

مسابقة في الثقافة العلمية الاسم:
مادة علوم الحياة

المدة: ساعة واحدة الرقم:

Answer the following exercises.

Exercise 1 (5 pts)

“The thyroid is an endocrine gland situated at the base of the neck. It plays an essential role in the organism. A minimum perturbation in its function may lead to repercussions in the organism: intensive fatigue, changes of mood, gain or weight loss and also muscular or cardiac troubles. The thyroid gland produces the hormones: T4 and T3. These thyroid hormones can't be produced without the action of the pituitary gland, situated at the base of the encephalon, and without the action of the hypothalamus which corresponds to a small region of the cerebrum. The thyroid gland needs also primary materials, for example iodine, which is a natural element present in certain foods, particularly in fish, crustacean and algae. A balanced diet provides approximately 100 microgram of iodine per day which is the quantity necessary for the sufficient production of the thyroid hormones.”

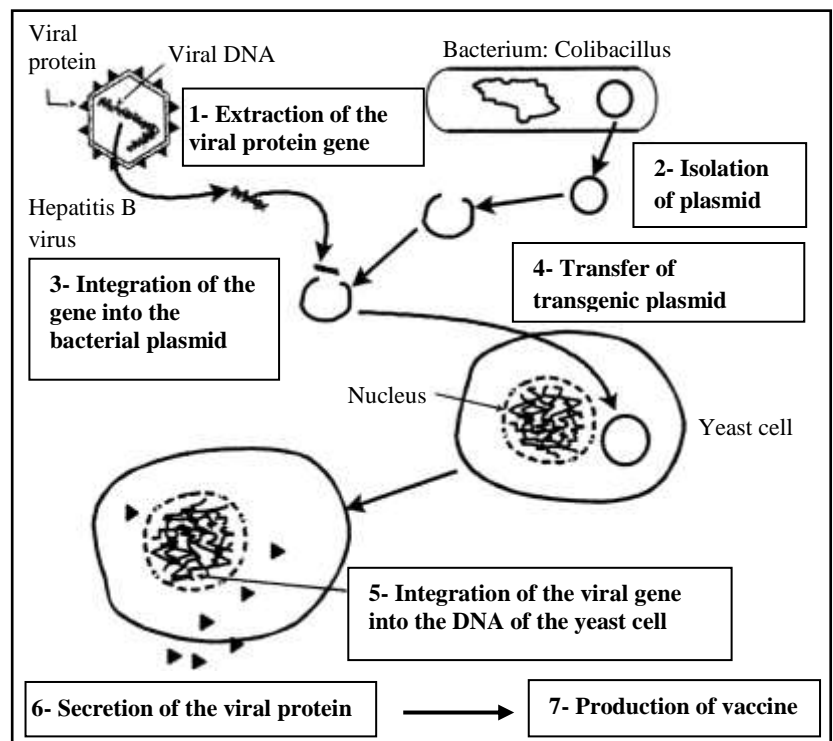
- 1- Pick out from the text:
 - 1.1- The structures which stimulate the production of the thyroid hormones;
 - 1.2- The natural element necessary for the production of T3 and T4, and its recommended quantity in food;
 - 1.3- The signs of the disfunctioning of the thyroid.
- 2- a- Explain why the thyroid hormones liberated into the blood modify the activity of certain body cells.
b- Specify, by referring to the text, two examples of these cells.
- 3- Explain how the synthesis of the thyroid hormones takes place.

Exercise 2 (5 pts)

The vaccine used against Hepatitis B, a dangerous liver disease, is the first vaccine produced by genetic engineering since 1988. Certain surface proteins of Hepatitis B virus have vaccinating properties, where they trigger the production of antibodies when introduced in a person's body, without causing the disease.

We seek to obtain large quantities of these viral proteins without utilizing the virus. Such proteins can be synthesized by the help of non pathogenic cells, the yeast cells.

The steps of this biotechnological method are shown in the adjacent document.



- 1- Write a short text that describes the different steps of this technique.
- 2- Pick out from the document the donor of the transferred gene.
- 3- Name the enzyme used in each of steps 1 and 3.
- 4- Explain why the manipulated yeast cell is qualified as transgenic.
- 5- Specify two advantages of this method for the production of peptide vaccines.

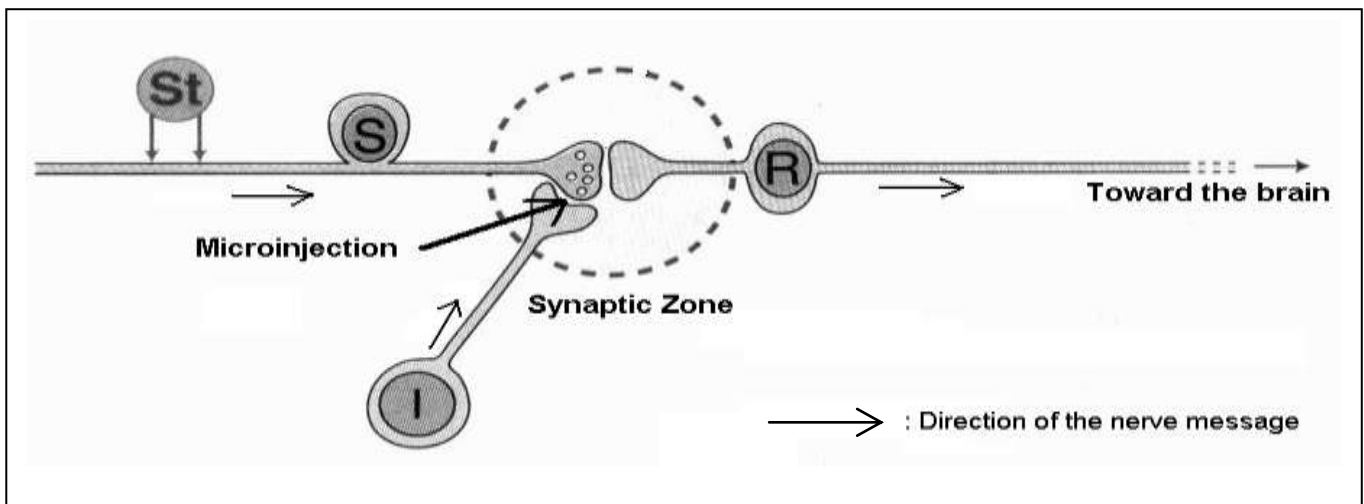
Exercise 3 (5 pts)

“Huntington chorea affects mostly adults between 30 to 50 years old. It is a neurodegenerative disease that provokes a profound alteration of the motor coordination centers leading to a decrease in the physical and intellectual capacities. The psychic troubles, that are almost not exhibited at the beginning of the disease, become very severe with time. The symptoms are varied: clumsiness, nervousness, disequilibrium, behavioral troubles and low intellectual abilities. These symptoms are due to a localized loss of neurons that secrete the neurotransmitter GABA which induces an inhibitory effect at the postsynaptic level. These neurons are situated in the striatum, a region in the encephalon essential for the transfer and control of the information coming from the cerebral cortex. The treatment of such a disease includes the intake of neuroleptic medicines that might be beneficial for patients who manifest strong, uncoordinated body movements. Recently, the grafting of “neurons” seems to be a promising treatment.”

- 1- Pick out from the text:
 - 1.1- The symptoms of the disease;
 - 1.2- The origin of this neurodegenerative disease;
 - 1.3- The role of GABA.
- 2- Based on the information derived from the text, establish the relationship between the motor troubles caused by this disease and its cerebral origin.
- 3- Name two other neurodegenerative diseases.

Exercise 4 (5 pts)

By immunofluorescence technique, scientists have been able to localize two chemical substances at the level of the dorsal horn of the spinal cord: substance P and enkephaline. The document below reveals a synaptic zone which includes the terminal bud of neuron S, having vesicles containing substance P, and the terminal bud of interneuron I which liberates enkephaline.



- 1- Identify, by referring to the document, a presynaptic neuron and a postsynaptic neuron. Justify the answer.

To determine the roles of substance P and enkephaline, we perform the following two experiments:

- Experiment 1:** We apply an effective stimulation on neuron S. We observe a decrease in the number of vesicles in neuron S, a liberation of substance P and pain sensation.
- Experiment 2:** We inject enkephaline in the synaptic zone, then we apply an effective stimulation on neuron S. We observe no decrease in the number of vesicles in neuron S, no liberation of substance P and no pain sensation.

- 2- Analyze these experiments. Draw out the role of substance P and that of enkephaline.
- 3- Enkephaline is qualified as “an endogenous morphine”. Justify this affirmation.

Exercise 1 (5 pts)

- 1.1- Structures : Pituitary gland and hypothalamus (½ pt)
 - 1.2- The natural element is iodine and the recommended quantity is 100 microgram of iodine per day. (1 pt)
 - 1.3- Intensive fatigue, changes of mood, gain or weight loss and also muscular or cardiac troubles. (1 pt)
- 2- a- The thyroid hormones modify the activity of target cells that possess specific receptors capable of recognizing these hormones and binding to them. (1 pt)
- 2- b- Muscle cells, adipose cells, cardiac cells, nerve cells. (1/2 pt)
- 3- The thyroid cells take primary materials, iodine and amino acids, from blood to synthesize a colloid substance. The two thyroid hormones T3 and T4 are then liberated in the blood from the colloid. (1 pt)

Exercise 2 (5 pts)

- 1- We extract the viral protein gene from the DNA of the hepatitis B virus that has viral proteins on its surface. We isolate the plasmid of a bacterium called Colibacillus and we integrate the viral protein gene into the bacterial plasmid.

This transgenic plasmid is then transferred into a yeast cell. The viral gene is integrated into the DNA found in the nucleus of the yeast cell that will secrete the viral protein. Then, the vaccine is produced. (2 pts.)
- 2- Hepatitis B virus (½ pt)
- 3- Step 1: restriction enzyme (1/2 pt)

Step 3 : DNA ligase (1/2 pt)
- 4- The yeast cell is qualified as transgenic because it integrates a new gene from another species, Hepatitis B virus, and it expresses a new character : the production of viral protein of Hepatitis B (1/2 pt)
- 5- Two advantages :
 - The vaccine produced by this method does not have health risks, or it contains the viral protein and not the attenuated virus which might in certain cases react with the body. (1/2 pt)
 - Economic advantage or the production of large quantities of vaccine that is not costly. (1/2 pt)

Exercise 3 (5 pts)

- 1.1- The symptoms are: clumsiness, nervousness, disequilibrium, behavioral troubles, low intellectual abilities. **(1pt)**
- 1.2- The origin of this disease is due to the loss of localized neurons that secrete the neurotransmitter GABA. **(1 pt)**
- 1.3- GABA induces an inhibitory effect at the postsynaptic level **(1 pt)**

2- The neurons of striatum produce the neurotransmitter GABA. The degeneration of these neurons is at the origin of GABA deficit which has an inhibitory effect. Consequently, motor troubles are the clinical manifestations of this disease. **(1 pt)**

3- Parkinson (**1/2pt**) and Alzheimer(**1/2 pt**).

Exercise 4 (5 pts)

- 1- Neuron S is presynaptic(**1/2 pt**) with respect to neuron R which is postsynaptic(**1/2 pt**) because neuron S contains in its terminal bud vesicles that store the neurotransmitter. (**1/2 pt**)
Or
Neuron I is presynaptic with respect to neuron S which is postsynaptic because the nerve message is transmitted always from a presynaptic neuron to a postsynaptic neuron.
- 2- A decrease in the number of synaptic vesicles in neuron S, a liberation of substance P and pain sensation are observed upon the effective stimulation of neuron S. On the contrary, no decrease in the number of vesicles in neuron S , no liberation of substance P and no pain sensation are observed upon the effective stimulation of neuron S preceded by the injection of enkephaline in the synaptic zone(**1 1/2 pt**).
This signifies that substance P assures the transmission of pain message and that enkephaline inhibits the liberation of this substance. Thus, substance P is the messenger of pain (**1/2pt**) and enkephaline is an analgesic substance which blocks the sensation of pain(**1/2 pt**)
- 3- Enkephaline and morphine have the same role: Inhibition of pain (**1/2 pt**)
However, enkephaline is synthesized in the body (endogenic substance) (**1/2 pt**).