

Applied Chemistry Modules

1. Module-1: Atomic Structure & Chemical Bonding

ATOMIC STRUCTURE & CHEMICAL BONDING

BOHR'S MODEL OF ATOM

Postulates of Bohr's model of atom

1. In an atom, electrons revolve around the nucleus in a definite circular path called orbits or shells
2. Each orbit or shell has a fixed energy and hence they are also called energy levels.
3. The orbits, $n = 1, 2, 3, 4, \dots$ are assigned as K, L, M, N.... Shells.
4. The electrons in an atom move from a lower energy level to a higher energy level by gaining the required energy and an electron moves from a higher energy level to lower energy level by losing energy.

Merits of Bohr's model of atom

Following are the merits of Bohr's atom model.

1. This model could explain the stability of atom.
2. It could explain the spectrum of hydrogen.
3. Bohr could derive an expression to calculate the energy of electron.

Demerits of Bohr's Model of atom

1. Bohr's model could not explain the fine spectrum of hydrogen
2. It could not explain the spectrum of elements other than hydrogen.
3. It could not explain chemical bonding.

DUAL NATURE OF MATTER

Matter has two nature ie, particle nature & wave nature. This is called dual nature of matter

Q. What is the wavelength of an [electron](#) moving at 5.31×10^6 m/sec?

Given: mass of electron = 9.11×10^{-31} kg $h = 6.626 \times 10^{-34}$ Js

HEISENBERG'S UNCERTAINTY PRINCIPLE

According to this principle, it is impossible to measure simultaneously the position and momentum of an extremely small particle like electron with absolute accuracy.

Q. An electron traveling at 2.6×10^5 m/s has an uncertainty in its velocity of 7.50×10^4 m/s. What is the uncertainty in its position?

ORBITAL

It is the region around the nucleus where there is maximum probability to find electrons.

Eg:- s – orbital (spherical shape).

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p- orbital (dumb bell shape).

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DIFFERENCES BETWEEN ORBIT AND ORBITAL

Orbit	Orbital
1.It is the circular path of electrons around the nucleus	1.It is the region around the nucleus where there is maximum probability to find electrons.
2.Two dimensional	2.Three dimensional
3.Circular in shape	3.Different orbitals have different shape (spherical shape, dumb bell shape etc.)
4.Different orbits have different number of electrons	4.Maximum number of electrons in any orbital is two

Quantum numbers

Quantum numbers are set of four numbers which give informations about an electron.

Four quantum numbers are,

1.Principal quantum number

This quantum number represents shell of electron

2. Azimuthal quantum number (subsidiary quantum number)

It represents subshell of electron

3.Magnetic quantum number

This quantum number represents orbital of electron

4.Spin quantum number

This represents spin of electron

SHELLS AND SUB SHELLS

ELECTRONIC CONFIGURATION OF ATOM

Distribution of electrons in the subshells of an atom is called electronic configuration.

Electrons are distributed in atom on the basis of three rules.

ie, Aufbau principle, Pauli's exclusion principle, and Hund's rule of maximum multiplicity

Electronic configuration of some elements

H (z=1) $1S^1$

He (z=2) $1S^2$

Li (z=3) $1S^2, 2S^1$

Be (z=4) $1S^2, 2S^2$

B (z=5) $1S^2, 2S^2, 2P^1$

C (z=6) $1S^2 2S^2 2P^2$

N (z=7) $1S^2 2S^2 2P^3$

O (z=8) $1S^2 2S^2 2P^4$

F (z= 9) $1S^2 2S^2 2P^5$

Ne (z=10) $1S^2 2S^2 2P^6$

Na (z=11) $1S^2 2S^2 2P^6 3S^1$

Aufbau principle

According to this principle, electrons are distributed in the increasing order of energy of subshells.

Hund's rule of maximum multiplicity.

According to this principle, pairing of electrons in a subshell(p,d,f) starts only after all the orbitals in that subshell are singly occupied.

Electronic configuration of Nitrogen (z = 7) is $1S^2 2S^2 \underline{2P^3}$ ie, $1S^2 2S^2 \underline{2P_x^1} \underline{2P_y^1} \underline{2P_z^1}$

Pauli's Exclusion Principle

According to this principle, no two electrons in an atom can have the same set of values for all the quantum numbers.

CHEMICAL BONDING

Chemical bond is a force of attraction which binds atoms together in a molecule.

Octet rule

According to this rule an atom should have EIGHT electrons in the outermost shell to have stability.

Electronegativity

Tendency of an atom to pull the shared paired of electrons towards it is called electronegativity.

Types of chemical bond

Three important types of chemical bond are : Ionic bond, Covalent bond and

Co-ordinate bond

Ionic bond

It is a chemical bond formed by the transfer of electrons from one atom to another.

Formation of ionic bond in NaCl

Formation of ionic bond in MgCl_2

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Covalent bond

It is a chemical bond formed by the sharing of a pair of electrons between two atoms

Eg:- Covalent bond in CH_4 molecule

Eg:- Co-valent bond in H_2O molecule

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Co-ordinate bond (Dative bond)

It is a chemical bond formed by the sharing of a pair of electrons between two atoms, but the shared pair of electrons are contributed by one atom alone.

Eg:- Co-ordinate bond in Sulphur dioxide (SO_2)

Eg:- Co-ordinate bond in OZONE (O_3)

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Hydrogen bond

It is the weak electrostatic force of attraction between hydrogen of one molecule and electronegative atom of another molecule.

Eg:- Hydrogen bonding in Water

High boiling point of water is due to the presence of hydrogen bonding between molecules.

Eg:- Hydrogen bond in NH_3

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