

CHEMISTRY

Chemistry is the branch of science that deals with the study of matter, its physical and chemical properties, chemical composition, the physical and chemical changes which it undergoes and the energy changes during these processes.

Father of Chemistry is **Robert Boyle**

Father of modern chemistry is **Lavoisier**.

Father of organic chemistry is **Friedrich Wohler**

- **Matter** is anything that occupies space and mass .It exists in seven states namely solid, liquid, gas, ionised plasma, Quark gluon plasma, Bose Einstein Condensate and Fermionic condensate
- Most abundant physical state in the universe is **Plasma**. In plasma state matter exists in the form of **ions**. Flames and all stars are in plasma state.
- **Element** is a pure substance that is composed of only one kind of atom
- **Compound** is a pure substance that is composed of two or more elements chemically combined in definite and constant proportions
- **Mixtures** are obtained by mixing two or more substance in any proportion.eg: cement and sand, sand and sugar etc.
- **Atom** is the smallest particle of matter that takes part in a chemical reaction .They are building blocks of everything in this universe. The term Atom is coined by **Ostwald**. E.g.: H, He, Ar.
- **Molecules** is the are the smallest particle of a substance which has properties of that substance Eg;H₂O, H₂SO₄ etc
- The term **molecule** was coined by **Avogadro**.

Structure of Atom

- Atom is comprised of three fundamental particles called protons, electrons and neutrons. Central part of the atom is called nucleus.
- Protons and neutrons are in the nucleus and electrons are revolving around the nucleus in a definite path called **Orbit** or **Shell**.
- Nucleus was discovered by **Rutherford** and it has positive charge.
- Wave mechanical model of atom was proposed by **Erwin Shrodinger**

Fundamental Particles

Electron:

- Electron is a negatively charged particle having an absolute charge of 1.6×10^{-19} Coloumbs
- Electron was discovered by Cathode ray experiment in 1897.
- The electron was discovered by **J.J Thomson**.
- The dual nature of electron was proposed by **Victor de-Broglie**.
- **Electron** is the lightest fundamental particle of an atom.

❖ **Proton**

- Proton is a positively charged particle having an absolute charge of 1.6×10^{-19} Coulombs.
- Proton was discovered by **Rutherford**.
- Proton is known as the identity card of an element.

❖ **Neutron**

- Neutron is uncharged or **neutral** particle.
- Neutron was discovered by **James Chadwick**.
- Neutron is the **heaviest** fundamental particle of an atom.

Sub atomic Particle

❖ **Positrons**

- Positrons were discovered by **Anderson**, these are positive counterpart of electrons. It is highly unstable and combines with electrons producing γ – rays.

❖ **Neutrinos and Anti- neutrons**

- Neutrinos are one of the fundamental particles which make up the universe.

- Neutrinos and Anti- neutrons are postulated by **Fermi**, these are particles of small mass (≈ 0) and zero charge.
- ❖ **Mesons**
- Mesons are positively and negatively charged particles having a mass intermediate between that of electron and proton.

- Atomic theory was first postulated by **John Dalton**
- Plum Pudding model of atom was suggested by **J J Thomson**
- Nuclear model of atom was suggested by **Ernest Rutherford**
- Wave Mechanical model of atom was proposed by **Erwin Shrodinger**
- Proton was discovered by **Rutherford**
- Electron was discovered by **J J Thomson**
- Neutron was discovered by **James Chadwick**

Characteristics of Atoms

- **Valancy:** It is the combining capacity of one atom to another. Noble gas has zero valancy, Hydrogen and Alkali metals shows Univalancy
- **Atomic Number (Z):** It is the number of protons or electrons in an atom.
- **Mass Number (A):** It is the sum of number of protons and neutrons present in the nucleus of an atom.
- **Atomic Weight:** The average weight of an atom of an element, based on the $\frac{1}{12}$ th mass of the C-12 carbon atom.
- **Avogadro's number:** It is the number (6.023×10^{23}) of particles found in 1 mole of compound.
- **Isotopes:** It is the atom of same element having the same atomic number and having different mass number. **Protium, Duterium and Tritium** is the isotopes of Hydrogen. Protium has no neutron (${}_1\text{H}^1$), Deuterium has one neutron (${}_1\text{H}^2$), and Tritium has two neutrons (${}_1\text{H}^3$).
- **Protium** is the most abundant form of Hydrogen present in the universe
- **Deuterium** is used in moderated fission reactors, usually as liquid **D₂O**, to slow **neutrons** without the high **neutron** absorption of ordinary hydrogen.
- Tritium is a **radioactive** form of hydrogen, used in research, fusion reactors and neutron generators. The radioactive properties of tritium are very useful.
- **Isobars:** Isobars are the atoms of two elements having same mass number but having different atomic number. Argon (${}_{18}\text{Ar}^{40}$) and Calcium (${}_{20}\text{Ca}^{40}$) are isobars. They have same mass number =40 but different atomic number.
- **Isotones:** these are the atoms which have different atomic number and mass number but having same number of neutrons. E.g. Tritium (${}_1\text{H}^3$) and Helium (${}_2\text{He}^4$)
- **Allotropes:** These are the different forms of the same element with different physical appearance.
- e.g.: White Phosphorous and Red Phosphorous, Oxygen (O₂) and Ozone (O₃).

Periodic Table of elements

- Periodic Table is the arrangement of elements according to some recurring property.
- **Mendeleev** is the father of periodic table, Mendeleev's periodic table was based up on the mass number .It was the first really successful arrangements of elements.
- **Moseley** was the father of Modern periodic table. Modern periodic table was based up on the atomic number.
- There are **7 periods** and **18 groups** in the modern periodic table
- The atomic number was first calculated by **Moseley**.
- The man maid elements are known as **Transuranics**.
- **Ionization Energy:** It is the energy required to remove one or more electron from the valance shell of an isolated gaseous atom.
- **Electron Affinity:** It is the amount of energy released on adding one or more electrons to the valance shell of an isolated gaseous atom.
- **Electro negativity:** It is the tendency of an atom to attract electrons to it when combined in a compound.

- Group 1 elements are called Alkali metals
- Group 2 elements are called Alkaline earth metals
- Group 17 elements are called Halogens
- Group 18 elements are called Noble Gases
- Elements from atomic no:58 to 71 are called Lanthanides or rare earths
- Elements from atomic no:90 to 103 are called Actinides

Chemical Bonding

- Chemical bonds are formed as a result of loss, gain or sharing of electrons between atoms of the reacting elements.
- **Electrovalent or Ionic Bond:** It is formed by transfer of one or more electrons from the atom of an electropositive element to the atom of electronegative elements. E.g. NaCl, CaO.
- **Covalent Bond:** It is the chemical bond formed between two combining atoms by mutual sharing of one or more electrons of atoms of non metallic element. E.g. HCl, H₂O, and NH₃.
- **Coordinate Bond:** It is a type of covalent bond in which only one of the atoms contributes both electrons of the shared electron pair. e.g. H₂SO₄, NH₄.
- **Hydrogen Bond:** It is an electrostatic force between covalently bonded hydrogen atom of one molecule and an electronegative atom
- **Van der Waal's bond:** It is the force of attraction between neighbouring atom because of their different dipoles induced by instantaneous unsymmetrical distribution of electrons in the atom
- **Metallic Bond:** It is the attractive force between mobile electrons and the metallic Kernels.

Chemical Reactions

- **Chemical Reactions:** Chemical reaction is a process by which one or more substance gets transformed into new substance.
- **Oxidation:** It is the chemical reaction involves addition of Oxygen or removal of Hydrogen. It involves loss of one or more electrons
- **Reduction:** It is the chemical reaction involves removal of Oxygen or addition of Hydrogen. It involves the gain of one or more electrons.
- **Oxidation Number of an element:** Is the no of electron lost, gain or shared as result of chemical bonding. In oxidation, oxidation number increases and in reduction oxidation number decreases.

Elements

- The most common element in atmosphere is Nitrogen.
- Most electropositive element is **Francium (Fr)**. But it is not stable being radioactive
- Francium is a **radioactive liquid element**.
- Most electropositive *stable element* is **Caesium (Cs)**. It is used in atomic clock.
- The reactive form of Phosphorus is White Phosphorus. It is strong **poison** and kept under in water.
- Red Phosphorous is non poisonous and used in **match boxes**.
- The halogens extracted from sea water are Chlorine (Cl) and Bromine (Br).
- Iodine (I) is obtained from sea weeds.
- **Lithium** is kept by covering paraffin wax.
- **Mercury** is generally used as thermometer fluid.
- The element common to all explosive is **Nitrogen (N)**.
- The element has highest melting point is **Tungsten**.
- The element which is used in photocopying drum is **Selenium**.
- The elements which are used for the manufacturing of transistors and IC's are **Silicon and Germanium**.

The most common element in universe is Hydrogen.
 The most common element in earth's atmosphere is Nitrogen
 The most common element in earth's crust is Oxygen
 The most common metal in earth's crust is Aluminium.

Important Elements

- ✓ **Fluorine** is the most reactive element. It is the most electro negative element.
- ✓ **Astatine** is the rarest element and radioactive halogen.
- ✓ **Carbon** has the highest melting point (4000K Diamond).
- ✓ **Tungsten** has the highest melting point in metals (3422°C or 3695K).
- ✓ **Chlorine** has the highest **electron affinity**.
- ✓ **Uranium** has the highest atomic mass among natural elements.
- ✓ **Polonium** is the most radioactive element.
- ✓ **Radon** is the radioactive gaseous element and also the heaviest gaseous element.
- ✓ **Osmium** is the densest element.
- ✓ **Lead** is the most stable element.
- ✓ **Technetium** is the first man made element.

Harmful Elements

Element	Diseases
Mercury	Minamatha (Catwalk disease)
Lead	Plumbism, Painter's colic
Cadmium	Itai-itai
Silicon	Silicosis
Copper	Wilson's disease
Aluminium	Alzheimers
Fluorine	Fluorosis
Arsenic	Black foot disease

➤ **Hydrogen:**

- The **most abundant element** in universe
- Hydrogen was discovered by **Henry Cavendish**.
- The only element with atomic number and mass number **one**.
- The process by which Hydrogen is produced commercially from water **Bosch process**.
- Hydrogen is the **lightest** element.
- Petrol is produced hydrogenation of coal or biomass.
- Liquid Hydrogen is used as **rocket fuel**.
- Hydrogen is considered as the **fuel of the future**, it is also considered as the **green fuel**.
- Vanaspathi ghee is produced through hydrogenation of vegetable oil.

➤ **Carbon**

- The element with **maximum tendency of catenation**(self linking property) is Carbon
- In nature carbon exists in crystalline and amorphous allotropes.
- Crystalline allotropes of Carbon are Diamond, Graphite, Fullerene, Graphene
- Amorphous allotropes of Carbon are Coal, Charcoal, and Lamp Black.

❖ **Diamond**

- Atoms of a Carbon are joined in a three dimensional tetrahedral structure in diamonds
- Diamond is brittle, crystalline and the hardest naturally occurring substance.
- It is used for cutting gases

❖ **Graphite**

- Graphite has a layered structure
- Graphite is a good conductor of heat and electricity
- Graphite is used in lead pencils
- Graphite is used as a lubricants
- Graphite is used for making electrodes

❖ **Fullerene**

- The forms of Fullerene, C₆₀ and C₇₀.C₆₀ are known as **Buckminster Fullerene**

❖ **Graphene**

- **Graphene** is a newly discovered allotrope of Carbon in which carbon atom is arranged in a single layered hexagon form

- **Nitrogen**
 - Nitrogen was discovered by **Daniel Rutherford**.
 - In Free State nitrogen constitute **78.082 %** of the air.
 - The sum total of the transformation undergone by nitrogen and nitrogenous compounds in nature in relation to the living organisms is called **nitrogen cycle**
 - Nitrogen is **non –poisonous**.
- **Oxygen**
 - **Oxygen** was discovered by **Joseph Priestley**
 - Its elemental nature was established by **Lavoisier**
 - Oxygen does not burn but helps things to burn
 - Oxygen's atomic number is 8 and the first synthetic atom is Oxygen-17
- **Sodium**
 - Sodium was discovered by **Humphrey Davy**
 - It is found in the form of sodium chloride, sodium nitrite (**Chile salt peter**), sodium nitrate (Glauber's salt) and borax (sodium tetra borate)
 - Sodium Carbonate (washing soda) and sodium bicarbonate (baking soda) are the main compounds
 - Sodium is extracted through **Down's process**
 - Sodium is stored in **kerosene**
 - Liquid sodium is used as a **coolant** in atomic reactors
 - The metal that regulates human blood pressure is Sodium
- **Aluminium**
 - Aluminium is the most abundant metal in the Earth's crust
 - Bauxite, Cryolite and Corundum are the ores of aluminium
 - Commercially aluminium is extracted from **Bauxite** through a combination of the **Bayer's process and Herold –Hall process**.
- **Gold**
 - Gold is known as the **king of metals**
 - Gold's symbol is **Au** and its atomic number is 79
 - Gold is the most ductile metal
 - Pure Gold is **24** carats (99.96%)
 - Gold is soluble in **aquaregia** and in **mercury**
 - **Aquaregia** is a mixture of Hydrochloric acid and nitric acid in the ratio **3:1**
- **Iron (Fe) and Steel**
 - The richest ores of iron are **Hematite and magnetite** and they contain 70% of iron
 - Three commercial varieties of iron are Cast iron, wrought iron and steel.
 - **Cast Iron (pig iron)** is the impure form of iron that contains highest proportion of carbon (**2.5-4%**)
 - **Wrought Iron** (malleable iron) is the purest form of iron, it contains minimum amount of Carbon (0.12-0.25 %)
 - **Steel** is the most important form of iron that contains 0.2-1.5% of carbon
 - Steel containing 0.2-0.5 % of carbon is known as **mild steel**
 - Steel containing 0.5-1.5 % of carbon is known as **Hard steel**
 - The steel used in the production of blade is **High Carbon Steel**.
 - **Stainless steel** contains iron, Chromium, Nickel and Carbon.
 - When iron rusts its weight increases.
 - Iron coated with Zinc is called **Galvanised Iron** and with Tin is called **Tin Plate**.
- **Zinc**
 - Zinc blend , Calamine , Zincite are the important ores of Zinc and it is extracted by Distillation
 - Impure zinc is known as Spelter.
 - Zinc is used in **Galvanization** and in **dry cells**.
- **Chlorine**
 - Chlorine , either as **liquid chlorine or chlorine water**, is used for bleaching and sterilization of drinking water
 - Chlorine is used as **oxidising agent**
 - **Sodium hypochlorite** is used as an antiseptic , Chloroform is used as an anaesthetic

- **Poly vinyl Chloride (PVC)** is an important plastic.
- Chlorine was invented by **Carl Scheele**.

➤ **Sulphur**

- In free state Sulphur is found in volcanic rocks and gases
- Sulphur is non poisonous to humans but toxic to lower organisms
- Sulphur is used for **treatment of skin diseases** and commercially used in **fertilisers**

➤ **Noble Gases**

- **Helium, Neon, Argon, Krypton Xenon and Radon** is known as noble gases. These are also called as **rare gases**.
- These do not enter into chemical reactions so they are called **Inert Gases**
- **Liquid Helium** is used in Cryogenics.
- Helium and Argon are used for **welding**.
- Helium was first discovered in Sun's atmosphere.
- Helium is used to inflate **aircraft tyres**.
- Neon is used in **marketing advertisement signs**
- Krypton (hidden gas) and Xenon (Stronger gas) discovered by W.Ramsay .
- Radon is obtained from radioactive disintegration of **Radium**

➤ **Metals**

- The elements which loose electrons in chemical reactions are called metals.
- A metal is an electropositive element which is hard, lustrous, malleable, ductile with tensile strength and a good conductor of heat and electricity.
- Malleability is property of the metal by which it can hammered into thin sheets
- Ductility is property of the metal by which it can be drawn into wires
- Metals can be stretched into some degree without fracturing and this measure is known as tensile strength.
- Metallurgy is the process of extracting metal in a pure state by large scale from its ore by chemical and physical means.
- Ore is the mineral from which the metal is extracted.
- **Gangue** is the impurity present in the Ore
- **Flux** is the substance added to ore for removing impurities. Flux are of two types Acidic flux (E.g. Silica) and Basic flux (E.g. Quick Lime)
- **Calcination** is the process of heating the ore below its melting point in absence of air to remove volatile impurities like Arsenic.
- **Roasting** is the process in which the ore is heated below its melting point in presence of air to oxidise the impurities.
- **Distillation** is the method of purifying a liquid by successive evaporation and condensation.
- The metal related to **arthritis** is Potassium.
- Zinc is the metal present in Human eye.
- The lightest metal is **Lithium**
- Liquid metal at room temperature is **Mercury**.
- The first known super conductor is **Mercury**.
- Non-metal which shows electric conductivity is **graphite**.
- Most harmful metal to human being is **Lead (Pb)**.
- The first metal used by human is **Copper**.
- The metal present in bath soap is **Potassium**.

Metalloids

- Some elements behave chemically both as metals and non metals .Such elements are called Metalloids. E.g. Silicon, Germanium, Boron.

Alloy

An alloy is a homogenous mixture of metals with other metals and non metals

Alloys	Constituents	Uses
Bronze(Bell Metal)	Copper, Tin	Statues, ornaments, coins, bells and medals

Steel	Carbon, Iron	Machinery
Aluminium Bronze	Aluminium, Copper	Coins, statues
Alnico	Aluminium, Cobalt, Iron, nickel	Magnets
Nichrome	Nickel, chromium, Iron, Manganese	Heating instruments
Manganese steel	Iron, carbon, Manganese	Rock driller, plates, rails, protecting shields
Brass	Copper, Zinc	Parts of machinery, wires, music instruments
Duralumin	Aluminium, Copper, Magnesium, Manganese	Aircraft parts, light tools
Silumin	Aluminium, Silicon	Making of engine parts
Magnalium	Aluminium, Magnesium	Steamer, trolley
Constantan	Copper, Nickel	Electric instruments
Invar	Iron, Nickel, Carbon	Clock, pendulum, Scientific measuring instruments
Phosphor bronze	Copper, Tin, Phosphorus	Spring and suspension, filament
Chrome vanadium steel	Iron, Carbon, Chromium, Vanadium	Axles of motor cars
Sterling silver	Copper, silver	Silver coins
Chrome steel	Chromium, Iron, Carbon	Spring, tools
Gun Metal	Copper, Zinc, Tin	Gun barrels
German Silver	Copper, Nickel, Zinc	Resistance wire, Utensils
Stainless steel	Iron, Carbon, Nickel, Chromium	Surgical instruments
Nickel Steel	Iron, Carbon, Nickel	Electric wire, Automobile parts
Solder	Lead, Tin	Electrical connections, fuse wire
Coinage silver	Copper, Nickel	Coins
Type metal	Copper, Lead, antimony	Types in printing
Electrum	Gold, Silver	--

Amalgam is an alloy in which one of the components is **mercury**

Compounds & their Uses

- Photographic films are coated with **silver bromide**
- Artificial rain is caused by **Silver iodide**.
- Hydrogen sulphide has the smell of **rotten egg**.
- Bleaching powder is chemically **Calcium Hypo Chlorite** (CaOCl_2).
- **Coral reefs** are chemically Calcium Carbonate.
- Dry Ice is Solid Carbon Dioxide.
- **Zinc Phosphide** and **Arsenic Sulphide** are rat poisons.
- Laughing gas is **nitrous oxide**. It is used as an **anaesthetic**.
- Benzyl Chloride is used as **tear gas**
- **Carborundum** is Silicon Carbide.
- **Potassium Cyanide** is used to reduce the melting point of gold.
- Sodium Citrate is used as a **preservative** for human blood.
- Sodium peroxide is used as **air purifier** in Submarines.
- Paper is chemically **Cellulose**.
- Rust is chemically **hydrated ferric oxide**.
- **Methyl Isocyanide** is the gas that caused Bhopal tragedy
- **Titanium dioxide** is used for manufacturing of white paints and it is the whitest compound.
- Impure Sodium Carbonate obtained in the industrial process is called **Black Ash**.
- Lead Chromate is used as pigments. It is known as **Chrome Yellow**.
- Ferro magnetic powder is coated in tape recorders.
- CO_2 is used in **fire extinguishers**.
- Aluminium compound used in fire extinguishers is called **Alum**.
- **Hypo** is chemically Sodium thiosulphate is used as fixer in photography
- Ferrous sulphate crystal is known as **green vitriol**.
- The main constituents of pearl are **calcium carbonate** and **magnesium carbonate**.

- **Ruby, Sapphire, Corundum** is Aluminium Oxide.
- **Smelling salt** is chemically Ammonium Carbonate.
- Zinc Oxide is known as **philosopher's wool**.
- Mica is the naturally occurring **Aluminium Silicate**. Mica is a good conductor of heat and bad conductor of electricity.
- Asbestos is known as **rock cotton**.
- Methyl Bromide is used as pesticide.
- Potassium Ferro cyanide is used in manufacturing of Prussian blue.
- Calcium Phosphate is found in the bones of animals.
- Vegetable Gold is **Saffron**.
- Baking powder is a mixture of tartaric acid and baking soda .Baking soda is sodium bicarbonate.
- Mixture of Copper Sulphate and Calcium Hydroxide is known as **Bordeaux** mixture. It is used as a fungicide.
- Gun powder is a mixture of **sulphur, Charcoal and nitre**
- **Formaldehyde** is used for preserving dead bodies.
- Sodium Benzoate is used for preserving grains and food.
- Ammonia is a compound of nitrogen and hydrogen (NH₃) and it is industrially manufactured through Haber's process.

Acids, Bases, & Salts

Acids

- Acids are substance which produces Hydronium Ions (H₃O⁺) in aqua solutions.
- **Hydrogen** is commonly seen in all acids.
- Acids turn blue litmus paper into red and it is sour in taste.
- Sulphuric acid is known as **king of chemicals** and **Oil of vitriol**.
- Sulphuric acid is manufactured through Contact process .It is used for manufacturing of fertilizers and explosives.
- Earliest known acid is **acetic acid** better known as **Vinegar**.
- Old name of HCl is **muriatic acid**. HCl is found in Gastric juice in Stomach.
- Weakest inorganic acid is Hydrocyanic acid.
- Dilute phenol is called **carbolic acid**
- The acid used for Hypnotic purpose is Barbituric acid
- Concentrated nitric acid is used for purification of gold.
- Old name of nitric acid is **Aqua Fortis**.
- Cola contains Phosphoric acid.
- Ordinary Soda water is chemically **Carbonic acid**.

Acids	Substance
Lactic Acid	Sour milk, Curd
Citric acid	Orange, lemon
Tartaric acid	Tamarind, Grape
Acetic acid	Vinegar
Oxalic acid	Onion , Chocolate
Hydrocyanic acid	Tapioca, tomato, banana
Lauric acid	Coconut milk
Capric acid	Coconut
Formic acid	Ants
Uric acid	Urine
Tannic acid	Tea
Stearic acid	Fat
Oleic acid	Olive oil
Maleic acid	Apple
Ascorbic acid	Apple

Bases

Oxides and hydroxides of metals are known as base

Some bases and their Uses

Sodium Hydroxide	Manufacturing of washing soap
Potassium Hydroxide	Toilet soap, Alkaline batteries
Calcium Hydroxide	Manufacturing of bleaching powder, mortar, softening of hard water, neutralising acid in the soil and water supplies
Magnesium Hydroxide	Used as antacids
Aluminium Hydroxide	Forming agent in fire extinguishers
Ammonium Hydroxide	Remove grease stains in clothes

pH Value

- Measure of acidic or basic character of a liquid or solution is pH Value
- pH scale is introduced by **Sorenson**
- pH value ranges from **0 to 14**
- Pure neutral solution has pH Value 7
- When pure water boils pH Value gradually decreases to 6.8
- pH Value > 7 up to 14 is basic
- pH value 0 to 6.9 is acidic

Pure water	7
Human blood	7.3or7.4
saliva	6.5- 7.4
Sea water	8.5
milk	6.5
tea	5.5
coffee	5
urine	6
Lemon juice	2.4

- Buffer solution is the solution which resists change in the pH value of alkali or acid.

Salts

Salts are ionic compounds containing a positive ion () and a negative ion (anion)

- Sodium bi Carbonate (baking soda) is an essential ingredient in baking water.
- **Sodium Benzoate** is a food preservative for pickles.
- **Potassium Nitrate** (Nitre) is used in the production of gun powder.
- Calcium Carbonate (Lime Stone) is used in the construction of building, cement industry

Water

- Water is known as **universal solvent**.
- Water has greatest density at **4° C**.
- Oxide of deuterium is called heavy water.
- Temporary hardness of water is due to the presence of **bicarbonates of Calcium and Magnesium**. It can be removed by boiling the water.
- Permanent hardness of water is due to the presence of **sulphates and chlorides of Calcium and Magnesium**. It can be removed by adding washing soda or by ion exchange method.

Applications of Chemistry

Polymer

- Polymer is a very large chain like molecules made up of monomers, which are small molecules .They can be naturally occurring or synthetic.
- **Cellulose and silk** are natural polymers . And Nylon, Rayon, Teflon, Polyester and Orlon are **synthetic polymers**.
- Plastics are synthetic polymers. First man made plastic is **Bakelite** and it is made from Phenol and Formaldehyde.
- Teflon is a polymer called Poly tetra fluoro ethylene. It is used to coat non stick cook wares
- **Rayon** is known as artificial silk and is used in carpets, tyre code, surgical dressing, fabrics etc.

Rubber

- Rubber is a polymer of **Isoprene** and is a naturally available elastic polymer
- First artificial rubber is Neoprene.
- **Vulcanisation** is the process of heating the rubber with Sulphur to enhance tensile strength, hardness elasticity and ability to withstand heat changes.

Cement

- Cement is a complex mixture of Aluminates and silicates of Calcium and it was invented by **Joseph Aspidin**.

Glass

- Glass is a super cooled liquid made up of **sand, lime and soda ash**.
- **Flint glass** is a type of glass used to make **lenses and prisms**. Its components are Silica, Potassium Carbonate and Lead Oxide
- **Fibre glass** is used to make helmets and Furniture
- **Safety glass** is used in the manufacture of bullet proof screens
- **Borax** increases the hardness and refractory character of glass.

Colours for Glasses can be given by using metallic oxides

Ferric acid	Yellow
Ferrous or Chromium	Green
Cobalt	Blue
Manganese dioxide	Purple
Nickel	Red
Cadmium Sulphide	Lemon Yellow
Uranium oxide	Greenish yellow
Cryolite/Calcium phosphate	Opaque milk white colour

Explosives

- **Trinitrotoluene (TNT)** is a highly explosive substance manufactured by the action of concentrated nitric acid on Toluene
- **Dynamite** was discovered by **Alfred Nobel**

Organic Chemistry

The study of hydrocarbons and their derivatives is known as Organic chemistry

- First organic compound synthesised in the laboratory is **urea**.
- The saturated hydrocarbons (carbon atoms linked together by single bonds) are comparatively stable to usual chemical reagents. They are known as Paraffins (Alkanes)
- Carbon atoms linked together by multiple bonds are known as unsaturated hydrocarbons (Alkenes, Alkynes)

Alkanes

- Alkanes are represented by general formula C_nH_{2n+2} .
- **Methane** (CH_4) is the first member of alkane series.
- Methane is called **Marsh gas or Damp fire**.

Alkenes

- Alkenes are represented by the general formula C_nH_{2n} . They are unstructured hydrocarbons and known as **Olefins**.
- The simplest alkene is **ethylene** or ethane C_2H_4 .

Alkaloids

- | | |
|---|--------------------------------------|
| ➤ | Coffee ----- Caffeine |
| ➤ | Pepper ----- Piperene |
| ➤ | Chilly ----- Capsaicin |

Alkyne

- Alkynes are represented by C_nH_{2n-2} .
- Acetylene (C_2H_2) is the simplest alkyne

Alcohols

- Alcohols are compounds which contains one or more hydroxyl group (OH)
- Methyl alcohol is called wood spirit ($CH_3 OH$).

- Ethyl alcohol (C_2H_5OH) is called **grain alcohol**. It is used in preparation of various beverages.
- Ethyl alcohol containing 5 to 10% methyl alcohol is called methylated spirit or denatured spirit
- **100% ethanol** is called absolute alcohol.
- Mixture of ethyl alcohol (95.87%) and water (4.13%) is known as rectified spirit.
- Compounds in which Oxygen atom is attached to primary carbon atom are called Aldehydes. General formula of Aldehyde is $RCHO$. If oxygen atom is attached to secondary carbon atom, then the compounds are known as Ketone. General formula of Aldehyde is $RCOR$
- **Formaldehyde** is used for preserving biological specimens.

Fuels

- **LPG** is liquefied petroleum gas. **Butane** is major component present in LPG
- Petroleum is commonly called as **liquid gold**
- Petrol is also known as **gasoline**.
- The rating of fuel is done on the basis of Octane number in petrol and cetane number in diesel.
- **Tetraethyl Lead (TEL)** is known as anti Knock compounds.
- Water gas is a mixture of hydrogen and Carbon monoxide and it is used as industrial fuel.
- Producer gas is a mixture of Nitrogen and Carbon Monoxide (CO).
- Methane is the major component of Compressed Natural Gas (CNG).
- Both LPG and CNG contain traces of **Propane**.
- Biogas contains **methane**.
- **Gobar gas** obtained from cow dung is used as an alternative for LPG.
- Coal gas is a mixture of Hydrogen (40%) Methane (35%) Carbon Monoxide (6%) Nitrogen (6%) Ethane (3%) Acetylene (2%) Carbon dioxide (1%).
- Carbon content in Coal varies with types of coal
 - **Anthracite** is the purest form of mineral coal and it contains 90% of carbon.
 - Bituminous coal contains 70% of carbon.
 - Lignite coal contains 40% of carbon.
 - **Peat** contains 10-15 % of carbon.
- Natural gas consist of Methane (84%) Ethane (8%) Propane (4%) and Butane (2%) together with small amount of other Hydrocarbon (2%).
- **Charcoal** is the most reactive form of Carbon.

Carbohydrates

- Compounds of carbon, Hydrogen and Oxygen are called Carbohydrates
- Monosaccharides are simple Carbohydrates. E.g. Glucose, Fructose
- Fructose is often called fruit sugar and it is the sweetest among natural sugar.
- Sweetness is measured using **Saccharimeter**.
- Honey is a mixture of equal amount of **Glucose and Fructose** with 20% water.
- **Saccharine** is the first artificial sugar.
- Sugar found in sugarcane and sugar beat is Cane sugar or **sucrose**.
- The sugar present in Grape is Glucose.
- The sugar present in milk is **Lactose**.

Common Name	Chemical Name
Rock Salt	Sodium Chloride
Carborundum	Silicon Carbide
Gypsum	Calcium Sulphate ($CaSO_4 \cdot 2H_2O$)
Plaster of Paris	Calcium Sulphate ($CaSO_4 \cdot 1/2H_2O$)
Common Salt	Sodium Chloride
Hypo	Sodium thiosulphate
Chalk	Calcium Carbonate
Spirit	Ethyl Alcohol
Baking Soda	Sodium bicarbonate
Soda Water	Carbonic acid
Lime stone	Calcium carbonate
Gun powder	Potassium Nitrate (Nitre)

Quick lime	Calcium oxide
Potash Alum	Potassium Aluminium Sulphate
Blue Vitriol	Copper Sulphate
Washing Soda	Sodium Carbonate
Caustic Soda	Sodium Hydroxide
White Vitriol	Zinc Sulphate
Green Vitriol	Ferrous Sulphate
Glauber's Salt	Sodium Sulphate
Chloroform	Trichloromethane
Bleaching Powder	Calcium Oxy Chloride
Epsom Salt	Magnesium Sulphate
Aspirin	Acetyl Salicylic Acid
Quartz	Silicon dioxide
Calamine	Zinc carbonate
Caustic Potash	Potassium Hydroxide

Nuclear Chemistry

➤ The branch of science that deals with the phenomenon of nuclei of atom is known as nuclear chemistry.

Radioactivity: It is the phenomenon of spontaneous emission of active radiation from certain substances and substance emitting such radiations is called radioactive substances.

- Radioactivity is of two types Natural and Artificial radioactivity
- If a substance emits radiation by itself it is called natural radioactivity
- If a substance does not possess radioactivity but starts emitting radiation on exposure to rays from a natural radioactive substance, it is called artificial radioactivity.
- The radioactive rays are of three kinds **Alpha (α), Beta (β), Gama (γ).**

Alpha (α)

- They consists of positively charged particle it is represented by ${}^2_2\text{He}_4$
- Velocity of alpha particle is $1/5^{\text{th}}$ of that of velocity of light.
- They can produce glow on a fluorescent screen.
- They effects photographic plate
- They can penetrate through metal foils
- They can cause ionisation of gases.

Beta (β)

- Beta rays consists of negatively charged particles i.e. electrons.
- Velocity of beta particles ranges between 33 to 99 % of that of light
- They can produce glow on a fluorescent screen.
- They affect photographic films.
- Beta particles have more penetrating power than alpha particles.
- Beta particles cannot ionise gases as strongly as alpha particles.

Gama (γ)

- Gamma rays are not constituted of charged particles. it is a form of powerful electromagnetic radiation with very short wavelength .And it is not deflected by any electric or magnetic field.
- Velocity of gamma rays is equal to that of light.
- They can produce glow on fluorescent screen
- They affect photographic films.
- They can cause ionisation of gases.
- They have much penetrating power than beta rays
- Half life period: Half life period of a radioactive element is the time required for the decay of one half of its original weight.
- **Artificial Transmutation** is the conversion of a stable nucleus by the bombardment of particles like proton, neutron etc. Artificial transmutation was discovered by Rutherford.
- **Nuclear fission** is the process of splitting up of two or more lighter nuclei by bombardment with a suitable sub-atomic particle
- Nuclear fission was discovered by **Ottohann and Strassman**

- **Nuclear fusion** is the reaction in which two or more nuclei collide at a very high speed and joint to form a nucleus. It is also called thermonuclear reaction.
- Natural radioactivity was discovered by Henry Becquerel
- Artificial radioactivity was discovered by **Irene Joliot-Curie** and **Frederic Joliot**
- The principle of atomic bomb is uncontrolled nuclear fission and that of Hydrogen bomb is nuclear fusion.
- Energy of sun is supposed to arise from nuclear fusion reaction.
- Simplest radioactive atom is tritium (${}^3_1\text{H}$). It is a beta emitter.
- Age of fossils is calculated by radio carbon dating using **Carbon-14**.
- **Cobalt-60** is used for the treatment of cancer.
- **Gold-198** is used for the treatment of Leukaemia
- Angiogram test is done by using **Sodium-24**.
- Strontium-89 is effective in reducing the pain of prostate and bone cancer.

Chemical Process

- **Chromatography** is the method to separate different components of a mixture by passing it through a solution.
- **Sublimation** is the conversion of substance directly from solid state to vapour state. Eg. Camphor, Iodine
- **Electroplating** is the deposition of a metal on another by electric current.
- **Bosch Process** is the production of Hydrogen by the catalytic reduction of steam with Carbon monoxide at 500°C.
- **Haber process:** The process in which Ammonia is prepared by combining Nitrogen and Hydrogen.
- **Contact Process:** The process of preparing sulphuric acid.
- **Ostwald Process :** The preparation of nitric acid
- **Cyanide process :** Used for the extraction of silver and gold
- **Pasteurisation:** The process by which milk is exposed to a high temperature from 62.8°C to 65.5°C for 30 minutes to destroy certain micro organisms and to prevent fermentation.

Miscellaneous Facts

- **White Phosphorous** has the smell of Garlic.
- Ammonium Chloride is called as '**Sal Ammoniac**'.
- The first alloy of Copper used by man is **Bronze**.
- The Scientist who classified elements as metals, non-metals and metalloids is **Lavoisier**.
- **Stibium** is the Latin name of Antimony.
- Joseph Priestly discovered **Soda water**.
- 'Antigen' is a substance of Stimulates the production of an antibody.
- In normal atmospheric air, oxygen contains 21 percent.
- The Atom Theory proposed by **John Dalton**.
- The gram molecular mass of water is 18 gm.
- **Linus Pauling** invented 'Electro negativity scale'.
- Uranium is known as **nuclear metal**.
- Calcium Oxychloride is the chemical formula of **Bleaching power**.
- Avogadro used the term 'molecule' first.
- **Lead** is the most stable element.
- Thorium is separated from **Monazite**.
- Chlorine used as a bleaching agent.
- **Mercury** has lowest melting point.
- Copper is used for the manufacturing of CD.
- The alloy used for making the body of aeroplane is **Duralumin**
- Sodium Bicarbonate is known as 'Baking Soda'.
- DDT (Dichloro Diphenyl Trichloro Ethane) was invented by **Paul Muller**.
- **Formic acid** is known as 'Methanoic acid'.
- **Cobalt oxide** compound gives blue colour to glass..
- Lignite is known as '**Brown coal**'.
- The unit used to measure the pollution is PPM (Parts per Million).
- **Titanium** is called 'Metal of Future'.

- Trichloro ethane is the chemical used in dry cleaning.
- **Brown ring test** is used to detect the presence of Nitrate.
- **Vanadium pentoxide** is used as a catalyst in the manufacture of Sulphuric acid.
- **Joseph Aspidin** invented cement.
- **Stainless steel** is the alloy used to make surgical tools.
- Sodium hydroxide is known as **Caustic soda**.
- **Naphthalene** is known as 'White tar'.
- **Oxygen** is the most abundant element present in human body.
- **Sodium** controls the blood pressure in human body.
- Beryllium Aluminium Silicate is the chemical name of **Emerald**.
- **Lead** is used in storage battery.
- **Carbon dioxide** is the gas used for extinguishing fire.
- Safety Lamp discovered by **Humphry Davy**.
- Heating in the absence of air is called **Calcinations**.
- 'Lead Chamber process' is related with the manufacture of **sulphuric acid in large scale**
- The preparation of soap involving process is called **Saponification**.
- **Covalent bond** is the chemical bond found in organic compounds.
- **Hermann Staudinger** is known as '*Father of Polymer Science*'.
- The organic compounds which have the smell of flowers and fruits are **Esters**.
- **Chain Isomerism** shows pentane.
- **Mondinote** wrote the text 'Anatomia'.
- Number of Isotopes of Oxygen are **3**.
- **Benjamin Franklin** invented the lightening rod.
- **Alfred Nobel** discovered dynamite.
- **Rayon** is known as 'Artificial silk'.
- **Stannum** is the Latin name of Tin.
- **Phosphorous** is kept in water.
- Noble gasses were discovered by **William Ramsay**.
- **Copper** is the first metal used by men.
- 100% acetic acid is known as **Methyl Phenyl Acetate**.
- **Anthracite** is known as 'Hard coal'.
- **Malic acid** is present in plum.
- **Copper** is used in telephone cable.
- Malathion is a **Pesticide**.
- **Safety glass** is used as wind glass in vehicles and Aeroplanes.
- A Thermo setting plastic is **Bakelite**.
- **Blue** colour is produced by Hydrogen vapour lamp.
- In **1974** first nuclear test explosion conducted in India.
- National Technology day is celebrated in **May 11**.
- **Berzelius** who gave symbols for elements.
- **Kekule** founded the structure of Benzene.
- **Iron pyrites** is known as 'fool's gold'.
- Amino acids are the building blocks of **Proteins**.
- The gas used in ice plants is **Ammonia**.
- **Fractional Distillation** is the method used for the purification of petroleum.