CHAPTER

15

Polymers

A Quick Recapitulation of the Chapter

1. Molecules of high molecular masses consisting of repeating units known as monomers linked to each other by covalent bonds are called **polymers**.
2. The process of formation of polymers from respective monomers is known as **polymerisation**.
3. **Classification of Polymers**

   On the basis of mode of source, they may be
   (a) natural (found in plants and animals)
   (b) semi-synthetic polymers (cellulose derivatives)
   (c) synthetic polymers (man-made polymers)

   On the basis of structure of polymers
   (a) Linear polymer (consist of long and straight chains)
   (b) Branched chain polymer (contain linear chains having some branches)
   (c) Cross-linked polymer (formed by bi-functional and tri-functional monomers and contain strong covalent bonds between various linear polymer).

   On the basis of mode of polymerisation
   (a) **Addition polymers** Formed by the repeated addition of monomer molecules possessing double or triple bonds. Alkene monomers to form a single huge molecule in the presence of a catalyst.
   They may be **homopolymer** (consisting of one monomer unit) or **copolymer** (consisting of two different monomeric unit).
   (b) **Condensation polymers** Formed by the repeated condensation reaction between two different bi-functional or tri-functional monomeric units with the elimination of simple molecules suchas water, alcohol etc.

   On the basis of molecular forces, they may be classified as elastomers, fibres, thermoplastic and thermosetting polymers. The strength of forces present in different types of polymer follow the order:

   Elastomer < thermoplastic < fibres < thermosetting.
4. Natural polymer possess elastic properties also termed as **elastomer**. It is a linear polymer of isoprene or *cis*-1, 4-polyisoprene.
5. **Biodegradable** polymers can be degraded by environmental process like degradation by bacteria enzymes, e.g. poly-β-hydroxybutyrate-co-β-hydroxy valerate (PHBV), nylon-2-nylon-6.

Polymer	**Monomer**(s)
Polythene (addition)	Ethene
Polypropene (addition)	Propene
Polystyrene (addition)	Styrene
Polyvinyl chloride (addition)	Vinyl chloride
Polytetrafluoroethene or teflon (addition)	Tetrafluoroethene
Nylon 6, 6 (condensation)	Hexamethylenediamine and adipic acid
Nylon 6 (condensation)	Caprolactam
Terylene or dacron (condensation)	Ethylene glycol and terephthalic acid
Natural rubber (addition)	Isoprene (1, 3-butadiene)
Neoprene (addition)	Chloroprene (3-chloro-1, 3-butadiene)
Buna-N (addition)	1, 3-butadiene and acrylonitrile
Buna-S (addition)	1, 3-butadiene and styrene
PHBV (condensation)	3-hydroxybutanoic acid and 3-hydroxypentanoic acid
Bakelite (condensation)	Phenol and formaldehyde

6. **Types of Polymerisation Reactions**
   (a) Addition or chain growth polymerisation takes place by the formation of either free radicals or ionic species. e.g. polythene, teflon and polyacrylonitrile.
   (b) Condensation or step growth polymerisation takes place with elimination of simple molecule like water, alcohol etc. e.g. polyamides (polymer with amide linkage), polyesters (polymers with ester linkage), phenol formaldehyde polymer (bakelite, novolac etc).
   (c) Copolymerisation is a polymerisation reaction in which a mixture of more than one monomeric species is allowed to polymerise and form a copolymer, e.g. butadiene-styrene copolymer.
7. **Vulcanisation** of rubber is done to improve the physical properties of rubber. This process consists of heating a mixture of raw rubber with sulphur and an appropriate additive at a temperature range between 373 K to 415 K.
   Synthetic rubbers is any vulcanisable rubber which is capable of getting stretched to twice its length.

Objective Questions Based on NCERT Text

Topic 1
Classification of Polymers

1. Examples of natural polymers are
(a) proteins, cellulose, starch
(b) rayon, cellulose, starch
(c) rayon, buna-S, starch
(d) proteins, buna-S, buna-N

2. Resins and rubber are the examples of
(a) natural polymers (b) synthetic polymers
(c) semi-synthetic polymers (d) None of these

3. To which category of polymers, cellulose derivatives belong to?
(a) Synthetic polymers (b) Semi-synthetic polymers
(c) Natural polymers (d) Branched polymers

4. Rayon is chemically known as
(a) cellulose nitrate (b) starch
(c) cellulose acetate (d) resins

5. Common examples of semi-synthetic polymers are
(a) cellulose and starch
(b) cellulose acetate and cellulose nitrate
(c) buna-N and buna-S
(d) cellulose nitrate and buna-S

6. Which among the following belongs to man-made polymers?
(a) Nylon-6,6 and rayon (b) Buna-S and buna-N
(c) Nylon-6,6 and buna-N (d) Rayon and buna-N

7. On the basis of structure of polymers, they can be classified as
(a) linear, branched and network polymers
(b) natural, synthetic and network polymers
(c) natural, synthetic and semi-synthetic polymers
(d) natural, synthetic and linear polymers

8. The polymers which consist of long and straight chains are known as
(a) linear polymers (b) cross-linked polymers
(c) branched polymers (d) network polymers

9. Consider the following figure of a polymer,

The type of polymer given in the figure is
(a) branched (b) network
(c) linear (d) cross-linked

10. Examples of linear polymers are
(a) HDP and PVC (b) HDP and LDP
(c) LDP and PVC (d) PVC and bakelite

11. What is full-form of HDP?
(a) High density polythelene
(b) High density polythene
(c) High density polypropene
(d) High density polypropylene

12. Polymers containing linear chains having some branches are known as
(a) network polymers (b) branched polymers
(c) linear polymers (d) cross-linked polymers

13. Consider the figure of a polymer,

The type of polymer(s) given in the figure is/are
(a) branched chain polymer (b) linear polymer
(c) cross-linked polymer (d) Either (a) or (c)

14. Low density polythene is an example of
(a) cross-linked polymer (b) natural polymer
(c) linear polymer (d) branched polymer

15. Cross-linked or network polymers are usually formed by
(a) bi-functional monomer (b) tri-functional monomer
(c) monofunctional monomer (d) Both (a) and (b)

16. In the following figure,

A and *B* respectively are
(a) branched and linear polymer
(b) cross-linked and linear polymer
(c) linear and branched polymer
(d) cross-linked and branched polymer

17. On the basis of mode of polymerisation, polymers can be classified as
(a) addition and condensation polymers
(b) addition and homopolymers
(c) homopolymers and copolymers
(d) None of the above

18. Homopolymers and copolymers are the types of
(a) condensation polymers (b) addition polymers
(c) linear polymers (d) branched polymers

19. The repeated addition of same monomer molecules having double or triple bonds is known as
(a) copolymer (b) elastomer
(c) homopolymer (d) fibre

20. The monomer unit of polythene is
(a) ethene (b) ethane
(c) ethyne (d) ethanol

21. What is $\left[CH_2 — CH(C_6H_5) \right]_n$?
(a) Homopolymer (b) Copolymer
(c) Both (a) and (b) (d) Neither (a) nor (b)

22. Copolymers are
(a) polymers made by addition polymerisation from two different monomers
(b) polymers made by condensation polymerisation from two different monomers
(c) polymers made by condensation polymerisation of a single monomer
(d) polymers made by addition polymerisation of a single monomer

23. Buna-S is a copolymer of
(a) ethene and styrene
(b) 1, 3-butadiene and ethene
(c) 1, 3-butadiene and styrene
(d) ethene and propene

24. Which one of the following is not a condensation polymer? **(CBSE AIPMT 2012)**
(a) Melamine (b) Glyptal
(c) Dacron (d) Neoprene

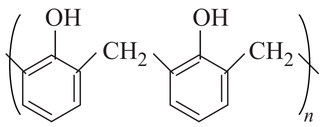
25. Which of the following does not come under the classification of polymer on the basis of source?
(a) Natural (b) Addition
(c) Condensation (d) Both (b) and (c)

26. The product of following reaction is
Hexamethylene diamine + adipic acid $\xrightarrow{\text{Polymerisation}}$
(a) nylon-6 (b) nylon-6,6
(c) teflon (d) bakelite

27. The correct classification of polymers based on molecular forces is
(a) linear, branched chain and cross linked polymers
(b) elastomers, fibres, thermoplastic and thermosetting polymers
(c) homopolymers and copolymers
(d) None of the above

28. Rubber like solids with elastic properties are called
(a) elastomers
(b) fibres
(c) thermosetting polymers
(d) thermoplastic polymers

29. Fibres have the characteristic features like
(a) thread forming solids
(b) high tensile strength and high modulus
(c) crystalline nature
(d) All of the above

30. Which one of the following is an example of a thermosetting polymer? **(CBSE AIPMT 2014)**
(a) $\left(CH_2 — \underset{\underset{Cl}{|}}{C} = CH — CH_2 \right)_n$
(b) $\left(CH_2 — \underset{\underset{Cl}{|}}{CH} \right)_n$
(c) $\left(\overset{\overset{H}{|}}{N} — (CH_2)_6 — \overset{\overset{H}{|}}{N} — \overset{\overset{O}{\|}}{C} — (CH_2)_4 — \overset{\overset{O}{\|}}{C} \right)_n$
(d) 

Topic 2
Types of Polymerisation Reactions

31. In addition polymerisation, the molecules of the different monomers add together to form a
(a) chain-growth polymer (b) homopolymer
(c) copolymer (d) (a), (b) and (c)

32. Which of the following does not act as a free-radical generating initiator?
(a) Acetyl peroxide (b) Benzoyl peroxide
(c) *tert*-butyl peroxide (d) Ethyl alcohol

33. In the following reaction,

$$\text{Ethene} \xrightarrow[350-570\ \text{K, traces of } O_2]{1000-2000\ \text{atm}} A$$

Here, *A* refers to
(a) HDP (b) LDP (c) teflon (d) melamine

34. Which of the following features is true about low density polythene?
(a) Highly branched structure
(b) Tough
(c) Poor conductor of electricity
(d) All of the above

35. HDP is formed in the presence of catalyst
(a) peroxide (b) *Ziegler-Natta*
(c) H_2 / Ni (d) Br_2 / Ni

36. Which of the following is used as the catalyst in the manufacture of polythene by *Ziegler-Natta* method?
(a) Titanium dioxide
(b) Titanium tetrachloride and triphenylaluminium
(c) Titanium isoperoxide
(d) Titanium tetrachloride and triethylaluminium

37. Teflon is manufactured by heating
(a) tetrafluoroethane (b) tetrafluoromethylene
(c) tetrafluoroethene (d) tetrafluoromethane

38. A polymer *X* is prepared by heating its monomer *Y* with a free radical or persulphate catalyst at high pressure. *X* is chemically inert and resistant to attack by corrosive reagents and useful in making non-stick surface coated utensils. Find *X* and *Y*.
(a) Teflon and tetrafluoroethene
(b) Orlon and polyacrylonitrile
(c) Teflon and Tetrafluoroethane
(d) Dacron and ethylene glycol

39. Which of the following polymers is used as a substitute for wool in the making of commercial fibres?
(a) Polyacrylonitrile (b) Teflon
(c) Bakelite (d) HDP

40. The commercial name of polyacrylonitrile is
(a) orlon (acrilan) (b) dacron
(c) bakelite (d) melamine

41. Acrilan is a hard, horny and a high melting material. Which one of the following represents its structure?

(a) $-\left(CH_2-\underset{\displaystyle CN}{\underset{|}{CH}}\right)_n-$ (b) $-\left(CH_2-\underset{\displaystyle COOCH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}\right)_n-$

(c) $-\left(CH_2-\underset{\displaystyle COOC_2H_5}{\underset{|}{CH}}\right)_n-$ (d) $-\left(CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}\right)_n-$

42. When polymerisation involves a repetitive condensation reaction between two bi-functional monomers. Some small molecules like H_2O, alcohol etc, are lost. This polymerisation is known as
(a) addition polymerisation
(b) step-growth polymerisation
(c) Both (a) or (b)
(d) Neither (a) nor (b)

43. Which of the following organic compounds polymerises to form the polyester dacron?
(CBSE AIPMT 2014)
(a) Propylene and *para* HO $-(C_6H_4)-$ OH
(b) Benzoic acid and ethanol
(c) Terephthalic acid and ethylene glycol
(d) Benzoic acid and *para* HO $-(C_6H_4)-$ OH

44. Which of the following polymers has ethylene glycol as one of the monomer units?
(a) $-(CH_2-CH_2)_n-$

(b) $-\left(O-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-C(=O)-O-\underset{\displaystyle CH_2CH_3}{\underset{|}{CH}}-CH_2-C(=O)\right)_n-$

(c) $-\left(OCH_2-CH_2OOC-C_6H_4-CO\right)_n-$

(d) $-\left(CH_2-CH=CH-CH_2-\underset{\displaystyle C_6H_5}{\underset{|}{CH}}-CH_2\right)_n-$

45. Which one of the following polymers is prepared by condensation polymerisation?

(a) Teflon (b) Natural rubber
(c) Styrene (d) Nylon-6,6

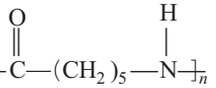
46. $-[-NH(CH_2)_6NHCO(CH_2)_4CO-]_n$ is a

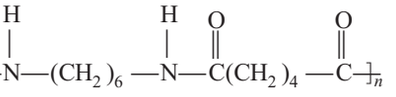
(a) homopolymer
(b) copolymer
(c) addition polymer
(d) thermosetting polymer

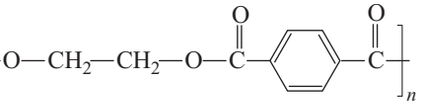
47. In the following reaction,

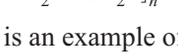
$$n\,HOOC(CH_2)_4COOH + n\,H_2N(CH_2)_6NH_2 \xrightarrow[\text{High pressure}]{553\ K}$$

Find the product.

(a) 

(b) 

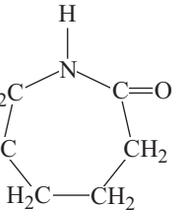
(c) 

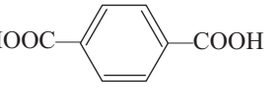
(d) 

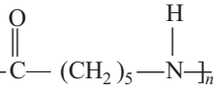
48. Nylon is an example of **(NEET 2013)**

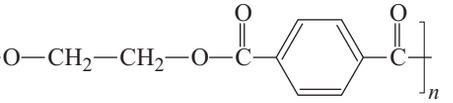
(a) polyester (b) polysaccharide
(c) polyamide (d) polythene

49. Identify the correct structure of caprolactam.

(a) 

(b) 

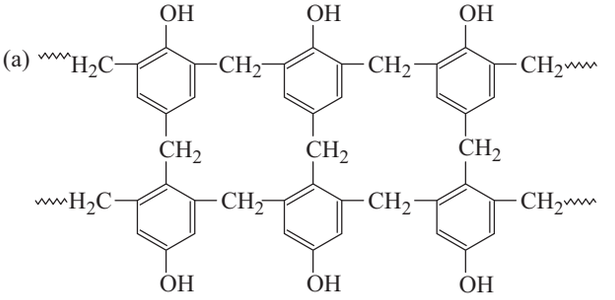
(c) 

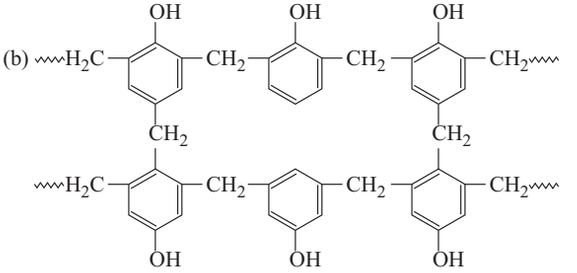
(d) 

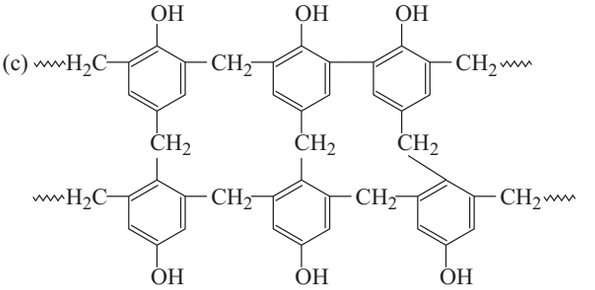
50. Of the following which one is classified as polyester polymer? **(CBSE AIPMT 2011)**

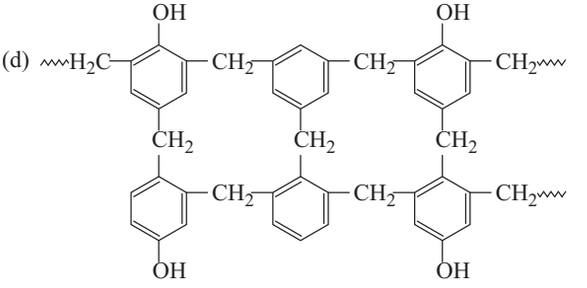
(a) Nylon-6, 6 (b) Terylene
(c) Bakelite (d) Melamine

51. Identify the correct structure of bakelite.

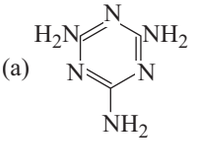
(a) 

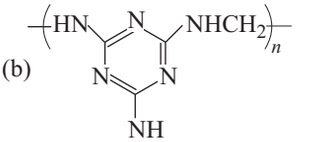
(b) 

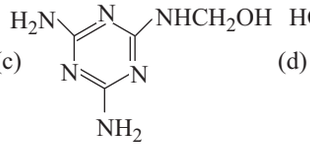
(c) 

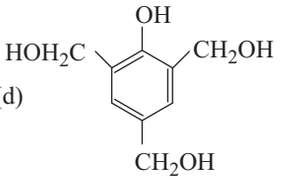
(d) 

52. When melamine and formaldehyde polymerise, a resin intermediate is formed. Identify the structure of this intermediate.

(a) 

(b) 

(c) 

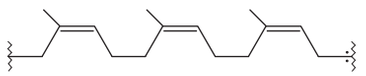
(d) 

53. The oldest synthetic polymer(s) is/are
(a) bakelite (b) novolac
(c) melamine (d) Both (a) and (b)

54. When the reaction initiates between the phenol and formaldehyde to give bakelite. This initial reaction is an example of
(a) aromatic nucleophilic substitution
(b) aldol condensation
(c) aromatic electrophilic substitution
(d) free radical reaction

55. Among the following polymers, the phenol formaldehyde resin is
(a) teflon (b) bakelite
(c) melamine (d) buna-N

56. In an isoprene polymer, all the isoprene have
(a) *cis*-1,4 configuration
(b) *trans*-1,4 configuration
(c) Both (a) and (b)
(d) None of the above

57. 

Identify this polymer.
(a) *Gutta- Percha* (b) Neoprene
(c) Polypropylene (d) Natural rubber

58. Which one of the following statements is not true?
(a) Buna-S is a copolymer of butadiene and styrene
(b) Natural rubber is a 1,4- polyisoprene
(c) In vulcanisation, the formation of sulphur bridges between different chains make rubber harder and stronger
(d) Natural rubber has the *trans*-configuration at every double bond

59. Which is the monomer of neoprene in the following? **(NEET 2013)**

(a) $CH_2=CH-C\equiv CH$ (b) $CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH=CH$

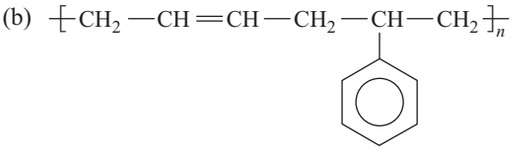
(c) $CH_2=\underset{\displaystyle Cl}{\underset{|}{C}}-CH=CH_2$ (d) $CH_2=CH-CH=CH_2$

60. In the following reaction,

$$n\,CH_2=\underset{\displaystyle Cl}{\underset{|}{C}}-CH=CH_2 \xrightarrow{\text{Polymerisation}} A$$

Here, A refers to

(a) $\left[-CH_2-\underset{\displaystyle Cl}{\underset{|}{C}}=CH-CH_2-\right]_n$

(b) 

(c) $\left[-CH_2-CH_2-\right]_n$

(d) $H_2C=CH-CN$

61. Which of the following structures represents neoprene polymer?

(a) $\left[-CH_2-\underset{\displaystyle Cl}{\underset{|}{C}}=CH-CH_2-\right]_n$

(b) $\left[-CH_2-\underset{\displaystyle CN}{\underset{|}{CH}}-\right]_n$

(c) $\left[-CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}-\right]_n$

(d) $\left[-\underset{\displaystyle C_6H_5}{\underset{|}{CH}}-CH_2-\right]_n$

62. Which structure of polymers is not correctly presented?

(a) Neoprene $\left[-CH_2-\underset{\displaystyle Cl}{\underset{|}{C}}=CH-CH_2-CH_2-\right]$

(b) Terylene $\left[-OC-C_6H_4-COOCH_2-CH_2-O-\right]_n$

(c) Nylon-6, 6 $\left[-NH(CH_2)_6NHCO(CH_2)_4-CO-\right]_n$

(d) Teflon $\left[-CF_2-CF_2-\right]_n$

63. Find the odd one
(a) polychloroprene (b) polyisoprene
(c) nitrile rubber (d) novolac

64. Which of the following statements is false?
(a) PTFE is called teflon
(b) LDP is called low density polythene
(c) PVC is also called polyvinyl chloride
(d) SBR is called natural rubber

65. Polymer which contains strong intermolecular forces, e.g. hydrogen bonding is
(a) polystyrene (b) nylon-6,6
(c) teflon (d) natural rubber

Topic 3
Molecular Mass of Polymers and Biodegradable Polymers

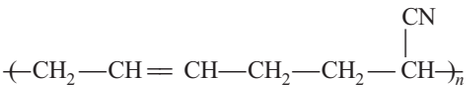
66. Polymer properties are closely related to their
(a) molecular mass (b) size
(c) structure (d) All of the above

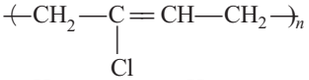
67. The growth of the polymer chain during their synthesis depends on
(a) availability of monomers
(b) types of monomer
(c) temperature of reaction mixture
(d) None of the above

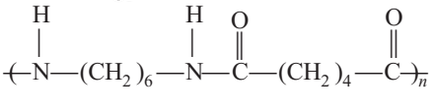
68. PHBV stands for
(a) poly β-hydroxybutyrate valerate
(b) poly-hydroxy butyrate valerate
(c) poly β-hydroxybutyrate-co- β-hydroxy valerate
(d) poly α-hydroxy butyrate-co- β-hydroxy valerate

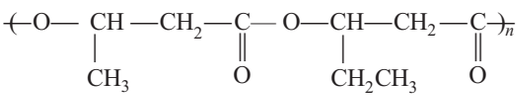
69. Consider the following statements about PHBV and identify the correct one.
(a) It is obtained by the copolymerisation
(b) It is used in speciality packaging, orthopaedic devices
(c) It undergoes bacterial degradation in the environment
(d) All of the above

70. Identify the biodegradable polymer.

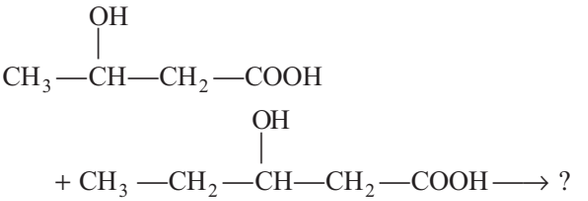
(a) 

(b) 

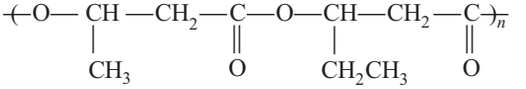
(c) 

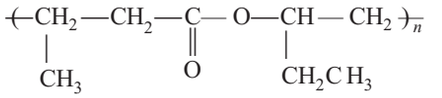
(d) 

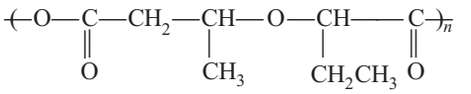
71. Consider the following reaction,

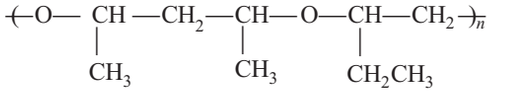


Identify the product.

(a) 

(b) 

(c) 

(d) 

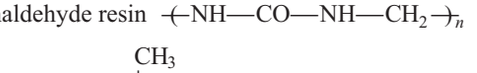
72. Which of the following is a biodegradable polymer?
(a) PHBV (b) Nylon-6
(c) Buna-S (d) Buna-N

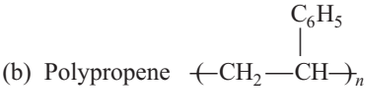
73. Biodegradable polymer which can be produced from glycine and amino caproic acid is
(CBSE AIPMT 2014)
(a) nylon 2-nylon 6 (b) PHBV
(c) buna-N (d) nylon-6, 6

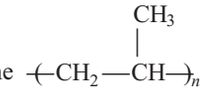
74. Monomeric unit of nylon 2- nylon 6 is
(a) glycine and caproic acid
(b) alinine and amino caproic acid
(c) alanine and caproic acid
(d) glycine and amino caproic acid

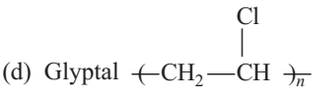
Topic 4
Polymer of Commercial Importance

75. Which of the following is correctly matched?

(a) Urea-formaldehyde resin 

(b) Polypropene 

(c) Polystyrene 

(d) Glyptal 

76. Baby feeding bottles and soft drinks bottles are usually made up of

(a) polyurethane (b) polyester
(c) polyamide (d) polyethylene-HDPE

77. Choose the correct statement regarding the use of glyptal.

(a) Used to manufacture rain coats
(b) Used to manufacture lacquers
(c) Used for making combs
(d) Used to manufacture toys

78. Among the following, which polymer is used for making combs, electrical switches, handles of utensils and computer discs?

(a) bakelite (b) glyptal
(c) polystyrene (d) PVC

79. Identify the polymer that is used to make unbreakable cups and laminated sheets.

(a) Glyptal
(b) Urea-formaldehyde resin
(c) Bakelite
(d) None of the above

Special Format Questions

I. More Than One Correct Option

80. Which of the following substances are polymers?

(a) Plastics (b) Paints
(c) Clothes (d) Synthetic rubber

81. Which of the following are the characteristics of thermoplastic polymers?

(a) Slightly branched long chain polymers
(b) Soften on heating and harden on cooling, can be reused
(c) Become infusible on moulding so cannot be reused
(d) Linear slightly branched long chain molecules

82. Which of the following are the characteristics of vulcanised rubber?

(a) It is more elastic
(b) It is soluble in inorganic solvent
(c) It has a crystalline structure
(d) It is more stiff as compare to other rubber

83. Which of the following polymers have vinylic monomer units?

(a) Teflon (b) Polystyrene
(c) Nylon (d) Acrilan

84. Which of the following monomers form biodegradable polymers?

(a) Caprolactam
(b) Ethylene glycol + phthalic acid
(c) Glycine + amino caproic acid
(d) 3-hydroxybutanoic acid + 3-hydroxypentanoic acid

II. Statement Based Questions

85. Consider the following statements.

I. Polymers are also referred macromolecules.
II. The molecular mass of polymers varies from $10^3 - 10^7$ u.
III. The repeating structural unit which combines to form polymer is monomer.
IV. The repeating structural unit are linked to each other by ionic bond.

Select the correct statement(s) and mark the correct option.

(a) Only I (b) Both II and III
(c) I, II and III (d) None of these

86. Consider the following facts,

I. Weakest intermolecular forces are present in elastomers.
II. Fibres possess crystalline nature.
III. Ionic bonds are present in thermoplastic polymers.

Identify the option with all correct statements.

(a) Both I and II (b) Both II and III
(c) Both I and III (d) I, II and III

87. Which of the following statements are incorrect?

I. Addition polymerisation is also known as chain-growth polymerisation.
II. Thermoplastics do not have any cross-links between the chains.
III. Hydrogen bonds or dipole-dipole interactions are present in fibres.

The option with all incorrect statements is

(a) I and II (b) Both II and III
(c) I, II and III (d) None of these

88. Consider the following statements,

I. Adipic acid and hexamethylene diamine are the monomeric units of nylon-6,6.
II. Nylon-6,6 is a polyester.

Which of the following statement is/are incorrect? Choose the correct option.

(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

89. I. Caprolactam is the monomer of nylon-6.
II. Dacron is the monomer of ethylene glycol.
III. Orlon is the monomer of polyacrylonitrile.
IV. Tetrafluoroethene is the monomer of teflon.

Which of the above mentioned statement(s) is/are correct? Choose the correct option.

(a) Only I (b) Only II
(c) Both I and IV (d) Both II and III

90. Consider the following statements about bakelite
I. It is a phenol-formaldehyde resin.
II. It is a linear product.
III. Soft bakelite is used for making glue, for binding laminated wooden planks and also in varnishes.
IV. Hard bakelite is useful in making combs, fountain pen, phonograph records, barrels etc.

Which of the above facts are true about bakelite? Choose the correct option.

(a) I, II and III (b) II, III and IV
(c) I, III and IV (d) I, II, III and IV

91. Properties of rubber include
I. it is a rubber latex, which is a colloidal suspension of rubber in water.
II. it is highly elastic.
III. it is found in tropical and semi-tropical parts of the world.

Which of the above statement(s) is/are true about rubber? Choose the correct option.

(a) Only III (b) Only II
(c) Only I (d) All of these

92. Which of the following statements is/are correct?
I. Raw rubber has high elasticity.
II. Tensile strength of vulcanised rubber is almost ten times as compared to raw rubber.

The correct option is

(a) Only II (b) Only I
(c) Neither I nor II (d) Both I and II

93. Which of the following is the correct increasing order of their intermolecular forces?
I. Buna-S < polythene < nylon-6, 6
II. Neoprene < polyvinyl chloride < nylon-6

Choose the correct option

(a) Only I
(b) Both are correct
(c) Only II
(d) None of these are correct

94. Consider the following statements regarding polymer
I. The functionality of ethene, propene, styrene acrylonitrile is two.
II. The functionality of ethylene glycol, adipic acid hexamethylene diamine is one.

Identify whether the above statements are correct or incorrect and according mark the correct option.

(a) Statement I is correct
(b) Statement II is correct
(c) Both statements I and II are correct
(d) Both the statements are incorrect

95. Consider the following statements,
I. PVC is useful in making unbreakable cups and laminated sheets.
II. Glyptal is useful in making paints and lacquers.
III. Polypropene is useful in making ropes, toys, pipes fibres etc.
IV. Bakelite is useful in making combs, electrical switches etc.

Which of the above statements are correct? Choose the correct option.

(a) Both I and II (b) Both II and III
(c) Both III and IV (d) II, III and IV

96. Which of the following statements is/are correct?
I. Molecular mass is expressed as an average.
II. Molecular mass of polymers can be determined by physical and chemical methods.

Choose the correct option.

(a) Only I (b) Only II
(c) Both I and II (d) None of these

III. Assertion-Reason Type Questions

■ **Directions** (Q Nos. 97-106) *In the following questions a statement of Assertion* (A) *followed by a statement of Reason* (R) *is given. Choose the correct answer out of the following choices.*

(a) Both A and R are correct; R is the correct explanation of A.
(b) Both A and R are correct; R is not the correct explanation of A.
(c) A is correct; R is incorrect.
(d) A is incorrect; R is correct.

97. **Assertion** (A) Most of the synthetic polymers are not biodegradable.

Reason (R) Polymerisation process basically induces toxic character in organic molecules.

98. **Assertion** (A) Thermosetting polymers undergo permanent change on heating.

Reason (R) On heating, extensive cross-links formed between polymer chains.

99. **Assertion** (A) Network polymers are thermosetting polymers.

Reason (R) Network polymers have high molecular mass.

100. **Assertion** (A) Olefinic monomers undergo addition polymerisation.

Reason (R) Polymerisation of vinyl chloride is initiated by peroxides/persulphates.

101. **Assertion** (A) Low density polythene is used in the insulation of electricity carrying wires.

Reason (R) LDP is chemically inert.

102. **Assertion** (A) Polytetrafluoroethene is used in making non-stick cookwares.

Reason (R) Fluorine has highest electronegativity.

103. **Assertion** (A) Polyamides are best used as fibres because of high tensile strength.

Reason (R) Strong intermolecular forces (like hydrogen bonding within polyamides) lead to close packing of chains and increase the crystalline character, hence provide high tensile strength to polymers.

104. **Assertion** (A) For making rubber synthetically, isoprene molecules are polymerised.

Reason (R) Neoprene (a polymer of chloroprene) is not a synthetic rubber.

105. **Assertion** (A) Molecular mass of polymer is expressed as an average.

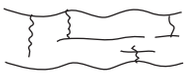
Reason (R) Polymer sample contains chains of varying lengths.

106. **Assertion** (A) Glyptal is a copolymer.

Reason (R) It has two monomeric units ethylene glycol and phthalic acid.

IV. Matching Type Questions

107. Match the following and choose the correct option from the codes given below.

Column I		Column II
A. Cross-linked	1.	
B. Linear	2.	
C. Branched-chain	3.	

Codes

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	2	1	3
(d)	2	3	1

108. Match the following and choose the correct option from the codes given below.

Column I (Classification basis)	Column II (Types of polymers)
A. Source	1. Network
B. Structure	2. Condensation
C. Molecular force	3. Natural
D. Mode of polymerisation	4. Elastomer

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	3	1	4	2
(c)	2	4	1	3
(d)	4	3	2	1

109. Match the following and choose the correct option from the codes given below.

Column I (Chemical name)	Column II (Polymer)
A. Polycaprolactam	1. Acrilan
B. Polyacrylonitrile	2. Natural rubber
C. *cis*-polyisoprene	3. Nylon-6

Codes

	A	B	C
(a)	2	3	1
(b)	3	1	2
(c)	1	2	3
(d)	1	3	2

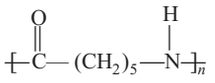
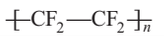
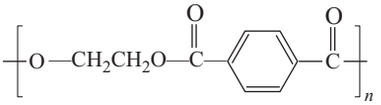
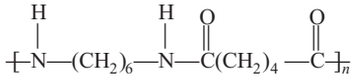
110. Match the following and choose the correct option from the codes given below.

Column I (Mode of polymerisation)	Column II (Polymer)
A. Condensation polymerisation	1. HDP
B. *Ziegler-Natta*	2. Nylon- 6,6
C. Free radical	3. PVC

Codes

	A	B	C
(a)	1	2	3
(b)	3	2	1
(c)	2	1	3
(d)	2	3	1

111. Match the following and choose the correct option from the codes given below.

	Column I (Name of the polymer)		Column II (Structure)
A.	Teflon	1.	
B.	Dacron	2.	
C.	Nylon-6, 6	3.	
D.	Nylon-6	4.	

Codes

	A	B	C	D
(a)	4	3	2	1
(b)	1	2	3	4
(c)	4	1	2	3
(d)	2	3	4	1

112. Match the following and choose the correct option from the codes given below.

	Column I		Column II
A.	Polyesters	1.	Novolac
B.	Polyamide	2.	Dacron
C.	Phenol-formaldehyde polymer	3.	Nylon-6
D.	Polyacrylonitrile	4.	Orlon

Codes

	A	B	C	D
(a)	1	2	4	3
(b)	4	1	3	2
(c)	3	4	2	1
(d)	2	3	1	4

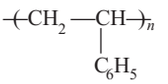
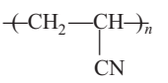
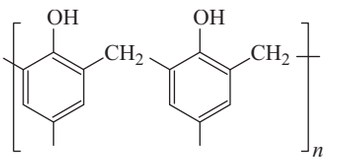
113. Match the following and choose the correct option from the codes given below.

	Column I (Polymer)		Column II (Uses)
A.	Bakelite	1.	Paints
B.	Teflon	2.	Phonograph records
C.	Melamine	3.	Unbreakable crockery
D.	Novolac	4.	Non-stick coated surface utensils

Codes

	A	B	C	D		A	B	C	D
(a)	1	3	4	2	(b)	2	4	3	1
(c)	3	2	1	4	(d)	4	1	2	3

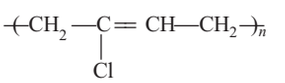
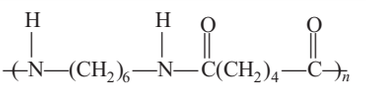
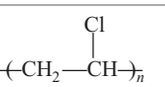
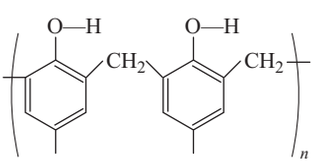
114. Match the polymers given in Column I with their repeating units given in Column II. Choose the correct option from the codes given below.

	Column I		Column II
A.	Polystyrene	1.	
B.	Novolac	2.	
C.	Buna-N	3.	
D.	Acrilan	4.	

Codes

	A	B	C	D
(a)	4	3	2	1
(b)	3	1	4	2
(c)	1	2	3	4
(d)	2	4	1	3

115. Match the following and choose the correct option from the codes given below.

	Column I		Column II
A.	PVC	1.	
B.	Bakelite	2.	
C.	Neoprene	3.	
D.	Nylon-6,6	4.	

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	2	3	4	1
(c)	4	1	2	3
(d)	3	4	1	2

116. Match the following and choose the correct option from the codes given below.

Column I (Material)		**Column II** (Polymer)	
A.	Wood laminates	1.	Dacron
B.	Ropes and fibres	2.	*cis*-polyisoprene
C.	Synthetic rubber	3.	Nylon
D.	Natural rubber latex	4.	Urea-formaldehyde resin
E.	Polyester fabric	5.	Neoprene

Codes

	A	B	C	D	E
(a)	1	5	3	4	2
(b)	2	4	1	5	3
(c)	5	2	4	3	1
(d)	4	3	5	2	1

117. Match the following and choose the correct option from the codes given below.

Column I (Polymer)		**Column II** (Monomer)	
A.	HDP	1.	Acrylonitrile
B.	Natural rubber	2.	Tetrafluoroethene
C.	Teflon	3.	Isoprene
D.	Acrilan	4.	Chloroprene
E.	Neoprene	5.	Ethene

Codes

	A	B	C	D	E
(a)	1	2	3	4	5
(b)	5	3	2	1	4
(c)	2	4	1	5	3
(d)	1	5	4	3	2

118. Match the following and choose the correct option from the codes given below.

Column I (Polymer)		**Column II** (Monomer)	
A.	PVC	1.	Propene
B.	Bakelite	2.	Vinyl chloride
C.	Glyptal	3.	Phenol + formaldehyde
D.	Polypropene	4.	Ethylene glycol + phthalic acid

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	2	3	4	1
(d)	3	1	2	4

V. Passage Based Questions

■ **Directions** (Q. Nos. 119-121) *Answer the following questions from the reaction given below*

Rubber is a natural polymer and possess elastic properties. It is also termed as elastomer and has a variety of uses. It is manufactured from rubber latex which is a colloidal dispersion of rubber in water. This latex is obtained from the bark of rubber tree and is found in India, Srilanka, Indonesia, Malaysia and South America. Natural rubber becomes soft at high temperature (> 335 K) and brittle at low temperatures (< 283 K) and shows high water absorption capacity. To improve upon these physical properties, a process of vulcanisation is carried out.

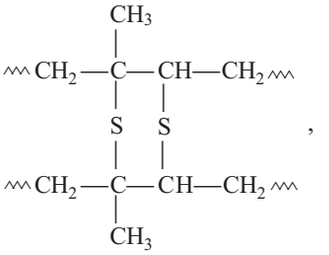
119. Which of the following statements about vulcanised rubber is/are correct?

(a) It is soluble in non-polar solvents
(b) It is non-resistant to attack by oxidising agents
(c) In vulcanised rubber sulphur forms cross links at the reactive sites of double bonds.
(d) All of the above statements

120. Which of the following elements is used in vulcanisation process?

(a) Sulphur (b) Phosphorus
(c) Silicon (d) Aluminium

121. Consider the following structures



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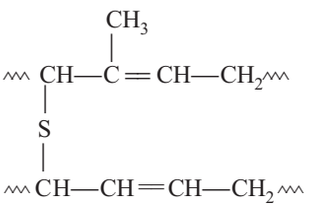


Which of the above given structures is/are the probable structure(s) of vulcanised rubber molecules?

(a) Only I (b) Both I and II
(c) Only II (d) None of these

NCERT & NCERT Exemplar Questions

NCERT

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

(a) The double bonds do not allow the polymer chain to come closer

(b) It is responsible for the strong force present within the polymer chain

(c) Double bond decreases the elasticity of polymer

(d) It is responsible for the strong force present within the polymer chain

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

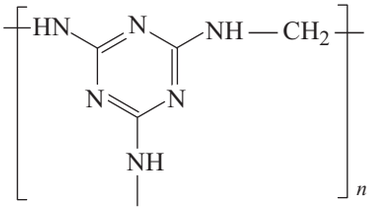
(a) Elastomers

(b) Fibre

(c) Thermoplastic and thermosetting polymers

(d) All of the above

124. Identify the monomer in the following polymeric structures.



(a) melamine + methanal

(b) melamine + butanal

(c) Decanedioic acid + hexamethylenediamine

(d) Ethylene glycol + terephthalic acid

125. Which of the following polymers of glucose is stored by animals?

(a) Cellulose (b) Amylose

(c) Amylopectin (d) Glycogen

NCERT Exemplar

126. Which of the following is not a semi-synthetic polymer?

(a) *Cis*-polyisoprene

(b) Cellulose nitrate

(c) Cellulose acetate

(d) Vulcanised rubber

127. Which of the following statements is not true about low density polyethene?

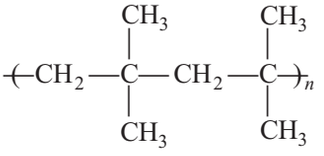
(a) Tough

(b) Hard

(c) Poor conductor of electricity

(d) Highly branched structure

128. Which of the following is a monomer of

 polymer?

(a) 

(b) 

(c) 

(d) 

Answers

1.	(a)	**2.**	(a)	**3.**	(b)	**4.**	(c)	**5.**	(b)	**6.**	(b)	**7.**	(a)	**8.**	(a)	**9.**	(c)	**10.**	(a)	**11.**	(b)	**12.**	(b)	**13.**	(a)	**14.**	(d)	**15.**	(d)
16.	(d)	**17.**	(a)	**18.**	(b)	**19.**	(c)	**20.**	(a)	**21.**	(a)	**22.**	(a)	**23.**	(c)	**24.**	(d)	**25.**	(d)	**26.**	(b)	**27.**	(b)	**28.**	(a)	**29.**	(d)	**30.**	(d)
31.	(c)	**32.**	(d)	**33.**	(b)	**34.**	(d)	**35.**	(b)	**36.**	(d)	**37.**	(c)	**38.**	(a)	**39.**	(a)	**40.**	(a)	**41.**	(a)	**42.**	(b)	**43.**	(c)	**44.**	(c)	**45.**	(d)
46.	(b)	**47.**	(b)	**48.**	(c)	**49.**	(a)	**50.**	(b)	**51.**	(a)	**52.**	(c)	**53.**	(d)	**54.**	(c)	**55.**	(b)	**56.**	(a)	**57.**	(d)	**58.**	(d)	**59.**	(c)	**60.**	(a)
61.	(a)	**62.**	(a)	**63.**	(d)	**64.**	(d)	**65.**	(b)	**66.**	(d)	**67.**	(a)	**68.**	(c)	**69.**	(d)	**70.**	(d)	**71.**	(a)	**72.**	(a)	**73.**	(a)	**74.**	(d)	**75.**	(a)
76.	(d)	**77.**	(b)	**78.**	(a)	**79.**	(b)	**80.**	(abcd)	**81.**	(abd)	**82.**	(ad)	**83.**	(abd)	**84.**	(cd)	**85.**	(c)	**86.**	(a)	**87.**	(d)	**88.**	(b)	**89.**	(c)	**90.**	(c)
91.	(d)	**92.**	(d)	**93.**	(c)	**94.**	(d)	**95.**	(d)	**96.**	(c)	**97.**	(a)	**98.**	(a)	**99.**	(a)	**100.**	(b)	**101.**	(a)	**102.**	(b)	**103.**	(a)	**104.**	(c)	**105.**	(a)
106.	(a)	**107.**	(c)	**108.**	(b)	**109.**	(b)	**110.**	(c)	**111.**	(d)	**112.**	(d)	**113.**	(b)	**114.**	(d)	**115.**	(d)	**116.**	(d)	**117.**	(b)	**118.**	(c)	**119.**	(d)	**120.**	(a)
121.	(b)	**122.**	(a)	**123.**	(d)	**124.**	(a)	**125.**	(d)	**126.**	(a)	**127.**	(d)	**128.**	(a)														

Hints & Explanations

1. (*a*) Proteins, cellulose, starch are the examples of natural polymers.

2. (*a*) Natural polymers are those polymers which are obtained by plants and animals, e.g. resins and rubbers, etc.

3. (*b*) Cellulose derivatives such as cellulose acetate and cellulose nitrate are semi-synthetic polymers.

4. (*c*) Rayon is chemically known as cellulose acetate.

5. (*b*) Cellulose acetate and cellulose nitrates are the common examples of semi-synthetic polymers.

6. (*b*) Buna-S and buna-N are man-made polymers or also known as synthetic polymers.

7. (*a*) On the basis of structure, polymers can be calssified as linear, branched and network polymers.

8. (*a*) The polymers which consist of long and straight chains are known as linear polymers, e.g. PVC, HDP, etc.

Linear polymer

9. (*c*) The polymer shown in the figure is linear polymer.

10. (*a*) Examples of linear polymers are HDP (high density polythene) and PVC (polyvinyl chloride).

11. (*b*) HDP stands for high density polythene. It is a linear polymer.

12. (*b*) Polymers containing linear chains having some branches are called branched polymers, e.g. LDP.

Branched polymer

13. (*a*) The polymer shown in the figure is branched chain polymer, e.g. LDP

14. (*d*) Low density polythene is an example of branched chain polymer because it contains linear structure having some branches.

15. (*d*) Cross-linked or network polymers are formed from bi-functional and tri-functional monomers and contain strong covalent bonds between various linear polymer chains, e.g. bakelite, melamine, etc.

16. (*d*) The figure shown as *A* and *B* are of cross-linked and branched polymers respectively.

17. (*a*) On the basis of mode of polymerisation, polymers can be classified as addition and condensation polymers.

18. (*b*) The repeated addition of monomer molecules possessing double or triple bonds results in the formation of addition polymers, e.g. formation of polythene from ethene. When single monomeric unit involves in addition polymerisation, then formed polymers are called homopolymers like polythene.

$$\underset{\text{Ethene}}{n\,CH_2{=}CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Polythene (homopolymer)}}{{-}(CH_2{-}CH_2){-}_n}$$

And when the addition polymers are formed from two different monomeric species, they are called copolymers like buna-N, buna-S, etc.

$$\underset{\text{1,3-butadiene}}{n\,CH_2{=}CH{-}CH{=}CH_2} + n\,\underset{\text{Stryrene}}{C_6H_5CH{=}CH_2} \longrightarrow$$

$$\underset{\text{Butadiene-styrene copolymer (buna-S)}}{{-}(CH_2{-}CH{=}CH{-}CH_2{-}CH_2{-}\underset{\displaystyle C_6H_5}{\underset{|}{CH}}){-}_n}$$

19. (*c*) Homopolymers are formed by the repeated addition of same monomer molecules having double or triple bonds

20. (*a*) Ethene is the monomer unit of polythene.

$$\underset{\text{Ethene}}{n\,CH_2{=}CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Polythene}}{{-}(CH_2{-}CH_2){-}_n}$$

21. (*a*) $-(-CH_2-CH(C_6H_5)-)_n$ is a homopolymer and its monomeric unit is styrene, $C_6H_5CH{=}CH_2$.

22. (*a*) Copolymers are polymers made by the addition polymerisation from two different monomers.

23. (*c*) Buna-S is a copolymer of 1, 3-butadiene and styrene.

24. (*d*) Condensation polymers are obtained by bi-functional molecules (monomers) with the elimination of smaller molecules whereas additional polymers are obtained from multiple bond containing monomers. Neoprene is a polymer of chloroprene ($CH_2 = C(Cl) - CH = CH_2$), so it is an addition polymer, not a condensation polymer.

25. (*d*) On the basis of source polymers can be classified as natural, semi-synthetic and synthetic.

26. (*b*) Hexamethylene diamine and adipic acid are the two monomeric units of nylon- 6,6 polymer.

27. (*b*) Polymers can be classified on the basis of molecular forces as elastomers, fibres, thermoplastic and thermosetting polymers.

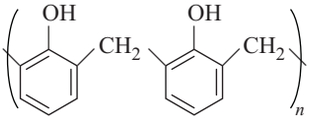
28. (*a*) Elastomers are rubber like-solids with elastic properties like-neoprene, buna-S, buna-N, etc.

29. (*d*) Fibres are basically thread forming solids which possess high tensile strength and high modulus. This is due to the strong intermolecular forces like hydrogen bonding. These strong forces also lead to close packing of chains and hence impart crystalline nature, e.g. terylene, nylon-6, 6 etc.

30. (*d*) (a) $-\!\left(-CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2-\right)_n$ is neoprene (synthetic rubber) which is a thermoplastic polymer.

(b) $-\!\left(-CH_2-\underset{\underset{Cl}{|}}{CH}-\right)_n$ is polyvinyl chloride which is also a thermoplastic polymer.

(c) $-\!\left(-\overset{\overset{H}{|}}{N}-(CH_2)_6-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-(CH_2)_4-\overset{\overset{O}{\|}}{C}-\right)_n$ is nylon 6, 6 a polyamide commonly known as fibre.

(d) 

is a linear polymer called bakelite or novolac. It is a thermosetting polymer formed by the condensation reaction of phenol and formaldehyde.

31. (*c*) When the molecules of the different monomers add together in the addition polymerisation, they form a copolymer.

32. (*d*) Ethyl alcohol never acts as a free radical generating initiator.

33. (*b*) Ethene $\xrightarrow[350-570\ K,\ traces\ of\ O_2]{1000-2000\ atm}$ LDP

34. (*d*) LDP has highly branched structure, is chemically inert, tough but flexible and a bad conductor of electricity.

35. (*b*) *Ziegler-Natta* catalyst is present in the formation of HDP.

36. (*d*) Titanium tetrachloride and triethylaluminium are used as *Ziegler-Natta* catalyst.

37. (*c*) Teflon is manufactured by heating tetrafluoroethene.

$$nCF_2 = CF_2 \xrightarrow[High\ pressure]{Catalyst} \underset{Teflon}{-\!\left(-CF_2-CF_2-\right)_n}$$

38. (*a*) *X* is teflon and *Y* is tetrafluoroethene.

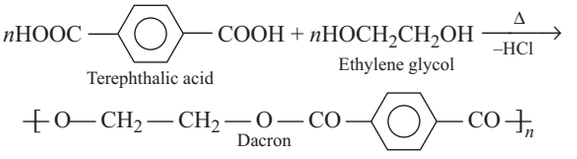
39. (a) Polyacrylonitrile is used as a substitute for wool in the making of commercial fibre.

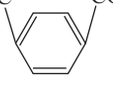
40. (*a*) Orlon (acrilan) is the commercial name of polyacrylonitrile.

41. (*a*) $n\underset{Acrylonitrile}{CH_2=CH-CN} \xrightarrow[Peroxide\ catalyst]{Polymerisation} \underset{Acrilan\ or\ polyacrylonitrile}{-\!\left(-CH_2-\underset{\underset{CN}{|}}{CH}-\right)_n}$

42. (*b*) When polymerisation involves a repetitive condensation reaction between two bi-functional monomers and some small molecules like H_2O, alcohol are also eliminated. Such polymerisation is called step-growth/condensation polymerisation.

43. (*c*) Dacron, commonly known as terylene, is obtained by heating mixture of terephthalic acid and ethylene glycol at 420-460 K in the presence of catalyst like zinc acetate and antimony trioxide.



44. (*c*) Dacron, $-\!\left(OCH_2-CH_2OOC\right.$  $\left.CO-\right)_n$ has ethylene glycol and terephthalic acid as its monomers.

45. (*d*) $nHOOC(CH_2)_4COOH + nH_2N(CH_2)_6NH_2$

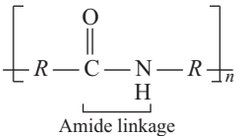
$$\xrightarrow{\Delta,\ -H_2O} \underset{Nylon\text{-}6,6}{-\!\left(-\overset{\overset{H}{|}}{N}-(CH_2)_6-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-(CH_2)_4-\overset{\overset{O}{\|}}{C}-\right)_n}$$

46. (*b*) $-\!\left(-NH(CH_2)_6NHCO(CH_2)_4CO-\right)_n$ is obtained by the condensation of hexamethylene diamine and adipic acid. It is a copolymer.

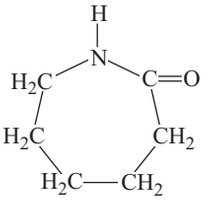
47. (*b*) $nHOOC(CH_2)_4COOH + nH_2N(CH_2)_6NH_2 \xrightarrow[High\ pressure]{553\ K}$

$$\underset{Nylon\text{-}6,6}{-\!\left(-\overset{\overset{H}{|}}{N}-(CH_2)_6-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-(CH_2)_4-\overset{\overset{O}{\|}}{C}-\right)_n}$$

48. (*c*) Nylon is a polyamide containing amide linkages $-\!\left(-CONH-\right)-$. These are prepared by condensation copolymerisation of diamines with dicarboxylic acids or by condensation polymerisation of lactam.

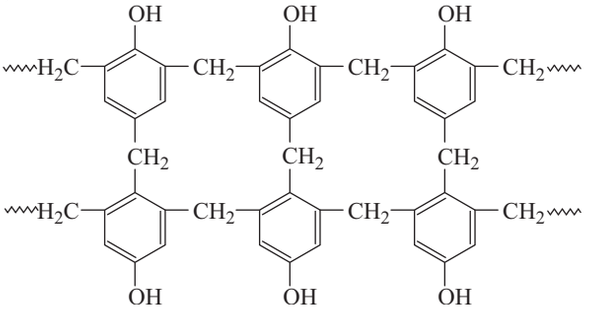


49. (*a*) Structure of caprolactam is

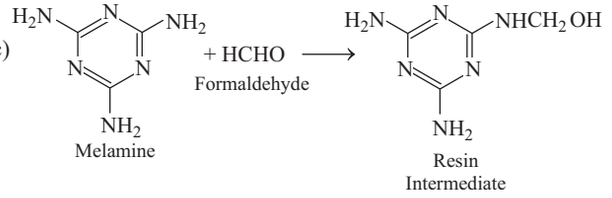


50. (*b*) Terylene is a polyester polymer because it is formed by the condensation polymerisation of the monomer units terephthalic acid (an acid) and ethylene glycol (an alcohol).

51. (*a*) Structure of bakelite



52. (c)



53. (*d*) Bakelite and novolac both are the oldest synthetic polymers.

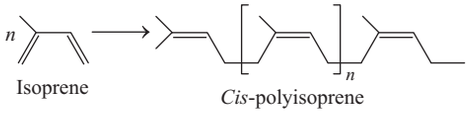
54. (*c*) The initial reaction between phenol and formaldehyde is an aromatic electrophilic substitution.

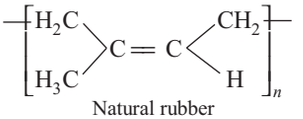
55. (*b*) Bakelite is the phenol-formaldehyde resin.

56. (a) In an isoprene polymer, all the isoprene have *cis*-1,4-configuration.

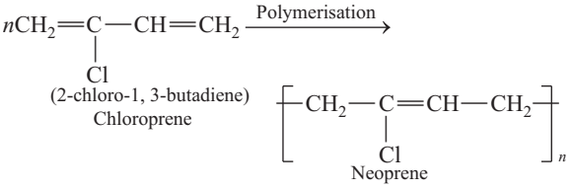
57. (*d*) Natural rubber is a linear polymer of 2-methyl-1, 3-butadiene.

58. (*d*) Natural rubber is *cis*-1, 4-polyisoprene and has only *cis*-configuration about the double bond.

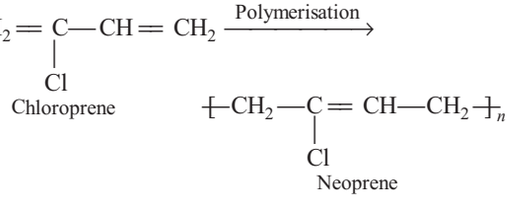




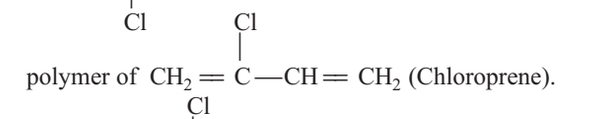
59. (*c*) Neoprene is synthetic rubber and is a homopolymer of chloroprene which is chemically 2-chlorobutane 1, 3-diene. It is obtained by free radical polymerisation of chloroprene.



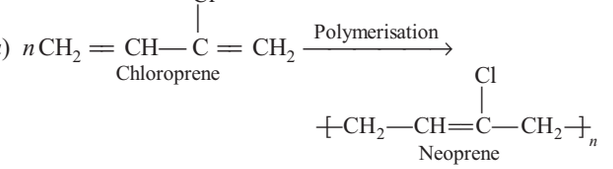
60. (*a*)



61. (*a*) (Neoprene) is a



62. (*a*)



63. (*d*) Novolac is the odd one. All the other ones are polydienes. Nitrile rubber is also called buna-N.

64. (*d*) SBR is not a natural rubber. It is a synthetic polymer.

65. (*b*) Nylon-6,6 contains strong intermolecular forces.

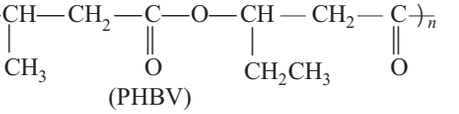
66. (*d*) Polymer properties are closely related to their molecular mass, size and structure.

67. (*a*) The growth of the polymer chains during their synthesis depends on the availability of monomers in the reaction mixture.

68. (*c*) PHBV stands for poly-β-hydroxybutyrate-co-β-hydroxy valerate. It is a biodegradable polymer.

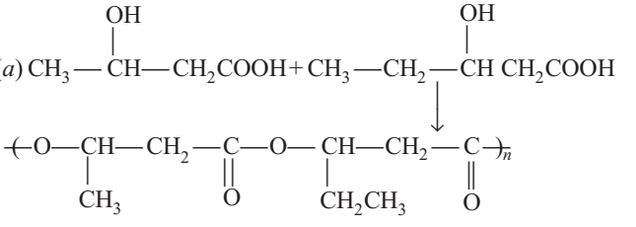
69. (*d*) PHBV is obtained by the copolymerisation and is used in speciality packaging, orthopaedic devices. It undergoes bacterial degradation in the environment.

70. (*d*)



is a biodegradable polymer.

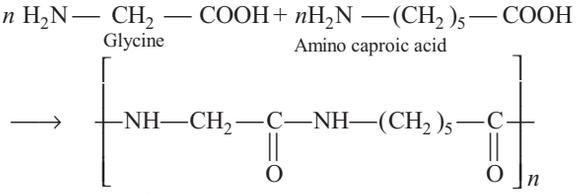
71. (*a*)



72. (*a*) PHBV is a biodegradable polymer.

73. (*a*) Nylon-2–Nylon-6

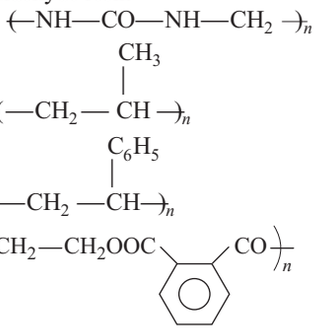
It is an alternating polyamide of glycine (containing two carbon atoms) and amino caproic acid or 6-aminohexanoic acid (containing six carbon atoms).



It is a biodegradable step-growth copolymer.

74. (*d*) Nylon-2–nylon-6 is a copolymer of glycine and amino caproic acid which is a biodegradable polymer.

75. (*a*) Urea-formaldehyde resin



76. (*d*) Baby feeding bottles and soft drinks bottles are usually made up of polyethylene- HDPE.

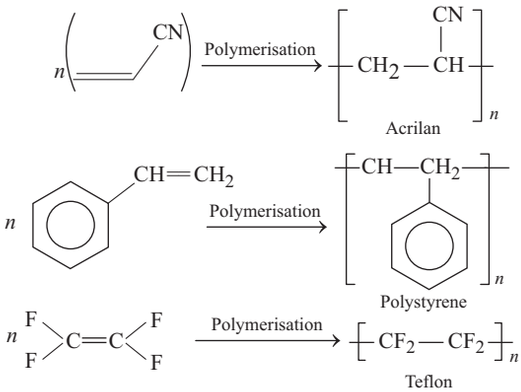
77. (*b*) Glyptal is used to manufacture paints and lacquers.

78. (*a*) Bakelite polymer is used for making combs, electrical switches, handles of utensils and computer discs.

79. (*b*) For making unbreakable cups and laminated sheets urea-formaldehyde resin is use.

82. (*a*, *d*) In vulcanised rubber, the polymer chains are held together by sulphur cross-linkages (— S—S—). These cross links make rubber more hard,elastic and stronger.

83. (*a*, *b*, *d*) Acrilan, polystyrene and teflon has vinylic monomer units as shown below.



85. (*c*) The repeating structural unit are linked to each other by covalent bonds.

86. (*a*) Elastomers have the weakest intermolecular forces. Fibres possess crystalline nature. Covalent bonds are present in thermoplastic polymer.

87. (*d*) Chain-growth polymerisation is an another term used for addition polymerisation. Thermoplastics are slightly branched chain structure. Strong intermolecular forces like H-bonding or dipole-dipole interactions are present in fibres.

88. (*b*) Nylon-6,6 is a polyamide of hexamethylene diamine and adipic acid

89. (*c*) Dacron is the polymer of ethylene glycol and terephthalic acid. Orlon is an another term used for polyacrylonitrile.

90. (*c*) Bakelite has a branched structure and not the linear.

91. (*d*) Rubber latex is a colloidal suspension of rubber in water.

It is highly elastic and found in tropical and semi-tropical parts of the world.

92. (*d*) Elasticity of raw rubber is high. Tensile strength of vulcanised rubber is almost ten times as compared to raw rubber.

93. (c) Neoprene < polyvinyl chloride < nylon-6 is the correct increasing order in terms of intermolecular forces.

94. (*d*) Functionality of a monomer means the number of bonding sites present in it, e.g. functionality of ethene, propene, styrene, acrylonitrile is one and that of ethylene glycol, adipic acid hexamethylene diamine is two

95. (*d*) PVC is useful in making raincoats, hand bags etc.

96. (*c*) Molecular mass is expressed as an average. Molecular mass of polymers can be determined by physical and chemical methods.

97. (*a*) Most of the synthetic polymers are not biodegradable because polymerisation process basically induces toxic character in organic molecules.

98. (*a*) Thermosetting polymers undergo permanent change on heating because extensive cross-links are formed between polymer chains while heating it.

99. (*a*) Network polymers are thermosetting and have high molecular mass.

100. (*b*) Both are correct but reason does not explains assertion.

101. (*a*) LDP is used in the insulation of electricity carrying wires as it is chemically inert.

102. (*b*) Both are correct but reason is not the correct explanation of assertion

103. (*a*) Both are correct and reason explains the assertion too.

104. (*c*) Neoprene is a synthetic polymer.

105. (*a*) Molecular mass is expressed as an average as the polymer sample contain chains of varying lengths.

106. (*a*) Glyptal is a copolymer of ethylene glycol and phthalic acid

107. (*c*) A → 2; B → 1; C → 3

108. (*b*) A → 3; B → 1; C → 4; D → 2

109. (*b*) A → 3; B → l; C → 2

110. (*c*) A → 2; B → l; C → 3

111. (*d*) A → 2; B → 3; C → 4; D → 1

112. (*d*) A → 2; B → 3; C → l; D → 4

113. (*b*) A → 2; B → 4; C → 3; D → 1

114. (*d*) A → 2; B → 4; C → l; D → 3

115. (*d*) A → 3; B → 4; C → 1; D → 2

116. (*d*) A → 4; B → 3; C → 5; D → 2; E → 1

117. (*b*) A → 5; B → 3; C → 2; D → l; E → 4

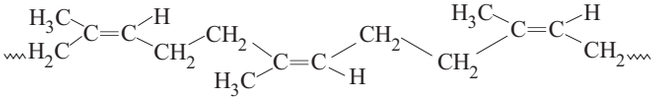
118. (*c*) A → 2; B → 3; C → 4; D → 1

119. (*d*) All given statements are correct.

120. (*a*) Sulphur

122. (*a*) Natural rubber is *cis*-polyisoprene. It is obtained by polymerisation of isoprene units at 1, 4 positions. In rubber molecule, double bonds are located between C_2 and C_3 of each isoprene unit. These *cis*-double bonds do not allow the polymer chain to come closer.

Therefore, only weak van der Waals' force are present. Since, the chains are not linear, they can be stretched just like springs and exhibit elastic properties.



Cis-polyisoprene
(Natural rubber)

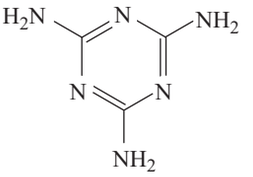
123. (*d*) On the basis of intermolecular forces, polymers are classified into groups or classes.

(i) Elastomer (ii) Fibres

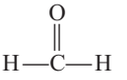
(ii) Thermoplastic polymers (iii) Thermosetting polymers

124. (*a*)

(a) 2,4,6-triamino -1,3,5-triazine or melamine



(b) Formaldehyde or methanal (HCHO)



125. (*d*) Glycogen is a polymer of glucose found in liver, brain and muscles of animals. Cellulose is a polymer found in plant while amylose and amylopectin are structural units of starch.

126. (*a*) *Cis*-polyisoprene is not a semisynthetic polymer while other three cellulose nitrate, cellulose acetate and vulcanised rubber are semisynthetic polymer made from cellulose and natural rubber respectively.

127. (*d*) Low density polythene has slightly branched but not highly branched structure.

128. (*a*)