مسابقة في الثقافة العلميّة – مادة علوم الحياة
المدة: ساعة واحدة

الاسم:
الرقم:

Exercise 1 (7 points) Fight Against Obesity

Although many factors can affect obesity, yet this latter is mainly due to an energetic imbalance where the energy supply is higher than the energy expenditure. This energetic imbalance depends at the same time on the environment, the behavior of the individual, and his genetic predisposition. Energetic supplies consist of the energy contained in solid foods and beverages that can be metabolized (used) by the body.

Document 1

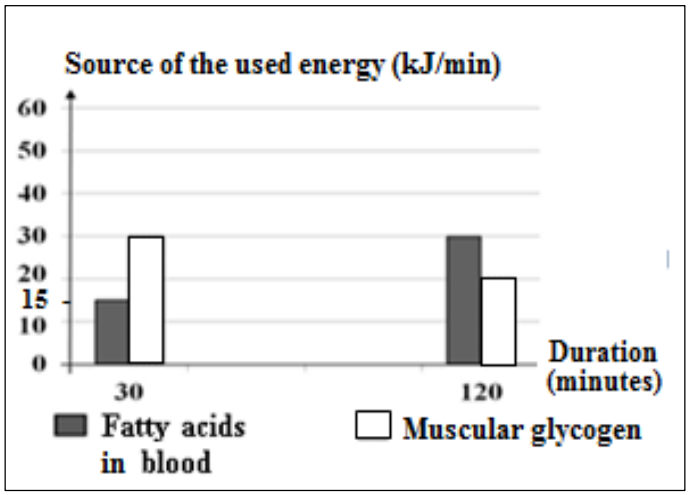
1- Pick out from document 1:
- **1.1-** The cause of obesity.
- **1.2-** The factors that affect the energetic balance.
- **1.3-** The constituents of the energetic supplies.

Obesity corresponds to the increase of the body mass due to the accumulation of fatty acids in the adipose tissue. In order to reduce obesity, two hypotheses are formulated:

Hypothesis 1: It's preferable to adopt a moderate physical activity for a longer duration.
Hypothesis 2: It's preferable to adopt an intense physical activity for a short duration.

In order to validate one of these hypotheses, the variation of the use of fatty acids in the blood and the muscular glycogen as sources of energy is measured in the following two cases:

Case 1: A moderate physical exercise during two different durations. The results are represented in document 2.
Case 2: An intense physical exercise of thirty-minute duration. The results, in this case, show a weak utilization of fatty acids as a source of energy.



Document 2

2- Draw a table showing the variation of the source of energy used as a function of the duration of the exercise (document 2).
3- Analyze the results obtained in document 2.
4- Indicate the hypothesis validated by the experimental results in the two cases. Justify the answer.
5- Name two diseases that are enhanced by obesity.

Exercise 2 (6.5 points) A Characteristic of a Receptor

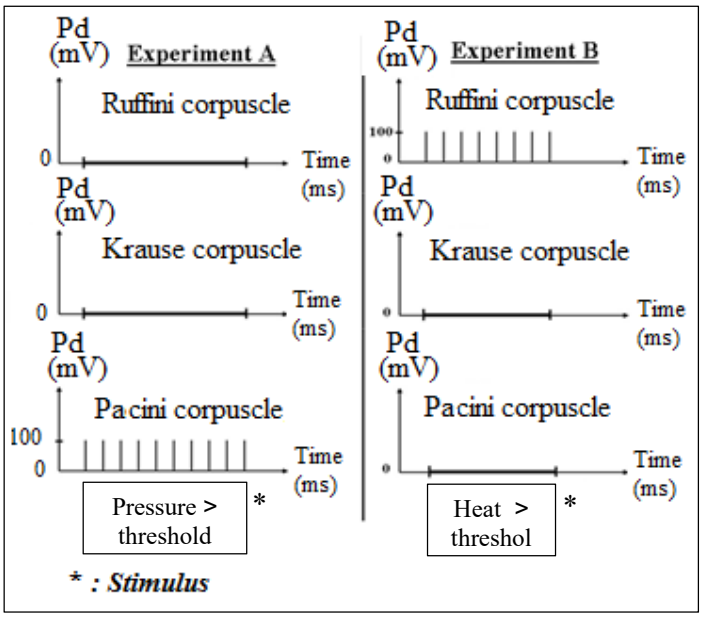
In the framework of studying the characteristics of sensory receptors, three experiments A, B and C are performed. Stimulations of supraliminal intensities (above threshold) are applied on three different receptors: Pacini corpuscle, Ruffini corpuscle, and Krause corpuscle. The obtained APs are recorded at the level of the nerve fiber that corresponds to each type of the receptors.

The results of the experiments A and B are represented in document 1.

1- Define the threshold intensity.
2- Pick out from document 1 the stimulus used in each experiment.
3- Specify, based on experiments A and B, the receptor that is sensitive to pressure and the one that is sensitive to heat.
4- Draw out the characteristic of the receptors revealed in document 1.

In experiment C, the three receptors are subjected to an intense cold.

5- Based on document 1, draw in case of experiment C, the possible recordings obtained at the level of the nerve fibers corresponding to each of the three types of the studied receptors, knowing that only Krause corpuscle is sensitive to cold.



Document 1

Exercise 3 (6.5 points) Diabetes Treatment

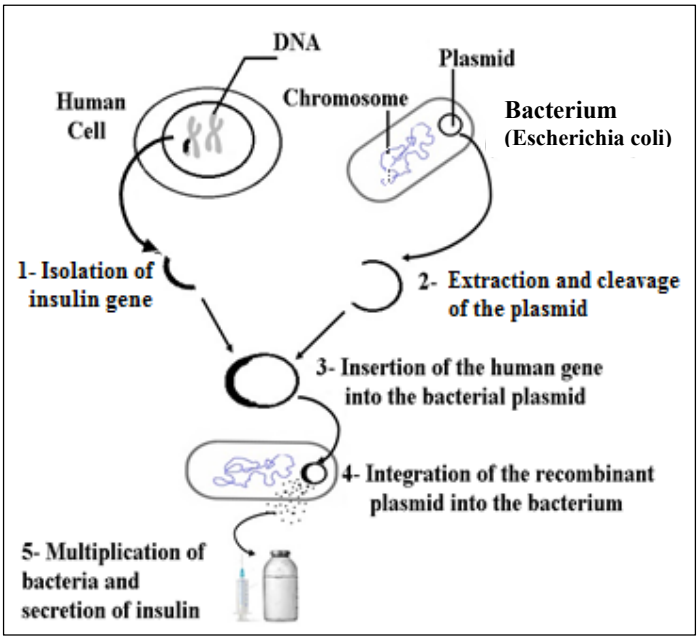
Diabetes is a chronic disease characterized by a constantly high level of glucose in blood. There are different types of diabetes; type 1 diabetes, type 2 diabetes, pregnancy diabetes, and other rare types. Type 1 diabetes is caused by the destruction of pancreatic beta cells responsible for the secretion of insulin (a hypoglycemic hormone).

Document 1

1- Pick out from document 1:
1.1- The definition of diabetes.
1.2- The different types of diabetes.
1.3- The cause of type 1 diabetes.

In order to treat type 1 diabetes, insulin will be produced by a genetic engineering technique, the transgenesis. The steps of this technique are represented in document 2.

2- Indicate the recipient cell and the donor cell of the transferred gene.
3- Name the enzymes used in steps 1 and 3.
4- Explain why the manipulated bacterium is called transgenic.
5- State a medical benefit and another economic one of insulin production by transgenesis.



Document 2

مسابقة في مادة علوم الحياة
اسس التصحيح

الاسم:
الرقم:

Part of the ex	Exercise 1 — Fight Against Obesity	Grade
1.1	The cause of obesity is an energetic imbalance where the energy supply is higher than the energy expenditure.	0.5
1.2	The factors are: the environment, the behavior of the individual and his genetic predisposition.	0.5
1.3	Energetic supplies consist of the energy contained in solid foods and beverages that can be metabolized (used) by the body.	0.5
2	<table><tr><td rowspan="3">Source of the used energy ($kJ.min^{-1}$)</td><td>Duration of the exercise (minutes)</td><td>30</td><td>120</td></tr><tr><td>Blood fatty acids</td><td>15</td><td>30</td></tr><tr><td>Muscular glycogen</td><td>30</td><td>20</td></tr></table> *Variation of the source of the used energy as a function of the duration of the exercise*	2
3	For an exercise of moderate intensity, when the duration of the exercise increases from 30 to 120 minutes, the use of fatty acids as source of energy increases from 15 to 30 kJ/min, on the contrary the use of muscular glycogen as a source of energy decreases from 30 to 20 kJ/min.	1
4	Hypothesis 1 is valid. Because obesity corresponds to the accumulation of fatty acids in the dipose tissue, and in case 2 of an intense physical exercise, the use of fatty acids as a source of energy is weak. On the contrary, this use is important in case 1of moderate physical exercise but for a prolonged duration.	1.5
5	- Cardiovascular diseases - Diabetes	1

Part of the ex	Exercise 2 — A Characteristic of a Receptor	Grade
1	The threshold intensity is the minimum intensity that is able to generate a response (an action potential)	1
2	Experiment A: pressure Experiment B: heat	1.5
3	The receptor sensitive to pressure is the Pacini corpuscle, since after applying the pressure on the three receptors (experiment A) only the nerve fiber corresponding to the Pacini corpuscle shows a response (10 APs). The receptor sensitive to heat is the Ruffini corpuscle, since after applying heat on the three receptors (experiment B) only the nerve fiber corresponding to the Ruffini corpuscle shows a response (8 APs).	1.5
4	Each type of sensory receptor is specific to only one type of stimulus.	1
5	<table><tr><td></td><td>Pacini corpuscule</td><td>Ruffini corpuscule</td><td>Krause corpuscule</td></tr><tr><td>Number of A.P/s</td><td>—</td><td>—</td><td>IIIII</td></tr></table> The recordings obtained at the level of the nerve fibers corresponding to each type of the studied receptors after applying cold stimulus.	1.5

Part of the ex	Exercise 3 LH Synaptic Functioning	Grade
1	With an intensity of stimulation I1, no AP is recorded at the level of neuron A. However, with a higher intensity I2, three AP/s are recorded at the level of this neuron. This number increases to 6 AP/s when the intensity is increased to I3.	1
2	The nervous message is coded in terms of the frequency of action potential as a function of the intensity of stimulation.	1
3	The synapse is excitatory because a nervous message is recorded at the level of the postsynaptic neuron B (2 AP/s) following the stimulation of the presynaptic neuron A with intensity I2.	1,5
4	At the level of the synapse, the transmission of the nerve message is unidirectional; it is transmitted in only one direction from the presynaptic neuron to the postsynaptic neuron.	1
5	The steps of the synaptic transmission are : - Arrival of the nervous message to the terminal bud of the presynaptic neuron. - Liberation of the neurotransmitter by exocytosis into the synaptic cleft. - Fixation of the neurotransmitter to the postsynaptic membrane receptors. - Generation of a postsynaptic membrane potential or transmission of the nervous message o the postsynaptic membrane. - Elimination of the neurotransmitter molecules by enzymatic degradation or by recapture of the neurotransmitters by the presynaptic membrane.	2

Part of the exercise	Exercice 3 SE Diabetes Treatment	Note
1.1	Diabetes is a chronic disease characterized by a constant high level of blood glucose	0,5
1.2	Type 1 diabetes, type 2 diabetes, pregnancy diabetes, and other rare types.	0,5
1.3	Type 1 diabetes is caused by the destruction of pancreatic beta cells responsible for the secretion of insulin	0,5
2	The recipient cell: the bacterium (*Escherichia coli*) The donor cell: the human cell	1
3	Etape 1: Restriction enzyme Etape 2: DNA ligase	1
4	The manipulated bacterium is called transgenic since it has integrated a new gene from another species (man) and this gene has been expressed (insulin secretion)	1,5
5	Medical benefit: the produced insulin doesn't cause allergy. Economic benefit: fast production, low cost, production of insulin in high amounts.	1,5