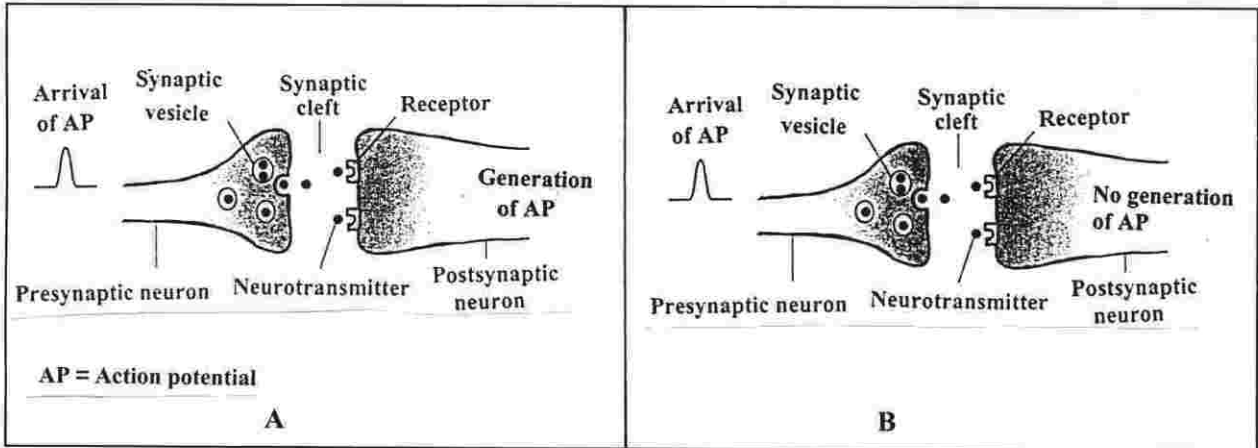


الاسم:
الرقم:مسابقة في الثقافة العلمية
(علوم الحياة)
المدة: ساعة واحدة

Answer the following questions.

Question I (4 pts)

The following document reveals two neuron-neuronic synapses, one is excitatory and the other is inhibitory.



- Specify the nature of each of the two synapses **A** and **B**. Justify the answer.
- Explain how the transmission of the nervous message is done at the level of a synapse upon giving an effective stimulus. Specify the fate of the liberated neurotransmitter after this transmission.

Question II (5 pts)

"The stimulating effect of coffee is due to its action on the membrane receptors of adenosine, a neuromodulator of the central nervous system that has specific receptors. When adenosine fixes on its receptors, the nervous activity slows down and the individual becomes sleepy. However, caffeine is antagonist to adenosine. It fixes on the same receptors, without reducing the neural activity. Thus, there will be less available receptors than the number necessary for the natural slowing of the activity, which leads to the activation of neurons and therefore to awakening.

The activation of several neuronal circuits by caffeine makes the pituitary synthesize hormones that make adrenal glands produce more adrenaline. Adrenaline causes an increase in the level of attention and ensures a peak of energy to the whole organism. This is an effect that all drinkers of coffee search for.

In general, each drunken cup of coffee is a stimulant, and the tolerance to coffee, if it exists, is not very important. However, a physical dependence exists. The symptoms of withdrawal appear one or two days after stopping coffee drinking. These symptoms are: headache, nausea, and sleepiness, in around one out of two individuals".

Neuromodulator: A neuropeptide liberated, at the same time and at the same place as a neurotransmitter .

- Pick-up from the text:
 - The effect searched for by coffee drinkers.
 - The symptoms of withdrawal.
- Justify, based on the text, the role of caffeine as an antagonist to adenosine.
- Explain why caffeine is qualified as a drug.

Question III (5 ½ pts)

We locked a rat in a cage composed of two identical compartments separated by a barrier whose height is 5cm. We present a sound signal to the rat followed by an electric shock applied on its paws. The rat jumps over the barrier towards the other compartment. In order to learn how to execute correctly this escape reaction, the rat must be subjected for 15 days to 10 trials per day, separated by an interval of 1 minute.
By time, the rat learns to escape to the other compartment when we present the sound signal, and hence avoids the electric shock.

Document 1

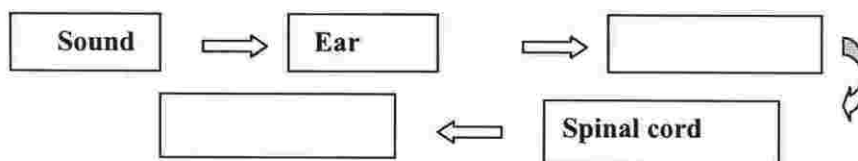
- a- Name the type of reflex that appears at the end of the experiment. Justify the answer.
- b- Indicate the absolute stimulus and the neutral stimulus.

Once this reaction is acquired, and if we make the rat hear the sound signal only and we subject it to 10 trials, we obtain the results shown in document 2.

Number of days after the acquisition of the reflex	Number of successful trials
15	10
20	5
21	2
22	0

- c- Analyze the table and draw out one characteristic of this type of reflex.
- d- Complete the following functional diagram.

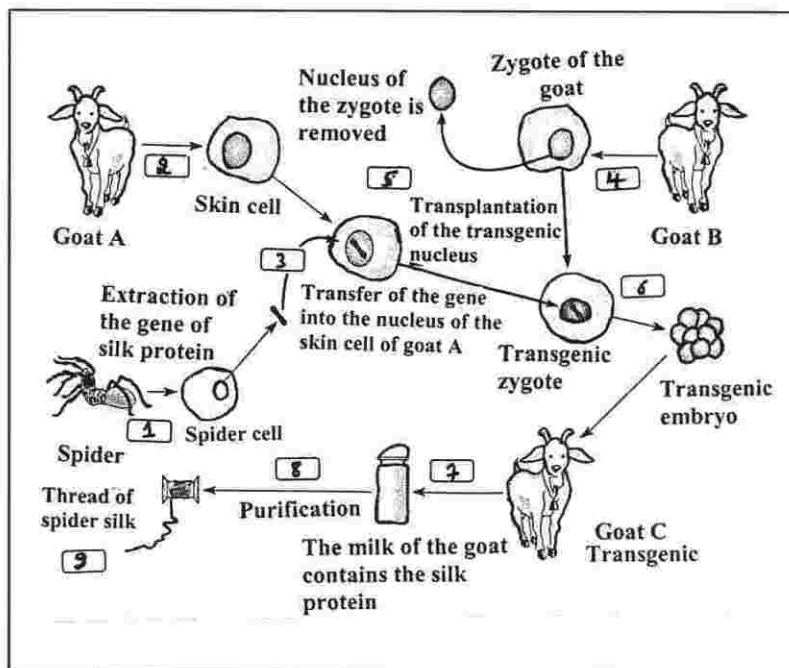
Document 2



Question IV (5 ½ pts)

The silk of spider is a protein more resistant than steel and lighter than a carbon fiber. Being flexible and recyclable, this protein is interesting to Man for various applications: stitching threads for surgery, bone prostheses, anti-bullets vests.... One inconvenience is that the raising of spiders is difficult, and the production of this silk is rare.

Studies on the mammary glands showed that they are similar to the glands of the silk of spiders. From these studies the idea of transferring the gene of the spider silk to a mammal, such as a goat, came out. The adjacent document reveals the method of gene transfer.



- a- Pick-up from the text the characteristics of the spider silk and its use.
- b- Describe, in a short text, the experiment of gene transfer.
- c- Specify the role of the spider silk gene in the cells of the goat.

الاسم:
الرقم:علوم الحياة
أسس التصحيح**Question I (4 pts)**

- a- Synapse **A** is excitatory because the arrival of action potential at the presynaptic neuron generates an action potential in the postsynaptic neuron. Thus, the nervous message has been transmitted. **(1 pt)**
Synapse **B** is inhibitory because the arrival of action potential at the presynaptic neuron does not generate an action potential in the postsynaptic neuron. Thus, the nervous message has not been transmitted. **(1 pt)**
- b- The transmission of the nervous message is done by neurotransmitters stored in the vesicles at the level of the presynaptic axon terminal. Once liberated in the synaptic cleft, these neurotransmitters fix on their specific postsynaptic receptors and change the potential of this membrane. **(1 pt)**
The neurotransmitter is degraded by enzymes and recaptured by the presynaptic neuron. **(1 pt)**

Question II (5 pts)

- a- 1- The effect that all drinkers of coffee search for is the increase in the level of attention and having a peak of energy in their organism. **(1pt)**
2- The symptoms are: headache, nausea, and sleepiness. **(1 pt)**
- b- Caffeine fixes on the same receptors of adenosine, which decreases the number of the available adenosine receptors. Since the role of adenosine is to slow down the nervous activity and to provoke sleepiness, and its effect is reduced, this leads to the activation of the neurons, and therefore, to an awakening provoked by the presence of caffeine. **(2 pts)**
- c- Caffeine is a drug because it leads to physical dependence. Withdrawal might lead to health troubles such as headache, nausea, and sleepiness. **(1 pt)**

Question III (5 ½ pts)

- a- Conditional reflex (**½ pt**), because it requires training. (**½ pt**)
- b- The absolute stimulus is the electric shock (**¾ pt**) and the neutral stimulus is the sound signal. (**¾ pt**)
- c- 15 days after the acquisition of the reflex, when the rat only hears the sound signal, all the trials are successful. On the other hand, after 20 days the number of successful trials decreases to become 5, and this number continues to decrease to become 0 on day 22. **(1 pt)**
If the two stimuli are not associated anymore, the reflex is lost. So this reflex is not permanent (**½ pt**)
- d- Cerebrum or auditory area (**½ pt**). Muscle or effector organ (**½ pt**)

Question IV (5 ½ pts)

- a- Characteristics: The spider silk is resistant, light, flexible, and recyclable. (**¾ pt**)
Use: stitching threads for surgery, bone prostheses, anti-bullets vests..... (**¾ pt**)

- b- We remove a cell from the spider and extract the gene of the silk protein. We transfer this gene into the nucleus of a skin cell taken from goat A. We take a zygote from goat B and we remove its nucleus. Then we transplant the nucleus of the cell taken from goat A into the anucleated zygote of goat B. We obtain a transgenic zygote that gives an embryo, which becomes a transgenic goat C. The milk produced by this goat contains the silk protein that, after purification, gives the spider silk thread. (**3 pts**)

- c- The gene of silk permits the synthesis of the silk protein by the mammary gland cells. (**1 pt**)