



**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. Inside T4 cells, the viral RNA undergoes reverse transcription into viral DNA by the reverse transcriptase enzyme. The viral DNA is then integrated into the DNA of the host cell. In the nucleus of the host cell, the viral DNA is transcribed into mRNA by the cellular mechanism of transcription. This mRNA contributes to the synthesis of the viral proteins (viral constituents) by translation. The RNA and the obtained proteins are necessary for the multiplication of the virus.*

**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 and of her two children at three different ages. These antibodies, anti-GP160, anti-GP120, anti-GP41 and anti-GP24, are directed against the proteins Gp160, Gp120, Gp 41, Gp24 of HIV.

2.1- Analyze the obtained results.

2.2- Draw out who of the two children 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.

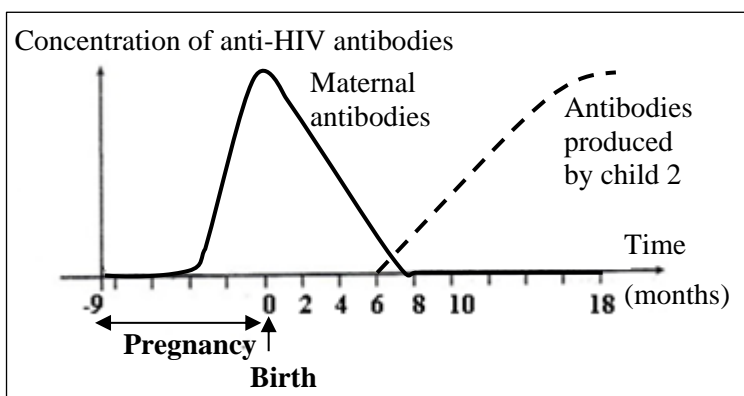
	Mrs. Y	Child 1			Child 2		
		Birth	6 <sup>th</sup> month	18 <sup>th</sup> month	Birth	6 <sup>th</sup> month	18 <sup>th</sup> month
Anti-GP160	—	—	—		—	—	—
Anti- GP120	—	—	—		—	—	—
Anti-GP 41	—	—			—		—
Anti-GP 24	—	—			—		—

**Document 2**

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

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.



**Document 3**

### 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.

#### 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 document 1b.

1- Specify the nature of each synapse S1 and S2.

#### 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 document 1b.

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

#### Experiment 3

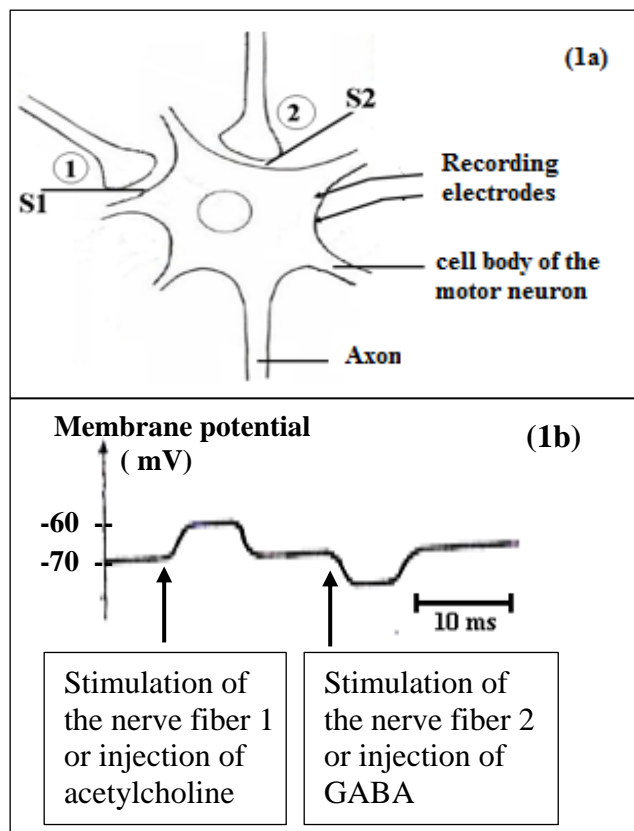
GABA or baclofen of same concentration are deposited at the level of S2. The variations of the membrane potential at the level of the cell body are represented in document 2.

3- Interpret the obtained results.

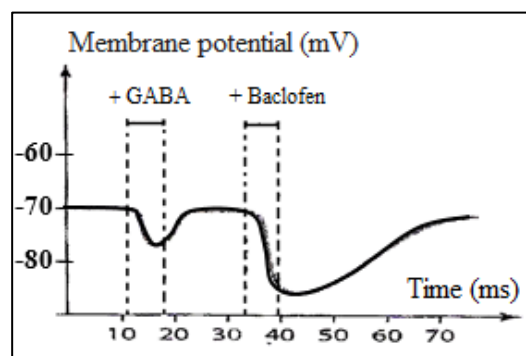
4- Explain, referring to the acquired knowledge, the mode of action of GABA.

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.

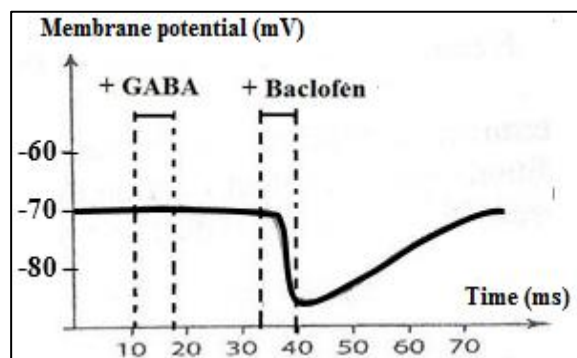
5- Verify if baclofen and GABA act on the same receptors.



Document 1



Document 2



Document 3

**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- Interpret the obtained results.

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 and discontinuous.

Experimental conditions Hormones (ng.mL <sup>-1</sup> )	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

The results are shown in document 2.

**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- Indicate one role for each of these ovarian hormones.

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- Name the type of feedback control revealed by each of the two cases, case 1 and case 2.

6- Establish, 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.

الاسم:  
الرقم:

مسابقة في مادة علوم الحياة  
اسس التصحيح

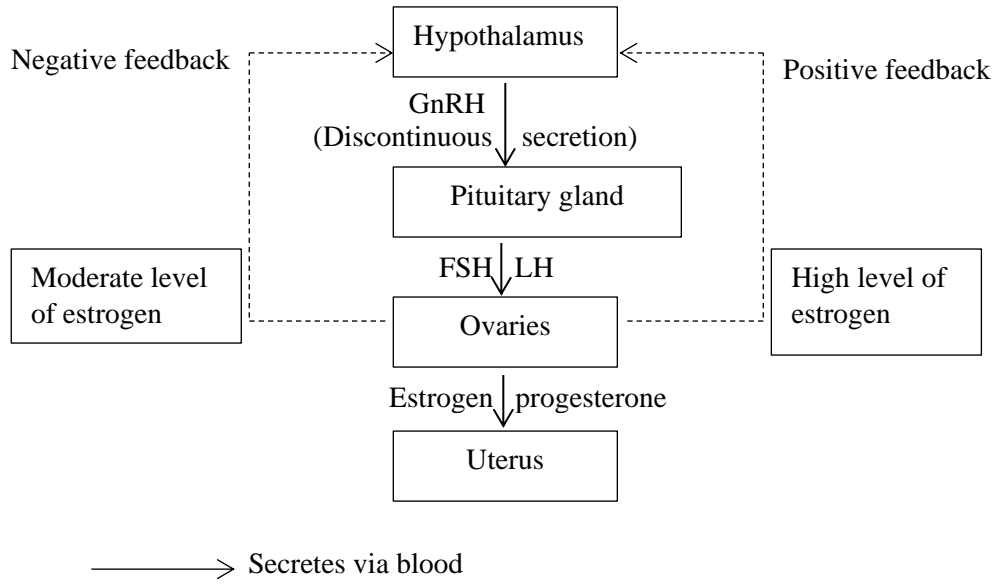
Part of the ex	Exercise 1	Pulmonary Emphysema	Grade
1	A progressive destruction of the lung tissue by the proteases of the white blood cells.		0.5
2	mRNA resulting from the transcription of the allele M1: ... AUC AAC GAU UAC ... Sequence of the amino acids of the polypeptide coded by the allele M1: ... -Ile - Asn - Asp - Tyr - ... mRNA resulting from the transcription of the allele M2: ... AUC AAC GAU UAG... Sequence of the amino acids of the polypeptide coded by the allele M2: ... -Ile - Asn - Asp		1
3	The mutation by substitution at the level of the 3rd nucleotide of triplet number 184 (C is replaced by G) is transcribed at the level of mRNA gives a truncated polypeptide having 183 amino acids instead of 418, leading to a non-functional protein alpha-antitrypsin (aT). This explains why alpha-antitrypsin is not found in the blood of an individual affected by pulmonary emphysema and consequently the pulmonary tissue is not protected against protease degradation and the patient shows manifestation of pulmonary emphysema.		1
4	The allele of the disease is recessive. The parents 1 and 2 are normal but gave two affected children 4 and 5. These children have taken the mutant allele from at least one of the parents. This parent does not phenotypically express the disease, so the mutant allele is being masked by the normal one. N: normal dominant allele. m: mutant recessive allele.		0.5
5	If the studied gene is carried on the non-homologous part of Y, in this case, any affected boy would necessarily have a sick father. For example, the affected boy 5 must have taken Y <sup>m</sup> from his father who would have as genotype XY <sup>m</sup> . Possessing such genotype, father 1 should be affected, which is not the case. If the studied gene is carried on the non-homologous part of chromosome X: in this case, the affected daughter 4 would have X <sup>m</sup> // X <sup>m</sup> as genotype (purity is the criterion of recessivity). She should have taken one of her mutant alleles X <sup>m</sup> from her father 1 who would have as genotype X <sup>m</sup> // Y who phenotypically should be affected, which is not the case. If the studied gene is carried on the homologous parts of X and Y: in this case, the affected boy 5 would have as genotype X <sup>m</sup> // Y <sup>m</sup> , and his sister 4 would have as genotype X <sup>m</sup> // X <sup>m</sup> They have taken respectively Y <sup>m</sup> and X <sup>m</sup> from their father 1. This latter should have as genotype X <sup>m</sup> // Y <sup>m</sup> and would be phenotypically affected. It's not the case. Therefore, the studied gene is not gonosomal but it is autosomal.		0.5
6	The genotype of individual 8 is N//m. He is phenotypically normal, possessing the normal dominant allele and the affected allele m is obligatory inherited from the homozygous diseased father 5.		0.5
7	Despite the presence of a normal allele in his genotype (heterozygous), individual 8 develops the same symptoms of pulmonary emphysema. Being a heavy smoker promotes the development of the disease. This shows that smoking is an environmental factor other than the genetic factor that could provoke this disease.		0.5

Part of the ex	Exercise 2	AIDS	Grade
1-1	The molecules recognized by HIV are: CD4 and CCR5		0.5
1-2	The target cell is: T4 cell		0.5
2-1	At birth, the electrophoregrams of both children 1 and 2 show the same 4 bands of the electrophoregram of Mrs. Y. These bands are observed at the levels of anti-GP160, anti-GP120, anti- GP41 and anti-GP24 antibodies. However, at 6 <sup>th</sup> month, the number of these bands decreases in both electrophoregrams of children 1 and 2 to show bands at the levels of anti-GP160 and anti-GP120 antibodies only. On the other hand, at the 18 <sup>th</sup> month, the electrophoregram of only child 2 shows the reappearance of the two bands which correspond to anti- Gp160 and anti-Gp120 compared to the electrophoregram of child 1 that does not show any band.		1
2-2	Child 2, because he is seropositive at the age of 18 <sup>th</sup> month.		0.5
3	Hypothesis: The origin of antibodies present at birth in both children is maternal.		1
4	Yes, because the concentration of anti-HIV antibodies of maternal origin appears in the child at the fifth month during pregnancy and increases to reach maximum at birth. Then, this concentration of the produced antibodies decreases to null after 8 months of birth when the concentration of the antibodies produced by child 2 is approximately null. Therefore, the origin of anti-HIV antibodies present at birth is exclusively maternal.		1
5	The appearance of anti-HIV antibodies is a consequence of his contamination by HIV. In fact, after the infection by HIV, the immune system develops a reaction against the virus which is translated in the production of specific antibodies against the diverse viral protein Gp160, Gp120, Gp41, and Gp24.		0.5

Part of the ex	Exercise 3	GABA and Baclofen	Grade
1	Synapse S1 is excitatory since a hypopolarisation of amplitude 10 mv is obtained following stimulation of this nerve fiber 1. Synapse S2 is inhibitory since hyperpolarization of amplitude 5 mv is obtained following the stimulation of nerve fiber 2.		1
2	An EPSP is recorded at the level of the membrane of the motor neuron following the stimulation of the nerve fiber 1 or the injection of acetylcholine at the level of the synapse S1. This indicates that the acetylcholine fixes on its specific receptors on the membrane, while an IPSP is recorded at the level of the membrane of the motor neuron following the stimulation of the nerve fiber 2 or the injection of GABA at the level of the synapse S2. This indicates that the fixation of GABA on its specific receptor of the same motor neuron. Therefore, the motor neuron possesses different types of membrane receptors of neurotransmitters.		1
3	A hyperpolarization of amplitude 5mv is obtained at the level of the membrane of motor neuron following the injection of GABA, similarly a hyperpolarization but of higher amplitude (15 mV) is obtained after the injection of baclofen. This shows that baclofen has an inhibitory effect more amplified than that GABA.		1
4	GABA fixes on its specific post-synaptic membrane receptors of the chemical dependent Cl <sup>-</sup> channels. This provokes the opening of these channels followed by the entrance of Cl <sup>-</sup> ions leading to hyperpolarization. That's why GABA has an inhibitory effect.		1
5	In a medium deprived from Cl <sup>-</sup> , no variation in the membrane potential is observed at the level motor neuron in the presence of GABA. However, a hyperpolarization of 15 mv is recorded in the presence of baclofen. Hence, these two act on different receptors.		1

Part of the ex	Exercise 4 Regulation of the Sexual Cycle	Grade												
1	<p>A disappearance of the ovarian and uterine cycles is obtained following the removal of the pituitary gland of the female chimpanzee (A). This shows that the pituitary gland is indispensable for the ovarian and uterine cycles.</p> <p>However, the periodic injections of anterior pituitary extracts in female chimpanzee (A) restores the ovarian and uterine cycles. This shows that the anterior pituitary acts on the ovaries and uterus by releasing chemical substances in blood.</p> <p>On the other hand, the periodic injections of the extracts of the anterior pituitary at chimpanzee (A) that is submitted to the ablation of the ovaries do not restore the uterine cycle. This shows that the control of the pituitary on the uterus is indirect; it necessitates the intervention of the ovaries.</p>	1												
2	<div data-bbox="245 600 1107 1182" data-label="Figure"> <table border="1"> <caption>Quantity of FSH and LH (ng/mL)</caption> <thead> <tr> <th>GnRH Injection Type</th> <th>FSH (ng/mL)</th> <th>LH (ng/mL)</th> </tr> </thead> <tbody> <tr> <td>Destruction of specific cells of the hypothalamus</td> <td>10</td> <td>2.5</td> </tr> <tr> <td>Discontinuous injections of GnRH</td> <td>100</td> <td>15</td> </tr> <tr> <td>Continuous injection of GnRH</td> <td>10</td> <td>2.5</td> </tr> </tbody> </table> </div> <p>Variation of the amount of FSH, LH according to GnRH injection types</p>	GnRH Injection Type	FSH (ng/mL)	LH (ng/mL)	Destruction of specific cells of the hypothalamus	10	2.5	Discontinuous injections of GnRH	100	15	Continuous injection of GnRH	10	2.5	1.5
GnRH Injection Type	FSH (ng/mL)	LH (ng/mL)												
Destruction of specific cells of the hypothalamus	10	2.5												
Discontinuous injections of GnRH	100	15												
Continuous injection of GnRH	10	2.5												
3	<p>After the continuous injection of GnRH into a female chimpanzee (B), which is submitted to the destruction of specific cells of the hypothalamus, the levels of FSH and LH remain low (<math>10 \text{ mg.mL}^{-1}</math> and <math>2.5 \text{ mg.mL}^{-1}</math>).</p> <p>On the contrary, when this chimpanzee is injected by GnRH discontinuously, the level of LH increases to <math>15 \text{ ng.mL}^{-1}</math> and that of FSH increases to <math>100 \text{ ng.mL}^{-1}</math>.</p> <p>This indicates that a moderate level of estrogen reduces the secretion of FSH and LH but the high level of estrogen stimulates the secretion of FSH and LH.</p>	0.75												
4	<p>Estrogen stimulates the proliferation of the uterine and vaginal mucosa.</p> <p>OR: Estrogen stimulates the development of the tube-like glands of the endometrium.</p> <p>Progesterone stimulates the gland secretions of the uterine mucosa and the cervix.</p> <p>OR: Progesterone stimulates the development of the spiral arterioles of the endometrium.</p>	0.5												
5	<p>Case 1: Negative feedback</p> <p>Case 2: Positive feedback.</p>	1												

6



0.75

Functional diagram showing the relation between the different organs participating in the regulation of the sexual cycles