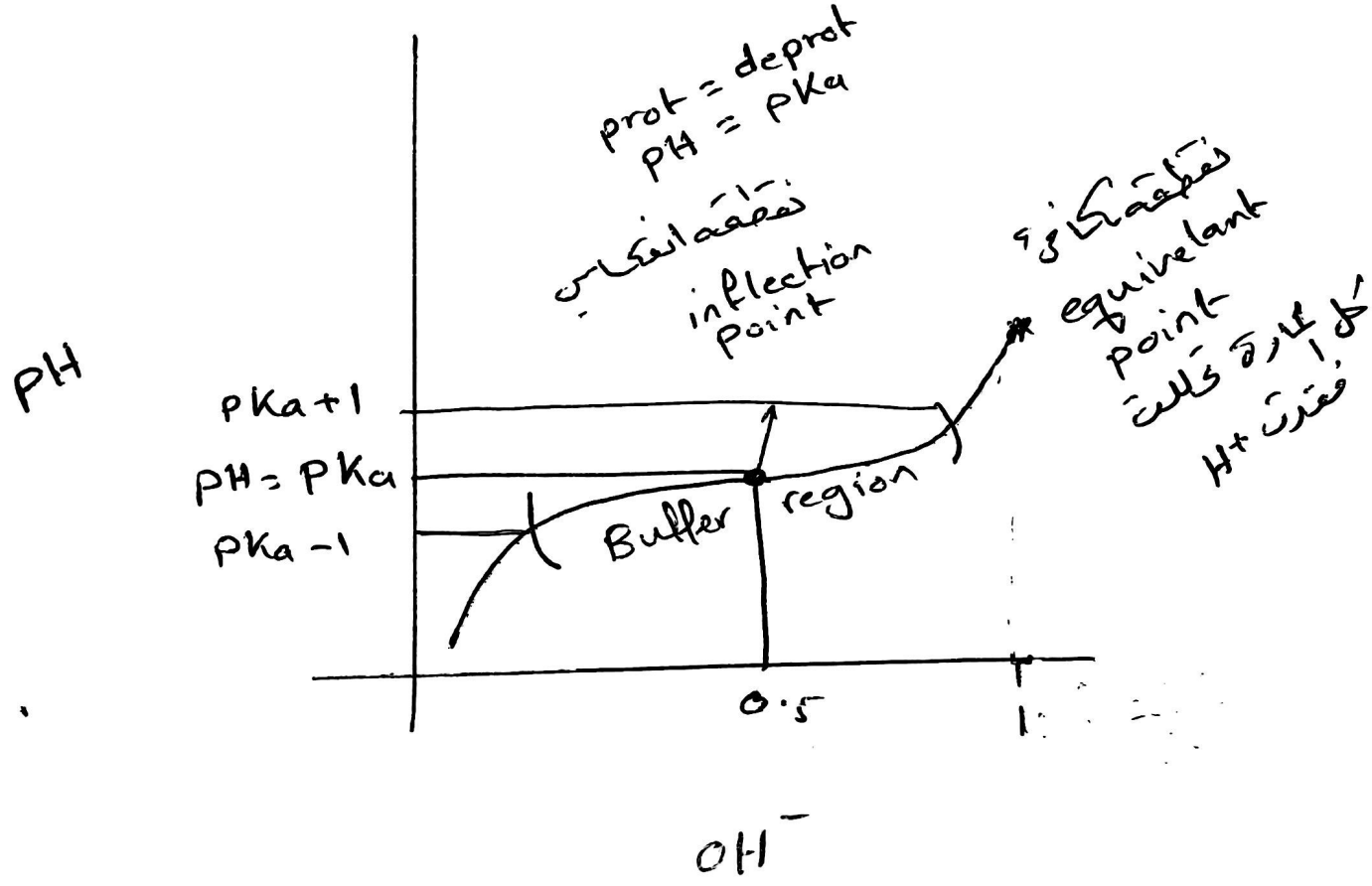
Itration of amino-acids

Remember:-

Titration Curve منحنى المعايرة



$pH < pKa$

أقل

أغلب الحالة

protonated

لم تفقد

$pH > pKa$

أكبر

أغلب الحالة

deprotonated

فقدت

أغلب الحالة تفقد H+ عندما

$pH > pKa$.

أكبر

Titration of amino-acids

مهم حفظها

acidic Group

$RH \rightarrow R^-$

$COOH \longrightarrow COO^-$

prot → dep

∴ −

Basic Group

$RH^+ \rightarrow R$

$NH_3^+ \longrightarrow NH_2$

prot → dep

+ ∴

على الأقل في كل حمض اميني توجد

2 titrable Groups

α amine: H_3N^+ — pKa 9-11

α Carboxyl: COOH — pKa ≃ 2

$H_3N^+ - C(H)(R) - COOH$

R-titrable

∴ 3 titrable Groups 7 amines

فقط في (7 من الأحماض الامينية)

R titrable

Aspartic acid	R	pKa = 3.86
Glutamic acid	R	pKa = 4.25
Tyrosine	R	pKa = 10.07
Cysteine	R	pKa = 8.33

R_acidic: R (RH) → R (R^-)

lysine		pKa = 10.5
Histidine		pKa = 6
Arginine		pKa = 12.48

R-Basic: R (RH^+) → R (R)

Not titrable

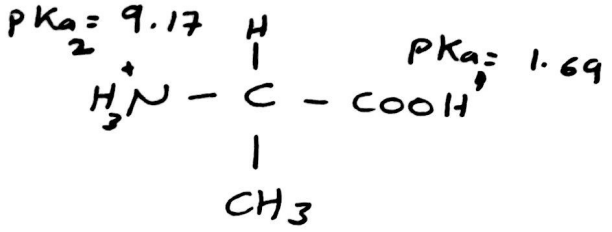
13 amine فقط

∴ 2 titrable groups

α-COOH

$\alpha - NH_3^+$

ration of alanine



2 titrable Groups

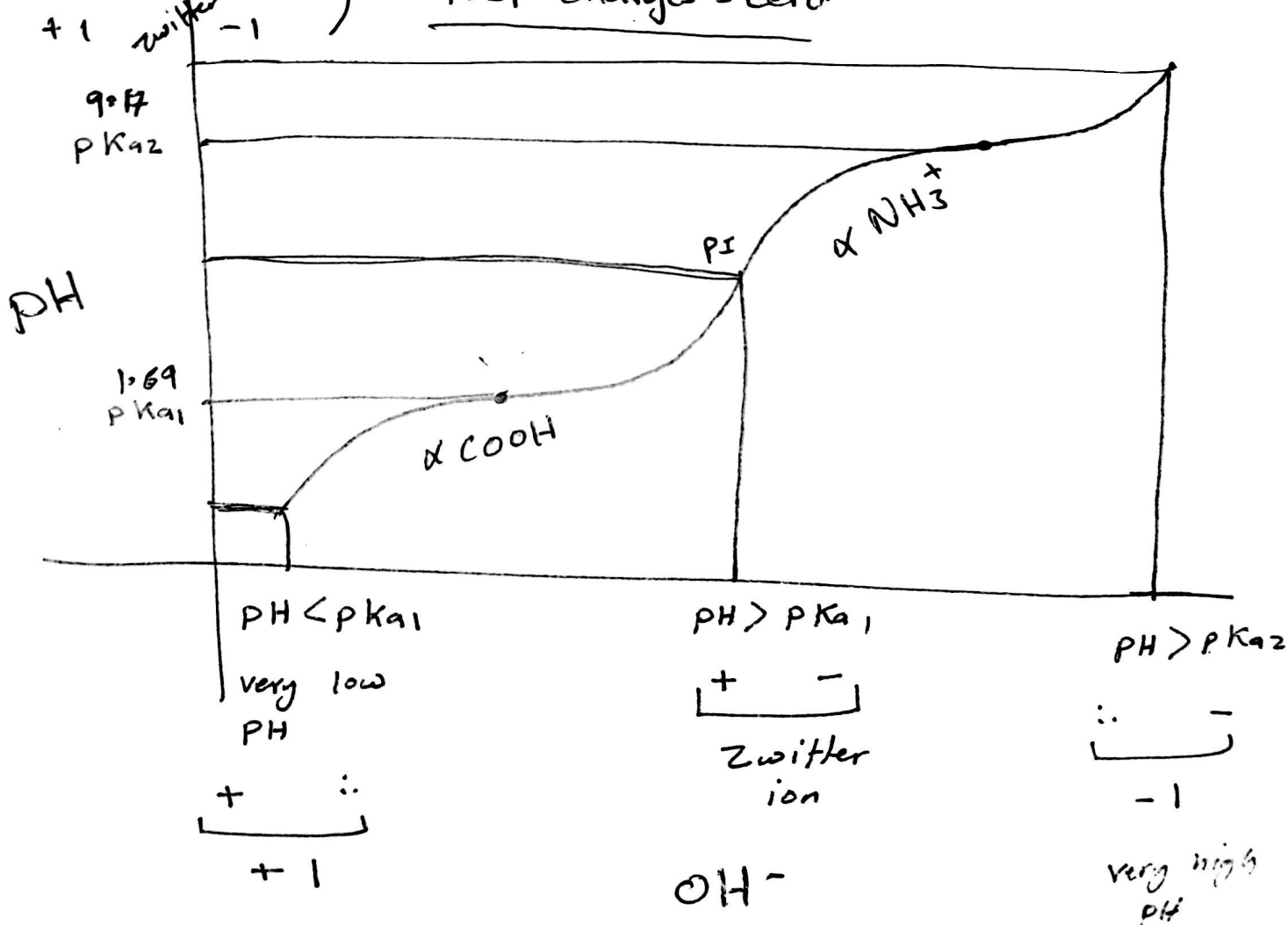
اولاً OH^- تتفاعل مع الحمض الاقوى (pKa الاقل) يعني آخر اول مجموعة تنفقد H^+ هي الاقل pKa (الاقل pKa يحوي Titration اول Curve)

2 titration Curve
2 Inflection point
2 Buffer capacity regions
2 OH^- equivelant needed
3 ionic forms

Isoelectric point (P_I) = $\frac{P_{Ka1} + P_{Ka2}}{2}$

النقطة التي عندها تتكون Zwitter ion

Net charges = Zero



rat is the pI for the following amino acids ?

$$PI = \frac{pK_1 + pK_2}{2}$$

Val

$\alpha COOH \quad pKa_1 = 2.32$

$\alpha - \overset{+}{N}H_3 \quad pKa_2 = 9.62$

Ser

$\alpha\ COOH \quad pKa_1 = 2.21$

$\alpha\ \overset{+}{N}H_3 \quad pKa_2 = 9.51$

Gln

$\alpha\ COOH \quad pKa_1 = 2.17$

$\alpha\ \overset{+}{N}H_3 \quad pKa_2 = 9.13$

titration of Histidine (Basic)

(lys
His
Arg)

$H_3\overset{+}{N} — \underset{|}{\overset{H}{\overset{|}{C}}} — COOH$

$pKa_3 = 9.69$ $pKa_1 = 1.5$

Imidazol

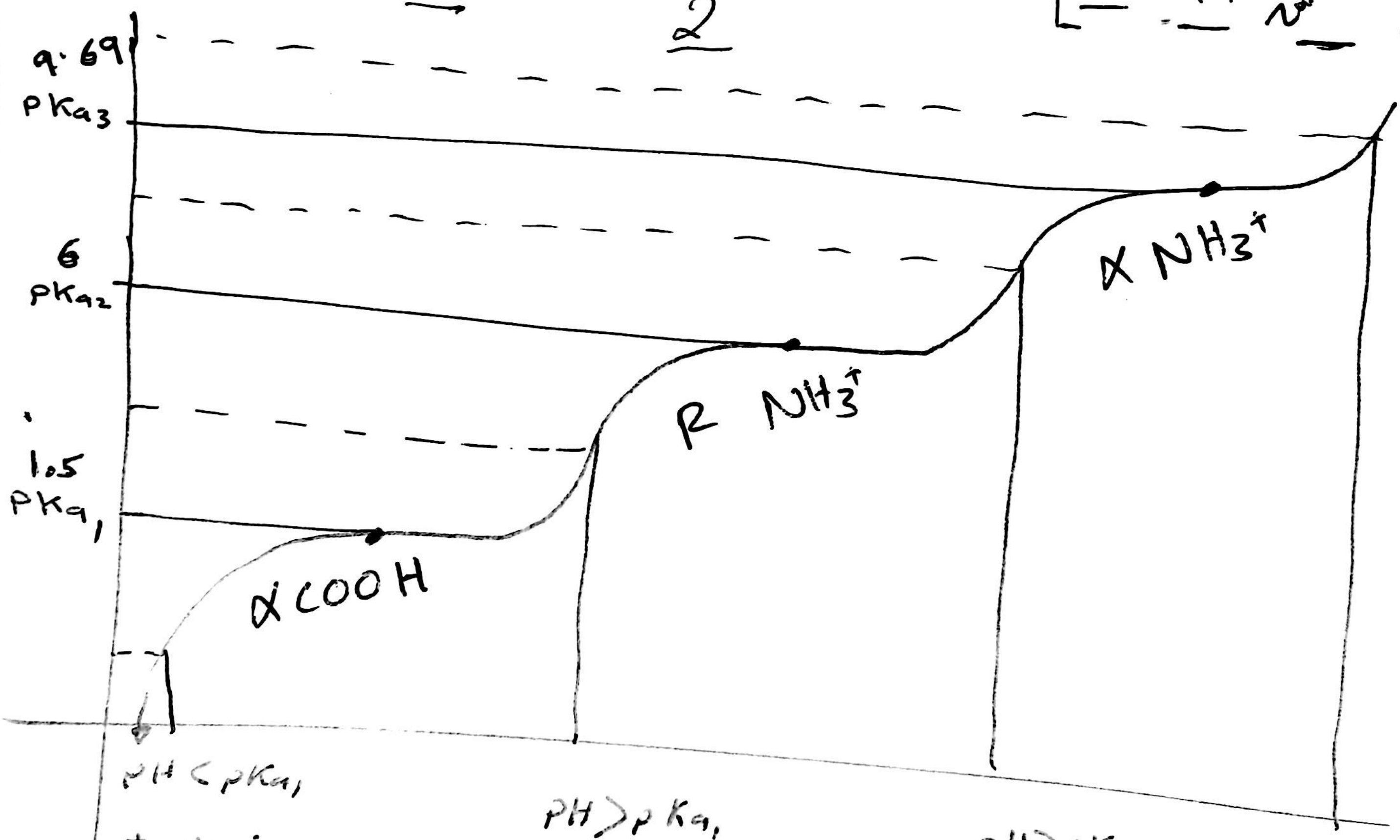
Basic

RH^+ $pKa_2 = 6$

3 titrable Group

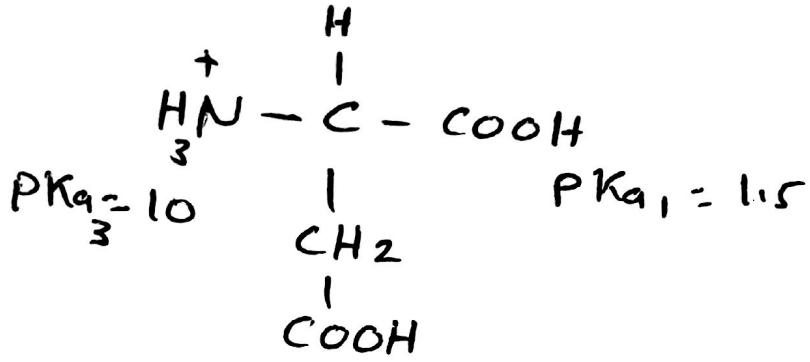
Isoelectric point (PI) = $\frac{\text{pKa اعلى تشبش}}{2}$

[* 4 ionic forms
+2 +1 zwitter -1]



pH < pKa_1	pH > pKa_1	pH > pKa_2	pH > pKa_3
+ + :	+ + -	+ : -	- : -
+2	+1	zwitter ion	-1
لم تفقد اي مجموعة H+	اول مجموعة فقدت	ثاني مجموعة فقدت	ثالث مجموعة فقدت
Very low pH			very high pH

of Aspartic acid (Asp, Glu, Tyr, Cys)

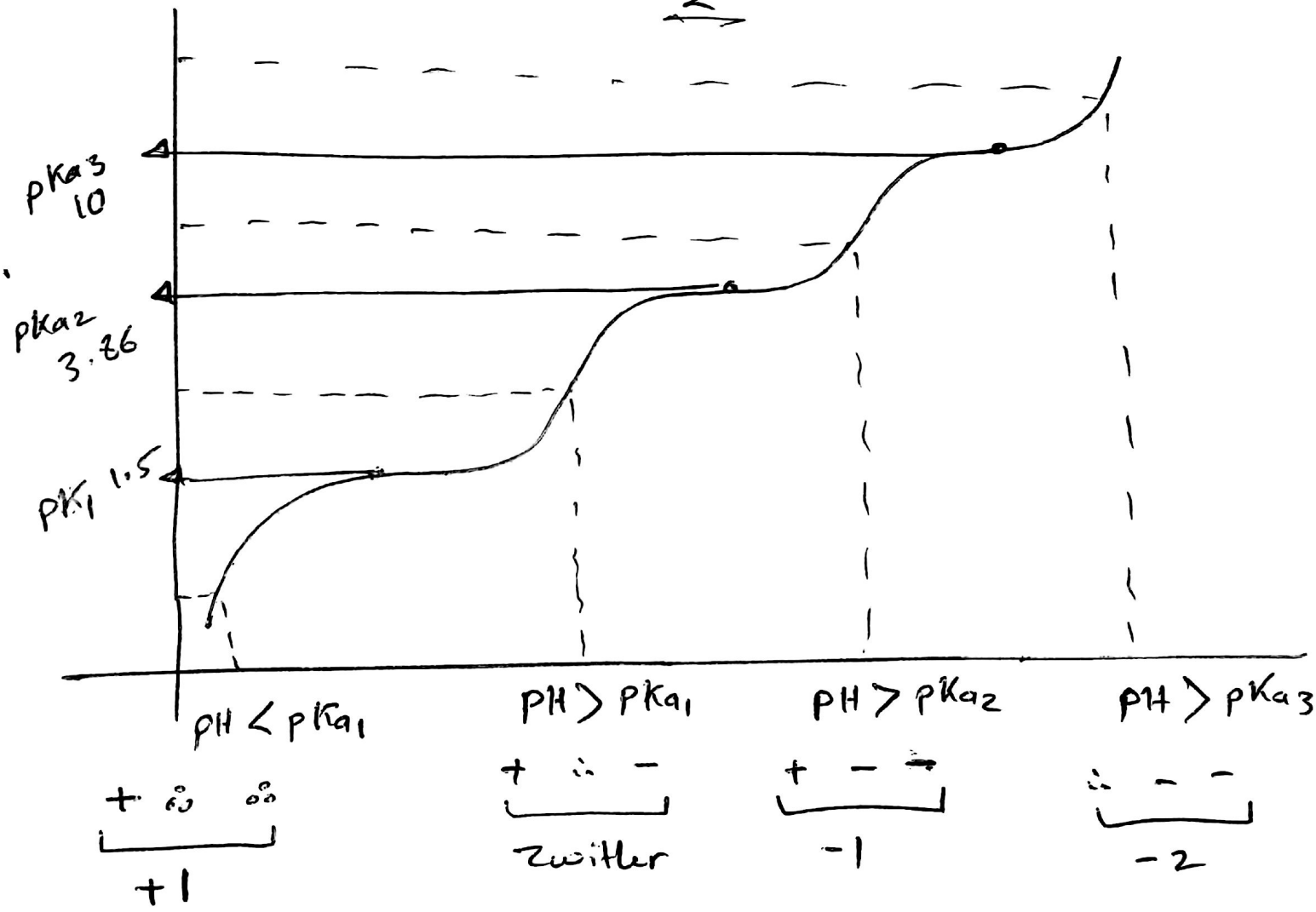


$pKa_3 = 10$ $pKa_1 = 1.5$

$pKa_2 = 3.86$

3 titrable Groups

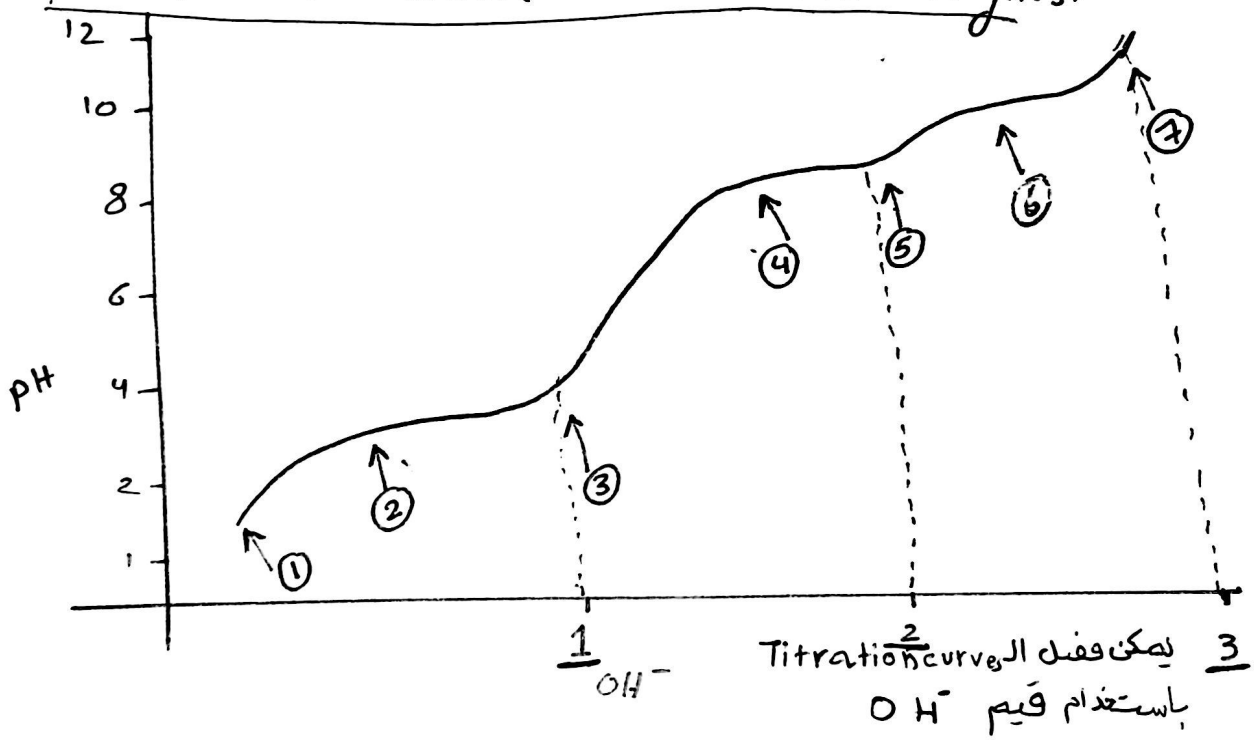
$$pI = \frac{pKa \text{ اقل قيمتين}}{2}$$



4 ionic forms [+1 zwitter -1 -2]

Important Notes

- at very low pH, the amino-acid is fully protonated and has the maximum positive charges
- at very high pH, the amino-acid is fully deprotonated and has the maximum negative charges
- the pI of acidic a.a is the lowest
  the pI of Basic a.a is the highest



Q: which points on the graph represent pKas?
2, 4, 6

Q: which point represent pKa of carboxyl group?
2

Q: at which point the amino acid has the maximum negative charges?
7

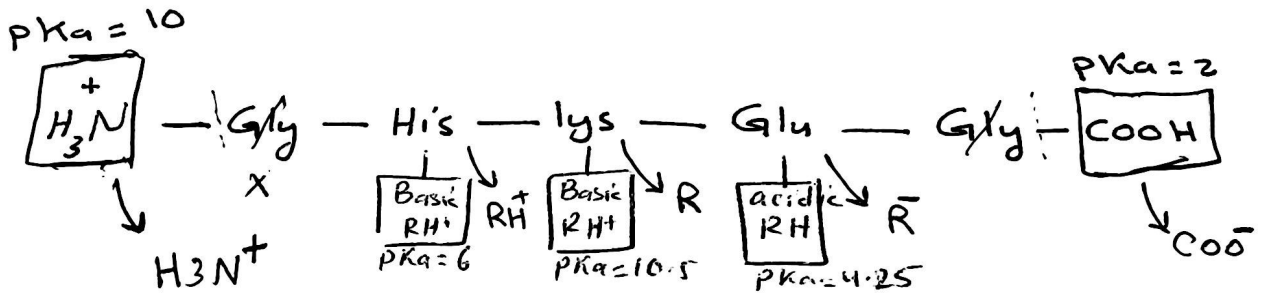
Q = at which point the amino-acid is fully protonated.
1

at is the PI for arginine ?

pKa_1 $\alpha.COOH = 2.1$

pKa_2 $\alpha.NH_3^+ = 10.5$

pKa_3 Guanidino = 12.28 group



what is the Net charge on this peptide.

at pH = 7

(يمكن أن تكون غير معطاة فيجب معرفة بأنهما دائماً موجودة)

\+ + ∴ − −

Net Charge = zero

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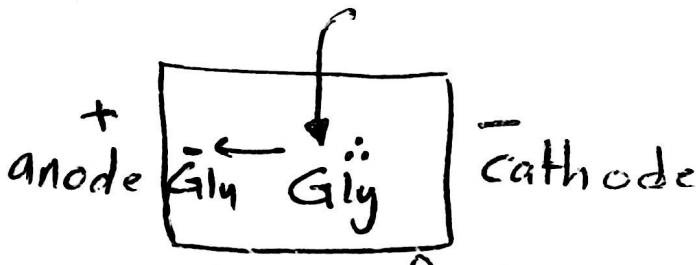
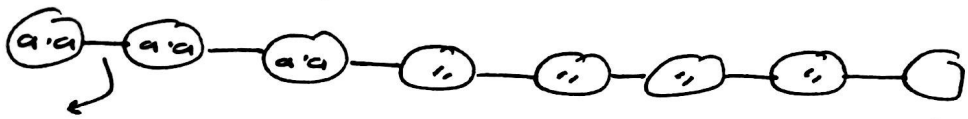
lectraphoresis : method for separating molecules in electric feild.

Gly / Glu at pH = 7



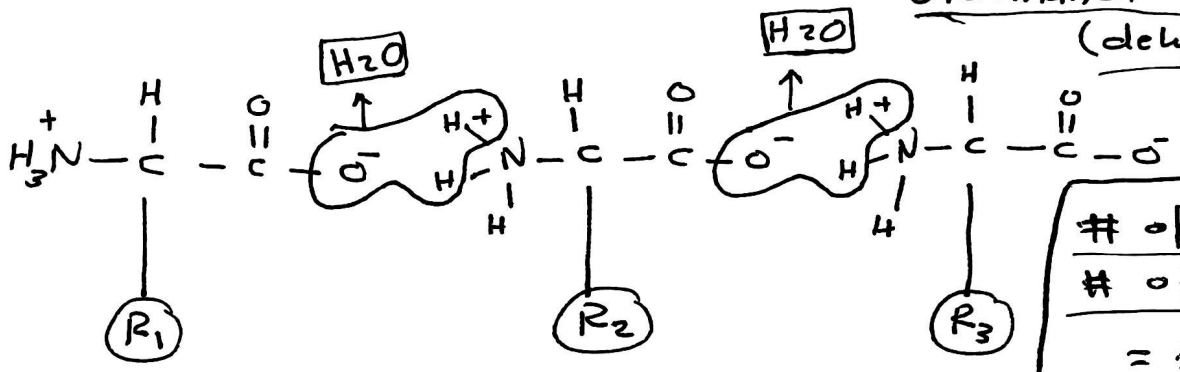
Protein: 100 - 1000s of amino-acids linked by peptide Bond.



Peptide Bond : covalent bond link a.a

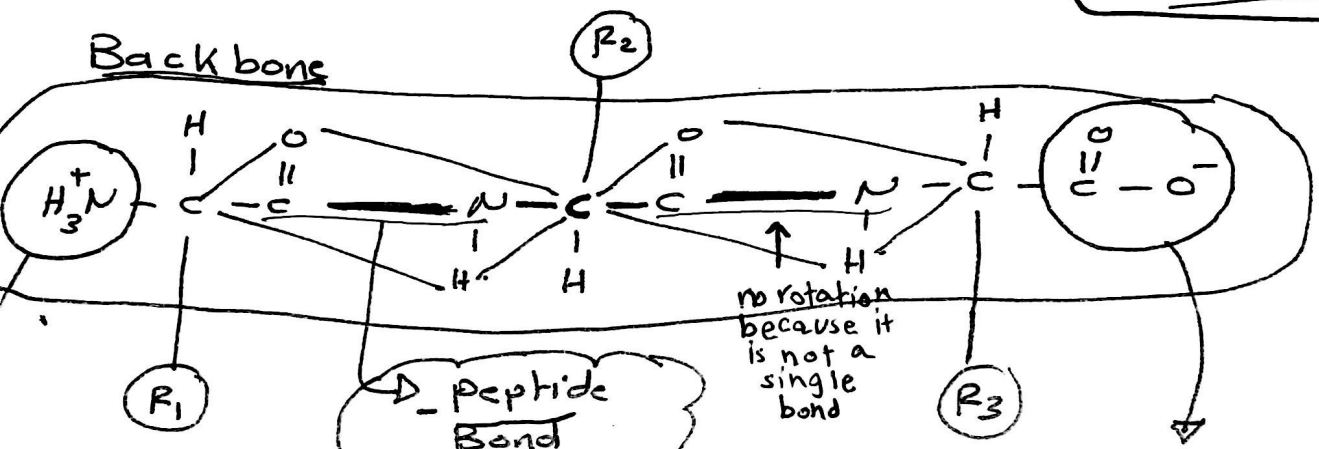
Polypeptide chain

إزالة
Elemination of water (dehydration)



# of water
# of peptide Bond
= # of a.a - 1

Backbone



- peptide Bond
  - covalent
  - amide bond

Amino-end
N-terminal

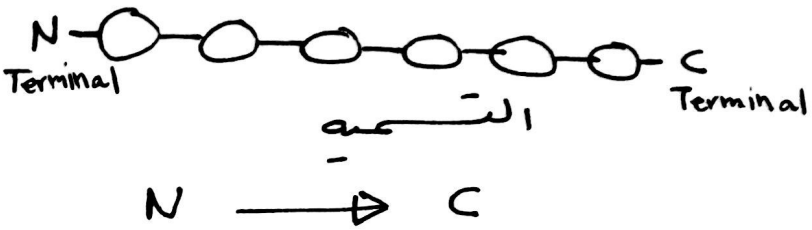
Carboxyl end
C-terminal

(on reality ⇒ Hybrid دمج)

Resonance
- stabilization
- partial double bond (stronger than any single bond)
- No rotation (Rigid)
- planner
- trans Not Cis

All Peptides

2 - several dozens of a.a



Dipeptides

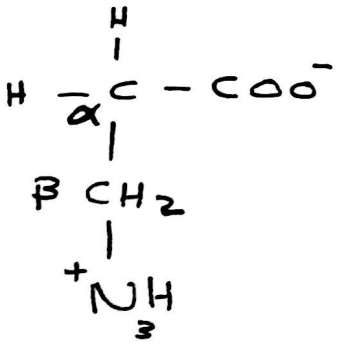
2 amino-acids

O-O

Ex:- Carnosine (in muscles)

β-alanyl – L- Histidine

All amino acids in our body are L-amino acids



β-alanine.

- Peptides

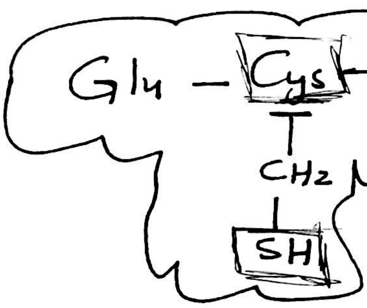
3 amino-acids O-O-O

Ex:- Glutathione → anti-oxidant (Good Reducing agent)

مضاد للعوامل المؤكسدة

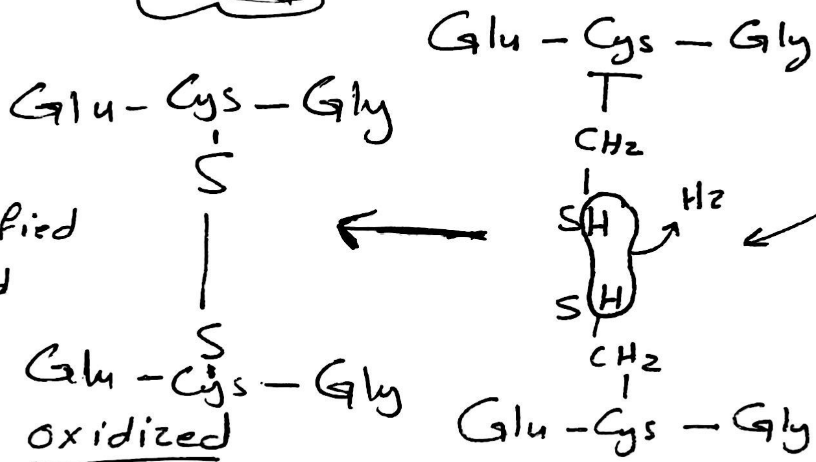
Scavenger for oxidizing agent

γ Glutamyl - L Cysteinyl - Glycine



or GSH

oxidizing agent ↓ يؤكسد مواد أخرى مثل DNA proteins ↓ Cancer aging



شايل خسران — oxidized form

GSSG

4 Peptide bonds

Reduced form — كسبان H

GSH

2 Peptide bonds

Oxidation — خسارة H

Reduction — كسب H

- Oxidizing agent → مادة كيميائية لها Reduction (تركيز)
- Reducing agent → مادة كيميائية لها Oxidation (تخسر)

...rides

amino-acids

Ex:- Enkephalines → Natural analgesics (Pain killer releifer) مسكنات طبيعية

→ From brain.

2 types

(Not important to memorize)

N - Tyr - Gly - Gly - phe - leu - C

N - Tyr - Gly - Gly - phe - Met - C

differ only in C-terminal

aromatic

important for activity.

Opioids or opiates

Ex:- Morphine, Codien مسكنات مخدرات

Enkephalines مشابهة لـ

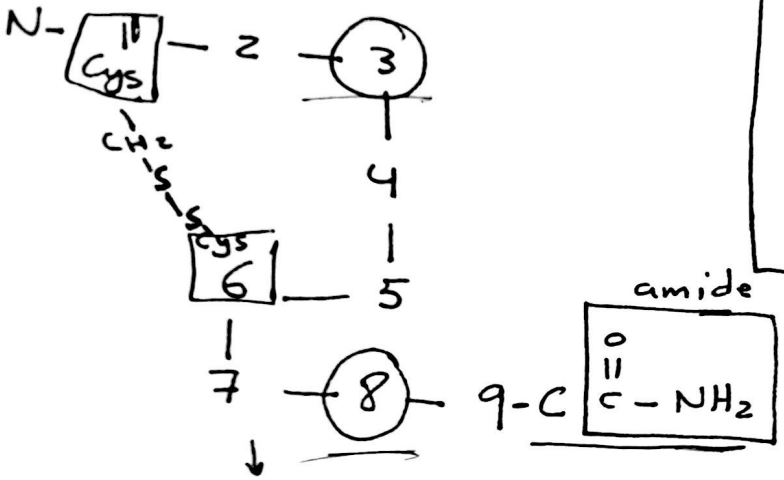
Cyclic peptides

9 amino-acids
Nonapeptides

ex:- Oxytocin

Vasopressin

from posterior pituitary Gland



Cyclic Structure due to S—S bond

	3	8
Oxytocin	Ile	leu
Vasopressin	phe	Arg

10 amino-acids
Decapeptides

Ex:- Gramicidine S

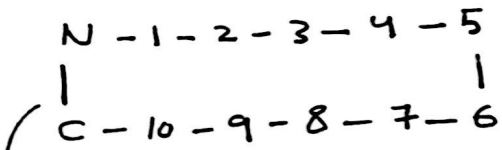
Tyrosidine A

Natural antibiotics

مضادات حيوية طبيعية

تفرزها بكتيريا اسمها

Bacillus Brevis



Cyclic Structure due to Peptide Bond

Contain

* D- amino - acids
* Ornithine

amino-acids Not found in our proteins → in Urea Cycle