Toppersnotes
Unleash the topper in you

SSC - CHSL

COMBINED HIGHER SECONDARY LEVEL

STAFF SELECTION COMMISSION

VOLUME – III

General Science

SIERRA INNOVATIONS

Index

Biology

Physics

Chemistry

CHEMISTRY

Chemistry: Study of matter and its property.
Father of chemistry = Lavoisier

Matter:

1. On the basis of states, matter is divided into solid, liquid and gas.

Solid	Liquid	Gas
1. Definite shape and volume.	1. Definite volume, indefinite shape	1. Indefinite shape and volume.
2. Highest density	2. Density < solid	2. Lower density
3. Maximum force of attraction	3. Less force of attraction	3. Negligible force of attraction.
4. Can't be Compressed	4. Can't be Compressed	4. Can be Compressed
5. Particles are highly Packed	5. loosely Packed	5. loosely Packed
Ex- Diamond, $CuSO_4$, etc.	Ex- water	Ex- O, N, etc.

2. On the basis of chemical composition, matter is divided into Element, Compound and Mixture.

Element	Compound	Mixture
1. An Element is a substance which is formed by two or more identical molecules. Ex- H, Cu, etc. 3-types of element metal, Non-metal and metalloids	1. A compound is a substance composed of the atoms of two or more elements combined in a definite proportion by weight. Ex- H_2O, $C_6H_{12}O_{11}$ etc.	1. A mixture is a substance composed of two or more compounds or elements in any Proportion by weight. Ex- milk, soil, air etc.

* 2. Other states of matter are plasma and Bose-Einestein Condensate (BES).

TYPES OF Mixture:-

Homogenous Mixture	Heterogenous Mixture
When a mixture has same composition throughout than it is known as Homogenous Mixture. Ex- NH_3 in air, sugar, in water	A mixture which does not have uniform Properties and composition. It can be seprated by boundaries. Ex- Colloids, Emulsions or Suspensions

Sepration of Mixture :-

The components of the mixture are seprated by various methods!

1. Sublimation
2. Crystalligation
3. Distillation
4. Chromatography

* Kinetic energy of the particles are minimum in the solid and liquid state but maximum in gases.
* The state of matter can be changed by changing temperature or pressure.
* The temperature at which state of solid changes to liquid at atmospheric pressure, called melting Point.
* Lowest melting point = Oxygen (-218.8°C)
* Highest melting point = Tungsten (3414°C)
* The temperature at which a liquid changes to a solid.
* Freezing point of Pure water = 0°C

* Evaporation is a surface Phenomenon.
Particles from the surface gain enough energy to overcome the forces the vapour state.

* The rate of evaporation depends upon the surface area exposed to the atmosphere, the temperature, the humidity and the wind speed. Evaporation Causes Cooling.

* Chemical Change ⇒ Burning of Coal, wood or leaves rusting.

* The proces of depositing a layer of zinc on iron is called galvanisation. (a layer of a metal like chromium or zinc or iron)

* Dry Ice = CO_2

* When a solid turn into gas without going through the liquid phase, it is called Sublimation.
Ex- Camphor, Napthalene, Anthracene etc.

* Food takes longer time to get cooked at high altitude because of at high altitude atmospheric Pressure and boiling point are quit low.

* When a gas transform directly into a solid, without going through the liquid phase, it is called desublimation or deposition

* The molecules of a gas being in continuous motion, frequently strike the inner walls of their Container.

* Temperature is defined at the measure of average heat. Temperature is independent of the number of Particles or Size and shape of the object.

Gas Laws :-

Gas laws: establish relationships between the three variables of volume, Pressure and temperature of a gas.

1. Boyle's Law :- The product of the volume and pressure of the given mass of dry gas is constant, at constant temperature.

2. Charle's Law :- At Constant pressure, the volume of a given mass gas increases or decreases by $\frac{1}{273}$ of its original volume at 32° F

3. Pressure Law :- At Constant Volume, the pressure of a given mass of gas increases or decreases by a constant fraction ($= \frac{1}{273}$) of its Pressure at 0°c for each degree Celsius.

Avagadro Number (N_A) :-

The definite number of atoms, molecules or ions of any substance represent one mole and this number is called Avagadro's Number.

$$N_A = 6.023 \times 10^{23}$$

Structure of Atom :-

The atomic theory of matter was first proposed by John Dalton. Fundamental particles of an atom are Electron, Proton and Neutron.

Proton (P)	Electron (e^-)	Neutron (N)
• Discovered by Rutherford	Discovered by J.J. Thomson, 1897	• Discovered by J. Chadwick in 1932
• Protons are Positively charged	• Electrons are negatively charged	• It has no charge
• Charge = 1.6×10^{-19} C	* Charge = -1.6×10^{-19} C	• The mass of a neutron is taken as one unit each

Atomic Nucleus - Rutherford :-

* The fast moving alpha (α) - Particles (doubtly - charged helium ions) were made to fall on an thin gold foil.

* Mass of an atom is the sum of the masses of Protons and neutrons present in the nucleus.

* Non-fundamental Particles of an atom Positron, Antiproton, Neutrino, Antineutrino, π- mesons, quarks and Bosons

* Valency :-

The number of electrons gained, lost or shared so as to make the octet of electrons in the outermost shell, is called valency.

Atomic Number :-

The atomic number is defined as the total number of protons present in the nucleus of an atom. It is represented by "Z"

Mass Number :-

The mass number is defined as the sum of the total number of nucleons (Protons and neutrons) Present in the nucleus of an atom. It is denoted by 'A'.

$$A = Z + n$$

Mole :-

Mole is the unit of amount of substance. One mole contains exactly 6.023×10^{23} elementary entities. Thus, avagadro number or avagadro constant is the no. of Particles found in one mole of a substance i,e. 6.023×10^{23} Particles per mole.

Isotopes :-

Atoms that have the same atomic number but different mass number are called isotopes.

Ex. $^{1}_{1}H$, $^{2}_{1}H$ and $^{3}_{1}H$

Isobars :-

Atoms which have the same mass number (A) but different atomic number (Z) are termed as isobars.

Ex- $^{24}_{11}Na$ and $^{24}_{12}Mg$

Isotones :-

Atoms having same number of neutrons

Ex- $^{14}_{6}C$, $^{15}_{7}N$ & $^{16}_{8}O$ $(n=8)$

* An isotope of uranium is used as a fuel in nuclear reactors.
* An isotope of Cobalt is used in the treatment of Cancer.

* An isotope of iodie is used in the treatment of goiter.

* Radioactive isotopes :-

Arsenic - 74 → detect tumors
Sodium - 24 → Blood clot
Iodine - 131 → Activity of thyroid gland.
Cobalt - 60 → Treatment of Cancer.

Mass Defect :-

The mass defect is the difference between the rest mass of a nucleus and the sum of the rest masses of its constitutional nucleons.

* Avagadro's Law provides a method to determine molecular weights of gaseous element.

Binding Energy :-

* The binding energy of a nucleus is the energy required to seprate a nucleus into its constituent parts.

* For heavier nuclei energy is released when they break up (fission)

* For lighter nuclei energy is released when they fuse together (fusion)

* Nuclear particles are held together by a nucleus strong force. A stable nucleus remains forever, but as the ratio of N/Z gets larger, the atoms decay. Elements with $Z > 82$ are all unstable.

* As the heavier atoms become more unstable, Particles and photons are emitted from the nucleus and it is said to be radioactive. All elements with $A > 82$ are radioactive

* Alpha particles = (2 proton and 2-neutron) least Penetrating
* β^- = Electron penetrating
* β^+ = (Positron) Penetrating
* γ-rays = Most Penetrating, high electro-magnetic radiation
* Radioactivity inuented by Henri Becquerel in 1896.
* Radium inuented by madam Curie and pierre Curie.

* <u>Half Life</u> :- The time during which half of the total number of the radioactive element disintegrate and it is represented by $T_{1/2} = \frac{0.693}{\lambda}$

Relative Charge

$e^- = -1$

$p^+ = +1$

n° = neutral

Ex- In the formula of water H_2O

Relative mass of Hydrogen = 1

Relative mass of oxygen = 16

O : H

~~16~~ : ~~2~~

8 : 1

Ex - How many molecules are present in 1 ml of water ?

Sol^n - Molecular mass of water, $H_2O = 1X2 + 16 = 18$ gm

18 gm of water contain 6.022×10^{23} molecules

1 gm of water contain $= \frac{6.022 \times 10^{23}}{18}$ molecules

$= 0.33 \times 10^{23}$ molecules

$= 3.3 \times 10^{22}$ molecules.

Atomic Mass unit (amu) :- A unit of mass used to express atomic and molecular weights, equal to one twelfth of the mass of an atom of carbon-12.

Molecular Mass :-

To determine the molecular mass of a Compound molecular formula is used.

Molecular Mass = Sum of atomic masses of all the atoms present in that molecule.

Ex- Molecular mass of CO_2 is

$1C + 2O$

$1 \times 12 + 2 \times 16 = 44\ u$

Ex How many p^+, n^0 and e^- are present in an atom of Plutonium 239?

Sol? $A = 239$, $Z = 94$

$A - Z = n^0 \Rightarrow 239 - 94 = 145$

$e^- = p^+ = Z = 94$

Ex Calculate the molecular mass of glucose, $C_6H_{12}O_6$?

Ans Molecular mass of $C_6H_{12}O_6$

$= 12 \times 6 + 12 + 16 \times 6$

$= 72 + 12 + 96$

$= 180\ u.$

Half-Life Period :-

The half-life of an isotope is the time in which one one-~~forth~~ half of its unstable nuclei will decay.

$N = N_0 (1/2)^n$, where 'n' is number of half lives.

ACID, BASE AND SALTS

ACID :-

An Acid is a compound, Produce, hydrogen ions, $H^+(aq)$ in solution, ~~which~~ are responsible for their.

Bronstead - Lowry Theory :-

According to this theory, an acid is any species that can donate a proton to another species.

* Hydrogen ions cannot exist alone, but they exist after combining with water molecules. so on dissolving in water yields hydronium ions (H_3O^+) as the only Positive ions
* The pressence of hydrogen ions makes acids strong and good electrolytes.

Properties of Acid :-

1. Acid taste sour.
2. Acid turn blue litmus red and methyl orange Pink.

Strong Acid :- HCl, H_2SO_4, HNO_3 etc.

Weak acid :- Acetic acid (CH_3COOH), formic acid ($HCOOH$), carbonic acid etc.

* **Indicators :-** Turmeric, litmus, china rose petals are naturally occuring indicators.

* **Olfactory Indicators :-**
There are some substances whose odour changes in acidic or basic media.

* **Uses of Acids :-**

1. H_2SO_4 is used in petroleum exploration.
2. HNO_3 is used in manufacturing of medicines, drugs and fertilizers.
3. HNO_3 and HCl are used in the preparation of aquaregia
4. Hydrochloric acid present in our stomach helps in the digestion of food.
5. Formic acid ($HCOOH$) is used as a preservator of green fruits.

6. Benzoic acid is used as perservator of medicines and food stuffs.
7. Phospheric acid is used in making fertilizers and detergents.
8. Boric acid is used to wash eyes.

Basicity of an Acid :-

is defined as the no. of ionizable hydrogen (H^+) ions present in one molecule of an acid.

Ex - $HCl \rightarrow$ Basicity = 1 - monobasic
$NH_3 \rightarrow$ Basicity = 1 - monobasic
$H_2SO_4 \rightarrow$ Basicity = 2 - dibasic
$H_3PO_4 \rightarrow$ Basicity = 3 - Tribasic

Some Naturally sources of Acids :-

Natural Source	Acid
Curd	Lactic Acid
Sting of red ants & bees	Formic Acid
Citrus fruits	Citric Acid
Vinegar	Acetic acid
Tea - tomatoes	oxalic acid
Apples	malic acid
Grapes	Tartaric acid
Orange	ascorbic acid (Citric acid)
Proteins	Amino acid
Grass, leaves, urine	Benzoic acid

Base :-

- A Base is substance that gives OH^- ions when dissolved in water. Bases are usually metal hydroxides (MOH), Ex- KOH, Na_2OH etc.
- Bronsted - lowry theory ⇒ According to this theory a base is a proton acceptors.
- Bases are soapy substances with a bitter taste.
- The strength of a base depends on the concentration of the hydroxyl ions when it is dissolved in water.
- Bases turn red litmus blue and turn methyl orange yellow.
- Bases soluble in water are called alkalies. All alkalies are base but all bases are not alkalies

Strong Base :- $NaOH$ (Caustic soda)
KOH (Caustic potash)
$Ca(OH)_2$

Weak Base :- $Mg(OH)_2$, NH_4OH

Uses :- (1) $Ca(OH)_2$ for house white washing, in production of bleaching powder.

(2) In manufacturing of soap, in purification of Petroleum in drugs.

(3) $Mg(OH)_2$

Salt :-

Salt is the generic name we use to describe any substance produced by the reaction of an acid with base.

Ex- $HCl + NaOH \longrightarrow \underset{\text{(salt)}}{NaCl} + H_2O$

- Potash alum $[K_2SO_4 \cdot Al_2(SO_4)_3\, 24H_2O]$
  [Potassium aluminium sulphate] → Double salt
  It is used in dyeing industries to fix the dye to the fabric and used for cleaning teeth.

Uses of Salts in Industries :-

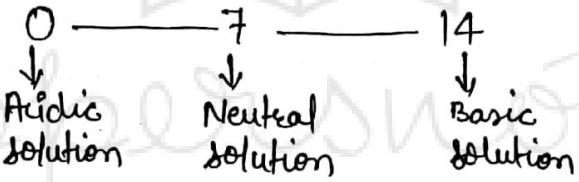
1. NaCl is used in the manufacture of Chlorine, Caustic soda, washing soda and baking soda.
2. KNO_3 is used in the production of gun powder in fire crackers, in glass industry and fertilizers etc.
2. $NaHCO_3$ (Baking powder) is used in removing acidity from human body.
4. KCl is used in the match industry
5. Silver bromide is used in photography.

pH Scale & Value :-

The scale that measures the strength of an acid or a base is called the pH scale.

This value lies between 0 and 14.

* In pH, p stands for potenz
* Higher the hydronium ion Concentration, lower is the pH value.
* **pH Value**



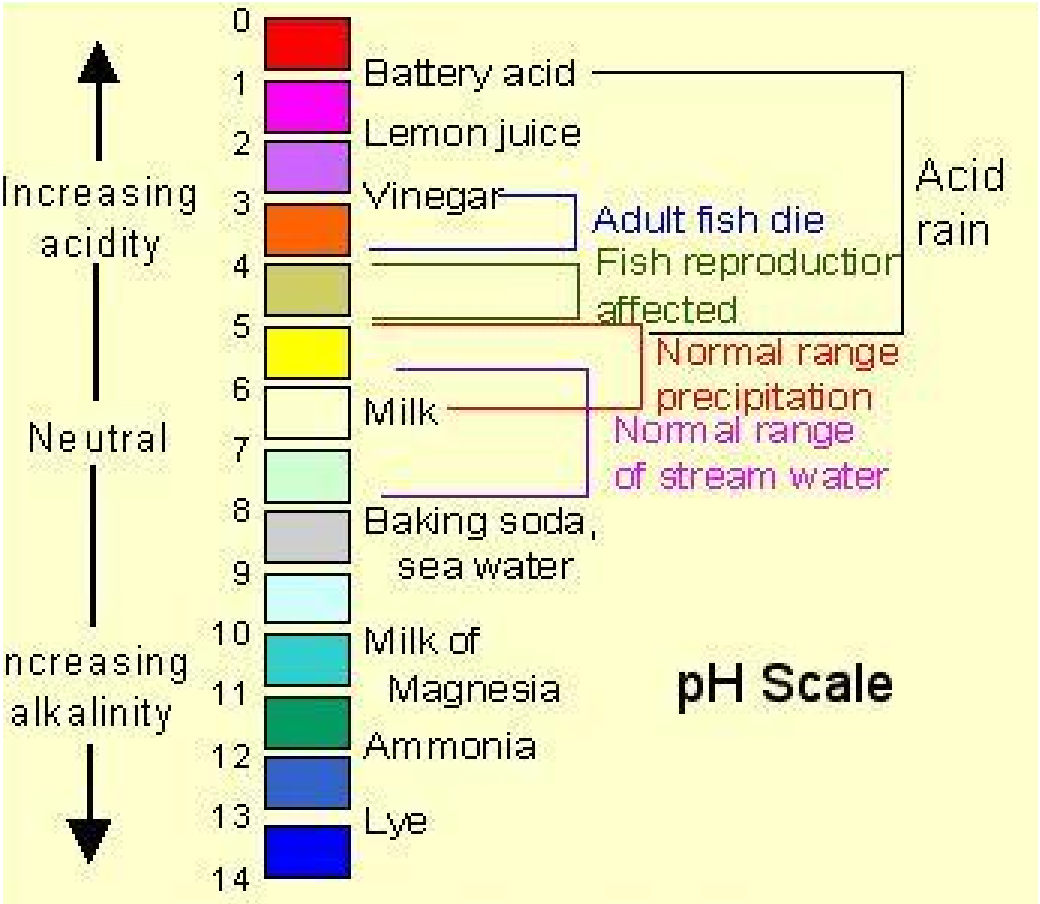
* Most food crops grow best at a pH of 7 - 7.8.
  If the soil is too acidic then by adding 'lime'. its pH can be raised.

  If the soil is too alkaline then its pH can be lowered by adding gypsum.
* Our stomach has pH around (1.2) (highly acidic) stomach Produces HCl which helps in digestion of food.
* Tooth decay starts when the pH of mouth is lower than 5.5
* Acid Rain – when pH of rain water is less than 5.6, it is called acid rain
* Gastric juice – 1.2

Lemon juice = 2.2
Pure water = 7.4
Human blood = 7.3 - 7.45
Milk of magnesia = 10
NaOH — 14
Beer — 4.0 - 5.0

Tears — 7.4
Salavia — 6.5 - 7.5
Urine — 5.5 - 7.5
Coffee — 4.5 - 5.5
Wine — 2.8 - 3.8
Vinegar — 2.4 - 3.4

* Our body works within the pH range 7.0 - 7.8



Courtesy of Environment Canada (http://www.ns.ec.gc.ca/)