

27- Polymerisation

Q-1) Addition and condensation polymerisation.

> Addition polymerisation:

- monomers have $C=C$

> Condensation polymerisation:

- usually contain functional groups such as:

- amines ($-NH_2$) and carboxylic acids ($-COOH$)

↳ polyamide + H_2O

- amines ($-NH_2$) and acyl chlorides ($-COCl$)

↳ polyamide + HCl

- ($-COOH$) and ($-OH$)

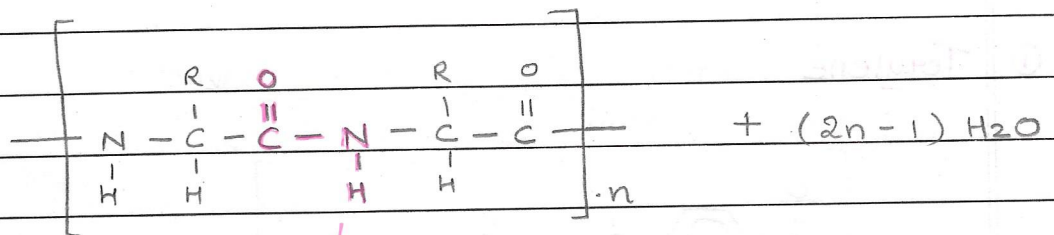
↳ polyester + H_2O

- ($-COCl$) and ($-OH$)

↳ polyester + HCl .

Q-2) Examples of polyamides

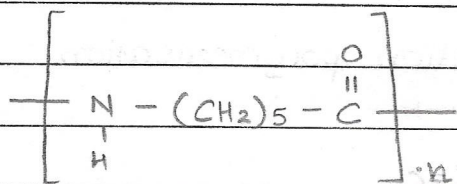
① Proteins:



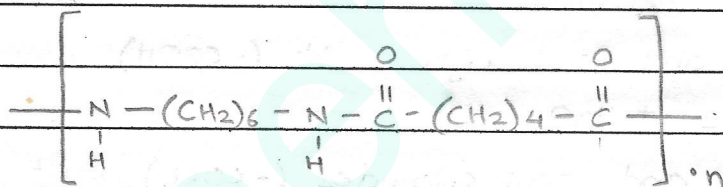
↓
peptide (amide) linkage



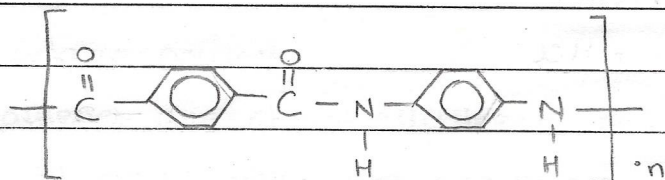
② Nylon 6



③ Nylon 6,6



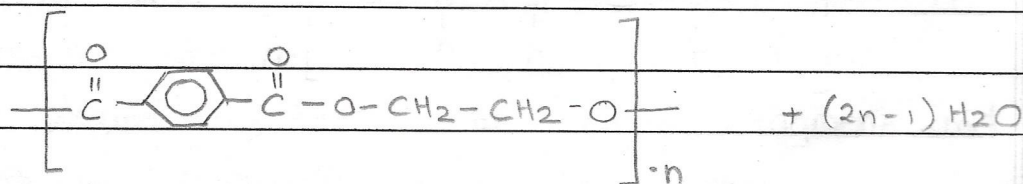
④ Kevlar



* forms hydrogen bonding between chains.

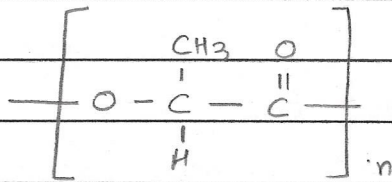
Q-3) Examples of polyesters.

① Terylene



* R-O means R-OH .

② * PLA (poly-lactic acid)



Q-4) Proteins and DNA.

* Primary structure :

sequence of amino acids in the polypeptide chain.

* Starts with $-\text{NH}_2$, ends with $-\text{COOH}$.

* Secondary structure :

formation of α helix and β pleated sheets by hydrogen bonding between $-\text{NH}$ of one peptide bond and $-\text{CO}$ of another.

* Tertiary structure :

α helix and β pleated sheets folded over.

* Stabilised by :

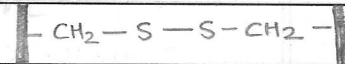
- disulfide bridges.

- VWF

- relatively weak hydrogen bonds

- ionic bonds (between NH_3^+ and COO^-)

polypeptide backbone



Base pairs

Adenine - Thymine (AT) = 2 Hydrogen bonds

Guanine - Cytosine (GC) = 3 Hydrogen bonds.



DNA is kept stable by:

- Hydrogen bonds between bases
- VWF between base pairs.

DNA replication:

- Hydrogen bonds and VWF ^{breaks} and DNA unwinds.
- Nucleotide triphosphates are brought to the chain
- Enzyme catalyses reactions
- Semi-conservative replication.

Q-5) LDPE and HDPE.

* **LDPE**

- branched chains
- weak VWF between non-polar chains
- NOT closely packed

* **HDPE**

- unbranched chains
- closely packed
- increased surface area of contact results in stronger VWF.

Q-6) Non-solvent based adhesives.

> Organic solvents used in adhesives are flammable and harmful to health.

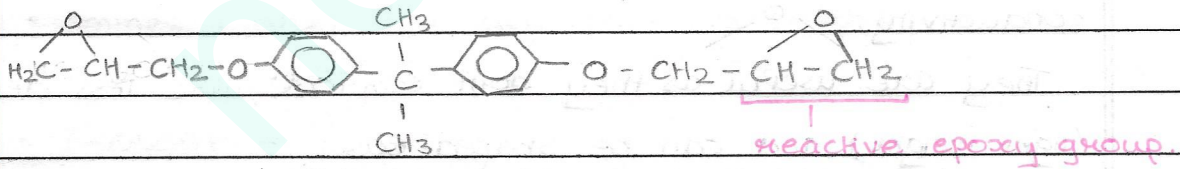
∴ non-solvent based adhesives have been developed

They usually contain silicon bonded to oxygen.

They set by reacting with the moisture in air (hydrolysis)

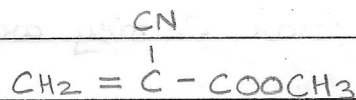
eg: **Epoxy resins** (condensation polymerisation)

Are a thermosetting polymer (set when heated) and form cross-links when the reactants are mixed.

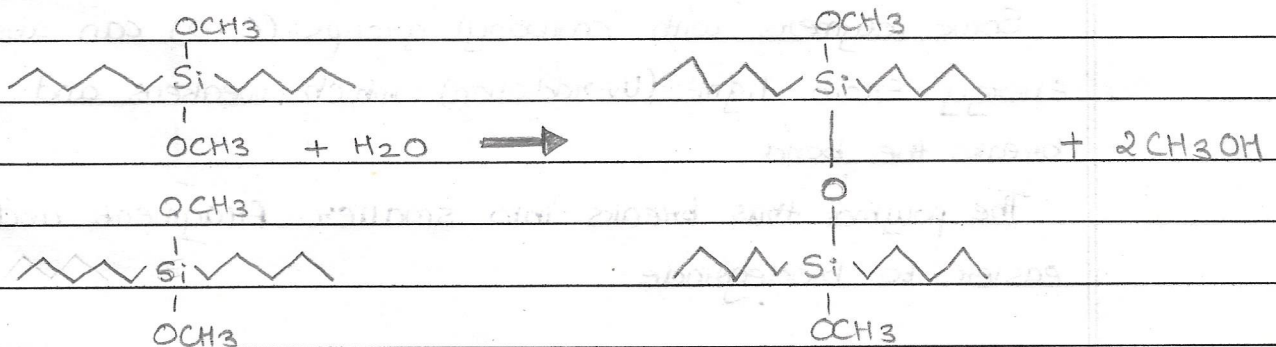


eg: **Superglue** (addition polymerisation)

Polymerisation is initiated by presence of moisture



eg: **SMP's** (silyl modified polymers)



Q-7) Conducting polymers.

eg: Ethyne (addition polymerisation)



It can conduct because its π bond spreads down the length of the polymer chain.

The overlapping p-orbitals of neighbouring carbons results in a long band of delocalised e^- that are free to move along the length of the chain.

Conducting substances eg: I_2 are added to improve conductivity.

They are useful as they don't corrode, are less dense (light-weight) and can be shaped easily.

Q-8) Degradable polymers

> Polyalkenes are chemically inert because of strong C-C and C-H bonds which are non-polar. \therefore they are difficult to biodegrade.

Polyamides and polyesters can be broken down by hydrolysis \therefore are biodegradable.

Some polymers with carbonyl groups ($\text{C}=\text{O}$) can absorb energy from light (UV radiation) which weakens and breaks the bond.

The polymer thus breaks into smaller fragments and is easier to biodegrade.