Amino acid

First stage
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2025-2026
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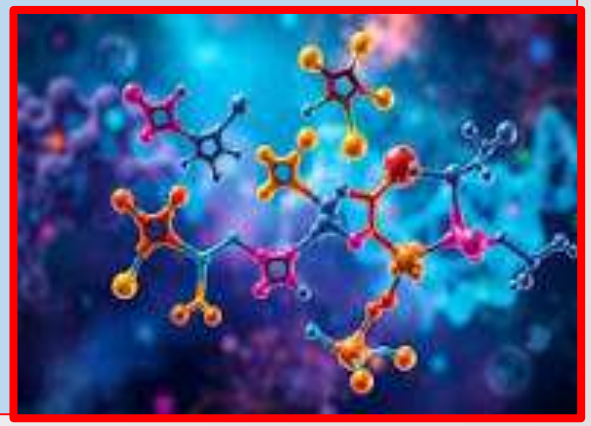
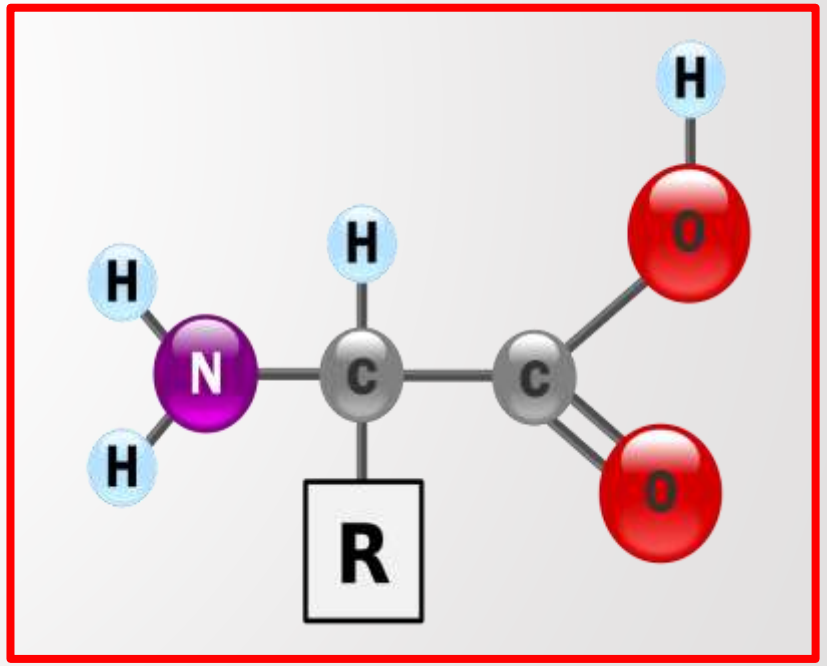
- Amino acids are organic compounds that combine to form proteins.or there are building blocks of protein, They contain two primary functional groups: an amino group (-NH2) and a carboxylic acid group (-COOH), along with a side chain (R-group) specific to each amino acid

- There are 20 amino acids in naturally occurring protein. By convention the -NH2 is placed ‘ to the left ’



General Structure

- Every amino acid (except proline) has a central carbon atom, called the alpha carbon, to which four different groups are attached
- A basic Amino group (-NH2)
- An acidic Carboxyl group (-COOH)
- A Hydrogen atom (H)
- A distinctive Side chain (R)



Classification of Amino Acids

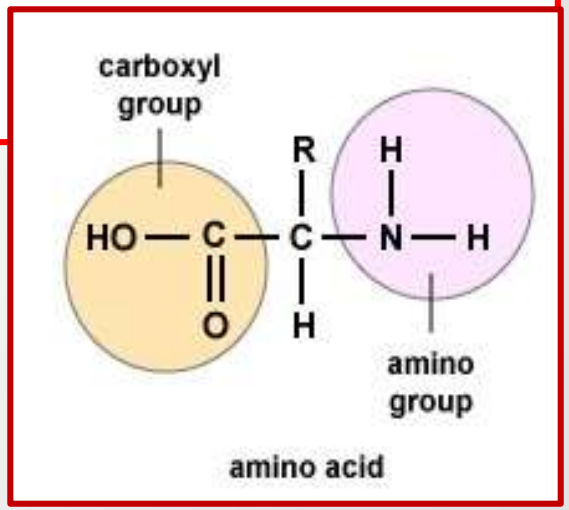
- Amino acids are generally classified based on the properties of their R-groups:
- Non-polar (Hydrophobic): Examples include Glycine, Alanine, Valine
- Polar, Uncharged (Hydrophilic): Examples include Serine, Threonine, Cysteine.
- Acidic (Negatively charged): Aspartic acid, Glutamic acid.
- Basic (Positively charged): Lysine, Arginine, Histidine

Chemical properties :Zwitterion Formation

- In an aqueous solution at physiological pH (around 7.4), amino acids exist as Zwitterions is called isoelectric point (PI) .The carboxyl group loses a proton, and the amino group gains one (the molecule has a net charge of zero).This creates a dipolar ion known as a Zwitterion

- **The Equation:**

- $NH_2—CH(R)—COOH \rightleftharpoons {}^{+}NH_3—CH(R)—COO^{-}$

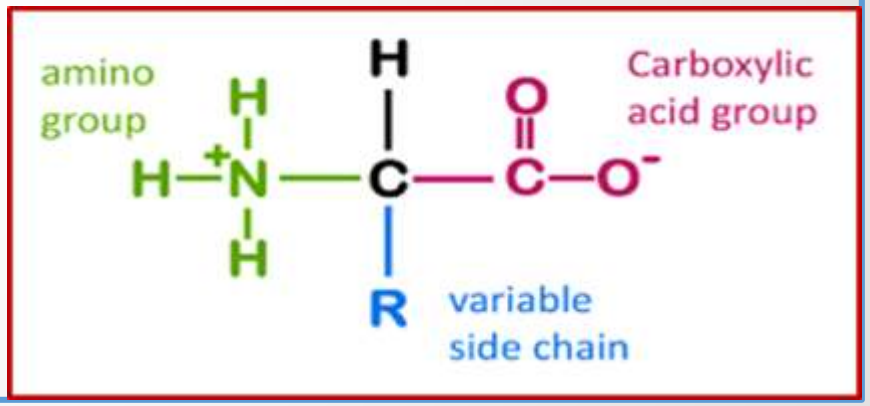


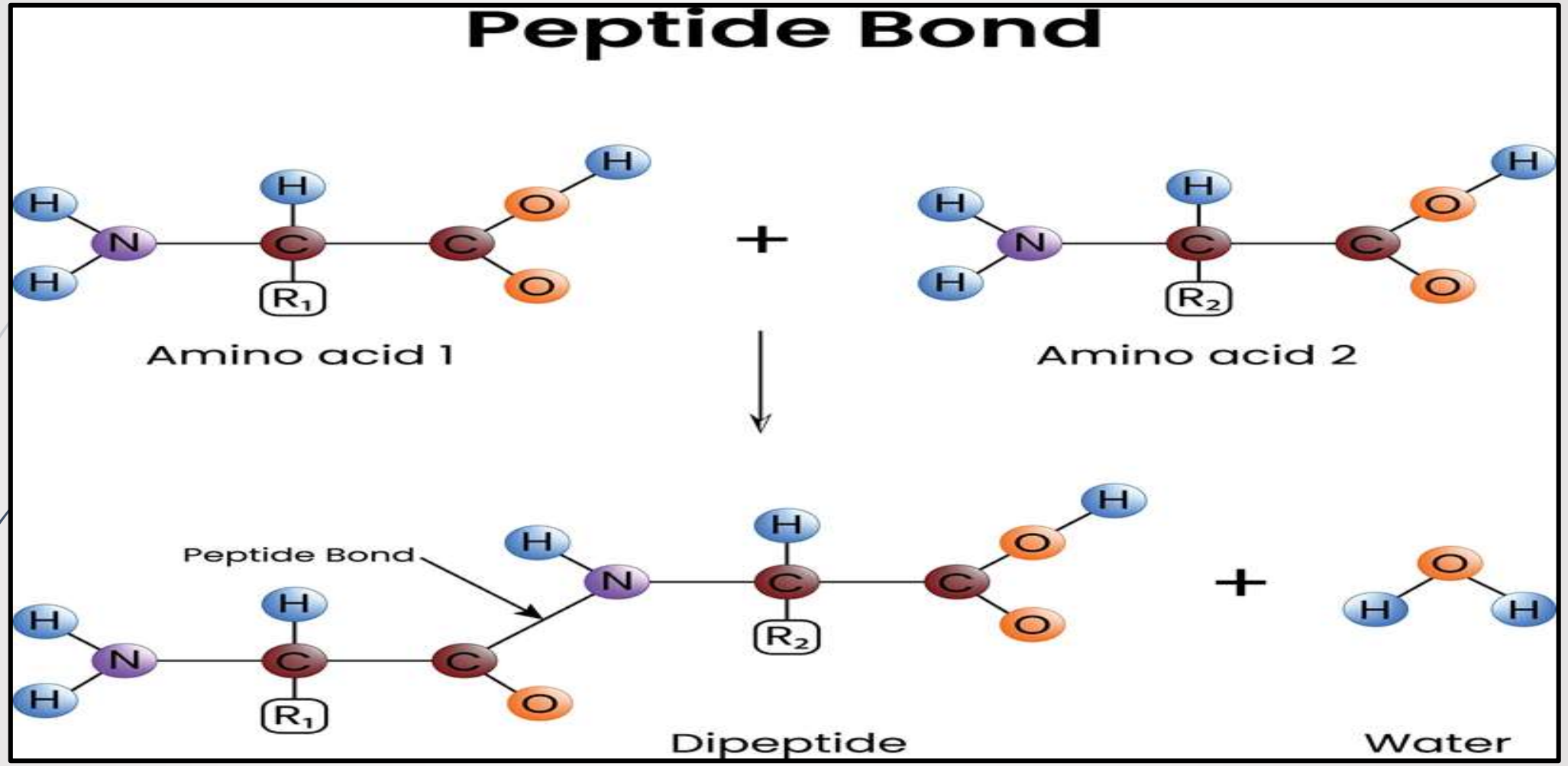
Chemical Reactions: Peptide Bond Formation

- Amino acids link together via dehydration synthesis to form peptide bonds. This happens when the carboxyl group of one molecule reacts with the amino group of another, releasing a molecule of water (H2O).

The Reaction:

- $R1—NH2+HOOC—R2 \rightarrow R1—NH—CO—R2+H2O$




Peptide Bond
Amino acid 1
Amino acid 2
Peptide Bond
Dipeptide
Water

- **Amphoteric nature& ionization** :(they can act as both an acid and base.this is due to the presence of both the acidic carboxyl group(-COOH) and the basic amino group (-NH2) depending on PH of the environment
- In acidic solutions (low PH) : the amino acids acts as base and picks up protons , becoming a cation(+)
- In basic solutions (high PH): the amino acid acts as an acid and loses protons , becoming an anion(-)

Physical properties

- The physical behavior of amino acids is detected by their ionized state:
- **Solubility**: most amino acids are soluble in water and insoluble in non –polar organic solvent (like benzene or ether)
- **Melting point:** they are crystalline solids with high melting point (usually above 200 C)
- **Taste:** Amino acids can be sweet (Glycine, Alanine)
- Tasteless(Leucine) or bitter (Arginine , isoleucine)
- **Optical Activity:** All amino acids except Glycine are optically active because the alpha-carbon is asymmetric (chiral). They exist in two isomeric forms: D and L. Proteins are almost exclusively composed of L-amino acids.

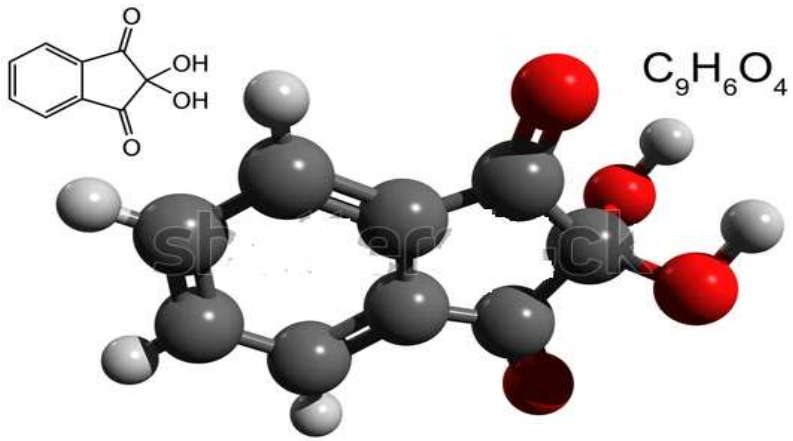
Qualitative Detection Tests (Identification)

- To identify the presence of amino acids or specific R-groups in a lab setting, we use several classic biochemical tests

Test Name	Target / Specificity	Positive Result
Ninhydrin Test	General a-amino acids	Purple/ Ruhemann's Blue (Yellow for Proline)
Xanthoproteic Test (Concentration nitric acid)	Aromatic R-groups (Tyrosine, Tryptophan)	Yellow/Orange color
Millon's Test	Phenolic group (Tyrosine)	Red precipitate
Sakaguchi Test	Guanidinium group (Arginine)	Red/Orange color
Lead Sulfide Test	Sulfur-containing (Cysteine)	Black precipitate (PbS)

The Ninhydrin Reaction Equation

- Ninhydrin reacts with the amino group to undergo oxidative deamination:
- Amino Acid+2Ninhydrin→Ruhemann's Blue+Aldehyde+CO2+3H2O



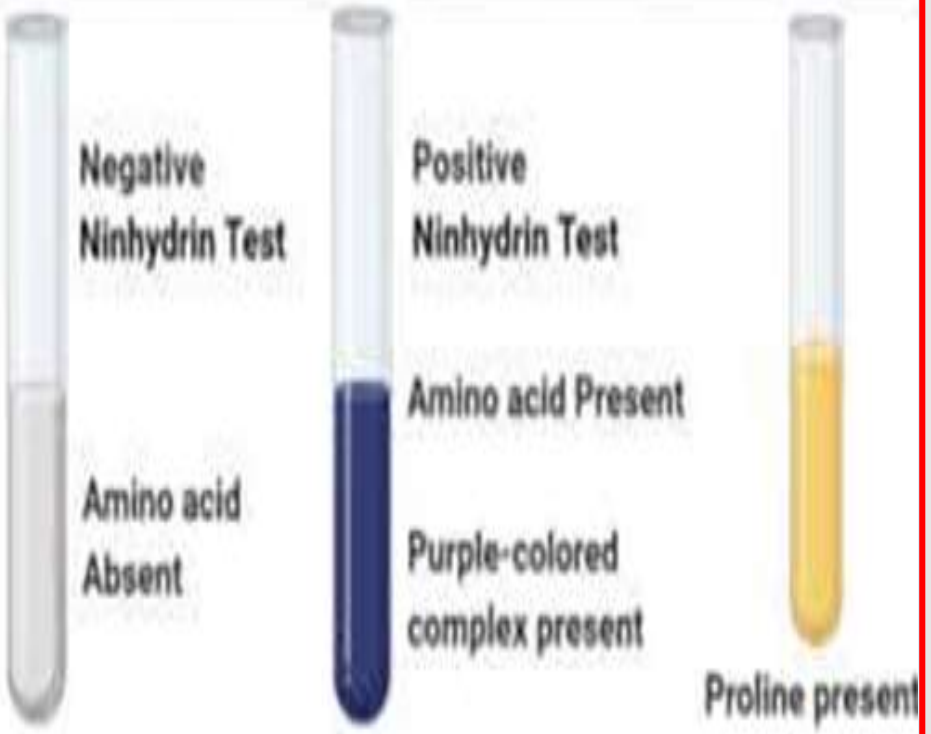
Ninhydrin

- **Description :** The presence of amino acids can be detected using the reagent ninhydrin.
- Ninhydrin reacts with amino acids to give a blue-violet colered specific. Certain amino acids can also be identified with specific coler reagents.
- When histidine reacts with diazosulfanilic acid . a cherry red coler is observed

Ninhydrin test for amino acids

Procedure: Add ninhydrin solution to amino acid solution; heat gently; purple/violet color forms.

Application: Protein and amino acid analysis in biochemistry



- •Amino acids are organic compounds that combine to form protein .
- Each 20 amino acids has a unique R-group that determines its chemical behavior (size , charge, and solubility)
- Amphoteric nature: they can act as both acids and bases
- All amino acids except Glycine are chiral, meaning they can exist in two forms D & L isomers
- Amino acids link together through covalent bonds called peptide bonds to form long polypeptide chains


Thank You