

الاسم : مسابقة في علوم الحياة والارض
الرقم : المدة : ساعة واحدة

Answer the following questions.

Question I (3 points)

Correct each of the following expressions :

- a- During mitosis, the two chromatids of each chromosome separate in metaphase.
- b- A chromosomal abnormality affects only the sex chromosomes.
- c- If a sperm carrying chromosome **X** fertilizes an ovum, the newborn will be a male.

Question II (6 points)

In human species the mode of transmission of hair color is autosomal. The allele responsible for "**dark hair**" character is dominant with respect to the recessive allele responsible for "**red hair**" character.

- a- Designate by symbols the corresponding alleles.

The marriage of a man **A** with dark hair to a woman **B** with dark hair gives birth to two children:
-boy **C** with red hair ;
-girl **D** with dark hair.

- b- 1- Write the genotype of boy **C**. Justify the answer.

2- Without doing a factorial analysis, explain how father **A** and mother **B** with dark hair give birth to son **C** with red hair.

- c- Son **C** marries a heterozygote woman **E** with dark hair.

Do a factorial analysis to determine the phenotypic proportions of the descendants of this couple.

Question III (4 points)

The mastication of food leads to its reduction into small pieces. A student wonders if this mastication facilitates the chemical digestion of food in the presence of digestive juices such as pancreatic juice.

To solve this problem, he performs an experiment in vitro showing the digestion of 50 grams of fish. The conditions of this experiment and the results obtained are shown in the document below.

		Conditions					
		50 g of fish	water in mL	pancreatic juice in mL	Temperature in °C		
Tube 1	in small pieces • • •	5	1	37	after 2 hours →	Tube 1	The small pieces of fish disappear.
Tube 2	in one large piece ■	5	1	37		Tube 2	The large piece of fish becomes smaller.

- a- What is the posed problem by the student?

- b- Indicate the variable factor in this experiment.

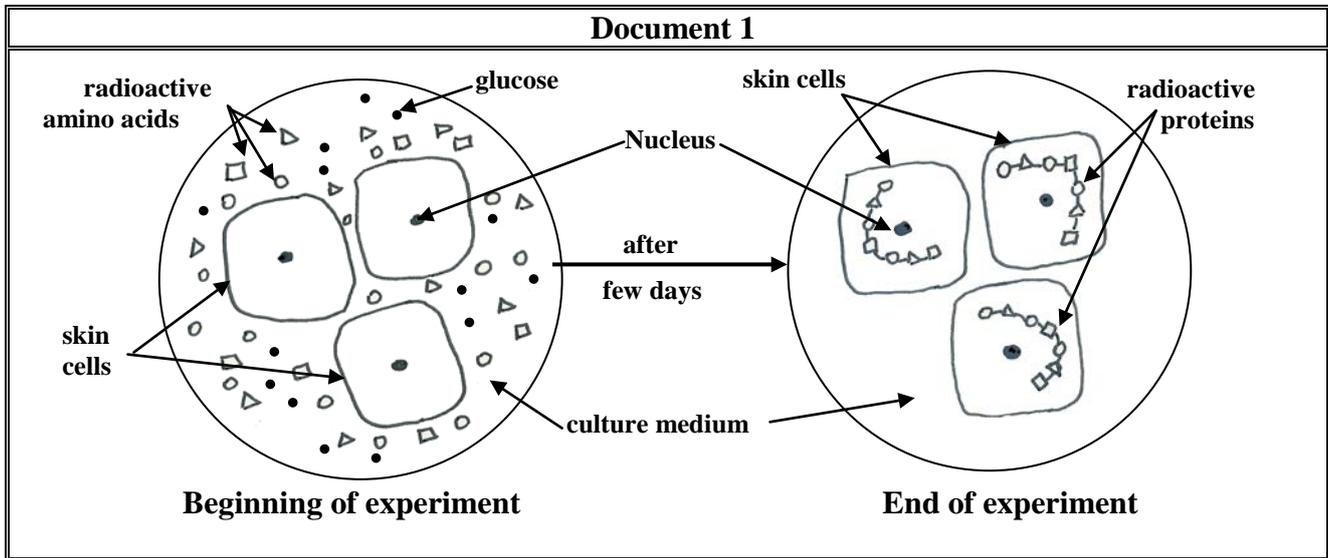
- c- Is the posed problem solved? Justify the answer by using the information provided by the above document.

Question IV (7 points)

During the assimilation mechanism, the cell synthesizes new matter such as proteins.

To identify certain elements necessary for assimilation, we perform an experiment on skin cells of a rat.

- We place these cells in a culture medium containing radioactive amino acids. We add to this medium glucose which is a nutrient utilized by the cells to produce energy. Few days later, radioactive proteins are formed in these cells, **document 1**.



a- Compare the culture medium and the cells at the beginning and at the end of the experiment. Derive the origin of the formed radioactive proteins.

- In addition, we measure the amount of energy consumed by these skin cells and the quantity of the formed radioactive proteins. The results of the measurements are given in **document 2**.

Document 2

Amount of energy consumed by the cells (arbitrary unit)	0	1	2	3	4
Quantity of the formed radioactive proteins ($\mu\text{g/mL}$)	0	4	8	12	16

b- Draw a graph (line curve) showing the variation of the quantity of the formed radioactive proteins as a function of the amount of energy consumed by the cells.

c- Analyze the results shown in **document 2**.

d- Based on the information provided by documents **1** and **2**, indicate the elements necessary for this assimilation.

Question I (3 points)

- a- During mitosis, the two chromatids of each chromosome separate in anaphase. (1 pt)
- b- A chromosomal abnormality affects the sex chromosomes.
or A chromosomal abnormality affects the sex chromosomes and autosomes.
or A chromosomal abnormality affects the chromosomes.
or A chromosomal abnormality affects all chromosomes. (1 pt)
- c- If a sperm carrying chromosome **X** fertilizes an ovum, the newborn will be a female.
or
If a sperm carrying chromosome **Y** fertilizes an ovum, the newborn will be a male. (1 pt)

Question II (6 points)

- a- Symbols of alleles :
D : dark hair, dominant.
r : red hair, recessive. (½ pt)
- b- 1) The genotype of boy **C** is **rr** (½ pt), because allele **r** is recessive, it's not expressed in the phenotype except in its homozygous state. (1 pt)
2) The genotype of son **C** is **rr** which indicates that father **A** and mother **B** with dark hair are heterozygote, each is of genotype **Dr** and each one of them gives allele **r** to son **C**. (1 pt)
- c- P : (C) ♂ rr × (E) ♀ Dr (½ pt)



(1 pt)

Table of cross :

	♂	♀	
			D ½
			r ½
♂	r 1		Dr ½
			rr ½

(1 pt)

The phenotypic proportions :

$$\frac{1}{2} [D]$$

$$\frac{1}{2} [r]$$

(½ pt)

Question III (4 points)

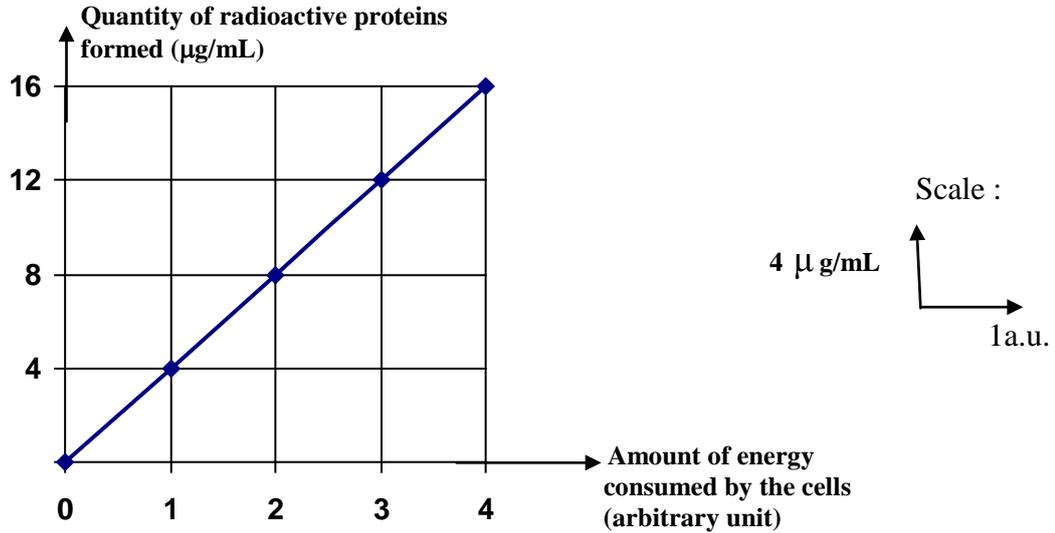
- a- Does mastication facilitate chemical digestion of food in the presence of digestive juices?(1 pt)
- b- Variable factor : Size of the fish pieces { - small pieces in tube 1.
- one large piece in tube 2. (1 pt)
- c- Yes (½ pt), because small pieces of fish disappeared in tube 1, while the large piece of fish in tube 2, placed under the same conditions for the small pieces, becomes smaller without disappearing. (1½ pts)

Question IV (7 points)

a- At the beginning of the experiment, the culture medium contains radioactive amino acids and glucose, while the cells do not; However, at the end of the experiment, the radioactive amino acids and glucose disappear from the culture medium while the cells contain radioactive proteins. **(1 pt)**

The origin of this protein is the radioactive amino acids. **(½ pt)**

b-



The variation of the quantity of formed radioactive proteins as a function of the amount of energy consumed by the cells. **(3 pts)**

c- The quantity of consumed radioactive proteins is 0 µg/mL for an amount of energy equals to 0 a.u. This quantity increases progressively with the increase in the amount of energy and reaches 16 µg/mL for an amount of energy equals to 4 a.u.

(1½ pts)

d- The necessary elements for formation of proteins are amino acids and energy. **(1 pt)**