① Polyethene

$$n(CH_2=CH_2) \xrightarrow{\text{Polymerization}} -(CH_2-CH_2)_n-$$

ethene — polythene

② PVC → Polyvinyl chloride

$$n\ CH_2=\underset{\underset{Cl}{|}}{CH} \xrightarrow{\text{Polymerization}} -\left(CH_2-\underset{\underset{Cl}{|}}{CH}\right)_n-$$

vinyl chloride — polyvinyl chloride

③ PAN → Polyacrylonitrile

$$n\ CH_2=\underset{\underset{CN}{|}}{CH} \xrightarrow{\text{Polymerization}} -\left(CH_2-\underset{\underset{CN}{|}}{CH}\right)_n-$$

Acrylo nitrile — PAN or (orlon)

④ Nylon-6,6 → adipic acid + Hexamethylene diamine

$$NH_2-(CH_2)_6-NH_2 + n\ COOH-(CH_2)_4-COOH$$

↓ Polymerisation

$$-\left(NH-(CH_2)_6-NH-CO-(CH_2)_4-CO\right)_n- + nH_2O$$

Classification of polymers:

A) Based on source of availability
- Natural polymers
  - starch
  - Nucleic acids
  - cellulose
  - Natural rubber
  - Proteins
  - Linen
- Synthetic Polymers
- Semisynthetic Polymers
  - Eg: cellulose diacetate Polymer
  - Vulcanise Rubber

Synthetic Polymers
Eg 1) Polyethylene
2) PVC
3) Nylon
4) Teflon
5) Bakelite
6) Terylene (Dacron)

- Vulcanization :

Natural Rubber + 3-5% sulphur → Cis-1,4-polypropene

Natural Rubber + 20-30% sulphur → Rubber is hard

Natural rubber + 3-10% sulphur → Rubber is little hard

Natural Rubber + 1-3% sulphur → Rubber is very soft

Trade name :- Polycarbonate

Monomer : Bisphenol + phosgene } App : Electrical & telecommunication, hardware, food grade plastic containers.

Dexton : Monomer → [lactic acid + glycolic acid]

a) ON Basis of STRUCTURE

1) Linear P	2) Branched chain P	3) Cross linked or network P
Eg. - High density poly thene (HDP)	Eg - Low density Polythene (LDP)	Eg - Bakelite
- Polyvinyl chloride (PVC)	- Glycogen	- Melamine formaldehyde resins
- Nylons	- starch	
- Polyesters		

c) ON Basis of Molecular FORCES: 1) Elastomers 2) fibres 3) Thermoplastics 4) Thermo setting.

★→ SOME IMP. ADDition Polymers

① LDP: (Low density poly thene)

$$n\,CH_2=CH_2 \xrightarrow[\text{high pressure (1000 - 2000 atm)}]{\text{Peroxide at } 350 - 370K,\ \text{Traces of } O_2} \underset{\text{polythene}}{-(CH_2-CH_2)_n-}$$

② HDP (High density polythene)

$$n\,CH_2=CH_2 \xrightarrow[5-7\ atm]{333-343K} -(CH_2-CH_2)_n-$$

(Zeigler - Natta Catalyst)

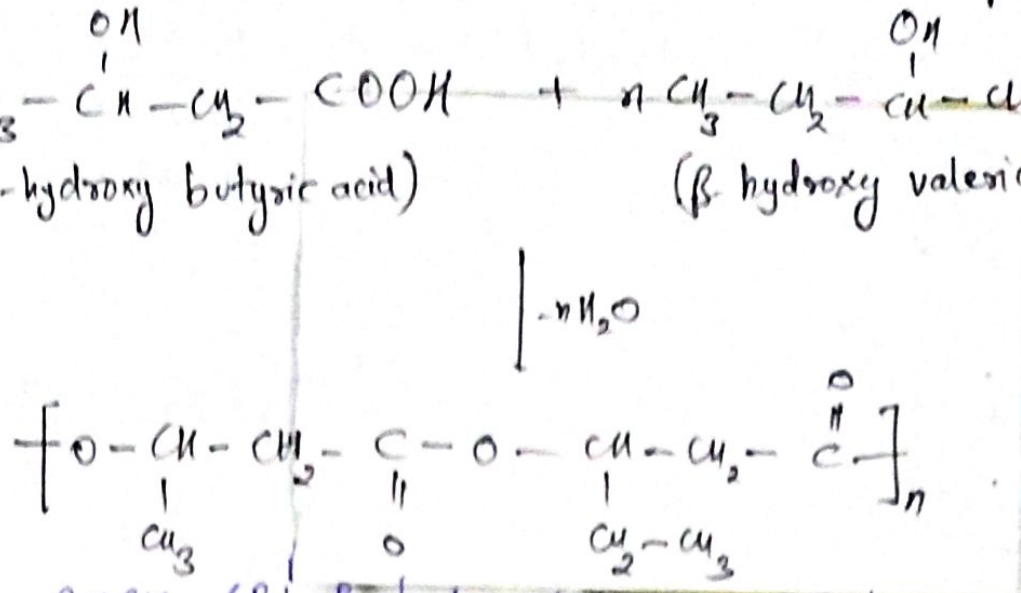
Zeigler - Natta catalyst.
⇓
$Al(C_2H_5)_3 + TiCl_4$

③ Telfon or Polytetrafluro ethylene

$$n\,CF_2=CF_2 \xrightarrow[\text{high pressure}]{\text{catalyst, Heat}} -(CF_2-CF_2)_n-$$

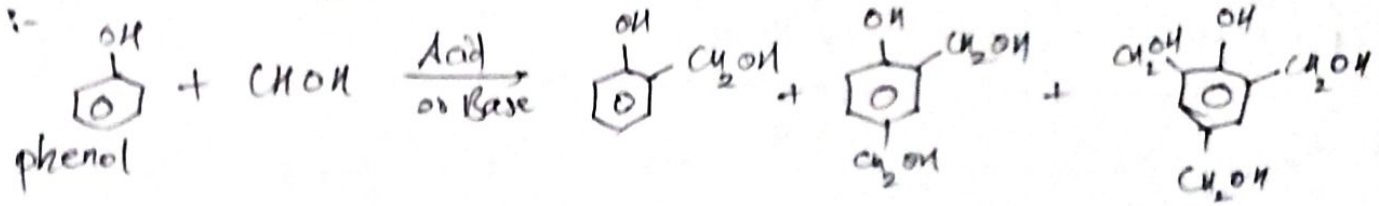
④ PAN or orlon

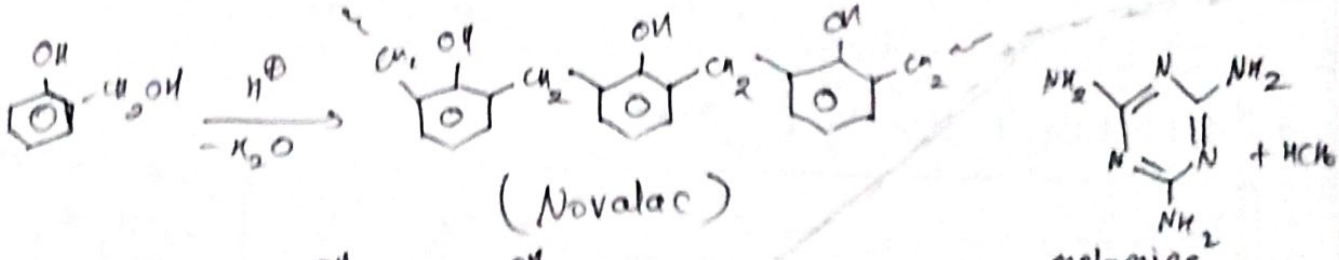
② PHBV : Monomer → (β-hydroxy butanoic acid + 3-hydroxy pentanoic acid)

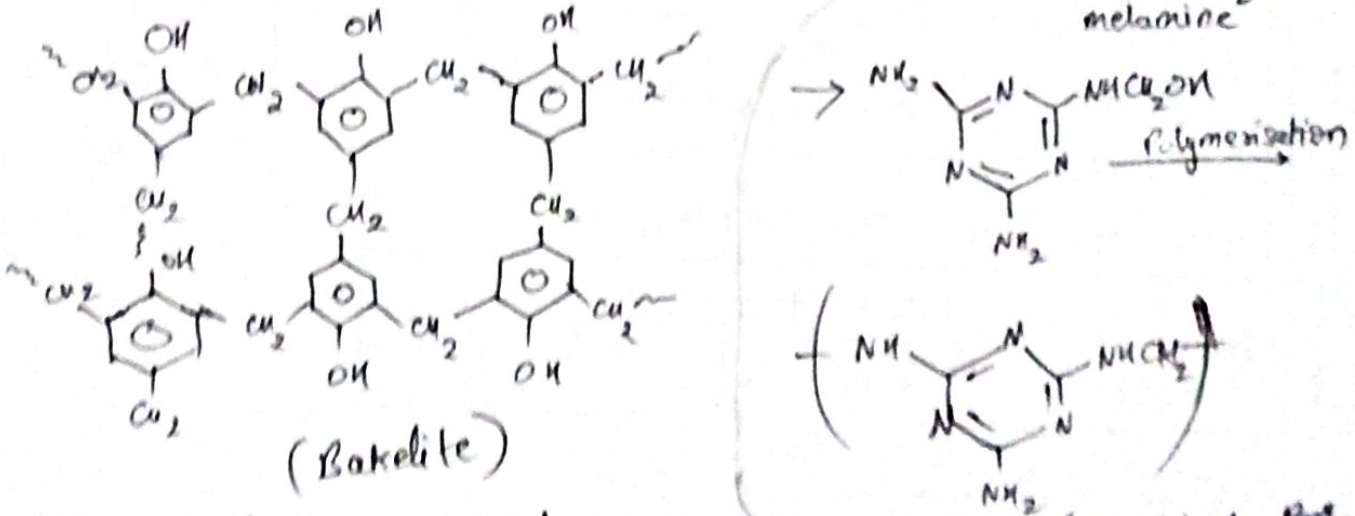


PHBV → (Poly β-hydroxy butyrate-co-β-hydroxy valerate)

Bakelite : formaldehyde + Phenol → Novalac → Bakelite







Other polymers of formaldehyde

a) with Urea (NH_2CONH_2) → Moulded plastic

b) with melamine : formaldehyde + melamine → Monomers $\xrightarrow{H_2O}$ formaldehyde melamine polymer

Condensation Polymers : ① Polyamides ② Polyester ③ Proteins

1) Polyester → Terylene, Glyptal $\left[-\overset{\overset{O}{\|}}{C}-O\right]$

Terylene : Monomer ⟶ (ethylene glycol + terephthalic acid)

$$n\,HO-CH_2-CH_2-OH + n\,H-O-\overset{\overset{O}{\|}}{C}-C_6H_4-\overset{\overset{O}{\|}}{C}-O-H$$

420 - 460 K | $-nH_2O$ ↓ Zinc acetate - antimony trioxide catalyst

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

Glyptal : Monomer ⟶ (ethylene glycol + Phthalic - acid)

$$n\,HO-CH_2-CH_2-OH + C_6H_4(COOH)_2$$

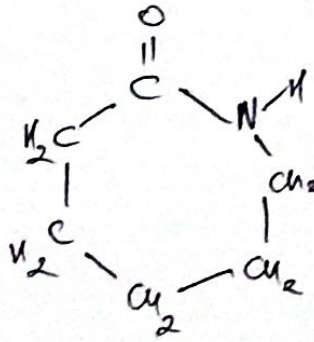
Δ | 533K

$$\left(O-CH_2-CH_2-O-\overset{\overset{O}{\|}}{C}-C_6H_4-\overset{\overset{O}{\|}}{C}\right)_n + H_2O$$

2) Polyamides ⟶ eg. Nylon 6,6 , Nylon-6

Nylon - 6,6 ⟶ Monomer ⟶ (Hexamethyl diammine + Adipic acid)

~~$NH_2-(CH_2)_6-$~~ Nylon - 6 ⇒ Monomer ⟶ ε - caprolactum.

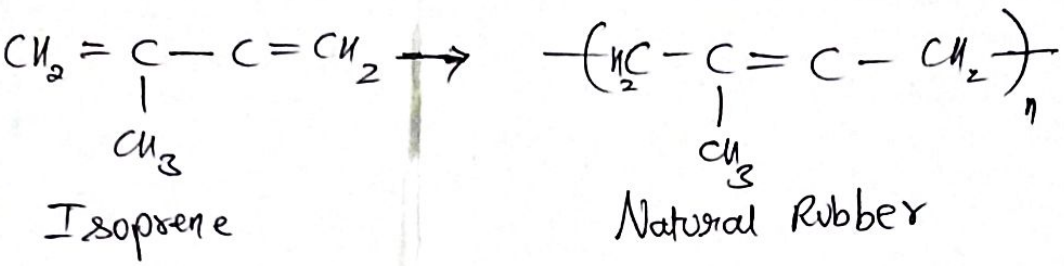


$$\xrightarrow[\text{Heat}]{H_2O} NH_2-(CH_2)_5-COOH \xrightarrow[-H_2O]{\text{Heat}} \left[NH-(CH_2)_5-\overset{\overset{O}{\|}}{C}\right]_n$$

Nylon-6

Natural & Synthetic Rubber

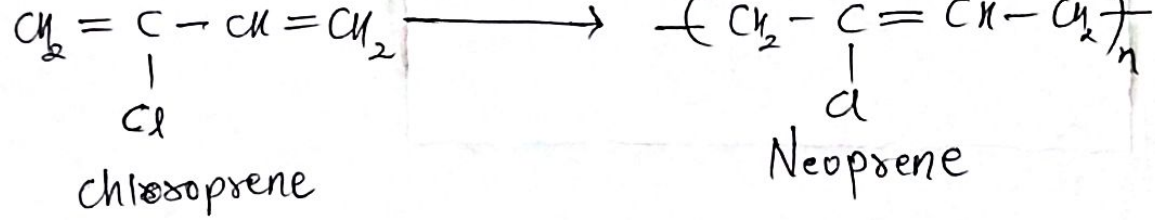
① **Natural Rubber** : Monomer → (2-methyl buta-1, 3-diene) Isoprene



Isoprene — Natural Rubber

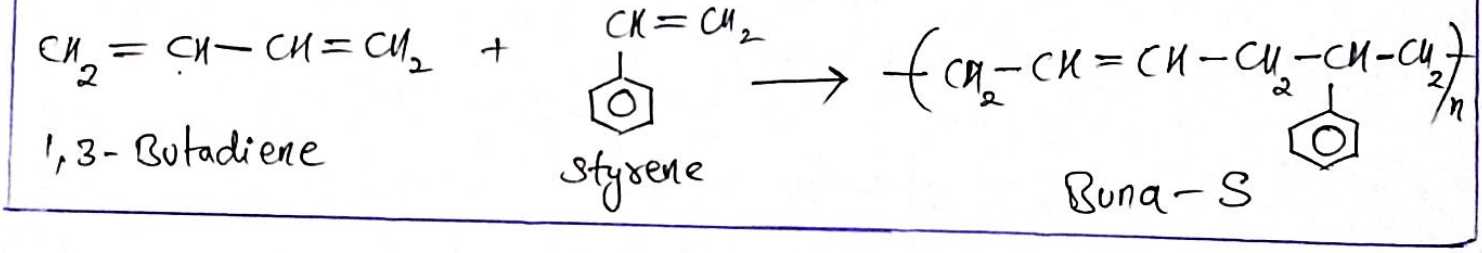
② Synthetic Rubber : Monomer → (2-chloro buta-1, 3-diene) Chloroprene

① Neoprene Rubber



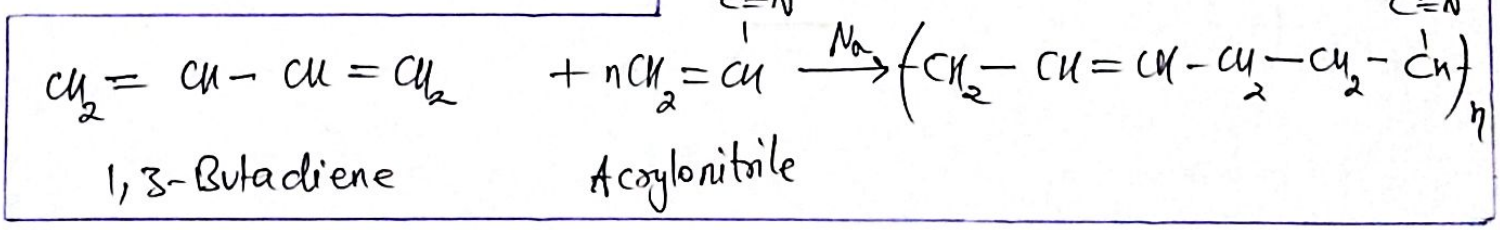
Chloroprene — Neoprene

② **Buna-S / Styrene Butadiene Rubber (SBR)**



1,3-Butadiene + Styrene → Buna-S

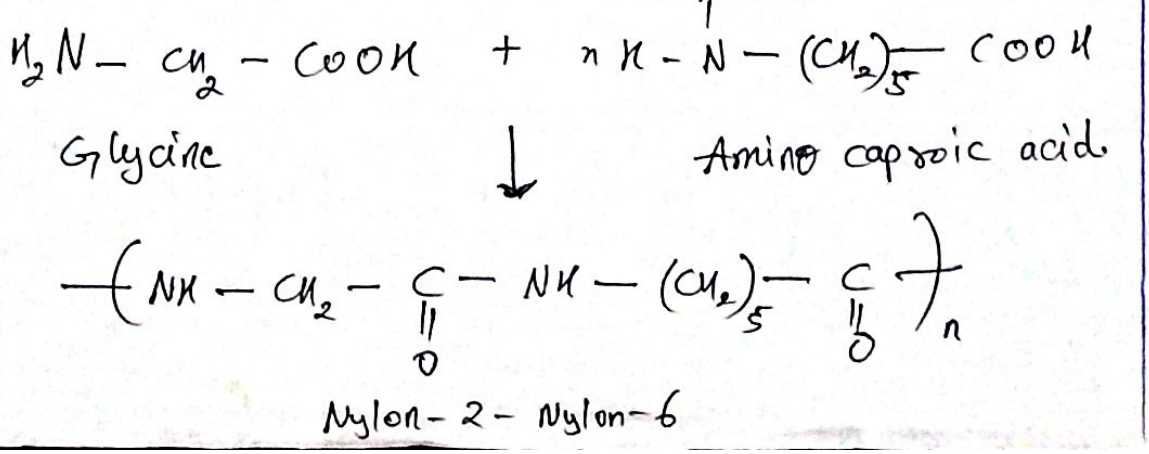
③ **Buna-N**



1,3-Butadiene + Acrylonitrile → Buna-N

Biodegradable Polymers:

① Nylon-2-Nylon-6 : Monomers → [Glycine + Amino caproic acid]



Glycine + Amino caproic acid → Nylon-2-Nylon-6

homopolymers — polythene, PVC, PAN, telfon, etc

Copolymers — Buna-S, Dacron, Nylon-6,6, Bakelite, etc.

Intermolecular forces :-

Thermo setting > Fibre > Thermo plastic > Elastomers

eg Bakelite, melamine,	Polyamide, Polyester, Terylene, Glyptal, Nylon-6, Nylon-6,6	PVC, polythene, Polystyrene, Polyvinyls	Neoprene, Buna-S, Buna-N, Vulconised Rubber

Add^n polymer ⟹ Chain growth polymers
Cond^n polymer ⇒ Step growth "

± PMMA (Poly methyl metacrylate) [Add^n poly] — Trade name: Perspex / acrylic glass

$$n.CH_2=C(CH_3)-C(=O)-O-CH_3 \longrightarrow -[CH_2-C(CH_3)(COOCH_3)]_n-$$

· Applications: lenses, paint, security barriers, LCD screen, shatter resistant glass