Chapter: BIOMOLECULES

Exercise

Question 1. What are macromolecules? Give examples.

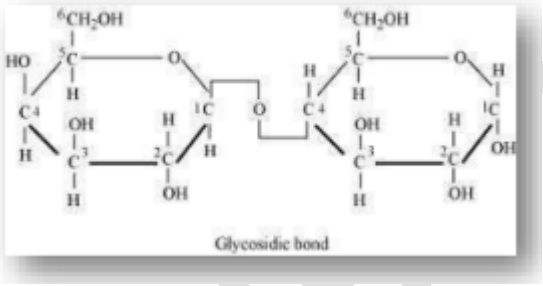
Answer:

Macromolecules are large complex molecules found in intercellular fluid in colloidal form. Polymerization of low molecular weight macromolecules results in their formation. Macromolecules include polysaccharides, proteins, and nucleic acids.

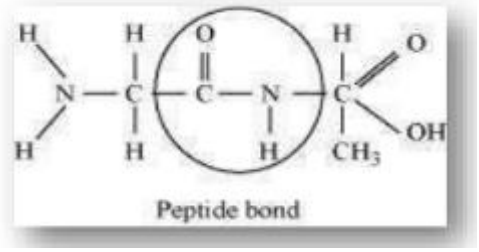
Question 2. Illustrate a glycosidic, peptide, and phospho-diester bond.

Answer:

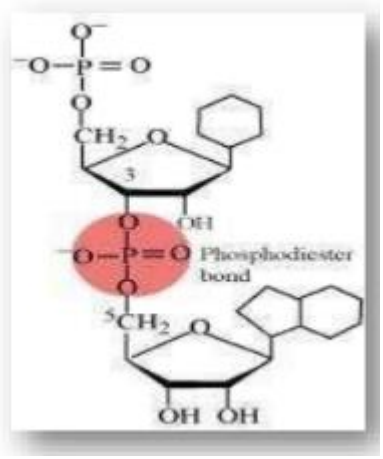
(a) A glycosidic bond is normally formed between carbon atoms 1 and 4 of adjacent monosaccharide units.



(b) A peptide bond is a covalent bond formed by the – NH – CO linkage between two amino acids.



(c) A phosphodiester bond is a strong covalent bond formed between two sugar groups and phosphate. Nucleic acids' sugar-phosphate backbone is made up of such bonds.



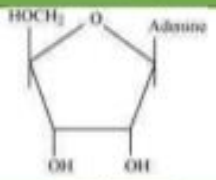
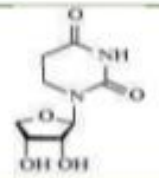
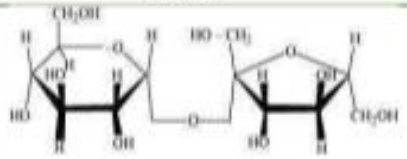
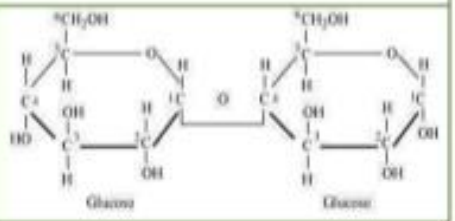
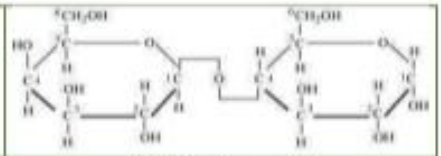
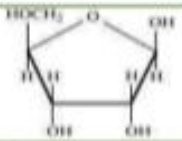
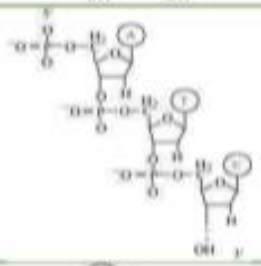
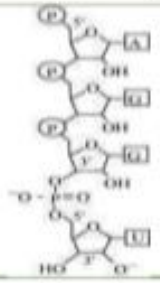
Question 3. What is meant by the tertiary structure of proteins?

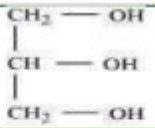
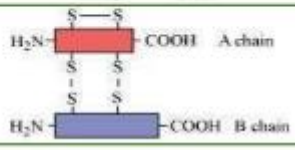
Answer:

The helical polypeptide chain coils and folds to form a complex three-dimensional shape known as protein tertiary structure. These coils and folds are designed to conceal non-polar amino acid chains while exposing polar side chains. The weak bonds formed between various parts of the polypeptide chain hold the tertiary structure together.

Question 4. Find and write down structures of 10 interesting small molecular weight biomolecules. Find if there is any industry that manufactures the compounds by isolation. Find out who are the buyers.

Answer:

	Molecule	Structure
1.	Adenosine	
2.	Thymidine	
3.	Sucrose	
4.	Maltose	
5.	Lactose	
6.	Ribose	
7.	DNA	
8.	RNA	

9.	Glycerol	
10.	Insulin	

(b)

	Compound	Manufacturer	Buyer
1.	Starch products	Kosha Impex (P) Ltd.	Research laboratories, educational institutes, and other industries, which use biomolecules as a precursor for making other products.
2.	Liquid glucose	Marudhar apparels	
3.	Various enzymes such as amylase, protease, cellulase	Map (India) Ltd	

Question 5. Proteins have a primary structure. If you are given a method to know which amino acid is at either of the two termini (ends) of a protein, can you connect this information to purity or homogeneity of a protein?

Answer:

Yes, we can use knowledge about protein sequences to determine how pure a protein is provided we're given a mechanism for determining them. It is common knowledge that the correct sequence of an amino acid is required for a protein's proper activity. If the sequence is altered, the structure and function will be altered as well. If we are provided a mechanism for discovering the sequence of an unknown protein, we can use this knowledge to determine its structure and compare it to any known accurate protein sequence. Any change in a protein's sequence can impact its purity or homogeneity. For example, a single change in the sequence of haemoglobin can cause the norm to shift.

Question 6. Find out and make a list of proteins used as therapeutic agents. Find other applications of proteins (e.g., cosmetics, etc.)

Answer:

The following proteins are used as therapeutic agents:

Thrombin and fibrinogen – These proteins aid in blood clotting.

Antigen (antibody) – It aids in the transfusion of blood.

Insulin – It aids in the maintenance of blood glucose levels in the body.

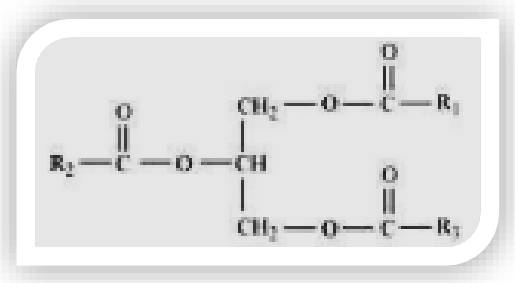
Renin – Aids in osmoregulation.

Proteins are also widely used in the production of cosmetics, toxins, and biological buffers.

Question 7. Explain the composition of triglyceride?

Answer:

A triglyceride is a glyceride composed of a single molecule of glycerol esterified with three fatty acids. The most prevalent sources are vegetable oils and animal fats.



Structure of triglyceride

Triglyceride has the following chemical formula:

$$R_2COO-CH_2CH(-OOCR_1)CH_2-OOCR_3$$

R1, R2, and R3 fatty acids are used. These three fatty acids could be the same or different.

Question 8. Can you describe what happens when milk is converted into curd or yoghurt from your understanding of proteins?

Answer:

Proteins are polymerized amino acids that have been assembled into macromolecules.

Proteins can be categorised at four different structural levels.

A polypeptide chain's main structure is made up of a linear series of amino acids.

Secondary structure – A three-dimensional structure is created by coiling the polypeptide chain.

The helical polypeptide chain is coiled and folded into a complicated structure known as a tertiary structure.

Quaternary structure - A quaternary structure is formed by joining multiple polypeptide chains together.

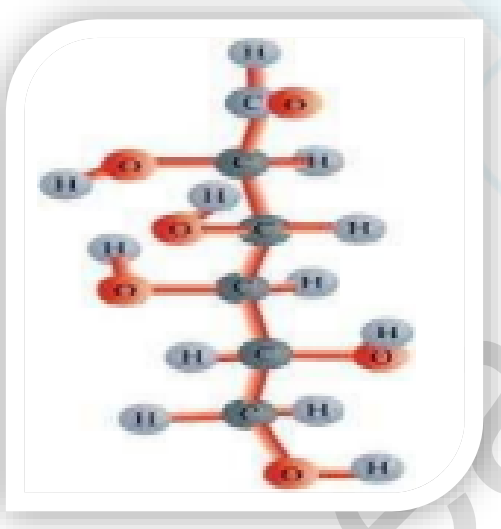
Milk contains a significant amount of globular proteins. When milk is processed into curd or yoghurt, these complex proteins are denatured, resulting in the shift of globular proteins to fibrous proteins.

Question 9. Can you attempt building models of biomolecules using commercially available atomic models (Ball and Stick models).

Answer:

Ball and stick models are three-dimensional molecular models used to describe the structure of biomolecules.

Atoms are represented as balls in the ball and stick model, while the bonds that hold the atoms together are represented as sticks. Springs form curved connections between the balls to represent double and triple bonds. The size and colour of various atoms vary, as shown by the relative size of the balls. It is the most basic and widely used model for representing biomolecular structures.



The oxygen atoms are represented by red balls, the hydrogen atoms by blue balls, and the carbon atoms by grey balls in the above ball and stick model of D-glucose.

Question 10. Attempt titrating an amino acid against a weak base and discover the number of dissociating (ionizable) functional groups in the amino acid.

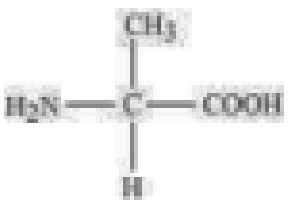
Answer:

Titration between a neutral or basic amino acid and a weak base will dissociate only one functional group, whereas titration between an acidic amino acid and a weak acid will dissociate two or more functional groups.

Question 11. Draw the structure of the amino acid, alanine?

Answer:

Structure of alanine



Question 12. What are gums made of? Is Fevicol different?

Answer:

Gums are made up of polysaccharides and heteropolysaccharides. They contain two or more monosaccharide types. PVA glue, on the other hand, is Fevicol (polyvinyl alcohol). It's certainly not a polysaccharide.

Question 13. Find out a qualitative test for proteins, fats and oils, amino acids and test any fruit juice, saliva, sweat and urine for them.

Answer:

(a) Conduct a protein analysis.

When Biuret's reagent is introduced to the protein, the colour of the reagent changes from light blue to purple.

c) Look for fats and oils.

Test for lubricity or grease

(c) Amino acid Ninhydrin test - Depending on the amino acid, the colourless solution becomes pink, blue, or purple when Ninhydrin reagent is added to it.

Item		Name of the test	Procedure	Result	Inference
1.	Fruit juice	Biuret's test	Fruit juice + Biuret's reagent	Colour changes from light blue to purple	Protein is present.
		Grease test	To a brown paper, add a few drops of fruit juice.	No translucent spot	Fats and oils are absent or are in negligible mounts.
		Ninhydrin test	Fruit juice + Ninhydrin reagent + boil for 5 minutes	Colourless solution changes to pink, blue, or purple colour	Amino acids are present.

2.	Saliva	Biuret's test	Saliva + Biuret's reagent	Colour changes from light blue to purple	Proteins are present.
		Grease test	On a brown paper, add a drop of saliva.	No translucent spot	Fats/oils are absent.
		Ninhydrin test	Saliva + Ninhydrin reagent + boil for 5 minutes	Colourless solution changes to pink, blue, or purple colour	Amino acids are present.
3.	Sweat	Biuret's test	Sweat + Biuret's reagent	No colour change	Proteins are absent.
		Solubility test	Sweat + Water	Oily appearance	Fats/oil may be present.
		Ninhydrin test	Sweat + Ninhydrin reagent + boil for 5 minutes	No colour change, solution remains colourless	Amino acids are absent.
4.	Urine	Biuret's test	Few drops of urine + Biuret's reagent	Colour changes from light blue to purple	Proteins are present.
		Solubility test	Few drops of urine + Water	Little bit of oily appearance	Fats may or may not be present.
		Ninhydrin test	Few drops of urine + Ninhydrin reagent + boil for 5 minutes	Colourless solution changes to pink, blue, or purple colour depending on the type of amino acid	Amino acids are present.

Question 14. Find out how much cellulose is made by all the plants in the biosphere and compare it with how much paper is manufactured by man and hence what is the consumption of plant material by man annually. What a loss of vegetation?

Answer:

All of the plants in the biosphere produce approximately 100 billion tonnes of cellulose per year, and one ton of paper requires the growth of 17 full-grown trees. Trees are also used to meet man's other needs, such as timber, food, medicine, and so on. As a result, calculating man's annual consumption of plant material is difficult.

Question 15. Describe the important properties of enzymes.

Answer:

- Enzymes are big molecular weight macromolecules with a complex structure.
- In cells, they catalyse biological reactions. They assist in the breaking down of large molecules into smaller ones or the joining of two smaller molecules to form a larger molecule.
- Enzymes do not initiate reactions. They do, however, aid in its hastening.

- The rate of a biological process is controlled by enzymes, not the direction of activity.
- The majority of enzymes have a high turnover rate. The number of molecules of a material that an enzyme operates on each minute is known as its turnover number.
- The fast turnover of enzymes enhances reaction efficiency.
- Enzymes have a very specific mechanism of action.
- The activity of enzymes increases as their concentration increases.