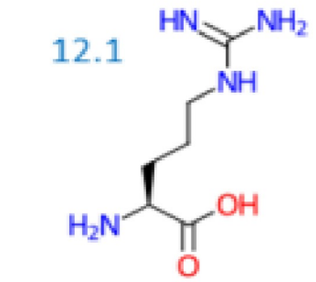
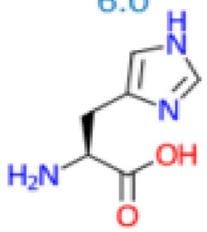
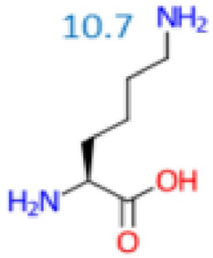
Amino acids- I



Arginine
Arg **R**

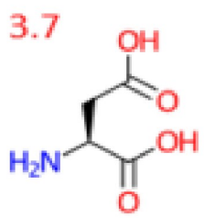


Histidine
His **H**

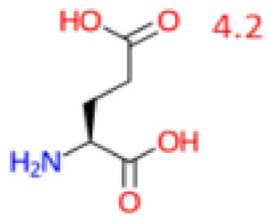


Lysine
Lys **K**

Positively charged



Aspartic Acid
Asp **D**

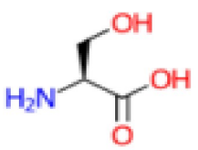


Glutamic Acid
Glu **E**

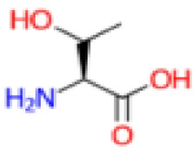
Negatively charged

12.1 or 6.0: pKa of side chain

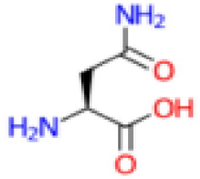
Sulfur or Selenium



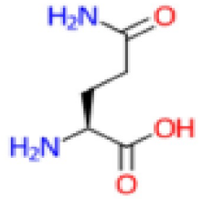
Serine
Ser **S**



Threonine
Thr **T**

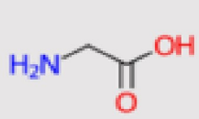


Asparagine
Asn **N**

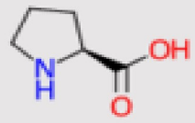


Glutamine
Gln **Q**

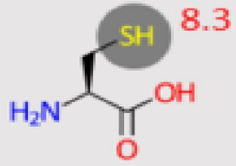
Polar uncharged



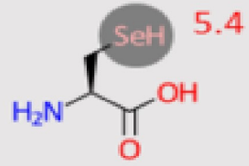
Glycine
Gly **G**



Proline
Pro **P**

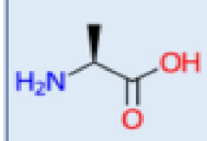


Cysteine
Cys **C**

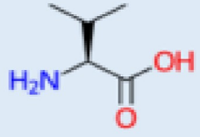


Selenocysteine
Sec **U**

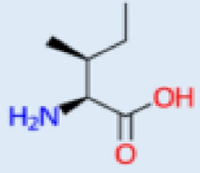
Special cases



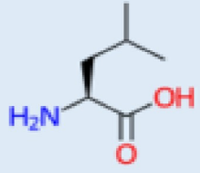
Alanine
Ala **A**



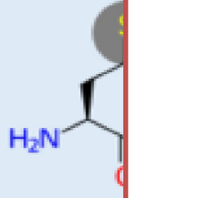
Valine
Val **V**



Isoleucine
Ile **I**



Leucine
Leu **L**



Methionine
Met **M**

Hy

Phenylalanine
Phe **F**

Tyrosine
Tyr **Y**

Tryptophan
Trp **W**

Hy

By

S.K.Sinha , Kota

Amino Acids

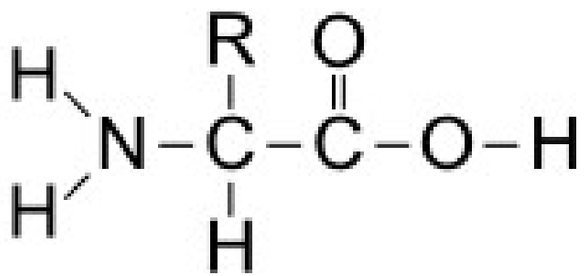
Amino acid: A compound that contains both an amino group and a carboxyl group.

α-Amino acid: An amino acid in which the amino group is on the carbon adjacent to the carboxyl group.

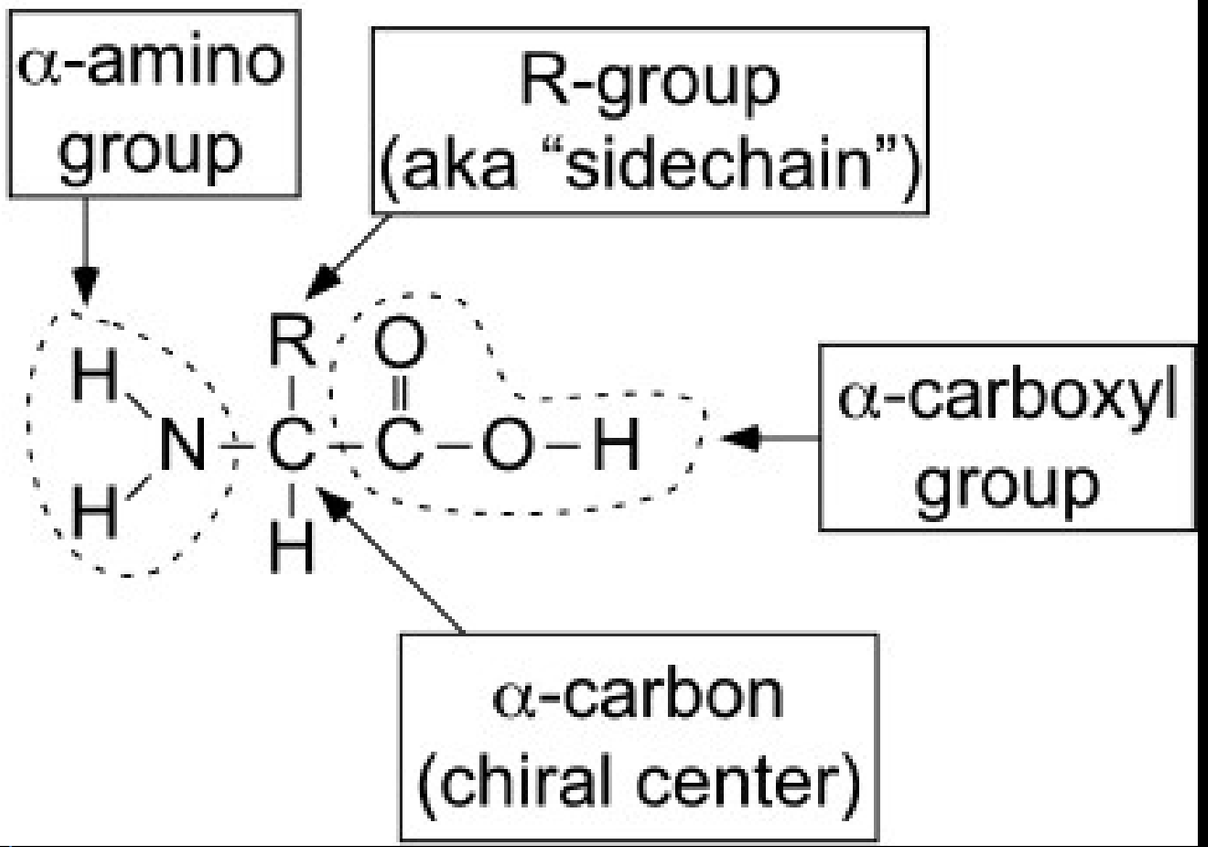
although α-amino acids are commonly written in the unionized form, they are more properly written in the zwitterion (internal salt) form.

Anatomy of an amino acid

General amino acid structure



Chemical anatomy of an amino acid



Anatomy of an amino acid

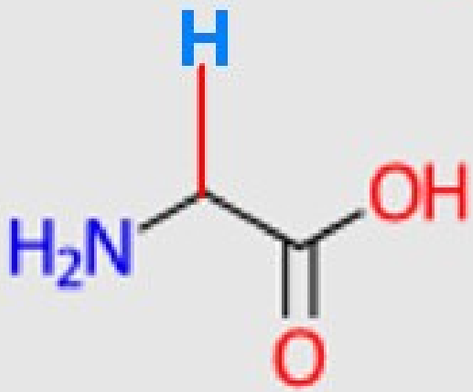
20 different amino acids occur in living cells.

4 chemical groups (composition of the R group):

- Acidic (negatively charged), (*n* = 2)
- Basic (positively charged), (*n* = 3)
- Neutral and polar, hydrophilic, (*n* = 6)
- Neutral and non-polar, hydrophobic, (*n* = 9)

Glycine

Acyclic HC.

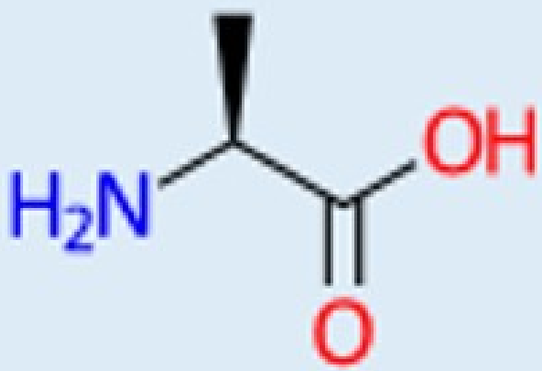


Glycine

Gly G

1. Hydrogen

Alanine



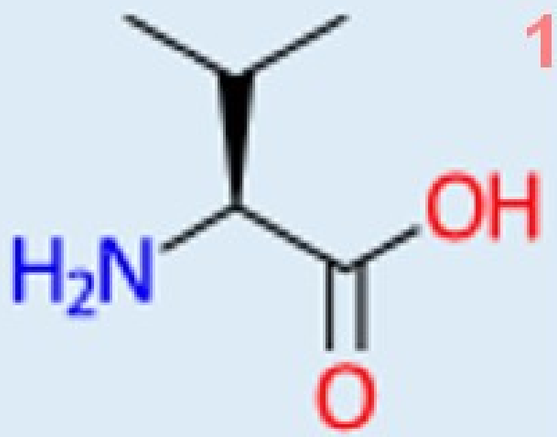
Alanine

Ala **A**

Acyclic HC.

1. Methyl

Valine



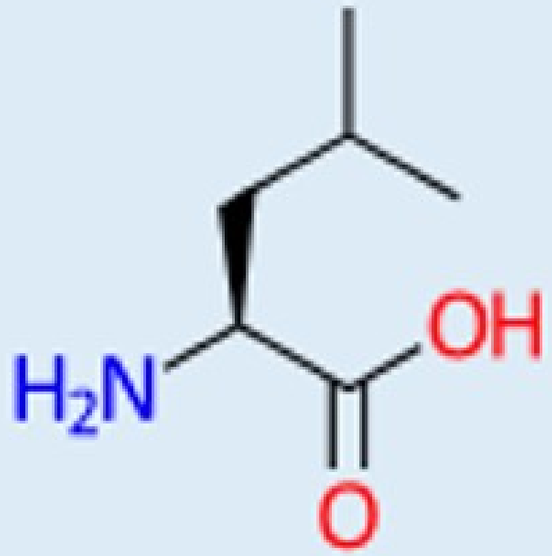
1. Acyclic HC.

Valine

Val **V**

1. Isopropyl

Leucine



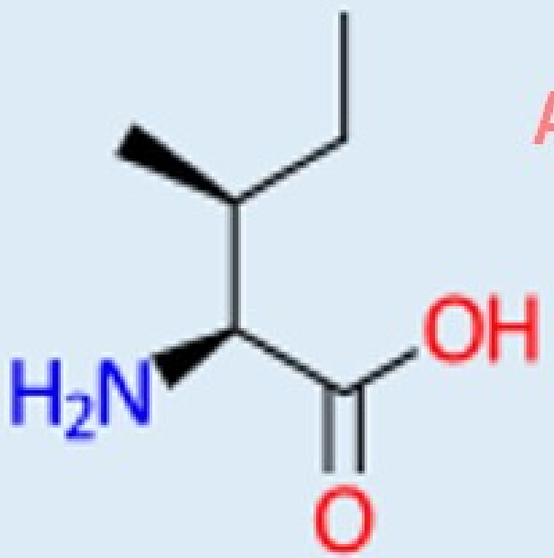
Acyclic HC

Leucine

Leu L

1. Isobutyl

Iso-leucine



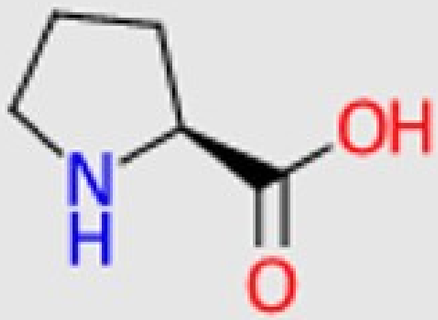
Acyclic HC.

Isoleucine

Ile I

1. Sec - Butyl

Proline



Cyclic HC.

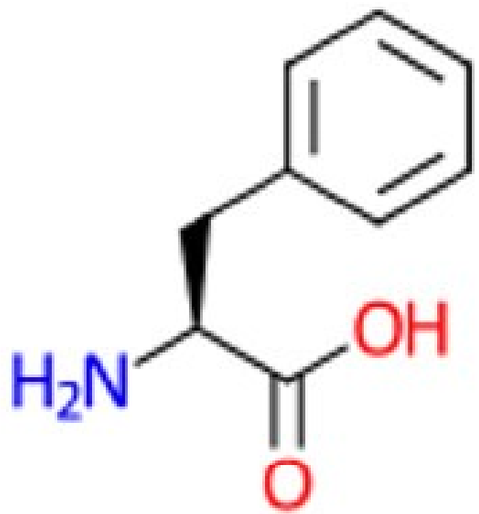
Proline

Pro **P**

1. Propyl in ring

PhenylAlanine

Aromatic



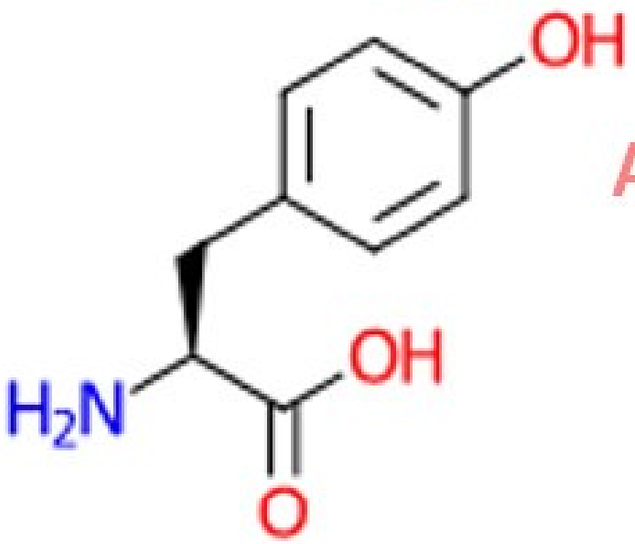
Phenylalanine

Phe F

1. Methyl
2. Benzene

Tyrosine

10.1

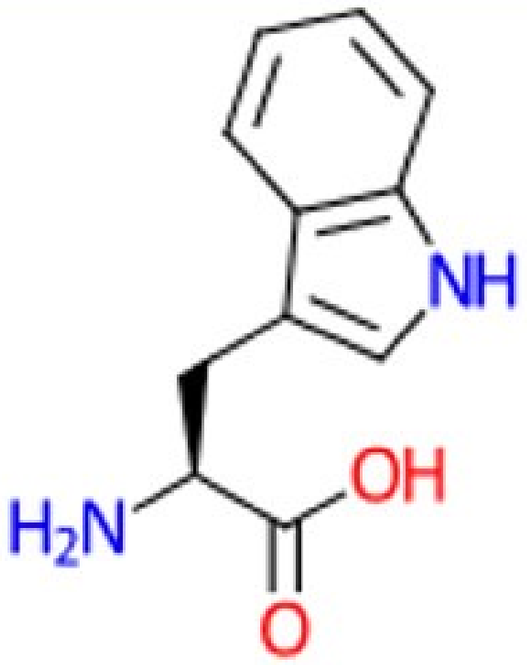


Tyrosine

Tyr **Y**

1. Methyl
2. p-Phenol

Tryptophan



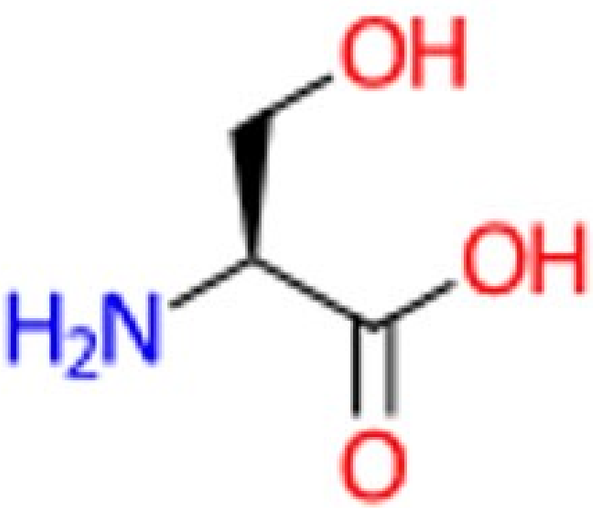
Aromatic

Tryptophan

Trp **W**

1. Methyl
2. 3-Indole

Serine

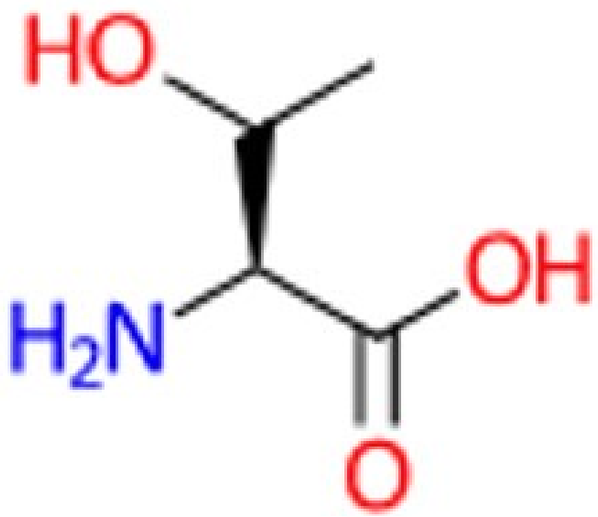


Serine

Ser **S**

1. Methyl
2. Hydroxy

Threonine

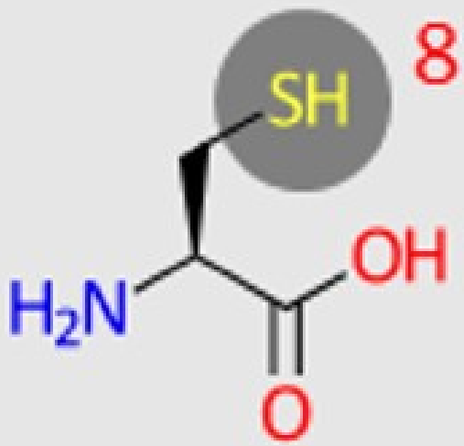


Threonine

Thr T

1. Ethyl
2. 1-Hydroxy

Cysteine



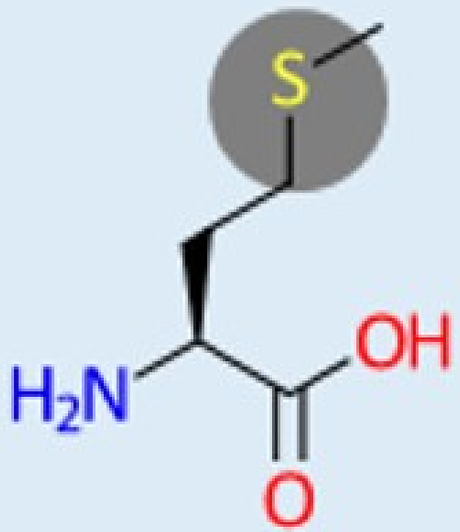
8.3 Sulphur

Cysteine

Cys C

1. Methyl
2. Thiol

Methionine



Sulphur

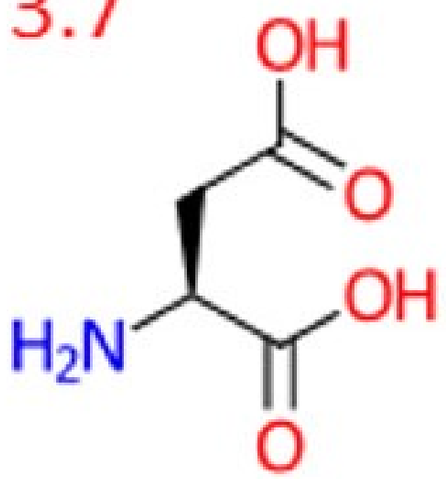
Methionine

Met **M**

1. Ethyl
2. Methylthio

Aspartic acid

3.7



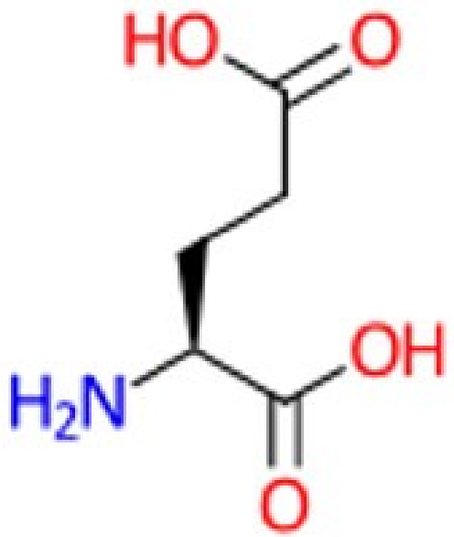
Acidic

Aspartic Acid

Asp **D**

1. Methyl
2. Carboxylic acid

Glutamic acid



4.2

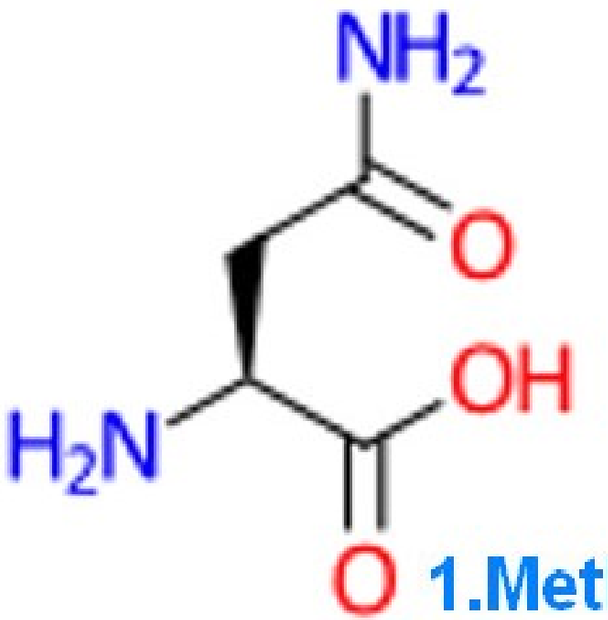
Acidic

Glutamic Acid

Glu **E**

1. Ethyl
2. Carboxylic Acid

Asparagine



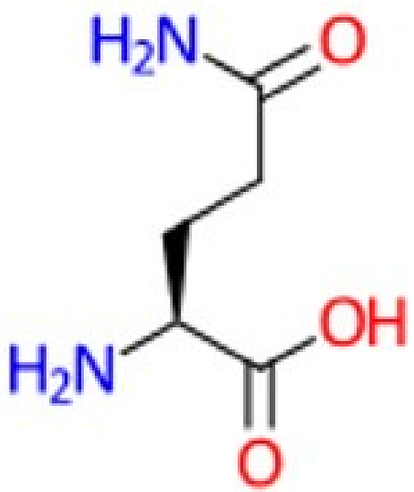
1.Methyl

2. Carboxamide

Asparagine

Asn **N**

Glutamine

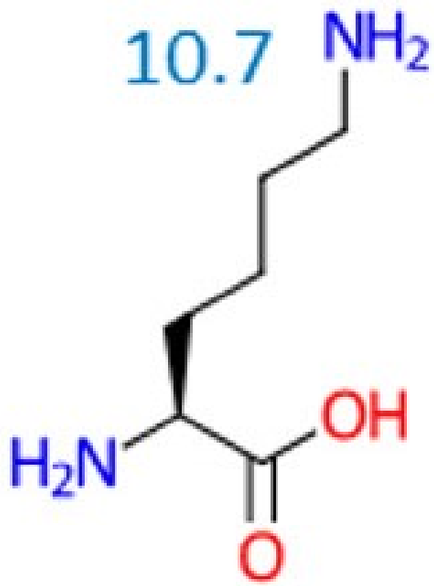


Glutamine

Gln **Q**

1. Ethyl
2. Carboxamide

Lysine



Basic

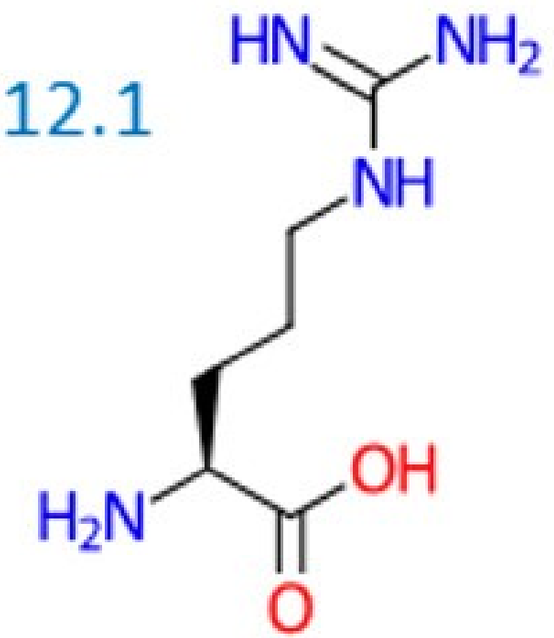
Lysine

Lys **K**

1. Butyl
2. Amine

Arginine

12.1



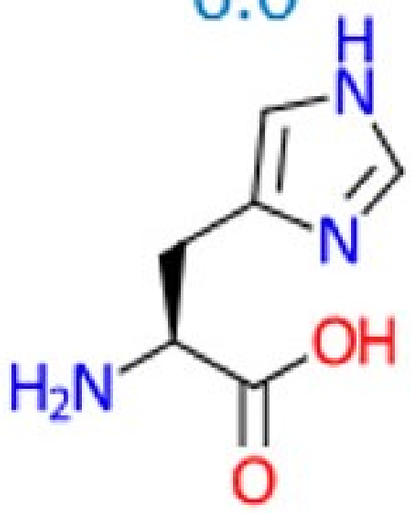
Arginine

Arg **R**

1. Propyl
2. Guanadine

Histidine

6.0



Basic

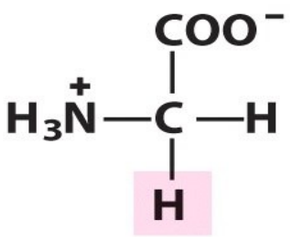
Histidine

His **H**

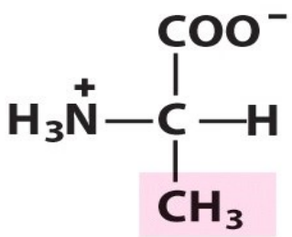
1. Methyl
2. Imidazole

The 20 Amino Acids

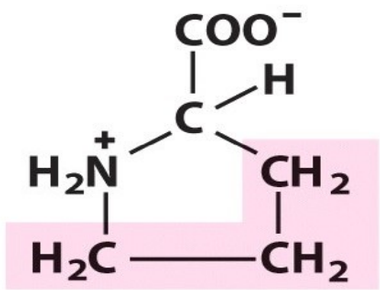
Nonpolar, aliphatic R groups



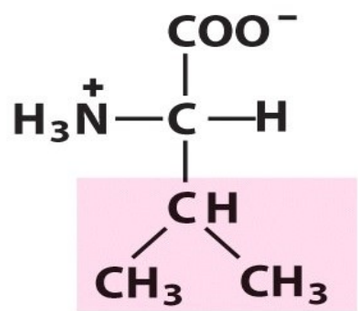
Glycine



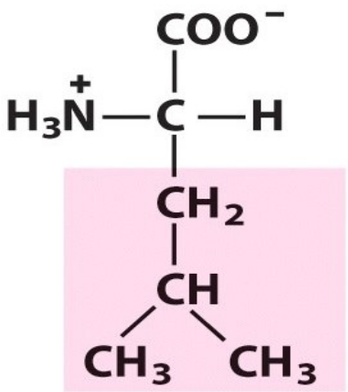
Alanine



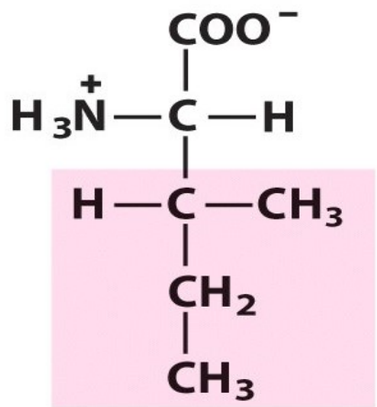
Proline



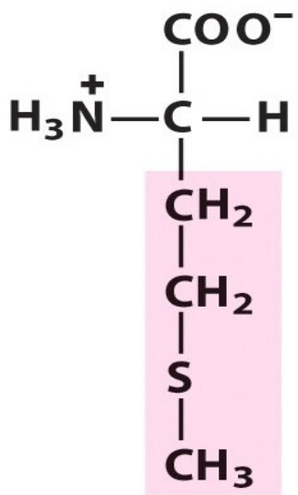
Valine



Leucine



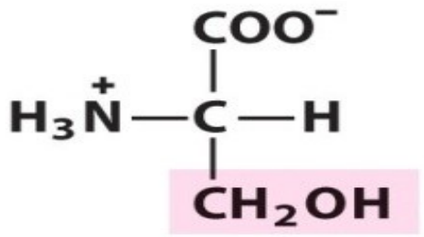
Isoleucine



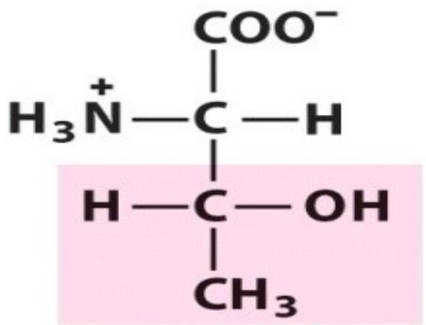
Methionine

The 20 Amino Acids

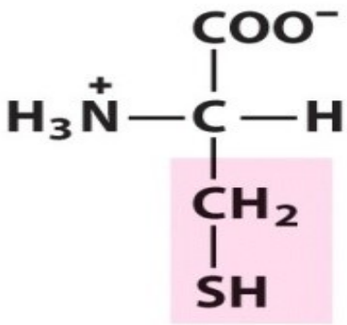
Polar, uncharged R groups



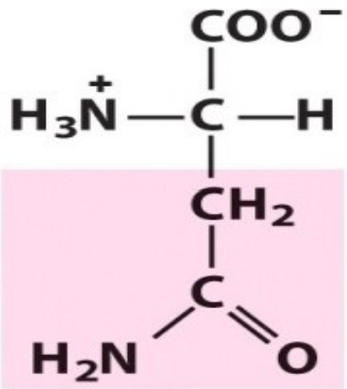
Serine



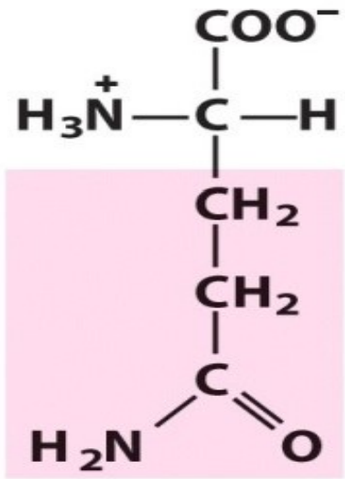
Threonine



Cysteine



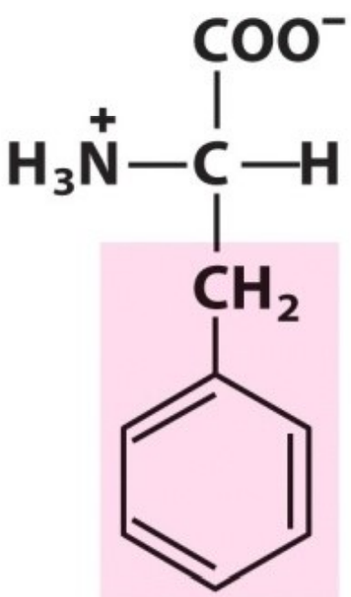
Asparagine



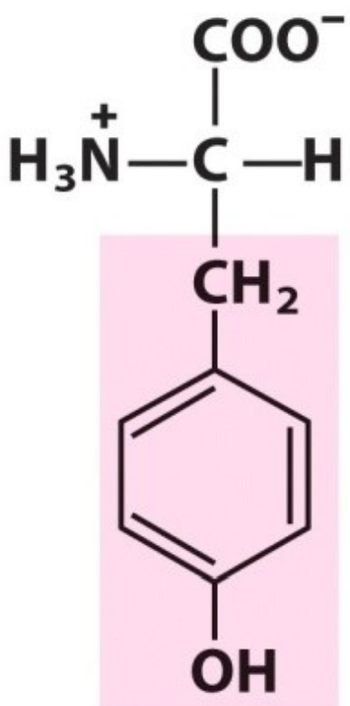
Glutamine

The 20 Amino Acids

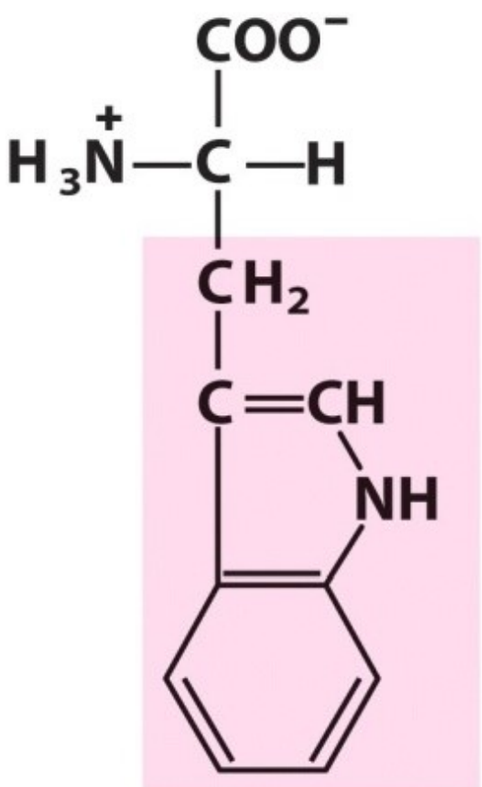
Aromatic R groups



Phenylalanine



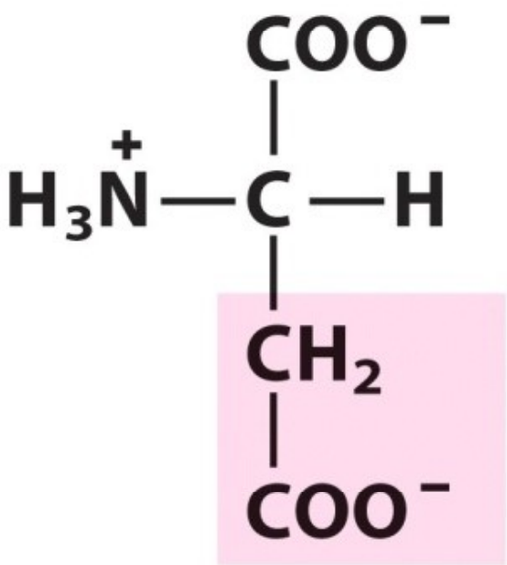
Tyrosine



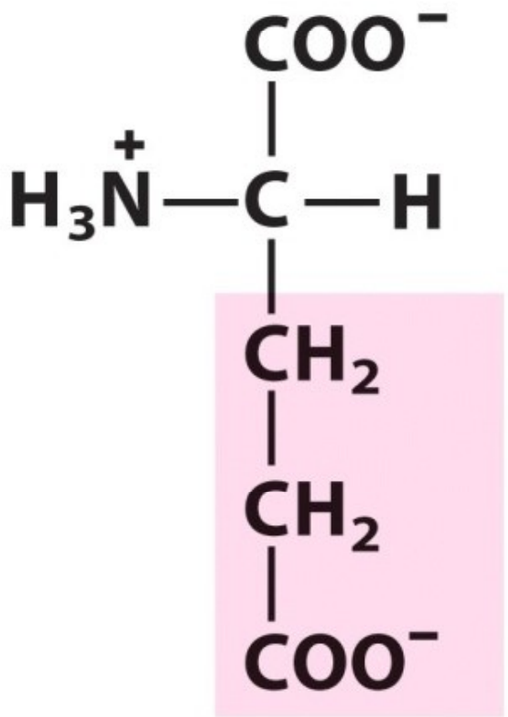
Tryptophan

The 20 Amino Acids

Negatively charged R groups

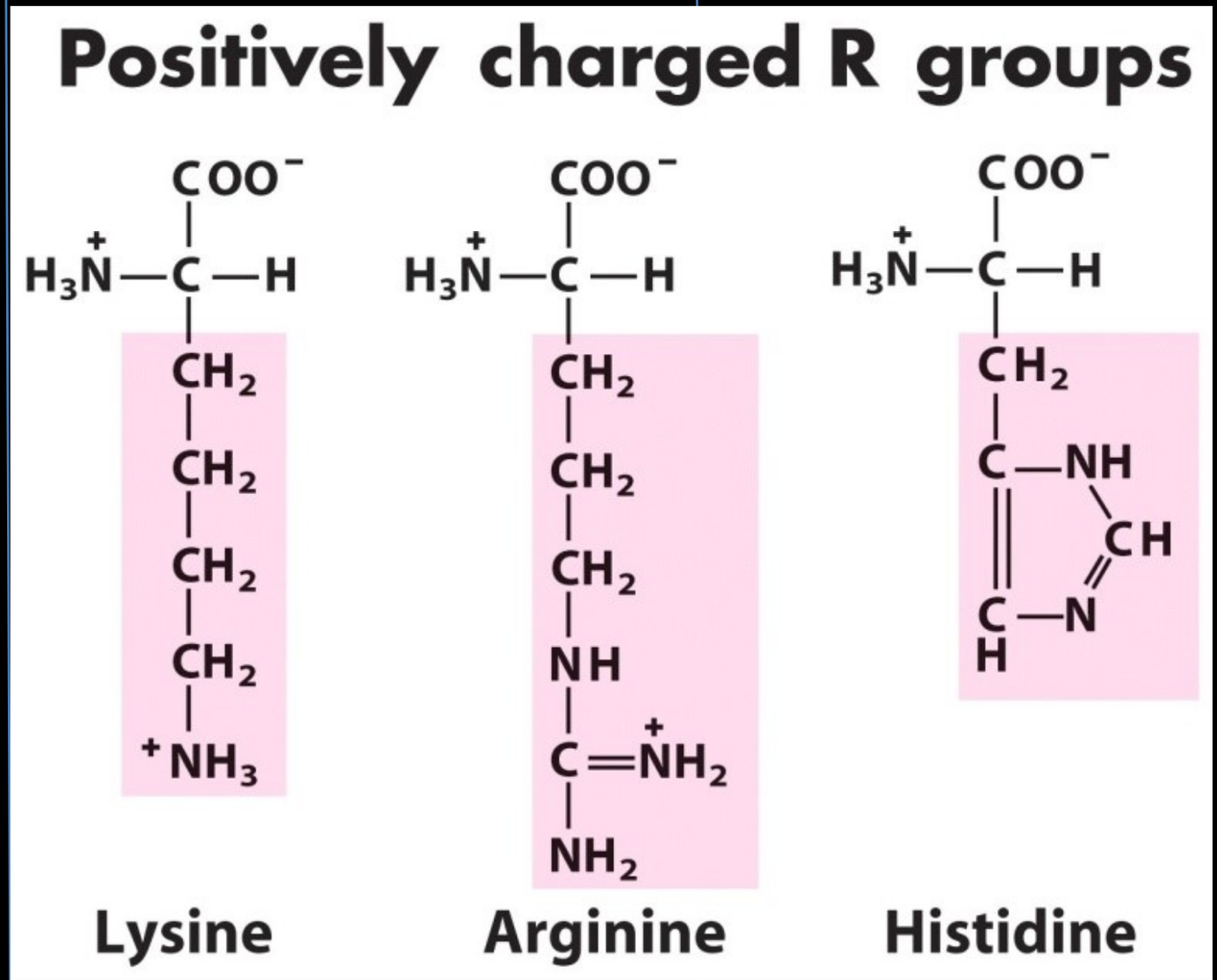


Aspartate



Glutamate

The 20 Amino Acids

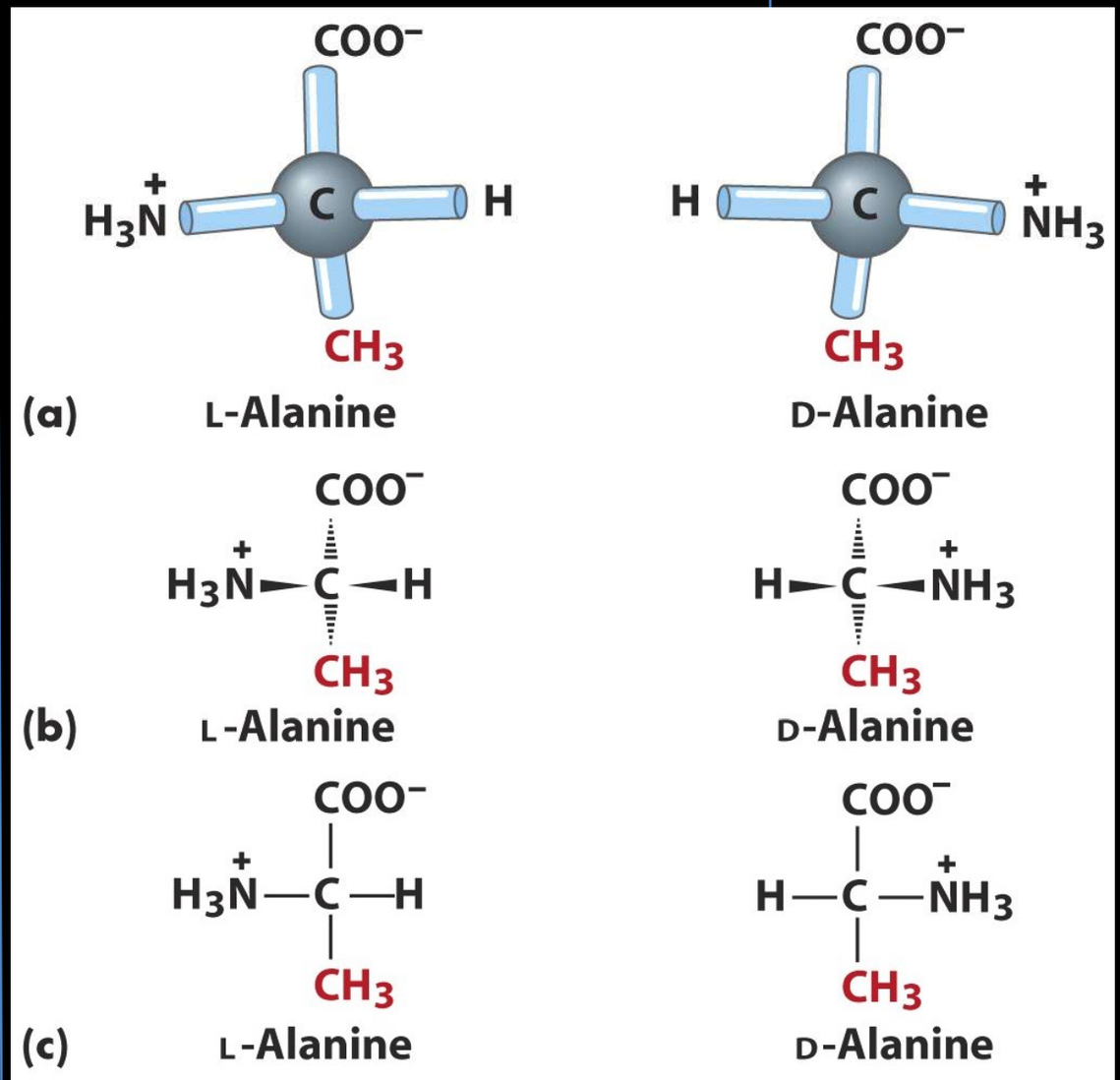


Essential amino acids

Ten amino acids are generally regarded as essential for humans:
A good memonic device for remembering these is "Private Tim Hall", abbreviated as:
PVT TIM HALL:

Valine, Leucine ,Isoleucine, Phenylalanine(Ph), Tryptophan(Ph), Threonine(OH), Methionine(s), Lysine(B), Arginine(B), Histidine(B),

Stereoisomers

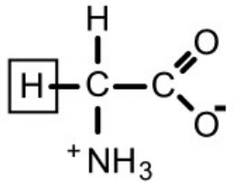


All amino acids in proteins are L-amino acids, except for

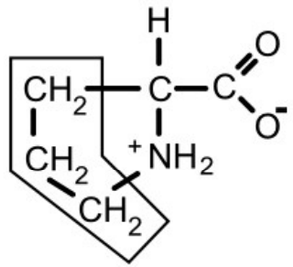
Glycine, which is achiral.

Non-polar amino acids

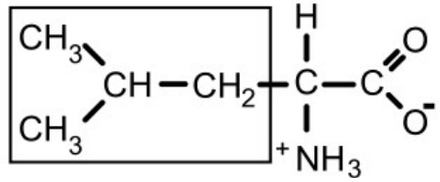
Glycine (Gly, G)



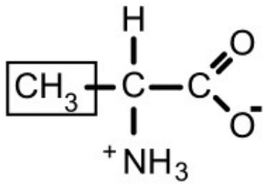
Proline (Pro, P)



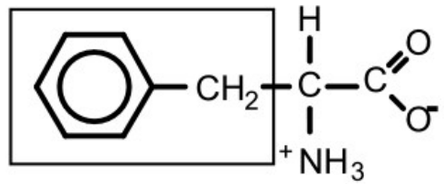
Leucine (Leu, L)



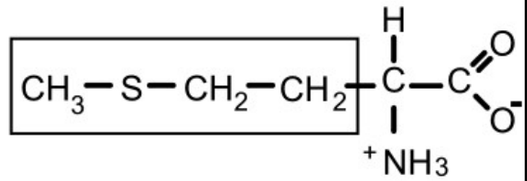
Alanine (Ala, A)



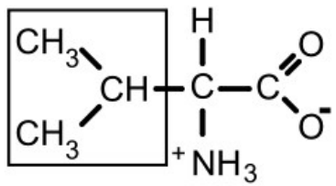
Phenylalanine (Phe, F)



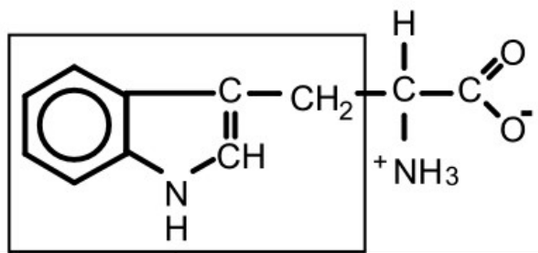
Methionine (Met, M)



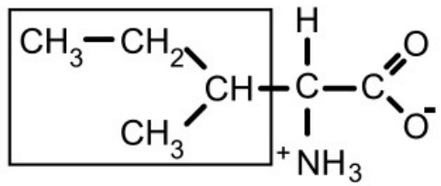
Valine (Val, V)



Tryptophan (Trp, W)

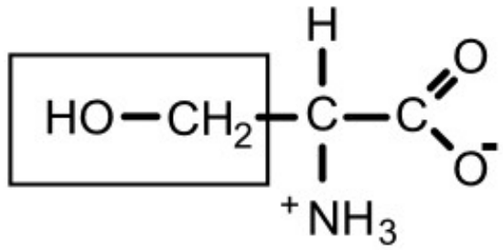


Isoleucine (Ile, I)

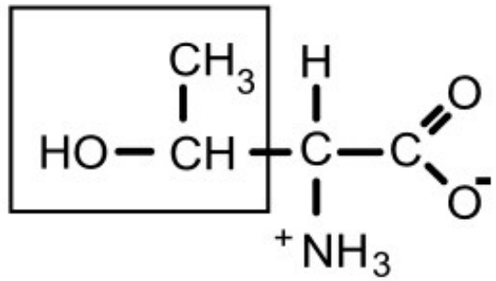


Polar, non-charged amino acids

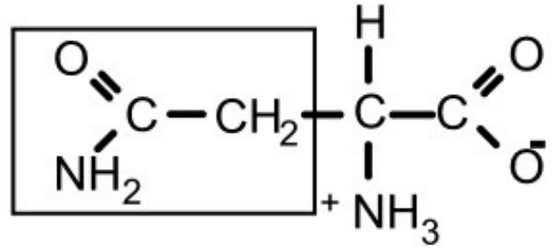
Serine (Ser, S)



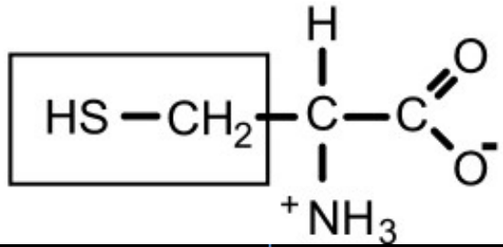
Threonine (Thr, T)



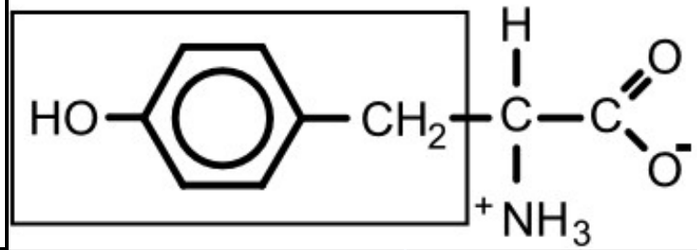
Asparagine (Asn, N)



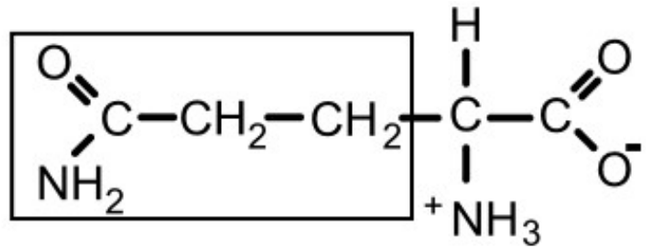
Cysteine (Cys, C)



Tyrosine (Tyr, Y)

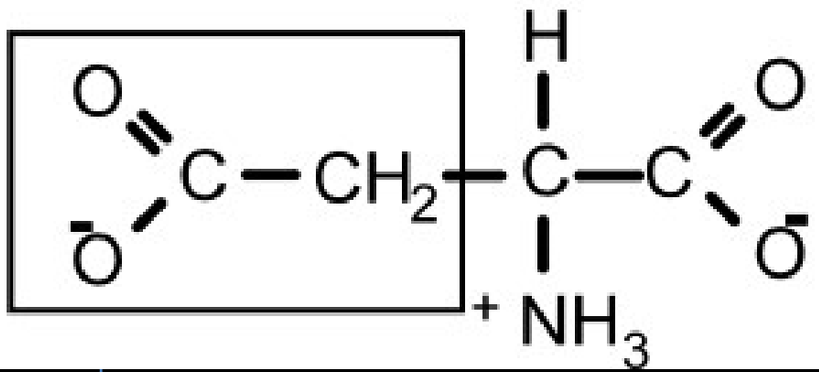


Glutamine (Gln, Q)

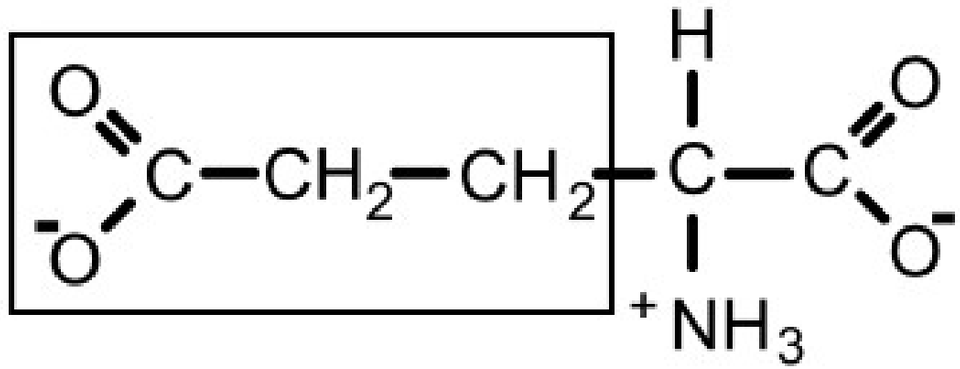


Acidic amino acids

Aspartate (Asp, D)

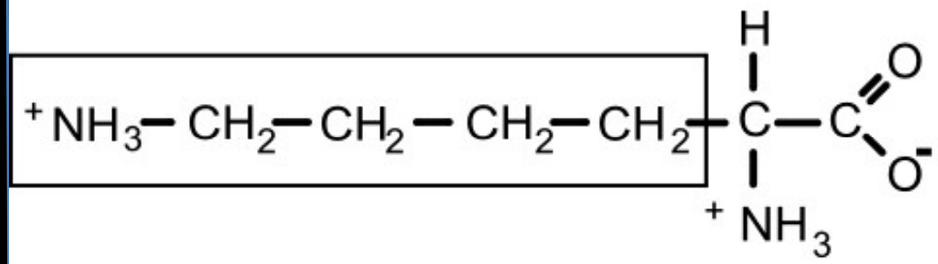


Glutamate (Glu, E)

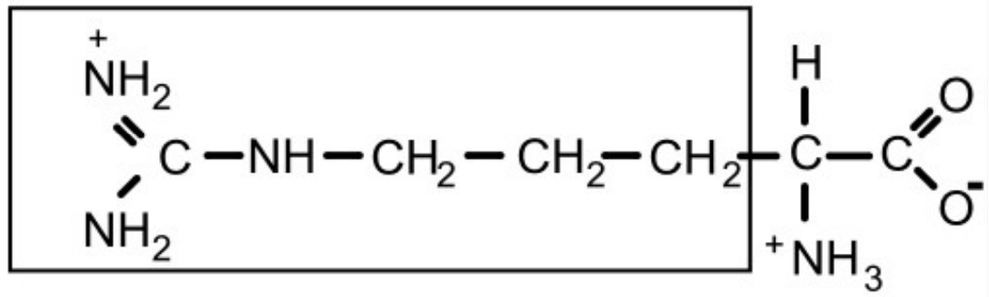


Basic amino acids

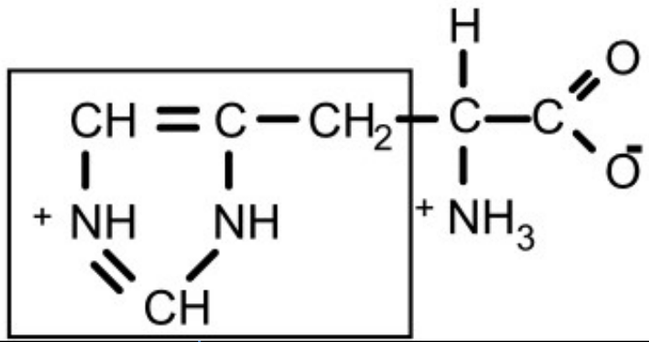
Lysine (Lys, K)



Arginine (Arg, R)



Histidine (His, H)
(protonated form)



Aromatic amino acids

To different degrees, all aromatic amino acids absorb ultraviolet light.
Tryptophan is responsible for most of the **absorbance** of ultraviolet light by proteins.
Tyrosine and tryptophan absorb more than do **phenylalanine**.

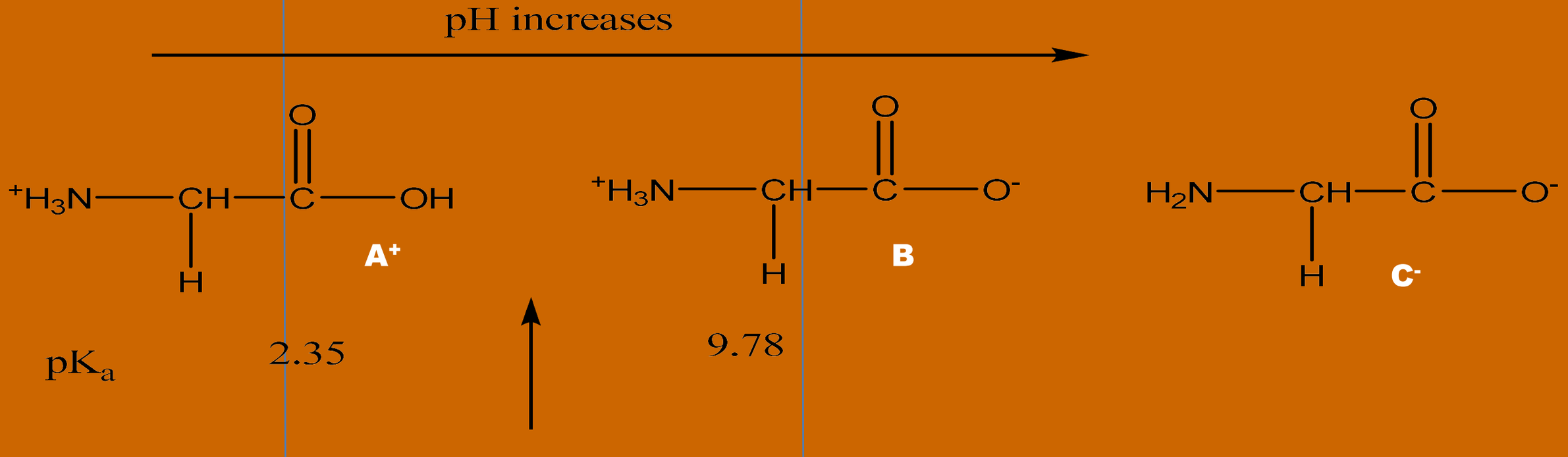
Isoelectric Point

Isoelectric Point

Isoelectric point (pI): pH at which an amino acid, polypeptide, or protein has a **total charge** of zero.

The pI for glycine, for example, falls between the pK_a values for the carboxyl and amino groups.

Isoelectric Point



Isoelectric Point of glycine

Again

$$pI = \frac{1}{2}\left(pK_a\ \alpha\text{–}COOH + pK_a\ \alpha\text{–}NH_3^+\right)$$

$$= \frac{1}{2}(2.35 + 9.78) = 6.06$$

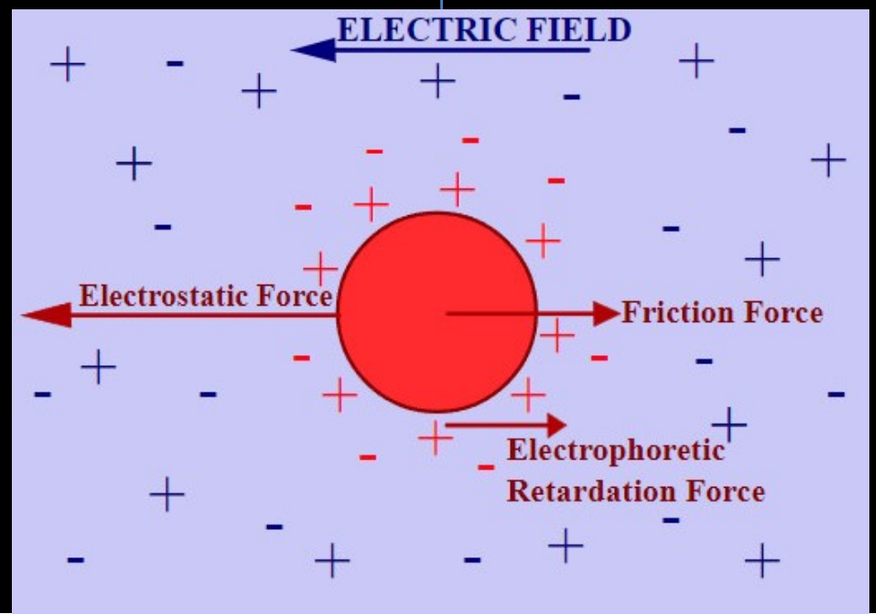
Isoelectric Point

Acidic Side Chains	pK_a of α–COOH	pK_a of α–NH_3^+	pK_a of Side Chain	pI
aspartic acid	2.10	9.82	3.86	2.98
glutamic acid	2.10	9.47	4.07	3.08
cysteine	2.05	10.25	8.00	5.02
tyrosine	2.20	9.11	10.07	5.63

Basic Side Chains	pK_a of α–COOH	pK_a of α–NH_3^+	pK_a of Side Chain	pI
arginine	2.01	9.04	12.48	10.76
histidine	1.77	9.18	6.10	7.64
lysine	2.18	8.95	10.53	9.74

Electrophoresis

Electrophoresis: The process of separating compounds on the basis of their electric charge. Electrophoresis of amino acids can be carried out using paper, starch, polyacrylamide and agarose gels, and cellulose acetate as solid supports.



Ninhydrin

The reagent commonly used to detect amino acid is ninhydrin.