Polymers Class 12 Key Points

CBSE Class 12 Chemistry · NCERT · for boards, NEET and JEE revision

ChapterNotes

What Is a Polymer?

$M_{polymer} \approx n \times M_{monomer}$ (n = degree of polymerisation)

Polymer molar mass is huge (≈10^4–10^7 g/mol); the monomer is always the small unit.

- Polymerisation = the joining reaction; n = number of repeat units
- Monomer is small; only the polymer has high molecular mass
- Identify the monomer first - that is what NEET asks

Three Ways to Tag a Polymer

Source · Structure · Molecular force

LDPE is branched, HDPE is linear - the most common trap.

- Source: natural / semi-synthetic / synthetic
- Structure: linear / branched / cross-linked (network)
- Force: elastomer / fibre / thermoplastic / thermosetting

Thermoplastic vs Thermosetting

Thermoplastic: no cross-links · Thermosetting: cross-linked

Bakelite is thermosetting (cannot remelt); polythene/PVC are thermoplastic.

- Thermoplastic = re-mouldable again and again (polythene, PVC)
- Thermosetting = cross-links on first heating, never remelts (Bakelite)
- Most assertion-reason traps sit on this difference

Addition (Chain-Growth) Polymerisation

Polymer empirical formula = monomer formula (nothing eliminated)

If H_2O or HCl is released, it is NOT addition.

- Needs an unsaturated monomer (C=C), e.g. ethene $CH_2{=}CH_2$
- Examples: ethene→polythene, vinyl chloride→PVC, $CF_2{=}CF_2$→Teflon
- Acrylonitrile→PAN/Orlon; styrene→polystyrene

Free-Radical Mechanism

Initiation → Propagation → Termination

Initiator = benzoyl peroxide (not sulphur, not sodium).

- Initiation: peroxide gives a radical that opens a C=C bond
- Propagation: radical attacks the next monomer, chain grows fast
- Termination: two radical ends pair up and stop growth

Condensation (Step-Growth) Polymerisation

n links eliminate ≈ n small molecules (H_2O, NH_3 or HCl)

Polymer formula differs from the monomers because something leaves.

- Monomers carry two groups: –OH, –COOH or $–NH_2$
- Amide (–CONH–) link → polyamide (nylon); ester (–COO–) link → polyester
- Nylon-6,6 = hexamethylenediamine + adipic acid (both 6 C)

Nylons, Polyesters & Resins

Nylon-6 ← caprolactam (1 monomer) · Terylene ← glycol + terephthalic acid

Glyptal uses phthalic (ortho) acid; Terylene uses terephthalic (para) acid.

- Nylon-6,6 = diamine + diacid (2 monomers); Nylon-6 = caprolactam (1)
- Bakelite = phenol + formaldehyde, cross-linked; Novolac = linear
- Melamine–formaldehyde → unbreakable crockery

Rubber, Copolymers & Vulcanisation

Vulcanisation: rubber + S (~3-5%) → cross-linked, tougher rubber

Buna-S = butadiene + styrene; Buna-N = butadiene + acrylonitrile.

- Monomer of natural rubber = isoprene (2-methyl-1,3-butadiene), cis geometry
- Sulphur forms cross-links (≈3-5% tyres, ≈30% ebonite) - not an initiator
- Neoprene = polychloroprene (homopolymer); Buna types are copolymers

Biodegradable Polymers

PHBV ← 3-hydroxybutanoic + 3-hydroxypentanoic acid · Nylon-2–nylon-6 ← glycine + aminocaproic acid

PVC, polythene and Teflon are non-biodegradable.

- PHBV: copolyester used in packaging and orthopaedics
- PGA, PLA, Dextron: dissolvable surgical sutures
- Nylon-2–nylon-6: alternating biodegradable polyamide

Average Molecular Mass & PDI

$\bar{M}_n = \Sigma N_i M_i / \Sigma N_i$ · $\bar{M}_w = \Sigma N_i M_i^2 / \Sigma N_i M_i$ · PDI = $\bar{M}_w / \bar{M}_n$

$\bar{M}_w \geq \bar{M}_n$ always; PDI = 1 only for a monodisperse sample.

- $\bar{M}_n$ counts every chain equally; $\bar{M}_w$ weights heavier chains more
- PDI ≥ 1; natural polymers (e.g. proteins) are nearly monodisperse
- Don't swap the two formulas - divide $\bar{M}_n$ by ΣN_i

Quick revision

- Addition: C=C monomers, no by-product (PE, PVC, PS, Teflon, PAN)
- Condensation: bifunctional monomers, loses H_2O (Nylon, Polyester, Bakelite)
- Thermoplastic: remould (PE, PVC, PS) | Thermosetting: cannot remould (Bakelite, melamine)
- Elastomers: rubber | Fibres: nylon, terylene (strong H-bonds)
- Natural rubber: cis-polyisoprene | Vulcanisation: + S → cross-linked
- Nylon-66: hexamethylenediamine + adipic acid | Nylon-6: caprolactam
- Terylene (PET): ethylene glycol + terephthalic acid
- LDPE: branched, flexible | HDPE: linear, rigid (Ziegler-Natta catalyst)
- Bakelite: phenol + formaldehyde → cross-linked thermosetting
- Teflon: PTFE → $(–CF_2–CF_2–)_n$ → non-stick, chemically inert

Full chapter notes with solved examples and practice questions: https://chapternotes.in/cbse/class-12-chemistry/polymers-class-12-notes/