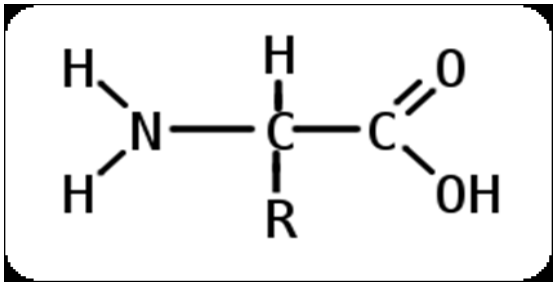
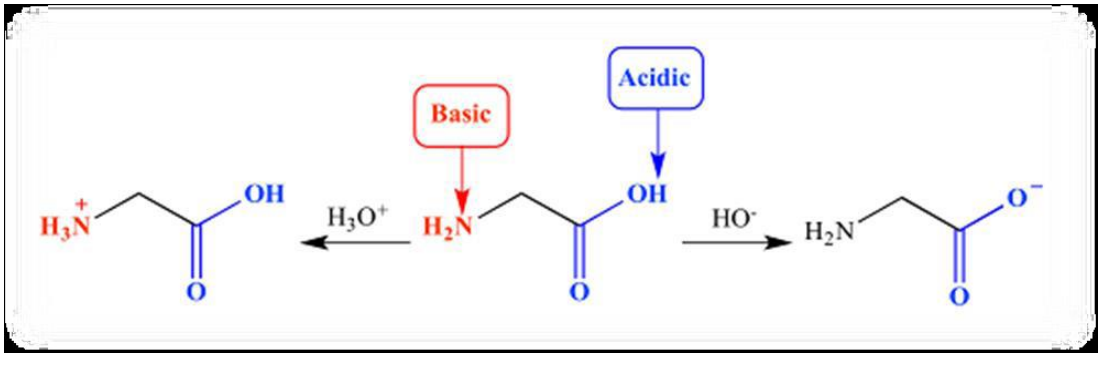
Amino Acids

Amino acids:

are molecules containing an amine group, a carboxyl acid group, and side chain.



Amino acids of the general formula **$RCH(NH_2)COOH$** are amphoteric, meaning that they can behave as amines in some reactions and as carboxylic acids in others.



At certain pH known as the isoelectric point an amino acid will have no net charge.

If the number of positive charges and negative charges is equal, then the molecule is called a Zwitterion, which has zero charge.

The net charge on the molecule is affected by the pH of its surrounding environment and can become more positive or negative due to the gain or loss of protons, respectively.

The importance of amino acids

.Amino acids are critical to life; due to being the building blocks for proteins, and also being intermediates in metabolic pathways.

Classification of amino acids

Amino acids are generally classified according to the properties of their side chain.

The side chain can make an amino acid a 1weak acid or a 2weak base, and a hydrophile if the side chain is polar, or 4hydrophobe if it is nonpolar.

Specific reactions for individual amino acids

1. Millon's test:

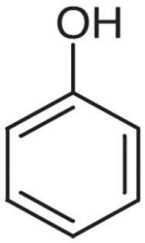
- Specific test to phenol containing structures. (Tyrosine, β-naphthol).
- Millon's reagent contains mercury dissolved in concentrated HNO_3.
- Red precipitate is a positive test result for phenols in the sample.

Phenol:

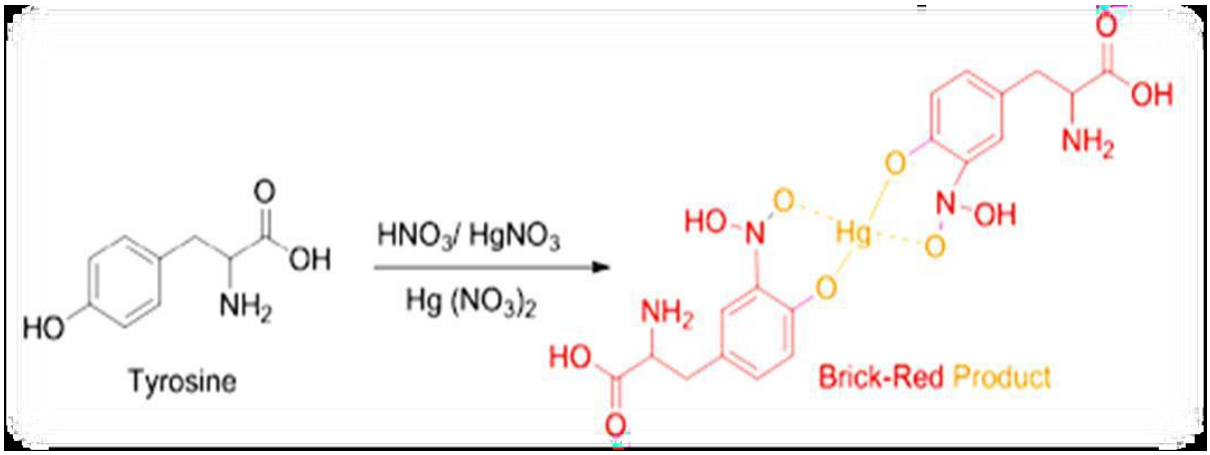
Also called carbolic acid, is an aromatic organic compound with the molecular formula (C_6H_5OH).

It is a white crystalline solid that is volatile.

The molecule consists of a phenyl group ($-C_6H_5$) bound to a hydroxy group ($-OH$). Mildly acidic, and requires careful handling because it can cause chemical burns.



Millon's chemical reaction:



Millon's Procedure:

1. Take **2ml of the amino acid** solution in a clean test tube.
2. Add **1-2 drops of Millon's** reagent.
3. Warm the solution in boiling water bath for ≈ 10 min.
4. The appearance of a **red colour** is a positive test result for the presence of phenols in the sample.
5. **Note:** This test is specific for phenols, if a sample also gives positive ninhydrin result THEN it is considered a phenolic amino acid.

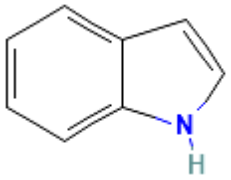
2. Hopkin's Cole test:

Specific test to indole group containing structures. (**Tryptophan**).

The glyoxylic aicd in glacial acetic acid reacts with the indole group in the presence of concentrated H_2SO_4.

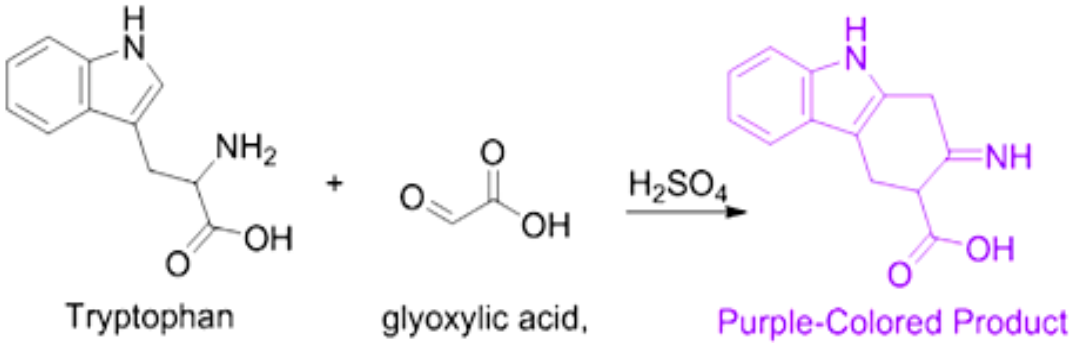
Purple colour is a positive test result for indole containing substances in the sample.

Indole:



- An aromatic heterocyclic organic compound
- with the formula (C_8H_7N).
- It consists of a six-membered benzene ring,
- fused to a five-membered pyrrole ring.

Hopkin's Cole chemical reaction:



Hopkin's Cole Procedure:

1. Take **2ml of amino acid** solution in a clean test tube.
2. Add **5 drops of Hopkin's** Cole solution.
3. Slowly add **2ml of H_2SO_4** along the side of the tube.
4. Notice the separation (Acid:bottom, Sample: Top).

5. The appearance of a purple ring is a positive test result for the presence of indole in the sample.

6. **Note:** This test is specific for indole, if a sample also gives positive ninhydrin result THEN it is considered an indole derivative amino acid.

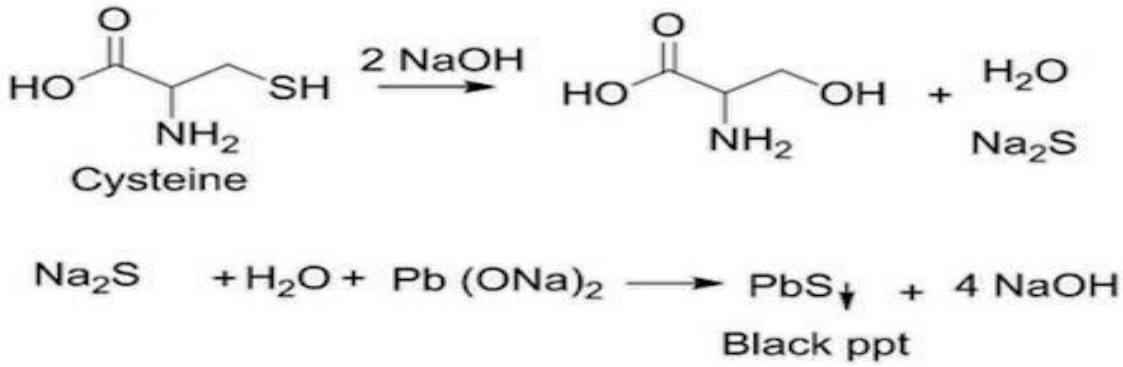
3. Lead-sulfide test:

Specific test for sulfide containing amino acids. (Cysteine, cystine).

When cystine is boiled with 40% NaOH, some of the sulfure in its structure will be converted to sodium sulfide Na_2S.

Sodium plumbate causes the precipitaion of PbS in the alkaline medium. (Brown colour is positive)

Lead-sulfide chemical reaction:



Lead-sulfide Procedure:

1. Take **2ml of amino acid** solution in a clean test tube.
2. Add **1 ml of 40% NaOH** solution.
3. Add **3 drops of 10%** Lead acetate solution.
4. Boil the mixture for ≈ 2 minutes.

5. The appearance of a brown precipitate is a positive test result for the presence of sulfides in the sample.

6. Note: This test is specific for sulfide, if a sample also gives positive ninhydrin result THEN it is considered an sulfide containing amino acid.