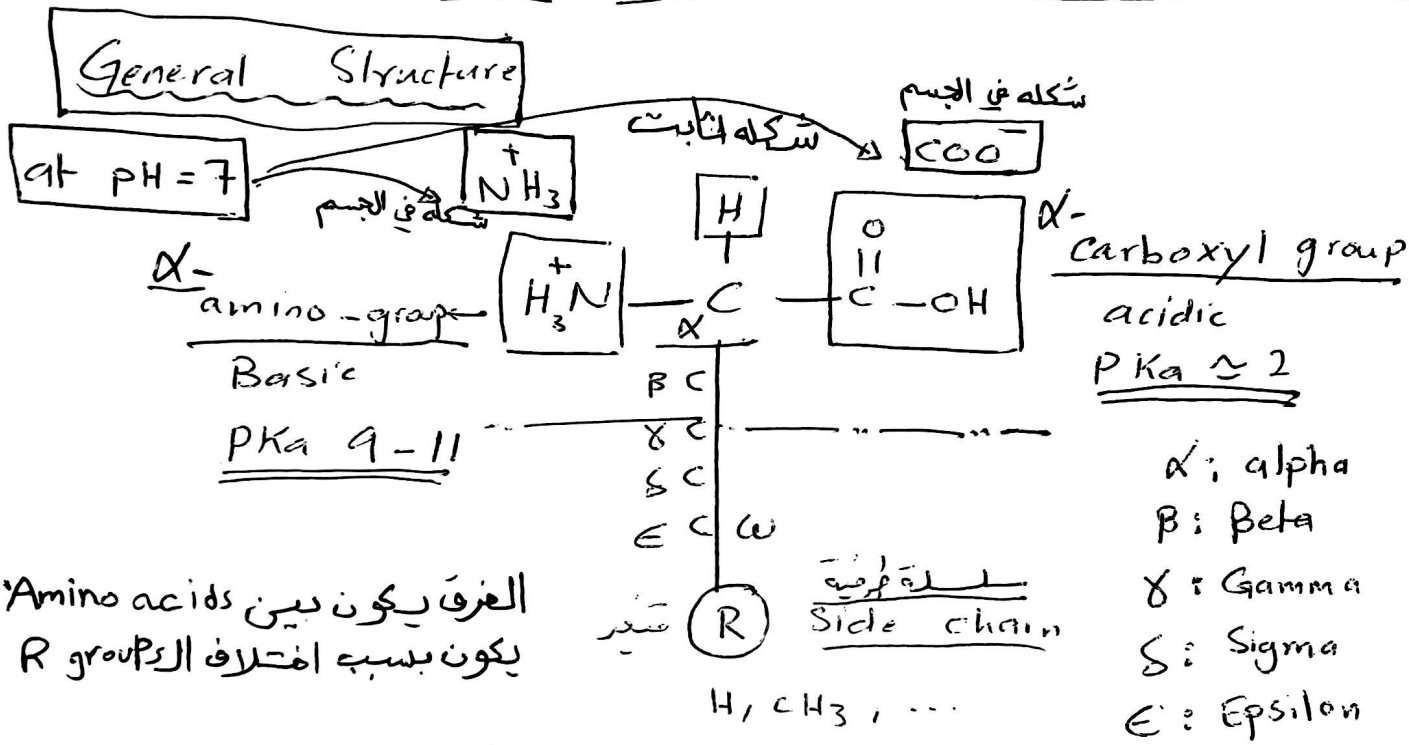
: Amino-acids الاحماض الامينية

• proteins :- Consists of 100 - 1000s of amino-acids Linked by peptide Bond

- peptid : small chain of aminoacids 2 - dozens

we have 20 type of amino acids in our proteins

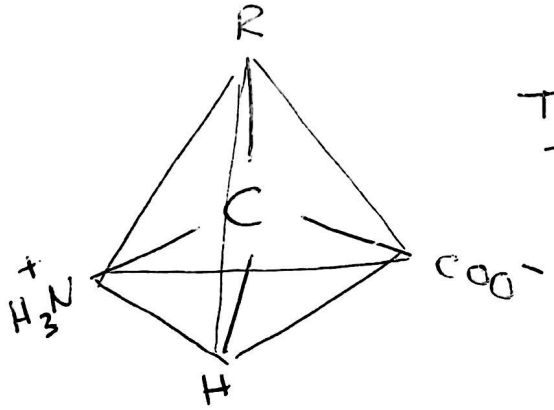
General Structure



Amino acids العرق يكون بين
يكون بسبب اختلاف الـ R groups

α : alpha
β : Beta
γ : Gamma
δ : Sigma
ε : Epsilon
ω : Omega

3D) structure of amino-acids



Tetrahedral Structure due to Covalent bonds

The Side chain group of amino acids are bounded to which carbon?

a. α carbon — αC
b. β carbon — βC
c. Carbonyl-carbon — $\overset{O}{\overset{\|}{C}}$
d. Different amino-acids have their side chain attached to different Carbons

Q: which of the following statements are true

a. the pKa of α-amino group is lower than the pKa of α-carboxyl group

b. the pKa of α-carboxyl group is lower than the pKa of α-amino-group

c. amino-acids are tehrahedral due to H-Bonds

d. the α-amino-group has negative charge at physiological pH

Compound has a mirror image صورة

- if the 2 mirror images are لا تنطبق
Non-superimposable

↓

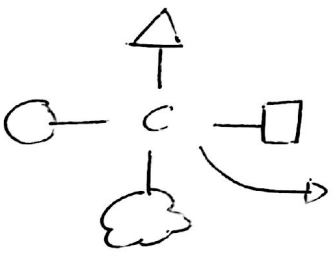
Chiral (Hands)

- if the 2 mirror images are تنطبق
Super-imposable

↓

Achiral

* دائماً اذا ارتبط الكربون على Assymetric Carbon يكون Chiral



ذرة كربون ترتبط مع
4-different partenars
٤ شركاء مختلفين

Assymetric C

↓

Chiral

↓

2 mirror images

Non-Super imposable

نظائر (Sterio isomers)

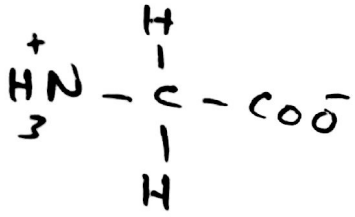
L
Lefo
left

D
Dextro
right

aminoacids have assymetric Carbon

Except Glycine

R = H



Symetric C

∴

1- Achiral

2- No sterioisomers

3- Optically inactive

All amino acids have 2 shapes (L and D) except Glycine.

↓

Chiral

↓

2 sterioisomers

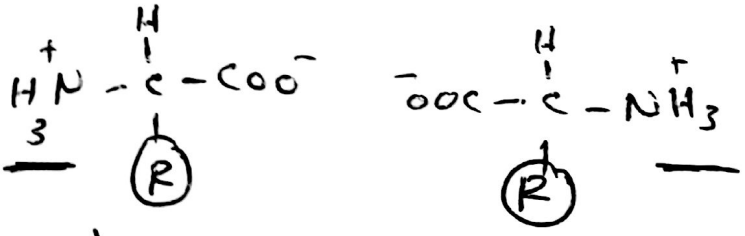
L "levo" left — rotate polarized light to left

D "Dextro" right — rotate polarized light to Right

هذه الطريقة مشتقة من سكر ثلاثي الكربون اسمه [Glyceraldehyde] في D, L كرسي موقع OH

كيف نرسم L, D ؟

NH_3^+ في موقع amino-group



L D

* All amino acids in our proteins are L

D-a.a ← 1- Bacterial Cell wall
2- Some Natural antibiotic

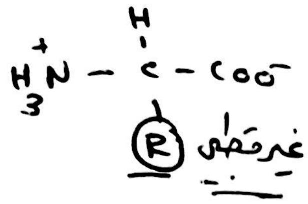
① aminoacids differ in **R-group** (Side chain)

حسب **R** تقسمنا الى **٤ عائلات**

1 <u>Non-Polar</u> a.a → R-group Non-polar

<u>at pH = 7</u>

<u>net charges = zero</u>

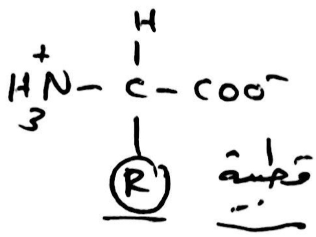


2 <u>Polar Uncharged</u> a.a → R-group polar

<u>at pH = 7</u>

<u>net charges = zero</u>

But at pH = 7
not charged



3 <u>acidic</u> a.a → R-group acidic

Contain COOH

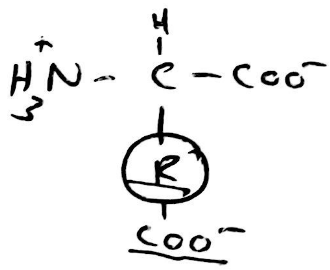
Polar Charged a.a

<u>at pH = 7</u>

<u>net charges</u>

<u>= −1</u>

at pH = 7 COO⁻
(−ve)



4 <u>Basic</u> a.a → R-group basic

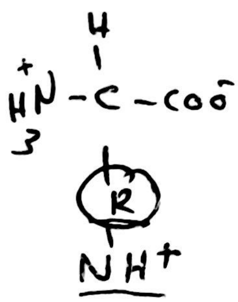
NH^+

<u>at pH = 7</u>

<u>net charges</u>

<u>= +1</u>

at pH = 7 ⊕



Memorize the shortcuts (Gly - Ala...)

1- Non-polar a.a (R → Non-polar)

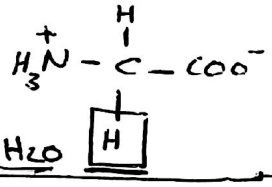
Aliphatic (Not aromatic)

Aromatic

Benzene Ring

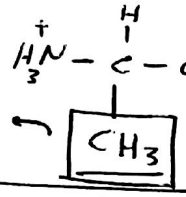
Benzene

Glycine (Gly)



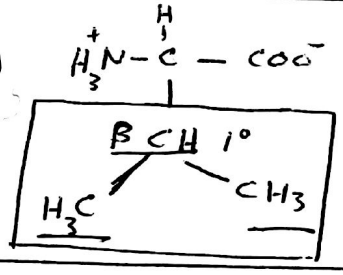
most soluble in H_2O

Alanine (Ala)



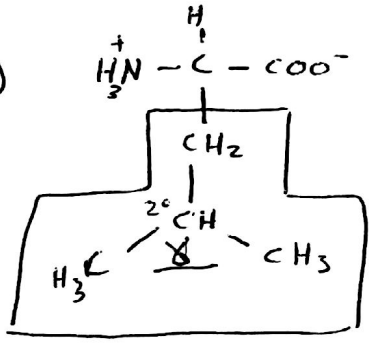
methyl group

Valine (Val)



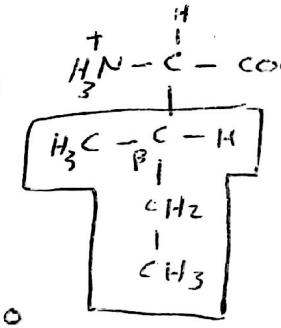
Branched at β-C

leucine (Leu)



Branched at γ-C

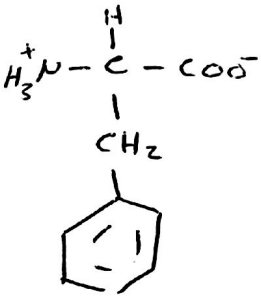
Isoleucine (Ile)



Branched at β

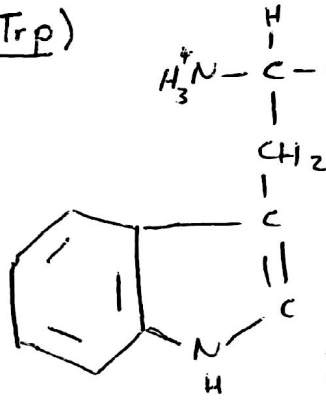
least soluble in H2O

phenylalanine (phe)



Benzene ring

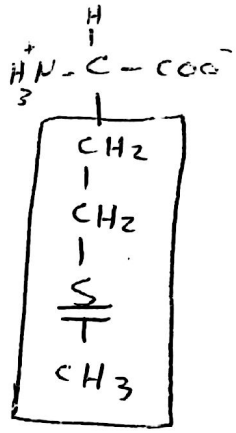
Tryptophane (Trp)



largest Side chain

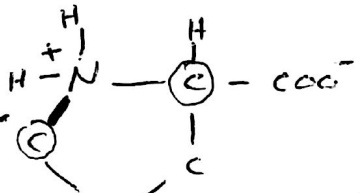
Indol ring (aromatic)

Methionine (Met)



Contain Sulfer

proline (pro)



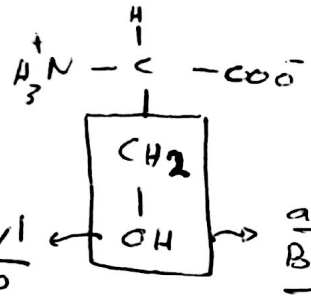
Secondary amine (connected to 2 carbons)

Cyclic aliphatic

(Imino-acid)

. Uncharched a.a (R → Polar But uncharged at pH = 7)

Serine (Ser)

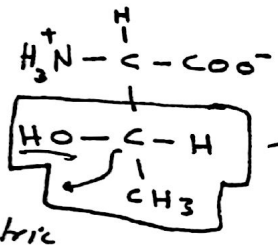


Hydroxyl Group

acidic
But very high pKa ≈ 15

NOT Titrable [Cannot have titration because the pKa is very high and the Ph cannot exceed it]

Thrionine (Thr)

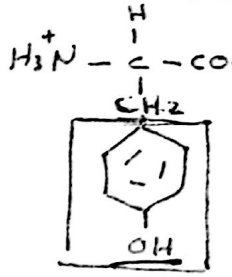


Second assymetric C

acidic
But very high pKa ≈ 15

NOT Titrable

Tyrosine (Tyr) Polar aromatic

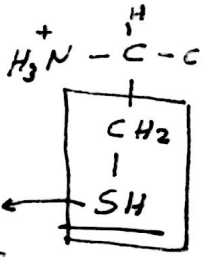


aromatic / phenol
acidic
pKa = 10.07

Titrable at pH = 7

if pH > 10

Cystein (Cys)

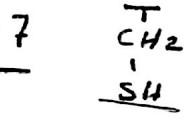


SH: Sulfohydryl or thiol group

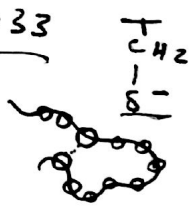
acidic pKa = 8.33

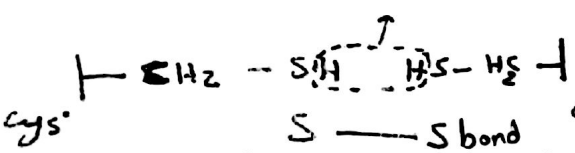
Titrable

at pH = 7



PH > 8.33

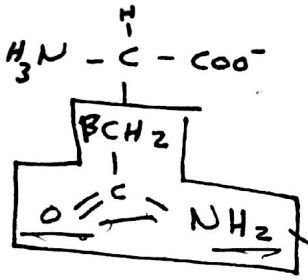




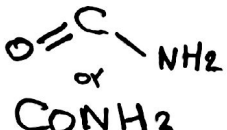
Cys — Cys
S — S bond
Disulfied Bridge.

(7)

Asparagine (Asn)



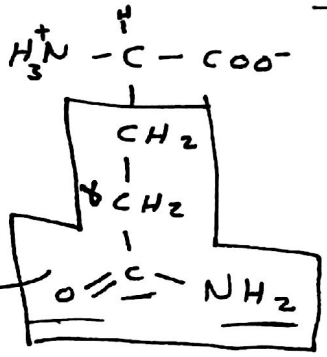
$CONH_2$



$CONH_2$ amide Group

Not titrable.

Glutamine (Gln)



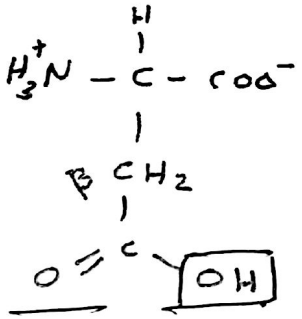
$CONH_2$

Acidic amino acid → R-group acidic

contain COOH

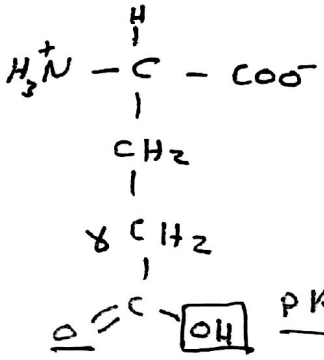
-ve at pH = 7

Aspartic acid (Asp)



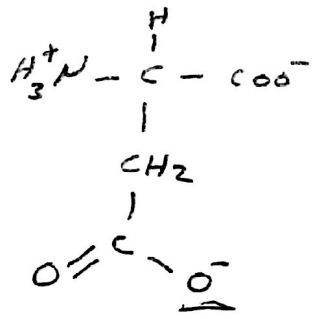
pKa = 3.86

Glutamic acid (Glu)



pKa = 4.25

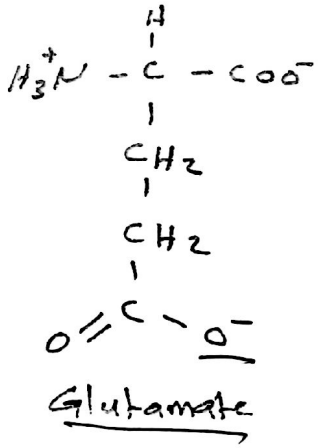
at pH = 7 pH > pKa



Aspartate

Given to groups who lost H^+

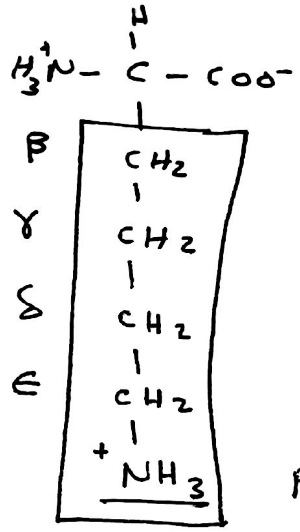
at pH = 7 pH > pKa



Glutamate

ic amino-acids (R → Basic $\overset{+}{N}H$ +ve at pH = 7)

Lysine (lys)



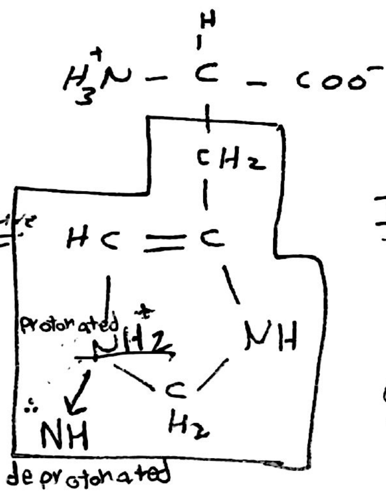
at pH = 11
the R group will be?

a. +
b. :
c. −

pKa = 10.5

Histidine (His)

Basic structure
acidic pKa



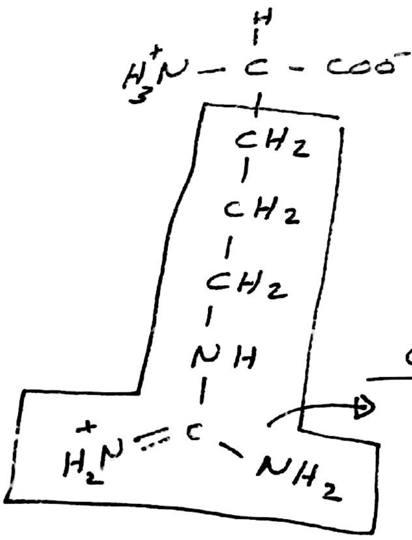
Imidazol Group

pKa = 6

at pH = 7 $\frac{\text{deprot NH}}{\text{prot } NH_2^+} = \boxed{\frac{10}{1}}$

تكون pKa هذه المجموعة تتغير حسب موقعها في البروتين

Arginine (Arg)



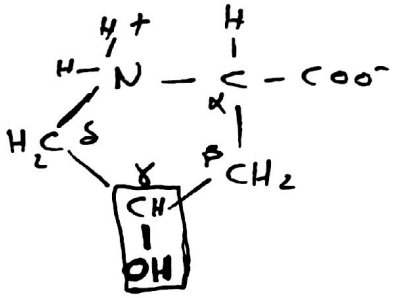
Guanidino Group
pKa = 12.48

Common amino-acids:

[1] Hydroxyproline

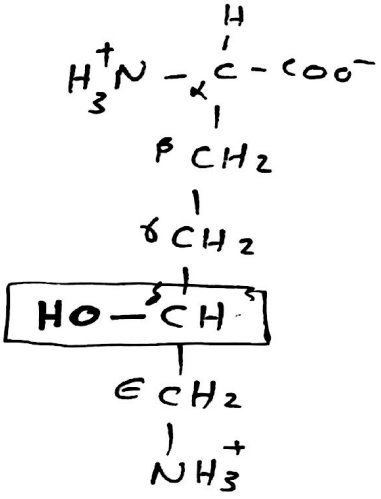
* OH on γ Carbon

Gamma



[2] Hydroxylysine

* OH on δ Carbon

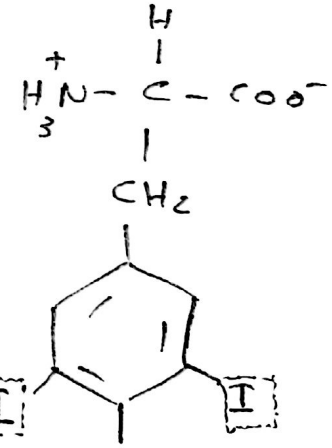


[1] + [2] found in Collagen protein of Connective tissues.

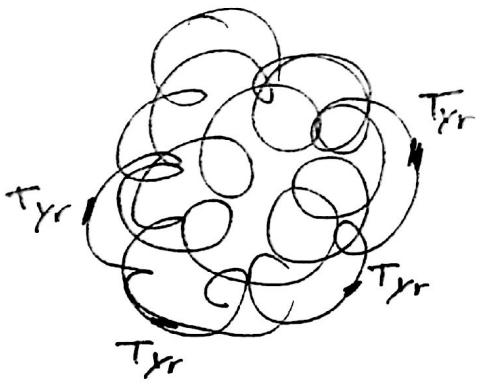
[3] Thyroxines (T_3, T_4)

* Thyroid gland hormones هرمونات الغدة الدرقية

* Derived from Tyrosine مشتقين



إضافة Phenol و يود إلى Tyrosine



Thyroglobuline البروتين الرئيسي

* post translational modification تعديل بعد ترجمة البروتين

The Side chain of Met is a poor hydrogen bond donor.

True False

Q: which amino-acid is often added to other molecules to increase water solubility?

a. Ala
b. Asp
c. Gly
d. Pro
E. Trp

Q: The pKa values of Side chains of the Common amino acids

a. are always at low pH
b. are always at high pH
c. depend on the chemical nature of the side chain
d. are not Known