



Proline, Pro, P

PROPERTIES OF COMMON AMINO ACIDS

Name	Abbr		Molecular Weight	Molecular Formula	Residue Formula	Residue Weight (-H ₂ O)	pKa ¹	pKb ²	pKx ³	pI ⁴
Alanine	Ala	A	89.10	C ₃ H ₇ NO ₂	C ₃ H ₅ NO	71.08	2.34	9.69	-	6.00
Arginine	Arg	R	174.20	C ₆ H ₁₄ N ₄ O ₂	C ₆ H ₁₂ N ₄ O	156.19	2.17	9.04	12.48	10.76
Asparagine	Asn	N	132.12	C ₄ H ₈ N ₂ O ₃	C ₄ H ₆ N ₂ O ₂	114.11	2.02	8.80	-	5.41
Aspartic acid	Asp	D	133.11	C ₄ H ₇ NO ₄	C ₄ H ₅ NO ₃	115.09	1.88	9.60	3.65	2.77
Cysteine	Cys	C	121.16	C ₃ H ₇ NO ₂ S	C ₃ H ₅ NOS	103.15	1.96	10.28	8.18	5.07
Glutamic acid	Glu	E	147.13	C ₅ H ₉ NO ₄	C ₅ H ₇ NO ₃	129.12	2.19	9.67	4.25	3.22
Glutamine	Gln	Q	146.15	C ₅ H ₁₀ N ₂ O ₃	C ₅ H ₈ N ₂ O ₂	128.13	2.17	9.13	-	5.65
Glycine	Gly	G	75.07	C ₂ H ₅ NO ₂	C ₂ H ₃ NO	57.05	2.34	9.60	-	5.97
Histidine	His	H	155.16	C ₆ H ₉ N ₃ O ₂	C ₆ H ₇ N ₃ O	137.14	1.82	9.17	6.00	7.59
Hydroxyproline	Hyp	O	131.13	C ₅ H ₉ NO ₃	C ₅ H ₇ NO ₂	113.11	1.82	9.65	-	-
Isoleucine	Ile	I	131.18	C ₆ H ₁₃ NO ₂	C ₆ H ₁₁ NO	113.16	2.36	9.60	-	6.02
Leucine	Leu	L	131.18	C ₆ H ₁₃ NO ₂	C ₆ H ₁₁ NO	113.16	2.36	9.60	-	5.98
Lysine	Lys	K	146.19	C ₆ H ₁₄ N ₂ O ₂	C ₆ H ₁₂ N ₂ O	128.18	2.18	8.95	10.53	9.74
Methionine	Met	M	149.21	C ₅ H ₁₁ NO ₂ S	C ₅ H ₉ NOS	131.20	2.28	9.21	-	5.74
Phenylalanine	Phe	F	165.19	C ₉ H ₁₁ NO ₂	C ₉ H ₉ NO	147.18	1.83	9.13	-	5.48
Proline	Pro	P	115.13	C ₅ H ₉ NO ₂	C ₅ H ₇ NO	97.12	1.99	10.60	-	6.30
Pyroglutamic	Glp	U	139.11	C ₅ H ₇ NO ₃	C ₅ H ₅ NO ₂	121.09	-	-	-	5.68
Serine	Ser	S	105.09	C ₃ H ₇ NO ₃	C ₃ H ₅ NO ₂	87.08	2.21	9.15	-	5.68

Threonine	Thr	T	119.12	C ₄ H ₉ NO ₃	C ₄ H ₇ NO ₂	101.11	2.09	9.10	-	5.60
Tryptophan	Trp	W	204.23	C ₁₁ H ₁₂ N ₂ O ₂	C ₁₁ H ₁₀ N ₂ O	186.22	2.83	9.39	-	5.89
Tyrosine	Tyr	Y	181.19	C ₉ H ₁₁ NO ₃	C ₉ H ₉ NO ₂	163.18	2.20	9.11	10.07	5.66
Valine	Val	V	117.15	C ₅ H ₁₁ NO ₂	C ₅ H ₉ NO	99.13	2.32	9.62	-	5.96

¹ pKa is the negative of the logarithm of the dissociation constant for the -COOH group.
² pKb is the negative of the logarithm of the dissociation constant for the -NH3 group.
³ pKx is the negative of the logarithm of the dissociation constant for any other group in the molecule.
⁴ pl is the pH at the isoelectric point.
Reference: D.R. Lide, *Handbook of Chemistry and Physics, 72nd Edition*, CRC Press, Boca Raton, FL, 1991.

HYDROPHOBICITY INDEX FOR COMMON AMINO ACIDS

The hydrophobicity index is a measure of the relative hydrophobicity, or how soluble an amino acid is in water. In a protein, hydrophobic amino acids are likely to be found in the interior, whereas hydrophilic amino acids are likely to be in contact with the aqueous environment.

The values in the table below are normalized so that the most hydrophobic residue is given a value of 100 relative to glycine, which is considered neutral (0 value). The scales were extrapolated to residues which are more hydrophilic than glycine.

At pH 2 ^A		At pH 7 ^B	
Very Hydrophobic			
Leu	100	Phe	100
Ile	100	Ile	99
Phe	92	Trp	97
Trp	84	Leu	97
Val	79	Val	76
Met	74	Met	74
Hydrophobic			
Cys	52	Tyr	63
Tyr	49	Cys	49
Ala	47	Ala	41
Neutral			
Thr	13	Thr	13
Glu	8	His	8
Gly	0	Gly	0
Ser	-7	Ser	-5

Gln	-18	Gln	-10
Asp	-18		
Hydrophilic			
Arg	-26	Arg	-14
Lys	-37	Lys	-23
Asn	-41	Asn	-28
His	-42	Glu	-31
Pro	-46	Pro	-46 (used pH 2)
		Asp	-55

^A pH 2 values: Normalized from Sereda et al., *J. Chrom.* 676: 139-153 (1994).
^B pH 7 values: Monera et al., *J. Protein Sci.* 1: 319-329 (1995).

1. Hayman M, Smith K, Cameron N, Przyborski S. 2005. Growth of human stem cell-derived neurons on solid three-dimensional polymers. *Journal of Biochemical and Biophysical Methods*. 62(3):231-240. <https://doi.org/10.1016/j.jbbm.2004.12.001>

2. Cho IJ, Ahn JY, Kim S, Choi MS, Ha TY. 2008. Resveratrol attenuates the expression of HMG-CoA reductase mRNA in hamsters. *Biochemical and Biophysical Research Communications*. 367(1):190-194. <https://doi.org/10.1016/j.bbrc.2007.12.140>

3. Polleux F, Ghosh A. 2002. The Slice Overlay Assay: A Versatile Tool to Study the Influence of Extracellular Signals on Neuronal Development. *Science Signaling*. 2002(136):pl9-pl9. <https://doi.org/10.1126/stke.2002.136.pl9>

4. Rama Rao KV, Reddy PV, Tong X, Norenberg MD. 2010. Brain Edema in Acute Liver Failure. *The American Journal of Pathology*. 176(3):1400-1408. <https://doi.org/10.2353/ajpath.2010.090756>

5. Marx M, Günter RH, Hucko W, Radnikow G, Feldmeyer D. 2012. Improved biocytin labeling and neuronal 3D reconstruction. *Nat Protoc*. 7(2):394-407. <https://doi.org/10.1038/nprot.2011.449>

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