

**SUBJECT: Polymer Chemistry**

**SUB.CODE: ECH618**

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**UNIT-I (Part-A)**

1. Polymers are obtained by which of the following polymerization reaction.  
(a) Addition (b) condensation  
(c) Both addition as well as condensation (d) polymers occur in nature only
2. Which of the following is an essential characteristic of a polymer?  
(a) High molecular weight and repetitive units (b) molecular weights is exact multiple of monomer (c) it must be synthetic (d) all of these
3. Which of the following is not a synthetic polymer?  
(a) bakelite (b) shellac (c) nylon (d) buna-S
4. Identify a thermosetting plastic  
(a) Nylon (b) terylene (c) rubber (d) bakelite
5. There is no loss of simple molecules like water, ammonia etc., during  
(a) Addition polymerization (b) condensation polymerization  
(c) Step growth polymerization (d) all of these
6. Which of the following step is not involved in chain growth polymerization?  
(a) Initiation (b) chain propagation (c) termination (d) condensation
7. Zeiglar-natta catalysts are employed in the polymerization of  
(a) Epoxy derivatives (b) vinyl derivatives (c) butadiene (d) isoprene
8. Polymer which is resistant to acids, alkalis and heat is  
(a)Teflon (b) nylon (c) Bakelite (d) polyurethane
9. The polymer commonly used in the preparation of ion-exchange resins is  
(a) Polyvinyl chloride (b) polystyrene (c) Perspex (d) vinyon

10. Condensation polymerisation of ethylene glycol and dimethyl terephthalate gives  
(a) glyptal (b) orlon (c) nylon (d) terylene
11. Polyurethane, used in foams, are obtained by condensation polymerization of  
(a) Glycerol and phthalic acid (b) diisocyanate and ethylene glycol  
(c) bisphenol and epichlorohydrin (d) adipic acid and hexamethylene diamine
12. Diepoxy prepolymer obtained on condensation of bisphenol and epichlorohydrin is cured with one of the following to get epoxy resin  
(a) hexamethylene diamine (b) diazobicyclooctane  
(c) sulphur monochloride (d) formaldehyde
13. Natural rubber is  
(a) cis-polymer of isoprene (b) trans-polymer isoprene (c) cis-polymer of chloroprene  
(d) Copolymer of butadiene and styrene
14. The word polymer meant for material made from -----  
a) Single entity b) two entities c) multiple entities d) any entity
15. Monomers are converted to polymer by  
a) Hydrolysis of monomers b) Protonation of monomers c) condensation reaction between monomers d) none of these
16. The individual small molecules from which the polymer is formed are known as  
a) Monomer b) Polymer c) Elastomer d) Plastics
17. Which of the following is not an example of addition polymer  
a) Terylene b) Polyethylene c) Poly propylene d) Poly styrene
18. The temperature below which a polymer is hard and above which it is soft  
a)  $-80^{\circ}\text{C}$  b)  $-60^{\circ}\text{C}$  c)  $-70^{\circ}\text{C}$  d)  $-50^{\circ}\text{C}$
19. In general strongest polymer group is  
a) Thermoplasts b) Thermosets c) Elastomers d) All polymers

20. Which of the following is a naturally occurring polymer?  
a) Teflon b) Starch c) Neoprene d) Nylon
21. the most widely used polymer is  
a) Polystyrene b) Polyethylene c) Polypropylene d) PVC
22. Which of the following is thermoplastic?  
a) Terylene b) Nylon c) Polyethylene d) All
23. The monomer of Teflon is  
a) Trifluoro ethylene b) Tetrafluoro ethylene c) Tetrafluoro ethane d) Ethylene
24. Nylon 66 is an example for  
a) Phenolic resin b) Poly olefin c) Poly amide d) Silicone polymer
25. Vinyon is a copolymer of  
(a) ethylene and acrylonitrile (b) acrylonitrile and vinyl acetate (c) vinyl chloride and vinylidene chloride (d) vinyl chloride and vinyl acetate
26. Glass like polymer plexiglass is obtained by polymerization of  
(a) Vinyl acetate (b) tetrafluoroethylene (c) methyl methacrylate (d) acrylonitrile
27. Which of the following is useful for desalination of sea water?  
(a) Epoxy resins (b) polyurethanes (c) melamine formaldehyde resins (d) ion-exchange resins
28. Heating of natural rubber with sulphur is a process which involves  
(a) Cross linking of polymer chains (b) reduction in unsaturation  
(c) Conversion thermoplastic materials to thermosetting  
(d) all of these
29. Nylon 6 is prepared from  
(a) hexamethylene diamine (b) adipic acid (c)  $\omega$ -amino caproic acid (d) none
30. Phenol resins are the combination of

- (a) Phenol and benzene (b) phenol and benzaldehyde (c) phenol and formaldehyde
- (d) Phenol and styrene

31. Which of the following is not correct regarding terylene

- (a) Step growth polymer (b) condensation polymer (c) synthetic fibre (d) thermosetting plastic

32. Synthetic fibres like nylon 66 are very strong because

- (a) they have high molecular weights and high melting point
- (b) They have linear molecules consisting of very long chains
- (c) They have a high degree of cross-linking by strong C-C bond
- (d) They have linear molecules interlinked with forces like hydrogen bonding

33. The mixing of two polymers yields

- (a) Block co-polymer (b) alternating co-polymer (c) polyblend (d) none of the above

34. Thermoplastics are

- (a) Linear polymers (b) both a and b (c) highly cross-linked (d) crystalline

35. Which of the following is a thermoplastic?

- (a) eborite (b) vulcanized rubber (c) bakelites (d) HDPE

36. Starch, cellulose are the polymer of

- (a) Glucose (b) sucrose (c) glucose + fructose (d) fructose

37. The monomer in a polymer molecule are joined through

- (a) H-bond (b) covalent bonds (c) electrovalent bond (d) dipole-dipole interaction

38. Number of reaction sites present in a monomer is called

- (a) Polymer (b) functionality (c) repeating units (d) copolymer

39. Which one of the following polymer is natural?

- (a) Polystyrene (b) terylene (c) cellulose (d) silicones

40. The glass transition is a second order thermal transition in amorphous polymers due to

- (a) Segmental motion (b) molecular motion (c) both (d) none of the above

Fill in the blanks

41. \_\_\_\_\_ polymer is an example for addition polymerization.
42. The hydroxyl compounds of silicones are called \_\_\_\_\_
43. A \_\_\_\_\_ is a micromolecule that combines with each other to form a polymer
44. The polymer Bakelite is formed from \_\_\_\_\_ and \_\_\_\_\_
45. The heterogeneity of a polymer sample is called \_\_\_\_\_
46. A polymer of silicon dioxide is called \_\_\_\_\_
47. The product of addition polymerization reaction is polyvinyl \_\_\_\_\_.
48. Buna-S is a polymer of -----and-----
49. PVC,nylons,polyesters,cellulose can all be considered having strong intermolecular forces broadly known as.....
50. on cooling molten polymers it's.....viscosity shoots up
- 51.....polymers (like polyacethlenes) that conduct electricity
- 52.....is a linear polymer of  $\beta$ -glucose with crystalline structure

Match the following

53. Repeating units - Stereoregular polymers
54. Isotactic - Foaming polymer
55. Polyethylene - Degree of polymerization
56. Polyurethane - Filler
57. Zinc oxide - Artificial kidney
58. Zinc oxide - Syndiotactic
59. Triethyl aluminium titanium chloride - Filler
60. Randomly arranged polymer - Elastomer

61. Oxygen initiator - Zeigler-natta catalyst

62. Styrene-butadiene – LDPE

Part-B

63. Define monomer.

64. What is addition polymerization?

65. Define polymer.

66. What is condensation polymerization?

67. How polymers are classified on the basis of molecular forces?

68. What are polymers? How are they classified?

69. Identify important difference in thermosetting and thermoplastic material giving examples

70. What are condensation polymers? Describe their formation taking two examples

71. Write the mechanism of free radical addition polymerization

72. What are ziegler-natta catalysts? Explain their importance in polymerization of vinyl derivatives

73. What are initiators?

74. What kinds of structural changes accompany bond-breaking and bond forming in olefins polymerization

75. What is copolymerization?

76. Give any two examples of linear polymer

77. Name the important copolymer of PVC

78. What are two process by which cellulose acetate is manufactured industrially?

79. Mention any two methods of determining glass transition temperature  $T_g$  of a polymer

Part-C

80. Define a) Degree of polymerization.

( b) Ionic copolymerization.

( c) Write a short note on condensation polymerization.

81. a) Write a note on coordination polymerization

b) Write a note on plastics

82. a) Write a note on coordination polymerization.

b) Write the initiation in radical polymerization.

c) Define monomer.

83. a) Explain the term blow moulding

b) Differentiate condensation and addition polymerization

84. Write about polymerization in homogeneous system.

61. a) Write about linear and branched polymers.

b) Write the mechanism of radical chain polymerization.

85. Write notes on

(a) Addition polymers (b) condensation polymers (c) synthetic rubber

(d) Vulcanization

86.(a) explain the functionality of polymers

(b) Write short notes on zeiglar-natta catalyst

87.(a) what is condensation polymerization? Give one example

(b) How is LDPE prepared industrially?

88. (a) what are polymers? Give two examples

(b) Mention the three major steps involved in the free radical mechanism of polymerization

UNIT-II (Part-A)

1. Zeiglar-natta catalyst is

(a)benzolperoxide (b)trialkyl aluminium+ ticl<sub>4</sub> (c) diazobicyclooctane (d) sodium

2. Bakelite is a condensation polymer obtained from

(a) Phenol and formaldehyde (b) urea and formaldehyde (c) glycerol and pthalic acid

(d)butadiene and styrene

3. Polymers in which groups are arranged randomly in space over the chain is known as -----

a) syndiotactic b)isotactic c) natural d) synthetic

4. T<sub>g</sub>/T<sub>m</sub> for symmetrical polymer is

(a)1/2 (b) 2/3(c)3/2(d) 0.33

5. Polypeptide configuration is

(a) α-helical (b) β-pleated (c) right hand helical (d) all

6. To express----- as a function of the polymer transfer constant

(a) Branching density (b) linear density (c) cross linked density

7. Nylon 6, 10 is used to manufacturing of

(a) Brushes (b) textile fibre (c) tyre cord

8. T<sub>g</sub>/T<sub>m</sub> for symmetrical polymer is

(a) ½ (b) 2/3 (c) 3/2 (d)0.33

9. HDPE differs from LDPE in

(a) degree of crystallinity (b)molecular weight (c)melting temperature (d) all of the above

Part-B

10. State the key difference between:

(a) Addition polymerization and condensation polymerization

(b) Copolymers and homopolymers



(c) syndiotactic polymers and isotactic polymers

(d) isotactic polymers and atactic polymers

11. What is meant by T<sub>g</sub>?

12. What is the relationship between T<sub>g</sub> and T<sub>m</sub> for symmetrical polymers?

13. Write the methods of preparation of HDPE and its uses.

14. What is glass transition temperature?

15. What is meant by degree of crystallinity?

16. Draw the plot of glass transition temperature and molecular weight of a polymer.

17. How T<sub>g</sub> is related with T<sub>m</sub> for symmetrical and unsymmetrical polymers?

18. Write about the strain induced morphology of crystalline polymer.

19. a) What is meant by degree of crystallinity? b) Why does a rubber ball become like glass below -70°C?

20. a) Write about strain induced morphology of crystalline polymers.

b) Briefly write about morphology and order in crystalline polymers.

21. How will you differentiate T<sub>m</sub> and T<sub>g</sub>?

22. What is viscoelastic state?

23. Differentiate crystalline state from amorphous state

24. What is irradiated polyethylene?

### Part-C

25.(a) explain morphology and order in crystalline polymers

(b) differentiate linear, branched and network polymers

26.(a) what are the factors that influence the glass transition temperature

(b) Explain how the structure of the polymer affects its mechanical properties

UNIT-III (Part-A)

1. Identify an elastomer

(a) Polythene (b) Teflon (c) neoprene (d) orlon

2. First synthetic or man-made fibre is

(a) Polyester (b) terylene (c) nylon (d) orlon

3. Process of vulcanization of rubber is done to

(a) Improve elasticity (b) improve tensile strength

(c) Increase softness (d) increase unsaturation

4. Which of the following synthetic rubber does not have unsaturation in their structure?

(a) Neoprene (b) buna (c) buna-S (d) polybutene

5. The synthetic rubber not having carbon chains as its backbone is

(a) thiokols (b) vistanex (c) silicone rubber (d) perbunan

6. buna-S rubber is obtained by polymerization of following

(a) Butadiene in presence of Na (b) styrene in presence of peroxide

(c) Butadiene and styrene in 3:1 molar ratio (d) butadiene and styrene in 1:3 molar ratios

7. Plastics in their pure form, after isolation and purification are usually known as

a) Natural b) binding c) virgin d) synthetic

8. ----- process is used for producing articles made of thermoplastic materials

a) Injection moulding b) blow moulding c) extrusion moulding d) foaming

9. ----- is used in converting a liquid prepolymer into a solid object

a) Die casting b) slush casting c) film casting d) moulding

10. Plastics in their pure form, after isolation and purification are usually known as

a) Natural b) Binding c) Virgin d) Synthetic

11. The process used for conversion of a liquid prepolymer to a solid object is

a) Die casting b) Compounding c) Film casting d) Calendaring

12. Which of the following can be easily stretched?

a) Fibres b) Elastomers c) Thermo plastics d) Thermo setting polymers

13. The transition of glassy solid into molten liquid is called

a) Critical temperature b) Boyle temperature c) Glass transition temperature d) Inversion temperature

14. The ingenious process for producing spongy material is called

a) Foaming b) Moulding c) Spinning d) Reinforcing

15. Plasticizers do not affect

(a) Modulus (b) Tg (c) dielectric loss (d) Tm

16. Hardness of plastics often involves cross-linking. This process is called

(a) Curing (b) vulcanization (c) compounding (d) plasticization

17. Which one of the following polymers is often highly crystalline?

(a) Fibres (b) plastics (c) elastomers (d) surface coating materials

18. Transfer moulding methods is used to prepare

(a) Thermoplastic material (b) thermosetting material

(c) Both thermoplastic and thermosetting

(d) None of the above

19. Stereoregular polypropylene is a highly..... and can be used as fibre

Fill in the blanks

20. The temperature at which the transition takes place is called the \_\_\_\_\_

21. The polydispersity ratio of the synthetic polymer is \_\_\_\_\_

22. Plastic tubes & pipes are generally made by \_\_\_\_\_ moulding.

23. Most of the plastics are safe to be used up to a maximum temperature of \_\_\_\_\_.

24. The temperature at which the change of state occurs from solid to liquid is called the \_\_\_\_\_.

10. The plastisols are produced by dispersing PVC particles into.....

25. a plastic has the following list of uses; drainpipes, replacement windows, sheet flooring, electrical insulation. The plastics are.....

26. ABS means

### Part-B

27. Define foaming.

28. What is compounding?

29. Define the term calendaring.

30. What are elastomers?

31. Write the three methods of spinning.

32. What are elastomers? Give an example.

33. Write a note on. a) Injection moulding ( b) Fibre spinning .

34. a) Define virgin polymer

b) Give an account of Film casting.

c) What is a syndiotactic polymer?

35. a) Why does a rubber ball become like glass below  $-70^{\circ}\text{C}$ ?

b) What is mean by  $T_m$ ?

c) What are the factors affecting the glass transition temperature?

36. a ) Write note on plasticizer

b) Give an account of Film casting

37. a) Write schematic diagram explaining vacuum-forming process for polymers.

b) What is meant by reinforcing? Draw schematic diagram showing hand lay-up technique for polymers.

38. a) Distinguish plastics and fibers.

b) Name the monomers for i) Urea formaldehyde resin ii) Terylene iii) Melamine iv) Glyptal

39. What is the difference between thermoforming and foaming?

40. Explain compounding

41. Differentiate plastics, elastomers and fibers from resins

42. Differentiate plastic

43. What are elastomers?

44. Mention any two advantages of injection moulding techniques than compression moulding

45. What are cellulose plastics?

### Part-C

46. Write shorts notes on

(a) Film casting

(b) Polyamides

47. Write any two methods of moulding of polymers

### UNIT-IV (Part-A)

1. Polydisperse nature of the polymer is the basis of the concept of ----- -molecular weight

a) Weight average molecular weight b) Average molecular weight c) Viscosity average molecular weight d) Number average molecular weight

2. There are 1000 repeat units in a polymer molecule, the degree of polymerization is

a) 2000 b) 1000 c) 500 d) 3000

3. The polydispersity ratio of the synthetic polymer is

a) Less than 1 b) Higher than 1 c) 0 d) None of the above

4. The number of repeating units in a polymer is called

a) Poydispersity b) Degree of polymerization c) Degree of crystallinity d) Depropagation

Fill in the blanks

5. The expression for the molecular weight of degree of polymerizations is \_\_\_\_\_.

6. The degree of polymerization and molecular mass of a polymer are related as \_\_\_\_\_

7. PMMA is \_\_\_\_\_

8. PMMA is.....

9. Fatigue is.....

10. The OH stretching vibrations can be seen in the IR spectrum of PVA at.....

Part-B

11. Define polydispersity

12. What is meant by average molecular weight?

13. Define plastics.

14. Define tensile strength.

15. Define polydispersity.

16. What is meant by degree of polymerization?

17. Calculate the polydispersity index, if mean average mass and number average masses are 91,888 and 55,000.

18. Equal masses of polymer (say 200,000) molecules with  $M_1 = 10,000$  and  $M_2 = 100,000$  are mixed. Calculate number average molar mass.

19. What is Number average molecular weight of a polymer?

20. a) Explain practical significance of molecular weight

b) Write a note on X-ray diffraction study.

21. a) Discuss about weight average molecular weight

b) Write a note on X-ray diffraction study

22. a) 10 numbers of molecules with  $M_1 = 10,000$  and  $M_2 = 100,000$  are mixed, calculate the number and mass average molar masses.

b) Write about hardness and abrasion resistance of polymers.

23. Differentiate LDPE and HDPE

24. Explain the expression for  $M_w, M_n$  and  $M_z$

25. Write short notes on tensile strength and fatigue

26. How is the number average molecular weight related to weight average molecular weight

27. Write short notes on abrasion resistance and impact

28. Explain degree of polymerization

29. Write down the expression for  $M_w, M_n, M_z$  and  $M_v$

30. Explain polydispersity and molecular weight with average molecular weight

31. Write short notes on tensile strength

32. How is the number average molecular weights related to weight average molecular weights?

33. Write mark-houwink-sakurada equation

### Part-C

34. What are the tests to be adopted in polymer analysis

35. What are practical significance of molecular weights

36. Explain the number average and weight average molecular weights with examples

37. How will you use X-ray diffraction and NMR study in the polymer morphology?

38.(a) compare the properties of LDPE and HDPE

(b) What are the common additives incorporated in polymers?

39. How will you use X-ray diffraction and NMR study in the polymer morphology?

UNIT-V (Part-A)

1. The polymer used for making contact lenses for eyes is

a) Polymethylmeth acrylate b) polyethyl acrylate c) polyethylene d) nylon6

2. Polyamides are prepared by -----process

a) Condensation b) Suspension c) Emulsion d) Addition

3. ----- catalyst is used for HDPE manufacturing process

a) Metal oxide b) Metal sulphide c) P d) BF<sub>3</sub>

4. Which of the following is a polyamide?

a) Nylon66 b) Teflon c) Terylene d) Bakelite

5. The polymer used for making contact lenses for eyes is

a) Poly methyl metha acrylate b) Poly ethylene c) Poly ethyl acrylate d) Nylon-6

6. The raw material for the preparation of monomers for silicone polymer is

(a) SiCl<sub>4</sub> (b) SiCl<sub>6</sub> (c) SiO<sub>2</sub> (d) SiCl<sub>2</sub>

7. The complete hydrolysis of cellulose gives.....

(a) D-fructose (b) D-glucose (c) D-ribose (d) L-glucose

fill in the blanks

8. epichlorohydrin+-----epoxy resin

9. The starting materials for producing silicone polymer is-----

10. Hexamethylene diamine and adipic acid is written as-----

11. Epoxy resins are used in.....

Part-B

12. Define phenolic resins



13. What are the biomedical applications of polymer?
14. How is PVC prepared?
15. What are the biomedical applications of polymer?
16. How polyethylene and polystyrene are prepared?
17. What are epoxy resins? Give one example.
18. Give an example for biomedical polymer used in artificial heart and contact lens.
19. How a linear silicone polymer is prepared from alkylchlorosilane?
20. a) Write a note on epoxy resins.  
b) Write a note on dental polymers.
21. a) Write the uses of LDPE  
b) Write a short note on silicone polymers
22. a) Write a note on polyamides  
b) Draw the schematic diagram of calendaring machine
23. a) How phenolic resins are prepared.  
b) Write about fire retarding polymers.  
c) Briefly discuss about electrically conducting polymers.
24. Give any two uses of phenolic resins
25. Plasticised PVC is considered as toxic. why?
26. Write any two uses of polyester resins
27. What are silicone polymers?

Part-C

28. Explain silicone polymers
29. How polymers are used in fire retarding and electrically conducting?
30. Write the structure and uses of ziegler-natta catalyst
31. Explain in detailed manner of polymer resins
- 32.(a) write down the preparation and uses of any three polyamides.  
(b) Explain in detail about phenolic polymers
33. Mention any four trade names of epoxy resins  
(b) Mention three types of epoxy resin
- 34.(a) Teflon is the polymer that results from the polymerization of tetrafluoroethylene. write a chemical formula for this reaction.what are some of the properties of Teflon.  
(b) What are the raw materials needed for the manufacture of epoxy resins.
35. Explain how the polymers are used in the treatment of kidney and contact lens.  
(b) What is the practical significance of molecular weights?