POLYMERS

CAPSULE FOR LITTLE DOERS 2015

SUBJECT- CHEMISTRY (CLASS 12)

Q1. What are polymers?

Ans- Polymers are defined as high molecular mass macro molecules, which consist of repeating structural units derived from the corresponding monomers. E.g. polythene, bakelite, rubber etc.

Q2. Distinguish between addition polymerisation and condensation polymerisation and give one example of each class?

Ans- Addition polymerization: In this process, polymers are formed by the repeated addition of monomer molecules possessing double or triple bonds. For example, the formation of polythene from ethene.

$$n CH_2 = CH_2 \xrightarrow{polymerisation} -[CH_2 - CH_2]-_n$$

Polythene

Condensation polymerization 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.

$$n NH_2 - (CH_2)_6 - NH_2 + nHOOC - (CH_2)_4 - COOH \xrightarrow{polymerisation}$$

Hexamethylene diamine Adipic Acid

$$-[N(CH_2)_6 NHCO(CH_2)_4 C]-_n + nH_2O$$

Q3. (a) How does vulcanization change the character of natural rubber?

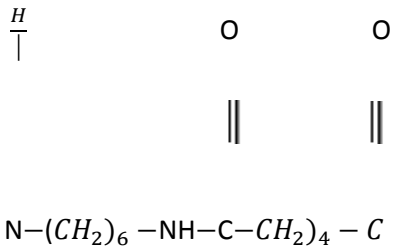
(b) Why are the numbers 66 and 6 put in names of nylon-66 and nylon-6?

Ans6(a)- Vulcanised rubber has the following advantage over natural rubber:

(1) It makes rubber resistant to wear and tear.
(2) Elasticity of rubber increases.
(3) Quite resistant to the action of organic acids. (b) Why are the numbers 66 and 6 put in names of nylon-66 and nylon-6?

Ans- (b) **Nylon-6,6:**Its both monomers contain six carbon atom each but the monomer of **Nylon-6** contains 6 Carbon atoms only

Nylon-6,6



Q4. What are biodegradable polymers? Give two examples?

Ans- 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. For example: Poly ß hydroxy butyrate-co- ß- hydroxy valerate (PHBV) , Nylon-2 Nylon-6.

Q5. What is the difference between thermosetting and thermoplastic polymers? Give one example of each.

Ans- Thermoplastic polymers: These are the linear or slightly branched long chain polymers possess intermolecular forces of attraction intermediate between elastomers and fibers. For example- Polythene, polystyrene, polyvinyl chloride etc.

Thermosetting polymers- These polymers are cross linked or heavily branched molecules which on heating undergo extensive cross linking in moulds and again become infusible. These cannot be reused. For example- Bakelite, melamine etc.

Q6. Differentiate between a homopolymer and a copolymer. Give one example of each.

Ans- A polymer formed by polymerization of monomers of the single substance is known as a homopolymer. E.g. Polythene.

$$n CH_2 = CH_2 \xrightarrow{polymerisation} [CH_2 - CH_2]_n$$

Polythene

Co-polymer: A polymer that is formed by the polymerization of two or more different monomers. Buna-S is a copolymer of butadiene and styrene. E.g.

$$n CH_2 = CH - CH = CH_2 + CH = CH_2 \rightarrow [CH_2 - CH = CH - CH_2 - \underset{\underset{C_6H_5}{|}}{CH} - CH_2]$$

Q7. Write equations used for the synthesis of (1) terylene (2) neoprene.

Ans- (1) $n HO CH_2 - CH_2OH + nHOOC - C_6H_5 - COOH \xrightarrow[Zinc\ Acetate\ and\ antimony\ trioxide]{Polymerisation,}$

$$(OCH_2 - CH_2 - O - \overset{\overset{O}{\|}}{C} - C_6H_5 - \overset{\overset{O}{\|}}{C})_n + nH_2O$$

(2) $n CH_2 = \underset{\underset{Cl}{|}}{C} - CH = CH_2 \xrightarrow{O_2\ or\ Peroxide} [CH_2 - \underset{\underset{Cl}{|}}{C} = CH - CH_2]_n$

Q8. (a) Write equations for the synthesis of Buna-S.

Ans- $n CH_2 = CH - CH = CH_2 + CH = CH_2 \rightarrow [CH_2 - CH = CH - CH_2 - \underset{\underset{C_6H_5}{|}}{CH} - CH_2]_n$

C_6H_5 C_6H_5

(b) Write the names and structures of the monomers of each of the following polymers: Natural Rubber, PVC, Teflon, Bakelite.

Ans- (1) $n CH_2 = C - CH = CH_2 \xrightarrow{O_2 \text{ or Peroxide}} [CH_2 - C = CH - CH_2]_n$

CH_3 CH_3

Isoprene

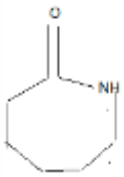
(2) Polyvinyl chloride- Vinyl chloride ($CH_2 = CHCl$)

(3) Teflon- Tetrafluoroethylene ($CF_2 = CF_2$)

(4) Bakelite- Formaldehyde (HCHO) And Phenol (C_6H_5OH)

Q9. Write equations to form :

(1) Nylon-6 (2) Nylon-66.

Ans- (1)  $\xrightarrow[H_2O]{533\,K-543K} H_2N-(CH_2)_5-COOH \xrightarrow[H_2O]{Heat} (HN(CH_2)_5-C)_n$

(2) $n H_2N-(CH_2)_6-NH_2$ + n HO-C-$(CH_2)_4-C-OH \xrightarrow[High\ Pressure]{553\,K}$

$(N-(CH_2)_6-NHCO-(CH_2)_4-C)_n$

Q10. Explain the following processes with a suitable example in each case:

(1) Chain Growth Polymerization

Ans-This process is initiated by initiators such as organic peroxides to produce free radicals to which the monomers are added and chain is formed. E.g. ethylene, propylene, tetrafluoroethylene, vinyl chloride etc. undergo chain growth polymerization.

(2) Step Growth Polymerization

Ans- Condensation occurs in a step wise manner with or without acid and hexamethylenediamine, phenol and formaldehyde etc. undergo step growth polymerization.

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POLYMERS

POLYMER	MONOMER(Name & Structure)	USES
Addition or Chain Growth Polymer		
Polythene	Ethene $CH_2=CH_2$	Insulator, ,Packing material,
Teflon (Polytetrafluoroethene)	Tetrafluoroethene $CF_2=CF_2$	Lubricant, Insulator and making non-stick cooking ware.
Poly acrylonitrile	Acrylonitrile $CH_2=CH-CN$	For synthetic fibres and synthetic wool.
Buna S	Buta-1,3-diene + Styrene $CH_2=CH-CH=CH_2$ $C_6H_5CH=CH_2$	Automobile tyres and Foot wears
Buna N	Buta-1,3-diene + Acrylonitrile $CH_2=CH-CH=CH_2$ $CH_2=CH-CN$	Oil seals, Tank lining
Natural Rubber	2-Methylbuta-1,3-diene (Isoprene)	Used for tyres after vulcanisation
Synthetic Rubber(Neoprene)	2-Chlorobuta-1,3-diene (Chloroprene)	Insulator, making conveyor belts and printing rollers
Polypropene	Propene $CH_3-CH=CH_2$	Ropes, toys, pipes and fibres
Polystyrene	Styrene $C_6H_5CH=CH_2$	Insulator, Wrapping material,toys, Radio and television cabinets.
Polyvinyl chloride (PVC)	Vinyl Chloride $CH_2=CH-Cl$	Rain coats, Hand bags, Vinyl flooring and water pipe.
Condensation or Step Growth Polymers		
Terylene(Dacron)	Ethane-1,2-diol + Benzene-1,4-dicarboxylic acid	Used for making fibres, safety belts, tents
Nylon 66	Hexamethylene diamine + Adipic acid $NH_2(CH_2)_6NH_2$ $HOOC(CH_2)_4COOH$	For making brushes,paratutes and ropes
Nylon 6	Caprolactum	Tyres cords,fabrics and ropes
Bakelite	Phenol + Methanal	Combs,electrical switches,handles of utensiles and computer discs
Melamine	Melamine + Methanal	Unbreakable crockery
PHBV **(biodegradable)**	3-Hydroxybutanoic acid + 3-Hydroxypentanoic acid	Specialty packaging, orthopedic devices, In controlled drug release
Nylon 2 – Nylon 6 **(biodegradable)**	Glycine + Amino caproic acid H_2N-CH_2-COOH $H_2N(CH_2)_5-COOH$	
Urea-formaldehyde resin	Urea + Formaldehyde	Unbreakable cups , laminated sheet
Glyptal	Ethane1,2-diol + Benzene-1,2-dicarboxylic acid	Binding material in preparation of mixed plastics and paints

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Semi-synthetic poly	Cellulose Acetate (Rayon)
Thermoplastic polymers	Linear or slightly branched / capable of repeatedly softening on heating and hardening on cooling. Example : Polythene, Polystyrene, Polyvinyls, etc.
Thermosetting polymers	Cross linked or heavily branched molecules. / on heating undergo extensive cross linking in moulds and again become infusible. These cannot be reused. Examples : Bakelite, Urea-formaldelyde resins.
Homo-polymer & Co-polymer	Homo-polymer → Polymer of a single monomeric species. Example : Polythene , PVC Co-polymer→ Polymer of more than one monomer .Example : Nylon66, Bakelite
Initiators	Benzoyl Peroxide [C6H5CO-O-O-CO-C6H5] (in free radical addition polymerization)
Vulcanisation of Rubber.	Natural rubber is soft at high temp and brittle at low temp and absorbs water. To improve these physical properties, it is heated with sulphur and an appropriate additive at a temperature range between 373 K to 415 K. On vulcanisation, sulphur forms cross links at the reactive sites of double bonds and thus the rubber gets stiffened.