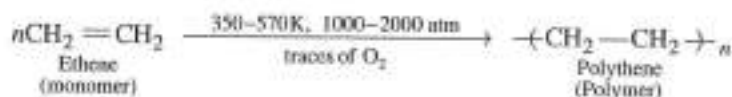


15 POLYMERS

BASIC CONCEPTS



- Polymers:** Polymers are the high molecular mass macromolecules, formed by the combination of large number of simple molecules called monomers. The process by which monomers are converted into polymers is called polymerisation.



2. Classification of Polymers

(a) Classification based on sources:

- Natural polymers:** Polymers found in nature, mostly in plants and animals are called natural polymers, e.g., proteins, natural rubber, etc.
- Semisynthetic polymers:** Polymers which are obtained by making some modifications in natural polymers by artificial means, e.g., nitrocellulose, cellulose acetate, etc.
- Synthetic polymers:** These are man-made polymers prepared in the laboratory, e.g., polythene, teflon, nylon, etc.

(b) Classification based on structure of polymers:

- Linear polymers:** These polymers consist of long and straight chains, e.g., high density polythene, polyvinyl chloride, nylon, etc.
- Branched chain polymers:** These polymers contain linear chains having some branches, e.g., low density polythene, glycogen, etc.
- Cross-linked or Network Polymers:** In this type of polymers, the initially formed linear polymer chains are joined together to form three dimensional network structure. Due to presence of cross links these polymers are also called cross-linked polymers, e.g., bakelite, melamine, etc.



(a) Linear chain



(b) Branched chain

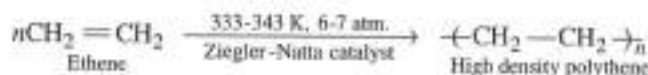


(c) Cross-linked

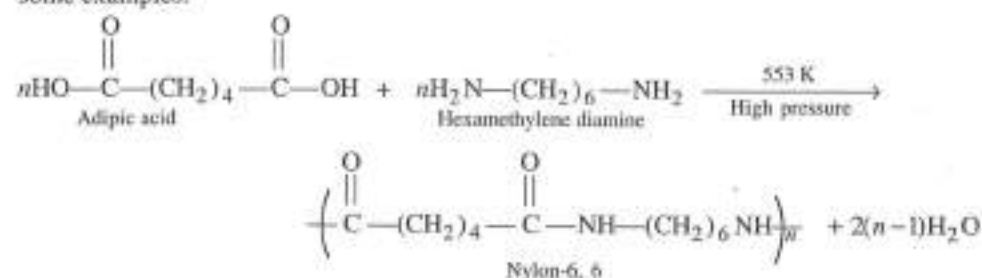
Fig. 15.1: Structure of polymer

(c) Classification based on mode of polymerisation:

- Addition polymers:** The addition polymers are formed by the repeated addition of same or different monomer molecules. The monomers used are unsaturated compounds, e.g., alkenes, alkadienes and their derivatives. Polythene is an example of addition polymer.



(ii) **Condensation polymers:** The condensation polymers are formed by the repeated condensation reaction between different bifunctional or trifunctional monomer units usually with elimination of small molecules such as water, alcohol, hydrogen chloride, etc. Nylon-6, nylon-6, 6 and terylene are some examples.



(d) **Classification based on molecular forces:**

- (i) **Elastomers:** These are the polymers having the weakest intermolecular forces of attraction between the polymer chains. The weak forces permit the polymer to be stretched. A few 'cross links' are introduced in between the chains, which help the polymer to retract to its original position after the force is released as in vulcanised rubber. Elastomers thus possess an elastic character, e.g., buna-S, buna-N, neoprene, etc.
- (ii) **Fibres:** These are the polymers which have the strongest intermolecular forces such as hydrogen bonds or dipole-dipole interactions. These polymers can be used for making fibre as their molecules are long and thread-like. Nylon-6, 6 and terylene are some common fibres.
- (iii) **Thermoplastics:** These polymers possess intermolecular forces of attraction intermediate between elastomers and fibres. These are linear or slightly branched chain polymers capable of repeatedly softening on heating and hardening on cooling, e.g., polythene, polypropylene, polystyrene, polyvinyl chloride, etc.
- (iv) **Thermosetting polymers:** These polymers are cross-linked or heavily branched molecules, which on heating undergo extensive cross-linking in moulds and again become infusible. These polymers cannot be reshaped, e.g., bakelite, urea-formaldehyde resins, etc.

Table 15.1: Differences between Thermoplastic and Thermosetting Polymers

S.No.	Thermoplastic Polymers	Thermosetting Polymers
(i)	These polymers soften on heating and harden on cooling.	On heating they undergo excessive cross linking and become hard.
(ii)	These polymers can be remoulded, recast and reshaped.	These polymers cannot be remoulded or reshaped.
(iii)	These are less brittle and soluble in some organic solvents.	These are more brittle and insoluble in organic solvents.
(iv)	These are formed by addition polymerisation.	These are formed by condensation polymerisation.
(v)	These polymers have usually linear structures.	These polymers have three dimensional cross-linked structures.
(vi)	Examples: Polyethylene, PVC, teflon, nylon, etc.	Examples: Bakelite, urea-formaldehyde resin, terylene, etc.

3. Types of polymerisation reactions

There are two broad types of polymerisation reactions:

(a) Addition polymerisation.

(b) Condensation polymerisation.

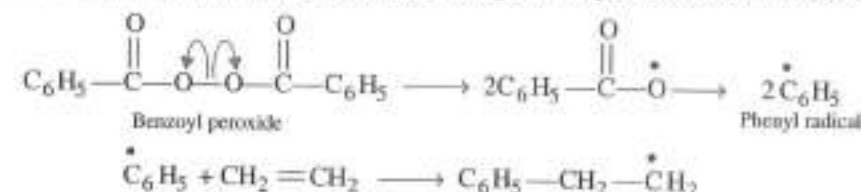
(a) **Addition polymerisation:** This type of polymerisation involves successive addition of monomer units to the growing chain carrying a reactive intermediate such as a free radical or anion.

Depending upon the nature of the reactive species involved addition polymerisation occurs by the following three mechanisms:

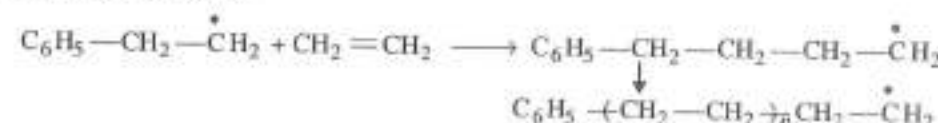
(i) Free radical polymerisation, (ii) Cationic polymerisation, (iii) Anionic polymerisation

Free radical polymerisation: A variety of alkenes or dienes and their derivatives are polymerised in the presence of a free radical generating initiator like benzoyl peroxide, acetyl peroxide, tert-butyl peroxide, etc. For example, the polymerisation of ethene to polythene consists of heating or exposing to light, a mixture of ethene with a small amount of benzoyl peroxide initiator. The sequence of steps may be depicted as follows:

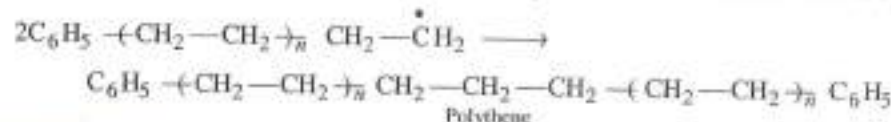
Chain initiation steps: Benzoyl peroxide undergo homolytic fission to form free radicals.



Chain propagating step:



Chain termination step: The chain reaction stops when two free radical chains combine.



(b) **Condensation polymerisation:** It occurs through a series of independent reactions (or steps). Each step involves the condensation between two bifunctional monomer units with elimination of simple molecule such as water, alcohol, etc., and leads to the formation of the polymer. Since the polymer is formed in a stepwise manner, the process is called step growth polymerisation, e.g., Nylon-6,6, dacron, bakelite, etc.

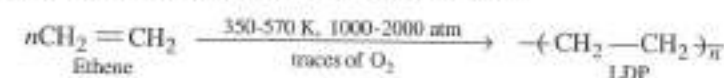
Table 15.2: Differences between Addition and Condensation Polymerisation

S.No.	Addition Polymerisation	Condensation Polymerisation
(i)	They are formed by adding monomers to a growing polymer chain without loss of any molecules.	Monomers combine together with the loss of small molecules like H ₂ O, NH ₃ , CO ₂ , CH ₃ OH, etc.
(ii)	It involves chain reaction.	It does not involve chain reaction.
(iii)	They are formed from unsaturated compounds.	Monomers have di or polyfunctional groups.
(iv)	Examples: Polythene, polypropene, PVC, teflon, etc.	Examples: Nylon-6,6, nylon-6, terylene, glyptal, bakelite, etc.

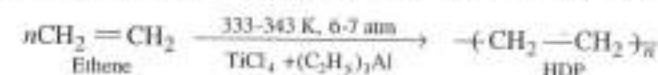
4. Preparation of Some Important Addition Polymers

(a) **Polythene**

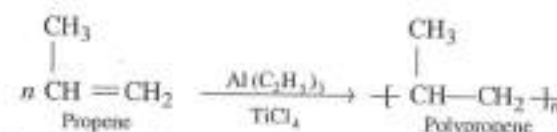
(i) **Low density polythene (LDP):** It is used in the insulation of electricity carrying wires, and manufacture of squeeze bottles, toys and flexible pipes.



(ii) **High density polythene (HDP):** It is used for manufacturing buckets, dustbins, pipes, bottles, etc.

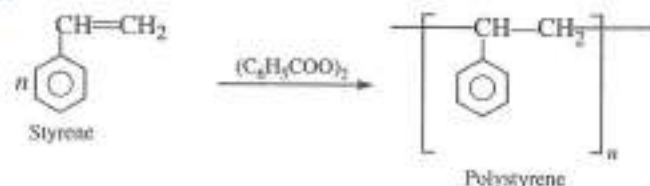


(b) **Polypropene:**



Uses: Manufacture of toys, ropes, pipes, carpet fibres, etc.

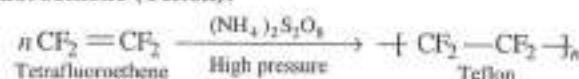
(c) **Polystyrene:**



Uses: As insulator, wrapping material, manufacture of toys, radio and television cabinets.

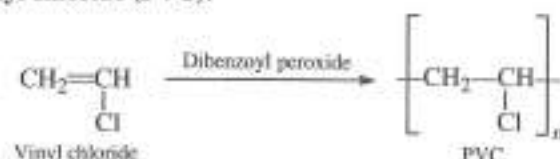
(d) **Polyhaloolefins:** These polymers are derived from halogen substituted olefins.

(i) **Tetrafluoroethene (Teflon):**



Uses: Making oil seals and gaskets, coating utensils to make them non-sticky.

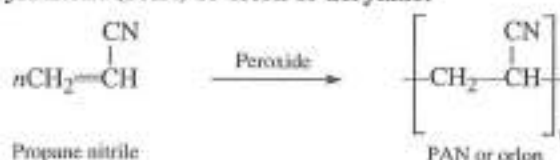
(ii) **Polyvinyl chloride (PVC):**



Uses: Manufacture of rain coats, water pipes, electrical insulation, hand bags, vinyl flooring.

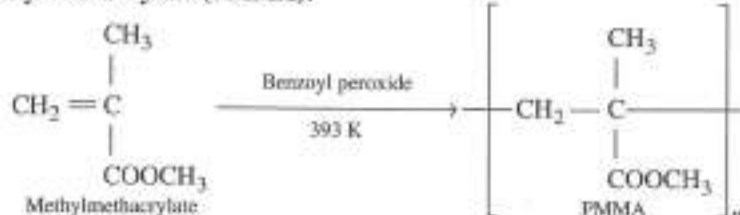
(e) **Polyacrylates:** These polymers are obtained from the ester of acrylic acid ($\text{CH}_2=\text{CH}\text{--COOH}$).

(i) **Polyacrylonitrile (PAN) or orlon or acrylane:**



Uses: As a substitute for wool in the manufacture of commercial fibres such as orlon which is used for making clothes, carpets and blankets.

(ii) **Polymethylmethacrylate (PMMA):**

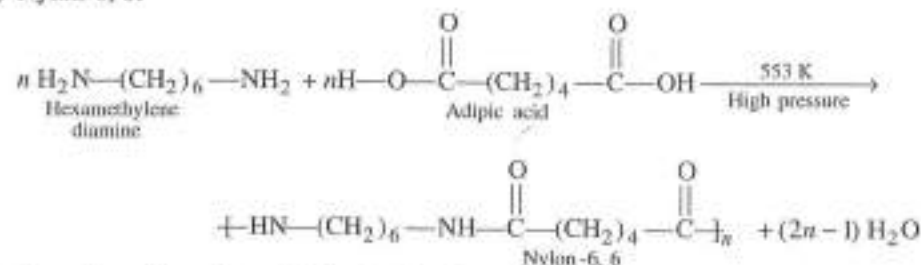


Uses: Manufacture of transparent objects such as aircraft windows, plastic jewellery, lenses, domes and sky lights.

5. Some Important Condensation Polymers

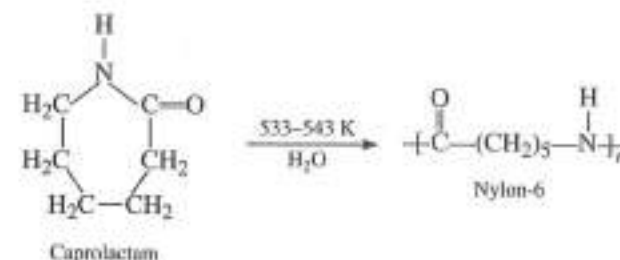
(a) **Polyamides:** Polymers possessing amide linkages (--CONH--) are called polyamides.

(i) **Nylon-6, 6:**



Uses: In making sheets, bristles for brushes and in textile industry.

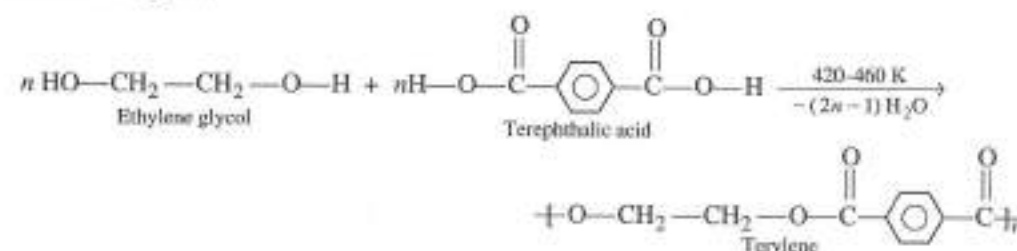
(ii) **Nylon-6:**



Uses: Manufacture of tyre cords, fabrics and ropes.

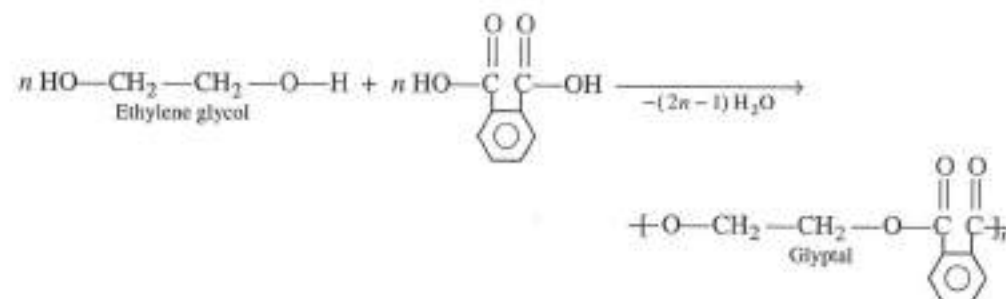
(b) **Polyesters:** Polymers possessing ester linkages (--C(=O)--O--) are called polyesters and are prepared by the condensation polymerisation of dicarboxylic acids with diols.

(i) **Dacron or terylene:**



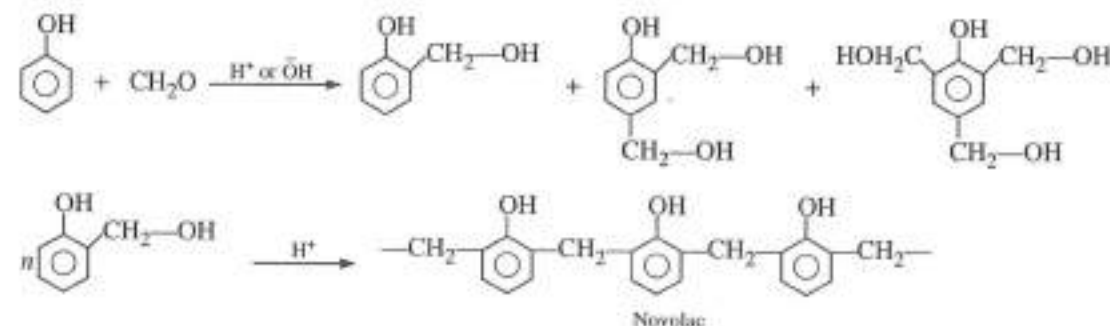
Uses: Manufacture of wash and wear fabrics, tyre cords, sails and seat belts.

(ii) **Glyptal:**

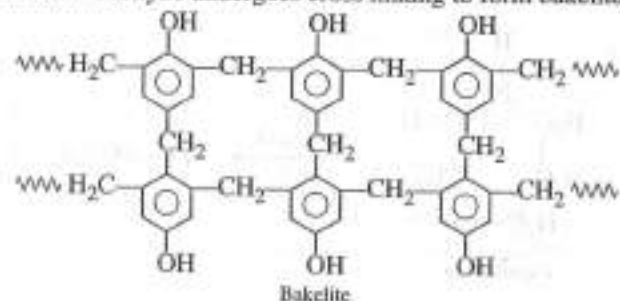


Uses: Manufacture of paints, lacquer and building materials.

(c) **Phenol-formaldehyde polymer (Bakelite and related polymers):** These are obtained by condensation reaction of phenol with formaldehyde in the presence of either an acid or base catalyst. The initial product could be a linear product, novolac.



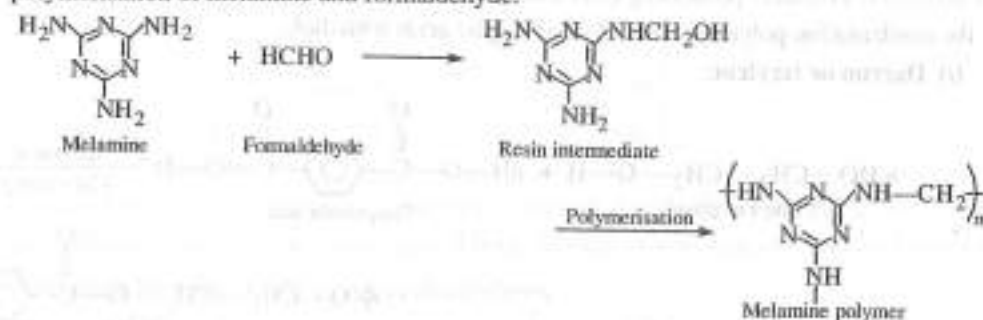
Novolac on heating with formaldehyde undergoes cross linking to form bakelite.



Uses: Novolac is used in paints.

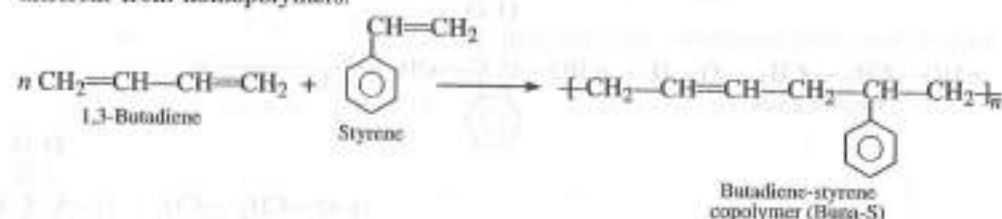
Bakelite is used for making combs, phonograph records, electrical switches and handles of various utensils.

(d) **Melamine-formaldehyde polymer:** Melamine-formaldehyde polymer is formed by condensation polymerisation of melamine and formaldehyde.



Uses: It is used in the manufacture of unbreakable crockery.

6. **Copolymerisation:** When two or more different monomers are allowed to polymerise together, the product formed is called a copolymer and the process is called copolymerisation. Copolymers have properties different from homopolymers.

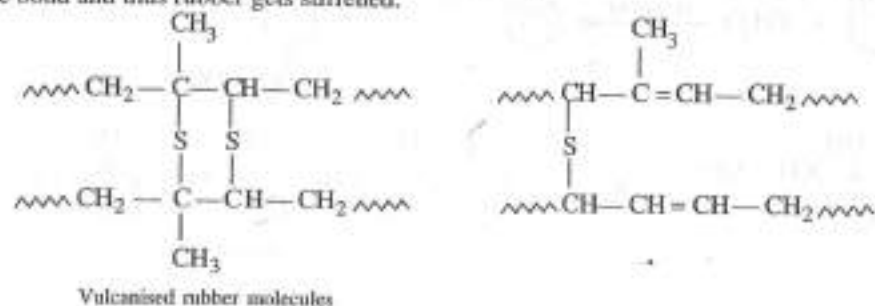


Uses: Buna-S is used for the manufacture of autotires, floor tiles, footwear components, cable insulation, etc.

7. Rubber

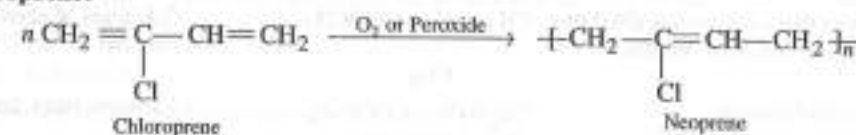
(a) **Natural rubber:** Natural rubber may be considered as a linear polymer of isoprene (α -methyl-1, 3-butadiene) and is also called as *cis*-1, 4-polyisoprene. The *cis*-polyisoprene consists of various chains held together by weak van der Waals interactions and has a coiled structure. Thus, it can be stretched like a spring and exhibits elastic properties.

(b) **Vulcanisation:** Vulcanisation is the heating of natural rubber with sulphur and an appropriate additive to improve its physical properties. On vulcanisation, sulphur forms cross-links at the reactive sites of the double bond and thus rubber gets stiffened.



(c) **Synthetic rubber:** Synthetic rubbers are either homopolymers of 1, 3-butadiene derivatives or copolymers of 1, 3-butadiene or its derivative with another unsaturated monomer.

Neoprene:



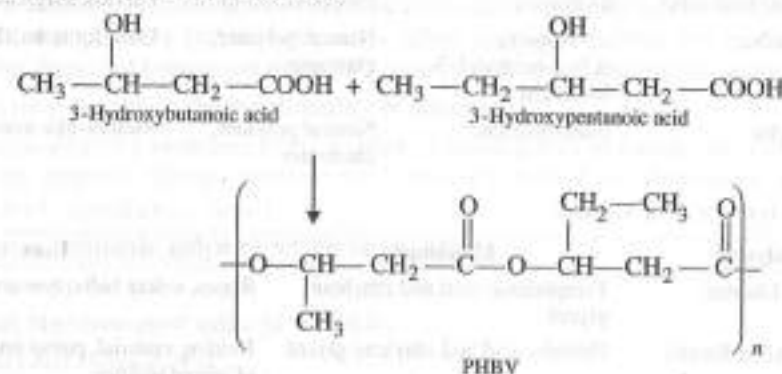
Uses: In the manufacture of conveyor belts, gaskets and hoses.

8. Biodegradable Polymers

Polymers that can be broken into small segments by enzyme-catalysed reactions are called biodegradable polymers. The required enzymes are produced by microorganisms. Since carbon-carbon bonds of chain growth polymers are inert to enzyme catalysed reactions, these polymers are non-biodegradable. To overcome this, certain bonds in the chain are to be inserted so that it can be made biodegradable. One such method to make a polymer biodegradable is to insert hydrolysable ester group into the polymer.

Aliphatic polyester, are biodegradable polymers and many of them are important commercial biomaterial. Some important examples are given below.

(i) **Poly- β -hydroxybutyrate-co- β -hydroxy valerate (PHBV):** This is a copolymer of 3-hydroxy butanoic acid and 3-hydroxy pentanoic acid.



Uses: It is used in speciality packaging, orthopaedic devices and in controlled release of drugs.

(ii) **Nylon-2-Nylon-6:** It is an alternating polyamide copolymer of glycine ($\text{H}_2\text{NCH}_2 - \text{COOH}$) and amino caproic acid ($\text{H}_2\text{N}-(\text{CH}_2)_5\text{COOH}$) and is biodegradable.

9. Addition Polymers at a Glance

S.No	Polymer	Monomer	Uses
1.	Polythene	Ethene ($\text{CH}_2=\text{CH}_2$)	Electrical insulator, packing materials, film, bottles, etc.
2.	Polypropene	Propene ($\text{CH}_3-\text{CH}=\text{CH}_2$)	Storage battery tanks
3.	Polystyrene	Styrene ($\text{C}_6\text{H}_5-\text{CH}=\text{CH}_2$)	In combs, plastic handles, toys
4.	Polyvinyl chloride (PVC)	$\text{CH}_2=\text{CHCl}$ Vinyl chloride	Pipes, raincoats, vinyl floorings
5.	Polytetrafluoro ethane (PTFE) or Teflon	$\text{CF}_2=\text{CF}_2$ Tetrafluoroethene	Non-stick kitchenwares, electrical insulator
6.	Polymono chlorotrifluoro ethene	Cl $\text{F}-\text{C}=\text{CF}_2$ Monochlorotrifluoro ethene	Non-stick kitchenwares
7.	Buna-S	1, 3-Butadiene and styrene	Automobile, tyres

8.	Buna-N	1,3-Butadiene and acrylonitrile	Used for storing oil and solvents
9.	Neoprene	2-Chloro-1, 3-butadiene (Chloroprene)	Insulation conveyor belt
10.	Polymethyl methacrylate (PMMA) (Perspex, Lucite or Acrylite)	$\text{CH}_3 - \text{C}(\text{CH}_3) - \text{COOCH}_3$	Substitute of glass and decorative material
11.	Polyethyl acrylate	$\text{CH}_2 = \text{CH} - \text{COOC}_2\text{H}_5$ Ethyl-2-propenoate	Lacquers, films, hose piping
12.	Polyacrylonitrile or Acrylane (orlon)	$\text{CH}_2 = \text{CH} - \text{C} \equiv \text{N}$ Vinyl cyanide	For making clothes, carpets and blankets

10. Natural Polymers at a Glance

S.No	Polymer	Monomer	Class	Uses
1.	Cellulose	β -Glucose	Biopolymer	Occurs in cotton, cell wall
2.	Starch	α -Glucose	Biopolymer	Food material storage in plants
3.	Proteins	Amino acids	Biopolymer	Essential for growth
4.	Nucleic acid	Nucleotides	Biopolymer	Essential for life perpetuation
5.	Rayon (Artificial Silk)	β -Glucose	Processed cellulose	Fabrics, surgical dressings
6.	Natural rubber	cis-Isoprene (Cis-2-methyl-1-3-butadiene)	Natural polymer, elastomer	Used for tyres after vulcanisation
7.	Gutta percha	trans-Isoprene	Natural polymer, elastomer	Rubber-like material

11. Condensation Polymers at a Glance

S.No	Polymer	Monomer	Uses
1.	Terylene (Dacron)	Terephthalic acid and ethylene glycol	Ropes, safety belts, tyre cord
2.	Glyptal (Alkyl Resin)	Phthalic acid and ethylene glycol	Binding material, paints and in preparation of mixed plastics
3.	Nylon-6	Caprolactam (cyclic amide)	Fibre, plastic, tyre cords and ropes
4.	Nylon-6, 6	Adipic acid and hexamethylene diamine	Sheets, bristles for brushes and in textile industry
5.	Bakelite	Phenol and formaldehyde	Electric switches and switch boards
6.	Melamine-formaldehyde resin	Melamine and HCHO	Crockery
7.	Urea-formaldehyde resin	Urea and HCHO	Crockery and laminated sheets

IMPORTANT QUESTIONS

[A] Remembering & Understanding-based Questions

Very Short Answer Questions

(1 mark)

Q. 1. What are polymers?

Ans. Refer to Basic Concepts Point 1.

Q. 2. How are polymers classified on the basis of structure of polymers?

Ans. On the basis of structure, the polymers are classified as below:

- (i) Linear polymers such as polythene, polyvinyl chloride, etc.
- (ii) Branched chain polymers such as low density polythene.
- (iii) Cross linked polymers such as bakelite, melamine, etc.

Q. 3. In which classes, the polymers are classified on the basis of molecular forces? [NCERT]

Ans. On the basis of intermolecular forces of attraction polymers are classified into the following classes:

- (i) Elastomers (ii) Fibres (iii) Thermoplastic polymers and (iv) Thermosetting polymers.

Q. 4. Give an example of elastomers. [CBSE Delhi 2009]

Ans. Buna-S, neoprene.

Q. 5. Define the term polymerisation. [NCERT]

Ans. Polymerisation is a process of formation of a high molecular mass polymer from one or more monomers by linking together a large number of repeating structural units through covalent bonds.

Q. 6. What do you understand by addition polymers?

Ans. Polymers which are formed by repeated addition of monomer molecules containing double and triple bonds are called addition polymers. Examples are polythene, PVC, PAN, PMMA, etc.

Q. 7. Give the structure and name of the polymer which is used for making non-stick utensils.

Ans. $\left[\begin{array}{c} \text{F} \quad \text{F} \\ | \quad | \\ -\text{C} - \text{C}- \\ | \quad | \\ \text{F} \quad \text{F} \end{array} \right]_n$. Teflon

Q. 8. Explain the term copolymerisation with two examples. [NCERT]

Ans. When a mixture containing more than one monomeric species is allowed to polymerise, the product obtained is called copolymer and the process is called copolymerisation. For example, Buna-S, a copolymer of 1,3-butadiene and styrene and Buna-N, a copolymer of 1,3-butadiene and acrylonitrile.

Q. 9. How do you explain the functionality of a monomer? [NCERT]

Ans. Functionality of a monomer is the number of binding sites in a molecule. For example, the functionality of ethene, propene, styrene, acrylonitrile is one and that of 1,3-butadiene, adipic acid, terephthalic acid, hexamethylenediamine is two.

Q. 10. Name a synthetic polymer which is an ester.

Ans. Terylene or dacron.

Q. 11. Write the monomer units of bakelite.

Ans. Phenol and formaldehyde.

Q. 12. What is the main constituent of bubble gum?

Ans. Styrene-butadiene copolymer.

Q. 13. Name a synthetic polymer which is an amide.

Ans. Nylon-6, 6.

Q. 14. What is a plasticiser?

Ans. Organic compounds which when added to plastics make them soft and workable are called plasticisers. Examples are di-n-octylphthalate, cresyl triphosphate, etc.

Q. 15. What is the commercial name of PMMA? What is its use?

Ans. The commercial name of PMMA (polymethylmethacrylate) is perspex. It is used as a substitute of glass. It is used for making lenses, transparent domes, aircraft windows and sky lights.

Q. 16. Explain the difference between Buna-N and Buna-S. [NCERT]

Ans. Both are copolymers. Buna-N is a copolymer of 1,3-butadiene and acrylonitrile while Buna-S is a copolymer of 1,3-butadiene and styrene.

Q. 17. Is $\text{NH} - \text{CHR} - \text{CO}$, a homopolymer or a copolymer? [NCERT]

Ans. It is a homopolymer because the repeating structural unit has only one type of monomer, i.e., $\text{NH}_2 - \text{CHR} - \text{COOH}$.

Q. 18. Identify the type of polymer.



Ans. Homopolymer

[NCERT Exemplar]

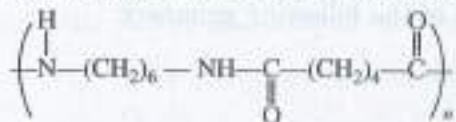
31. (i) Give an example of synthetic rubber and mention its main advantage.
 (ii) Write the structure of the monomer 'dacron'.
 (iii) Arrange the following polymers in the increasing order of their tensile strength:

Nylon-6, Buna-S, Polythene

32. Write the mechanism of free radical polymerisation of ethene. [CBSE Delhi 2016]

33. (i) What is the role of benzoyl peroxide in the polymerisation of ethene?

(ii) Identify the monomers in the following polymer:



[CBSE (North) 2016]

34. Write:

- (i) Reaction involved in the preparation of biodegradable polyester.
 (ii) Monomer unit of synthetic rubber (neoprene).
 (iii) One use of Nylon-6, 6.



16 CHEMISTRY IN EVERYDAY LIFE

BASIC CONCEPTS



- (a) **Drugs:** Drugs are chemical substances of low molecular masses (~100–500 u) which interact with macromolecular targets and produce a biological response.
 (b) **Medicines:** Drugs which produce a therapeutic and useful biological response.
 (c) **Chemotherapy:** The use of chemicals for treatment of diseases.

2. Classification of Drugs

- On the basis of pharmacological effect:** This classification is based on pharmacological effect of the drugs. It is useful for the doctors because it provides them the whole range of drugs available for the treatment of a particular type of problem. For example, analgesics have pain killing effect, antiseptics kill or arrest the growth of microorganisms.
- On the basis of drug action:** It is based on the action of a drug on a particular biochemical process. For example, all antihistamines inhibit the action of histamines which causes inflammation in the body.
- On the basis of chemical structure:** It is based on the chemical structure of the drug. Drugs classified in this way share common structural features and often have similar pharmacological activity. For example, sulphonamides have common structural features as seen in Fig. 16.1.
- On the basis of molecular targets:** Drugs usually interact with biological macromolecules such as carbohydrates, proteins, lipids and nucleic acids called target molecules. This classification is based upon the type of the molecular target with which the drug interact. This is the most useful classification for medicinal chemists.

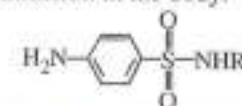


Fig. 16.1: Structural features of sulphonamides

3. **Enzymes:** Proteins which perform the role of biological catalysts in the body are called enzymes.

(a) **Catalytic action of enzymes:** In their catalytic activity, enzymes perform two major functions:

- The first function of an enzyme is to hold the substrate for a chemical reaction. Active sites of enzymes hold the substrate molecule in a suitable position, so that it can be attacked by the reagent effectively. Substrates bind to the active site of the enzymes through a variety of interactions such as ionic bonding, hydrogen bonding, van der Waals interaction or dipole-dipole interaction.
- The second function of an enzyme is to provide functional groups that will attack the substrate and carry out chemical reaction.

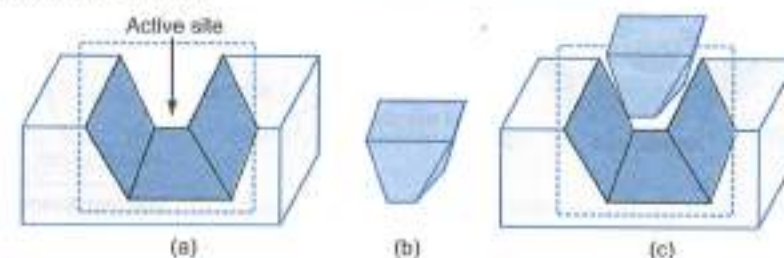


Fig. 16.2: (a) Active site of an enzyme, (b) Substrate, (c) Enzyme holding the substrate

- (b) **Drug-enzyme interaction:** Drugs can block the binding site of the enzyme and prevent the binding of substrate, or can inhibit the catalytic activity of the enzyme. Such drugs are called enzyme inhibitors. Drugs inhibit the attachment of substrates on active site of enzymes in two different ways:

- (i) Drugs compete with the natural substrate for their attachment on the active sites of enzymes. Such drugs are called competitive inhibitors.

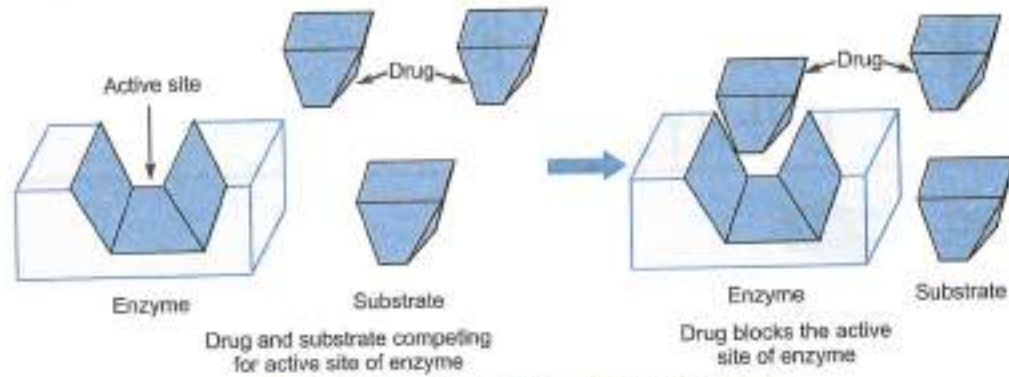


Fig. 16.3: Drug and substrate competing for active site

- (ii) Some drugs do not bind to the enzyme's active site. These bind to a different site of enzyme which is called allosteric site. This binding of inhibitor at allosteric site changes the shape of the active site in such a way that substrate cannot recognise it.

If the bond formed between an enzyme and an inhibitor is a strong covalent bond and cannot be broken easily, then the enzyme is blocked permanently. The body then degrades the enzyme-inhibitor complex and synthesises the new enzyme.

- **Receptors:** Proteins that are crucial to body's communication process are called receptors.

Receptor proteins are embedded in the cell membrane in such a way that their small part possessing active site projects out of the surface of the membrane and opens on the outside region of the cell membrane.

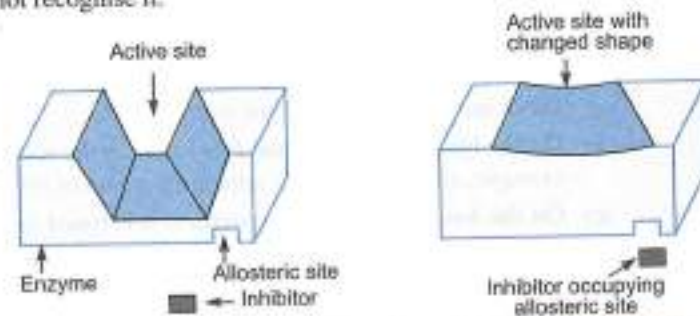


Fig. 16.4: Non-competitive inhibitor changes the active site of enzyme after binding at allosteric site

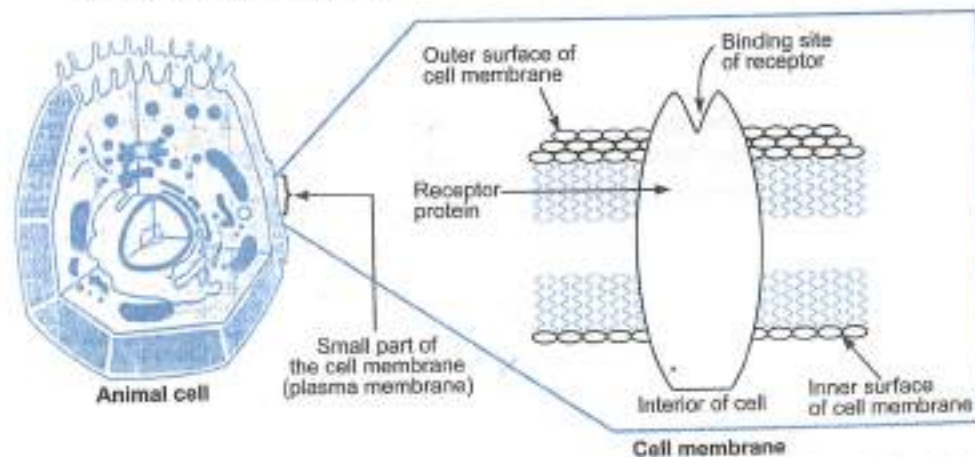


Fig. 16.5: Receptor protein embedded in the cell membrane with its active site opening on the outside region of the cell.

In the body, message between two neurons and that between neurons to muscles is communicated through certain chemicals. These chemicals, known as chemical messengers are received at the binding sites of receptor proteins. To accommodate a messenger, shape of the receptor site changes. This brings about the transfer of message into the cell. Thus, chemical messenger gives message to the cell without entering the cell.

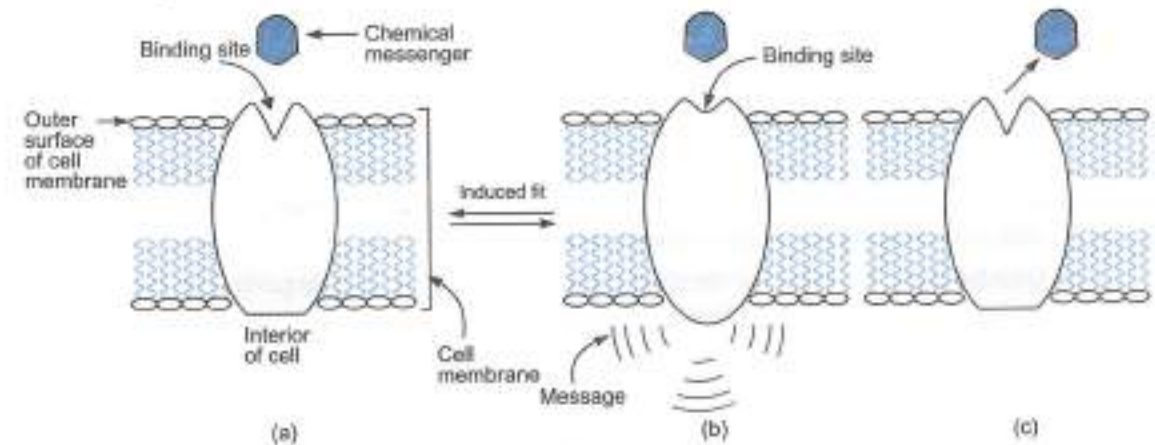


Fig. 16.6: (a) Receptor receiving chemical messenger

(b) Shape of the receptor changed after attachment of messenger

(c) Receptor regains structure after removal of chemical messenger

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

- **Agonists:** Drugs that mimic the natural messenger by switching on the receptor are called agonists. These are useful when there is a lack of natural chemical messenger.

4. **Neurologically Active Drugs:** Analgesics and tranquilizers are neurologically active drugs. These affect the message transfer mechanism from nerve to receptor.

- (a) **Analgesic:** Drugs which reduce or abolish pain without causing impairment of consciousness, mental confusion, incoordination or paralysis or some other disturbances of nervous system are called analgesics. These are classified as follows:

- (i) **Non-narcotic analgesics:** These drugs are non-addictive. Aspirin and paracetamol are important examples of non-narcotic analgesics. These drugs are effective in relieving skeletal pain such as that due to arthritis. These drugs have many other effects such as reducing fever and preventing platelet coagulation.

- (ii) **Narcotic analgesics:** These are the drugs which when administered in small doses relieve pain and produce sleep. Alkaloids like morphine, codeine and heroin belong to the class of narcotic analgesics. These are chiefly used for the relief of postoperative pain, cardiac pain and pains of terminal cancer, and in child birth.

- (b) **Tranquilizers:** Tranquilizers are a class of chemical compounds used for the treatment of stress, fatigue, and mild or even severe mental diseases. These relieve anxiety, stress, irritability or excitement by inducing a sense of well-being.

Examples:

- Tranquilizers like, chlordiazepoxide and meprobamate are used for relieving tension.
- Iproniazid and phenelzine are used as antidepressant.
- Barbiturates, viz., veronal, amytal, nembutal, luminal and seconal are hypnotic, i.e., sleep producing agents.
- Equanil is used in controlling depression and hypertension.

