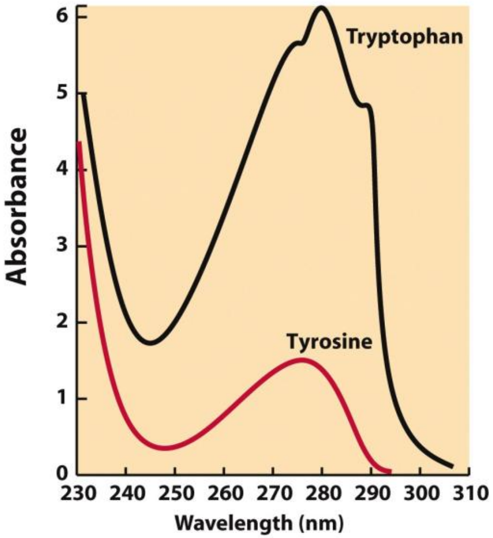
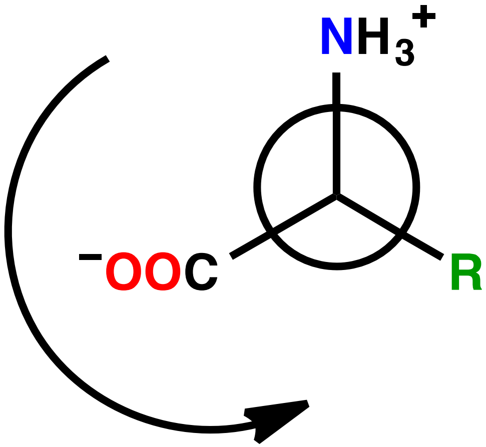
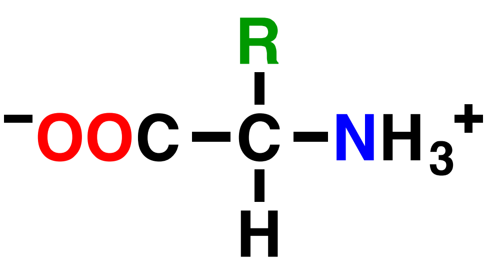




Amino Acids

BCHE 7200 Advanced Biochemistry I

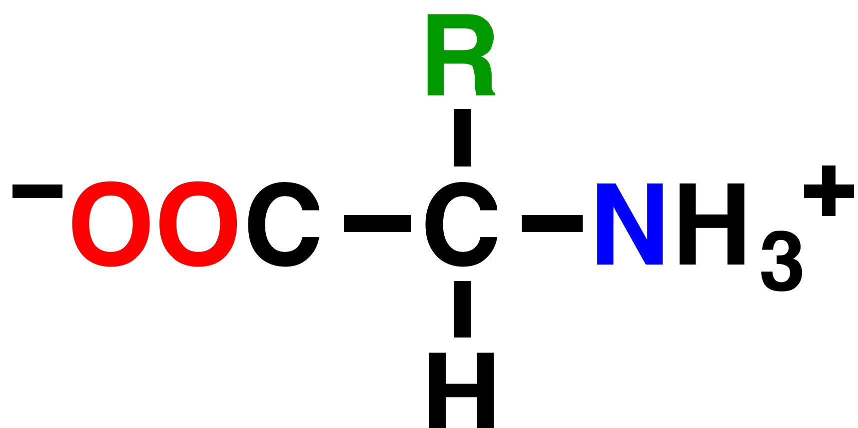
Lecture 4



$$E = E° - \frac{RT}{nF}\ln\frac{[A_{red}]}{[A_{ox}]}$$

α-Amino Acids

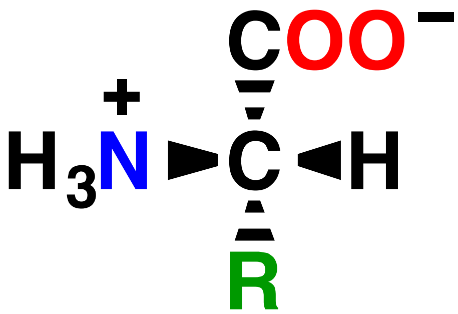
- Proteins are composed of amino acids
- 20 canonical amino acids
- Differ in identity of R group



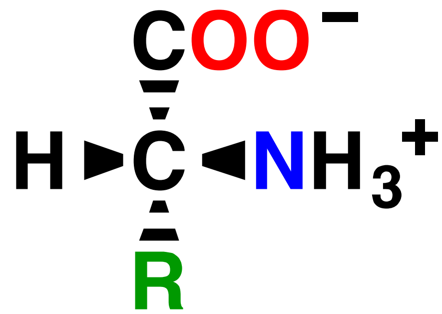
Why α?

Stereochemistry of Amino Acids

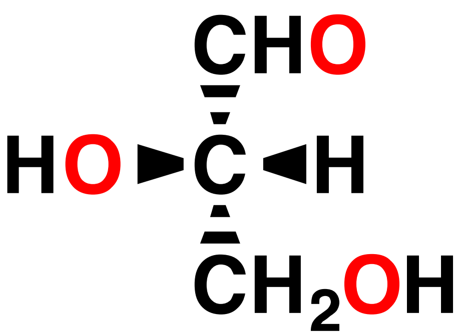
- D,L System (Emil Fisher)



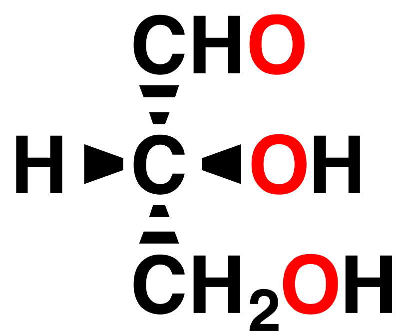
L-Amino Acid



D-Amino Acid

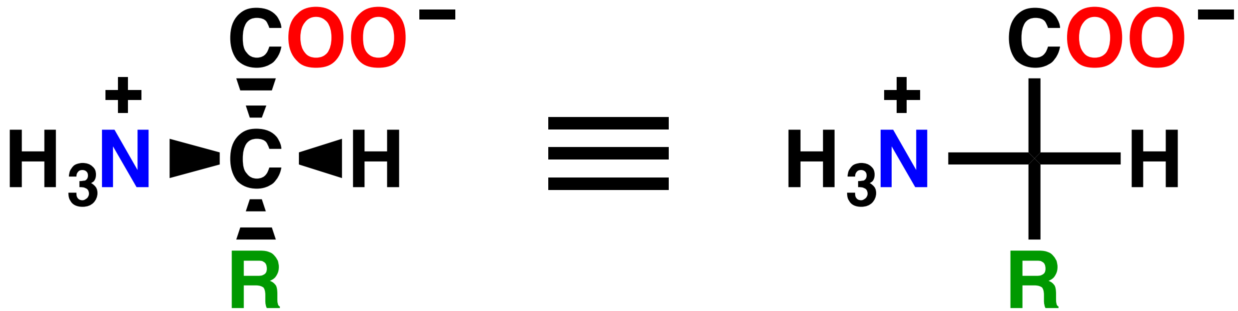


L-Glyceraldehyde



D-Glyceraldehyde

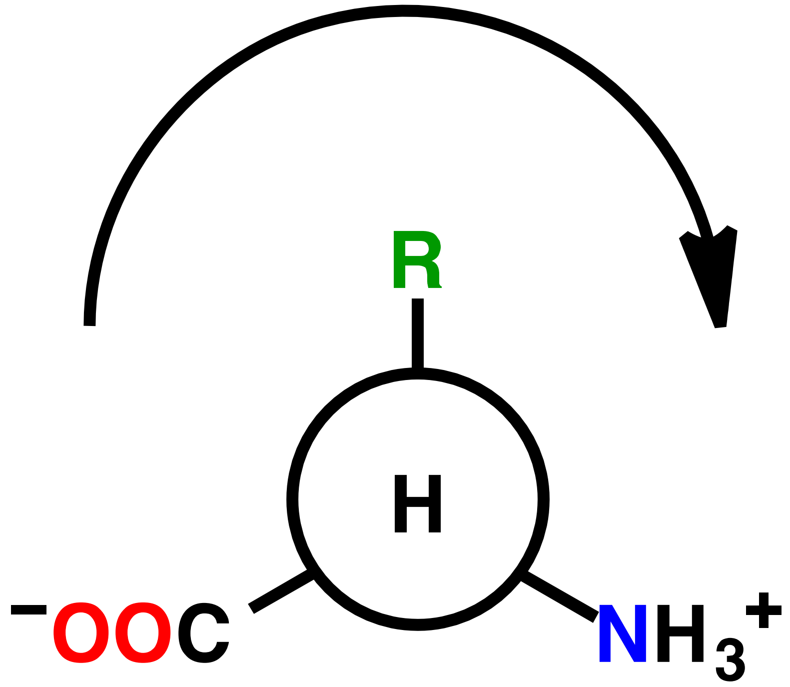
Fisher Projection



L-Amino Acid

- Amino acids in proteins have the L-configuration

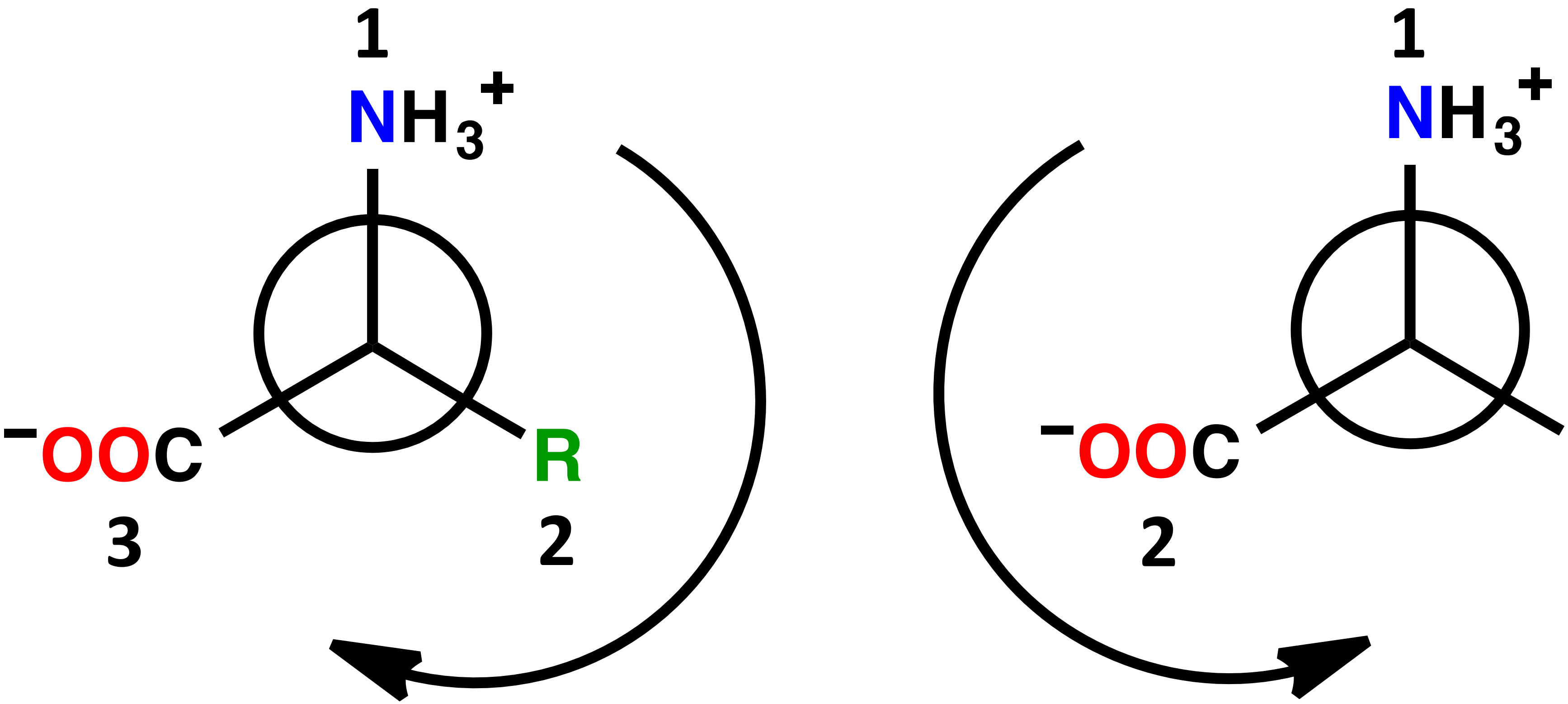
Newman Projection



‘CORN’

L-Amino Acid

D,L vs. *R*,*S* System



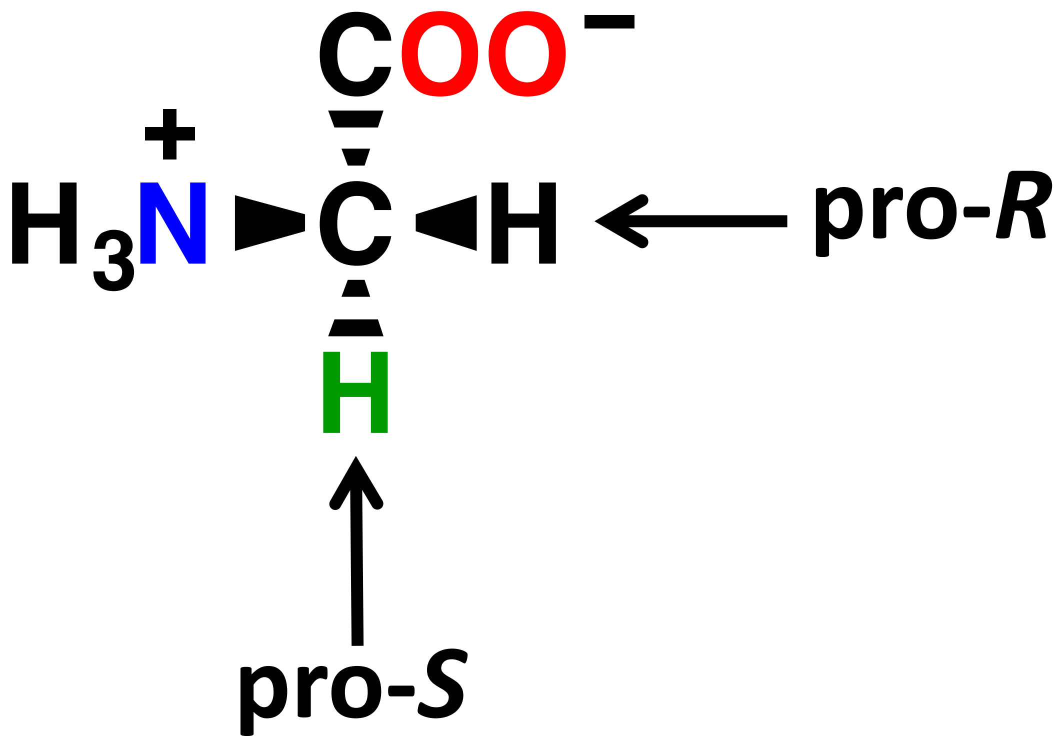
R-configuration

S-configuration

- Most L-amino acids also have the *S*-configuration (except cysteine)

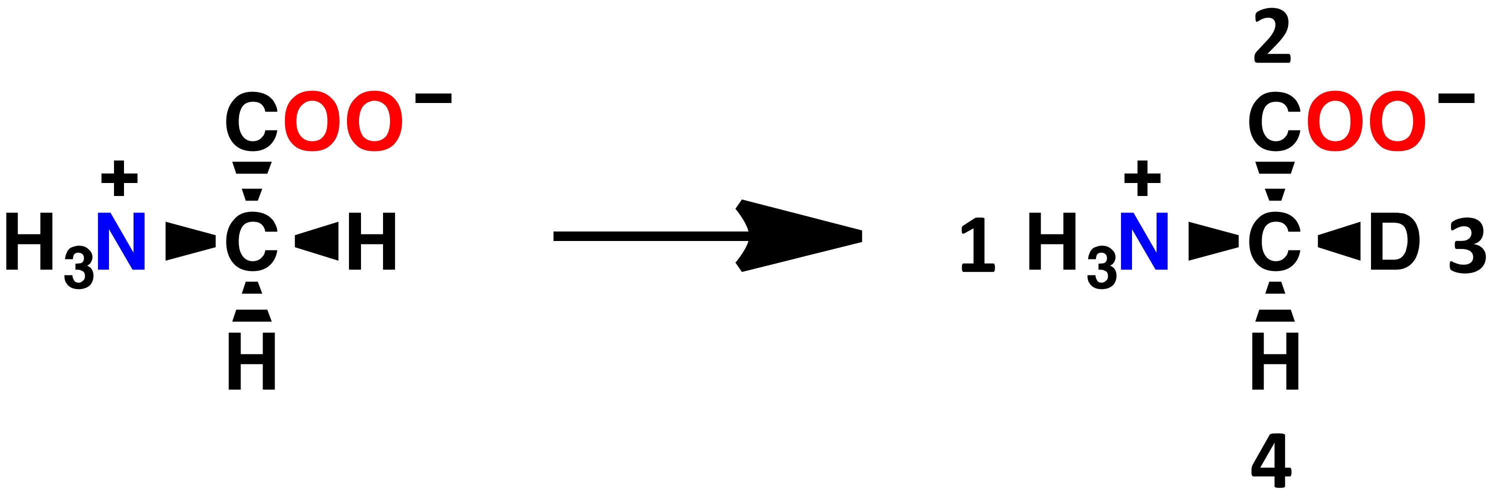
Prochirality

Glycine



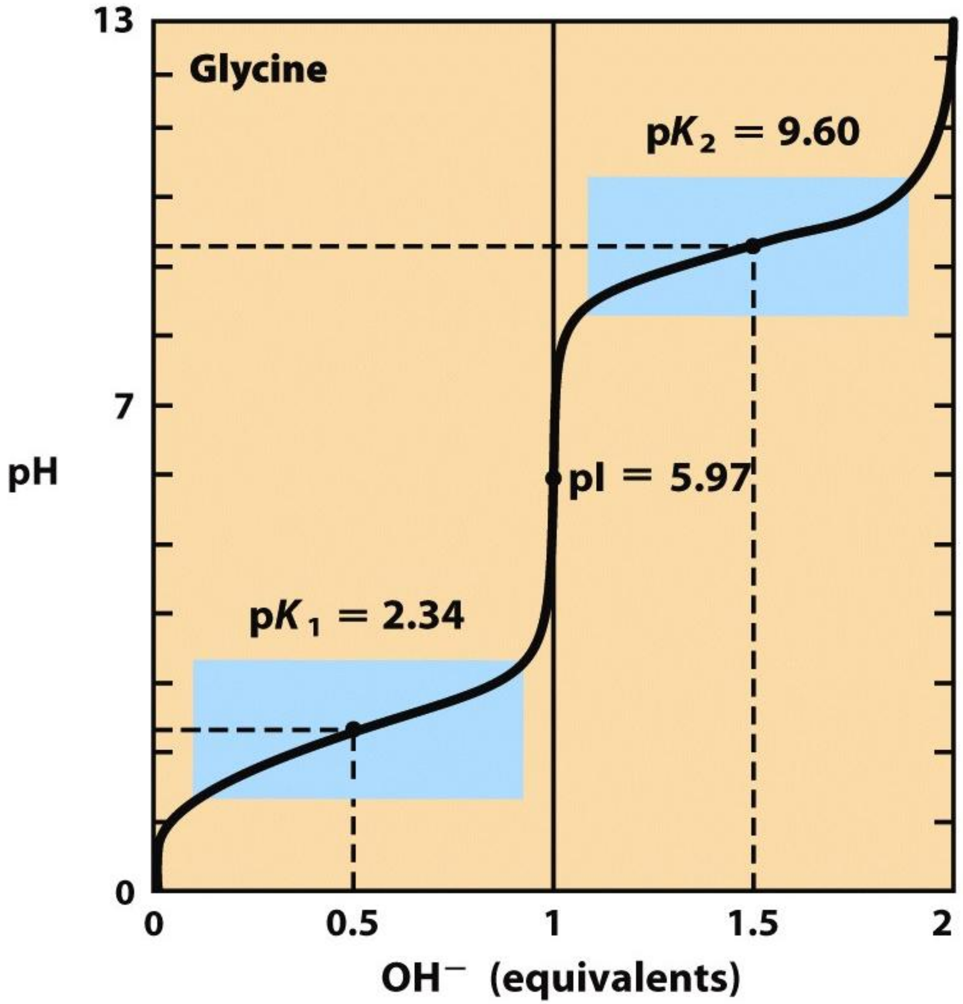
- Does the α-carbon have the *R*- or *S*-configuration?

How to Determine pro-*R* or pro-*S*?



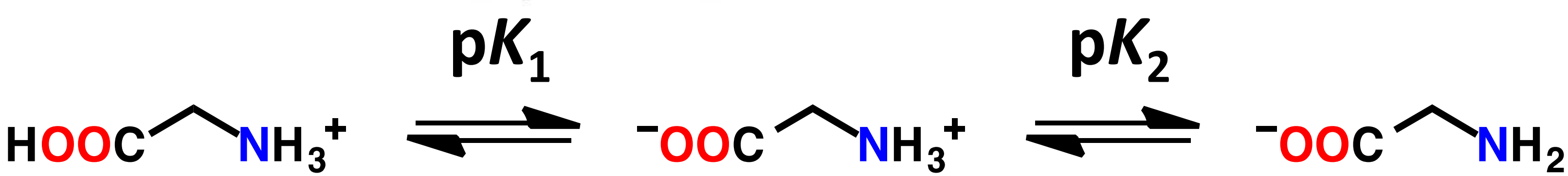
- Substitute one H with D
- Assign priorities and determine *R* or *S*
- If *R*, H substituted with D was pro-*R*
- If *S*, H substituted with D was pro-*S*

Titration Curve of Glycine

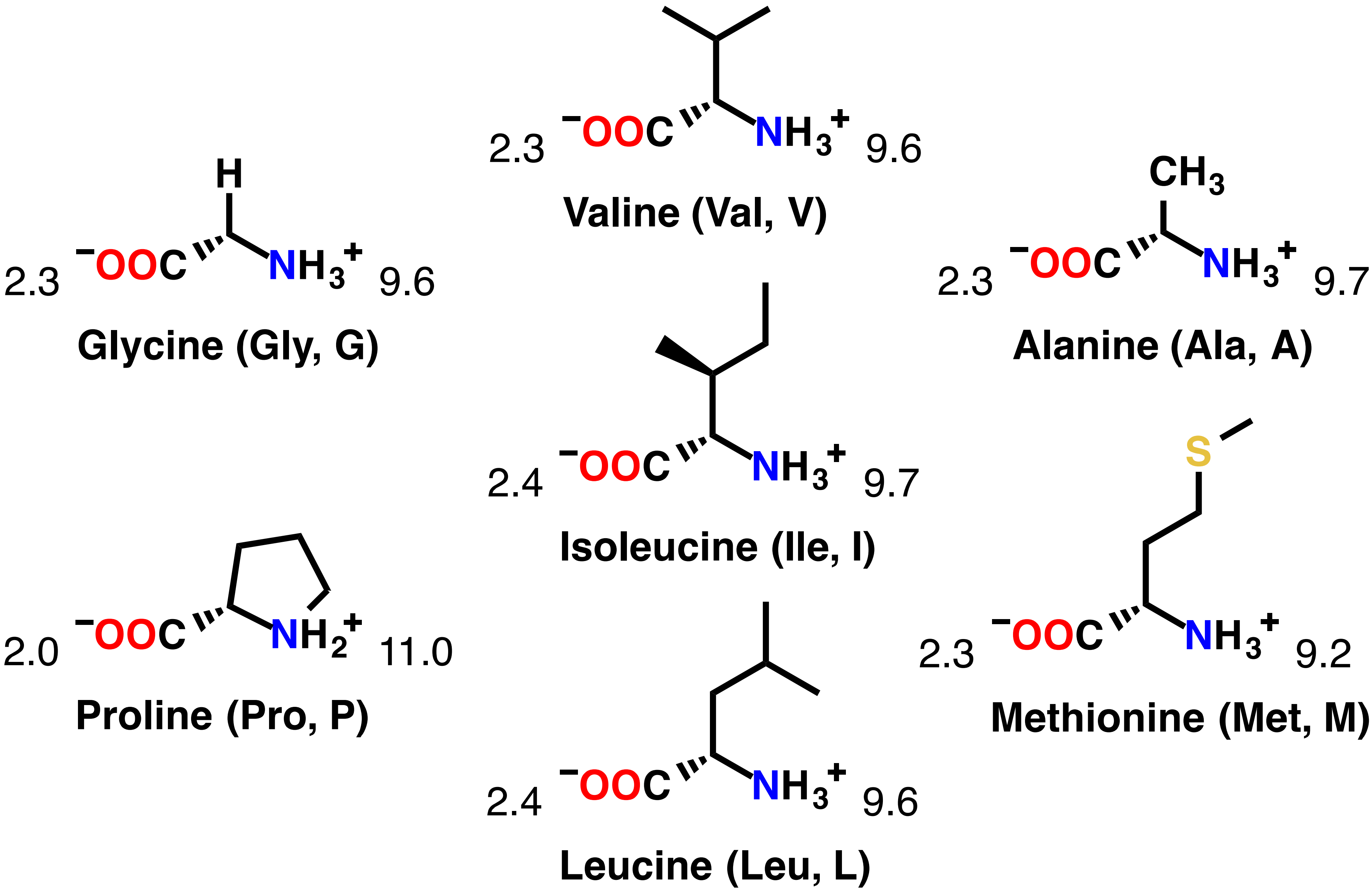


$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

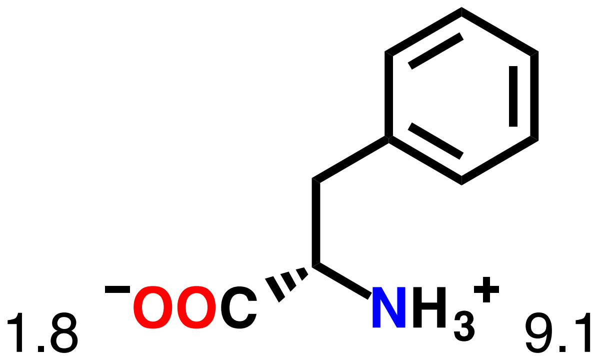
pI: isoelectric point, pH where there is no net charge



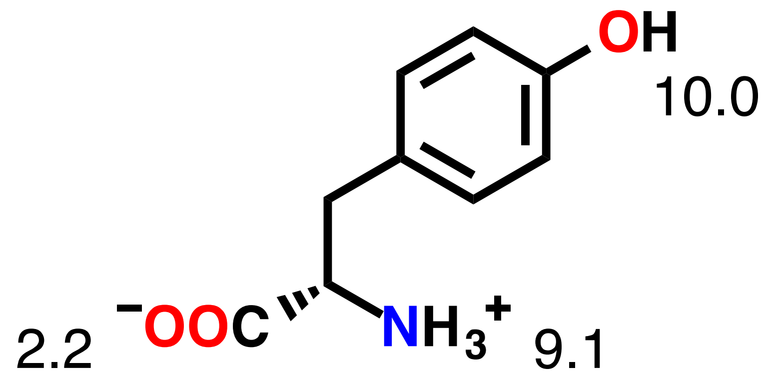
Nonpolar Aliphatic R Groups



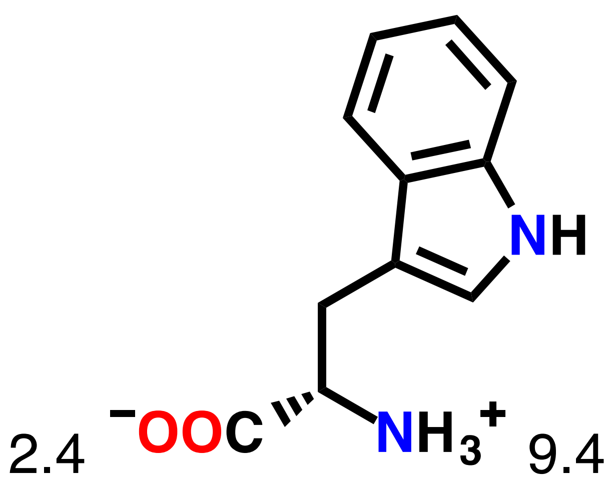
Aromatic R Groups



Phenylalanine (Phe, F)



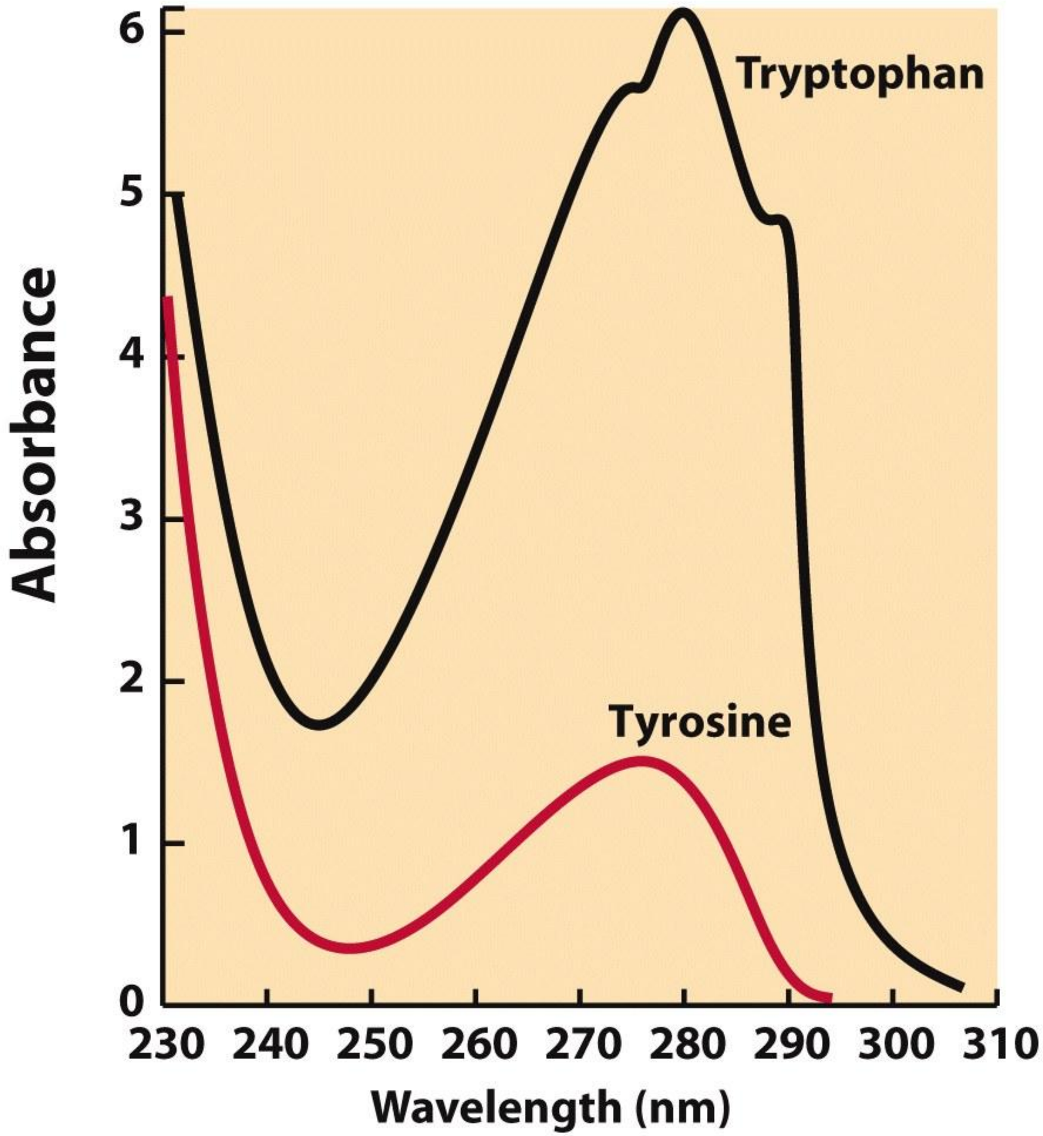
Tyrosine (Tyr, Y)



Tryptophan (Trp, W)

Nonpolar aliphatic and aromatic residues often found in protein interiors

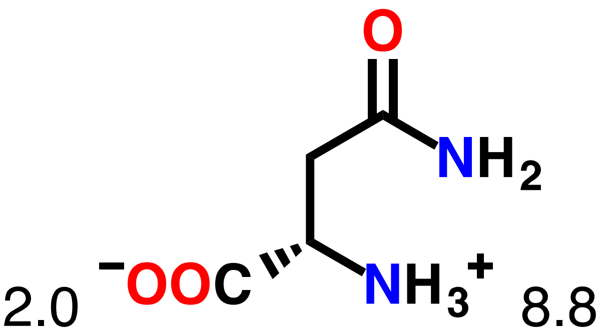
Absorption Spectrum of Amino Acids



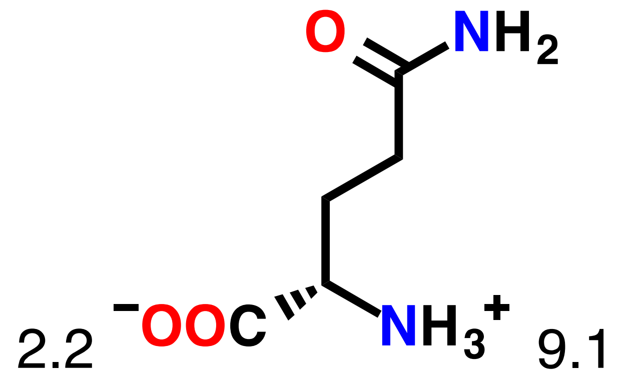
Beer's Law

$$A = \varepsilon l c$$

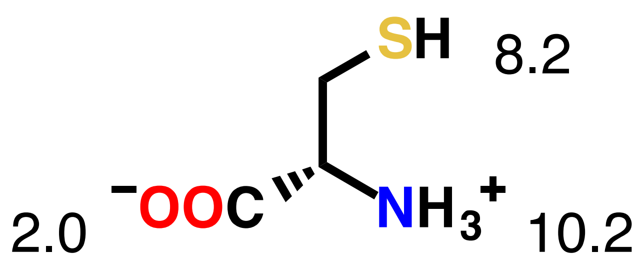
Polar Uncharged R Groups



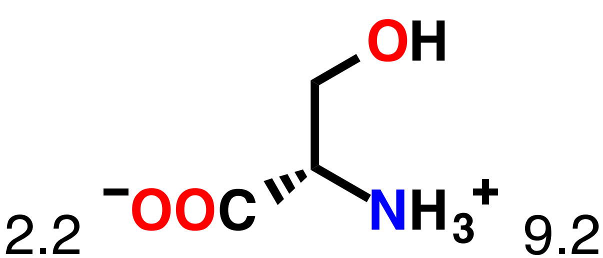
Asparagine (Asn, N)



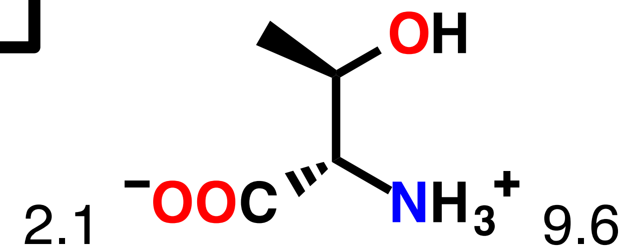
Glutamine (Gln, Q)



Cysteine (Cys, C)

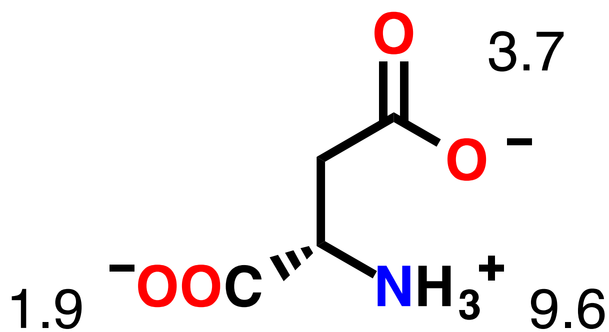


Serine (Ser, S)

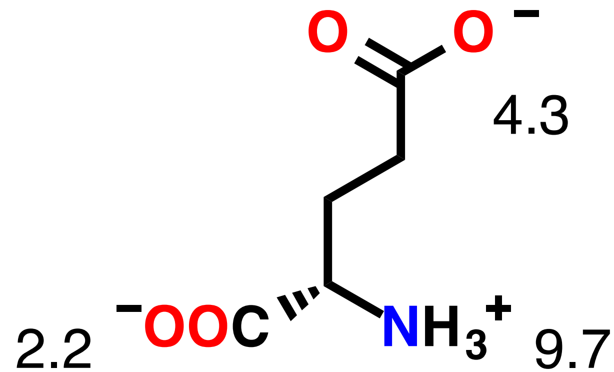


Threonine (Thr, T)

Negatively Charged R Groups

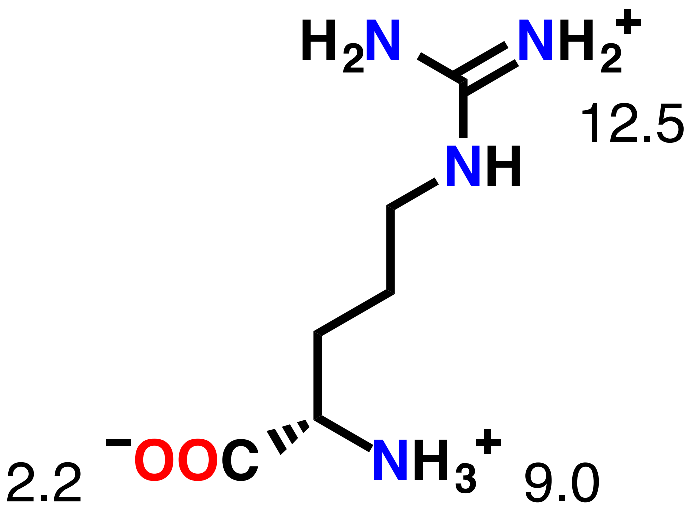


Aspartate (Asp, D)

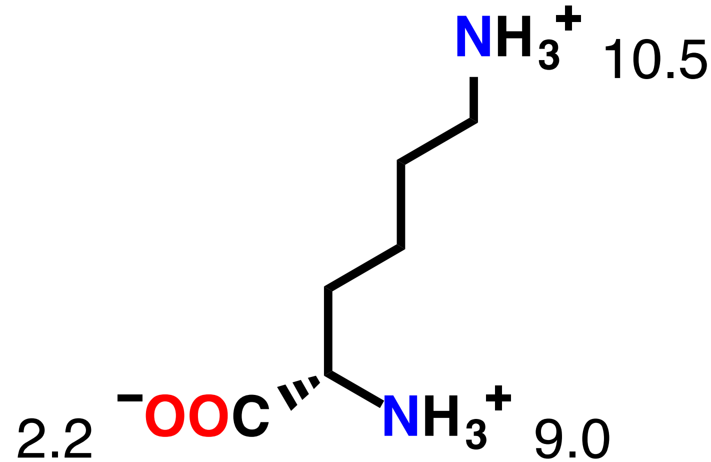


Glutamate (Glu, E)

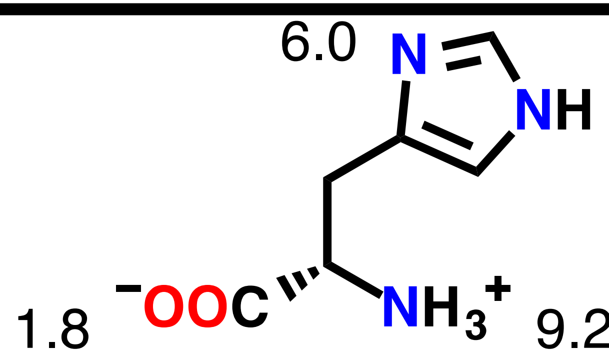
Positively Charged R Groups



Arginine (Arg, R)

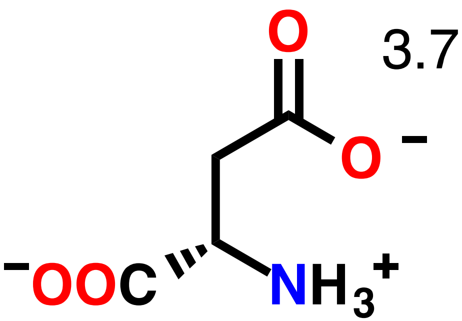


Lysine (Lys, K)

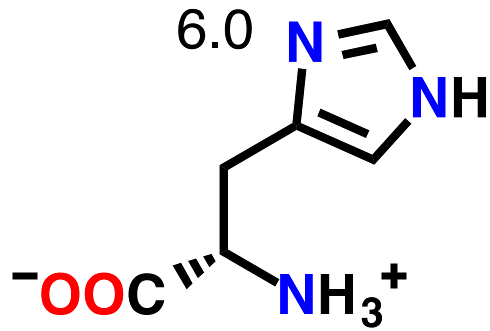


Histidine (His, H)

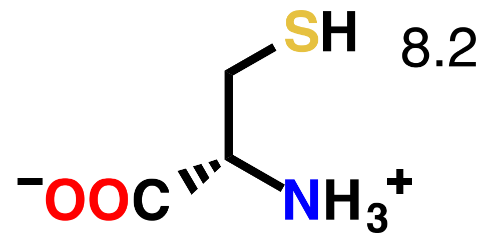
Acid-Base Residues



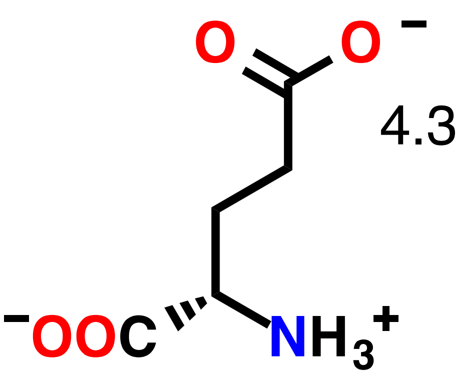
Aspartate (Asp, D)



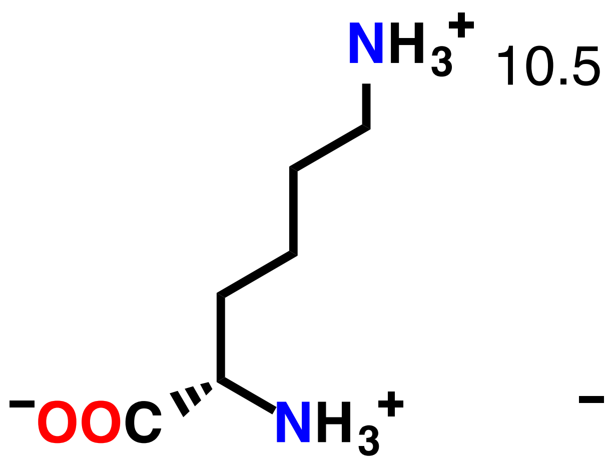
Histidine (His, H)



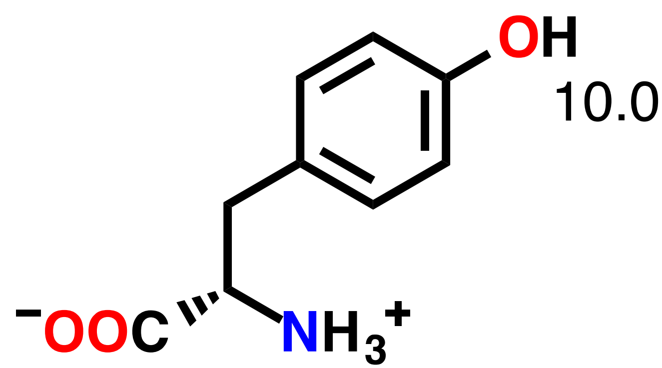
Cysteine (Cys, C)



Glutamate (Glu, E)

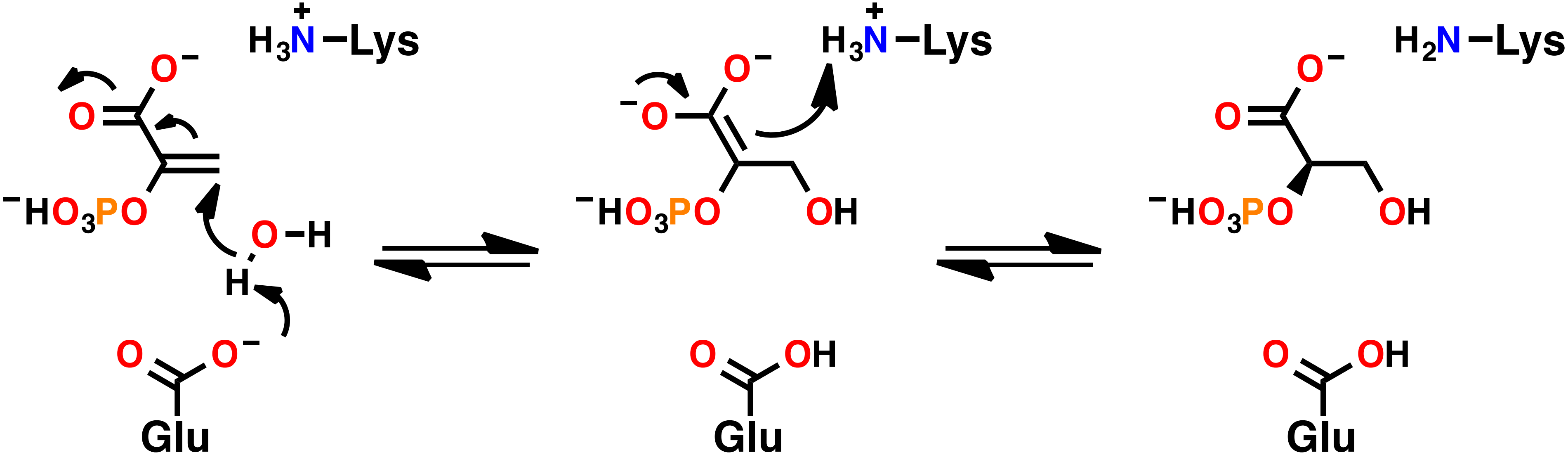


Lysine (Lys, K)



Tyrosine (Tyr, Y)

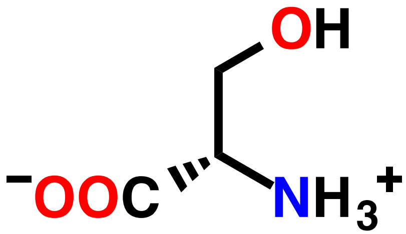
Microscopic Reversibility



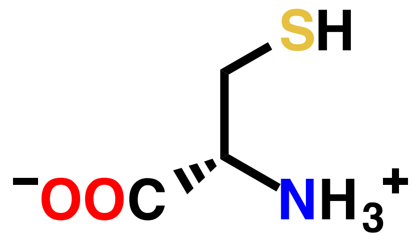
Enolase

Reverse Protonated Form

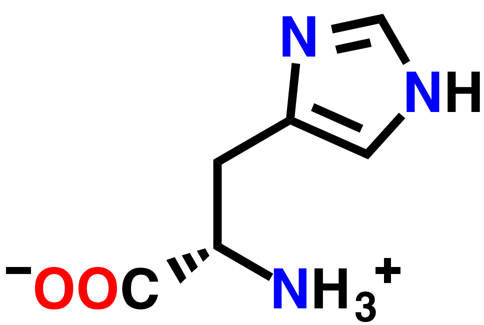
Nucleophiles



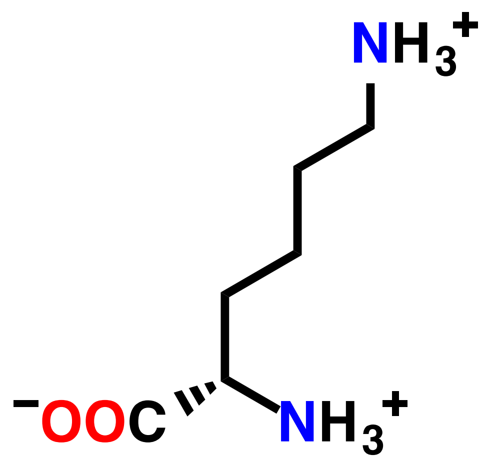
Serine (Ser, S)



Cysteine (Cys, C)



Histidine (His, H)

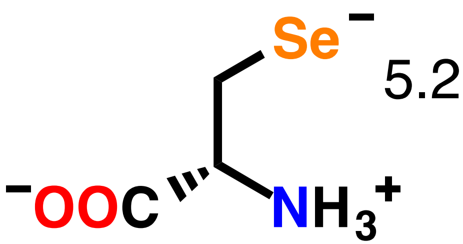


Lysine (Lys, K)

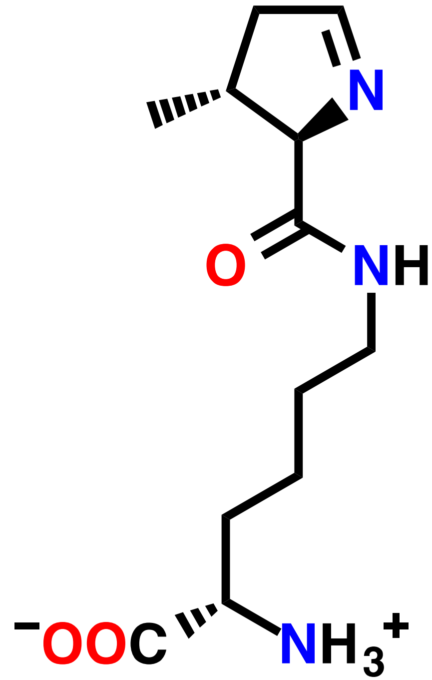
Non-standard Amino Acids

Nucleophile
Acid-base

Electrophile



Selenocysteine (Sec, U)

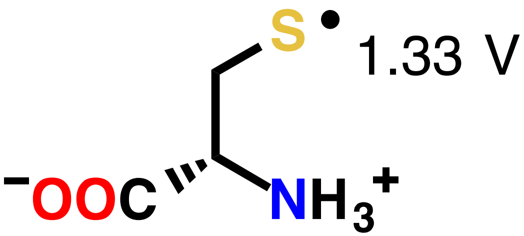


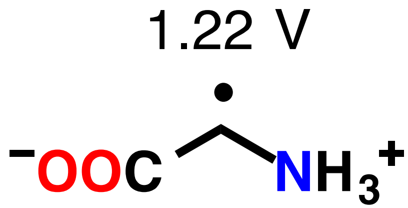
Pyrrolysine (Pyl, O)

Opal (UGA) stop codon suppression

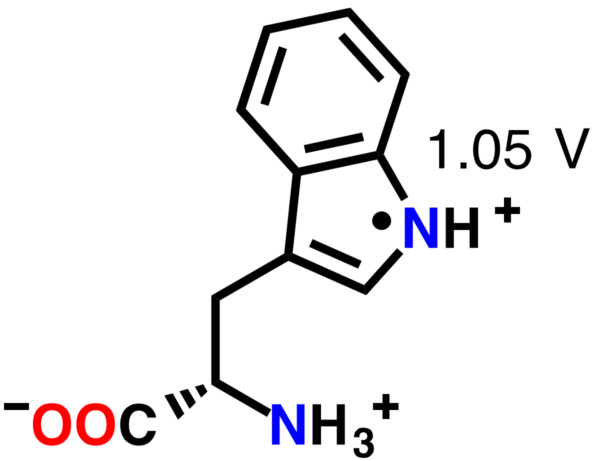
Amber (UAG) stop codon suppression

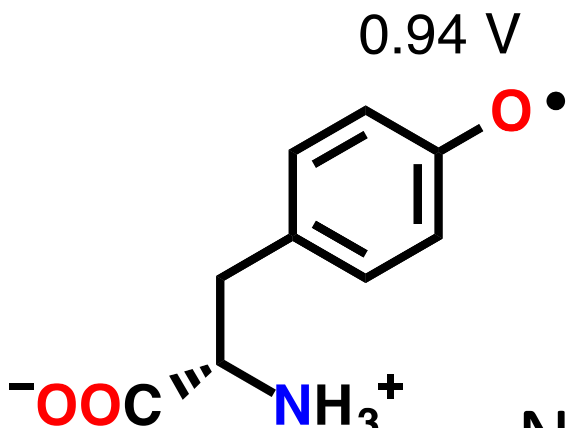
Radicals





Captodative Effect





$$A_{ox} + ne^- \longrightarrow A_{red}$$

Nernst Equation

$$E = E° - \frac{RT}{nF} \ln \frac{[A_{red}]}{[A_{ox}]}$$

$E°$ and pH

- Electron transfer reactions are often proton-coupled in biological systems
- $E°$ is a function of pH

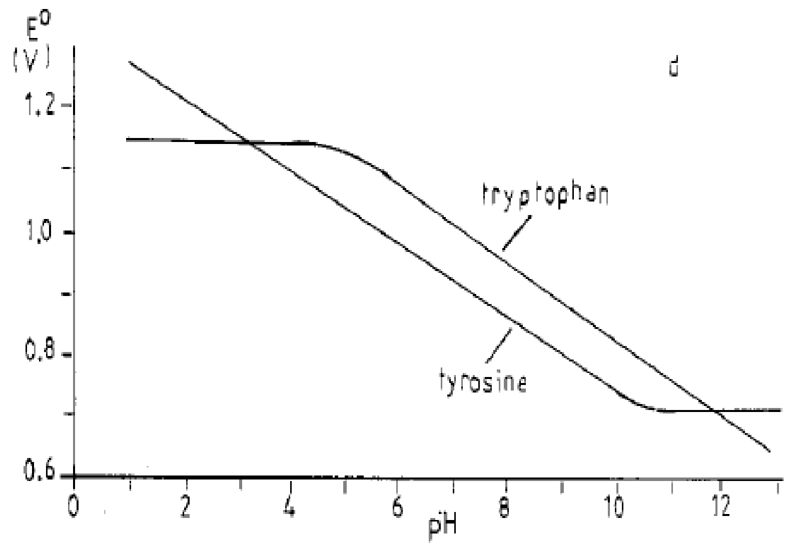


Figure 2. Plots of measured $E°$ vs pH for (a) tryptophan (b) tyrosine, and (c) *p*-methoxyphenol. Trace (d) compares the data obtained for tryptophan and tyrosine.

Harriman, A. (**1987**) *J. Phys. Chem. 99*, 6102-6104.