NCERT Class 11 Biology Chapter 9 – Biomolecules

1. What are macromolecules? Give examples

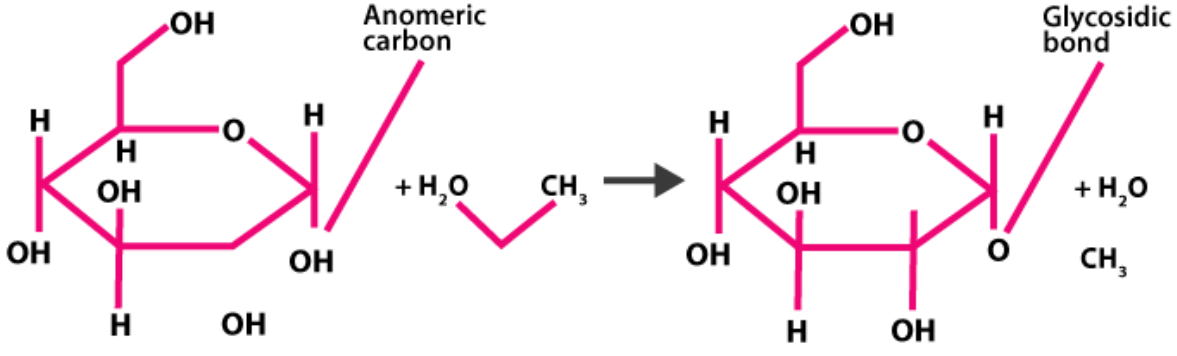
Solution:

Macromolecules are the biomolecules that are formed by the polymerisation of a huge number of micromolecules possessing higher molecular weight. Micromolecules are found in the colloidal state in the intercellular fluid due to their insoluble nature. Protein is a macromolecule.

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

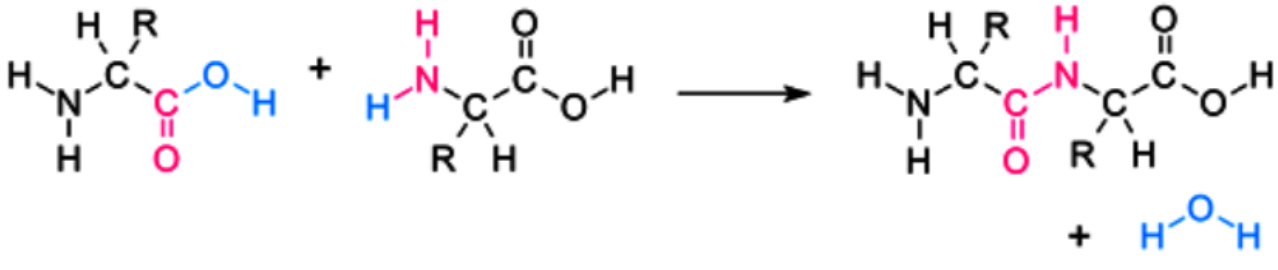
Solution:

Glycosidic bond – The bond between the individual monosaccharides is called a glycosidic linkage. This bond is formed between two carbon atoms of two adjacent monosaccharide units.

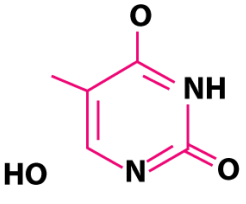


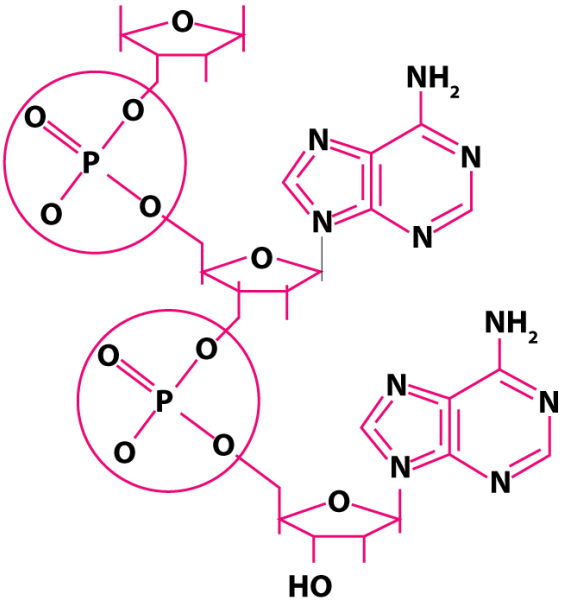
Peptide bond – It is a covalent bond. The amino acids in proteins are linked to one another through peptide bonds. It is formed when the carboxyl group (-COOH) of one amino acid interacts with the amino group (-NH2) of the adjacent amino acid when condensed.

Formation of Peptide bond – Example



Phospho-diester bond – That joins successive sugar molecules in a polynucleotide. It is a strong covalent bond formed between two adjacent sugar groups and phosphate. These are the bonds that form the sugar-phosphate backbone of the nucleic acids.

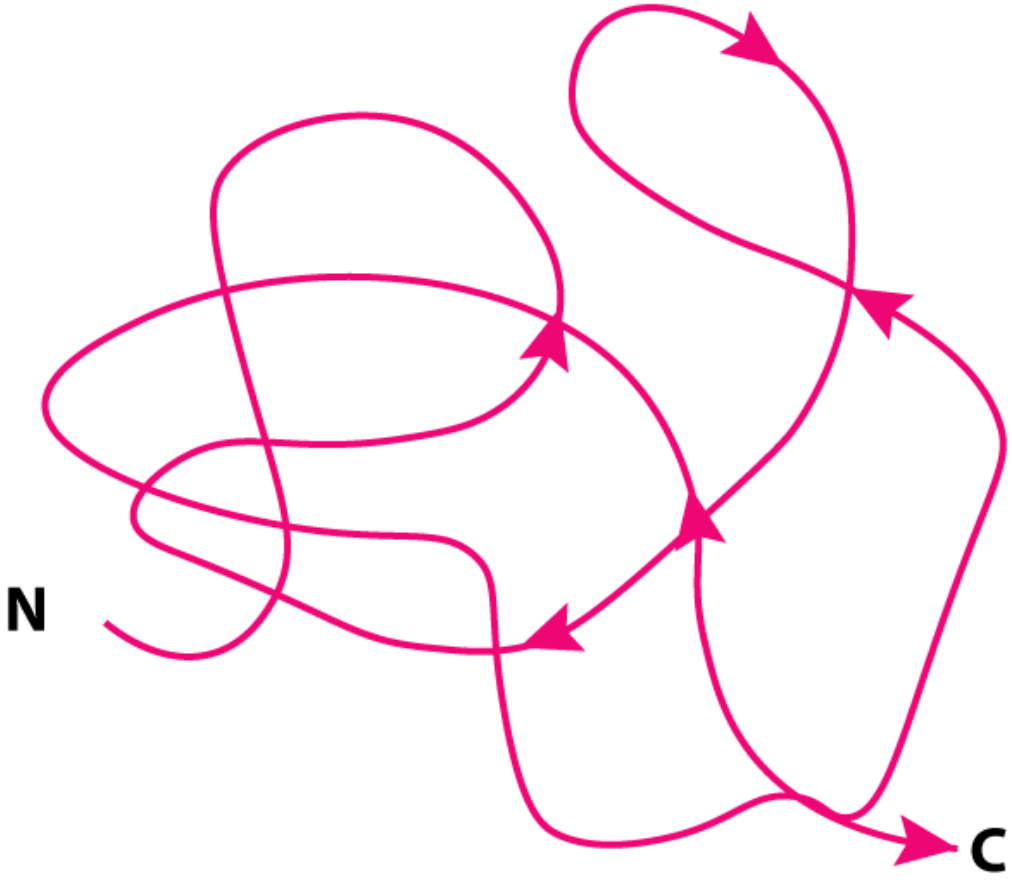




3. What is meant by the tertiary structure of proteins?

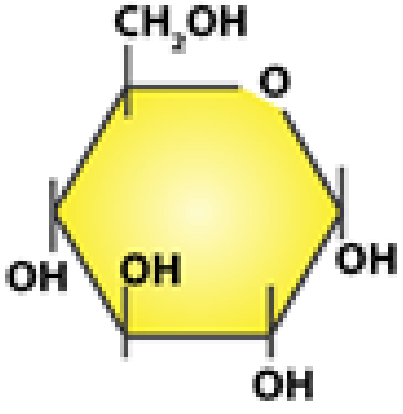
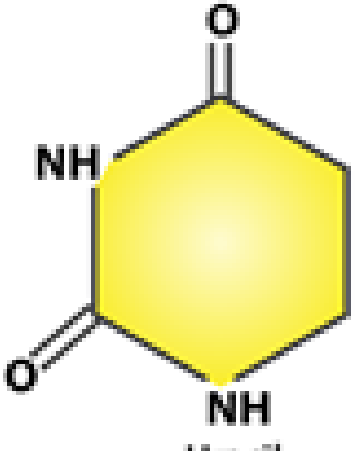
Solution:

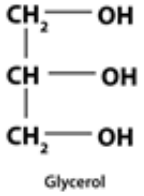
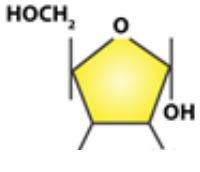
It is a structure that forms when the secondary coiled polypeptides are folded to produce a hollow, wollen ball-like structure. It is folded such that the functional side groups appear on the surface while the inactive side groups are found inside.

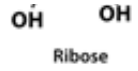
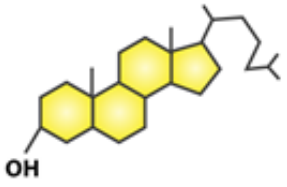
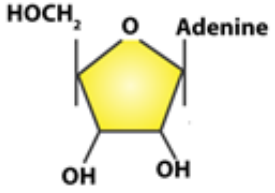


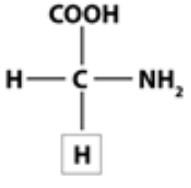
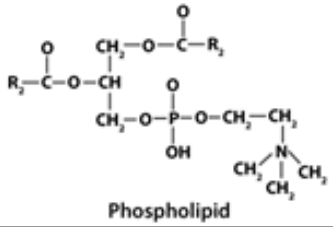
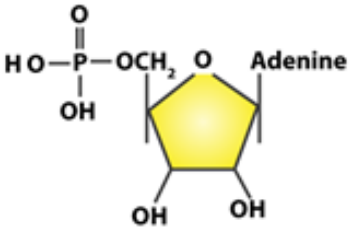
4. Find and write down structures of 10 interesting small molecular weight biomolecules. Find if there is any industry which manufactures the compounds by isolation. Find out who are the buyers.

Solution:

Name of the biomolecule	Structure
Glucose($C_6H_{12}O_6$)	 Glucose
Uracil	 Uracil

Glycerol	 Glycerol
Ribose	

	 Ribose
Cholesterol	 Cholesterol
Adenosine	 Adenosine

Glycine	 Glycine
Phospholipid	 Phospholipid
Adenylic acid	 Adenylic acid

Compound	Manufacturer	Buyer
Starch	Premier starch products private limited	Research institutes and laundries
Liquid Glucose	Imperial liquid glucose	Used in making flavoured drinks and in

		research
Enzymes like amylase, protease, and cellulase	Planet Biotech India	Used in research

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 the purity or homogeneity of a protein?

Solution:

The positional information of a protein is called the primary structure of the protein. The first amino acid in a protein is called the N-terminal amino acid, and the last amino acid in a protein is called the C-terminal amino acid.

Yes, we can connect this information to check the purity or homogeneity of a protein. On the basis of carboxyl and amino groups, amino acids can be acidic, basic and neutral. Proteins can be acidic, basic and neutral.

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

Solution:

Following is the list of proteins used as therapeutic agents.

Insulin, Oxytocin, Immunoglobin, Antidiuretic Hormone(ADH), Thrombin, Fibrinogen, Renin and streptokinases.

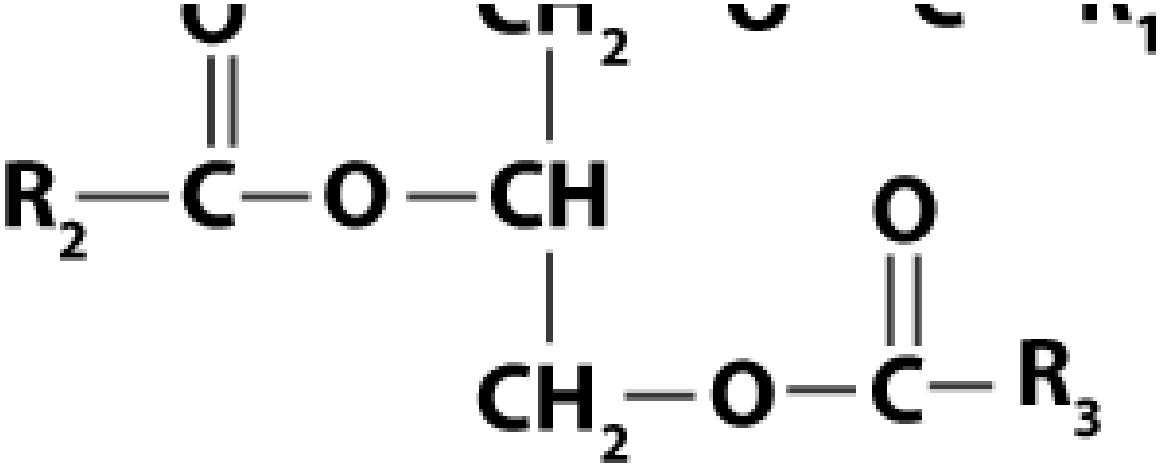
Some other applications are

- They are used as artificial sweeteners. Thaumatin is a low-calorie sweetener.
- Proteins are used as dietary supplements to maintain health.
- They are used in creams and shampoos.

7. Explain the composition of triglyceride.

Solution:

When glycerol combines with three fatty acids on each of the OH groups through ester bonds, it is known as a triglyceride.



Triglyceride

All three fatty acids of triglyceride in pure fat are similar, while in mixed fat, they are dissimilar.

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

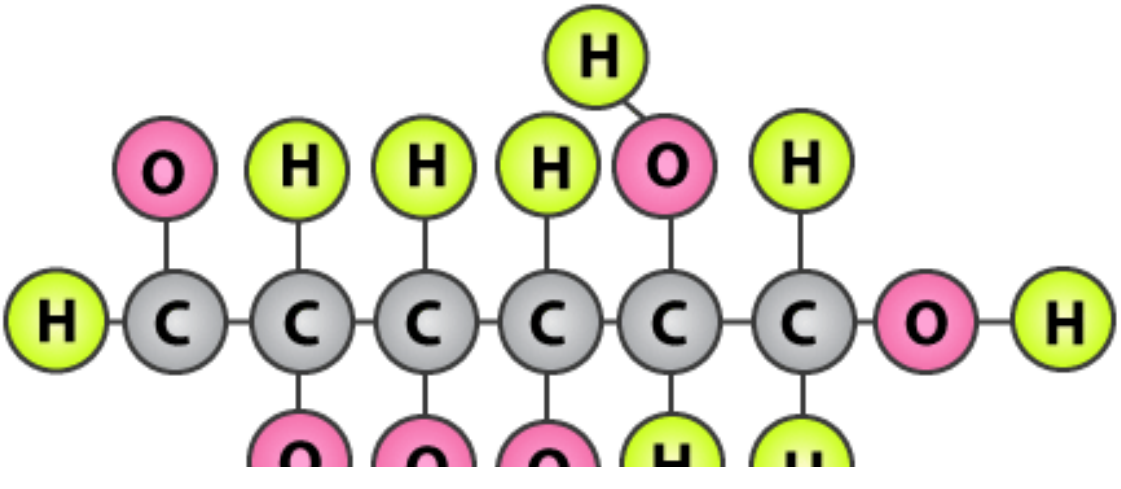
Solution:

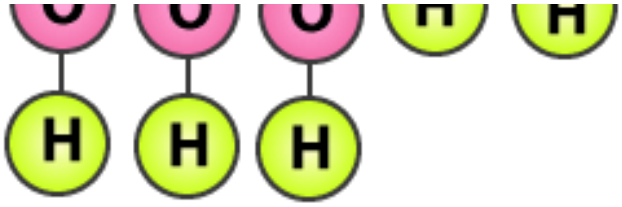
During fermentation, milk protein such as casein is denatured, which transforms globular proteins into fibrous proteins. This change is responsible for the production of curd or yoghurt.

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

Solution:

Yes, Biomolecules can be represented by the ball and stick model. Here, the bonds which hold the molecule are indicated by sticks, while the atoms are represented by balls. The figure below is a model of D-glucose, where atoms of hydrogen are indicated by green balls, oxygen atoms are represented by pink balls, and carbon atoms are represented by grey balls.





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

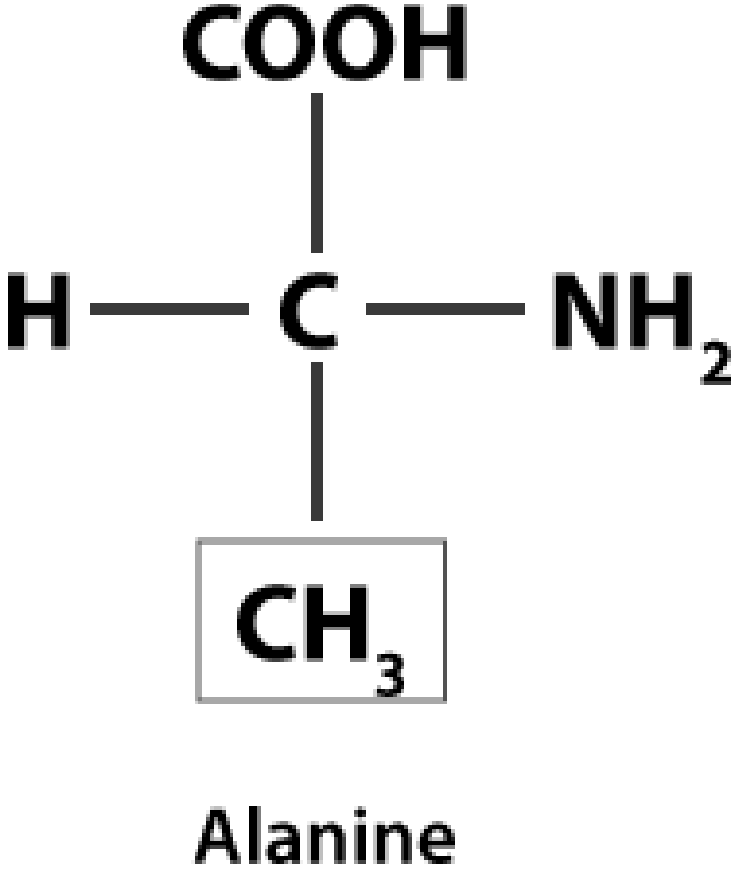
Solution:

The pH of the amino acid is recorded, and the weak base is slowly supplemented to the amino acids while continuously noting the pH. The number of changes recorded indicates the number of ionisable functional groups –COOH in the acidic range and –NH2 in the alkaline range.

11. Draw the structure of the amino acid alanine.

Solution:

The structure of Alanine is as follows:



Alanine

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

Solution:

Gums are heteropolysaccharides formed by different monosaccharide units associated with glycosidic bonds. On the other hand, Fevicol is different from gums, as it is made up of synthetic polymers.

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

Solution:

Qualitative test for proteins

Biuret test: Biuret test identifies the presence of proteins by turning the colour of the solution from light blue to purple.

Qualitative test for fats and oils

Grease test for oils: Certain oils give a translucent stain on blue paper. This test can be used to detect the presence of oils and fats.

Qualitative test for amino acids

Ninhydrin test

Upon adding ninhydrin reagent to the solution, the colour of the solution turns to pink, purple or blue based on the type of amino acid.

Test	Name of item	Procedure	Result	Conclusion
Biuret's test	Fruit juice	Juice + biuret's reagent	Change of colour from light blue to purple	Presence of protein
	Saliva	Saliva + biuret's reagent	Change of colour from light blue to purple	Presence of protein
	Sweat	Sweat + biuret's reagent	Colour does not change	Absence of protein
	Urine	Drops of urine + biuret's reagent	Change of colour from	Presence of protein

			light blue to	
Grease test	Fruit juice	Few drops of juice on brown paper	A translucent spot is not observed	Absence of oils and fats
	Saliva	Few drops of saliva on the brown paper	A translucent spot is not observed	Absence of oils and fats
Solubility test	Sweat	Water added with sweat	Oil presence	Fats or oils can be present
	Urine	Water added to a few drops of urine	Slight oily presence	Fats may or may not be present
Ninhydrin test	Fruit juice	Juice+ninhydrin reagent (boil for few minutes)	Change of colour from no colour to purple, pink or blue	Presence of amino acids
	Saliva	saliva+ninhydrin reagent (boil for a few minutes)	Change of colour from no colour to purple, pink or blue	Presence of amino acids
	Sweat	sweat+ninhydrin reagent (boil for a few minutes)	No colour change	Absence of amino acids
	Urine	urine+ninhydrin reagent (boil for a few minutes)	Depending upon the type of amino acid,	Presence of amino acids

			the colourless solution changes to purple, pink or blue colour	

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

Solution:

The biosphere produces about 100 billion tonnes of cellulose out of 170 billion tonnes of total organic matter. Production of paper consumes about 0.5 billion tonnes of wood. Trees are also utilised for other purposes, including food, medicines, timber, spices, etc. An approximate estimate of 1.5 billion tonnes of food is required. Wood requirement for various purposes includes 2 billion tonnes. Therefore, it is difficult to gauge the annual consumption of plant material by man. Thus, the use of cellulose led to a great loss of vegetation.

15. Describe the important properties of enzymes.

Solution:

Almost all enzymes are proteins. Important properties of enzymes are as follows:

- They have a higher molecular weight and are complex macromolecules.
- They catalyse the biochemical reactions involved in the cell, assisting in breaking down larger molecules into simpler molecules or getting together two smaller molecules to form a larger one.
- Enzymes do not initiate but accelerate a reaction.
- They affect the rate of biochemical reaction and do not influence the direction of the reaction.
- They are action-specific.
- A higher turnover of enzymes causes an increase in the efficiency of a reaction. Most of the enzymes have a high turnover number.
- Enzymes are affected by temperature. As the temperature increases, enzymatic activity decreases. Maximum activity is observed at 30-40 degree Celsius.
- Maximum activity is observed at a 6-8 pH level.
- With an increase in substrate concentration, the enzymatic velocity also increases, reaching maximum velocity.