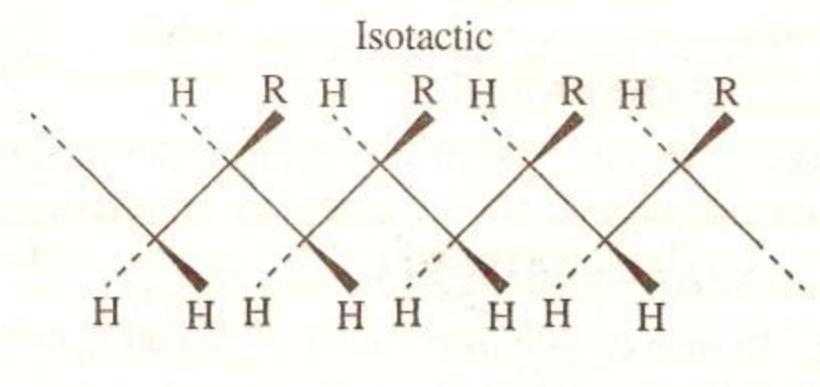
POLYMERS

2. Based on Tacticity :

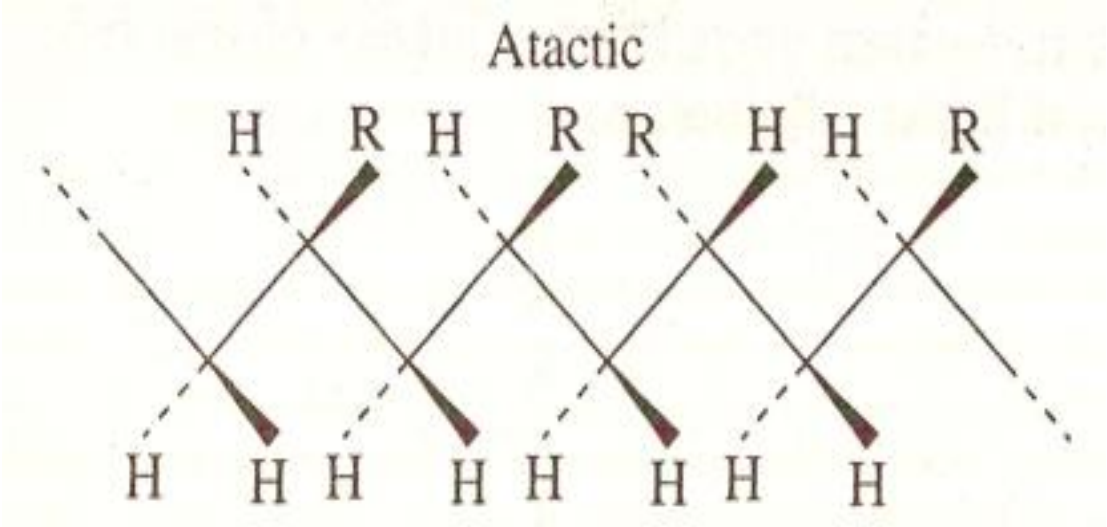
The orientation of monomeric units in a polymer molecule can take place in an orderly or disorderly fashion with respect to the main chain. The difference in configuration (tacticity) do affect their physical properties. Based on tacticity they are classified as follows:

(i) Isotactic Polymer: The head-to-tail configuration, in which the functional groups are all on the same side of the chain, is called isotactic polymer, e.g.,



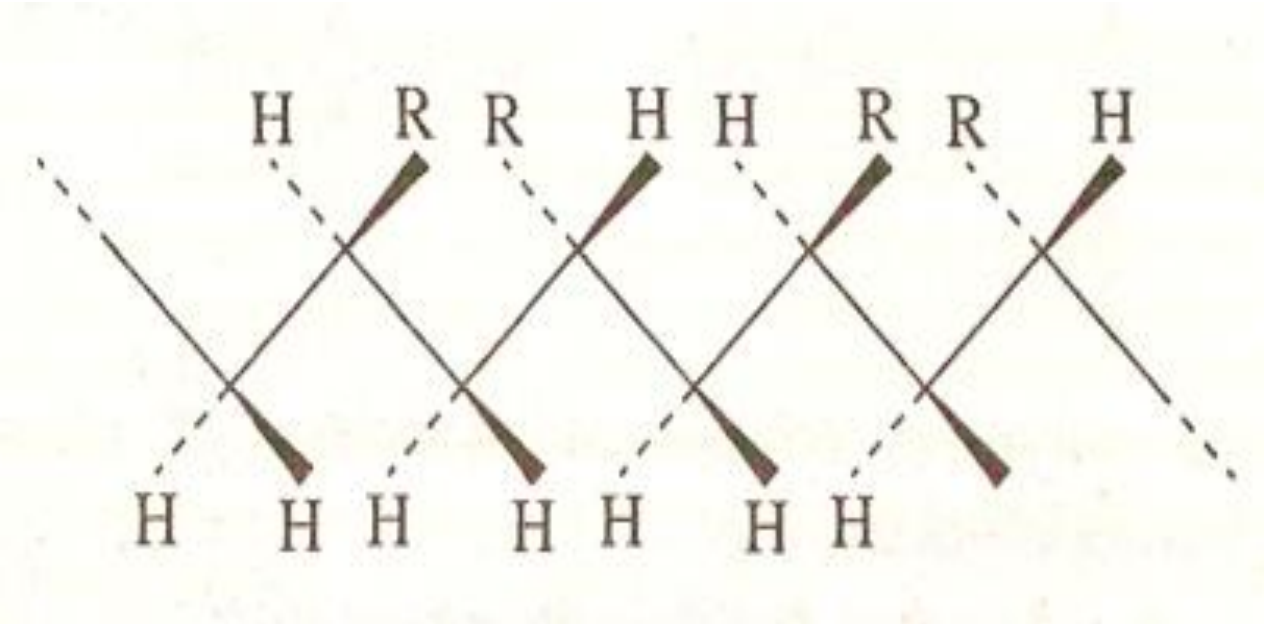
POLYMERS

(ii) Atactic Polymer: If the arrangement of functional groups are at **random** around the main chain, it is called **atactic polymer,** *e.g.,* polypropylene.



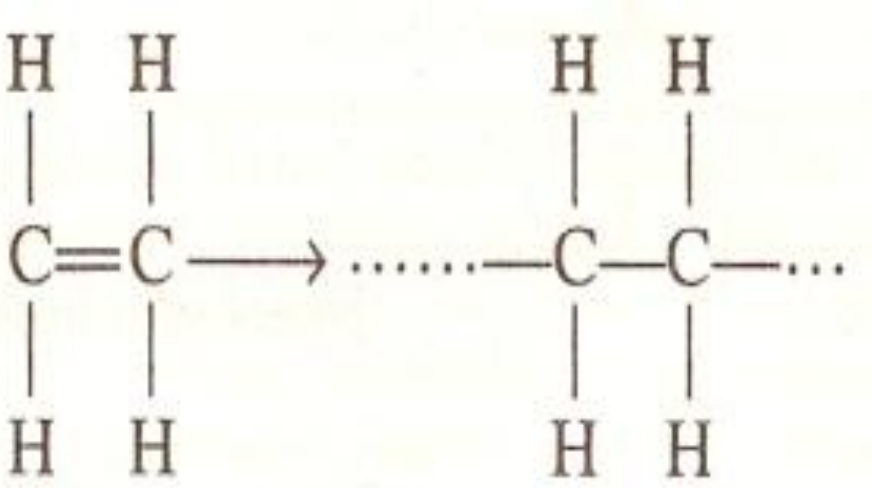
POLYMERS

iii) Syndiotactic: If the arrangement of side groups is in **alternating** fashion, it is called **syndiotactic polymer,** *e.g.,* gutta percha.



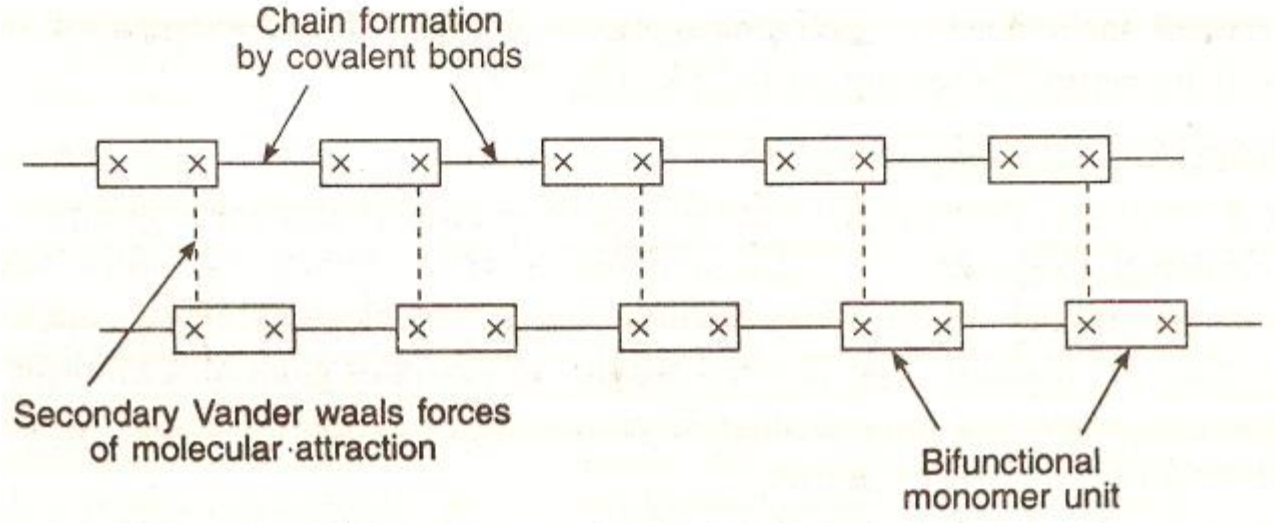
POLYMERS

3. Depending upon Functionality Functionality: For a substance to act as a monomer, it must have at least two reactive sites or bonding sites. The number of bonding sites in a monomer, is referred to as its functionality. In ethylene, the double bond can be considered as a site for two free valencies. When the double bond is broken, two single bonds become available for combination.



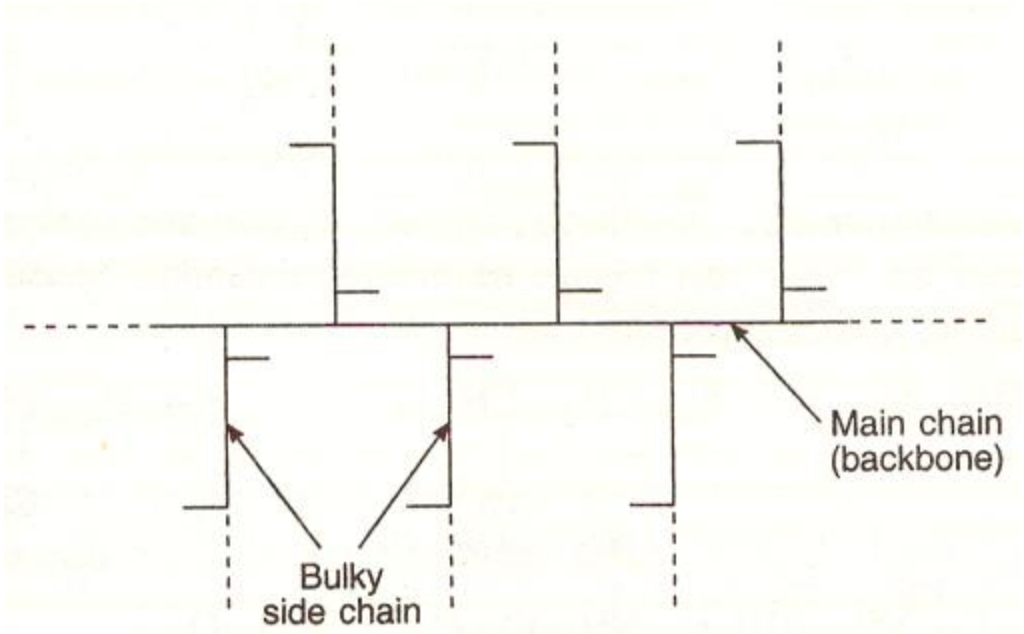
POLYMERS

(i) Linear or Straight Chain Polymer: In case of a **bifunctional monomer,** two reactive groups attach side by side to each other forming **linear or straight chain polymer.** Linear molecules consist of monomer units linked by primary covalent bonds, but the different chains are held together by secondary vander waals forces of molecular attraction. This gives the possibility of chain movement in one direction.



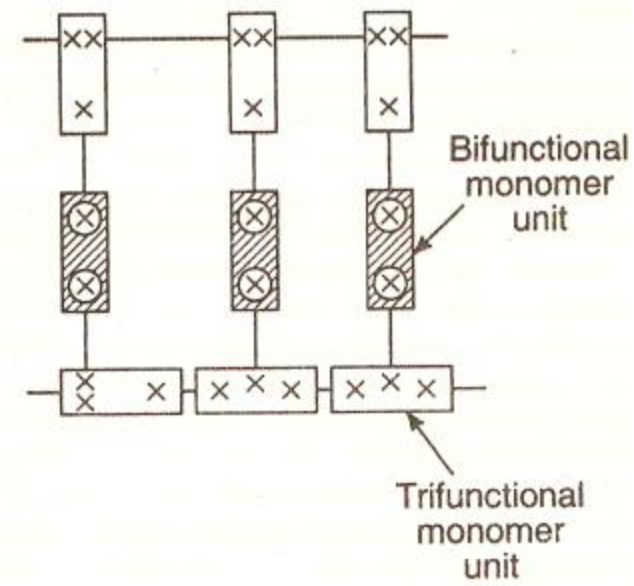
POLYMERS

(ii) Branched Chain Polymers: During the chain growth, side chains may also form, resulting in branched-chain polymers. Such a molecule is a linear, but the movement in brached-chain molecules is, generally, more restricted than that of simple straight-chain molecules. A branched-chain polymer also results, when a trifunc-tional monomer is mixed in small amounts with a bifunctional monomer and polymerised.



POLYMERS

(iii) Network Polymer: In case of polyfunctional groups, monomer molecules are connected to each other by covalent bonds, resulting in the formation of a three-dimensional netwrork polymer. In such polymeric molecules the movement of individual molecules is prevented by strong cross-links.



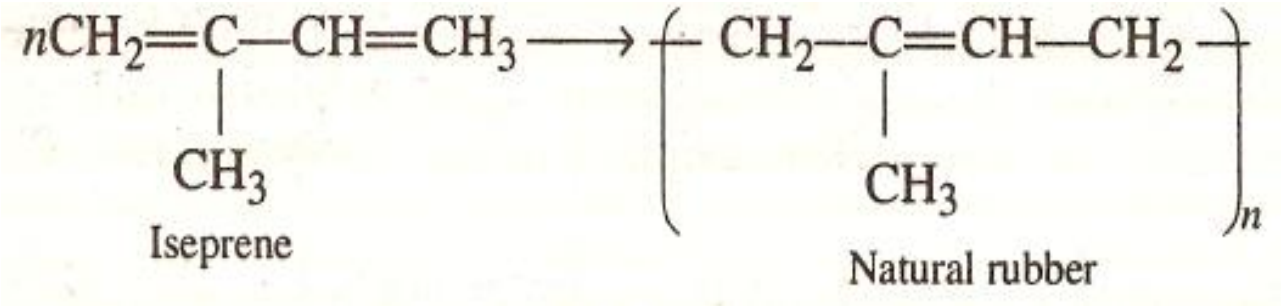
POLYMERS

4. Based on Origin :

Based on origin, the polymer can be broadly classified into three groups:

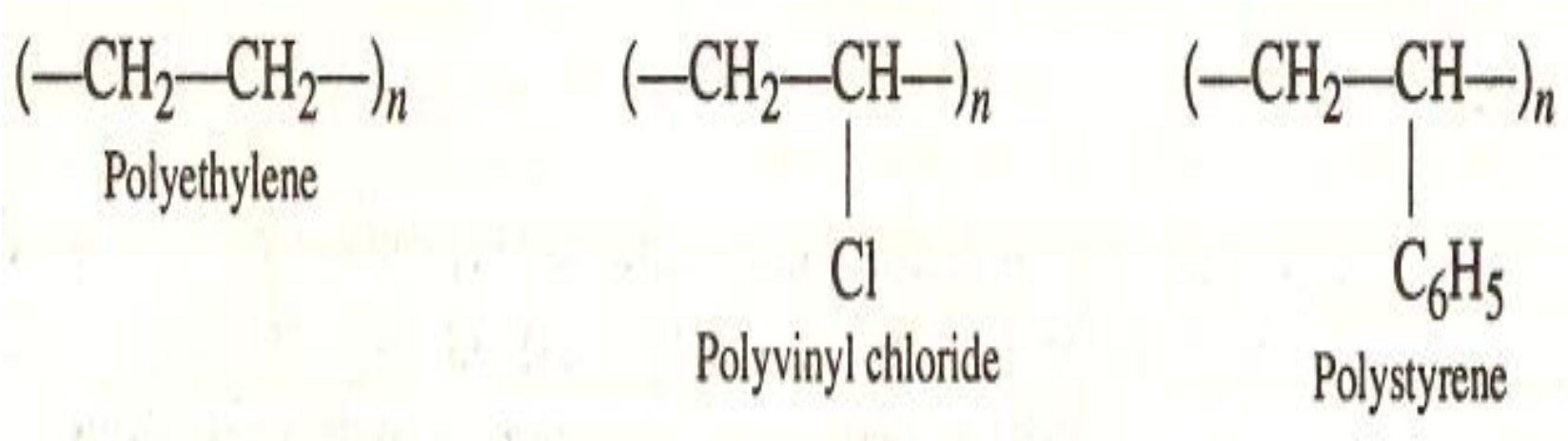
(i) Natural Polymers: These polymer occur in nature, *i.e.,* they have either vegitable or an animal origin. They include starch, cellulose, proteins, nucleic acids, natural rubbber etc. cellulose and starches are the polymers of glucose.

Natural rubber contains isoprene (2-methyl-1, 3-butadiene) repeat unit.



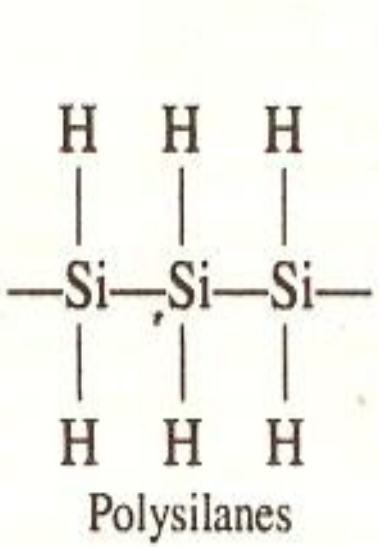
POLYMERS

(ii) Synthetic Polymers: Synthetic polymers are man made polymers. Most of the synthetic polymers are long-chain organic molecules containing thousands of monomer units. Most common synthetic polymers are :

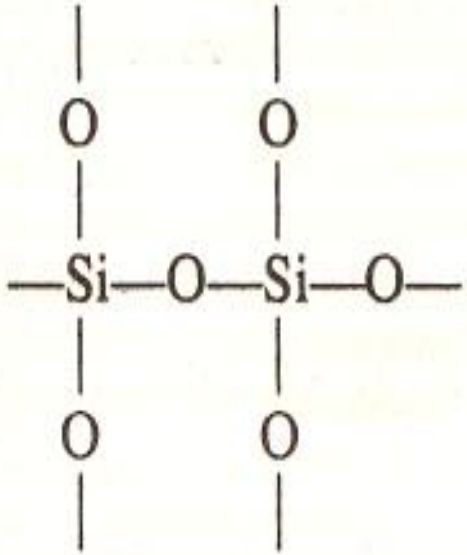


POLYMERS

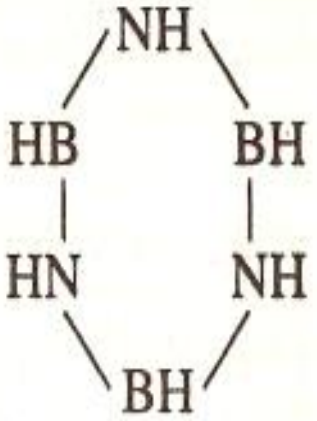
(iii) Inorganic Polymers: These are polymers containing no carbon atoms. The chains of these polymers are composed of different atoms joined by chemical bonds, while weaker inter-molecular forces act between the chains, *e.g.,*



Polysilanes



Silicon di-oxide



Borazole

POLYMERS

Classification Based on Molecular Forces :

(i) Elastomers: Held together by the weakest intermolecular forces *e.g.,* Vulcanized Rubber. Vulcanization is a process of treating natural rubber with sulphur. Rubber is vulcanized to render it nonplastic and give it greater elasticity and ductility.

(ii) Fibres: Strong intermolecular hydrogen bonding, *e.g.,* nylon-66.

(iii) Thermoplastics: Some polymers soften on heating and can be converted into any shape that they can retain on cooling. The process of heating, reshaping and retaining the same on cooling can be repeated several times. Such polymers, that soften on heating and stiffen on cooling are termed 'thermoplastics' *e.g.,* polyethylene, PVC, nylon and sealing wax.

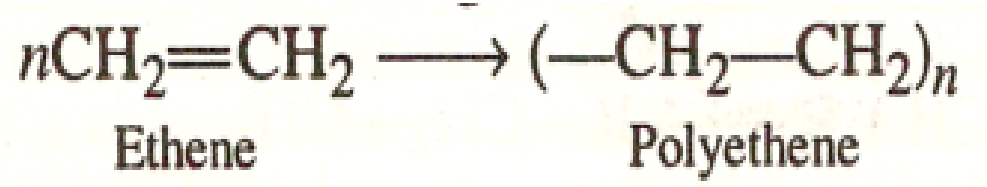
POLYMERS

(iv) Thermosetting: Some polymers undergo some chemical change on heating and convert themselves into infusible mass. They are like Yolk of egg, which on heating sets into a mass and once set cannot be reshaped. Such polymers, that become infusible and insoluble mass on heating, are called 'thermosetting' polymers *e.g.,* bakelite.

POLYMERS

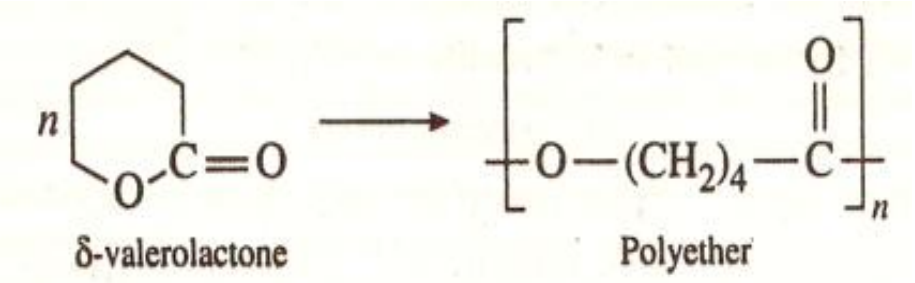
POLYMERIZATION : Polymerization is the process by which simple (monomer) molecules join together to form very large (polymer) molecules. Hence, the synthesis of large molecular weight polymers by the combination of monomer molecules is termed as polymerization. There are three different ways for doing polymerizaton :

(a) By opening a double bond, *e.g.,*



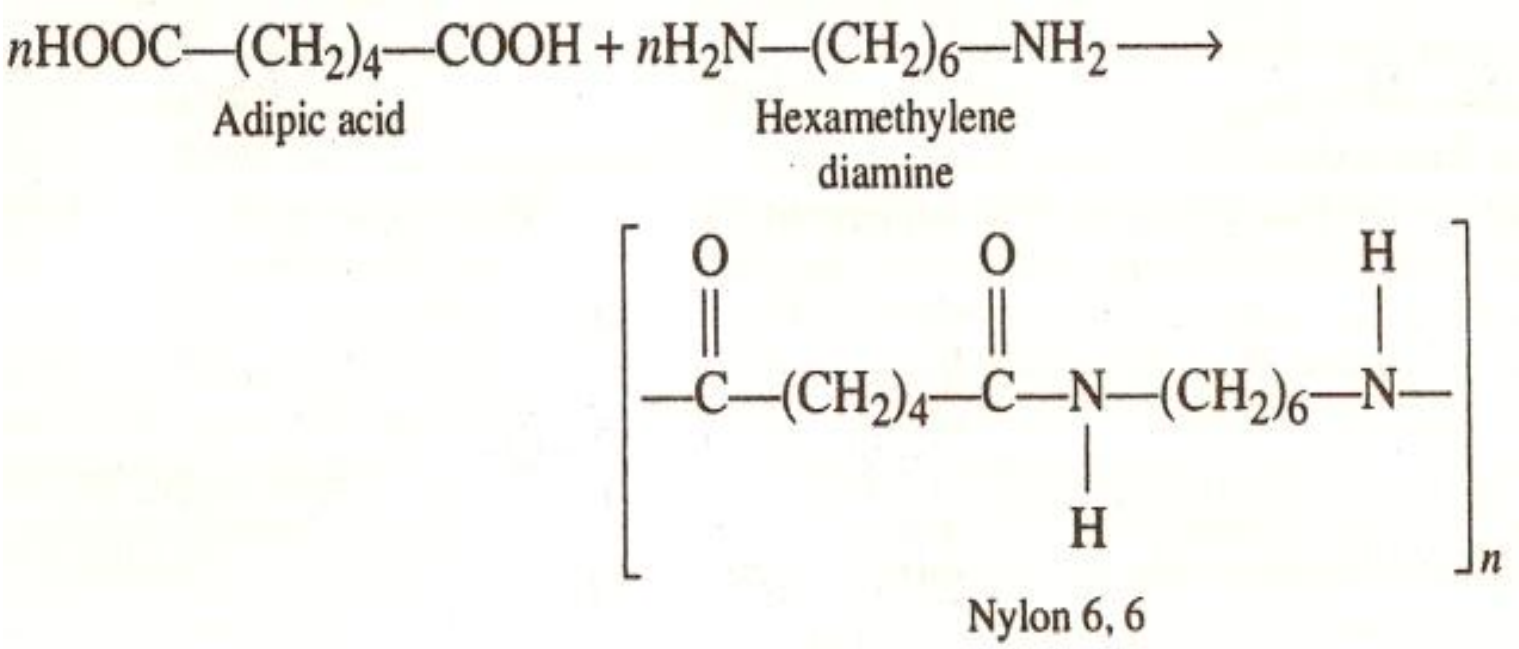
POLYMERS

(b) By opening a ring e.g.



δ-valerolactone Polyether

(c) By using molecules having two functional groups e.q.



Nylon 6, 6