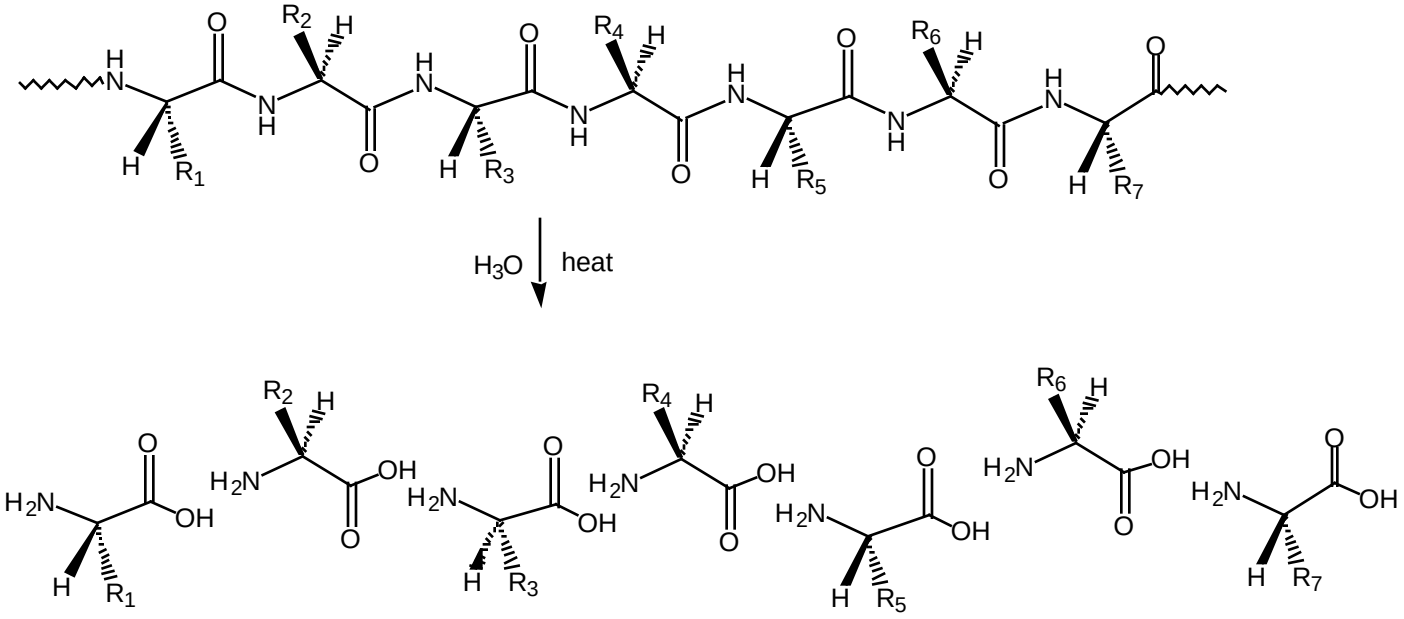
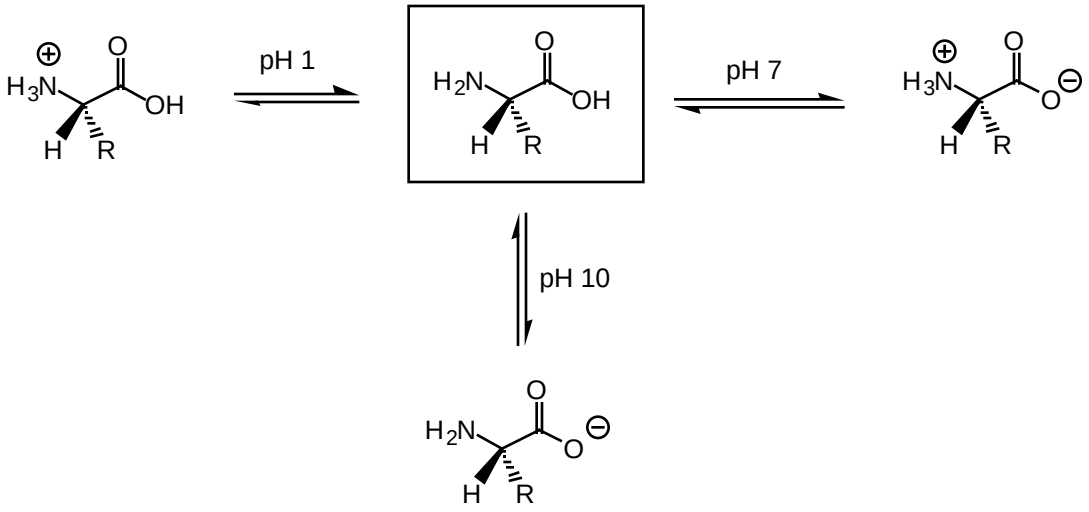
Analysis of proteins involves determining the amino acid content: which amino acids are present
what is the sequence of the amino acids?

A piece of a protein:



How separate and identify?



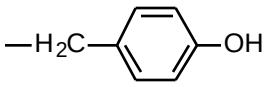
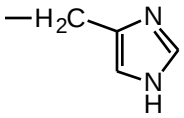
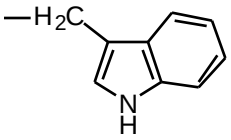
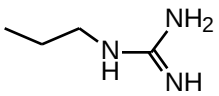
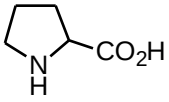
Henderson-Hasselbach equation:

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

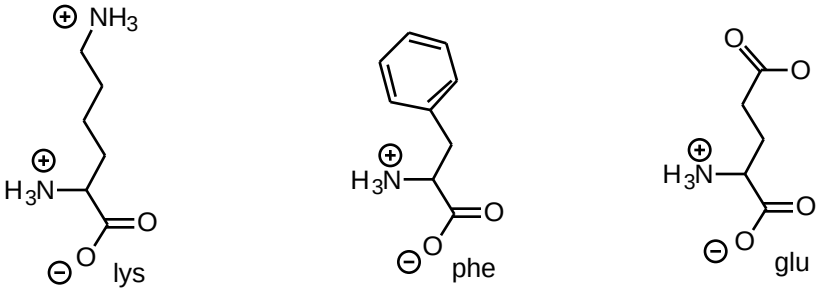
Separation of amino acids by **electrophoresis:**

Amino acids can be (+), (-), or neutral (zwitterion): when the net charge is zero, **isoelectric point in pH**

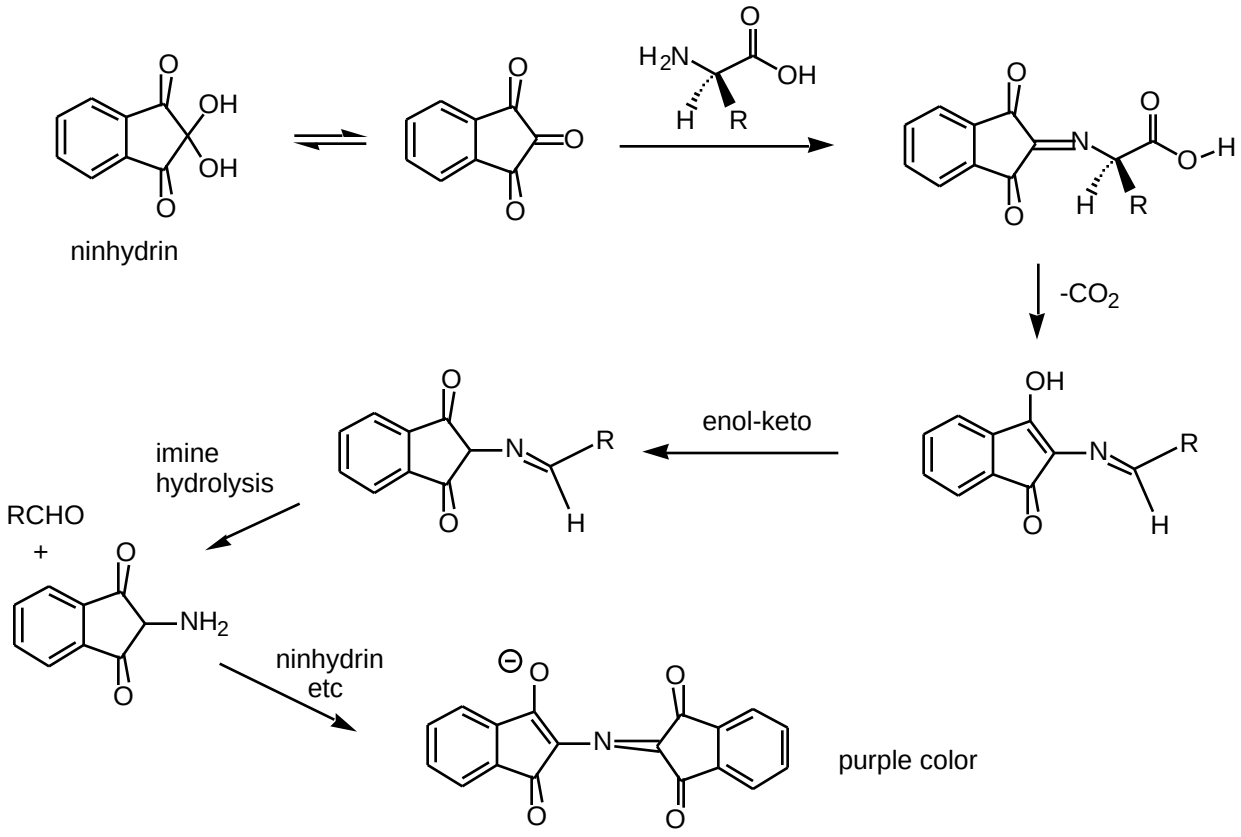
Each amino acid has a characteristic pH for the isoelectric point.

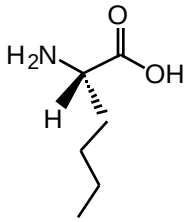
R	name	isoelectric point
H	glycine	6
CH_3	alanine	6
$CH(CH_3)_2$	valine	6
$CH_2CH(CH_3)_2$	leucine	6
$CHCH_3(CH_2CH_3)$	isoleucine	6
$-CH_2Ph$	phenyl alanine	5.9
	tyrosine	5.7
	histidine	7.6
	tryptophan	5.9
$-CH_2OH$	serine	5.7
$-CH(CH_3)OH$	threonine	5.6
$-CH_2SH$	cysteine	5.0
$-CH_2CH_2SCH_3$	threonine	5.6
$-CH_2CO_2H$	aspartic acid	2.9
$-CH_2CH_2CO_2H$	glutamic acid	3.2
$-CH_2CONH_2$	asparagine	5.4
$-CH_2CH_2CONH_2$	glutamine	5.7
$-CH_2CH_2CH_2CH_2NH_2$	lysine	9.7
	arginine	10.8
	proline	6.1

Assume pH 5.5

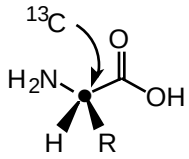


Apply potential; allow migration. Then "visualize" Add solution of ninhydrin Text 26.2C

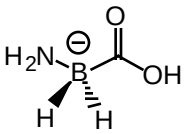




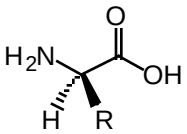
n-butyl glycine



^{13}C labeled carbon

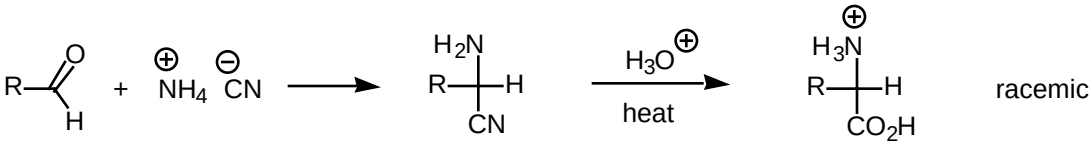


boraglycine



D-amino acids

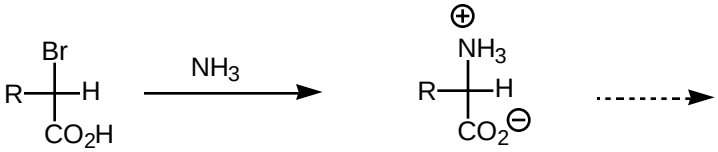
The Strecker synthesis

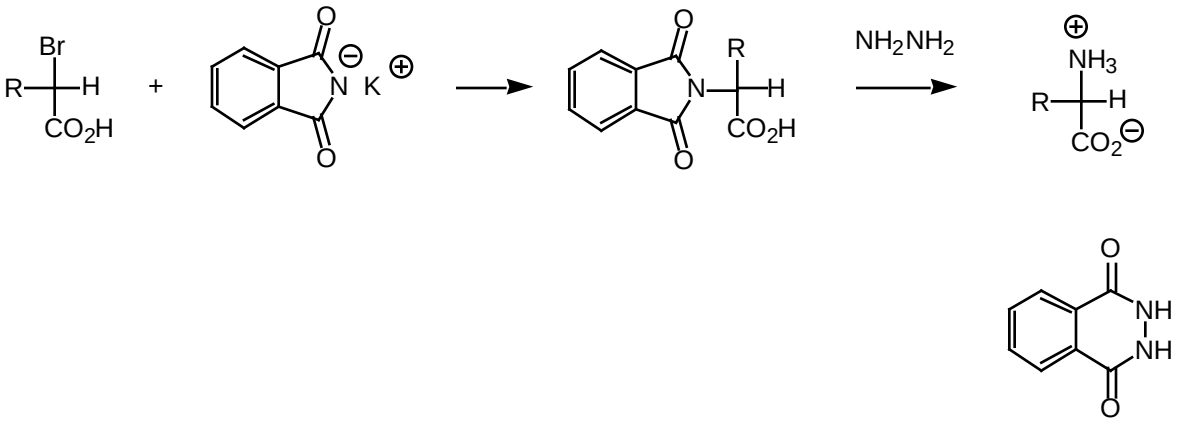


racemic

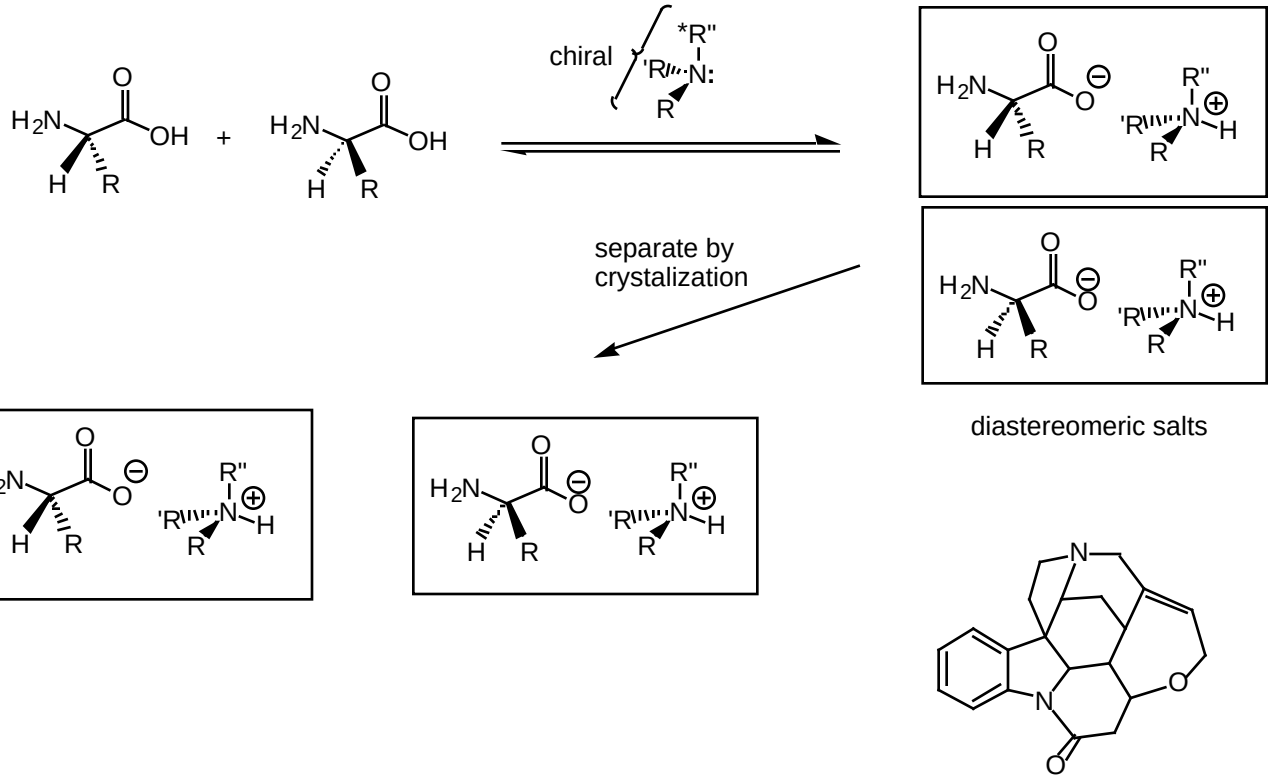
via:

Substitution reactions:



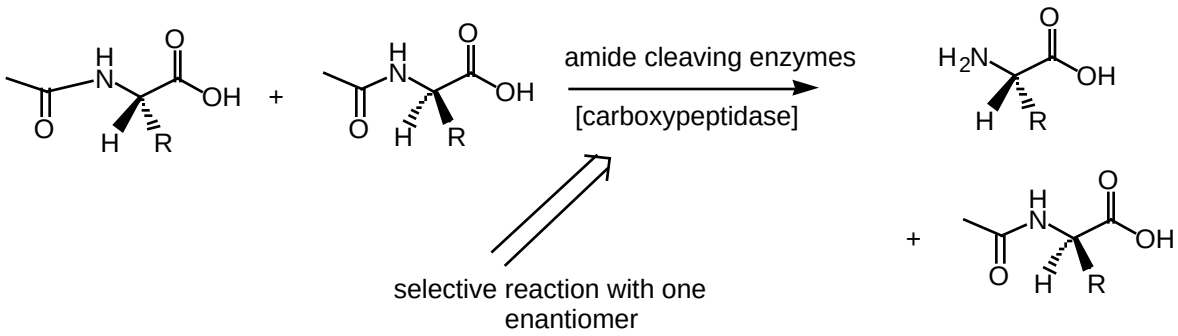


But how make homochiral amino acids? One enantiomer



Enzymatic resolution:

Isolate enzyme and purify, mix with the reactants



Extremely efficient: 99% selective

Alternative: Selective organic synthesis