

الاسم :
الرقم :
مسابقة في الثقافة العلمية: مادة "علوم الحياة"
المدة : ساعة واحدة

Answer the following exercises.

Exercise 1 (5 pts.)

Gene therapy necessitates "importing" new genes into body cells. To introduce these genes, we should concentrate the DNA of these genes and pack them into small "sacs" of lipid nature, that can be swallowed by the cells.

The work done on rabbits led researchers to use this technique for introducing the gene coding for the growth factor of blood vessels, inside the cardiac tissues of animals suffering from Ischemia*.

Experiments are to be done in the coming year on persons suffering from cardiac ischemia. It is hoped that the gene coding for the growth factor would lead to the formation of new blood vessels that carry oxygen and vital nutrients to the cardiac muscle regions that are deficient in oxygen and nutrients.

Pour La Science, July 2003

* A disease pertaining to obstruction of blood vessels that causes a decrease of oxygen

1. Pick out from the text:

1-1- The steps of the used technique.

1-2- The expected results of this gene therapy in humans.

2. "This technique is qualified as transgenesis". Justify this statement by referring to the text.

3. Mention three applications of transgenesis in the field of medicine, and one application in the field of agriculture.

Exercise 2 (5 pts.)

In stress situations (fear, violent emotions...) the body presents various manifestations: cardiac rhythm acceleration, face paleness, modification in respiratory rhythm. . .

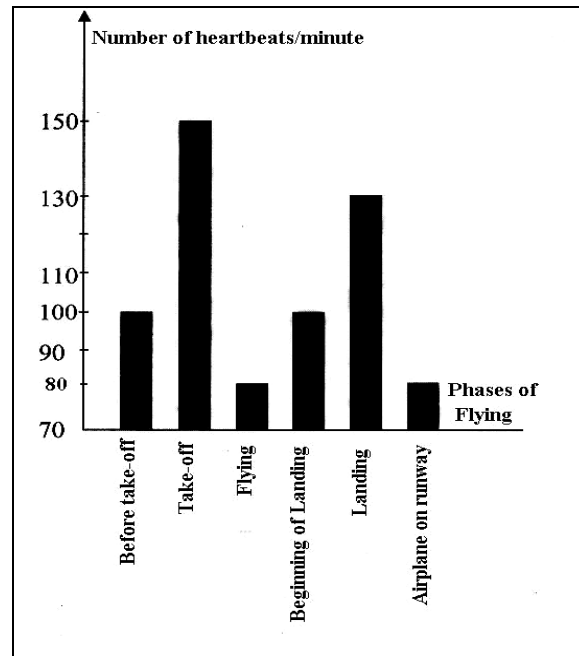
The adjacent histogram reveals the cardiac rhythm of a pilot during the different phases of flying.

1. Name the three phases of the stress reaction.

2. Analyze the obtained results, and draw out the phases of flying that are the most stressful for the pilot.

3. Indicate, using the acquired knowledge, the physiological cause, which is at the origin of the manifestations observed during the stress phases.

4. Is the mode of communication that took place in this state of stress nervous, hormonal, or neuro-hormonal? Justify the answer.



Exercise 3 (5 Pts.)

Amphetamines are substances used to fight fatigue. Their consumption leads to cognitive and psychic troubles, decrease in body weight, liver and kidneys disorders, cardiac and vascular troubles, and degradation of nerve cells.

Like cocaine, amphetamines increase the concentration of dopamine in the synaptic cleft. In fact, amphetamines enter into the presynaptic buds by Dopamine carriers. Once they are in the presynaptic buds, amphetamines induce the expulsion of dopamine molecules stored in the vesicles into the synaptic cleft.

Moreover, Amphetamines decrease dopamine recapture; and when they are in high concentration, they inhibit an enzyme, Mono-amine Oxidase A, which degrades dopamine. As a result, the concentration of dopamine increases in the synaptic cleft .

Amphetamines lead to a strong psychological dependence, mild physical dependence, and very strong tolerance. Amphetamines' withdrawal leads to insomnia and depression.

1. Pick out from the text:

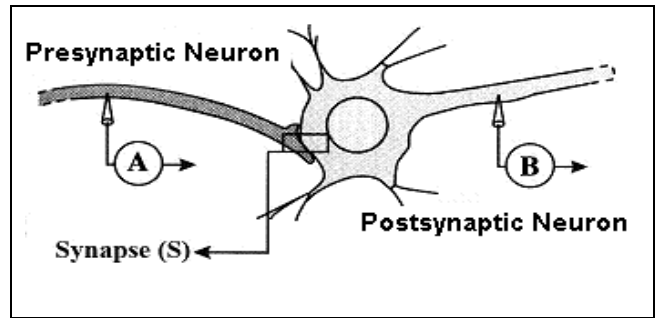
- 1-1- The consequences of amphetamines' consumption.
- 1-2- The effects of withdrawal of amphetamines.
- 1-3- The action of high concentration of amphetamines at the level of a synapse.

2. Referring to the acquired knowledge and to the text:

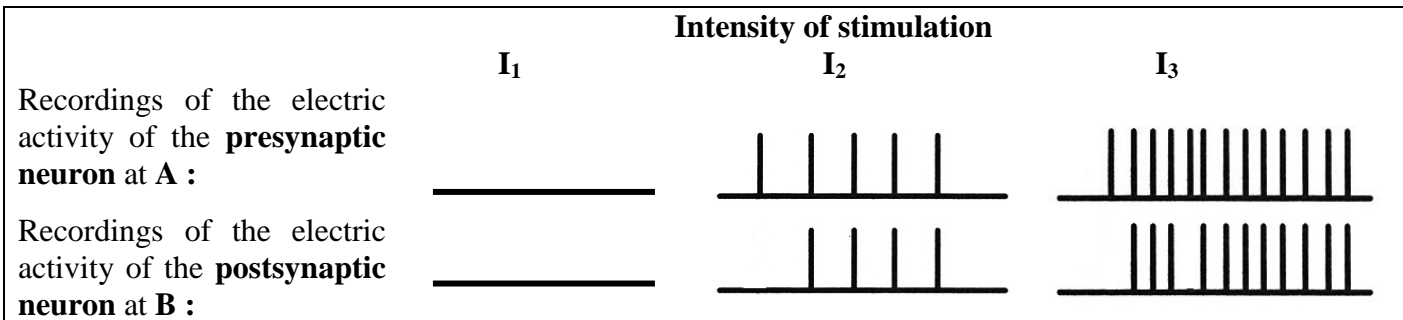
- 2-1- Justify that amphetamines act as a drug.
- 2-2- Explain how amphetamines' consumption prolong pleasure sensation.

Exercise 4 (5 pts.)

We perform a series of electric stimulations of increasing intensity on a presynaptic neuron and we record the electric activity of the presynaptic and post synaptic neurons. Document 1 shows the experimental set-up, and document 2 represents the recordings obtained during a certain time (t).



Document 1



Document 2

N.B. each vertical tracing corresponds to an action potential (AP)

1. Represent, in one table, the variations of the frequency of AP (number of AP/t) of the two neurons at A and B as a function of the intensity of stimulation.
2. Justify, in reference to document 2, that the nerve message is coded by the modulation of frequency of action potentials and not by the amplitude.
3. Is synapse (S) represented in document 1 inhibitory, or excitatory? Justify the answer.

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اسس التصحيح**Exercise 1 (5 pts.)****1-1-** The steps are:

" - concentrate the DNA of these genes and pack them into small "sacs", of lipid nature, that can be swallowed by the cells. (1/2 pt.)

- introducing the gene coding for the growth factor of blood vessels, inside the cardiac tissues of animals suffering from ischemia." (1/2 pt.)

1-2- "It is hoped that the gene coding for the growth factor would lead to the formation of new blood vessels that carry oxygen and vital nutrients to cardiac muscle regions that are deficient in oxygen and nutrients." (1 pt.)

2. We transfer the gene coding for the growth factor of blood vessels to cardiac tissues to another organism, the rabbit, or human, that suffers from ischemia and we expect that it's expressed in this human that is it forms blood vessels . Hence, it is a gene transfer from one species to another qualified as transgenesis . (1 pt.)

3. Field of medicine: Production of insulin (1/2 pt), production of vaccines .(1/2 pt) .production of growth hormone (1/2 pt.)

Field of agriculture: Production of insects resistant plants. (1/2 pt)

Exercise 2 (5 pts.)

1. Alarm phase or (fight-flight reaction), resistance phase, and exhaustion phase. (1 pt.)

2. The number of heartbeats increases from 100 beats/min before take-off to 150 beats/min at take off, then the number decreases rapidly to 80 beats/min. during the flying phase. At the beginning of landing the number increases again to reach 130 beats/min. at landing. Then it decreases again to 80 beats/min. when the airplane is at the run-way. (1 pt.)

Therefore, the most stressful phases of flying that correspond to the highest cardiac rhythms are: Take off and landing (1/2 pt).

3. We can attribute the observed manifestations, during the stress phases, to an increase of plasma hormone: adrenaline, secreted by the adrenal medulla. (1 pt)

4. Neuro-hormonal (1/2 pt), because the nervous system interferes via a nerve impulse then the endocrine system interferes by secreting hormones: Epinephrine (adrenaline) and glucorticoids. (1 pt.)

Exercise 3 (5 pts.)

- 1-1- The consumption of amphetamines leads to cognitive and psychic troubles, decrease in body weight, liver and kidneys disorders, cardiac and vascular troubles, and degradation of nerve cells.(1pt.).
- 1-2- Amphetamines' withdrawal leads to insomnia and depression. (1/2 pt.)
- 1-3- Amphetamines in high concentration inhibit the enzyme, Mono-amine Oxidase A, which degrades dopamine. (1pt.)
- 2-1- Amphetamines lead to a strong psychological dependence, mild physical dependence, and very strong tolerance, which are characteristics of drugs consumption. This shows that amphetamines act as a drug. (1pt.).
- 2-2-. Dopamine is a neurotransmitter responsible for pleasure sensation and amphetamines increase the amount of dopamine in the synaptic cleft by increasing their release, decreasing their recapture, and inhibiting their degradation. Therefore, dopamine remains trapped into the synaptic cleft, which increases and prolongs pleasure sensation. (1 1/2 pt.)

Exercise 4 (5 pts.) .

1.

Intensity of stimulation	I₁	I₂	I₃
Frequency of AP at A (in AP/t)	0	5	13
Frequency of AP at B (in AP/t)	0	4	11

Variation of AP frequency at A and at B as a function of the intensity of stimulation (2 pts.)

2. Coded by the modulation of frequency, because we observe an increase in the frequency from 5 to 13 AP as a function of the increased intensity, $I_2 < I_3$ at A.

OR

Because we observe an increase in the frequency from 4 to 11 AP as a function of the increased intensity, $I_2 < I_3$ at B. (3/4 pt.)

Not by the amplitude, because whatever the intensity of stimulation was, the amplitude is always constant (in the two recordings corresponding to I_2 and I_3 in both neurons). (3/4 pt)

3. Excitatory synapse (1/2 pt), because we observe a nerve message at B upon stimulating the presynaptic neuron by intensities I_2 and I_3 .
This means that synapse S permits the transmission of the nervous message from presynaptic neuron to the postsynaptic neuron. (1 pt)