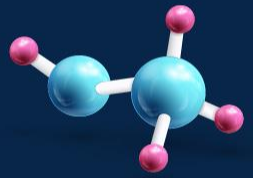
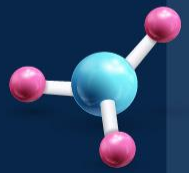
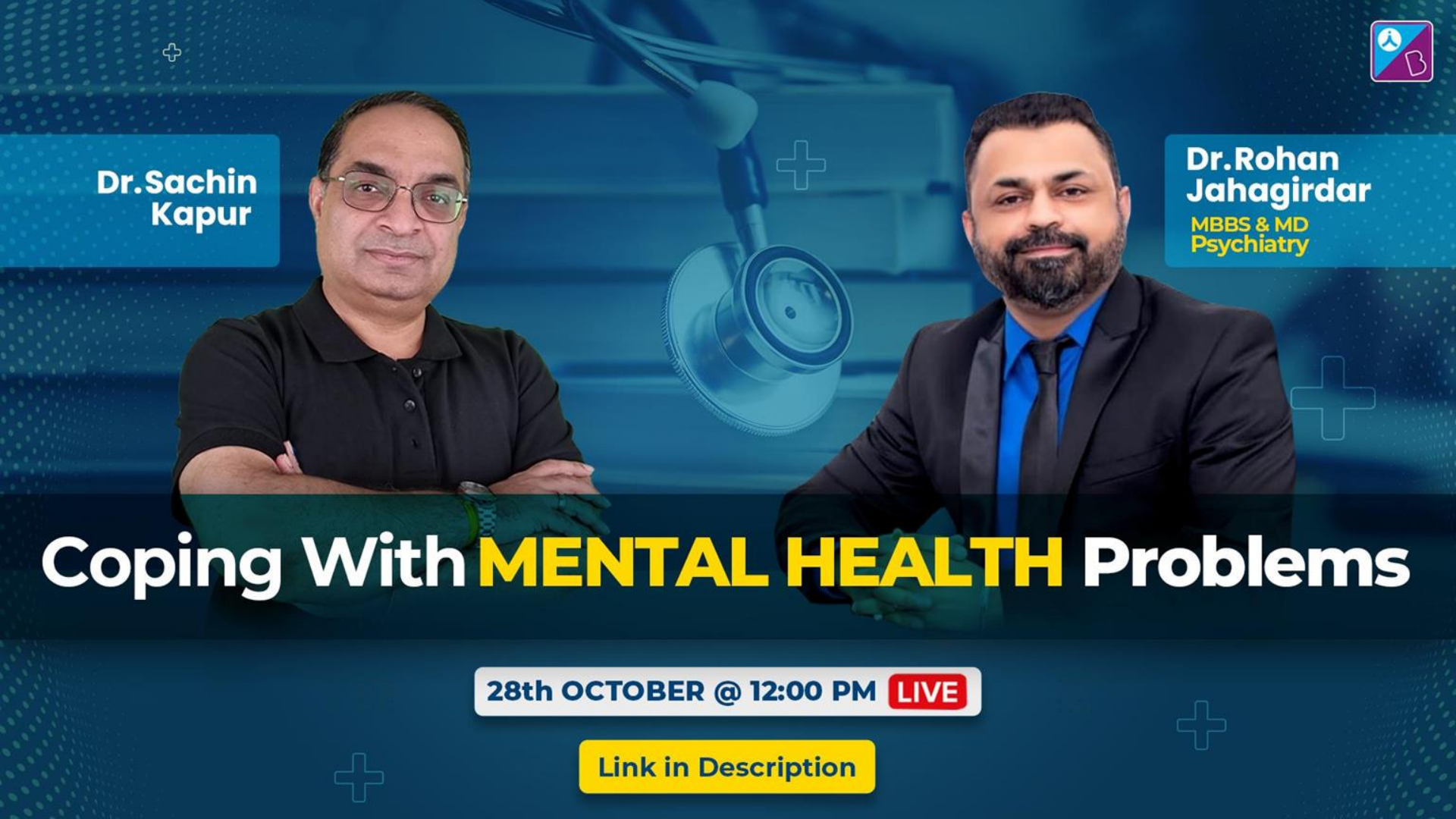
POLYMERS - L1





CHEMISTRY

ANOOP SIR


Dr.Sachin Kapur
Dr.Rohan Jahagirdar
MBBS & MD Psychiatry
Coping With MENTAL HEALTH Problems
28th OCTOBER @ 12:00 PM LIVE
Link in Description

ANTHE

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CHEMISTRY SUPER 30

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FREE

SMART PLAYLIST

FREE NEET RESOURCES

MISSION MBBS 2023 & 2024

- ALL YOUTUBE LECTURES
- ANNOTATED SESSION NOTES
- DAILY PRACTICE QUESTION & ANSWERS

LINK IN DESCRIPTION

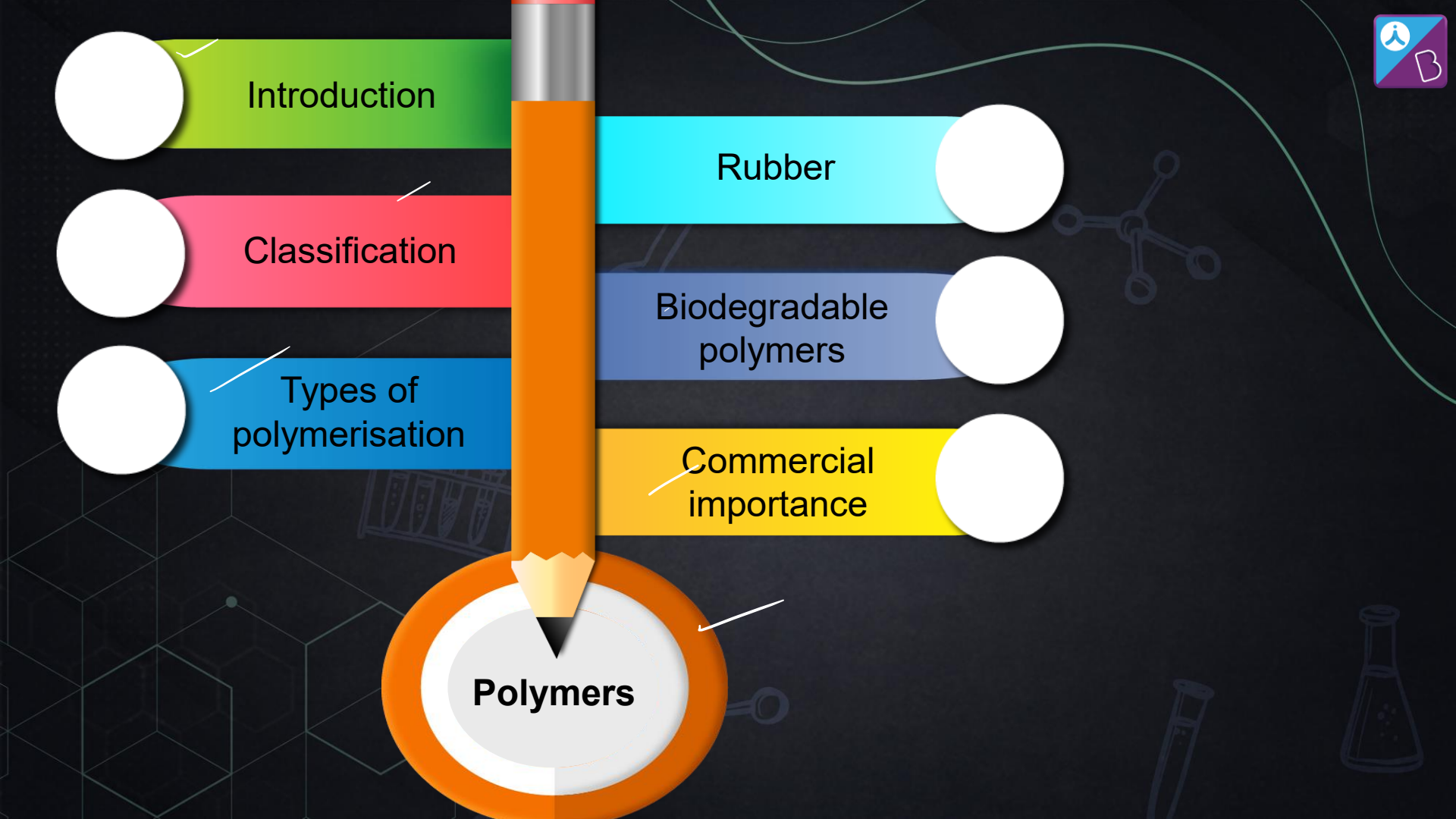
Aakash + BYJU'S

Aakash BYJU'S

NEET STUDENTS' SURVEY

LINK IN DESCRIPTION

https://t.me/neetaakashdigital


Introduction
Classification
Types of polymerisation
Rubber
Biodegradable polymers
Commercial importance
Polymers

Poly + meros → A molecule made up of many identical parts.
many parts

Identical part → Repeating unit

$$\{A-B\}_n$$

The stable molecules which join together to form repeating unit are called 'Monomers'

Polymers in which repeating unit is made of only one monomer are termed Homopolymers

Polymers in which a repeating unit is made by two monomers is termed a 'copolymer'

Source

1) Natural → starch, Glycogen, cellulose → glucose

Proteins

nucleic acids

2. Semisynthetic → Rayon

3. Synthetic → PVC,

Classification based on reaction used to create polymer.

1. Addition reaction → monomer unit has at least one unsaturation
   - → double bond
   - → triple bond
   - → cyclic structure

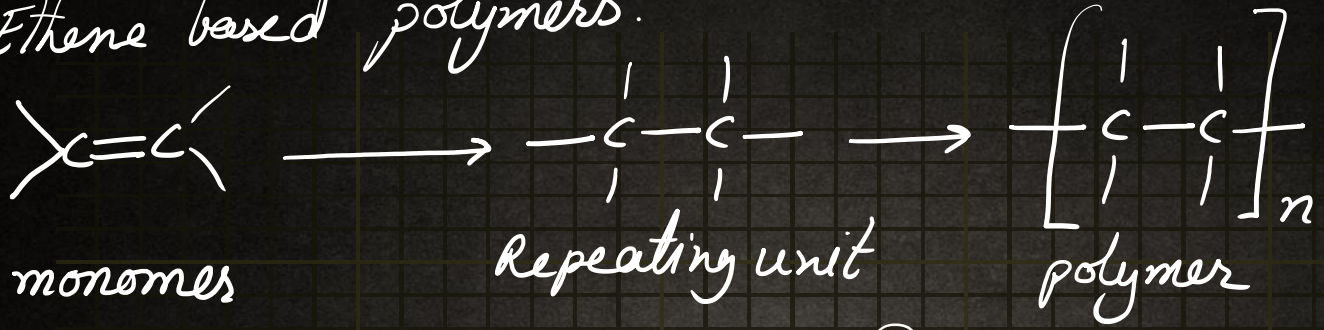
   one unsaturation is lost by each monomer unit

   No molecule is released out

2. Condensation polymer → Condensation reaction
   - → two molecules join together with release of a small molecule.
   - → Step growth polymers.

Addition polymers → chain growth polymers

1. Ethene based polymers.



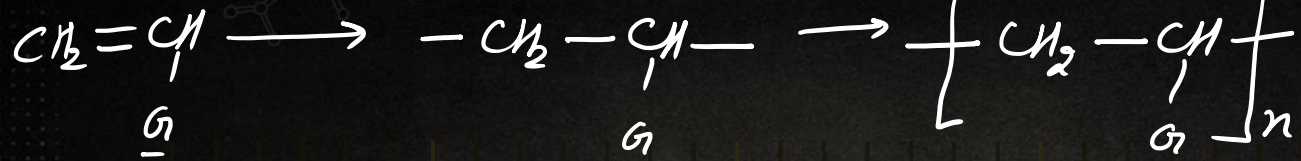
monomer — Repeating unit — polymer

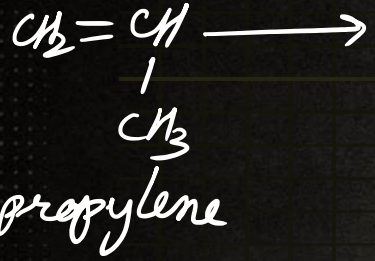
$CH_2=CH_2 \longrightarrow -CH_2-CH_2- \longrightarrow -[CH_2-CH_2]_n-$

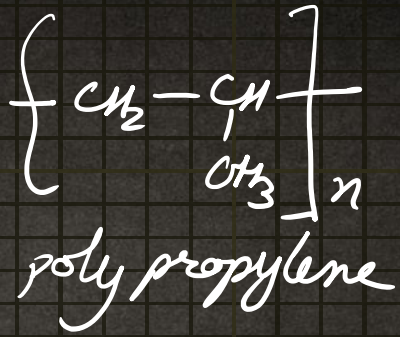
ethene — poly + ethene — poly(ethene)

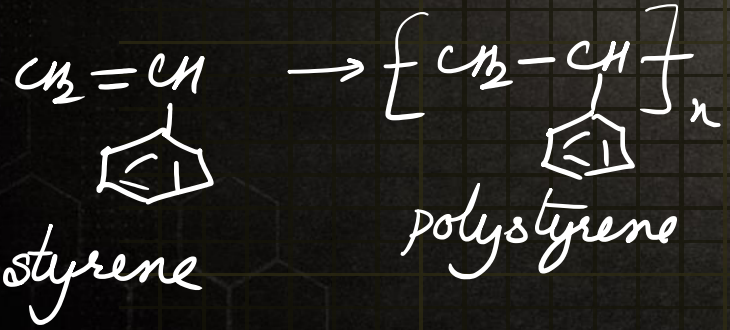
Homopolymer

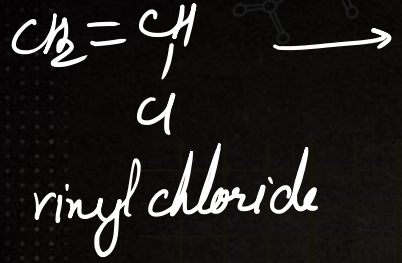
Synthetic


CH2=CH
G
monomer
−CH2−CH−
G
{CH2−CH}n
G


CH2=CH
CH3
propylene


{CH2−CH}n
CH3
polypropylene

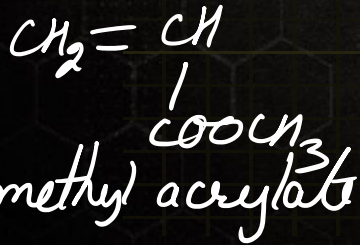

CH2=CH
styrene
{CH2−CH}n
polystyrene



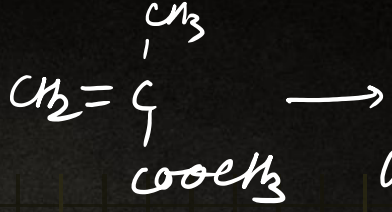
vinyl chloride → polyvinyl chloride PVC

→ acrolein

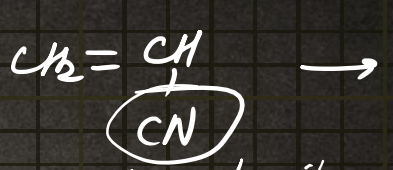
acrylic acid → polyacrylic acid



methyl acrylate

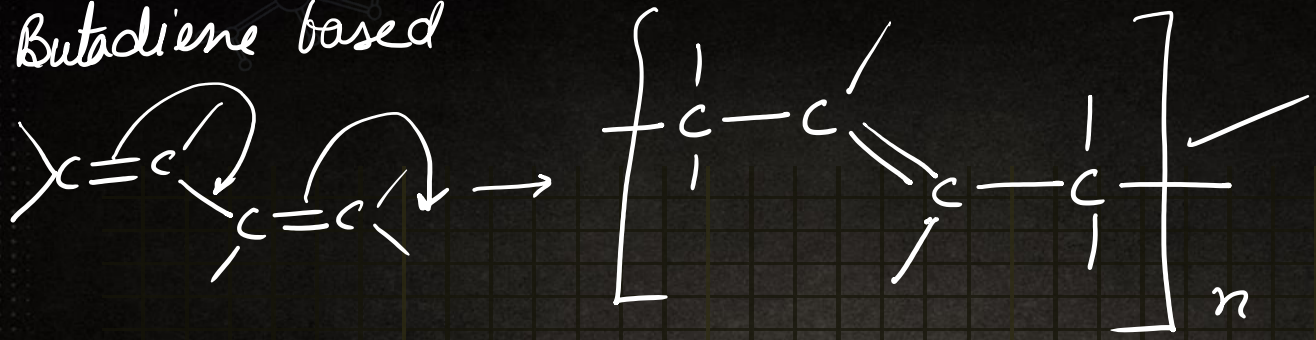


→ polymethyl methacrylate PMMA



acrylonitrile → Polyacrylonitrile PAN

2. Butadiene based

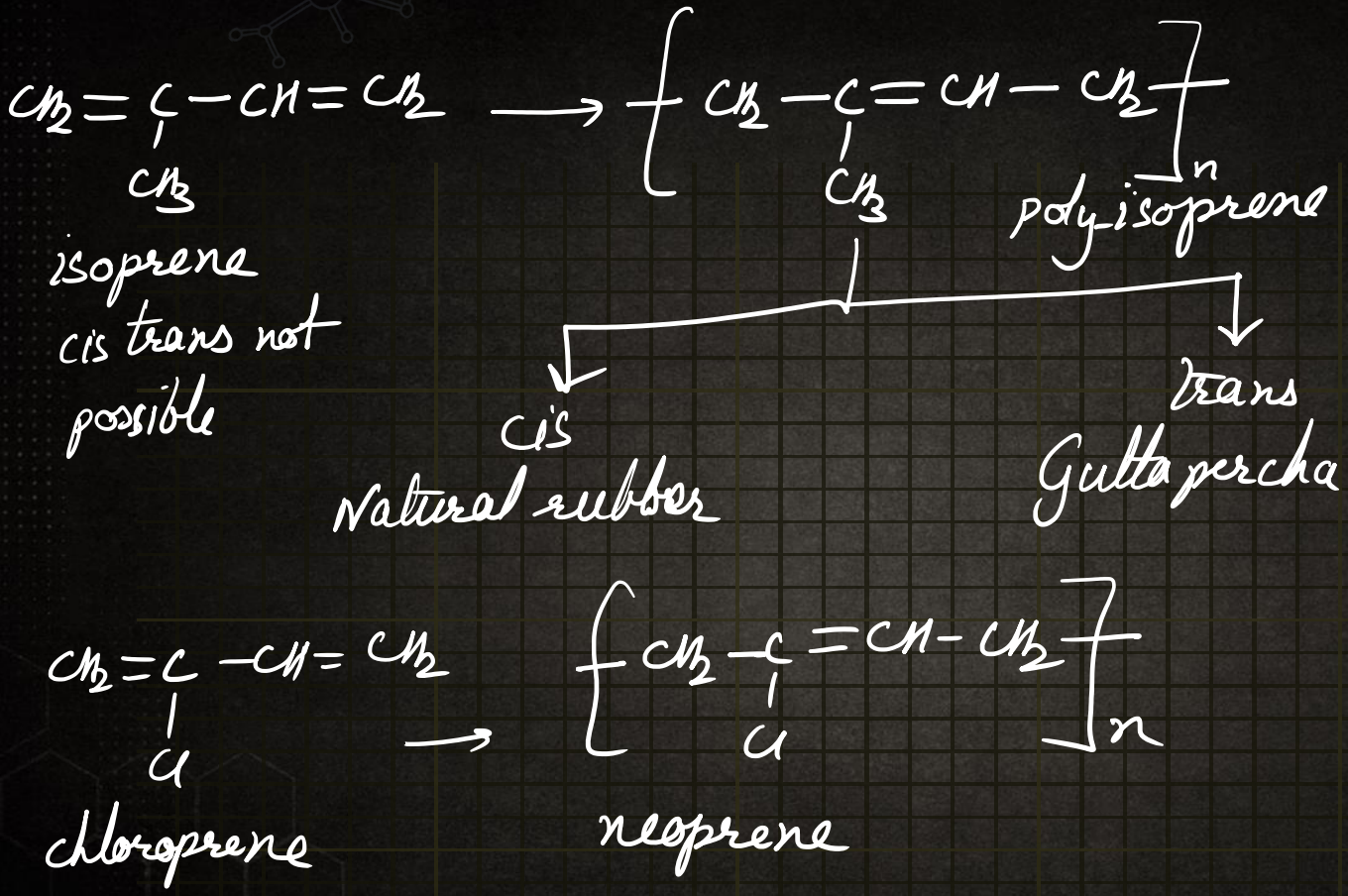


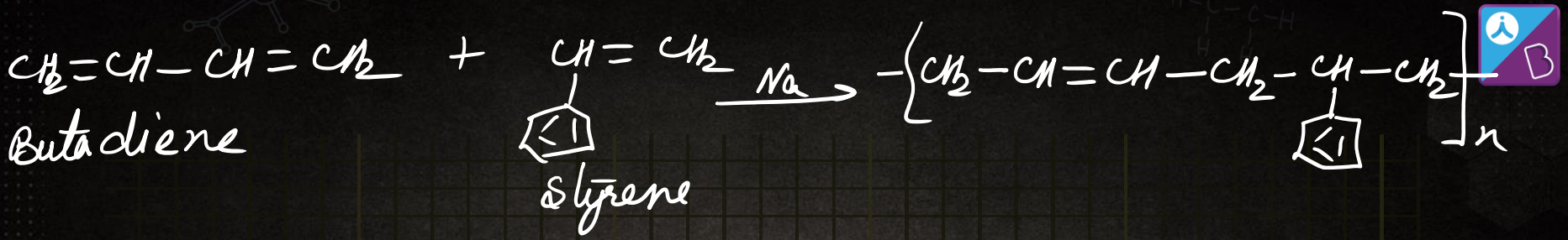
$CF_2 = CF_2$ → $\{CF_2 - CF_2\}_n$

tetra flouroethylene — Poly tetra flouroethylene

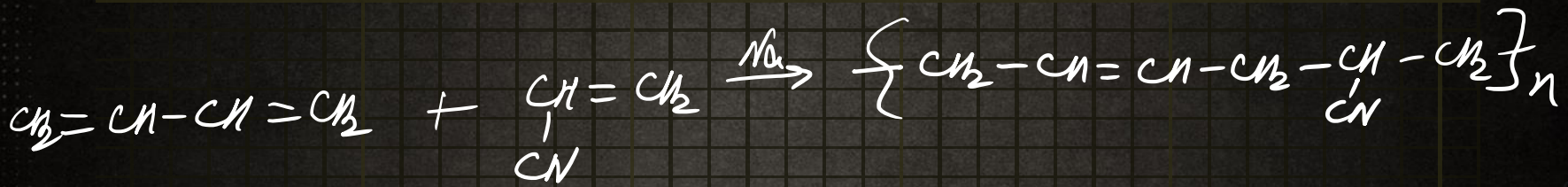
PTFE

Teflon.


CH2=C(CH3)-CH=CH2
isoprene
cis trans not possible
[CH2-C(CH3)=CH-CH2]n
poly-isoprene
cis
Natural rubber
trans
Gutta percha
CH2=C(Cl)-CH=CH2
Chloroprene
[CH2-C(Cl)=CH-CH2]n
neoprene

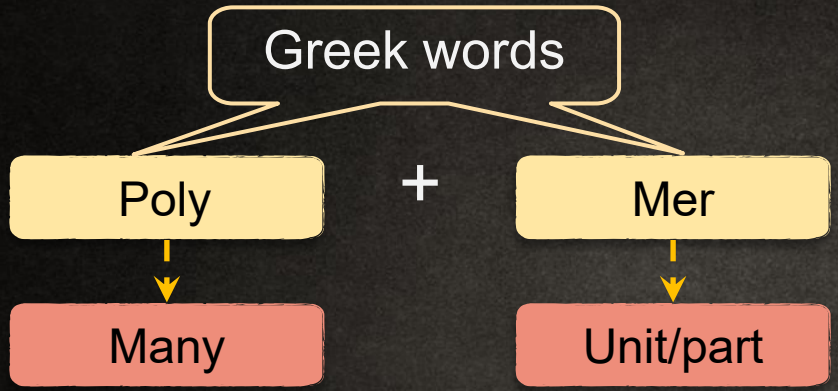


BuNaS



BuNaN

Polymer



Macromolecules

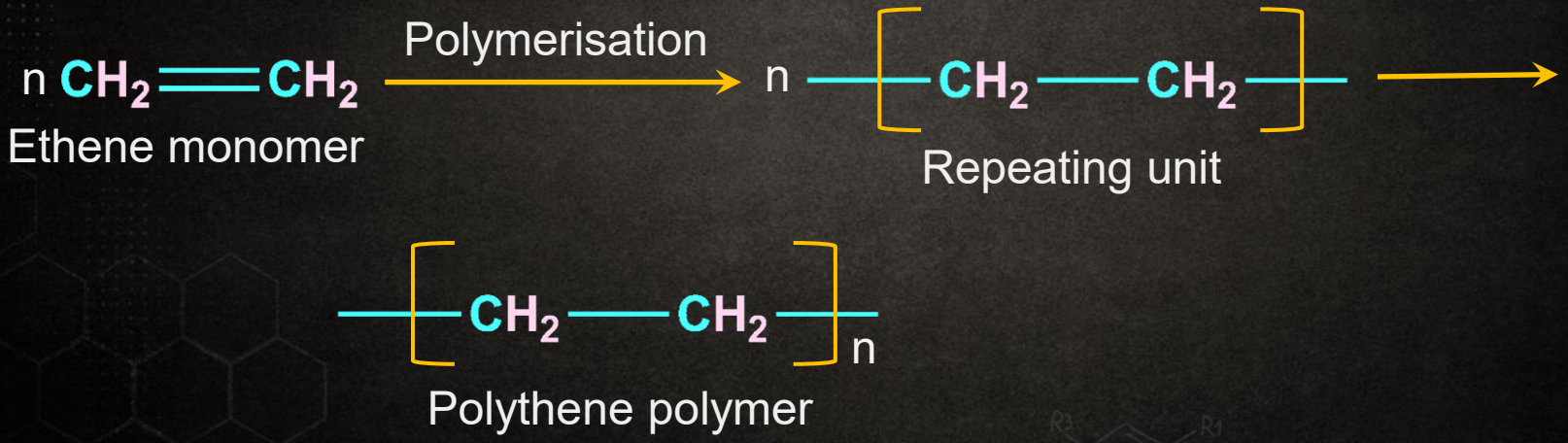
Very large molecules having **high** molecular mass

10^3–10^7 u

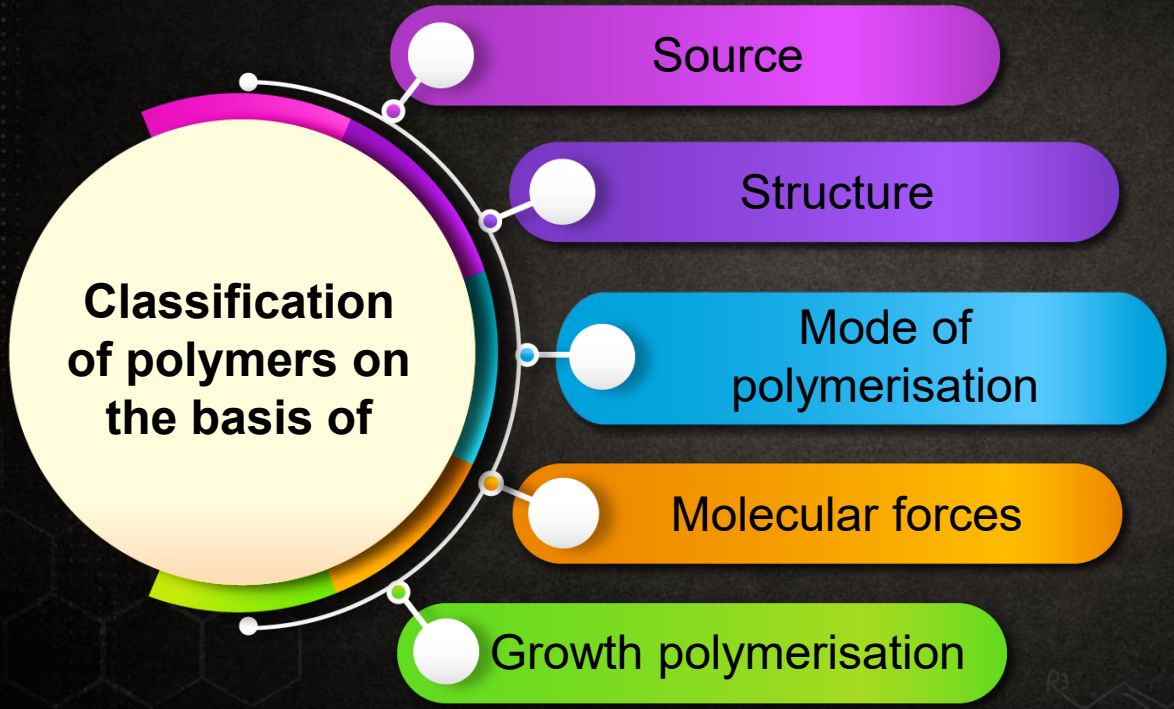
Polymerisation

The process of formation of **polymers** from respective **monomers** that are linked by a **covalent bond**

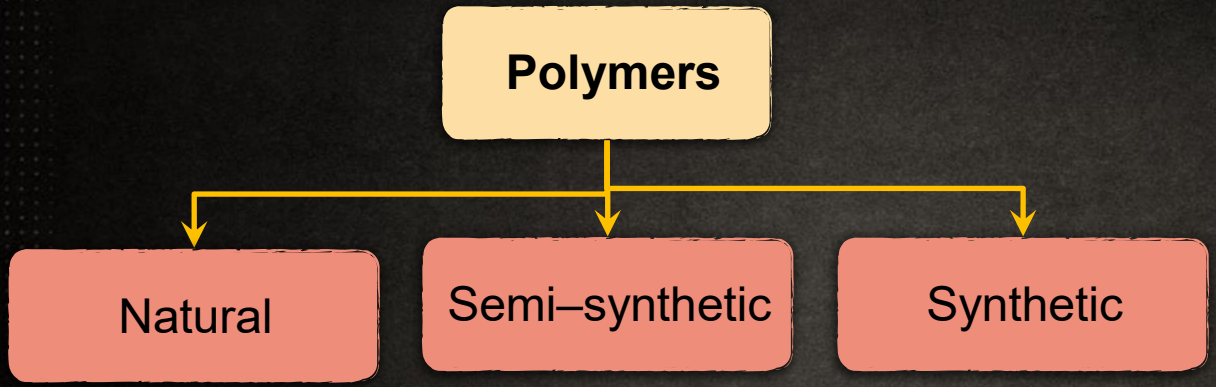
Formation of **polythene** from **ethene**



Classification of Polymers



Classification Based on Source



Natural Polymers

Polymers that are derived from **plants** and **animals**

Proteins, **cellulose**, **starch**, **natural rubber,** and more

Semi–Synthetic Polymers

Polymers that are derived from both **petroleum** and **natural products**

Rayon, **cellulose nitrate**, and more

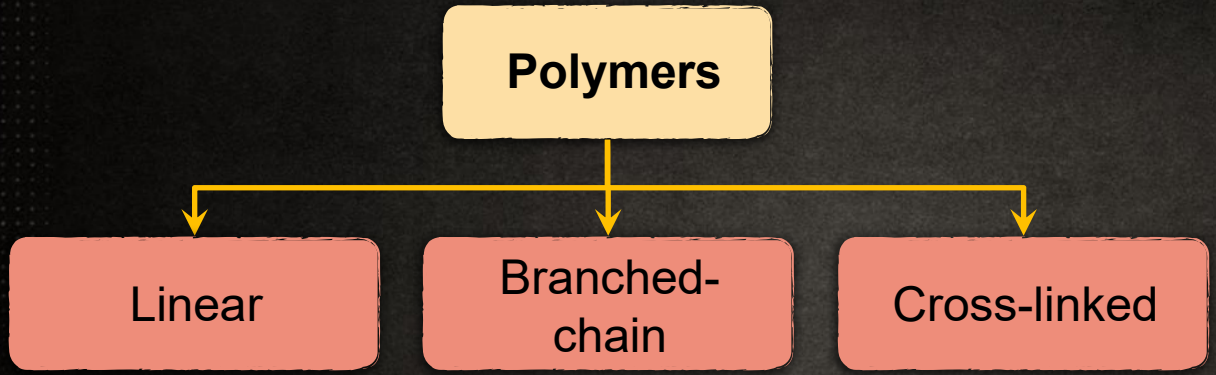
Cellulose acetate

Synthetic Polymers

Polymers that are **man–made** or derived from **petroleum oil**

- Plastic → **Polythene**
- Synthetic fibre → **Nylon 6,6**
- Synthetic rubber → **Buna–S**

Classification Based on Structure



Linear Polymers

Examples: High density **polythene**, **polyvinyl chloride** (PVC), and more

Polymer consisting of **long** and **straight chains**

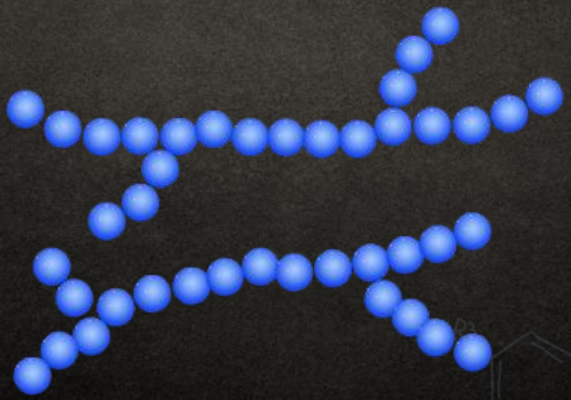
Represented as

Branched-Chain Polymers

Examples: Low density **polythene, polypropylene**, and more

Polymer consisting of **linear chains** having some **branches**

Represented as



Cross-Linked or Network Polymers

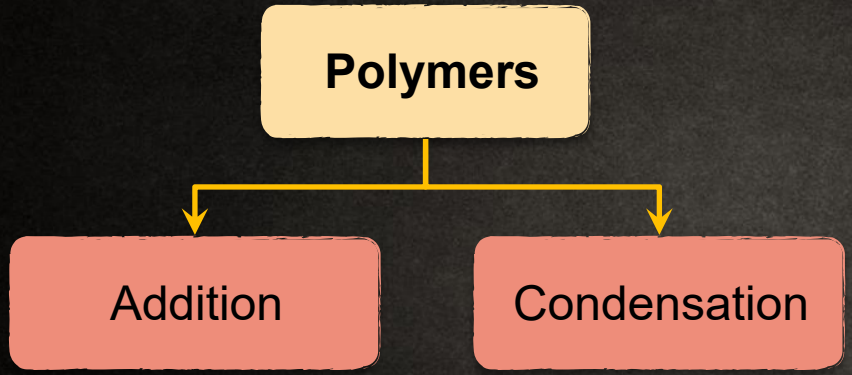
Examples: **Bakelite, melamine**, and more

They are formed from **bifunctional** and **trifunctional** monomers.

They contain **strong covalent bonds** between various linear chains.

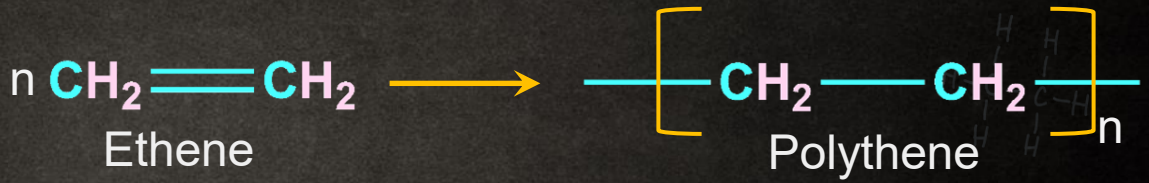
Represented as

Classification Based on Mode of Polymerisation



Addition Polymers

Formation of **polythene** from **ethene**



They are formed by **repeated** addition of **monomers** possessing **double** or **triple** bonds.

Propyne

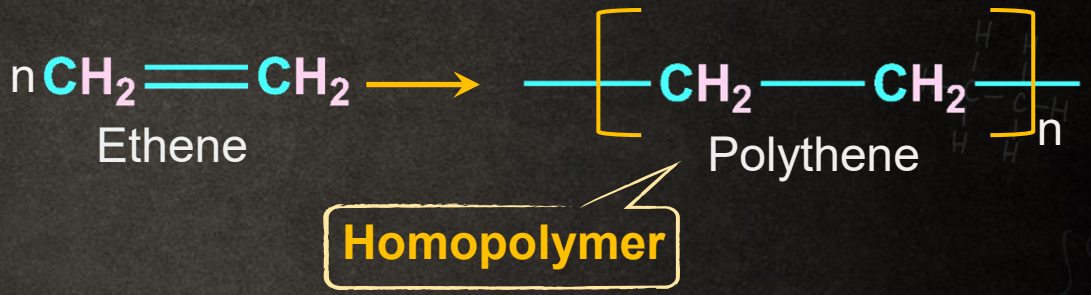
Ethene

Homopolymer

An addition polymer formed by the **polymerisation** of only **single monomeric** species

Homopolymer

Formation of **polythene** from **ethene**



Copolymers

Addition polymers formed by **polymerisation** of **two different** monomers

Copolymers

Examples: Buna-S, Buna-N, and more

Buna-S

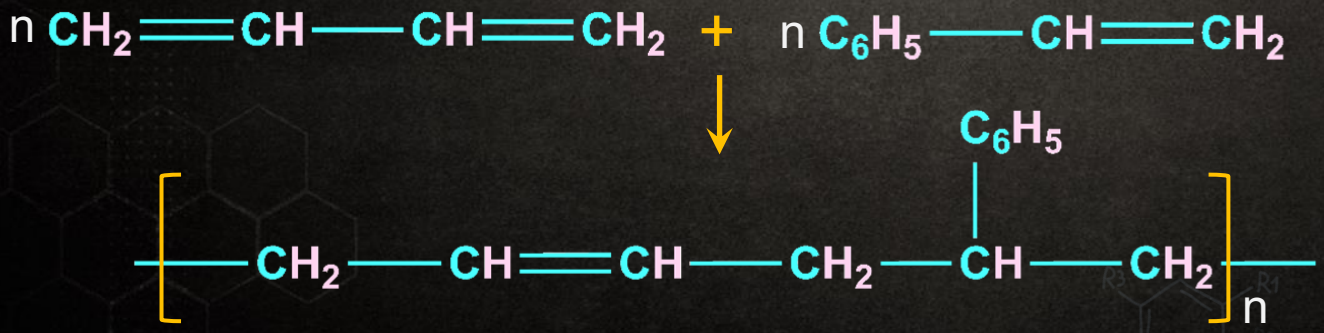
Catalyst: **Na**

Buna-S

1,3-Butadiene

Styrene

Reaction



Butadiene-styrene copolymer (**Buna-S**)

Buna-N

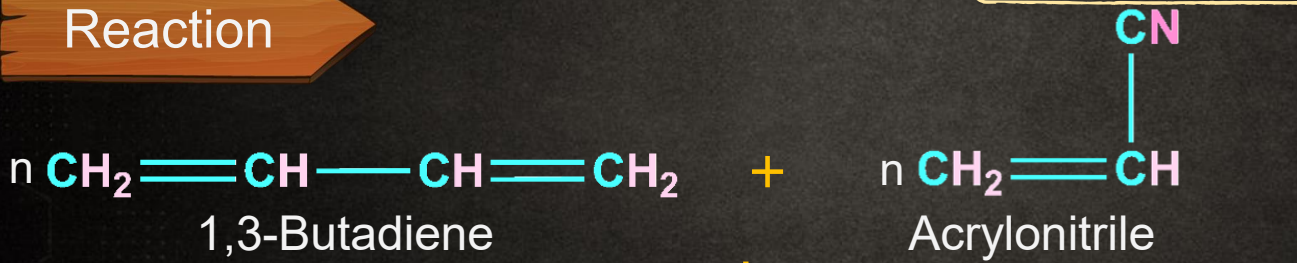
Catalyst: **Na**

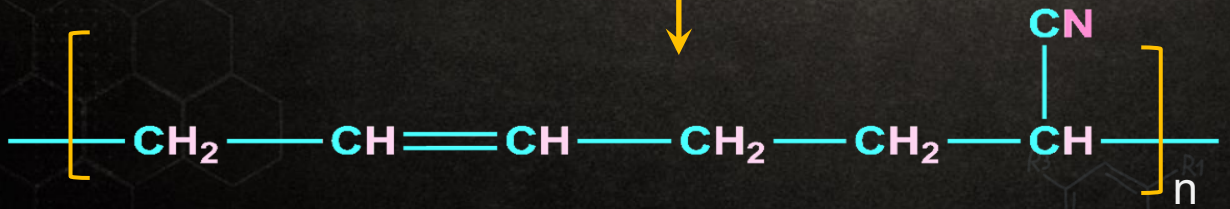
Buna-N

1,3-Butadiene

Acrylonitrile

Reaction





Buna-N

Condensation Polymers

They are formed by **repeated condensation** reactions between two different **bifunctional** or **trifunctional** monomeric units.

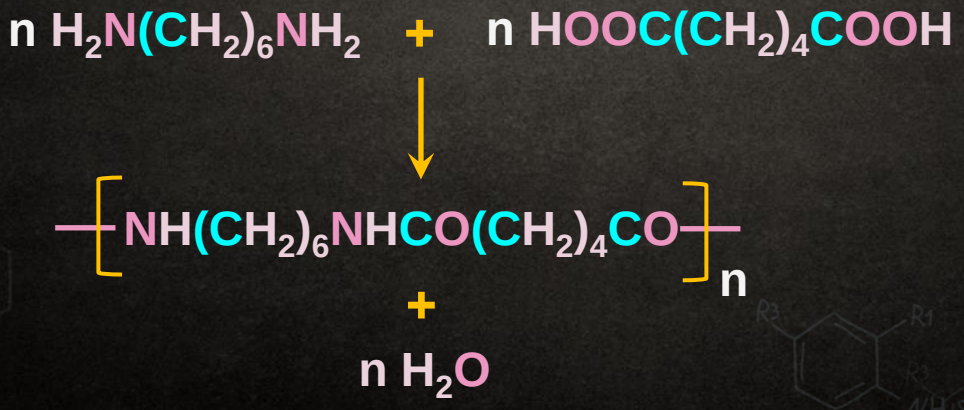
Condensation Polymers

EXAMPLE

Nylon 6,6

Hexamethylene diamine

Adipic acid



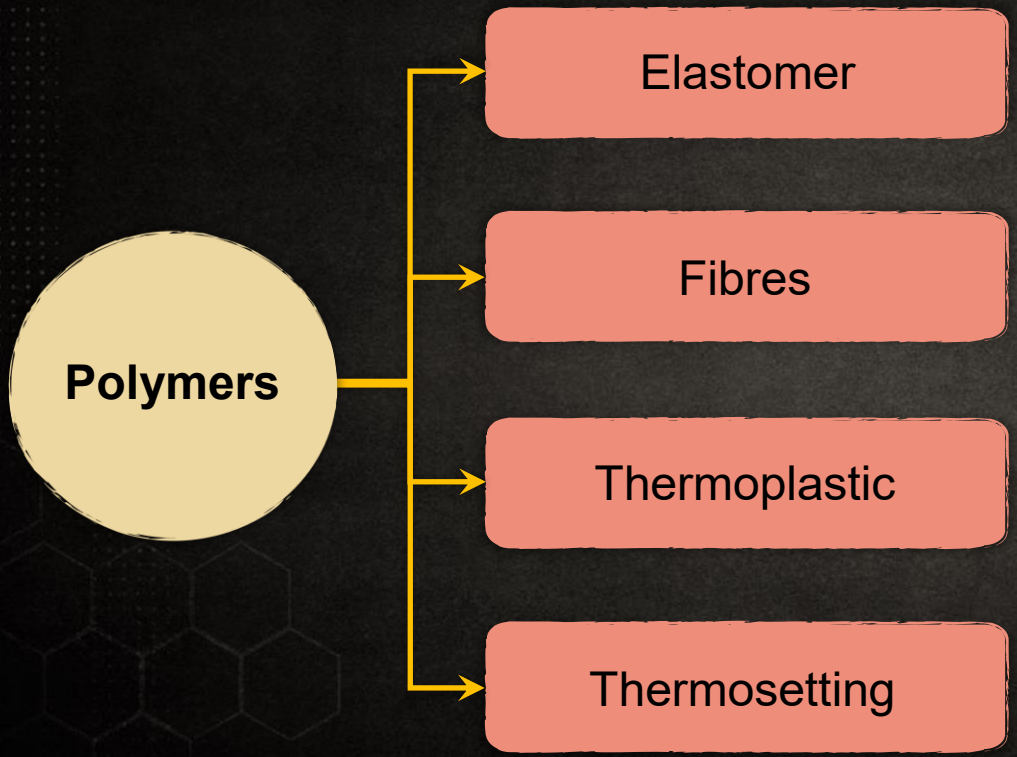
Classification Based on Molecular Forces

The mechanical properties of polymer like **tensile strength, elasticity, toughness**, and more are governed by

Intermolecular forces such as **van der Waals forces** and **hydrogen bonds**

Binds the **polymer chain**

Classification Based on Intermolecular Forces



Elastomers

The polymer chains are held together by the **weakest intermolecular forces**.

Permit **stretching**

This forms a few **cross-links** between the chains that help the polymer to **retract** to its **original position** after the **force** is released.

Buna-S, Buna-N, neoprene and more

Synthetic rubber

Fibres

They are thread-forming **solids** that possess **high tensile strength** and **modulus.**

Hydrogen bonds

Strong intermolecular forces present

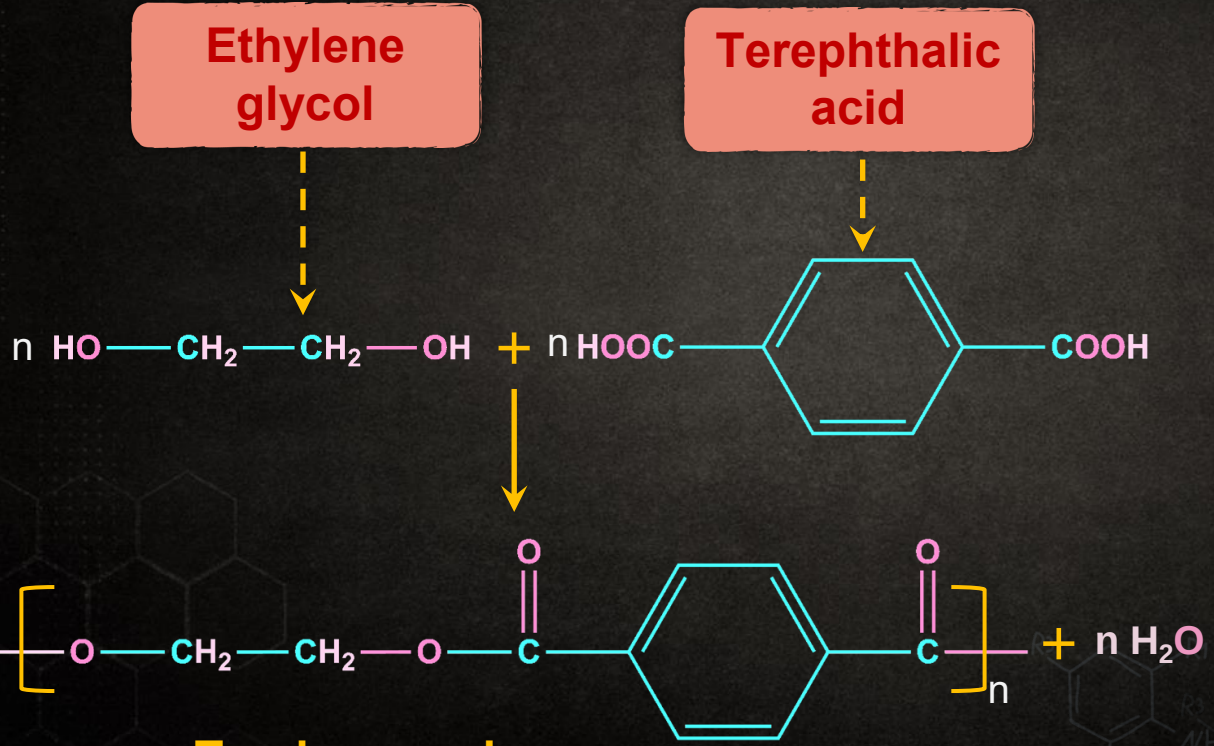
Nylon 6,6, terylene, and more

Terylene

Monomers

Ethylene glycol

Terephthalic acid



Terylene or dacron

Which of the following organic compounds polymerises to form the polyester Dacron?

NEET 2014

a. Propylene and para HO——(C_6H_4)——OH

b. Benzoic acid and ethanol

c. Terephthalic acid and ethylene glycol

d. Benzoic acid and para HO——(C_6H_4)——OH

Thermoplastic Polymers

Linear or **slightly branched** long-chain molecules

Capable of repeatedly being **soft** on **heating** and **hard** on **cooling**

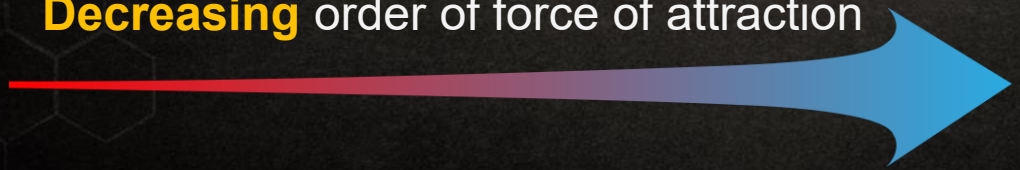
Polythene, polystyrene, polyvinyl chloride (PVC), and more

NOTE

In **thermoplastics**, the intermolecular forces of attraction are **intermediate** between **elastomers** and **fibres.**

Fibres > **Thermoplastics** > **Elastomers**

Decreasing order of force of attraction



Thermosetting Polymers

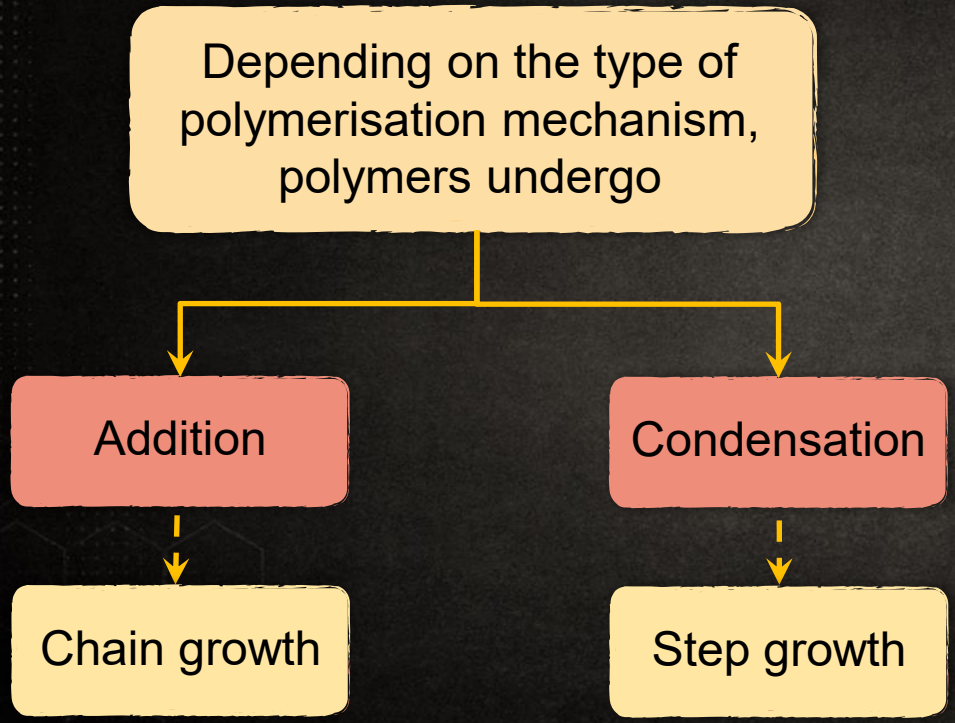
They are **cross-linked** or **heavily branched** polymers.

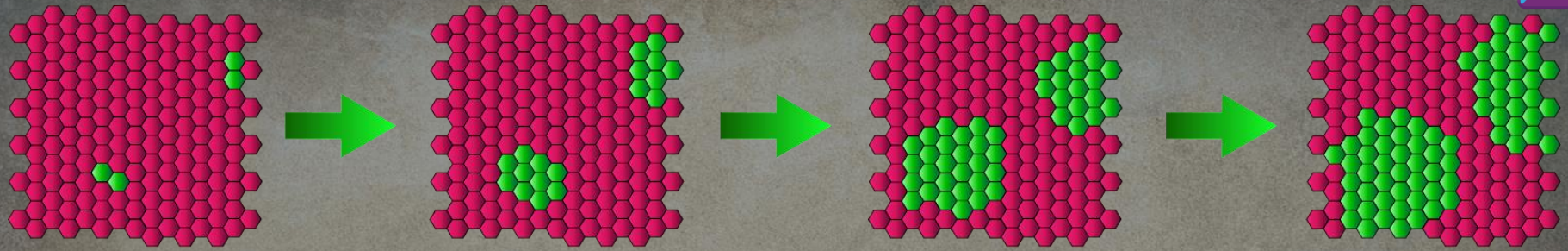
On heating, they undergo **extensive cross-linking** in moulds and they again become **infusible**.

Cannot be used

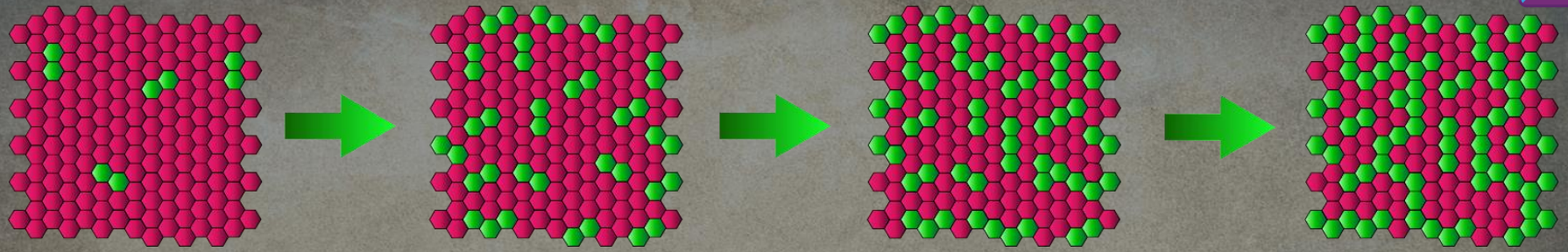
Bakelite, urea-formaldehyde resins, and more

Growth Polymerisation



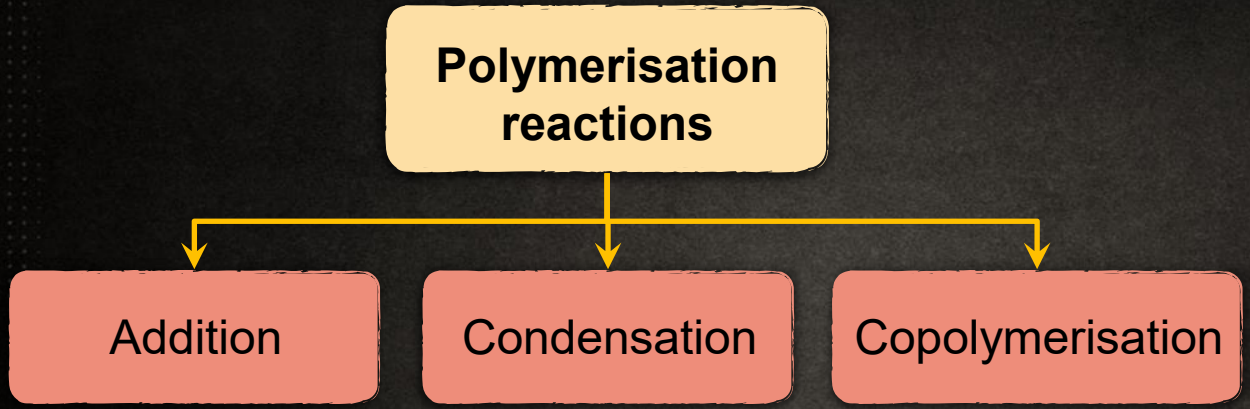


Chain Growth



Step Growth

Types of Polymerisation Reactions

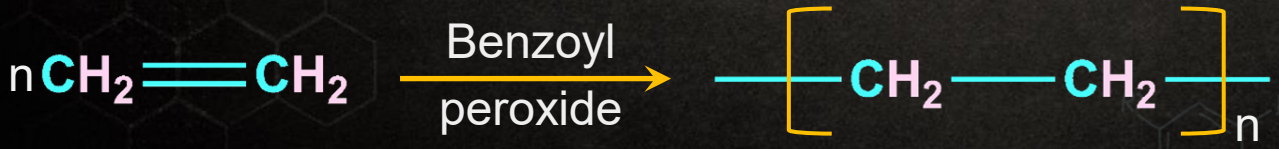


Addition Polymerisation

The molecules of same **monomer** or **different monomers** add together

This mode leads to an **increase** in the chain length.

Polymerisation of **ethene** to **polythene**



NOTE

Generally, in addition polymerisation, an **increase in chain** length is **governed** by **free radical mechanism**.

Mechanism of
Addition Polymerisation

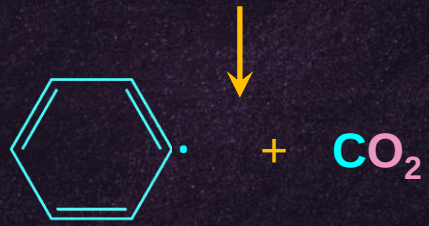
Steps Involved in Addition Polymerisation

Step 1	Chain initiation
Step 2	Chain propagation
Step 3	Chain termination

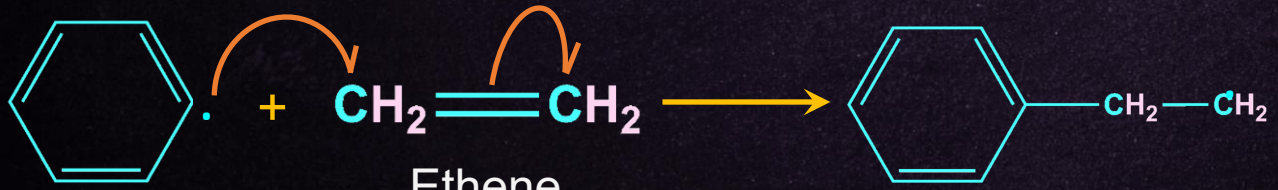
Chain Initiation

Benzoyl peroxide

Chain initiator

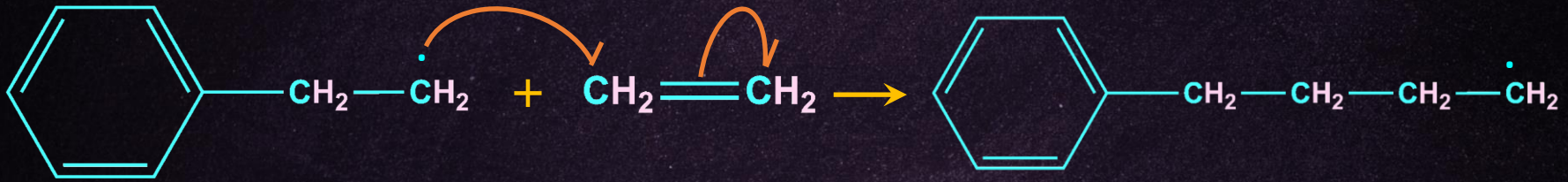


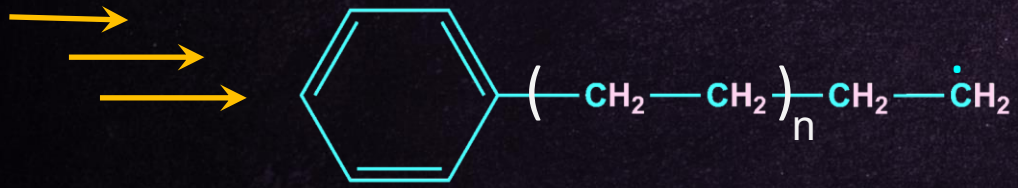
Phenyl free radical



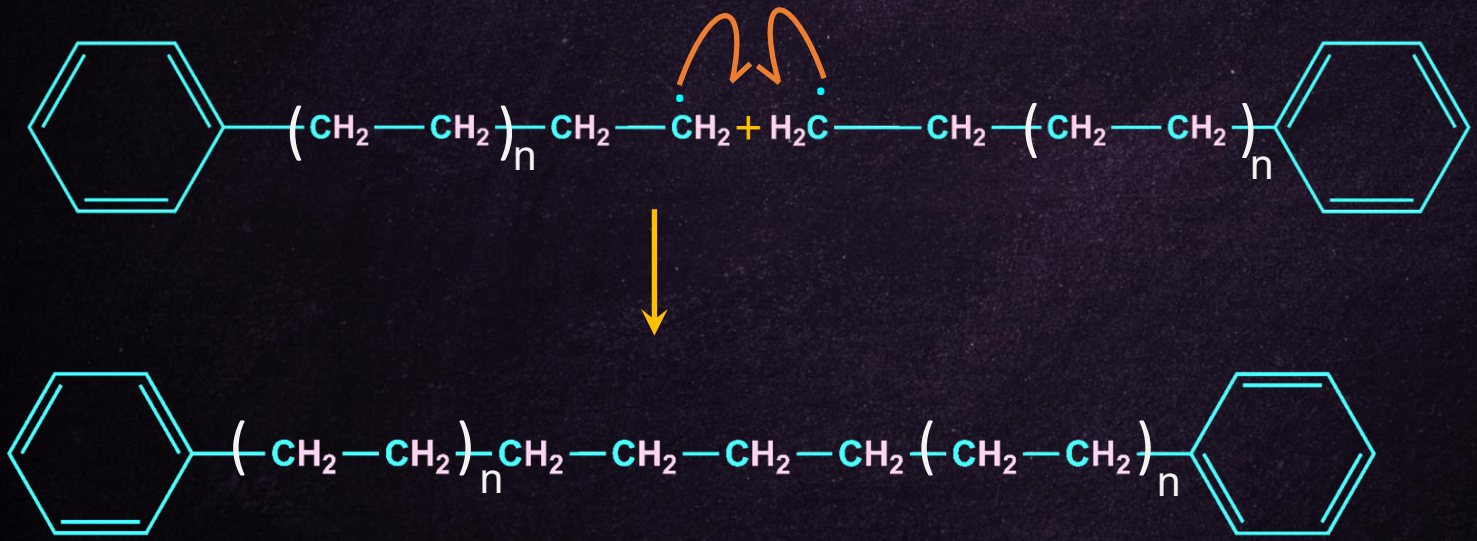
Ethene

Chain Propagation





Chain Termination



Nylon is an example of:

NEET 2013

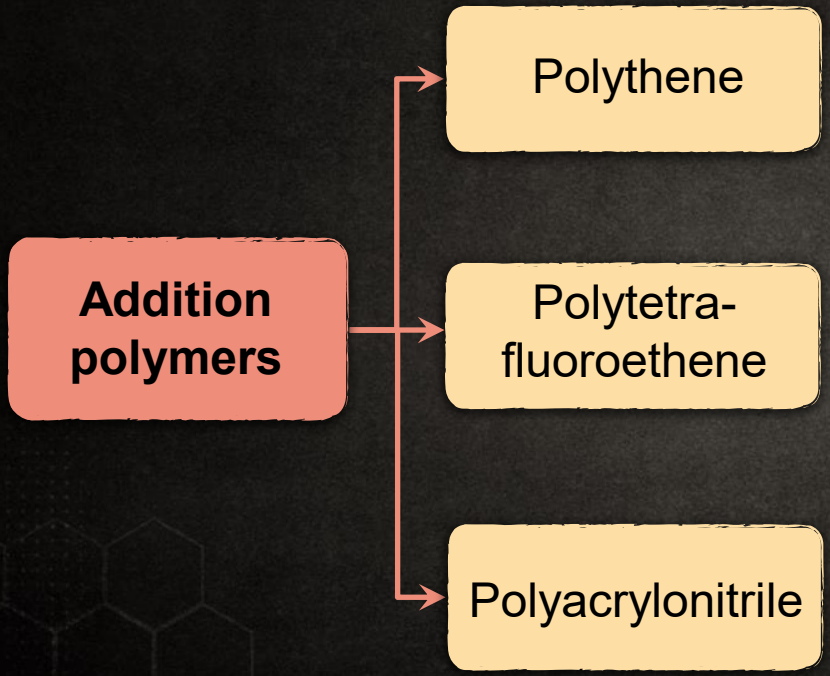
a. Polyamide

b. Polythene

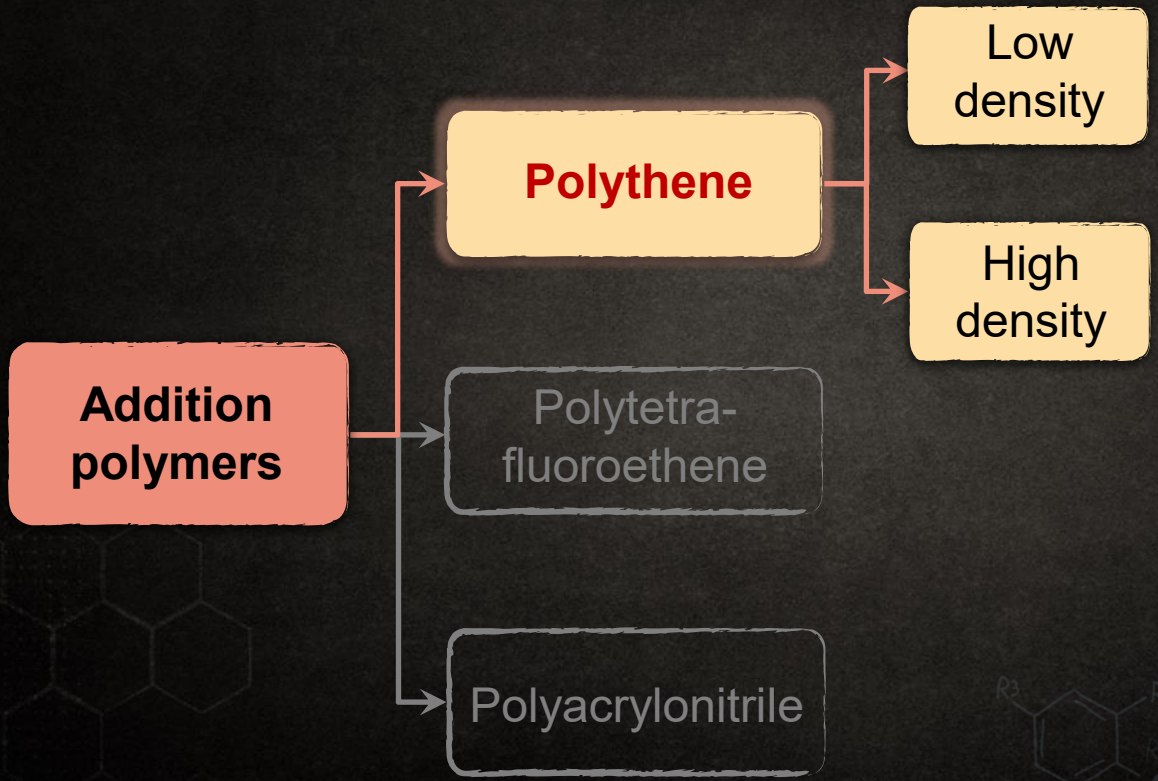
c. Polyester

d. Polysaccharide

Addition Polymers



Addition Polymers



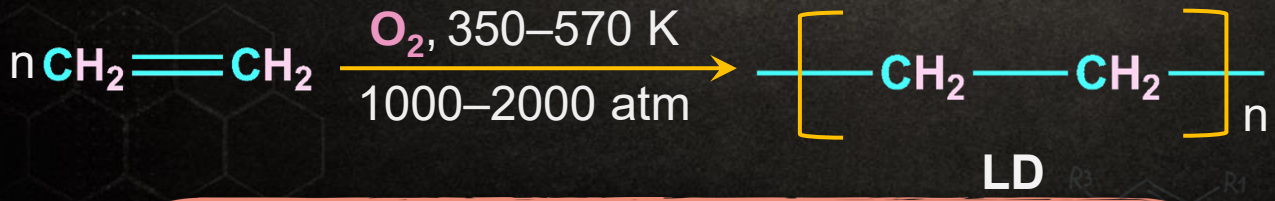
Low Density Polythene (LDP)

It is obtained by the polymerisation of ethane under **certain conditions** in the presence of O_2 or a **peroxide initiator.**

High pressure **1000–2000 atm**

Temperature **350–570 K**

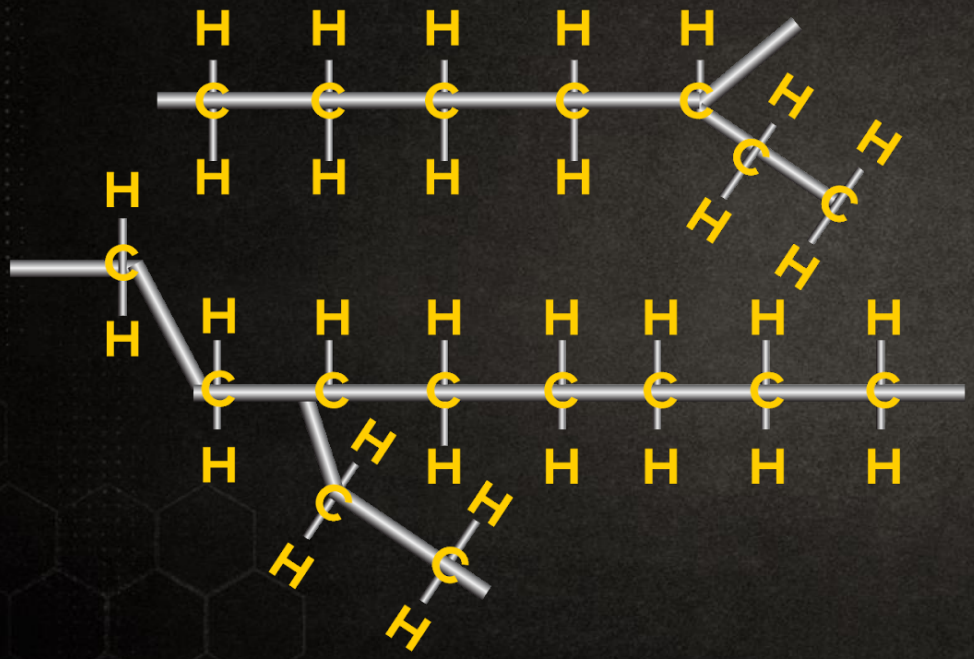
Reaction



LD

Reaction occurs by **free radical mechanism.**

Low density polythene



Characteristics of LDP

Chemically **inert**

Tough

Flexible

Poor conductor of **electricity**

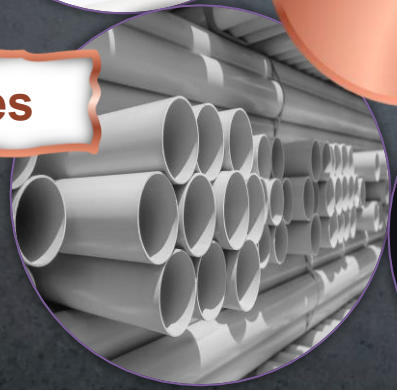
Uses

In bottles

In electric wires

In toys

In pipes



In wrappers

High Density Polythene (HDP)

It is obtained by the addition polymerisation of **ethene** in a **hydrocarbon** solvent in the presence of a **catalyst.**

Ziegler–Natta catalyst

$TiCl_4 + (C_2H_5)_3Al$

Ziegler–Natta Catalyst

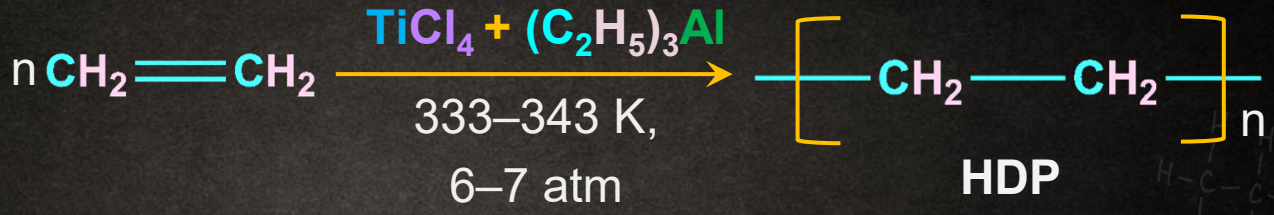
KARL ZIEGLER

GIULIO NATTA

Noble Prize 1963

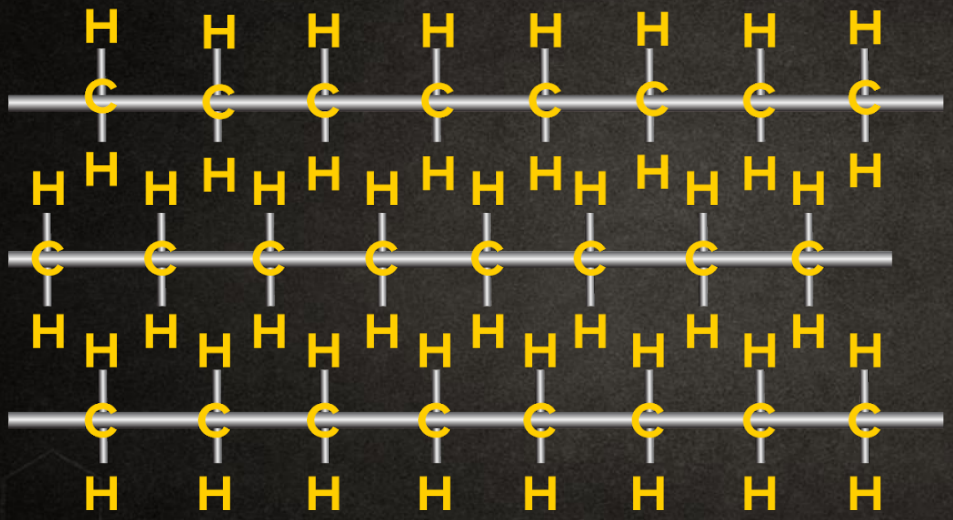
High Density Polythene (HDP)

Reaction



Low temperature and **pressure** is required.

High density polythene



Characteristics of HDP

Highly **dense**

Chemically **inert**

Tougher and **harder**

Uses

In bottles and pipes

In buckets and dustbins

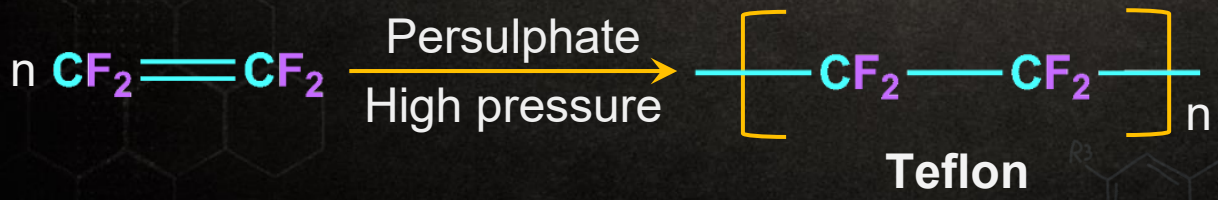
In making of plastic plates

Teflon

Reaction

It is manufactured by heating **tetrafluoroethene** with any **free radical** or **persulphate catalyst.**

At **high pressure**



Teflon

Characteristics of Teflon

1. Chemically **inert**

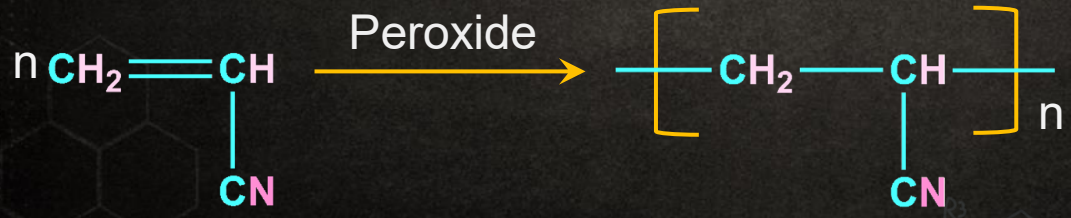
2. Resistant to attack by **corrosive agents**

Polyacrylonitrile

Reaction

It is obtained by the **addition** polymerisation of **acrylonitrile** in the presence of a **catalyst.**

Peroxide



Polyacrylonitrile
(PAN)

Which of the following is classified as polyester polymer?

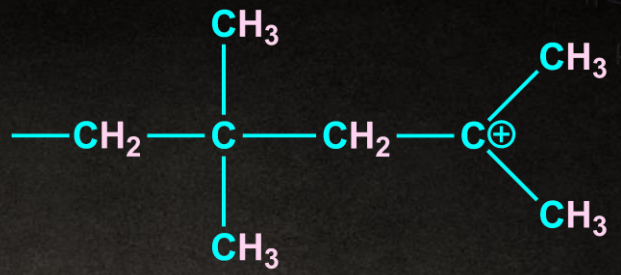
AIPMT 2011

a Terylene

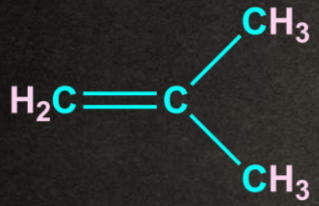
b Bakelite

c Melamine

d Nylon 6,6

The monomer of the polymer  is:

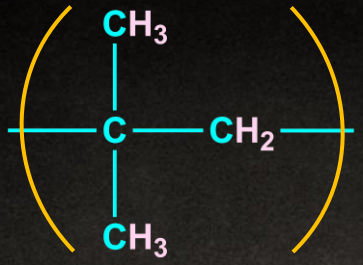
AIPMT 2005

a 

b $CH_3CH=CHCH_3$

c $CH_3CH=CH_2$

d $(CH_3)_2C=C(CH_3)_2$

The monomer of  is:

AIPMT 2002

a. 2-Methylpropene

b. Styrene

c. Propylene

d. Ethene

“Stay Positive, Work Hard. Make It Happen!”

THANK YOU