Polymers

Q1: Define the following terms: monomer and polymer.

Ans:

Polymers can be defined as a macro-molecules having high molecular mass, which are made of repeating structural units derived from monomers. Polymers consists of a high molecular mass (103–107u). In one polymer, numerous monomer units are combined together by strong covalent bonds. Polymers can be both synthetic and natural. Rubber, polythene and nylon 6, 6 are examples of polymers. Simple and reactive molecules called as monomers, fuse with each other in large groups through covalent bonds to give rise to polymers. **Eg: propene, ethene, vinyl chloride, styrene.**

Q2: Explain natural and synthetic polymers with the help of two examples of each type?

Ans:

Polymers that are found in nature are called Natural Polymer. They are formed from plants and animals. Various examples of natural polymer are protein, starch, cellulose, etc.

Polymers made by human beings are known as Synthetic Polymer. **Various examples of synthetic polymer are synthetic rubbers (Buna-5), plastic (polythene), synthetic fibres (nylon 6, 6).**

Q3: Differentiate between homo-polymer and co-polymer by giving example of each.

Ans

HOMO-POLYMER	CO-POLYMER
Polymerization of a single monomer leads to formation of polymers which are known as homo-polymers. In other words, from one monomer, the repeating units of homo-polymers are formed. Example: homo-polymer of ethane is polythene.	Co-polymers are polymers whose repeating units are derived from monomers which are of two types. **Examples: Co-polymer of 1, 3 – butadiene and styrene is Buna – S.**

Q4: Briefly explain the functional of a monomer?

Ans:

The functional of a monomer may be defined as the total number of binding sites, which are present in that particular monomer.

For example, adipic acid and 1, 3-butadiene is two and that of propene and ethene is one

Q5: Explain the term polymerization.

Ans:

The process of forming high molecular mass (103–107u) macro-molecules, consisting of repeated structural units formed or derived from monomers is known as **polymerization**. Various monomer units are joined by strong covalent bonds in a polymer.

Q6: Determine whether (–NH—CHR—C0–)n **, is a homo-polymer or a co-polymer?**

Ans:

(–NH—CHR—C0–)n is a **homo-polymer**, the reason being that it is derived from a single monomer unit, NH2—CHR—COOH.

Q7: Determine the classes in which the polymers are classified on the basis of molecular forces?

Ans:

On the basis of inter molecular forces magnitude present in polymers, polymers are classified in groups given below:

(i) Elastomers

(ii) Fibres

(iii) Thermosetting polymers

(iv) Thermoplastic polymers

Q8: Differentiate between condensation and addition polymerization?

Ans:

Condensation Polymerisation : The process in which the polymers are formed by the repeating condensation reactions in between the two different bifunctional or trifunctional monomers.In this process molecules such as hydrochloric acid or water is eliminated.

For example, nylon 6, 6 is the result of condensation polymerization of hexamethylenediamine and adipic acid.

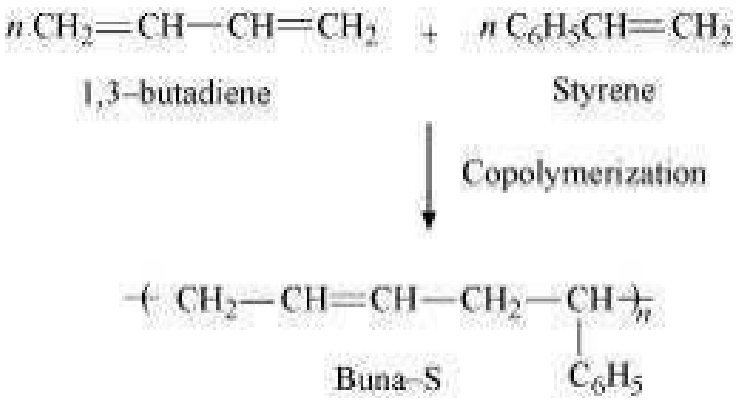
Addition Polymerisation: The process in which, the monomers having double or triple bonds are added repeatedly to form polymers.

For example, Addition polymerization of ethene leads to formation of **Polyethene.**

Q9: Explain co-polymerization with the help of two examples.

Ans:

Co-polymerisation is the process of forming polymers from two or more different monomeric units. In a co polymer, multiple units of each monomer are present. **Example of co polymerization is the process of forming polymer Buna-S from 1, 3-butadiene and styrene.**

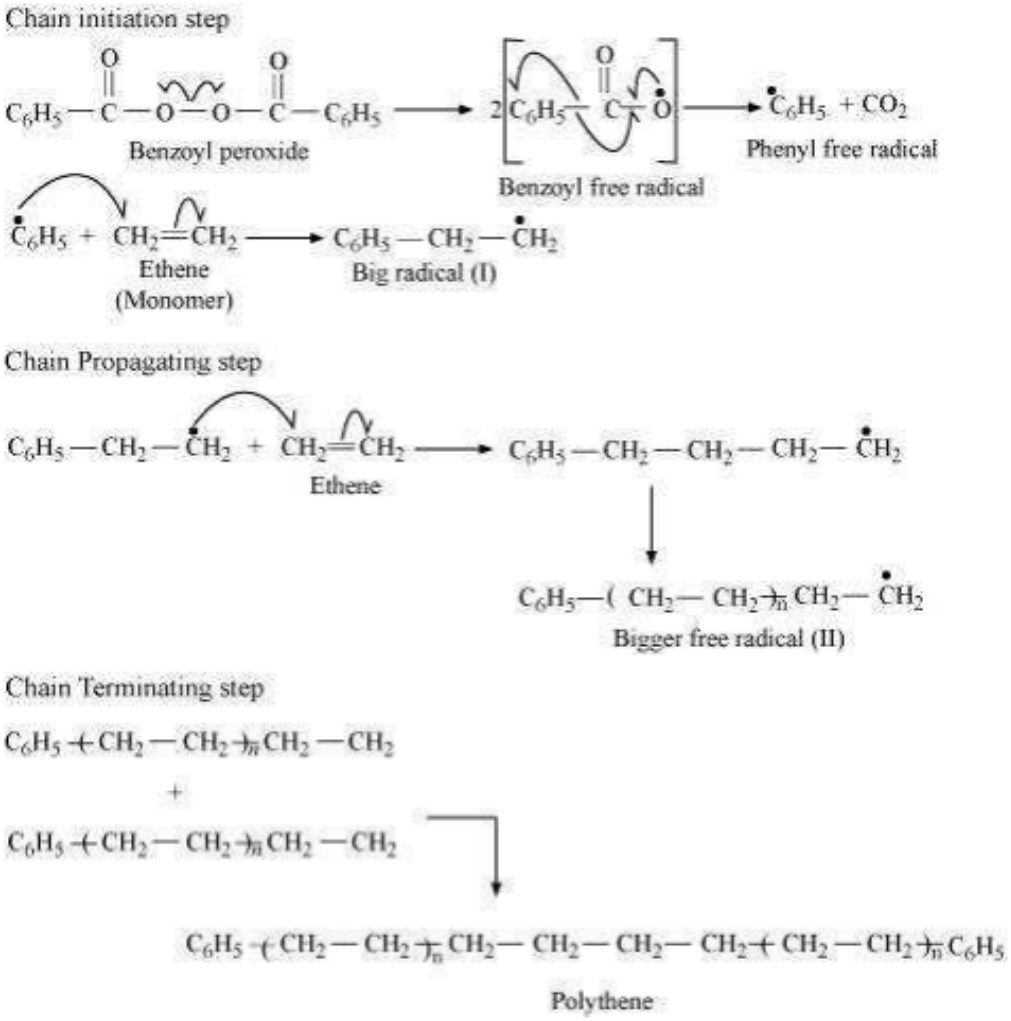


Nylon 6, 6 a copolymer formed by hexamethylenediamine and adipic acid.

Q10: Explain free radical mechanism for polymerisation of the ethene.

Ans:

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



Q 11: Define thermosetting and thermoplastics polymers? Give two examples of thermosetting and thermoplastics polymers?

Ans:

Polymers which are cross-linked or heavily branched polymers which get hardened during the molding process are called thermosetting polymers. They cannot be softened again on heating

Eg: urea-formaldehyde resins, bakelite.

Polymers which are linear (slightly branched) long chain polymers, which can be repeatedly softened and hardened on heating are called thermoplastic polymers. Hence, they can be modified again and again. **Eg: polystyrene, polythene.**

Q 12: List out the monomers used for obtaining the below polymers.

(1) Polyvinyl chloride (2) Teflon (3) Bakelite

Ans:

(1) Vinyl chloride ($CH_2=CHCl$)

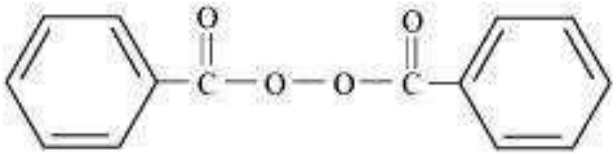
(2) Tetrafluoroethylene ($CF_2=CF_2$)

(3) Formaldehyde (HCHO) and phenol (C_6H_5OH)

Q 13: Write the name and structure of one common initiators, which are used in free radical addition polymerisation.

Ans:

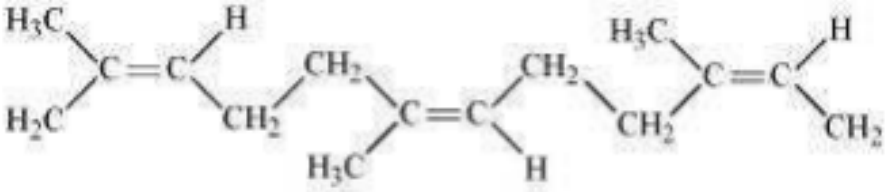
Benzoyl peroxide is one of the common initiator used in free radical addition polymerization.



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

Ans:

Natural rubber is a linear cis-polyisoprene in which the double bonds are present between C2andC3 of the isoprene units.



Natural rubber

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

Q 15: Discuss the main purpose of vulcanization of rubber.

Ans:

Natural rubber is useful but has problems associated with its use. The disadvantages of natural rubber are as follows:

1. Natural rubber is sticky and soft at room temperature. At elevated temperatures i.e grater than 335 K, it becomes even softer. At low temperatures i.e less than 283K, it becomes brittle. Therefore natural rubber can be used only at temperature range of 283 K-335 K to maintain its elasticity.

2. It absorbs large amount of water

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

4. It is soluble in non-polar solvents.

5. Can be easily attacked by oxidizing agents.

Vulcanization is done mainly to improve the properties of natural rubber. 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.

Q 16: Give the monomeric repeating units of Nylon-6 and Nylon-6, 6?

Ans:

The monomeric repeating unit of nylon 6 is [NH–(CH2)5–CO], which is derived from Caprolactam.

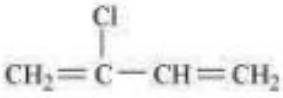
The monomeric repeating unit of nylon 6, 6 is [NH–(CH2)6–NH–CO–(CH2)4–CO], which is derived from hexamethylene diamine and adipic acid.

Q 17: List out the names and its structures of the monomers for the following polymers:

(i) Buna-S (ii) Buna-N

(iii) Dacron (iv) Neoprene

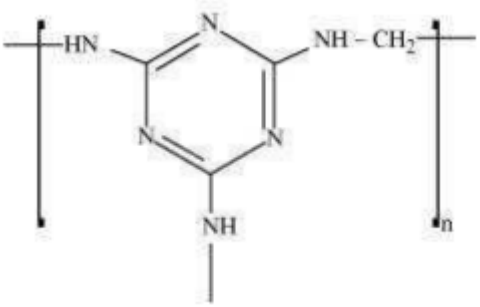
Answer

Polymer		Monomer	Structure of monomer
i	Buna-S	1, 3-butadiene	$CH_2=CH-CH=CH_2$
		Styrene	$C_6H_5CH=CH2$
ii	Buna-N	1, 3-butadiene	$CH_2=CH-CH=CH_2$
		Acrylonitrile	$CH_2=CH-CN$
iii	Neoprene	Chloroprene	
iv	Dacron	Ethylene glycol	HOH_2C-CH_2OH
		Terephthalic acid	

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

(i)

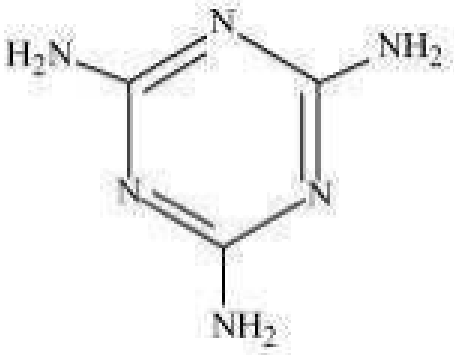
(ii)



Ans:

(i) The monomers of the given polymeric structure are hexamethylene diamine [H2N(CH2)6NH2] and decanoic acid [HOOC−(CH2)8−COOH].

(ii) The monomers of the given polymeric structure are:

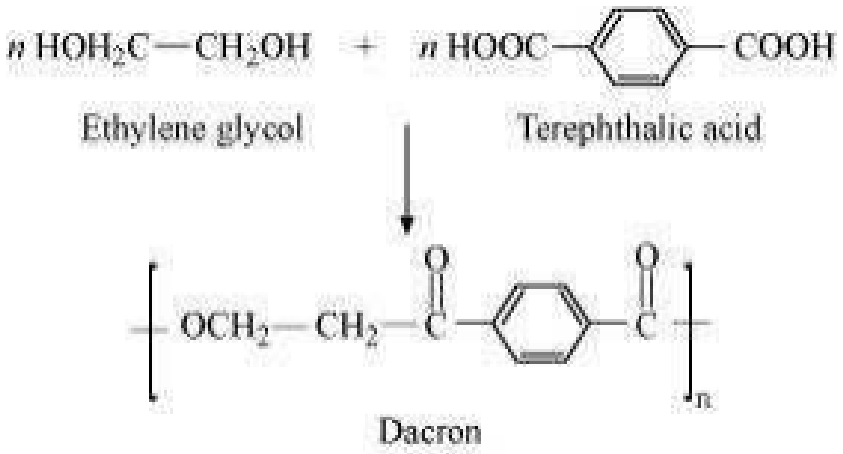


and HCHO

Q 19: How can dacron be obtained from terephthalic acid and ethylene glycol?

Ans:

Dacron is formed by the condensation polymerisation of terephthalic acid and ethylene glycol.

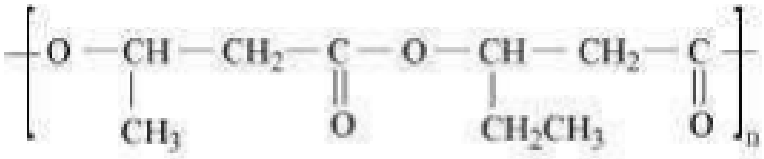


Dacron

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

Ans:

A polymer, which can be decomposed by bacteria are called as Biodegradable polymer. Poly – β – hydroxybutyrate – CO – β – hydroxyvalerate (PHBV) an example of a biodegradable aliphatic polyester.



PHBV