unknown elements. Chemists began to search for these "missing" elements and found several of them.

The modern Periodic Table has three basic characteristics that provide information about the atom. The example of the carbon atom is shown below.



The elements may be classified according to whether they are metals, nonmetals or metalloids (or semimetals).

A Periodic Table of Elements is provided on the following page. You are expected to know the names and symbols of some common elements (these have been highlighted in the Periodic Table on the following page).

PERIODIC TABLE OF THE ELEMENTS

1
1.0079
H
hydrogen
hydrogène

2
4.003
He
helium

1.1 Classification of the Elements

Atoms of the elements are organized in the Periodic Table according to property in the sequence of their atomic numbers, Z (the number of protons in the atom). There are several ways in which the elements are classified and it is necessary to know them.

1.1.1 Metals and Nonmetals

The vast majority of elements are metals.

Alkali metals

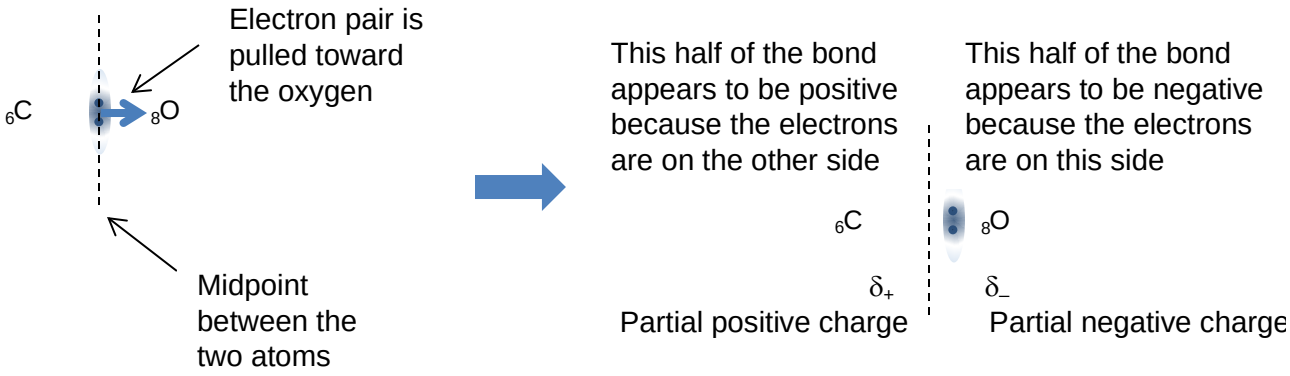
6. FORMATION OF COMPOUNDS

In nature, all systems tend to move to the state of greatest stability. Thus, for example, atoms combine with each other to form compounds only so that they can become more stable

Recall that an atom consists of protons and neutrons densely packed into a nucleus at the centre of the atom

7. BOND POLARITY

Covalent bonds are formed when two nonmetal atoms combine chemically by sharing electrons. However the electrons are not always shared equally. Consider the bond between a carbon and oxygen atom. Both atoms are nonmetals so the two atoms share a pair of electrons. However the carbon atom has 6 protons, whereas the oxygen atom has 8 protons. The shared electrons (negatively charged) will be pulled more strongly toward the more positive oxygen nucleus:



The result is that one half of the bond (in this case on the oxygen side) appears to have a negative charge while the other half of the bond appears to be positive (the carbon side). The negative side is referred to as having a partial negative charge (δ_-); remember this is a covalent bond. In an ionic bond this would be a full negative charge ($-$). Similarly, the positive side is referred to as having a partial positive charge (δ_+).

A bond polar is sometimes simply represented by an arrow pointing from the positive end to the negative end of the bond.

The unequal sharing of electrons in a covalent bond thus results in one end of the bond being partially negative while the other end is partially positive. Thus the bond is said to be a polar covalent bond (or just simply a polar bond). Most covalent bonds are polar. The common bond types in biology and their relative polarity are provided below.

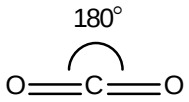
H—C C—N C— & • N—O H—N H— & • C—O H—O

Least Polar Most Polar

8. Hydrogen Bonding and Water

There are several very important consequences of bond polarity. These relate to the shape of molecules and consequently, the overall polarity of the molecule and some physical properties of the molecule.

Consider the case of the molecule carbon dioxide, CO_2. Carbon dioxide is a linear molecule with carbon in between two oxygen atoms.



The double lines represent double bonds, namj EMC 80 0 m (n)-17t65 -1H68(m)5(r3318Tw 0.565 t b)-1w m e

The interaction between different molecules is known as intermolecular forces (i.e., forces between molecules).

All polar molecules iW

9.2. Bases

Bases can be defined as substances that can bind H^+. As with acids, bases can be either strong or weak.

Examples of common bases

Ammonia (NH_3)	Weak
Sodium bicarbonate ($NaHCO_3$)	Weak
Sodium carbonate (Na_2CO_3)	Weak
Sodium hydroxide ($NaOH$)	Strong
Sodium hypochlorite ($NaOCl$)	Weak

* Sodium hypochlorite is the important component of bleach

9.3. pH

The pH scale is used as a measure of acidity or basicity in water solutions. Acids release H^+ in water, so the greater the number of H^+ ions present in the solution the more acidic will be the solution. Bases bind H^+, therefore the smaller the number of H^+ ions present in the solution the more c >>B 96(s)-4 0.09he3( )11(t)11(h)