Exercise-1

Marked questions are recommended for Revision.

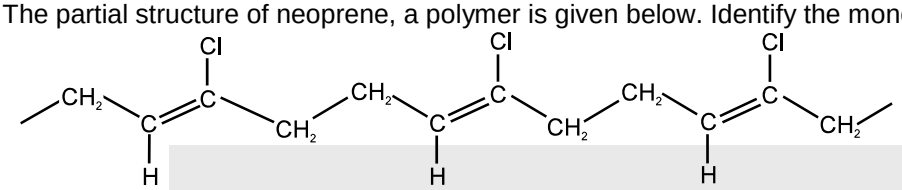
PART - I : SUBJECTIVE QUESTIONS

Section (A) : Polymers

A-1. Differentiate between a homopolymer and a copolymer. Give one example of each type.

A-2. What is meant by vulcanisation of rubber ? Why is rubber vulcanised ? Give an important application of vulcanised rubber.

A-3. The partial structure of neoprene, a polymer is given below. Identify the monomer unit.



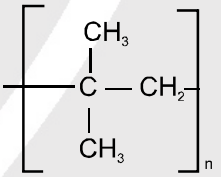
A-4. Classify the following as addition and condensation polymer
polymers : Terylene, Bakelite, polyvinyl chloride, polythene

A-5. What is the difference between Buna-N and Buna-S

A-6. Arrange the following in the increasing order of their intermolecular forces
Nylon-6, Neoprene, Polyvinyl chloride
(I) (II) (III)

PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Polymers

A-1. Monomer of given polymer  is :

(A) 2-Methylpropene (B) Styrene (C) Propylene (D) Ethene

A-2. Starch is polymer of
(A) α-D-Glucose (B) β-D-Glucose
(C) α-D-Glucose and β-D-Glucose (D) α-D-Fructose

A-3. Polymer which has amide linkage is
(A) Nylon -6,6 (B) Terylene (C) Teflon (D) Bakelite

A-4. Nylon-6,6 is made by using
(A) Phenol (B) Benzaldehyde (C) Adipic acid (D) Succinic acid

A-5. Which of the following is a nitrogen containing polymer ?
(A) Polyvinyl chloride (B) Bakelite (C) Nylon (D) Terylene

A-6. Buna-S is a polymer of :
(A) Butadiene only (B) Butadiene and nitryl
(C) Styrene only (D) Butadiene and styrene

A-7. Condensation product of caprolactum is :
(A) nylon-6 (B) nylon-6,6 (C) nylon-60 (D) nylon-6, 10

A-8. Ziegler-Natta catalyst is :
(A) $K[PtCl_3(C_2H_4)]$ (B) $(Ph_3P)_3RhCl$ (C) $Al_2(C_2H_5)_6 + TiCl_4$ (D) $Fe(C_5H_5)_2$

PART - III : MATCH THE COLUMN

1. Match **Column-I** with **Column-II**.

	Column-I (polymer)		**Column-II (monomer)**
(A)	Bakelite	(p)	ε-caprolactum
(B)	Polypropylene	(q)	Ethylene glycol + phthalic anhydride
(C)	Glyptal	(r)	propene
(D)	Nylon-6	(s)	Phenol + formaldehyde

Exercise-2

Marked questions are recommended for Revision.

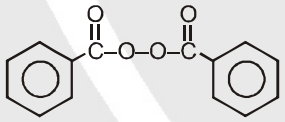
PART - I : ONLY ONE OPTION CORRECT TYPE

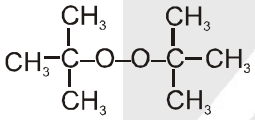
1. Which of the following contains isoprene unit ?
(A) Natural rubber (B) Polyethylene (C) Nylon-6,6 (D) Dacron

2. Which of the following is condensation polymer ?
(A) Polystyrene (B) PVC (C) Polyester (D) Teflon

3. Which of the following polymerises most easily ?
(A) $CH_3CH_2C{\equiv}CH$ (B) $CH_2{=}CH{-}CH{=}CH_2$
(C) $CH_3CH_2{-}CH{=}CH_2$ (D) $CH{\equiv}C{-}C{\equiv}CH$

4. Which of the following is radical initiator

(A) R–N=N–R (B) 

(C)  (D) All

5. The polymerisation reaction shown below

$$2CH{\equiv}CH \xrightarrow{CuCl} CH{\equiv}C{-}CH{=}CH_2 \xrightarrow[Cu_2Cl_2/NH_4Cl]{HCl} CH_2{=}\underset{\displaystyle Cl}{\underset{|}{C}}{-}CH{=}CH_2 \xrightarrow[(2)\ Polymerisation]{(1)\ CH_3MgCl} \left[-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}{=}CH-CH_2\right]_n$$

would produce :
(A) PVC (B) neoprene (C) chloroprene (D) Rubber

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

1. Among the following no. of condenstion polymer
Nylon-6, Buna-N, Buna-S, Nylon-6,6, Nylon-6,10, PVC, Polystyrene, Teflon.

2. How many of the following polymers are addition polymer
(i) Polyvinyl chloride (ii) Terylene (iii) Teflon (iv) Neoprene
(v) Buna-S (vi) Nylon-6,6 (vii) Natural rubber (viii) Bakelite

PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. Which of the following are polyamide polymer ?
(A) Protein (B) Nylon–6,6 (C) Nylon–6 (D) Polystyrene

2. Preparation of nylon from hexamethylene diamine and adipic acid is an example of :
(A) addition polymerisation (B) homopolymerisation
(C) condensation polymerisation (D) copolymerisation

3. Which of the following are condensation polymer ?
(A) Terylene (B) Bakelite (C) Polyvinyl chloride (D) Nylon-6,6

Exercise-3

*** Marked Questions may have more than one correct option.**

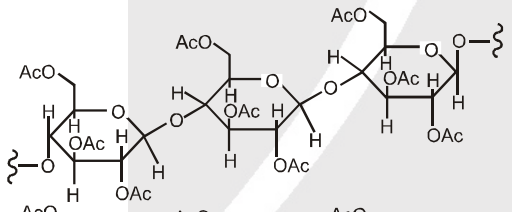
PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

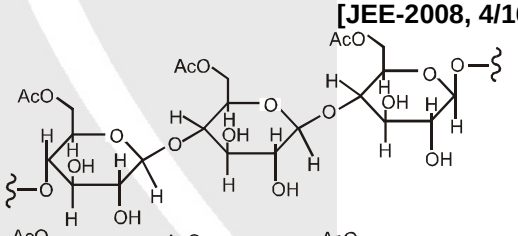
1. Write down the heterogenous catalyst involved in the polymerisation of ethylene. **[JEE-2003, 2/60]**

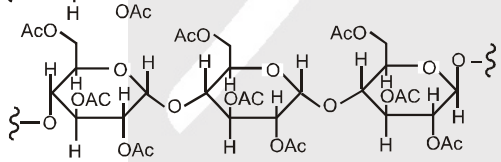
2. Match the chemical substances in **Column-I** with type of polymers/type of bonds in **Column-II**. **[JEE-2007, 6/162]**

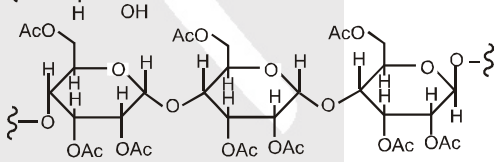
	Column-I		**Column-II**
(A)	cellulose	(p)	natural polymer
(B)	nylon-6,6	(q)	synthetic polymer
(C)	protein	(r)	amide linkage
(D)	sucrose	(s)	glycoside linkage

3. Cellulose upon acetylation with excess acetic anhydride/H_2SO_4 (catalytic) gives cellulose triacetate whose structure is **[JEE-2008, 4/163]**

(A) 

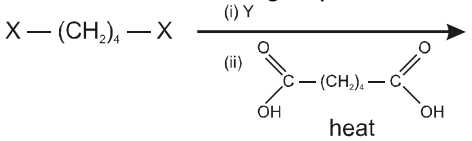
(B) 

(C) 

(D) 

4. Among celluose, poly vinyl chloride, nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is : **[JEE 2009, 3/160]**
(A) Nylon (B) Poly vinyl chloride (C) Cellulose (D) Natural Rubber

5.* The correct functional group X and the reagent/reaction conditions Y in the following scheme are



condensation polymer : **[JEE 2011, 4/180]**

(A) X = $COOCH_3$, Y = H_2/Ni/heat (B) X = $CONH_2$, Y = H_2Ni/heat
(C) X = $CONH_2$, Y = Br_2/NaOH (D) X = CN, Y = H_2/Ni/heat

6. The total number of lone-pairs of electrons in melamine is **[JEE(Advanced)-2013, 4/120]**

7. On complete hydrogenation, natural rubber produces **[JEE(Advanced)-2016, 3/124]**
(A) ethylene-propylene copolymer (B) vulcanised rubber
(C) polypropylene (D) polybutylene

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

JEE(MAIN) OFFLINE PROBLEMS

1. Monomers are converted to polymers by **[AIEEE-2002, 3/225]**
(1) Hydrolysis of monomer (2) Condensation between monomers
(3) Protonation of monomers (4) none

2. Complete hydrolysis of cellulose gives **[AIEEE-2003, 3/225]**
(1) D-fructose (2) D-ribose (3) D-glucose (4) L-glucose

3. Nylon threads are made up of **[AIEEE-2003, 3/225]**
(1) Polyvinyl polymer (2) Polyester polymer (3) Polyamide polymer (4) Polyethylene polymer

4. Which of the following is a polyamide ? **[AIEEE-2005, 1½/225]**
(1) Bakelite (2) Terylene (3) Nylon-6,6 (4) Teflon

5. Which of the following is fully fluorinated polymer **[AIEEE-2005, 3/225]**
(1) PVC (2) Thiokol (3) Teflon (4) Neoprene

6. Bakelite is obtained from phenol by reacting with **[AIEEE-2008, 3/105]**
(1) CH_3CHO (2) CH_3COCH_3 (3) HCHO (4) $(CH_2OH)_2$

7. Buna-N synthetic rubber is a copolymer of : **[AIEEE-2009, 4/144]**
(1) $H_2C=CH-CH=CH_2$ and $H_5C_6-CH=CH_2$ (2) $H_2C=CH-CN$ and $H_2C=CH-CH=CH_2$
(3) $H_2C=CH-CN$ and $H_2C=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH=CH_2$ (4) $H_2C=\underset{\displaystyle Cl}{\underset{|}{C}}-CH=CH_2$ and $H_2C=CH-CH=CH_2$

8. The polymer containing strong intermolecular forces e.g. hydrogen bonding is **[AIEEE-2010, 4/144]**
(1) teflon (2) nylon-6,6 (3) polystyrene (4) natural rubber

9. Which one is classified as a condensation polymer ? **[JEE (Main)-2014, 4/120]**
(1) Dacron (2) Neoprene (3) Teflon (4) Acrylonitrile

10. Which polymer is used in the manufacture of paints and lacquers ? **[JEE(Main) 2015, 4/120]**
(1) Bakelite (2) Glyptal (3) Polypropene (4) Poly vinyl chloride

11. Which of the following statements about low density polythene is **FALSE**? **[JEE(Main) 2016, 4/120]**
(1) It is a poor conductor of electricity.
(2) Its synthesis required dioxygen or a peroxide initiator as a catalyst.
(3) It is used in the manufacture of buckets, dust-bins etc.
(4) Its synthesis requires high pressure.

12. The formation of which of the following polymers involves hydrolysis reaction? **[JEE(Main) 2017, 4/120]**
(1) Bakelite (2) Nylon 6,6 (3) Terylene (4) Nylon 6

JEE(MAIN) ONLINE PROBLEMS

1. Structure of some important polymers are given. Which one represents Buna-S ? **[JEE(Main) 2014 Online (09-04-14), 4/120]**

(1) $(-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_2-)_n$

(2) $(-CH_2-CH=CH-CH_2-\underset{\displaystyle C_6H_5}{\underset{|}{CH}}-CH_2-)_n$

(3) $(-CH_2-CH=CH-CH_2-\underset{\displaystyle CN}{\underset{|}{CH}}-CH_2-)_n$

(4) $(-CH_2-\underset{\displaystyle Cl}{\underset{|}{C}}=CH-CH_2-)_n$

2. Which one of the following class of compounds is obtained by polymerization of acetylene ?
[JEE(Main) 2014 Online (09-04-14), 4/120]

(1) Poly-yne (2) Poly-ene (3) Poly-ester (4) Poly-amide

3. Which one of the following is an example of thermosetting polymers ?
[JEE(Main) 2014 Online (19-04-14), 4/120]

(1) Neoprene (2) Buna-N (3) Nylon 6, 6 (4) Bakelite

4. Match the polymers in column-A with their main uses in column-B and choose the correct answer :
[JEE(Main) 2015 Online (10-04-15), 4/120]

Column-A	**Column-B**
(A) Polystyrene	(i) Paints and lacquers
(B) Glyptal	(ii) Rain coats
(C) Polyvinyl chloride	(iii) Manufacture of toys
(D) Bakelite	(iv) Computer discs

(1) (A) - (iii) , (B) - (i), (C) - (iii), (D) - (iv)
(2) (A) - (iii) , (B) - (i), (C) - (ii), (D) - (iv)
(3) (A) - (ii) , (B) - (iv), (C) - (iii), (D) - (i)
(4) (A) - (iii) , (B) - (iv), (C) - (ii), (D) - (i)

5. Which one of the following structures represents the neoprene polymer ?
[JEE(Main) 2015 Online (11-04-15), 4/120]

(1) $\left(CH_2-\underset{C_6H_5}{\underset{|}{CH_2}}\right)_n$ (2) $\left(CH_2-\underset{CN}{\underset{|}{CH}}\right)_n$

(3) $\left(CH_2-\underset{Cl}{\underset{|}{C}}=CH-CH_2\right)_n$ (4) $\left(CH_2-\underset{Cl}{\underset{|}{CH}}\right)_n$

6. **Assertion :** Rayon is a semisynthetic polymer whose properties are better than natural cotton.
Reason : Mechanical and aesthetic properties of cellulose can be improved by acetylation.
[JEE(Main) 2016 Online (09-04-16), 4/120]

(1) Both assertion and reason are correct, and the reason is the correct explanation for the assertion.
(2) Both assertion and reason are incorrect.
(3) Assertion is incorrect statement, but the reason is correct.
(4) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion.

7. Which of the following polymers is synthesized using a free radical polymerization technique ?
[JEE(Main) 2016 Online (10-04-16), 4/120]

(1) Teflon (2) Melamine polymer (3) Nylon 6,6 (4) Terylene

8. Which of the following is a biodegradable polymer ? **[JEE(Main) 2017 Online (09-04-17), 4/120]**

(1) $\left(HN-(CH_2)_6NHCO-(CH_2)_4-\overset{\overset{O}{\|}}{C}\right)_n$ (2) $\left(HN-(CH_2)_5CONH-CH_2-\overset{\overset{O}{\|}}{C}\right)_n$

(3) $\left(HN-(CH_2)_5-\overset{\overset{O}{\|}}{C}\right)_n$ (4) $\left(\overset{\overset{O}{\|}}{C}-C_6H_4-COO-(CH_2)_2-O\right)_n$

9. The copolymer formed by addition polymerization of styrene and acrylonitrile in the presence of peroxide is :
[JEE(Main) 2018 Online (15-04-18), 4/120]

(1) $\left(\underset{CH_3}{\underset{|}{\overset{H_5C_6\ CN}{\overset{|\quad|}{C}}}}-CH-CH_2\right)_n$ (2) $\left(CH_2-\underset{C_6H_5}{\underset{|}{CH}}-CH_2-\underset{CN}{\underset{|}{CH}}\right)_n$

(3) $\left(\overset{H_5C_6\quad CN}{\overset{|\qquad|}{CH_2-CH-CH-CH_2}}\right)_n$ (4) $\left(\underset{C_6H_5}{\underset{|}{CH}}-CH_2-CH_2-\underset{CN}{\underset{|}{CH}}\right)_n$

10. Which of the following statements is not true? **[JEE(Main) 2018 Online (15-04-18), 4/120]**

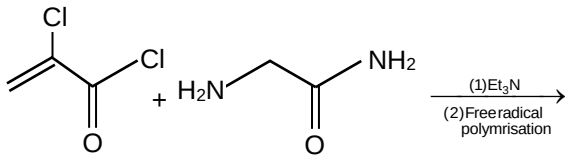
(1) Step growth polymerization requires a bifunctional monomer.

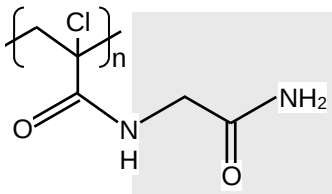
(2) Nylon 6 is an example of step-growth polymerization.

(3) Chain growth polymerization includes both homopolymerisation and copolymerisation.

(4) Chain growth polymerization involves homopolymerisation only.

11. Major product of the following reaction is : **[JEE(Main) 2019 Online (09-01-19), 4/120]**



(1)


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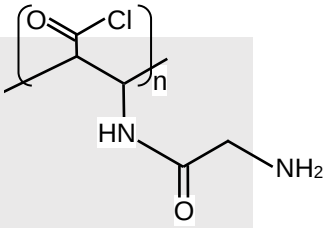

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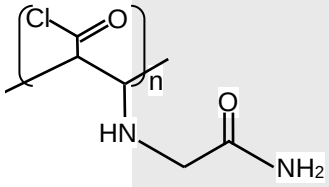

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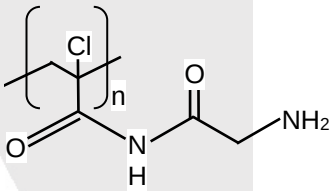
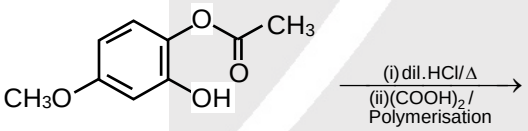
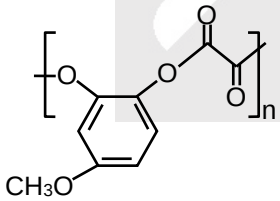


12. The major product of the following reaction is: **[JEE(Main) 2019 Online (10-01-19), 4/120]**



(1)


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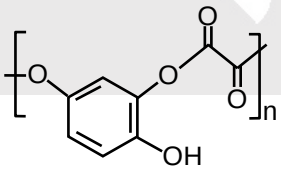

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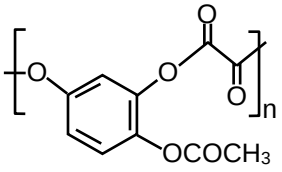

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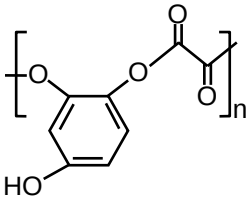
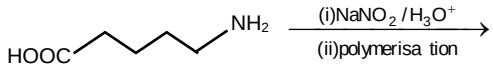
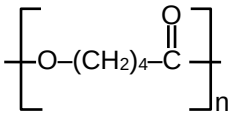
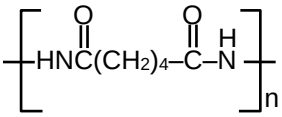
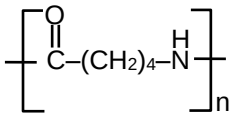


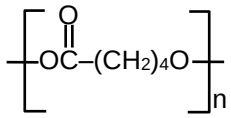
13. The polymer obtained from the following reactions is: **[JEE(Main) 2019 Online (11-01-19), 4/120]**



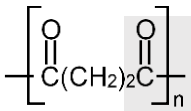
(1) 

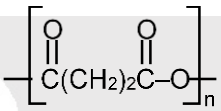
(2) 

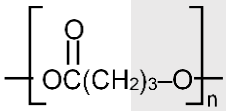
(3) 

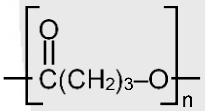
(4) 

14. The homopolymer formed from 4-hydroxy-butanoic acid is: **[JEE(Main) 2019 Online (11-01-19), 4/120]**

(1) 

(2) 

(3) 

(4) 

15. Poly-β-hydroxybutyrate-co-β-hydroxyvalerate (PHBV) is a copolymer of

[JEE(Main) 2019 Online (12-01-19), 4/120]

(1) 3-hydroxybutanoic acid and 2-hydroxypentanoic acid

(2) 3-hydroxybutanoic acid and 4-hydroxypentanoic acid

(3) 2-hydroxybutanoic acid and 3-hydroxypentanoic acid

(4) 3-hydroxybutanoic acid and 3-hydroxypentanoic acid

16. The two monomers for the synthesis of Nylon-6,6 are: **[JEE(Main) 2019 Online (12-01-19), 4/120]**

(1) $HOOC(CH_2)_4COOH$ & $H_2N–(CH_2)_6–NH_2$

(2) $HOOC(CH_2)_6COOH$ & $H_2N(CH_2)_4NH_2$

(3) $HOOC(CH_2)_6COOH$ & $H_2N(CH_2)_6\,NH_2$

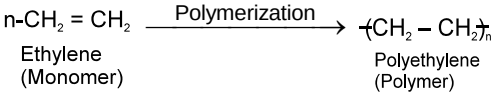
(4) $HOOC(CH_2)_4COOH$, $H_2N–(CH_2)_4NH_2$

Answers

EXERCISE - 1

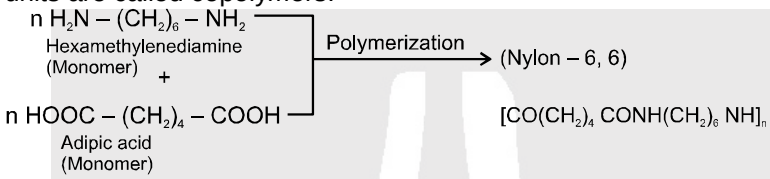
PART – I

A-1. **(i) Homopolymers :** Polymers in which repeating structural units are derived from only one type of monomer units are called homopolymers.



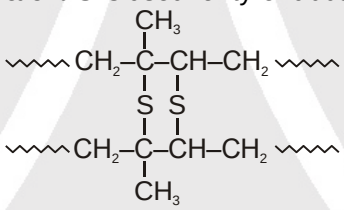
Other examples polypropylene, polyvinyl chloride (PVC), polyisoprene, neoprene (polychloroprene) polyacrylonitrile (PAN), nylon-6, polybutadiene, teflon (polytetrafluoroethylene), cellulose, starch, glycogen etc.

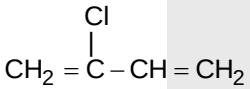
(ii) Copolymers : Polymers in which repeating structural units are derived from two or more types of monomer units are called copolymers.



A-2. Raw rubber does not possess the characteristic of the rubber with which we are familar in order to give it strength & elasticity it is vulcanised. **In the vulcanization process, raw rubber is mixed with small amount of sulphur and heated**.

1-3 % S is used for rubber bands & 5% S is used for tyre rubber.



A-3. 

A-4. **Addition polymer :** Polyvinyl chloride, polythene
Condensation polymer : Bakelite, terylene

A-5. Buna-N $\rightarrow$ Copolymer of 1, 3-butadiene and acrylnitride
Buna-S $\rightarrow$ Copolymer of 1, 3-butadiene and styrene

A-6. II < III < I

PART – II

A-1. (A) **A-2.** (A) **A-3.** (A) **A-4.** (C) **A-5.** (C)

A-6. (D) **A-7.** (A) **A-8.** (C)

PART – III

1. A $\rightarrow$ s, B $\rightarrow$ r, C $\rightarrow$ q D $\rightarrow$ p

EXERCISE – 2

PART – I

1.	(A)	**2.**	(C)	**3.**	(B)	**4.**	(D)	**5.**	(D)

PART – II

1.	3	**2.**	5

PART – III

1.	(ABC)	**2.**	(CD)	**3.**	(ABD)

EXERCISE – 3

PART – I

1.	Ziegler Natta catalyst. ($R_3Al + TiCl_4$)	**2.**	(A - p, s); (B - q, r); (C - p, r); (D - s)	**3.**	(A)				
4.	(D)	**5.**	(CD)	**6.**	6	**7.**	(A)		

PART – II

JEE(MAIN) OFFLINE PROBLEMS

1.	(2)	**2.**	(3)	**3.**	(3)	**4.**	(3)	**5.**	(3)
6.	(3)	**7.**	(2)	**8.**	(2)	**9.**	(1)	**10.**	(2)
11.	(3)	**12.**	(4)						

JEE(MAIN) ONLINE PROBLEMS

1.	(2)	**2.**	(1)	**3.**	(4)	**4.**	(2)	**5.**	(3)
6.	(1)	**7.**	(1)	**8.**	(2)	**9.**	(2)	**10.**	(4)
11.	(1)	**12.**	(1)	**13.**	(1)	**14.**	(4)	**15.**	(4)
16.	(1)								