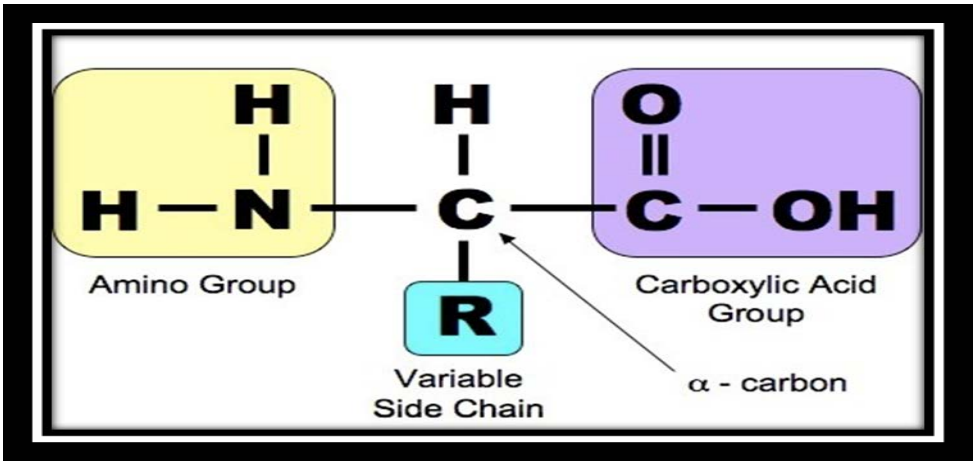
FAQ's

1) Briefly explain the structure of amino acid with a diagram.

Ans: The basic structure of amino acid consists of a α-carbon atom covalently attached to a Hydrogen atom, an amino group (NH_2), carboxyl group (COOH) and a side-chain R group



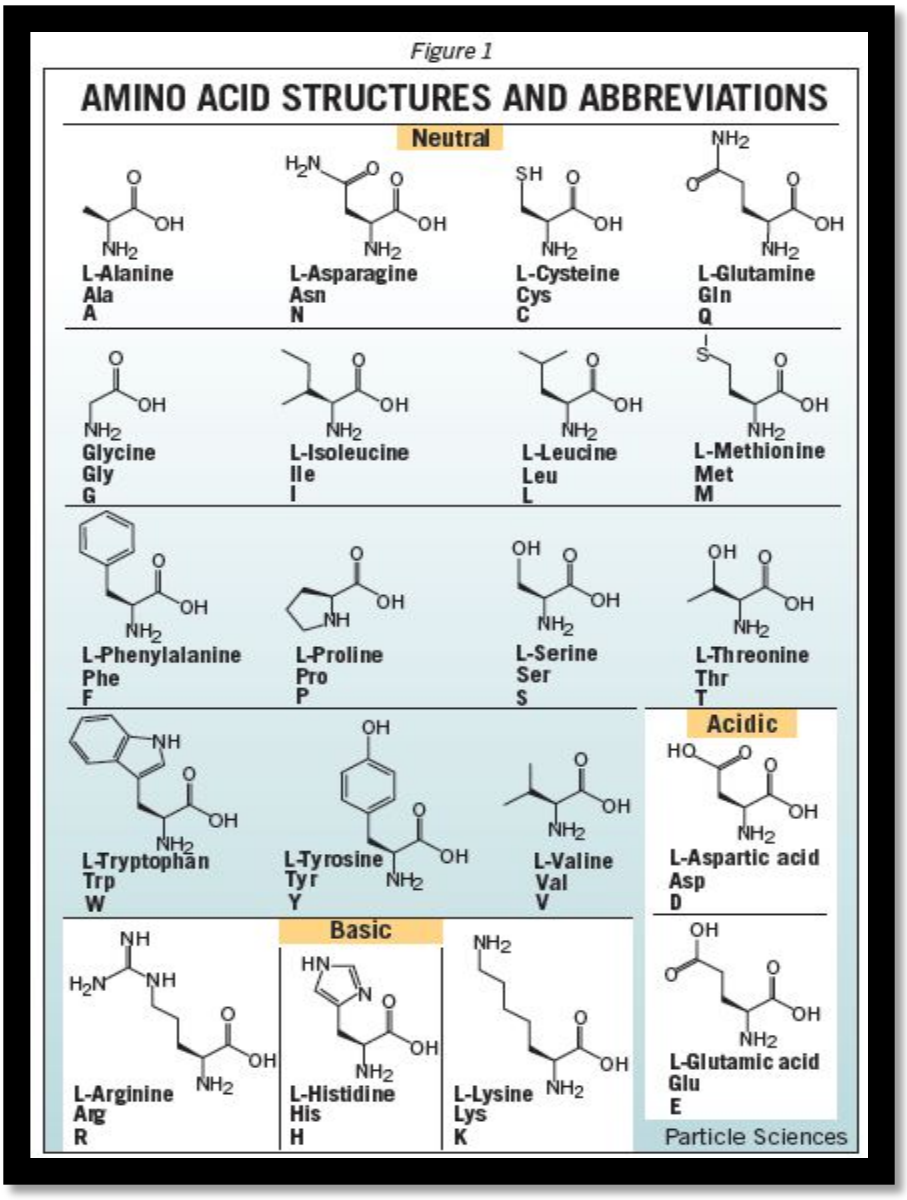
2) What is a peptide bond?

Ans: Individual amino acids are joined together in long chains by forming peptide bond. It is the bond which is formed between amino groups (NH_2) of one amino acid to carboxyl group (COOH) of another amino acid. A dipeptide bond is two amino acids joined by a peptide bond, likewise; oligopeptide refers to a chain of 4-10 amino acids. The sequence formed with more than 10 amino acids is referred to as proteins or polypeptides.

3) Define C- terminus & N-terminus.

Ans: Amino acids, as the name itself indicates, contain both a basic amino group (NH_2) & an acidic carboxyl group (COOH). The di-functionality of these two groups allows the individual amino acids to join together in long chains by forming peptide bonds.The end of the peptide or protein sequence with a free carboxyl group is called the *carboxy-terminus* or *C-terminus*& the end of free amino group is called *amino- terminus or N- terminus.*

4) Give the structure of essential & non-essential amino acids.
   Ans:



5) Differentiate between alpha helix & beta sheath structures of proteins.

Ans: The two main types of secondary structure are the α-helix and the ß-sheet.

Alpha helix: is a right-handed coiled strand. The side-chain substituents of the amino acid groups in α-helix extend to the outside. Hydrogen bonds form between the oxygen of the C=O of each peptide bond in the strand and the hydrogen of the N-H group of the peptide bond form amino acids below it in the helix. The hydrogen bonds make this structure especially stable. The side-chain substituents of the amino acids fit in beside the N-H groups.

Beta-sheet: The hydrogen bonding in a *ß-sheet* is between strands (inter-strand) rather than within strands (intra-strand). The sheet conformation consists of pairs of strands lying side-by-

side. The carbonyl oxygens in one strand hydrogen bond with the amino hydrogens of the adjacent strand. The two strands can be either parallel or anti-parallel depending on whether the strand directions (N-terminus to C-terminus) are the same or opposite. The anti-parallel ß-sheet is more stable due to the more well-aligned hydrogen bonds.

6) What are the forces involved in determining the secondary & tertiary proteins?
   Ans: The various forces involved in determining the proteins structures are as follows:

Ionic or electrostatic bonds: These results from the attractive force between ionized groups of opposite charge.

Hydrogen bonds: These results from H+ (proton) that is shared between two neighboring electro-negative atoms. The H+ can be shared between nitrogen or oxygen atoms which are close to each other.

Hydrophobic interactions: In these water is excluded by non-polar groups. These associate with each other so that they are not in contact with water.

In globular proteins the side chains of the most hydrophobic amino acids (non-polar) aggregate inside the molecule, & the polar (charged) groups protrude from the surface of the tertiary structure. The hydrophobic residues repel the water molecules that surround the protein, thereby causing the globular structure to be more compact.

Vander Waals interactions: They occur only when two atoms come very close together. The closeness of two molecules can induce charge fluctuations which may produce dipoles & mutual attraction at very short range.

7) Write a note on denaturation of proteins.

Ans: The loss of secondary, tertiary or quaternary structure due to exposure to a stress factor is called denaturation. Denaturation causes a protein to unfold & lose its shape.Due to the nature of the weak interactions controlling the three-dimensional structure, proteins are very sensitive molecules. The term native state is used to describe the protein in its most stable natural conformation. This native state can be disrupted by a number of external stress factors including high temperature, pH, removal of water, alcohol, oxidation, agitation, presence of hydrophobic surfaces, presence of metal ions etc. Protein functions are mainly dependent on its shape; hence denatured proteins lose their ability to function properly. In addition to becoming denatured, proteins can also form aggregates under certain stress conditions.

8) Give the classification of proteins based on their structure with examples.

Ans: Proteins can be classified depending on the structure of amino acids. The side chains are the deciding factors for intra- and intermolecular interactions in proteins, and hence, for protein properties, aminoacids can be classified as:

- Amino acids with nonpolar, uncharged side chains: e. g., glycine, alanine, valine, leucine, isoleucine, proline, phenylalanine, tryptophan and methionine.
- Amino acids with uncharged, polar side chains: e. g., serine, threonine, cysteine, tyrosine, asparagine and glutamine.
- Amino acids with positively charged (basic) side chains: e. g. histidine, lysine and arginine.
- Amino acids with negatively charged (acidic) side chains: aspartic acid, glutamic acid.

9) How proteins are classified based on conformation & composition.

Ans:

Proteins	Characteristics	Example or occurrence
Globular		
Albumins	Soluble in water, dilute salt solutions, dilute acids, & bases. Coagulated by heat	Lactalbumin, egg albumin, serum albumin
Globulins	Soluble in salt solutions, insoluble in water	Serum globulin, arachin&conarchin of peanuts, myosin.
Histones	Basic proteins. Soluble in most common solvents	Nucleoproteins
Fibrous (Scleroproteins)		
Collagens	Resistant to digestive enzymes; insoluble	Skin, tendons, bones
Elastins	Partially resistant to digestive enzymes	Arteries, tendons, elastic tissues
Keratin	Highly insoluble & resistant to digestive enzymes; high cysteine content	Skin, hair, nails

10) Differentiate between complete & incomplete proteins.

Ans: Proteins can be divided into 3 types depending on their quality as;

- **Complete proteins** – Foods that supply all the essential amino acids in the proportions the body needs are called complete proteins or high quality proteins.
- **Partially complete proteins-** Foods that partially lack in one or more essential amino acids are referred to as partially complete proteins

- **Incomplete proteins** – Foods that completely lack in one or more essential amino acids are called low quality proteins or incomplete proteins.

Although both plant & animal foods contain protein, the quality of protein in these foods differs. Higher quality protein produces a faster growth rate. Pattern & abundance of essential amino acids, relative amounts of non-essential amino acids, digestibility & presence of trypsin inhibitors affect the quality of proteins & in turn affect the growth rate.

11) Give the nutritional classification of amino acids.

Ans: Based on their nutritional/physiological roles, amino acids can be differentiated as:

- **Essential amino acids:** They are the amino acids that cannot be synthesized in the body & therefore has to be supplied by foods.

- **Nonessential amino acids:** They are the amino acids that the body can synthesize if adequate amounts of nitrogen are available in the diet.

- **Conditionally essential amino acids:** Some of the nonessential amino acids may become conditionally essential if the body cannot make them because of illness or in certain circumstances where the body lacks the necessary precursors or enzymes to make them.

12) RDA of proteins for different age groups.

Ans:

Recommended Dietary Allowances (RDA)	
Age group	**Grams of proteins needed/day**
Children (1-3years)	17
Children (4-8years)	20
Children (9-13years)	40
Girls (14-18years)	50
Boys (14-18years)	54
Women (18+years)	55
Men (18+years)	60

13) What are the important functions of proteins?

Ans: Proteins play a central role in biological systems & their synthesis occurs in ribosomes. On the functional basis, proteins can be classified according to their biological role as:

Enzymes - Hexokinase, Lactate dehydrogenase, DNA polymerase.
Contractile proteins - myosin, actin, flagellar proteins.
Storage proteins - casein, ovalbumin, ferritin, zein
Transport proteins - Hemoglobin, myoglobin, serum albumin
Protective proteins – antibodies, thrombin, complement fibrinogen, ricin,

Hormones – insulin, growth hormone
Structural proteins – glycoproteins, collagen, elastin, fibroin
Genetic proteins – nucleoproteins, histones.

14) Determination of protein quality.

Ans: Quality of protein is affected by the amino acid content, amino acid imbalance, interference of non-available carbohydrates & trypsin inhibitors & influence of heating & processing.There are different methods for evaluating quality of proteins such as chemical assays, biological assays, etc.One of the methods of evaluating the quality of proteins is by experimentally determining the biological value (BV).

The BV measures the ability of a protein to support 'growth & maintenance'. The BV of a protein is defined as the percentage of the absorbed nitrogen (NX6.25=protein) retained in the body. Protein quality is directly related to BV; higher the BV better will be protein nutritionally.

$$BV=\frac{\text{N retained in the body}}{\text{N absorbed}} \times 1OO$$

15) Differentiate between simple & conjugated proteins.

Ans: Proteins are complex organic compounds. The basic structure of protein is a chain of amino acids. They can be classified as simple, conjugated or derived proteins based on their complexity. They are as follows:

Simple proteins: which yield only amino acid on hydrolysis.e.g.,Protamine, Albumin, Globulins, etc.

Conjugated proteins: These are made up of simple proteins (apoprotein) & non protein substance known as prosthetic group. They yield not only amino acids but also other organic or inorganic compounds.e.g., Nucleoproteins, Chromo protein, Glycoproteins, Phosphoproteins, Lipoproteins, and Metalloproteins, and

Derived proteins: These are formed from simple & conjugated proteins & are the degradation products obtained by the action of acids, alkalis or enzymes on proteins.e.g., Denatured proteins, Metaproteins, Secondary proteoses, peptones, polypeptides, simple peptides and amino acids are the derived proteins.