

مسابقة في مادة علوم الحياة

المدة: ثلاث ساعات

(باللغة الإنكليزية)

الاسم:

الرقم:

Exercise 1 (5 points)**Pulmonary Emphysema**

Pulmonary emphysema is a fatal disease. This disease is due to a progressive destruction of the lung tissue by the proteases of the white blood cells.

In fact, in the normal case, there are substances in the blood plasma called alpha antitrypsin (aT) which protect the pulmonary cells from being destroyed by inhibiting the action of proteases.

1- Pick out from the text the cause of pulmonary emphysema.

Alpha antitrypsin (**aT**) is a protein composed of **418** amino acids produced by liver cells.

M1 is the normal allele of the gene responsible for the synthesis of “**aT**”.

M2 is the mutant allele of the gene responsible for the synthesis of “**aT**”.

2.1- Determine, referring to document 1, the amino acid sequence of the portion of the alpha antitrypsin coded by the fragment of the non-transcribed strand of M1.

Non-transcribed strand of the allele **M1** : ¹⁸¹ ¹⁸⁴
ATC AAC GAT TAC ...

2.2- Determine, referring to document 1, the amino acid sequence of the portion of the alpha antitrypsin coded by the fragment of the non-transcribed strand of M2.

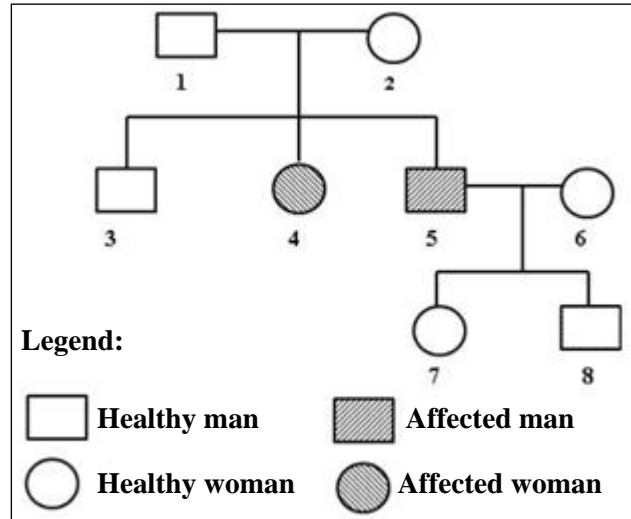
Non-transcribed strand of the allele **M2** : ¹⁸¹ ¹⁸⁴
ATC AAC GAT TAG ...

Codons	Amino acid
AUC	Ile
AAC	Asn
GAU	Asp
UAC	Tyr
UAG	Stop

Document 1

2- Explain how the modifications in the nucleotide sequence of the studied allele lead to the appearance of pulmonary emphysema.

Document 2 represents the pedigree of a family of which some members are affected by pulmonary emphysema.



Document 2

4- Indicate whether the allele **M2** which is responsible for this disease is dominant or recessive. **Justify**.

- 5.1- Verify** If the gene responsible for pulmonary emphysema is carried on the non-homologous part of **Y**.
- 5.2- Verify** If the gene responsible for pulmonary emphysema is carried on the non-homologous part of **X**.
- 5.3- Verify** If the gene responsible for pulmonary emphysema is carried on the homologous part of **X** and **Y**.
- 5.4- Draw out** the localization of this gene.

6- Write the genotype of individual 8. **Justify** the answer.

Individual 8 is a heavy smoker and has manifested the same symptoms of pulmonary emphysema.

7- Show that there is a factor other than the genetic factor that could provoke this disease.

Exercise 2 (5 points)

AIDS

The acquired immunodeficiency syndrome (AIDS) is due to a retrovirus, human immunodeficiency virus (HIV).

HIV recognizes and binds to CD4 and CCR5 proteins present on the surface of T4 cells, resulting in the entrance of viral RNA into the host cell.

Document 1

1- Draw out from document 1:

1.1- The molecules recognized by HIV.

1.2- The target cell of HIV.

Mrs. Y, who is seropositive for HIV, has two children whose HIV seropositivity has been monitored from birth till the age of 18 months.

Document 2 represents :

- the electrophoregrams of anti-HIV antibodies of Mrs. Y,
- the electrophoregrams of anti-HIV antibodies of her two children at three different ages.

These antibodies:

- anti-GP160,
- anti-GP120,
- anti-GP41,
- anti-GP24,

are directed against the proteins Gp160, Gp120, Gp 41, Gp24 of HIV.

	Mrs. Y	Child 1			Child 2		
		Birth	6 th month	18 th month	Birth	6 th month	18 th month
anti-GP160	—	—	—		—	—	—
anti- GP120	—	—	—		—	—	—
anti-GP 41	—	—			—		—
anti-GP 24	—	—			—		—

Document 2

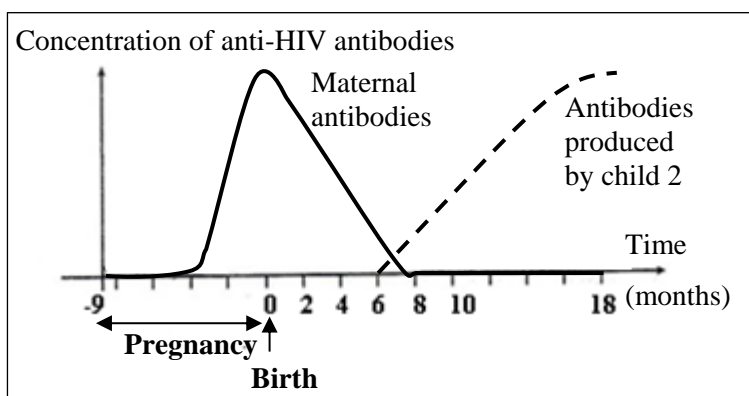
2.1- Compare the electrophoregrams of child 1 at birth, 6th month and 18th month to that of his mother Mrs Y.

- **Compare** the electrophoregrams of child 2 at birth, 6th month and 18th month to that of his mother Mrs Y.

2.2- Draw out the child (1 or 2) who is seropositive for HIV at the age of 18 months.

3- Propose a hypothesis concerning the origin of the antibodies present at birth in the two children.

Document 3 represents the evolution of the concentration of anti-HIV antibodies in child 2 before and after birth.



Document 3

4- Do the results of document 3 **validate** the hypothesis formulated in question 3?

Justify the answer.

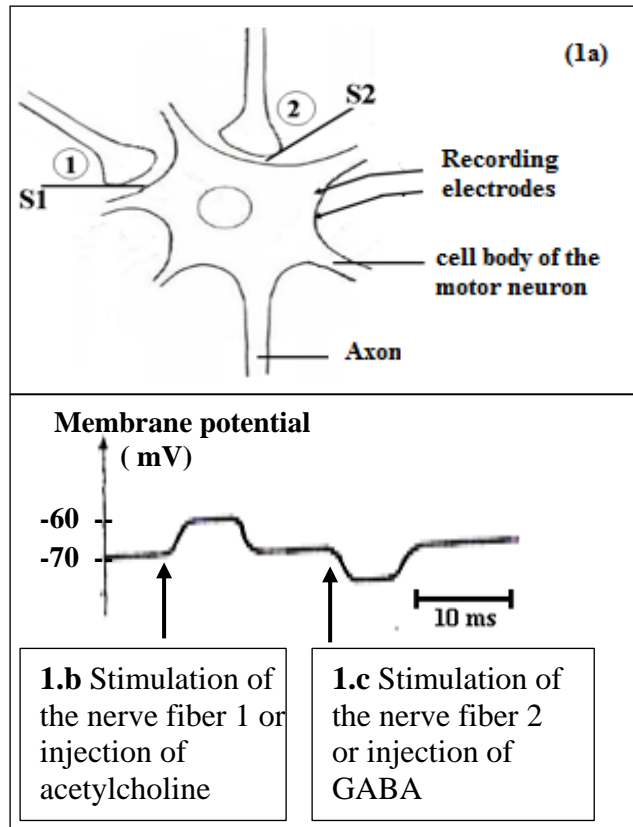
5- Explain the reappearance of anti-HIV antibodies after the age of 6 months in child 2.

Exercise 3 (5 points)

GABA and Baclofen

Baclofen is a chemical substance, known for its relaxant action.

In order to study the action of baclofen at the level of certain neurons, several experiments are performed using the same setup shown in document 1a.



Document 1

Experiment 1

An effective stimulation is applied on nerve fiber 1 and then on nerve fiber 2.

The obtained results recorded at the level of the cell body of the motor neuron are represented in documents 1b and 1c.

1.1- Indicate, referring to document 1b, the nature of the synapse S1.

Justify the answer.

1.2- Indicate, referring to document 1c, the nature of the synapse S2.

Justify the answer.

Experiment 2

Acetylcholine is deposited at the level of synapse S1.

Another time, GABA is deposited at the level of the synapse S2.

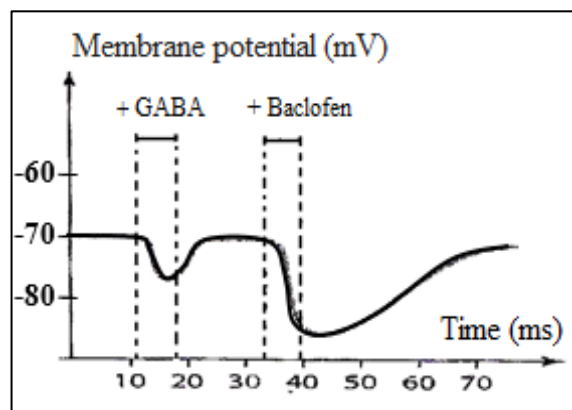
The results recorded at the level of the cell body of the motor neuron are represented in documents 1b and 1c.

2. **Show that** the motor neuron has different types of membrane receptors for neurotransmitters.

Experiment 3

GABA or baclofen of same concentration are deposited at the level of **S2**.

The variations of the membrane potential at the level of the cell body are represented in document 2.



Document 2

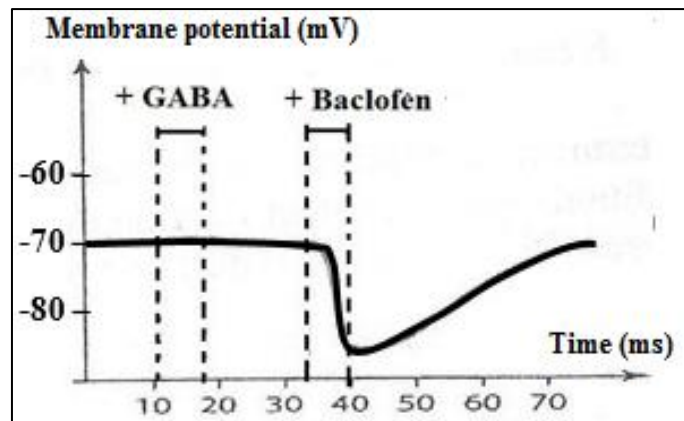
3.1- **Analyze** the results obtained by GABA and baclofen (document 2).

3.2- **What can you draw out?**

4.1 **Indicate** the membrane receptors of GABA.

4.2 **What are the consequences of fixation of GABA on the receptors?**

In order to verify if baclofen acts on GABA receptors, experiment 3 is repeated, but the motor neuron is placed in a medium without Cl⁻. The results are presented in document 3.



Document 3

- 5.1-** Compare the obtained results of GABA and of baclofen in document 3.
- 5.2-** Does GABA and baclofen act on the same receptors?

Exercise 4 (5 points)**Regulation of the Sexual Cycle**

In the framework of studying the functional relations between hypothalamus, pituitary gland, ovaries and uterus, a series of experiments are performed on the same female chimpanzee (A). The conditions and the obtained results are represented in document 1.

Experiment	Conditions	Results
1	Ablation of the pituitary gland in female chimpanzee (A)	Disappearance of ovarian and uterine cycles.
2	Ablation of the pituitary gland then periodic injections of anterior pituitary extracts in female chimpanzee (A)	Reestablishment of the ovarian and uterine activities.
3	Ablation of the pituitary gland then ablation of the ovaries followed by periodic injections of extracts from the anterior pituitary gland in female chimpanzee (A).	No reestablishment of the uterine activity.

Document 1

1.1 Analyze the results of experiments 1 and 2.

- What can you draw out?

1.2 Analyze the results of experiments 1 and 3.

- What can you draw out?

In order to study the effect of the hypothalamus on the pituitary secretion, the following experiment is performed:

In a female chimpanzee (B), some specific cells of the hypothalamus are destroyed. The secretions of FSH and LH by the anterior pituitary gland decreased.

This female is injected with GnRH (hormone of the hypothalamus) in two manners:

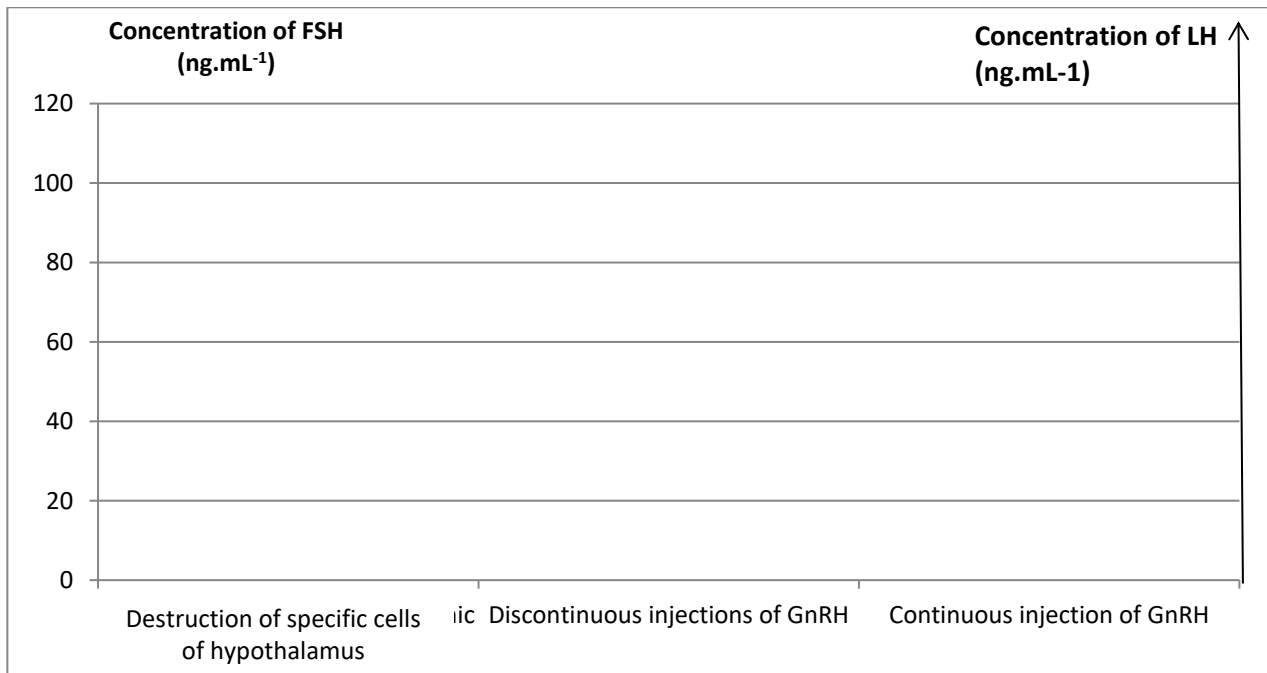
- Continuous
- discontinuous.

The results are shown in document 2.

Experimental conditions Hormones (ng.mL ⁻¹)	Destruction of specific cells of the hypothalamus	Discontinuous injections of GnRH	Continuous injection of GnRH
FSH	10	100	10
LH	2.5	15	2.5

Document 2

2-Construct a histogram that represents the results obtained in document 2.



3-Justify the following statement: “The secretion of FSH and LH is stimulated by the discontinuous secretion of GnRH by the hypothalamus”.

The ovaries secrete the hormones estrogen and progesterone.

4-1-Indicate one role of estrogen.

4-2- Indicate one role of progesterone.

A moderate level of estrogen provokes a decrease in the level of FSH and LH (case 1). On the contrary, the high level of estrogen provokes an increase in the secretion of FSH and LH (case 2).

5.1-Name the type of feedback control revealed in case 1.

5.2-Name the type of feedback control revealed in case 2.

6- Complete, by referring to all what precedes a functional diagram showing the relations existing between the different organs involved in the regulation of the sexual cycles.

