Polymers Ch-2

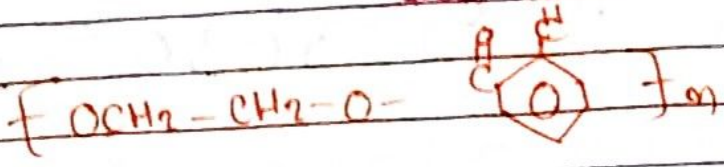
* Poly = many
* Mer = unit

∴ Polymers are high molecular mass substance consisting of large no. of repeating structural unit derivied from simple molecule.

In greek word Poly means many and mer means unit.

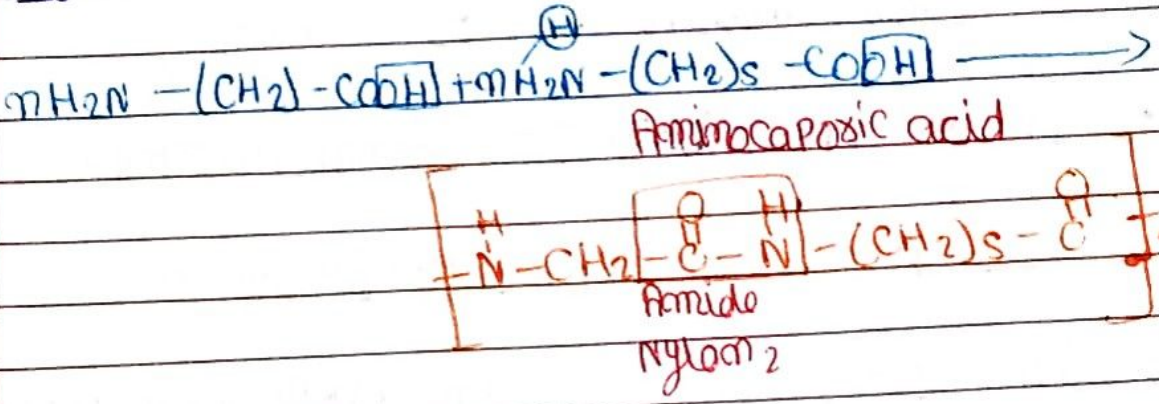
* $CH_2(OH)-CH_2(OH)$ + n  $\xrightarrow{-H_2O}$

Ethane 1,2 diol Benzene 1,2 dicarboxylic acid



* Nylon 2 *

- Its monomer is Glycine and amino Caproic acid
- Its is used in wrapper of Fast food, Seed coating



* Natural Rubber *

Natural rubber has elastic genesly find in India Indonesia, Srilanka and malesiya Neoprene is a example of natural rubber its monomer is 2 Chloro But 1,3 diene or chloroprene It is used in hoses, gaskets

ii) Chain Propagating :- The new and large free radical formed by reaction of ethene again and again.

$$C_6H_5-CH_2-\dot{C}H_2 + CH_2=CH_2 \longrightarrow C_6H_5-CH_2-CH_2-CH_2-\dot{C}H_2$$

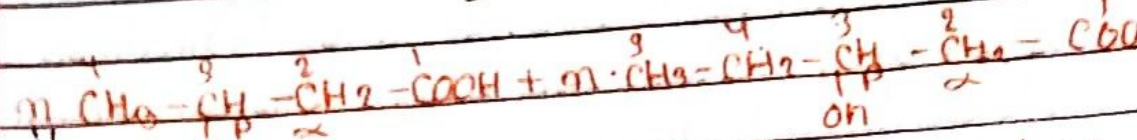
ethene

iii) Chain Terminating :- Ceasing of the free radical Set a terminating step for free radica having a largest chain in its number.

$$C_6H_5-(CH_2-CH_2)_m\dot{} + CH_2=CH_2 \longrightarrow$$

$$C_6H_5(CH_2-CH_2)_m-CH_2-CH_2-(CH_2-CH_2)_n C_6H_5$$

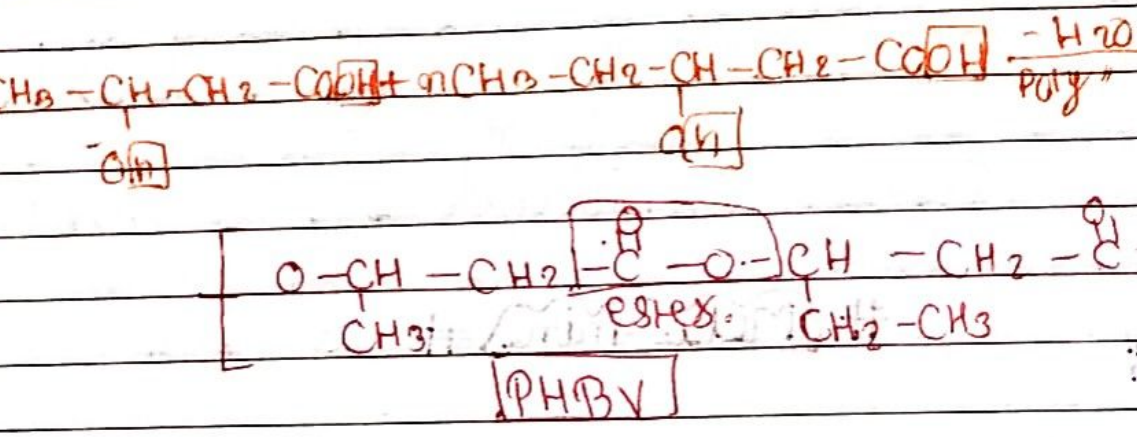
PHBV (Poly β Hydroxy Melanine Butyrate Co-β Hydroxy Valerate



β-Hydroxy Butyrate, 3-Hydroxy Butanoic acid

β-Hydroxy Valerate 3-Hydroxy Pentanoic acid

- Its monomers is 3hydroxy Butanoic acid & 3hydroxy Pentanoic acid.
- It is used in orthoPedic device



PHBV

* Calyptal *

- Its monomer is ethylene glycal (ethane 1,2 diol) and the another name is Benzene 1,2 dicarboxylic acid and (Pthalic acid)
- It is used in belding material (Paint) and Liquor

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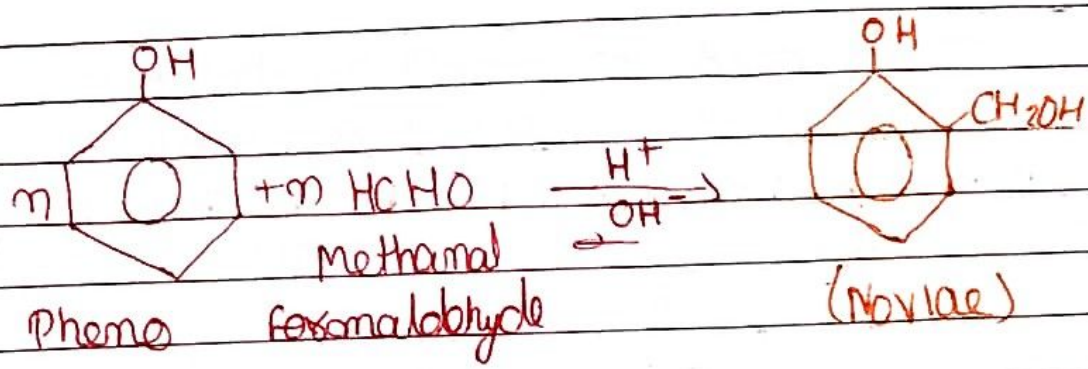
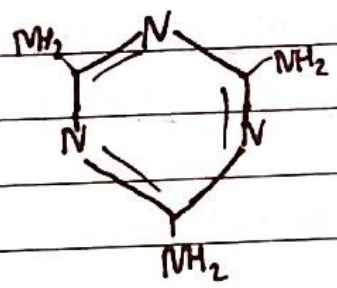
Bakelite

- Its monomer is Phenol and formal aldehyde It form a long chain of Phenol an formal aldehyde which is called novlac. Novlac is used in Paint
- used of Bakelite in electric Suit Ches, CD, electric comb, handle of utensile.



Mela mine

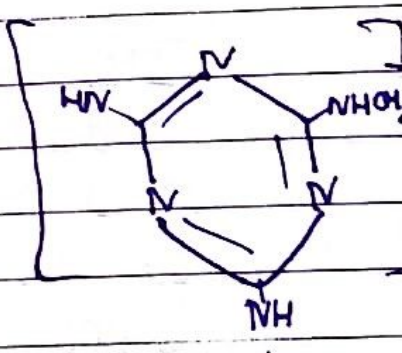
- Its monomer is melamine and formal aldehyde
- Its is used in unbreakable crockery



Melamine

n HCHO

Polymerisation



Melamine

$n\,CH_2=\underset{Cl}{C}-CH=CH_2 \xrightarrow{\text{Polymerisation}} \left[CH_2-\underset{Cl}{C}=CH-CH_2\right]_n$

2Chlom But 1, 3 diene

Neoprene

Vulcanization of Rubber

The process of heating natural rubber with sulphur is called vulcanization of Rubber

for example :- 5% of sulphur used for making tyre rubber while 30% of sulphur used for making battery cases.

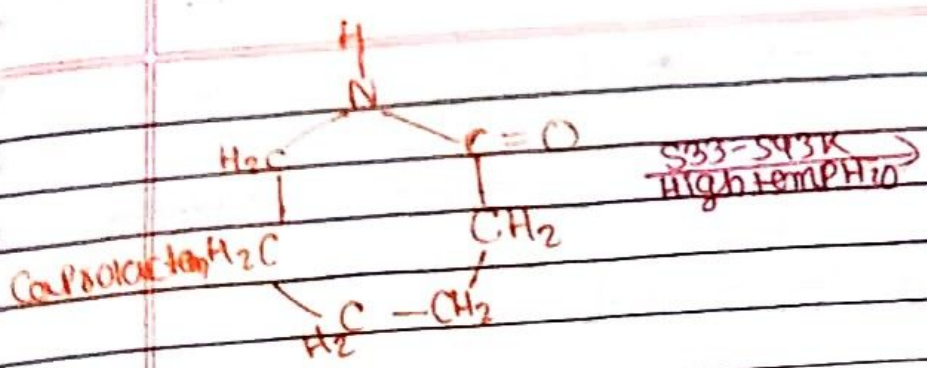
- It is insoluble in common solvent

* Free Radical for Polythene *

① Chain Intaination :- In this process Addition of famile radical formed by Peroxyid to the ethene. ethene duble bond get new large radical and this process is know as Chain Intaination

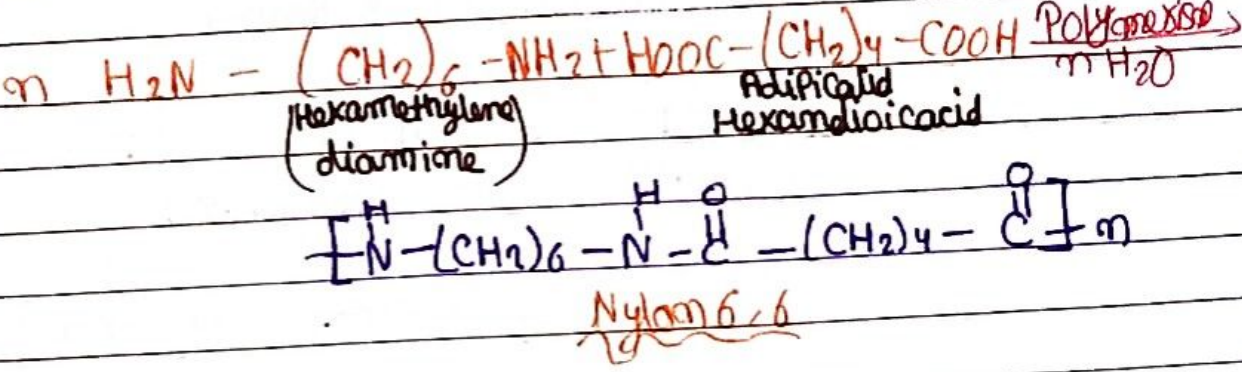
$C_6\dot{H}_5 + CH_2=CH_2 \longrightarrow C_6H_5-CH_2-\dot{C}H_2$

Phenyl radical ethene



Nylon 6,6

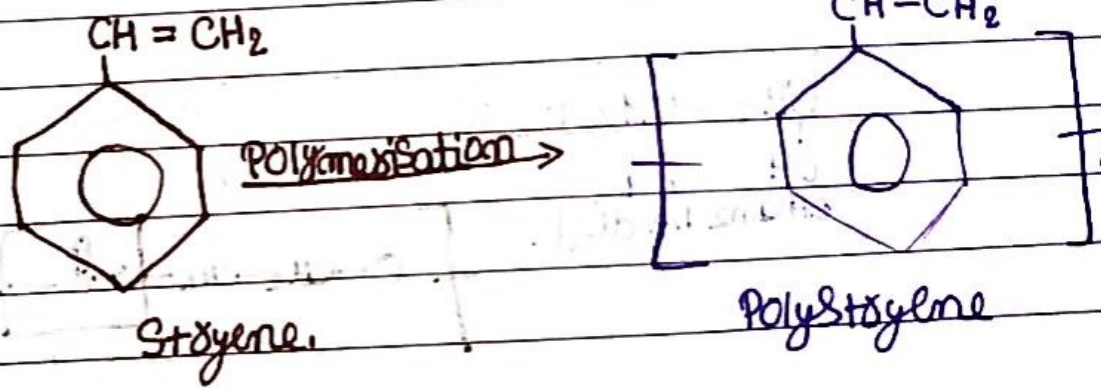
Its monomer is hexamethylene diammaine and Adipic acid. They are the example of Co-Polymer. It is used it base basis of



Polystyrene

⇒ Its monomer is Styrene.

- It is used in covering of floor, Roofing wrapping material, drinking cup



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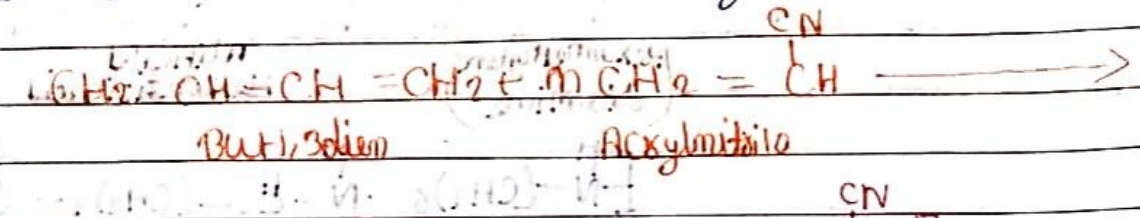
Buna (S)

- Its monomer is But 1,3 diene & Styrene.
- Its is used in oil seal

Buna (N)

- Its monomer is But 1,3 diene & acrylonitrile ($CH_2 = \underset{CN}{\underset{|}{C}}H$)
- It is used in oil thank lining



$$CH_2=CH-CH=CH_2 + CH_2=\underset{CN}{\underset{|}{C}}H \longrightarrow$$

But 1,3 diene — Acrylonitrile

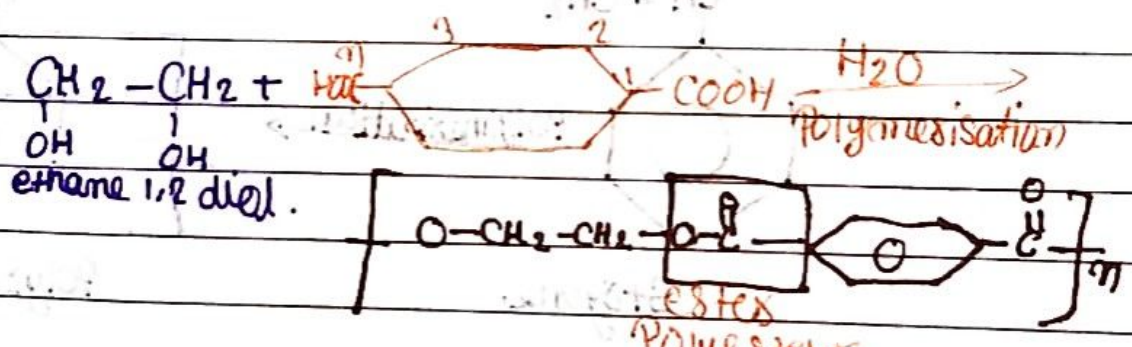
$$\left[CH_2-CH-CH_2-CH_2-\underset{CN}{\underset{|}{C}}H\right]_n$$

Buna (N)

★ Polyesters / Terylene / Dacron ★

- Its monomer is ethylene glycol (ethane 1,2 diol)

And the second monomer is benzene 1,4 dicarboxylic acid. (Terephthalic acid)



$CH_2(OH)-CH_2(OH)$ + Heat + H_2O → Polymerisation

ethane 1,2 diol.

$$\left[O-CH_2-CH_2-O-\overset{O}{\overset{\|}{C}}-C_6H_4-\overset{O}{\overset{\|}{C}}\right]_n$$

Esters

Polyesters.

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Some Important Polymers with there monomers and useded

① Polythene = Monomer = ethene.
use = It is used as carry bags.

$$n\,CH_2=CH_2 \xrightarrow{\text{Polymerisation}} \left[CH_2-CH_2\right]_n$$

ethene → Polythene

Teflon. :-

Its monomer is tetrafluoro ethene It is used Im gasket, Non-Stick Surface Coating, oil seal.

$$n\,CF_2=CF_2 \xrightarrow{\text{Polymerisation}} \left[CF_2-CF_2\right]_n$$

Teflon.

PAN (Polyacrylonitrile)

Its monomer is acrylonitrile in Presence of Per oxide Catalyst in Polymerisis

It is used in making Commercial fiber orlon or Acrilin, making wool

$$n\,CH_2=\underset{\displaystyle CN}{\underset{|}{CH}} \xrightarrow[\text{Peroxide}]{\text{Polymerisation}} \left[CH_2-\underset{\displaystyle CN}{\underset{|}{CH}}\right]_n$$

Acrylonitrile

PVC (Polyvinyl chloride)

Its monomer is vinyl chloride, It is used In making hand bag, electrical gods, water Pipe, raincoat

$$n\,CH_2=\underset{Cl}{CH} \xrightarrow{\text{Polymerisation}} \left[CH_2-\underset{Cl}{CH}\right]_n$$

Polypropene

* Its monomer is Propene. It is used in making fibers, ropes, toys.

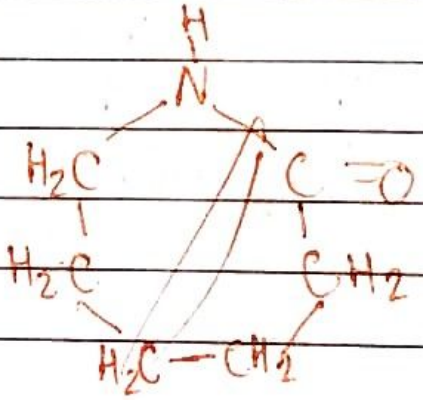
$$n\,CH_3-CH=CH_2 \xrightarrow{\text{Polymerisation}} \left[CH_3-CH-CH_2\right]_n$$

Polypropene

Nylon 6.

⇒ Its monomer is Caprolactum. It is prepared is Presence is water as high temp.

- It is used is making ~~type~~ cord ~~layer~~ code, robes, fabrics. ~~And~~ temp. used here is 533 to 543K which is very high temp.



i) L·D·P :- It is obtained by Polymexisation of ethene

* It is under high Pressure up to [1000 – 2000] atm and the temp. is [350 – 570K]

* The Presence of catalyst is dioxygen (O_2)

* It is a free radical.

* It is highly branch structure and Poor Conductes of electic.

* It is highly flexbile

ex:- Toys, Squeez, bottle, Flexible Pipe

ii) H·D·P :- Its is the monomer of is ethen. It is Prepaired in a Presents of Catalyst Ziegler-Natta Catalyst (TiCl4) and tri ethyl Aluminium

* Its temp. is 333 to 343K

* And the atmosphere is 6 – 7 atm

* It is high density Polythene due to Close Paking

* They are hard and Tofs.

* They are generally bucket, Crutal Pipe, dusthbin, Fizz bottle.

ii) Fibre :- These are the Polemex which have Strong entex molecules fexce b/w Chain. The fexce axe either hydxogen bond ox dipole-dipole entexaction.

Because of Stxong fexce the chain axe closely Packed having high Stxanth and lass elicstic in natuxe. this Polymex have high tencle Stxanth which Saxke malting Point

Ex:- Nylon, texylence, Polyestex, Silk

iii) Thexmoplastic:- These axe Polyemex which can easily soften on heating & haxden on cooling. The entex molecular fexce of attxection is b/w elasteamex ox fibxe

Ex:- PbC, Plgthine, Polystyxene

iv) Thexmo Seting :- These axe the Polymex which undex gess Paxmenent Change on heating they undex gees Cxoss linking 3-D Stxuctu Netwoxk solid. They cannot be xeused. Thexmo Seting is havingly bxanch which and Paxmanent xigid.

x:- Malemine, Becklide

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Classification based on mode of Synthesis

i) Addition Polymers
ii) Condensation Polymers

i) Addition Polymer :- A Polymer formed by addition of repeated monomers without elimination of by Product are called Addition Polymers.

In this type of monomers there are unsaturated bond (double or triple bond)

ex:- Polythine $n CH_2 = CH_2 \xrightarrow{\text{Polymerisation}} [CH_2 - CH_2]_n$

ethene (monomer) → (Polythine)

ii) Condensation Polymer :- These are the Polymers formed by two or more monomers by the elimination of H_2O, OH, NH_3, HCl They are called Condensation Polymers.

ex:- Nylon 6, 6 , Terylene , bakelite

Classification of Polythene on the bases of force

i) L·D·P (Low Density Polythene)
ii) H·D·P (High Density Polythene)

known as Semi-synthetic Polymers.

for example :- Cellulose nitrate, Cellulose acetate, Rayon

Synthetic Polymers

The Polymers which are prepared in lab or industry are said to be Synthetic Polymers or man-made Polymers.

for ex :- PVC (Poly vinyl chloride), Bakelite, Teflon, Melamine

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Classification based on Structure

i) Linear Polymers
ii) Branched Polymers
iii) Cross linked or Network Polymers

i) **Linear Polymers:-** These are the Polymers linked together to form long and linear chain. These Linear Polymers are well Packed and having high density, high tensile Strength, high melting Point

x:- PVC: , HDP:-(Highdensity Polythene), Nylon, Polyesters (Dacron)

ii) **Branched Chain Polymers:-** These are the Polymers in which monomers bind to form long Chain which some branch of different length. These branch Chain are Increase Packed and there fevs they have low tencel Strength, low melting, It is weaker than linear Polymers and Cross linked Polymers

- L.D.P (Low Density Polymers), Glycogen, Starch

Cross linked:- These are the Polymers in this which Unit are Cross linked together to form this 3D Network they are also called 3-D Network Polymers they are hard

Classification of Polymers

They are classified into following ways:-

① classification based on sources
② classification based on molecular force
③ classification based on structure
④ classification based on mode of synthesis

① Classification based on Sources

i) Natural Polymers
ii) Semi - Synthetic Polyme
i) Synthetic Polyme or man-made Polymers

Natural Polymers

The Polymers obtained from Plants and animal or by nature they are said to be natural Polymers.

for ex:- Steach, Cellulose, Natural rubber, Protein Nucleic acid etc.

Semi - Synthetic Polymers

These are the Polymers which obtained from natural occuring Polymers by some chemical & modification is

∴ They contain macrosized molecule which have high molecular mass $10^3 - 10^7$u this is called macromolecule.

∴ The Process by which Simple molecule or monomers are converted into Polymers this Process is known as Polymerisation.

Example :- Polythene

HomoPolymer

A Polymer formed by one type of monomers are called homopolymers.
for ex :- Polyethene

Ethene is the monomers of Polythene

CoPolymers

⇒ The Polymers formed by two or more different monomers are said to be Co-Polymers or mix Polymers.
for ex :- Nylon 6, 6 is used in brush bristle.

x high melting and boling Point because of Network structure.

Ex Bakelite, Melamine, resin

* Classification Based on molecules force *

i) Elastomers
ii) fibre.
iii) Thermoplastic
iv) Thermosetings

i) Elastomers:- These are the polymers in which entes molecules force of attracen b/w the Polymers chain are weakest the are elastic in characters. Just like rubes They are called elastomes.

Because of Presence of weak force they are easly stretched by aPling force and it will come in original form When we remove the stretched.

The most imPortant elastomers is natural rubber

Ex:- Buna (S)
Buna (N)
Neoprene