

Polymers

SOLUTIONS

EXERCISE - O

1. **Ans. (A)**Starch is a polymer of α -D-glucose2. **Ans. (A)**

Nylon-6, 6 has amide linkage

3. **Ans. (A)**

PDI abbreviates as polydispersity index of polymer.

$$PDI = \frac{\overline{M}_w}{\overline{M}_n}$$

For natural polymers $PDI = 1$, i.e., $\overline{M}_w = \overline{M}_n$ For synthetic polymers $PDI > 1$ i.e., $\overline{M}_w > \overline{M}_n$ 4. **Ans. (C)**

Buna-S (SBR) is synthetic rubber.

5. **Ans. (C)**Ziegler-Natta catalyst is $Al_2(C_2H_5)_6 + TiCl_4$.6. **Ans. (A)**

The monomer is 2-Methylpropene

7. **Ans. (D)**

Buna-S is a polymer of Butadiene and styrene

8. **Ans. (D)**

Final product shown in the reaction is natural rubber (isoprene).

9. **Ans. (B)** $CH_2=CH-CH=CH_2$ is conjugated diene which forms stable intermediate hence polymerises the fastest.10. **Ans. (A)**

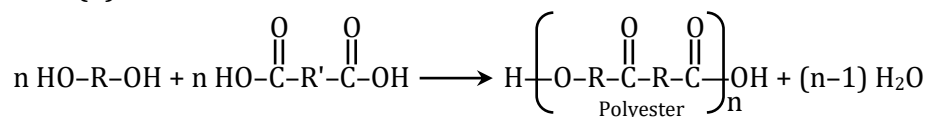
Condensation product of caprolactam is nylon-6

11. **Ans. (D)**

All the free radical initiators catalyse the free radical polymerisation.

12. **Ans. (B)**

Given polymer is formed by urea and formaldehyde, hence is called urea formaldehyde resin.

13. **Ans. (C)**14. **Ans. (B)**

Aspartame is an artificial sweetener, III is an incorrect statement.

Aspartame is an ester derivative of a dipeptide, made by aspartic acid and phenylalanine.

15. **Ans. (A)**

Natural rubber contains isoprene unit.

16. **Ans. (C)**

Column I (Polymer)		Column II (Uses)	
a.	PHBV	s.	Control drug release
b.	PCTFE	p.	Non-sticky surface of cooking pans.
c.	PMMA	q.	Transparent domes.
d.	Glyptal	r.	Paints, lacquers

17. **Ans. (A)**

Column-I (Structure)		Column-II (Polymer)	
a.		r.	Melmac
b.		t.	Perlon
c.		p.	Polyisobutylene
d.		q.	PEA
e.		s.	Dacron

18. **Ans. (A)**

In elastomers, the molecular forces of attraction are weak van der Waals type which are the weakest.

19. **Ans. (A)**

In thermoplastics linear chain exists. In thermosetting polymers, cross-links exist. Bakelite is an example of thermosetting polymer. Nylon-6, 6 is an example of fibre. (a) is correct while (b), (c) and (d) are incorrect.

20. **Ans. (D)**

The hardest of all is thermosetting polymers. Hence, choice (D) is correct while (A), (B) and (C) are incorrect.

21. **Ans. (A)**

'a' is correct because $-C_6H_5$ group is electron 'withdrawing' which stabilizes carbanion. (b), (c) and (d) have electron releasing group which destabilize the carbanion.

22. **Ans. (D)**

All of these can induce anionic polymerisation because they are source of base NH_2^- , $C_4H_9^-$, OH^- .

23. **Ans. (C)**

In (d) $\text{CH}_2 = \underset{\text{CH}_3}{\text{CH}}$, methyl group is electron-releasing, therefore, stabilizes carbocation. (a), (b) have

electron withdrawing group which will destabilize carbocation. But in (c), carbocation is stabilised by resonance and is more stable than (d).

24. **Ans. (ACD)**

25. **Ans. (ABCD)**

(A) A dipeptide has one peptide link between two amino acids.

(B) By convention N-Terminus is kept at left and C-terminus at right in the structure of a peptide

(C) If only one amino group and one carboxylic acid, group are available for reaction, then only one dipeptide can form.

(D) A polypeptide with more than hundred amino acid residues (mol. mass > 10,000) is called a protein.

26. **Ans. (CD)**

Preparation of nylon-6, 6 is an example of condensation polymerisation, as it is formed by elimination of H_2O molecules from hexamethylenediamine and adipic acid.

EXERCISE - S

1. **Ans. (1)**

PDI abbreviates as polydispersity index of polymer.

$$\text{PDI} = \frac{\overline{M}_w}{\overline{M}_n}$$

For natural polymers $\text{PDI} = 1$, i.e., $\overline{M}_w = \overline{M}_n$

For synthetic polymers $\text{PDI} > 1$ i.e., $\overline{M}_w > \overline{M}_n$

2. **Ans. (2)**

3. **Ans. (1)**

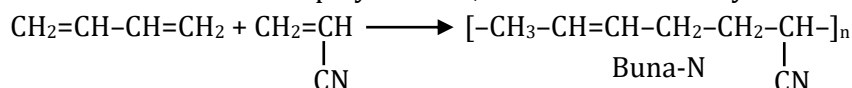
(D) Poly(ethylene terephthalate)

Rest all are addition polymers

EXERCISE - JEE (Main) PYQ

1. **Ans. (3)**

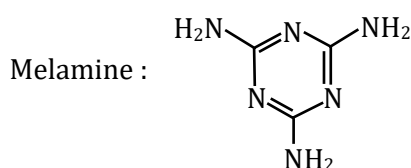
Buna-N is an addition copolymer of 1,3-butadiene and acrylonitrile.



2. **Ans. (4)**

Poly-β-hydroxybutyrate-co-β-hydroxy valerate is an example of polyester.

3. **Ans. (1)**



Formaldehyde HCHO

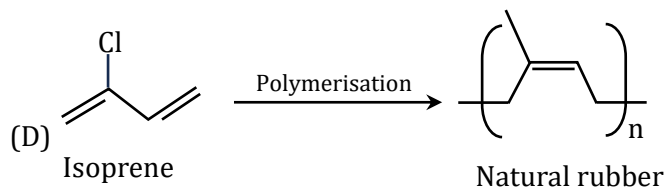
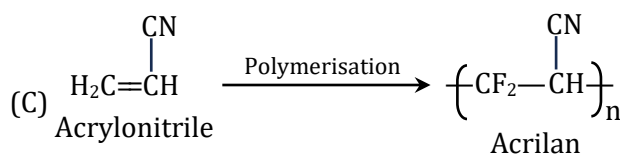
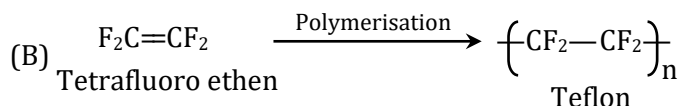
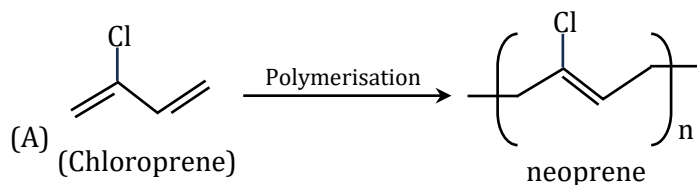
Melamine formaldehyde Resin is melamine polymer

4. Ans. (2)

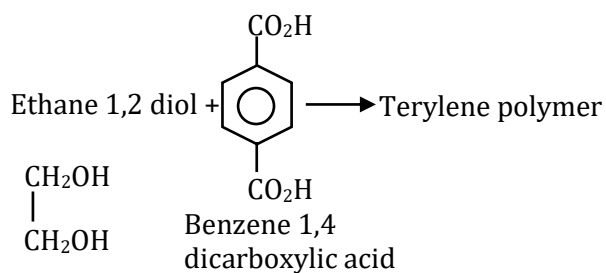
A-III, B-IV, C-I, D-II

List-I (Polymer)	List-II (Used for items)
A. Nylon 6,6	Bristles of brushes
B. Low density polythene	Toys
C. High density polythene	Buckets
D. Teflon	Non-stick utensils

5. Ans. (1)



6. Ans. (3)



7. Ans. (2)

Neoprene is elastomer

Nylon-6, 6 is fiber

PVC is thermoplastic

Novolac is thermosetting

8. Ans. (4)

Rayon is semisynthetic polymer.

9. **Ans. (3)**

Neoprene : Elastomer

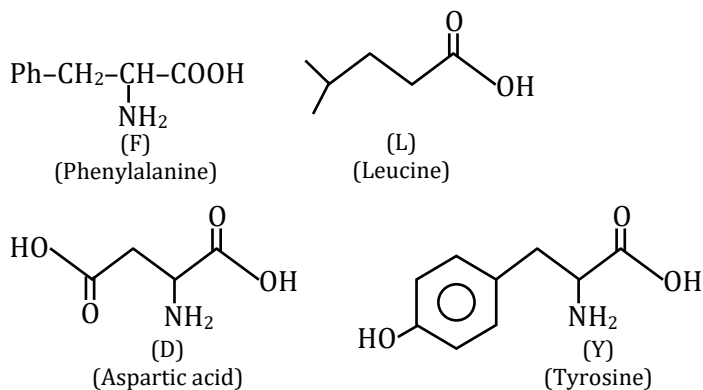
Polyester : Fibre

Polystyrene : Thermoplastic

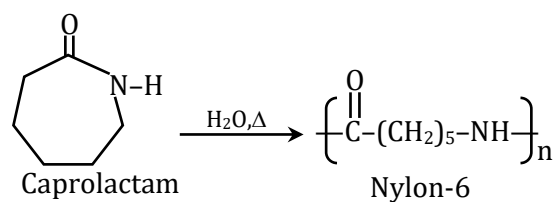
Urea-Formaldehyde Resin: Thermosetting polymer

10. **Ans. (2)**

Hydrolysis of the given tetrapeptide will give the following:



11. **Ans. (4)**



12. **Ans. (2)**

A-III, B-IV, C-II, D-I

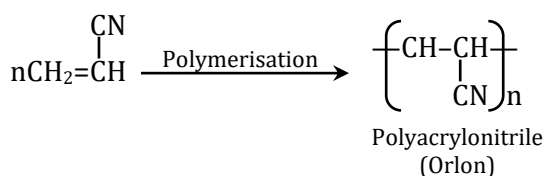
	List- I (Name of polymer)	List- II (Uses)
A.	Glyptal	Paints and Lacquers
B.	Neoprene	Gaskets
C.	Acrilan	Synthetic wool
D.	LDP	Flexible pipes

13. **Ans. (6)**

Number of peptide linkage = (amino acid- 1)

$$= 7 - 1 = 6$$

14. **Ans. (1)**



15. **Ans. (4)**

(A) Nylon-2-nylon-6

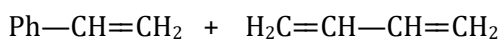
Biodegradable polymer and polyamides (II)

(B) Buna-N $\rightarrow$ Butadiene acrylonitrile rubber $\rightarrow$ synthetic rubber (III)

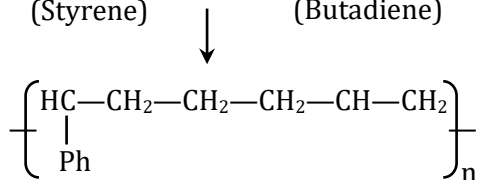
(C) Urea-formaldehyde resin → Thermosetting polymer (I)

(D) Dacron → Polyester polymer of ethylene glycol and terephthalic acid (IV)

16. **Ans. (2)**



(Styrene) (Butadiene)



17. **Ans. (4)**

Ethene undergoes addition polymerisation to high density polythene in the presence of catalyst such as AlEt_3 and TiCl_4 (Ziegler – Natta catalyst) at a temperature of 333 K to 343 K and under a pressure of 6–7 atmosphere.

18. **Ans. (2)**

$\text{S}_1 \Rightarrow$ HDPE is formed by TiCl_4 & $\text{Al}(\text{Et})_3$.

$\text{S}_2 \Rightarrow$ Nylon-6 is formed by caprolactam.

19. **Ans. (4)**

Nylon-6– Caprolactum (Monomer)

Natural rubber – Isoprene (Monomer)

Vulcanized rubber – Sulphur containing rubber

Neoprene – Chloroprene (Monomer)

20. **Ans. (2)**

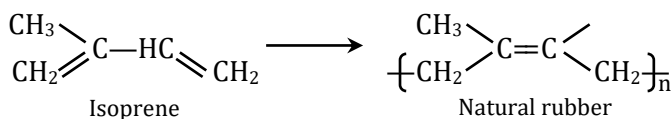
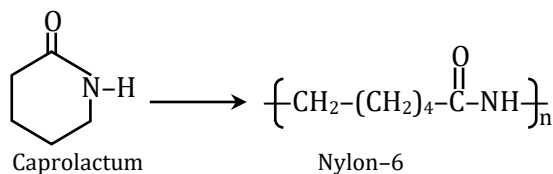
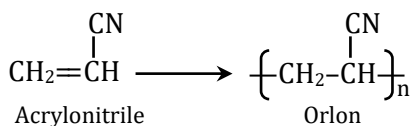
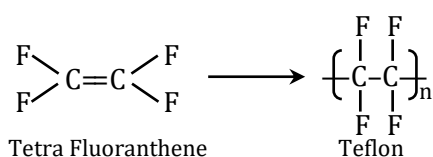
Hexamethylenediamine on reaction with adipic acid forms Nylon 6, 6 which shows H-bonding due to presence of amide group.

$\text{AlEt}_3 + \text{TiCl}_4$ is Ziegler-Natta catalyst used to prepare high density polyethylene.

2-chloro-1, 3-butadiene (chloroprene) is monomer of neoprene which is a rubber (an elastomer)

Phenol – formaldehyde forms Bakelite which is heavily branched (cross-linked) polymer

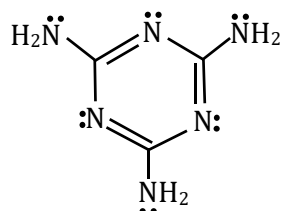
21. **Ans. (1)**



EXERCISE - JEE (Advanced) PYQ

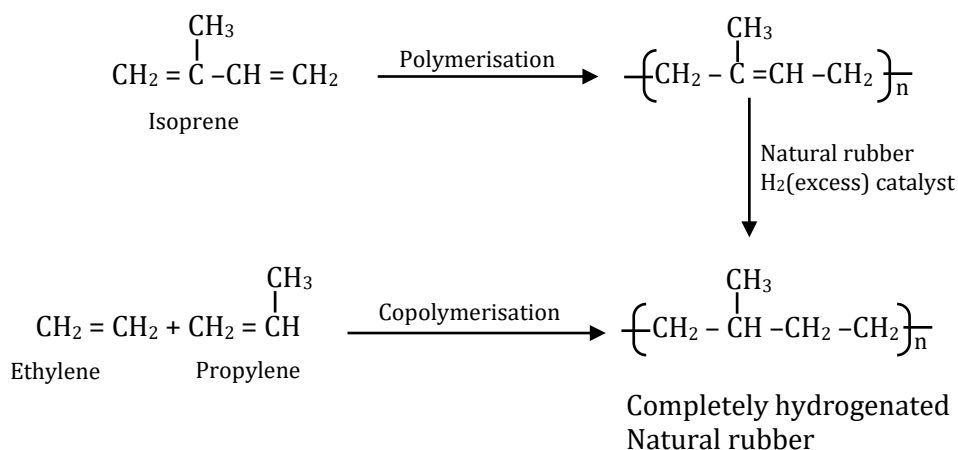
1. **Ans. (6)**

Structure of melamine is as follows



Total no. of lone pairs of electron is '6'.

2. **Ans. (A)**



3. **Ans. (B,D)**

A. Natural rubber is polyisoprene containing cis alkene units

B. Nylon-6 has amide linkage $\left[\text{HN} - (\text{CH}_2)_5 - \text{C} \right]_n$
 $\parallel$
 O

C. Cellulose has only β -D glucose units.

D. $\text{F}_2\text{C} = \text{CF}_2 \xrightarrow{\text{Persulphate}} \left[\text{CF}_2 - \text{CF}_2 \right]_n$

4. **Ans. (B,C)**

(A) The polymerisation of neoprene gives natural rubber.

(B) is correct statement

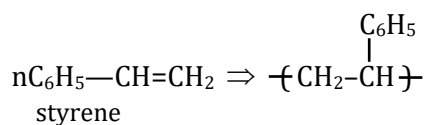
(C) is correct statement

(D) Ethene at 350-570 K temperature and 1000-2000 atm pressure in the presence of a peroxide initiator yields low density polythene.

JEE (Main) Practice Paper

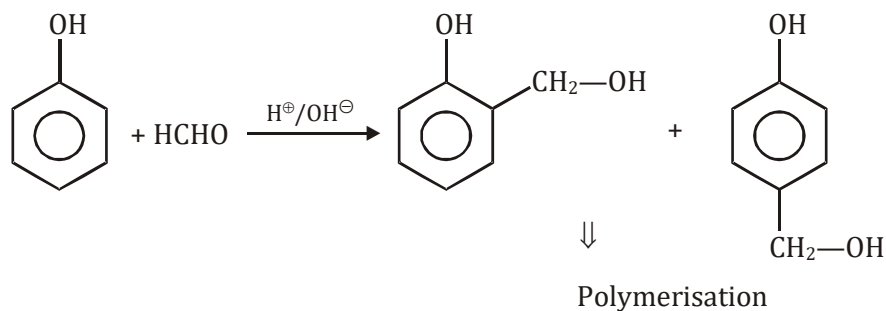
SECTION-A

1. **Ans. (4)**



2. **Ans. (1)**

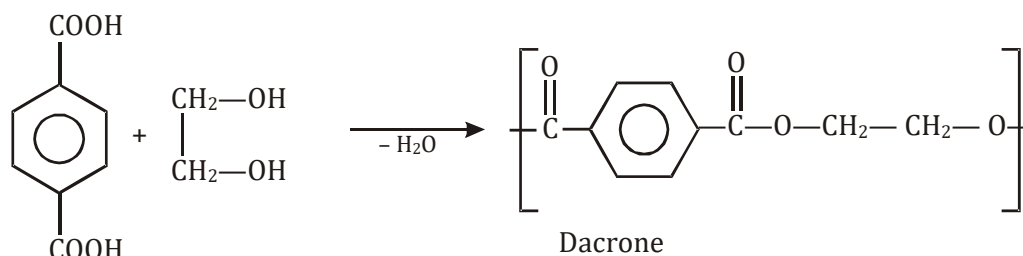
Weakest intermolecular forces are present in Neoprene

3. **Ans. (3)**

Bakelite

4. **Ans. (3)**

Dacron

5. **Ans. (3)**

Novalac is linear polymer of phenol and formaldehyde

6. **Ans. (1)**

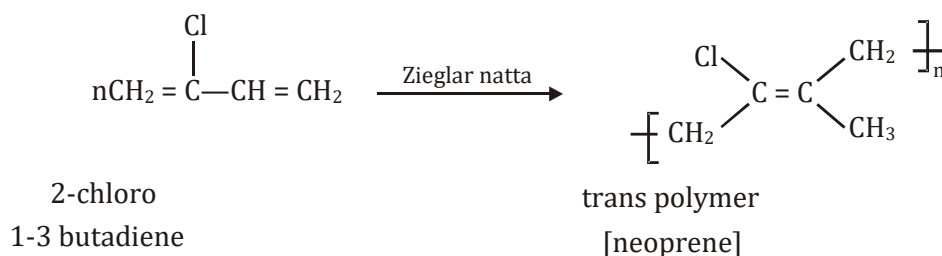
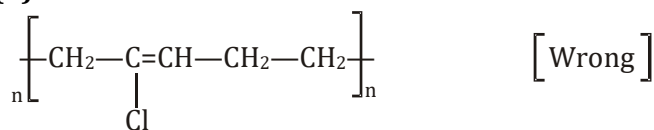
Cis-Polyisoprene is not semisynthetic polymers

7. **Ans. (2)**

Nylon-66 is an example of condensation polymerization

8. **Ans. (1)**

Natural rubber has the trans configuration at every double bond.

9. **Ans. (3)**10. **Ans. (1)**

Terylene is polyester polymer?

11. **Ans. (2)**

Neoprene is addition polymer

12. **Ans. (4)**

Nylon 66 is Fibers polymer

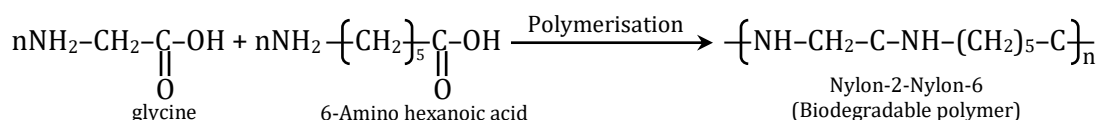
13. **Ans. (4)**

$\text{H}_2\text{N} - \text{CH}_2 - \text{COOH}$ and $\text{H}_2\text{N} - (\text{CH}_2)_5 - \text{COOH}$

14. **Ans. (4)**

Nylon is an example of polyamide

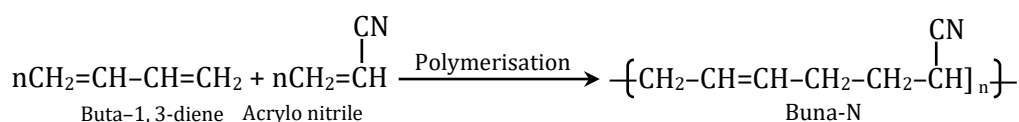
15. **Ans. (4)**



16. **Ans. (2)**

$\text{Ph} - \text{CH} = \text{CH}_2$

17. **Ans. (1)**



18. **Ans. (2)**

Radical polymerisation has more change for those monomers whose free radicals are more stable.

19. **Ans. (1)**

2-Methylbuta-1,3-diene is monomer of natural rubber.

2-Chlorobuta-1,3-diene is monomer of neoprene.

20. **Ans. (1)**

Bakelite → Electrical switches

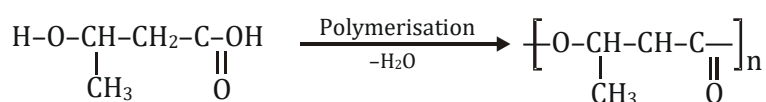
Melamine-formaldehyde resin → Unbreakable crockery

Nylon 6 → Tyre, cords

Polytetrafluoroethane → Non-stick cookwares

SECTION-B

1. **Ans. (104)**



Molecular formula of monomer is $[\text{C}_4\text{H}_8\text{O}_3]$, molecular mass = 104.

2. **Ans. (3)**

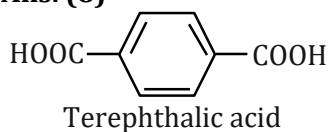
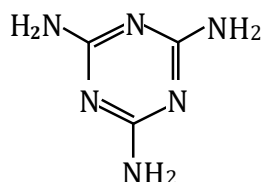
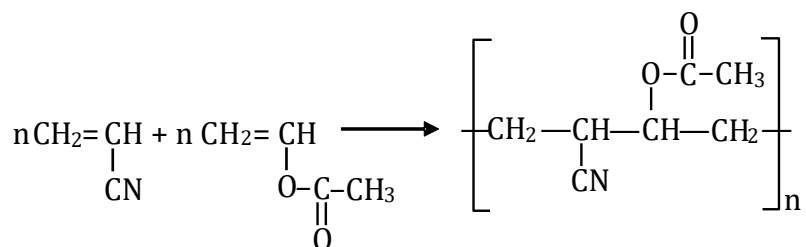
Orlon is a polymer of acrylonitrile.

3. **Ans. (6)**

(i), (ii), (iii), (vi), (vii) and (ix) are addition polymers.

4. **Ans. (3)**

Condensation polymers : Nylon-6,6, Nylon-6,10, Nylon-6

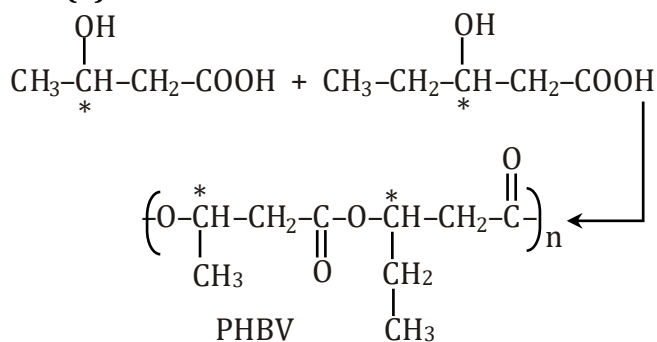
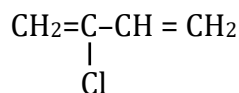
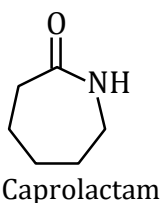
5. **Ans. (8)**6. **Ans. (6)**7. **Ans. (38.129)**

Molecular mass of Acrylonitrile = 53

Molecular mass of Vinyl acetate = 86

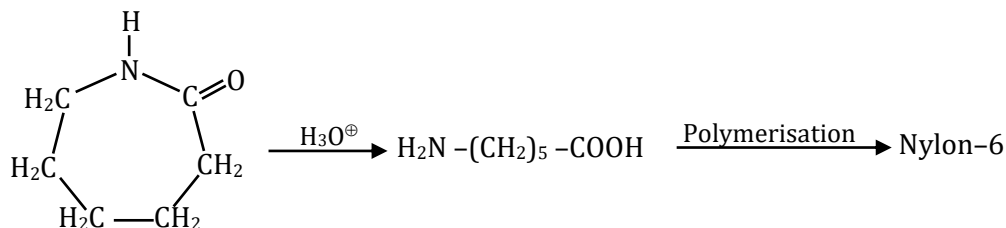
Molecular mass of repeated unit = 139

$$\text{Mass \% of Acrylonitrile} = \frac{53}{139} \times 100 = 38.129 \%$$

8. **Ans. (2)**9. **Ans. (4)**10. **Ans. (5)**

JEE (Advanced) Practice Paper

1. **Ans. (C)**
Nylon is a step growth polymer or condensation polymer.
2. **Ans. (D)**
Teflon is chain growth polymer or addition polymer.
3. **Ans. (D)**
Wool, silk and Leather are example of natural polymer.
4. **Ans. (D)**



5. **Ans. (A,B,C,D)**
(A) High density polythene is a linear polymer.
(B) Low density polythene is a branched chain polymer.
(C) Chain growth polymers are also known as addition polymer.
(D) Step growth polymer is also known condensation polymer.
6. **Ans. (A,B,C)**
In thermoplastic polymers, the intermolecular forces of attraction are in between elastomers and fibers.
7. **Ans. (C)**
Nylon-66 is example of condensation polymer. Alanine having pH 6 at isoelectric point.
8. **Ans. (AD)**
Teflon and polystyrene are example of thermoplastic polymer.
9. **Ans. (AB)**
3-hydroxybutanoic acid + 3-hydroxypentanoic acid $\rightarrow$ PHBV
Glycine + amino caproic acid $\rightarrow$ Nylon-2-Nylon-6
PHBV and Nylon-2-Nylon-6 are biodegradable polymer.
10. **Ans. (ABD)**
 $\text{CH}_2=\text{CH}-\text{Cl}$ (PVC)
 $\text{Ph}-\text{CH}=\text{CH}_2$ (Polystyrene)
 $\text{CF}_2=\text{CF}_2$ (Teflon)
11. **Ans. (B)**
(A) Addition polymer : - Buna-S, Buna-N, polyethene
(B) Condensation polymer :- Nylon-6,6
(C) Homopolymer:- Polythene
(D) Copolymers :- Buna-S, Buna-N, Nylon 6,6

Polymers

12. **Ans. (A)**

(A) Monomers of bakelite are : Phenol + formaldehyde.

(B) Monomer of Polypropylene is : Propene

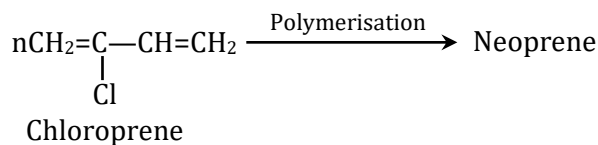
(C) Monomers of Glyptal are : Ethylene glycol + phthalic anhydride

(D) Monomer of Nylon-6 is : caprolactum.

13. **Ans. (C)**

Ziegler-Natta catalyst $\Rightarrow R_3Al + TiCl_4$

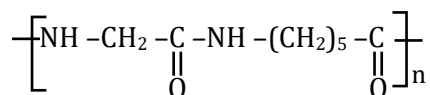
14. **Ans. (A)**



15. **Ans. (D)**

All are free radical initiators and catalyse the free radical polymerisation.

16. **Ans. (16.47)**



Molecular formula of monomer is $[C_8H_{14}O_2N_2]$

$$\% \text{ nitrogen} = \frac{28}{170} \times 100 = 16.47$$

17. **Ans. (5)**

All are correctly matched.

18. **Ans. (5)**

All are correctly matched.

19. **Ans. (4)**

(i), (ii), (iii), (iv) are prepared by condensation polymerisation reaction.

20. **Ans. (4)**

(i), (ii), (iii), (iv) contains 1, 3-Butadiene (word root) as one of the monomer.