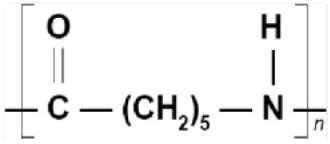
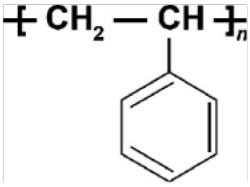
Date: 23/10/2021

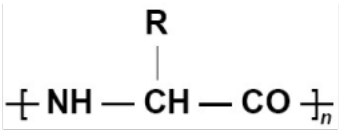
Q1. Write the name of following polymer:



Q2. Write the name of following polymer:

Q3. How are polymers classified on the basis of structure of polymers?

Q4. Is  **a homopolymer or a copolymer?**

Q5. 

Is $+NH-CH(R)-CO+_n$ **a homopolymer or copolymer?**

Q6. Classify the following as addition and condensation polymers: Terylene, Bakelite, Polyvinyl chloride, Polythene.

Q7. Write the name of following polymer: $+CF_2-CF_2+_n$

Q8. Give examples of biodegradable polymers.

Q9. Write the monomers of polythene and teflon.

Q10. Write the preparation of glyptal.

Q11. Write the structures of monomers used and one use of each of the following polymers:
(a) Teflon (b) Buna-N

Q12. Write the preparation of Nylon-2-Nylon-6.

Q13. Differentiate between chain growth and step growth.

Q14. What is the importance of PHBV polymers?

Q15. Write two uses of Teflon.

Q16. Give the examples of semisynthetic polymers.

Q17. How is dacron obtained from ethylene glycol and terephathalic acid?

Q18. What do you understand by the term 'polyamides'?

Q19. What is PHBV? Write its use also.

Q20. In which classes, the polymers are classified on the basis of molecular forces?

Q21. Name giving its formula, a free radical generating initiator.

Q22. What are the alternative terms for addition polymerisation?

Q23. Name different kinds of polymers based upon the molecular forces.

Q24. What are copolymers?

Q25. Give two examples each of linear polymer and cross linked polymer.

Q26. What are the different polymers based upon the mode of polymerisation?

Q27. What are the monomers involved in the formation of Nylon 6, 6?

Q28. What is the repeating structural unit in polythene polymer?

Q29. Define the term polymerisation.

Q30. Write the names and structure of the monomers of the following polymers.

(a) Buna-S (b) Neoprene (c) Nylon-6

Q31. What is natural rubber chemically?

Q32. What does the polymer PHBV stand for?

Q33. Why do we consider the average molecular mass of polymers?

Q34. Name two synthetic rubbers.

Q35. What are the two main uses of low density polythene?

Q36. What is the material used in making unbreakable crockery?

Q37. What is phenol-formaldehyde polymer popularly known as?

Q38. What are the chief uses of dacron?

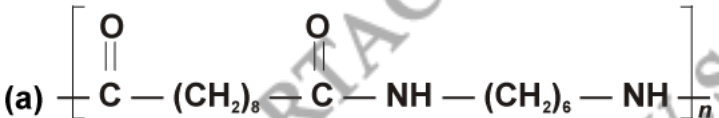
Q39. What is coprolactam?

Q40. What is teflon?

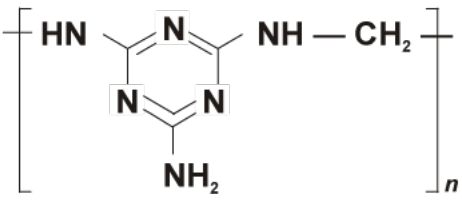
Q41. Distinguish between the terms homopolymer and copolymer and give one example of each.

Q42. Identify the monomer in the following polymer structures.

(a)



(b)



Q43. Explane the term copolymerisation and give two examples.

Q44. What are the monomeric repeating units of Nylon-6 and Nylon-6,6?

Q45. Define thermoplastics and thermosetting polymers with two examples of each.

Q46. Arrange the following polymers in increasing order of their molecular forces:

(a) Nylon-6,6 Buna-S, Polythene (b) Nylon-6, Neoprene, Polyvinyl chloride.

Q47. Explain the differences between Buna-N and Buna-S.

Q48. How can you differentiate between addition and condensation polymerisation?

Q49. Distinguish between 'chain growth polymerisation' and 'step growth polymerisation' and give one example each process.

Q50. Write the names of monomers used for getting the polymers PVC and PMMA. State one use for each of these polymers.

Q51. Distinguish between the term homopolymer and copolymer and give one example of each type.

Q52. What is a biodegradable polymer? Given an example of a biodegradable aliphatic polyster.

Q53. Differentiate between Nylon-6 and Nylon-6,6.

Q54. (a) Write equations for the synthesis of Buna-S.
(b) Write the names and structures of the monomers of the following polymer: Natural rubber

Q55. What are the different ways of initiating addition polymerisation? Describe one of them for polymerising vinyl chloride.

Q56. How are low density polyethylene and high density polyethylene manufactured? How do they differ in their densities?

Q57. Write the free radical mechanism for the polymerisation of ethene.

Q58. How are low density polythene and high density polythene manufactured? Write their uses also.

Q59. Write the monomers used for getting the following polymers:
(a) Polyvinyl Chloride (b) Teflon (c) Bakelite

Q60. Explain the differences between polyacrylates and polyesters.

Q61. How is bakelite formed? Explain the reactions with equations.

Q62. Why should one always use purest monomer in free radical polymerisation?

Q63. What is natural rubber? Explain the structure of natural rubber.

Q64. Will you prefer to polymerise acrylonitrile under anionic or cationic polymerisation conditions? Exaplain your choice.

Q65. Why is cationic polymerisation preferred in case of vinylic monomers containing electron donating groups?

Q66. Write the information asked for in the following polymers:
(a) Bakelite — Materials used for preparation. (b) PVC — Monomer unit.
(c) Synthetic rubber — Material required for preparation.
(d) Nylon-6,6 — Materials required for preparation.

Q67. Write equations used for the synthesis of (a) terylene, (b) neoprene.

Q68. Why does styrene undergo anionic polymerisation easily?

Q69. How does the presence of carbon tetrachloride influence the course of vinylic free radical polymerisation? Explain with an example.

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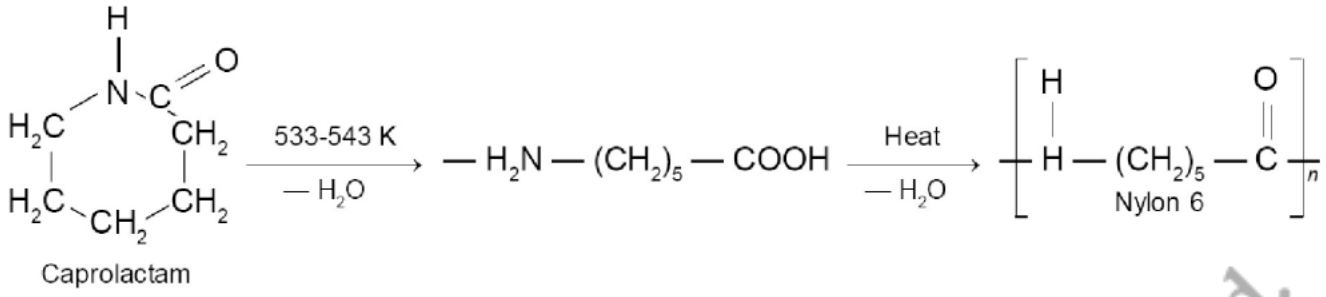
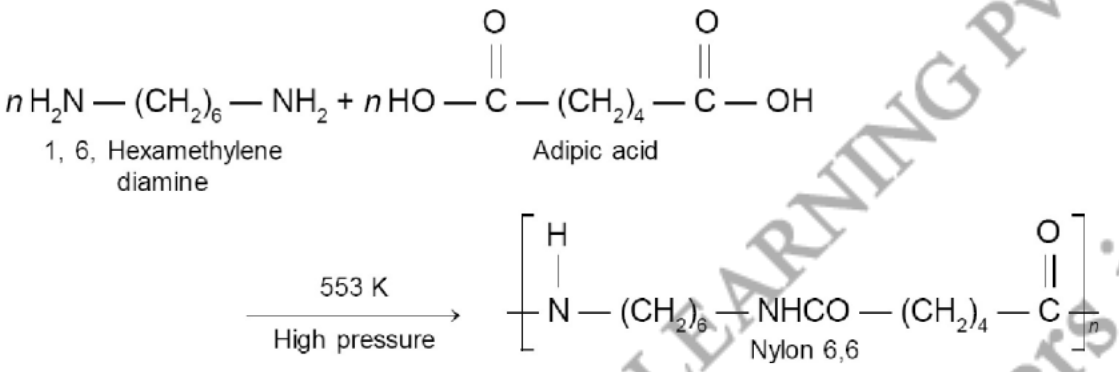
S1. Polymer - Nylon 6
Monomer - Carprolactam



S2. Polymer - Nylon 6,6
Monomer - Hexamethylenediamine and adipic acid.



S3. On the basis of structure, the polymers are classified as below:

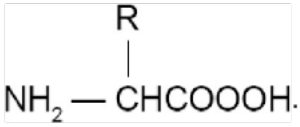
(a) Linear polymer as polythene, polyvinyl chloride etc.

(b) Branched chain polymers as low density polythene.

(c) Cross linked polymers as bakelite, melamine etc.

S4. It is a homopolymer and the monomer from which it is obtained is styrene

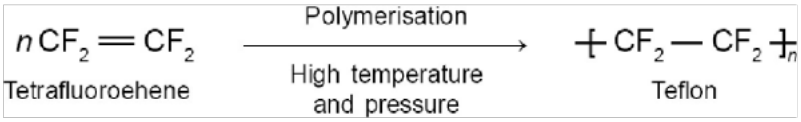
S5.

Homopolymer. Because it is obtained from a single monomer 

S6. (a) **Addition polymers**: Polyvinyl chloride, Polythene.

(b) **Condensation polymers**: Terylene, Bakelite.

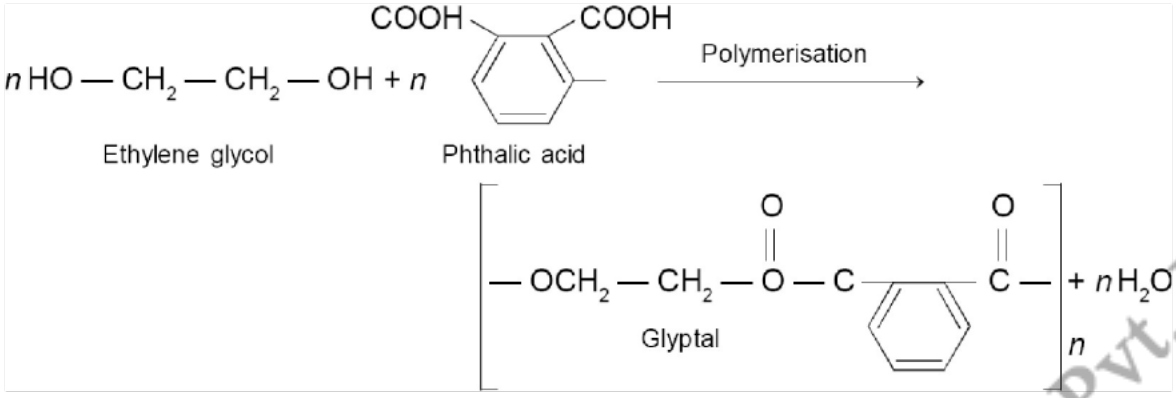
S7. Polymer - Teflon
Monomer - Tetrafluoroethene



S8. **Examples:** Poly-β-hydroxy butyrate-co-β-hydroxy valerate (PHBr), nylon-2, nylon-6.

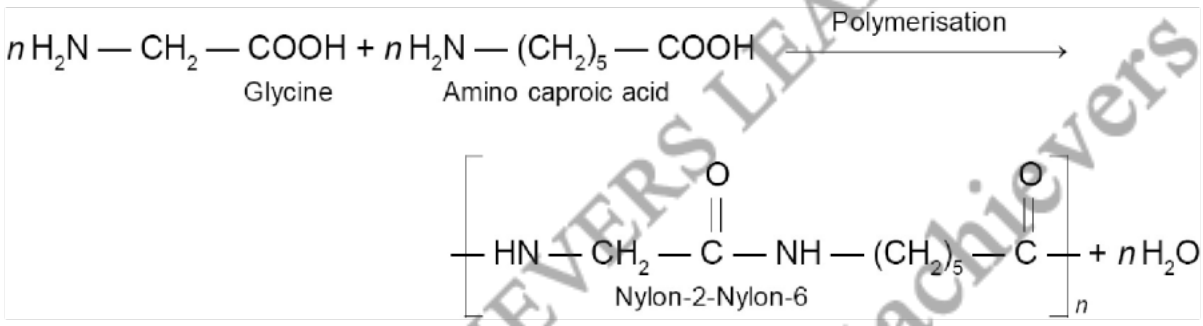
S9. (a) $CH_2 = CH_2$ Ethene (b) $CF_2 = CF_2$ 1, 1, 2, 2 tetrafloroethene

S10.



S11. (a) **Teflon:** Its monomer is tetrafluroethene, $CF_2 = CF_2$.
It is used in making oil seals and gaskets.
(b) **Buna-N:** Its monomer are $CH_2 = CH - CH = CH_2$ and $CH_2 = CH - CN$.
It is used in making oil seals, manufacture of hoses and tank linings.

S12.



S13. Difference between chain and step growth

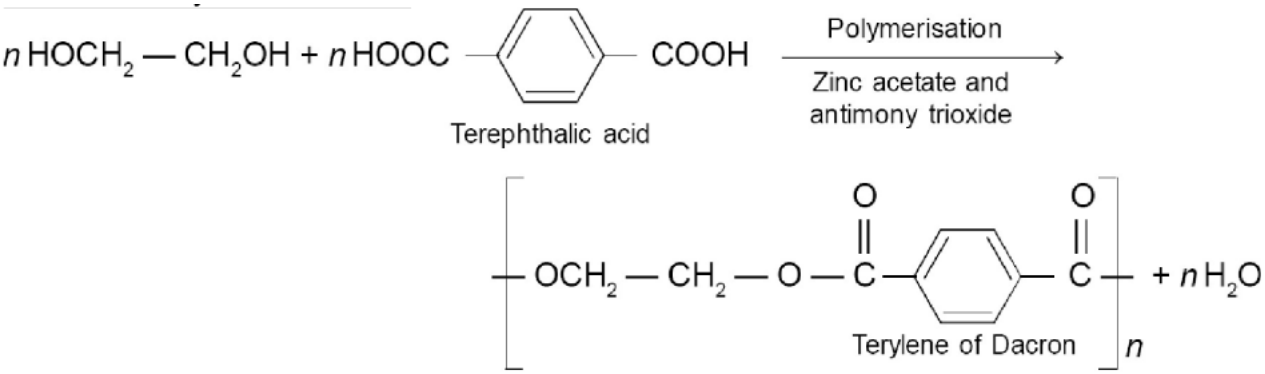
S.No.	Chain Growth	Step Growth
1.	It is reaction in which monomer, having one or more double bonds, undergo repeated addition in a chain fashion.	It is a reaction which involves a series of condensation reactions, between simple monomers containing polar groups.

S14. It is a bio-degradable polymer which undergoes bacterial degradation in atmosphere.

S15. (a) As a material resistant to heat and chemical attack.
(b) For coating articles and cookware to make them non-sticky.

S16. Gun-Cotton (cellulosenitrate), Vulcanised rubber etc.

S17. *Dacron* is synthetic *condensation polymer* which has *ester group* in the polymer chain. Terylene also known by the name.



S18. The polymers having amide linkages in the chain is known as polyamides.

Example: Nylon-6,6.

S19. PHBV is a copolymer of 3-hydroxy butanoic acid and 3-hydroxypentanoic acid. It is a biodegradable polymer used in speciality packaging and as a biomedical material.

S20. On the basis of molecular forces present between the chains of various polymers, the polymers are classified as follows:

(a) Elastomers–Buna-S (b) Fibres–Nylon 6,6

(c) Thermoplastics –polythene (d) Thermosetting–Bakelite.

S21. Nenezoyl peroxide, $C_6H_5 - \overset{O}{\overset{\|}{C}} - O - O - \overset{O}{\overset{\|}{C}} - C_6H_5$.

S22. Addition polymerisation is also known as chain growth polymerisation.

S23. (a) Elastomers (b) Fibres

(c) Thermoplastic polymers (d) Thermosetting polymers.

S24. Polymers obtained from two different monomers are called copolymers.

Example: Buna-S.

S25. **Linear polymer:** High density polythene and polyvinyl chloride.

Cross linked polymer: Bakelite and melamine.

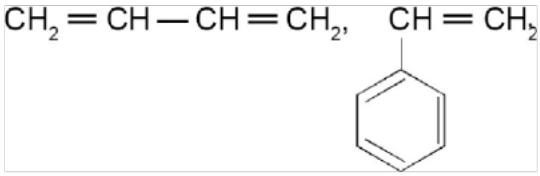
S26. (a) Addition polymers (b) Condensation polymers.

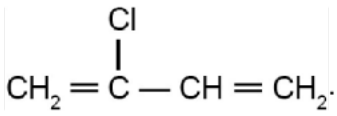
S27. Hexamethylene diamine and adipic acid.

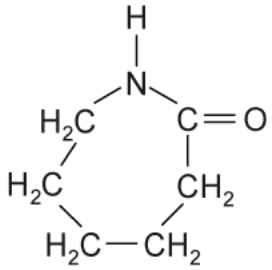
S28. Ethene $CH_2 = CH_2$.

S29. The process of formation of polymers by joining the repeating structural units on a large scale is called polymerisation.

Example: Transformation of ethene to form polythene.

S30. (a) **Buna-S:** 1, 3-Butadiene and Styrene 

(b) **Neoprene:** Chloroprene  .

(c) **Nylon-6:** Caprolectum 

S31. Natural rubber is polysioprene or poly (2-methyl-1, 3-butadiene).

S32. Poly-β-hydroxybutyrate-co-β-hydroxy valerate.

S33. This is because the polymer sample contains chains of varying length.

S34. (a) Neoprene (b) Buna-S.

S35. It is used in the insulation of electricity carrying wires. It is used in the manufacture of squeeze bottles and toys.

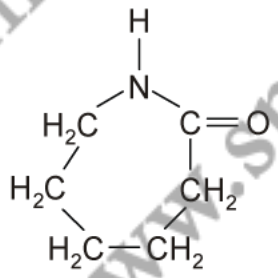
S36. Melamine.

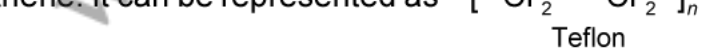
S37. Bakelite.

S38. (a) It is used in blending with cotton and wool fibres as it is crease resistant.

(b) It is used as glass reinforcing material in safety helmets.

S39. It has the formula $C_6H_{11}NO$. The structure of the compound is

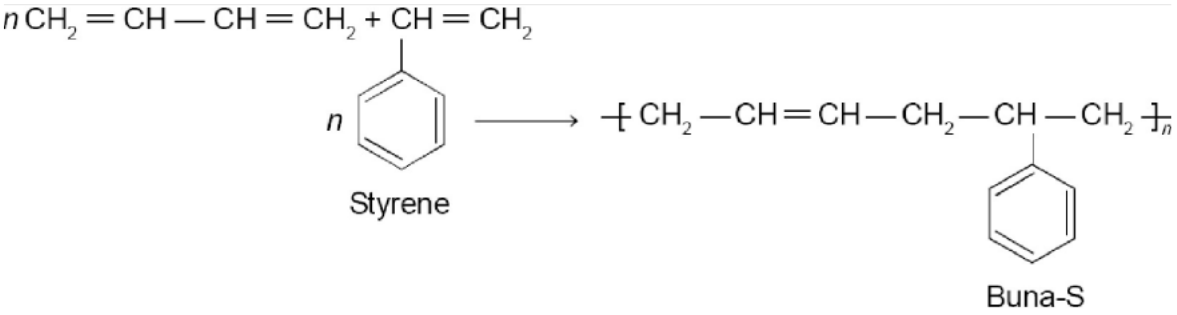


S40. It is the polymer of tetrafluoroethene. It can be represented as 
Teflon

S41. (a) **Homopolymer:** Traditional polymer formed by polymerisation of monomers of the single substances is known as a homopolymer polythene for example: **Polythene**

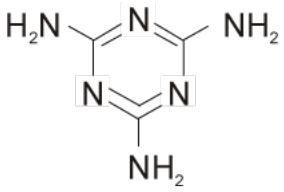
(b) **Copolymer:** Copolymer is a polymer that is formed by polymerising two or more different monomers. Buna-S rubber is a copolymer of butadiene and styrene.

Example:

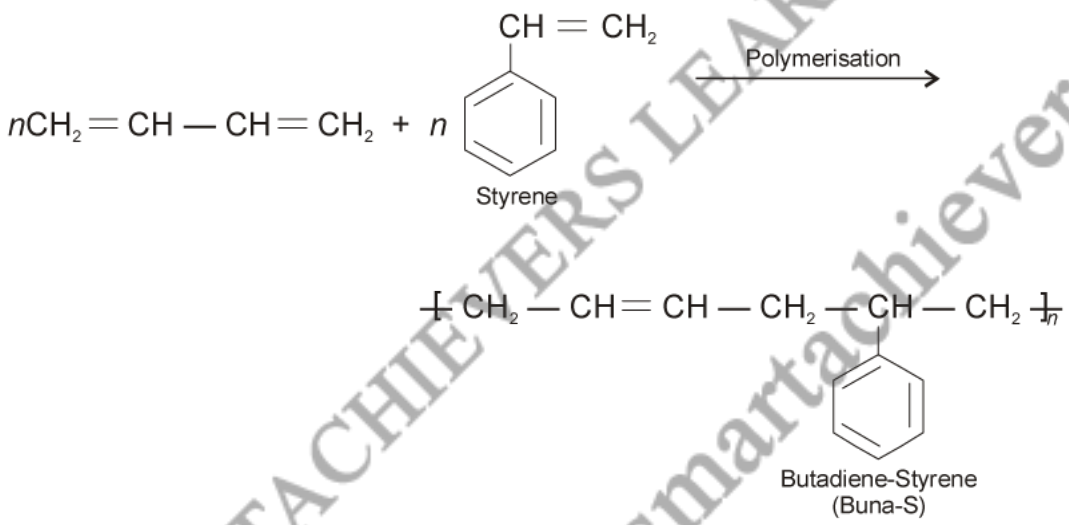


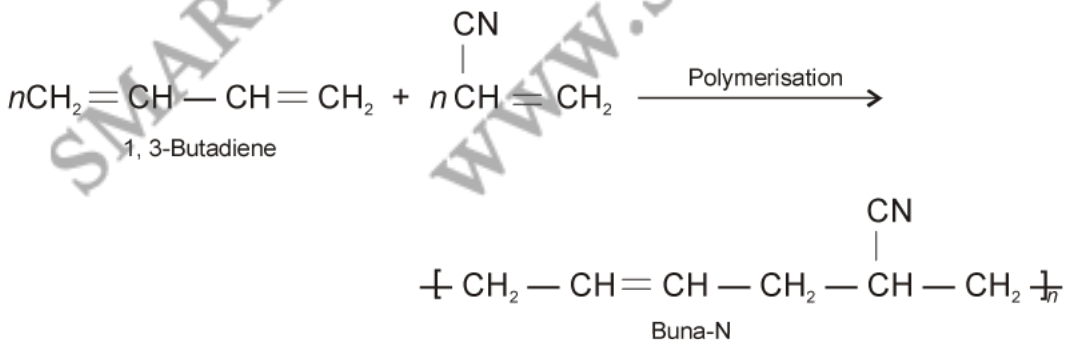
S42. The monomers forming the polymer are:

(a) Decanoic acid $HOOC-(CH_2)_8-COOH$ and Hexamethylene diamine $H_2N-(CH_2)_6-NH_2$.

(b)  and $HCHO$ (Formaldehyde) (CH_2OH)

S43. Copolymerisation is a process in which a mixture of more than one monomeric species is allowed to polymerise. The copolymer contains multiple units of each monomer in the chain. The examples are (a) copolymer of 1, 3-butadiene and styrene and (b) 1, 3-butadiene and acrylonitrile.

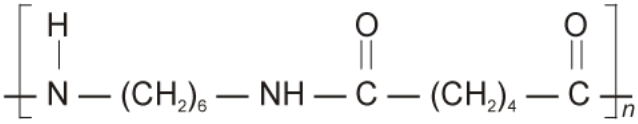
(a) 

(b) 

S44.

(a) Nylon-6: Caprolectum $\left[\begin{matrix} H \\ | \\ N-(CH_2)_5-C \\ \| \\ O \end{matrix}\right]_n$.

(b) Nylon-6, 6: 1,6-Hexamethylene diamine and adipic acid.



S45. (a) **Thermoplastic polymers:** These are the linear or slightly branched long chain molecules capable of repeatedly softening on heating and hardening on cooling. These polymers possess intermolecular forces of attraction intermediate between elastomers and fibres.

Examples: Polythene, Polystyrene, Polyvinyl chloride, etc.

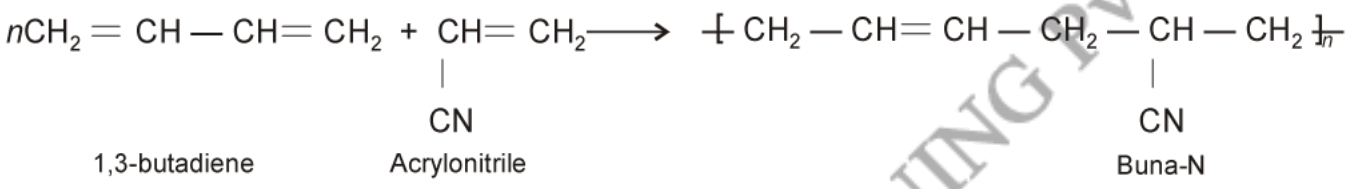
(b) **Thermosetting polymers:** These polymers are cross-linked in moulds and again become infusible. These cannot be reused.

Examples: Bakalite, Melamine, etc.

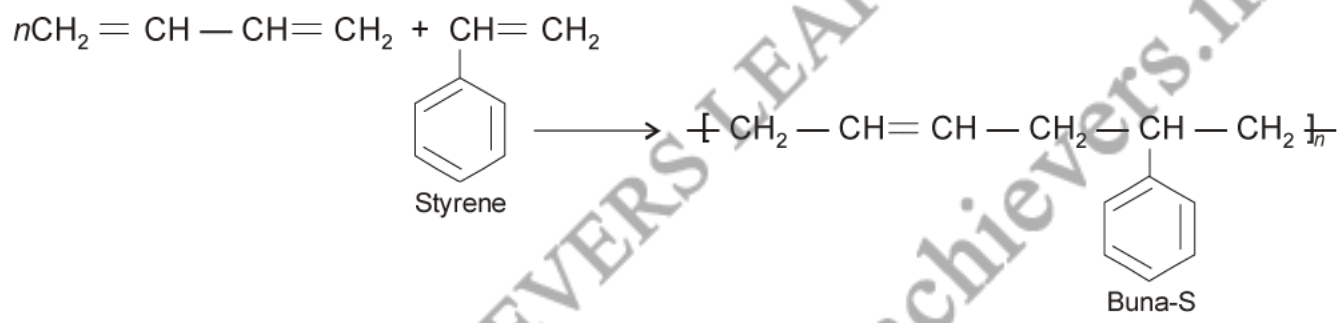
S46. (a) Buna-S < Polythene < Nylon-6,6.

(b) Neoprene < Polyvinyl chloride < Nylon-6.

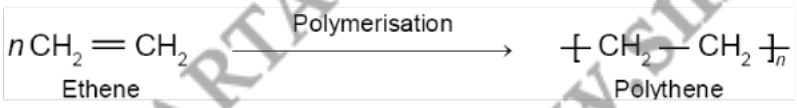
S47. **Buna-N** is a copolymer of 1, 3-butadiene and acrylonitrile.



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



S48. (a) **Addition polymerisation:** In this process polymers are formed by the repeated addition of monomer molecules possessing double or triple bonds, e.g., the formation of polythene from ethene.



(b) **Condensation polymerisation** is a process in which two or more bifunctional molecules undergo a series of condensation reactions with the elimination of some simple molecules and leading to the formation of polymers.

S49. Chain growth polymerisation takes place in unsaturated monomers and involves free radical addition polymerisation. It is also called addition polymerisation. Polythene is formed by chain growth polymerisation.

Step growth polymerisation involves condensation between monomers having multifunctional group. It is also known as condensation polymerisation.

Nylon 6, 6 is obtainded by step growth polymerisation.

S50. **PVC:** Vinyl chloride is the monomer used in PVC. It is used for making pipes and electrical insulators.

PMMA: Methyl methacrylate is the monomer used in PMMA> It is used as substitute of glass.

S51. Polymers formed by the linking of a large number of one type of monomers are called homopolymer.

Example: $n\underset{\text{Ethene}}{CH_2 = CH_2} \longrightarrow \underset{\text{Polythene (Homopolymer)}}{+ CH_2 - CH_2 +_n}$

Polymers formed by the linking of large number of two or more types of monomers are called copolymers.

Example:

$$n H_2N(CH_2)_6NH_2 + n HOOC(CH_2)_4COOH \longrightarrow \underset{\text{Nylon 6, 6 (Copolymer)}}{+ NH(CH_2)_6NHCO(CH_2)_4CO +_n} + n H_2O$$

S52. **Biodegradable polymers:** The polymers which degrade in the environment with time are called biopolymers or biodegradable polymers. They do not cause environmental problems.

Structure: Biodegradable synthetic polymers are polymers which have same functional groups as are present in biopolymers and lipids.

Examples: Poly-β-hydroxy butyrate-co-β-hydroxy valerate (PHBr), nylon-2, nylon-6.

S53. The difference between Nylon-6 and Nylon-6,6:

S.No.	Nylon-6	Nylon-6,6
1.	It is synthesised from caprolactum which in turn is synthesised from cyclohexane.	It is synthesized by the condensation polymerisation of a 6-carbon atom dicarboxylic acid and 6-carbon atom amine hexamethylene diamine.
2.	It is used for moulding frictionless bearing, gears etc., which work smoothly without lubrication.	It is mainly used for making textile fibre, which finds used in making dress, saries and socks etc.

S54. (a) Buna-S is prepared by addition polymerisation of buta-1, 3-diene and styrene.

$$n CH_2 = CH - CH = CH_2 + n \underset{C_6H_5}{CH = CH_2} \xrightarrow{Na} \left(+ CH_2 - CH = CH - CH_2 - \underset{C_6H_5}{CH} - CH_2 + \right)_n$$

(b) The monomer of natural rubber is isoprene *i.e.*, 2-methylbut-1, 3-diene or

$$CH_2 = \underset{CH_3}{C} - CH = CH_2$$

S55. Polymerisation can be initiated in three ways:

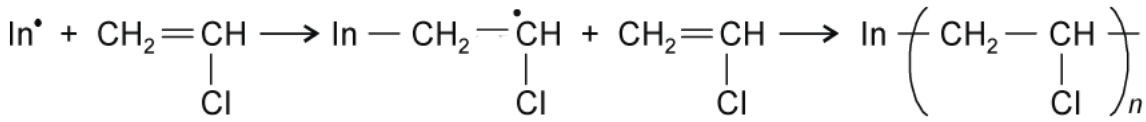
(a) Free radical polymerisation using peroxide as initiator.

(b) Cationic polymerisation using H^+ as initiator.

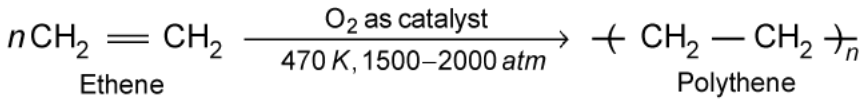
(c) Anionic polymerisation using KNH_2 as initiator.

Free radical polymerisation of vinylchloride:

$In \longrightarrow In^{\bullet}$ (In stands for free radical initiator and $In^{\bullet}$ for free radical)



S56. (a) **Low density polyethylene:** It is manufactured by compressing ethene under very high pressure at about 470 K in the presence of very small amount of oxygen as catalyst.



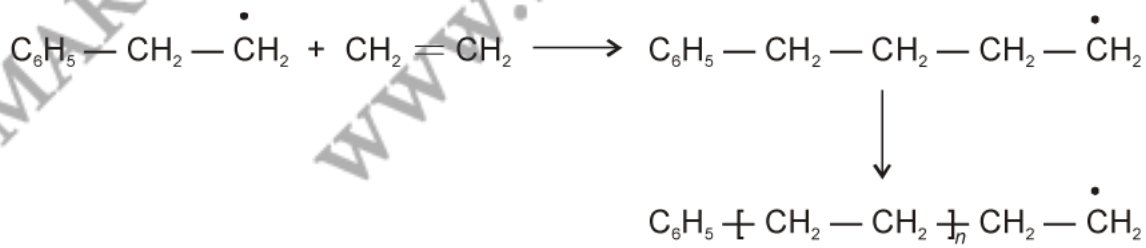
The polymer consists of branched chains and, therefore, has low density.

(b) **High density polyethylene:** It is manufactured by passing ethene under pressure into an inert solvent (aromatic hydrocarbon) containing $(C_2H_5)_3Al$ and $TiCl_4$ called Ziegler-Natta catalyst. After polymerisation, the catalyst is decomposed by adding dilute acid and the crystalline polymer is filtered off. This polymer consists of almost linear chains and, therefore, has higher density.

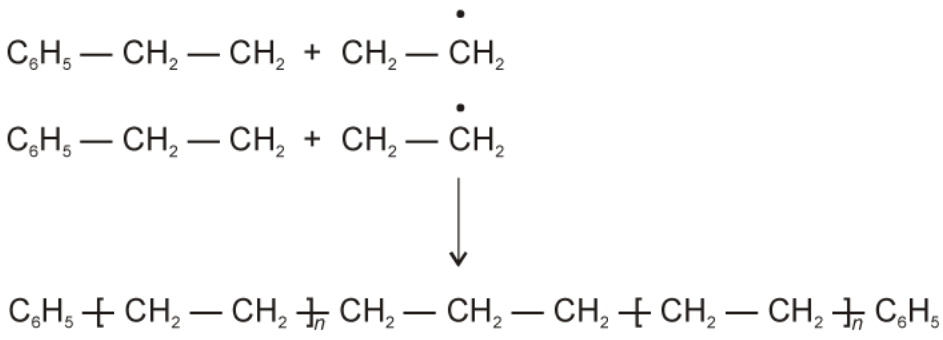
S57. The mechanism of chain growth polymerisation of ethene of free radical mechanism is given below:

Step I: Chain initiation step

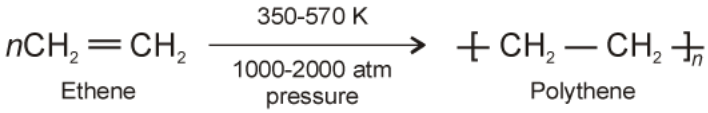
Step II: Chain propagation step



Step III: Chain terminating step



S58. **Low density polythene:**



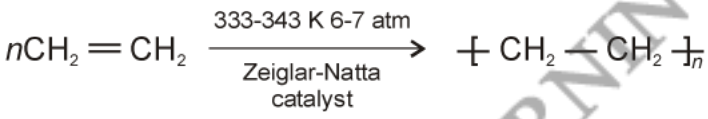
Uses:

(a) As a packing material in the form of thin plastic bags.

(b) As insulation of electricity carrying wires and cables.

(c) For the manufacture of pipes, toys, squeeze bottles.

High density polythene:



Uses:

(a) For the manufacture of buckets, tubes, dustbins etc.

(b) For the manufacture of different house wares, pipes etc.

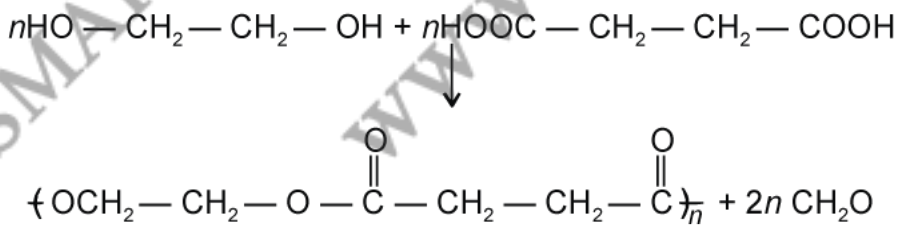
S59. (a) **Polyvinyl Chloride:** Vinyl chloride ($CH_2 = CHCl$).

(b) **Teflon:** Tetrafluoroethylene ($CF_2 = CF_2$).

(c) **Bakelite:** Formaldehyde (HCHO) and phenol (C_6H_5OH).

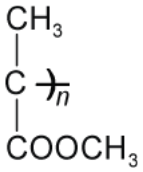
S60. **Polyesters:** The polymers having ester linkages and called polyesters. These are formed by condensation reaction between the hydroxy group of an alcohol with carboxylic group of an acid. The reaction is accompanied with the elimination of water molecule.

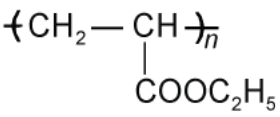
Example: Terylene is a polyester.

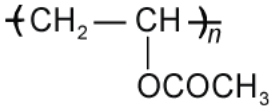


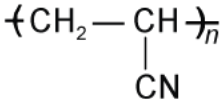
Dacron is the best known of the polyesters. It is condensation polymer of ethylene glycol and terephthalic acid.

Polyacrylates: Polymers obtained by the addition polymerization of various types of acrylic monomers are called polyacrylates. Important polymers of this class are:

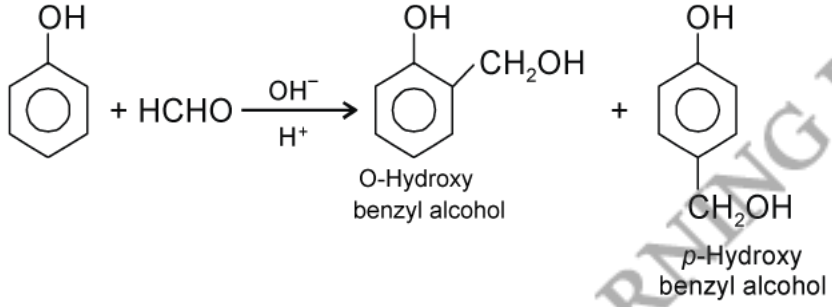
(a) Polymethyl acrylate 

(b) Poly ethyl acrylate 

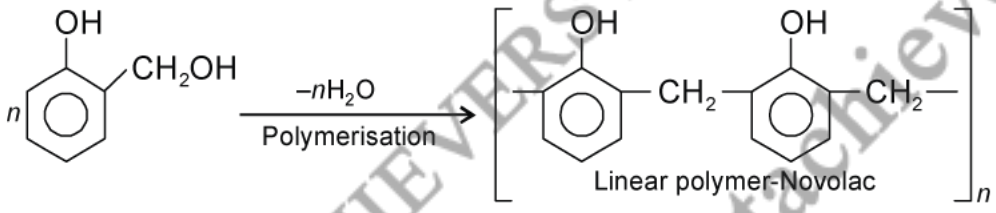
(c) Polyvinyl acetate 

(d) Polyacrylo nitrile 

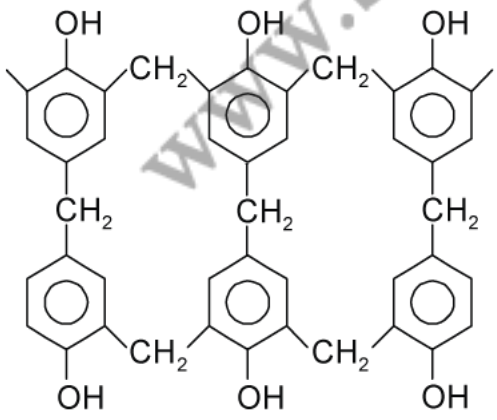
S61. Bakelite is a condensation polymer and is obtained from phenol and formaldehyde in the presence of either an acid or base.



The condensation of *o*-hydroxy benzyl alcohol or *p*-hydroxy benzyl alcohol gives a linear polymer called 'Novolac'



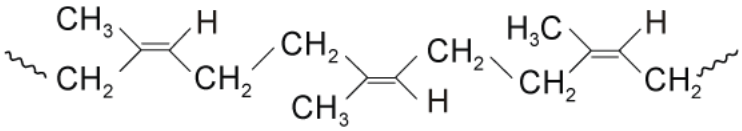
On further heating with formaldehyde, 'novolac' undergoes cross-linking to form an infusion solid called bakelite. This is very hard, scratch and water resistant. It possess excellent, electrical insulating character and hence, it finds major use in making electrical goods.



Bakelite

S62. It is because even the traces of certain impurities, which can act as chain transfer agent (or inhibitor) can interfere with the original polymerisation chain reaction. Hence monomers should be free from all impurities particularly such inhibitors. Examples of inhibitors (or chain transfer agents) are: CCl_4, CBr_4, amines, phenols, quinones etc.

S63. Natural rubber is considered as a linear 1, 4-polymer of isoprene (2-methyl-1, 3-butadiene). In this polymer, the residual double bonds are located between C_2 and C_3 of isoprene units in the polymer. All these doubles bonds have cis-configuration.

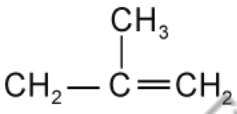


Natural rubber

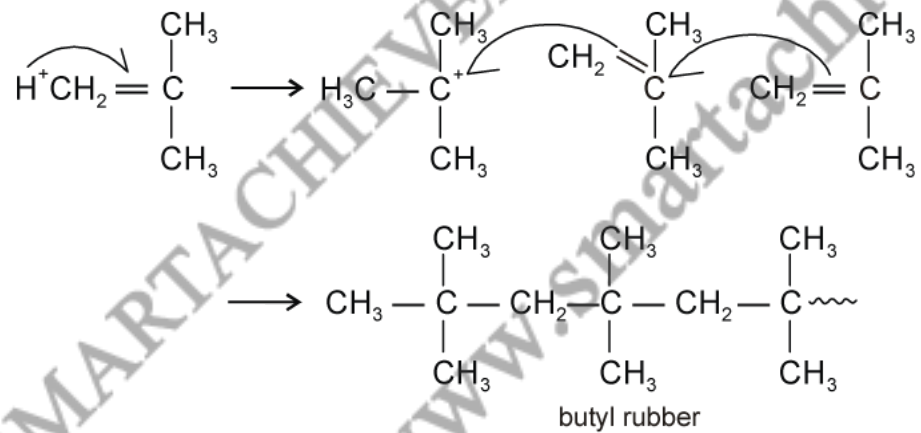
S64. We will prefer to polymerise acrylonitrile (CH_2 = CHCN) under anionic addition polymerisation conditions. It is because under anionic conditions, the active centre of propagating species is negatively charged. The polymerisation easily occurs with monomers like acrylonitrile becaus it contains electron withdrawing group such as nitrile. The density and facilitate the attack by nucleophile. Thus, acrylonitrile should be polymerised under anionic polymerisation conditions.

S65. In cationic addition polymerisation, a cationic intermediate species, for propagating the addition chain process, is formed. Such as intermediate is easily stablised by a monomer carrying electron donating group like isobutylene, i.e.,

The vinylic monomer containing electron



The vinylic monomer containing electron donating group *e.g.,* isobutylene easily stabilises cation intermediate which are formed by addition of H^+ at C = C bond. Thus cationic polymerisation is facilitated in monomers containing electron donating groups.



butyl rubber

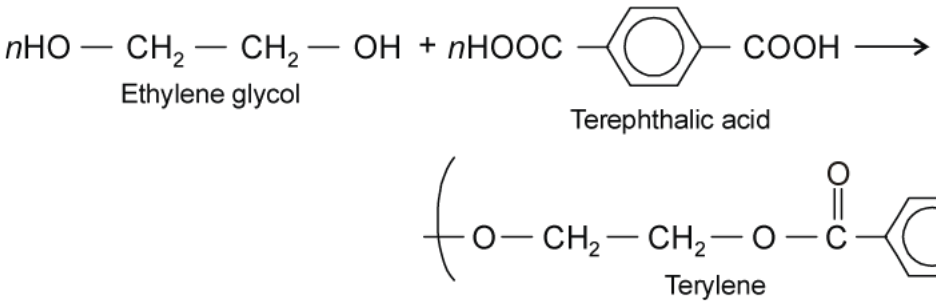
S66. (a) Phenol and formaldehyde

(b) Vinyl chloride

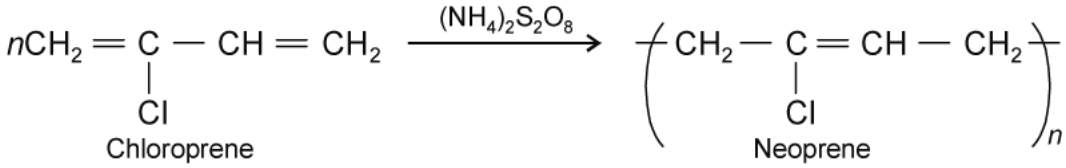
(c) Chloroprene

(d) Adipic acid and hexamethylene diamene.

S67. (a) Terylene is prepared by the condensation between ethylene glycol and terephthalic acid.

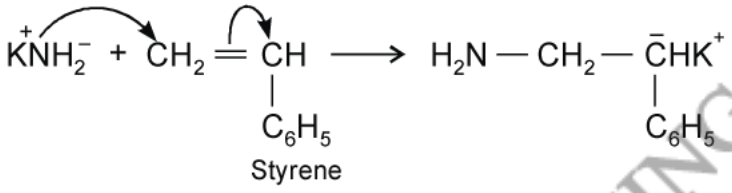


(b) Neoprene is obtained by addition polymerisation of chloroprene.

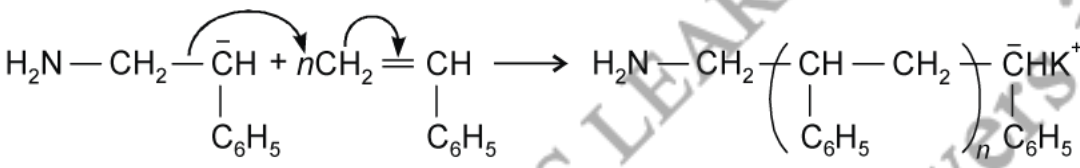


S68. **Anionic Addition Polymerisation:** Styrene undergoes anionic polymerisation easily. This is because C_6H_5 — Group in styrene is electron withdrawing resulting in the formation of ions.

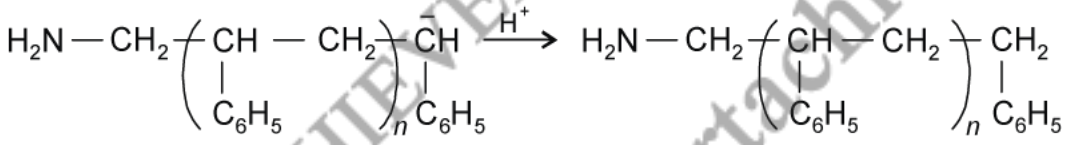
(a) **Chain Initiation Step:**

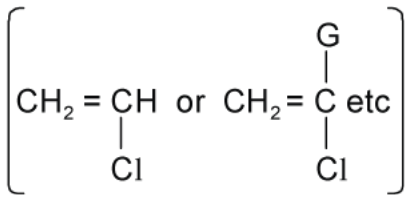


(b) **Chain propagation Step:**



(c) **Chain Termination Step:**



S69. Carbon tetra chloride is a chain transer agent (or inhibitor) and greatly influences the polymerisation process. For example, vinyl chloride or its derivatives 

in the presebce if CCl_4 polymerise to form PVC etc., of a lower average molecular mass. It is due to the fact growing vinylic radical which normally would add on a monomer react with CCl_4 to end the original chain and produces a new radical which (CCl_3) initiates a new polymerisation chain with monomer. It is illustrated as follows :