CHEMISTRY IN EVERYDAY LIFE

MEDICINE OR DRUGS

Chemical substances helping to a human body or an animal either for treatment of diseases or to reduce suffering from pain are called medicine or drug.

The treatment of disease by chemical compound which destroy the micro organism without attacking the tissue of the human body is known as chemotherapy, and the compounds used are called chemotherapeutic agent. In general the drug may be defined as the substances used in the prevention, diagnosis, treatment or cure of disease in man or animals. Drug may be single chemical substance or a combination of two or more different substances. An ideal drug should satisfy the following requirements.

(i) When administered to the ailing individual, its action should be localised at the site where it is desired to act. (In actual practice, there is no drug which behaves in this manner).
(ii) It should act on a system with efficiency and safely.
(iii) It should have minimum side effects.
(iv) It should not injure host tissue or physiological process.
(v) The cell should not acquire resistance to the drug after sometime.

Very few drugs satisfy all the above requirements each drug has an optimum dose, below which it has no action and above this level it becomes a poison.

CHEMOTHERAPY

"The use of chemicals to destroy infectious micro organisms without causing any injury to the host is called as chemotherapy" .

Distinction between drugs and medicines :

- From chemistry point of view, there is no distinction between the terms drugs and medicines. i.e all drugs are medicines and all medicines are drugs.
- A medicine is a chemical substance which cures a disease safe to use and has negligible toxicity also does not cause addiction. In contrast a drug is a chemical substance which cures the disease but causes addiction and has serious side effects.

CLASSIFICATION OF DRUGS :

(a) On the basis of Pharmacological effect :

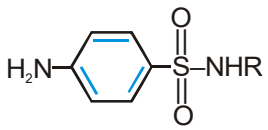
This classification is based on pharmacological effect of the drug. It is useful for doctors because it provides them the whole range of drugs available for treatment of particular type of health related problem for example, analgesics have pain killing effect antiseptics kill or stop the growth of micro organisms, tranquilizers reduces mental stress.

(b) On the basis of drug action :

It is based on the action of a drug on a particular biochemical process. For example, all antihistamines inhibit the action of the compounds histamine which causes inflammation in the body. There are various ways in which action of histamine can be blocked.

(c) On the basis of chemical structure : -

Drugs classified in this way share common structural features and often have similar pharmacological activity. For example sulphonamides have common structural feature, given below.



Structural features of sulponamides

(d) On the basis of molecular targets :-

Drugs usually interact with biomolecules such as carbohydrates, lipids, proteins and nucleic acids. These are called target molecules or drug targets.

Drug Target Interaction :

Macromolecules of biological origin perform various functions in the body for example proteins which perform the role of biological catalysts in the body are called enzymes, and those which are crucial to communication system in the body are called receptors.

Enzymes as Drug Targets :

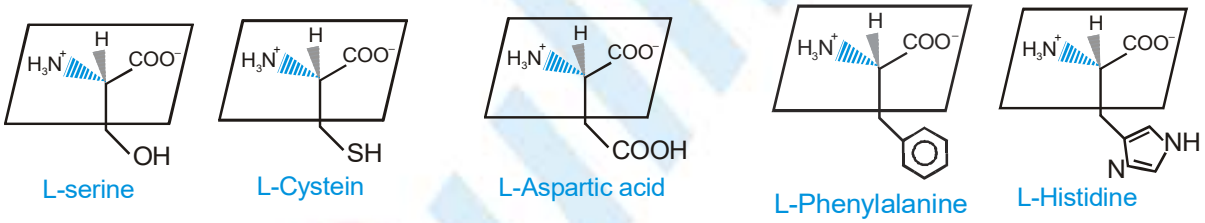
(a) Catalystic action of enzymes :

In catalytic activity, enzymes perform two major functions as follows

(i) To hold the substrate for chemical reaction :

Enzymes have active sites which hold the substrate molecules in a suitable position so that it can be attacked by reagent effectively. Substrate bind to the active site of the enzyme through a ionic bonding, hydrogen bonding vander waal's interaction or dipole-dipole interaction.

(ii) The second function of the enzyme is to provide functional group which will attacks the substrate to carry out chemical reaction. This function is carried out by some other amino acid residues of protein on the active site of the enzyme.



L-serine L-Cystein L-Aspartic acid L-Phenylalanine L-Histidine

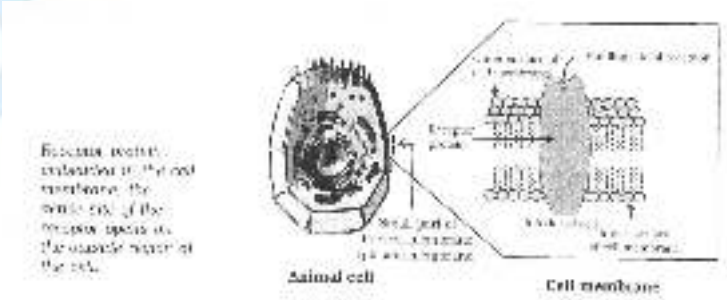
The part of amino acid which lies outside the box acts as a nucleophile in enzyme catalysed reaction but the part of the amino acid which is enclosed in the box is involved in the formation of peptide bond in protein molecule.

D-2 : Same drugs compete with the natural substrate for their attachment on the active sites of enzymes. Such drugs are called **competitive inhibitors.**

D-3 : Some drugs do not bind to the enzyme's active site. These bind to a different site of enzyme which is called **allosteric site.** This binding of inhibitors at allosteric site changes the shape of the active site in such a ways that substrate cannot recognise it.

Receptors as Drug Targets :

Receptors are proteins that are crucial to body's communication process. Majority of these are embedded in cell membranes in such a way that their small part possessing active site project out of the surface of the membrane and open on the outside region of the cell membrane



Ex.1 **How do receptors transfer message to the cell ?**

In the body, message between two neurons and between neurons to muscles is communicated through certain chemicals. These chemicals are known as chemical messengers, and received at the binding sites of receptor proteins. To accommodate a messenger shape of receptor site changes.

Note : There are large number of different- receptors in the body that interact with different-Chemical messengers. These receptors show selectivity for one chemical messenger over the other because their binding sites have different shape, structure and amino acid compositions.

D-4 : Drugs that bind to the receptor site and inhibit its natural function are called **antagonists**. These are useful when blocking of message is required.

D-5 : Other types of drugs that mimic the natural messenger by switching on the receptor these are called **agonists**. These are useful when there is lack of natural chemical messenger.

Various type of medicinal compounds are -

(A) Antiseptics :

Which prevent or destroy the growth of the harmful micro organism, common antiseptics are-

Dettol, Savlon, Cetavelon, acriflavin, lodine, methylene blue, mercurochrome & $KMnO_4$.

Dettol is a mixture of chloroxylenol and terpineol. Its dilute solution is used to clean wounds.

Bithional -It is added to soap to impart antiseptic properties

(B) Disinfectants :

The chemical compounds capable of completely destroying the micro organism are termed as disinfectants. These are toxic to living tissues.

These are utilized for sterilization of floor, toilets instruments & cloths.

eg. 1% solution of phenol in disinfectant while 0.2% solution of phenol is antiseptic.

*One substance can act as an antiseptic and also act as disinfectant for example

(a) 0.2 percent solution of phenol is an antiseptic while its 1% solution is disinfectant.

(b) Chlorine in 0.2 to 0.4 ppm in aqueous solution is used to disinfect drinking water.

(c) Hexachlorophene :- It is mainly used in soaps creams and emulsions.

(d) Thymol : It is a natural derivative of phenol and is a powerfull disinfectant

(e) Amyl meta cresol (5-methyl-2-pentyl phenol) it is used as antiseptic in mouth wash or gargles.

(f) Gentian violet and methylene blue are organic dyes but used as effective antiseptic.

(C) Analgesics :

The substance which are used to get relief from pain. These are of two types -

(a) Narcotics or habit forming drugs

(b) Non-narcotics

(a) Narcotics : These are alkaloids and mostly opium products, causes sleep and unconsciousness when taken in higher doses.

e.g. Morphine, codeine, heroine

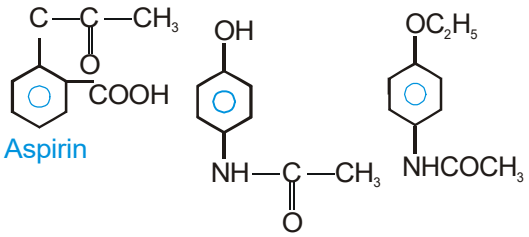
(b) Non-narcotics : Analgesics belonging to this category are effective antipyretics also.

e.g. Aspirin & novalgin, Ibuprofen, Naproxen

(D) Antipyretics :

To bring down the body temp. in high fever are called antipyretics.

e.g - (a) Aspirin, (b) Analgin (Novalgin), (c) Paracetamol, (d) Phenacetin



Aspirin

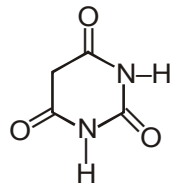
p– Ethoxy acetanilide
(Phenacetin)

(E) Antimalarials :

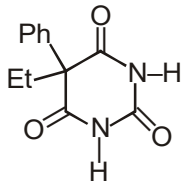
To bring down the body temperature during malarial fever.
e.g. Quinine, Chloroquine, Paraquine and Primaquine etc.

(F) Tranquilizers :

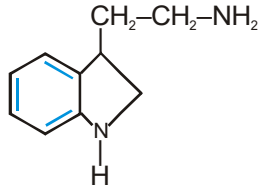
The chemical substances which acts on the central nervous system and has a calming effect. Since these are used for mental diseases so are known as psychotherapeutic drugs.



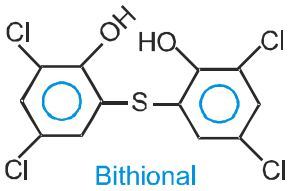
Barbituric acid



Luminal



Serotonin



Bithional

EDUBULL KEY POINTS

Reserpine, an alkanoid, is a powerful tranquilizer. It is obtained from a plant, Rauwolfia serpentina (common name - Sarpagandha) which grows in India.

They are of two types - (a) Sedative or hypnotics (b) Mood elevators

(a) **Sedative** : Reduce nervous tension and promote relaxation. e.g. Reserpine, barbituric acid and its derivatives as luminal & seconal.

(b) **Mood elevators or Antidepressants :** A drug used for treatment of highly depressed patient, who has lost his confidence.

Example : Benzedrine (amphetamine)

(G) Anaesthetics :

These are chemical substances helping for producing general or local insensibility to pain and other sensation.
These are of two types (a) General (b) Local

(a) General :- Produce unconsciousness and are given at the time of major surgical operations.

Example : Gaseous form → Nitrous oxide, ethylene, cyclopropane etc.

Liquid form → Chloroform, divinyl ether and sodium pentothal etc.

(b) Local anaesthetics: Produce loss of sensation on a small portion of the body. It is used for minor operations.

Example : Jelly form → Oxylocain

Spray form → Ethyl chloride

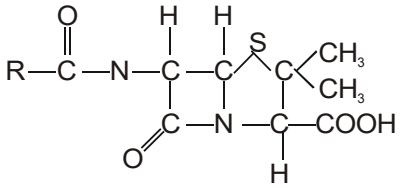
Injection form → Procain

(H) Antibiotics : The chemical substances produced from some micro organism (fungi bacteria or mold) and are used to inhibits the growth of other micro organism.

These are effective in the treatment of infections diseases.

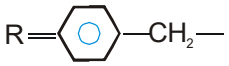
Example : Penicillin - It is highly effective drug for pneumonia, Bronchitis, abscesses, sore throat etc.

For other naturally occurring penicillin -



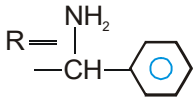
Penicillin

R - May be -

 (Penicillin G)

$R = CH_3—CH_2—CH=CH—CH_2—$ (Penicillin-F)

$R = CH_3—(CH_2)_6—$ (Penicillin-K)

 (Ampicillin)

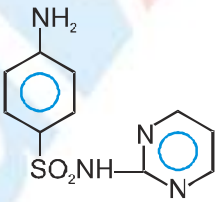
Bactericidal	**Bacteriostatic**
Penicillin	Erythromycin
Aminoglycosides	Tetracycline
ofloxacin	Chloramphenicol

Synthetic antibiotics are Streptomycin - (Tuberculosis),

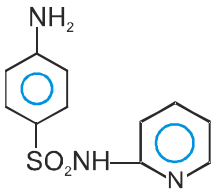
Chloromycetin - (Typhoid, Meningitis, Pneumonia, diarrhoea, dysentery etc.)

Tetracycline - (Acute fever, trachoma, dysentery & urinary tract infection)

(I) **Sulpha drugs :** Having great antibacterial powers. These are a group of drugs which are derivatives of sulphanilamide.



Sulphadiazine



Sulphapyridine

Other sulpha drugs are - (a) **Sulphathiazole** -Mainly used in severe infections.

(b) **Sulpha guanidine** - Used in bacillary dysentery

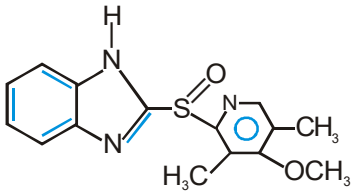
(c) **Sulpha pyridine -** Used in pneumonia

(d) **Sulpha diazine** - Used in dysentery, urinary infection and respiratory infection.

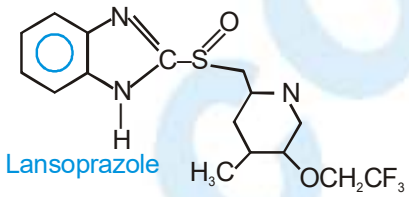
Drugs According to Their Action :

Antacids

- The chemicals which are used to reduce the acidity of the stomach are called antacids. Acidity is one of the common ailments associated with digestion.
- Antacids are nature is basic. Their PH value is in the range of 7.0 to 8.0.
- Omeprazole and lansoprazole are also marketed as antacid. They prevent the formation of acid in the stomach. Their structures are as follows :-



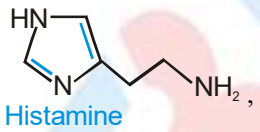
Omeprazole



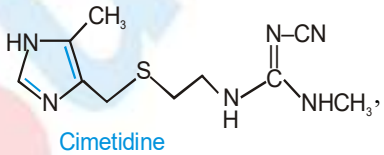
Lansoprazole

Antihistamines or Antiallergic Drugs :

- Antigens from environment and food create allergic reactions in our body. In this situation Histamine a chemical released from certain cells in our body during allergic reaction, are produced.
- Antihistamines are the drugs which diminish or abolish the effects of histamine.
- Synthetic drugs Brompheniramine (Dimetapp), Chlorpheniramine and terphenadine (selane) act as antihistamine.
- The antihistamine do not effect the secretion of acid in stomach because antiallergic and antacid drugs work on different receptors.



Histamine



Cimetidine

Ranitidine

Types of Chemical Messengers

There are two types of chemical messengers :

(i) Hormones (ii) Neurotransmitters.

(i) Hormones

- Hormones are a group of chemicals which are produced in the ductless (endocrine) glands. These enter the blood stream and travel to different parts of the body activating all the receptors which recognise them for message transfer.
- It is released from adrenal medulla in stress or danger situation. It prepare the body for physical exercise to beer the stress.

Classification of hormones

Based on their chemical structure ; hormones fall into three classes.

Steroid hormones :

- Steroids alcohols are called sterols. These are fat soluble.
- Cholesterol is the most common sterol present in animals. It is a part of all cell membranes and is the starting point for the synthesis of all other steroids.

Steroid hormone	Organs of secretion	Function
(1) Male sex hormone : (a) Testosterone (b) Dihydrotestosterone (c) Androgens	Testes. Adrenal Cortex	Stimulate the development of male sex characteristics during puberty; normal functioning of male sex. Affects anabolic system.
(2) Female sex hormone : (a) Estrone (estrogens) (b) Estradiol.	Ovaries	Development female sex characteristic during puberty. Normal functioning of female sex organs. Affect anabolic system.
(3) Corticoids : (a) Cortisone. (b) Corticosterone. (c) Aldosterone.	Adrenal Cortex	Regulates the metabolism of water; mineral salts. The deficiency of these leads to loss of fluids. The excess of these results in an increase in blood pressure.
(4) Digitoxitgenine	Plant digitalis	To regulate heart functions.

Peptide hormones :

Peptide hormones	Origans of secretion	Functions
(1) Vasopressin (nanopeptide)	Posterior lobe of pituitary gland.	Control the reabosorption of water in kidneys.
(2) Oxytosin (namopeptide)	Posterior lobe of pituitary gland.	Cause contraction of uterus during child birth.
(3) Insulin	Pancreas	Regulates the metabolism of glucose.
(4) Angiotensin (octapeptide)	Present in blood plasma of persons with high blood pressure.	Potent vasoconstrictor i.e. it contracts the blood vessels.

Amine hormones :

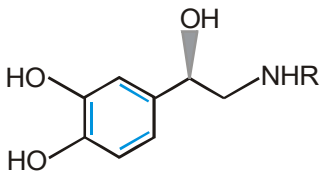
Those which are neither steroids nor peptides. These are water soluble amine compounds.

Amine hormones	Organs of secretion	Functions
(1) Adrenaline	Adrenal medulla (a small gland above each kidney.)	Increase pulse rate and blood pressure. Releases glucose from glycogen and fatty acids from fats.
(2) Thyroxine	Thyroid gland	Controls metabolism of carbohydrates ; lipids and proteins.

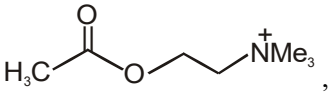
(ii) Neurotransmitters :

- Nerves transfer message through neurotransmitters.
- There are small molecules such as acetyl choline, dopamine and serotonin.
- These bind to the receptor (target) for a very short time to transfer message to it and depart quickly unchanged after transfering the message.

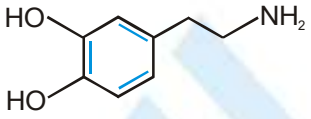
- The receptor then forward the message inside the cell.
- After leaving the active site of receptor, neurotransmitters undergo degradation and lose their capability to transfer message.
- The degradation products of neurotransmitters go back to the nerve endings to form the active messenger again and thus the cycle of message transfer can be repeated again.



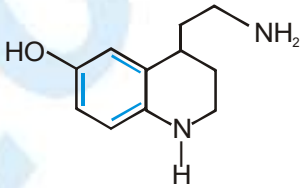
R = Me (It will be Adrenaline) (EPINEPHRINE)
R = H (It will be NORADRENALINE) (NOREPINEPHRINE)



Acetylcholine ,



Dopamine ,



SEROTONIN

Ex. How do drugs reach special targets ?

Different receptors which interact with one specific chemical messenger differ slightly in their bonding sites. For example, there are two types of adrenergic receptors called α-adrenergic and β-adrenergic receptors. Both these receptors differ slightly in the structure of their active sites but still can bind epinephrine. Therefore it is possible to design drugs which can bind better with one type of adrenergic receptor than the other. Another Important point about receptors is that they are not evenly distributed in the body.

Ex. Why do drugs cause side effects ?

Side effects are caused when a drug bind to more than one type of receptors. For example, some anti depressant drugs bind to serotonin receptor, side effects can arise if the drug interacts with histamine or acetylcholine receptor or if the degradation product of the drug is also biologically active and interacts with some other receptors.

ROCKET PROPELLANTS

In order to provide sufficient push to the rocket satellites to enter into the space, some chemical fuels are used, which are termed as rocket propellants.

- A propellant is a combination of two compounds i.e.

(a) An explosive compound called fuel (b) Oxidiser

- A chemical compound should satisfy the following conditions to function as propellant–

(1) The burning of fuel should not leave any ash.

(2) The burning of fuel should produce a large volume of gases/g of fuel.

(3) The combustion should proceed at a fast rate.

Depending upon physical state of fuel and oxidiser, the propellants are of three types

(a) Solid propellants (b) Liquid propellants (c) Hybrid propellants

(a) **Solid propellants :** In which fuel and oxidiser both are solid. These are of two types

(I) Composite propellant : It contains polymeric binder as fuel and ammonium perchlorate as oxidiser.

Fuel - Polyurethane or polybutadiene, Oxidiser - Ammonium perchlorate

(II) Double base propellant : It consist of nitro cellulose and nitroglycerine.

Disadvantage of solid propellant :

- Once they ignite, they burns with a predetermined rate.
- These do not have the start and stop capability.

(b) **Liquid propellant :** These are of two types -

(I) Monoliquid propellant : when a single liquid acts as fuel and oxidiser.

eg. -Nitromethane, Methyl nitrate, H_2O_2 etc.

(II) Biliquid propellant - It comprises a liquid fuel and a liquid oxidiser e.g. Fuel $\rightarrow$ Kerosene, alcohol, hydrazine monomethyl hydrazine (MMH) or liquid hydrogen

Oxidiser $\rightarrow$ Liquid oxygen, nitrogen tetraoxide (N_2O_4) or nitrous acid

Advantages :

(I) These provides higher thrust than solid propellants.

(II) The thrust can be controlled by switching on and off the flow of liquid propellant.

(c) **Hybrid propellant :** These consists of a solid fuel and a liquid oxidizer. e.g.

Fuel $\rightarrow$ Acrylic rubber

Oxidiser $\rightarrow$ Liquid N_2O_4

Specific impulse (Is) :

The superiority and performance of a propellant is expressed in terms of specific impulse (Is).

$$Is = \sqrt{\frac{T}{M}}$$

Where T = Flame temperature, M = average molecular mass.

Thus the performance of rocket propellant will be better if flame temperature is higher and the average mass of the product gas is lower.

CHEMICALS IN FOOD

Chemicals are added to food for their preservation, enhancing their appeal and adding nutritive values in them Main categories of food additives are as follows

(i) Food colours.

(ii) Flavours and sweeteners.

(iii) Fat emulsifiers and stabilising agents.

(iv) Flour improvers antistaling agent and bleaches.

(v) Antioxidants

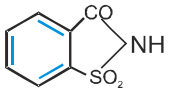
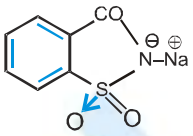
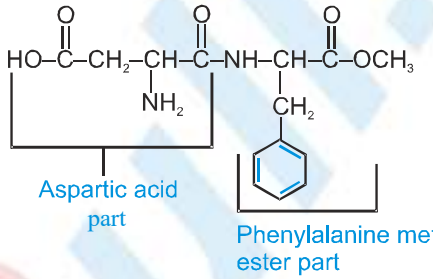
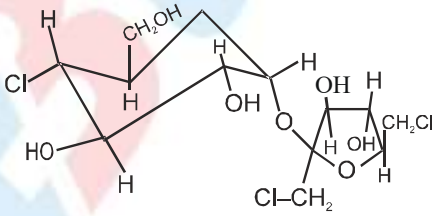
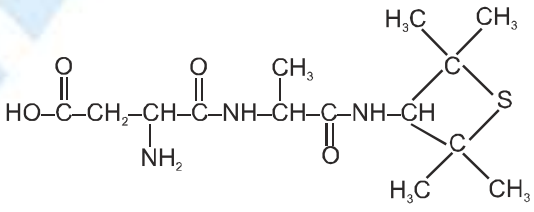
(vi) Preservatives

(vii) Nutritional supplements such as minerals, vitamins and amino acids except category

None of the above have nutritive values.

Artificial sweetening agents :

- Natural sweeteners e.g. sucrose added to calorie intake and therefore many people prefer to use artificial sweeteners for example like Saccharine (It is ortho-sulphobenzimide which is insoluble in water but its sodium or potassium salts are soluble in water It is the first popular artificial sweetening agent used since 1879. It is about 550 times more sweet as cane sugar.
- It's use is of great value to diabetic persons and people who need to control intake calories.
- It is used in pan masala cheap Ice cream, cheap drinks, mouthwash, cheap toffies, toothpaste).

Artifical sweeteners	Structural formula	Sweetness value in comparison to cane sugar
(1) Saccharine (o-sulpha) (insoluble in water benzimide)		550
(2) Sodium salt of saccharine (Soluble in water)		
(3) Aspartame		100
(4) Sucralose		600
(5) Alitame		2000

- There are some other sweetening agents which has higher sweetening values than sugar e.g.

(1) Cyclamate - (Cyclohexyl sulphamate) its sweetness value is 7100.

(2) Nectarin - (2- Amino-4-nitro propoxy benzene) its sweetness value is 50,000. Both of these are not used as sweetening agent because they causes throat cancer and have bitter taste.

- At present sucralose which is trichloroderivative of sucrose is sold as an useful artificials sweetener. It is stable at cooking temperature and does not provide calories.
- Its appearance and taste are like sugars.
- ASPARTAME is also the most successful and widely used artificial sweetener. It is roughly 100 times as sweet as cane sugar It is methyl ester of dipeptide formed from aspartic acid and phenylalanine. Use of aspartame to cold foods and soft drinks is limited because it is unstable at cooking temperature.
- Again aspartame on metabolic decomposition give phenylpyruvic acid which is harmful to the people suffering from disease, especially to infants it causes brain damage and mental retardation.

Food Preservatives :

- The chemical which are used to stop undesirable change in food caused by microorganism and save them from spoiling are called preservatives. It reduces (stop the growth) and rate reactions occurring due to bacteria in food).
- The following properties must be present in a preservative :
  (i) It should not react with food material. (ii) It's effect should be for longer period.
  (iii) It should not decrease the quality of food. (iv) It should not have harmful effect on the body.

Important preservatives are as follows :

(1) **Sodium benzoate :** It's 0.06% to 0.1% concentration is used for preservation of fruit juice , jam, jelly, pickles etc.

(2) **Parabens :** These are alkyl p-hydroxy benzoate and used for preservation of tomato sauce etc.

(3) **Sorbates :** These are salt of sorbic acid and used for preservation of milk cheese preparation certain meats and fish products. It inhibit the growth of yeast

(4) **Propionates :** These are ethyl and phenyl ester of propionic acid and used for the preservation of biscuits and baked product, etc. from mould fungi etc.

(5) **Sodium or potassium metabisulphite ($Na_2S_2O_5$ or $K_2S_2O_5$) :** It is used as a preservative for food products such as jams, squashes, pickles etc. It's preservative action is due to SO_2 which dissolves in water to give sulphurous acid.

$$Na_2S_2O_5 \longrightarrow Na_2SO_3 + SO_2 \; ; \quad SO_2 + H_2O \longrightarrow H_2SO_3$$

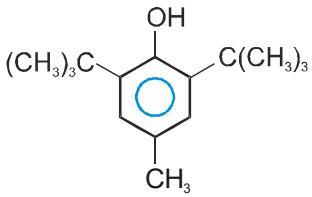
Sulphurous acid inhibits the growth of yeasts, mould and bacteria

(6) **Epoxides :** Epoxides are gases and preserves low moisture foods like nuts, dried fruits. The food must be exposed to these chemicals in closed chamber for sufficient time. Epoxides destroy all type of microorganism including spores and viruses.

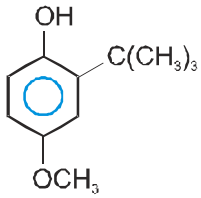
(7) **p-Hydroxy benzoate ester :** The methyl, ethyl propyl and heptyl esters of p-hydroxybenzoic acid are used as preservatives in baked foods, soft drinks, beer and syrups. They have no perceptible effect on flavour and are effective in inhibiting the growth of mould and yeast but are less effective on bacteria.

Antioxidants :

- The chemical substance which reduce the rate of reaction with oxygen in food, thus help in their preservation are called antioxidants.
- These are most important and necessary food chemicals added in the food they are more reactive towards oxygen than the food.
- They reduce the rate of formation of free radicals responsible for ageing process 2,6 ditertiary butylhydroxy toluene (p-crysol, BHT) and 2-tertiary butyl hydroxy anisole (BHA) are two most familiar antioxidants used. Butter can be preserved for many year by adding BHA. Their structures are as follows.



(BHT)



(BHA)

CLEANSING AGENTS :

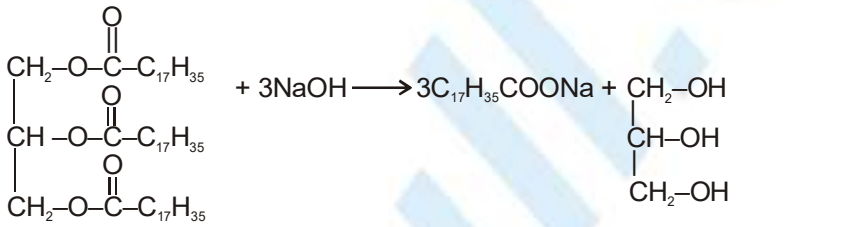
Soaps and Detergents :

Soaps and detergents are used since long

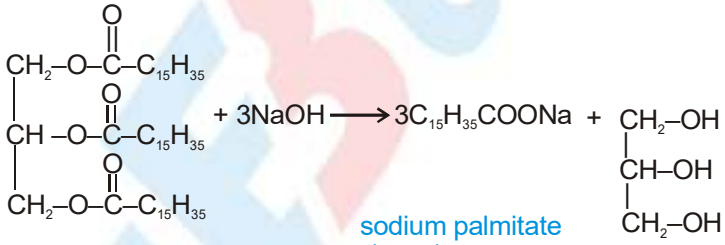
SOAPS

- Soaps are sodium or potassium salts of long chain fatty acids e.g steric, oleic and palmitic acids. soap containing sodium salts are formed by heating fat (i.e. glyceryl ester of fatty acid) with aqueous sodium hydroxide solution.

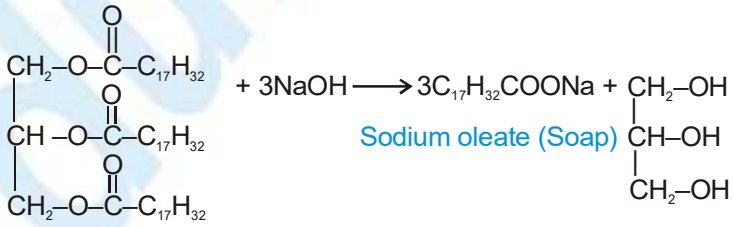
  This reaction is known as SAPONIFICATION.



Glyceryl ester of stearic acid (Fat) | sodium hydroxide | Sodium stearate (soap) | Glycerol (or glycerine)



Glyceryl palmitat | sodium palmitate (soap)



Glyceryl oleate | Sodium oleate (Soap)

- Generally potassium soaps are soft to the skin. These can be prepared by using potassium hydroxide solution in place of sodium hydroxide.

Types of Soaps

There are so many types of soaps due to the using different raw materials

(i) **Toilet soaps** are prepared by using better grades of fats and oils and care is taken to remove excess alkali. colour and perfumes are added to make them more attractive.

(ii) **Water floating soaps :** are made by beating tiny air bubbles before their hardening

(iii) Transparent soaps : are made by dissolving the soap in ethanol and then evaporating the excess solvent.

(iv) **Medicated soap:** Substances of medical values are added. In some soaps deodorants are added.

(v) **Shaving soaps :** They contain glycerol to prevent rapid drying. A gum called rosin is added while making them. It forms sodium rosinate which lathers well

(vi) **Loundry soaps** contains fillers like sodium rosinate, sodium silicate borax and sodium carbonates.

(vii) **Soaps chips:** These are made by running a thin sheet of melted soap into a cool cylinder and scraping of the soap in small chips.

(viii) **Soap granules :** These are dried miniature soap bubbles.

(ix) **Soap powders** and scouring soaps contain some soap. A scouring agent (abrasive) such as powdered pumice or finely divided sand and builders like sodium carbonate and trisodium phosphate. Builders make the soap act more rapidly.

Soaps do not work in hard water :

Hard water contains calcium and magnesium ions. The ions form insoluble calcium and magnesium soaps when sodium soap or potassium soaps are dissolved in hard water

$$2C_{17}H_{35}COONa + CaCl_2 \rightarrow 2NaCl + (C_{17}H_{35}COO)_2Ca$$

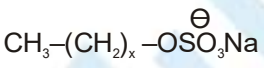
insoluble calcium stearate

These insoluble soaps separate as scum in water and are useless as cleaning agent in fact these are hinderance to good washing. Hair washed with hard water become dull because of sticky precipitate. The precipitate adheres on to the fibre of cloth or hairs as gummy mass.

Detergents

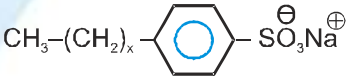
The synthetic products , which like soaps remove dust and grease from a surface are called detergents, since they are not soap but work like a soap so they are also called as soapless soap.

Detergents are mainly sodium salts of either sulphuric or sulphonic acids with long chain hydrocarbons. Their general formula is as follows :



sodium alkyl sulphate

or



sodium alkyl sulphonate

These can be used both in soft and hard water, as they give foam even in hard water

Synthetic detergents are mainly classified into three categories :

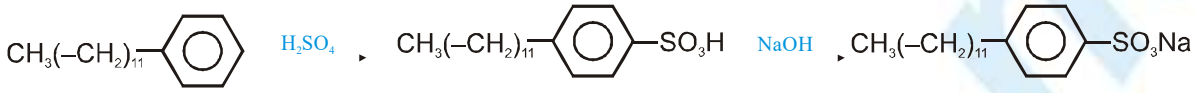
(i) Anionic detergents (ii) Cationic detergents (iii) Non-ionic detergents

(i) Anionic Detergents

These are sodium salt of sulphonated long chain alcohols or hydrocarbons. Alkyl hydrogen sulphate formed by treating long chain alcohols with concentrated sulphuric acid are neutralised with alkali to form anionic detergents. Similarly alkyl benzene sulphonates are obtained by neutralising alkyl benzene sulphonic acid with alkali.

$CH_3–(CH_2)_{10}–CH_2OH \xrightarrow{H_2SO_4} CH_3–(CH_2)_{10}–CH_2–OSO_3H \xrightarrow{NaOH} CH_3–(CH_2)_{10}–CH_2–\overset{\ominus}{O}\overset{\oplus}{SO_3}.Na$

Lauryl alcohol — Lauryl hydrogen sulphate — Sodium lauryl sulphate

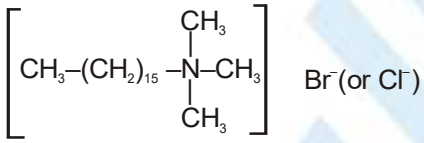


Dodecyl benzene — Dodecyl benzene sulphonic acid — Sodium dodecyl benzene sulphonate.

In anionic detergents, the anionic part of the molecule is involved in the cleansing action. These are smoothly used for household work and are also used in toothpastes.

(ii) Cationic detergents

These are quaternary ammonium salts of amines with acetates, chlorides or bromides as anion. Cationic part possess a long hydrocarbon chain and a positive charge on nitrogen atom Hence these are called cationic detergents. Cetyltrimethylammonium bromide is a popular cationic detergent. Their hydrophilic end is a cation. So they are also known as invert soap . They have germicidal properties and are expensive, therefore these are of limited use. These detergents are used in hair conditioners.



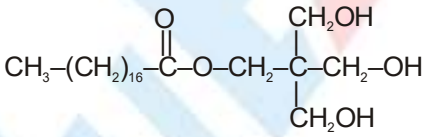
Cetyltrimethyl ammonium bromide (or chloride)

(iii) Non ionic detergents : These are mostly esters of poly hydroxy alcohols. They are in liquid form, and do not contain any ion in their constitution. One such detergent is formed when stearic acid reacts with polyethylene glycol.

$CH_3–(CH_2)_{16}COOH + HO(CH_2+CH_2O)_nCH_2–CH_2–OH \xrightarrow{-H_2O} CH_3(–CH_2)_{16}COO(CH_2–CH_2O)_nCH_2–CH_2–OH$

Stearic acid — Poly ethylene glycol

Another such non ionic detergent is pentaerythrityl monostearate it is as follows :-



Pentaerythritol mono stearate

EDUBULL KEY POINTS

Liquid dish washing detergents are non ionic type. Main problem that appears in the use of this type of detergents. is that if their hydrocarbon chain is highly branched then bacteria cannot degrade this easily, they pollute rivers and other water sources. If hydrocarbon chain is unbranched then they are decomposed by microorganism and thus no pollution occur from them.

Difference between soap and detergents

Although the action of soap and detergents is similar but there are following differences between them :

(1) Soaps are salts of weak acid and strong base whereas detergents are salts of strong acid and strong base.

(2) Aqueous solution of soap is basic where as aqueous solution of detergents is neutral.

$$R\text{–}COONa + H_2O \longrightarrow R\text{–}COOH + NaOH$$

Soap — Weak acid strong base

$$ArSO_3Na + H_2O \longrightarrow ArSO_3H + NaOH$$

Detergent — Strong acid strong base

(3) Woolen and silk cloths in which soft fibres are present cannot be washed with soap whereas all type of fabrics can be washed with detergents

(4) Soap cannot work in hard water because soaps are precipitated as insoluble salt by reaction with Ca^{2+} and Mg^{2+} ions. Thus more soap is used for removing dust and grease from the clothes where as detergents are not precipitated by Ca^{2+} and Mg^{2+} ions. Thus detergents can be used in hard water also.

PETROLEUM

- The **composition** of crude petroleum varies with place of occurrence but essentially it is a mixture of alkanes, cycloalkanes, aromatic hydrocarbons, S, N and oxygen compounds and natural gas, etc.
- Modern theory of **origin of petroleum** explains (i) the presence of chlorophyll and haemin (ii) presence of coal deposits near oil fields (iii) presence of N and S compounds along with optically active substance (iv) presence resin and helium gas.
- The crude oil obtained by **mining of petroleum** contains impurities.
- The process of dividing crude oil into useful fractions with different boiling ranges [i.e. uncondensed gases ($C_1 - C_4$), crude naptha (C_5–C_{10}; 30–150ºC), kerosene ($C_{11} - C_{16}$; 150–250ºC), heavy oil (C_{16}–C_{18}; 250–400ºC), residual oil ($C_{17} - C_{40}$; above 400ºC) and non-volatile residue] and free from undesirable impurities is termed **refining of petroleum.**
- Crude naphtha on refractionation yields : (i) Petroleum ether ($C_5 - C_6$ at 30º-70ºC), (ii) Petrol or gasoline (C_6–C_8 at 70–120º) and benzene derivatives (C_8–C_{10} at 120–150ºC).
- **Liquefied petroleum gas (LPG) :** It is chiefly a mixture of butane and isobutane (domestic gas) compressed under pressure as liquid and stored in iron cylinders. The major sources of LPG are natural gas and also obtained from refining and cracking of petroleum.
- **Compressed natural gas (CNG) :** The natural gas compressed at very high pressure is called compressed natural gas (CNG). It mainly consists of methane (95%) and other 5% is made up of various gases such as ethane, propane and butane including small amount of other gases N_2, He, CO, H_2S and water vapours. The CNG is now being used as a better fuel than gasoline because of its complete combustion and no unburnt carbon is being released into the atmosphere to cause air pollution.

Artificial Methods for Manufacture of Gasoline

(a) Cracking : It is a process in which high boiling fractions consisting of higher hydrocarbons are heated strongly to decompose them into lower hydrocarbons with low boiling points.

The process of cracking involves the breaking of C–C and C–H bonds resulting in the formation of smaller molecules of various types.

$$\text{Long chain alkanes} \xrightarrow{400\text{-}800^\circ C} \text{Smaller alkanes} + \text{Alkenes} + H_2$$

(b) Bergius process (Hydrogenation of coal) :

$$\text{Coal} + H_2 \xrightarrow[500°C,\ 250atm]{Fe_2O_3 catalyst} \text{Mixture of hydrocarbons or crude oil (Synthetic petroleum)}$$

(c) Fischer-Tropsch process (Hydrogenation of water gas) :

$$xCO + yH_2 \xrightarrow[250°C,\ 5\text{-}10\ atm]{Co \text{ or } Ni} \text{Mixture of hydrocarbons} + H_2O \text{ (Synthetic petroleum)}$$

(water gas)

Knocking : The metallic sound produced due to irregular burning of the fuel is termed as knocking. A fuel with minimum knocking property is always preferred.

- The tendency to knock fall off is in the following order :
  Straight chain alkanes > branched chain alkanes > alkenes > cycloalkanes > aromatic hydrocarbons.
- **Octane number :** The octane number of a given sample may be defined as the percentage by volume of iso-octane present in a mixture of iso-octane and heptane. Heptane which causes maximum knocking is assigned the octane number zero, while iso-octane (2,2,4-trimethyl pentane) which causes minimum knocking is given the octane number 100.

Antiknock compounds : To reduce knocking property or to improve the octane number of a fuel, certain chemicals are added to it. These are called antiknock compounds. Tetraethyl lead **(TEL)** is the best antiknock compound.

Other methods for improving octane number of gasoline : The octane number of petrol (gasoline) can be improved by (i) increasing the proportion of branched chain alkanes (by isomerisation or reforming) or alkylation aromatisation) (ii) addition of TEL $(C_2H_5)_4Pb$ or methanol or ethanol.

Cetane number : The cetane number of a diesel oil is the percentage of cetane (hexadecane) by volume in a mixture of cetane and α-methyl naphthalene. It is used for grading the diesel oils. Hexadecane has been assigned cetane number 100 while α-methyl naphthalene is assigned zero cetane number.

Flash point : The lowest temperature at which an oil gives sufficient vapours to form an explosive mixture with air is referred to as flash point of the oil. The flash point in India is fixed at 44ºC.

Petrochemicals : All such chemicals which are derived from petroleum or natural gas are called **petrochemicals.** They provide raw materials for the manufacturer of dyes, drugs, plastics, fabrics, insecticides, detergents, food preservatives and disinfectants, etc.

COSMETICS

- Any such chemical substance which beautifies the human body by cleansing, altering or promoting the appearance.
- According to their uses, different cosmetic items are classified into different categories.

CREAMS

The word 'cream' is in such common use that definition is almost superfluous.
Traditionally cosmetic creams have been marketed and sold on the basis of their 'function'. On the basis of their function, some important types of cosmetic creams are :

(a) Cleansing creams (b) Cold creams (c) Massage creams
(d) Night creams (e) Moisturising creams (f) Foundation creams
(g) Vanishing (h) All-purpose creams

Some of the creams are briefly discussed below.

(a) **Cleansing creams :** Cleansing creams have high average oil contents. This cream effect the cleansing of the skin surface efficiently and removes facile make up, surface grime, lipstick and oil pleasantly without completely degreasing the skin.

(b) **Cold creams :** The name of the cream stems from the cooling effect of such products on the skin. Cold creams are of particular historical interest since they are among the first cosmetic emulsions to be described in the literature. These creams lubricate the skin and prevent roughness and chaffing.

(c) **Massage creams :** Such creams tend to be high-oil content or water in oil, soft solid or viscous liquid creams.

(d) **Vanishing creams :** This provides an oil phase which melts above body temperature and crystallises in a suitable form.

(e) **Foundation creams :** There is a wide choice of emulsifying agents which include glyceryl monostearate, diglycol stearate and polyoxyethylene derivatives etc.

(f) **Sunburn Creams :** These creams save the skin from sunburn in summer.

(g) **Bleach Creams :** These creams exert a bleaching effect on dark skin. One or more of the compounds like titanium oxide, zinc oxide, hydrogen peroxide, hydroquinone, etc. are also added in the preparation of this cream.

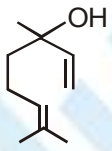
PERFUMES

Perfumes are the materials used to provide fragrance. It is a mixture of pleasant smelling fragrance. It is a mixture of pleasant smelling substances dissolved in a suitable solvent.

The essential characteristics of a good perfume are : harmonious odour, lasting fragrance, stability, volatility and ability to get fixed in the required cosmetic. A perfume invariably consists of three ingredients : (i) a vehicle, (ii) Fixative, and (iii) odour producing (odoriferous) substance. A brief description of these constituents of perfume is given below :

Fixative : The substance which make the perfume last longer by decreasing its volatility are known as fixatives.

Odoriferous (or odourous) substances : Both natural and synthetic substances are used to impart characteristics odour-producing substances may be essential oils from the flowers, fruits, roots and leaves of certain plants.



Linalool

TALCUM POWDER

Talcum powder is used to reduce irritation of the skin. Talcum powder, like face powder and body powders contains talc i.e., hydrated magnesium silicate [$Mg(OH)_2\ Si_4O_{10}$] as one of the most important ingredient. The other main constituents of talcum powder include chalk ($CaCO_3$), zinc oxide, zinc stearate and a suitable perfume. Generally specific ingredients such as antiseptic and cooling agents are also added. A good powder is one which spreads evently, stays on well and has right degree of opacity (i.e., covering power).

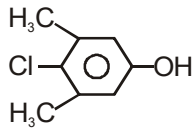
Talcum powders should be dusted with care to prevent inhalation of the fine particles which cause irritation in the lungs.

DEODORANTS

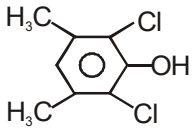
are the chemical substances which are applied primarily to mask the body odour, Since this is considered a non-therapeutic purpose and a function of the body is not considered to be altered, they are classed as cosmetics. Deodorants may contain an astringent* such as aluminium sulphate, which closes the openings of he sweat glands.

The body odour is largely produced by the action of bacteria following perspiration.

Phenolic antibacterials which have figured as effective body deodorants are parachlorometaxylenol and dichlorometa-xylenol having the following structures.



p-Chlorometaxylenol



Dichlorometaxylenol

DYES

1. A dye is a coloured substance that can be applied in solution or dispersion to a substrate, giving it a coloured appearance.
2. Every coloured substance is not a dye.
3. The colour of the dye depends upon the colour absorbed by the dye.
4. **Chromophores :** The groups responsible for colour of a compound are called chromophores. Some chromophores are : –NO, $–NO_2$, –N = N, quinonoid structure, etc.
5. **Based upon chemical constitution dyes** can be classified as indigoid dyes, nitro dyes, azo dyes, phthalein dyes, anthraquinone dyes and triphenyl methane dyes.

Based upon application dyes can be classified as :

(a) **Acid Dyes** They are sodium salts of azo dyes containing sulphonic acid or carboxylic acid group. Examples : Orange I, Orange II, methyl red, etc.

(b) **Basic Dyes** These dyes contain ($–NH_2$) group or ($–NR_2$) group as chromophore or auxochrome. Examples: aniline yellow, butter yellow, Chrysoidine–G.

(c) **Direct Dyes** These are directly applied to the fabrics from an aqueous solution. Examples : martius yellow and cango red.

(d) **Disperse Dyes** In this type of dyes the minute particles of the dyes are dispersed in suitable reagents before dying the fabric. Examples : cellition fast pink B

(e) **Azo dyes** These are also known as **insoluble azo dyes** or **in grain dyes**. Example : Para red

(f) **Vat Dyes** It imparts colour to the cloth by oxidation and reduction. The fabric is dipped in the solution of the dye. When the fabric is exposed to air, the reduced dye is oxidised and imparts colour to the fabric. Example : indigo

(g) **Mordant Dyes** These are used primarily for wool and are applied to the fabric after treating it with a metal ion. Depending upon the metal ion same dye can impart different colours.

Table : Solubility of Organic Compounds

Compound	H_2O(cold)	aq.$NaHCO_3$	aq. NaOH	aq. HCl
(I) Small aliphatic compound with F.G.(Hydrogen bonding) C_1 to C_2 (a) R – COOH (b) R – OH (c) R – NH_2 (d) R – C(=O) – NH_2	soluble	soluble	soluble	soluble
(II) Small aliphatic compound containing two F.G (Hydrogen bonding) C_1 to C_5 (a) 2(COOH) - diacids (b) 2(–OH) – diols/glycol/ sugar (c) 2(NH_2) (d) – COOH + (–OH) (e) (–COOH) + (NH_2) (f) –$CONH_2$ some common compounds are urea, glucose, oxalic acid, succinic acid	soluble	soluble	soluble	soluble
(III) Aromatic acids (H_2O insoluble) Benzoic acid & dervative (a) Ar – COOH (b) Ar – SO_3H (c) picric acid (d) Ar – C(=O) – Cl	Insoluble Insoluble Insoluble Insoluble	soluble ArCOONa soluble soluble –	soluble ArCOONa soluble soluble –	Insoluble Insoluble Insoluble Insoluble
(IV) Phenols	Insoluble	Insoluble	soluble Ph – ONa	Insoluble
(V) Aromatic Amines, Anilines (weaker bases) Ar – NH_2	Insoluble	Insoluble	Insoluble	Soluble $Ar\overset{+}{N}H_3Cl^-$

CHEMICAL SEPARATION OF ORGANIC COMPOUNDS (POC - II)

Purification of organic compounds

- The organic compounds derived from natural sources or prepared in the laboratory are seldom pure. They are usually contaminated with other substances.
- Purification means the removal of undesirable impurities associated with a particular organic compound, i.e to obtain the organic compound in pure state.
- Various methods have been developed to purify organic compound

(1) Physical methods

(i) Crystallisation (ii) Sublimation (iii) Distillation
(iv) solvent extraction (v) chromatography

(2) Chemical methods

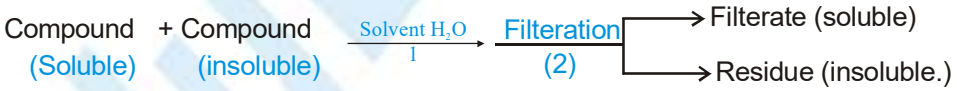
- Chemical methods of separation depend upon the nature of the functional group present in the component. Hence these can be applied to solid as well as liquid compounds.
- A chemical method can be applied only when one of the components of the mixture is soluble in a particular solvent while the other is insoluble in the same solvent .
- Separation is the first step during the actual analysis of organic mixture. It is the most important step in the sense that if separation is incomplete the result will not be correct because the impure compound will give tests of different functional group and its melting point will also be very much different from that of the pure compound obtained from complete separation.

Separation of Binary mixtures of organic compounds :

The usual systematic scheme for separating a solid binary mixture is discussed below.

(i) Separation with water
(ii) Separation with sodium bicarbonate
(iii) Separation with sodium hydroxide
(iv) Separation with hydrochloric acid
Solubility of two components.

Separation Scheme for organic compounds :



- The mixture of organic compounds can be separated by using appropriate solvent.
- Most of the aromatic compounds are water insoluble due to large hydrophobic group of six carbon atom
- Aromatic acids are insoluble in water but soluble in aqueous $NaHCO_3$ solution or NaOH solution, due to salt formation.
- Aromatic hydroxy compounds are water insoluble but are soluble in aqueous NaOH solution due to salt formation.
- Aromatic amine (Aniline 1°, 2°, 3°) are organic base and water insoluble but are soluble in aqueous HCl solution due to salt formation.
- Aliphatic compoud with atleast two functional group (which can form H-bonding) are water soluble.

Ex. Diacids, diols. diamines, hydroxy acids (OH,COOH), Amino acids ($-NH_2$, –COOH) .

Ex. oxalic acid , malonic, maleic, fumaric acid, glycol, glycerol, sucrose, glucose etc.

Solubility of Organic Compounds

Compound	H_2O(cold)	aq.$NaHCO_3$	aq. NaOH	aq. HCl
(I) Small aliphatic compound with F.G.(Hydrogen bonding) C_1 to C_2 (a) R – COOH (b) R – OH (c) R – NH_2 (d) R – C(=O) – NH_2	soluble	soluble	soluble	soluble
(II) Small aliphatic compound containing two F.G (Hydrogen bonding) C_1 to C_5 (a) 2(COOH) - diacids (b) 2(–OH) – diols/glycol/ sugar (c) 2(NH_2) (d) – COOH + (–OH) (e) (–COOH) + (NH_2) (f) –$CONH_2$ some common compounds are urea, glucose, oxalic acid, succinic acid	soluble	soluble	soluble	soluble
(III) Aromatic acids (H_2O insoluble) Benzoic acid & dervative				
(a) Ar – COOH	Insoluble	soluble ArCOONa	soluble ArCOONa	Insoluble
(b) Ar – SO_3H	Insoluble	soluble	soluble	Insoluble
(c) picric acid	Insoluble	soluble	soluble	Insoluble
(d) Ar – C(=O) – Cl	Insoluble	–	–	Insoluble
(IV) Phenols	Insoluble	Insoluble	soluble Ph – ONa	Insoluble
(V) Aromatic Amines, Anilines (weaker bases) Ar – NH_2	Insoluble	Insoluble	Insoluble	Soluble $Ar\overset{+}{N}H_3Cl^-$

1. Chemistry in Everyday life helps us to have a look that where chemistry is used in our day to day life's routine. Medicines, Drugs, Chemical messangers in our body (hormones & neurotransmitters), Rocket propellants, chemicals in food, cleansing agents such as soaps & detergents, petrol the most important thing in the world in the present scenario, all types of cosmetics can be explained with the help of chemistry.

Thus advancement in chemistry helps us to synthesize & manufacture all these products economically and improve our standard of living. With the further enhancement of chemistry scientist are trying to delve into other fields as well so that further improvisation can be done.

2.

DETERGENTS

Anionic Detergents	Cationic Detergents	Non-ionic Detergents
• The anionic part of the molecule is involved in the cleansing action. • These are smoothly used for household work and in toothpaste.	• There hydrophilic end is a cation, so they are also known as **invert soap**. • These detergents are used in hair conditioners.	• They are in liquid form, and do not contain any ion in their constitutions. • They are generally used in sanitary cleaning.

3.

DYES

Based on Chemical Constitution

- Indigoid Dyes
- Nitro Dyes
- Azo Dyes
- Phthalein Dyes
- Anthraquinone Dyes
- Triphenyl Methane Dyes

Based upon Application

- Acid Dyes
- Basic Dyes
- Direct Dyes
- Disperse Dyes
- Azo Dyes
- Vat Dyes
- Mordant Dyes