



U-4 Chemistry

Chemistry (SRM Institute of Science and Technology)



Scan to open on Studocu

U-4 Macromolecules (Polymers)

Macromolecules:

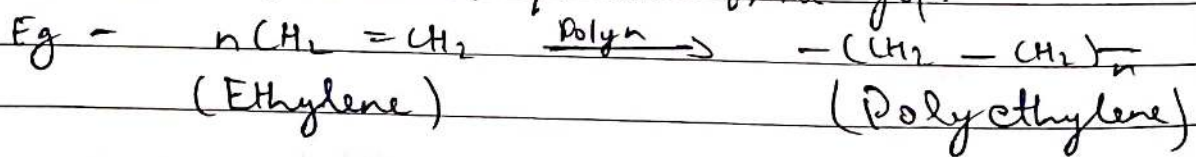
- They are very large molecules that are formed by the polymerisation of smaller molecules called monomers.
- Herman Staudinger coined the term in 1920.
- Made up of more than 1000 atoms.
- Contain C, H, O.
- Eg: Carbohydrates, Proteins, Lipids, Nucleic Acids (Glyc)

Polymers

- Term coined in 1833 by 'Jons Jacob'.
- derived by greek word poly \rightarrow many, & meros \rightarrow units.
- It is a chemical rxn in which smaller molecules (monomers) combined to give big molecule (polymer), with/without elimination of small molecules like H_2O , HCl , etc.

Requirement of monomer:

Multiple bond / Active functional group.



Degree of polymerisation (n):

It is the no. of repeating units in polymer chain.

$$DP = \frac{\text{mol. wt. of the polymeric network}}{\text{mol. wt. of repeating unit}}$$

mol. wt. (500 - 1000) \rightarrow Oligopolymer

(above 5000) \rightarrow High polymer.

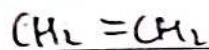
Functionality :

- It's the no. of bonding site or reactive site in a functional group present in monomer.
- For monomer to undergo polymerisation, it must have atleast 2 reactive / bonding sites.

Ex:-

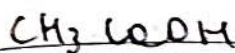
Ex: 1 grp

Functionality

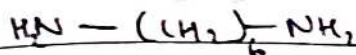


2 reactive sites on d.s. of =

2



1



2



3.



(glycerol).

Significance of functionality.

1. Bi functional - 2
2. Tri functional - 3
3. Polyfunctional - >3

Tacticity :-

- Derived from greek word which means arrangement / order.

- One of properties of polymer.

- It is an important consideration because it affects both physical and chemical properties.

- The orientation of monomeric unit or functional group in a polymer molecule can take place in an orderly / disorderly manner w.r.t. main chain called Tacticity.

Types

Isotactic

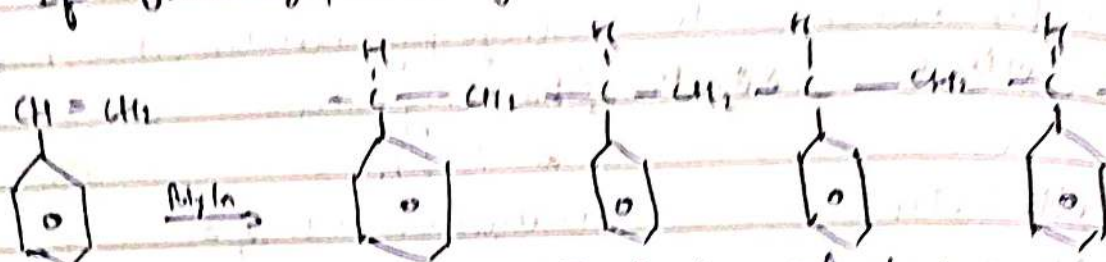
Syndiotactic

Atactic

1. Isotactic :

If functional group arranged on same side of main chain.

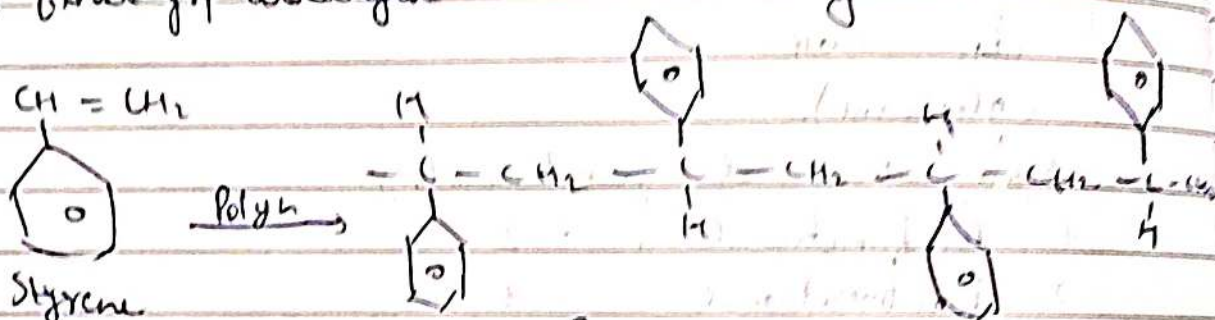
Eg:



2. Syndiotactic :

If functional group arranged in an alternating manner.

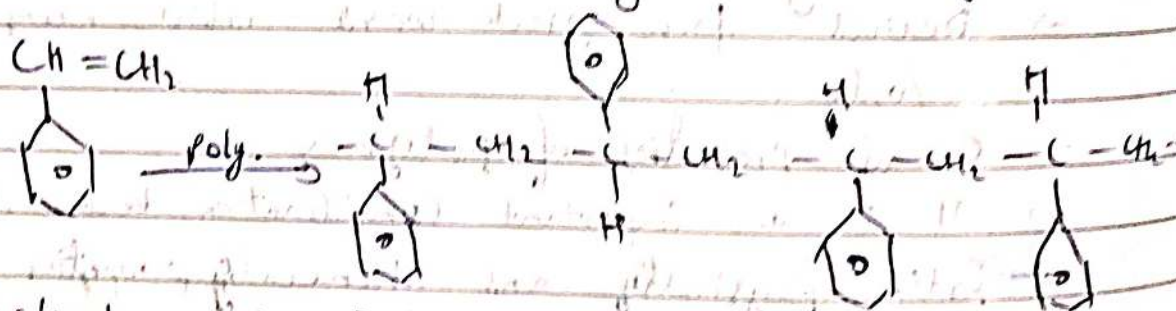
Eg:



3. Atactic :

If functional groups are arranged randomly.

Eg:



Classification of Polymers :

- They cannot be classified under one category because of its complex structure, diff behaviour & app.
- Backbone of polymer is usually made up of C-atoms

BASED ON ORIGIN

Natural
Polymers

Semi-synthetic
Polymers

Synthetic
Polymers

- | | | |
|--|---|--|
| <p>→ They occur naturally.</p> <p>→ Found in plants & animals.</p> <p>→ Eg: Protein, Starch, cellulose, biopolymers.</p> | <p>→ They are derived from natural Poly and undergo further chemical modification.</p> <p>→ Eg. Nylon, PVC.</p> | <p>→ They are man-made polymers.</p> <p>→ Eg: Plastic, synthetic Rubber.</p> <p>→ Used in industries and dairy products.</p> |
|--|---|--|

BASED ON NOMENCLATURE

↓
Homopolymers

↓
Heter/copolymer

↓
Homochain poly

↓
Heterochain
Polymer

• Linear

• Random

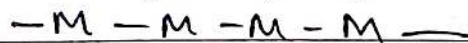
• Branched

• Block

• Cross linked

• Graft

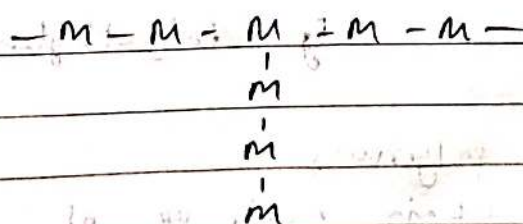
* Homopolymer: A polymer containing same type of monomer. Eg polyethylene.



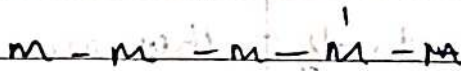
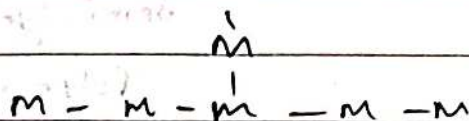
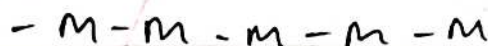
* Linear:

Monomer are arranged linearly.

* Branched:



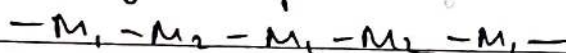
* Cross linked:



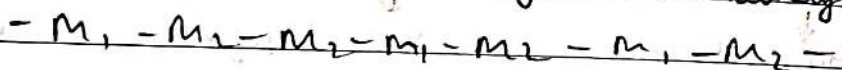
* Hetero/Copolymer:

Polymer containing more than one type of monomer.

Eg: Nylon

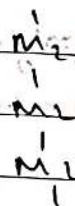
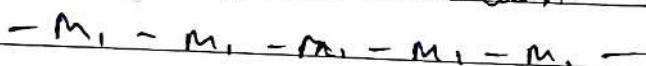


* Random - M_1 & M_2 are arranged randomly.



* Block - $-M_1-M_1-M_1-M_1-M_1-M_2-M_2-M_2-$

* Graft - M_1 is main chain



* Homochain polymers:

If main chain is made up of same species of atom.

Eg: Polyethylene: $-C-C-C-C-$

* Heterochain polymers

If main chain made up of diff species of atom

Eg Nylon $-C-C-O-C-O-C-$

A few topics in blue left)

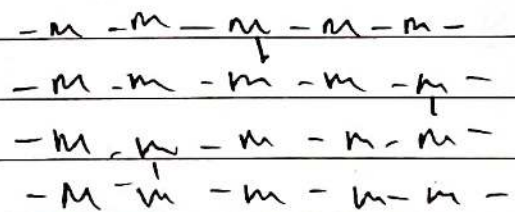
Plastics

Thermoplastic

Thermosetting plastic

1 Thermoplastic: → prepared by addition polymerisation.

- made up of linear polymer.
- the polymer chains are held together by weak intermolecular force of attraction.
- By applying ~~force~~^{Heat} & pressure this weak force more weak.
- These plastics can be moulded into any desired shape.
- They soften on heating & harden on cooling.
- The repeated heating & cooling do not alter the chemical nature of material.
- They are generally soluble in organic solvents.
- Eg: Polyethylene, PVC



2. Thermosetting plastic

- Prepared by condensation polymerisation.
- Made up of cross-linked or 3-d structures.
- chains held together by strong covalent bonds.
- Set into a given shape quickly when manufactured.
- It gets harder on heating, once harder cannot be softer again.
- Almost insoluble in organic solvents.

→ Eg: Bakelite, Poly ester.

