Electronic Configuration and Atomic Structure

Electric configuration

The distribution of electrons in the various shells of an atom is known as the electron configuration. The following table shows the electronic configuration of some atoms.

Table 2: Electric configuration of atoms of some elements

Elements	Symbol	Atomic number	Energy shells and number of electrons in them			
			K(1)	L(2)	M(3)	N(4)
Hydrogen	H	1	1			
Helium	He	2	2			
Lithium	Li	3	2	1		
Beryllium	Be	4	2	2		
Boron	B	5	2	3		
Carbon	C	6	2	4		
Nitrogen	N	7	2	5		
Oxygen	O	8	2	6		
Fluorine	F	9	2	7		
Neon	Ne	10	2	8		
Sodium	Na	11	2	8	1	
Magnesium	Mg	12	2	8	2	
Aluminum	Al	13	2	8	3	
Silicon	Si	14	2	8	4	
Phosphorous	P	15	2	8	5	
Sulfur	S	16	2	8	6	
Chlorine	Cl	17	2	8	7	
Argon	A r	18	2	8	8	
Potassium	K	19	2	8	8	1
Calcium	Ca	20	2	8	8	2

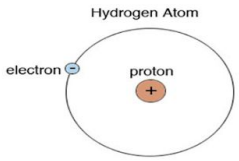
How to draw the atomic structure of an atom?

To draw the atomic structure of hydrogen atom:

1. Draw a small circle. Write 1P and 0 N. This represent nucleus.
2. Draw another circle outside the inner circle. Since, the atom of hydrogen element contains 1 proton, the number of an electron will be the same. Therefore, write e or Q the outer circle. This cell is k shell.

The atomic structure of some or the element are shown as follow:

Hydrogen



The atomic number of hydrogen is 1 and its mass number is also 1.

Number of electrons = Atomic number = 1

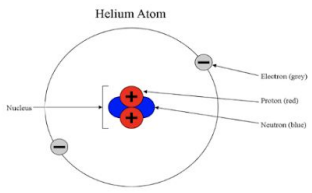
Number of protons = Atomic number = 1

Number of neutrons = Mass number - Atomic number

Thus, the hydrogen atom contains only one proton in its nucleus at high speed in the lowest energy level.

shell K L M N
no. of electrons 1 0 0 0

Helium



Mass no. = 4

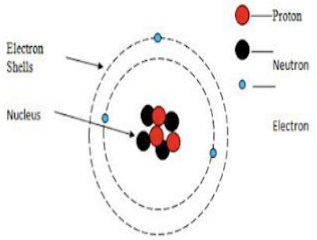
Atomic Number = 2

Proton = 2

Neutron = 2

Electron = 2

Lithium



Mass no. = 7

Atomic no. = 3

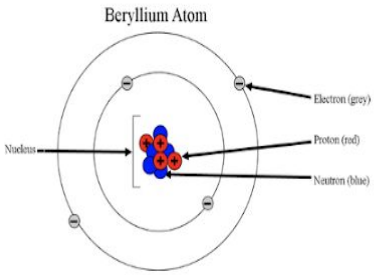
Proton = 3

Neutron = 4

Electrons = 3

shell	K	L	M	N
no. of electrons	2	1	0	0

Beryllium



Mass no. = 9

Atomic no. = 4

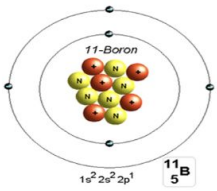
Proton = 4

Neutron = 5

Electron = 2, 2

shell	K	L	M	N
no. of electrons	2	2	0	0

Boron



Mass no. = 11

Atomic no. = 5

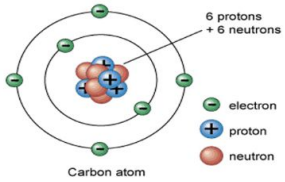
Proton = 5

Neutron = 6

Electron = 2, 3

shell	K	L	M	N
no. of electrons	2	3	0	0

Carbon



Mass no. = 12
Atomic no = 6
Proton = 6
Neutron = 6
Electron = 2, 4
The atomic weight of carbon is 6 and its mass is 12. Therefore, it contains 6 electrons, 6 protons, and 6 neutrons.

shell	K	L	M	N
no. of electrons	2	4	0	0

Classification of Elements

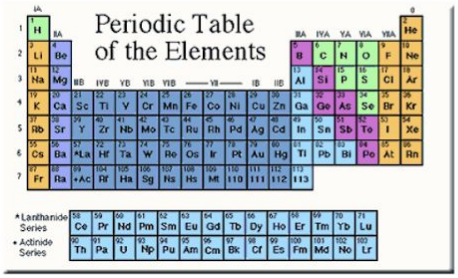
Applications of Periodic table

1. Classification of elements: The main utility of the system is that it affords a scheme of classification of elements, which is helpful in the study of 109 elements is reduced to nine groups only.
2. Prediction of new elements: Mendeleev left many gaps in his original table and their atomic mass, physical and chemical properties of the elements to be discovered: Later on these new elements to be discovered.
3. Correction of doubtful atomic masses: Many doubtful atomic masses were corrected with the help of this classification.

Mendeleev's periodic table

Mendeleev's periodic table was based on atomic mass. In 1913, Mosley from his studies on x- rays found that the atomic number is the more fundamental property of an element than its atomic mass. Thus, atomic number was adopted as the basis of the modern periodic table.

Modern periodic table



The properties of elements are a periodic function of their atomic numbers. This means that if the elements are arranged in order of their atomic number, then elements with similar properties are repeated after a regular interval.

Modern periodic law:

The properties of elements are a periodic function of their atomic numbers. This means that if the elements are arranged in order of their increasing atomic number, then elements with similar properties are repeated after a regular interval. The periodic table based on this law is known as the modern periodic table.

Description of the long form of periodic table:

1. In this periodic table, the elements are arranged in order of their increasing atomic number.
2. There are seven periods. The first period contains two elements and is the shortest period. The second and the third periods containing 8 elements each are called short periods. The fourth and the succeeding periods are the long periods.
3. The table has 18 vertical columns, but the number of the group is 16 only. This is because group VIII has three vertical columns.

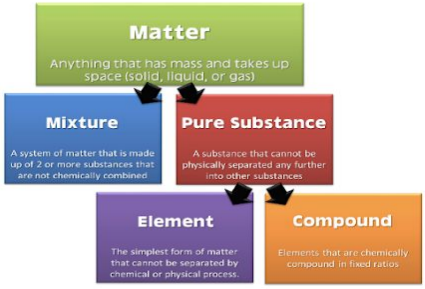
Advantages of modern periodic table:

1. The modern periodic table is based on the most fundamental property, the atomic number of elements, while Mendeleev's periodic table is based on the atomic masses of elements.
2. In Mendeleev's periodic table, there are several anomalies, e.g. the position isotopes, wrong order of atomic masses of atomic masses of some elements, etc. In this long form of the periodic table, these anomalies have been removed.
3. In this modern periodic table, the sub-groups A and B are clearly separate because the elements belonging to subgroup B have slightly different properties. In Mendeleev's periodic table, the sub-groups are kept together.

Introduction to Matter

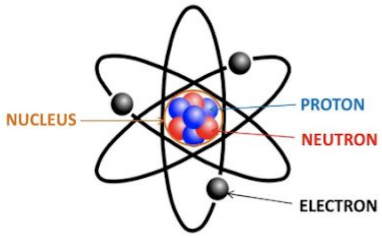
Introduction

Various types of substances can be found in our surrounding. Some substances are very simple whereas some are very complex. Some substances can be broken into other simpler substances while some substances cannot be broken. A substance which cannot be further broken down into other simpler substances is called an element. Hydrogen, oxygen, nitrogen, chlorine, mercury, lead, etc. are the examples of the element. There are altogether 109 elements known so far. Out of them, 92 elements are naturally found and remaining 26 elements are artificially prepared by scientists. Elements combine together to form a new substance, which is called a compound. Salt, water, chalk, carbon dioxide, etc. are the examples of a compound.



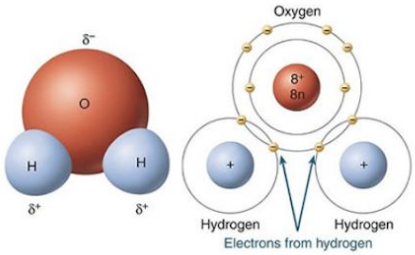
Atom

An atom is the smallest particle of an element which can take part in a chemical reaction. They are different in size, masses, and chemical properties. For example atoms of hydrogen are similar in all respects whereas the atoms of oxygen elements are different. 118 elements have 118 different types of atoms. So, different elements have different atoms.



Molecule

The smallest particles of an element or compound are called molecule. For example, a molecule of chlorine is made of two atoms of chlorine, it is denoted by Cl. The molecule of a compound contains two or more atoms of different elements. For example, a molecule of water (H_2O) contains two atoms of hydrogen and one atom of oxygen. It is represented by H_2O.



Structure of Atom

Dalton's concept of the indivisibility of atom was completely discredited by a series of experimental evidence obtained by scientists. As a result of extensive studies, it was concluded that atoms are made up of three subatomic particles: electrons, protons, and neutrons.

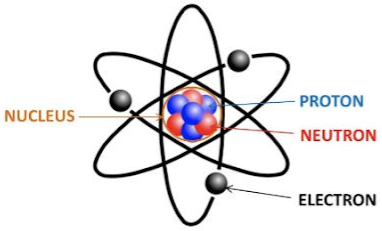
Sub- atomic particles of atom

The mass of sub-atomic particles is very small. The mass of these particles cannot be expressed in gram. Therefore, their masses are expressed in a different unit called atomic mass unit. This atomic mass unit is written as a. m. u. in short.

Proton and electron both have an electric charge. This charge is measured in a unit called Coulomb in short.

1. Electron

Characteristics of an electron: An electron is a negatively charged particle found in the atom of all the elements. The electron are located outside the nucleus in an atom. The only hydrogen atom contains one electron, all other contain more than one electron.



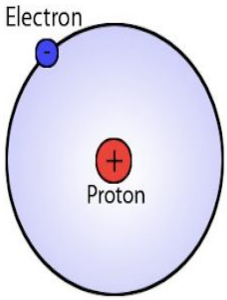
Mass: The mass of an electron is about 1/1836 the mass of hydrogen atom. The mass of hydrogen atom is 1 a. m. u, hence the relatives mass of an electron = 1/ 1836 a. m. u. The atomic mass is a unit of mass used to express relative atomic masses. It is equal to 9.109×10^{-31} kg.

Charges: The electron is found to carry 1.602×10^{-19} coulomb of negative charge. This quantity of charge has been shown to be the smallest negative charge carried by any particle. Thus, the charge carried by an electron is taken to be a unit negative charge (-1).

2. Proton

Characteristics of a protonA proton is a positively charged particle found in the atoms of all the elements. They are located in the nucleus of an atom. Only hydrogen atoms contain one proton in its nucleus, an atom of all other elements contains more than one proton.

a. A proton is a positively charged particle present in the nucleus of atoms of all elements.



Source: www.quora.com
Fig: Proton of Hydrogen atom

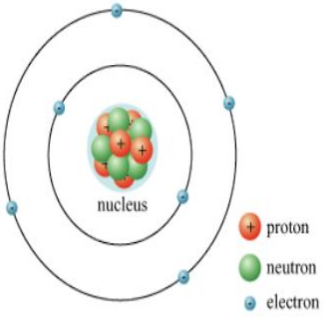
b. **Mass**: The mass of a proton is practically equal to the mass of the hydrogen atom i. e. 1836 times that of an electron. The relative mass of an element is equal to 1.005757 a. m. u. which is taken to be equal to 1 a. m. u. The absolute mass of a proton is 1.672×10^{-27}kg.

c. **Charge**: The electron on a proton is equal in magnitude and opposite in sign to that of an electron. The charge carried by a proton is equal to 1.602×10^{-19} coulomb which is taken to be one unit of positive charge (+). Thus, a proton is said to carry a unit positive charge.

3. Neutron

Characteristics of neutrons The neutron is a neutral particle found in the nucleus of an atom. Atoms of all elements contain neutrons except hydrogen atom which does not contain any neutron. Thus, the fundamental particle not present in a hydrogen atom is neutron. A hydrogen atom contains only one proton and one electron.

a. **Charge:** A neutron carries no charge, i. e. it is a neutral particle.



Source: www.hk-phy.org
Fig: Neutron

b. **Mass:** The mass of the neutron is nearly equal to that of the proton. Thus, the relative mass of a neutron = 1 a. m. u. and its absolute mass = 1.6×10^{-27}kg.