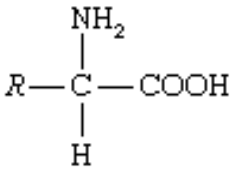
Amino acid

Amino acid**,** any of a group of organic molecules that consist of a basic amino group (—NH_2), an acidic carboxyl group (—COOH), and an organic *R* group (or side chain) that is unique to each amino acid. Each molecule contains a central carbon (C) atomto which both an amino and a carboxyl group are attached. The formula of a general amino acid is:

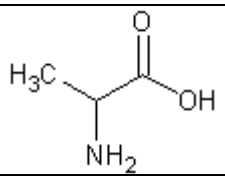
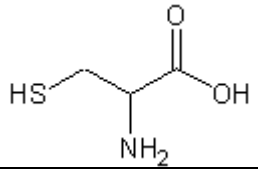
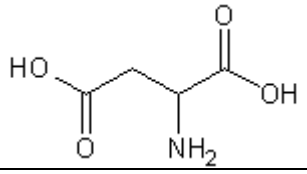
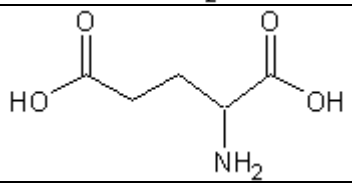
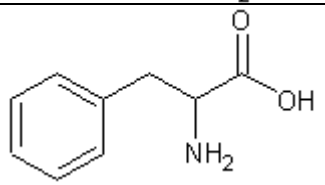
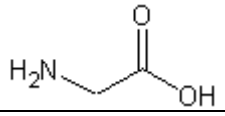
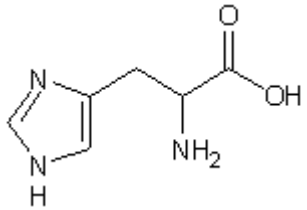


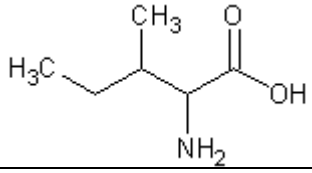
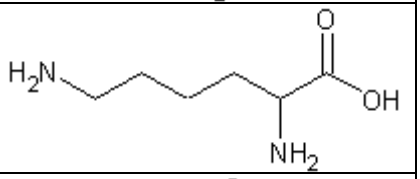
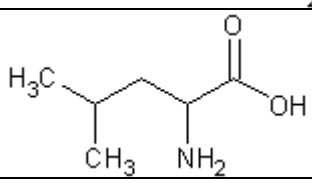
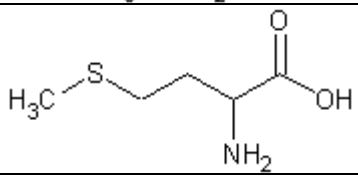
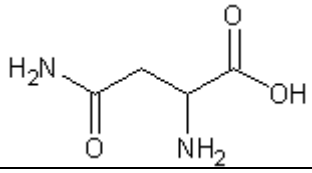
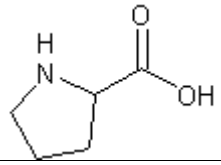
The amino acids differ from each other in the particular chemical structure of the *R* group

Amino acids play central roles both as building blocks of proteins and as intermediates in metabolism. The 20 amino acids that are found within proteins convey a vast array of chemical versatility. Humans can produce 10 of the 20 amino acids (non-essential amino acids). The others must be supplied in the food (essential aminoacids).

IUPAC nomenclature

amino acids are named as amine derivative of carboxylic acids, using the prefix *amino to* indicate the presence of amino group. a locant is used to indicate the position of amine group in the carbon chain of the carboxylic acid.

Amino Acid	**IUPAC code**	**Three letter code**	**Systematic Name**	**Formula**
Alanine	A	Ala	2-Aminopropanoic acid	
Cysteine	C	Cys	2-Amino-3-mercaptopropanoic acid	
Aspartic Acid	D	Asp	2-Aminobutanedioic acid	
Glutamic Acid	E	Glu	2-Aminopentanedioic acid	
Phenylalanine	F	Phe	2-Amino-3-phenylpropanoic acid	
Glycine	G	Gly	Aminoethanoic acid	
Histidine	H	His	2-Amino-3-(1H-imidazol-4-yl)-propanoic acid	

Isoleucine	I	Ile	2-Amino-3-methylpentanoic acid	
Lysine	K	Lys	2,6-Diaminohexanoic acid	
Leucine	L	Leu	2-Amino-4-methylpentanoic acid	
Methionine	M	Met	2-Amino-4-(methylthio)butanoic acid	
Asparagine	N	Asn	2-Amino-3-carbamoylpropanoic acid	
Proline	P	Pro	Pyrrolidine-2-carboxylic acid	

Acid Base Properties Of Amino Acids

zwitterion

the free amino acids exist largely as dipolar ions or "zwitterions" (German for "hybrid ions"; a zwitterion carries an equal number of positively and negatively charged groups). All amino acid contains an acidic carboxylic group and a basic amino group. It can form a zwitter ion at pH=7. Zwitter ion forms when carboxylic group releases it proton and remains in an anionic form and NH_2 group takes a proton and remains in a cationic form. At this pH it is called isoelectronic point.

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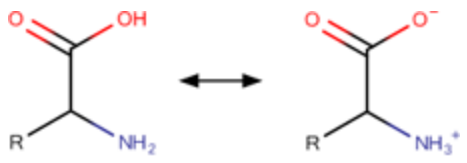
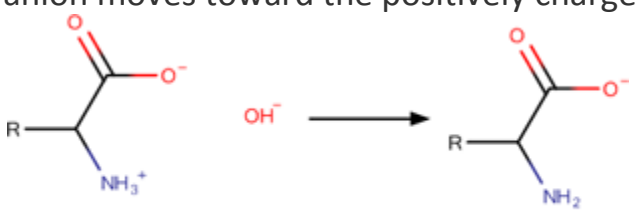


Zwitter ion

The Isoelectric Point

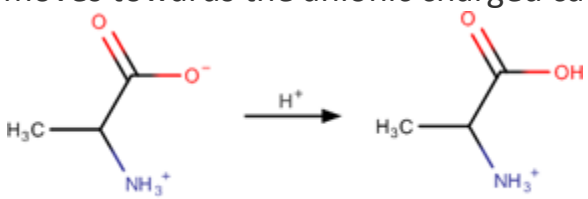
the isoelectric point, **pI**, is the pH of an aqueous solution of an amino acid (or peptide) at which the molecules on average have no net charge. In other words, the positively charged groups are exactly balanced by the negatively charged groups.

At this isoelectric point, the positive ion does not move towards anode and negative charge does not move towards cathode.
When a base is added to the amino acid increasing the pH of the solution, then positive charge on the NH_3^+ is removed and the molecule becomes an anion. This anion moves toward the positively charged anode.



anionic species

In the presence of an acid, the carboxylate anion takes one proton from the acid solution and becomes neutral. The net amino acid becomes cationic charged and moves towards the anionic charged cathode.

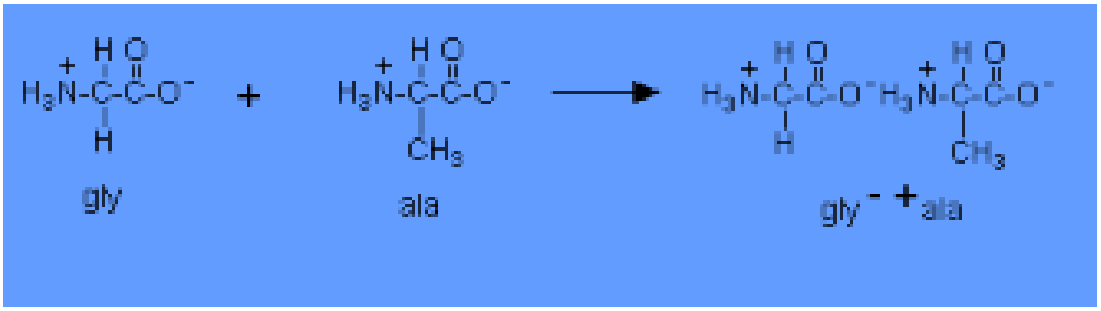


cationic species

Salt Formation:

Amino acids react with each other in a typical acid-base neutralization reaction to form a salt.

The reaction is simply the transfer of the -H (positive ion) from the acid to the amine and the attraction of the positive and negative charges. The acid group becomes negative, and the amine nitrogen becomes positive because of the positive hydrogen ion.

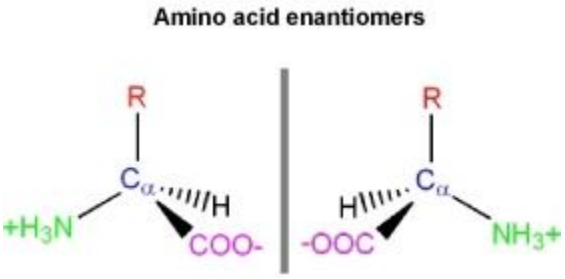


For example: glycine (gly) and alanine (ala) may just interact in the zwitterion form by an attraction of the positive (amine) of the alanine and negative (carboxyl acid) charges to form the salt.

Optical Activity

Enantiomeric molecules have an optical property known as optical activity - the ability to rotate the plane of plane polarized light. Clockwise rotation is known as "dextrorotatory" behavior and counterclockwise rotation is known as "levorotatory" behavior.

With the exception of glycine, all the 19 other common amino acids have a uniquely different functional group on the central tetrahedral carbon, so optically active. there exists two possible, non-superimposable, mirror images of the amino acids:

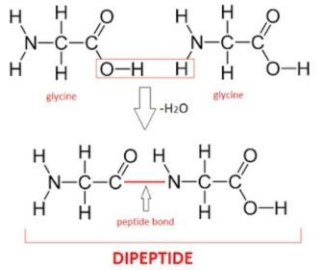


PEPTIDE

Amino acids can be linked by a condensation reaction in which an —OH is lost from the carboxyl group of one amino acid along with a hydrogen from the amino group of a second, forming a molecule of water and leaving the two amino acids linked via an amide—called, in this case, a peptide bond. when individual amino acids are combined to form proteins, their carboxyl and amino groups are no longer able to act as acids or bases, since they have reacted to form the peptide bond. Therefore, the acid-base properties of proteins are dependent upon the overall ionization characteristics of the individual *R* groups of the component amino acids.

DIPEPTIDE

a peptide composed of two amino-acid residues.



TRIPEPTIDE

A **tripeptide** is a peptide derived from three amino acids joined by two or sometimes three peptide bonds.

When one molecule of three different aminoacids react together to form a tripeptide, there are six possibilities/

for example

ala-cys-glu ala-glu-cys cys-ala-glu cys-glu-ala glu-ala-cys glu-cys-ala

POLYPEPTIDES AND PROTEINS

A peptide is two or more amino acids joined together by peptide bonds;
a polypeptide is a chain of many amino acids; and a protein contains one or

more polypeptides. Therefore, proteins are long chains of amino acids held together by peptide bonds.