

# Chemistry Grade 10Th

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## 1 Basic Theory

### 1.1 Atom

The smallest particle of matter, no independent existence.

#### 1.1.1 Constituents of Atom

Table 1: Constituents of Atom

Constituent	Mass	Charge
Protons	$1.672 * 10^{-27}kg$	$+1e$
Neutrons	$1.674 * 10^{-27}kg$	$+1e$
Electrons	$9.10 * 10^{-31}kg$	$0e$

#### 1.1.2 Properties

- Atomic Radius: distance between center of nucleus of atom and its outermost shell  
*Period* - decreases; *Inert gases have bigger atomic radius than halogens*  
*Group* ↓ - increases
- Nuclear Charge: positive charge present in the nucleus of atom, equal to number of protons, i.e., the atomic number  
*always increases*
- Valency: combining capacity of atom or the number of electrons lost, gained or shared by the atom  
*Period* - increases till 4, then decreases  
*Group* ↓ - remains same
- Metallic Character: tendency of losing valence electrons  
*Period* - decreases  
*Group* ↓ - increases

- **Non-Metallic Character:** tendency of gaining valence electrons  
*Period*  $\vec{\uparrow}$  - increases  
*Group*  $\downarrow$  - decreases
- **Chemical Reactivity:** tendency of losing or gaining electrons  
*Period*  $\vec{\uparrow}$  - decreases then increases  
*Group*  $\downarrow$  - increases
- **Ionization Potential:** The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion  
*Unit:*  $\text{kJmol}^{-1}$   
*Period*  $\vec{\uparrow}$  - increases; He is the highest, Cs is the lowest, Fr is not determined correctly as it is radioactive  
*Group*  $\downarrow$  - decreases
- **Electron Affinity:** The amount of energy released while converting a neutral isolated gaseous atom into a negatively charged gaseous ion by addition of electron  
*Unit:*  $\text{kJmol}^{-1}$   
*Period*  $\vec{\uparrow}$  - increases; Cl is highest, this property has a number of exceptions in both, periods and groups  
*Group*  $\downarrow$  - decreases
- **Electronegativity:** tendency of an atom in a molecule to attract the shared pair of electrons towards itself  
*Unit:* none (dimensionless property) *Period*  $\vec{\uparrow}$  - increases; F is highest with 4.0, Cs is lowest with 0.7  
*Group*  $\downarrow$  - decreases

## 1.2 Molecule

made of atoms, has independent existence, takes part in all reactions

### 1.2.1 Atomicity

number of atoms in a molecule

### 1.2.2 Caused by

Covalent bond (sharing of electrons) between two atoms

### 1.2.3 Properties

- **Electrical Conductor:** only polar covalent molecules as electrolytes
- **Magnetic:** depends on atoms
- **Solubility:** depends on atoms, refer solubility section

### 1.3 The Periodic Table

The periodic table has 18 Groups and 7 Periods. Elements of period 3 are called typical elements as they represent the general properties of their groups

$G_1$  Alkali Metals:  $H^1, Li^3, Na^{11}, K^{19}$

$G_2$  Alkaline Earth Metals:  $Be^4, Mg^{12}, Ca^{20}$

$G_3 - G_{12}$ : Transition elements, properties change periodically

$G_{13}$  Boron Family:  $B^5(Metalloid), Al^{13}$

$G_{14}$  Carbon Family:  $C^6, Si^{14}(Metalloid)$

$G_{15}$  Nitrogen Family:  $N^7, P^{15}$

$G_{16}$  Oxygen Family or chalcogen:  $O^8, S^{16}$

$G_{17}$  Halogen:  $F^9, Cl^{17}$

$G_{18}$  Halogen:  $He^2, Ne^{10}, Ar^{18}, Kr^{36}$

#### 1.3.1 Finding the group and period of an element

Period: Number of shells

Group: if (number of valence electrons) < 2 then (number of valence electrons + 10) else (number of valence electrons)

#### 1.3.2 Periodicity

properties that reappear at regular intervals or have a gradual variation

#### 1.3.3 Comparison of Alkali and Halogens

Alkali:

- shining white solid metal
- possesses one valence electron
- forms positive ion
- good conductors of electricity
- react vigorously with water and acid
- reducing agents

Halogens:

- colored diatomic non metals
- possess seven valence electrons
- form negative ion
- non conductors of electricity
- generally do not react with dilute acids and water
- oxidizing agents

## 1.4 Chemical Bonding

A chemical bond may be defined as the force of attraction between any two atoms in a molecule to maintain stability

### 1.4.1 Stability

electron arrangement of closest inert gas as they are stable and nonreactive

### 1.4.2 Electrovalent Bond | Ionic Bond

The chemical compounds formed as a result of the transfer of electrons from one atom of an element to another atom of another element

- Ion: charged particle formed due to gain or loss of one or more  $e^-$   
Atom lose  $e^-$  to form electropositive element (cation)  
Atom gain  $e^-$  to form electronegative element (anion)
- Electrovalency: The number of electrons, an atom of an element loses or gains to form an electrovalent bond is called its electrovalency
- Conditions:
  - Low Ionization Potential: easily lose  $e^-$ , cations form easily
  - High electron affinity: anion forms easily
  - Large electronegativity difference
- The metals of  $G_{1,2,13}$  combine with  $G_{15,16,17}$ . CsF is the most ionic compound
- Bonds between metals and non-metals and ionic except hydrogen

### 1.4.3 Electron Dot symbol | Lewis Symbol

Generally, the valence  $e^-$  of first element is marked by a '.' while that of second element by 'x'.

### 1.4.4 Covalent Bond | Molecular Bond

The chemical bond that is formed by mutual sharing of one or more pairs of electrons

- Types: Single, Double, Triple
- Covalency: number of electrons in formation of shared pair
- Non-polar compounds: Shared pair is equally distributed, formed in similar atoms (H-H, Cl-Cl, O=O) or when electronegativity difference between dissimilar atoms is little ( $CH_4$ ,  $CCl_4$ ). Do not ionize in water due to lack of charge separation
- Polar Compound | Dipole molecule: Shared pair is not equally distributed, fractional charges develop (HCl,  $H_2O$ ). Ionise in water or solution. It has both slight positive and slight negative charge, hence known as a dipole molecule

- Ionization: The fractional charges in solution are converted to complete charges and ions are produced
- Conditions:
  - four or more  $e^-$  in valence shell except H, He, B, Al, etc
  - High electronegativity
  - High electron affinity
  - High Ionization Potential
- Hydrogen can combine with  $G_{14-17}$  with covalent bond

#### 1.4.5 Coordinate Bond | Dative Bond | Co-Ionic Bond

The bond formed by sharing of a pair of electrons, provided entirely by one of the atoms but shared by both

Conditions:

- One compound has lone pair: a pair of  $e^-$  not shared by any other atom
- One compound is short of pair

#### 1.4.6 Elements with more than one type of bond

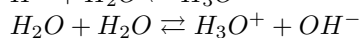
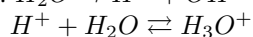
- Ammonium Chloride ( $NH_4Cl$ ) has all three bonds
- Electrovalent and Covalent:  $NaOH$ ,  $CaCO_3$
- Covalent and Coordinate:  $H_2SO_4$

#### 1.4.7 Formation of Hydroxyl ( $OH^-$ ) Ion



#### 1.4.8 Self Ionization of water

Eq:  $H_2O \rightarrow H^+ + OH^-$



## 2 Acids, Bases and Salts