المركز التربوي للبحوث والإنماء	الهيئة الأكاديميّة المشتركة قسم : العلوم	المادة: علوم الحياة الشهادة: الثانوية العامة فرع: الاداب والانسانيات نموذج رقم -٢- المدّة : ساعة واحدة

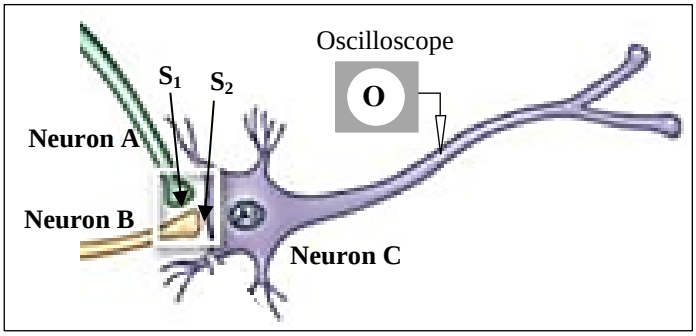
نموذج مسابقة (يراعي تعليق الدروسَ والتوصيف المعدل للعام الدراسي ٢٠١٦-٢٠١٧ وحتى صدور المناهج المطورة)

Exercise 1 : (6 points)

A Presynaptic Facilitation

"Presynaptic facilitation" can lead to the increase in the release of the neurotransmitters by the terminal arborizations of the sensory neurons under the action of another neuron.

Document 1 represents the synapses between various neurons.



Document 1

1. Indicate the presynaptic neuron and the postsynaptic neuron for each of the synapses S_1 and S_2.

Neuron B is effectively stimulated. Then, the two neurons A and B are simultaneously stimulated by a stimulation having the same intensity as the previous one. Document 2 represents the frequency of the action potentials recorded by the oscilloscope O as well as the quantity of the neurotransmitters released by the neurons A and B in each case.

	Stimulation of neuron B	Simultaneous stimulation of neurons A and B
Frequency of A.P recorded on neuron C		
Quantity of neurotransmitter released by neuron A	**0**	+
Quantity of neurotransmitter released by neuron B	+	+++
(+) Moderate quantity		(+++) Important quantity

Document 2

2. Specify if synapse S_2 is excitatory or inhibitory.

3. Show that neuron A exerts a presynaptic facilitation on neuron B.

4. What caused the increase in the frequency of A.P in C?

Exercise 2 (7 points)

The Healthy Runner's Diet

During a physical activity, the energy expenditure can be estimated from the intensity of respiration. Document 1 represents the different intensities of respiration required for various activities.

Activities	Intensity of respiration ($L.kg^{-1}.h^{-1}$)
At rest	0.25
Slow walking	0.40
Quick walking	0.90
Running	2.50

Document 1

An athlete weighing 60 kg and of height 170 cm wants to participate in a marathon. He should run for 2 hours on daily basis.

1. Calculate :

1.1. The volume of oxygen gas consumed by the athlete during two hours of training.

1.2. The corresponding energy expenditure, knowing that the energy released by consuming 1 L of oxygen gas is 20 kJ.

In order to cover the supplementary energy requirements associated with this exercise, a dietitian prescribes for this athlete a high-carbohydrate diet (document 2) and provides him with the possible composition of this diet (document 3).

Food categories	Grain product	Fruits	Vegetables	Dairy products
Quantity (in portions)	15	6	6	5

Document 2

The best sources of carbohydrates are cereals (preferably whole grains) such as bread, rice, and pasta, as well as fruits, vegetables and low-fat dairy products. Food labels indicate the total amount of carbohydrate present in each of the given food portions.

- a portion of a cereal product, such as a slice of bread or 1/2 cup of cooked rice or pasta, and a portion of fruit, such as a piece of fruit or 3/4 cup of fruit juice, each provides 15 grams of carbohydrates.
- a portion of dairy products, such as 1 cup of low fat milk or yogurt or 1.5 ounces of cheese provides 12 grams of carbohydrates.
- a portion of vegetables, such as 1 cup of raw leafy vegetables, 1/2 cup of chopped vegetables, or 3/4 cup of vegetable juice, provides 5 grams of carbohydrates.

Document 3

2. Calculate:

2.1 -the quantity of carbohydrates, in grams, provided by the diet prescribed by the dietitian (doc.2 and doc.3).

2.2 -the total energy provided by this carbohydrate supplement, knowing that 1 g of carbohydrate gives 17 kJ.

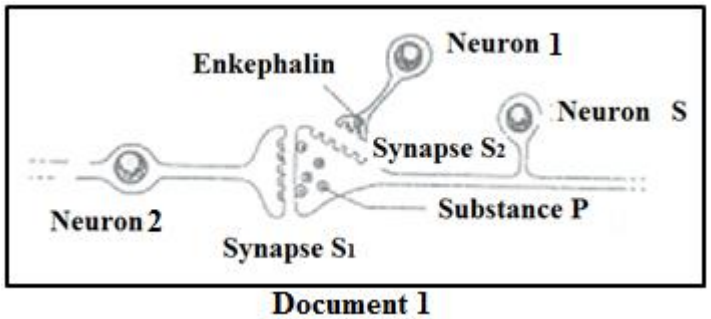
3 - Deduce if this calculated value of energy can cover the energy requirements related to the training program of this athlete.

Exercise 3 (7 points)

The Mode of Action of Morphine

Morphine, an analgesic used primarily to stop the sensation of pain, acts on specific receptors in the brain and in the spinal cord. Document 1 represents the set of neurons involved in the transmission of the pain message at the level of the spinal cord.

1- Formulate two hypotheses concerning the mode of action of morphine.



Document 1

Doc.1 is adopted from the 1st session of 2003

To determine the mode of action of morphine, many experiments are performed. The conditions and the obtained results are presented in document 2, taking into consideration that in each experiment the applied stimulation is effective, the amount of neurotransmitters released as well as the intensity of pain sensation are estimated by special techniques.

Experiments	Experimental conditions	Amount of released neurotransmitters in (a.u)		Intensity of the painful sensation
		Enkephalin in S2	Substance P in S1	
1	Simulation of neuron S	7	10	+++
2	Stimulation of neuron 1 and of neuron S	20	2	+
3	Injection of morphine in S_1 and stimulation of neuron S	7	10	+++
4	Blockage of enkephalin release followed by an injection of morphine into S2 and later a stimulation of neuron S	0	0	-
+++ : Intense pain + : Weak pain - : No pain				

Document 2

2- Deduce the role of enkephalin.

3- Justify, by referring to experiment 1 and 4, the analgesic role of morphine.

4- Determine the mode of action of morphine as analgesic.

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أسس التصحيح (تراعي تعليق الدروس والتوصيفّ المعدل للعام الدراسي 2016 - 2017 وحتى صدور المناهجّ المطورة)

Part of the Ex	Correction	Mark
	Exercise 1 (6 points)	
1	The presynaptic neuron of synapse S_1 is the neuron A and the postsynaptic neuron is the neuron B. The presynaptic neuron of synapse S_2 is the neuron B and the postsynaptic neuron is the neuron C.	**1.5**
2	Synapse S_2 is excitatory since a response of 4 APs of the same amplitude are recorded by oscilloscope O connected to neuron C (postsynaptic neuron) when neuron B (presynaptic neuron) is stimulated.	**1.5**
3	The quantity of neurotransmitters released by neuron A is null whereas, a moderate quantity of neurotransmitters is released when only neuron B is effectively stimulated. This released quantity increases to be moderate for neuron A and high for neuron B, always greater than that of A after the simultaneous stimulation of neurons A and B; this shows that the action of neuron A facilitates the release of neurotransmitters by neuron B which is the presynaptic neuron of synapse S2. This corresponds to a phenomenon of facilitation where the action of a neuron increases the liberation of neurotransmitters by the terminal arborizations of sensory neurons.	**2**
4	The increase in the frequency of A.P in neuron C is due to the increase in the quantity of neurotransmitters released by neuron B from moderate to important.	**1**

Parts of Ex	Exercise 2 (7 points)	Mark
1.1	Volume of dioxygen= 60 Kg x 2.5 $\mathbf{L.kg^{-1}.h^{-1}}$ x 2 h = 300 L	**1**
1.2	Energy expenditure = I.R × 20 Kj/L Energy expenditure = 300 L× 20 Kj/L= 6000 Kj.	**1**
2.1	15 portions of grain product x 15= 225 grams 6 portions of fruit x15= 90 grams 6 portions of vegetables x 5g= 30 grams 5 portions of dairy products x 12 = 60 grams Total amount of carbohydrates= 225 +90+ 30+ 60= 405 g	**2**
2.2	Energy provided by these portions of the carbohydrate supplement is = 405 x 17 kj/g= 6885 Kj	**1**
3	The energy provided by 405g of carbohydrates is 6885Kj, which is slightly greater than the amount of energy expended by the athlete during his training which is 6000Kj. Hence, the energy requirements are met.	**2**

Part of the Ex	Correction	Mark
	Exercise 3 (7 points)	
1	Hypothesis: Morphine blocks the exocytosis of substance P (pain substance). or Morphine blocks the receptors of substance P (pain substance). or Morphine destroys substance P (pain substance). or Morphine binds to enkephalin receptors causing the same effect.	**2**
2	Following the stimulation of neuron S only, the pain feeling is intense. On the other hand, after the stimulation of neurons 1 and S, the pain feeling becomes weak and the enkephalin level increases 3 times more from 7 a.u to 20 a.u. This means that the strong secretion of enkephalin by neuron 1 decreased the sensation of pain. So, enkephalin is an analgesic.	**1 ½**
3	Following the stimulation of neuron S only, the secretion of enkephalin is 7a.u and the pain feeling is intense. On the other hand, the blockage of enkephalin release (amount = 0 a.u) followed by an injection of morphine into S_2 then by a stimulation of neuron S lead to the disappearance of pain sensation. So, morphine blocks the sensation of pain even in the absence of enkephalin, and consequently it is an analgesic substance.	**1 ½**
4	The intensity of pain is extreme following the stimulation of neuron S only or following the injection of morphine into the synapse S1 followed by the stimulation of the neuron S (Enkephalin = 7 a.u and substance P = 10 a.u); whereas it shows no pain following the injection of morphine in S2 followed by the stimulation of the neuron S despite the blocking of the release of enkephalin, an analgesic substance, in S2 (Enkephalin = 0 and substance P decreases to zero). So, morphine acts only at the level of S2 enkephalin synapse and acts as enkephalin by decreasing the secretion of substance P and blocking the pain sensation. Therefore, morphine binds to the enkephalin receptors and totally inhibits the exocytosis of substance P which stops the sensation of pain.	**2**