

Class: 12th

Subject: Chemistry

Chapter 14: [MACROMOLECULES](#)

🔴 Keypoints Important MCQs:

1. Macromolecules are formed from small units called:

(a) Polymers

(b) Monomers

(c) Ions

(d) Radicals

2. Biological macromolecules are also called:

(a) Thermoplastics

(b) Synthetic materials

(c) Life molecules

(d) Carbohydrates

3. Man-made macromolecules are known as:

(a) Natural polymers

(b) Biological molecules

(c) Synthetic polymers

(d) Enzymes



4. Polymer chains may be:

- (a) Only linear
- (b) Only branched
- (c) Linear, branched or cross-linked ✓
- (d) Only cross-linked

5. A thermoplastic polymer can be:

- (a) Permanently hardened
- (b) Softened and hardened by heating and cooling repeatedly ✓
- (c) Melted only once
- (d) Never softened

6. A thermosetting polymer:

-
- (a) Softens again and again
 - (b) Becomes permanently hard on heating** ✓
 - (c) Becomes flexible
 - (d) Converts into thermoplastic

7. Polymerization mainly involves:

- (a) Hydrolysis
- (b) Addition and condensation reactions** ✓
- (c) Neutralization
- (d) Oxidation

8. Polyethene is produced by:

- (a) Condensation polymerization
- (b) Addition polymerization** ✓

(c) Substitution reaction

(d) Redox reaction

9. Nylon and terylene are examples of:

(a) Addition polymers

(b) Copolymers

(c) Condensation polymers

(d) Natural polymers

10. Natural macromolecules include:

(a) PVC and polystyrene

(b) Carbohydrates, proteins, fats, nucleic acids

(c) Glass and rubber

(d) Metals and minerals

11. The most abundant biomolecules on Earth are:

(a) Proteins

(b) Enzymes

(c) Carbohydrates

(d) Lipids

12. Proteins are polymers of:

(a) Sugars

(b) Amino acids

(c) Nucleotides

(d) Fatty acids

13. Lipids are soluble in:

(a) Water

(b) Organic solvents

(c) Acids

(d) Alkalis

14. Fats and oils are included in:

(a) Proteins

(b) Carbohydrates

(c) Lipids

(d) Polymers

15. Enzymes are:

(a) Carbohydrates

(b) Vitamins

(c) Proteins that catalyze biochemical reactions



(d) Mineral salts

 **Important MCQs:**

1. Staudinger proposed the concept of:

(a) Aromaticity

(b) Macromolecules

(c) Hybridization

(d) Electrolysis

2. Macromolecules are made up of repeating units called:

(a) Isomers

(b) Monomers

(c) Radicals

(d) Atoms

3. The word "polymer" means:

- (a) One part
- (b) Many parts
- (c) Medium part
- (d) No part

4. Degree of polymerization refers to:

- (a) Number of chains
- (b) Number of repeating units in a chain
- (c) Number of monomer types
- (d) Molecular mass

5. In polythene, the repeating unit is:

- (a) CH_2

(b) CH_2-CH_2 ✓

(c) CH_3-CH_3

(d) $\text{CH}_2=\text{CH}_2$

6. Molecular mass of a polymer =

(a) $\text{DP} + \text{monomer mass}$

(b) $\text{DP} \times \text{mass of repeat unit}$ ✓

(c) $\text{Monomer mass} \div \text{DP}$

(d) $\text{Monomer mass} + \text{DP}$

7. A polymer with DP 1000 and repeat unit mass 63.5 has molecular mass:

(a) 635

(b) 6350

(c) 63500

(d) 635000

8. Polymers with molecular mass between 10,000–1,000,000 are usually:

(a) Salts

(b) Plastics, rubbers or fibres

(c) Acids

(d) Bases

9. A homopolymer is formed from:

(a) One monomer only

(b) Two monomers

(c) Three monomers

(d) Four monomers

10. Polyvinyl acetate is an example of:

(a) Copolymer

(b) Natural polymer

(c) Homopolymer

(d) Elastomer

11. A copolymer is formed by polymerization of:

(a) One monomer

(b) Two monomers together

(c) Three monomers

(d) Four monomers

12. Vinyl acetate + butyl maleate produce a:

- (a) Homopolymer
- (b) Natural polymer
- (c) Copolymer
- (d) Condensed polymer

13. Terpolymers are prepared from:

- (a) One monomer
- (b) Two monomers
- (c) Three monomers
- (d) Four monomers

14. Weather-resistant paints are made from:

- (a) Polythene
- (b) PVC

(c) Butyl acrylate, methacrylate & acrylic acid polymer

(d) Rubber

15. Thermoplastic polymers can be:

(a) Softened repeatedly on heating

(b) Hardened permanently

(c) Melted only once

(d) Not molded

16. PVC pipes are examples of:

(a) Thermosetting polymers

(b) Thermoplastic polymers

(c) Natural fibres

(d) Elastomers

17. Thermosetting polymers:

- (a) Soften when heated
- (b) Can be reshaped again and again
- (c) Become hard and cannot be softened again
- (d) Melt easily

18. Thermosetting polymers, when heated:

- (a) Melt
- (b) Decompose instead of melting
- (c) Crystallize
- (d) Polymerize again

19. Epoxy resins are:

- (a) Natural polymers

(b) Thermoplastic polymers

(c) Thermosetting polymers

(d) Copolymers

20. Polymer structure can be:

(a) Only linear

(b) Only cyclic

(c) Linear, branched or cross-linked

(d) Only 3D

21. Polymerization was classified into two main types by W.H. Carothers in:

(a) 1919

(b) 1929

(c) 1939

(d) 1949

22. Addition polymerization involves which reactive species?

(a) Ions

(b) Free radicals

(c) Carbocations

(d) Anions

23. The first step in addition polymerization is:

(a) Propagation

(b) Termination

(c) Initiation

(d) Crystallization

24. In addition polymerization, free radicals are produced by the decomposition of:

- (a) Acids
- (b) Organic peroxides
- (c) Alcohols
- (d) Esters

25. Condensation polymerization usually eliminates:

- (a) Carbon dioxide
- (b) Hydrogen gas
- (c) Water or methanol molecules
- (d) Nitrogen gas

26. Nylon and polyester fibres are produced through:

- (a) Addition polymerization
- (b) Condensation polymerization
- (c) Chain isomerism
- (d) Oxidation reactions

27. PVC is produced by the polymerization of vinyl chloride at:

- (a) 25°C and 1 atm
- (b) 52°C and 9 atm
- (c) 80°C and 20 atm
- (d) 100°C and 15 atm

28. Addition of a plasticizer to PVC:

- (a) Makes it harder

- (b) Reduces its colour
- (c) Increases its flexibility
- (d) Makes it brittle

29. Polystyrene is widely used in:

- (a) Tyre manufacturing
- (b) Food containers and toys
- (c) Metal polishing
- (d) Textile printing



30. Polyvinyl acetate (PVA) is mostly used as:

- (a) Fuel
- (b) Adhesive and binder in paints
- (c) Dye

(d) Rubber substitute

31. The four major classes of organic compounds in living cells include carbohydrates, lipids, proteins and:

(a) Vitamins

(b) Nucleic acids

(c) Minerals

(d) Hormones



32. Carbohydrates are commonly known as:

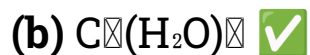
(a) Salts

(b) Sugars

(c) Proteins

(d) Lipids

33. The empirical formula of many carbohydrates can be written as:



34. Monosaccharides containing 6 carbon atoms are called:

(a) Pentoses

(b) Hexoses

(c) Trioses

(d) Tetroses

35. Glucose is also known as:

-
- (a) Sugar of milk
 - (b) Fruit sugar
 - (c) Grape sugar / blood sugar
 - (d) Cane sugar

36. The sweetest naturally occurring sugar is:

- (a) Glucose
- (b) Lactose
- (c) Fructose
- (d) Maltose

37. Sucrose is a disaccharide of:

- (a) Glucose + Galactose
- (b) Glucose + Fructose

(c) Glucose + Mannose

(d) Fructose + Maltose

38. Lactose is commonly called:

(a) Fruit sugar

(b) Table sugar

(c) Milk sugar

(d) Cane sugar



39. Polysaccharides are:

(a) Sweet crystalline solids

(b) Insoluble and tasteless solids

(c) Volatile liquids

(d) Sugars

40. The main storage form of carbohydrates in animals is:

- (a) Starch
- (b) Cellulose
- (c) Glycogen
- (d) Sucrose

41. Starch consists of two components:

- (a) Glucose and fructose
- (b) Amylose and amylopectin
- (c) Glycogen and cellulose
- (d) Ribose and deoxyribose

42. Amylose gives a blue colour with:

- (a) Copper sulphate

(b) Iodine solution

(c) Silver nitrate

(d) Fehling's solution

43. The most abundant structural polysaccharide is:

(a) Starch

(b) Cellulose

(c) Glycogen

(d) Amylopectin



44. Cellulose is a polymer of:

(a) α -D-glucose

(b) β -D-glucose

(c) Fructose

(d) Maltose

45. Glycogen is also known as:

(a) Fruit starch

(b) Plant starch

(c) Animal starch

(d) Marine starch

46. Proteins are made up of:

(a) Fatty acids

(b) Amino acids

(c) Sugars

(d) Glycerol

47. The element not always found in proteins is:

- (a) Nitrogen
- (b) Oxygen
- (c) Sulphur
- (d) Phosphorus (sometimes absent)

48. The primary structure of protein refers to:

(a) Folding of chains

(b) Sequence of amino acids

(c) Helical shape

(d) 3-D arrangement

49. Denaturation of proteins is caused by:

(a) Salt solution

(b) Oxidation, heat, pH change

(c) Freezing

(d) Evaporation

50. A common example of protein denaturation is:

(a) Melting of sugar

(b) Boiling of water

(c) Cooking of egg white (albumin) ✓

(d) Freezing milk

51. Lipids are soluble in:

(a) Water

(b) Alcohol

(c) Non-polar solvents like ether, benzene ✓

(d) Acids

52. The building blocks of lipids are:

- (a) Amino acids
- (b) Fatty acids and glycerol
- (c) Sugars
- (d) Proteins

53. Fats are:

- (a) Saturated triglycerides (solid)
- (b) Unsaturated liquids
- (c) Polymers
- (d) Proteins

54. Oils are glycerides containing:

- (a) More saturated acids

(b) More unsaturated fatty acids

(c) Only aromatic acids

(d) Only short chain acids

55. Hardening of oils is carried out by adding:

(a) Oxygen

(b) Nitrogen

(c) Hydrogen (H_2) in presence of catalyst

(d) Carbon dioxide

56. Saponification is the reaction of a fat/oil with:

(a) Acid

(b) Alcohol

(c) Alkali (NaOH or KOH) to form soap + glycerol

(d) Oxygen

57. Rancidity of oils is mainly due to:

(a) Polymerization

(b) Hydrolytic or oxidative reactions producing bad smell

(c) Crystallization

(d) Freezing

58. Iodine number measures the:

(a) Amount of free fatty acids

(b) Degree of unsaturation in fats and oils

(c) Density of oil

(d) Viscosity of oil

59. Acid number measures the:

(a) Quantity of triglycerides

(b) Free fatty acids in fat or oil (mg KOH per gram)

(c) Presence of soap

(d) Water content

60. Cholesterol is:

(a) A carbohydrate

(b) A protein

(c) The most abundant animal sterol (a steroid)

(d) A polysaccharide

61. Enzymes are:

(a) Biological catalysts produced by living cells

(b) Hormones

(c) Vitamins

(d) Carbohydrates

62. Enzymes speed up reactions by a factor of up to:

(a) 10^2

(b) 10^5

(c) 10^{10}

(d) 10^{20}



63. Region of enzyme where substrate binds is called:

(a) Cofactor site

(b) Active site

(c) Salt bridge

(d) Inhibitor site

64. The protein part of an enzyme is called:

- (a) Cofactor
- (b) Coenzyme
- (c) Apoenzyme
- (d) Prosthetic group

65. The non-protein component of an enzyme is called:

- (a) Substrate
- (b) Co-factor / co-enzyme
- (c) Catalyst
- (d) Activator

66. Which ion acts as cofactor for carbonic anhydrase?

- (a) Mg^{2+}

(b) Fe^{2+}

(c) Zn^{2+} ✓

(d) Cu^{2+}

67. Enzymes are named by adding “-ase” to:

(a) Element name

(b) Product name

(c) Substrate name ✓

(d) Reaction name



68. Enzymes that catalyze oxidation-reduction reactions are:

(a) Hydrolases

(b) Ligases

(c) Oxidoreductases ✓

(d) Lyases

69. Transferases catalyze:

(a) Oxidation

(b) Exchange of functional groups like phosphate/acyl between compounds ✓

(c) Hydrolysis

(d) Photochemical reactions

70. Hydrolases catalyze:

(a) Removal of water

(b) Hydrolysis reactions ✓

(c) Polymerization

(d) Oxidation

71. Enzymes that catalyze removal or addition of groups to double bonds are:

(a) Isomerases

(b) Oxidases

(c) Lyases

(d) Transferases

72. Fumarase converts fumaric acid into:

(a) Citric acid

(b) Maleic acid

(c) Oxalic acid

(d) Lactic acid

73. Ligases perform reactions involving:

(a) Breaking of molecules

(b) Linking two molecules using energy from high-energy bonds (ATP) ✓

(c) Oxidation

(d) Polymerization

74. Enzyme specificity means:

(a) One enzyme works on all substrates

(b) Enzyme acts only on one substrate or group of related substrates ✓

(c) Enzyme changes structure

(d) Enzyme becomes inactive

75. Enzymatic reactions usually:

(a) Irreversible

(b) Always unidirectional

(c) Reversible (can go both directions) ✓

(d) Stop at equilibrium

76. Isoenzymes are:

(a) Identical genetically

(b) Same function but chemically/physically different forms of an enzyme from same organism ✓

(c) Enzymes from different species

(d) Enzymes of plant origin only

77. Enzyme activity is directly proportional to:

(a) Square of substrate concentration

(b) Enzyme concentration (rate \propto $\sqrt{\text{enzyme concentration}}$) ✓

(c) Light intensity

(d) Pressure

78. Most enzymes work best at temperature:

(a) 10°C

(b) 25°C

(c) 37°C (body temperature)

(d) 80°C

79. Optimum pH for salivary amylase is:

(a) 1–2

(b) 4–5

(c) 6.4 – 6.9

(d) 9–10

80. Substances that decrease enzyme activity are called:

(a) Activators

(b) Catalysts


(c) Inhibitors

(d) Promoters

 **Keypoints Important Short Questions:**

1. Define Carboxylic Acids.

Answer:

 Carboxylic acids are organic compounds containing the -COOH (carboxyl group) as their functional group.

2. What are macromolecules?

Answer:

👉 Macromolecules are very large molecules formed by the combination of many small units called monomers.

3. Define Thermoplastic Polymer.

Answer:

👉 A thermoplastic polymer softens on heating and hardens on cooling, e.g., polyethene.

4. Define Thermosetting Polymer.

Answer:

👉 A thermosetting polymer becomes permanently hard when heated and cannot be softened again.

5. What are synthetic polymers?

Answer:

👉 Synthetic polymers are man-made macromolecules produced through chemical processes.

6. Name the types of polymer chains.

Answer:

👉 Polymer chains may be linear, branched, or cross-linked.

7. Define Addition Polymerization.

Answer:

👉 Addition polymerization is the process in which monomers add together without the loss of any molecule to form a polymer, e.g., polyethene.

8. Define Condensation Polymerization.

Answer:

👉 Condensation polymerization is the process in which monomers combine with the elimination of a small molecule like water or methanol, e.g., nylon.

9. What are carbohydrates?

Answer:

👉 Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen, and are the most abundant biomolecules on earth.

10. Classify carbohydrates.

Answer:

👉 Carbohydrates are classified into monosaccharides, oligosaccharides, and polysaccharides.

🔥 Important Short Questions

1. Define Carboxylic Acids.

Answer:

👉 Carboxylic acids are organic compounds containing the -COOH (carboxyl group) as their functional group.

Example: Acetic acid (CH_3COOH), Formic acid (HCOOH)

2. What is a homopolymer?

Answer:

👉 A homopolymer is a polymer formed by the polymerization of a single type of monomer.

Example: Polyvinyl acetate (from vinyl acetate)

3. What is a copolymer?

Answer:

👉 A copolymer is a polymer formed by the polymerization of two different monomers.

Example: Vinyl acetate + Butyl maleate → Copolymer

4. What is a terpolymer?

Answer:

👉 A terpolymer is a polymer formed by polymerizing three different monomers together.

Example: Butyl acrylate + Methyl methacrylate + Acrylic acid
→ Terpolymer (used in weather-resistant paints)

5. Define thermoplastic polymer.

Answer:

👉 A thermoplastic polymer is one that can be softened on heating and hardened on cooling repeatedly without significant change in properties.

Example: Polyvinyl chloride (PVC), Plastic toys

6. Define thermosetting polymer.

Answer:

👉 A thermosetting polymer is one that becomes permanently hard on heating and cannot be softened again.

Example: Epoxy resin, Synthetic varnish

7. What is the degree of polymerization (DP)?

Answer:

👉 The degree of polymerization is the number of repeating monomer units in a polymer chain.

Example: In PVC with DP = 1000, molecular mass = mass of repeating unit \times 1000

8. Give an example of a thermoplastic polymer.

Answer:

👉 Polyvinyl chloride (PVC), used in pipes and floor coverings

9. Give an example of a thermosetting polymer.

Answer:

👉 Epoxy resin, used in coatings for bridges, dams, and floors

10. Why are polymers important in daily life?

Answer:

👉 Polymers replace natural materials like wood and cotton and are widely used in plastics, fibers, rubbers, and other synthetic materials.

Example: Nylon in clothing, Polyethylene in packaging, PVC in pipes

11. Who classified the polymerization process in 1929?

Answer:

👉 W.H. Carothers classified the polymerization process into two types: Addition and Condensation polymerization.

12. Define Addition Polymerization.

Answer:

👉 Addition polymerization is a free-radical reaction in which monomers add together without the loss of any molecule to form a polymer.

13. What are the three steps of addition polymerization?

Answer:

👉 Initiation, Propagation, and Termination.

14. Define Condensation Polymerization.

Answer:

👉 Condensation polymerization involves the mutual reaction of two functional groups with the removal of small molecules like water or methanol to form polymers.

15. Give an example of addition polymer.

Answer:

👉 Polyvinyl chloride (PVC) and polystyrene are examples of addition polymers.

16. Give an example of condensation polymer.

Answer:

👉 Nylon and polyester fibers are examples of condensation polymers.

17. What is Polyvinyl Acetate (PVA) mainly used for?

Answer:

👉 PVA is mainly used as an adhesive material and as a binder for emulsion paints.

18. Name the monomers of acrylic resins.

Answer:

👉 Methyl methacrylate, acrylic acid, and butyl acrylate.

19. What are polyester resins made from?

Answer:

👉 Polyester resins are formed by reacting an alcohol (ethane-1,2-diol) with aromatic bi-functional acids (benzene-1,4-dicarboxylic acid).

20. What is Nylon 6,6 and its uses?

Answer:

👉 Nylon 6,6 is a condensation polymer made from adipic acid and hexamethylene diamine. It is used as a textile fiber due to its high strength, elasticity, toughness, and abrasion resistance.

21. What are biopolymers?

Answer:

👉 Biopolymers are naturally occurring polymers present in living organisms, including carbohydrates, proteins, lipids, and nucleic acids.

22. Define carbohydrates.

Answer:

👉 Carbohydrates are organic compounds composed of carbon, hydrogen, and oxygen, commonly called sugars, and serve as the most abundant biomolecules on earth.

23. What are monosaccharides? Give examples.

Answer:

👉 Monosaccharides are simple sugars that cannot be hydrolyzed, e.g., glucose, fructose, galactose.

24. What are disaccharides? Give examples.

Answer:

👉 Disaccharides are sugars formed by two monosaccharides via glycosidic linkage, e.g., sucrose, lactose, maltose.

25. What are polysaccharides? Give examples.

Answer:

👉 Polysaccharides are high molecular mass carbohydrates that yield many monosaccharides on hydrolysis, e.g., starch, cellulose, glycogen.

26. What is the difference between starch and cellulose?

Answer:

👉 Starch is a polymer of α -D-glucose used for energy storage in plants, while cellulose is a polymer of β -D-glucose providing structural support in plant cell walls.

27. Define proteins.

Answer:

👉 Proteins are high molecular weight nitrogenous compounds that yield amino acids on complete hydrolysis and are essential for life.

28. Name the elements commonly present in proteins.

Answer:

👉 Proteins contain carbon, hydrogen, oxygen, nitrogen, and may also contain phosphorus, sulfur, and trace elements like iron, copper, iodine, manganese, and zinc.

29. What are simple proteins? Give examples.

Answer:

👉 Simple proteins yield only amino acids on hydrolysis, e.g., albumins, globulins, collagen, legumin.

30. What are conjugated (compound) proteins? Give examples.

Answer:

👉 Conjugated proteins are proteins combined with non-protein groups called prosthetic groups, e.g., phosphoproteins, lipoproteins.

31. What is the primary structure of proteins?

Answer:

👉 The primary structure is the linear sequence of amino acids in a polypeptide chain.

32. What is denaturation of proteins?

Answer:

👉 Denaturation is the disruption of protein structure by heat, pH change, or chemicals, e.g., cooking of egg white.

33. Define lipids.

Answer:

👉 Lipids are naturally occurring organic compounds of animal and plant origin, insoluble in water but soluble in organic solvents.

34. What are the main types of lipids?

Answer:

👉 Lipids are classified as simple lipids (fats and oils), compound lipids (phospholipids, lipoproteins), and derived/associated lipids (sterols, vitamins, terpenes).

35. What is the chemical structure of fats and oils?

Answer:

👉 Fats and oils are triglycerides formed by the esterification of glycerol with three fatty acids.

36. Define saponification.

Answer:

👉 Saponification is the hydrolysis of fats or oils with alkali to form soap (salt of fatty acid) and glycerol.

37. What is the iodine number?

Answer:

👉 The iodine number measures the degree of unsaturation in fats or oils; it is the grams of iodine that react with 100 g of fat.

38. What is the rancidity of fats and oils?

Answer:

👉 Rancidity is the spoilage of fats or oils due to hydrolytic or oxidative reactions that produce foul-smelling compounds.

39. What are steroids? Give examples.

Answer:

👉 Steroids are naturally occurring lipids with a perhydrocyclopentanophenanthrene nucleus, e.g., cholesterol, ergosterol, sex hormones.

40. Mention the importance of lipids in living organisms.

Answer:

👉 Lipids provide energy, act as insulators, are part of cell membranes, and serve as precursors for physiological compounds like steroid hormones.

41. Define enzymes.

Answer:

👉 Enzymes are biological catalysts produced by living cells that speed up chemical reactions without being consumed.

42. What are apoenzyme and coenzyme?

Answer:

👉 Apoenzyme is the protein part of an enzyme, while a coenzyme (or cofactor) is the non-protein component essential for enzyme activity.

43. Give examples of enzymes and their cofactors.

Answer:

👉 Fe^{2+} – chrome oxidase, Zn^{2+} – carbonic anhydrase, Mg^{2+} – glucose-6-phosphatase.

44. How are enzymes named? Give examples.

Answer:

👉 Enzymes are named by adding the suffix “-ase” to the substrate they act on, e.g., urease (acts on urea), sucrase (acts on sucrose), cellulase (acts on cellulose).

45. Name the six main types of enzymes according to IUB.

Answer:

👉 Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, Ligases.

46. What is enzyme specificity?

Answer:

👉 Enzyme specificity means an enzyme acts only on one substrate or a group of closely related substrates.

47. List factors affecting enzyme activity.

Answer:

👉 Enzyme concentration, substrate concentration, temperature, pH, presence of activators or inhibitors, and radiation.

48. What is the optimum temperature and pH for enzymes?

Answer:

👉 Most enzymes work best at $\sim 37^{\circ}\text{C}$. Example: salivary amylase optimum pH is 6.4–6.9.

49. What is the biological importance of enzymes?

Answer:

👉 Enzymes help in metabolism, disease diagnosis (e.g., LDH in heart disease), medical treatments (e.g., thrombin for bleeding), and cancer therapy (e.g., L-asparaginase).

50. What are nucleic acids and their main types?

Answer:

👉 Nucleic acids are biomolecules that store and transmit genetic information. Main types: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid).

EXERCISE

Q. 1 Fill in the blanks

(i) Macromolecules are built up from small units called _____.

Answer: monomers ✓

(ii) Nylon is a polyamide and terylene is a _____.

Answer: polyester ✓

(iii) Nylon is prepared by the reaction of _____ and hexamethylenediamine.

Answer: adipic acid ✓

(iv) Based on their thermal properties, plastics are divided into _____ main classes.

Answer: two ✓

(v) Polyvinyl chloride is a _____ plastic.

Answer: thermoplastic ✓

(vi) Glucose is stored as _____ in the liver.

Answer: glycogen ✓

(vii) Glucose and fructose are water _____ carbohydrates.

Answer: soluble ✓

(viii) Protein after digestion changes to _____.

Answer: amino acids ✓

(ix) Purine and pyrimidine _____ are of nucleic acids.

Answer: bases ✓

(x) Addition of a plasticizer _____ the flexibility of the polymer.

Answer: increases ✓

Q. 2 Indicate True or False.

1. Nylon 6,6 and terylene are condensation polymers.

Answer: True

Reason: Both are formed by condensation polymerization.

2. The disposal of plastics does not cause any pollution problem.

Answer: False

Reason: Plastics cause environmental pollution.

3. Fructose is a polysaccharide carbohydrate.

Answer: False

Reason: Fructose is a monosaccharide, not polysaccharide.

4. Human beings get no food nutrient from cellulose.

Answer: True

Reason: Humans cannot digest cellulose; it provides fiber only.

5. The most abundant and the most important steroid in the human body is vitamin D.

Answer: ✗ False

Reason: Cholesterol is the most abundant steroid, not vitamin D.

6. Enzymes are the compounds containing C, H and O only.

Answer: ✗ False

Reason: Enzymes also contain nitrogen, sometimes sulfur or phosphorus.

7. The degree of unsaturation of fats is measured by their iodine number.

Answer: ✓ True

Reason: Iodine number measures unsaturation in fats.

8. Activity of an enzyme varies with temperature and pH.

Answer: True

Reason: Enzyme activity depends on temperature and pH.

9. Nucleic acids are biological catalysts.

Answer: False

Reason: Nucleic acids store genetic information; they are not catalysts.

10. The nucleic acids are responsible for protein synthesis in the human body.

Answer: True

Reason: Nucleic acids direct protein synthesis.

Q. 3. Multiple choice questions. Encircle the correct answer.

(i) In which of these processes are small organic molecules made into macromolecules:

- (a) the cracking of petroleum fractions
- (b) the fractional distillation of crude oil
- (c) the polymerization of ethene
- (d) the hydrolysis of proteins

(ii) Which of these polymers is an addition polymer:

- (a) nylon-6,6
- (b) polystyrene
- (c) terylene
- (d) epoxy resin

(iii) Which of these polymers is a synthetic polymer:

(a) animal fat

(b) starch

(c) cellulose

(d) polyester

(iv) Plastics are a pollution problem because many plastics:

(a) are made from petroleum

(b) are very inflammable

(c) burn to produce toxic fumes

(d) decompose to produce toxic products

(v) The fibre which is made from acrylonitrile as monomer:

(a) PVC

(b) rayon fibre

(c) acrylic fibre

(d) polyester fibre

(vi) A polymeric substance that is formed in the liquid state and then hardened to a rigid solid is called a:

(a) fibre

(b) plastic

(c) varnish

(d) polyamide resin



(vii) Vegetable oils are:

(a) unsaturated fatty acids

(b) glycerides of unsaturated fatty acids

(c) glycerides of saturated fatty acids

(d) essential oils obtained from plants

(ix) Which one of the following nitrogenous bases is not present in RNA:

(a) cytosine

(b) adenine

(c) thymine

(d) uracil

(x) Which one of the following enzymes brings about the hydrolysis of fats:

(a) urease

(b) maltase

(c) zymase

(d) lipase

(xi) The reaction between fat and NaOH is called:

- (a) esterification
- (b) hydrogenolysis
- (c) fermentation
- (d) saponification

(xii) Which one of the following statements about glucose and sucrose is incorrect:

- (a) both are soluble in water
- (b) both are naturally occurring
- (c) both are carbohydrates
- (d) both are disaccharides

☀ Q. 4 Explain the following terms: (a) Addition polymer, (b) Condensation polymer, (c) Thermoplastic, (d) Thermosetting plastic

(a) Addition Polymer

- Formed by joining unsaturated monomers (with double bonds) without losing any molecule.
- All atoms of the monomer appear in the polymer chain.
- Usually has a linear chain structure.

Example: Polyethylene, Polystyrene.

Structure Formula:

Monomer: $\text{CH}_2=\text{CH}_2 \rightarrow$ **Polymer:** $-\text{[CH}_2-\text{CH}_2\text{]}-\text{}$

(b) Condensation Polymer

- Formed by reaction of bifunctional monomers with elimination of a small molecule (e.g., H_2O , CH_3OH).
- Usually strong and sometimes rigid polymers.
- **Example:** Nylon-6,6, Terylene.

-
- Functional groups involved: $-\text{OH}$, $-\text{COOH}$, $-\text{NH}_2$.

Structure Formula:



(c) Thermoplastic

- Softens on heating and can be reshaped repeatedly.
- Linear or slightly branched polymer chains.
- Recyclable and reusable.
- **Example:** PVC, Polyethylene, Polystyrene.
- Flexible and soft.

Explain:

Linear chains loosely packed \rightarrow Softens on heat \rightarrow Can be remolded

(d) Thermosetting Plastic

- Hardens permanently on heating and cannot be reshaped.
- Highly cross-linked 3D polymer chains.

-
- Heat-resistant and durable.
 - **Example:** Bakelite, Epoxy resins.
 - Hard and rigid.

Explain:

Cross-linked network → Hard structure → Does not soften on heat.

◆ **Summary Points:**

1. Addition Polymer: Formed without loss of molecules, linear, **example:** polyethylene.

2. Condensation Polymer: Forms with elimination of small molecule, strong, **example:** Nylon.

3. Thermoplastic: Softens on heating, reshaped, recyclable, flexible.

4. Thermosetting Plastic: Hardens permanently, cross-linked, durable, heat-resistant.

★ Q. 5 Write notes on: (a) Polyester resins, (b) Polyamide resins, (c) Epoxy resins

(a) Polyester Resins

Definition: Polyester resins are condensation polymers formed by the reaction between a dibasic acid (like phthalic acid) and a dihydric alcohol (like ethylene glycol).

Properties:

- Hard, strong, and rigid
- Insoluble in water
- Heat-resistant
- Can be molded into desired shapes

Uses:

- Manufacturing of plastic sheets, pipes, tanks
- Coating and laminates
- Used in making fiberglass reinforced plastics (FRP)

Structure formula:



(b) Polyamide Resins

Definition: Polyamide resins are condensation polymers formed by reaction of diamines with dibasic acids. Nylon is the most common example.

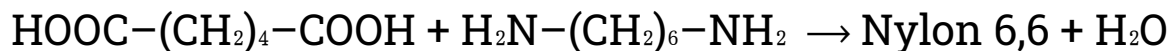
Properties:

- Strong and durable
- Resistant to abrasion
- Can be drawn into fibers
- Semi-crystalline structure

Uses:

- Textiles (nylon fibers)
- Engineering plastics
- Ropes, films, and molded objects

Structure formula:



(c) Epoxy Resins

Definition: Epoxy resins are synthetic polymers containing epoxide groups. They are formed by reaction of epichlorohydrin with bisphenol A.

Properties:

- Excellent adhesive properties
- High chemical and heat resistance
- Strong, rigid, and durable
- Can be cured using hardeners to form a thermosetting plastic

Uses:

- Adhesives and coatings
- Electrical insulation
- Composite materials for aircraft, boats, and automobiles

Explain:

Epichlorohydrin + Bisphenol A \rightarrow Epoxy resin \rightarrow Cured using hardener \rightarrow Solid thermoset

Summary Points:

1. **Polyester resins:** Hard, rigid, used in FRP, pipes, coatings.
2. **Polyamide resins:** Strong, durable, used in fibers, textiles, engineering plastics.
3. **Epoxy resins:** Adhesive, heat and chemical resistant, used in coatings and composites.

🌟 Q. 6 What is the repeating unit in each of the following polymers?

❖ Answer:

(a) **Polystyrene**

👉 Repeating unit: $-\text{[CH}_2\text{-CH(C}_6\text{H}_5\text{)]}-$

It is formed by the polymerization of styrene ($\text{C}_6\text{H}_5-\text{CH}=\text{CH}_2$) via addition polymerization.

(b) Nylon 6,6

👉 **Repeating unit:** $-\text{[NH}-(\text{CH}_2)_6-\text{NH-CO}-(\text{CH}_2)_4-\text{CO]}-$

It is a condensation polymer formed by hexamethylenediamine + adipic acid.

(c) Teflon (Polytetrafluoroethylene, PTFE)

👉 **Repeating unit:** $-\text{[CF}_2-\text{CF}_2]-$

It is formed by polymerization of tetrafluoroethylene ($\text{CF}_2=\text{CF}_2$).

(d) Orlon (Polyacrylonitrile, PAN)

👉 **Repeating unit:** $-\text{[CH}_2-\text{CH}(\text{CN})]-$

It is formed by polymerization of acrylonitrile ($\text{CH}_2=\text{CH}-\text{CN}$).

☀ Q. 7 What are carbohydrates and how are they classified?

❖ Definition:

👉 Carbohydrates are organic compounds made up of carbon, hydrogen, and oxygen, usually in the ratio of 1:2:1 ($C_nH_{2n}O_n$).

👉 They are biomolecules that serve as the primary source of energy in living organisms.

👉 Carbohydrates are also called sugars and are polyhydroxy compounds of aldehydes or ketones.

Classification of Carbohydrates:

1. Monosaccharides

- Simple sugars that cannot be hydrolyzed into smaller sugars.
- **General formula:** $C_nH_{2n}O_n$ ($n = 3$ or more).
- **Examples:** Glucose, Fructose, Galactose
- Can be aldoses (aldehyde group) or ketoses (ketone group).

2. Disaccharides (Oligosaccharides)

- Formed when two monosaccharides combine with the loss of a water molecule (glycosidic linkage).
- **Examples:** Sucrose (Glucose + Fructose), Lactose (Glucose + Galactose), Maltose (Glucose + Glucose)
- **Hydrolysis** breaks them back into monosaccharides.

3. Polysaccharides

- **Long chains** of monosaccharide units; high molecular mass.
- **Generally** insoluble and tasteless; called “non-sugars”.

Functions: Energy storage and structural components.

Examples:

- **Starch:** Storage in plants; polymer of α -glucose.
- **Glycogen:** Storage in animals; highly branched α -glucose polymer.
- **Cellulose:** Structural component in plants; polymer of β -glucose.

◆ **Summary Points:**

- Carbohydrates = Carbon + Hydrogen + Oxygen
- Monosaccharides = Simple sugars
- Disaccharides = Two monosaccharides joined
- Polysaccharides = Many monosaccharides; energy storage or structural role

✨ **Q. 8 Point out one difference between the compounds in each of the following pairs.**

❖ **Answer:**

(a) Glucose and Fructose

- **Glucose:** It is an aldose sugar, meaning it contains an aldehyde group (-CHO) at the end of its carbon chain. Its molecular formula is $C_6H_{12}O_6$. Glucose is the primary source of energy in our body.
- **Fructose:** It is a ketose sugar, meaning it contains a ketone group (C=O) usually at the second carbon. Its molecular formula is also $C_6H_{12}O_6$, but the structural arrangement is different. Fructose is found in fruits, honey, and is sweeter than glucose.

Key Difference: Glucose is an aldose while fructose is a ketose.

(b) Sucrose and Maltose

- **Sucrose:** It is a disaccharide made of glucose + fructose. It is a non-reducing sugar because its glycosidic bond involves the aldehyde/ketone group of both monosaccharides, so it cannot reduce Fehling's solution.
- **Maltose:** It is a disaccharide made of glucose + glucose. It is a reducing sugar because the aldehyde group of one glucose unit is free to react with oxidizing agents.

Key Difference: Sucrose is non-reducing, Maltose is reducing.

(c) Cellulose and Starch

- **Cellulose:** It is a structural polysaccharide present in plant cell walls. It is composed of β -D-glucose units linked by β -1,4 glycosidic bonds. It is insoluble in water and cannot be digested by humans due to the absence of cellulase enzyme. Provides structural strength to plants.
- **Starch:** It is a storage polysaccharide in plants. It is composed of α -D-glucose units linked by α -1,4 and α -1,6

glycosidic bonds. It is soluble in water and is a major source of energy for humans.

Key Difference: Cellulose is a structural polysaccharide, while starch is a storage polysaccharide.

☀ **Q. 9 What are lipids? In what way fats and oils are different?**

❖ **Answer:**

Lipids:

Lipids are a group of naturally occurring organic compounds present in plants, animals, and some microorganisms. They are insoluble in water but soluble in organic solvents such as ether, chloroform, and acetone. Lipids include fats, oils, waxes, phospholipids, and steroids. They play important biological roles:

- **They serve** as a concentrated source of energy.
- **They provide** insulation and protection to organs and tissues.
- They **form** an essentially part of cell membranes (phospholipids and cholesterol).

-
- **Some lipids** act as precursors of hormones (steroids) and vitamins (Vitamin D, A, E, K).

Chemically, the basic building blocks of lipids are:

- Fatty acids – long-chain carboxylic acids
- Glycerol – a three-carbon alcohol

Fats and Oils:

Fats and oils are both triglycerides, meaning they are esters of glycerol and fatty acids. They differ in physical state, source, and chemical structure:

1. Fats:

- Solid or semi-solid at room temperature
- Contain mainly saturated fatty acids (no double bonds)
- Higher melting point
- Usually obtained from animals (e.g., butter, ghee)
- Provide long-term energy storage

2. Oils:

- **Liquid** at room temperature
- **Contain** mainly unsaturated fatty acids (one or more double bonds)
- **Lower** melting point
- **Usually** obtained from plants (e.g., olive oil, sunflower oil)
- Important for nutrition and cooking

Key Differences in Words:

Fats are solid, saturated, and mostly animal-based, whereas oils are liquid, unsaturated, and mostly plant-based. Both are energy sources, but their physical properties differ due to the saturation of fatty acids.

◆ **Summary:**

- Lipids are organic compounds insoluble in water, soluble in organic solvents.
- **Serve as energy storage, insulation**, cell membrane components, and hormone precursors.
- **Fats:** solid, saturated, animal source, high melting point.
- **Oils:** liquid, unsaturated, plant source, low melting point.

☀ Q. 10 Define saponification number and iodine number.
Discuss the term rancidity.

❖ Answer:

1. Saponification Number:

The **saponification** number of a fat or oil is defined as the number of milligrams of potassium hydroxide (KOH) required to saponify 1 gram of the fat or oil.

- **Saponification** is the reaction in which a fat or oil reacts with a strong alkali (like NaOH or KOH) to form glycerol and soap.
- It is an important parameter to measure the average molecular weight of fatty acids present in the fat or oil.
- Higher saponification number indicates shorter chain fatty acids.

Example Reaction:

Triglyceride + 3 KOH → Glycerol + 3 Soap molecules

2. Iodine Number:

The iodine number measures the degree of unsaturation in a fat or oil. It is defined as the number of grams of iodine that can react with 100 grams of fat or oil.

- **Unsaturated** fats contain double bonds in their fatty acids, which can react with iodine.
- A **higher iodine** number indicates a higher level of unsaturation (more double bonds).
- **Oils usually** have higher iodine numbers than fats because oils are rich in unsaturated fatty acids.

3. Rancidity:

Rancidity is the spoilage of fats and oils, resulting in an unpleasant odor and taste. It occurs due to:

- **Hydrolytic rancidity:** Fat is broken down by water, often with the help of enzymes, forming free fatty acids and glycerol.
- **Oxidative rancidity:** Unsaturated fats react with oxygen in the air, forming aldehydes, ketones, and peroxides, which are foul-smelling compounds.

Factors affecting rancidity:

- Exposure to air, heat, light, and moisture
- Presence of unsaturated fatty acids (oils are more prone)

Prevention:

- Store fats and oils in airtight containers
- Add antioxidants like vitamin E, BHT, BHA
- Keep away from sunlight and high temperatures

◆ Summary:

- **Saponification number:** mg of KOH to saponify 1 g of fat → indicates fatty acid chain length.
- **Iodine number:** g of iodine reacting with 100 g of fat → indicates unsaturation.
- **Rancidity:** Spoilage of fats/oils → hydrolytic or oxidative → causes bad odor/taste.

★ Q. 11 What is the difference between a glycoside linkage and a peptide linkage?

❖ Answer

1. Glycoside Linkage:

- A glycoside linkage is a type of covalent bond that joins a sugar molecule (monosaccharide) to another molecule, which may be another sugar or a non-sugar molecule.
- **It is formed by a condensation reaction**, in which a hydroxyl group (-OH) of one sugar reacts with the anomeric carbon of another sugar, releasing water (H₂O).

Example: In maltose, two glucose molecules are joined by an α-1,4-glycosidic bond.

Key Features:

- Found in carbohydrates
- Joins sugar molecules
- Formed by condensation reaction

2. Peptide Linkage (Peptide Bond):

-
- A peptide linkage is a type of covalent bond that joins amino acids in proteins.
 - It is formed by a condensation reaction between the amino group ($-\text{NH}_2$) of one amino acid and the carboxyl group ($-\text{COOH}$) of another amino acid, releasing water (H_2O).

Example: In a dipeptide, glycine and alanine are joined by a peptide bond ($-\text{CO}-\text{NH}-$).

Key Features:

- Found in proteins
- Joins amino acids
- Formed by condensation reaction

Difference Between Glycoside Linkage and Peptide Linkage:

- **Type of Molecules Involved:** Glycoside → sugars; Peptide → amino acids
- **Bond Formed:** Glycoside → C–O–C linkage; Peptide → C–N linkage
- **Location in Biomolecules:** Glycoside → carbohydrates; Peptide → proteins

-
- **Functional Groups Reacting:** Glycoside → hydroxyl groups; Peptide → amino and carboxyl groups

◆ **Summary:**

1. Glycoside linkage joins sugars, peptide linkage joins amino acids.
2. Glycoside bond is C–O–C, peptide bond is C–N.
3. Both are formed by condensation reactions.
4. Glycoside → carbohydrates, Peptide → proteins.

★ **Q. 12 What is the chemical nature of enzymes? Discuss the classification of enzymes.**

❖ **Answer:**

Chemical Nature of Enzymes:

- Enzymes are biological catalysts that accelerate chemical reactions in living organisms without being consumed.

-
- **Chemically**, most enzymes are proteins composed of long chains of amino acids folded into specific three-dimensional shapes.
 - **Some enzymes** also require non-protein components for their activity:

1. **Apoenzyme**: The protein part of the enzyme.

2. **Cofactor or Coenzyme**: Non-protein component essential for enzyme activity.

- Cofactors can be inorganic ions like Fe^{2+} , Zn^{2+} , Mg^{2+} .
- Coenzymes are organic molecules like vitamins (e.g., NAD^+ contains niacin).

Enzymes are highly specific (act on a specific substrate) and very efficient (speed up reactions up to 10^{20} times).

Classification of Enzymes:

The International Unions of Biochemistry (IUB) classifies enzymes into six main types based on the type of reaction they catalyze:

1. Oxidoreductases

- Catalyze oxidation-reduction reactions.
- **Examples:** Oxidase, dehydrogenase, peroxidase.

2. Transferases

- Transfer functional groups (like phosphate or acyl) from one molecule to another.
- **Examples:** Phosphotransferase, transaminase.

3. Hydrolases

- Catalyze hydrolysis reactions, breaking bonds using water.
- **Examples:** Proteases (protein → amino acids), lipases (fats → glycerol + fatty acids).

4. Lyases

- Add or remove groups to form double bonds or break double bonds without hydrolysis.
- **Examples:** Decarboxylase, aldolase.

5. Isomerases

- Catalyze rearrangement of atoms within a molecule to form isomers.
- **Example:** Fumarase converts fumaric acid → maleic acid.

6. Ligases (Synthetases)

- Join two molecules together using energy from ATP or other high-energy bonds.
- **Examples:** Acetyl-CoA carboxylase, DNA ligase.

◆ Summary:

1. Enzymes are mostly proteins, sometimes with non-protein cofactors.
2. They are specific and highly efficient biological catalysts.
3. **Classified into six types:** Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, Ligases.
4. Each type acts on a specific type of chemical reaction.

☀ Q. 13 What are nucleic acids? Write down the role of DNA and RNA in life.

❖ Answer:

Nucleic Acids:

- Nucleic acids are biomacromolecules present in the nucleus and cytoplasm of all living cells.
- They are essential for storing and transmitting genetic information.
- **Chemically**, nucleic acids are polymers of nucleotides, each nucleotide consisting of three components:

1. Nitrogenous base – either purine (adenine, guanine) or pyrimidine (cytosine, thymine in DNA, uracil in RNA).

2. Pentose sugar – ribose in RNA, deoxyribose in DNA.

3. Phosphate group.

Two main types of nucleic acids: DNA (Deoxyribonucleic Acid) and RNA (Ribonucleic Acid).

Role of DNA in Life:

- 1. Genetic Information Storage:** DNA stores all hereditary information of an organism.
- 2. Replication:** DNA replicates to pass genetic information to the next generation.
- 3. Protein Synthesis Template:** DNA provides the instructions for synthesizing proteins, controlling cell structure and function.

Role of RNA in Life:

- 1. Protein Synthesis:** RNA acts as a messenger and functional molecule in protein synthesis.
 - mRNA carries the genetic code from DNA to ribosomes.
 - tRNA brings amino acids to ribosomes.
 - rRNA is a structural and catalytic component of ribosomes.

2. Gene Expression: RNA helps regulate gene expression and control various cellular processes.

3. Catalytic Functions: Some RNA molecules (ribozymes) have enzymatic activity.

◆ **Summary:**

1. Nucleic acids = DNA + RNA, polymers of nucleotides.

2. DNA stores and transmits genetic information.

3. RNA translates genetic information into proteins.

4. Both DNA and RNA are essential for growth, development, and reproduction.

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

Author: Muhammad Asghar

Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.

Copyright & Usage Policy

© 2025 Muhammad Asghar. All rights reserved.

No part of these notes may be reproduced, redistributed, or used for commercial purposes without explicit written permission from the author. These notes are intended solely for personal study and educational use.