

## CBSE NCERT Solutions for Class 12 Chemistry Chapter 15

### Back of Chapter Questions

1. What are polymers?

**Solution:**

Polymers are high molecular mass macromolecules, which are formed by repeating structural units derived from monomers. Polymers have a high molecular mass usually ranging between  $10^3 - 10^7$  u. In a polymer, various monomer units are joined by strong covalent bonds. Polymers can be natural as well as synthetic.

Some examples of polymers are Nylon 6, Teflon and Polythene.

2. How are polymers classified on the basis of structure?

**Solution:**

On the basis of structure polymers can be classified as follows:

1. Linear polymers:

Linear polymers are formed of long straight chains. They can be depicted as:



For e.g., high-density polythene (HDP), polyvinyl chloride, etc.

2. Branched-chain polymers:

Branched-chain polymers are basically linear molecular chains along with some branches. These polymers are represented as:

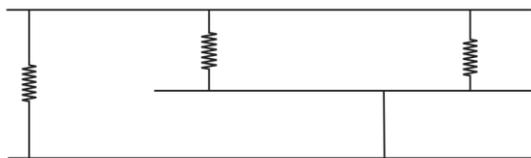


For e.g., low density polythene (LDP), amylopectin, etc.

3. Cross-linked or Network Polymers:

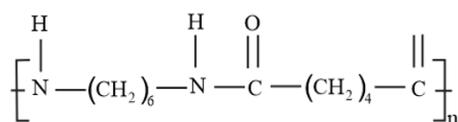
Cross-linked polymers have cross-linking strong covalent bonds between linear chains that give rise to a network-like structure. These polymers contain bi-functional and tri-functional monomers and strong covalent

bonds between various linear polymer chains. Polymers bakelite and Melmac are two examples of Cross-linked polymers.

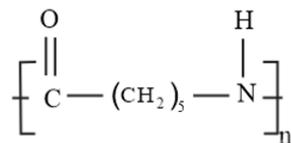


Concept insight: Based on structure: Linear, Branched, cross-linked.

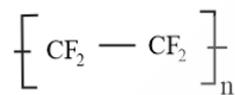
3. Write the names of monomers of the following polymers:



(i)



(ii)

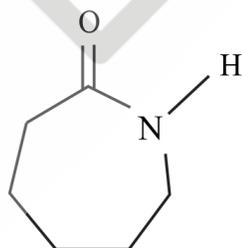


(iii)

**Solution:**

(i) Consists of two monomers – Hexamethylenediamine  $[\text{H}_2\text{N} - (\text{CH}_2)_6 - \text{NH}_2]$  and adipic acid  $[\text{HOOC} - (\text{CH}_2)_4 - \text{COOH}]$

(ii) The monomer is known as



Caprolactam

(iii) Tetrafluoroethylene ( $\text{CF}_2 = \text{CF}_2$ ) is the monomer.

4. Classify the following as addition and condensation polymers: Terylene, Bakelite, Polyvinyl, chloride, Polythene.

**Solution:**



- (ii) Neoprene < polyvinyl chloride < Nylon 6

### Back of the chapter questions

1. Explain the terms polymer and monomer.

**Solution:**

Polymers are high molecular mass macromolecules, which are formed by repeating structural units derived from monomers. Polymers have a high molecular mass usually ranging between  $10^3 - 10^7$  u. In a polymer, various monomer units are joined by strong covalent bonds. Polymers can be natural as well as synthetic.

Some examples of polymers are Polythene, rubber, Bakelite, Buna-N

Monomers are simple, reactive molecules that combine with each other in large chains through covalent bonds to give polymers.

Some examples of monomers are ethene, propene, styrene, vinyl chloride.

2. What are natural and synthetic polymers, Give two examples of each type.

**Solution:**

Polymers that are found in nature are natural polymers. These polymers are formed by plants and animals.

Examples of natural polymers are protein, cellulose, starch, resins, etc.

Synthetic polymers are polymers made by human beings. They are derivatives of natural polymers.

Examples of synthetic polymers include plastic (polythene), synthetic fibres (nylon 6, 6), synthetic rubbers (Buna - S).

3. Distinguish between the terms homopolymer and copolymer and give an example of each.

**Solution:**

Homopolymer	Copolymer
The polymers that are formed by the polymerization of a one monomer unit are called homopolymers i.e. the repeating units of homopolymers are derived only from one monomer.	A copolymer is a polymer that is derived from more than one type of monomer. The polymerization of monomers into copolymers is called copolymerization.
Example: Polythene is a homopolymer of ethane	Example: Buna S is a copolymer of 1, 3-butadiene and styrene

4. How do you explain the functionality of a monomer?

**Solution:**

The number of binding sites that is/are present in that monomer so as to bond with other monomers to form a polymer is known as functionality of a monomer.

For example, the functionality of monomers such as ethene and propene is one and that of 1, 3-butadiene and adipic acid is two.

5. Define the term polymerization.

**Solution:**

Polymerization is the process where monomer molecules react together in a chemical reaction to form long polymer chains or three-dimensional networks. In a polymer, various monomer units are joined by strong covalent bonds.

Polymerization is broadly classified into two categories:

1. Chain-Growth or Addition Polymerization
2. Step-Growth or Condensation Polymerization

The interaction of Hexamethylenediamine and adipic acid to form Nylon 6, 6 is an example of a Polymerization reaction.

6. Is  $\left\{ \text{NH} - \text{CHR} - \text{CO} \right\}_n$ , a homopolymer or copolymer?

**Solution:**

$\left\{ \text{NH} - \text{CHR} - \text{CO} \right\}_n$  is polyvinylchloride. It is a homopolymer because it is obtained from the same type of repeating monomer unit,  $\text{NH}_2 - \text{CHR} - \text{COOH}$ .

7. In which classes, the polymers are classified on the basis of molecular forces?

**Solution:**

On the basis of the magnitude of intermolecular forces of attraction that is present in polymers, they are classified into four groups. They are:

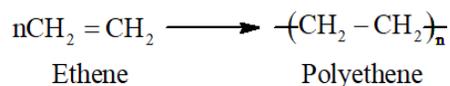
- (i) Elastomers
- (ii) Fibres
- (iii) Thermoplastic polymers
- (iv) Thermosetting polymers

8. How can you differentiate between addition and condensation polymerization?

**Solution:**

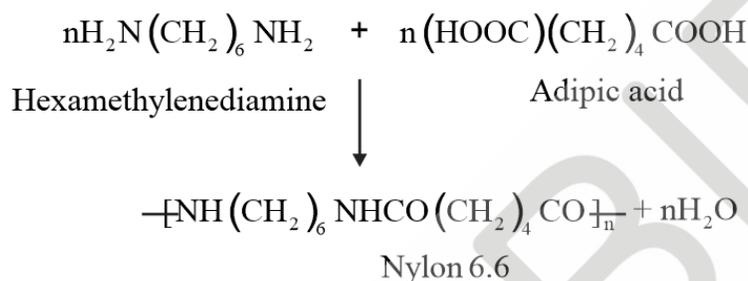
Addition polymerization is the process of repeated addition of monomers, possessing double or triple bonds to form polymers. The monomers generally join

together to form saturated polymers. For example, Addition polymerization of ethene forms polyethene.



The process of formation of polymers by repeated condensation reactions between two different bi-functional monomers is known as condensation polymerisation. Molecules such as water or hydrochloric acid are released as by products in each condensation reaction.

Nylon 6, 6 is formed by the condensation polymerization of hexamethylenediamine and adipic acid.

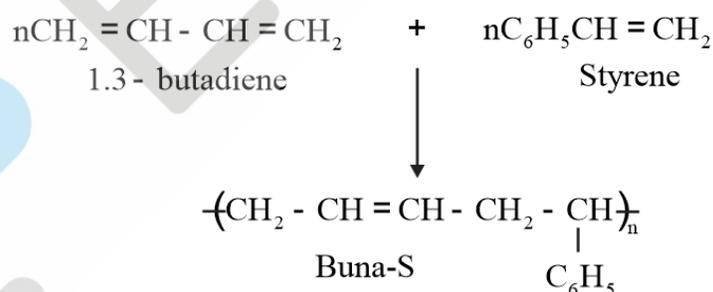


9. Explain the term copolymerization and give two examples.

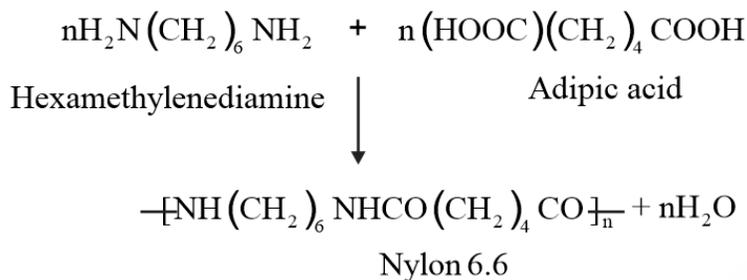
**Solution:**

A copolymer is a polymer that is derived from more than one type of monomer. The polymerization of monomers into copolymers is called copolymerization. Multiple units of each monomer are present in the copolymer.

Example: Buna S is a copolymer of 1, 3-butadiene and styrene



Nylon 6, 6 is a copolymer formed by copolymerisation of hexamethylene diamine and adipic acid.



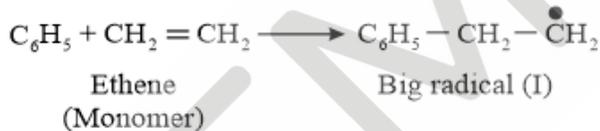
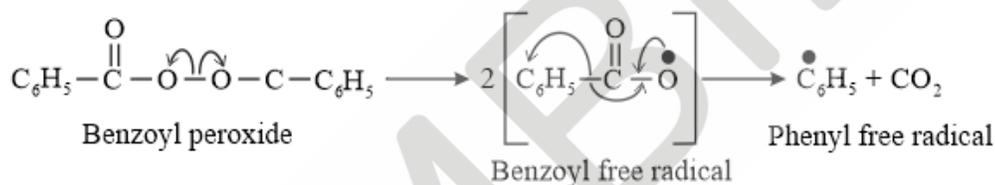
10. Write the free radical mechanism for the polymerization of ethene.

**Solution:**

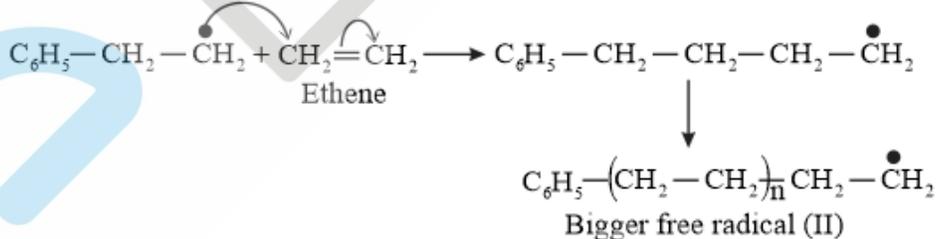
Polymerization of ethene to polythene includes heating or exposing to light a mixture of ethene with a small amount of benzoyl peroxide as the initiator.

The reactions involved in this process are:

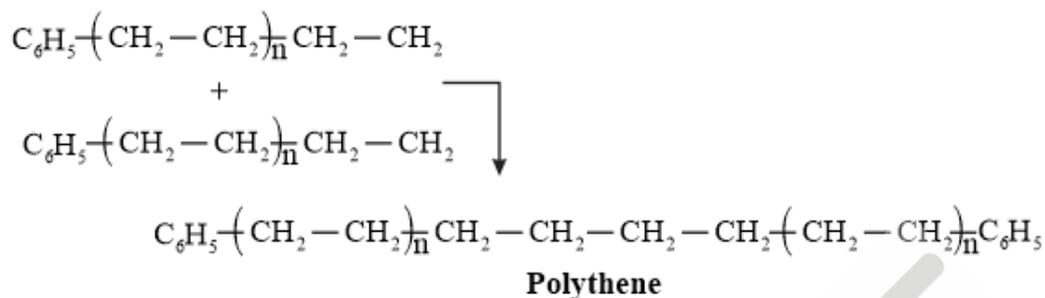
**Chain initiation step:**



**Chain propagating step**



**Chain Terminating Step**



11. Define thermoplastics and thermosetting polymers with two examples of each.

**Solution:**

Thermoplastic polymers are linear (slightly branched) long-chain polymers, which can be repeatedly softened on heating and hardened on cooling. Hence, they can be modified again and again. They possess intermolecular forces of attraction whose magnitude is intermediate between elastomers and fibers. Examples of thermoplastics are polythene, polystyrene, polyvinyl etc.

Thermosetting polymers are cross-linked and heavily branched polymers which on heating undergo extensive cross-linking in moulds and become infusible. These polymers cannot be softened again on heating. Examples of thermosetting plastics are bakelite, urea-formaldehyde resins.

12. Write the monomers used for getting the following polymers.

- (i) Polyvinyl chloride
- (ii) Teflon
- (iii) Bakelite

**Solution:**

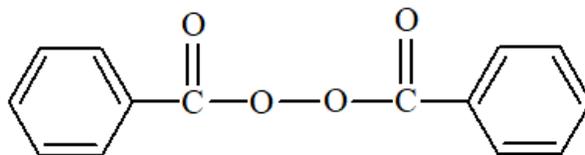
Monomers used for getting the polymers are:

- (i) Vinyl chloride ( $\text{CH}_2 = \text{CHCl}$ )
- (ii) Tetrafluoroethylene ( $\text{CF}_2 = \text{CF}_2$ )
- (iii) Formaldehyde ( $\text{HCHO}$ ) and phenol ( $\text{C}_6\text{H}_5\text{OH}$ )

13. Write the name and structure of one of the common initiators used in free radical addition polymerisation.

**Solution:**

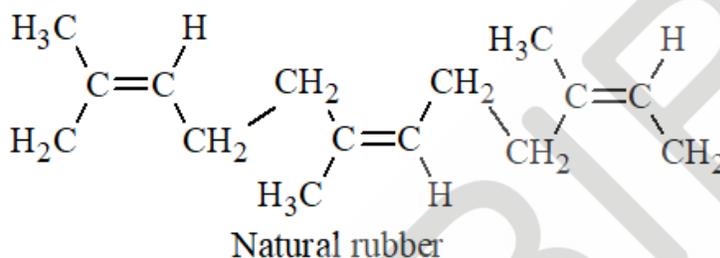
Benzoyl peroxide is one of the most common initiator used in free radical addition polymerization. The structure of Benzoyl peroxide is:



14. How does the presence of double bonds in rubber molecules influence their structure and reactivity?

**Solution:**

Natural rubber is a linear cis-polyisoprene in which the double bonds are present between C<sub>2</sub> and C<sub>3</sub> of the isoprene units.



Because of this configuration, It increases the elasticity of the rubber, as the chains are held together by weak van der Waals forces and have coiled structure.

15. Discuss the main purpose of vulcanization of rubber.

**Solution:**

Vulcanization of natural rubber is done to improve properties such as hardness, toughness and tensile strength. In Vulcanization, a mixture of raw rubber with sulphur and appropriate additives is heated at a temperature range between 373 K and 415 K. Some Additives like Zinc oxide are used to accelerate the process since this is a slow process. During this process, sulphur cross-links are formed which makes increases rubber's hardness and toughness with greater tensile strength. This vulcanized rubber has excellent elasticity, property of low water absorption and resistance to oxidation & organic solvents.

16. What are the monomeric repeating units of Nylon - 6 and Nylon - 6,6?

**Solution:**

The monomeric repeating unit of nylon 6 is  $[\text{NH} - (\text{CH}_2)_5 - \text{CO}]$ , which is derived from Caprolactam.

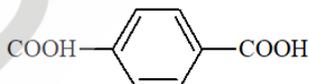
The monomeric repeating unit of nylon 6,6 is  $[\text{NH} - (\text{CH}_2)_6 - \text{NH} - \text{CO} - (\text{CH}_2)_4 - \text{CO}]$ , which is derived from hexamethylenediamine and adipoyl chloride.

17. Write the names and structures of the monomers of the following polymers:

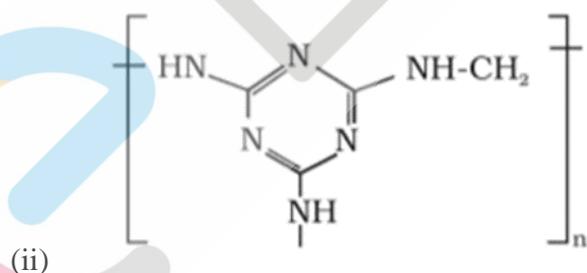
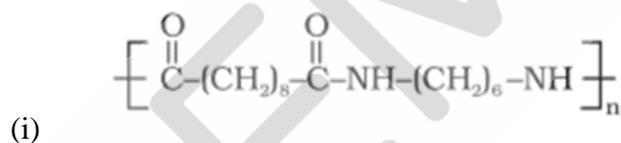
(i) Buna-S

- (ii) Buna-N
- (iii) Dacron
- (iv) Neoprene

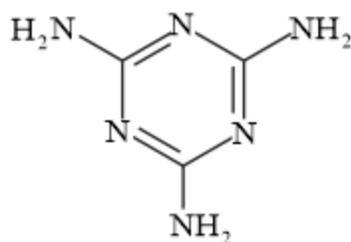
**Solution:**

Sr. No.	Polymer	Monomer	Structure of Monomer
i	Buna – S	1,3 – butadiene	$\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$
		Styrene	$\text{C}_6\text{H}_5\text{CH} = \text{CH}_2$
ii	Buna – N	1,3 – butadiene	$\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$
		Acrylonitrile	$\text{CH}_2 = \text{CH} - \text{CN}$
iii	Neoprene	Chloroprene	$\begin{array}{c} \text{Cl} \\   \\ \text{CH}_2 = \text{C} - \text{CH} = \text{CH}_2 \end{array}$
iv	Dacron	Ethylene glycol	$\text{HOH}_2\text{C} - \text{CH}_2 \text{OH}$
		Terephthalic acid	$\text{COOH} - \text{C}_6\text{H}_4 - \text{COOH}$ 

18. Identify the monomer in the following polymeric structures.

**Solution:**

- (i) The monomers of the given polymeric structure are decanoic acid  $[\text{HOOC} - (\text{CH}_2)_8 - \text{COOH}]$  and hexamethylene diamine  $[\text{H}_2\text{N} - (\text{CH}_2)_6 - \text{NH}_2]$ .
- (ii) The monomers of the given polymeric structure are melamine and formaldehyde.

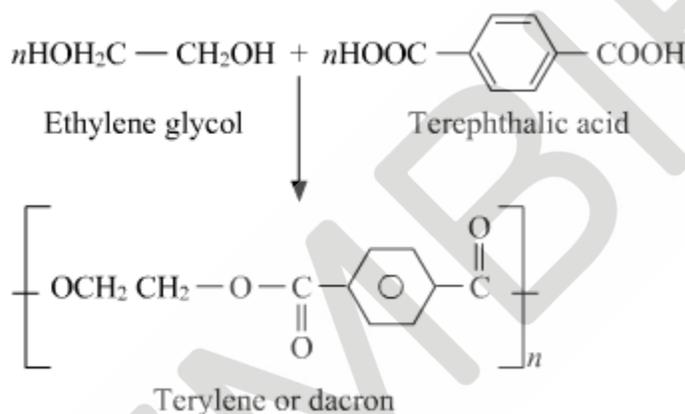


and HCHO

19. How is dacron obtained from ethylene glycol and terephthalic acid?

**Solution:**

The condensation polymerization of ethylene glycol and terephthalic acid produces dacron. The temperature maintained for the reaction is 420 to 460 K and the catalyst used is zinc acetate- antimony trioxide.



20. What is a biodegradable polymer? Give an example of a biodegradable aliphatic polyester

**Solution:**

A polymer that can be decomposed by bacteria is called a biodegradable polymer. Biodegradable polymers get degraded into simpler components like water, carbon dioxide, Nitrogen etc. upon decomposition by the action of living organisms.

Poly- $\beta$ -hydroxybutyrate-co- $\beta$ -hydroxyvalerate (PHBV) is an example of biodegradable aliphatic polyester.

