BIOMOLECULES

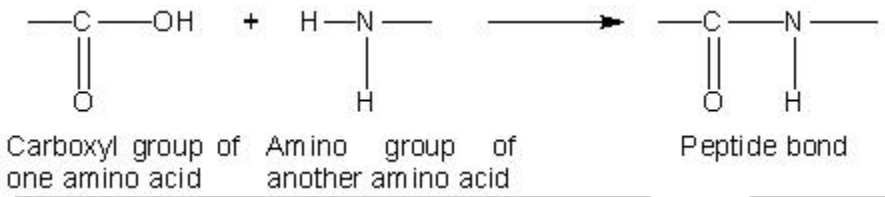
Topic: 3

PEPTIDES- PROTEINS- STRUCTURE

VERY SHORT ANSWER QUESTIONS

1. **What is peptide?**

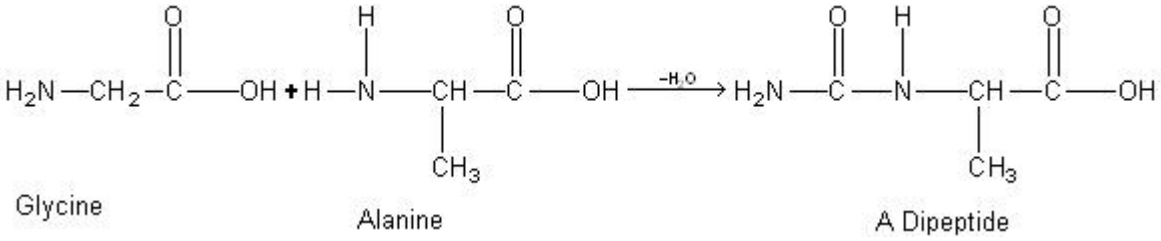
Ans:) Proteins are formed by joining the carboxyl group of one amino to the α - amino group of another acid. The bond formed between two amino acids by the elimination of water molecules is called peptide linkage.



The product formed by linking amino acid molecules through peptide linkage -CO - NH - is called a peptide.

2. **What is dipeptide?**

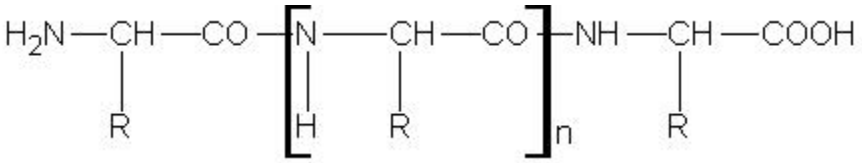
Ans: When two amino acids combined in this way the resulting product is called a dipeptide.



Peptide are further designated as tri, tetra or penta peptides accordingly as they contain three, four or five amino acid molecules, same or different

3. What is polypeptide?

Ans: If a large number of α - amino acids (100 to 1000) are joined by peptide bonds the resulting polyamide is called polypeptide.



By convention a peptide having molecular weight upto 10,000 is called polypeptide.

4. What is protein?

Ans: By convention a peptide having molecular weight upto 10,000 is called polypeptide. While a peptide having a molecular mass more than 10,000 is called a protein.

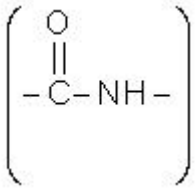
SHORT ANSWER QUESTIONS

1. **What are different tests performed on proteins?**

Ans: Tests of protein

Biuret test

(i) On adding a dilute of copper sulphite to alkaline solution of protein, a violet colour is developed.

(ii) This test is due to the presence of peptide  linkage.

Millon's test

(a) Millon's reagent consists of mercury dissolved in nitric acid (forming a mixture of mercuric & mercurous nitrates).

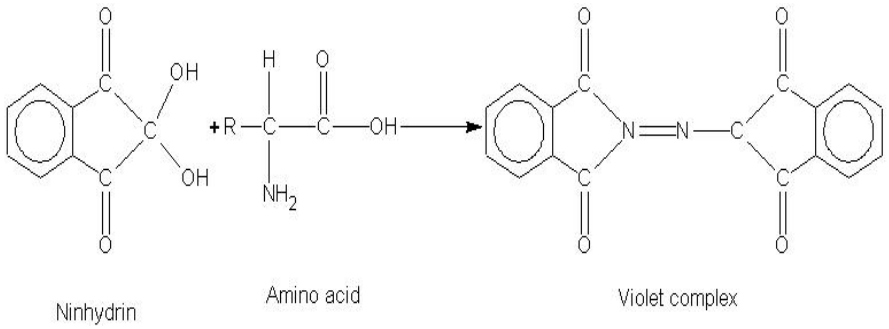
(b) When millon's reagent is added to a protein, a white ppt is formed, which turn brick red on heating.

(c) This test is given by protein which yield tyrosine on hydrolysis (due to the presence of phenolic group).

Nihydrin test

(i) This test is given by all proteins.

(ii) When protein is boiled with a dilute solution of ninhydrin, a violet colour is produced.



2. **What are the uses of proteins?**
3. **Ans: <u>Uses of Proteins</u>**

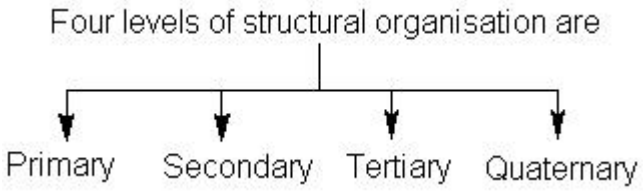
(i) Protein constitute as essential part of our food, meat, eggs, fish, cheese provide protein to human beings.
(ii) Casein (a milk protein) is used in the manufacture of artificial wool & silk.
(iii) Amino acid needed for medicinal use & feeding experiment, are prepared by hydrolysis of proteins.
(iv) Gelatin is used in desserts, salads, candies bakery goods etc.
(v) Leather is obtained by tanning the protein of animal hides.
(vi) Hemoglobin present in blood is responsible for carrying oxygen and CO_2.
(vii) Hormones control various processes.
(viii) Enzymes are the proteins produces by living system & catalyse specific biological reaction.

4. **Explain how many structures of proteins can exist?**

Ans : Structure of Proteins

(i) Proteins have three dimensional structures.
(ii) There are number of factors which determine the exact shape of proteins.

Structure of Proteins



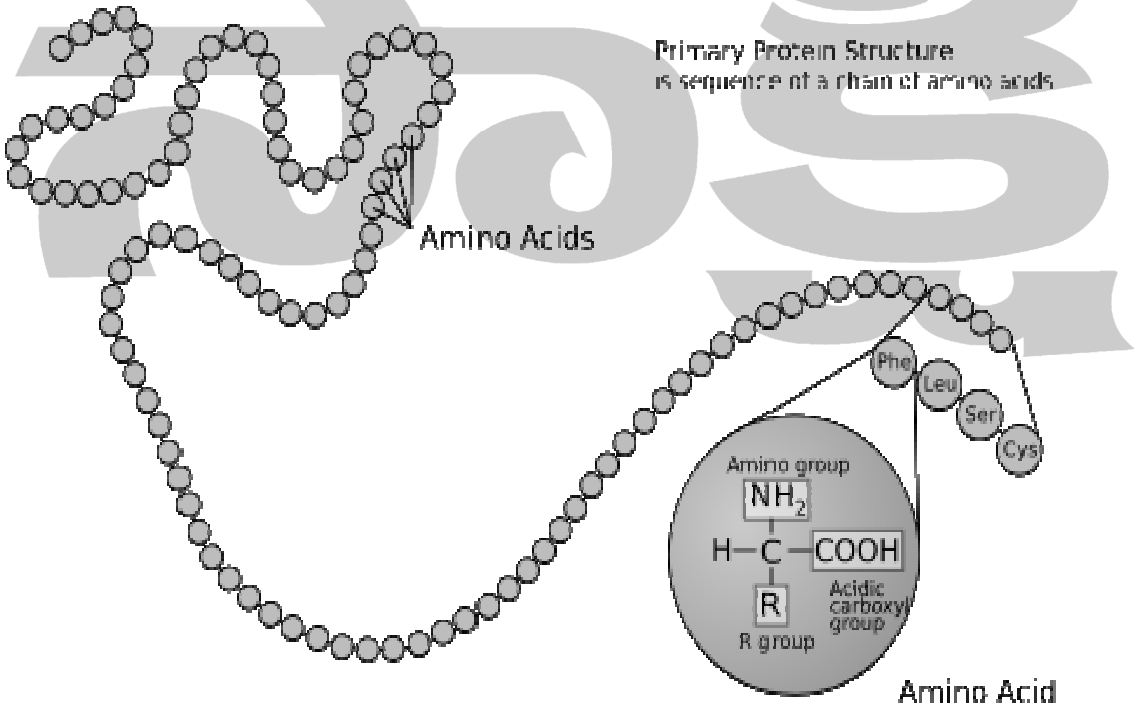
LONG ANSWER QUESTIONS

1. Explain the primary structure of protein.

Primary structure

(i) This type of structure was given by Friedrich Sanger in 1953 in Insulin.
(ii) Primary structure is conformed by single polypeptide chain in a linear manner.
(iii) All amino acid are attached in a straight chain by peptide bond.

In general, polypeptides are unbranched polymers, so their primary structure can often be specified by the sequence of amino acids along their backbone. However, proteins can become cross-linked, most commonly by disulfide bonds, and the primary structure also requires specifying the cross-linking atoms, e.g., specifying the cysteines involved in the protein's disulfide bonds. Other crosslinks include desmosine.The chiral centers of a polypeptide chain can undergo racemization. In particular, the L-amino acids normally found in proteins can spontaneously isomerize at the C^{α} atom to form D-amino acids, which cannot be cleaved by most proteases. Finally, the protein can undergo a variety of posttranslational modifications, which are briefly summarized here. The N-terminal amino group of a polypeptide can be modified covalent



2. Explain the secondary structure of protein.

Ans: Secondary structure:

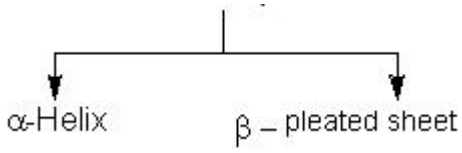
(i) The fixed configuration of polypeptide skeleton is referred to as the secondary structure of protein.

(ii) It gives information

(a) About the manner in which the protein chain is folded and bent.

(b) About the nature of the bond which stabilizes this structure

(iii) This structure of protein is mainly of two types



(A) α-Helix

(a) The chain of α-amino acids coiled as a right handed screw (called α-helix) because of the formation of hydrogen bond.

(b) The spiral is held together by H-bonds between N–H and C = O group vertically adjacent to one another.

(c) X-Ray studies have shown that there are approximately 3.6 amino acid unit for each turn in helix.

(d) Such proteins are elastic i.e., they can be stretched.

(e) On stretching weak H-bonds break up and the peptide act like a spring.

(f) The hydrogen bonds are reformed on releasing the tension.

e.g. Myosin, Keratin, Tropomysin.

(B) Beta-pleated sheet

(a) Polypeptide chains are arranged side by side.

(b) The chains are held together by a very large number of hydrogen bond between C = O and NH of different chains.

(c) These sheets can slide over each other to form a three dimensional structure called a beta pleated sheet.

e.g. Silk has a beta pleated structure.

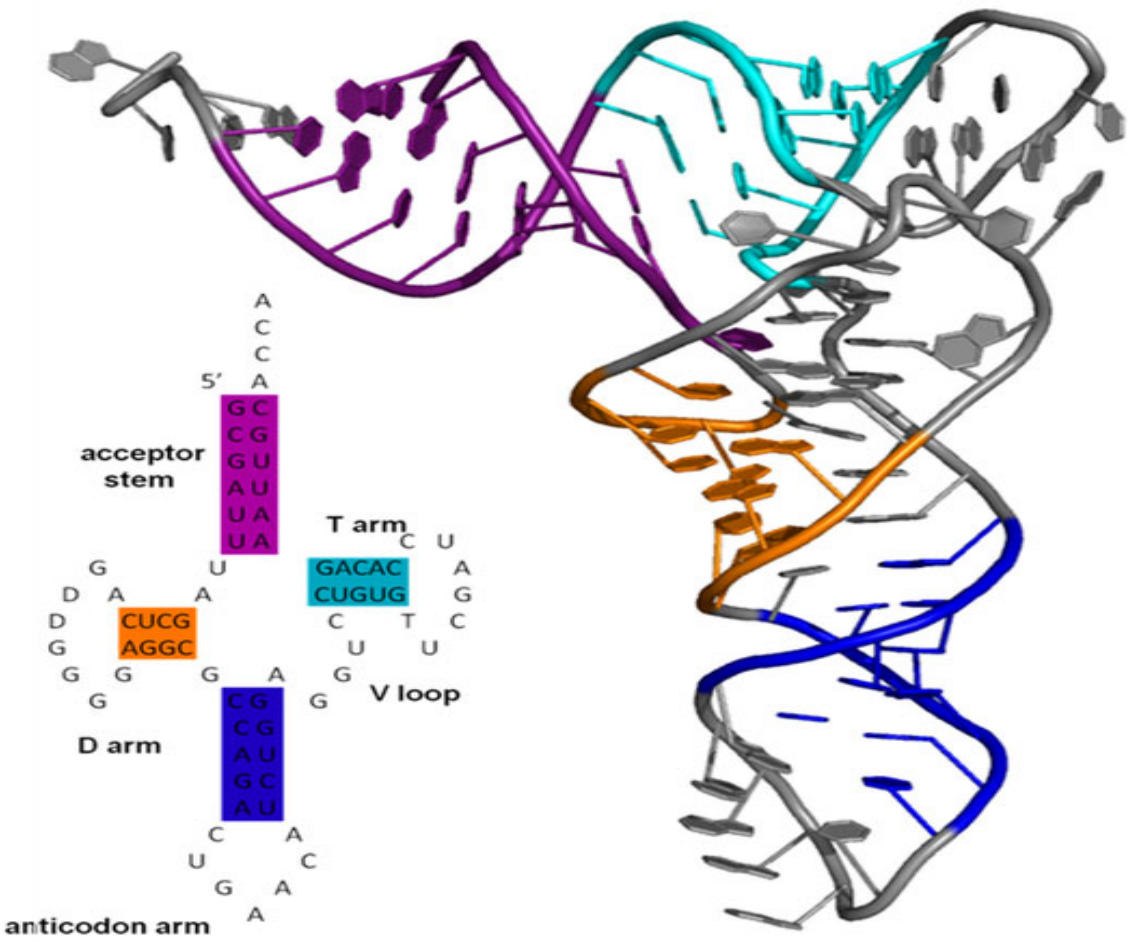
3. **Explain the tertiary structure of Proteins.**

Ans: Tertiary structure

(i) It refers to the arrangement and interrelationship of the twisted chain of protein into specific layer or fibres.

(ii) This tertiary structure is maintained by weak inter atomic force such as, H-bonds hydrophobic bond, van der Waals' force and disulphide bonds (eg Insulin).

e.g. Protein of tobacco mosaic virus (TMV); Myoglobin; Hemoglobin



4. **Explain the quaternary structure of protein.**

Ans: Quaternary structure

(i) When two or more polypeptide chain united by the force other than covalent bond i.e., peptide and disulphide bonds.

(ii) It refers to final three dimensional shape that results from twisting bonding and folding of the protein helix.

(iii) It is most stable structure.

Quaternary structure refers to the association of multiple individual protein chains into a single protein with multiple subunits. The arrangement of the subunits gives rise to a stable structure, which can usually be dissociated in the laboratory, but is very strongly bound *in vivo*.

- The subunits may be identical or different
- When they are different, each subunit tends to have a different function

Common shorthand for describing such proteins is to use Greek letters for each type of subunit, and subscript numeral to specify numbers of units.

- A protein designated a_2bg consists of two a units and one each of b and g.

The subunits usually are held together by hydrophobic interactions, the clustering serving to reduce exposure of hydrophobic side chains to the solvent. Occasionally, ionic interactions between carboxylate and amino side chains may contribute.

5. Explain the classification of proteins.

Classification of Proteins

There are two methods for classifying proteins.

(i) Classification according to **Composition**

(ii) Classification according to **Functions**

I. **Classification according to Composition**

Simple proteins

(i) Simple proteins are those which yield only α-amino acids upon hydrolysis.

(ii) Simple proteins are composed of chain of amino acid unit only joined by peptide linkage.

Examples are:
Egg (albumin); Serum (globulins); Wheat (Glutelin); Rice (Coryzenin)

Conjugated proteins

(i) Conjugated proteins are those which yield α - amino acids plus a non protein material on hydrolysis.

(ii) The non protein material is called the prosthetic group.

Example:

Casein in milk (prosthetic group is phosphoric acid); Hemoglobin (prosthetic group is Nucleic acid); Chlolesterol (prosthetic group – lipid).

According to molecular shape, proteins are further classified into two types.

(A) **Fibrous protein**

(a) These are made up of polypeptide chain that are parallel to the axis & are held together by strong hydrogen and disulphide bonds.

(b) They can be stretched & contracted like thread.

(c) They are usually insoluble in water.

Example:

Keratin (hair, wool, silk & nails); Myosin (muscle)

(B) Globular Proteins

(a) These have more or less spherical shape (compact structure).

(b) α - amino helix are tightly held bonding; H – bonds, disulphide bridges, ionic or salt bridges:

Examples:

Albumin (egg)

II. **Classification According to functions**

The functional classification includes following groups.

Structural proteins

These are the fibrous proteins such as collagen (skin, cartilage & bones) which hold living system together.

Blood proteins

(i) The major proteins constituent of the blood are albumin hemoglobin & fibrinogen.

(ii) Their presence contribute to maintenance of osmotic pressure, oxygen transport system & blood coagulation respectively.