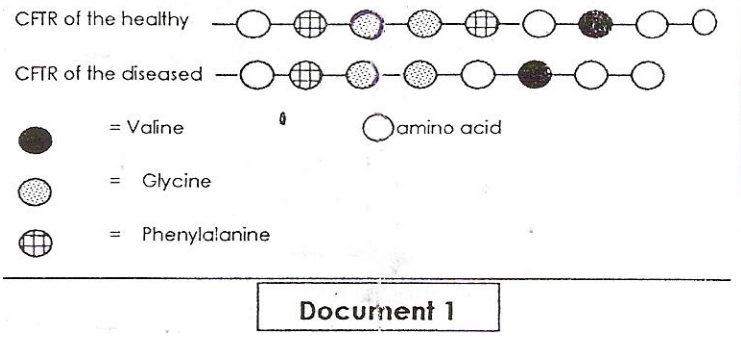
Class: 3 rd. Secondary (L. S.) **Second Unified Exam** **Points:** 20 pts.
Subject: Biology **Duration:** 150 min.

Exercise I: A hereditary disease, cystic fibrosis (7 pts)

Cystic fibrosis is a disease characterized by the obstruction of the bronchi by mucus, which leads to a decrease in the capacity of respiration.
This disease is expressed by a mutant allele localized on chromosome 7.
Document 1 shows a stretch of the amino acid sequence of the responsible protein in each of the healthy individual and the diseased.



Document 1

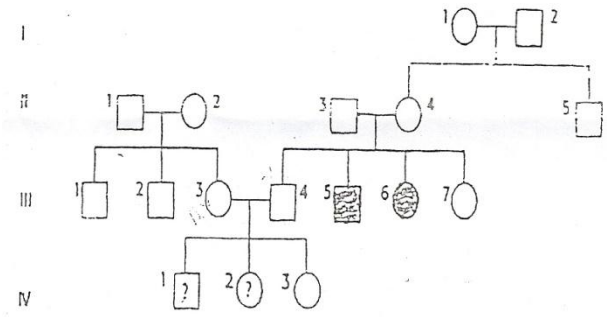
1- Compare the two amino acid sequences. What can you conclude concerning the cause of the disease?
Document 2 shows the pedigree of a family presenting cystic fibrosis.

Normal male

Normal female

Diseased male

Diseased female



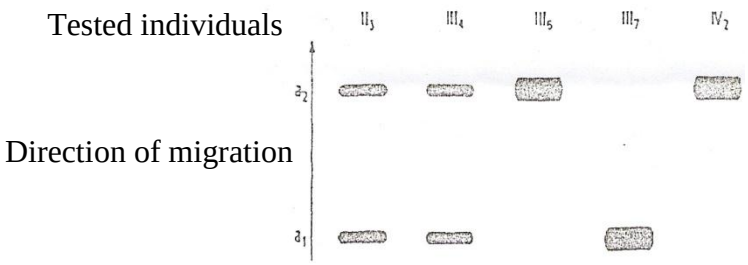
Document 2

2- Based on the information presented in document 2, indicate whether the allele responsible for the disease is dominant or recessive. Justify the answer.

3- What are the probabilities of individuals IV-1 and IV2 to be carrying the mutant allele or not? Explain.

4- Can we be certain whether IV-1and IV-2 are carrying the mutant allele or not? Explain.
Document 3 shows the DNA restriction fragments of chromosomes pair 7 by Southern Blot done on certain individuals of the pedigree in document2.

Document 3



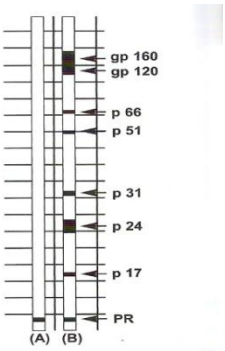
5- Which of the two alleles a_1 or a_2 is the mutant one? Justify.

6- Designate by symbols the two alleles and the genotype of each tested individual revealed in document 3. Justify each genotype.

Exercise II: Transmission of HIV (7pts)

Some tests have been done on a pregnant woman in order to detect the presence of HIV. To do that, the proteins of HIV (designated by p and gp) are separated on a gel by electrophoresis and transferred by migration, on a hard support of nitrocellulose membrane.

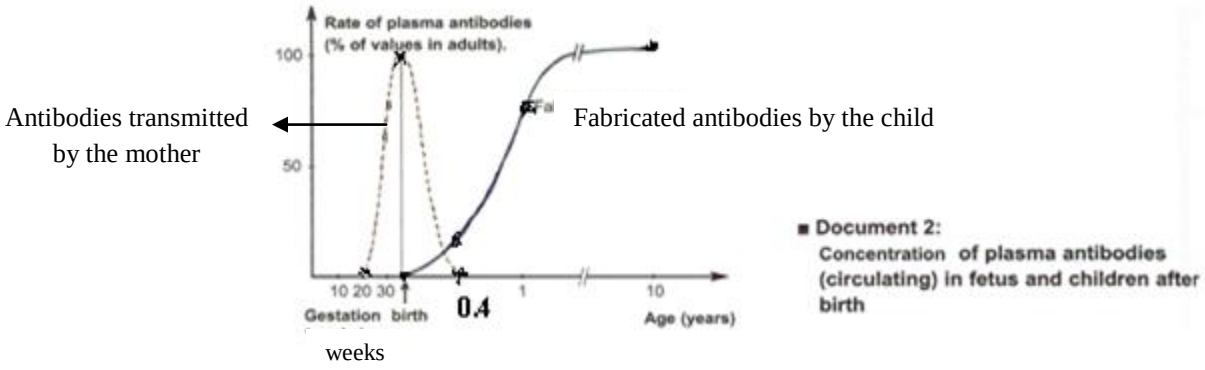
The serum to be tested is deposited on this membrane (B), a control test is done by the serum of an individual not infected by the HIV (A). A marked protein (MP) non HIV allows aligning the bands (document 1).



■ Document 1: Proteinogram of 2 individuals A&B.

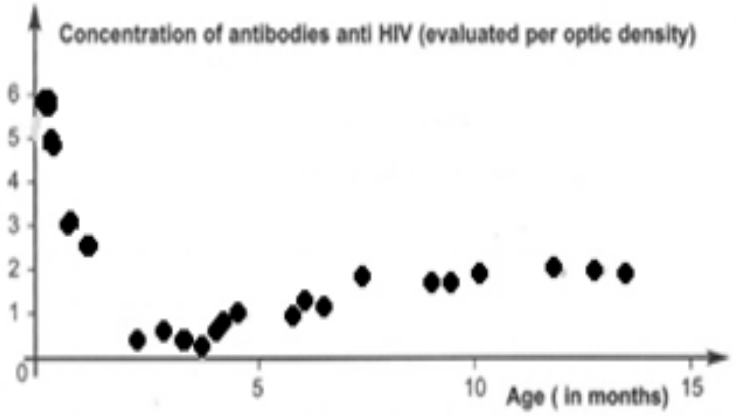
1- What are you looking for in the mother's serum?

2- What diagnosis can we do concerning the infection of the mother by HIV? Justify your answer by referring to document 1.
Document 2 shows the evolution of the concentration of circulating antibodies in fetus and in children after birth.



■ Document 2:
Concentration of plasma antibodies (circulating) in fetus and children after birth

By a suitable method, we follow the concentration changes of anti-HIV antibodies in this woman's child after birth. Document 3 shows the obtained results.

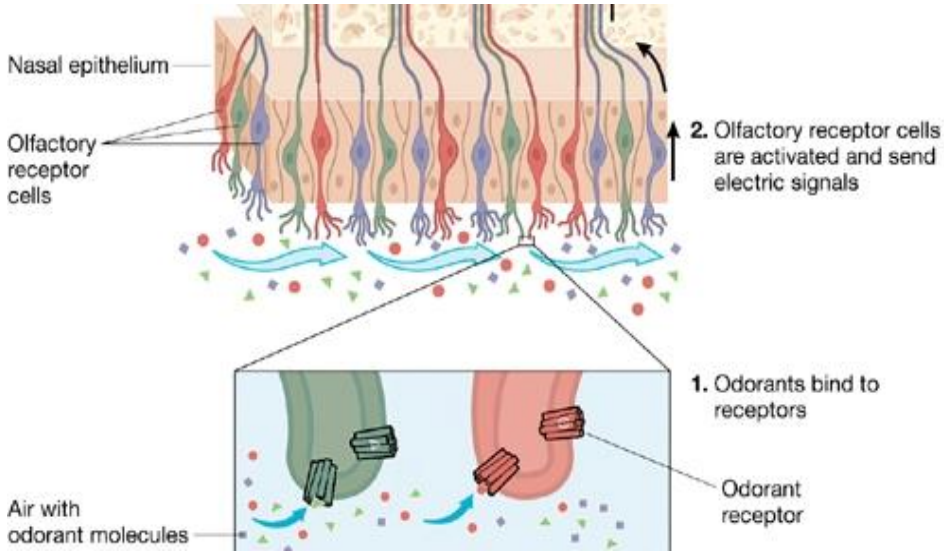


■ Document 3:
Concentration of antibodies anti HIV in the child

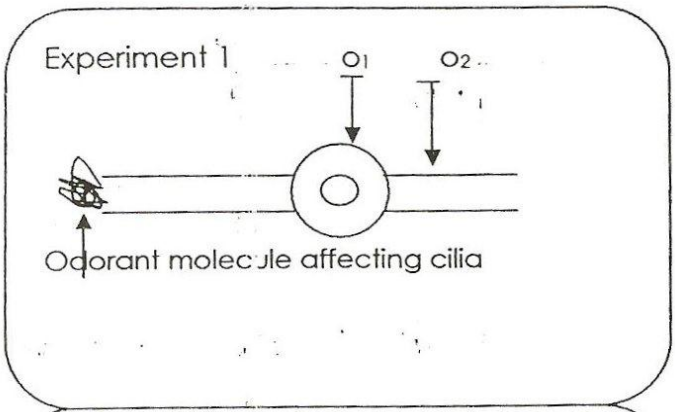
3- Change the graph of document 2 into a table.
4- Analyze the curves of document2.
5- Explain the origin and the evolution of the child's anti-HIV antibodies (document3) according to the given in document 2.
6- What diagnosis can we do concerning the child's infection by HIV?

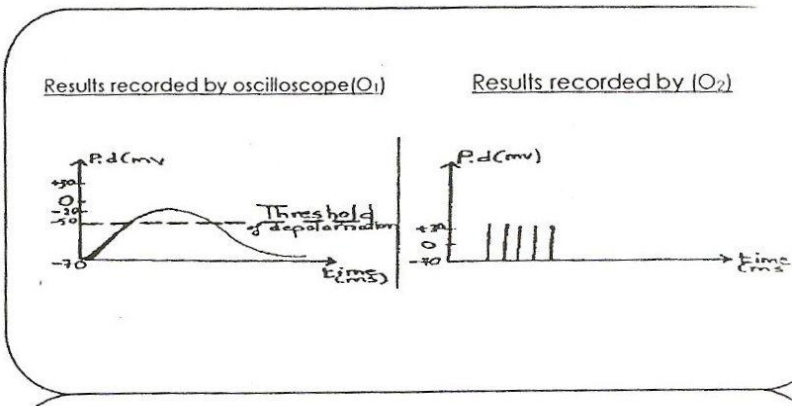
<u>Exercise III</u>: Olfactory sensations (6 pts)

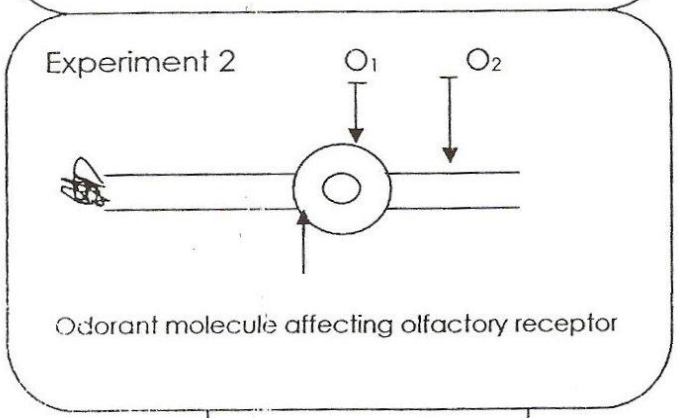
Olfactory receptors (for smell) are sensory neurons located in the nasal cavity (document 1). These receptors respond to the chemical stimulation of an odorant molecule by producing a generator potential, thus initiating an olfactory response.



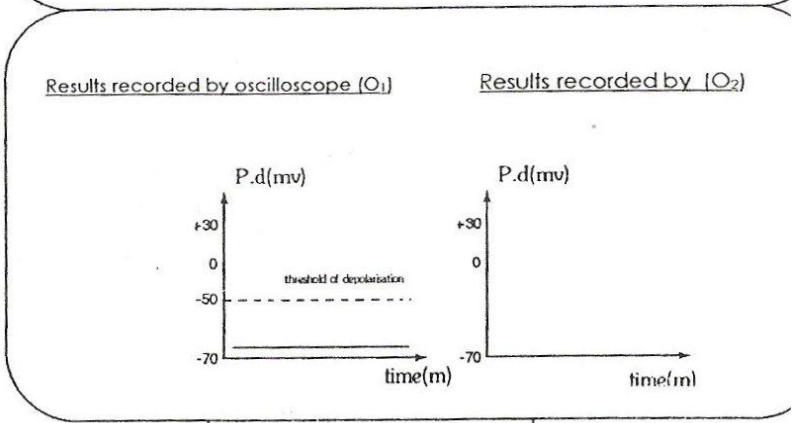
A- In order to study which part of the olfactory sensory cell receives the stimulus and initiates the nerve message, the following experiments are done as shown in document 2.







Document 2



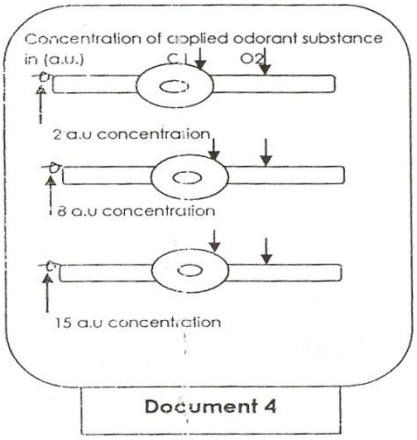
Document 3

The results that are recorded by oscilloscopes O1 and O2 are shown in thedocument3.

1- Draw out the problem which arises in this study.

2- Analyze the results of the experiments of doc. 2. What can you deduce?

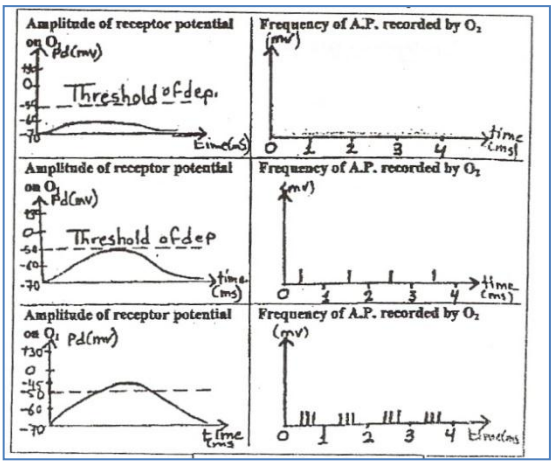
B- For determining the role of sensory receptors in coding the nerve message, we apply an odorant molecule of different concentrations as shown in document 4; the results are represented in document 5.

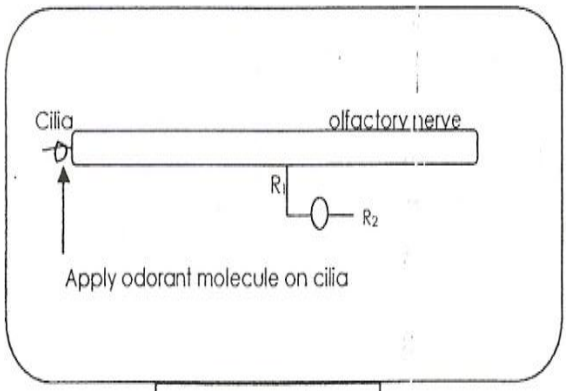


Document 4

3- Compare the results of document 5. What can you deduce?

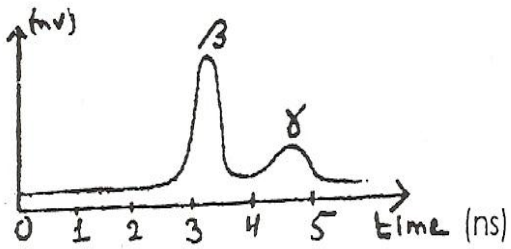
C- In the framework of studying the response of the olfactory nerve, we established the experimental setup shown in document 6. R_1 and R_2 are placed far from the stimulus, where R_1 is placed on the surface of the nerve and R_2 is connected to a fixed potential.
The cilia of olfactory nerve receive an effective chemical stimulus, an odorant molecule and the resulting response is shown in document 7.





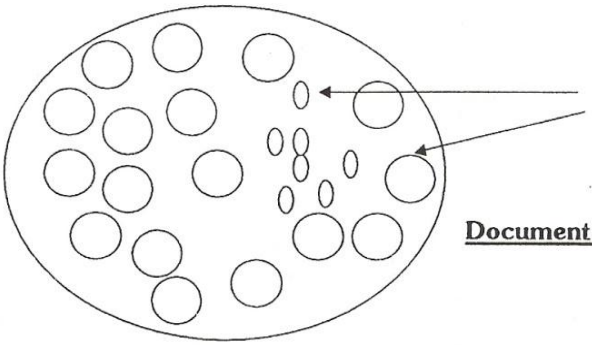
Document 6

Results recorded by oscilloscope



Document 7

4- Formulate a hypothesis that explains the obtained results.
To verify the formulated hypothesis, studies are done on this nerve whose results are shown in document 8.



Document 8: transverse section done on the level of olfactory nerve.

◯ ≈ 10 - 16 micro meter

○ ≈ 1- 7 micro meter

5- Is the hypothesis formulated validated? Justify the answer in reference to document 8.

Good Work!