Department of biology

((anlytical chemistry))

Stage1

LEC 1

general chemistry

By

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Chemistry:

- ✓ Chemistry is a subdiscipline of science that deals with the study of matter and the substances that constitute it.
- ✓ It also deals with the properties of these substances and the reactions undergone by them to form new substances.

The main branches of Chemistry:

1. Organic Chemistry:

- ✓ Organic Chemistry is one of the most important branches of chemistry that studies chemical compounds containing carbon elements combined with 'carbon-hydrogen' bonds (hydrocarbons).
- ✓ It is often known as the 'Chemistry of Life' that deals with the structure, properties and reactions of organic compounds.
- ✓ A study of Organic Chemistry helps students to identify and classify the various naturally occurring compounds and to create one with desired properties and functions.

2. Inorganic Chemistry

- ✓ Inorganic Chemistry studies the structure, properties and reactions of non-carbon chemical compounds or those that do not contain carbon-hydrogen bonds.
- ✓ The subject includes the synthesis and **behavior** of inorganic or organometallic chemical compounds found in the earth's crust and non-living matter.

3. Physical Chemistry

- ✓ Physical Chemistry covers the 'physical properties' of chemical compounds using law and various concepts of **Physics**, such as **motion**, **energy**, **force**, time, statistical mechanics, quantum chemistry and thermodynamics.
- ✓ This is one of the most exciting branches of Chemistry which allows students to understand the physical characteristics of chemical compounds like temperature, volume, pressure, conductivity, plasticity, strength, surface tension in liquids, solubility, viscosity, boiling point, melting point and colour.

4. Analytical Chemistry

- ✓ Analytical Chemistry is one of the quantitative branches of Chemistry that deals with the 'identification, separation and quantification' of chemical substances.
- ✓ The knowledge of Analytical Chemistry enables chemists and scientists to determine the amount of chemical substances in a given material.The subject has been further classified into the following two categories:

1. **Qualitative Analysis:** It involves processes that are carried out to identify a chemical substance in a given sample.
2. **Quantitative Analysis:** It involves finding out the concentration or amount of the substance in the given sample

5.Biochemistry

- ✓ Biochemistry studies the biological structure, composition and chemical reactions at the cellular and molecular level.
- ✓ This covers a range of living organisms such as planta, insects, viruses, microorganisms, etc.
- ✓ Biochemistry is an amalgamation of Biology with Organic, Inorganic and Physical Chemistry.
- ✓ Various topics covered in this subject include issues related to diseases, the chemical basis of heredity and how living organisms derive energy from food.

Law of conservation of mass

- ✓ The law of conservation of mass states that mass within a closed system remains the same over time.
- ✓ The mass in an isolated system can neither be created nor be destroyed but can be transformed from one form to another".
- ✓ Because the same atoms are present in a reaction at the beginning and at the end, the amount of matter in a system does not change.

Law of Conservation of Mass Examples

1. **Combustion process:** Burning of wood is a conservation of mass as the burning of wood involves Oxygen, Carbon dioxide, water vapor and ashes.
2. **Chemical reactions**: To get one molecule of H2O (water) with the molecular weight of 10, Hydrogen with molecular weight 2 is added with Oxygen whose molecular weight is 8, thereby conserving the mass.

Dalton's Atomic Theory

This theory contained five main propositions:

1. All matter is comprised of tiny, definite particles called atoms.
2. Atoms are indivisible and indestructible.
3. All atoms of a particular element share identical properties, including weight.
4. Atoms of different elements contain different mass.
5. Atoms of different elements combine in fixed whole-number ratios when forming compounds.

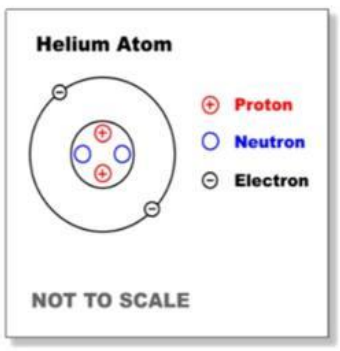
The three laws of Dalton's atomic theory:

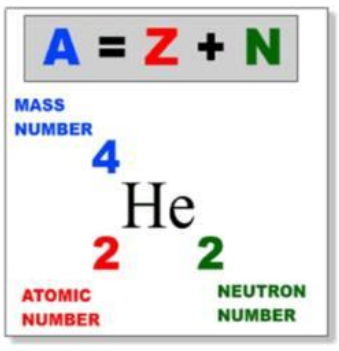
Dalton built his theory upon laws previously identified by Lavoisier and Proust as a basis for his atomic theory:

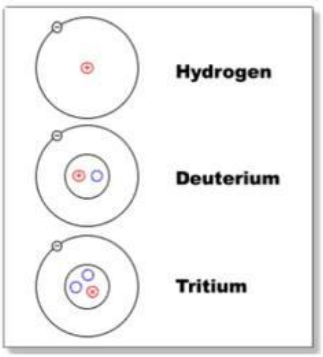
1. Law of Conservation of Mass
2. Law of Definite Proportions.
3. Law of Multiple Proportions.

Atomic structure

- ✓ Atoms can join together to form molecules, which make up most objects.
- ✓ Different elements (e.g. **oxygen, carbon, uranium**) are made up of different types of atoms.
- ✓ An atom is the smallest unit of an element that will behave as that element.
- ✓ Atoms consist of an extremely small, **positively** charged nucleus surrounded by a cloud of **negatively** charged electrons.
- ✓ Although typically the nucleus is less than one ten-thousandth the size of the atom, the nucleus contains more that 99.9% of the mass of the atom.
- ✓ Nuclei are made of positively charged protons and electrically neutral neutrons held together by a nuclear force.
- ✓ This force is much stronger than the electrostatic force that binds electrons to the nucleus, but its range is limited to distances of the order of 1 x 10-15 meters.
- ✓ The number of protons in the nucleus is called **the atomic number** (**Z**), the atomic number defines the element.
- ✓ The number of neutrons in the nucleus is denoted by (**N**).
- ✓ **The mass number** (**A**) of the nucleus is equal to (**Z + N**).
- ✓ The mass of the nucleus in atomic mass units (amu) is usually slightly different from the mass number.
- ✓ Atoms of the same element can have different number
- ✓ of neutrons and they are called isotopes of that element. As an example hydrogen has three (3) isotopes: hydrogen-1 (hydrogen), hydrogen-2 (deuterium) and hydrogen-3 (tritium).







Atomic Number & Mass Number

- ✓ Atomic number and mass number are always whole numbers because they are obtained by counting whole objects (protons, neutrons, and electrons).
- ✓ The sum of the mass number and the atomic number for an atom (A-Z) corresponds to the total number of subatomic particles present in the atom.

- ✓ The mass number reports the mass of the atom's nucleus in atomic mass units (amu).
- ✓ Mass Number is equal to the total number of protons and neutrons.

mass number – atomic number = number of neutrons

Then are you ready to answer these questions

Atomic number of a nucleus is Z and atomic mass is M. Find the number of neutrons.

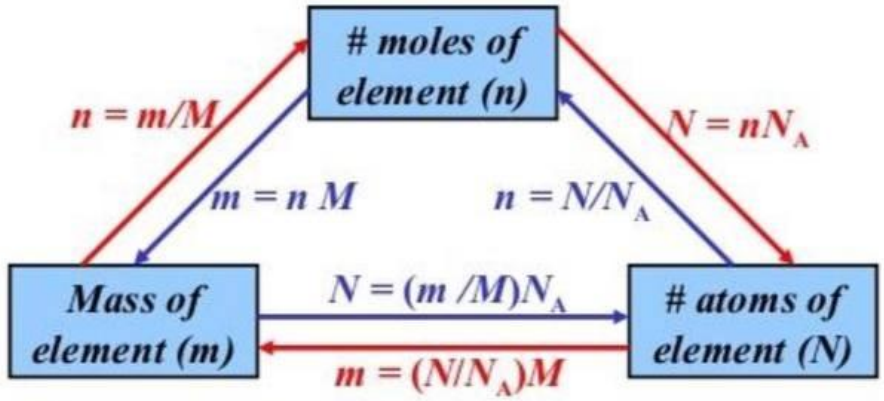
What do we call the atomic species of the same element differing in mass?

An atom has a mass number of 23 and atomic number 11. The number of protons is _____.

Avogadro's Number and the Mole

- ✓ One mole of a substance is equal to 6.022×10^{23} units of that substance (such as atoms, molecules, or ions).
- ✓ The number 6.022×10^{23} is known as Avogadro's number or Avogadro's constant.
- ✓ The concept of the mole can be used to convert between mass and number of particles.

Relationships between Mass, Mole, and Avogadro's Number



n: number of moles
m: mass
M: molar mass
N: number of atoms
N_A: Avogadro's number, 6.022×10^{23}