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

مسابقة في الثقافة العلمية
مادة علوم الحياة
المدة: ساعة واحدة

الاسم:
الرقم:

Answer the following exercises:

Exercise 1 (5 points) Hypercholesterolemia

Cholesterol is necessary for the organism. It is transported in the blood in various forms, mainly by globular particles, LDL (low density lipoprotein).
These LDL bind to protein receptors situated on the outer membranes of cells. Then these receptors aggregate and allow, by endocytosis, the penetration of LDL into the cells where they are degraded. This assures the supply of cholesterol to these cells.
In adult individuals, hypercholesterolemia (increase in cholesterol level in blood) is due to a diet very rich in cholesterol. In other individuals, hypercholesterolemia takes place in early childhood. In this case, the cause of the disease is related to LDL receptors. Either these receptors are not found on the membranes of these cells, or they are found but not functional.

1- Draw out from the text :
1.1- The main form of transportation of cholesterol in blood.
1.2- The process of LDL penetration of into the cell.
2- Justify, based on the text, how LDL receptors might be at the origin of hypercholesterolemia.
3- Name another form by which cholesterol is transported in blood and specify the role of this form.

Exercise 2 (5 points) Diet and food ration

A study done on a sample of 1000 people per country, 49 to 50 years old, shows that the rate of mortality due to heart disease is 77.3% in the United States and 3.8% in Crete (a Greek island). Document 1 shows the partial composition of the food diets in the United States and in Crete.

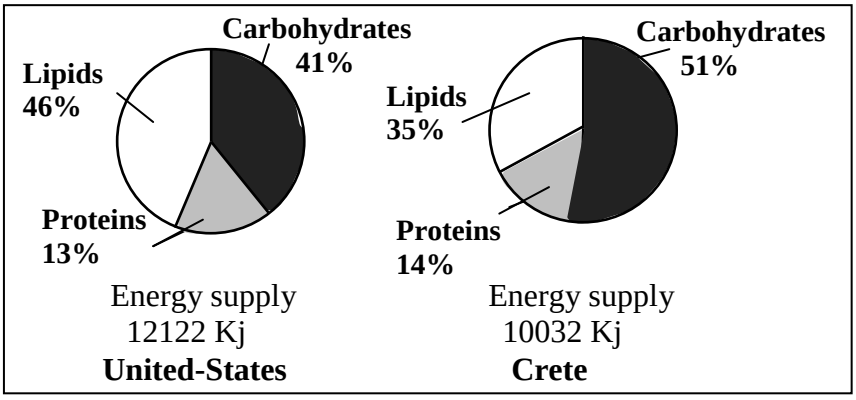
Food in g/day	bread	Dried legumes	Green legumes	Fruits	Meat	Added lipid (animal fat)	Added lipid (olive oil)
United States	97	1	171	233	273	33	0
Crete	380	30	191	464	35	0	95

Document 1

1- Compare the composition of the two food diets.

Document 2 shows the portions of the consumed food rations and the energy supply in these two countries.

2- Specify, by referring to document 2, the food ration that might lead to obesity. Justify the answer.
3- Explain, taking into consideration the information provided by documents 1 and 2, the probable cause of the high mortality rate in the United States.



Document 2

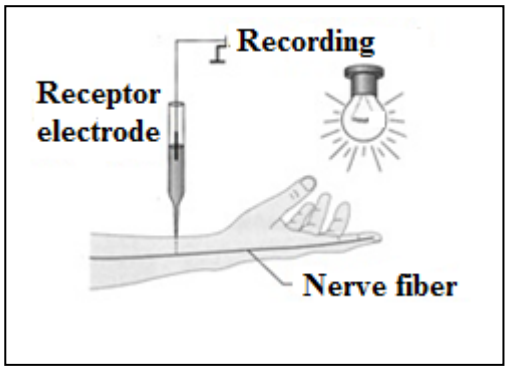
Exercise 3 (5 points) **Alcohol Dependence**

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.

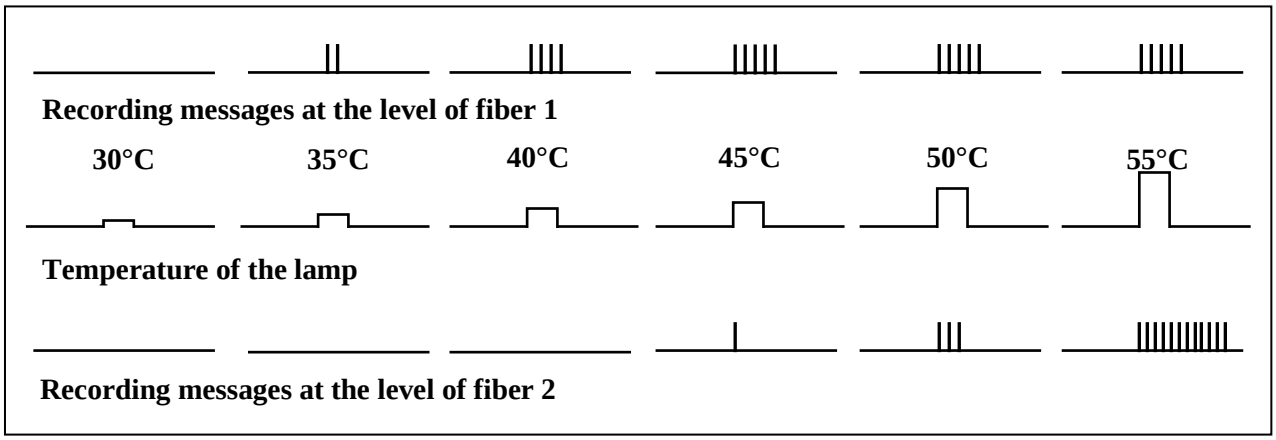
Exercise 4 (5 points) **The Activity of a Thermoreceptor and a Nociceptor**

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	It is transported by LDL.	**1**
1-2	LDL penetrate, by endocytosis, by means of protein receptors.	**1**
2	In an individual affected by hypercholesterolemia, the LDL receptors are not present or non-functional. LDL cannot penetrate into the cells. The level of LDL in the blood remains high.	**11/2**
3	HDL**(1/2 pt)** It transports the cholesterol to be degraded from the tissues towards the liver.**(1pt)**	**11/2**

Part of the ex.	Answer key	Note
	Exercice 2 (5 points)	
1	The diet in the United States is much richer than that in crete in: meat (273 g/d > 35 g/d) and added lipids/ animal fat (33 g/d > 0 g/d). On the contrary, it is poorer in dried legumes (1 g/d < 30 g/d), green legumes (171 g/d< 191 g/d), fruits (233 g/d < 464 g/d) and added lipids / olive oil (0 g/d < 95 g/d).	**11/2**
2	The food ration in the United States**(1/2 pt)** because the energy supplied by the food diet in the United States 12122 Kj is greater than that supplied by the food diet in crete,10032Kj. Also, the consumed lipid in the food diet of United States 46% is greater than that in the food diet in Crete, 35%. **(1pt)**	**11/2**
3	The mortality due to cardiovascular diseases is related to the accumulation of cholesterol in the vessels that narrows the coronary artery and develops atherosclerosis thus leading to myocardial infarction. Or this cholesterol is supplied by a diet rich in lipid of animal origin. This corresponds to the food diet of the inhabitants of the United States which is rich in lipids supply (doc 2) and of animal origin (doc 1)	**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		**2**

Temperature (in ^{o}C)		**30**	**35**	**40**	**45**	**50**	**55**
Messages recorded (in number of action potentials)	**Fiber 1**	0	2	4	5	5	5
	Fiber 2	0	0	0	1	3	12

The variation in the frequency of action potential or the recorded messages at the level of fibers 1 and 2 as a function of temperature

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 threshold temperature “minimum” 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 threshold temperature “minimum” 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**