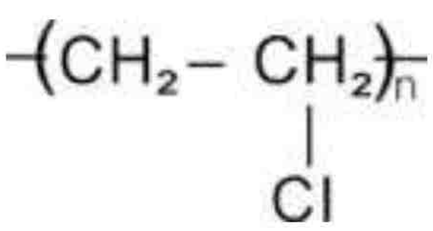
Chapter#14

Macromolecules

1. Define macromolecules.

Ans: Macromolecules or polymers are described as large molecules built up from small repeating units called monomers.

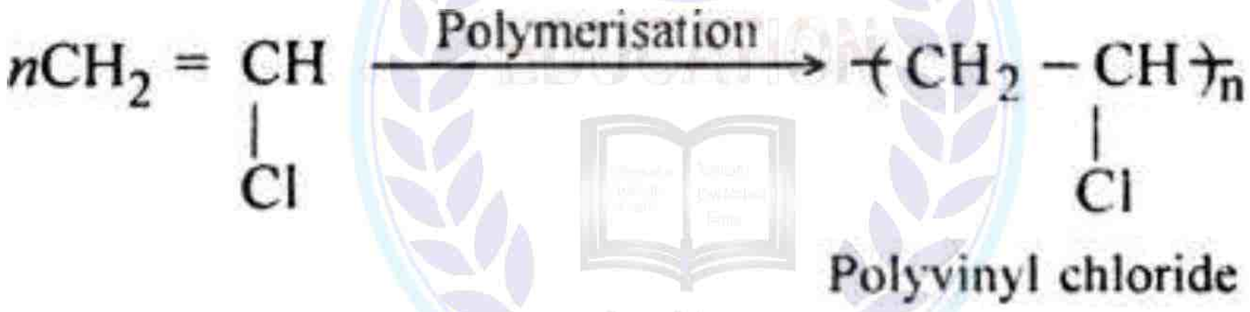
For Example: Polyvinyl Chloride is a macromolecule.



2. Define polymerization.

Ans: Polymerization is a process of reacting monomer molecules together in a chemical reaction to form polymer chains or three-dimensional networks.

Example:

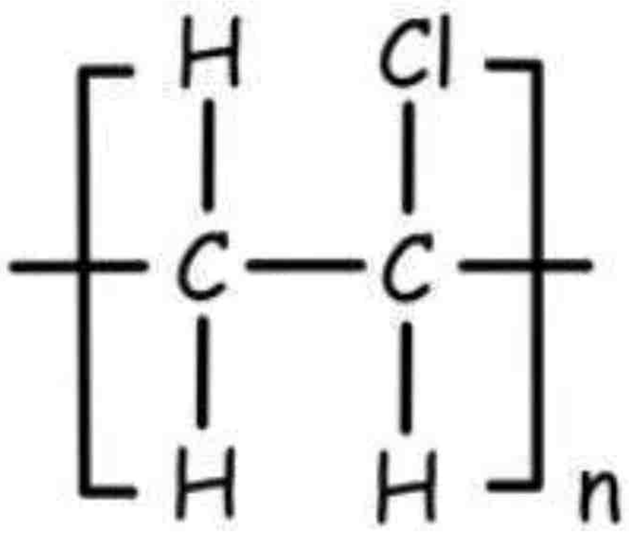


3. What are polymers? Give two examples.

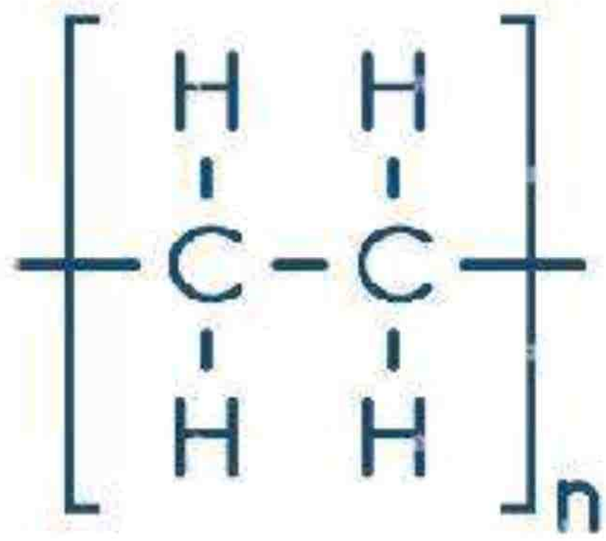
Ans: The word polymer is derived from Greek word, poly means **many** and mer means **parts**. Polymers or macromolecules are defined as large molecules build up from small repeating units called monomers. The repetition may be linear or branched or interconnected to form three

dimensional network. Examples are artificial fibres, plastics, synthetic varnish etc.

Examples:



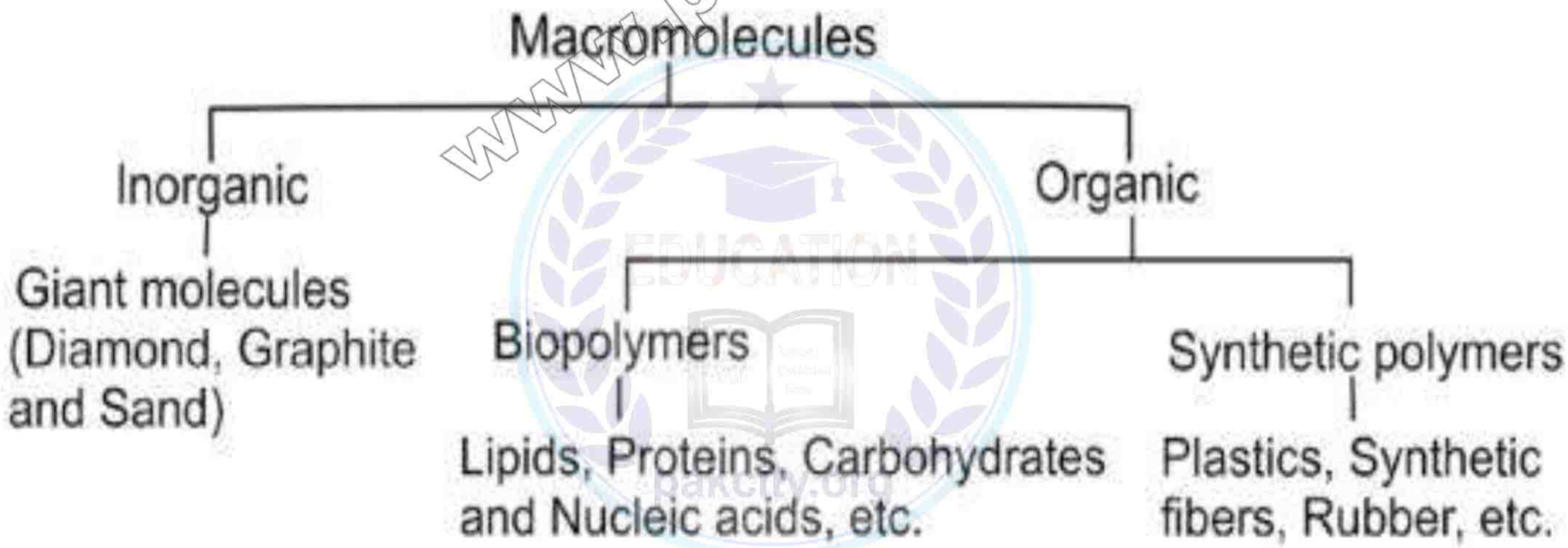
Polyvinyl Chloride
(PVC)



polyethylene

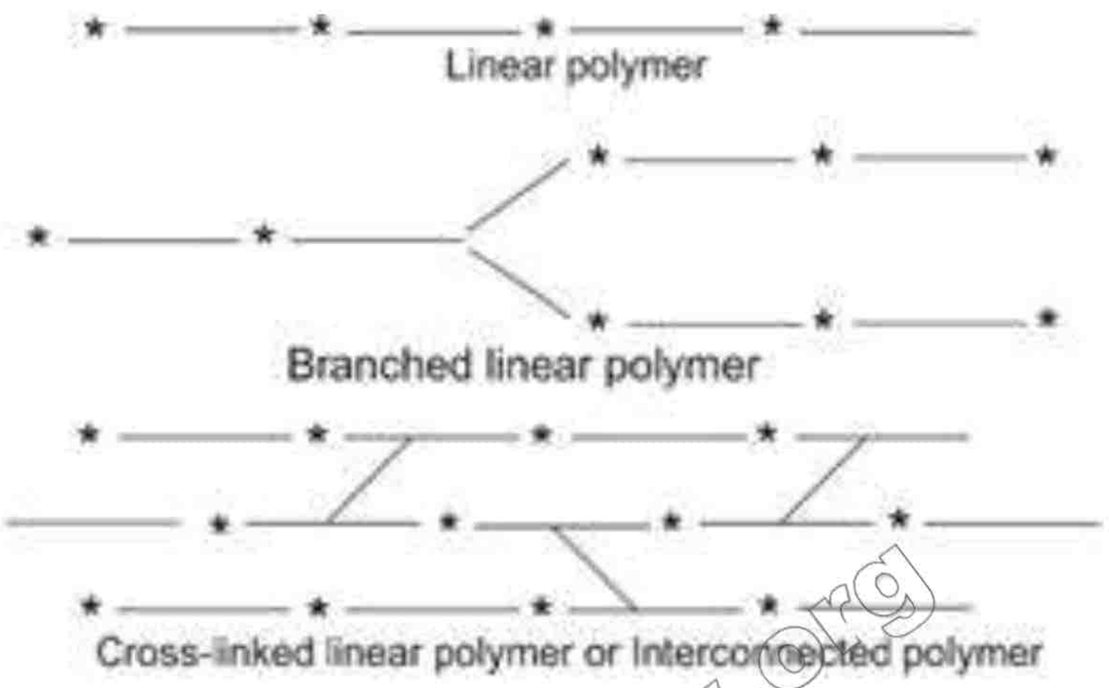
4. Give classification of macromolecules.

Ans:



5. Mention the three ways of polymerization.

Ans: In some cases the repetition is linear while in others, it is branched or interconnected to form three dimensional network.



6. Define degree of polymerization.

Ans: The length of the polymer chain is specialized by the number of repeating units in the chain known as the degree of polymerization (DP), for example, in linear polythene.

$$—CH_2 - CH_2 - CH_2 - CH_2 - CH_2—$$

The repeating unit is

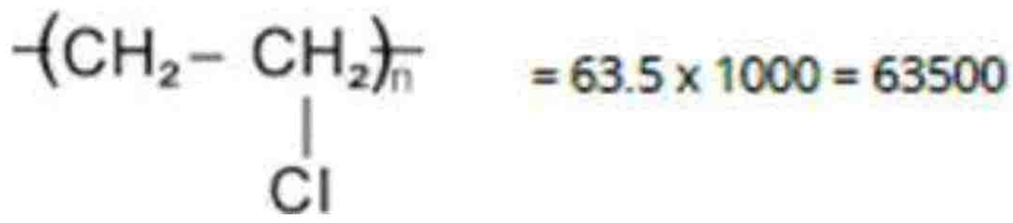
$$-(CH_2 - CH_2)_n-$$

Where, n is called degree of polymerization and it is usually a large number.

7. How is the molecular mass of the polymer calculated?

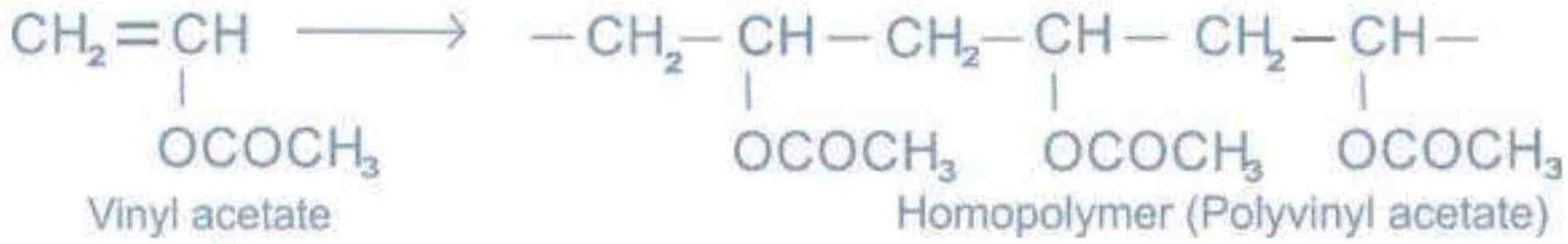
Ans: The molecular mass of the polymer is the product of the molecular mass of the repeating unit and the DP For example, polyvinyl chloride, a polymer of DP 1000, has a molecular mass.

Mol. mass = Mol. mass of the repeating unit x DP



8. What is a homopolymer?

Ans: A homopolymer is formed by the polymerization of a single type of monomer. For example, the polymerization of vinyl acetate.

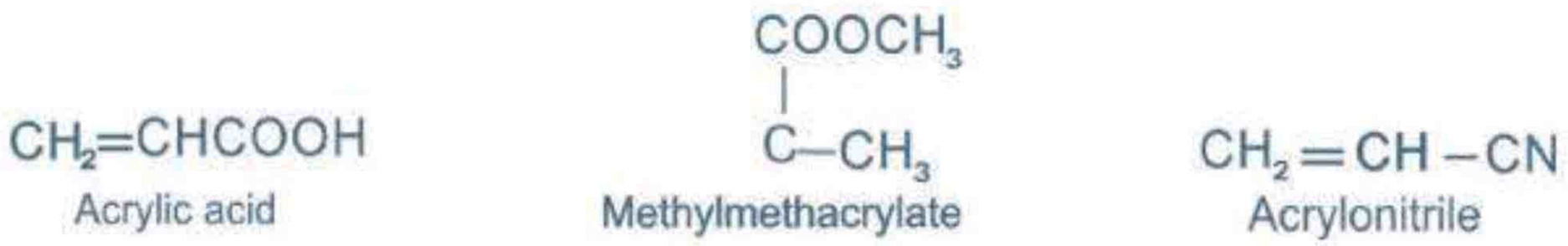


9. Why is a copolymer?

Ans: A copolymer is formed by the polymerization of two monomers together, e.g; vinyl acetate reacts with butyl maleate to give a copolymer.

10. What is a terpolymer?

Ans: In terpolymer three different monomers are polymerized and the polymerization reaction is carefully controlled. For example, combination of butyl acrylate, methacrylate and acrylic acid monomers gives a highly tough polymer which serves as a weather-resistant paint.



11. What is the classification of polymers based on thermal properties?

Ans: Based on thermal properties polymers are of two types:

1. Thermoplastic

   A thermoplastic polymer is one which can be softened repeatedly when heated and hardened when cooled with a little change in properties. For example; PVC pipes, plastic toys, etc.

2. Thermosetting plastic

   The polymers which become hard on heating and cannot be softened again are called thermosetting polymers. A thermosetting polymer, on heating, decomposes instead of melting. For example, synthetic varnish, epoxy resins, etc.

12. What is a thermoplastic polymer?

Ans: A thermoplastic polymer is one which can be softened repeatedly when heated and hardened when cooled with a little change in properties.

Examples: PVC pipes, plastic toys, etc.

13. What is a thermosetting plastic?

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Examples: synthetic varnish, epoxy resins, etc.

14. What are the types of polymerization process?

Ans: There are two types of polymerization process:

1. Addition polymerization

   It is a free-radical addition reaction which involves initiation, propagation and termination steps. For example, polymerization of styrene. Addition of polymerization is catalyzed by thermal or photochemical decomposition of organic peroxides to give free radicals.

2. Condensation polymerization

This type of polymerization results from the mutual reaction of two functional groups. The reaction usually involves the removal of a water molecule or a methanol molecule. It takes place at both ends of the growing chain. For example, dicarboxylic acids or esters combine with diols to get the desired polymer like nylon and polyester fibre. Such polymerizations are generally ionic in nature.

15. Give mechanism of addition polymerization.

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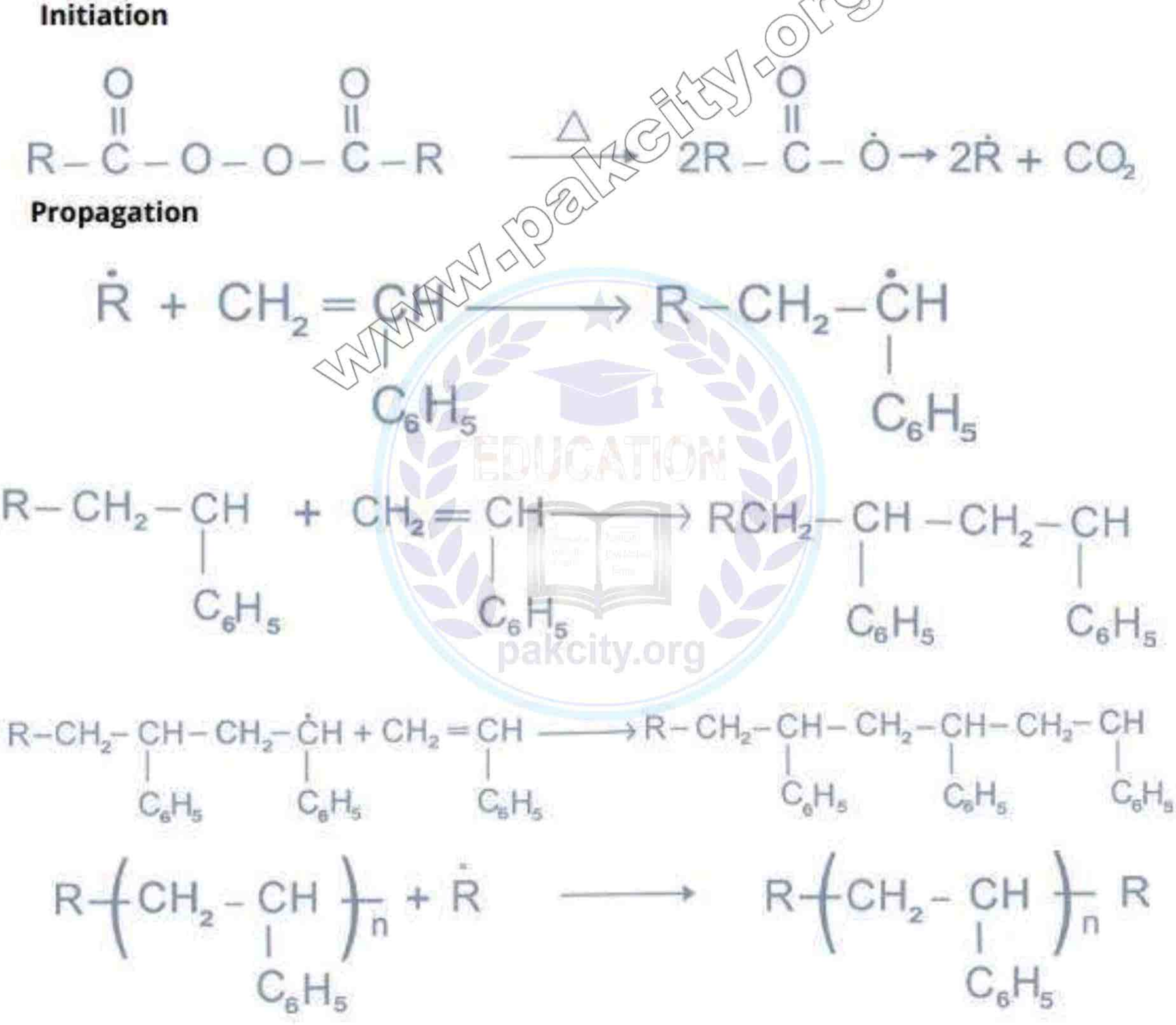
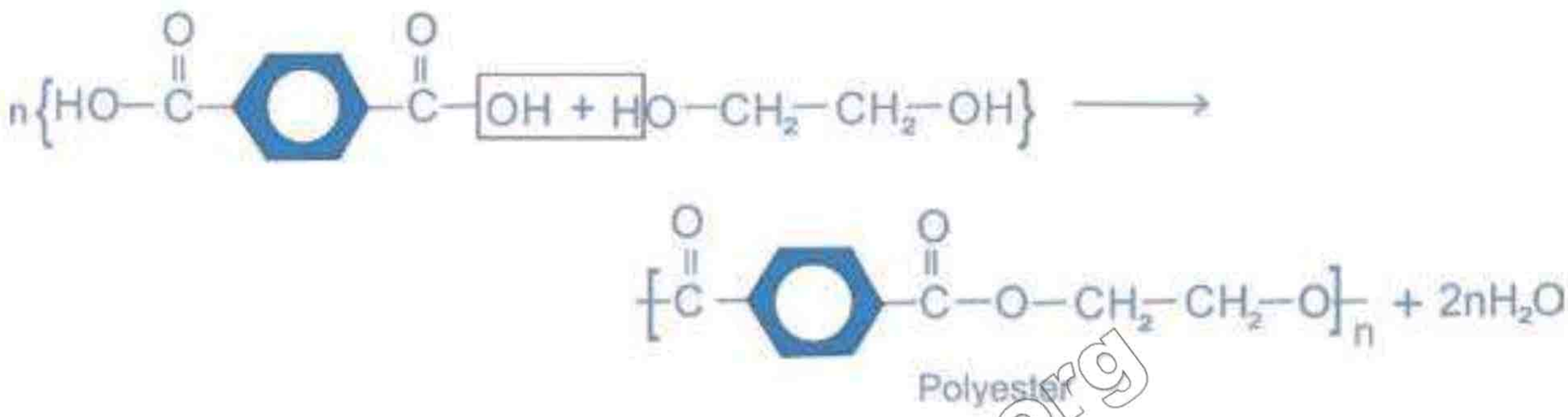


16. Give mechanism of condensation polymerization.

Ans: This type of polymerization results from the mutual reaction of two functional groups. The reaction usually involves the removal of a water molecule or a methanol molecule. It takes place at both ends of the growing chain. For example, dicarboxylic acids or esters combine with diols to get the desired polymer like nylon and polyester fibre. Such polymerizations are generally ionic in nature.



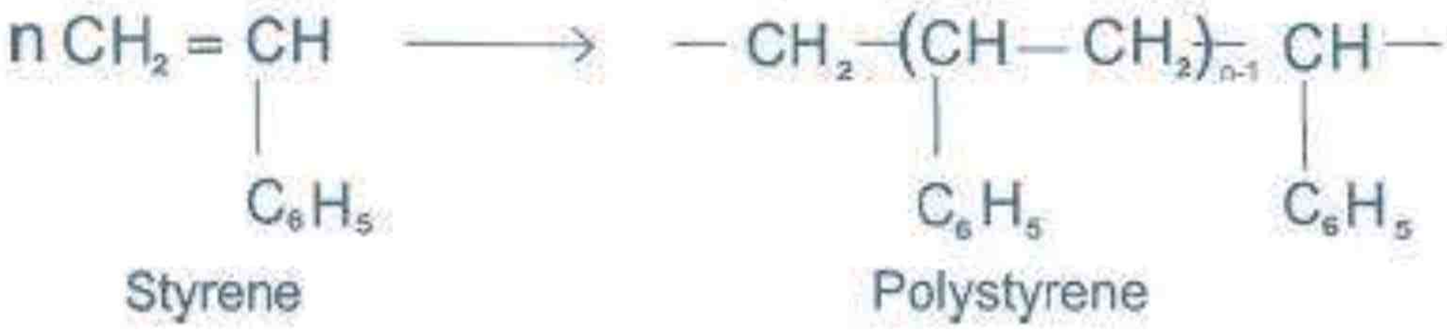
17. How polyvinyl chloride is prepared?

Ans: It is an addition polymer obtained by polymerizing vinyl chloride at 52°C and 9 atmospheric pressure.

Addition of a plasticizer improves the flexibility of the polymer. It is widely used in floor coverings, in pipes, in gramophone recorders, etc.

18. How polystyrene is prepared?

Ans: It is also an addition polymer and is obtained by the polymerization of styrene in the presence of a catalyst. Polystyrene is used in the manufacture of food containers, cosmetic bottles, toys and packing material, etc.

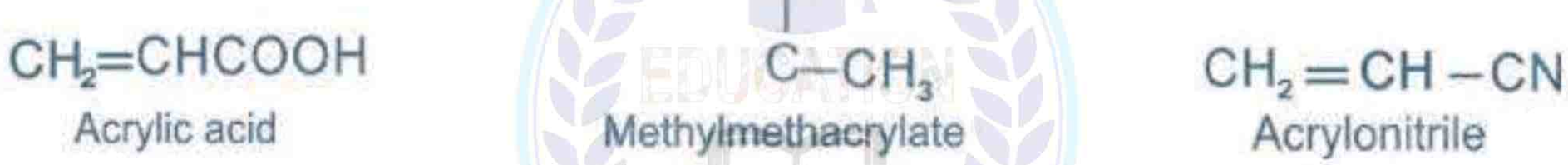


19. What do you know about polyvinyl acetate?

Ans: PVA is a colourless, non-toxic resin. It is supplied in a number of grades differing in the degree of polymerization. The resin has a characteristics odour. It is mostly used as an adhesive material and as a binder for emulsion paints.

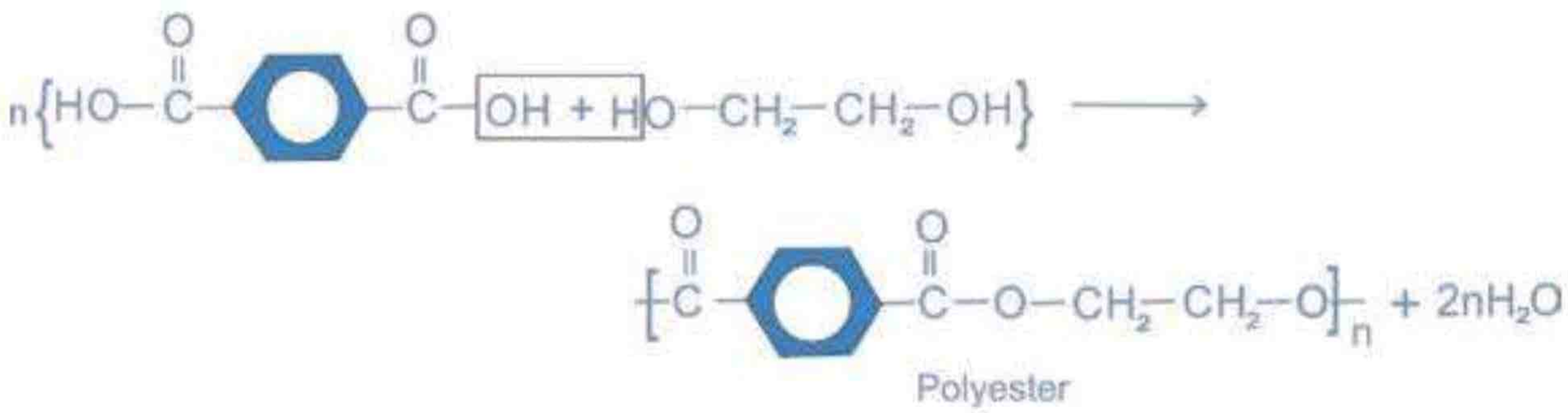
20. What are acrylic resins? Give an example.

Ans: These are closely related to the vinyl resins. The most important monomers of acrylic resins are methylmethacrylate, acrylic acid and butyl acrylate. The acrylic fibres are based largely on acrylonitrile. Acrylic resins are used in the manufacture of plastics, paints for car industry and water based weather resistant paints.



21. What is polyester? Give an example.

Ans: Polyester resins are the product of the reaction of an alcohol (ethane 1, 2 diol) and aromatic bi-functional acids (benzene 1,4-dicarboxylic acid). This product has a large number of uses in clothing. Polyester is often blended cotton or wool for summer and winter clothing. Polyester resins are also used for making water tanks, etc.



22. What are polyamide resins? Give an example.

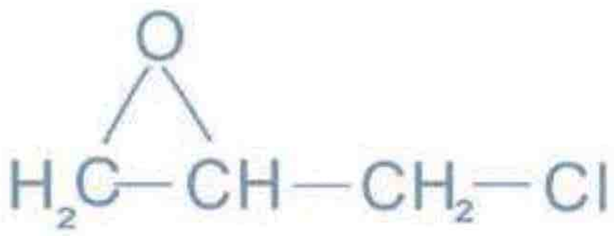
Ans: These resins are formed by the condensation of polyamines with aliphatic dicarboxylic acids.

One of the most famous condensation polymers discovered is Nylon.

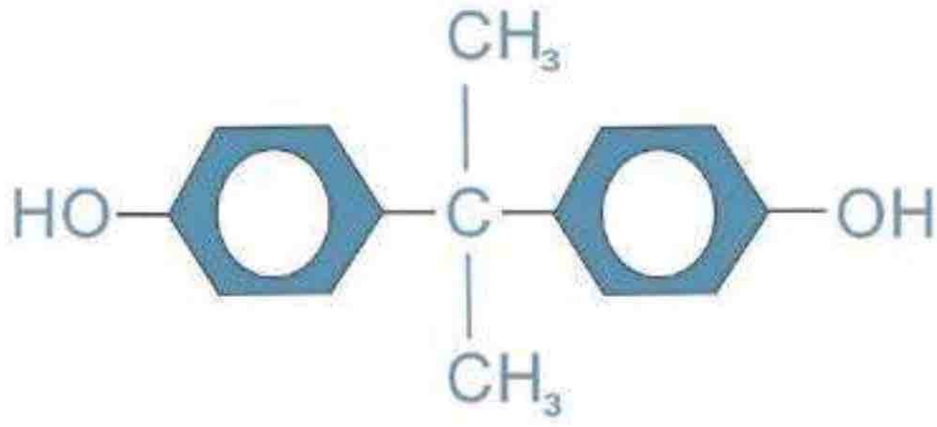
The word Nylon has been accepted as a generic name for synthetic polyamides. Nylon 6, 6 is the most important polyamide. It is obtained by heating adipic acid (hexanedioic acid) with hexamethylene diamine. Nylon 6,6 derives its name from its starting materials adipic acid and hexamethylene diamine,both of which have six carbon atoms. Nylon is mainly used as a textile fibre. It has a combination of high strength, elasticity, toughness and abrasion resistance.

23. What are epoxy resins?

Ans: The epoxy resins are fundamentally polyethers but retain their name on the basis of their starting materials and the presence of epoxide group in the polymer. The epoxy resin is made by condensing epichlorohydrin with diphenylol propane.



Epichlorohydrin



Diphenylolpropane

The major use of epoxy resins is in coating materials which give toughness, flexibility, adhesion and chemical resistance. Industrial materials, thermal power stations, packing materials are coated with epoxy paints. Dams, bridges, floors, etc. are painted with epoxy resins.

24. What are biopolymers?

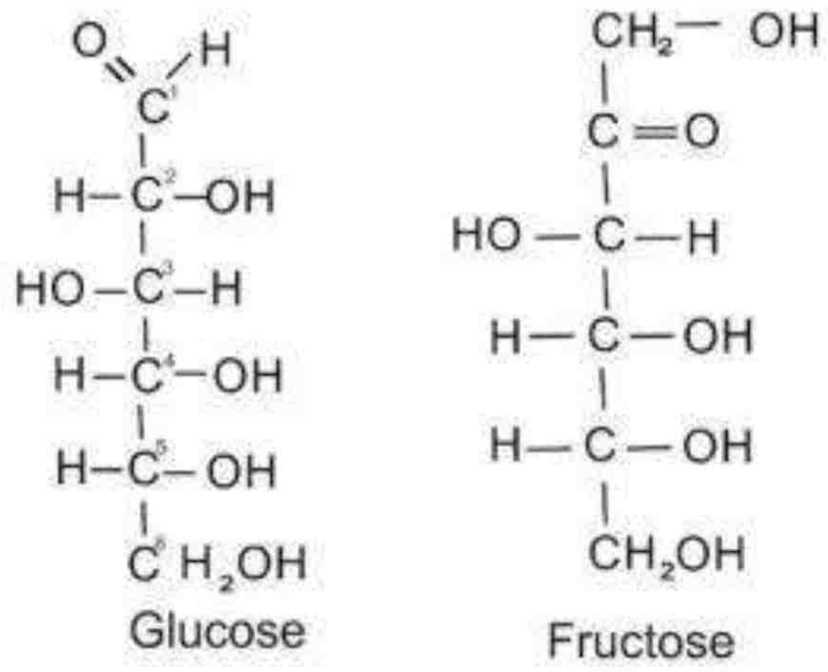
Ans: The polymers of biological origin i.e. animal and plant origin are called biopolymers. Examples are carbohydrates, lipids, proteins.

25. What are carbohydrates? Why are they called so?

Ans: The term carbohydrate is applied to a large number of relatively heterogeneous compounds. They are the most abundant biomolecules on earth. The name carbohydrate (hydrate of carbon) is derived from the fact that the first compound of this group which was studied had an empirical formula Cx $(H_2O)y$. They are commonly called 'sugars' and are 'polyhydroxy compounds' of aldehydes and ketones.

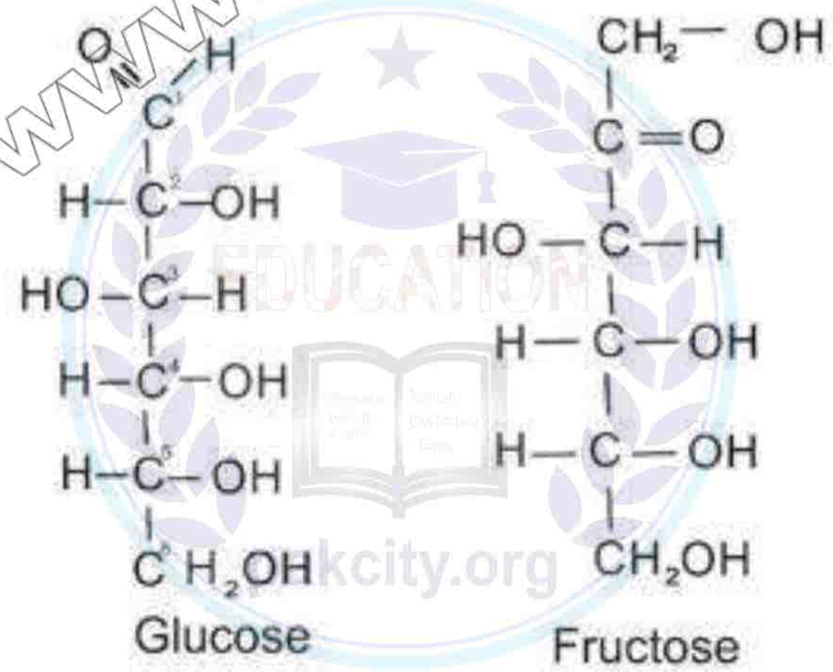
26. What are monosaccharaides?

Ans: These are simple sugars which cannot be hydrolyzed. They have an empirical formula $(CH_2O)_n$ where n = 3 or some large number. Monosaccharides are either aldoses (aldehydic group) or ketoses (ketonic group). Common examples are glyceraldehyde, glucose, fructose, etc.



27. What are hexoses and pentoses?

Ans: Sugars with five carbon atoms are called pentoses and those with six carbon atoms are called hexoses. They are more stable as cyclic structures than as open chain structures. Glucose and fructose are very common examples of hexoses, both of which have molecular formula, $C_6H_{12}O_6$.

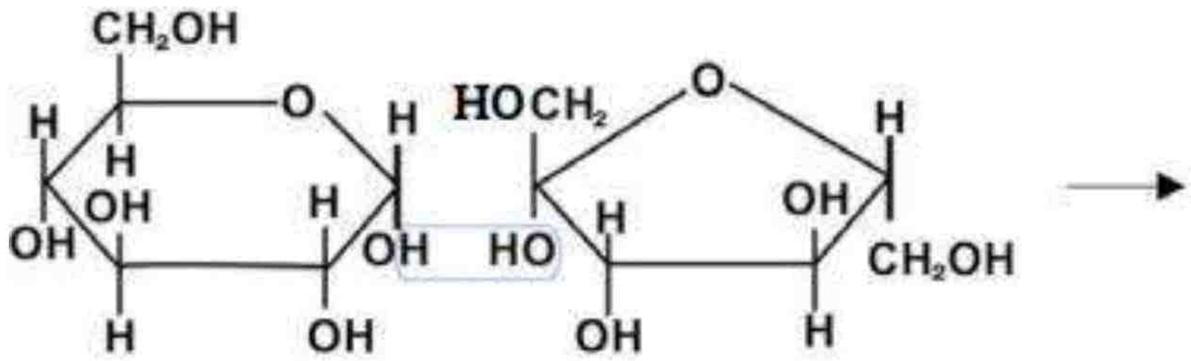


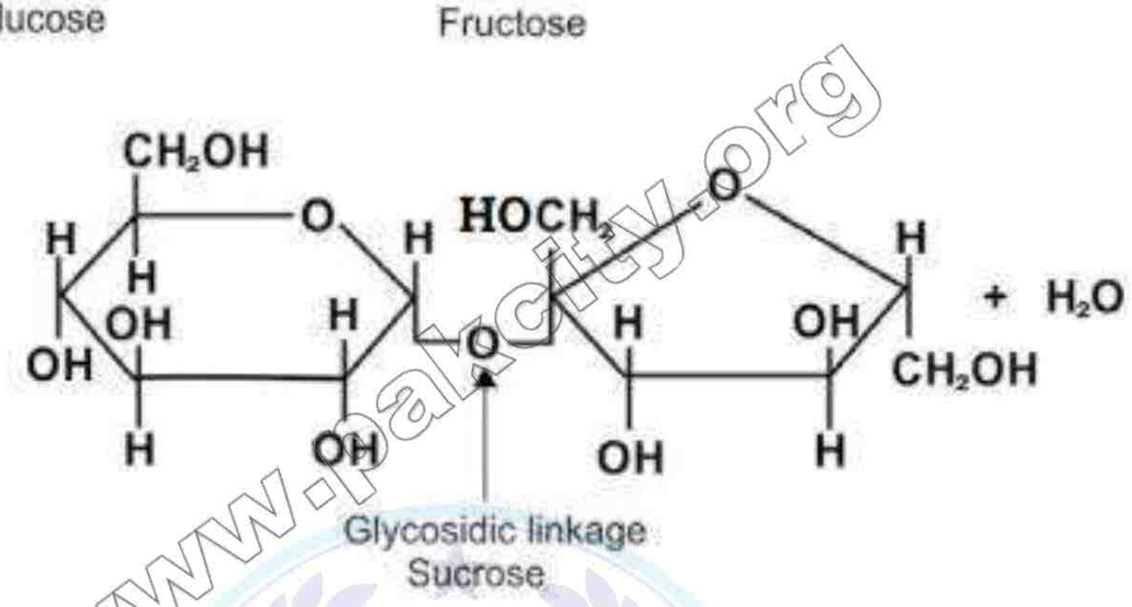
28. What are disaccharides and oligosaccharides?

Ans: When two units of monosaccharides combine they form disaccharides. On hydrolysis they yield monosaccharides. Examples are sucrose, lactose, maltose.

The oligosaccharides are formed when two to nine monosaccharide units combine by the loss of

water molecules. This results in the formation of a glycosidic linkage. For example, sucrose which is a common table sugar, is a disaccharide of glucose and fructose. Conversely, hydrolysis of an oligosaccharide by water in the presence of an acid or by enzymes yields two or more monosaccharide units.





29. What are trisaccharides?

Ans: Trisaccharides, which yield three monosaccharide molecules on hydrolysis, have molecular formula, $C_{18}H_{32}O_{16}$, for example, raffinose.

30. What are polysaccharides?

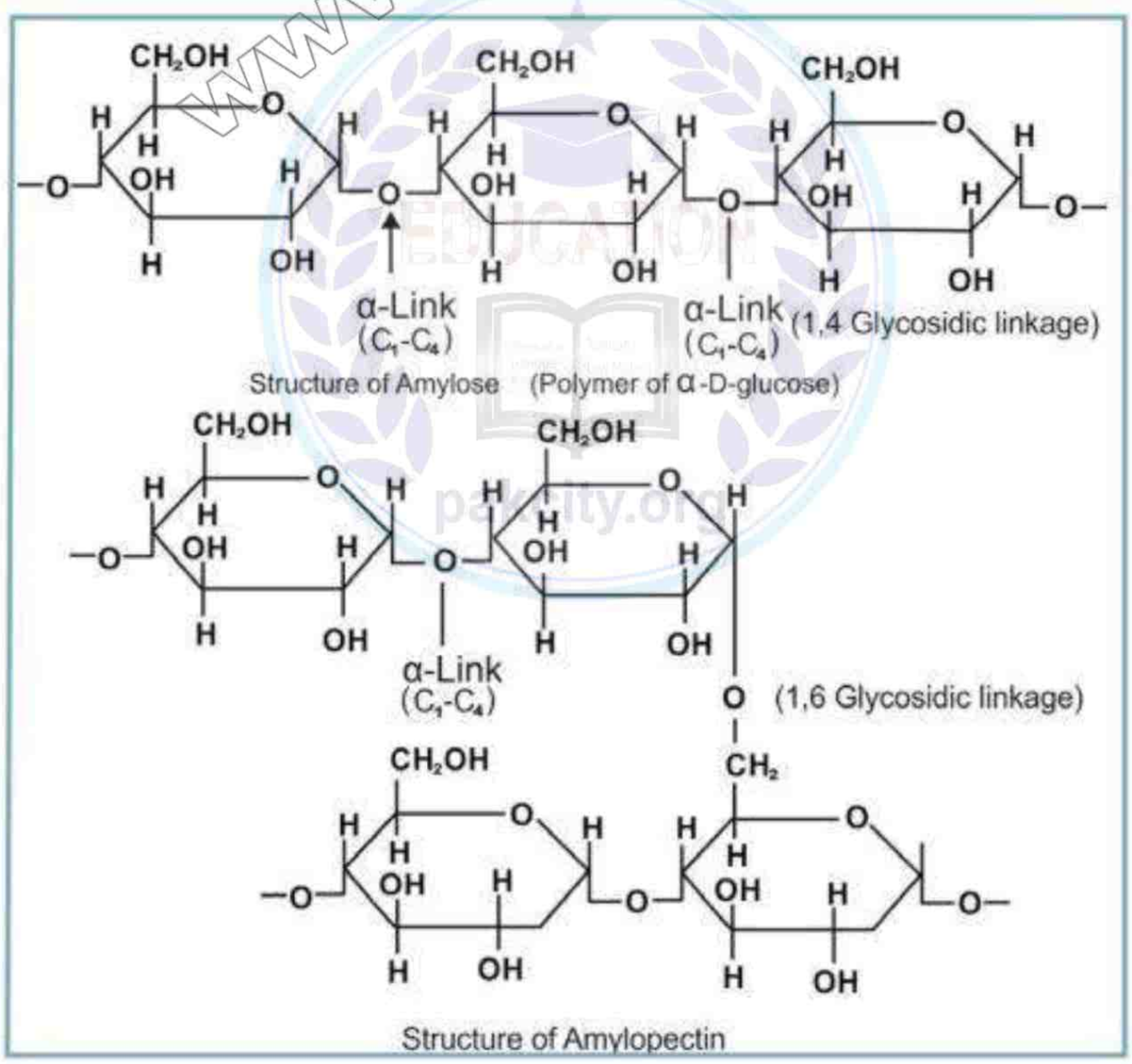
Ans: The polysaccharides are carbohydrates of high molecular mass which yield many monosaccharide molecules on hydrolysis. Examples are, starch and cellulose, both of which have molecular formula, $(C_6H_{10}O_5)_n$. The polysaccharides are amorphous solids, insoluble in water and tasteless and are called 'non-sugars'.

31. What are the functions of polysaccharides?

Ans: Polysaccharides perform two principal functions in animals and plants. They are used as energy storage compounds and for building structural elements of cells. Plants store glucose as starch and animals store glucose in the form of a highly branched polymer known as glycogen. Glycogen is stored in the liver and muscles.

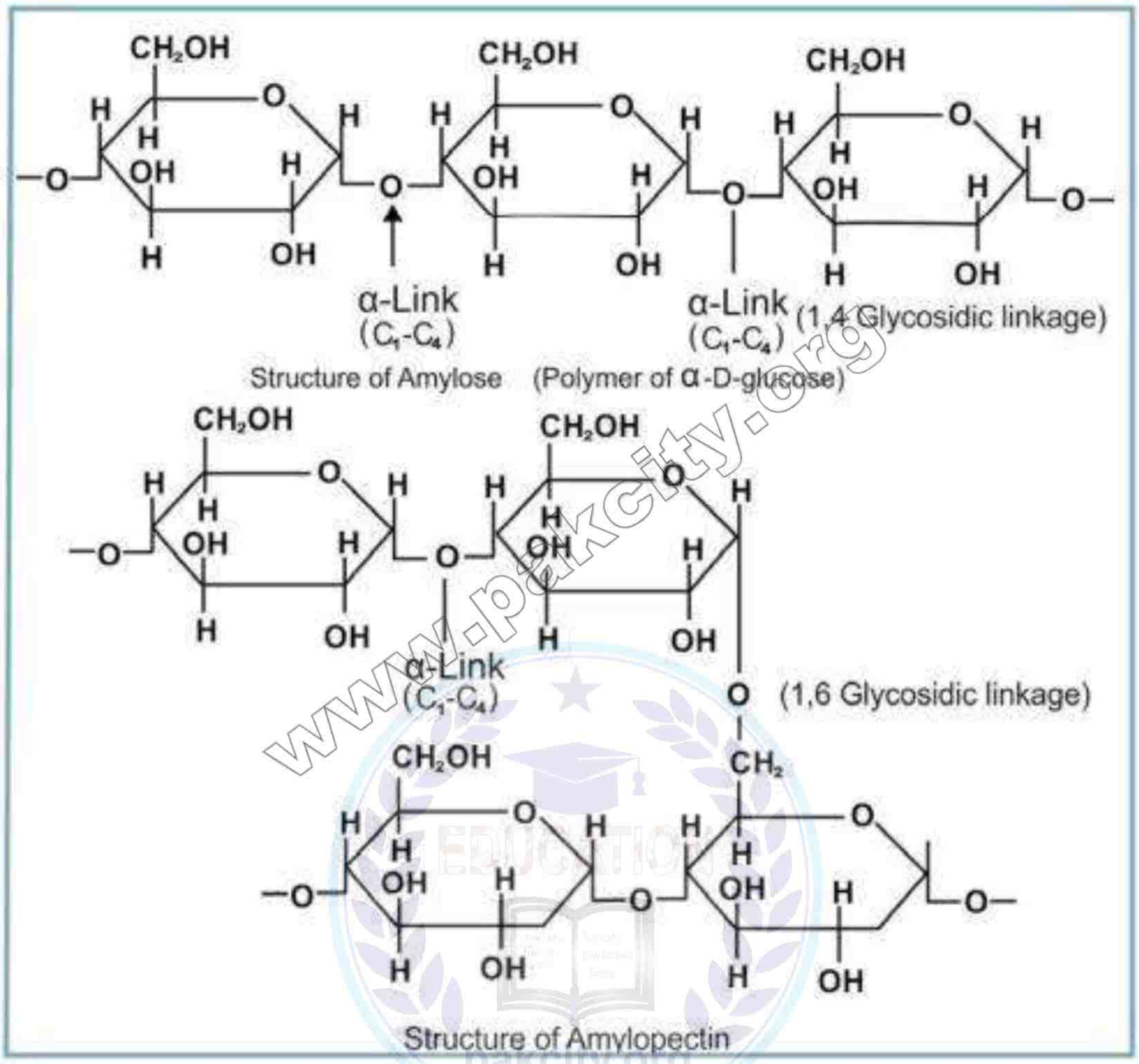
32. What is starch?

Ans: Starch is the most important source of carbohydrates in human diet. The chief commercial sources of starch are wheat, rice, maize, potatoes and barley. Starch is a polymer of α-D-glucose. Starch is not a pure compound. It is a mixture of two polysaccharides, amylose and amylopectin which can be separated from one another. Amylose is soluble in water and gives a deep blue colour with iodine while amylopectin is insoluble and gives no colour. Natural starch consists of 10 to 20% amylose and 80 to 90% amylopectin. It is used in coating and sizing of paper to improve the writing qualities. It is also used in laundering and in the manufacture of glucose and ethyl alcohol.



33. What is the difference between amylase and amylopectin?

Ans: Starch is not a pure compound. It is a mixture of two polysaccharides, amylose and amylopectin which can be separated from one another. Amylose is soluble in water and gives a deep blue colour with iodine while amylopectin is insoluble and gives no colour. Natural starch consists of 10 to 20% amylose and 80 to 90% amylopectin.



34. What are the uses of starch?

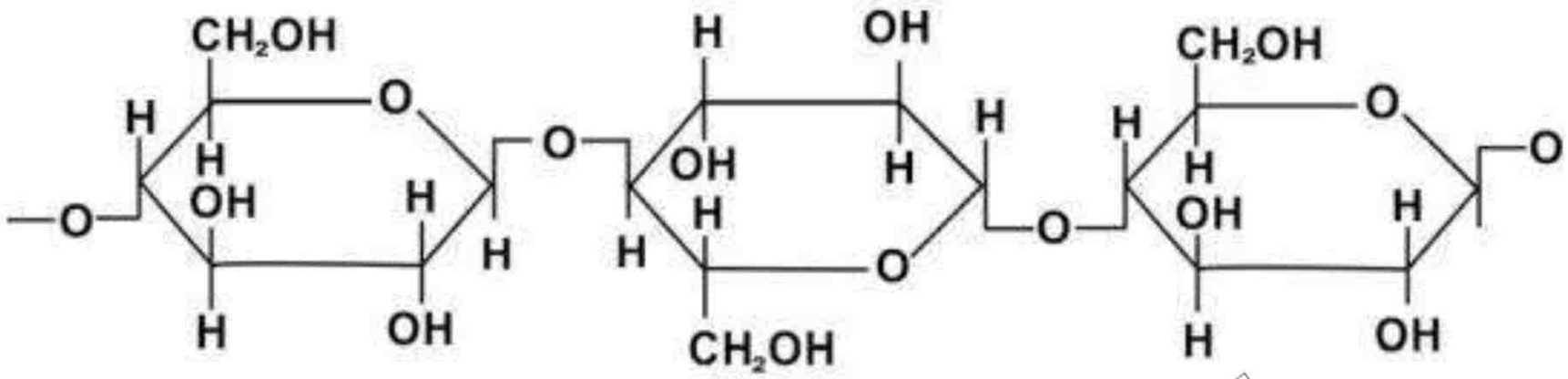
Ans: 1. It is used in coating and sizing of paper to improve the writing qualities.

2. It is also used in laundering and in the manufacture of glucose and ethyl alcohol.

35. What is the difference between cellulose and glycogen?

Ans: **Cellulose:**

The most abundant structural polysaccharide is cellulose. Some 100 billion tons of cellulose are produced each year by plants. For example, cotton is 99% cellulose and the woody parts of trees are generally more than 50% cellulose. It is a polymer of β -D-glucose. It is present mainly in the plant kingdom but also occurs in some marine animals. It is an unbranched polymer consisting of a large number (up to 2500) of glucose residues joined to each other through β -1—>4 linkages.



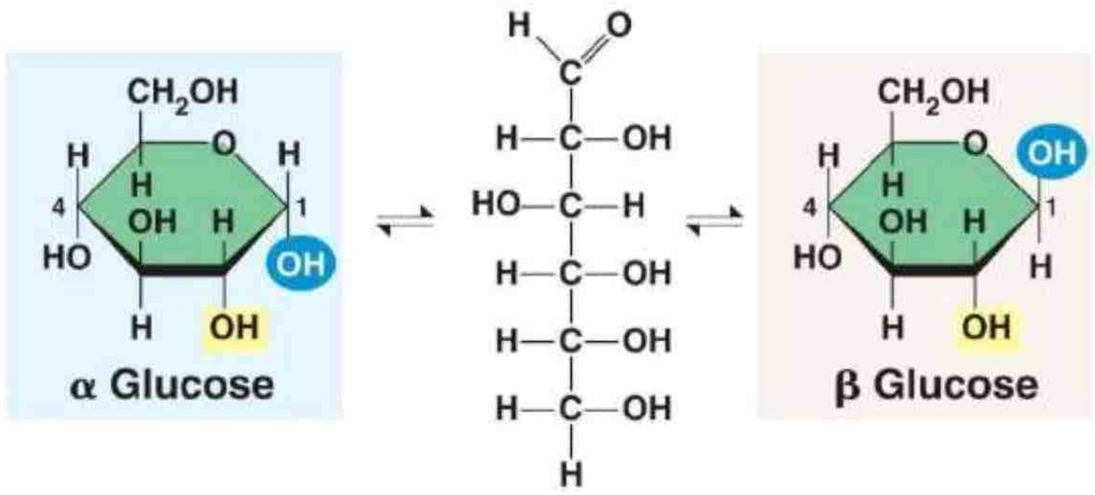
Cellulose (Polymer of β-D-glucose)

Glycogen:

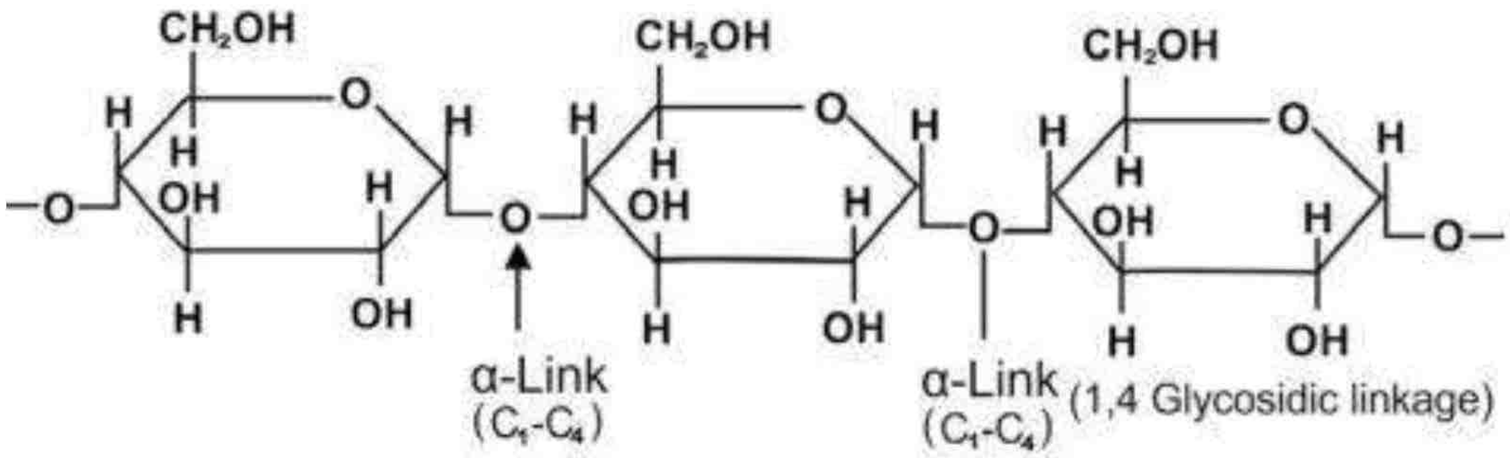
It occurs mainly in the liver and muscles where it represents the main storage polysaccharide in the same way as starch functions in plant cells. Glycogen is therefore also called 'animal starch'. Its structure closely resembles with that of amylopectin having 1 4 and 1 6 glycosidic linkages. Human glycogen is a much more branched molecule than amylopectin. On hydrolysis it yields glucose units.

36. Justify by writing the structural formulas that amylase is condensation polymer of α-Dglucose and cellulose is polymer of β-D glucose.

Ans:

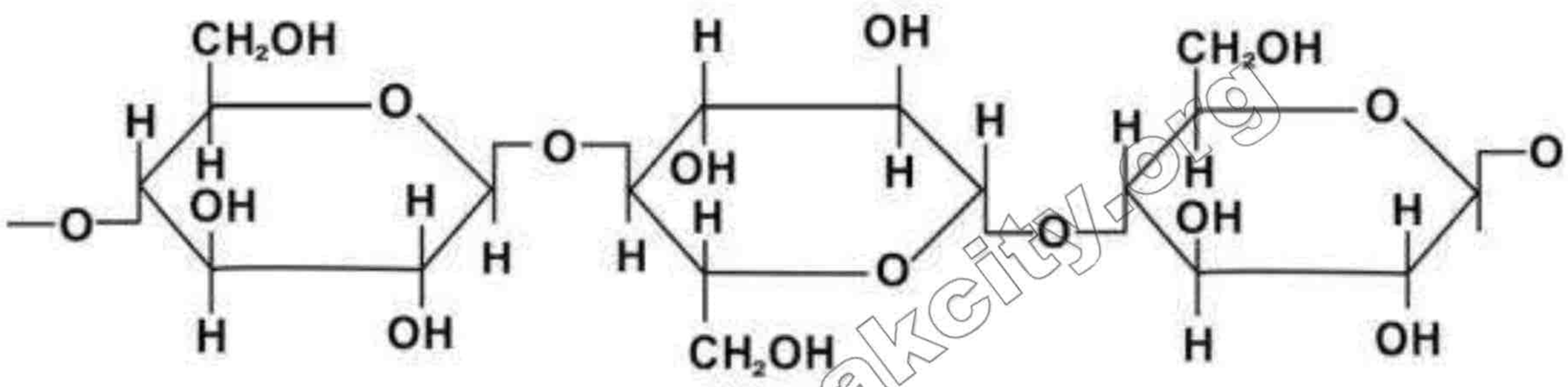


Amylose is a condensation polymer of α- D Glucose.



Structure of Amylose (Polymer of α-D-glucose)

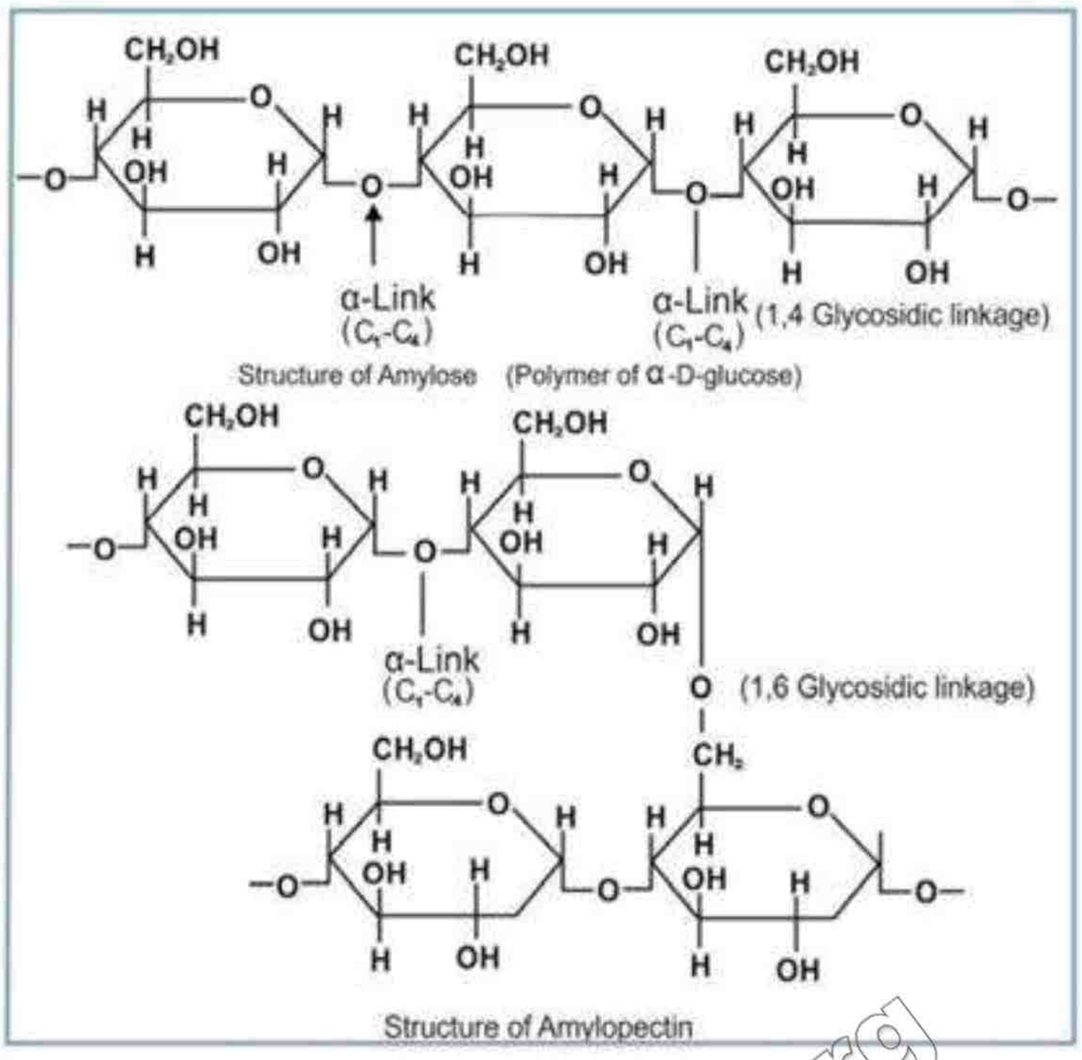
Cellulose is a condensation polymer of β-D glucose .



Cellulose (Polymer of β-D-glucose)

37. Write the structure of starch.

Ans:



Structure of Amylose (Polymer of α-D-glucose)

Structure of Amylopectin

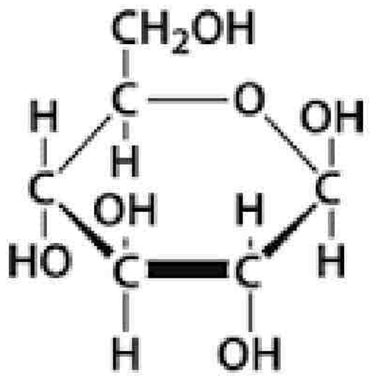
38. What is difference between glucose and fructose?

Ans: The difference in glucose and fructose is their chemical structure. Both are sugars, but

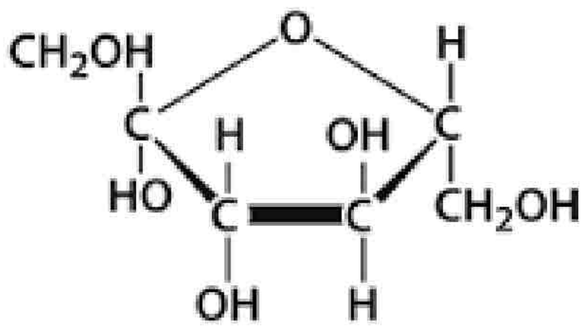
1. Glucose forms a 6 membered ring in solution, while fructose makes a 5 membered ring.

2. Glucose contains an aldehydic functional group whereas fructose contains a ketonic functional group.

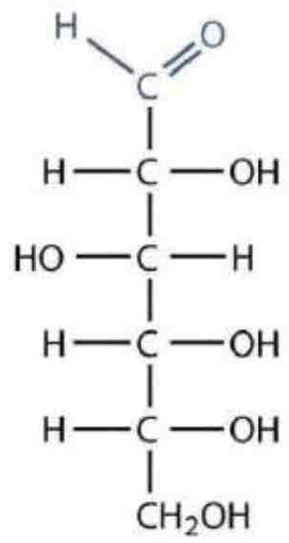
3. Structures of Glucose & Fructose



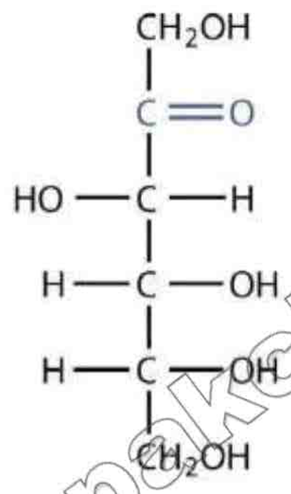
glucose



fructose



Glucose
(an aldohexose)



Fructose
(a ketohexose)

39. What are proteins?

Ans: The name protein is derived from the Greek word proteios meaning of prime importance. Thus proteins may be defined as the high molecular weight organic materials, which upon complete hydrolysis, yield amino acids.

40. What are the characteristics of proteins?

Ans:

1. Proteins are present in all living organisms and without proteins life would not be possible.
2. They are present in muscles, skin, hair and other tissues that make up the bulk of the body's non-bony structure.

3. All proteins contain the elements carbon, hydrogen, oxygen and nitrogen. They may also contain phosphorus and traces of other elements like iron, copper, iodine, manganese, sulphur and zinc. Proteins are very high molecular weight macromolecules.
4. All proteins yield amino acids upon complete hydrolysis.

41. How are proteins classified?

Ans: Based on the physico-chemical properties, proteins may be classified into three types:

1. **Simple proteins**

   These proteins on hydrolysis yield only amino acids or their derivatives. For example, albumins, globulins, legumin, collagen, etc.

2. **Compound or Conjugated proteins**

   In these molecules the protein is attached or conjugated to some non- protein groups which are called prosthetic groups. For example, phospho-proteins are conjugated with phosphoric acid, lipoproteins are conjugated with lipid substances like lecithin, cholesterol and fatty acids.

3. **Derived proteins**

   This class of protein includes substances which are derived from simple and conjugated proteins. For example, proteoses enzymes, peptones, oligopeptides, polypeptides, etc.

42. What are simple proteins? Give an example.

Ans: These proteins on hydrolysis yield only amino acids or their derivatives. For example, albumins, globulins, legumin, collagen, etc. Globulins are insoluble in water but soluble in dilute salt solutions. They are found in animals, e.g lactoglobulin is found in muscles and also in plants. Legumin and collagen proteins are present in the connective tissues throughout the body. They are the most abundant proteins in the animal kingdom forming some 25 to 35% of body protein.

43. What are compound proteins? Give an example.

Ans: In these molecules the protein is attached or conjugated to some non- protein groups which are called prosthetic groups. For example, phospho-proteins are conjugated with phosphoric acid, lipoproteins are conjugated with lipid substances like lecithin, cholesterol and fatty acids.

44. What are derived proteins? Give an example.

Ans: This class of protein includes substances which are derived from simple and conjugated proteins. For example, proteoses enzymes, peptones, oligopeptides, polypeptides, etc. Based on their functions, proteins may also be classified as regulatory or hormonal proteins, structural proteins, transport proteins, genetic proteins, etc.

45. Explain structure of proteins OR What is the difference between primary, secondary, tertiary and quaternary protein?

Ans: Proteins assume at least three levels of structural organization.

(i) Primary structure

(ii) Secondary structure

(iii) Tertiary structures

Some proteins also possesses a fourth structure called the quaternary structure.

The sequence of the amino acids combined in a peptide chain is referred to as the primary structure.

The secondary structure of a protein is a regular coiling or zigzagging of polypeptide chains caused by hydrogen bonding between >NH and >C=0 groups of amino acids near each other in the chains.

The three dimensional twisting and folding of the polypeptide chain results in the tertiary structure of proteins.

46. How proteins are denatured?

Ans: The structure of proteins can be disrupted easily by heat, change in pH and under strongly oxidizing or reducing conditions. Under such conditions the proteins undergo denaturation. The most familiar example of denaturation is the change that takes place in albumin, the principal component

of egg white, when it is cooked. In this particular case the change is irreversible.

47. What is the importance of proteins?

Ans: Following are the points showing importance of proteins:

1. Proteins take an essential part in the formation of protoplasm which is the essence of all forms of life.

2. Nucleoproteins which are complexes of proteins with nucleic acids serve as carriers of heredity from one generation to the other.

3. Enzymes which are biological catalysts are protein in nature. Without them life is not possible.

4. Many proteins have specialized functions. Haemoglobin acts as a carrier of O_2. Some proteins act as hormones which have regulatory functions, for example; insulin, thyroxine etc.

48. Define lipids.

Ans: Lipids (Greek, lipos means fat) are naturally occurring organic compounds of animals and plants origin which are soluble in organic solvents and belong to a very heterogeneous group of substances.

Examples: Fats & Oils

49. What are the characteristics of lipids?

Ans: Lipids have the following characteristics:

1. They are insoluble in water and soluble in non-polar solvents e.g. ether, chloroform and benzene, etc.

2. Their primary building blocks are fatty acids, glycerol and sterols.

3. They are utilized by the living organisms.

50. What are the sources of fats and oils?

Ans: Fats and oils come from a variety of natural sources like animals, plants and marine organisms.

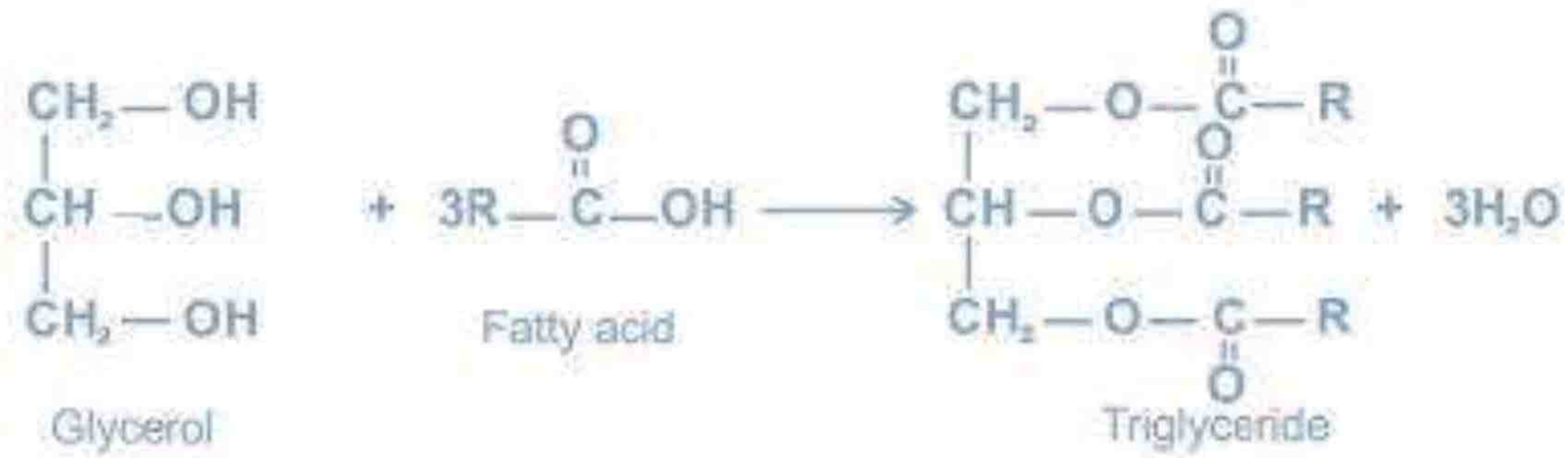
Animal fats are located particularly in adipose tissue cells. Butter and ghee are a special type of

animal fats which are made from milk. Vegetable oils are chiefly present in seeds and nuts of plants.

Marine oils are obtained from sea animals like salmons and whales etc.

51. What is the structure of fats OR How fats are synthesized?

Ans: Fats and oils are triesters formed from glycerol and long chain acids called fatty acids.



Triester of glycerol is called a triglyceride or glyceride.

52. What is the difference between a fat and an oil?

Ans: The degree of unsaturation of the constituent fatty acid determines whether a triglyceride will be a solid or a liquid. The glycerides in which long chain saturated acid components predominate tend to be solid or semi-solid and are termed as fats. On the other hand, oils are glycerol esters which contain higher proportion of unsaturated fatty acid components and are in liquid form at room temperature.

53. How are lipids classified? (Only give names of types as answer to this question. Separate question can come for each type. Then give detail of that specific type there)

Ans: Lipids are classified as:

1. Simple Lipids

These are esters of fatty acids with glycerol. For example, common fats and oils.

2. Compound Lipids

These contain radicals in addition to fatty acids and alcohol and include glycerol phospholipids, sphingolipids, lipoproteins and lipopolysaccharides.

3. Derived or Associated Lipids

They are the hydrolytic products of the above mentioned compounds. Sterols, vitamin D and terpenes belong to this class of lipids.

54. What are the characteristics of lipids? (Mention any four as answer to short question)

Ans: Following are the characteristics of lipids:

1. Oils and fats may either be liquid or non-crystalline solids at room temperature.

2. When pure they are colourless, odourless and tasteless.

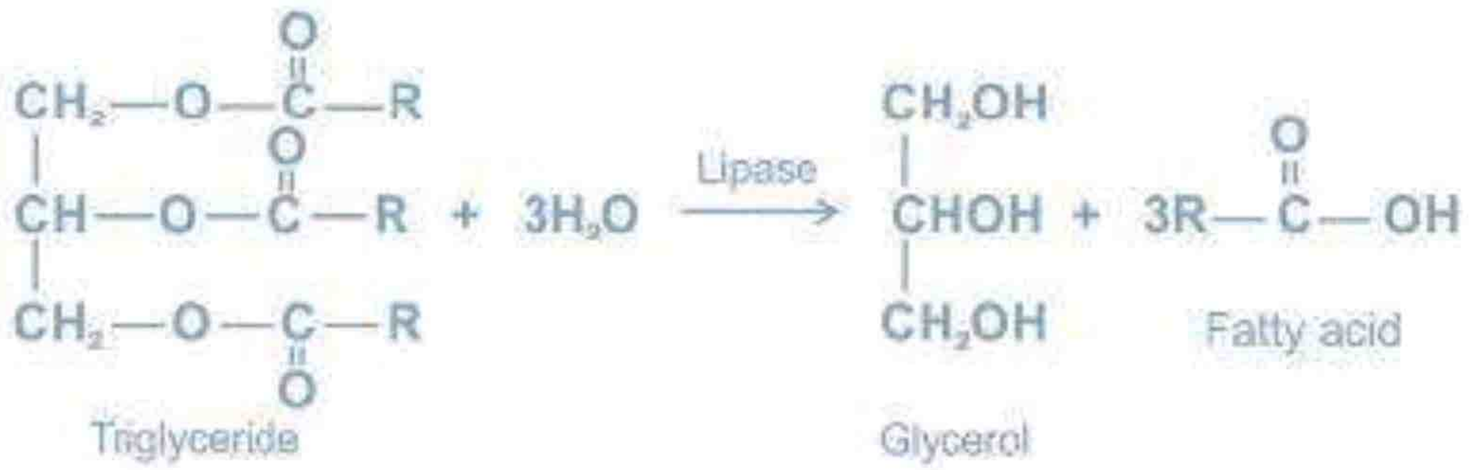
3. They are insoluble in water and readily soluble in organic solvents like diethyl ether, acetone, carbon tetrachloride and carbon disulphide.

4. They readily form emulsions when agitated with H_2O in the presence of soap or other emulsifiers.

5. They are poor conductor of heat and electricity and therefore serve as excellent insulator for the animal body.

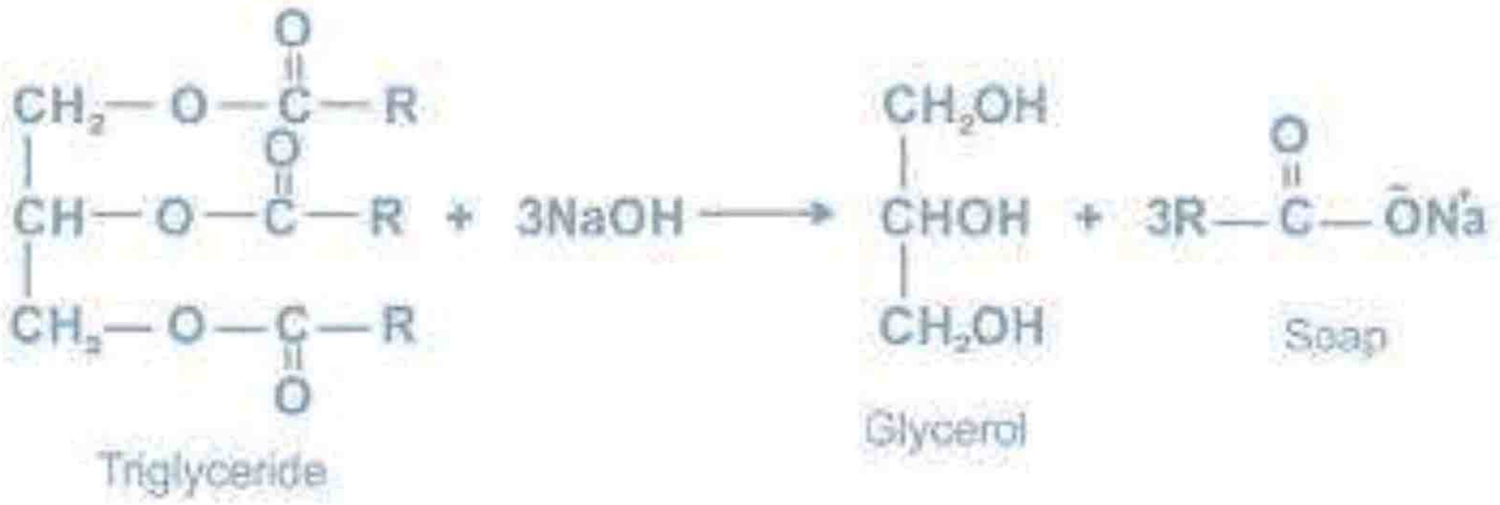
55. How are lipids hydrolyzed?

Ans: Triglycerides are easily hydrolyzed by enzymes called lipases to fatty acids and glycerol.



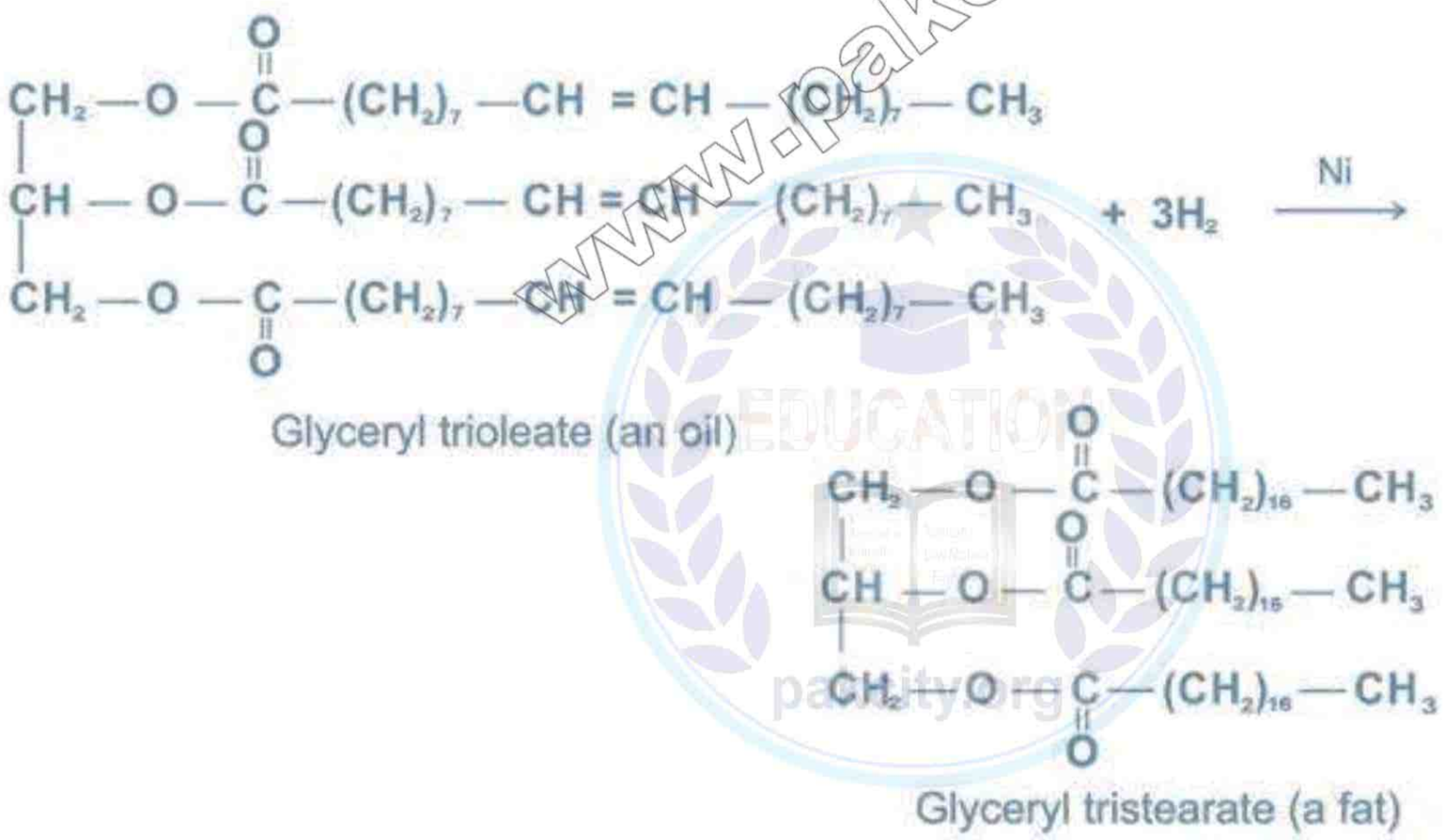
56. How are lipids saponified?

Ans: It is the hydrolysis of a fat or an oil with an alkali to form soap (salt of fatty acid) and glycerol.



57. What is meant by hardening of oils?

Ans: Unsaturated glycerides react with hydrogen in the presence of a metal catalyst to give saturated glycerides. The result is the conversion of a liquid glyceride (an oil) into a semi-solid glyceride (a fat).



58. What is saponification number? Give an example.

Ans: It is defined as the number of milligrams of potassium hydroxide or sodium hydroxide required to saponify one gram of the fat or oil. For example, one mole of glycerol tripalmitate (mol. wt = 807) requires 168,000 mg of KOH for saponification. Therefore, one gram of fat will require 168000/807

mg of KOH. Hence the saponification number of glycerol tripalmitate is 208.

59. What is rancidity of fats and oils?

Ans: Fats or oils are liable to spoilage and give off an odour known as rancidity. It is mainly caused by the hydrolytic or oxidative reactions which release foul smelling aldehydes and fatty acids. Oils from sea animals which contain a relatively high proportion of unsaturated acid chains deteriorate rapidly.

60. What is iodine number? Give an example.

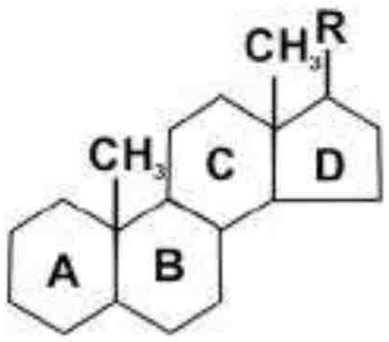
Ans: The extent of unsaturation in a fat or an oil is expressed in terms of its iodine number. It is defined as the number of grams of iodine which will add to 100 grams of a fat or an oil. The value of iodine number depends on the number of double bonds present in the acid component of the glycerides. The glycerides with no double bonds have zero iodine number.

61. What is acid number?

Ans: The acid number of a fat or an oil tells the amount of free fatty acids present in it. It is expressed as the number of milligrams of potassium hydroxide required to neutralize one gram of fat.

62. What are steroids?

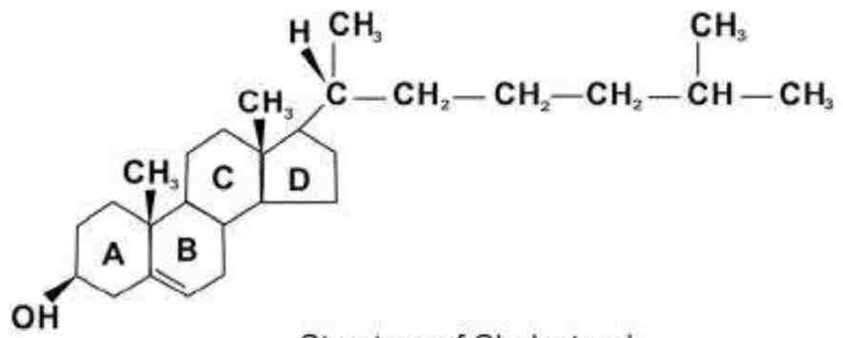
Ans: Steroids are naturally occurring lipids. Their parent nucleus has perhydrocyclopentanophenanthrene component which consists of three six- membered rings (A, B and C) and one five-membered ring (D). These rings are joined or fused to each other and have a total of 17-C atoms.



Structure of Steroid Nucleus

63. What is the function of cholesterol? Draw its structure.

Ans: Cholesterol is present both in the free as well as esterified form in the blood, animal tissues, egg, yolk, various oils and fats and nerve tissues. Its increased quantities in blood makes plaque like deposits in the arteries causing blood pressure and other heart diseases.



Structure of Cholesterol

64. What is ergosterol?

Ans: It is the sterol of fungi and yeasts. When irradiated with ultraviolet rays, it is converted into ergocalciferol or vitamin D2.

65. What are phospholipids?

Ans: Phospholipids are molecules of enormous biological importance. In the compounds, two of the hydroxyl groups are esterified with fatty acids and third forms a link with phosphoric acid or a derivative of phosphoric acid.

66. What is the importance of lipids?

Ans: Following are the points showing importance of lipids:

1. They are good source of energy and make the food more palatable.

2. They exert an insulating effect on the nervous tissues.

3. They are good energy reservoirs in the body.

4. Lipids are an integral part of cell protoplasm and cell membranes.

5. Some lipids act as precursors of very important physiological compounds. For example, cholesterol is the precursor of steroid hormones.

67. What are enzymes?

Ans: Enzymes can be defined as the reaction catalysts of biological systems produced by living cells and are capable of catalyzing chemical reactions.

68. What is apoenzyme and co-factor?

Ans: The protein component of the enzyme is called apoenzyme and the non-protein component is called the co-factor or co-enzyme. The co-factors include inorganic ions and complex organic or metallo-organic molecules. Important inorganic co-factors along with their respective enzymes include Fe^{2+}(chrome oxidase) Zn^{2+}(carbonic anhydrase) and Mg^{2+}(glucose 6- phosphatase), etc. Many enzymes contain vitamins as their co-factors, for example; nicotinamide adenine dinucleotide contains nicotinamide vitamin and thiamine pyrophosphatase contains vitamin B1.

69. How are enzymes classified?

Ans:

1. Oxidoreductases

These enzymes catalyze oxidation-reduction reactions. Common examples are oxidase, dehydrogenase and peroxydase.

2. Transferases

These enzymes bring about an exchange of functional group such as phosphate or acyl between two compounds. For example, phospho-transferases, etc.

3. Hydrolases

These enzymes catalyze hydrolysis.They include proteases called protolytic enzymes.

4. Lyases

These enzymes catalyze the addition of ammonia, water or carbon dioxide to double bonds or removal of these to form double bonds, for example phospho-glyceromutases.

5. Isomerases

These enzymes catalyze the transfer of groups within molecules to yield isomeric forms of the substrate. An example is the conversion of fumaric acid to maleic acid in' the presence of fumarase enzyme.

6. Ligases

These enzymes link two molecules together through the breaking of high energy bonds, for example; acetyl S COH, a carboxylase and succinic thiokinase.

70. What are the properties of enzymes? OR Discuss any two properties of enzymes.

Ans: Following are the properties of enzymes:

1. Enzymes are specific in their action which means that an enzyme will act on only one substrate or a group of closely related substrates.

2. Enzymes with few exceptions are protein in nature.

3. Most enzymatic reactions are reversible.

4. The enzymes from the same organisms which catalyze the same reaction but are chemically and physically distinct from each other are called isoenzymes.

71. Mention the factors affecting enzyme activity.

Ans: Following are the factors affecting enzyme activity:

1. Enzyme concentration
2. Temperature
3. Effect of pH
4. Presence of co-enzymes, activators, inhibitors
5. Radiation

72. What is the effect of enzyme concentration on enzyme activity?

Ans: The rate of an enzymatic reaction is directly proportional to the concentration of the substrate.

The rate of reaction is also directly proportional to the square root of the concentration of enzyme.

It means that the rate of reaction also increases with the increasing concentration of enzyme.

73. What is the effect of temperature on enzyme activity?

Ans: The enzymatic reaction occurs best at or around 37 °C which is the average normal body temperature. The rate of chemical reactions is increased by a rise in temperature but this is true only over a limited range of temperature. The enzymes usually destroy at high temperature. The activity of enzymes is reduced at low temperature. The temperature at which an enzyme reaction occurs the fastest, is called its optimum temperature.

74. What is the effect of pH on enzyme activity?

Ans: Just like temperature, there is also an optimum pH at which an enzyme will catalyze the reaction at the maximum rate. For example, the optimum pH of salivary amylase is 6.4 to 6.9.

75. What is the effect of co-enzymes, activators and inhibitors on activity of enzymes?

Ans: The enzyme action is also increased or decreased in the presence of some other substances such as co-enzymes, activators and inhibitors. For example, some enzymes consist of simple proteins only such as insulin. Most of the enzymes are, however, the combination of a coenzyme and an apo-enzyme. Activators are the inorganic substances which increase the enzyme activity. For example; Mg^{2+} and Zn^{2+} ions are the activators of phosphatase and carbonic anhydrase enzymes respectively. Inhibitors are the substances which reduce the enzyme activity.

76. Briefly describe the two factors that affect the activity of enzymes.

Ans:

Factors affecting enzyme activity:

1. Enzyme concentration:

The rate of an enzymatic reaction is directly proportional to the concentration of the substrate. The rate of reaction is also directly proportional to the square root of the concentration of enzyme. It

means that the rate of reaction also increases with the increase in the concentrationof enzyme.

2. Temperature:

The enzymatic reaction occurs best at or around 37°C which is the average normal body temperature. The rate of chemical reactions is increased by a rise in temperature but this is true only over a limited range of temperature. Enzymes usually destroy at high temperature. The activity of enzymes is reduced at low temperature. The temperature at which an enzymereaction occurs the fastest is called its optimum temperature.

77. What is denaturation of proteins?

Ans:

The structure of proteins can be disrupted easily by heat, change in PH and under strong oxidizing and reducing conditions. Under such conditions the proteins undergo denaturation. The most familiar example of denaturation is the change that takes place in albumin, the principle component of egg white, when it is cooked. In this particular case the change is irreversible.

78. What is the effect of radiation on activity of enzyme?

Ans: Generally enzymes are readily inactivated by exposure to ultraviolet light, beta rays, gamma rays and X-rays.

79. What is the importance of enzymes?

Ans: Enzymes are of great biological importance and are of great help in the diagnosis of certain diseases. Some examples are, alkaline phosphatase is raised in rickets and obstructive jaundice, lactic dehydrogenase or LDH-1 is raised in heart diseases. Many enzymes have proved very useful as drugs. For example; thrombin is used locally to stop bleeding. Many enzymes are used for cancer treatment, for example, L-asparaginase has proved very useful in the treatment of blood cancer in children.

80. What are nucleic acids? What is their function?

Ans: Nucleic acids were first demonstrated in the nuclei of pus cells in 1868 and in sperm heads in 1872 by Friedrik Miescher. They are present in every living cell as well as in viruses and have been found to be the essential components of the genes. They contain in their structure the blue-prints for the normal growth and development of each and every living organism.

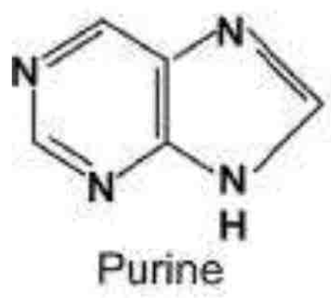
The nucleic acids are responsible for the two fundamental functions which are common to all living organisms, these are (a) their ability to reproduce, store and transmit genetic information and (b) to undergo mutation.

81. What are the types of nucleic acids?

Ans: Two types of nucleic acids have been discovered, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). In the body nucleic acids occur as part of the conjugated proteins called nucleoproteins.

82. What are the components of nucleic acids?

Ans: Both DNA and RNA are formed by joining together a large number of nucleotide units and mononucleotides units, each of which is a nitrogenous base sugar phosphoric acid complex.



Purine

Pyrimidine

Nitrogenous bases are either purine or pyrimidine derivatives. Purines include adenine and guanine whereas pyrimidines include, cytosine, uracil and thymine. A nucleoside is a combination of nitrogenous base (purine or a pyramidine) with a sugar (ribo or deoxyribose). Depending upon the presence of ribo or a deoxyribo, nucleoside can either be a ribonucleoside or deoxyribonucleoside.

Dexoyribonucleic acid (DNA) carries the genetic information and ribonucleic acid (RNA) is involved in putting this information to work in the cell.

83. What is the difference between DNA and RNA?

Ans:

DNA	**RNA**
1. DNA is Deoxyribonucleic acid .	1. RNA is ribonucleic acid.
2. It carries genetic information.	2. It puts this information to work in cell
3. Sugar in DNA is 2-deoxyribose	3. Sugar in RNA is ribose.
4. It is double stranded .	4. It is single stranded.
5.Four bases are found in DNA. Cytosine, Thymine, Adenine & Guanine.	5. In RNA thymine is replaced by Uracil

84. What is the repeating unit in each of the following polymers?

(a) Polystyrene ***(b) Nylon 6,6***

(c) Teflon ***(d) Orlon***

Ans:

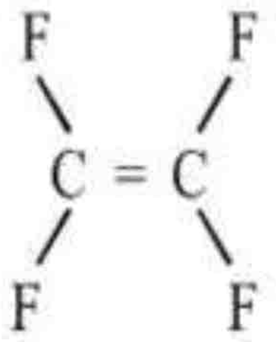
(a) In polystyrene repeating unit is styrene ($H_2C{=}CH\text{-}C_6H_5$)

(b) In nylon 6,6 repeating units are adipic acid and hexamethylene diamine

Adipic acid $HOOC—(CH_2)_4—COOH$

Hexamethylene diamine $H_2N—(CH_2)_6—NH_2$

(c) In Teflon repeating unit is tetrafluoro ethene



(d) In Orlon repeating unit is acrylonitrile CH_2=CH-CN

85. Point out one difference between the compounds in each of the following pairs:

a. Glucose and Fructose ***b. Sucrose and maltose***

c. Cellulose and starch

Ans:

a. Glucose is polyhydroxy aldehyde and fructose is polyhydroxy ketone (Detail given in answer of Q no. 38).

b. Maltose on hydrolysis gives glucose

$$C_{12}H_{22}O_{11} \xrightarrow{\text{Maltase}} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose on hydrolysis gives glucose and fructose

$$C_{12}H_{22}O_{11} \xrightarrow{\text{Sucrase}} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + C_6H_{12}O_6 \text{ (Fructose)}$$

c. Starch is a polymer of α-D Glucose and cellulose is a polymer of β-D glucose (Detail given in answer of Q no. 32 & 36).

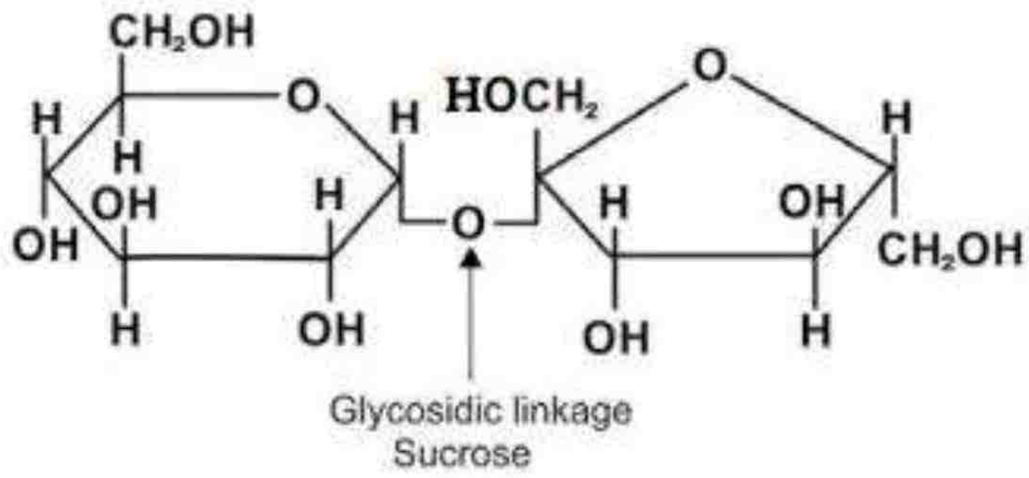
86. What is the difference between a glycosidic linkage and a peptide linkage?

Ans:

Glycosidic linkage

This is present in oligosaccharides and polysaccharides. Monosaccharides combine with the

release of water molecule forming a glycosidic linkage. For example, in sucrose molecule.



Peptide linkage

Amino acids combine with the release of water molecule thereby forming a peptide bond. For example,