Chapter -15 (Polymers)

Exercise Questions:

Question :1 Explain the term polymer and monomer.

Answer:

Polymers are high molecular mass macromolecules composed of repeating structural units derived from monomers. Polymers have a high molecular mass . in polymers, various monomer units are joined by strong covalent bonds. Polymers can be natural as well as synthetic. Polythene, rubber, and nylon6,6 are examples of polymers. Monomers are simple, reactive molecules that combine with each other in large numbers through covalent bonds to give rise to polymers. For example ethene, propene, vinyl chloride.

Question :2 What are natural and synthetic polymers? Give two examples of each type.

Answer:

Natural polymers are polymers that are found in nature. They are formed by plants and animals. Examples include proteins, cellulose, starch, etc. synthetic polymers are polymers made by human beings. Examples include plastics, synthetic fibres, synthetic rubber etc.

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

Answer:

Homopolymer	Copolymer
The polymers that are formed by the polymerization of a single monomer ate known as homopolymers. In other words, the repeating units of homopolymers are derived only from one monomer.	The polymers whose repeating units are derived from two types of monomers known as copolymers.
For example – polythene is homopolymer of ehtene.	For example – buna-s, is a polymer of 1,3-butadiene and styrene.

Question :4 How do you explain the functionality of a monomer?

Answer:

The functionality of a monomer is the number of binding sites that is/are present in that 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.

Question :5 Define the term polymerisation.

Answer:

Polymerization is the process of forming high molecular mass macromolecules, which consists of repeating structural units derived from monomers. In a polymere, various monomer units are joined by strong bonds.

Question :6 Is (NH-CHR-CO)n, a homopolymer or completely?

Answer:

(NH-CHR-CO), is homopolymer, because it is obtained from a single monomer unit, NH_2-CHR-COOH

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

Answer:

On the basis of magnitude of intermolecular forces present in the polymers, they are classified into the following groups;

i.) Elastomers.
ii.) Fibres.
iii.) Thermoplastic polymers.
iv.) Thermosetting polymers.

Question :8 How can you differentiate between addition and condensation polymerisation?

Answer:

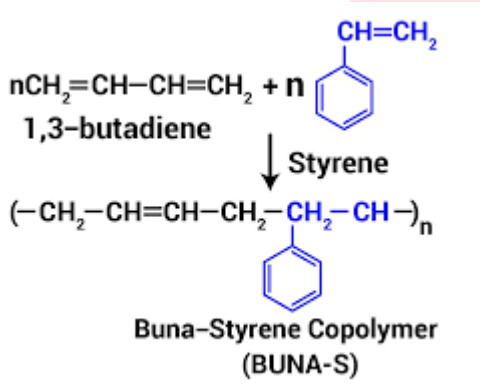
Addition polymerization	Condensation polymerization
Monomers must have either a double bond or triple bond.	Monomers must have two similar or different functional groups.
Produces no by- products.	By – products such as ammonia water and HCl are produced.

Addition of monomers result in polymer .	Condensation of polymers result in monomers.
The molecular weight of the resultant polymers is a multiple of monomer's molecular weight.	The molecular weight of the resultant polymers is not a multiple of monomer's molecular weight.
Lewis acids or base, radicals are catalyst in addition polymerization.	The catalyst in condensation polymerisation are catalyst in condensation polymerization.
Common examples are PVC, Teflon.	Common examples are nylon, silicon etc.

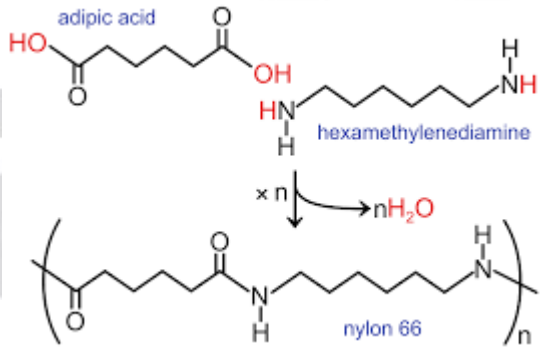
Question :9 Explain the term copolymerisation and give two examples.

Answer:

The polymers from two or more different monomeric units is called copolymerisation. Multiple uniots of each monomers are present in a copolymer. The process of forming polymer Buna – s from 1,3-butadiene and styrene is an example of copolymerisation.



Nylon 6,6 is also a copolymer formed by hexamethylenediamine and adipic acid.

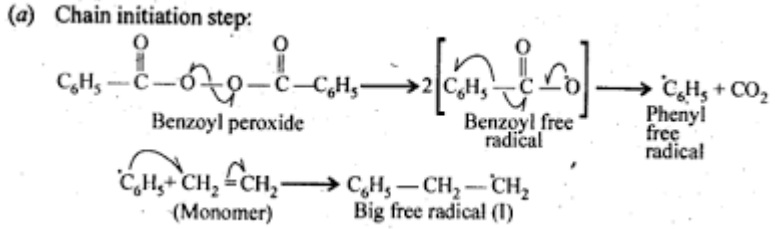


Question :10 Write the free radical mechanism for the polymerisation of ethane.

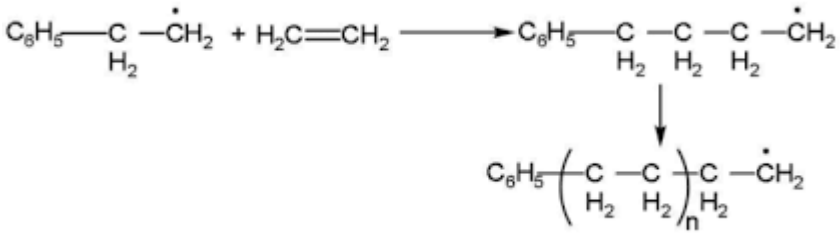
Answer:

Free radical mechanism for the polymerisation of ethane has the following steps.

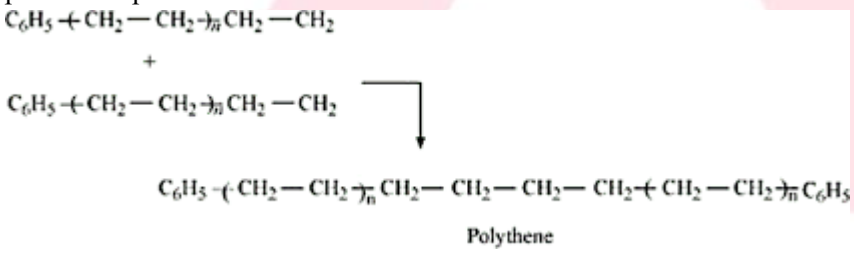
1.)Chain initiation - The chain is initiated by free radicals, Ra , produced by reaction between some of the ethene and the oxygen initiator like benzoyl peroxide



2. Chain propagation - Each time a free radical hits an ethene molecule a new bigger free radical is formed.



3. Chain termination - At the end two free radicals hit each other producing the final molecule. The process stops here because no new free radicals are formed.



Question :11 Define thermoplastic and thermosetting polymers with two examples of each.

Answer:

Thermoplastic polymers are linear long chain polymers, which can be repeatedly softened and hardened on heating. Hence, they can be modified again and again.

Examples include polythene, polystyrene.

Thermosetting polymers are cross-linked or heavily branched polymers which get hardened during the moulding process. These plastics cannot be softened again on heating. Examples of thermosetting plastics include Bakelite, urea – formaldehyde.

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

I. **Polyvinyl chloride**

II. **Teflon**

III. **Bakelite**

Answer:

i.) Vinyl chloride ($CH_2=CHCl$)

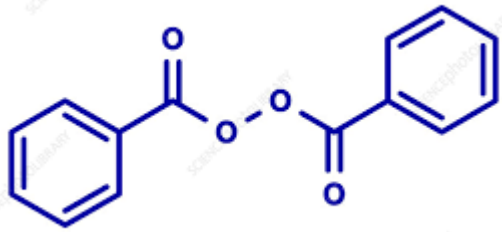
ii.) Tetreafluoroethylene ($CF_2=CF_2$)

iii.) Formaldehyde (HCHO) and phenol (C_6H_5OH)

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

Answer:

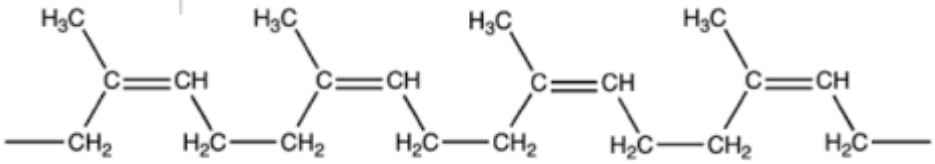
One common initiator in free radical addition polymerisation is benzoyl peroxide. Its structure is given below:



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

Answer:

Natural rubber is a linear cis - polyisoprene in which the double bonds are present between C_2 and C_3 of the isoprene units.



Because if the cis-configuration, intermolecular interaction between the various strands of isoprene are quite weak. As a result, various strands in natural rubber are arranged randomly. Hence, it shows elasticity.

Question :15 Discuss the main purpose of vulcanisation of rubber.

Answer:

Natural rubber though useful has some problems associated with its use. These limitations are discussed below:

1. Natural rubber is quite soft and sticky at room temperature. At elevated temperatures (> 335 K), it becomes even softer. At low temperatures (< 283 K), it becomes brittle. Thus, to maintain its elasticity, natural rubber is generally used in the temperature range of 283 K-335 K.

2. It has the capacity to absorb large amounts of water.

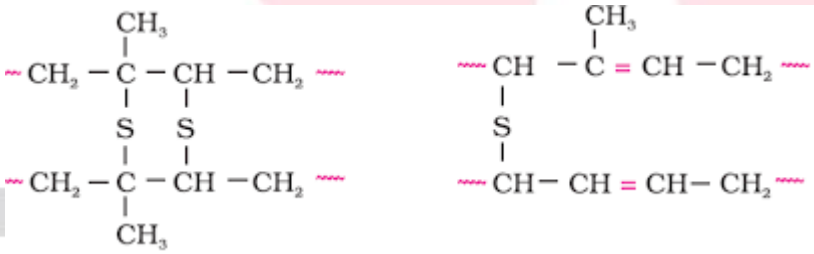
3. It has low tensile strength and low resistance to abrasion.

4. It is soluble in non-polar solvents.

5. It is easily attacked by oxidizing agents.

Vulcanization of natural rubber is done to improve upon all these properties. In this process, a mixture of raw rubber with sulphur and appropriate additive is heated at a temperature range between 373 K and 415 K.

This is a slow process, therefore some additives like zinc oxide etc. are used to accelerate the process. During this process, sulphur cross links are formed which makes rubber hard, tough with greater tensile strength .The vulcanized rubber has excellent elasticity, low water absorption, resistance to oxidation & organic solvents.



Question :16 What are the nominative repeating units of Nylon-6 and Nylon-66?

Answer:

The monomeric repeating unit of nylon 6 if [NH – $(CH2)_5$ – CO] which is derived from caprolactum.

The monomeric repeating unit of nylon 6,6 is [NH – $(CH2)_6$ – NH – CO – $(CH2)_4$ – CO] which is derived from hexamethylendiamine and adipic acid.

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

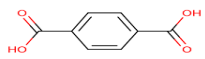
I. **Buna-S**

II. **Buna-N**

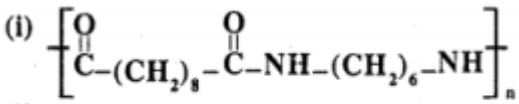
III. **Dacron**

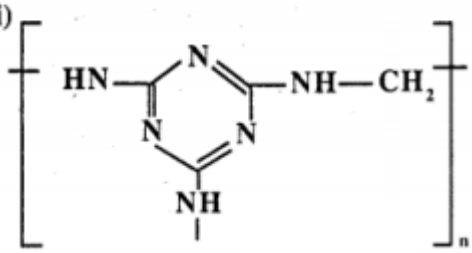
IV. **Neoprene**

Answer:

Polymer	Monomer	Structure of monomer
Buns – S	1,3-butadiene Styrene	CH2 = CH – CH – CH2 C6H5CH = CH2
Buna – N	1,3-butadiene Acrylonitrile	CH2 = CH – CH = CH2 CH2 = CH – CN
Neoprene	Chloroprene	CH2 = CHCl – CH = CH2
Dacron	Ethylene gylcol Terephthalic acid	HOH2C – CH2OH 

Question :18 Identify the monomer in the following polymeric structures.

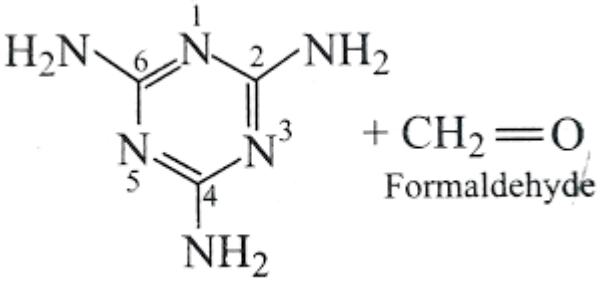
(i) 

(ii) 

Answer:

i.) The monomers of the given polymeric structure are decanoic acid. [HOOC – $(CH3)_8$ – COOH] and hexamethylenediamine [$H2N(CH2)_6NH2$]

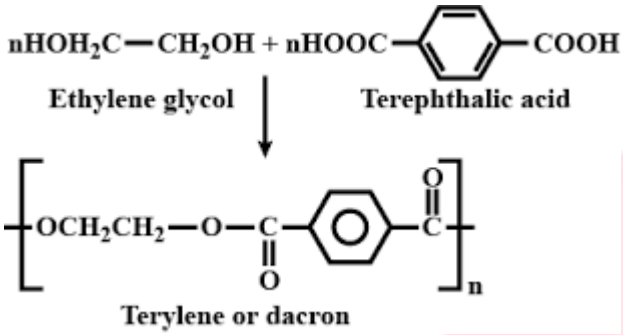
ii.) The monomer of the given polymeric structre are



Question :19 How is Dacron obtained from ethylene glucose and terephthalic acid?

Answer;

The condensation polymerisation of ethylene glycol and terephthalic acid leads to the formation pof Dacron.



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

Answer:

A polymer that can be decomposed by bacteria is called a biodegradable polymer. Poly - β – hydroxybutyrate – CO - β – hydroxyvalerate (PHBV) is a biodegradable aliphatic polyester.