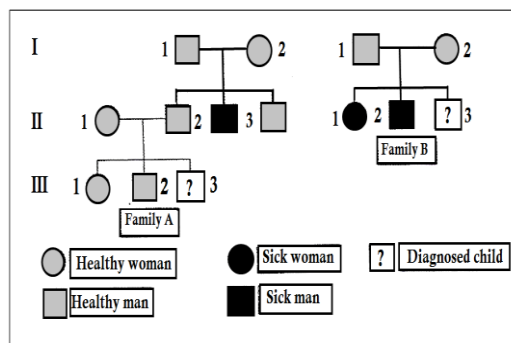


Final Exam

EXERCISE I (5 pts) Genetics

A. Two couples, A and B, are expecting a child, and they have in their family persons suffering from phenylketonuria. This disease, that has a frequency of 1/50 in Europe, is related to a deficiency in an enzyme, the phenylalanine hydroxylase or P AH. In normal conditions, the P AH transforms the amino acid phenylalanine into tyrosine. The increase in the concentration of phenylalanine in the blood is accompanied by an abnormal development of the brain. A simple and practical test is performed at the birth of all children. If the disease is diagnosed (at birth or before), an alimentary diet composed of a very weak level of phenylalanine allows us to avoid the dangerous effects of this disease.

- 1- Is the allele responsible for the disease dominant or recessive?
 - 2- Discuss, logically, the chromosomal localization of the gene responsible for this sickness.
- Using the above information (text and document), indicate what is the risk for the diagnosed children in each of families A and B to be affected by the phenylketonuria.



Document 1

B- After having followed a treatment with a genetician, the two studied families decided to analyze their DNA and that of their children at birth in order to establish a diagnosis. four alleles can be at the origin of this disease. The table (doc 1) presents a part of codons corresponding to three of these muted alleles in regions a, band c of the gene. Also, the sequence of the normal allele in these three regions is indicated.

Phenotype of the individuals	Sequence from the codon 277 to the codon 283 (region a of the gene)	Sequence from the codon 308 to the codon 314 (region b of the gene)	Sequence from the codon 405 to the codon 411 (region c of the gene)
Normal	UAUACCCCGA ACCUGACAUC	CUUGCUCUCUG GGUGCACCU	ACAAUACCUGG GCCCUUCUCA
Sick	UAUACCCCAA CCUGACAUC	Identical to the normal allele	Identical to the normal allele
	Identical to the normal allele	CUUGCCUCUCC GGGUGCACCU	Identical to the normal allele
	Identical to the normal allele	Identical to the normal allele	ACAAUACCUGG GCCCUUCUCA

Document 2

- 3- Determine the type and localization of the mutation in each of the three alleles of the sick individuals.

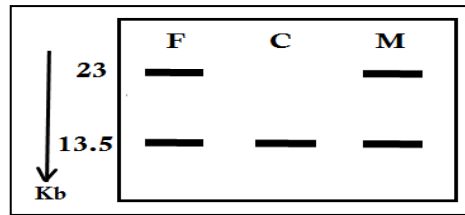
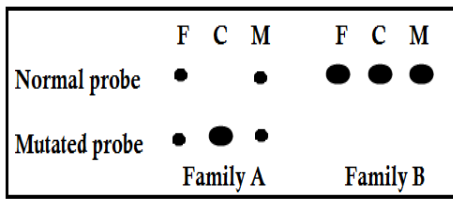
The DNA has been extracted from the cells of the parents and from the child of each couple. After amplification using PCR (polymerase chain reaction), DNA has been subjected to the action of a restriction enzyme that is specific to the sites of region a. The obtained fragments have then been separated by electrophoresis, denatured, transferred on filter, and then taken out using two specific probes; one corresponding to the normal sequence, and the other to the mutant one. This technique is called OSA (Oligoprobe Specific Allele; doc 2)

Document 2 Sequence of the normal allele's specific probe:

TATACCCCGAACCTGACAT

Sequence of the mutant allele's specific probe:

TATACCCCAAACCTGACAT



F:father: C: child; M: mother

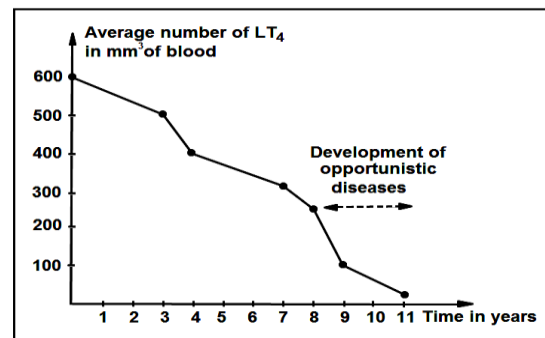
Document 3: profile of bands obtained by southern for the members of family B

- Do the results obtained in the ASO technique allow us to determine the genotypes of the parents and the diagnosed children of the two families A and B? Explain.
- Family B is subjected to a second test. Region c of the gene has been analyzed using the Southern blot technique (doc 3) knowing that the length of fragment c is 23 kb. In fact, the mutation in region c shows a site of cut for the restriction enzyme MspL. After the action of the enzyme, denaturation and electrophoresis, the obtained fragments have been revealed by a radioactive probe corresponding to region c of the gene.
- Formulate a hypothesis that may explain the results obtained by the technique used on family B.
- Use document 3 to confirm or reject your hypothesis.

EXERCISE II (5 pts) HIV treatment

The virus of the human immunodeficiency (HIV) affects the human resistance and leads to the weakening of immunity defenses of the organism, which supports the development of opportunistic diseases which are due to the multiplication of infectious agents (bacteria or virus).

Document 1 shows the natural evolution of a number of LT_4 measured among contaminated patients by the HIV since several years .



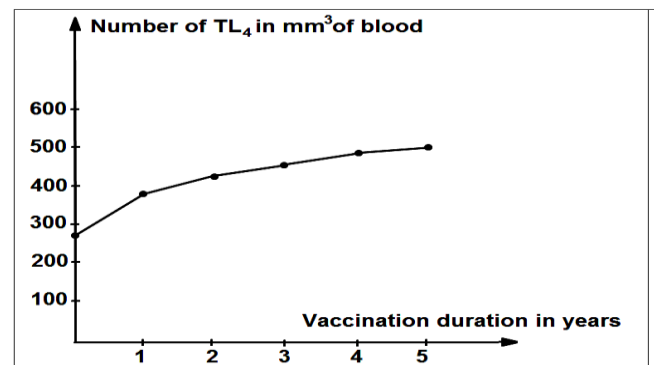
- Draw a table representing the variation of the average number of LT_4 , as a function of time.
- Analyze document 1.

Document 1

What can you deduce about resistance to the infectious agents responsible of opportunistic disease ?

A treatment including three drugs was managed during 5 years with individuals having at the beginning of the treatment between 200 and 350 LT_4 by mm^3 of blood. Document 2 shows the modification of the number of LT_4 in HIV carriers versus the time of medication treatment.

- Referring to documents 1 and 2, explain the role of the treatment in these infected individuals



Document 2

The effectiveness of the production of antibody after a vaccination against the pneumococcus (bacterium responsible for pneumonia) .

Document 3 shows the rate of LT₄ and the effectiveness of the immunizing result after a vaccination against the pneumococcus.

4- Compare the two results then specify the factor responsible for effectiveness of antibodies

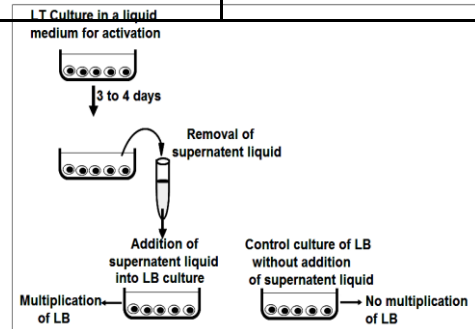
	Average number of LT ₄ in mm ³ of blood	Effectiveness of the production of antibody
First category of individuals	Equal to or higher than 500	Effective production
Second category of individuals	Less than 200	Slightly effective production

Document 3

Document 4 shows the role of the activated LT₄, where lymphocytes T₄ extracted from a healthy individual are put in culture containing macrophages and of a substance that acts like an antigen: it is said that the LT₄ are then activated .

The supernatant liquid of this culture is then taken. Cultures in parallel are carried out lymphocytes B (LB) in the presence of an antigen:

some of these cultures are put in contact with the supernatant liquid, others are used as a control of the antigens and of the macrophages



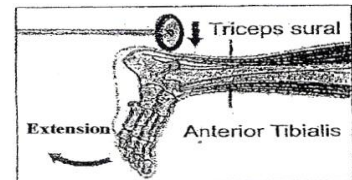
Document 4

5- Interpret these results. What can you deduce concerning the role of the activated LT₄

6- Referring to the given data and acquired knowledge, make a functional diagram showing the different stages that led to the production of antibodies

EXERCISE III (5 pts) Myotatic reflex

To understand the activity of the two muscles of the lower leg, the anterior tibialis and the triceps sural, during a reflex act and during their voluntary movement, the following experiment is done:



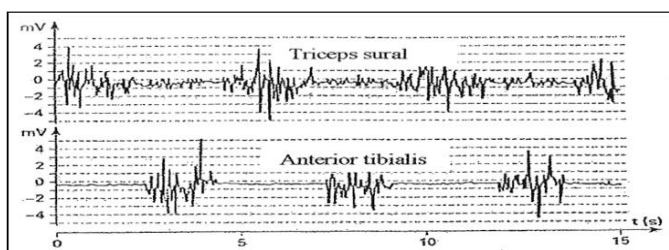
Document 1

1st experiment: Stretching of the triceps sural by hitting the Achillian tendon, connected to the muscle, an immediate extension of the foot and the contraction of the mentioned muscle is provoked, document 1.

2nd experiment: We place electrodes on the skin of a person at the level of the triceps sural and the anterior tibialis and we ask this person to perform alternating movements of his foot: extension followed by flexion. The obtained recordings are presented in document 2.

3rd experiment: Same experimental setup as that in the second experiment was performed in three different conditions of Achillian reflex. The obtained recording are presented in document 3.

Document 2





Document 3

- 1- What type of reflex is revealed in the first experiment? Justify the answer.
- 2- Interpret the results of the second experiment. What can you deduce concerning the role of each of these two muscles?
- 3- What can you deduce from the recordings of document 3?

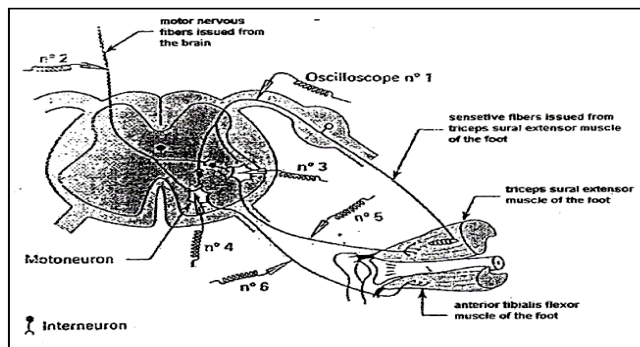
In order to know if a person is capable to control an Achillian reflex we perform the experimental set-up shown in document 4. We record the electric activity at the level of the triceps surae, the anterior tibialis, and corresponding network of neurons, in the following cases:

Case A: Achillian Reflex during relaxed anterior tibialis.

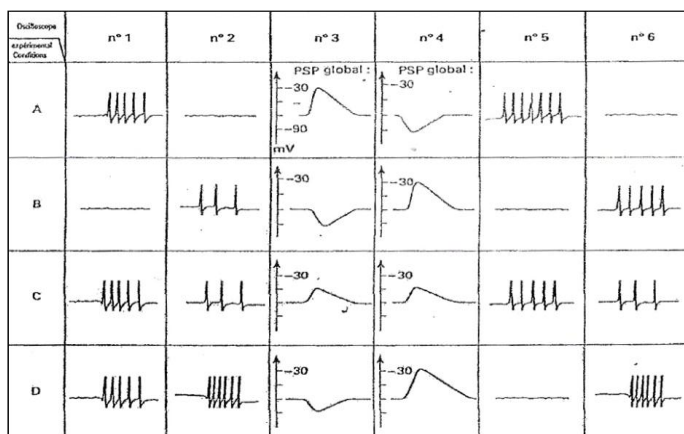
Case B: Slight voluntary contraction of the anterior tibialis.

Case C: Achillian reflex during slight contraction of anterior tibialis.

Case D: Achillian reflex during strong contraction of anterior tibialis.



Document 4



Document 5

The results are presented in document 5:

4- Explain the obtained results and deduce the kinds of synapses in this reflex.

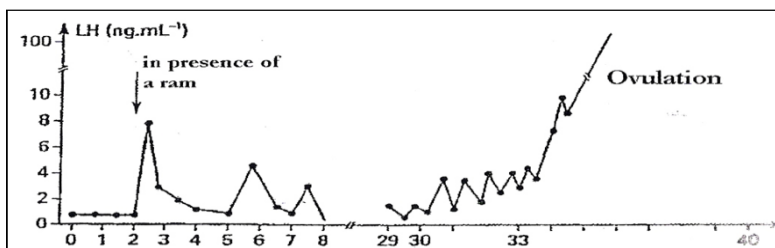
EXERCISE IV (5 pts)

Hormonal regulation

A- Ovarian activity.

Between the periods of reproduction, the female sheep is at rest and don't present cycles. However, researchers have observed the following: the introduction of a ram into a troop of sheep, isolated from males since a month and are at rest (sexually), provokes in the following days, ovulation in 50% of the females. The concentration of LH in the plasma was measured every two hours in the female sheep. (Document 1)

Document 1



A.1- Interpret document 1.

On the other hand, researchers placed female sheep in different experimental conditions and noted the number of those which had a corpus luteum

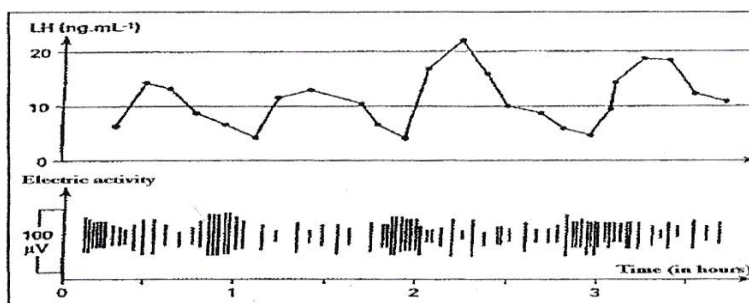
Experimental conditions	Presence of sheep having a corpus luteum
Female sheep isolated from ram (male sheep) permanently	7
Sheep where the mouth was covered with grass smelling rams wool	48
Sheep in contact with a ram	50

Document 2

What additional information can you pick up from document2? Justify your answer.

B- 1- Measures taken for the change in plasma concentration of LH as it goes out of the pituitary gland and the activity of some neurons in hypothalamus in female sheep after 28 hours from being with ram. (Document 3a)

Document 3a



2- We follow in parallel the change in LH as it goes out of pituitary and the changes in hypothalamic GnRH in the blood system between hypothalamus and the pituitary gland. (Document 3b)

3- Analyze documents 3a and 3b and deduce.

4- Make a functional diagram that shows how the presence of a ram leads to ovulation in a female sheep.

