Chapter – Biomolecules

Very Short Answer Type Question **1 Mark**

1. Name polysaccharide which is stored in the liver of animals.

Ans. Glycogen is the body's reserve polysaccharide, which is mostly made up of hepatic glycogen. Glycogen is produced in both the liver and the muscles.

2. What structural feature is required for a carbohydrate to behave as reducing sugar?

Ans. The presence of an aldehydic group $(-CHO)$ such as glucose, mannose, galactose, and other reducing sugars, or a -ketol group$(-CO-CH_2OH)$ such as fructose, is one of the structural properties of reducing sugars.

3. How many asymmetric carbon atoms are present in $D(+)$ **glucose?**

Ans. The glucose molecule has four chiral carbon atoms.

4. Name the enantiomer of D**-glucose.**

Ans. β-D-$(+)$ - glucopyranose

5. Give the significance of $(+)$**-sign in the name D-(+)-glucose.**

Ans. The “D” isomer is dextrorotatory, as denoted by a (+) sign (or, in certain cases, a lower case “d”), whereas the “L” isomer is levorotatory, as shown by a (-) sign.

6. Give the significance of the prefix 'D' in the name $D-(+)$-glucose.

Ans. The hydroxyl group at the chiral carbon that is farthest from the greatest oxidised carbon (Aldehyde group in this example) with regard to glyceraldehyde is referred to as $D(+)$ glucose. The hydroxyl group is on the right side, as indicated by the letter 'D.'

7. Glucose is an aldose sugar but it does not react with sodium hydrogen sulphite. Give a reason.

Ans. An aldehyde group is present in glucose. It, on the other hand, does not react with sodium hydrogen sulphite to generate bisulphite addition products. This is because this reaction takes place in the presence of a free aldehyde group, but there is no free $-CHO$ group in glucose's structure.

8. Why sucrose is called invert sugar?

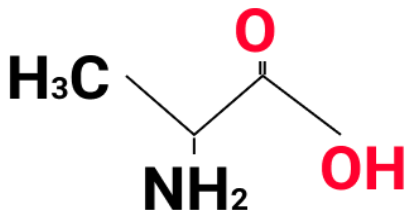
Ans. When sucrose is hydrolyzed, the sign of rotation changes from dextro (+) to laevo (-), and the result is known as invert sugar.

9. Name the building blocks of proteins.

Ans. Amino acids.

10. Give the structure of the simplest optically active amino acid.

Ans. Alanine is the simplest optically active amino acid.



11. Name the amino acid which is not optically active.

Ans. Glycine is the most basic amino acid and the only one that does not have an optical activity. It doesn't have any stereoisomers.

12. Write the Zwitter ionic form of amino acetic acid.

Ans. The other name of amino acetic acid is Glycine.

Zwitter ionic form of glycine is:

$$NH_3^+ - CH_2 - COO^-$$

13. Name the enzyme which catalyzes the hydrolysis of maltose into glucose.

Ans. Maltase

14. Give reason: Amylase present in the saliva becomes inactive in the stomach.

Ans. As hydrochloric acid is present in the stomach lining; this causes the stomach to have a low pH value. The pH of the stomach is about 1-2 which is extremely acidic, this acidity causes the salivary amylase's protein structure to denature and change shape and become inactive.

15. How would you explain the amphoteric behavior of amino acids?

Ans. In a single molecule, amino acids have both an acidic (carboxyl group) and a basic (amino group). They neutralise each other in aqueous solutions. A proton is released by the carboxyl group, whereas it is accepted by the amino group. Amino acids react with both acids and bases in their zwitter ionic form, displaying amphoteric behaviour.

16. Which forces are responsible for the stability of $\alpha-$ helical structure of proteins.

Ans. The stability of proteins' alpha-helical structure is due to hydrogen bonding. The $C=O$. A group of an amino acid builds a hydrogen bonding with the $N-H$ bond of an amino acid four residues later in the alpha helix.

17. How are polypeptides different from proteins?

Ans. A peptide is made up of two or more amino acids linked by peptide bonds; a polypeptide is a long chain of amino acids; and a protein is made up of one or more polypeptides. As a result, proteins are made up of lengthy chains of amino acids joined by peptide bonds.

18. Which nucleic acid is responsible for carrying out protein synthesis in the cell.

Ans. Ribonucleic acid, or RNA, is primarily engaged in the process of protein synthesis.

19. The two strands in DNA are not identical but complementary. Explain.

Ans. Despite the fact that the two strands of DNA are not similar, they are joined together through hydrogen bonds. Adenine and cytosine create hydrogen bonds with thymine and guanine, respectively. As a consequence, the two strands function as a complement to one another.

20. When RNA is hydrolyzed, there is no relationship among the quantities of different bases obtained. What does this fact suggest about the structure of RNA?

Ans. When RNA is hydrolyzed, the amounts of the various bases obtained have no connection. Because of the fact that RNA is a single-stranded biopolymer molecule.

21. What type of linkage holds together the monomers of DNA and RNA?

Ans. Phosphodiester linkage holds DNA and RNA monomers together.

22. Mention the number of hydrogen bonds between adenine and thymine.

Ans. The two nitrogenous bases, Adenine and Thymine, are held together by two hydrogen bonds.

23. A child diagnosed with bone deformities, is likely to have the deficiency of which vitamin?

Ans. Vitamin D insufficiency affects how calcium is deposited in the bones, making it necessary for healthy bone formation and growth. It can also lead to bone deformities in humans.

24. What is meant by the term DNA fingerprinting?

Ans. In a criminal investigation, DNA fingerprinting is a laboratory method used to establish a relationship between biological evidence and a suspect. A DNA sample from a crime scene and a DNA sample from a suspect are compared. Paternity can also be established via DNA fingerprinting.

25. List two important functions of proteins in the human body.

Ans. Protein is required for body cell development and their repair function in case of wear and tear of cells. Protein is the vital part or the building components of organs, muscles, skin, and hormones.

26. Name the vitamin responsible for coagulation of blood.

Ans. Vitamin K is important for blood clotting and avoiding excessive bleeding.

27. Except vitamin B_{12}, all other vitamins of group B, should be supplied regularly in diet. Why?

Ans. B vitamins are necessary for the correct functioning of the body's cells. They aid in the conversion of food into energy (metabolism), the formation of new blood cells, and the maintenance of healthy skin, brain, and other bodily structures.

28. How is glucose prepared commercially?

Ans. Starch is used to make glucose in the commercial world. At $393\ K$

, starch is cooked with diluted H_2SO_4. It is hydrolyzed to produce glucose.

29. What is the structural difference between glucose and fructose?

Ans. The difference between glucose and fructose are:

Glucose	**Fructose**
Hexokinase/glucokinase is the enzyme that kick-starts the metabolism of glucose. Aldohexose is the type of sugar present in glucose. It takes on the shape of a pyranose ring.	Fructose is a ketohexose that requires fructokinase to begin metabolism. It takes the shape of a furan ring.

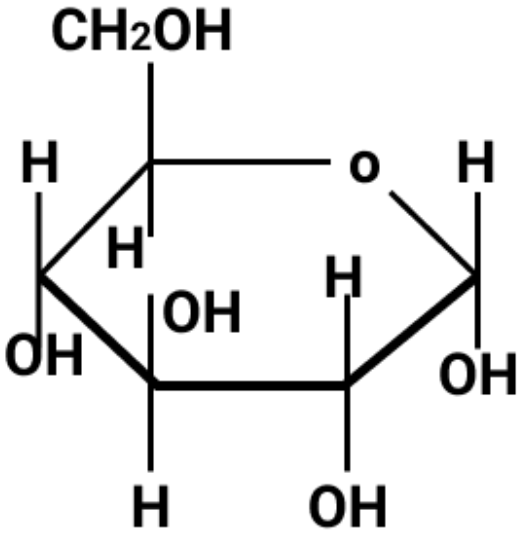
30. What is the difference between an oligosaccharide and a polysaccharide?

Ans. The difference between an oligosaccharide and a polysaccharide are:

Oligosaccharide	**Polysaccharide**
An oligosaccharide is a saccharide polymer with a limited number of monosaccharides (usually three to ten simple sugars). Cell recognition and cell binding are two tasks that oligosaccharides can perform. Example: sucrose, lactose, maltose etc.	Polysaccharides are polymeric carbohydrates with lengthy chains made up of monosaccharide units linked together by glycosidic connections. Example: starch, glycogen etc.

31. Give the Haworth projection of D-glucopyranose.

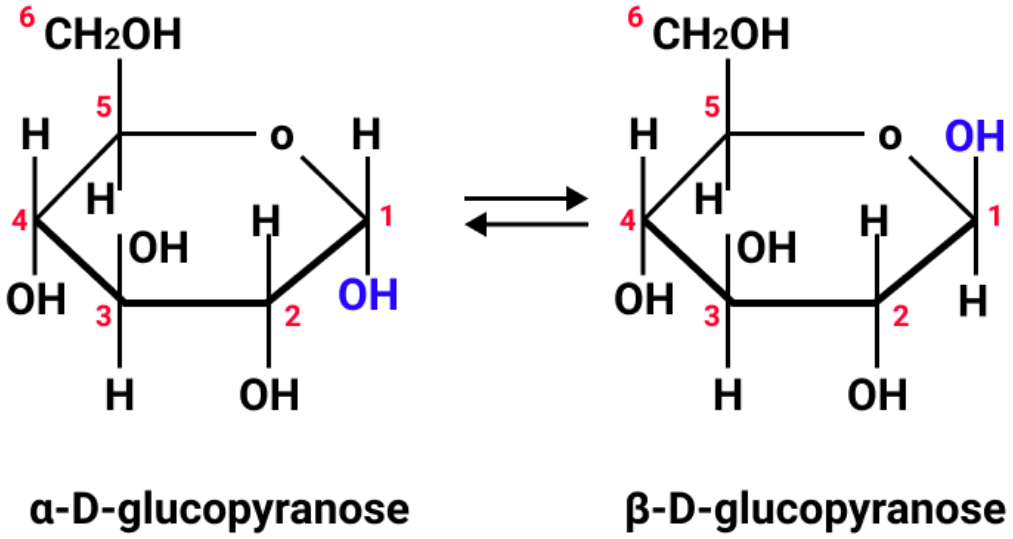
Ans.



Short Answer Type Question **2 Mark**

1. What are anomers? Give the structures of two anomers of glucose.

Ans. Anomers are epimers of cyclic monosaccharides or glycosides that differ in their C - 1 configuration if they are aldoses, or their C - 2 configuration if they are ketoses. Anomeric carbon or anomeric centre refers to the epimeric carbon in anomers. Two anomers of glucose are α-D-glucopyranose and β-D-glucopyranose.



α-D-glucopyranose β-D-glucopyranose

2. Write the hydrolysed products of

(i) Maltose

Ans. Maltase is an enzyme that breaks down maltose into two molecules of D-glucose.

(ii) Cellulose

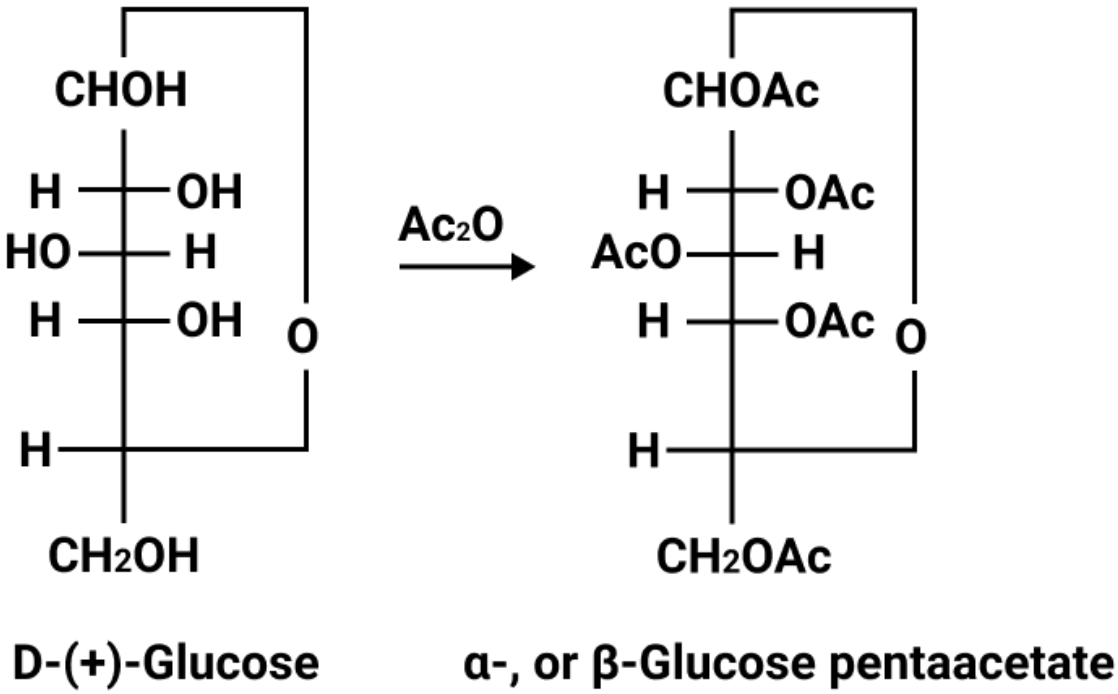
Ans. The hydrolysis of cellulose polymers occurs when acids break the 1,4-glycosidic linkages, resulting in the sugar molecule glucose or oligosaccharides. In the hydrolysis of cellulose, mineral acids such as HCl and H_2SO_4 have been employed.

3. Name the two components of starch? Which one is water soluble?

Ans. Starch consists of two major components i.e. amylose and amylopectin. Amylose is water-soluble, out of the two components, but amylopectin is water-insoluble.

4. (i) Acetylation of glucose with acetic anhydride gives glucose pentaacetate. Write the structure of the pentaacetate.

Ans.



(ii) Explain why glucose pentaacetate does not react with hydroxylamine?

Ans.D-glucose pentaacetate does not react with NH_2OH . Because pentaacetate does not form an open chain structure.

5. What are vitamins? How are they classified?

Ans. Vitamins are chemical molecules that are important micronutrients that an organism need in little amounts for its metabolism to function properly. Essential nutrients are unable to be produced in the body, either entirely or in adequate amounts, and must therefore be acquired from food.

Classification of vitamins: Water-soluble and fat-soluble vitamins are the two types of vitamins. There are 13 vitamins in humans: four fat-soluble vitamins (A, D, E, and K) and nine water-soluble vitamins (8 B vitamins and vitamin C).

6. (i) Why is sucrose called a non-reducing sugar?

Ans. Sucrose is a non-reducing sugar because it has a glycosidic connection between $C-1$ of -glucose and $C-2$ of -fructose holds the two monosaccharide units of glucose and fructose together. So, sucrose has no free aldehyde or ketone next to the $CHOH$ group, sucrose is a non-reducing sugar.

(ii) Give the type of glycosidic linkage present in sucrose.

Ans. Sucrose is a disaccharide, which is a molecule made up of two monosaccharides: glucose and fructose. $C-1$ on the glucosyl subunit and $C-2$ on the fructosyl unit form an ether bond, which connects them.

7. Classify the following as monosaccharides or oligosaccharides.

(i) Ribose

(ii) Maltose

(iii) Galactose

(iv) Lactose

Ans. Any of the fundamental molecules that serve as the building blocks of carbohydrates is referred to as a monosaccharide, often known as a simple sugar.

An oligosaccharide is a saccharide polymer with a limited number of monosaccharides (usually three to ten simple sugars).

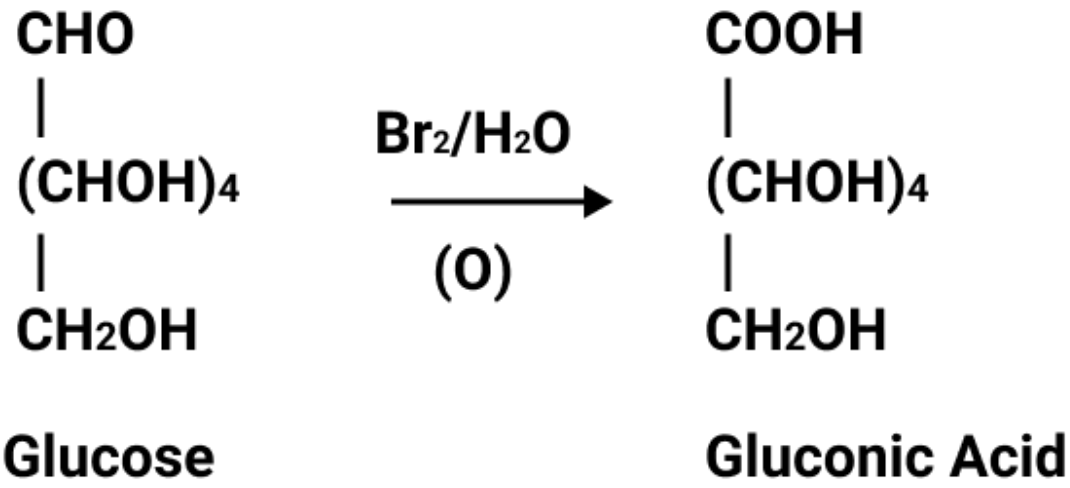
Monosaccharides: ribose, galactose

Oligosaccharides: maltose, lactose

8. Write the products of oxidation of glucose with

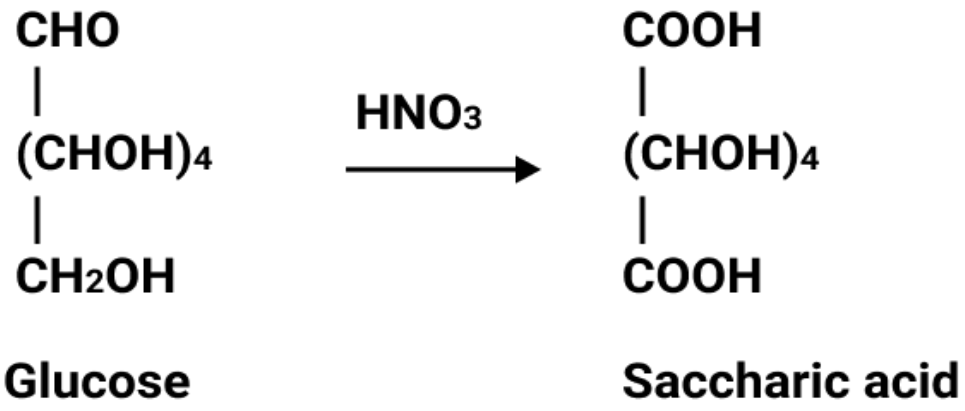
(a) Bromine water

Ans. On reaction with bromine water, oxidation of glucose to gluconic acid occurs.



(b) Nitric acid

Ans. With nitric acid, glucose yields saccharic acid.



9. State two main differences between globular and fibrous proteins.

Ans. The difference between globular and fibrous proteins are:

Fibrous proteins	**Globular proteins**
Fibrous proteins are structural proteins that are made up of long and narrow strands (they are something)	Globular proteins are more compact and rounded in form, and they have a functional purpose (they do something)

10. Classify the following α -amino acids as neutral, acidic or basic.

(i) $HOOC-CH_2-CH(NH_2)COOH$

Ans. acidic α -amino acid

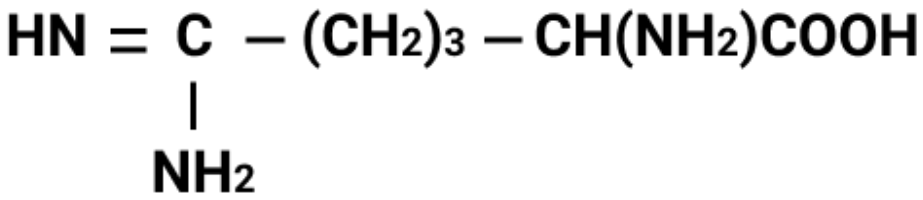
(ii) $C_6H_5-CH_2-CH(NH_2)COOH$

Ans. neutral α -amino acid

(iii) $H_2N-(CH_2)_4-CH(NH_2)-COOH$

Ans. Basic α -amino acid

(iv)



Ans. Basic α -amino acid

11. You have two amino acids, *i.e.* glycine and alanine. What are the structures of two possible dipeptides that they can form?

Ans. Two symmetrical dipeptides (GlyGly and AlaAla) and two unsymmetrical dipeptides (GlyAla and AlaGly) may be made from glycine (Gly) and alanine (Ala).

12. What are essential and non-essential amino acids? Give one example of each type.

Ans. Essential amino acids are amino acids that the body cannot synthesize or manufacture and must be obtained through dietary supplements.

Example: valine, tryptophan etc.

Nonessential amino acids are amino acids that are generated or synthesized by human bodies but are not consumed through food supplements.

Example: glycine, glutamic acid etc.

13. Name four types of intermolecular forces which stabilize 2° and 3° structure of proteins.

Ans. Hydrogen bonds, disulphide connections, van der Waals, and electrostatic forces of attraction are the primary factors that stabilize the secondary and tertiary structures of proteins.

14. Classify the following as globular or fibrous proteins.

(i) Keratin

(ii) Myosin

(iii) Insulin

(iv) Hemoglobin.

Ans. Fibrous proteins are structural proteins that are made up of long and narrow strands (they are something) example: keratin and myosin.

Globular proteins are more compact and rounded in form, and they have a functional purpose (they do something) example: insulin and hemoglobin.

15. What do you understand by

(a) Denaturation of protein

Ans. Denaturation is a process in which proteins or nucleic acids lose their native forms by exposing them to an external strain or chemical, such as a tough acid or

base, a concentrated inorganic salt, an organic solvent, radiation, or heat. When proteins in a live cell are denatured, the cell's functioning is disrupted, and the cell may die.

(b) Specificity of an enzyme.

Ans. Enzymes show specificity when it comes to the particular reactions they catalyze. Only a few enzymes have absolute specificity, which means they will catalyze only one reaction. Other enzymes will have a preference for a specific chemical bond or functional group. There are four different forms of specificity in general: Absolute specificity, group specificity, linkage specificity, and stereo chemical specificity.

16. On electrolysis in acidic solution, amino acids migrate towards cathode while in alkaline solution they migrate towards anode.

Ans. Amino acid exists as a dipolar ion. When an ion transforms to a positive ion during electrolysis in an acidic medium, it migrates to the cathode, whereas when an ion changes to a negative ion during electrolysis in a basic medium, it migrates to the anode.

In acidic solution, COO^- group of zwitter ion formed from α -amino acid is protonated and NH_3^+ groups is left unchanged while in basic solution deprotonation converts NH_3^+ to NH_2 and COO^- is left unchanged.

17. (i) Name the disease caused by deficiency of vitamin D.

Ans. Rickets is a condition in which children's bones become weak and mushy. A deficiency of vitamin D in the body causes rickets. Vitamin D is required for calcium and phosphorus to be used in the formation of bones.

(ii) Why cannot vitamin C be stored in our body?

Ans. Because our body can't produce vitamin C, as it's a water-soluble vitamin, it doesn't retain well. It dissolves in water and is expelled through urine if your body doesn't utilize it immediately. As a result, it is not stored in our bodies in substantial amounts.

18. Define the terms hypervitaminosis and avitaminosis.

Ans. Hypervitaminosis is a disorder in which a person's body has too much vitamin A and vitamin D. This can occur if a person consumes too many vitamins or utilizes certain acne treatments for an extended length of time. Vision difficulties, skin abnormalities, and bone discomfort are all symptoms of hypervitaminosis and can cause liver damage and put strain on the brain in long-term instances.

Avitaminosis is a set of illnesses caused by a deficiency in one or more vitamins. It can happen if you have persistent severe diarrhoea or heavy sweating, or if you have elevated vitamin requirements during periods of fast growth, such as during infancy or pregnancy.

19. Explain what is meant by:

(i) A peptide linkage

Ans. A peptide linkage is a chemical connection created between two molecules when one of their carboxyl groups interacts with the other's amino group, releasing a molecule of water (H_2O). This is a condensation process (also known as a dehydration synthesis reaction) that happens between amino acids.

(ii) A glycosidic linkage

Ans. A glycosidic bond, also known as a glycosidic linkage, is a form of covalent connection that connects a carbohydrate (sugar) molecule to another group by loss of H_2O.

20. Give the sources of vitamin A and E, name the deficiency diseases resulting from lack of vitamin *A* and *E* in the diet.

Ans. Sources of vitamin-A:

yellow, red and green (leafy) vegetables including mango, spinach, apricot papaya etc. and cheese, eggs, oily fish, milk and yoghurt.

Inadequate vitamin A intake, lipid malabsorption, and liver problems can all lead to insufficiency. Immunity and hematopoiesis are harmed, and rashes and usual ocular symptoms result (example, xerophthalmia, night blindness). Typical ocular signs and low vitamin A levels are used to make the diagnosis.

Sources of Vitamin-E: Plant oils – such as rapeseed (vegetable oil), sunflower, soya, corn and olive oil, nuts and seeds, wheatgerm – found in cereals and cereal products etc.

Vitamin E requires fat to be absorbed by the digestive system. Vitamin E insufficiency can result in loss of sensation in the arms and legs, loss of body movement control, muscular weakness, and visual difficulties due to nerve and muscle damage. A weaker immune system is another symptom of malnutrition.

21. What are the main functions of DNA and RNA in the human body?

Ans. DNA has separate functions: genetics, immunology, and structure. All of which is dependent on the sugar phosphate backbone and bases in different ways.

Genetic information is encoded via the nucleotide sequence along the backbone. Replication, encoding information, mutation/recombination, and gene expression are the four functions of DNA.

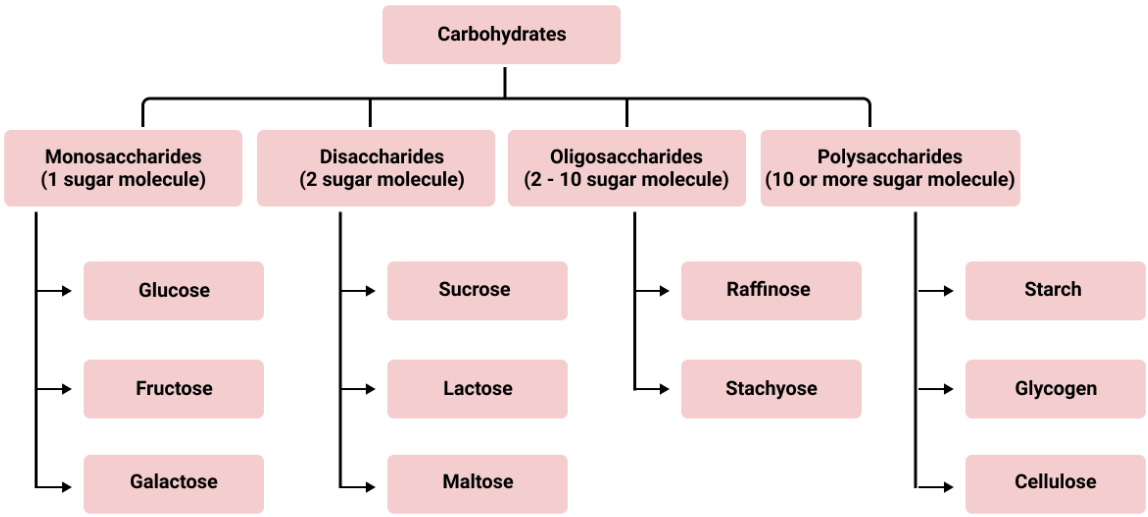
RNA: Make it easier for DNA to be translated into proteins. In protein production, it acts as an adaptor molecule. It acts as a messenger between the DNA and the ribosomes.

In all living cells, RNA are the carriers of genetic information.

Short Answer Type Question **3 Mark**

1. How are carbohydrates classified?

Ans. carbohydrates are mainly classified into four primary groups—monosaccharides, disaccharides, oligosaccharides, and polysaccharides. Although there are some other classifications criteria, this one is the most widely used.



2. (i) Name four bases present in DNA.

Ans. Adenine, Guanine, Thymine and Cytosine are the four nitrogen bases present in DNA.

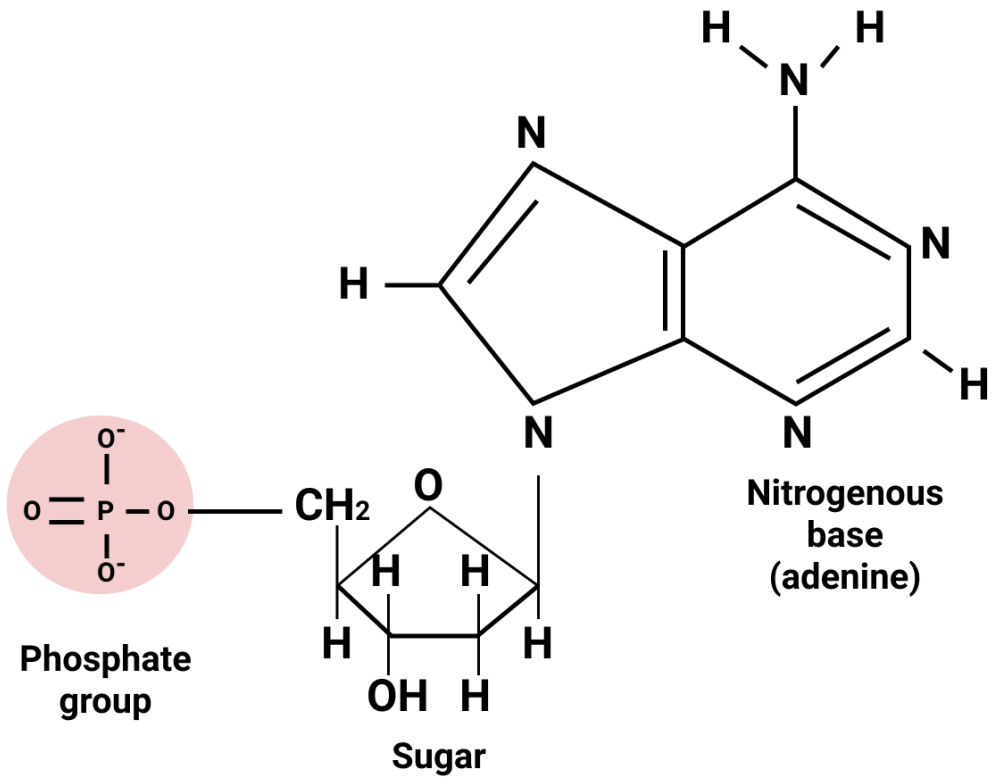
(ii) Which of them is not present in RNA.

Ans. Thymine is absent in RNA. Instead of thymine, Uracil is present in RNA.

(iii) Give the structure of a nucleotide of DNA.

A nucleotide includes a sugar molecule with a phosphate group and a nitrogen-containing base linked to it. Nucleic acids are made up of nucleotides, which are the building blocks of DNA/RNA.

Structure of a nucleotide of DNA:



3. Differentiate between the following:

(i) Secondary and tertiary structure of protein.

Ans. Secondary structure of protein refers to the regular, repeating arrangements in space of adjoining amino acid residues. Hydrogen bonds between amide hydrogens and carbonyl oxygen in the peptide backbone hold it together. α -helices and β -structures are the most commonly involved structures.

Tertiary structure: The three-dimensional structure of a protein is known as the tertiary structure. It is the next degree of protein folding complexity. Individual amino acids in the primary sequence can interact to form secondary structures such as helices and sheets, and individual amino acids from different parts of the primary sequence can interact via charge-charge, hydrophobic, disulfide, or other interactions, but the formation of these bonds and interactions will change the protein's general structure.

(ii) α -Helix and β -pleated sheet structure of protein.

Ans. The α-helix is a typical secondary structural element in proteins, created when amino acids "wind up" to form a right-handed helix with side-chains pointing out from the center coil.

Hydrogen interactions between carbonyl oxygen and the amino group of every third residue in the helical turn stabilize a -helix secondary structure, with each helical turn including 3.6 amino acid residues.

The β -pleated sheet is a frequent secondary structural style in normal proteins. Beta sheets are made up of beta strands that are joined laterally by at least two or three backbone hydrogen bonds to create a twisted, pleated sheet. Intermolecular -sheets with both a hydrophilic and a hydrophobic face are formed by hydrogen bonding between individual strands.

(iii) fibrous and globular proteins.

Ans. Fibrous proteins: Polypeptide chains are arranged roughly in parallel along a single axis in fibrous proteins, resulting in long fibers or huge sheets. These proteins are typically mechanically tough and resistant to water solubilization. In nature, fibrous proteins frequently serve a structural role.

Globular proteins: Globular proteins have a three-dimensional molecular structure that can range from a sphere to a cigar. A globular protein's structure is usually split into three or four levels. The peptide chain's basic structure is just the sequence of amino acids.