Chemistry in Everyday Life

Chemicals in Medicine

Chemical substances used for the treatment of diseases and to reduce the suffering from pain are called **medicines** or **drugs**. A medicine is a chemical substance that cures the disease and is not only safe to use but also not cause any addiction or much toxicity while a drug cures disease and may cause side effects and creates addition etc. e.g., Penicillin is a medicine while Heroin is a drug.

Definitions

A medicine is a chemical substance which cures the disease, is safe to use, has negligible toxicity and drug is a chemical substance which also cures the disease but is habit forming, causes addiction and has serious side effects.

Drug — Target interaction

- Proteins which act as biological catalysts in the body are called enzymes.
- Proteins which are crucial to communication system in the body are called receptors.
- Proteins which carry polar molecules across the membrances are called carrier proteins.

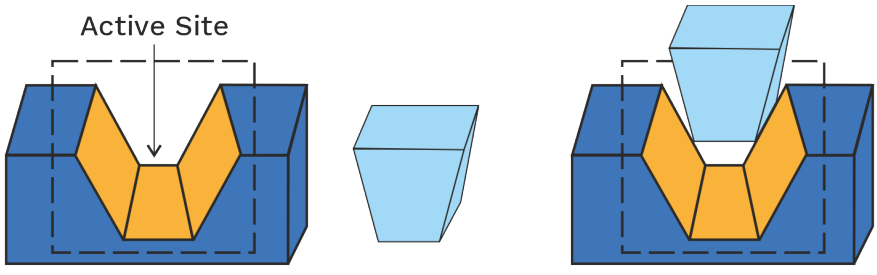
Concept Ladder

The drugs in our body can be administrated by oral, intravenous injections which is determined by the physical and chemical properties and the site of desired action.

(1) Enzymes as Drug Targets

(i) Catalytic action of enzymes

- The substrate molecules bind to the amino acid residues of the protein present on the active site of the enzyme through a variety of interactions such as hydrogen bonding, dipole-dipole interactions, van der Waals interactions and ionic bonding. These binding forces should be strong enough to hold the substrate long enough so that the enzyme can catalyse the reaction, but weak enough to allow the products to depart after their formation.



(a) Enzyme (b) Substract (a) Enzyme

- The function of the enzyme is to provide functional groups which will attack the substrate to carry out the chemical reaction.
- This function is carie out by some other amino acid residues of protein present on the active site of the enzyme. These provide free amino groups to attack the substrate and bring about chemical reaction.
- If the amino acid serine is present nearby the substrate held on the active site, then its –OH group is free to act as a nucleophile in the enzyme catalysed reaction.
- Similarly, the functional groups such as –SH of L-cystein, –COOH of L-aspartic acid, phenyl ring of L-phenylalamine and heterocyclic ring of L-histidine can participate as nucleophile in enzyme catalysed reactions.

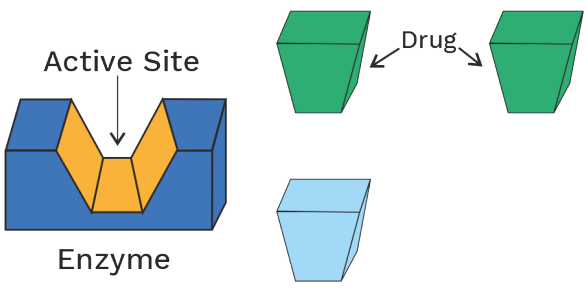
(ii) Drug-enzyme interaction

Drugs which inhibit any of the two activities of the enzymes are called enzyme inhibitors. Enzyme inhibitors can block the binding site theregby preventing the binding of the substrate to the active site and hence inhibiting the catalytic activity of the enzyme.

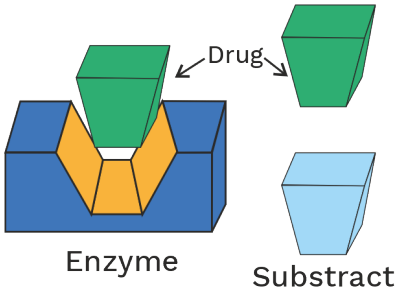
- Drugs which compete with natural substrate for their attachment on the acitve sites of enzymes are called competitive inhibitors.

Concept Ladder

If the bond formed between an enzyme and the drug (inhibitor) is a strong covalent bond which cannot be broken easily, then the enzyme is blocked permanently. The body then degrades the enzyme drug (inhibitor) complex and synthesizes the new enzyme.



Drug and substrate competing for active site of enzyme

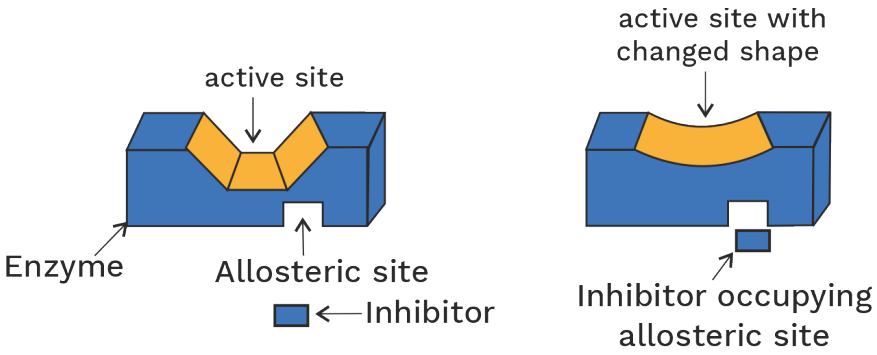


Drug blocks the active site of enzyme

- Some drugs, however, do not bind to the active site but bind to a different site of the enzyme which is called allosteric site. This binding of the drug at allosteric site changes the shape of the active site of the enzyme in such a way that the natural substrate cannot recognize it. Such drugs are called non-competitive inhibitors.

Rack your Brain

Why do drugs reach Specific Targets?

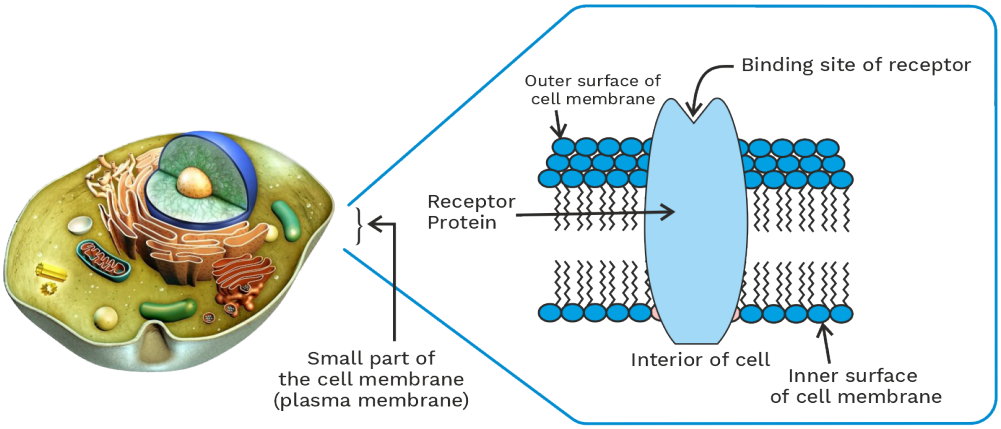


(2) Receptors as Drug Targets

For communication system in the body, receptors are proteins which are crucial to it. Majority of receptors are embedded in cell membranes in such a wayOO that their small part possessing the active site projects out of the surface of the membrane and opens on the outside region of the cell membrane.

Concept Ladder

The bond formed between an enzyme and the drug (inhibitor) is a strong covalent bond which cannot be broken easily, then the enzyme is blocked permanently.



Animal cell Cell Membrane

Chemical Messengers

On the binding site of the receptor protein, these chemical messengers are received. The shape of the receptor protein changes a little for accommodation of these chemical messengers, and it gives the message to the cell without even entering the cell. After the transfer of the message, the chemical messenger departs and the active site of the receptor protein returns to its original shape.

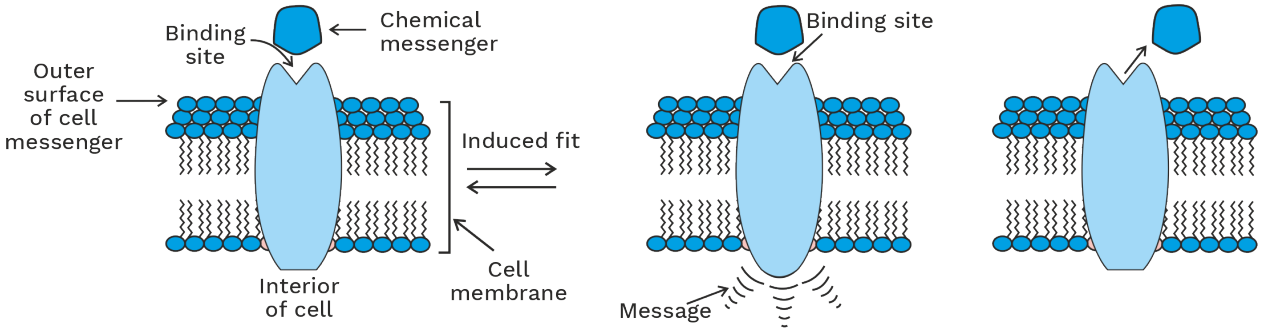
Definitions

The message between two neurons or that between neurons and muscles is communicated through certain chemical substances called chemical messengers.

Types of chemical messengers

(i) Hormones

(ii) Neurotransmitters



(a) (b) (c)

(i) Hormones

They are the group of biomolecules which are generated 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. They are not deactivated very quickly. Adrenaline (epinephrine) is an example of a hormone. It is released from adrenal medulla in situations of stress or danger. It prepares the body (animals or humans) for physical exercise to bear the stress.

Definitions

The chemical substances which suppress the action of hormones that promote pregnancy are called antifertility drug. These are actually synthetic hormones.

(ii) Neurotransmitters

Nerves transfer message through neurotransmitters. These are small molecules such as acetylchloine, dopamine and serotonin. These bind to the receptor for a very short time to transfer message to it and after transferring the message departed unchanged quickly. Then the message inside the cell is forwarded by receptor. After leaving the active site of receptor, neurotransmitters undergo degradation and lose their capability to transfer message. In other words, unlike hormones, they are quickly deactivated. 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.

Rack your Brain

Why do drugs cause side effects?

Definitions

It is the branch of science in which chemicals are used for the treatment of diseases. (Father of chemotherapy is Paul Ehrlich).

Chemotherapy

- Chemicals used in the chemotherapy are frequently classified according to their actions.
- For example, analgesics relieve pain, antipyretics reduce body temperature, anti-inflammatories control inflammation and antibiotics kill bacteria and other microorganisms.

Generally, Chemotherapy word is used as a type of treatment for cancer that uses one or more than one anti-cancer drugs as part of a standardized chemotherapy regimen.

(1) Antipyretics

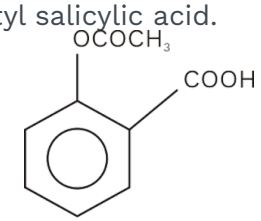
Antipyretics are substances used to bring down body temperature in case of high fever. For example, aspirin, phenacetin and paracetamol, analgin.

Rack your Brain

Which antipyretic drug acts as a vaso-dialator?

Aspirin

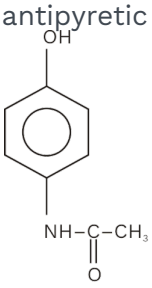
It is a common antipyretic and is chemically known as acetyl salicylic acid.



Aspirin

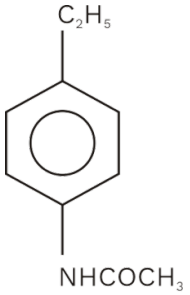
- It may ulcerate the stomach wall and cause bleeding (Gastric irritant) by producing salicylic acid, when taken taken empty-stomach.
- Sodium and calcium salts of aspirin are more soluble and are less harmful.

Paracetamol: Chemically, it is 4-acetamidophenol. It is a better antipyretic than aspirin.



4-acetamidophenol
(Paracetamol)

Phenacetin: It is 4-ethyl acetinalide.



Phenacetin

Concept Ladder

Aspirin helps to make the blood thinner and thus prevents the formation of blood clots in the coronory arteries thereby preventing heart attacks.

Rack your Brain

Name any two derivatives of narcotic drug, morphine.

Previous Year's Questions

Which of the followiong is an analgesic?

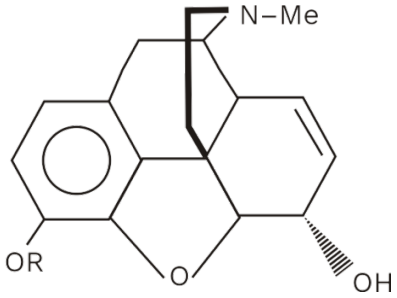
[AIPMT]

(1) Penicillin
(2) Streptomycin
(3) Chloromycetin
(4) Novalgin

(2) Analgesics

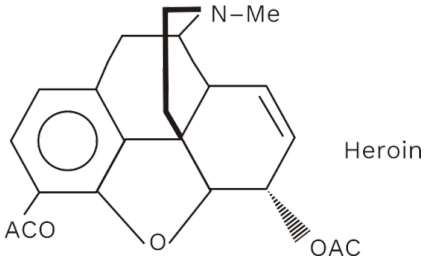
These are drugs used for relieving pain.

- Aspirin, phenylbutazone or butazoledene and some other antipyretics act as analgesics (also known as narcotics).
- Some narcotics (which produce sleep and unconsciousness) can also be used as analgesics. For example, morphine, marijuana, codeine, pethidine and heroin (morphine diacetate). These are known to be habit forming so must be used only in severe pain.



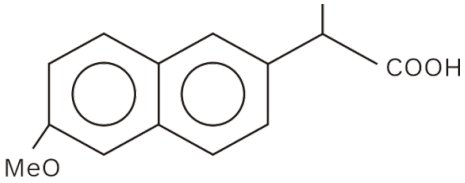
If R = H, then the product formed is morphine petydine hydrochloride.

If R = CH_3, then the product formed is codeine.



Heroin

- Now, ibuprofen, dichlophenac sodium, naproxen are also used as analgesics.



Naproxen

Concept Ladder

The most common non-narcotic analgesics are Aspirin and paracetamol.

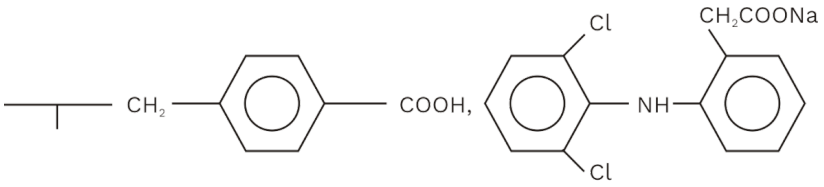
Rack your Brain

Which is the safest analgesics drug?

Previous Year's Questions

Aspirin is an acetylation product of **[AIPMT]**

(1) m-hydroxybenzoic acid
(2) o-dihydroxybenzene
(3) o-hydroxybenzoic acid
(4) p-dihydroxybenzene



Ibuprofen Dichlorofenac Sodium

(3) Antibiotics

They are chemical substances produced by microorganisms (fungi, bacteria and moulds) that can inhibit the growth or even destroy other microorganisms.

Broad spectrum antibiotics are medicines effective against several different types of harmful microorganisms, like tetracycline, chloramphenicol. Narrow spectrum antibiotics which are effective mainly against gram-positive or gram-negative bacteria whereas the antibiotics which are effective only against a single organism or disease are called limited spectrum antibiotics.

Penicillin has a narrow spectrum. Ampicillin and amoxicillin are derivatives of penicillin. Penicillin and cephalosprin are β-lactam antibiotics.

Penicillin:

In 1929, Alexander Fleming discovered Penicillin from penicillium notatum.

- It is used against a large number of infections caused by various bacteria.
- It is an effective drug for sore throat, pneumonia, abscesses and, bronchitis.
- Other antibiotics like streptomycin and tetracycline are used against diseases caused by bacteria.
- Some antibiotics are disease specific, for example, streptomycin for tuberculosis and chloramphenicol for typhoid.

Concept Ladder

Antibiotics kill bacteria, effectively fighting bacterial infections only. They do not work against viruses or viral infections and can actually cause more harm than good.

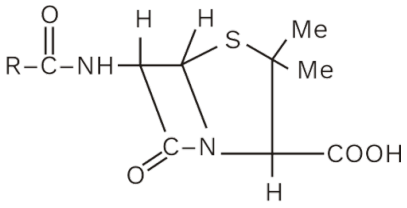
Rack your Brain

Name any two antibiotics which can be used for curing Tuberculosis.

Previous Year's Questions

Among the following, the narrow spectrum antibiotic is : **[AIPMT]**

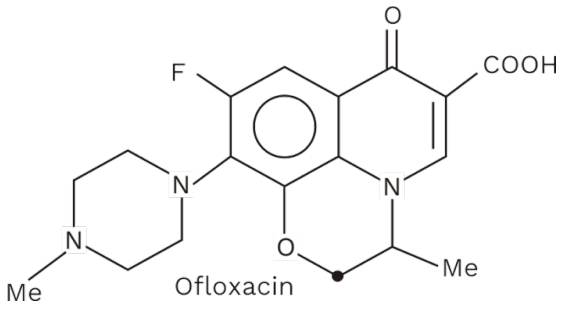
(1) chloramphenicol
(2) penicillin G
(3) ampicillin
(4) amoxicillin



Penicillin

If R is $C_6HCH_2^-$. It is called Penicillin–G or Benzyl penicillin.

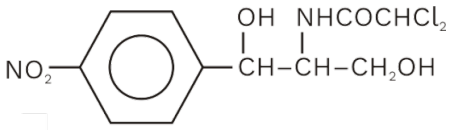
If R is $C_6H_5OCH_2^-$, Penicillin–V or Phenoxy methyl penicillin.



Ofloxacin

Chloramphenicol:

Chloramphenicol is a broad-spectrum antibiotic. It is rapidly absorbed from the gastro-intestinal tract and hence can be given orally in case of acute fever, typhoid, certain form of urinary infections, dysentery, meningitis, and pneumonia.



Chloramphenicol

(4) Tranquilizers

The chemical substances which act on the central nervous system and have a calming effect to reduce anxiety and tension are known as tranquilizers.

They are of two types:

1. Sedative or hypnotics
2. Mood elevators or anti-depressants

Rack your Brain

Why tetracyclines is avoided during pregnancy?

Concept Ladder

The chloramphenicol cause the hematological toxicity. It produce direct, dose depenedent bone marrow depression.

Definitions

Tranquillizers are the chemical substances which are used for the treatment of stress, mild and severe mental diseases.

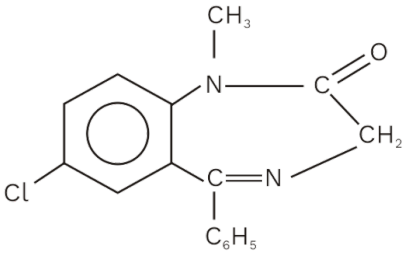
Sedatives and hypnotics

Sedatives:

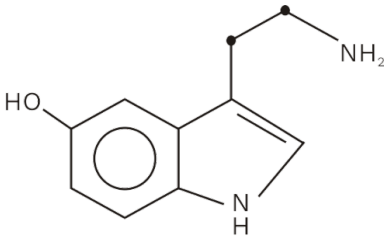
Sedatives are central nervous system depressants that reduce nervous tension and promote relaxation without inducing sleep. For example, diazepam (calmpose), meprobamate (equanil), serotonin, etc.

Rack your Brain

Diazepam also used in to reduce alcohol withdrawal symptoms.



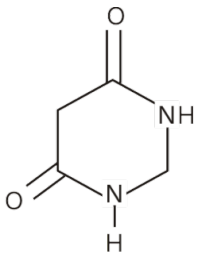
Valium (Diazepam)



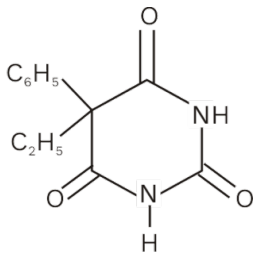
Serotonin

Hypnotics : They are central nervous system depressants that induce sleep.

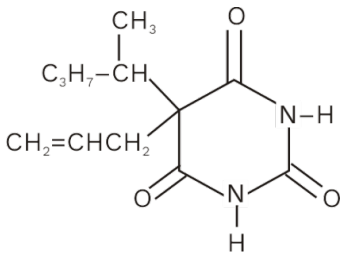
- Synthetic compound used as sedative and hypnotics is barbituric acid and its derivatives such as luminal, Seconal and equanel.



Barbituric acid



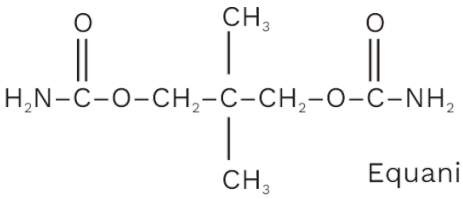
Luminal



Seconal

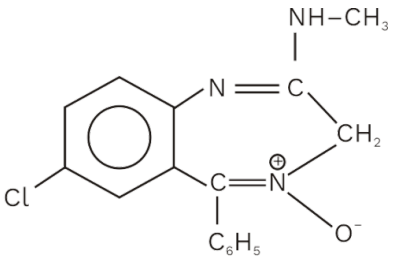
Concept Ladder

Tranquillizers are neurologically active drugs which affect the message transfer mechanism rom nerve to receptor. These are also called psychotherapeutic drugs.

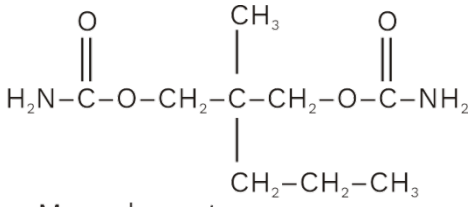


Equanil

- Some known hypnotic tranquilizers are chlordiazepoxide and meprobamate.



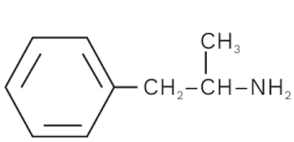
Chlordiazepoxide



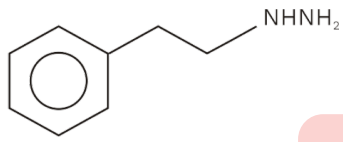
Meprobamate

Anti-depressants: They are drugs used for the treatment of highly depressed patients.

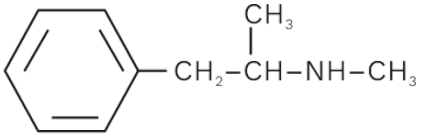
- They are also known as mood elevators.



Benzedrine (amphetamine)



Phenelzine (Nordil)



Methamphetamine

Concept Ladder

If the level of noradrenarline in the body is low, then the message transfer mechanism becomes slow and the person suffers from depression.

Previous Year's Questions

Which one of the following is employed as a tranquilizer? **[AIPMT]**

(1) Naproxen
(2) Tetracycline
(3) Chlorpheniramine
(4) Equanil

Rack your Brain

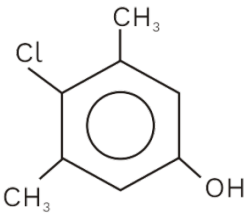
Name a drug that should be given to patients with shattered cofidence.

(5) Antiseptics and Disinfectants

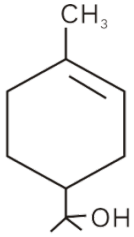
Antiseptics

Antiseptics are the chemicals which kill or prevent the growth of microorganisms. For example, Salol, Dettol, Acriflavine, Catavelon, Potassium permanganate etc.

- Dettol is a mixture of terpineol and chloroxylenol and is a famous antiseptic.

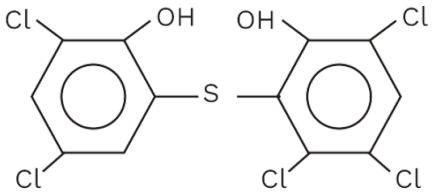


Chloroxylenol



α-Terpineol

- Salol (phenyl salicylate) is an intestinal antiseptic.
- Aqueous solution of boric acid is a mild antiseptic for eyes.
- Bithional is used in soaps to reduce bacterial odour on skin.



Bithional

- Antiseptics are applied to living tissues and can be applied to wounds, cuts, ulcers and diseases on skin surfaces.
- For drinking purpose chlorine is used to make water fit. Low concentration of sulphur dioxide is used for sterilizing squashes for preservation.
- Iodine is a powerful antiseptic. It is employed as tincture of iodine. Iodoform (CHI_3) is used as an antiseptic wound powder.

Concept Ladder

Anantiseptic is applied to the body or living cells, while disinfectants are applied to non living surfaces, such as countertops and handrails.

Rack your Brain

A healing product is antiseptic or disinfectant?

Previous Year's Questions

The mixture of chloroxylenol and terpineol acts as

[AIPMT]

(1) analgesic
(2) antiseptic
(3) antipyretic
(4) antibiotic

- Some organic dyes, gentian violet and methylene blue are used as antiseptics.
- H_3BO_3 is used as an antiseptic to wash eyes.

Disinfectants:

- Disinfectant kills microorganisms however these are not safe for contact with living tissues. These can be applied to inanimate objects such as floor, instruments, etc., A solution of cresols in e.g., soap water (Lysol).
- By varying the conc. of the solution, the same substance can act as a disinfectant as well as an antiseptic for ex. A 1% solution of phenol acts as a disinfectant while its 0.2% solution is an antiseptic.

(6) Anti-viral Drugs

- The most common anti-viral drug is AZT (3'-azido, 3'-deoxythymidine) which is used in AIDS.

(7) Anti-fertility Drugs or Oral Contraceptives

- These are used to check pregnancy in woman. They control the female menstrual cycle and ovulation. For example, Enovid-E (It is mixture of norethindrone and mestranol). Such drugs have normally a combination of a synthetic oestrogen and a progesterone derivative (to check ovulation) (to control Menstrual cycle). The most common oestrogens are Novestrol or ethinylestradiol and progesterone derivative is Norethindrone.

Concept Ladder

Tincture of iodine is 2-3% solution of iodine in alcohol-water. It is pawerful antiseptic and is usually applied on wounds.

Previous Year's Questions

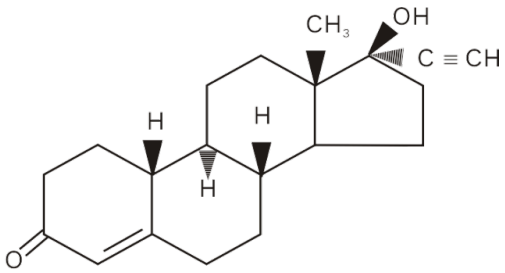
Bithional is generally added to the soaps as an additive to function as a/an?

[NEET]

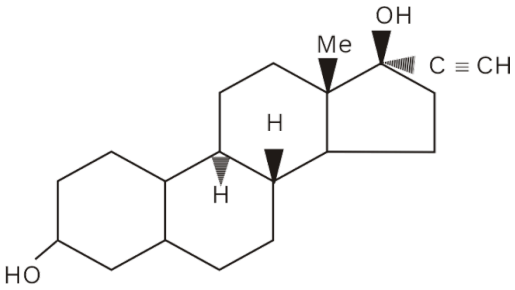
(1) buffering agent
(2) antiseptic
(3) softener
(4) dryer

Rack your Brain

Which is used as 'morning after pill'?



Norethindrone

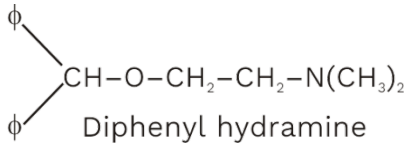


Novestrol (Ethvnvlesiradiol)

(8) Anti-allergic Drugs or Antihistamines

- These are used in case of allergy as the allergy reactions are due to the liberation of histamine in the body that's why these drugs are known as Antihistamines. These drugs interfere with the natural action of histamine by competing with histamine for bindingsites of receptor where histamine exerts its effects. These are quite effective in case of rhinitis, nausea in pregnancy, fever etc.

E.g.,



Diphenyl hydramine

Rack your Brain

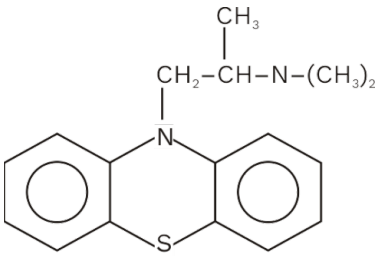
What is the best natural birth control method?

Concept Ladder

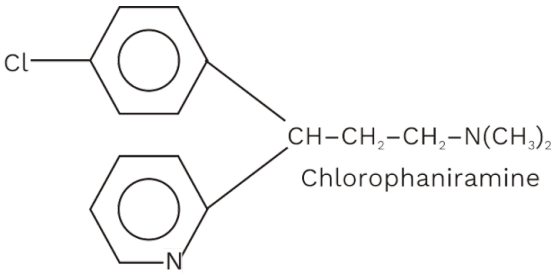
Anti-histamines are the drugs which diminish or abolish the effects of histamine, a chemical released by mast cells during and allergic reaction.

Rack your Brain

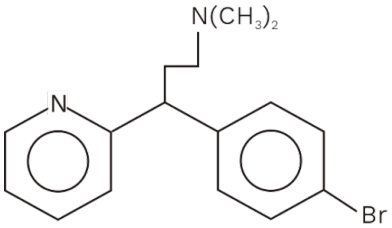
What are responsible for nasal congestion associated with common colds, coughs?



Promethazine



Chlorophaniramine



Bromopheniramine

Previous Year's Questions

Artificial sweetener which is stable under cold conditions only is

[AIPMT]

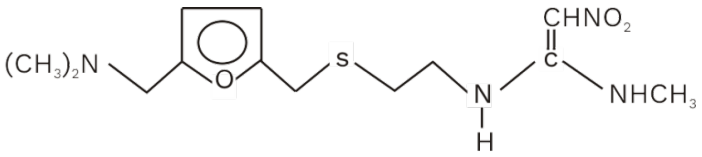
(1) saccharine
(2) sucralose
(3) aspartame
(4) alitame

(9) Antacids

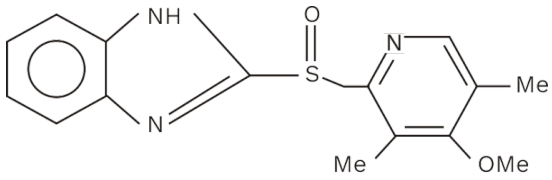
- These are used to remove acidity in stomach. For example, magnesium hydroxide magnesium carbonate, magnesium trisilicate, aluminium hydroxide etc.
- Now omeprazole and lansoprazole are also used as antacids.
- Metal hydroxides are better as they increase pH only up to 7.

Concept Ladder

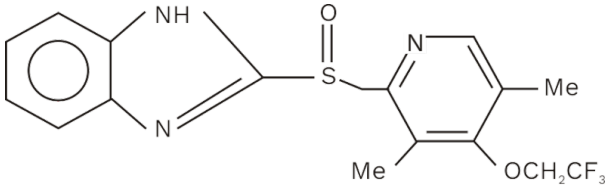
In case of advance acidity stages, ulcers become life threating and the only treatment is the removal of the affected part of atomach.



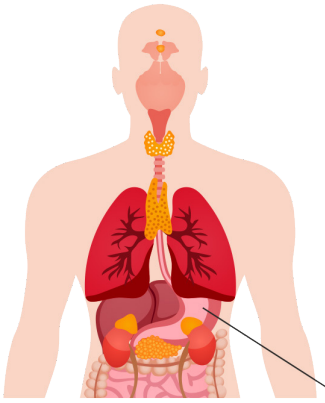
Ranitidine (Zantac)



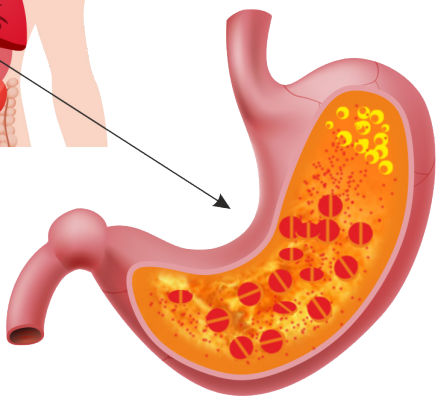
(Omeprazole)



Lansoprazole



Antacids work by counteracting, or neutralising, any excess stomach acid.



Rack your Brain

Can you guess the role of histamines in acidity?

Previous Year's Questions

Which one of the following is employed as antihistamine? **[AIPMT]**

(1) Diphenyl hydramine
(2) Norethindrone
(3) Omeprazole
(4) Chloramphenicol

Concept Ladder

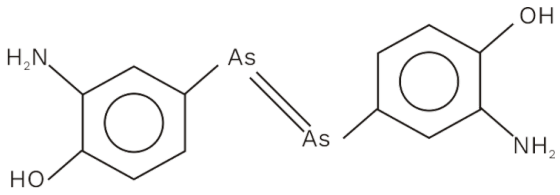
All these drugs not only neutralise HCl but also prevents it's formation to give relief from hyperacidity.

(10) Anti-malarial

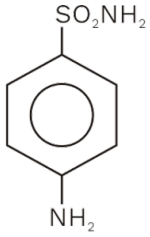
Such medicines are used to bring down body temperature during malaria fever. For example, Quinine (from cinchona sp.), Paraquine, Chloroquine, Primaquine.

(11) Anti-microbials

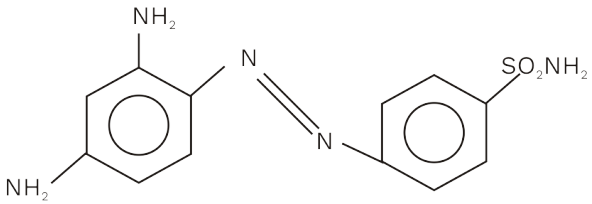
- Such drugs cure diseases caused by microbes like bacteria, fungi, virus etc., these may be bactericidal (kill microorganisms) and bacteriostatic (check growth of microorganism). Some common Anti microbials are as follows:



Sal Varsan (Arsphenamine)
Used in syphills



Sulphanilamide
(Main component of Sulpha drugs)



Prontosil

(12) Anaesthetics

- These are chemical substances administered for producing general or local insensibility to pain and other sensation.

Rack your Brain

How many types of malaria are there?

Concept Ladder

Sulpha Drugs are anti-microbial as well as inhibit the growth of bacteria as well. They have also been found to be active against gram-positive and gram-negative cocci, bacilli and protozoa.

Rack your Brain

What type of anaesthetic should be taken for a tooth extraction surgery?

- Anaesthetics are of two types:
  (a) General anaesthetics
  (b) Local anaesthetics

General Anaesthetics: They produce unconsciousness and are given when major surgical operations are to be performed.

- Some of the common general anaesthetics are in Liquid form: Nitrous oxide, cyclopropane, ethylene etc.

Local Anaesthetics: They produce loss of sensation on a small portion of the body where the drug is applied.

- Local anaesthetics are used for minor operations.

Jelly Form	Xylocaine
Spray Form	Ethyl chloride
Injection Form	Procaine

Rack your Brain

Is local anesthesia safer than general anesthesia?

Some chemicals used in foods

Chemicals used in foods are called food additives and these are mainly as follows:

Preservatives:

- These are used to protect food against the infection of bacteria, moulds, yeast and other fungal infection. For example, Sodium benzoate which metabolizes into hippuric acid ($C_6H_5CONHCH_2COOH$) and secreted in urine.
- Potassium or sodium meta bisulphite ($Na_2S_2O_5$) is used in pickles, gems etc.
- Some salts of Sorbic acid and Propionic acid and phydroxy benzoate esters are also used as preservative.

Concept Ladder

Detergents are more soluble because the sulfonate group does not attach itself to teh ions present in hard water.

Colouring agent:

- Some dyes natural or synthetic are used to give colour to food stuffs, however, these must not be harmful. For example, natural edible colours are turmeric, carotene, saffron, caramel, annatto etc.

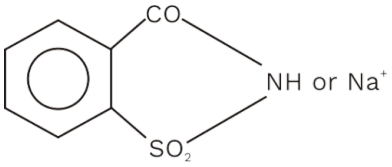
Rack your Brain

What is added in detergents to produce whiteness in clothes?

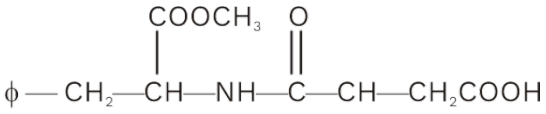
- Some synthetic edible colours are azodye, tetragene, TiO_2 etc.

Sweetening agents:

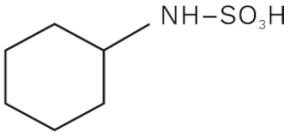
- Sucrose, fructose are natural sweeteners.
- Saccharine (sodium or calcium salt of saccharin acid) is used as most common sweetener. It is nearly 600 times more sweet than sucrose. It is known to be biodegradable.
- Cyclamate (N-cyclohexylsulphamate) sucralose (trichloro derivative of sucrose), Aspartame, L-glycose are some other common sweeteners.
- These are calorie free and do not cause tooth decay.



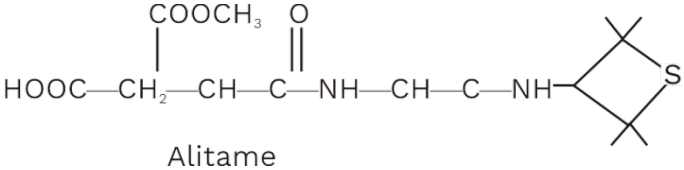
Saccharin



Aspartame



Cyclomate



Alitame

Concept Ladder

Artificial sweeteners are also called as low calorie sweeteners because these chemicals pass through human body unmetabolized.

Rack your Brain

Which artificial sweetening agent break down in our body?

Previous Year's Questions

The artificial sweetner stable at cooking temperature and does not provide calories is **[NEET]**

(1) saccharin
(2) aspartame
(3) sucralose
(4) alitame

Flavouring agents:

- The most common flavour vanilla iss 3-methyl-4-hydroxy benzaldehyde.

Antioxidants:

- These are used to prevent oxidation of fat in food stuffs like biscuits, potato chips etc. For example, Butylated hydroxy toluene (BHT), butylated hydroxy anisole (BHA), SO_2 is used as an oxidant in wine, beers etc.
- Both BHT and BHA check the ageing of food material.

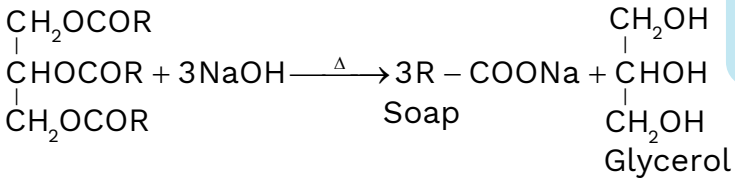
Rack your Brain

What is the safest artificial sweetener to use?

Soaps and Detergents

Soaps

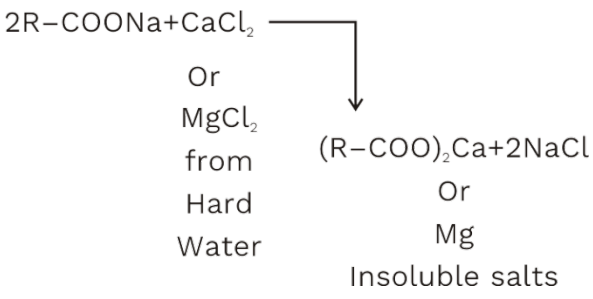
- Soaps are the sodium and potassium salt of higher fatty acids like stearic acid ($C_{17}H_{35}COOH$), palmitic acid ($C_{15}H_{31}COOH$), Lauric acid ($C_{11}H_{23}COOH$), linoleic acid ($C_{17}H_{31}COOH$).
  Soap can be manufactured by Saponification as follows:



Concept Ladder

Soaps are known as surfactants (compounds that reduce the surface tension between a liquid and another substance) and therefore help in the emulsification of oils in water.

- Soaps are completely biodegradable however these cannot be used with hard water as Ca^{2+} and Mg^{2+} give curdy white precipitate.



Previous Year's Questions

Bithional is generally added to the soaps as an additive to function as a/an

[AIPMT]

(1) softener
(2) dryer
(3) buffering agent
(4) antiseptic

These insoluble salts or scums inhibits cleaning action of soap by hinderance.

- Soaps can also not be used in acidic solution as acids precipitate the insoluble R-COOH to reduce cleaning.

Cleansing action of soap

This property largely depends upon its wetting action as well as its power of emulsification and adsorption of dirt and grease particles.

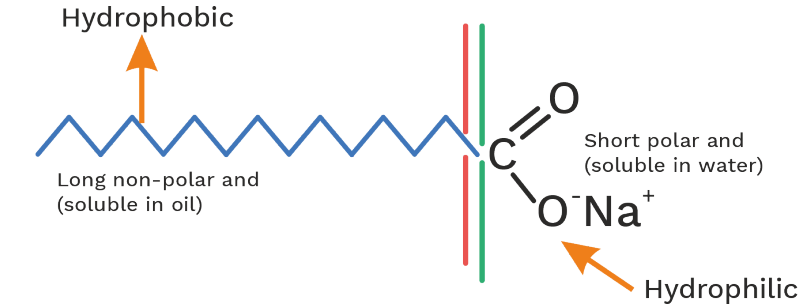
When soap is rubbed the dirt is washed away due to the two-fold action of soap

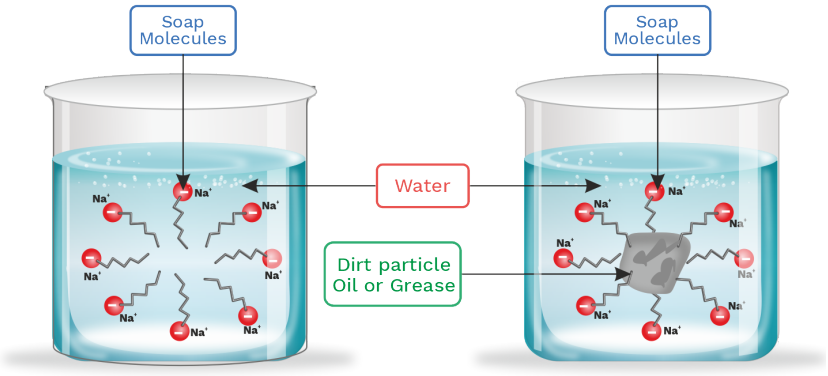
(1) The soap emulsifies the grease and loosens its grip on the dirt

(2) Soap forms a colloidal solution in water which adsorbs dirt particles and removes them.

Rack your Brain

Can micro-organisms in sewage oxidise soaps?





(a) Soap Micelle

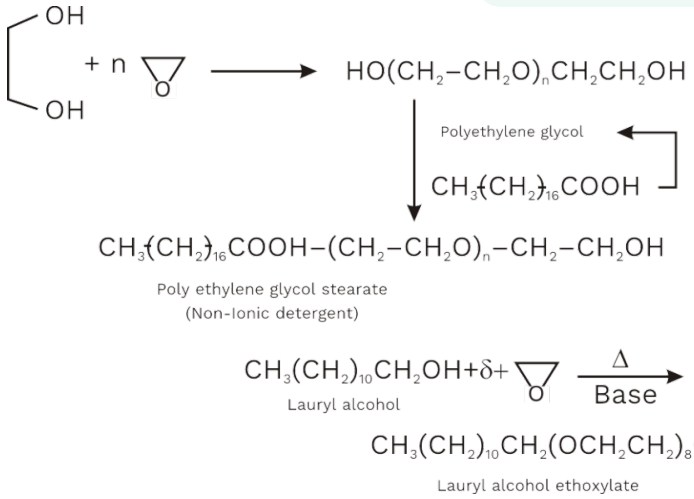
(a) Soap Micelle entraps the dirt particle

Cleansing Action Of Soap

Detergents

- Detergents are Na salts of alkyl hydrogen sulphate of alkyl benzene sulphonates or alcohol.
- They are not completely biodegradable but can be used in hard water.
- Detergents are of three types:

Non-Ionic detergents: These are high molecular mass esters of polyethylene glycol and stearic acid. These may also be formed by the reaction of ethylene oxide and long chain alcohols like lauryl alcohols.



Cationic detergents: These are quaternary ammonium salts (like chloride, bromide etc.) having one or more long chain of alkyl groups and having germicidal properties. For example, Cetyltrimethyl ammonium chloride $[CH_3(CH_2)_{15}\ N^+(CH_3)_3\ ]Cl^-$.

Anionic detergents: In these detergents, the larger part of the molecules are anions and these are effective in acidic solution also. These are of two types:

(1) Sodium alkyl sulphate: These are formed by the reaction of long chain alcohols and concentrated H_2SO_4 as follows:

Previous Year's Questions

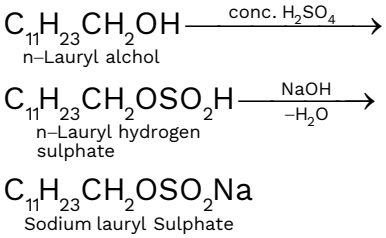
The liquefied gas that is used in dry cleaning along with a suitable detergent is :

[AIPMT]

(1) Water gas
(2) Petroleum gas
(3) NO_2
(4) CO_2

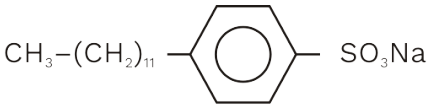
Rack your Brain

What is chromogen?

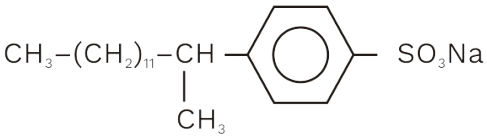


(2) Alkyl benzene sulphonates:

The most common domestic detergent of this type is sodium dodecylbenzene sulphonate (SDS) and sodium-4-(2- dodecyl) benzene sulphonate.



Sodium, 4- (dodecyl) benzene Sulphonate (SDS)



Sodium, 4- (2-dodecyl) benzene Sulphonate (SDS)

Previous Year's Questions

Which of the following is a cationic detergent? **[AIPMT]**

(1) sodium stearate
(2) cetyltrimethyl ammonium bromide
(3) sodium dodecylbenzene sulphonate
(4) sodium lauryl sulphate

Rack your Brain

What are the similarites and difference of soaps and detergents?

Cleansing action of detergents

- Detergents are substances containing a long hydrocarbon portion and an ionic portion.
- The hydrocarbon portion is soluble in oils and greases but insoluble in water.
- The ionic portion is soluble in water but insoluble in oils and greases.
- The use of such detergents as soaps to clean greasy surface with water is an excellent application.
- Detergent serves as a link between the grease and water and mixes them as a suspension.
- Adding a detergent to water gives a colloidal suspension of the detergent in which the hydrocarbon ends cluster together and the

Previous Year's Questions

Which of the following forms cationic micelles above certain concentration? **[AIPMT]**

(1) Sodium dodecyl sulphate
(2) Sodium acetate
(3) Urea
(4) Cetyltrimethylammonium bromide

ionic ends put outwards into the surface of the surrounding bulk of water.

- Much of the detergent also concentrates at the outer surfaces of the water, the ionic and remaining in the water.
- Thus, the water surface is covered by a layer which will readily wet, and dissolve grease or oil. When the water, which contained detergent, is agitated in the presence of oil, the oil is dispersed into droplets within the water. In this way, the oil is removed with water.

Rack your Brain

What is use of oxidizer?

Propellants

- It is a combination of a fuel and an oxidizer which when ignited undergoes combustion to release a large quantity of hot gases.
- According to Newton's Third's law of motion, from the nozzle of the rocket when gases are passed, motor of rocket provides the necessary thrust for the rocket for movement in forward direction.
- Propellants are classified into three states according to their physical state, (a) solid propellants (b) liquid propellants and (c) hybrid propellants.

Definitions

Chemical substance (fuels) used for launching rockets are called rocket propelants.

Solid Propellant

- Composite propellant is the most widely used solid propellant is which there is a blend of a polymeric binder such as polybutadiene or polyurethane as fuel and ammonium perchlorate as oxidizer.
- Here, some additives (metals such as aluminium or magnesium in finely divided form) are added to modify the performance of the propellant.
- Double base propellant mainly consists of nitro-glycerine and nitrocellulose. Nitrocellulose gels in nitro-glycerine sets in as a solid mass.

Concept Ladder

Solid propellats, once ignited continue to burn with a predetermined rate without having a start or stopping capadility.

Liquid Propellant

Mono propellant:

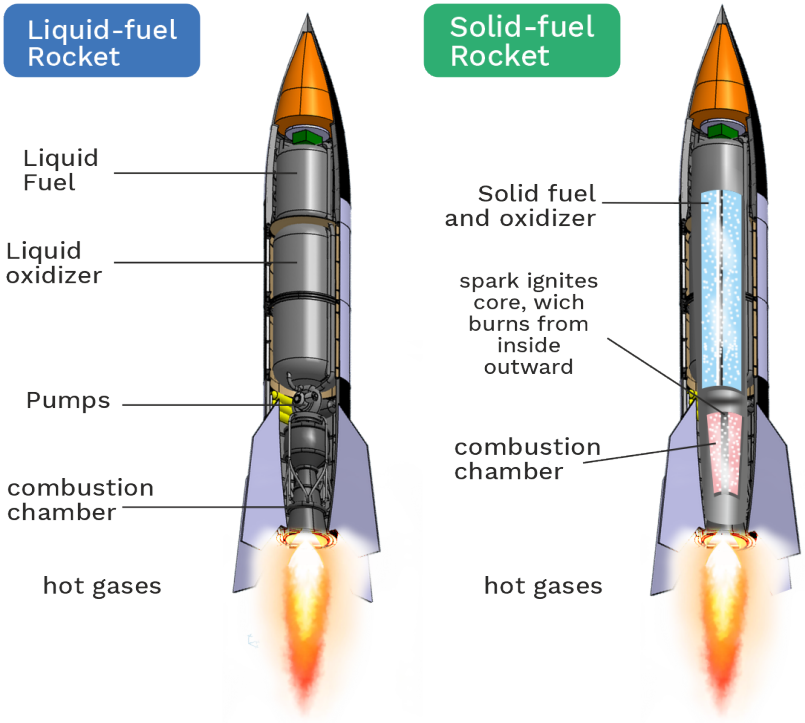
Monopropellants are liquid propellants where in a single chemical compound on decomposition or ignition gives out hot gases. For example, hydrazine, methyl nitrate, nitromethane and hydrogen peroxide.

Biliquid propellant: It consists of a combination of an oxidizer such as liquid oxygen, nitrogen tetroxide (N_2O_4) or nitric acid and a fuel such as kerosene, alcohol, hydrazines or liquid hydrogen, Liq., O_2, Dimethyl hydrazine etc.

- These biliquid propellants, give higher thrusts than solid propellants.

Concept Ladder

Liquid propellants consist of an oxidiser such as liquid oxygen, dinitrogen tetraoxide (N-204) or nitric acid and a fuel such as kerosene, alcohol, hydrazine or liquid hydrogen.



Hybrid propellants: It contains a solid fuel and a liquid oxidizer. For example, acrylic rubber (as a solid fuel) and N_2O_4 (liquid oxidizer).

- The hybrid rocket propellant used in the American space or Saturn booster rocket programme has a combination of kerosene and liquid oxygen as the propellant for the initial stages and liquid oxygen and liquid hydrogen for the latter stages.
- The Titan ballistic missile has a mixture of hydrazine (fuel) and dinitrogen tetroxide (oxidizer).
- The Russian rockets generally use a liquid propellant Conscenario.
- The SLV-3 and ASLV rockets use composite solid propellants.
- Space shuttle uses liquid O_2 and liquid H_2 along with a solid booster in the lower stages.

Specific Impulse

The performance of a rocket propellant is expressed in terms of specific impulse

$$(I_s).(I_s) = \sqrt{T_c / M}$$

$$I_S = \frac{1}{g}\sqrt{(2\gamma / \gamma - 1)(rRT_c / M)(1 - P_C / PO_e)^{r-1/r}}$$

Rack your Brain

What is the propellant used in Saturn Booster Rocket of American Space Programme?

Concept Ladder

PSLV uses a solid propellant in the first and third stage while N_2O_4 and UDMH in the second stage and N_2O_4 and MMH in fourth stage.

Q.1 Given one example of an arfificial sweetener used by diabetic patients.

A.1 Dia- betic patients can use saccharin (in form of its sodium salt) as artificial sweetener.

Q.2 What problem arises in using alitane as artificial sweetener?

A.2 It is difficult for controlling sweetness of the food to which alitane is added as it is a high potency artificial sweetener.

Here,

R = Gas constant

M = Average molecular mass of the exhaust products

γ = Ratio of specific heat at constant pressure to specific heat at constant volume

T_c = Combustion chamber temperature

P_c = Chamber pressure

P_e = External pressure

Dyes

- Dyes are chemical compounds which have particular colours and are capable of being fixed to the fabric (wool, silk), paper, leather etc., permanently from its solution.
- These should be chemically stable and resistant to the action of water, light and soap.
- All coloured substances are not necessarily dyes, however, a coloured substance is classified as a dye, if it fulfils following features:

1. It must possess a suitable colour.
2. It should be capable of getting fixed on the material from its solution either directly or with the help of a mordant.
3. When fixed to the fabric, it should remain fast to the exposure of light, resistant to the action of water, dilute acid and dilute alkali.

Concept Ladder

Azo dyes constitute the larget and the most important group of synthetic dyes. The azo dyes contain one or more azo groups -N=N-, as the chromophore.

Rack your Brain

Orange (Azo Dye) is an example of which type of dye?

Q.3 What type of forces are involved in binding of substrate to the active the active site of enzyme?

A.3 van der Waals interactions, ionic bonding, hydrogen bonding etc

Q.4 Explain why some times foaming is seen in river water near the place where sewage water is poured after treatment?

A.4 Detergents (which are not biodegradable) persist in water even after sewage treatment and thus cause foaming in river water.

Cause of Exhibition of Colour

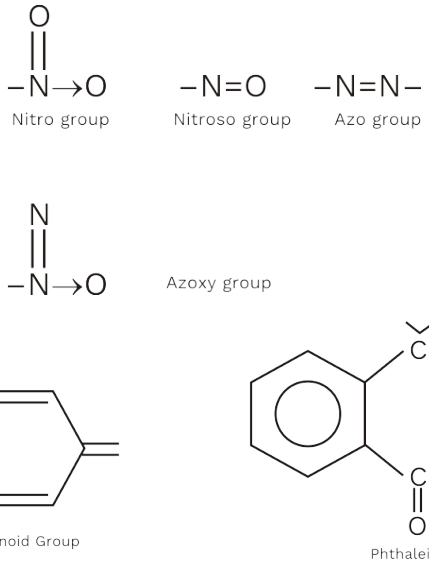
When a beam of visible light falls on a coloured substance, certain part of the light is absorbed, and the rest is reflected.

- The colour of the substance is the colour of the reflected light which is the complimentary colour of the light absorbed.
- According to the chromophore–auxochrome theory as proposed by Otto witt, the colour of the dye is due to the presence of certain groups in the molecule.

Chromophore

The colour of the dye is due the to the presence of certain groups containing multiple bonds called chromophores.

For example,



A coloured compound having a chromophoric group is known as a chromogen.

Auxochrome

- Nitrobenzene is a pale-yellow compound but when the auxochrome –OH is present in ortho or para position to the nitro group, it becomes deep yellow. Similarly, azobenzene

Concept Ladder

To make a substance coloured, the chromophore has to be conjugated with an extensive system of alternate single and double bonds as exists in aromatic compounds.

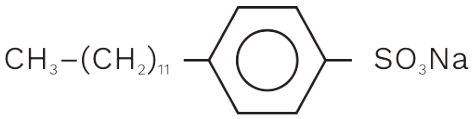
Rack your Brain

What is the natural black dye?

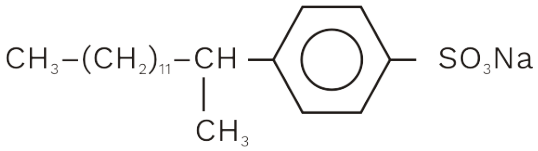
Definitions

Certain groups, which do not produce colour themselves, but when present along with chromophores increase the intensity of colour of the dye. They are called **auxochromes.**

has red colour while p-amino azobenzene is brilliant red.



Sodium, 4- (dodecyl) benzene Sulphonate (SDS)



Sodium, 4- (2-dodecyl) benzene Sulphonate (SDS)

Rack your Brain

What is the oldest known dye?

Classification of Dyes

Dyes have been classified as follows:

- Classification based on their constitution
- Classification based on their application

Classification of dyes based on their constitution:

Depending upon the nature of the chromophoric group present in the dye, dyes are of following types:

(1) Nitro dyes Martius yellow, picric acid
(2) Nitroso dyes Mordant green-4
(3) Azo dyes Para red, Methyl orange
(4) Indigo dyes Indigo

Concept Ladder

Acidic auxochromes –OH, $-SO_3H$, –COOH
Basic auxochromes $-NH_2$, –NHR, $-NR_2$
Neutral auxochromes –OR

Q.5 What are antagonistic drugs?

A.5 Antagonistic drugs are those drugs which get bind to the receptor site and inhibit its natural function. For example, the antacid drug cimetidine is called the antagonistic drug since it binds to the receptor sit in stomach where otherwise histamine will bind and hence the secretion of HCl is reduced thereby reducing/removing hyperacidity.

(5) Phthalein dyes Phenolphthalein
(6) Triphenylmethane dye p-rosaniline
(7) Anthraquinone dyes Alzarin

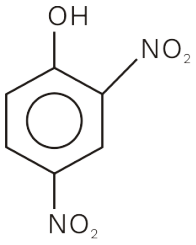
Classification of dyes based on their application

Acid dyes:

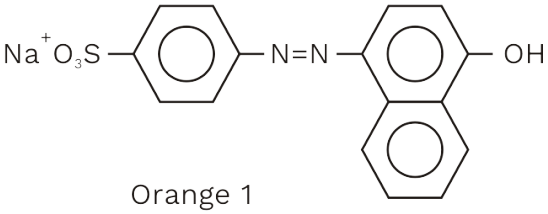
They do not have affinity for cotton, for example, orange-1. Orange-1 is prepared by coupling of diazotized sulphanilic acid with α-naphthol.

Concept Ladder

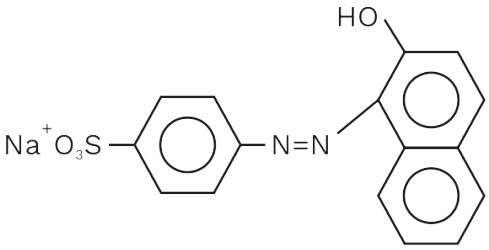
Acid dyes are usually salts of sulphonic acids and can be applied to wool, silk and nylon.



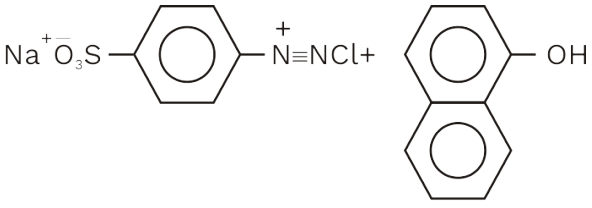
Martius yellow



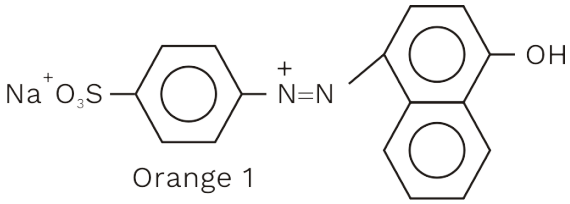
Orange 1



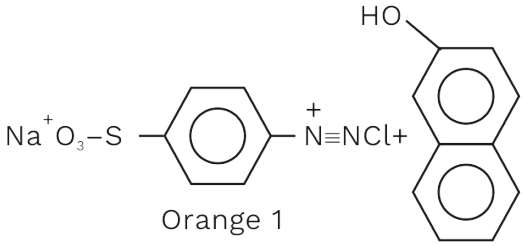
Orange 2



Diazotized sulphanilic acid α-naphthol

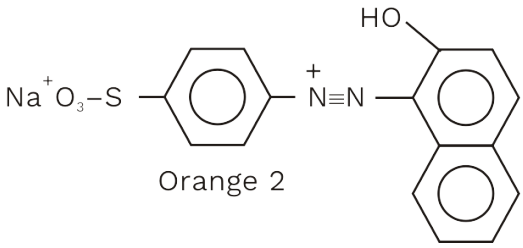


Orange 1



Orange 1

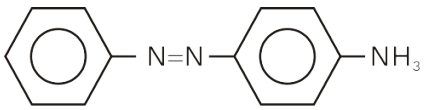
β-naphthol



Orange 2

Basic dyes:

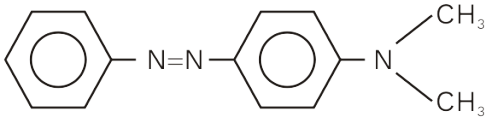
To dye modified nylons and polyesters, these dyes are used. For ex. malachite green and aniline yellow.



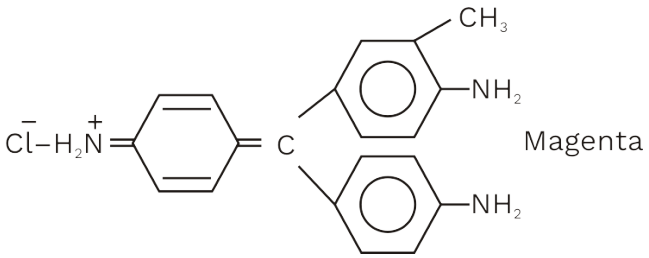
p-aminoazobenzene(Aniline yellow)

Concept Ladder

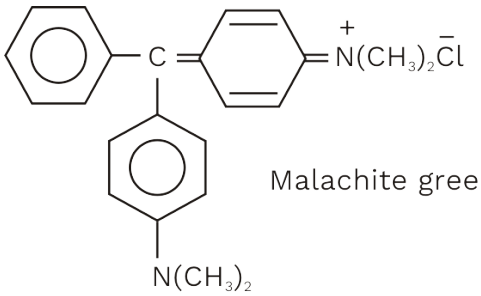
Basic dyes contain amino groups which in acid solutions form water soluble cations.



N, N-dimethyl p-aminoazobenzene (Butter yellow)



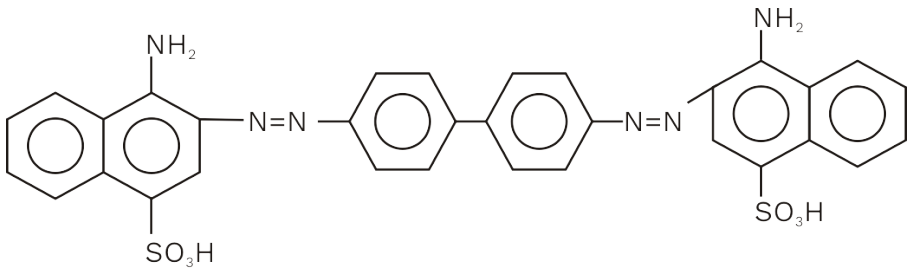
Magenta



Malachite green

Direct dyes:

These are directly applied to the fabrics from an aq. solutions and are very useful for the fabrics forming hydrogen bonds. They are thus useful for wool, cotton, rayon, nylon and silk. For ex. congo red and martius yellow.



(Congo Red)

Mordant dyes:

These are applied on the fabric after treating it with a metal ion. Fabric and the dye in turn co-ordinates to the metal ion after got bounded with it. The same dye can give different colours, this property depends upon the metal ion used.

Fibre reactive dyes:

Generally, the bonding is through the substitution of a leaving group of fibres (silk, wool or cotton). For ex. derivative of 2, 4-dichloro-1, 3, 5-triazine.

Disperse dyes:

In such dyes, minute particles of the dye are dispersed or spread from a suspension into the fabric, where they diffuse. Such dyes are used for polyesters, nylon and polyacrylonitrile. For example, cellitone fast pink B, cellitone fast blue B.

Vat dyes:

These insoluble dyes are reduced to a colourless soluble form (leuco) and then applied to the fabrics where they are oxidized to the insoluble coloured dye by exposure to air or an oxidizing agent. For example, indigo.

Azo dyes:

These are derived by coupling of a phenol or naphthol adsorbed on the surface of a fabric with a diazonium salt. Cotton, silk, polyester and nylon can be dyed by this method.The colour is not very 'fast' as the interaction is by surface adsorption.

Ingrain dye:

These are water insoluble azo dyes which are produced in situ on the surface of fabrics by coupling reactions. For example, para red.

Carbon Fibres:

Carbon fibers are composed of silky black threads of pure carbon which are stronger than steel, lighter than aluminium, and stiffer than titanium. For e.g., carbon fiber reinforces plastics.

Concept Ladder

Such dyes attach themselves to the fibre by an irreversible chemical reaction. Thus, the dyeing is 'fast' and the colour is retained for a longer time.

Previous Year's Questions

Diazo coupling is useful to prepare some

[AIPMT]

(1) pesticides
(2) dyes
(3) proteins
(4) vitamins

- Carbon Fibres Reinforces Plastics (CFRP): By reinforcing carbon fibers into light weight matrix like epoxy or polyester resin it can be obtained. It is used to make helicopter blades and wing nosels etc.

Some Advanced Chemical Materials

Ceramics: These can be obtained after the firing of china clay that is Kaolin ($Al_2O_3.2SiO_2.2H_2O$) at high temperature.

- Even at very low temperature they act as super conductors.

e.g., $HgBa_2Ca_2Cu_2O_8$ has a critical temperature of 153 K or –120°C

- These may be glass ceramics, super conductive ceramics, abrasive ceramics etc.
- In super conductive ceramics, the elements present are Y, Ba, Cu and O mainly. These are used in

(1) Transmission of signals and high speed switching for computers.

(2) Electrical power transmission.

(3) Magnets used in high energy particle accelerators.

Fungicides, Herbicide and Insecticide etc.

- 2, 4-dichloro phenoxy acetic acid & 2, 4, 5-trichloro phenoxy acetic acid are two common herbicides.
- Malathion and Parathion are two famous biodegradable organo phosphate insecticides.
- Cetyltrimethyl ammonium chloride a type of cationic detergent can be used as a germicide.
- Piperazine is used against roundworms and pinworms.
- Aldrin, Dialdrin, Methoxychlor, D.D.T. (dichloro diphenyl trichloro ethane) and B.H.C. (benzene hexa chloride), are some non-biodegradable insecticide.
- Abscisic acid is a plant growth inhibitor.

Concept Ladder

Carbon Fibre Reinforces Carbon (CFRC): It is obtained by reinforcing carbon fibers into carbon matrix. It is used in making superior sports goods like tennis rackets, racing car bodies etc.

Rack your Brain

What is the rotenticides?

Concept Ladder

Bordeaux mixture ($CuSO_4$ + lime water), Copper sulphate, 2, 4, 6-Trichlorophenol, copper naphthalene are famous fungicides.

Q.6 What are limited spectrum antibiotics? Give one example.

A.6 Limited spectrum antibiotics are specific for certain diseases only.
Ex. Streptomycin for tuberculosis.

Q.7 Explain the cleaning action of soap?

A.7 Cleaning action of soap : This action is due to the fact that soap molecules form micelles around the oil droplets, the oil droplet surrounded by stearate ions is pulled in water and removed from the dirty surface, since the polar groups can interact with water, hydrophilic part projects out of the grease droplet like the bristles. Thus soap helps in emulsifica- tion and washing away of oils and fats.

Q.8 Why do soaps not work in hard water?

A.8 Hard water contains Ca^{2+} and Mg^{2+} ions. The Ca and Mg salts formed by these ions, act as scum. The insoluble scum sticks on the clothes, hence cleaning capacity of soap decreases when sodium or potassium soaps are dissolved in hard water.

Q.9 What are food preservatives? Name two such substances.

A.9 Food preservatives : For prevention of spoilage of food due to microbial growth, thses are used.
Example : vegetable oils, sodium benzoate etc.

Q.10 Explain the following types of substances with one suitable example, for each case :
(i) Food preservatives.
(ii) Analgesics.

A.10 (i) Food preservatives : For prevention of spoilage of food due to mi- crobial growth, thses are used.
Example : vegetable oils, table salt , sodium benzoate etc.
(ii) Analgesics : Analgesics abolish pain or reduce without causing impair- ment of mental confusion, consciousness, in coordination or some other disturbance of nervous system.
They are of two types :
(a) Narcotic analgesics Example : Morphine
(b) Non-narcotic analgesics Example : Aspirin

Q.11 What are the following substances? Give one example of each type.
(i) Antacid
(ii) Antiseptics

A.11 (i) Antacid : Those substances which raise the pH to an appropriate level in stomach by neutralizing the excess acid are called antacids.
Example : Sodium bicarbonate, magnessium hydroxide
(ii) Antiseptics : These prevent the growth of micro-organisms and can even kill them and safe to be applied on living tissues.
Example : Soframycin, furacin etc.

Q.12 What are the following substances? Give one example of each of them.
(i) Enzymes
(ii) Sweetening agents

A.12 (i) Enzymes : They are biological catalysts having high molecular mass and are chemically globular proteins. They are highly specific in their actions because of presence of active sites of definite size and shape on their surfaces that is why only specific substrate can fit in them.
Example : Pepsin, amylase
(ii) Sweetening agents : The agents that are sweet in taste but do not add any calories in our body are known as artificial sweetening agents. These can be excreted through urine easily.
Example : Aspartame, saccharin etc.

Q.13 Explain the Antifertility drugs with one suitable example.

A.13 Antifertility drugs : These are also known as birth control pills or oral contra-cep- tives, they are are used to check pregnancy in women. These are use for controlling the female menstrual cycle and ovulation.
Example : Ethinyl estradol, Norethindrone, Mestranol.

Q.14 What are the following substances ? Give one example of each.
(i) Antihistamines
(ii) Tranquilizers

A.14 (i) Antihistamines : They are amines which are used as drugs to control the allergic effects produced by histamines. Ex. Terfenadine.
(ii) Tranquilizers : They are a class of chemical compounds used for the treatment of stress, and severe mental disease. Ex. Equanil.

Q.15 If water contains dissolved Ca^{2+} ions, out of soaps and synthetic detergents, which will you use for cleaning clothes?

A.15 For cleaning clothes we will use synthetic detergents as they can produce lather even with the hard water which contains Ca^{2+} ions.

Q.16 Give two examples of macromolecules that are chosen as drug targets.

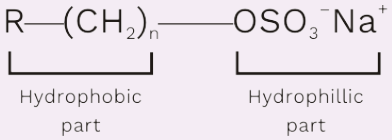
A.16 Carbohydrates and proteins.

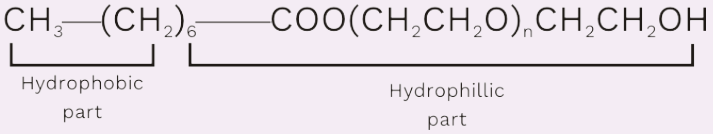
Q.17 Why is use of aspartame limited to cold foods and soft drinks?

A.17 For cold foods and soft drinks use of aspartame limited because it decom-poses at baking or cooking temperature.

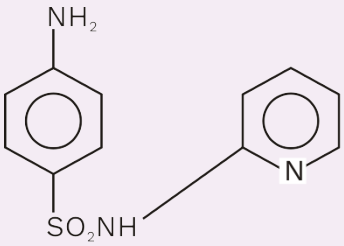
Summary

- Ernst Chain and Howard Florey isolated penicillin in pure form and exhibited its effectiveness as an antibiotic for the first time. The empirical formula of penicillin is $C_4H_{11}O_4Sn_2R$.
- Amyl metacresol is 5-methyl-2-pentyl phenol and is used as an antiseptic in mouth washes.
- Gentian violet and methylene blue are dyes and effective antiseptics also.
- Penicillin-G or 2 is most commonly used as an antibiotic and it is benzyl penicillin.
- Chloroquine, proquanil and pyrimethanamine are used to kill parasites in blood.
- Pentaprazole and omnoprazole inhibit gastric secretion.
- Cimetidine, rantidine are used in the treatment of peptic ulcers.
- Antihistamine drugs diminish the effect of histamine in allergic reactions.
- Gallic acid and propyl gallate are also used as antioxidants in food preservative.
- LSD (Lysergic acid diethylamide) is a powerful psychedelic drug which disturbs vision and hearing capacity of the person.
- Alarm pheromones are secreted by insects to alarms others against intruders. For example, bees secrete isoamyl acetate.
- Trail hormones are secreted by insects to attract other insects to the food source. For example, citral and citronellal are secreted by ants.
- Microalloyd steel has a good combination of strength formability and toughness. It has metals like V, Sn in small quantities.
- APC is a mixture of aspirin, phenacetin, and caffeine.
- N, N-dimethyl -meta -toluamide is a well-known insect repellent used in odomos (mosquito repellent cream).
- Salbutamol is an effect drug for asthma.
- Salvarsan is used to treat syphilis.
- Microalloyd near 24 carat gold has 99.56% higher gold content.
- Paramino salicylic acid (PAS) and isonicotine hydrazide (INH) are used in the treatment of tuberculosis.

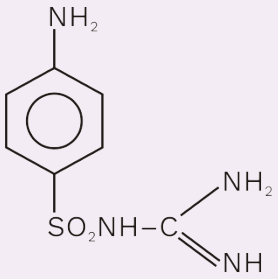




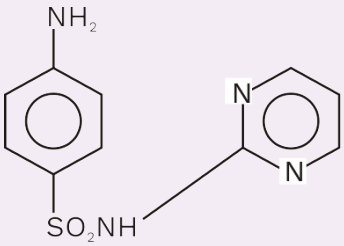
Sulpha drugs are derivatives of sulphanilamide and some common sulpha drugs are:



Sulphapyridine
(Used in pneumonia)



Sulphapyridine
(Used in Bacillary Dusemtery)



Sulphadiazine
(used in Dysentery and
infections of urinary
and respratory organs)