Class 12 Chemistry – Polymers | Study Guide

1. Theory in Simple Words with Visuals

1.1 What are Polymers?

Polymers are **large molecules made by joining small repeating units called monomers**.
Think of **monomers as Lego blocks** – when you connect many blocks, you get a long chain called a polymer.

Visual Analogy:

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Monomer → Lego block
Polymer → Long Lego chain
```

1.2 Classification of Polymers

A. On the basis of origin:

Type	Examples	Notes
Natural	Rubber, Starch, Cellulose	Found in plants/animals
Synthetic	Nylon, Bakelite, PVC	Man-made in factories

B. On the basis of structure:

Type	Structure	Example
Linear	Straight chain	Polyethylene
Branched	Chain with branches	Low-density polyethylene (LDPE)
Cross-linked	Chains connected	Bakelite, Vulcanized rubber

C. On the basis of polymerization:

Type	Monomer Example	Reaction Type
Addition	Ethene → Polyethene	Double bond opens → chain forms
Condensation	Hexamethylene diamine + Adipic acid → Nylon-6,6	Small molecule (H_2O) eliminated

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1.3 Important Polymers & Uses

Polymer	Monomer	Use	Fun Tip
Polyethylene	Ethene	Bags, bottles	Most common plastic
Polypropylene	Propene	Ropes, toys	“PP = Pretty Polypropylene”
PVC	Vinyl chloride	Pipes, raincoats	Water-proof
Teflon	Tetrafluoroethylene	Non-stick coating	“F for Food-safe”
Bakelite	Phenol + Formaldehyde	Electrical switches	First plastic
Nylon-6,6	Hexamethylene diamine + Adipic acid	Ropes, textiles	Strong fiber
Polyacrylonitrile	Acrylonitrile	Fiber	“PAN fiber = clothes”

1.4 Properties of Polymers

- **High molecular weight** → Strong & tough
- **Thermoplastic vs Thermosetting:**
  - Thermoplastic: Softens on heating (PVC, PE)
  - Thermosetting: Hard, doesn’t soften (Bakelite, Melamine)
- **Elasticity:** Natural rubber is elastic

Visual Analogy:

- Thermoplastic = **Playdough** (softens with heat)
- Thermosetting = **Baked cake** (hard once set)

1.5 Biodegradable vs Non-biodegradable Polymers

- **Biodegradable:** Can be broken down by microbes (e.g., Starch, Cellulose, PLA)
- **Non-biodegradable:** Cannot be easily degraded (e.g., PVC, Polystyrene)

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2. Key Concepts & Formulas

Concept	Formula / Notes	Mnemonics / Tips
Degree of Polymerization (n)	n = (Molecular weight of polymer) / (Molecular weight of monomer)	“How many blocks make the chain?”

Concept	Formula / Notes	Mnemonics / Tips
Addition Polymerization	No byproduct; monomers have double bond	Polyethylene, PVC
Condensation Polymerization	Small molecule eliminated (H_2O, HCl)	Nylon, Bakelite

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3. Solved Numerical / Reaction Problems

Example 1: Degree of Polymerization

Problem: Polyethylene has molecular weight 280, monomer ethene = 28. Find n.
Solution:
n = 280 / 28 = 10
Tip: Always divide polymer MW by monomer MW.

Example 2: Condensation Polymer Reaction

Problem: Write the reaction for Nylon-6,6 formation.
Solution:
Hexamethylene diamine + Adipic acid → Nylon-6,6 + H_2O

Tip: Count –H from diamine and –OH from acid → H_2O eliminated per link.

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4. Previous Years' Board Questions (Solved)

- Differences between addition and condensation polymers
- Examples of natural vs synthetic polymers
- Thermoplastic vs thermosetting polymers
- Biodegradable vs non-biodegradable polymers
- Reaction of monomers to polymer (e.g., Nylon, Bakelite)

High-weightage: Classification, uses, and chemical reactions

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5. Quick Revision Notes / Important Points

- **Polymers = monomers linked**
- **Addition:** Double bond opens → chain forms
- **Condensation:** Small molecule eliminated (H_2O/HCl)
- **Thermoplastic vs Thermosetting:** Soft vs Hard
- **Important Polymers:** PE, PP, PVC, Teflon, Bakelite, Nylon, PAN
- **Natural vs Synthetic:** Rubber, starch vs Nylon, Bakelite

Visual Table:

Polymer	Type	Use	Reaction Type
PE	Synthetic	Bags	Addition
PVC	Synthetic	Pipes	Addition
Nylon-6,6	Synthetic	Fiber	Condensation
Bakelite	Synthetic	Electrical	Condensation
Starch	Natural	Food	–

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6. Predicted / Likely Questions

1. Classify polymers with examples
2. Difference between addition and condensation polymerization
3. Thermoplastic vs thermosetting polymers
4. Reaction for Nylon, Bakelite, Polyesters
5. Biodegradable vs Non-biodegradable polymers

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7. Exam Tips & Tricks

- Use **flowcharts** for polymer classification
- Remember **key monomers** → **polymer** → **use** table
- Draw **structures** of Nylon, Bakelite, Teflon for marks
- For numericals: **Degree of polymerization formula**

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8. Visual & Kid-Friendly Learning Style

Analogy:

- Monomer = Lego brick
- Polymer = Lego castle
- Thermoplastic = Playdough
- Thermosetting = Cake

Flowchart Example:

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Polymers
├─ Natural → Rubber, Starch
├─ Synthetic
│   ├─ Addition → PE, PVC, Teflon
```

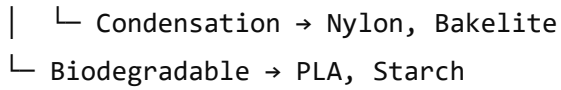
└─ Condensation → Nylon, Bakelite
└─ Biodegradable → PLA, Starch