وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	امتحانات الشهادة الثانوية العامة فرع الاجتماع والاقتصاد	دورة سنة ٢٠١٢ العادية

الاسم:
الرقم:

مسابقة في الثقافة العلمية
مادة علوم الحياة
المدة: ساعة واحدة

Answer the following exercises:

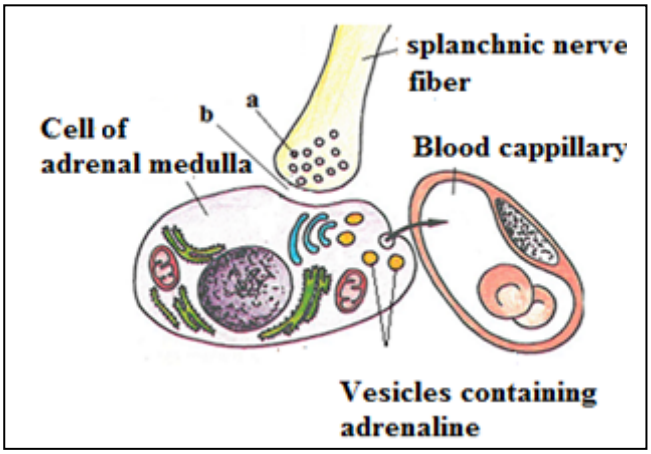
Exercise 1 (5 points) **Transgenic Sugar beet**

A viral disease, rhizomania, of the sugar beet has been spread throughout Europe since the 1950s. When a culture of sugar beet is contaminated, the yield loss may reach 80%.Also, the sugar content of beet passes from 18% to less than 10%. Thanks to biotechnology and to the progress of genetics; the gene responsible for the synthesis of the protein envelope of the rhizomania virus was isolated and then introduced in a stable manner into the genetic material of the sugar beet. The objective is to enhance sugar beet cells to produce small amounts of viral envelope protein, which provokes a defense response against this virus. This response is effective by inhibiting any attack of the plant by the same virus. Like all viruses, that of rhizomania has the ability to mutate very easily; thus this defense becomes quickly useless.

1- Pick out from the text :
  1.1- The name of the disease attacking the sugar beet.
  1.2- The consequences of this disease on the sugar beet plant.
2- Draw out, by referring to the text, the steps of the technique used to produce disease-resistant sugar beet.
3- Explain why the manipulated sugar beet is a GMO (genetically modified organism).
4- Indicate, by referring to the text, an advantage and an inconveniency of this biotechnology method.

Exercise 2 (5 points) **Adrenaline Secretion**

The adrenal gland is an endocrine gland innervated by the splanchnic nerve. It is formed of two parts: a central part, the adrenal medulla, and a periphral part, the adrenal cortex. The cells of the adrenal medulla secrete adrenaline. These cells are in contact with blood cappillaries and with the terminals of the splanchnic nerve fibers as shown in the adjacent document.



1- Name **"a"** and **"b"**.

To specify the conditions of adrenaline secretion, we perform the following experiments:

Experiment 1: In a rat, we isolate the splanchnic nerve and we stimulate it electrically. Then we immediately collect a blood sample from the vein leaving the adrenal medulla. It reveals a significant increase in the concentration of adrenaline.

Experiment 2: On the adrenal medulla cells, we inject in **"b"** acetylcholine which is normally present in **"a"** .These cells release adrenaline.

Experiment 3: We use certain detergents in order to destroy the membranous receptors of the adrenal medulla cells, at level **"b"**, then we inject acetylcholine at this level .These cells do not release adrenaline.

2- Interpret each of these experiments. Deduce the chain of events which lead to the release of adrenaline by the adrenal medulla.
3- List two differences between the nervous communication and the hormonal communication**.**

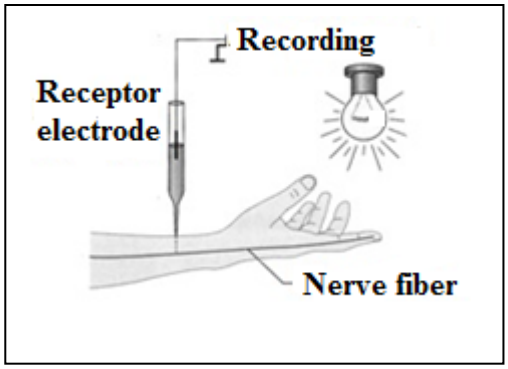
Exercise 3 (5 points) **Alcohol Dependence**

Dopamine is a neurotransmitter that induces the sensation of pleasure. Alcohol fixes on dopamine neurons increasing their activities and enhancing them to release more dopamine. Another phenomenon reinforces indirectly the production of dopamine: Alcohol favors the release of substances such as enkephalin. This enkephalin binds to receptors situated on neurons which release GABA, an inhibitory neurotransmitter .These GABA neurons cease their inhibitory action on dopamine neurons permitting an increase in the production of dopamine.
On the other hand, another substance such as acamprosate can act on dopamine neurons .This acamprosate is a chemical molecule that inhibits the action of certain amino acids which have an excitatory effect on dopamine neurons, and it also prevents the binding of alcohol on dopamine neurons.

1- Show, by referring to the text, the two modes of action of alcohol on the sensation of pleasure.
2- Justify, based on the text, how the utilization of acamprosate might limit alcohol dependence.
3- Explain drug tolerance in the case of alcohol.

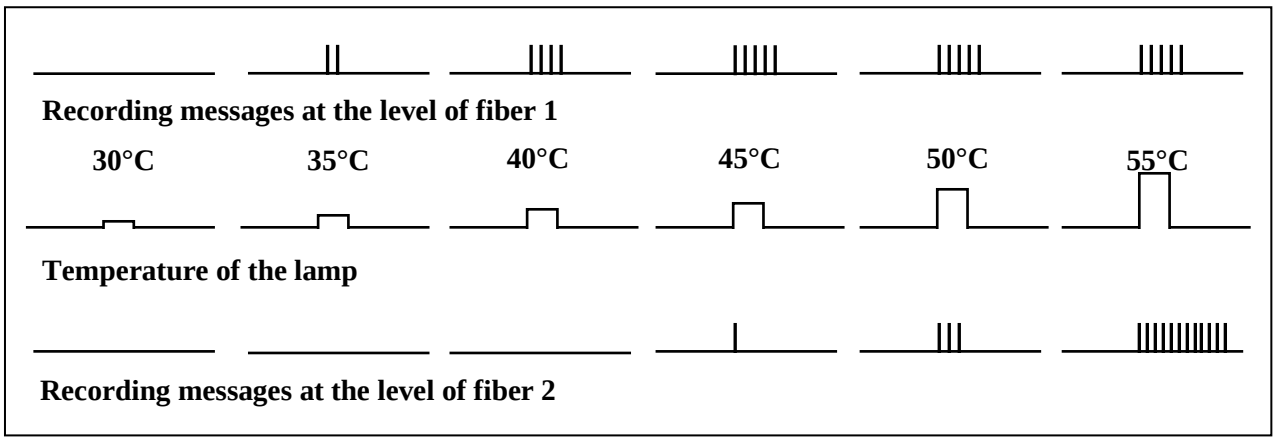
Exercise 4 (5 points) **The Activity of a Thermoreceptor and a Nociceptor**

We perform an experiment on two types of nerve fibres of an individual. Fiber 1 issued from a cutaneous thermo receptor and involved in thermal sensation. Fiber 2 issued from a nociceptor and involved in the painful sensation.
The individual puts his hand in front of a lit lamp. Document 1 is a schematic representation of the experimental set up. We increase progressively the power of the lamp, leading to an increase in its heating temperature. We record the nervous messages propagating at the level of these two fibers using fine receptor electrodes.



Document 1

The experimental results are shown in document 2.



Document 2

N.B. Each vertical line corresponds to an action potential

1- Draw a table that translates the obtained results.
2- Justify, based on document 2, the following statement: "the nervous message, at the level of a nerve fiber, is coded by modulation of frequency of action potential and not by amplitude."
3- Pick out by referring to document 2, for each of the receptors, the threshold temperature, starting from it heat and pain sensation take place. Justify the answer.

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Part of the Ex.	Answer key	Note
	Exercice 1 (5 points)	
1-1	Rhizomania	**1/2**
1-2	The yield loss may reach 80%. **1/2 pt** The sugar content of beet passes from 18% to less than10%. **1/2pt**	**1**
2	- Isolation of the gene responsible for the synthesis of the protein envelope of rhizomania virus - Introduction of the gene into the genetic material of the beet - Production of small quantities of viral envelope proteins by sugar beet cells	**11/2**
3	The beet is considered as a GMO, because it receives a foreign gene, integrating it in its genome and gives it a new property: the defense response against the rhizomania virus.	**1**
4	**Advantage:** the modified sugar beet possesses a defense system for inhibiting the attack of the plant by the rhizomania virus. **1/2 pt** **Inconveniency:** the defense response induced by this method could be quickly useless because the rhizomania virus has the ability to mutate very easily. **1/2 pt**	**1**

Part of the Ex.	Answer key	Note
	Exercice 2 (5 points)	
1	a : synaptic vesicle or vesicle containing neurotransmitters (**1/2 pt)** b : synaptic cleft (**1/2 pt)**	**1**
2	**Experiment 1**: a significant increase in the concentration of adrenaline is revealed following the electrical stimulation of the splanchnic nerve. This indicates that the secretion of adrenaline by the adrenal Medulla is provoked via a nervous pathway.(**1/2 pt)** **Experiment 2**: There is a release of adrenaline by the cells of the adrenal medulla after injection of acetylcholine at the level of "b". This means that acetylcholine stimulates the adrenal medulla cells to secrete adrenaline.(**1/2pt)** **Experiment 3**: There is no release of adrenaline by the adrenal medulla cells after destroying their membrane receptors and injecting acetylcholine at the level of "b". This shows that acetylcholine stimulates the adrenal medulla cells after binding on their membrane receptors.(**1/2pt)** Thus, the stimulation of splanchnic nerve provokes the release of acetylcholine that binds on the membrane receptors on the adrenal medulla cells enhancing them to secrete adrenaline.(**1/2 pt)**	**2**
3	Two differences out of five **Nervous communication** / **Hormonale communication** Requires the intervention of nerve centers / Requires the intervention of endocrine glands The message is transmitted by nerve fibers / The message is transmitted by blood Nervous message: train of action potentials / Hormonal messenger or chemical messenger Rapid / Slow Short lasting / Long lasting	**2**

Part of the Ex.	Answer key	Note
	Exercise 3 (5 points)	
1	Alcohol activates dopamine neurons in two modes : - Direct mode: alcohol fixes on dopamine neurons increasing their activities and enhancing them to release more dopamine and hence increasing the sensation of pleasure. - Indirect mode: alcohol favors the release of substances such as enkephalin .This enkephalin binds to receptors situated on neurons which release GABA, an inhibitory neurotransmitter. Then these GABA neurons cease their inhibitory action on dopamine neurons thus permitting the activation of these neurons, provoking the sensation of pleasure.	**2**
2	Acamprosate opposes the effect of alcohol because it inhibits the binding of alcohol on dopamine neurons and prevents the action of these neurons by inhibiting the action of certain excitatory amino acids. As a result the sensation of pleasure decreases, and the individual desire for alcohol is diminished.	**2**
3	Tolerance is the increase in the dose of drug intake by the alcoholic person in order to obtain the same sensation of pleasure felt with the previous lower doses.	**1**

Part of the Ex.	Answer key	Note
	Exercise 4 (5 points)	
1	<table><tr><td colspan="2">Temperature (in ^{o}C)</td><td>30</td><td>35</td><td>40</td><td>45</td><td>50</td><td>55</td></tr><tr><td rowspan="2">Messages recorded (in number of action potentials)</td><td>Fiber 1</td><td>0</td><td>2</td><td>4</td><td>5</td><td>5</td><td>5</td></tr><tr><td>Fiber 2</td><td>0</td><td>0</td><td>0</td><td>1</td><td>3</td><td>12</td></tr></table> Changes in the frequency of action potential or the recorded messages at the level of fibers 1 and 2 as a function of temperature	**2**
2	The frequency of AP in fiber 1 increases from 2 to 5 following an increase of temperature from 35 °C to 45 °C, keeping the same amplitude. Or The frequency of AP in fiber 2 increases from 1 to 12 following the increase of temperature from 45 °C to 55 °C, keeping the same amplitude.	**1**
3	- The minimum threshold temperature for fiber 1 is greater than 30 °C and less than 35 °C since there is no response when the temperature is 30 °C ; on the contrary, there are 2 recorded AP for a temperature of 35°C.(**1 pt)** - The minimum threshold temperature for fiber 2 is greater than 40°C and less than 45°C since there is no response when the temperature is below or equal to 40 ° C; in the contrary ,there is 1 recorded AP for a temperature of 45°C .(**1 pt)**	**2**