PROJECT WORK

SYNTHETIC POLYMERS

SUBMITTED TO

DEPARTMNENT OF CHEMISTRY

SVCR GOVT. DEGREE COLLEGE

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January-2019

PROJECT WORK

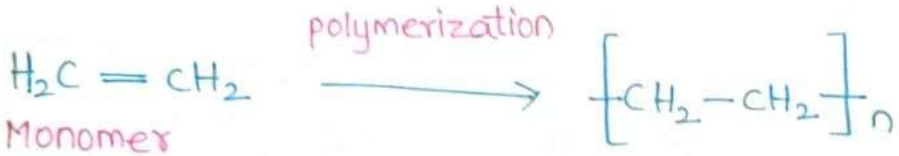
SYNTHETIC POLYMER

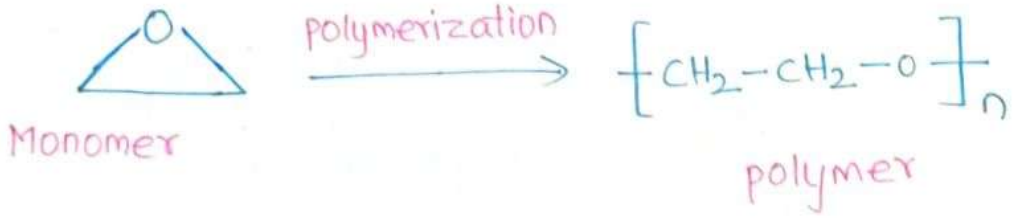
Polymerization :-

* A large molecule formed by repetitive bonding (covalent) of smaller molecules (monomers) is called a polymer.
* This process of formation of polymers from respective monomers is called polymerization.
* polymer contains repeating units.
* Macro molecules contain no repeating units,

  Ex :- DNA, proteins etc.,
* A polymer is a macro molecule.

  But a macromolecule may not be a polymer.





polymerization :-

* The number of repeating units (n) in the chain. So formed is called the "degree of polymerization" (DP=n)
* polymers with a high degree of polymerization are called "high polymers" and those with

low degree of polymerization are called oligo polymer.

* polymers do not exhibit strength for $n<30$ and that the optimum strength of most of the polymers is obtained at n around 600.

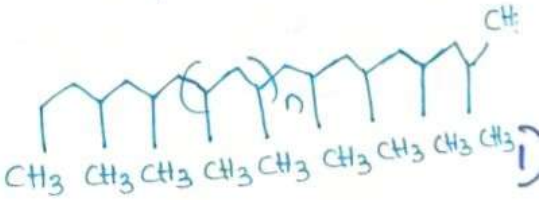
Common polyolefins :-

Monomer → polymer

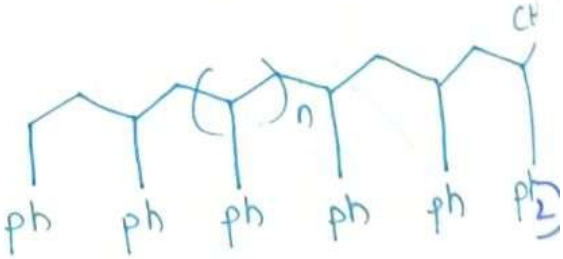
① ethylene ⟹ polyethylene

Repeat unit

② propylene ⟹ polypropylene



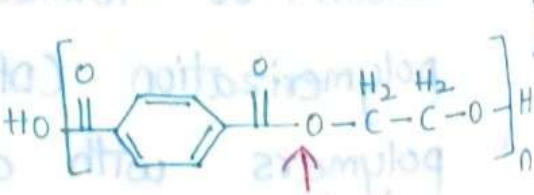
③ Styrene ⟹ polystyrene



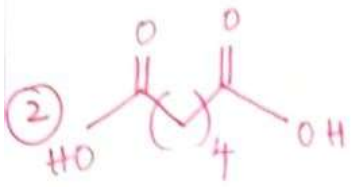
polyesters, Amides & urethanes :-

Monomer → polymer

① Terephthalic acid + Ethylene glycol ⟹ poly (ethene terephthalate)



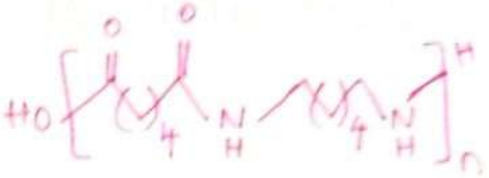
Ester

② 

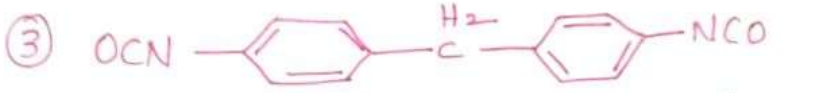
Adipic Acid

1,6-Diamino hexane

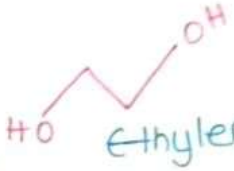
Nylon 6,6



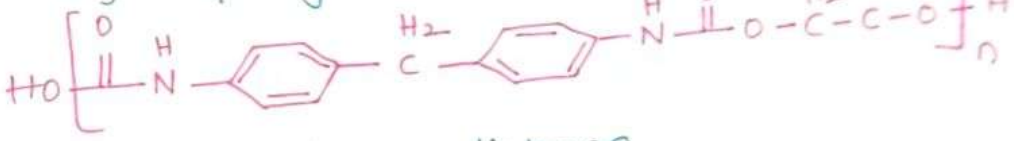
Amide

③ 

4,4-disocyanto phenyl methane



Ethylene glycol

Spandex ⟹ 

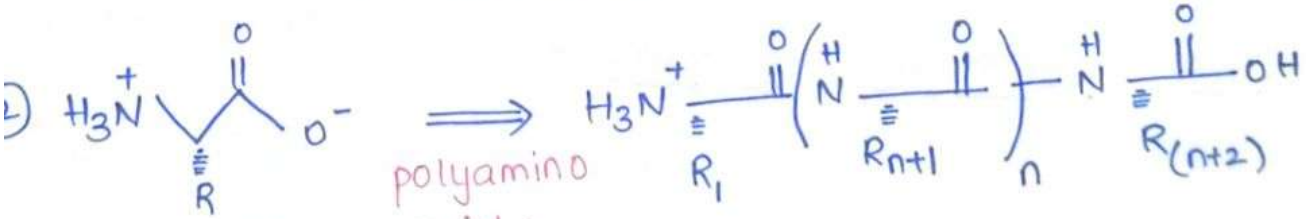
Urethane linkage

Natural polymer:-

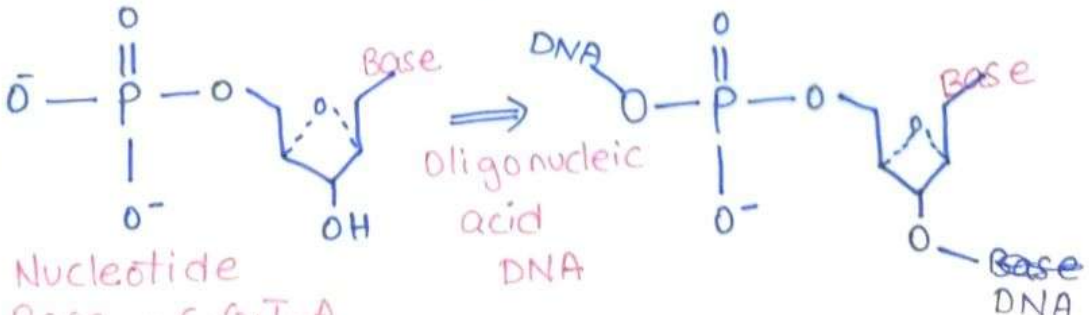
Monomer ⟹ polymer

① 

Isoprene ⟹ polyisoprene: Natural rubber

② 

Amino acids ⟹ polyamino acid: protein



Nucleotide Base = C, G, T, A ⟹ Oligonucleic acid DNA

Classification of polymers :-

The following are the common classifications of polymers :-

1. by source
2. by Back bone of the chain
3. by structure
4. by composition
5. by mode of polymerization
6. by molecular force

Source of polymers :-

* **Natural polymers :-**

These polymers are found in plants and animals.

Ex :- proteins, cellulose, starch, resins and rubbers.

* **Semi-synthetic polymers :-**

Cellulose derivatives as Cellulose acetate (rayon) and cellulose nitrate, etc, are the usual examples of this sub category.

* Synthetic polymers :-

A variety of synthetic polymers as plastic (polythene), synthetic fibres (nylon-6,6) and synthetic rubbers (Buna-S) are examples of man-made polymers.

Back Bone polymer :-

* organic polymers :-

A polymer whose backbone chain is essentially made of carbon atoms is termed as organic polymer.

The atoms attached to the side valencies of the backbone carbon atoms are, however, usually those of hydrogen, oxygen, nitrogen etc.,

The majority of synthetic polymers are organic.

* Inorganic polymers :-

on the other hand, generally chain back bone contains no carbon atom is called inorganic polymers.

Ex:- Glass and silicone rubber.

* Structure polymer :-

* Linear polymers :-

These polymers consists of long and straight chains.

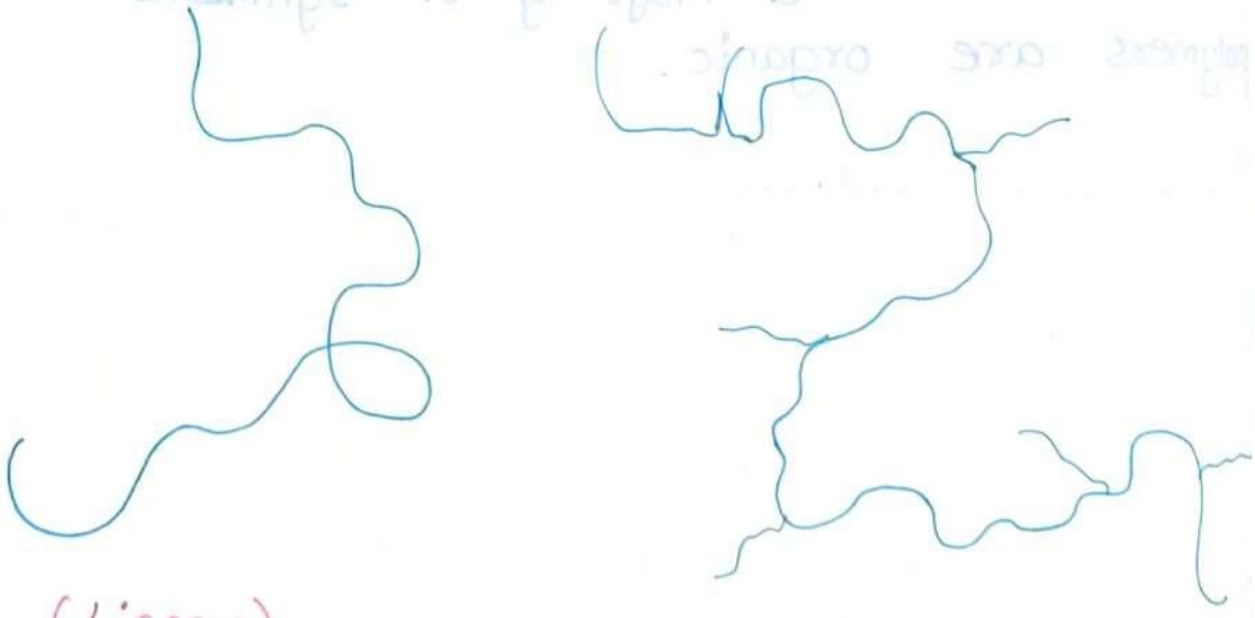
Ex :- high density polythene, pvc etc.,

linear polymers are commonly relatively soft, often rubbery substances, and often likely to soften (or melt) on heating and to dissolve in certain solvent.

* Branched polymers :-

These polymers contain linear chains having some branches.

Ex :- low density polythene.



(Linear)

(Branched)

Composition polymers :-

* **Homopolymer :-**

A polymer resulting from the polymerization of a single monomer; a polymer consisting substantially of a single type of repeating unit.

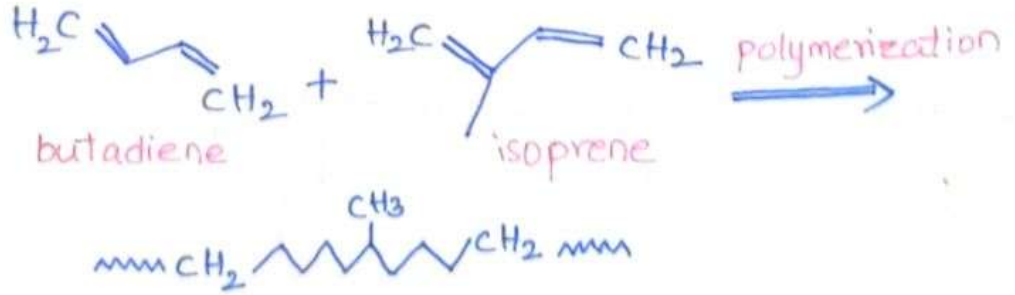
* **copolymer :-**

When two different types of monomers are joined in the same polymer chain, the polymer is called a copolymer.

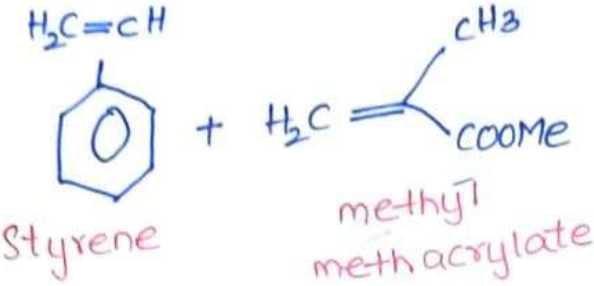
Copolymerization :-

A heteropolymer or copolymer is a polymer derived from two (or more) monomeric species, as opposed to a homopolymer where only one monomer is used.

Copolymers include SBR, styrene-acrylonitrile, and ethylene-vinyl acetate.

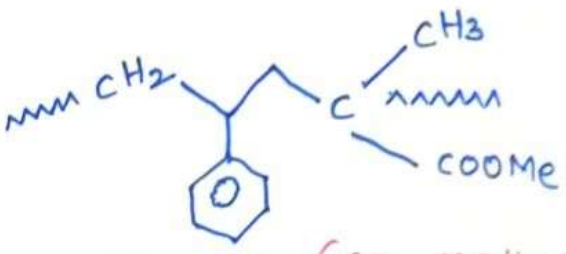
① 

butyl rubber

② 

Styrene

methyl methacrylate



polystyrene (co-methyl methacrylate)

* Mode of polymerisation :-

* Addition polymers :-

The addition polymers are formed by the repeated addition of monomer molecules possessing double or triple bonds,

Ex :- The formation of polythene from ethene and polypropene from propene.

Monomers → polymers

① $CH_2 = CH_2 \longrightarrow \{CH_2-CH_2\}_n$

~~Ethene~~ → polyethylene

② 

Styrene → polystyrene

③ $CH=CH_2$ (CN) $\longrightarrow$ $+CH-CH_2+_n$ (CN)

Cyanoethene — orion

* Many plastics are addition polymers made from hydrocarbon sources.
* The hydrocarbon must be unsaturated in order to polymerize.

* condensation polymers :-
  * The condensation polymers are formed by repeated condensation reaction between two different bi-functional or tri-functional monomeric units.
  * In these polymerisation reactions, the elimination of small molecules such as water, alcohol, hydrogen chloride, etc. take place.
  * The examples are terylene (dacron), nylon 6,6, nylon 6.
* Nylon 6,6 is formed by the condensation of condensation polymers.

* Molecular forces polymers :-

The mechanical properties of polymers are governed by intermolecules forces like vanderwalls and hydrogen bonds present in the polymer, these forces also bind the polymer chains.

Under this category, the polymers are classified into :-

* Elastomers.
* Fibres
* liquid resins
* plastics

* Elastomers :-

→ These are rubber - like solids with elastic properties.

→ In these elastomeric polymers, the polyme chains are random coiled structures, the are held together by the weakest intermolecular forces, so they are highly amorphous polymers.

→ These weak binding forces permit the polymer to be stretched.

Ex:- Buna-S, Buna-N, neoprene etc.,

* Fibres:-

→ If drawn into long filament like material whose length is at least 100 times its diameter, polymers are said to have been converted into 'fibre'.

→ polymeric chains are straight chains polymers, they are held together by the strong intermolecular forces like hydrogen bonding, these strong forces also lead to close packing of chains and thus impart crystalline nature.

Ex:- Nylon 6,6, polyesters (terylene) etc.,

* Liquid Resins:-

→ polymers used as adhesives, potting compound sealants etc. in a liquid form are described liquid resins.

→ Examples are epoxy adhesives and polysulphide sealants.

* plastics :-

→ A polymer is shaped into hard and tough utility articles by the application of heat and pressure; it is used as a 'plastic'.

→ The intermolecular force between polymer chains are intermediate between elastomers and fibres, so they are partially crystalline.

→ Typical examples are polystyrene, PVC and polymethyl methacrylate.

They are two types :-

① Thermo plastic.

② Thermo setting.

* Thermo plastic :-

→ Some polymers soften on heating and can be converted into any shape that they can retain on cooling. The process of heating, reshaping and retainning the same on cooling can be repeated several times.

→ The polymers, that soften on heating and shiffen on cooling, are termed, 'thermo plastics'.

* Thermo setting :-

→ Thermo setting polymers undergo some chemical change on heating and convert themselves into an infusible mass.

→ They are like the yolks of egg, which on heating sets into a mass and once set, cannot be reshaped.

Ex :- Bakelite, urea-formaldelyde resins, etc.,