15

Chemistry in Everyday Life

Chemistry plays a vital role in every sphere of human life. Many substances which are used in daily life, are chemical compounds, e.g. soaps, detergents, household bleach, toothpaste etc. This chapter will cover three applications of chemistry namely-medicines, food materials and cleansing agents.

IN THIS CHAPTER ....

- Drugs and their Classification
- Drug-Target Interaction
- Therapeutic Action Different Classes of Drugs
- Chemicals in Food
- Cleansing Agents

Drugs and Their Classification

The chemical substances either of natural or synthetic origin, used for treating diseases and reducing suffering from pain are called **medicines** or **drugs."** The average molecular mass of drug is ~ 100 u to 500 u.

Actually, when the biological response of a drug is therapeutic and useful, it is termed as **medicine** and used for diagnosis, prevention and treatment of diseases. If medicines are taken in higher doses than the recommended, these acts as a potential poisons.

Note All medicines are drug but all drugs are not medicines.

The branch of science which deals with the treatment of disease using suitable chemical compounds is called **chemotherapy.** On this basis, the various drugs used for curing diseases are also known as **chemotherapeutic agents**.

Classification of Drugs

Drugs are classified into following types are as follows

(i) **On the basis of pharmacological effect** It provides the whole range of drugs available for the treatment of a particular type of problem, e.g. analgesic, antiseptic, etc.

(ii) **On the basis of drugs action** It explains the action of a drugs on a particular biochemical process.

(iii) **On the basis of chemical structure** It is based on the similar structure of drug. Drugs with similar structure have similar pharmacological activity.

(iv) **On the basis of molecular targets** Drugs are usually interact with biomolecules such as carbohydrates, fats, lipids. These are called **target molecules**.

Drug-Target Interaction

Macromolecules of biological origin such as proteins, carbohydrates, lipids, enzymes and nucleic acids are called drug targets because drug interact with these macromolecules.

The two types of drug-target interaction are as follows

1. Enzymes as Drug Target

Enzymes have active sites that bind to the substrate for effective and quick chemical reaction. The functional groups present at the active site of enzyme interact ion with functional groups of substrate *via* ionic bonding, hydrogen bonding, van der Waals' interactions, dipole-dipole interaction, etc.

Some drugs interfere with that interaction by blocking the binding site of enzyme and prevent the binding of actual substrate with enzyme. This inhibits the catalytic activity of the enzyme. Hence, these are called **enzyme inhibitors.** These are of two types, i.e. competitive inhibitors and non-competitive inhibitors.

(i) **Competitive inhibitors** are those drugs which compete with substrate for the attachment on active sites of enzymes.

(ii) **Non-competitive inhibitor** are those drugs which changes the active site of enzymes after binding at **allosteric site.** Sites different from active site of the enzymes where a molecule (drug molecule) can bind and affect the active site are called **allosteric site**.

Note If the formation between an enzyme and an inhibitor is a strong bond, then the enzyme is blocked permanently. Then the body synthesises new enzyme.

2. Receptors as Drug Targets

Receptors are proteins that are crucial for the body's communication process.

These proteins are embedded in the cell membrane. The active site of the receptor opens on the outside region of the cell membrane.

Chemical messengers are used to communicate, the messages between two neurons and between neurons to muscles. Receptor receives chemical messenger from its binding site (or active site). Shape of the receptor site changes which results in the transfer of messages into the cell.

Receptor regains their shape after the removal of chemical messenger.

Receptors bonding are explained by two drugs, i.e. **antagonistic drug** and **agonistic drug**.

(i) **Antagonistic drugs** are those that bind to the receptor site and inhibit its natural function.

(ii) **Agonistic drugs** are those that mimic the natural messenger by switching on the receptor.

Example 1. *The correct match between Item-I and Item-II is*

	Item-I		Item-II
A.	Allosteric effect	P.	Molecule binding to the active site of enzyme.
B.	Competitive inhibitor	Q.	Molecule crucial for communication in the body.
C.	Receptor	R.	Molecule binding to a site other than the active site of enzyme.
D.	Poison	S.	Molecule binding to the enzyme covalently.

Codes ***(JEE Main 2019)***

(a) $A \rightarrow P$; $B \rightarrow R$; $C \rightarrow S$; $D \rightarrow Q$

(b) $A \rightarrow P$, $B \rightarrow R$; $C \rightarrow Q$; $D \rightarrow S$

(c) $A \rightarrow R$; $B \rightarrow P$; $C \rightarrow S$; $D \rightarrow Q$

(d) $A \rightarrow R$; $B \rightarrow P$; $C \rightarrow Q$; $D \rightarrow S$

Sol. (*d*) (A) Molecule binding to a site other than the active site of enzyme is called allosteric effect.

(B) Molecule binding to the active site of enzyme is called competitive inhibitor.

(C) Molecule crucial for communication in the body is called receptor.

(D) Molecule binding to the enzyme covalently is called poison.

Thus, the correct match is :

$$A \rightarrow R,\ B \rightarrow P,\ C \rightarrow Q,\ D \rightarrow S.$$

Therapeutic Action of Different Classes of Drugs

Depending upon therapeutic action drugs are broadly classified into following types

Antipyretics

The chemical substances which are used to decrease the body temperature during high fever are called **antipyretics**, e.g. paracetamol, aspirin, phenacetin (4-ethoxy acetanilide), analgin, novalgin etc. Out of these, paracetamol is the most popular antipyretics.

Note Paracetamol, aspirin, novalgin and phenacetin act as an antipyretics as well as analgesics.

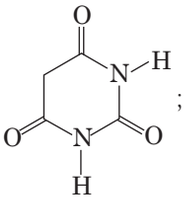
Tranquilizers

The chemical compounds which are used for the treatment of stress, mild and severe mental diseases are known as **tranquilizers**. They induce the sense of fitness and relieve stress and fatigue. Therefore, these drugs are also known as **psychotherapeutic drugs.** They form an essential part of sleeping pills.

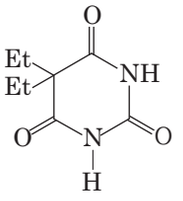
Tranquilizers act on central nervous system and habit forming in nature. They make the patient passive and help to control their emotional distress or depression. Moreover, they simply help the individuals to work with full capacities that they already have.

Derivatives of barbituric acid, i.e. **barbiturates** such as amytal, veronal, nembutal, seconal and luminal are the examples of **hypnotic** tranquilizers (sleep producing) whereas equanil, valium, serotonin, chlorodiazepoxide, meprobamate are examples of **non-hypnotic** tranquilizers.

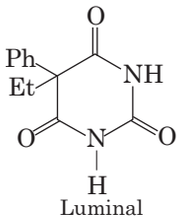
An alkaloid resperine, extracted from the plant called "*Rauwolfia serpentina*" is also a tranquilizer which lowers the blood pressure and slows down the pulse rate.



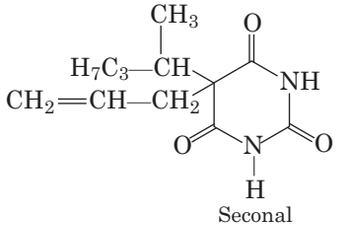
Barbituric acid



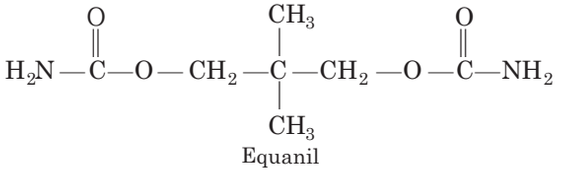
Veronal (barbital)



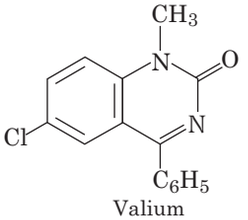
Luminal



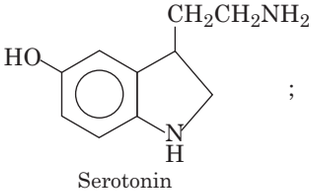
Seconal



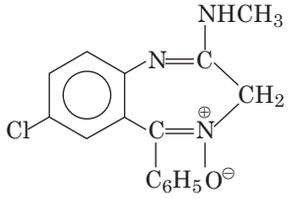
Equanil



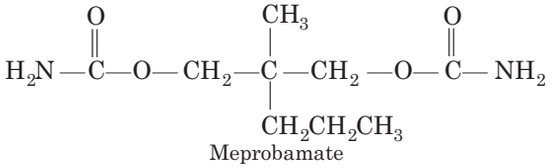
Valium



Serotonin



Chlorodiazepoxide



Meprobamate

Note Tranquilizers and **analgesics** are neurologically active drugs.

Tranquilizers are classified into following types are as follows

(i) **Sedatives** These act as depressant and suppress the activities of central nervous system (CNS). These are given to mentally agitated and violent patients. Sedatives gives a feeling of calmness, relaxation or drowsiness in the body.
e.g. valium, barbiturates, diazepam etc.

(ii) **Antidepressants** These drugs are given to persons with shattered confidence. These drugs act on central nervous system and produce a feeling of well being and confidence in the person of depressed mood. These are also termed as mood booster drugs.
e.g. Iproniazid, phenelzine, equanil, vitalin, benzedrine, tofranil, methedrine, cocaine etc.

(iii) **Hypnotics** These are used to reduce mental tension and anxiety. e.g. chloretone, luminal, seconal etc.

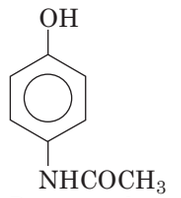
(iv) **Psychedic drugs** These are produce hallucination, disturb vision, hearing, also cause false feeling of happiness. e.g. Powerful psychedic drug is **LSD** (lysergic acid diethylamide) and **mescaline**.

Analgesics

The medicines which are used to reduce or abolish pain are known as analgesics. In simple words, we can say, analgesic is the medical name for pain killers.
These can be further divided into two types.

(i) **Non-narcotic** (or non-addictive) **analgesics** The non-habit forming chemicals which are used to reduce mild or to moderate pain such as headache, toothache, muscle and joint pain etc., are called non-narcotic analgesics. Because of its non-habit forming nature, they are also called as **non-addictive**. These drugs do not produce sleep and unconsciousness.

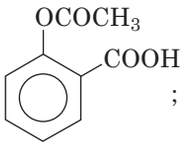
Some examples of non-narcotic analgesics are naproxen, diclofenac sodium or potassium, ibuprofen, paracetamol, ketoprofen, mefenamic acid etc.



Paracetamol
(4-acetamidophenol)

Some non-narcotic analgesics have consists anti-inflammatory properties, i.e. they inhibit the synthesis of prostaglandins which leads to inflammation in a tissue and causes pain. Due to these properties, it also known as **non-steroidal anti-inflammatory drugs** (NSAIDS).

Examples of such drugs (medicines) with their structure are given below



Acetyl salicylic acid
or 2-acetoxy benzoic acid
(Aspirin)

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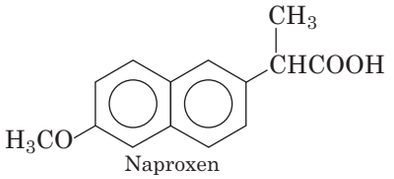
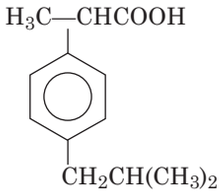
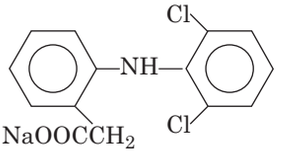


Naproxen



Ibuprofen



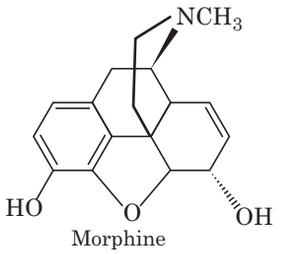
Dichlorofenac sodium

Aspirin

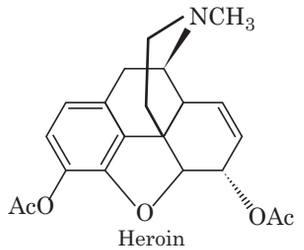
Aspirin is the most common analgesic along with antipyretic (temperature lowering), anti-inflammatory and anti-blood clotting properties (due to its anti-blood clotting action, it is widely used to prevent heart attack). Moreover aspirin is also used to check pregnancy related problems, viral inflammation in AIDS patients and cancer. Aspirin is supposed to be toxic to the liver.

In some cases, it causes bleeding from the wall of stomach and gastric irritation. Infact, in empty stomach aspirin gets hydrolysed into salicylic acid which is responsible for these problems. Therefore, it is advised that aspirin should not be taken into empty stomach. However, calcium and sodium salts of aspirin are more soluble and less harmful.

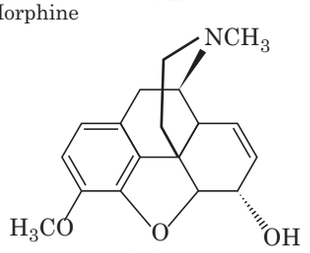
(ii) **Narcotic** (or addictive) **analgesics** The pain relieving drugs which produce sleep and unconsciousness are called **narcotic analgesics**. Unlike non-narcotic analgesics, these are habit forming. These are more effective than non-narcotic drugs. These are mostly opium derivatives and used only in severe pain,
e.g. morphine, codeine, meperidine, heroin (or morphine diacetate obtained by acetylation of morphine) etc.



Morphine



Heroin



Codeine

These drugs when used in small dose, relieve pain and produce sleep but their large dose, causes laziness, convulsions and ultimately death.

Antimicrobials

The chemicals which are used to cure infections caused by microbes (microorganisms) either by killing or destroying them, are known as **antimicrobials**. Microbes are extremely small organisms that can be seen through microscope only.
e.g. bacteria, viruses etc. The microbes which produce diseases/infections are known as **pathogens**.

Antibiotics, antiseptics and disinfectants are also named as **antimicrobials drugs**.

Antibiotics

It refers to a substance produced completely or partly by chemical synthesis, which in low concentrations inhibit the growth or destroy micro-organisms by intervening in their metabolic processes.

In search for these drug that can kill bacteria, arsenic based drug followed by sulpha drugs were discovered. i.e. sulphanilamide, sulphadiazine, sulphadimidine, sulphasomidine etc.

These are as follows

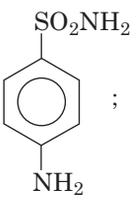
- By using bacteriostatic drug which inhibits or arrests the growth of microbes.
- By using bactericidal drug which kills the microbes.
- By increasing immunity and resistance to infection of the body.

Some examples of antibiotics are tetracycline, penicillin, chloramphenicol.

Sulpha drugs are a group of drugs which are derivatives of sulphanilamide and have great antimicrobial capacity, thus these are used widely against diseases such as dyptheria, dysentry, tuberculosis etc., caused by cocci, (type of bacteria).

Examples of **sulpha drugs** are sulphanilamide (*p*-amino benzene sulphonamide) and its derivative such as sulphadiazine, sulphadimidine, sulphadimethoxine, sulphadoxine, sulphasomidine, sulphaguanidine etc.

In structure, these drugs are analgoues of *p*-amino benzoic acid as shown below.



Sulphanilamide
(*p*-amino benzene
sulphonamide)

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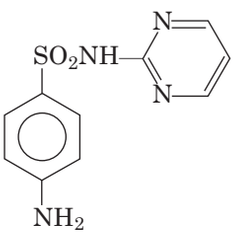
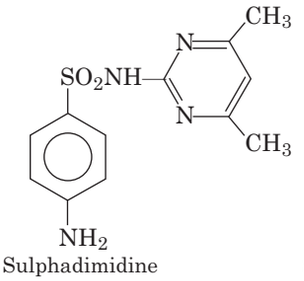
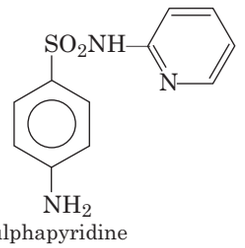


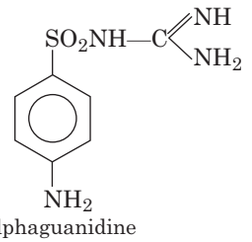
Sulphadiazine



Sulphadimidine



Sulphapyridine



Sulphaguanidine

Sulphonamides in combination with trimethoprim are used for the treatment of urinary tract infection.

Types of Antibiotics

The two types of antibiotic are as follows

(i) **Bactericidal** These antibiotics kill the bacteria in the body, e.g. penicillin, amino glycosides, ofloxacin.

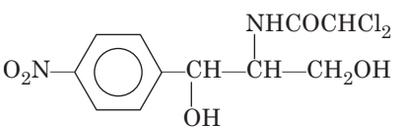
(ii) **Bacteriostatic** These antibiotics inhibit or stop the growth of bacteria in the body, e.g. erythromycin, tetracycline, chloramphenicol.

Spectrum of Action of Antibiotics

The full range of micro-organisms attacked by an antibiotic is called its **spectrum of action**.

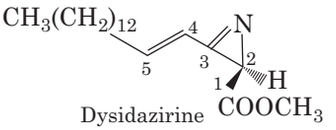
These are characterised into following two types

(i) **Broad spectrum antibiotic** Antibiotics which kill or inhibit a wide range of gram positive and gram negative bacteria are called **broad spectrum** antibiotics, e.g. ampicillin, amoxycillin, chloramphenicol, vancomycin, ofloxacin. All are broad spectrum antibiotics and used for the treatment of typhoid, acute fever, pneumonia, dysentery, whooping cough and certain urinary infections. Chloramphenicol is readily absorbed from the gastro-intestinal tract and hence, it can be given orally.



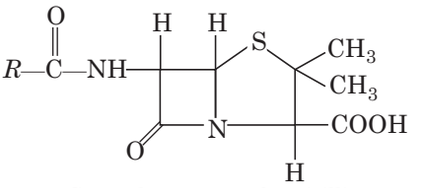
Chloramphenicol

Streptomycin which is also an antibiotic is highly effective for curing tuberculosis. It is also used for the treatment of meningitis and pneumonia. Dysidazirine, an antibiotic, is supposed to be toxic towards certain strains of cancer cells.



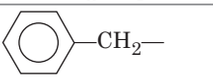
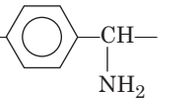
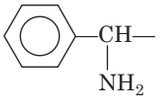
Dysidazirine

(ii) **Narrow spectrum antibiotic** Antibiotics which is effective mainly against gram positive or gram negative bacteria are called **narrow spectrum antibiotics**. e.g. penicillin, penicillin-G. Penicillin is a narrow spectrum antibiotic and used for curing sore throat, genorhoea, rheumatic fever etc.
General structure of penicillin and its derivatives are given below



General structure of penicillin

Types of Different Penicillines (derivatives)

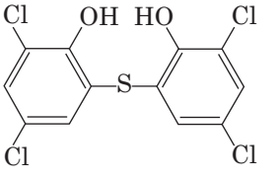
R group	Name
$R \Rightarrow$ 	Penicillin-G or Benzyl penicillin
$R \Rightarrow CH_3CH_2CH{=}CH{-}CH_2$	Penicillin-F
$R \Rightarrow CH_3{-}(CH_2)_6{-}$	Penicillin-K
$R \Rightarrow$ 	Ampicillin*
$R \Rightarrow$ 	Amoxycillin*

Antiseptics and Disinfectants

The chemicals which either prevent the growth of microorganisms or kill them but not harmful for living tissues, are known as **antiseptics**. Being harmless to living tissues, antiseptics can be safely applied on wounds, ulcers, cuts and diseased skin surfaces. These are not ingested like antibiotics.

These drugs also reduce odours caused by bacterial decomposition on the body or in the mouth.

These are, mixed with body deodorants, face powders and breath purifiers, e.g. bithional, an antiseptic, is mixed to medicated soaps to impart antiseptic properties.



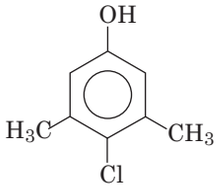
Bithional

The chemical substances which also kill the microorganisms but are not safe to apply over living tissues are called **disinfectants**. They play an important role in water treatment and in public health sanitation. They are actually used for inanimate objects such as floors, toilets, instruments etc.

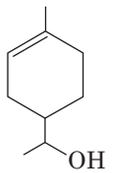
Many times, the same substance act as an antiseptic as well as disinfectant on the basis of its concentration, e.g. 0.2% solution of phenol is an antiseptic whereas its 1% solution act as disinfectant. Similarly, low concentration of SO_2 is used to sterilise squash for preservation but its high concentration is used as disinfectant for living organisms.

Other examples of antiseptics and disinfectants are as follows

- **Dettol** is one of the most commonly used antiseptic. It is a mixture of chloroxylenol and α-terpineol. It is chloroxylenol which is responsible for its antiseptic and disinfectant properties.



Chloroxylenol



α-terpineol

- 0.2 to 0.4 ppm (parts per million) concentration of chlorine is used for making water fit for drinking.
- **Savlon** in non-aqueous solution is used as an antiseptic.
- **Amyl *meta*-cresol** (5-methyl-2-pentylphenol) is an antiseptic which is used as a mouthwash or gargles in infections of the mouth and throat.
- **Iodine and iodoform** both are powerful antiseptics. Iodine is employed as tincture, i.e. a solution of 2-3% iodine in alcohol and water mixture while iodoform is used as powder for wounds.
- A dilute aqueous solution of **boric acid** is used as a weak antiseptic for eyes. Boric acid is also used as antiseptic in baby talcum powders.
- **Hydrogen peroxide**, salol (phenyl salicylate) and mercurochrome are also used as antiseptics.
- A soapy solution of cresol, called **lysol**, is used as disinfectant.
- Some **organic dyes** such as gention violet, methylene blue have antiseptic property and are used for dressing wounds and for treating various skin diseases.

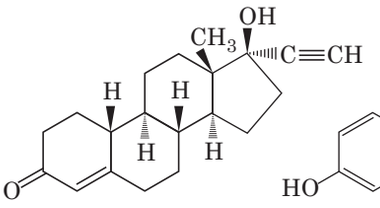
Antifertility Drugs

The chemicals which are used to prevent unwanted pregnancy in womans are known as **antifertility drugs**. These are also known as **birth control pills** or **oral contraceptives**. The basic aim of these drugs is to prevent conception or fertilisation.

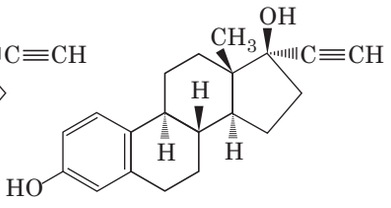
Chemically, antifertility drugs belong to the class of natural products, known as **steroids**. Steroids are the active ingredients of antifertility drugs. These check the pregnancy by controlling female menstrual cycle and ovulation. These are contain a mixture of synthetic estrogen and progesterone derivatives which are more potent than the natural hormones.

The common progesterone, used are ethynodial, norethindrone, noresthistereone, lynestrenol etc., and estrogens used are ethynylestradiol, mestranol etc.

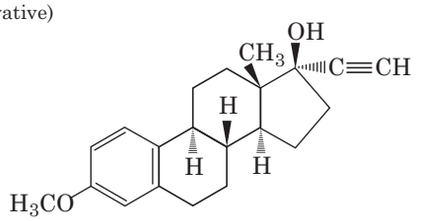
e.g. A brand name **enovid *E***, contains a mixture of norethindrone (a progesterone derivative) and mestranol (a synthetic estrogen).



Norethindrone
(a progesterone derivative)

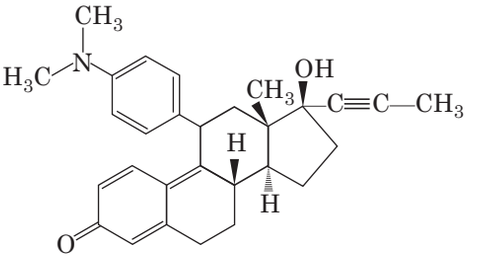


Ethynylestradiol
(an estrogen)



Mestranol
(ethynylstradiol monomethyl ether)
(an estrogen)

Ormeloxifene (centchroman, saheli) is also known as **effective antifertility drug**. Mifepristone is a synthetic steroid that checks the effect of progesterone and it is used as a **"morning after pill"**.



Mifepristone (a synthetic steroid)

Adverse effects These contraceptives may cause disruption of normal menstrual cycle (prolonged or excessive bleeding) and increase in weight. In some cases, prolonged infertility has been reported after the use of these contraceptives.

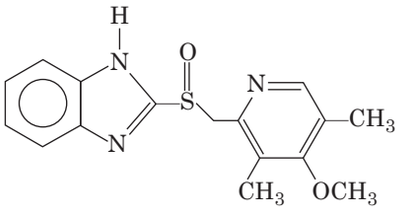
Antacids

Wall of stomach secretes acid to make the stomach acidic and for the digestion of food. When the acid is secreted in

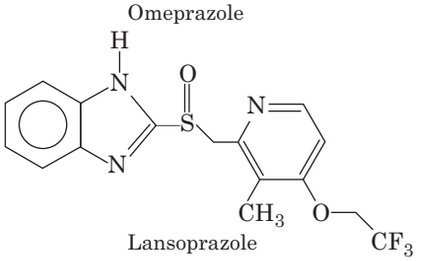
excess, it leads to indigestion, heart burn or gastric ulcers. The chemicals which are used to neutralise the excess acid present in the gastric juice and to raise the pH of stomach upto an appropriate level are called **antacids**.

Some, acids are neutralised by bases and weak bases such as sodium bicarbonate ($NaHCO_3$), magnesium hydroxide [$Mg(OH)_2$], magnesium carbonate ($MgCO_3$), magnesium trisilicate, aluminium hydroxide etc. So, these are used as antacids.

Generally, antacids in liquid form are more effective than that in the form of tablets because these have great surface area available for interaction and neutralisation of acid. Calcium salts can also be used as antacids but they are not so effective. Recently, omeprazole and lansoprazole have been synthesised to give quick relief from acid gastritis.

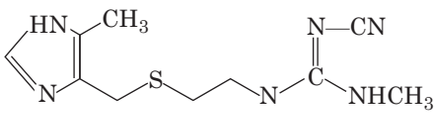


Omeprazole

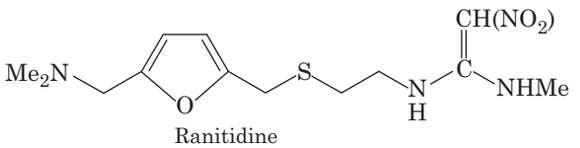


Lansoprazole

Histamine is also stimulates the secretion of pepsin and hydrochloric acid. To prevent hyperacidity, produced by histamine, cimetidine (tegamet) and ranitidine (zantac) are used as antacid.



Cimetidine



Ranitidine

Cimetidine and ranitidine both are prevent the interaction of histamine with the receptors of stomach wall, which results in the release of lesser amount of acid.

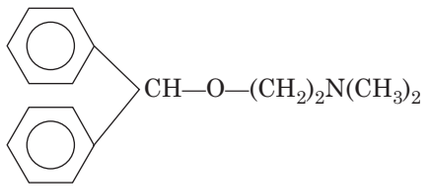
Note Milk acts as a weak antacid and possesses a protective action against acidity.

Antihistamines

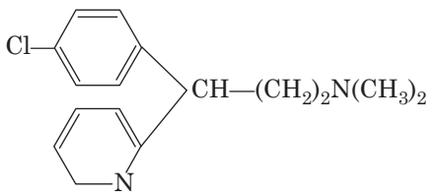
These are also known as **anti-allergic drugs**. Since, allergy is caused due to secretion of histamine (by mast cells) in the body. These drugs interfere with the natural action of histamine by competing with histamine for binding sites of receptor where histamine exerts its effect.

In other words, "the chemicals which diminish or abolish the effect of histamine and hence, prevent the allergic reactions such as high fever, mild asthma, nasal discharge etc., are known as antihistamines.

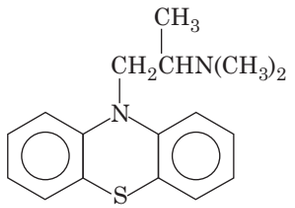
These drugs are also useful for conjunctivitis (i.e. inflammation of conjunctiva of eye) and rhinitis (i.e. inflammation of nasal mucosa). The common examples of antihistamines are diphenylhydramine (common name benadryl), pheniramine maleate (avil), chlorpheniramine maleate (zeet), promethzine etc.



Diphenylhydramine (benadryl)



Chlorpheniramine



Promethazine

Anaesthetics

The chemicals which produce general or local insensibility to pains and other sensations are called **anaesthetics**. Here, the word 'local' means 'in a limited area'.

Some anaesthetics acts after inhaling its vapours, e.g. diethyl ether, nitrous oxide, cylopropane etc., while others are administered orally or injected into the body, e.g. morphine and pathedine.

Cocaine, novocine (procaine), xylocaines and ethyl chloride are some examples of local anaesthetics. These are used for tooth extraction or small surgical operations.

Example 2 *Match the following drugs with their therapeutic actions* ***(JEE Main 2020)***

Column I		Column II	
(i)	Ranitidine	(a)	Antidepressant
(ii)	Nardil (Phenelzine)	(b)	Antibiotic
(iii)	Chloramphenicol	(c)	Antihistamine
(iv)	Dimetane (Brompheniramine)	(d)	Antacid
		(e)	Analgesic

(a) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e)
(b) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)
(c) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c)
(d) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)

Sol. (c)

(i) Ranitidine → Antacid

[Ranitidine, in which backward flow of acid occur from stomach.]

(ii) Nardil (Phenelzine) → Antidepressant.

[It is used as an antidepressant and anxiotytic]

(iii) Chloramphenicol → Antibiotic

[It is an antibiotic used for treatment of bacterial infections]

(iv) Dimetane (Brompheniramine) → Antihistamine

[It is used for treatment of the symptoms of common cold and allergic such as runny nose, itchy eyes etc.]

Correct match is

(i) → (d), (ii) → (a), (iii) → (b) and (iv) → (c)

Chemicals in Food

All those chemicals which are added to food for preservation and enhancing its appeal are called **food additives**. These include antioxidants, artificial sweeteners, preservatives, edible colours, flour improvers etc. With the exception of preservatives, antioxidants and artificial sweetener, the remaining classes mentioned above have no nutritional value.

Food Preservatives

During the storage and distribution of food, several undesirable changes occur in flavour, colour, texture and appetitic appeal. To avoid these changes, some chemicals are added in food. These chemicals are known as **preservatives**.

In other words, the chemicals which are used to protect food from microbe actions, i.e. which arrest the process of fermentation, acidification and any other decomposition of food are known as **food preservatives**.

Some important examples of food preservatives are given below

(i) **Carboxylates** such as sodium benzoate (C_6H_5COONa) are commonly used to preserve food. It is used as preservative in soft drinks and acidic foods. It is metabolised by conversion to hippuric acid ($C_6H_5CONHCH_2COOH$) which is ultimately excreted with urine. Sodium and calcium propionates are used as preservatives in breads and cakes.

(ii) **Vitamin E** is naturally occurring food preservative found in vegetable oils.

(iii) **Sodium metabisulphite** The jams and squashes-pickles are preserved by adding sodium metabisulphite ($Na_2S_2O_5$) or potassium metabisulphite ($K_2S_2O_5$). The sulphurous acid present in it inhibit the growth of microbes.

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

(iv) In cheese, baked food, pickles meat, sorbic acid and its salts are used as preservative.

(v) Epoxides and ethyl formates are used for the preservation of species, nuts and dried fruits.

(vi) Table salt, sugar and vegetable oils are also used as preservatives.

Artificial Sweetening Agents

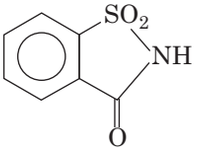
The chemicals which are not sugars (carbohydrates) but give sweetening effect to the food and enhance its odour and flavour are called **artificial sweetening agents**. Usual sweeteners such as sucrose and fructose add calorific intake in addition to sweetness while artificial sweeteners give sweetening effect without producing any calories. This is because these chemicals do not undergo the biochemical reactions in the body, i.e. they pass through the human body unmetabolised.

Therefore, these chemicals are also called as **low calorie sweeteners or calorie-free sweeteners**.

Some important artificial sweeteners are as follows

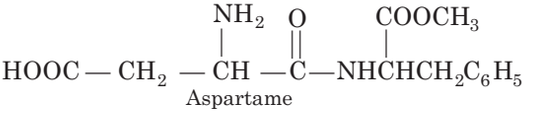
(i) **Saccharin** (*o*-sulphobenzimide) It is the first discovered **artificial sweetener**. It is very popular sweetening agent. It is about 550 times sweeter than cane sugar. It is non-biodegradable compound but has no calorific value.

In market, it is available in the form of its sodium or calcium salts as these are water soluble. It has proved to be a life saver for countless diabetics and has great value to peoples who need to control intake of calories.



Saccharin

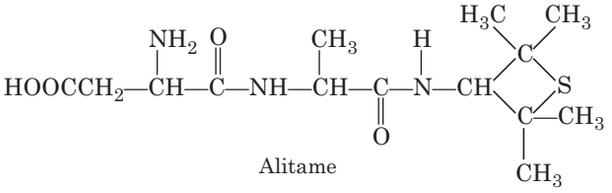
(ii) **Aspartame** It is methyl ester of the dipeptide obtained from phenylalanine and aspartic acid. Its structure is



Aspartame

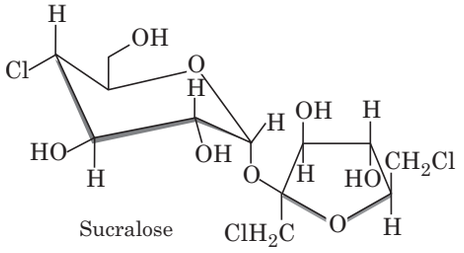
It is also known as **"Nutra sweet"**. It is about 100 times sweeter than cane sugar. The only limitation for it is that at baking or higher temperatures, it gets decomposed. So, its use is limited only in cold foods and soft drinks.

(iii) **Alitame** It is more stable than aspartame at high temperature. It is about 2000 times sweeeter than sucrose.



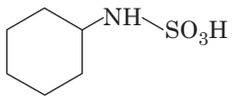
Alitame

(iv) **Sucralose** It is a trichloro derivative of sucrose. It is about 650 times sweeter than cane sugar. It is a zero calorie sugar.



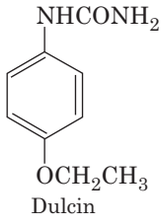
Sucralose

(v) **Cyclamate** Chemically, it is N-cyclohexylsulphamate. It is only twenty times sweeter than **cane sugar**.



Cyclamate

(vi) **Dulcin** (a urea sweetener) It is only twenty five times sweeter than cane sugar. It has the following structure



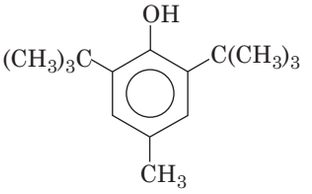
Dulcin

Other examples of this category are nitro anilines, dihydrochalcones (DHC) etc.

Antioxidants

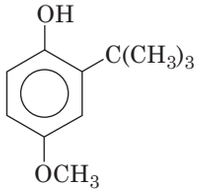
Unsaturated oils and fats containing food materials, when stored, undergo deterioration because of the oxidation by atmospheric oxygen.

To avoid the action of oxygen (oxidation) and prevent the spoilage of food materials, certain chemicals are added. These chemicals are known as antioxidants. BHA (butylated *p*-hydroxyanisole), BHT (butylated *p*-hydroxy toluene), esters of gallic acid and lecithin are some examples of antioxidants.



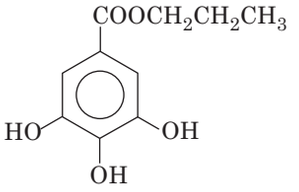
BHT

Butylated hydroxy toluene



BHA

Butylated hydroxy anisole



Propyl gallate
(an ester of gallic acid)

Some antioxidants are already present in food materials. e.g.

Sources of Some Antioxidant

Antioxidants	Food materials containing antioxidants
Vitamin C (ascorbic acid)	Fruits and vegetables
Vitamin E (tocopherols)	Vegetable oils
Carotenoids	Fruits and vegetables
Polyphenolic antioxidants	Tea, coffee, soyabean, red wine, chocolate etc.

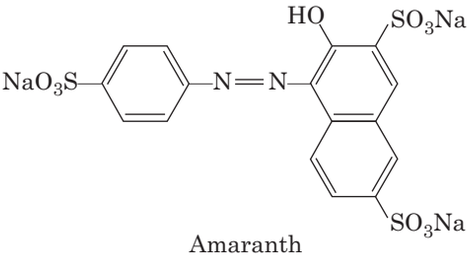
Sulphur dioxide and sulphite are useful antioxidants for wine and beers, sugar syrups, peeled fruits, etc.

Edible Colours

The chemicals which are used for imparting colour to the food and to increase the eye appeal are called **edible colours**. These are essentially dyes which may be either of natural or synthetic origin. Azo dyes are used as synthetic edible colours. However, these are harmful for young children and asthma patients. The most important synthetic dye is **tetrazine** but its use is banned now.

The common natural colour are chlorophyll (green colouring matter extracted from leaves), saffron (prepared from flowers), caramel (obtained by heating sugar), turmeric (obtained from dried and ground root of ginger) etc.

The other synthetic colours used in food products are amaranth (a red brown powder with saline taste), indigo carmine (blue), ponceau (fast green), erythrosin etc.



Amaranth

Cleansing Agents

These are also known as **surfactants** or **surface active agents**. Those chemicals which concentrate at the surface of the solution or interfaces or surface films, reduce surface tension of the solution and help in removing dirt and dust by emulsifying grease are known as **surfactants**. Soaps and detergents belong to this class.

Soaps

The mineral salts of higher fatty acids such as oleic acid ($C_{17}H_{33}COOH$), stearic acid ($C_{17}H_{35}COOH$) and palmitic acid ($C_{15}H_{31}COOH$) etc., are called **soaps**.

Out of these, only sodium and potassium salts of fatty acids being water soluble, are widely used for cleaning purposes and are commonly known as **common soaps**.

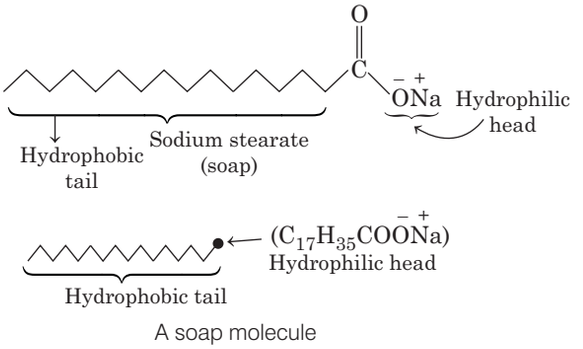
Other soaps, being water insoluble are less useful. Sodium soaps are hard whereas potassium soaps are soft to skin. Therefore, sodium soaps are used for washing purposes and potassium soaps are used as liquid soaps, shaving creams and toilet soaps.

Composition of Soaps

Chemically, soaps contain two parts

(i) **Non-polar hydrocarbon part** which is fat soluble and also called **hydrophobic** or **lipohilic** (*lipo* = fat; *philic* = loving) part.

(ii) **Polar carboxylate part** which is water soluble and also called **hydrophilic** or **lipophobic** (*lipo* = fat; *phobic* = hating) part.

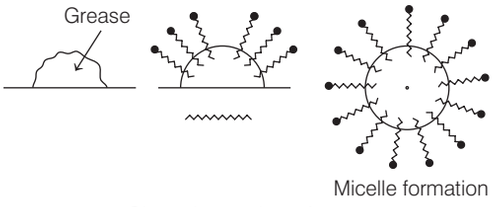


A soap molecule

Cleansing Action of Soap

On applying soap to a dirty wet cloth, the hydrocarbon part (non-polar part) of soap dissolves in grease or dust while the polar carboxylate part is directed towards water. Thus, an emulsion is formed between grease particles and water molecules, which appears in the form of foam.

On washing the cloth with excessive water, these dirt, dust or grease particles are washed away from the surface of cloth along with soap and the cloth becomes clean.



Cleansing action of soap

- **Advantages** Soaps are 100% biodegradable, i.e. these are completely degraded by the microorganisms. Therefore, these do not creates water pollution.
- **Limitations** Soaps cannot be used in hard water because calcium and magnesium ions present in hard water form curdy white precipitate with soap. Soaps cannot be used in acidic solution. This is because insoluble fatty acids are precipitated by acids which adhere to the fabrics and prevent dyeing process.

$$\underset{\text{Soap}}{2\,R\text{COO}^{-}_{+}\text{Na}} + \underbrace{\text{Ca}^{2+}\text{ or Mg}^{2+}}_{\text{From hard water}} \longrightarrow \underset{\text{White curdy ppt.}}{(R\text{COO})_2\text{Ca or Mg}}$$

Detergents

The structure of detergents is similar to the soaps. These are also used for cleansing purpose, although these

do not contain usual soaps like sodium salts of fatty acids. Hence, these are also known as "**soapless soap**". These are better cleansing agents than soaps. This is because these do not form insoluble precipitates with calcium and magnesium salts of hard water.

These are also effective in acidic solution to form alkyl hydrogen sulphate which is soluble.

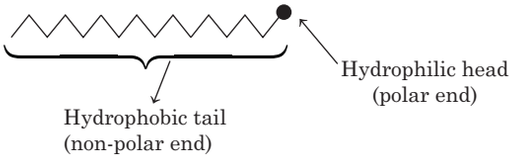
Chemically, detergents are sodium or potassium salts of long chain alkyl or aryl sulphonates or sulphates.

Composition of Detergents

Detergents are structurally similar to soaps. These are contains

- a long non-polar hydrocarbon chain with 12 or more carbon atoms which is hydrophobic or lipophilic in nature.

- a polar ionic part which is hydrophilic or lipophobic in nature.

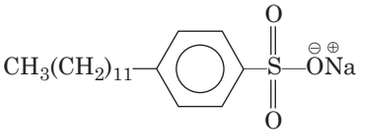


Structure of detergents

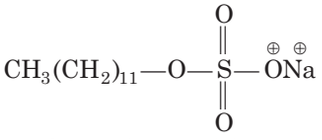
The hydrophilic surface active group may be anionic, cationic or neutral.

On the basis of nature of surface active group, detergents may be classified into three categories.

(i) **Anionic detergents** contain anionic hydrophilic group such as alkyl hydrogen sulphates and alkyl benzene sulphonates.



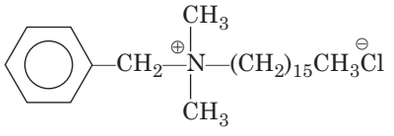
Sodium *p*-*n*-dodecyl benzenesulphonate (SDS)



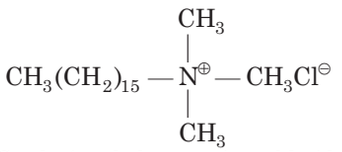
Sodium lauryl sulphate

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

(ii) **Cationic detergents** are also called as **invert detergents**. In these, the polar head of the detergent is positively charged. These are infact, quaternary ammonium salts (chlorides, bromides, acetates) containing one or more long chain alkyl groups, e.g.



Benzylcetyldimethyl ammonium chloride

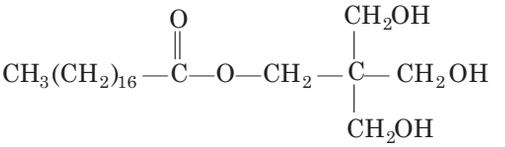


Cetyl trimethyl ammonium chloride

These detergents are widely used as fabric softeners and germicides.

Cetyl trimethyl ammonium bromide is a popular cationic detergent and is used in hair conditioners.

(iii) **Neutral detergents** contain non-ionic but polar groups capable of forming H-bonding with water. These are monoesters of polyhydric alcohols or polyethers derived from ethylene oxides, e.g.



Non- ionic detergent

These detergents are also called **non-ionic detergents** and used as liquid dish washing detergent.

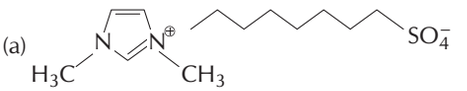
Applications and Limitations of Detergents

Detergents do not produce hydroxyl ions on hydrolysis, so these can be used safely for woollen garments.

Straight chain alkyl groups containing detergents are biodegradable whereas branched chain alkyl groups containing detergents are non-biodegradable. Hydrocarbon side chains stops the bacteria from attacking and breaking the chains.

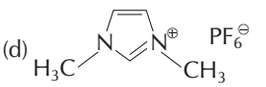
This results in the slow degradation of detergent molecule. These detergents persist in water even after sewage treatment and cause foaming in river water.

Example 3. *An ionic micelle is formed on the addition of* ***(JEE Main 2020)***

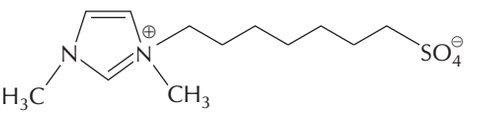


(b) liquid diethyl ether to aqueous NaCl solution

(c) sodium stearate to pure toluene excess water to liquid



Sol. (a) An ionic micelle is formed due to presence of hydrophobic chain. It can easily be formed by the addition of



Practice Exercise

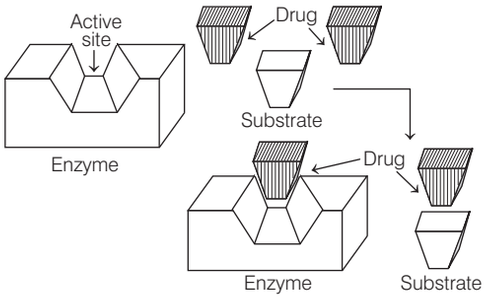
ROUND I Topically Divided Problems

Drugs and Drug-Target Interaction

1. All antihistamines inhibit the action of histamine which causes inflammation in the body and allergic reaction. This exmaple is based on
(a) drug action (b) pharmacological effect
(c) chemical structure (d) molecular targets

2. Substrates bind to the active site of the enzyme through various types of bonds. Which of the following interaction is responsible for the binding of these two?
(a) Hydrogen bonding
(b) Ionic bonding
(c) Dipole-dipole interaction
(d) All of the above

3. Which type of inhibition is shown in the following figure of drug and enzyme interaction ?



Choose the correct option.
(a) Competitive inhibition
(b) Non-competitive inhibition
(c) Allosteric inhibition
(d) None of the above

4. What happens to the receptor proteins when chemical messengers approach it ?
(a) Shape of receptor site changes
(b) Shape of receptor site remain same
(c) Binding site of the receptor gets blocked
(d) Receptor gets degraded

5. Receptors are selective in nature because it binds to
(a) all type of chemical messengers
(b) a particular type of chemical messenger
(c) cell membrane
(d) All of the above

6. Which of the following statements are incorrect about receptor proteins? *(NCERT Exemplar)*
(a) Majority of receptor proteins are embedded in the cell membranes
(b) The active site of receptor proteins opens on the inside region of the cell
(c) Chemical messengers are received at the binding sites of receptor proteins
(d) Shape of receptor change during attachment of messenger

7. Which forces are involved in holding the drugs to the active site of enzymes?
I. Ionic bonding
II. Hydrogen bonding
III. van der Waals' interaction
IV. Dipole-dipole interaction. *(NCERT)*
(a) I and II (b) I and III
(c) II and IV (d) I, II, III and IV

8. The most useful classification of drugs for medicinal chemists is *(NCERT Exemplar)*
(a) on the basis of chemical structure
(b) on the basis of drug action
(c) on the basis of molecular targets
(d) on the basis of pharmacological effect

9. Aspirin is known as *(AIEEE 2012)*
(a) acetyl salicylic acid (b) phenyl salicylate
(c) acetyl salicylate (d) methyl salicylic acid

10. The drug used to bring down fever are known as *(AIEEE 2005)*
(a) analgesic (b) antibiotic
(c) antipyretic (d) tranquilizer

11. Equanil is
(a) artificial sweetener (b) tranquilizer
(c) antihistamine (d) antifertility drug

12. Noradrenaline is a/an *(JEE Main 2019)*
(a) antidepressant (c) antihistamine
(c) neurotransmitter (d) antacid

13. Drug which helps to reduce anxiety and brings about calmness is
(a) tranquilizer (b) diuretic
(c) analgesic (d) antihistamine

14. Luminal, a barbiturate drug, is used as a/an
(a) antihistamine (b) sedative
(c) antiseptic (d) antimalarial

15. Low level of noradrenaline is the cause of depression. What type of drugs are needed to cure this problem ? *(NCERT)*
(a) Sedatives (b) Antidepressants
(c) Hypnotics (d) Psychedic

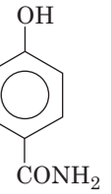
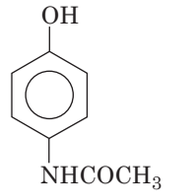
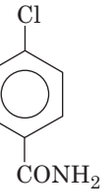
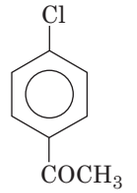
16. Which statement about aspirin is not true ? *(NCERT Exemplar)*
(a) Aspirin belongs to narcotic analgesics
(b) It is effective in relieving pain
(c) It has antiblood clotting action
(d) It is a neurologically active drug

17. The drug used for the prevention of heart attacks is
(a) aspirin (b) valium
(c) chloramphenicol (d) cephalsoprin

18. Which of the following drugs is an analgesic ?
(a) Sulphaguanidine (b) Paludrin
(c) Analgin (d) Iodex

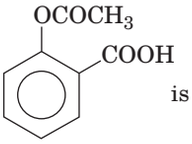
19. If a person is suffering from the deficiency of noradrenaline, what kind of drug can be suggested? *(JEE Main 2020)*
(a) Antihistamine
(b) Analgesic
(c) Antidepressant
(d) Anti-inflammatory

20. Heroin is acetyl derivative of
(a) caffeine (b) cocaine
(c) nicotine (d) morphine

21. The correct structure of the drug paracetamol is
(a) 
(b) 
(c) 
(d) 

22. A drug that is antipyretic as well as analgesic is
(a) chloropromazine hydrochloride
(b) *para*-acetamidophenol
(c) chloroquin
(d) penicillin

23. Which of the following can possibly be used as analgesics without causing addiction and any modification?
(a) Morphine
(b) N-acetyl*para*-aminophenol
(c) Diazepam
(d) Tetrahydrocatecol

24. The compound  is used as *(AIEEE 2002)*
(a) antiseptic (b) antibiotic
(c) analgesic (d) pesticide

25. An antibiotic effective in treatment of pneumonia, bronchitis etc., is
(a) penicillin (b) patalin
(c) chloromycetin (d) tetracycline

26. Sulpha drugs are the derivatives of
(a) benzenesulphonic acid
(b) sulphanilic acid
(c) sulphanilamide
(d) *p*-aminobenzoic acid

27. Medicine which is an antibiotic is
(a) ampicillin (b) aspirin
(c) compose (d) All of these

28. With respect to drug-enzyme interaction, identify the wrong statement *(JEE Main 2021)*
(a) Non-competitive inhibitor binds to the allosteric site
(b) Allosteric inhibitor changes the enzyme's active site
(c) Allosteric inhibitor competes with the enzyme's active site
(d) Competitive inhibitor binds to the enzyme's active site

29. Which one of the following is not bacteriostatic antibiotic ?
(a) Erythromycin (b) Tetracycline
(c) Chloramphenicol (d) Ofloxacin

Therapeutic Effects of Drugs

30. Which of the following statements is not correct? *(NCERT Exemplar)*
(a) Some antiseptics can be added to soaps
(b) Dilute solutions of some disinfectants can be used as antiseptic
(c) Disinfectants are antimicrobial drugs
(d) Antiseptic medicines can be ingested

31. Which of the following statements is not true ?
(a) Some disinfectants can be used as antiseptics at low concentration
(b) Sulphadiazine is a synthetic antibacterial
(c) Ampicillin is natural antibiotic
(d) Aspirin is analgesic and antipyretic both

32. One of the most known antiseptic, dettol is a mixture of terpineol and
(a) bithional (b) chloroxylenol
(c) *o*-cresol (d) serotonin

33. A substance which can act both as an antiseptic and disinfectant is
(a) aspirin (b) chloroxylenol
(c) bithional (d) phenol

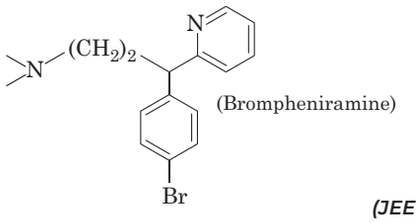
34. Which is the correct statement about birth control pills ? *(NCERT Exemplar)*
(a) Contain estrogen only
(b) Contain progesterone only
(c) Contain a mixture of estrogen and progesterone derivatives
(d) Progesterone enhances ovulation

35. Oral contraceptive drugs contain
(a) mestranol (b) norethindrone
(c) Both (a) and (b) (d) None of these

36. Which of the following is not used as an antacid ?
(a) Magnesium hydroxide (b) Sodium carbonate
(c) Sodium bicarbonate (d) Aluminium phosphate

37. Anti-allergy drugs are
(a) antimicrobials (b) antihistamines
(c) antivirals (d) antifungals

38. The following molecule acts as an



(Brompheniramine)

(JEE Main 2020)
(a) antiseptic (b) antidepressant
(c) antibacterial (d) antihistamine

39. Which of the following is used as a local anaesthetic agent ?
(a) Diazepam (b) Procaine
(c) Mescaline (d) Seconal

Chemicals in Food

40. The preservative which is used to preserve breads and cakes is
(a) sodium benzoate (b) sodium metabisulphite
(c) sodium propionate (d) sodium sorbate

41. Which of the following is not a artificial sweetener?
(a) Sucralose (b) Alitame (c) Saccharin (d) Sucrose

42. Trade name of aspartame is
(a) alitame (b) saccharin
(c) sucralose (d) nutra sweet

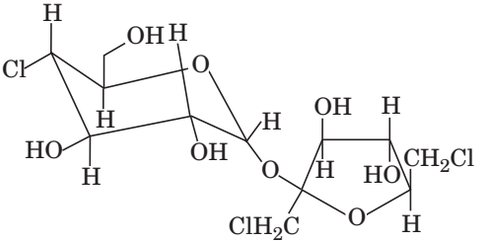
43. Hippuric acid has the formula
(a) $CH_3CONHCH_2COOH$ (b) $C_6H_5CONHCH_2COOH$
(c) $C_6H_5NHCOOH$ (d) $NH_2CONHCOOH$

44. Choose the correct statement.
(a) Saccharin is 650 times sweeter than sugar
(b) Aspartame is 550 times sweeter than sugar
(c) Sucralose is 160 times sweeter than sugar
(d) Alitame is 2000 times sweeter than sugar

45. Which of the following is an aritificial edible colour?
(a) Saffron (b) Carotene (c) Tetrazine (d) Melamine

46. Which of the following is used as an antioxidant in food?
(a) BTX (b) BHT
(c) BHC (d) All the three

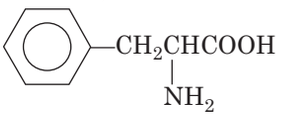
47. The following structure represents



(a) sucrose (b) sucralose
(c) aspartame (d) alitame

48. Aspartame is one of the good artificial sweeteners whose use is limited to cold foods and soft drinks because
(a) it has very low boiling point
(b) it gets dissociated at cooking temperature
(c) it is sweetener at low temperature only
(d) it is insoluble at higher temperatures

49. Aspartame is a non-nutritive sweetener. Assuming that both, amide and ester bonds are hydrolysed in the stomach, the amino acids obtained is

(a) 

(b) 

(c) Both (a) and (b)
(d) None of the above

50. Which of the following chemicals can be added for sweetening of food items at cooking temperature and does not provide calories? *(NCERT Exemplar)*
(a) Sucrose (b) Glucose (c) Aspartame (d) Sucralose

51. Which of the following will not enhance nutritional value of food ? *(NCERT Exemplar)*
(a) Minerals (b) Artificial sweeteners
(c) Vitamins (d) Aminoacids

52. Which of the following are not used as food preservatives? *(NCERT Exemplar)*
(a) Table salt (b) Sodium benzoate
(c) Cane sugar (d) Benzoic acid

Cleansing Agents

53. Glycerol is added to soap. It functions …… .
(a) as a filler *(NCERT Exemplar)*
(b) to increase leathering
(c) to prevent rapid drying
(d) to make soap granules

54. Which of the following is not a surfactant?
(a) $CH_3 — (CH_2)_{15} — N^+(CH_3)_3\,Br^-$
(b) $CH_3 — (CH_2)_{14} — CH_2NH_2$
(c) $CH_3 — (CH_2)_{16} — CH_2OSO_2^-Na^+$
(d) $OHC — (CH_2)_{14} — CH_2 — COO^-Na^+$

55. Which of the following is a *germicide* also?
(a) Cationic detergent (b) Anionic detergent
(c) Non-ionic detergent (d) None of these

56. Structurally biodegradable detergents should contain
(a) highly branched alkyl chain
(b) normal alkyl chain or less branched alkyl chain
(c) cyclopentyl side chain
(d) benzyl side chain

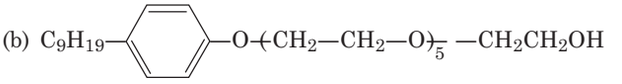
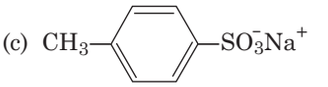
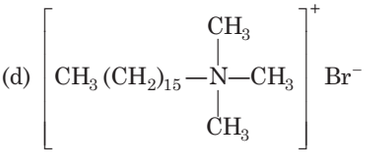
57. Soaps are classified as
(a) esters
(b) ethers
(c) carbohydrates
(d) sodium salts of fatty acids

58. The detergent which is used as a *germicide* is
(a) sodium lauryl sulphate
(b) cetyltrimethyl ammonium chloride
(c) lauryl alcohol ethoxylate
(d) sodium-2-dodecylbenzenesulphonate

59. Which of the following is an anionic detergent ?
(a) $CH_3(CH_2)_{16}CH_2OSO_3Na$
(b) $CH_3(CH_2)_{16}\overset{+}{N}(CH_3)_3Cl^-$
(c) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$
(d) $C_6H_5SO_3Na$

60. Compound which is added to soap to impart antiseptic properties is *(NCERT Exemplar)*
(a) sodium lauryl sulphate
(b) sodium dodecyl benzene sulphonate
(c) resin
(d) bithional

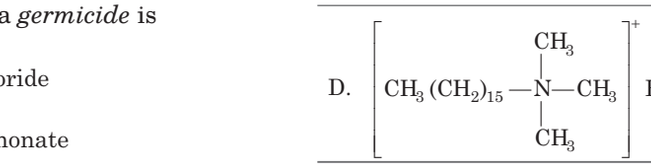
61. Polyethylene glycols are used in the preparation of which type of detergents? *(NCERT Exemplar)*
(a) Cationic detergents (b) Anionic detergents
(c) Non-ionic detergents (d) Soaps

62. Which of the following is an example of liquid dishwashing detergent?
(a) $CH_3(CH_2)_{10} — CH_2OSO_3^-Na^+$
(b) 
(c) 
(d) 

63. Which category of the synthetic detergents is used in toothpaste? *(NCERT Exemplar)*
(a) Anionic detergents (b) Cationic detergents
(c) Non-ionic detergents (d) All of the above

64. Hair shampoos belong to which class of synthetic detergents? *(NCERT Exemplar)*
(a) Anionic detergents (b) Cationic detergents
(c) Non-ionic detergents (d) All of these

65. Match structures given in Column I with the type of detergents given in Column II.

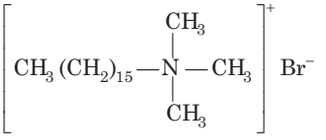
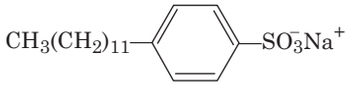
Column I	Column II
A. $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$	1. Cationic detergent
B. $C_{17}H_{35}COO^-Na^+$	2. Anionic detergent
C. $CH_3 — (CH_2)_{10}CH_2SO_3^-Na^+$	3. Non-ionic detergent
D. 	4. Soap

(NCERT Exemplar)

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	3	4	(b)	3	4	2	1
(c)	4	3	1	2	(d)	2	3	4	1

66. Match the detergents given in Column I with their uses given in Column II. *[NCERT Exemplar]*

Column I		Column II
A.		1. Dish washing powder
B.		2. Laundry soap
C.	$C_{17}H_{35}COO^-Na^+ + Na_2CO_3 +$ Rosin	3. Hair conditioners
D.	$CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$	4. Toothpaste

Codes

	A	B	C	D
(a)	3	2	1	4
(b)	4	1	2	3
(c)	3	4	2	1
(d)	2	4	4	1

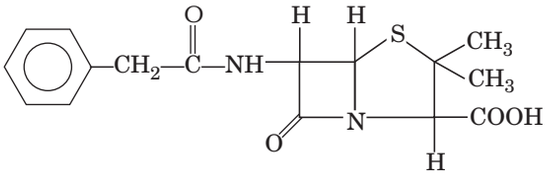
67. Detergents obtained from LAB are biodegradable. LAB stands for
(a) laboratory tested raw material
(b) low anionic balance
(c) linear alkyl benzene
(d) None of the above

68. Which of the following is an anionic detergent ?
(a) Sodium lauryl sulphate *(JEE Main 2016)*
(b) Cetyltrimethyl ammonium bromide
(c) Glyceryl oleate
(d) Sodium stearate

ROUND II Mixed Bag

1. If you spill a chemical toilet cleaning liquid on your hand, your first aid would be *(JEE Main 2020)*
(a) vinegar (b) aqueous NaOH
(c) aqueous $NaHCO_3$ (d) aqueous NH_3

2. The structure given below is known as



(a) penicillin-F (b) penicillin-G
(c) penicillin-K (d) ampicillin

3. Which of the following statement is not true about the drug barbital?
(a) It causes addiction
(b) It is a non-hypnotic drug
(c) It is a tranquillizer
(d) It is used in sleeping pills

4. Select the incorrect statement.
(a) Equanil is used to control depression and hypertension
(b) Mifepristone is a synthetic steroid used as "morning after pill"
(c) 0.2 per cent solution of phenol is an antiseptic while its 1.0 per cent solution is a disinfectant
(d) A drug which kills the organism in the body is called bacteriostatic

5. Which set has different class of compounds ?
(a) Tranquilizers : equanil, heroin, valium
(b) Antiseptics : bithional, dettol, boric acid
(c) Analgesics : naproxen, morphine, aspirin
(d) Bactericidal : Penicillin, aminoglycosides, ofloxacin

6. Which of these is a hypnotic ?
(a) Metaldehyde
(b) Acetaldehyde
(c) Paraldehyde
(d) None of these

7. The functions of antihistamine are *(JEE Main 2021)*
(a) Antiallergic and analgesic
(b) Antacid and antiallergic
(c) Analgesic and antacid
(d) Antiallergic and antidepressant

8. The correct match between Item-I and Item-II is

Item - I		Item - II	
A.	Norethindrone	P.	Antibiotic
B.	Ofloxacin	Q.	Antifertility
C.	Equanil	R.	Hypertension
		S.	Analgesics

Codes *(JEE Main 2019)*
(a) (A) → (Q); (B) → (R); (C) → (S)
(b) (A) → (Q); (B) → (P); (C) → (R)
(c) (A) → (R); (B) → (P); (C) → (S)
(d) (A) → (R); (B) → (P); (C) → (R)

9. Which detergent can cause maximum pollution?

(a) $CH_3CH(C_4H_9)—CH_2CH_2CH(C_4H_9)(CH_2)_3CH(C_4H_9)CH_2CH_2SO_3Na$

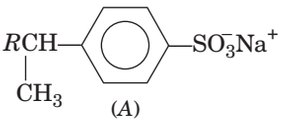
(b) $CH_3(CH_2)_{10}CH_2OSO_3Na$

(c) $CH_3CH(C_3H_7)—(CH_2)_6CH(C_4H_9)CH_2SO_3Na$

(d) $[CH_3(CH_2)_{15}N(CH_3)_3]^+Br^-$

10. For the preparation of a detergent '*A*' (given below) from benzene, the following steps are involved

I. $\xrightarrow[\text{HF, Friedel-Crafts'}]{R\text{CH}=\text{CH}_2}$ II. $\xrightarrow{H_2SO_4/SO_3}$

III. $\xrightarrow{\text{NaOH}}$  (*A*)

These steps should be in sequence

(a) I, II, III (b) II, I, III (c) II, III, I (d) I, III, II

11. The correct match between Item - I and Item - II is

	Item-I (Drug)		**Item-II** (Test)
A.	Chloroxylenol	P.	Carbylamine test
B.	Norethindrone	Q.	Sodium hydrogen carbonate test
C.	Sulphapyridine	R.	Ferric chloride test
D.	Penicillin	S.	Bayer's test

Codes *(JEE Main 2019)*

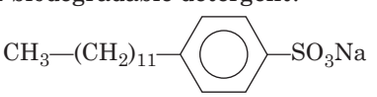
(a) A → R ; B → P ; C → S ; D → Q

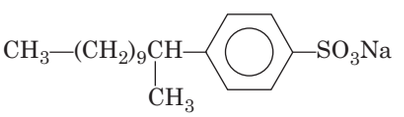
(b) A → R ; B → S ; C → P ; D → Q

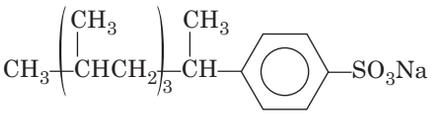
(c) A → Q ; B → P ; C → S ; D → R

(d) A → Q ; B → S ; C → P ; D → R

12. Which of the following is a example of non-biodegradable detergent?

(a) 

(b) 

(c) 

(d) $CH_3(CH_2)_{10}CH_2OSO_3Na$

13. Which of the following is known as invert detergent?

(a) Pentaerythritol monostearate

(b) Sodium stearyl sulphate

(c) Trimethyl cetyl ammonium bromide

(d) Ethoxylated non-phenol

14. Detergents are prepared by the action of H_2SO_4 followed by neutralisation by starting with

(a) cholesterol (b) cyclohexanol

(c) lauryl alcohol (d) *p*-nitrophenol

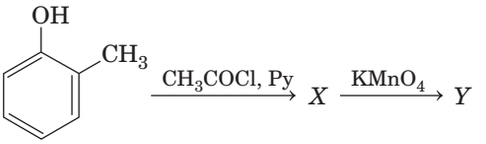
15. The mechanism of action of "Terfenadine" (Seldane) is *(JEE Main 2020)*

(a) Inhibits the secretion of histamine

(b) Inhibits the action of histamine receptor

(c) Helps in the secretion of histamine

(d) Activates the histamine receptor

16. 

The final product '*Y*' is medicine. Which of the following is incorrect regarding '*Y*' ?

(a) It has analgesic as well as antipyretic properties

(b) It helps to prevent heart attack

(c) It has anti-blood clotting action

(d) It suppresses the gastric anomalies

17. Compounds with antiseptic properties are

(a) $CHCl_3$ *(NCERT Exemplar)*

(b) CHI_2

(c) Boric acid

(d) 0.3 ppm aqueous solution of Cl_2

18. Which of the following statements are incorrect about penicillin ? *(NCERT Exemplar)*

(a) An antibacterial drug

(b) Ampicillin is its synthetic modification

(c) It has bacteriostatic effect

(d) It is a narrow spectrum antibiotic

19. Amongst the following antihistamines, which are antacids ? *(NCERT Exemplar)*

(a) Ranitidine

(b) Brompheniramine

(c) Terfenadine

(d) Aspirin

20. The antifertility drug "Novestrol" can react with

(a) $ZnCl_2$/HCl; $FeCl_3$; alcoholic HCN

(b) Br_2/water; $ZnCl_2$/HCl; $FeCl_3$

(c) alcoholic HCN; NaOCl; $ZnCl_2$/HCl

(d) Br_2/water; $ZnCl_2$/HCl; NaOCl

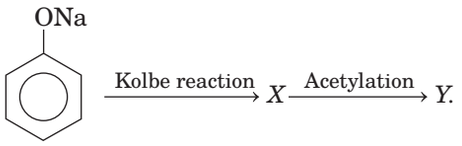
21. Which of the following sets of reactants is used for the preparation of paracetamol from phenol?

(a) HNO_3 , H_2/Pd, $(CH_3CO)_2O$

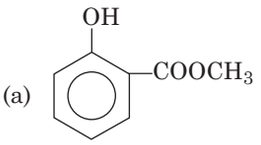
(b) H_2SO_4 , H_2/Pd, $(CH_3CO)_2O$

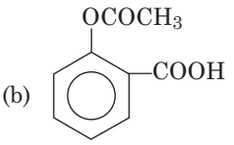
(c) $C_6H_5N_2Cl$, $SnCl_2$/HCl, $(CH_3CO)_2O$

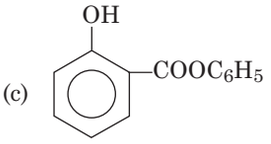
(d) Br_2/H_2O, Zn/HCl, $(CH_3CO)_2O$

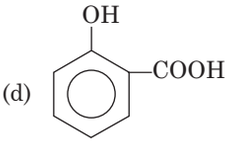
22. 

Product '*Y*' is

(a) 

(b) 

(c) 

(d) 

23. Which of the following statements is correct ? *(NCERT Exemplar)*

(a) Some tranquilizers function by inhibiting the enzymes which catalyse the degradation of noradrenaline

(b) Tranquilizers are non-narcotic drugs

(c) Transquilizers are chemical compounds that do not affect the message transfer from nerve to receptor

(d) Tranquilizers are chemical compounds that can relieve pain and fever

24. Salvarsan is arsenic containing drug which was first used for the treatment of *(NCERT Exemplar)*

(a) syphilis (b) typhoid

(c) meningitis (d) dysentry

25. A narrow spectrum antibiotic is active against *(NCERT Exemplar)*

(a) gram positive or gram negative bacteria

(b) gram negative bacteria only

(c) single organism or one disease

(d) both gram positive and gram negative bacteria

26. The compound that causes general antidepressant action on the central nervous system belongs to the class of *(NCERT Exemplar)*

(a) analgesics (b) tranquilizers

(c) narcotic analgesics (d) antihistamines

27. In the following sets of compounds, the one which contains only medicinal compounds is

(a) alizarin, phenacetin, morphine

(b) aspirin, gention violet, phenolphthalein

(c) boric acid, chloramphenicol, aspirin

(d) 9-oxodecanoic acid, boric acid, morphine

Answers

Round I

1. (a)	**2.** (d)	**3.** (a)	**4.** (a)	**5.** (b)	**6.** (b)	**7.** (d)	**8.** (c)	**9.** (a)	**10.** (c)
11. (b)	**12.** (c)	**13.** (a)	**14.** (b)	**15.** (b)	**16.** (a)	**17.** (a)	**18.** (c)	**19.** (c)	**20.** (d)
21. (b)	**22.** (b)	**23.** (b)	**24.** (c)	**25.** (a)	**26.** (c)	**27.** (a)	**28.** (c)	**29.** (d)	**30.** (d)
31. (c)	**32.** (b)	**33.** (d)	**34.** (c)	**35.** (c)	**36.** (b)	**37.** (b)	**38.** (d)	**39.** (b)	**40.** (c)
41. (d)	**42.** (d)	**43.** (b)	**44.** (d)	**45.** (c)	**46.** (b)	**47.** (b)	**48.** (b)	**49.** (c)	**50.** (d)
51. (b)	**52.** (d)	**53.** (c)	**54.** (b)	**55.** (a)	**56.** (b)	**57.** (d)	**58.** (b)	**59.** (a)	**60.** (d)
61. (c)	**62.** (b)	**63.** (a)	**64.** (b)	**65.** (b)	**66.** (c)	**67.** (c)	**68.** (a)		

Round II

1. (c)	**2.** (b)	**3.** (b)	**4.** (d)	**5.** (a)	**6.** (c)	**7.** (b)	**8.** (b)	**9.** (a)	**10.** (a)
11. (b)	**12.** (a)	**13.** (c)	**14.** (c)	**15.** (b)	**16.** (d)	**17.** (c)	**18.** (c)	**19.** (a)	**20.** (b)
21. (a)	**22.** (b)	**23.** (a)	**24.** (a)	**25.** (a)	**26.** (b)	**27.** (c)			

Solutions

Round I

1. The given example is based on the action of drug on a particular biochemical process.

2. Substrates bind to the active site of the enzyme through hydrogen bonding, ionic bonding and dipole-dipole intractions. So, all of these are responsible for enzyme substrate interaction.

3. Competitive inhibition is shown in the given figure. Here, drug competes with the natural substrate for their attachment on the active sites of enzymes.

5. Receptors are selective in nature as they bind to a particular type of chemical messenger. This is because, their binding sites have different shape, structure and amino acid composition.

6. A receptor is a protein molecule usually found embedded within the plasma membrane surface of a cell that receives chemical signals from outside the cell.

7. Ionic bonding, H-bonding, van der Waals' interactions, dipole-dipole interaction etc., are involved in holding the drugs to the active site of enzyme.

8. Carbohydrates, lipids, proteins and nucleic acids are target molecules or drug targets. Drugs possessing some common structural features have same action on targets. That's why the classification based on molecular targets is the most useful classification for medicinal chemists.

9. Acetyl salicylic acid is the chemical name of aspirin.

10. Antipyretics are used to bring down the body temperature in fever.

12. Noradrenaline is one of the example of neurotransmitters. It plays a major role in mood changes. If the level of noradrenaline is low for some reason, then signal-sending activity becomes low and the person suffers from depression.

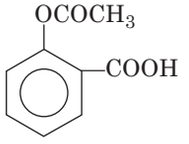
13. Tranquilizers reduce anxiety and bring about calmness.

15. Antidepressants such as iproniazid and phenylzine are needed because noradrenaline is a neuro transmitter and it plays an important role in mood changes. Its low level causes depression.

16. Aspirin belongs to the class of non-steroidal anti-inflammatory drug. Narcotic analgesic means a drug like morphine or any opium-derived compound which relieve the pain and induces sleep.

17. Due to anti-blood clotting action of aspirin, it is used to prevent heart attack.

23. N-acetyl-para-aminophenol (or paracetamol) is an antipyretic which can also be used as analgesic to relieve pain without addiction and mood modification.

24. 

is aspirin. It is an acetylated product of salicylic acid as an analgesics.

25. Penicillin is an effective medicine for pneumonia disease. Compared with other drugs, this agent also causes less GI upset, and it has the potential for good compliance because of its reduced dosing frequency.

26. Sulpha drugs are the derivatives of sulphanilamide.

28. Some drug do not bind to the enzyme's active site. These bind to a different site of enzyme which called allosteric site. This binding of inhibitor at allosteric site changes the shape of the active site in such a way that substrate can not recognise it. Such inhibitor is known as non-competitive inhibitor.

29. Erythromycin, tetracycline and chloramphenicol are bacteriostatic type antibiotic whereas ofloxacin is bactericidal type antibiotic.

30. Antiseptics are applied to the living tissues such as wounds, cuts, diseased skin surfaces. These are not injected like antibiotics.

31. 0.2 % solution of phenol acts as antiseptic and its 1% solution is a disinfectant. Aspirin as well as antipyretics but ampicillin is a penicillin derivative used for the treatment of a variety of infections.

33. 0.2% solution of phenol is an antiseptic while its 1% solution is disinfectant.

34. Birth control pills contain the combination of estrogen and progesterone derivatives which will prevent the ovulation; i.e. the release of egg from ovaries.

35. Oral contraceptive drugs contain mestranol (an estrogen) and norethindrone (a progesterone derivative).

38. Synthetic brompheniramine is an antihistamine that is used to treat sneezing, runny nose and itchy or watery eyes caused by allergies, hay fever and the common cold.

41. Sucrose is a natural sweetener whereas sucralose, alitame and saccharin are artificial sweeteners.

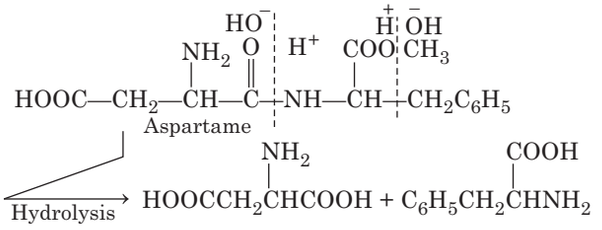
44. Correct answer is alitame is 2000 times sweeter than sugar. On other hand; saccharin is 110 times sweeter than sugar, aspartame is 180 times sweeter than sugar.

46. Butylated hydroxytoluene (BHT) is an organic compound primarily used as an antioxidant food additive. BHA also used as antioxidant.

47. Sucralose is trichloro derivative of sucrose. Its appearance and taste are like sugar.

48. Aspartame gets dissociated at cooking temperature.

49.



50. Sucrose and glucose provide energy. Aspartame is used in cold foods and soft drinks because it is unstable at cooking temperature. Sucralose is stable at cooking temperature and it does not provide calories.

51. Minerals, vitamins and amino acids have nutritive value but artificial sweeteners are only sweetening agent.

52. Sodium benzoate is used as preservative (not benzoic acid).

53. Glycerol is added to soap (toilet soap and shaving creams) to prevent rapid drying.

54. Every surfactant contains two parts *viz.*, a hydrophobic part and a hydrophilic part.

The compound $CH_3(CH_2)_{14}CH_2NH_2$ contains only hydrophobic part but no hydrophilic part, hence it is not a surfactant.

55. Cationic detergents are quaternary ammonium salts, containing long chain alkyl groups and possesing *germicidal* properties.

58. Cetyltrimethyl ammonium chloride is a cationic detergent it is used to prepare cosmetics because, it possesses germicidal properties.

60. Bithional is added to soap to impart antiseptic properties.

61. Polyethylene glycol are used to prepare non-ionic detergents. These do not contain any ion in their constitution.

62. Non-ionic detergents are used as liquid dishwashing detergents.

63. Toothpaste—anionic detergents

67. LAB stands for linear alkyl benzene.

69. Sodium lauryl sulphate $[(CH_3(CH_2)_{10}CH_2OSO_3^-Na^+)]$ = Anionic detergent

Cetyl trimethyl ammonium bromide

$$\left[CH_3(CH_2)_{15}-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{N}}}}-CH_3\right]^+ Br^- = \text{Cationic detergent}$$

Glyceryl oleate $[(C_{17}H_{32}COO)_3C_3H_5]$ = Non-ionic detergent

Sodium stearate $[C_{17}H_{35}COO^-Na^+]$ = Anionic soap

Round II

1. Toilet cleaning liquid contains mainly HCl and surfactants like classical ATX. HCl is corrosive to our skin. So, it should be removed immediately.

The first aid for removal of HCl should be basic in nature. But NaOH is a hard base whereas NH_4OH is a very soft base. So, the best substance to remove the spill (HCl) is $NaHCO_3$.

$$HCl + NaHCO_3 \longrightarrow NaCl + CO_2\uparrow + H_2O$$

3. Barbital or varonal is a sleep producing drug, i.e. hypnotic tranquilizer. It is used in sleeping pills and causes addiction.

4. Bacteriostatic drugs inhibit the growth of microorganism while bactericidal drugs kill the microorganisms.

5. Heroin is not a tranquilizer, it is a narcotic analgesic.

7. Antihistamines are used to relieve or prevent the symptoms of high fever and other types of allergy. They work by preventing the effects of a substance called histamine, which is produced by the body. Histamine can cause itching, sneezing, runny nose, and watery eyes.

8. (A) **Norethindrone** It is an antifertility drug(*Q*) containing synthetic progesterone derivative. [Other similar drug, is ethinylestradiol (novestrol)].

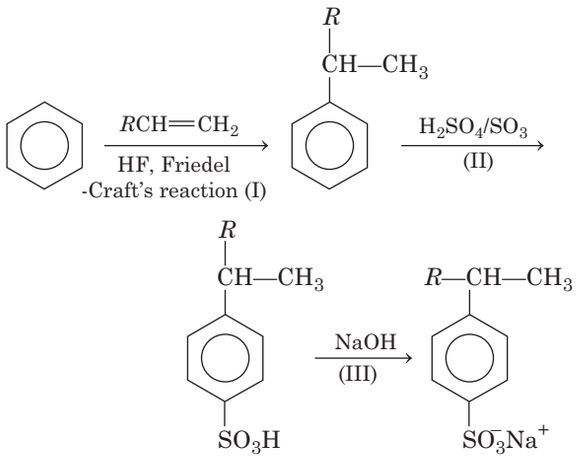
(B) **Ofloxacin** It is an antibiotic (*P*), i.e. produced wholly or partly by chemical synthesis with low concentration of microorganism. [Some other similar drugs : Penicillin, chloramphenicol, salvarsan etc.]

(C) **Equanil** (meprobamate) It is a mild tranquilizer for relieving hypertension. It relieve anxiety, stress, excitement by inducing a sense of well being. (Other similar drug is chlordiazepoxide).

The correct match is A → (Q) B → (P) C → (R).

9. Greater the branching, greater is the non-biodegradability of a detergent. A non-biodegradable detergent cause maximum pollution.

10.



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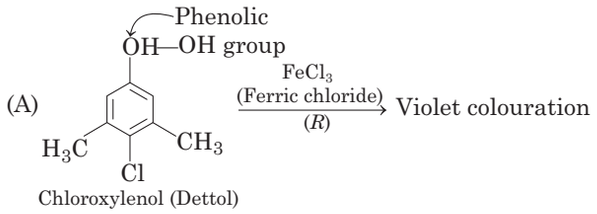
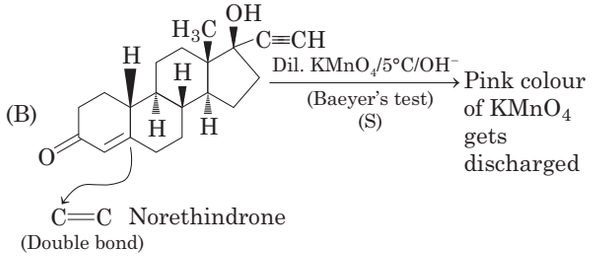
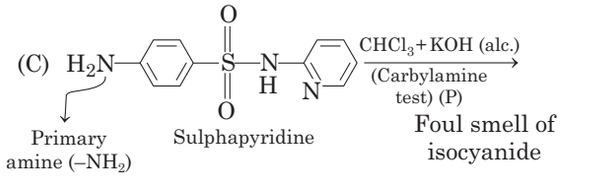
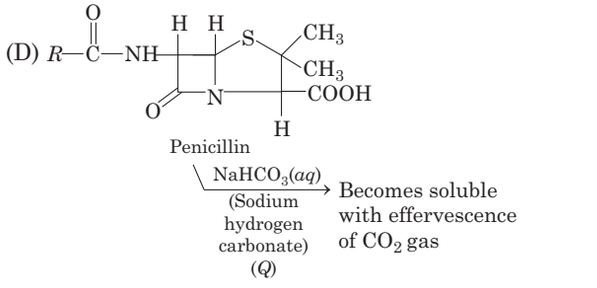




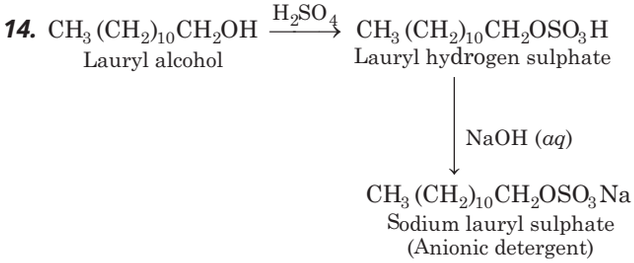




Thus, the correct match is

A → R; B → S; C → P; D → Q.

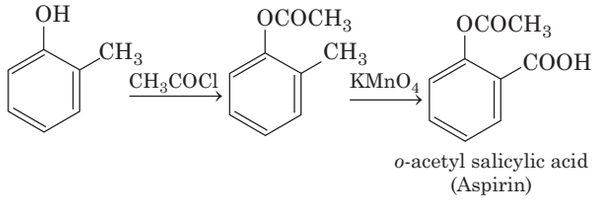
14.



15. Seldane (Terfenadine) is also an antihistamines drug. Which interfere with the natural action of histamine by competing with histamine for binding sites of receptors, where histamine acts.

Thus, it do not affect the secretion of acid in stomach but compete with histamine where histamine exterts its effect.

16.

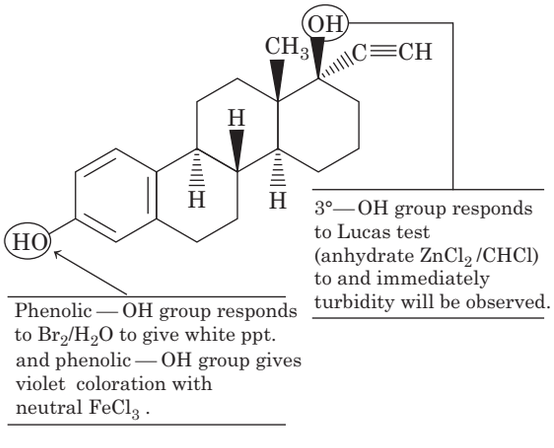


17. Boric acid in dilute aqueous solution is weak antiseptic for eyes. 0.3 ppm aqueous solution of Cl_2 is disinfectant.

18. Penicillin is bactericidal (has killing effect) and it is a narrow spectrum antibiotic.

19. Ranitidine and cimetidine are used as antacids.

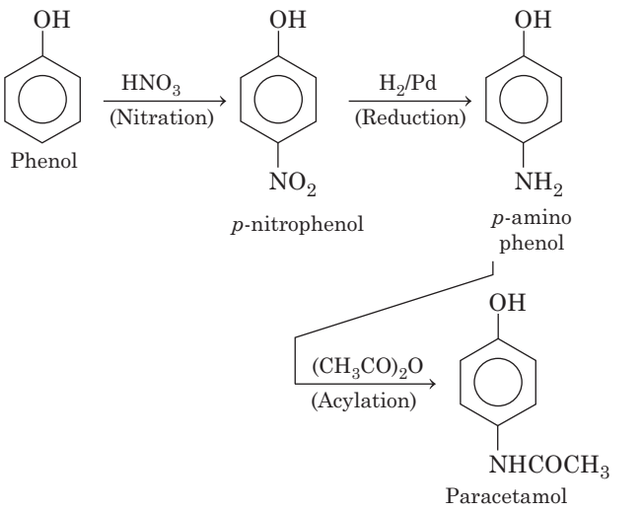
20. The antifertility drug "novestrol" or ethinylestradiol has the following structure



So, the correct combination of reagents is in option (b).

i.e. Br_2/ water, $ZnCl_2$/HCl and $FeCl_3$.

21.



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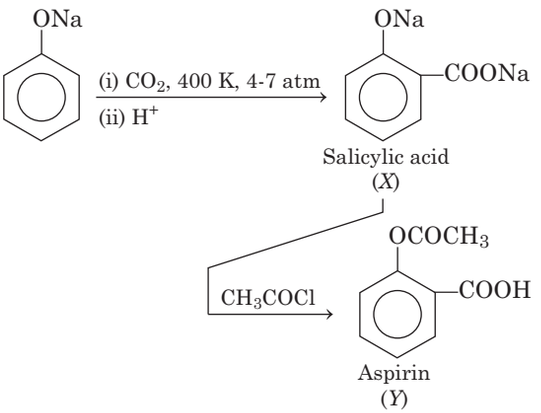

Product '*Y*' is aspirin.

23. Various types of tranquilizers function by different mechanism. For example, noradrenaline is one of the neurotransmitters. If the level of noradernaline is low, then the signal-sending activity becomes low and the person suffers from depression.

In such situation, person requires antidepressant drugs. These drugs inhibit the enzymes which catalyse the degradation of noradrenaline.

Due to this the level of neurotransmitter becomes normal, it can activate its receptor for longer periods of time, thus counteracting the effect of depression.

24. Salvarsan contains —As═As— linkage. It is used for the treatment of syphilis. Although, it is toxic to human beings, but its effect on the bacteria, spirochete, which causes syphilis is much greater than on human beings.

25. Narrow spectrum antibiotics are effective mainly against gram-positive or gram-negative bacteria.
If antibiotics are effective against a single organisms or disease, they are known as **limited spectrum antibiotics.**

26. Tranquilizers causes general antidepressant action on the central nervous system. They affect the message transfer mechanism from nerve to receptor..