

مسابقة في الثقافة العلمية الاسم:  
مادة علوم الحياة

المدة: ساعة واحدة الرقم:

Answer the following exercises.

## Exercise 1 (5 pts)

“Food is at the origin of many risk factors for cardiovascular diseases. Food fibers (food components that are not digested in the humans) might be one of the implicated food factors. For example, mortality due to cardiac arrest is four times less in persons who ingest 37g of fibers and more per day than in persons who ingest 20g of fibers. If we add soluble fibers (purified fibers or Kidney beans) to food, we decrease the blood cholesterol, especially the “bad” cholesterol capable of provoking a blood clot which blocks the arteries. Fibers would act by blocking the digestion of fats and increasing the elimination of cholesterol by the organism.

Thousands of years ago, foods were rich in fibers as it is, nowadays, in many regions of the world. Consequently, almost all industrial countries recommend the ingestion of 25 – 35g of fibers per day, by eating considerable quantities of whole grain bread and cereals, as well as legumes and fruits.”

- 1- Pick out from the text:
  - 1.1- The quantity of fibers recommended per day in industrial countries;
  - 1.2- The sentence which shows the relationship between the mortality due to cardiac arrest and the quantity of ingested fibers;
  - 1.3- The foods rich in fibers.
- 2- Specify the chemical nature of fibers.
- 3- Justify, by referring to the text, that fibers prevent cardiovascular diseases.
- 4- Explain how fibers would favor a slimming diet.

## Exercise 2 (5 pts)

Osteoporosis is a nutritional disease. It is characterized by a feeble mass of bones and the deterioration of the bone tissue, both responsible for bone fragility and the increase in the risk of bone fractures. It affects especially women above 50 years old. The bone tissue is formed of proteins and mineral salts that are very rich in calcium. The risk of osteoporosis depends on two factors: the density of bone minerals and the speed of its decrease with age. The value of the density of bone minerals, which corresponds to the concentration of calcium fixed by bones, depends on genetic factors and the food taken during the growth period.

The adjacent table shows the variation of the density of bone minerals as a function of the age of women.

Age of women (in years)	2	10	20	30	50	60	70	80
Density of bone minerals (in % of maximal value)	15	40	90	90	90	70	60	50

Average age of menopause  
↓

- 1- Pick out from the text:
  - 1.1- The characteristics of osteoporosis;
  - 1.2- The risk factors of osteoporosis.
- 2- Draw the curve showing the variation of the density of bone minerals as a function of the age of women.
- 3- Analyze the results shown in the table. What can you deduce concerning the risk of bone fractures?

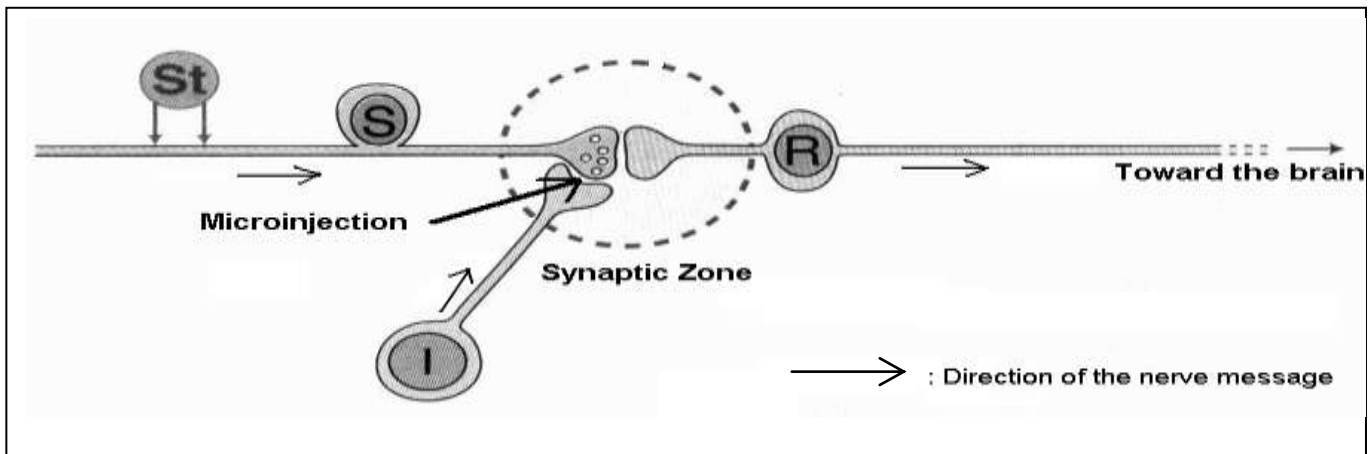
### Exercise 3 (5 pts)

“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, neurons’ grafting 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 of 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- The quantity of fibers recommended is 25 – 35g/day. ( ½ pt)  
 1.2- For example, mortality due to cardiac arrest is four times less in persons who ingest 37g of fibers and more per day than in persons who ingest 20 g of fibers. ( 1 pt)  
 1.3- Whole grain bread and cereals, as well as legumes and fruits. ( 1 pt)

2- Carbohydrates or cellulose or polysaccharides. ( 1/2 pt)

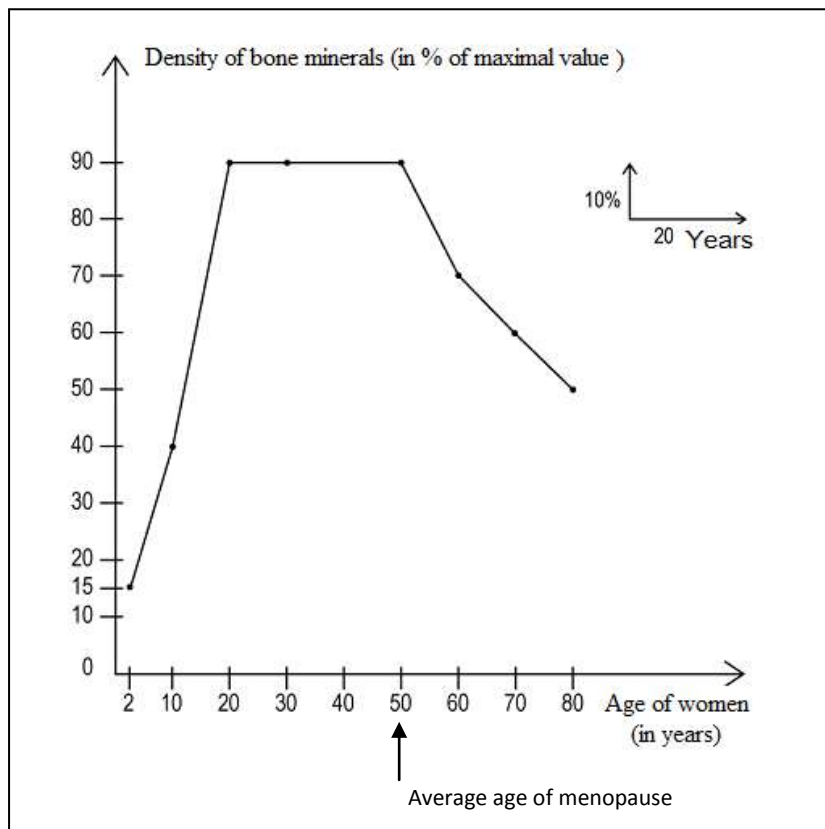
3- It prevents cardiovascular diseases because the ingested soluble fibers decrease blood cholesterol, particularly bad cholesterol, capable of provoking a blood clot which blocks the arteries leading to cardiovascular diseases. (1 pt)

4- It favors a slimming diet because it blocks the digestion of food fats, the principle cause of obesity( ¼ pt); Moreover, fibers are not digested, and have no energy value. (1/4 pt); Fibers enhance the transmission of food along the intestine( ¼ pt) and produce a sensation of satiety( ¼ pt).

**Exercise 2 (5 pts)**

- 1.1- It is characterized by a feeble bone mass and the deterioration of the bone tissues, both responsible for the fragility of bones and the increase in the risk of bone fractures. ( 3/4 pt)  
 1.2- The risks of osteoporosis depend on two factors: the density of bone minerals and the speed of its decrease with age. (3/4 pt)

2- (2 pts)



**Variation of the density of bone minerals as a function of the age of women.**

3- The density of bone minerals (DBM) increases from 15% to 90%, the maximum possible value, between 2 and 20 years after which, it remains constant at 90% between 20 and 50 years. However, this density decreases rapidly after 50 years, the average age of menopause to reach 50% at the age of 80 years. This shows that the fixation of calcium is uniquely effective during the age of growth and reaches its optimum value at 20 years, and that bones get de-mineralized with age specifically after menopause. **(1 pt)**

Therefore, the risk of bone fractures or osteoporosis increases after menopause. **(1/2 pt)**

### Exercise 3 (5 pts)

- 1.1- The symptoms are: clumsiness, nervousness, disequilibrium, behavioral troubles and 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, 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**)