

Exercise 1 (7points)

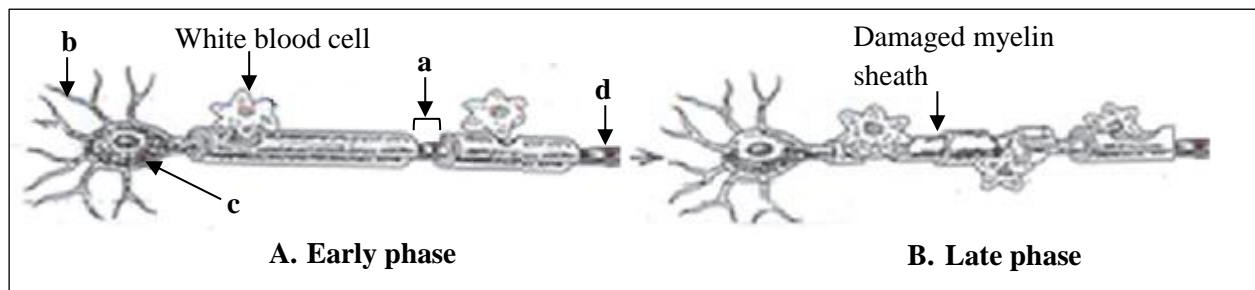
Multiple Sclerosis, a Neurological Disease

Multiple sclerosis is a neurological disease that begins with visual troubles, partial paralysis, clumsiness, or walking problems. This disease is due to a progressive destruction of the myelin sheath by white blood cells.

Document 1

- 1- Pick out from document 1:
1-1- the symptoms of multiple sclerosis.
1-2- the cause of this disease.

Document 2 shows the aspect of a myelinated neuron of an affected individual at the early phase A (beginning of the disease) and at the late phase B.



Document 2

- 2- Label the structures a, b, c and d of document 2.

Document 3 represents the speed of conduction of the nervous message recorded at the level of a myelinated nerve fiber during the two phases mentioned in document 2, as well as in a healthy individual.

	Healthy individual (Control)	Affected individual (Early phase)	Affected individual (Late phase)
Speed of conduction of nerve message (in m/s)	100	70	10

Document 3

- 3- Construct a histogram that shows the results presented in document 3.
4-1- Analyze the obtained results.
4-2- What can you conclude?
5- Name two other neurological diseases.

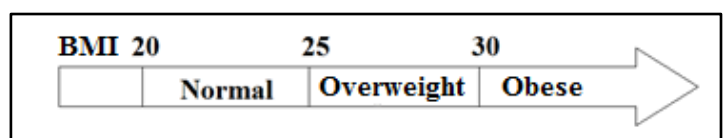
Exercise 2 (6 points)

Obesity

Obesity, a state characterized by an abnormal or excessive accumulation of body fat, can lead to dangerous consequences on health. Three individuals A, B and C consult a dietitian. These persons are of the same age (30 years) and have the same height (1.7m), but they differ in their body masses: A = 70 kg, B = 90 kg and C = 105 kg.

The body mass index (BMI) is used to measure the degree of obesity (document 1). This index is obtained by applying the formula:

$$BMI = \frac{mass (kg)}{(Height m)^2}$$



Document 1

- 1- Calculate the BMI of each individual.
- 2- Identify, by referring to document 1, the category to which each individual belongs.

Document 2 reveals the life style and the food ration of each of the individuals A, B, and C.

		Individual A	Individual B	Individual C
Life style		Moderate activity	Sedentary (no activity)	Moderate activity
Food ration (g)	Carbohydrates	117		117
	Proteins	27		27
	Lipids	31.5		64

Document 2

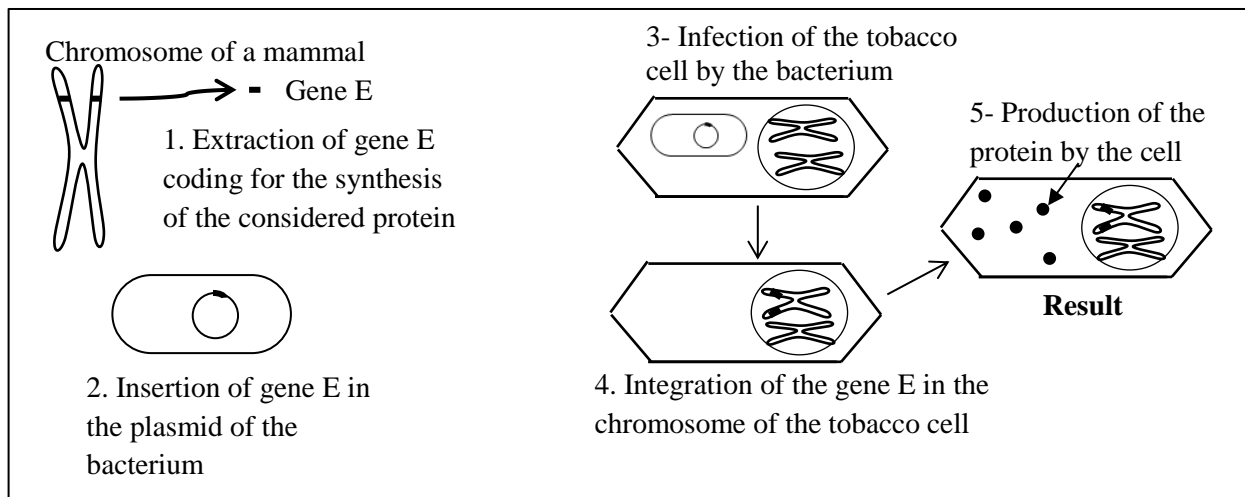
- 3- Compare the life styles and the food rations of these three individuals.
- 4- Draw out the cause (s) of the excess of the body mass in the concerned individuals.
- 5- Name two diseases that obese people might suffer from.

Exercise 3 (7 points)

An Application of Biotechnology

Referring to certain genetic manipulations, researchers could transform plants into factories producing useful substances for humans.

For instance, genetically modified cells of tobacco plants become able to produce a protein whose absence in humans provokes a severe disease: cystic fibrosis. The document below shows some steps of the used technique.



- 1- Describe in a short text the different steps of the technique presented in the document.
- 2- Name the enzyme used in step 1 and that used in step 2.
- 3- Draw out the role of the bacterium.
- 4- Name the technique schematized in the document. Justify the answer.
- 5- State two other applications of this technique, one in the agricultural field and another one in the medical field.

Part of the ex	Exercise 1 (7points) Multiple Sclerosis, a Neurological Disease	Mark								
1.1	The symptoms of multiple sclerosis are visual troubles, partial paralysis, clumsiness, or walking problems.	0.75								
1.2	The cause of this disease is the progressive destruction of the myelin sheath by white blood cells.	0.75								
2	a : Ranvier's node b : dendrite c : cell body d : axon	1								
3	<p>A histogram representing the speed of conduction of the nervous message in two individuals, a healthy one and another one affected by multiple sclerosis during two phases.</p> <p style="text-align: right;">Scale : 1 cm = 20 m/s</p> <table border="1"> <caption>Data from the histogram</caption> <thead> <tr> <th>Individual</th> <th>Speed of conduction (m/s)</th> </tr> </thead> <tbody> <tr> <td>Healthy individual</td> <td>100</td> </tr> <tr> <td>Affected individual (early phase)</td> <td>70</td> </tr> <tr> <td>Affected individual (late phase)</td> <td>10</td> </tr> </tbody> </table>	Individual	Speed of conduction (m/s)	Healthy individual	100	Affected individual (early phase)	70	Affected individual (late phase)	10	1.5
Individual	Speed of conduction (m/s)									
Healthy individual	100									
Affected individual (early phase)	70									
Affected individual (late phase)	10									
4.1	The speed of conduction of the nervous message recorded at the level of a myelinated nerve fiber in the healthy individual is 100 m/s more than that in the early phase of the affected individual which is 70 m/s. However, this speed decreases to 10 m/s in the late phase of the same affected individual.	1								
4.2	I conclude that, multiple sclerosis reduces (decelerates) the speed of conduction of the nervous message.	0.5								
5	Parkinson and Alzheimer	1.5								

Part of the ex	Exercise 2 (6 pts) Obesity	Mark
1	BMI of A = $70 / (1.7)^2 = 24.2 \text{ kg/m}^2$ BMI of B = $90 / (1.7)^2 = 31.1 \text{ kg/m}^2$ BMI of C = $105 / (1.7)^2 = 36.3 \text{ kg/m}^2$	1.5
2	The BMI of A is 24.2 kg/m^2 which is in the normal range (20 and 25), thus individual A belongs to the category « normal ». The BMI of B is 31.1, a value higher than 30 which corresponds to the category of obesity, thus individual B is considered obese. The BMI of C is 36.3, which is also more than 30 corresponding to obesity, thus individual C belongs also to the category «obesity».	1.5
3	The two individuals A and C have the same moderate activity, but B has a sedentary life style. The quantities of carbohydrates (117 g) and proteins (27 g) are the same in the food ration of the three individuals A, B and C. However, the quantity of lipids in the food ration of individual C (64 g) is greater than that in the food ration of B and C which is 31.3g.	1
4	The cause of the excess of the body mass in individual B is the sedentary life style. The cause of the excess of the body mass in individual C is the food rich in lipids.	1
5	Hypertension, atherosclerosis, cardiovascular diseases, diabetes...	1

Part of the ex	Exercise 3 (7 points) An Application of Biotechnology	Mark
1	The gene E coding for the synthesis of the considered protein is extracted from the chromosome of a mammal. Then, this gene is inserted in the plasmid of the bacterium which infects the tobacco cell, integrates gene E in its chromosome. As a result, the cell is able to produce this protein.	1.5
2	Step 1: Restriction Enzyme. Step 2: DNA ligase	1.5
3	Transfer of gene E from mammal to tobacco cells or vector	1
4	Transgenesis, because there is a transfer of gene E from one species (cells of mammal) to another species (tobacco cells) in order to be expressed into the corresponding protein	1.5
5	Applications in the agricultural field: production of insect resistant plants, production of herb resistant plants, production of plants of accelerated growth. Applications in the medical field: production of insulin , production of therapeutic protein, vaccines, production of growth hormone.	1.5