

ORGANIC CHEMISTRY

- Organic chemistry involving the scientific study of the structure, properties, composition, reactions, and preparation (by synthesis or by other means) of carbon-based compounds, hydrocarbons, and their derivatives
- Hydrocarbons and their derivatives are called Organic Compounds
- Carbon has three allotropes — diamond, graphite and amorphous carbon.
- Fullerenes are newly discovered allotropes of carbon.
- Compounds of carbon and hydrogen are called hydrocarbons.
eg: Fuels,
- Compounds of carbon, Hydrogen and oxygen (C:H:O – 1:2:1) are called carbohydrates.
eg: Sucrose, glucose, cellulose
- Turpentine is an essential oil which is an important solvent for polishes and lacquers.
- LPG means Liquefied petroleum gas, major component present in it is Butane.
- Leakage of LPG can be identified by mixing it with Ethyl Mercaptan.
- CNG means Compressed Natural Gas, major component is methane
- Both, LPG & CNG contain traces of propane.
- CFCs are also known as Ozone Depleting Substances (ODS) for it causes depletion of the

Important Compounds & Discoverers

Carbondioxide	Joseph Black
Benzene	Michael Faraday
Morphine	Friderich Sertumer (Germany, 1805)
Aspirin	Dreser (Germany, 1889)
Dichloro Diphenyl Trichloro Ethane (DDT)	Paul Muller (Germany, 1939)
Carbon tetra chloride	Michael Faraday
Carbon hexa chloride	Michael Faraday
Ozone	Christian Friedrich Schonbein (1840)
Carbon Monoxide (first prepared)	JMF de Lassone (France, 1778)
Carbon monoxide (first identified the composition)	William Cruikshank (England, 1800)
Nitrous Oxide	Joseph Priestly

Ozone layer.

- The domestic cooking gas consists mostly of liquefied butane and isobutane.
- RDX and Nitroglycerine are explosives.
- The chemical commonly used for preserving biological specimens is **formaldehyde**.
- Alcoholic beverages contain ethyl alcohol.
- Protein is composed of carbon, hydrogen, nitrogen and oxygen.
- The solution used to detect glucose in urine is Benedict solution (Alkaline solution of copper sulphate and sodium citrate).

Corrosion

The process of damage of metals by the action of any medium from its surroundings is called corrosion of metals.

- Bio-energy is a renewable source of energy.
- Crude petroleum is converted into petrol through a process called fractional distillation.
- Lead is added to petrol as an octane booster to prevent knocking.
- Mercury is generally used as a thermometric fluid rather than water because it has greater visibility than water.
- Cooking oil can be converted into vegetable ghee by the process of hydrogenation.
- Ethanol is also called 'grain alcohol'.
- The commonly used refrigerant in fridges is Freon (dichloro difluoro methane).
- Freshly passed urine has no smell, but when it is allowed to stand, it develops a strong ammonia odour owing to conversion of urea to ammonia by bacteria.
- Cheese and vinegar are made by fermentation.
- Non-stick kitchenware are

coated with teflon and potassium hydrogen tartrate.

- Teflon is a polymer named 'poly tetrafluoro-ethylene (PTFE).
- The main constituent of dynamite is T.N.T.
- Anthracite is the purest form of mineral coal.
- Gelatin is used in the manufacture of icecream to prevent crystal growth.
- Soaps are produced by the **saponification** of fats with alkali solution.
- Ethylene is a gas used for the artificial ripening of green fruit.
- *Natural gas predominantly is methane.*
- The chief chemical constituent of petroleum is hydrocarbons.
- Among the fertilizers, urea has the maximum nitrogen content.
- Wood heated in an enclosed container will produce charcoal.
- Petrol is otherwise known as gasoline.
- *Enzymes* are substances that convert organic substances into simpler substances.
- Chemically enzyme is protein.
- Gas oil is same as the diesel oil.
- Interferon is a substance produced by cells in response to virus infections. It usually prevents other viruses from infecting simultaneously.
- Chemically interferon is a *glycoprotein*.
- The sweetest among the sugars is **fructose** ($C_6H_{12}O_6$).
- Artificial silk is also called **rayon**.

- Gobar gas is a natural gas obtained from cow dung and it has higher fuel value and commercial value. It is used as an alternative fuel to LPG.
- Chiefly biogas contains **methane** while LPG (Liquefied petroleum gas) contains **butane**.
- Marsh gas is Methane.
- Coal gas is a mixture of hydrogen (48%), methane (35%), carbon monoxide (6%), nitrogen (6%), carbon dioxide (1%).
- Methane causes about 38% of the warming of the globe through the green house effect.

Diamond

- The atoms of carbon are joined in a 3-dimensional tetrahedral structure in diamond.
- Diamond is brittle, crystalline and the hardest naturally occurring substance.
- It is the densest form of carbon.
- Transparent to light and X-rays, it is a good conductor of heat, but not of electricity.
- It is insoluble in all known solvents.

Application of some common organic compounds

1. Alkanes

The major sources of alkanes in nature are petroleum and natural gas. The refining of these give liquefied petroleum gas (LPG), petroleum ether, petrol, kerosene oil, fuel oil, diesel, lubricating oil, paraffin wax, asphalt, etc. These are commonly used in our daily life and industry as fuels.

2. Alkenes

Common Organic Compounds

Common name . Chemical name

Marsh gas Methane
 Chloroform ... Trichloromethane
 Methanol Methyl Alcohol
 Ethanol Ethyl Alcohol
 Vinegar Acetic acid

The lower alkenes (C_2H_4 to C_5H_{10}) are obtained during refining of petroleum. The important uses of alkenes are given below:

- a) Alkenes are used to prepare many polymers such as polyethylene (from ethene), polypropylene (from propene), synthetic rubber (from 1, 3-butadiene), polyvinyl chloride, PVC (from vinyl chloride), polyvinyl cyanide, orlon (from vinyl cyanide), etc.
- b) Alkenes can be used to prepare other organic compounds like alcohols, aldehydes, ketones on a large scale.

3. Alkynes

The important alkyne is acetylene. It is used:

- a) for synthesis of large number of organic compounds.
- b) for welding purposes.

4. Arenes

These are also known as aromatic compounds. These are obtained from petroleum and coal.

- a) Simple arenes like benzene, toluene, xylene, etc., are used to manufacture synthetic fibres, synthetic detergents and explosives (e.g. trinitro-

- toluene, TNT).
- b) Naphthalene is used as moth balls.
 - c) Naphthalene and anthracene are used to prepare artificial dyes for textiles.

5. Alcohol

The two important alcohols are methanol (methyl alcohol) and ethanol (ethyl alcohol).

6. Aldehydes and ketones

The two important aldehydes are methanal (formaldehyde) and ethanal (acetaldehyde) and two important ketones are propanone (acetone) and 2-butanone (methyl/ethyl ketone).

7. Alkyl halides

8. Acid

The acids like methanoic acid (formic acid) and ethanoic acid (acetic acid) are present in ants and vinegar respectively.

9. Nitro compounds

The important uses of nitro compounds are:

- a) Nitro compounds such as nitromethane, nitro ethane and nitrobenzene are used as industrial solvents.
- b) Many nitro compounds such as nitroglycerol, nitrocellulose and trinitrotoluene (TNT) are used as explosives.

10. Amines

- a) Amines are used in the manufacture of nylon.
- b) Aromatic amines are important intermediates in dye-stuff industry.
- c) Compounds containing

both amines and carboxylic acids as functional groups are called amino acids. These are constituents of proteins which are also building blocks of living things.

11. Amides

These are mostly used as laboratory reagents. Urea is commonly used as a well known fertilizer. It is also used in the manufacture of resins.

- ❑ Benzene is a solvent for fats, resins etc.
- ❑ Ethanol or ethyl alcohol which is found in alcoholic beverage is made by heating ethylene and water under pressure in the presence of a catalyst.
- ❑ Acetylene is used in artificial ripening of fruits.
- ❑ Acetylene or Ethyne is the simplest member of alkyne family.
- ❑ Turpentine is an essential oil which is an important solvent for polishes and lacquers.
- ❑ Gelatin is used in the manufacture of ice cream to prevent crystal growth.
- ❑ Cheese and vinegar are made by fermentation.
- ❑ The chemical name of aspirin is acetyl salicylic acid.
- ❑ The sugar found in milk is lactose.
- ❑ Chemically, cane sugar is sucrose.
- ❑ Methane causes about 38% of the warming of the globe through the green house effect.
- ❑ Soaps are produced by the saponification of fats with alkali solution.
- ❑ CFCs(chloro-fluoro carbons)

are also called Ozone Depleting Substances (ODS) for it causes depletion of the Ozone layer.

- ❑ The main constituent of dynamite is T.N.T.
- ❑ Marsh gas is methane.
- ❑ The sweetest among sugar is fructose.
- ❑ Teflon is a polymer named polytetrafluoro ethylene (PTFE).
- ❑ Non-stick kitchenware are coated with teflon and potassium hydrogen tartarate.
- ❑ RDX (cyclo trimethylene trinitramine) and Nitroglycerine are explosives.
- ❑ Amino acids are the basic components of proteins.
- ❑ Chemically interferon is a glycoprotein.
- ❑ Alkaline solution of copper sulphate and sodium citrate is called Benedict's Solution which is used to detect glucose in urine.
- ❑ The chemical commonly used for preserving biological specimens is formaldehyde.
- ❑ Cooking oil can be converted into vegetable ghee by the process of hydrogenation.
- ❑ Petrol is otherwise known as gasoline.
- ❑ Chemically enzyme is protein.
- ❑ Enzymes are substances that convert organic substances into simpler substances.
- ❑ Ethanol is also called grain alcohol.
- ❑ The commonly used refrigerant in fridges is freon (dichloro difluoro methane).
- ❑ Wood heated in an enclosed container will produce charcoal.
- ❑ Amines are used in the manu-

fracture of nylon.

- Ethanoic acid (acetic acid) is used to prepare plastics, paints and rayon.
- 1,2,3 - propane triol is known as glycerol which is used in confectionary and cosmetics.

Radioactivity

- The phenomenon of spontaneous emission of active radiations from certain substances is called radio activity and the substance emitting such radiations are called radio active substances.
- Radioactivity is classified into two types natural radioactivity and artificial radioactivity.
- If a substance emits radiations by itself, it is said to possess natural radio activity.
- If a substance does not possess radioactivity, but starts emitting radiation on exposure to rays from a natural radio active substance, it is said to possess induced or artificial radio activity.
- Under the influence of electric and magnetic field, the radioactive rays split into three kinds. They are named alpha (α), beta (β) and gamma (γ) rays.

Properties of alpha rays:

- 1) Consists of positively charged particles.
- 2) It is represented by ${}^4_2\text{He}$
- 3) Velocity of alpha particles is approximately $\frac{1}{10}$ th of that of light.
- 4) They can penetrate through thin metal foils.
- 5) They cause ionisation of gases
- 6) They can produce glow on a fluorescent screen.

- 7) They affect photographic plates.

Properties of Beta rays:

- 1) Consists of negatively charged particles.
- 2) Beta particles are nothing but electrons.
- 3) Velocity of Beta particles ranges between 33 and 99% of that of light.
- 4) They have more penetrating power than alpha particles.
- 5) They cannot ionise gases as strongly as α -particles can.
- 6) They can produce glow on a fluorescent screen.
- 7) They affect photographic plates.

Properties of gamma rays:

- 1) γ -rays are not deflected by magnetic or electric field.
- 2) They are not constituted of charged particles. γ -rays are a form of powerful electromagnetic radiation of very short wavelength.
- 3) Velocity of gamma rays equals that of light.
- 4) They have much higher penetrating power than α and β rays.
- 5) They can cause ionisation of gases.
- 6) They produce glow on fluorescent screen.
- 7) They affect photographic plates.

The main cause of radioactive disintegration is the instability of the nucleus.

Group Displacement law:

“The emission of an α -particle by an element results in the formation of a new element which lies two places to the left of the parent element and the emission of a β -particle results in the formation of a new element

which lies one place to the right of parent element in the periodic table”.

- Decay constant (λ) may be defined as the fraction of the total number of radio active atoms disintegrating in unit time.
- Half life period ($t_{1/2}$): The half life period of a radio active element is defined as the time required for the decay of one half of its original amount

$$t_{1/2} = \frac{0.693}{\lambda}$$

- **Artificial transmutation:** The conversion of a stable nucleus into another nucleus by the bombardment of particles like protons, neutrons, α -particles etc is known as artificial transmutation.
- Nuclear Fission is defined as the process of splitting of a heavy nucleus into two or more lighter nuclei by bombardment with a suitable sub-atomic particle.
- The principle of atomic bomb is the uncontrolled nuclear chain reaction.
- Nuclear Fusion may be defined as a process in which two or more lighter nuclei combine to form a heavier nucleus.
- The nuclear fusion reaction is the basis of the hydrogen bomb.
- **Radio carbon dating:** is the technique of determining the age of old carbonaceous materials using the radio activity of carbon-14 isotopes.
- Radio carbon dating was developed by Willard F.Libby and he was awarded Nobel Prize for the same.
- Natural radioactivity was discovered by Henry Becquerel.
- Artificial Radioactivity was

discovered by **Irene Curie & F. Juliot.**

- Simplest Radioactive atom is ${}_1\text{H}^3$ (Tritium)
- Tritium is a beta emitter.
- The daughter element of Tritium is Helium - $3({}_2^3\text{He})$
- Age of fossil can be calculated by *Radio - Carbon - Dating*, using carbon - 14.
- *Wine Dating* can be done by using Tritium.
- Rock-Dating (Age of planet) can be calculated by Uranium dating by using U-238 and Pb - 206.
- Radioactive Iodine (Iodine - 131) is used for the treatment of Hyper Thyroidism.
- Cobalt - 60 isotope is used for cancer treatment.
- Deficit in blood-circulation is identified by using phosphorus - 32
- Gold - 198 is used for the treatment of Leukaemia.
- Angiogram Test is done by using sodium - 24
- Bone Cancer can be diagnosed by using phosphorus - 32.
- Highest velocity is shown by gamma rays (same as light)
- Highest penetrating power is also shown by gamma rays due to very high energy (very short wavelength)
- During beta emission isobars are produced.
- Controlled fission reaction is done in Nuclear Reactor.
- The coolants used in Nuclear Reactor is Liquid Sodium.
- Graphite Rods and Cadmium Rods are used as moderator in Nuclear Reactor.
- Five research reactor of India at BARC are Purnima, Zerlina, Dhruva, Circus and Apsara.

Important Processes

Bosch process	Hydrogen
Castner process	Sodium
Down's process	Sodium
Nelson cell	NaOH
Castner Kellner cell	NaOH
Lowing process	NaOH
Solvay process	Na_2CO_3 & NaHCO_3
Leblanc process	Na_2CO_3
Precht process	K_2CO_3
MacArthur Forrest process (Cyanide process)	Ag
Parke's process	Ag
Pattinson's process	Ag
Cupellation process	Ag (Purification)
Mond process	Ni
Baeyer's process	Al
Serpeck's process	Al
Hoope's process	Al (Purification)
Hall-Heroult process	Al
Goldschmidt process	Thermite welding
Carter process	basic lead carbonate (White lead)
Haber's process	NH_3
Birkeland-Eyde process	NO , HNO_3
Oswald process	NO , HNO_3
Deacon's process	Cl_2
Lead chamber process	H_2SO_4
Contact process	H_2SO_4
Kaldo and L.D. process	Steel
Corey-House	Alkane
Oxo process	Alcohol
Dow's sea water process	Mg
Pidgeon process	Mg
Cyanamide process	NH_3
Bessimer-Thomas process	Steel
Siemens process	Steel
Frasch process	Sulphur
IMI process	Ti

- Important Power stations in India are
 1. Tarapur Atomic Power Station - Maharashtra
 2. Rajasthan Atomic Power Station - Kota
 3. Narora Atomic Power Station - U.P
 4. Indira Gandhi Centre of Research - Kalpakkam (Chennai)
- Nuclear Fusion reaction takesplace in *Hydrogen Bomb*.

- Strongest Radioactive element is RADIUM.
- Liquid Radioactive metal is FRANCIUM
- Gaseous Radioactive element is RADON
- Unit of Radioactivity is Becquerel (Bq) ($1\text{Bq} = 1$ disintegration per second)
 $1\text{ curie} = 3.7 \times 10^{10} \text{ Bq}$
- Photographic film is very strongly affected by beta rays.

Common Name Chemical Name

Rock Salt	Sodium chloride (NaCl)
Carborundum	Silicon carbide
Gypsum	Calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)
Plaster of paris	Calcium sulphate ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$)
Nitre	Potassium nitrate (NaCl)
Red Lead	Triplumbic tetroxide (Pb_3O_4)
Common Salt	Sodium chloride
Hypo	Sodium thiosulphate
Candy fluid	Potassium permanganate (KMnO_4)
Soda nitre	Sodium nitrate
Chalk	Calcium carbonate (CaCO_3)
Spirit	Ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$)
Caustic potash	Potassium hydroxide (KOH)
Baking soda	Sodium bicarbonate (NaHCO_3)
Soda water	Carbonic acid
Limestone	Calcium carbonate (CaCO_3)
Gun powder Nitre	Potassium nitrate (KNO_3)
Lunar Caustic	Silver nitrate (AgNO_3)
Slaked lime	Calcium hydroxide (Ca(OH)_2)
Quick lime	Calcium oxide (CaO)
Liquor ammonia	ammonium hydroxide (NH_4OH)
Potash alum	Potassium aluminium sulphate
Blue vitriol	Copper sulphate (CuSO_4)
Washing soda	Sodium carbonate (NaOH)
Caustic soda	Sodium hydroxide
Calomel	Mercurous oxide
White vitriol	Zinc sulphate (ZnSO_4)
Sal ammoniac	Ammonium chloride (NH_4Cl)
Pearl Ash	Potassium carbonate
Green vitriol	Iron sulphate (FeSO_4)
Glauber's salt	Sodium sulphate
Caustic lotion	Silver nitrate
Chloroform	Trichloro methane (CHCl_3)
Litharge	Lead oxide
Bleaching powder	Calcium hypochlorite
Epsom salt	Magnesium sulphate
Aspirin	Acetyl salicylic Acid
Pentothal	Sodium pentothal
Quartz	Calcium oxide (CaO)

Chemical Processes

- **CHROMATOGRAPHY:** The modern and most effective method to separate different components of a mixture.
- **SUBLIMATION:** The conversion of substance directly from solid to vapour state.
Camphor, Iodine etc. undergoes sublimation.
- **OXIDATION:** The process of loss of electrons in a chemical reaction.
- **ELECTRO PLATING:** The deposition of the metal on another by electric current .
- **PASTEURIZATION** of milk is the process by which milk is exposed to a high temperature from 62.8°C - 65.5°C for 30 minutes to destroy certain micro - organisms and to prevent or arrest fermentation.
- ▶ The method used to obtain alcohol from molasses is called **fermentation**.
- **Bessemer Process :** Removal of impurities from molten metal by blowing air through the molten charge in a Bessemer converter. Used to remove carbon and phosphorus from steel; sulphur and iron from copper.
- **Bosch Process :** 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:** Preparation of sulphuric acid.
- **Alumino thermic process :** Preparation of chromium and manganese.
- **Cyanide process :** Used for the extraction of silver and gold.

Salts & Colours

1. Ferric salts – yellow
2. Ferrous salts – Green
3. Cobalt salts – Blue
4. Manganese dioxide – Purple
5. Nickel salt – green
6. Cupric oxide – Red
7. Cadmium sulphide – Lemon Yellow
8. Uranium oxide - Greenish Yellow
9. Cryolite - Milky
10. Calcium phosphate - Milky (opaque)

Miscellaneous

- Kevlar is a material for making bullet proof dresses.
- The oil in water is an example of *suspension*.
- Catalyst in a chemical reaction generally helps to accelerate the reaction.
- The main use of salt in the diet is to produce hydrochloric acid to digest the food.
- *Chlorination* means the addition of a small quantity of chlorine in water as a germicide.
- Hydrogen has the same atomic number and mass number.
- The ultimate source of nitrogen is the atmosphere but, plants and animals cannot assimilate atmospheric nitrogen directly.
- The animals get their nitrogen supply in the form of proteins from plants which in turn get their nitrogen supply from the soil in the form of nitrates.
- Ammonia (NH_3) is a compound of nitrogen. It can be manufactured by combining nitrogen and hydrogen at low temperature under high pressure.
- Air pollution caused by automobiles can be reduced by using lead free petrol and design alternations in automobiles.
- Carbon monoxide (CO) is most carcinogenic in nature.
- Normal Oxygen (O_2) and Ozone (O_3) are allotropes of oxygen.
- Diamond, corundum and topaz are all very hard. A scale called Moh's scale is used to indicate the degree of hardness of minerals.
- Purest form of iron is wrought iron.
 - ▶ Pure water is obtained from sea water by the process of distillation
 - ▶ Helium is preferred to hydrogen in air balloons because it does not form an explosive mixture with air.