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.

A **moderate intensity exercise:**

for a thirty- minute duration

- The source of the used energy as fatty acid is 15 kJ/min.
- The source of the used energy as muscular glycogen is 30 kJ/min.

for a one hundred twenty- minute duration

- the source of the used energy as fatty acid is 30 kJ/min.
- the source of the used energy as muscular glycogen is 20 kJ/min.

Document 2

Case 2: An intense physical exercise of of thirty-minute duration. The results, in this case, show a weak utilization of fatty acids as a source of energy.

2- Replace a,b,c, and d in the table by the appropriate values of the source of the used energy (document 2).

	Duration of exercise (minutes)	30	120
Source of energy used (kJ/min)	Blood fatty acid	a)	b)
	Muscle glycogen	c)	d)

Title: Variation of the the source of the used energy (kJ/min) as a function of duration of the exercise.

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.

Experiment A: The application of a supraliminal stimulation (pressure) on Raffini corpuscle and Krause corpuscle does not show any action potential (no response). However, on Paccini corpuscle, this stimulation provokes 10 action potentials (AP) of the same amplitude 100 mV.

Experiment B: The application of a supraliminal stimulation (heat) on Krause corpuscle and on Paccini corpuscle does not show any action potential (no response). However, on Raffini corpuscle, this stimulation provokes 8 action potentials (AP) of the same amplitude 100 mV.

Document 1

1- Define the threshold intensity.

2- Pick out from document 1 the stimulation 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- Conclude 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, choose the right answer to fill the table below representing the recoding on Krause corpuscle receptor by using, knowing that Krause corpuscle is the only receptor sensitive to cold:

a) no response or b) 10 action potentials

	Pacini corpuscle	**Ruffini corpuscle**	**Krause corpuscle**
Number of AP (action potential)	no response	no response	

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.

Step 1: Insulin gene is isolated from the DNA of the human cell.
Step 2: The plasmid of a bacterium (Escherichia coli) is extracted and undergoes cleavage.
Step 3: Insertion the human gene into the bacterial plasmid to obtain a recombinant plasmid.
Step 4: The recombinant plasmid is integrated into the bacteria.
Step 5: The bacteria multiply and secrete insulin.

Document 2

2- Indicate the recipient cell and the donor cell of the transferred gene (document 2).

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.