27- Polymerisation

Q-1) Addition and condensation polymerisation.

> **Addition polymerisation:**

- monomers have C=C

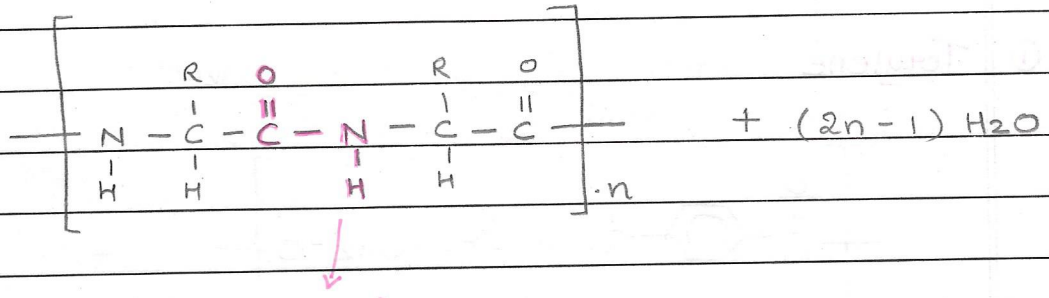
> **Condensation polymerisation:**

- usually contain functional groups such as:

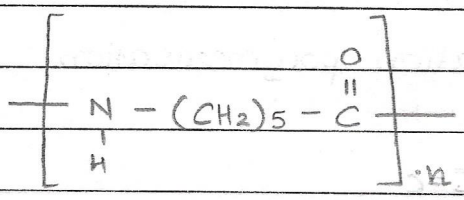
- amines ($-NH_2$) and carboxylic acids ($-COOH$)
  ↳ polyamide + H_2O
- amines ($-NH_2$) and acyl chlorides ($-COCl$)
  ↳ polyamide + HCl
- ($-COOH$) and ($-OH$)
  ↳ polyester + H_2O
- ($-COCl$) and ($-OH$)
  ↳ polyester + HCl.

Q-2) Examples of polyamides.

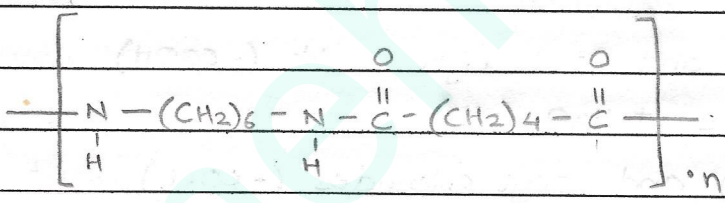
① **Proteins:**



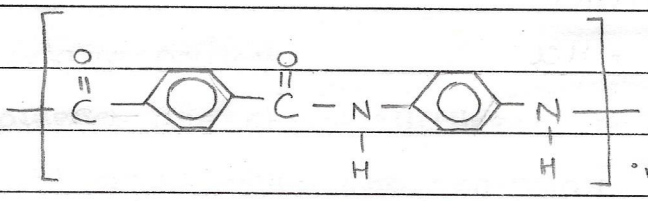
② Nylon 6



③ Nylon 6,6



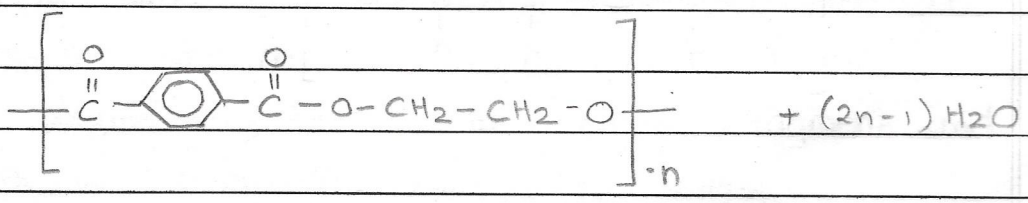
④ Kevlar



* forms hydrogen bonding between chains.

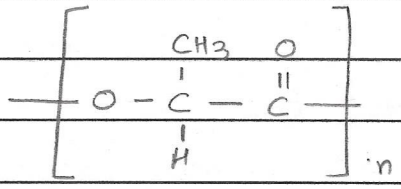
Q-3) Examples of polyesters.

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 -NH2, ends with -COOH.

* Secondary structure :

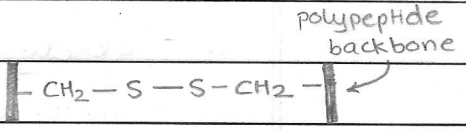
formation of α helix and β pleated sheets by Hydrogen bonding between -NH of one peptide bond and -CO of another.

* Tertiary structure :

α helix and β pleated sheets folded over.

* Stabilised by :

- disulfide bridges.



- VVF
- relatively weak hydrogen bonds
- ionic bonds (between NH_3^+ and COO^-)

Base pairs

Adenine - Thymine (AT) = 2 Hydrogen bonds

Guanine - Cytosine (GC) = 3 Hydrogen bonds.

DNA is kept stable by:

- Hydrogen bonds between bases
- VVF between base pairs.

DNA replication:

- Hydrogen bonds and VVF break 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 VVF between non-polar chains
  - NOT closely packed

* HDPE
  - unbranched chains
  - closely packed
  - increased surface area of contact results in stronger VVF.

Q-6) Non-solvent based adhesives.

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

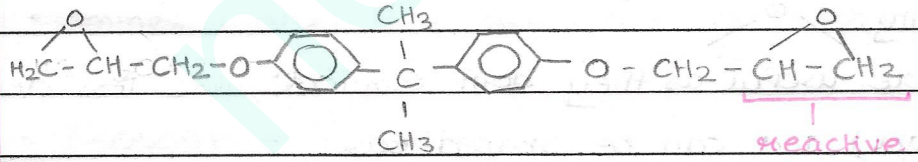
∴ non-solvent based adhesives have been developed

They usually contain silicon bonded to oxygen.

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

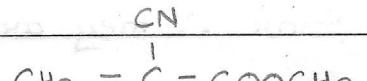
eg: Epoxy resins (condensation polymerisation)

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

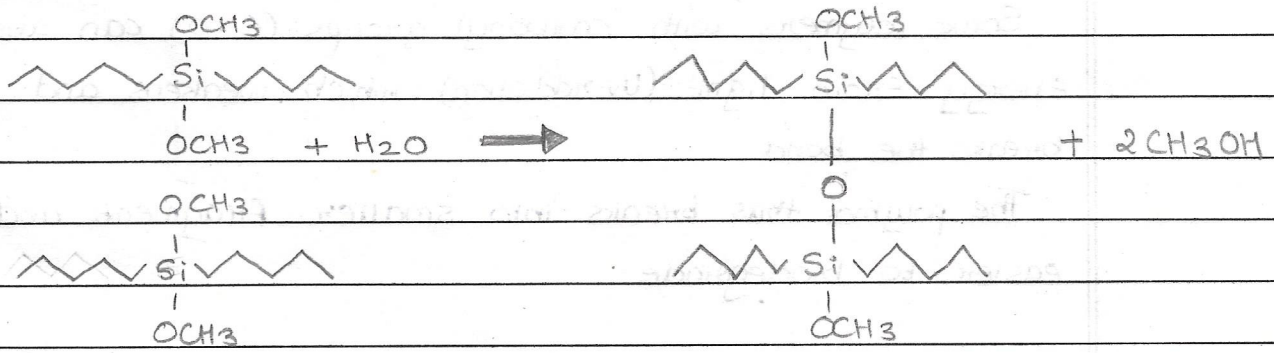


eg: Superglue (addition polymerisation)

Polymerisation is initiated by presence of moisture



eg: SMP's (silyl modified polymers)



Q-7) Conducting polymers.

eg: Ethyne (addition polymerisation)

monomer : $H-C\equiv C-H$

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 dont 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. ∴ they are difficult to biodegrade.

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

Some polymers with carbonyl groups (C=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.