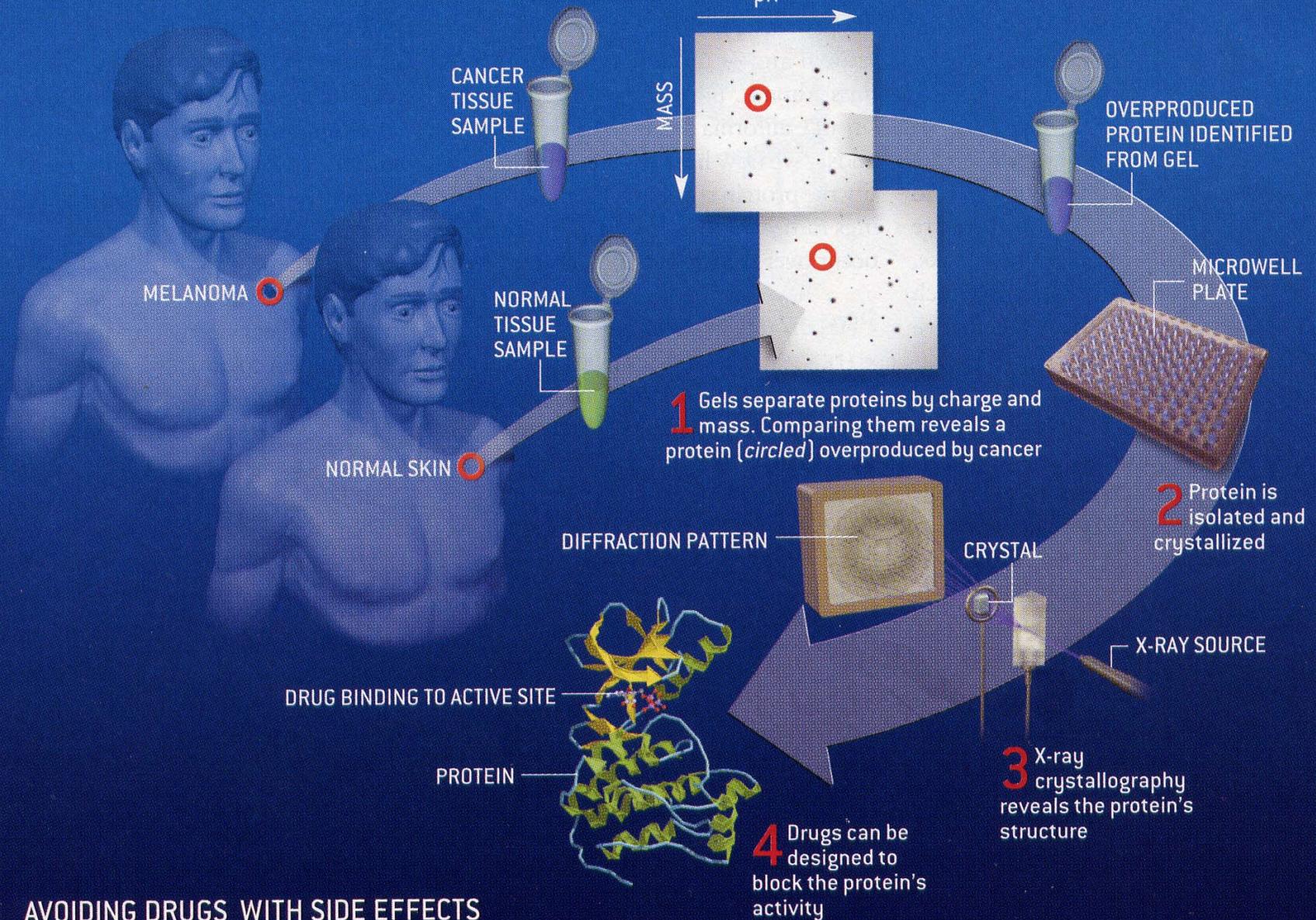


# HOW PROTEOMICS CAN HELP DRUG DEVELOPMENT

## FINDING NEW DRUG TARGETS

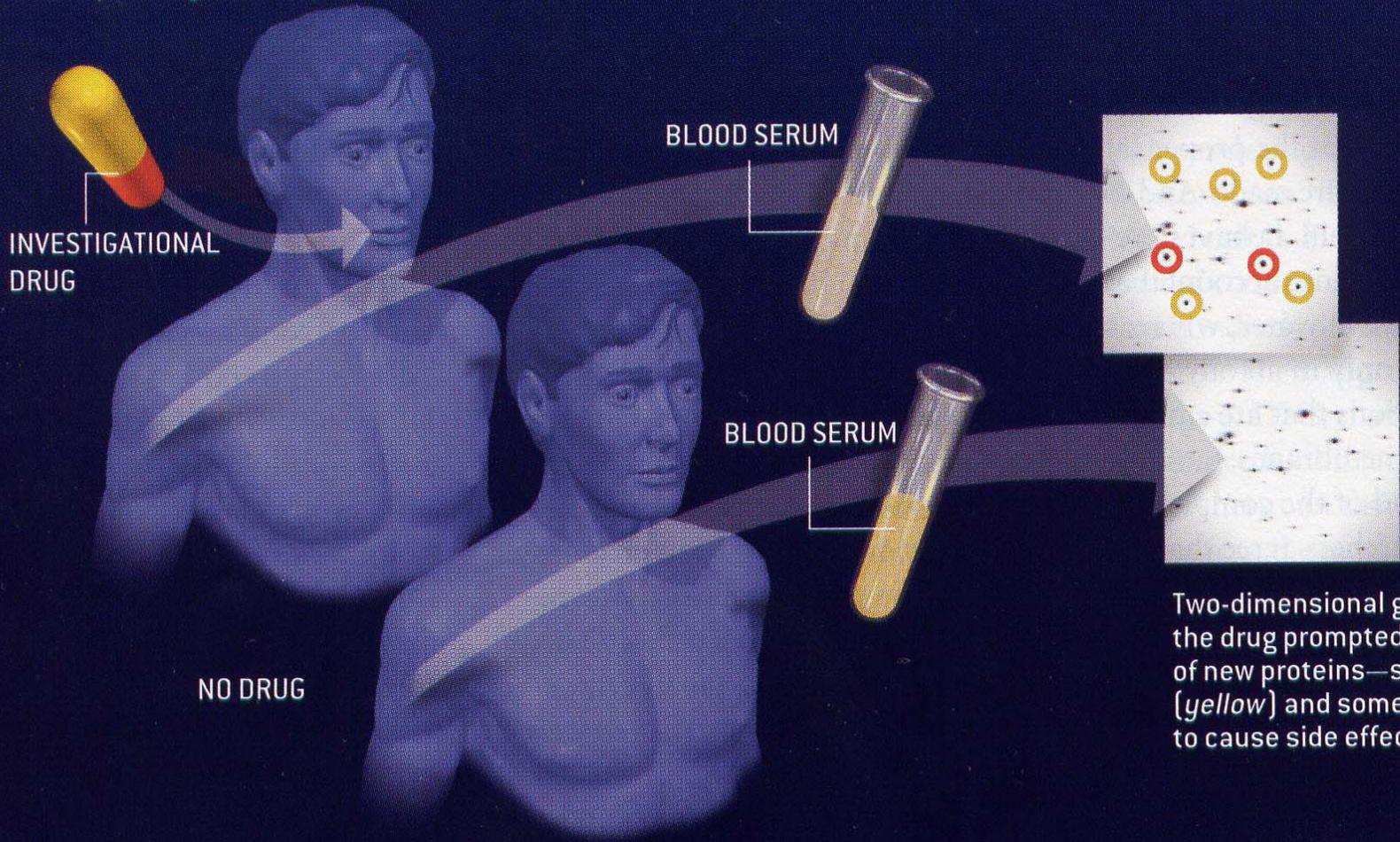
(Here, devising a drug to kill the skin cancer melanoma)



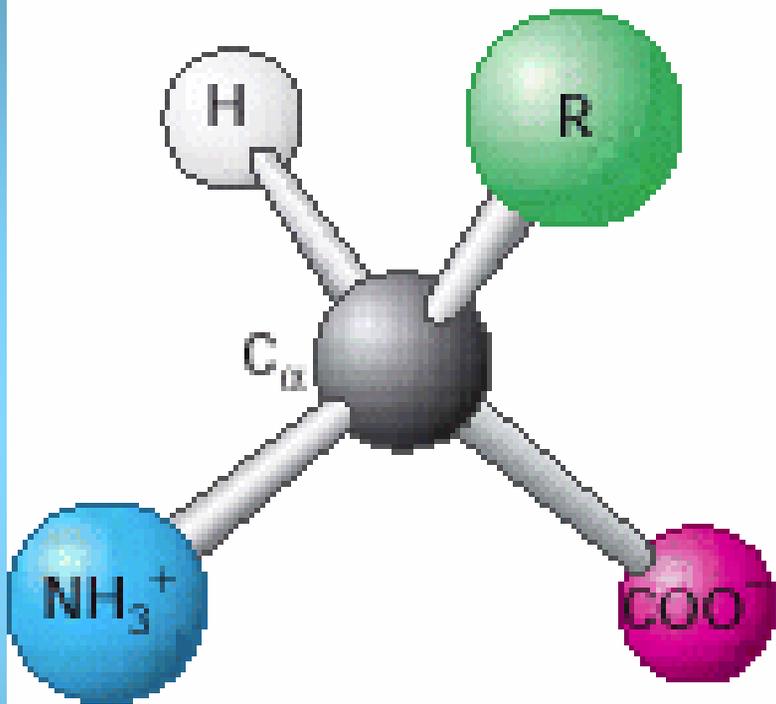
# AVOIDING DRUGS WITH SIDE EFFECTS

(Here, determining whether an investigational drug prompts production of possibly harmful proteins)

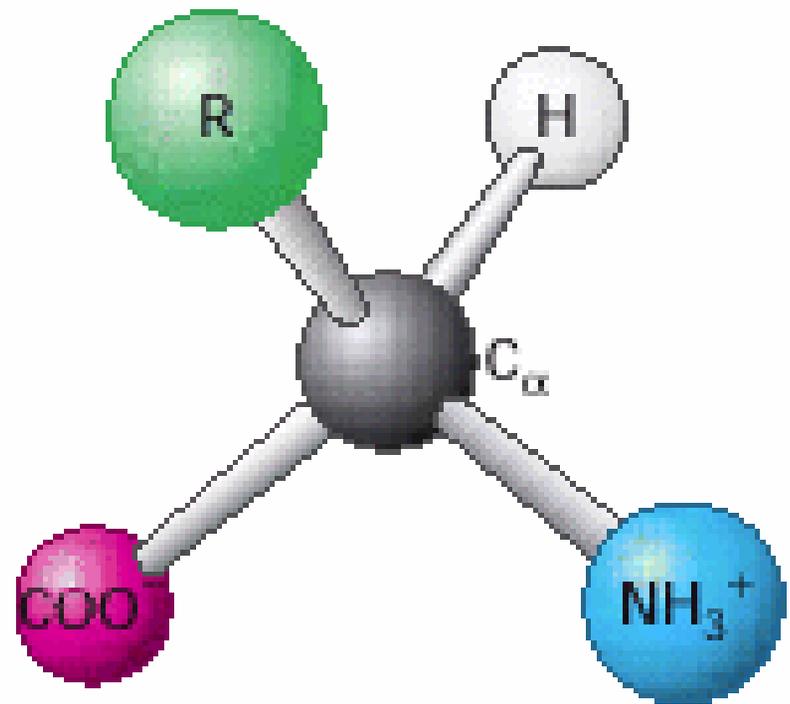
activity



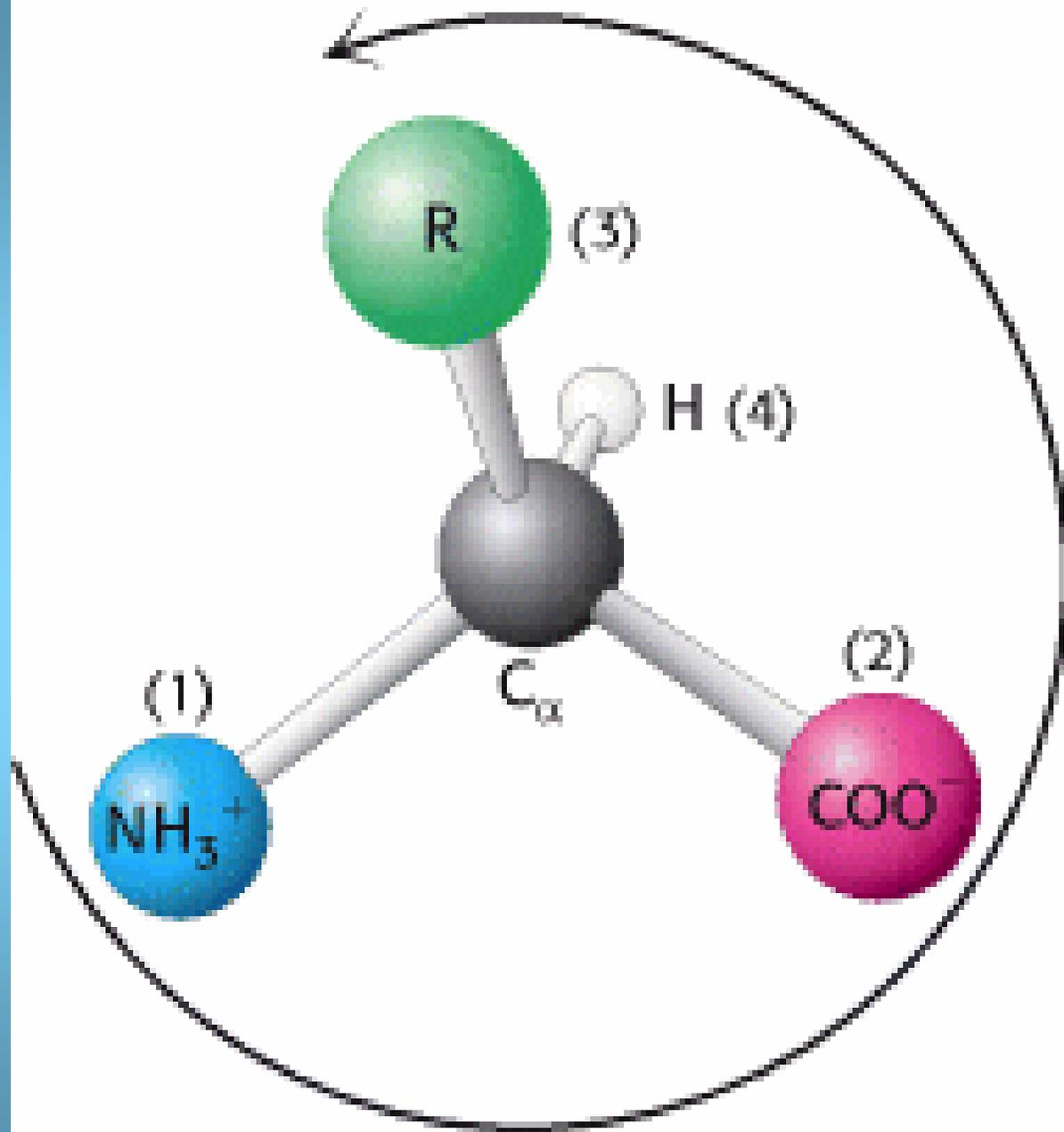
Two-dimensional gels show that the drug prompted the production of new proteins—some innocuous (*yellow*) and some with potential to cause side effects (*red*)

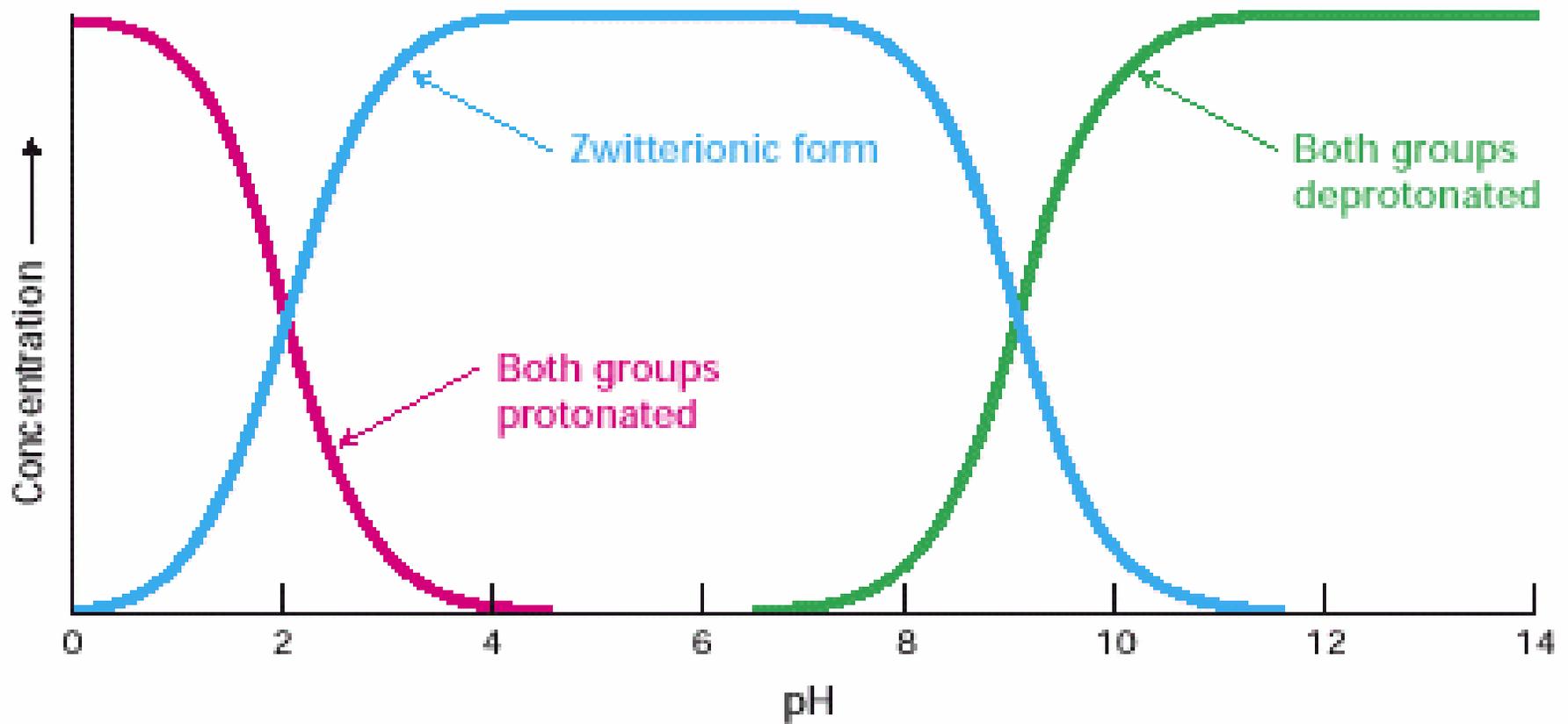
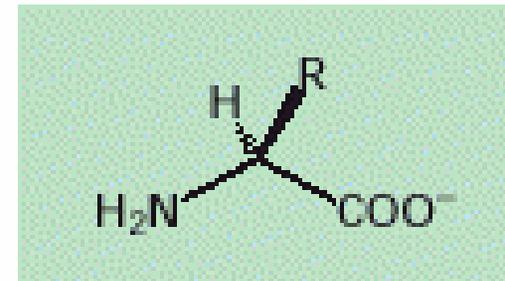
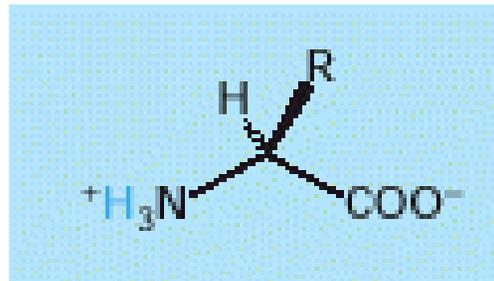
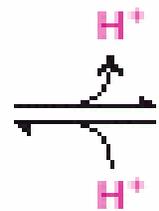
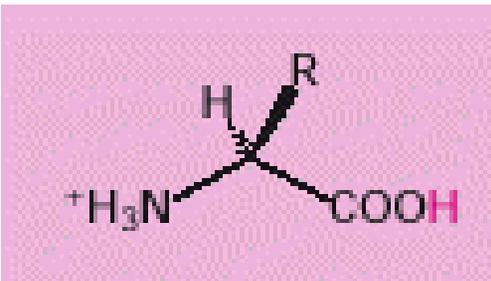


**L isomer**

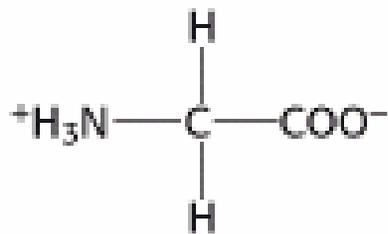
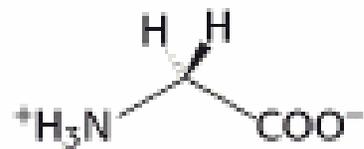
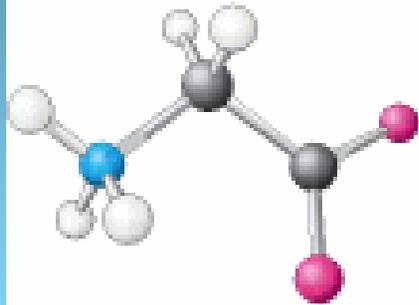


**D isomer**



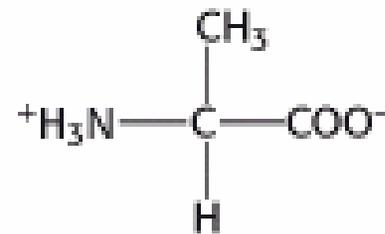
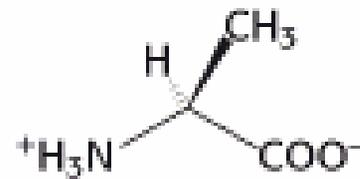
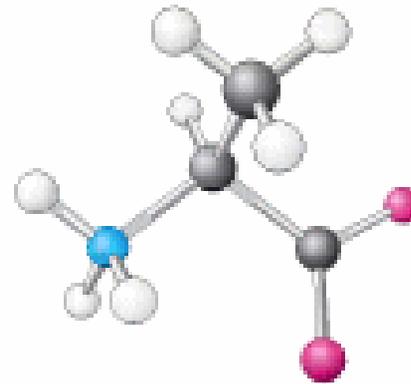


**Glycine  
(Gly, G)**

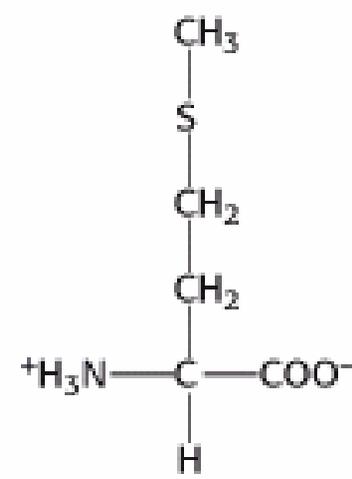
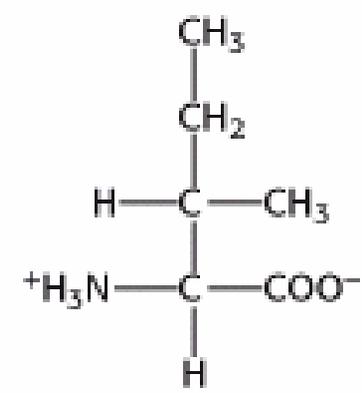
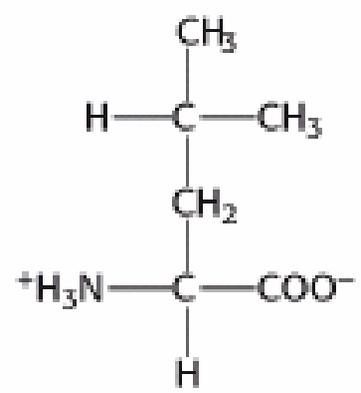
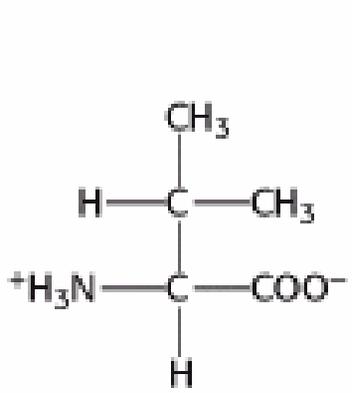
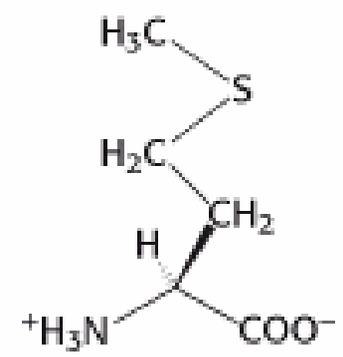
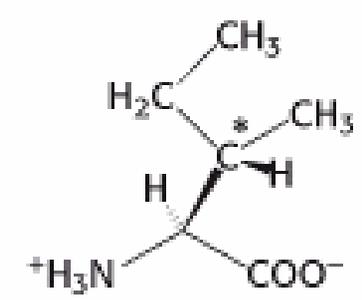
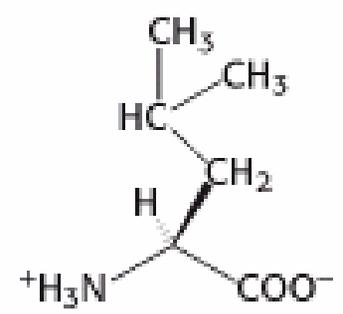
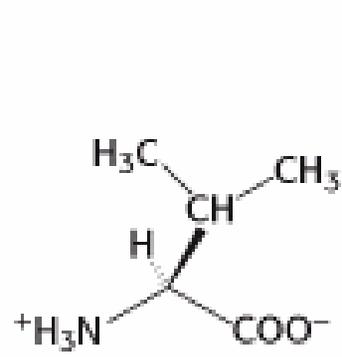


**Glycine  
(Gly, G)**

**Alanine  
(Ala, A)**



**Alanine  
(Ala, A)**

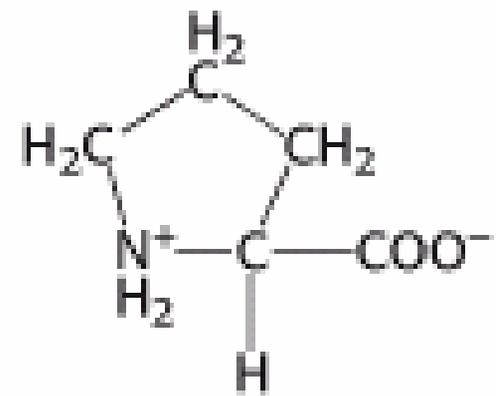
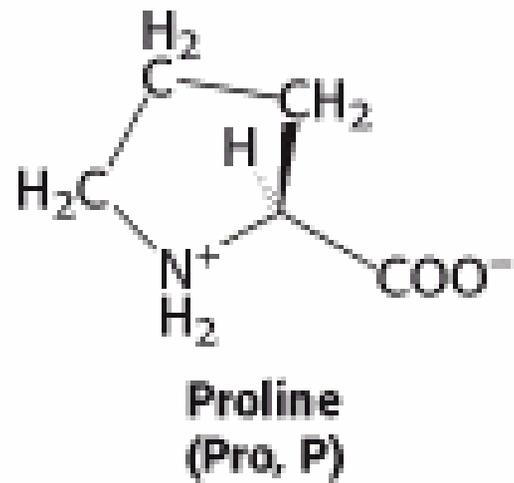
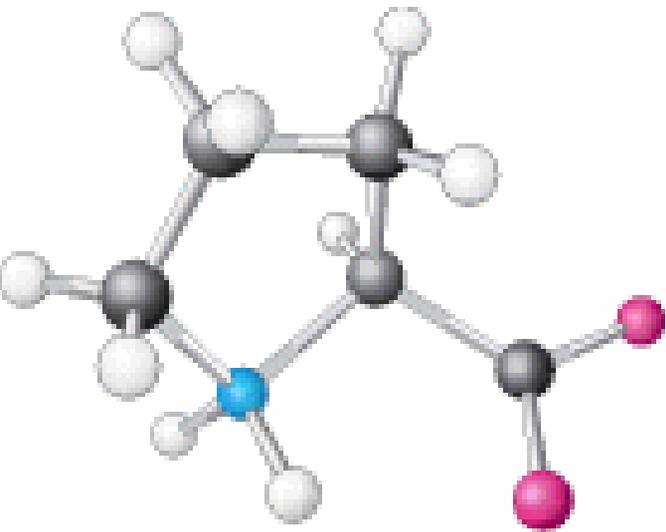


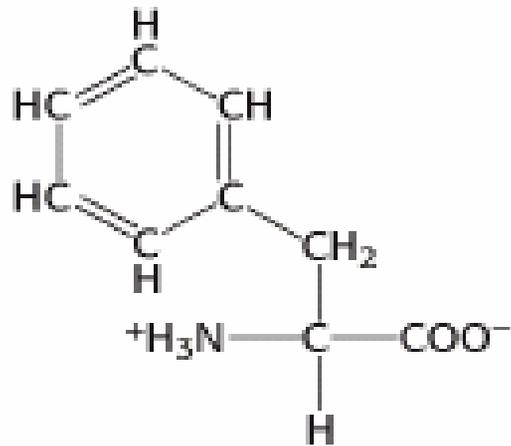
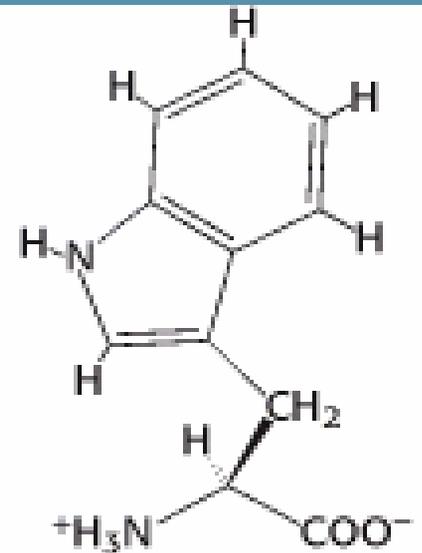
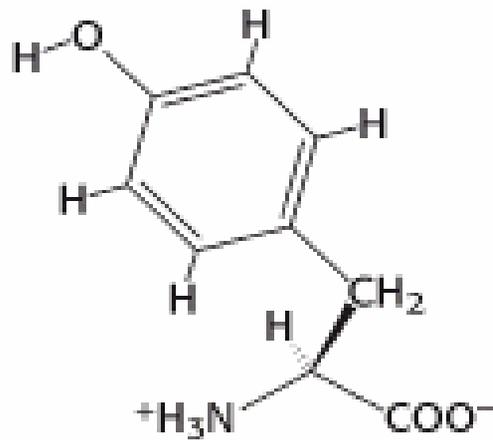
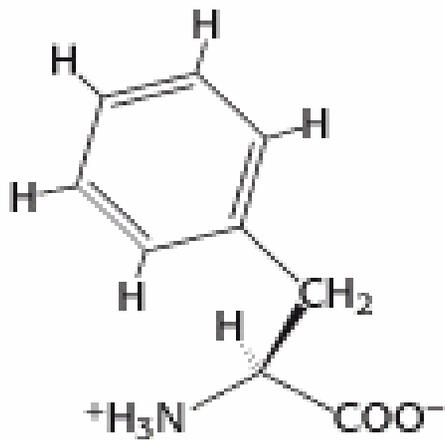
**Valine**  
(Val, V)

**Leucine**  
(Leu, L)

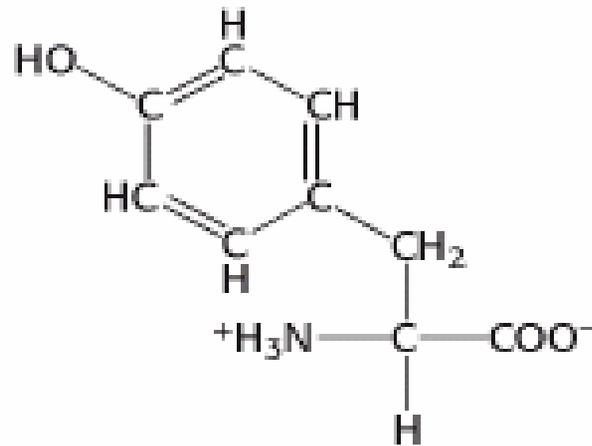
**Isoleucine**  
(Ile, I)

**Methionine**  
(Met, M)

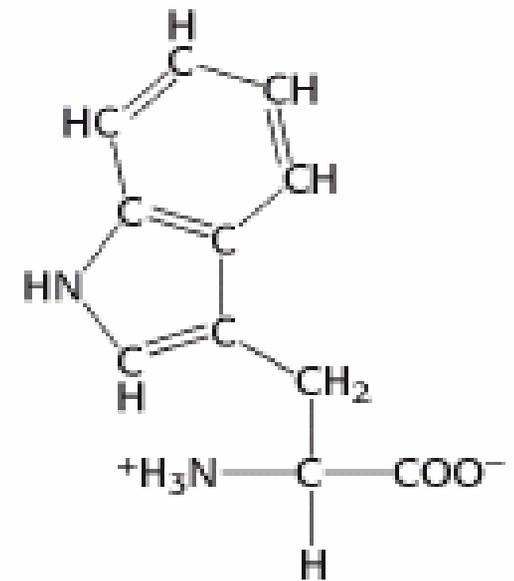




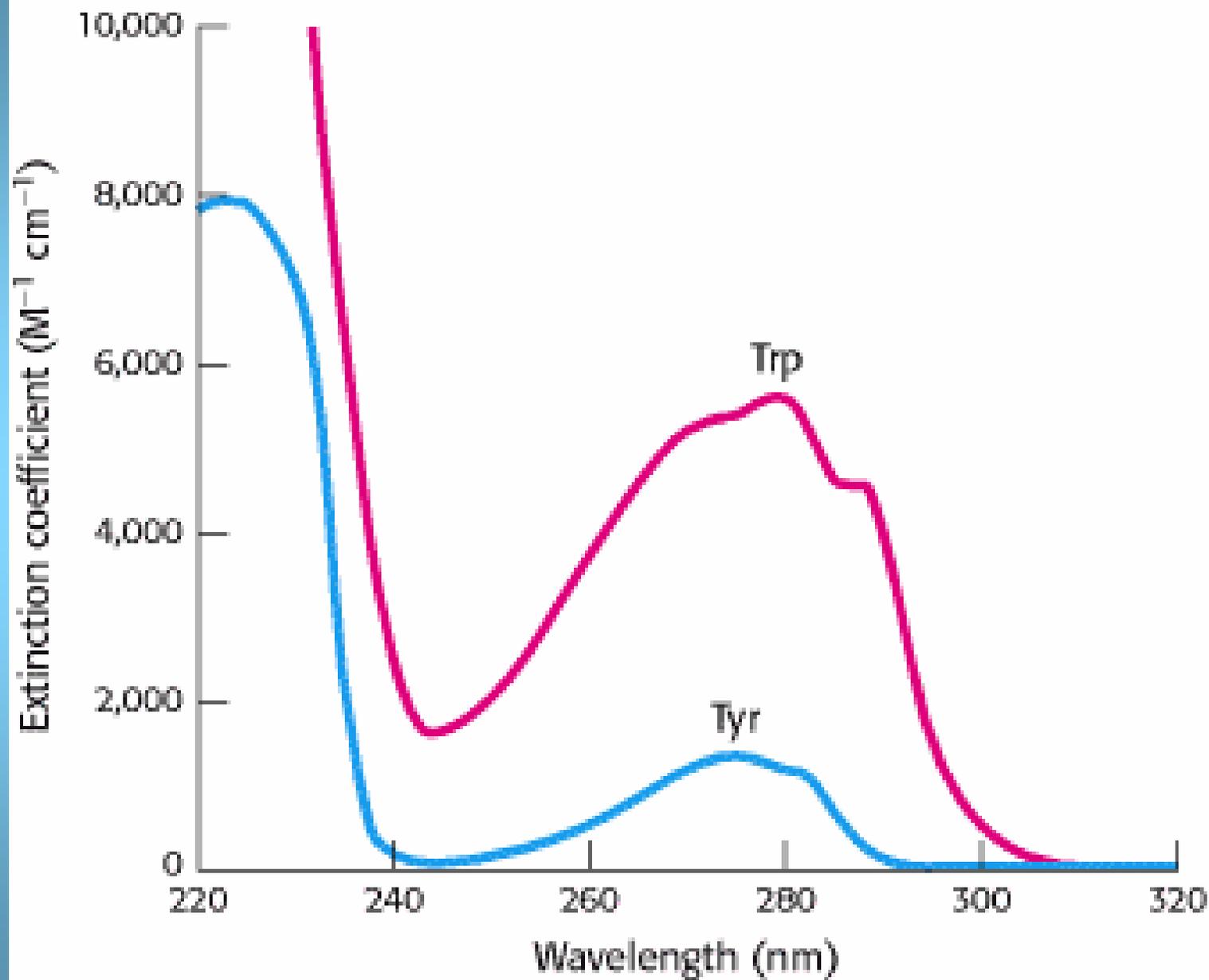
**Phenylalanine**  
(Phe, F)

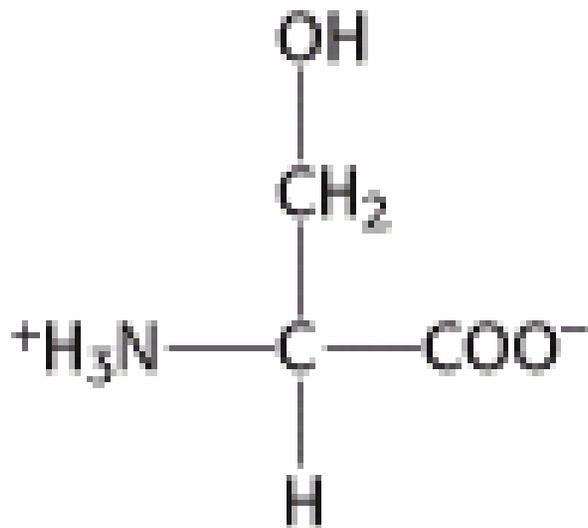
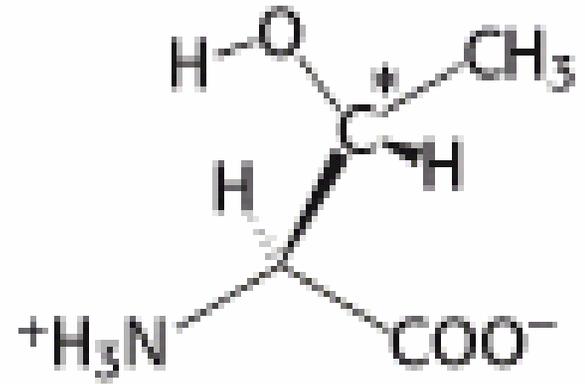
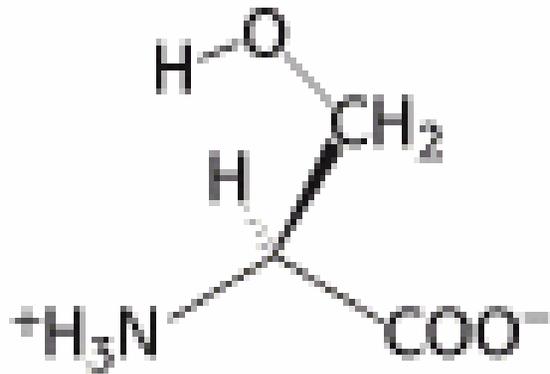


**Tyrosine**  
(Tyr, Y)

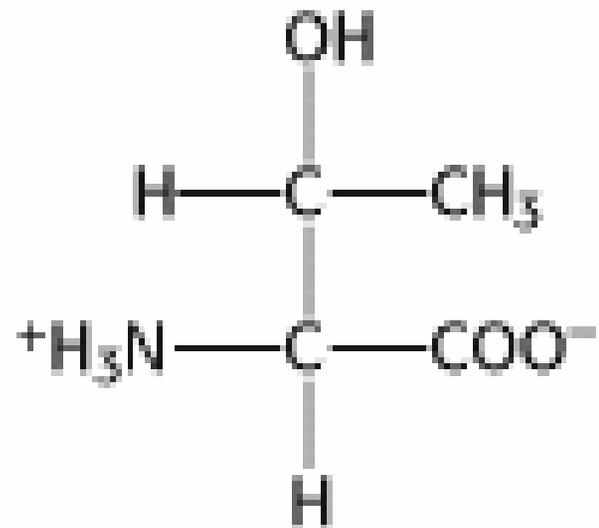


**Tryptophan**  
(Trp, W)

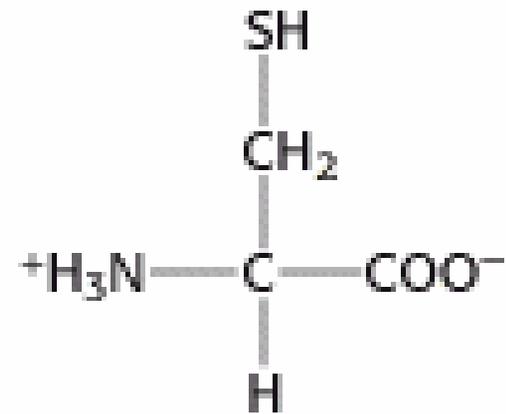
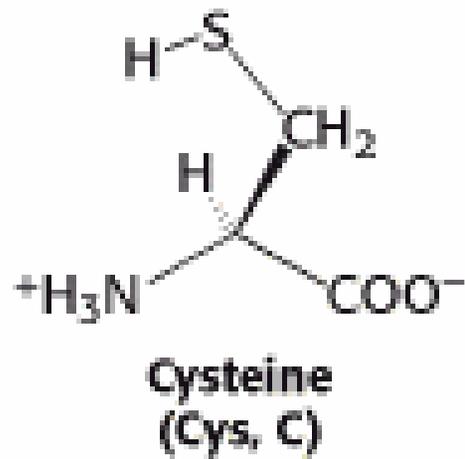
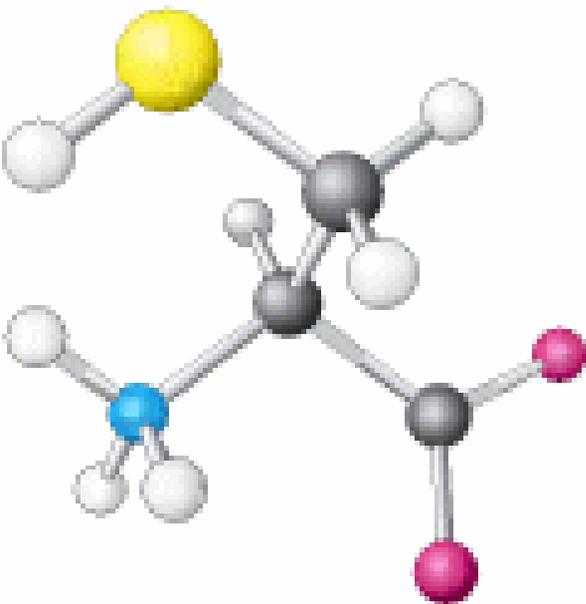


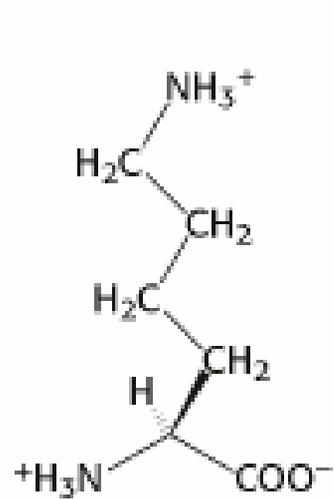


**Serine**  
(Ser, S)

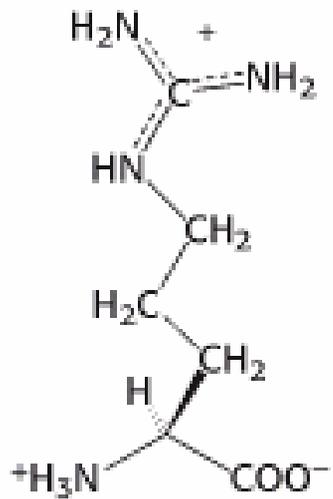


**Threonine**  
(Thr, T)

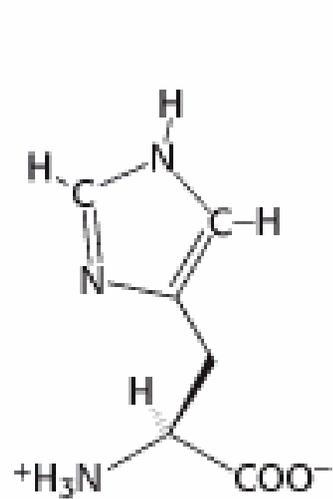




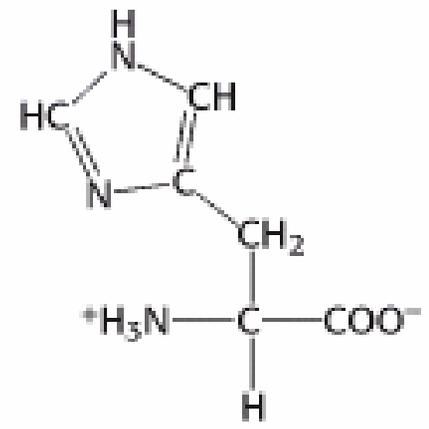
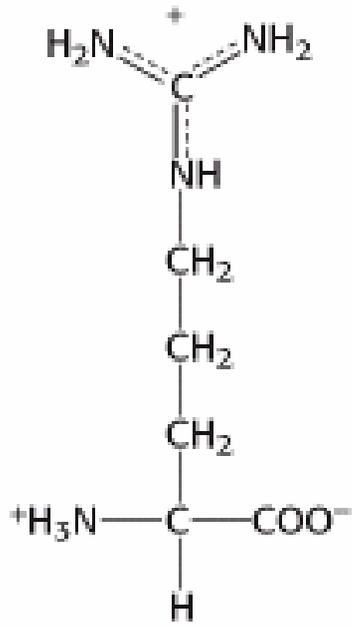
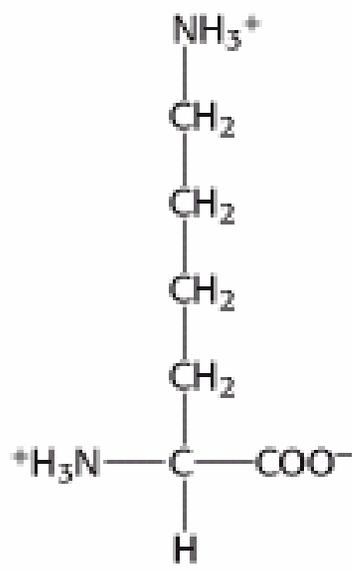
**Lysine**  
(Lys, K)

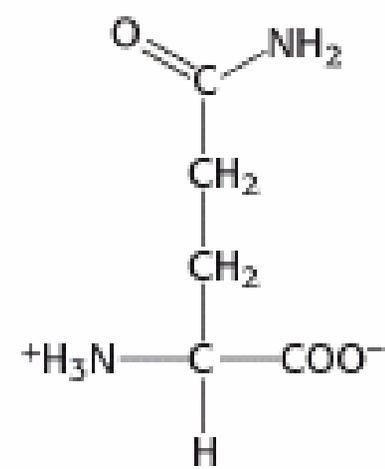
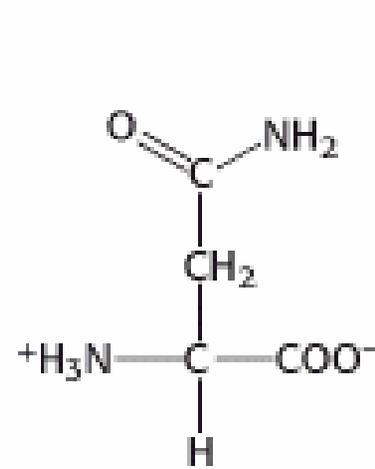
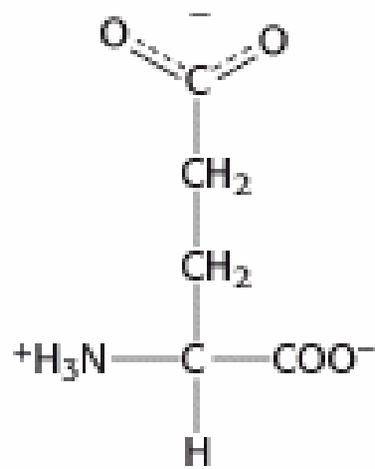
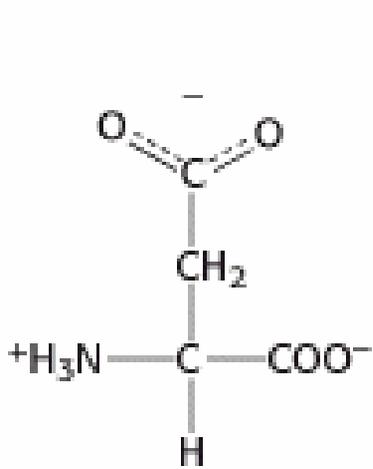
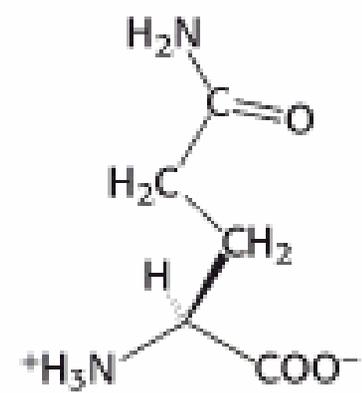
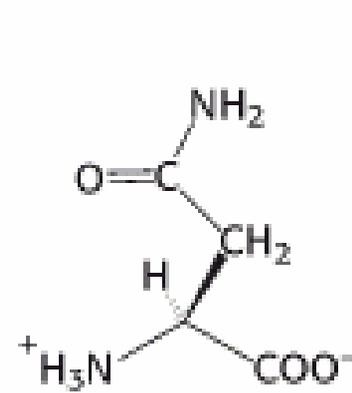
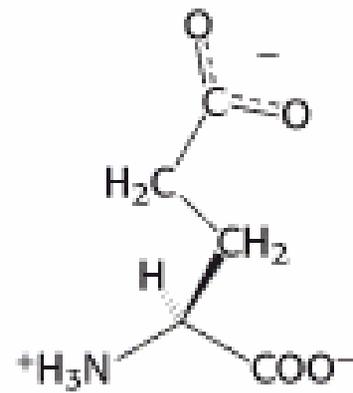
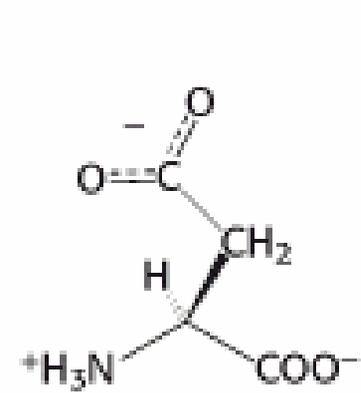


**Arginine**  
(Arg, R)



**Histidine**  
(His, H)



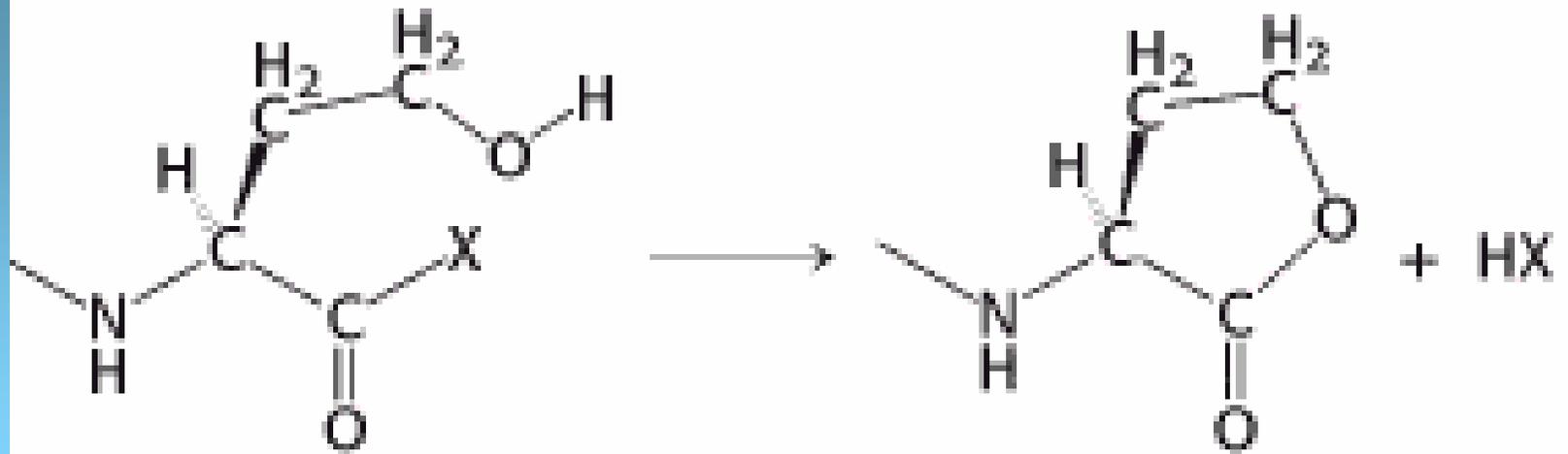


**Aspartate**  
**(Asp, D)**

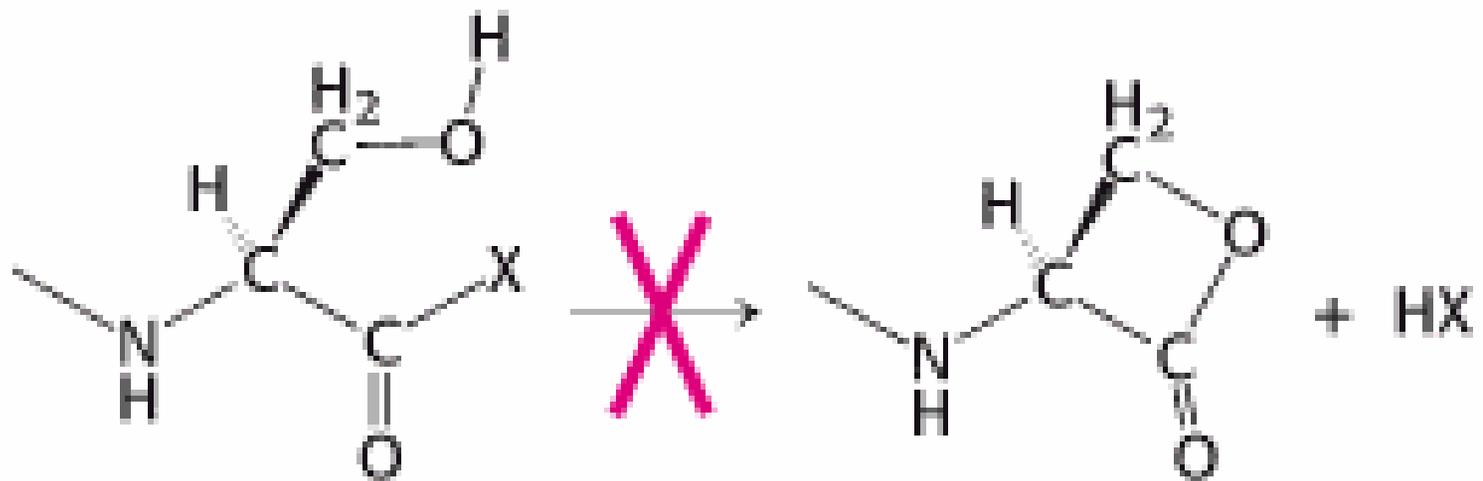
**Glutamate**  
**(Glu, E)**

**Asparagine**  
**(Asn, N)**

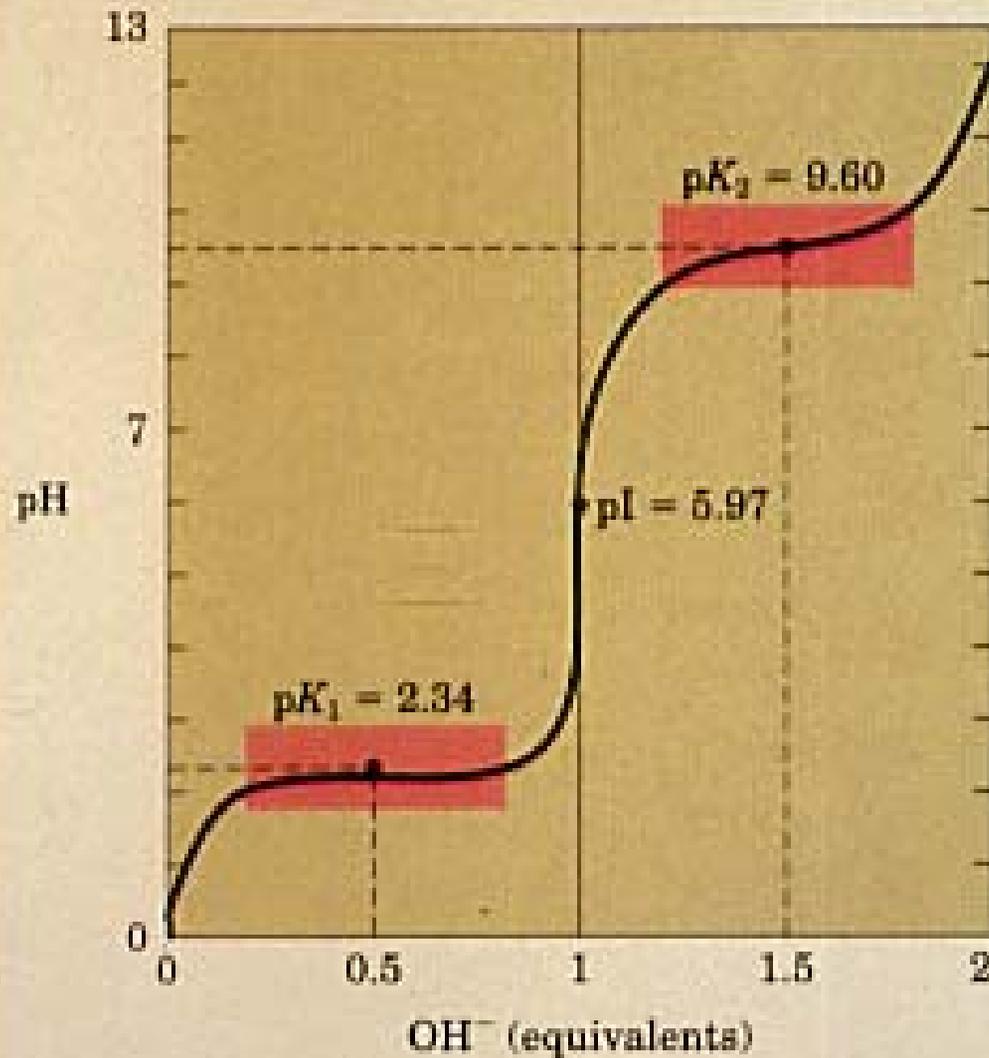
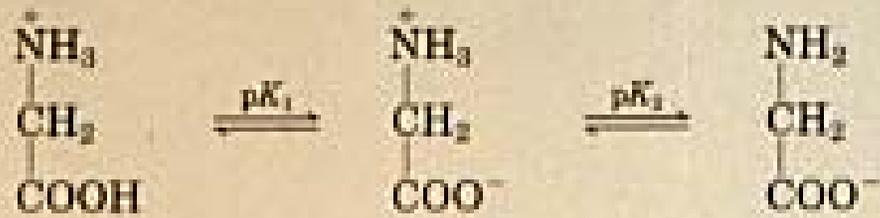
**Glutamine**  
**(Gln, Q)**

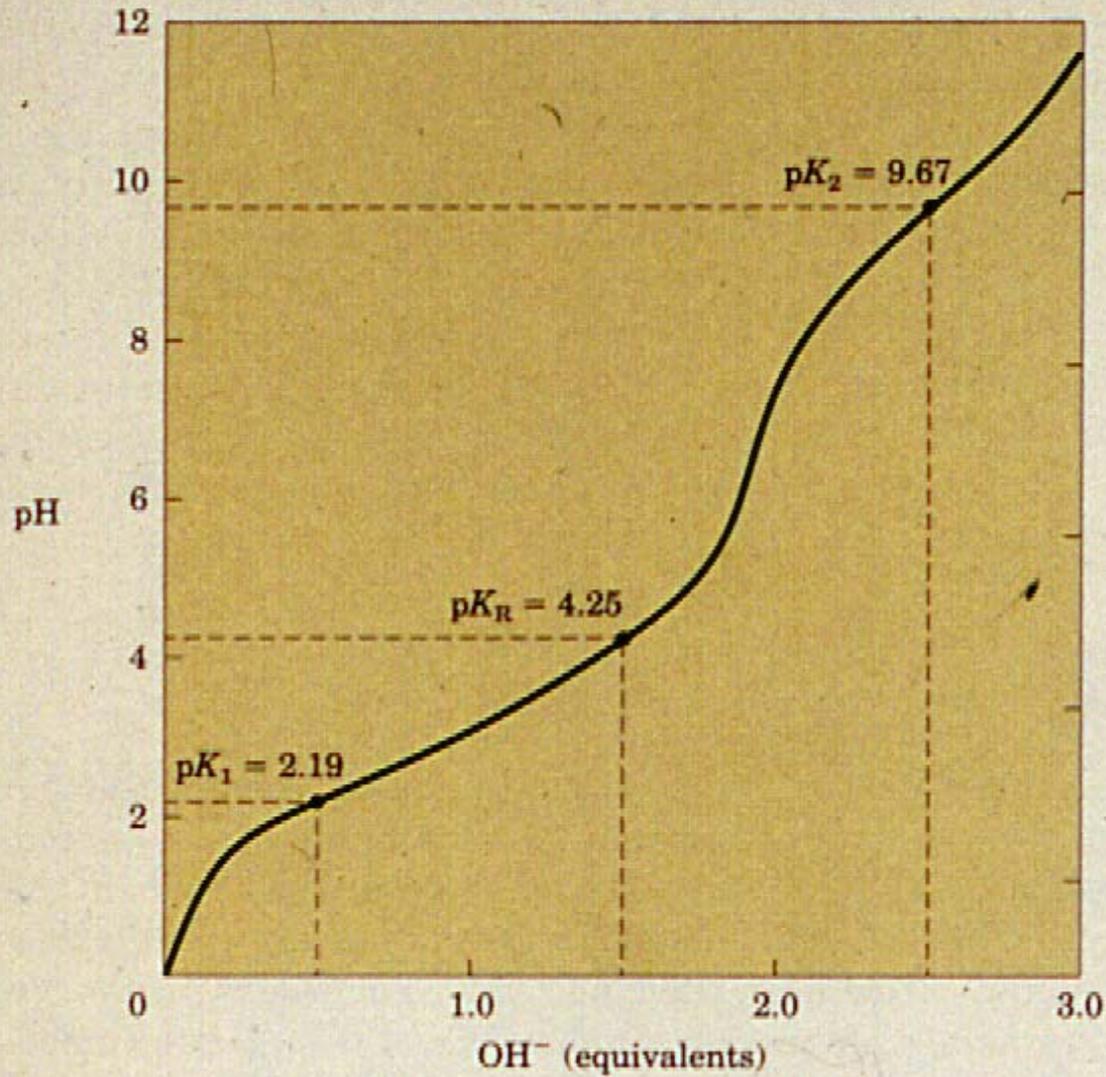
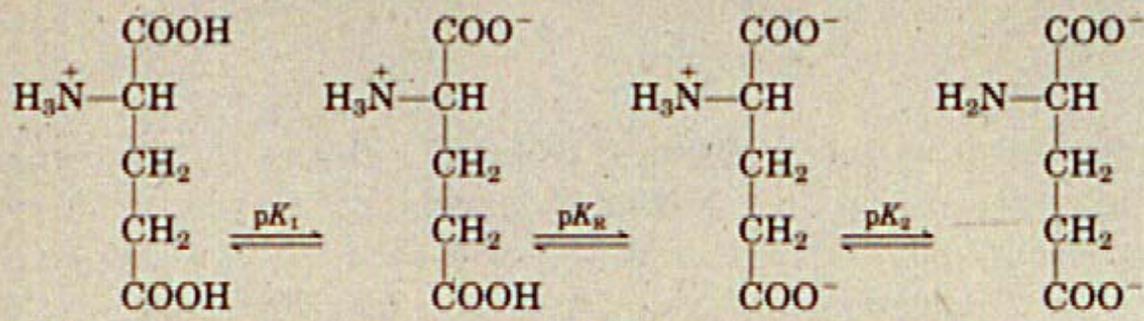


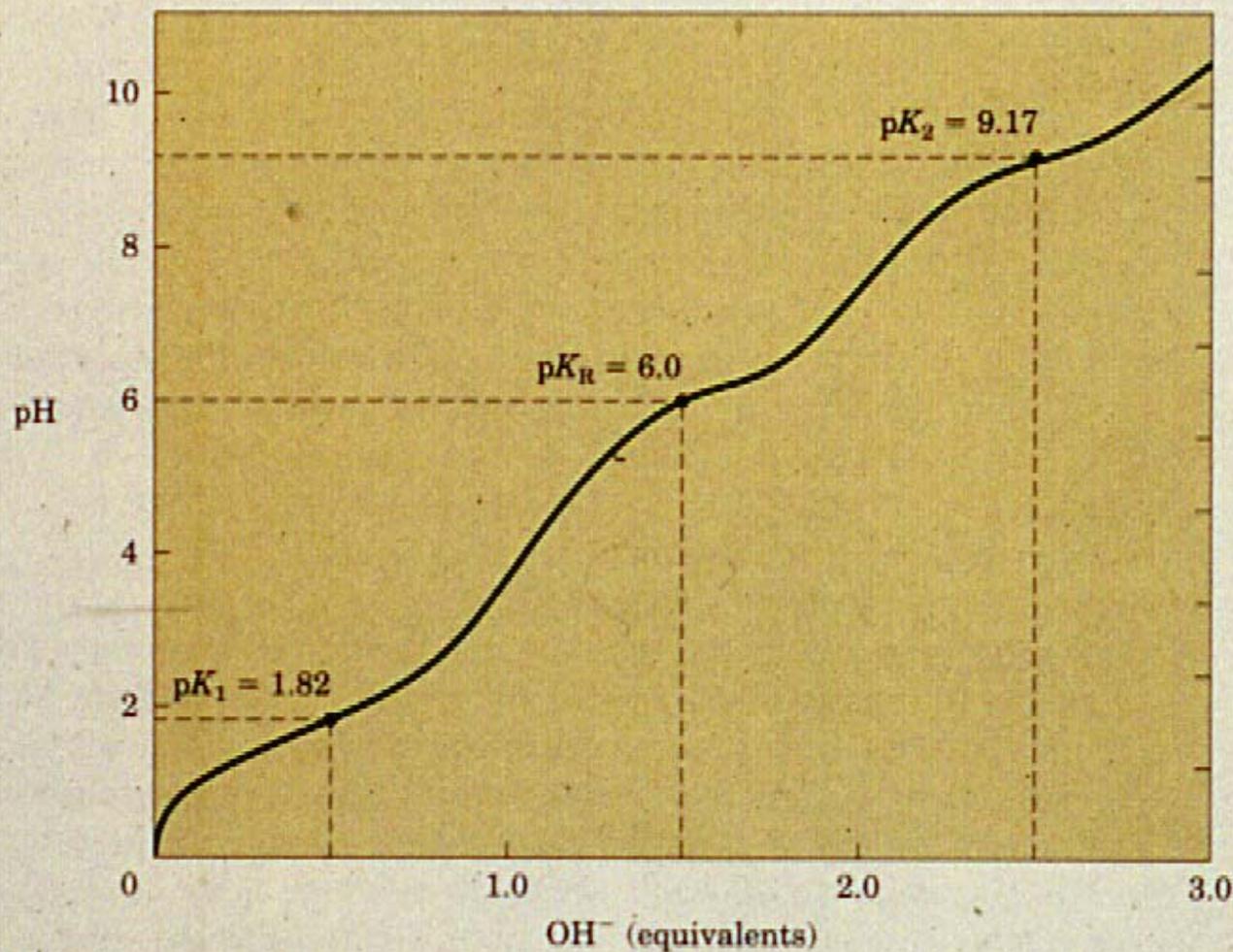
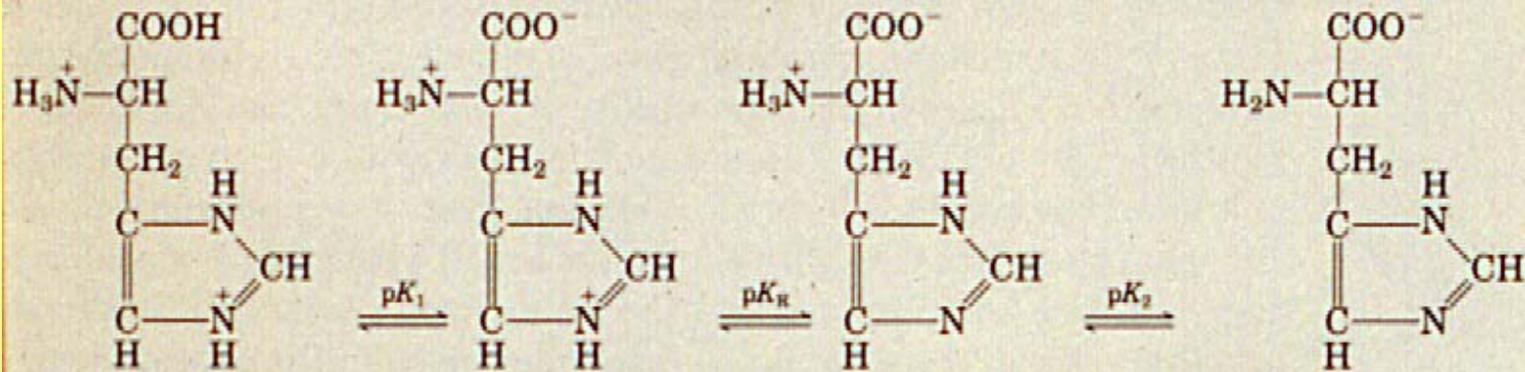
**Homoserine**



**Serine**





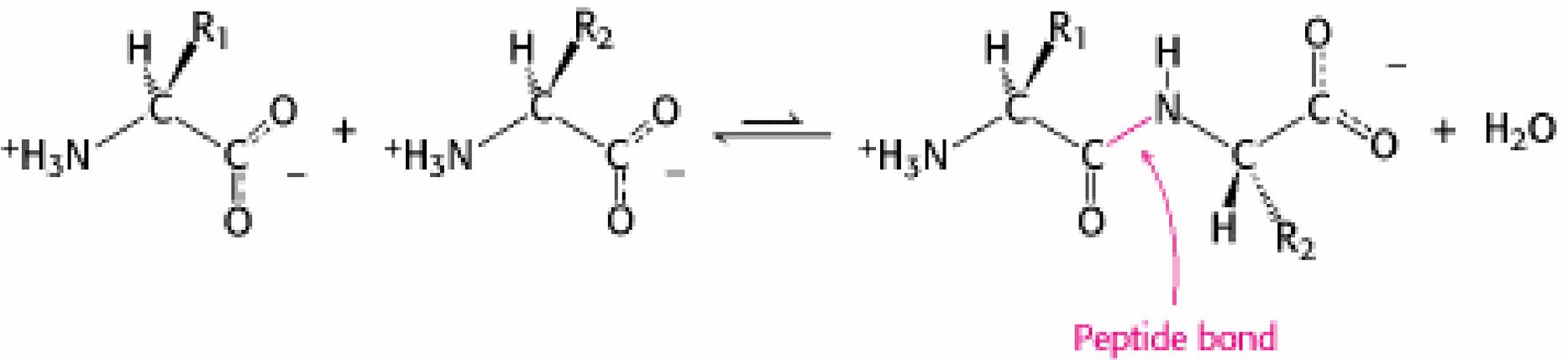


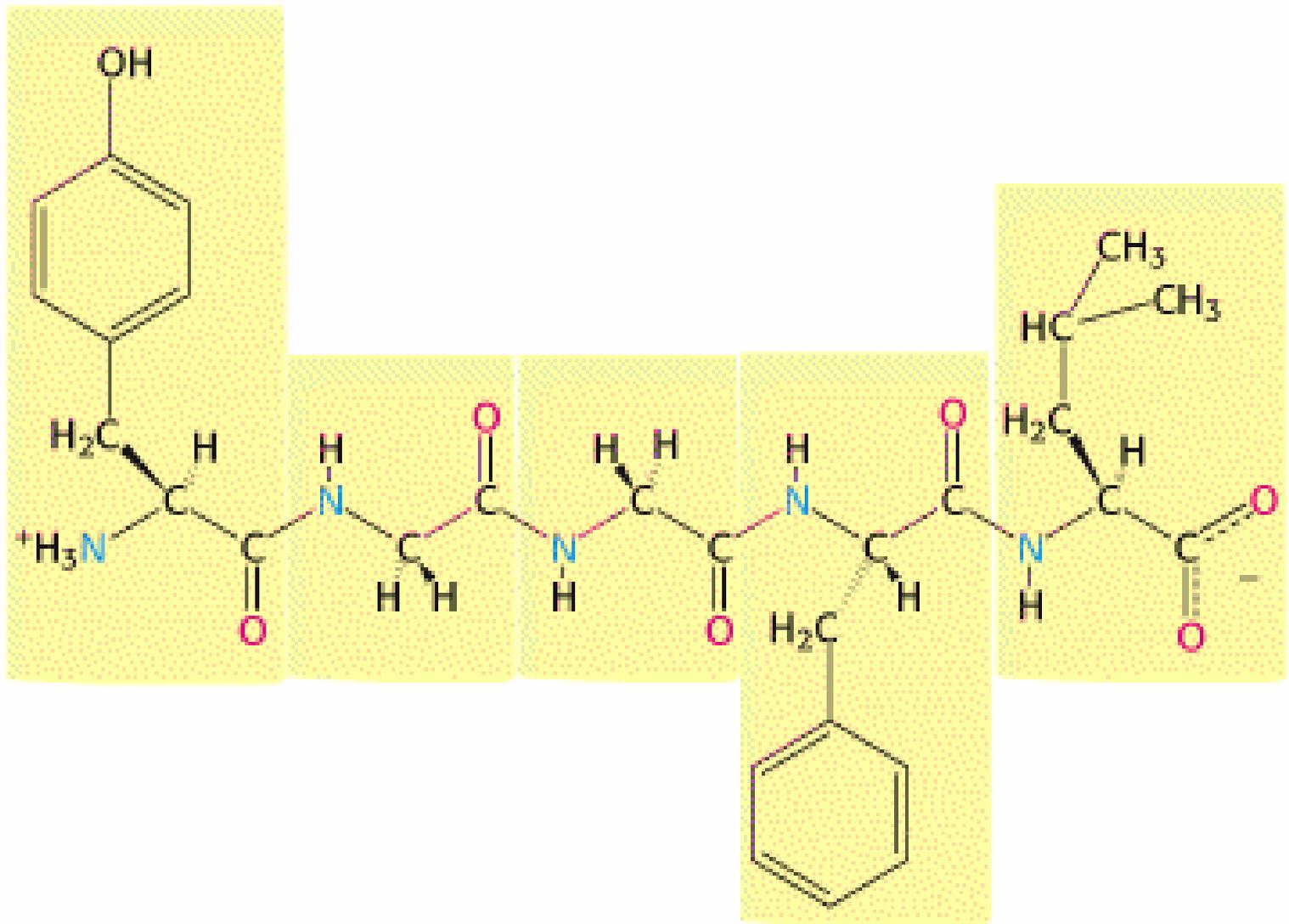
Group	Acid	$\rightleftharpoons$	Base	Typical $pK_a^*$
Terminal $\alpha$ -carboxyl group		$\rightleftharpoons$		3.1
Aspartic acid Glutamic acid		$\rightleftharpoons$		4.1
Histidine		$\rightleftharpoons$		6.0
Terminal $\alpha$ -amino group		$\rightleftharpoons$		8.0
Cysteine		$\rightleftharpoons$		8.3
Tyrosine		$\rightleftharpoons$		10.9
Lysine		$\rightleftharpoons$		10.8
Arginine		$\rightleftharpoons$		12.5

\* $pK_a$  values depend on temperature, ionic strength, and the microenvironment of the ionizable group.

Amino acid	Three-letter abbreviation	One-letter abbreviation
Alanine	Ala	A
Arginine	Arg	R
Asparagine	Asn	N
Aspartic Acid	Asp	D
Cysteine	Cys	C
Glutamine	Gln	Q
Glutamic Acid	Glu	E
Glycine	Gly	G
Histidine	His	H
Isoleucine	Ile	I

Leucine	Leu	L
Lysine	Lys	K
Methionine	Met	M
Phenylalanine	Phe	F
Proline	Pro	P
Serine	Ser	S
Threonine	Thr	T
Tryptophan	Trp	W
Tyrosine	Tyr	Y
Valine	Val	V
Asparagine or aspartic acid	Asx	B
Glutamine or glutamic acid	Glx	Z





Tyr

Gly

Gly

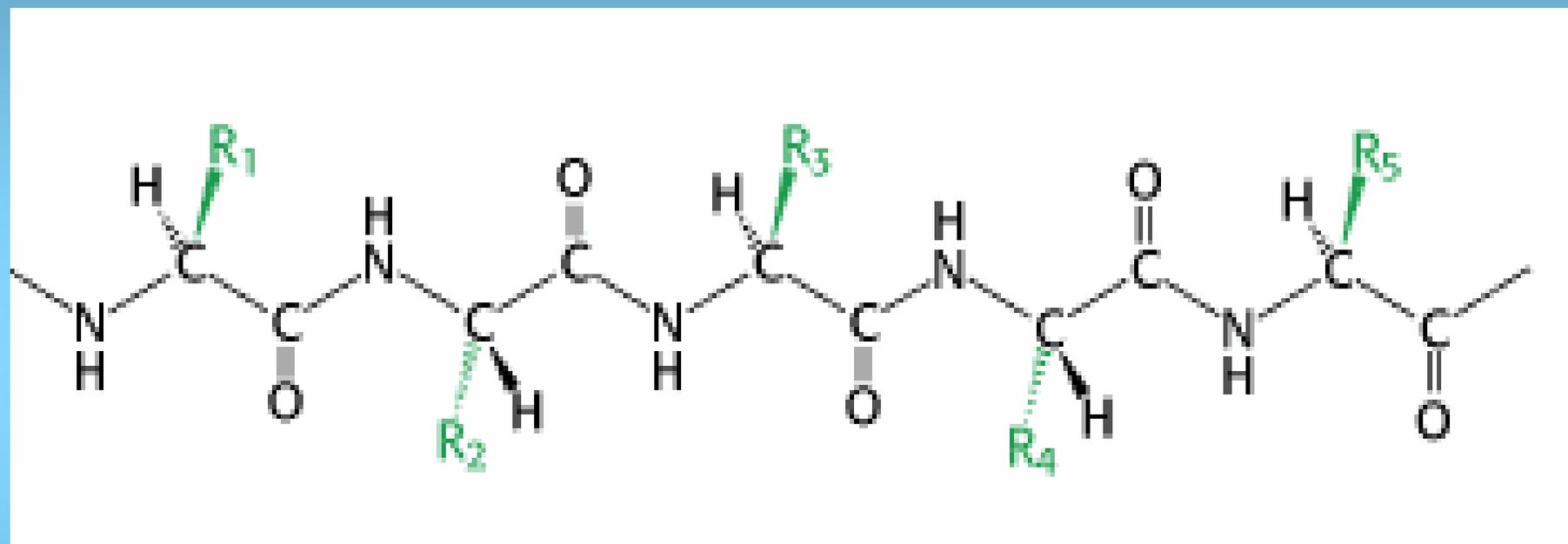
Phe

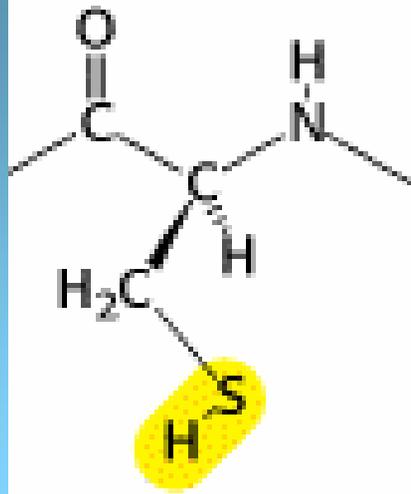
Leu

Amino  
terminal residue

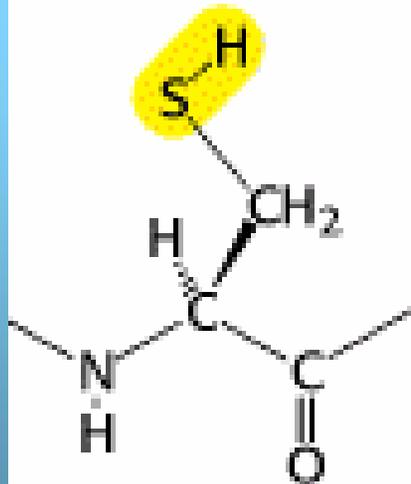
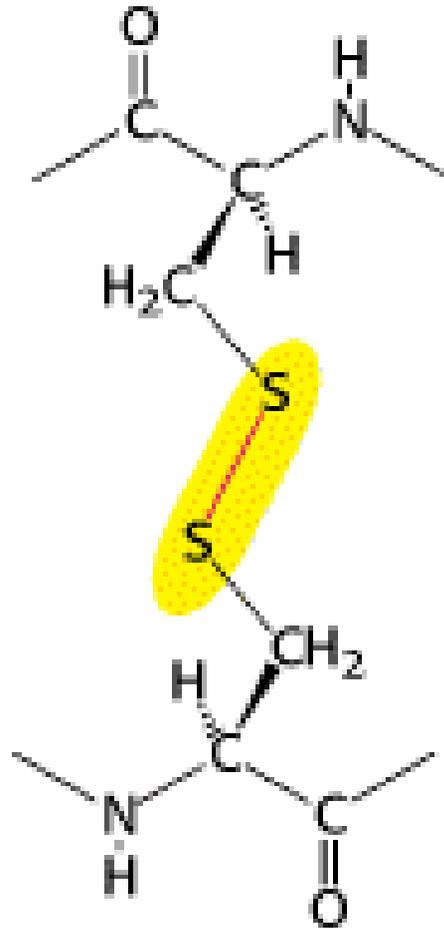


Carboxyl  
terminal residue





Cysteine



Cysteine

Cystine

**A chain**  
Gly-Ile-Val-Glu-Gln-Cys-Cys-Ala-Ser-Val-Cys-Ser-Leu-Tyr-Gln-Leu-Glu-Asn-Tyr-Cys-Asn  
5 10 15 21

**B chain**  
Phe-Val-Asn-Gln-His-Leu-Cys-Gly-Ser-His-Leu-Val-Glu-Ala-Leu-Tyr-Leu-Val-Cys-Gly-Glu-Arg-Gly-Phe-Phe-Tyr-Thr-Pro-Lys-Ala  
5 10 15 20 25 30

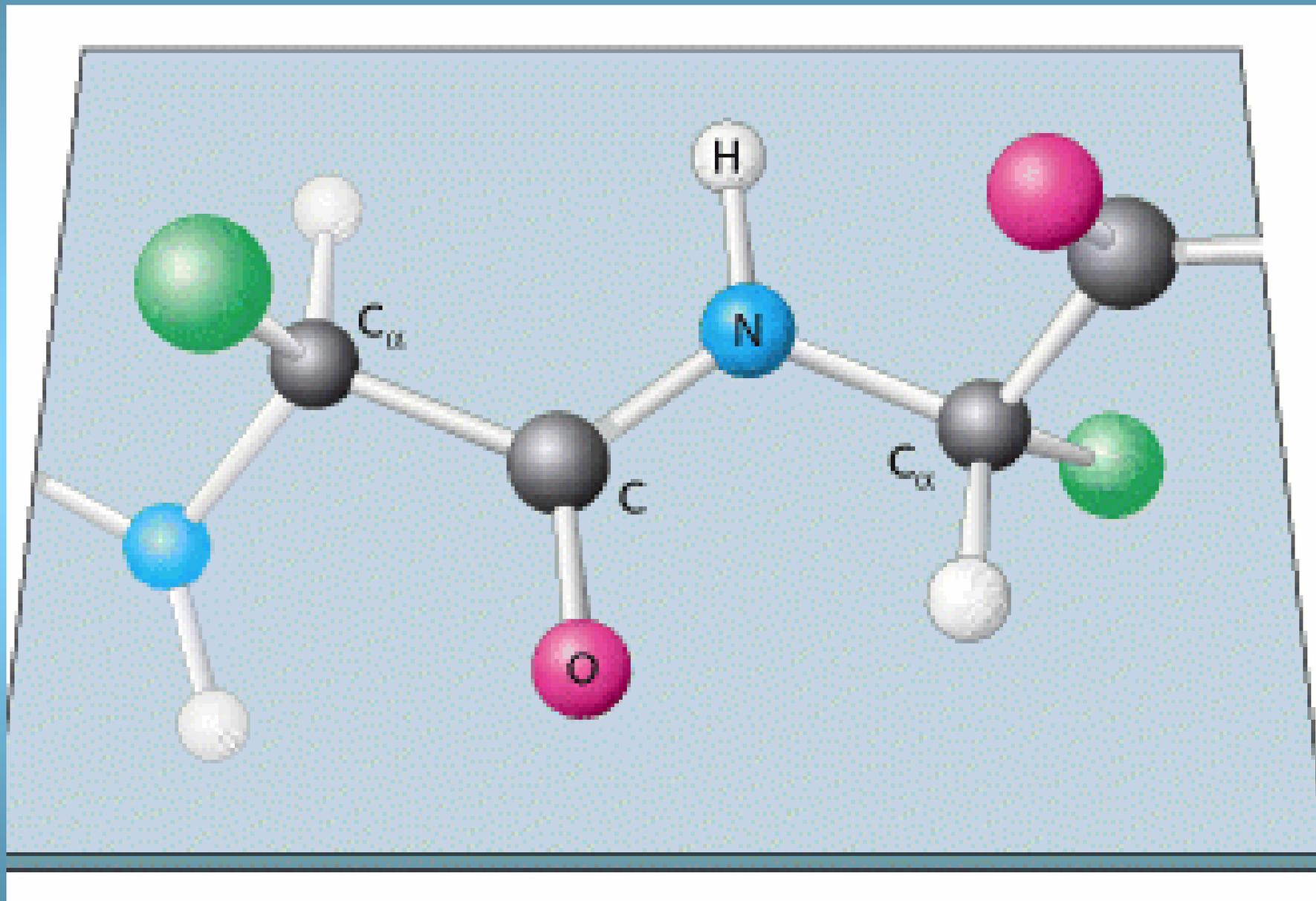
S ————— S

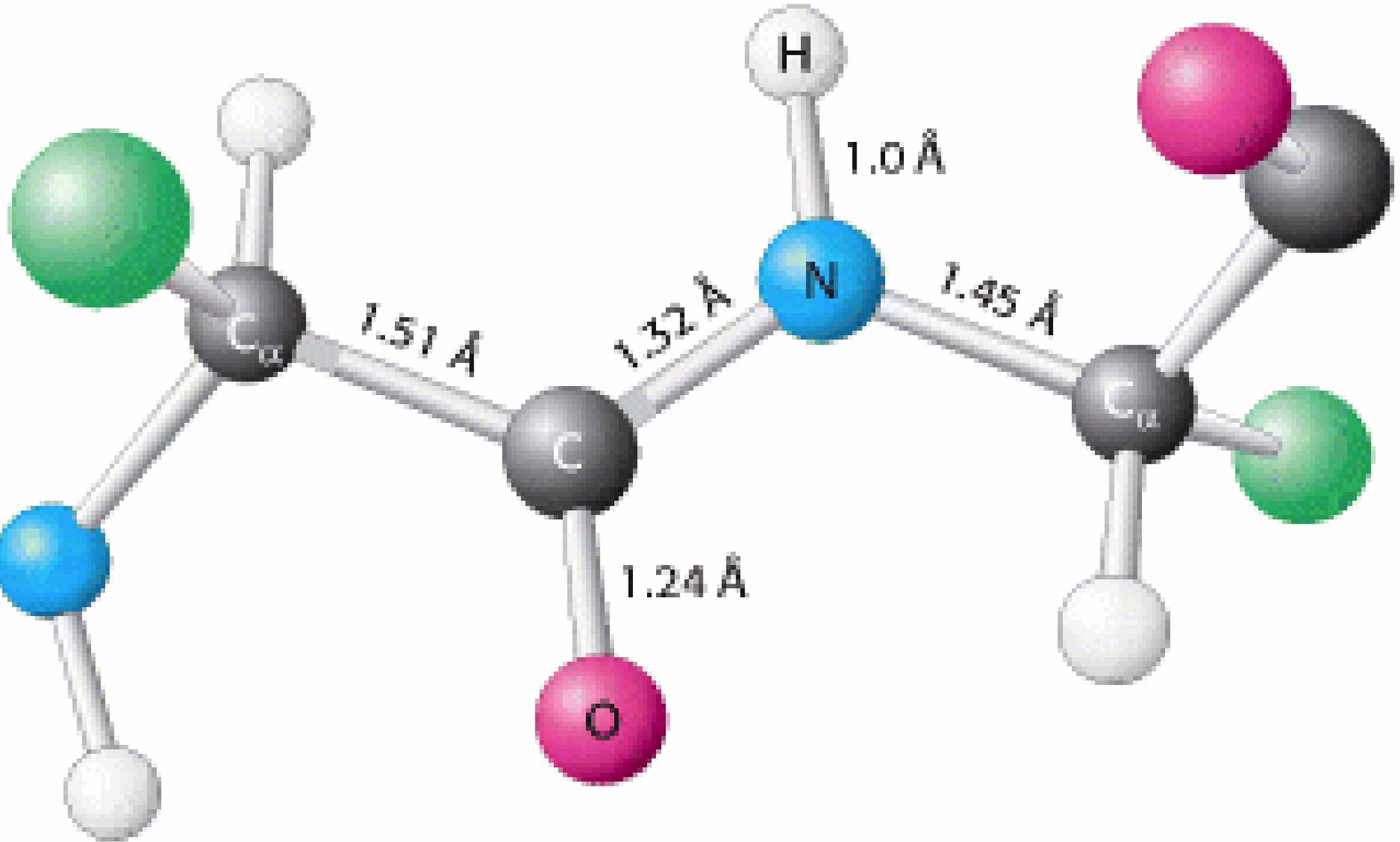
S

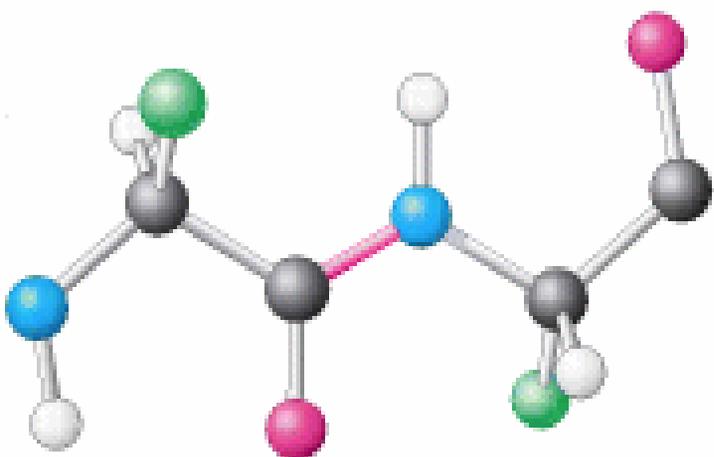
S

S

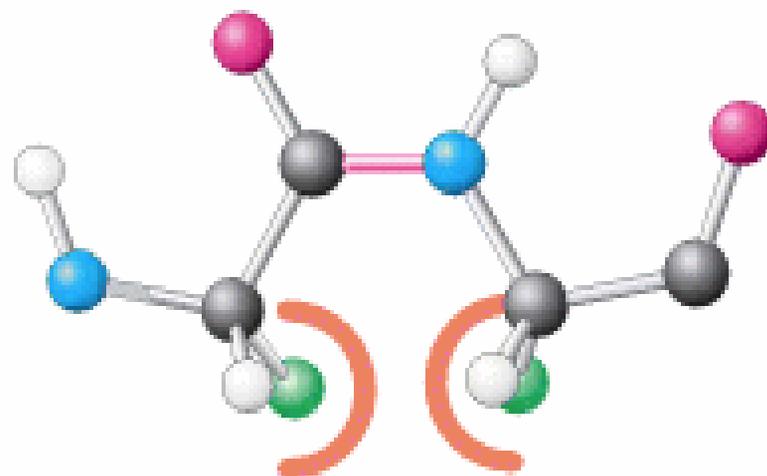
S



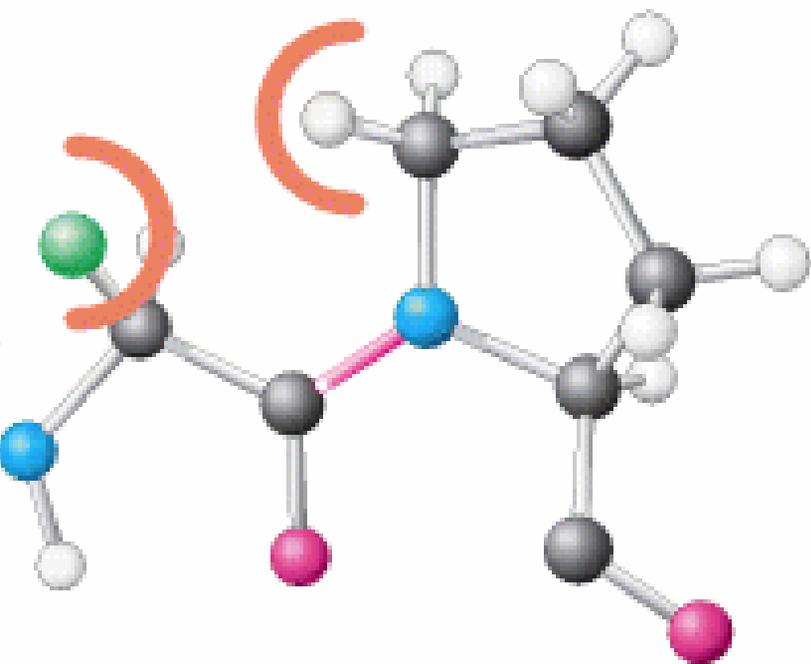




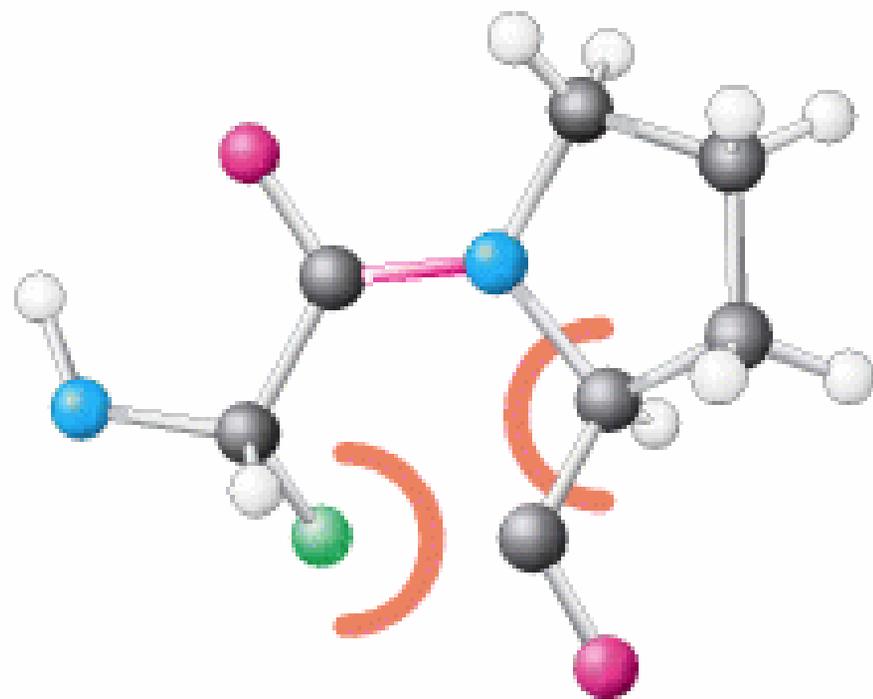
**Trans**



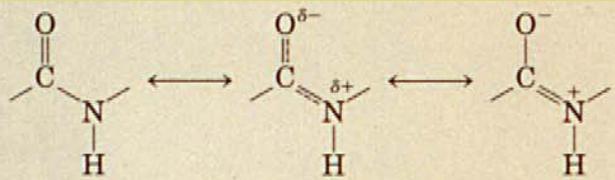
**Cis**



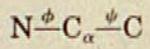
**Trans**



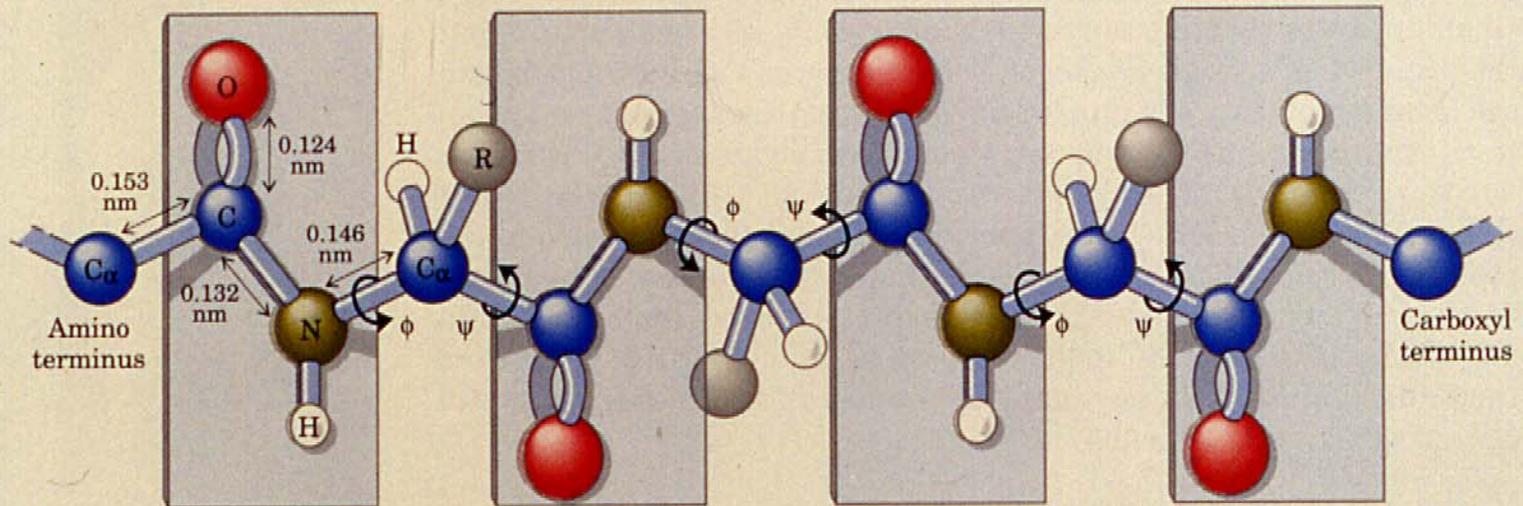
**Cis**

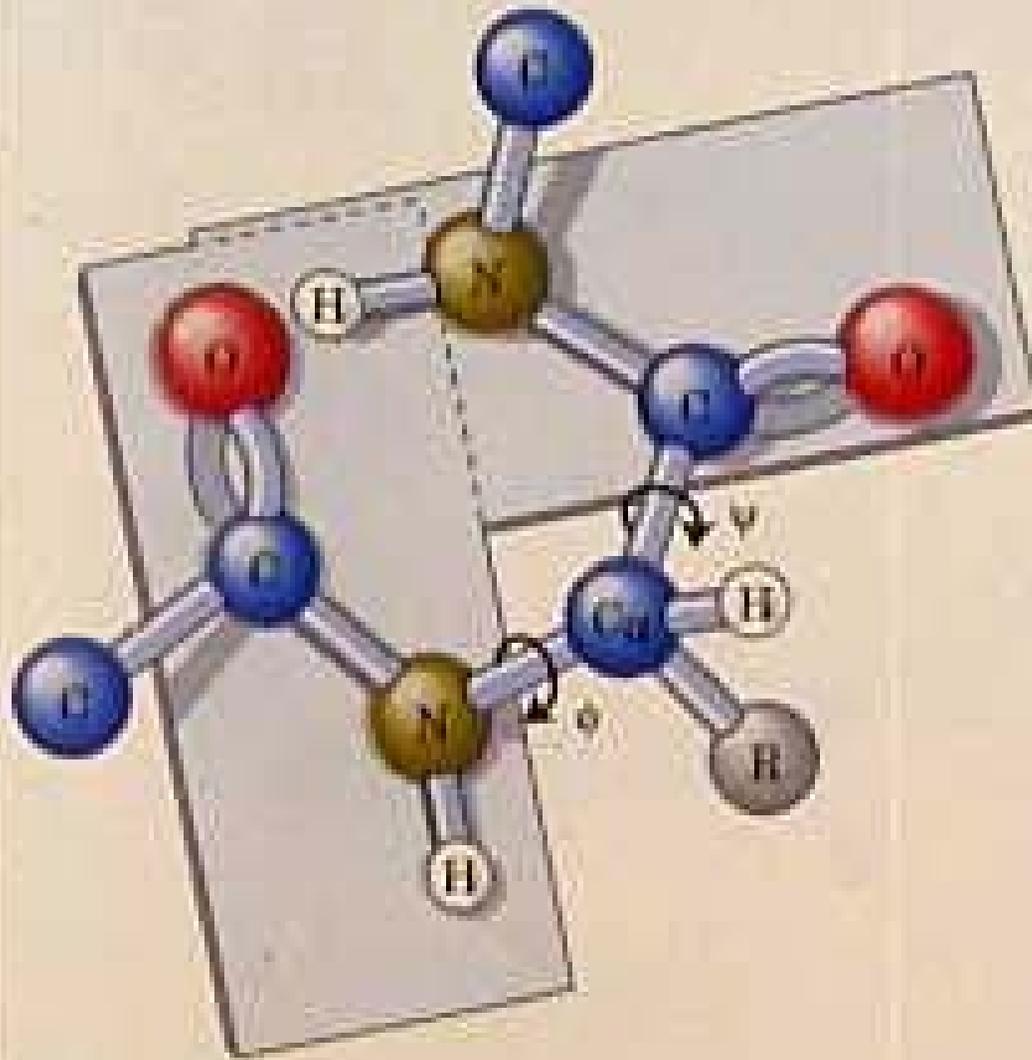


(a)



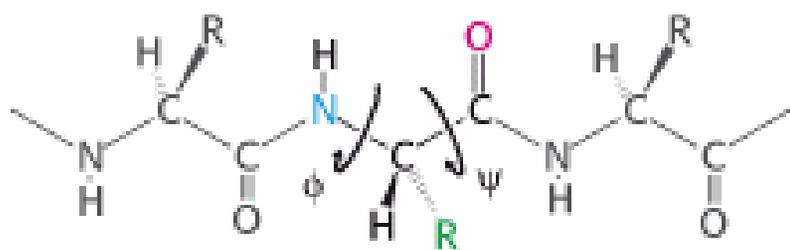
(b)



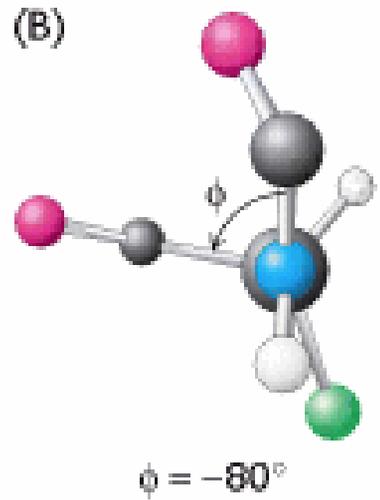


(d)

(A)



(B)



(C)

