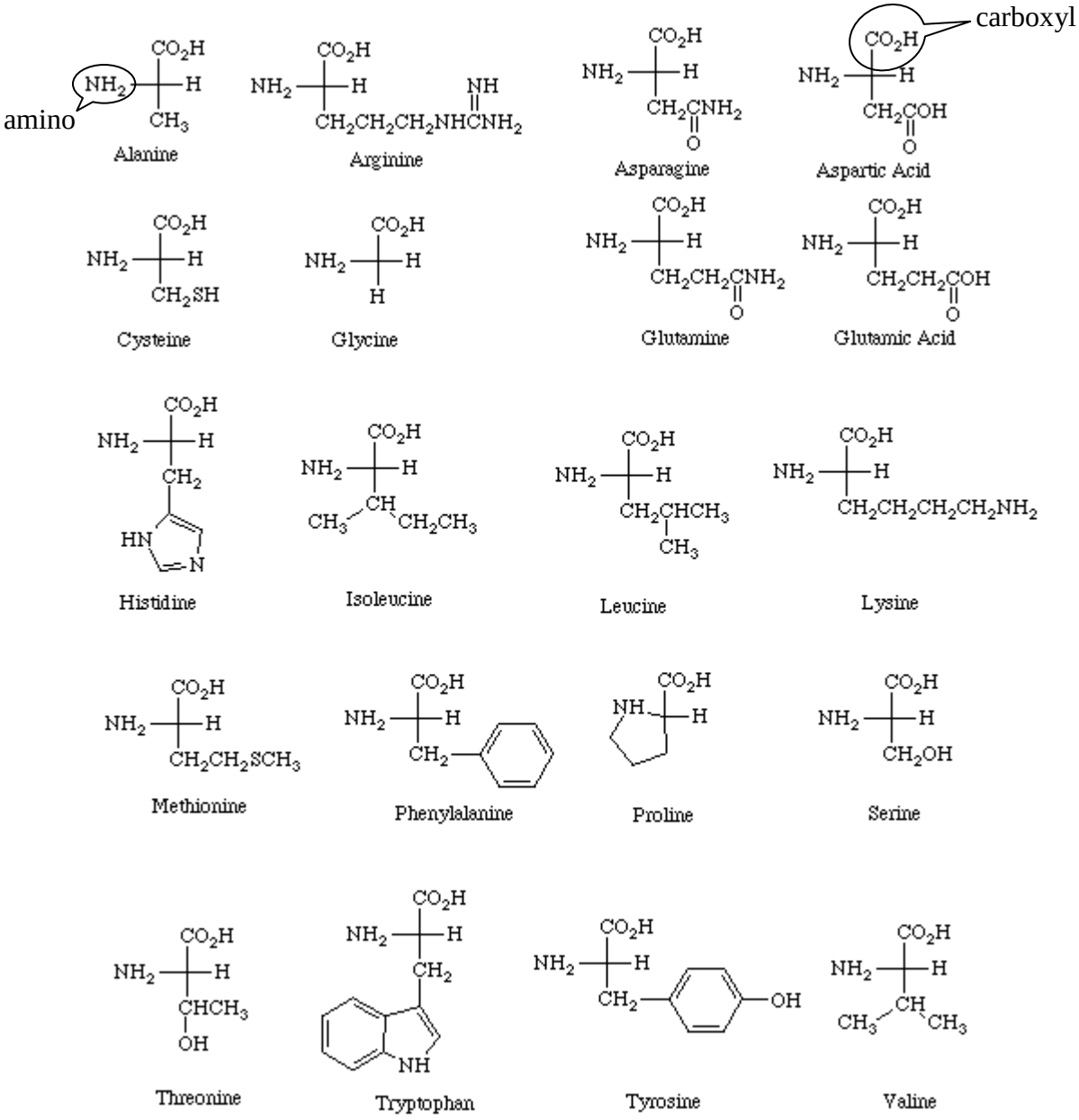
Amino Acid Structures

These are L-α-aminoacids shown in their Fischer projections.

The structures are listed in alphabetical order. Ionizable groups (amino and carboxyl) are shown in their neutral form - this implies absolutely nothing about the predominant form at any particular pH. These neutral forms DO NOT exist at any pH.



The following table gives the pKa values for the α-carboxylic acid group, the α-amino group, and any ionizable side chains.

Amino Acid pKa Values

Amino Acid	α-carboxylic acid	α-amino	Side chain
Alanine	2.35	9.87	
Arginine	2.01	9.04	12.48
Asparagine	2.02	8.80	
Aspartic Acid	2.10	9.82	3.86
Cysteine	2.05	10.25	8.00
Glutamic Acid	2.10	9.47	4.07
Glutamine	2.17	9.13	
Glycine	2.35	9.78	
Histidine	1.77	9.18	6.10
Isoleucine	2.32	9.76	
Leucine	2.33	9.74	
Lysine	2.18	8.95	10.53
Methionine	2.28	9.21	
Phenylalanine	2.58	9.24	
Proline	2.00	10.60	
Serine	2.21	9.15	
Threonine	2.09	9.10	
Tryptophan	2.38	9.39	
Tyrosine	2.20	9.11	10.07
Valine	2.29	9.72	

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• **Non-polar** • **Hydrophobic**		• **No charge (non-acidic amino acids)** • **Polar** • **Hydrophilic**		• **Negatively charged (acidic amino acids)** • **Polar** • **Hydrophilic**		• **Positively charged (basic amino acids; non-acidic amino acids)** • **Polar** • **Hydrophilic**	
Amino acid	**pI**	**Amino acid**	**pI**	**Amino acid**	**pI**	**Amino acid**	**pI**
Phenylalanine phe f	5.48	Cysteine cys c	5.02	Aspartic acid asp d	2.77	Histidine his h	7.47
Methionine met m	5.74	Asparagine asn n	5.41	Glutamic acid glu e	3.22	Lysine lys k	9.59
Tryptophan trp w	5.89	Glutamine gln q	5.65			Arginine arg r	11.15
Isoleucine ile i	5.94	Threonine thr t	5.64				
Valine val v	5.96	Tyrosine tyr y	5.66				
Leucine leu l	5.98	Serine ser s	5.68				
Alanine ala a	6.00						
Glycine gly g	5.97						
Proline pro p	6.30						

EXAMPLES OF IONIZATION STATES OF GLUTAMIC ACID

GLUTAMIC ACID – an acidic amino acid

The major ionic species are shown at the pH's where they would occur in Part A. The major species when pH=pKa are shown in Part B.

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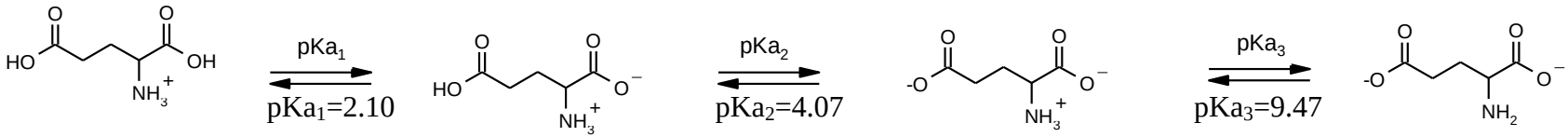

pH<pKa$_1$
pH=1

pH=pI=3.09
(pKa$_2$+pKa$_3$)/2=3.09

pH=6.77
(pKa$_2$+pKa$_3$)/2=6.77

pH>pKa$_3$
pH=11

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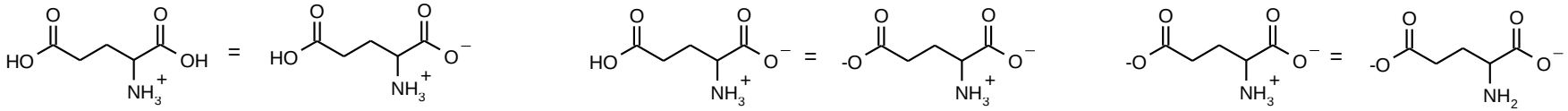

pH=pKa$_1$=2.10

pH=pKa$_2$=4.07

pH=pKa$_3$=9.47