AL- MUSTAQBAL UNIVERSITY

College Of Health And Medical Techniques

Prosthetic Dental Techniques Department

Second Grade

Second Semester

Lecture 3 (The theoretical part)

(Introduction To Analytical chemistry))

By:

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Introduction

General Chemistry is an introduction to the basic concepts of chemistry, including atomic structure and bonding, chemical reactions, and solutions. Other topics covered include gases,thermodynamics, kinetics and equilibrium, thermodynamics, redox, and chemistry of the elements. **Beyond General Chemistry** Organic Chemistry - Chemistry studies focusing on the carbon atom and compounds. Inorganic Chemistry - Chemistry studies focusing on salts, metals, and other compounds not based on carbon. Biochemistry - Chemistry studies of or relating to living organisms.

1- Branches of Chemistry

Chemistry itself has a number of branches:

• *Analytical chemistry* seeks to determine the composition of substances.

• *Biochemistry* is the study of chemicals found in living things (such as DNA and proteins).

• *Inorganic Chemistry* studies substances that do not contain carbon.

• *Organic chemistry* studies carbon-based substances. Carbon, as described in more detail

• *Physical chemistry* is the study of the *physical properties* of chemicals, which are characteristicsthat can be measured without changing the composition of the substance.

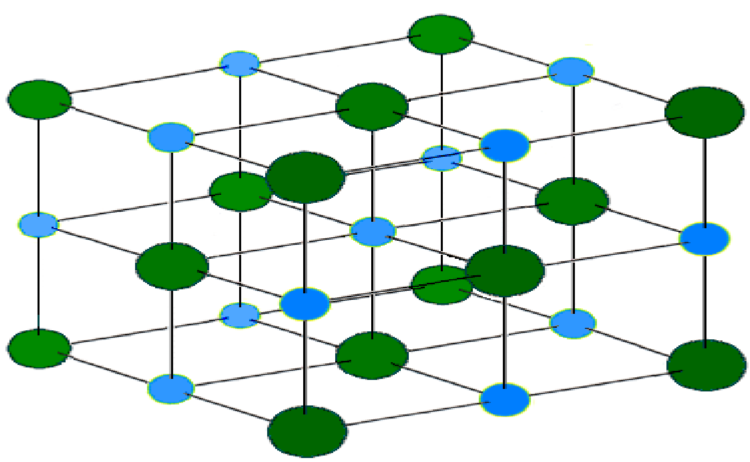

Figure 1 This is the structure of table salt, or *sodium chloride*

Chemistry as a discipline is based on a number of other fields. Because it is a measurement based science, math plays an important role in its study and usage. A proficiency in high-school level algebra should be all that is needed in this text, and can be obtained from a number of sources1. Chemistry itself is determined by the rules and principles of physics2. Basic principles from physics may be introduced in this text when necessary.

1.2. Why Study Chemistry?

There are many reasons to study chemistry. It is one pillar of the natural sciences necessary for detailed studies in the physical sciences or engineering. The principles of biology and psychology are rooted in the biochemistry of the animal world, in ways that are only now beginning to be understood. Modern medicine is firmly rooted in the chemical nature of the human body. Even students without long term aspirations in science find beauty in the infinite possibilities that originate from the small set of rules found in chemistry. Chemistry has the power to explain everything in this world, from the ordinary to the bizarre. Why does iron rust? What makes propane such an efficient, clean burning fuel? How can soot and diamond be so different in appearance, yet so similar chemically? Chemistry has the answer to these questions, and so many more. Understanding chemistry is the key to understanding the world as we know it.

1.3.Basic Properties of Matter

Matter is defined as anything that has **mass** and **volume**.
Mass is a measure of an object's inertia. It is proportional to weight: the more mass an object has, the more weight it has. However, mass is not the same as weight. Weight is a force created by the action of gravity on a substance while mass is a measure of an object's resistance to change in motion. Mass is measured by comparing the substance of interest to a standard kilogram called the International Prototype Kilogram (IPK). The IPK is a metal cylinder where the height and diameter both equal 39.17 millimeters and is made of an alloy of 90% platinum and 10% iridium. Thus, the standard kilogram is defined and all other masses are a comparison to this kilogram. When atom masses are measured in a mass spectrometer, a different internal standard is used. Your take home lesson with regard to mass is that mass is a relative term judged by a comparison.

Volume is a measure of the amount of space occupied by an object. Volume can be measured directly with equipment designed using graduations marks or indirectly using length measurements depending on the state (gas, liquid, or solid) of the material. A *graduated cylinder*, for example, is a tube that can hold a liquid which is marked and labeled at regular intervals, usually every 1 or 10 mL. Once a liquid is placed in the cylinder, one can read the graduation marks and record the volume measurement. Since volume changes with temperature, graduated equipment has limits to the precision with which one can read the measurement. Solid objects that have regular shape can have their volume calculated by measuring their dimensions. In the case of a box, it's volume equals length times width times height. It is particularly interesting to note that measuring is different from calculating a specific value. While mass and volume can both be determined directly relative to either a defined standard or line marks on glass, calculating other values from measurements is not considered measuring. For example, once you have measured the mass and volume of a liquid directly, one can then calculate the density of a substance by dividing the mass by the volume. This is considered indirectly determining density. Interestingly enough, one can also measure density directly if an experiment which allows the comparison of density to a standard is set up. Another quantity of matter directly or indirectly determined is the **amount of substance**. This can either represent a counted quantity of objects (e.g. three mice or a dozen bagels) or the indirectly determined number of particles of a substance being dealt with such as how many atoms are contained in a sample of a pure substance. The latter quantity is described in terms of moles. One mole is a specifically defined as the number of particles in 12 grams of the isotope Carbon-12. This number is 6.02214078(18)x 1023 particles.

Units of Measure

- Mass: the kilogram (kg). Also, the gram (g) and milligram (mg).
- 1 kg = 1000 g
- 1000 mg = 1 g.
- Volume: the liter (L), milliliter (mL). Also, cubic centimeters (cc) and cubic meters
(m3).
- 1 cc = 1 mL
- 1000 mL = 1 L
- 1000 L = 1 m3
- Amount: the mole (mol).
- 1 mol = 6.02214078(18)x 1023 particles

Figure 2 Matter has mass and volume, as exemplified by this concrete block.

1.3. Atoms, Elements, and Compounds

The fundamental building block of matter is the atom.

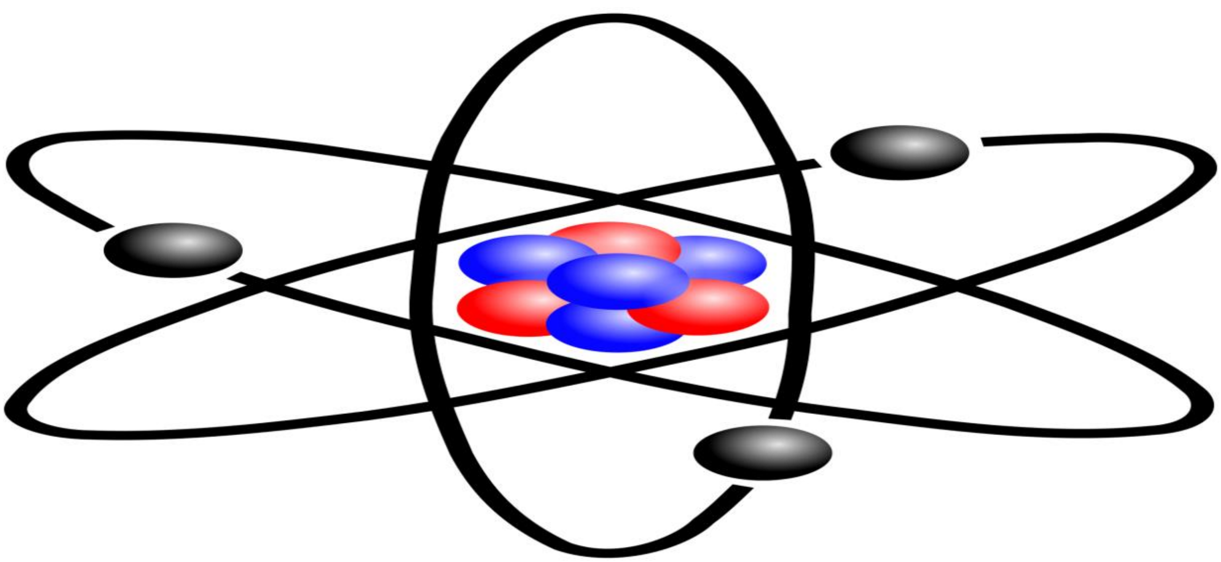

Figure 3 The red dots are protons and the blue dots are neutrons.

- Atom: A fundamental building block of matter composed of protons, neutrons, and electrons.
- Element: A uniquely identifiable atom recognized by the number of protons in the nucleus.

1.4. Properties of Matter

Properties of matter can be divided in two ways: extensive/intensive, or physical/chemical.

• *Extensive* properties depend on the amount of matter that is being measured. These include mass and volume. • *Intensive* properties do not depend on the amount of matter. These include density and color.	• *Physical* properties can be measured without changing the chemical's identity. The freezing point of a substance is physical. When water freezes, it's still H_2O. • *Chemical* properties deal with how one chemical reacts with another. We know that wood is flammable because it becomes heat, ash, and carbon dioxide when heated in the presence of oxygen.

1.5. States of Matter

One important physical property is the *state of matter*. Three are common in everyday life: solid, liquid, and gas. The fourth, *plasma*, is observed in special conditions such as the ones found in the sun and fluorescent lamps. Substances can exist in any of the states. Water is a compound that can be liquid, solid (ice), or gas (steam)

Figure 4 The ice in this picture is a solid. The water in the picture is a liquid. In the air there is water vapor, which is a gas.

Figure 4 The ice in this picture is a solid. The water in the picture is a liquid. In the air there is

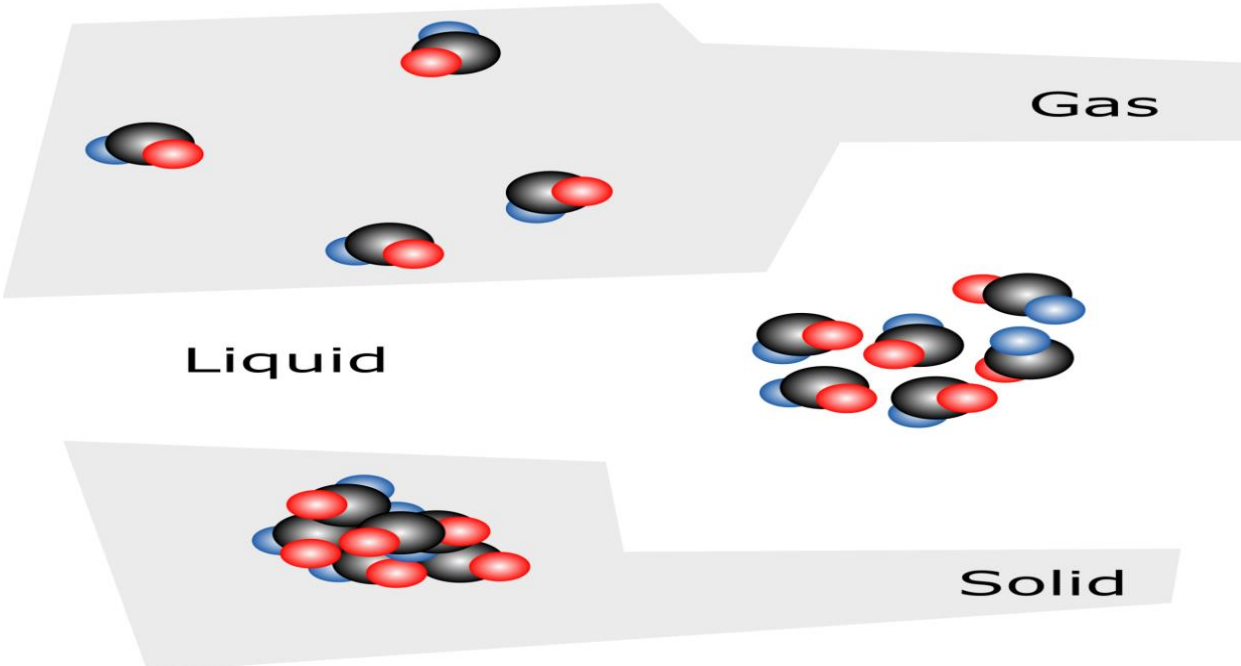

Figure 5 The states of matter depend on the bonding between molecules.

- **Solids** have a definite shape and a definite volume.
- **Liquids** have a definite volume, but they do not have a definite shape.
- **Gases** have no definite volume and no definite shape.
- **Plasma** which are usually gaseous state of matter in which a part or all of the atoms or molecules are dissociated to form ions.

1.6. Types of Mixtures

There are many kinds of mixtures. They are classified by the behavior of the **phases**, or substances that have been mixed.

1.6.1. Homogeneous Mixtures

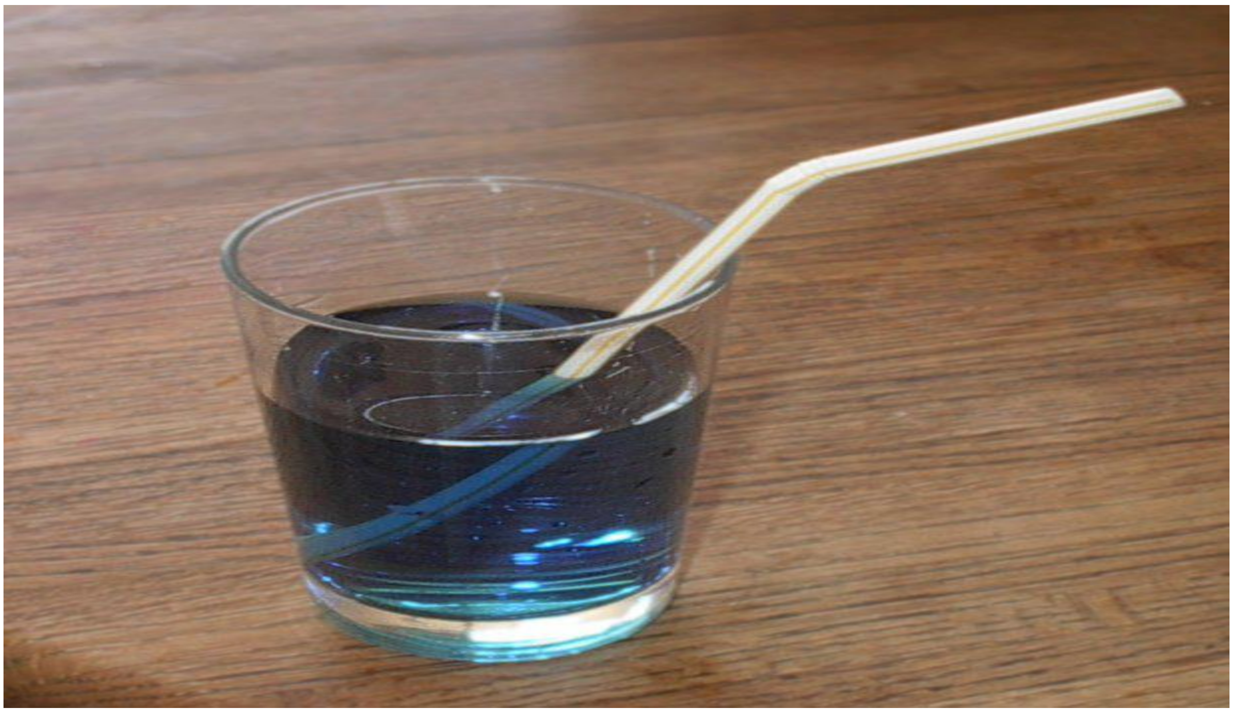

Figure 6 Soda water is a homogeneous mixture. (The straw looks broken because of Refraction *)*

A homogeneous mixture is uniform, which means that any given sample of the mixture will have the same composition. Air, sea water, and carbonation dissolved in soda are all examples of homogeneous mixtures, or solutions. No matter what sample you take from the mixture, it will always be composed of the same combination of phases. Chocolate chip ice cream is not homogeneous—one spoonful taken might have two chips, and then another spoonful might have several chips. An example for a homogeneous mixture is a solution. The substance that gets dissolved is the **solute**. The substance that does the dissolving is the **solvent**. Together they make a **solution**. If you stir a spoonful of salt into a glass of water, salt is the solute that gets dissolved. Water is the solvent. The salty water is now a solution, or homogeneous mixture, of salt and water. When different gases are mixed, they always form a solution. The gas molecules quickly spread out into a uniform composition.

1.6.2. Heterogeneous Mixtures

A **heterogeneous mixture** is not uniform. Different samples may have different compositions, like the example of chocolate chip ice cream. Concrete, soil, blood, and salad are all examples of heterogeneous mixtures.

Figure 7 This dust is a suspension because it settles after the work is done.

Suspensions When sand gets kicked up in a pond, it clouds the water. Soon the sand settles down, and is no longer mixed into the water. This is an example of a **suspension**. Suspensions are heterogeneous mixtures that will eventually settle. They are usually, but not necessarily,composed of phases in different states of matter. Italian salad dressing has three phases:the water, the oil, and the small pieces of seasoning. The seasonings are solids that will sinkto the bottom, and the oil and water are liquids that will separate.

Colloids

Figure 8 Toothpaste is a colloid, because it's part solid and part liquid.

A colloid is a heterogeneous mixture of two substances of different phases. Shaving cream and other foams are gas dispersed in liquid, toothpaste, and other gels are liquid dispersed in solid. Dough is a solid dispersed in a liquid. Smoke is a solid dispersed in a gas.

1.7.Numbers Used to Describe Atoms

1.7.1. Numbers

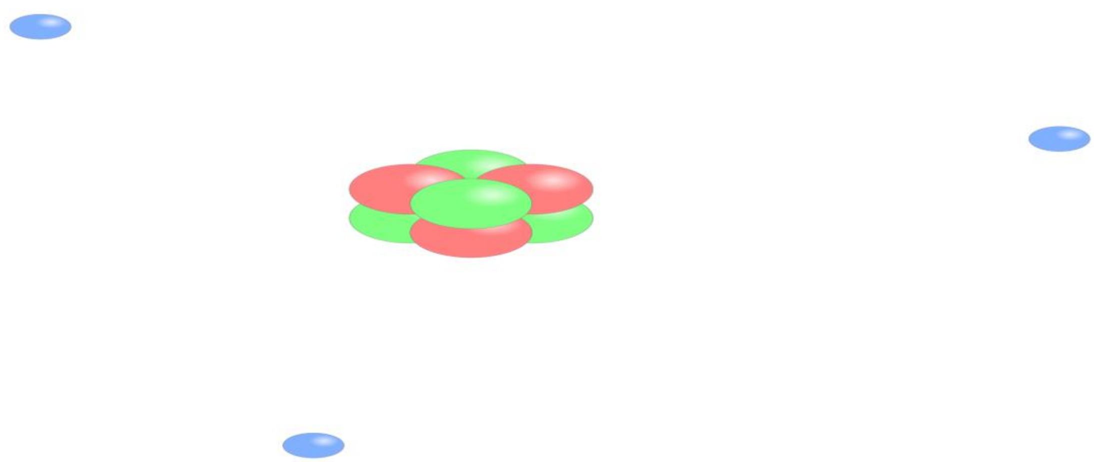

Figure 9 If the red parts are protons and the green parts are neutrons, what's the atomic, neutron, and mass number of this atom? (lithium)

The **Atomic number** is the number of protons in the nucleus of an atom. This number determines the element type of the atom. The atomic number is sometimes denoted **Z**. Continuing with the example of neon, $Z = 10$.

The **Neutron number** is the number of neutrons in the nucleus of an atom. Remember that neutrons have no electric charge, so they do not affect the chemistry of an element. The neutron number is sometimes denoted **N**.

The **Mass number** is the sum of protons and neutrons in an atom. It is denoted **A**. To find the mass number of an atom, remember that **A = Z + N**. The mass number of an atom is always an integer.

Isotopes of the same element have nearly identical chemical properties (because they have the same number of protons and electrons). Their only difference is the number of neutrons, which changes their nuclear properties like radioactivity.

$^{19}_{9}F$ This is how we write fluorine-19. The atomic number is below and the mass number is above, followed by its symbol on the periodic table of the elements.