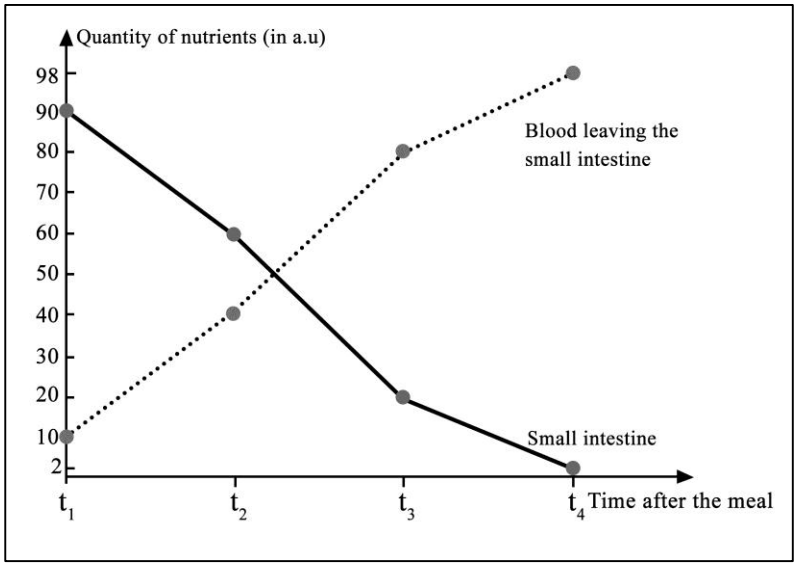
مسابقة في مادة علوم الحياة والأرض
المدة: ساعة واحدة

الاسم:
الرقم:

Answer the following four exercises.

Exercise 1 (6 points) Intestinal functions

In the framework of studying one of the functions of the small intestine, the quantity of nutrients is measured in this organ as well as in the blood leaving the small intestine after a meal. The results of the performed measurements are represented in the adjacent document.



1. Draw a table showing the variation in the quantity of nutrients in the small intestine and in the blood as a function of time.

2-1. Analyze the results shown in the adjacent document.
2-2. What do you conclude concerning the intestinal function revealed in the document?

3. Indicate another function ensured by the small intestine.

4. List the characteristics of the surface of exchange of the small intestine.

Exercise 2 (3 points) Urine analysis

The analysis of urine permits to detect certain diseases. The presence of proteins in urine indicates a damage of the functional unit of the kidney, the nephron. However, the presence of glucose in urine indicates another disease called diabetes, characterized by a high level of glucose in the blood.

Individual	Level of proteins in urine (g/L)	Level of glucose in urine (g/L)
X (normal)	0	0
Y	1.5	0
Z	0	2

The adjacent document represents the results of urine analysis of a normal individual X and two other individuals Y and Z showing health troubles.

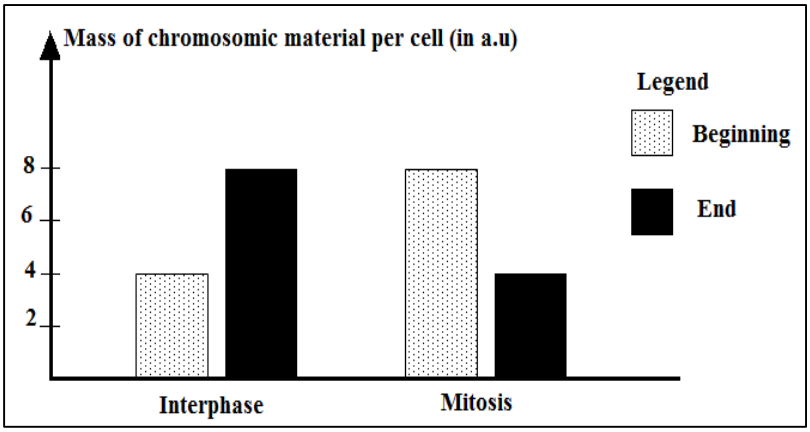
1. Pick out from the text :
- **1-1.** the functional unit of the kidney
- **1-2.** one characteristic of diabetes.

2. Identify the individual Y or Z who has:
- **2-1**. diabetes
- **2-2**. damage in the nephrons.

Exercise 3 (5.5 points) The Cell cycle

The cell cycle is the series of events that take place in a cell. It includes an interphase and mitosis. At the end of the cell cycle two daughter cells are produced.

The adjacent document represents the variation of chromosomic material in a body cell during one cell cycle.



1. Pick out the two phases of the cell cycle.

2. Show, by referring to the adjacent document, that the chromosomal material duplicates during interphase.

3-1. Compare the chromosomal material at the beginning of interphase to that at the end of mitosis.
3-2. What do you conclude?

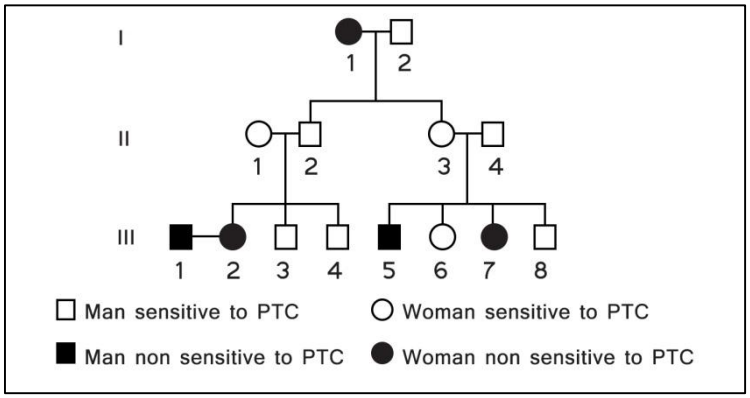
4. Draw a labeled scheme of a chromosome:
- **4-1.** at the beginning of mitosis
- **4-2.** at the end of mitosis.

Exercise 4 (5.5 points) Sensitivity to PTC

In 1931, during a laboratory work, Arthur Fox discovered that PTC powder (a chemical substance) tastes bitter for certain persons while it doesn't for others.

1. Pose the problem revealed in the above text.

The sensitivity to PTC is a hereditary trait coded by a gene located on chromosome n^0 7. The adjacent pedigree shows the transmission of this trait in a family.



2. Show that the allele coding for the sensitivity to PTC is dominant over the allele coding for the non-sensitivity to PTC.

3. Designate by symbols the corresponding alleles.

4. Indicate the genotypes of I_1, II_2 and III_3 .

5. Make the necessary factorial analysis which verifies the phenotypic results of the descendants of the couple II_3 and II_4.

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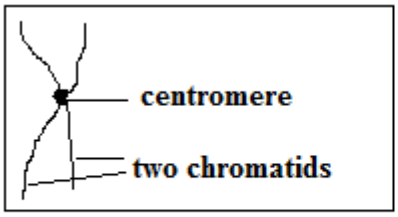
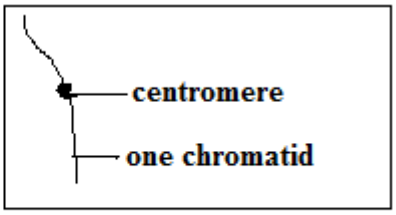
معيار أسس التصحيح

<table>
<tr><th>Part of the ex</th><th>Answer key (6 points)
Intestinal functions</th><th>Mark</th></tr>
<tr><td>1</td><td>
<table>
<tr><td colspan="2">Time after a meal</td><td>t_1</td><td>t_2</td><td>t_3</td><td>t_4</td></tr>
<tr><td rowspan="2">Quantity of nutrients in (a.u.)</td><td>In the small intestine</td><td>90</td><td>60</td><td>20</td><td>2</td></tr>
<tr><td>In the blood leaving the small intestine</td><td>10</td><td>40</td><td>80</td><td>98</td></tr>
</table>
Table showing the variation in the quantity of nutrients, as a function of time after the meal.</td><td>2</td></tr>
<tr><td>2-1</td><td>At t_1 the quantity of nutrients is 90 a.u. at the level of the small intestine which is greater than that at the level of the blood leaving the small intestine, 10 a.u. This quantity decreases from 90 a.u to 2a.u. between t_1 and t_4 at the level of the small intestine. On the contrary, it increases from 10 a.u. to 98a.u. at the level of the blood leaving the small intestine during the same duration .</td><td>1.5</td></tr>
<tr><td>2-2</td><td>The revealed intestinal function is intestinal absorption.</td><td>0.5</td></tr>
<tr><td>3</td><td>The other function of the small intestine is: (one function is considered)
- Chemical digestion by digestive enzymes.
or
- Mechanical digestion
or
- passage of food due to peristaltic movements.</td><td>0.5</td></tr>
<tr><td>4</td><td>The characteristic of the surface of exchange at the level of the small intestine are:
- Thin wall
- Large surface area of exchange
- Highly vascularized.</td><td>1.5</td></tr>
</table>

Part of the ex	Answer Key (3 points) Urine analysis	Mark
1-1	The functional unit of the kidney is the nephron.	**0,5**
1-2	The characteristic of diabetes is high level of glucose in the blood.	**0.5**
2-1	The presence of glucose in urine indicates that the individual is diabetic. Since the level of glucose in the urine of individual Z is 2 g/L greater than that of the normal individual X which is nil (0g/L),thus , individual Z is diabetic.	**1**
2-2	The presence of proteins in the urine indicates a damage in the nephrons. Since the level of proteins in the urine of individual Y is 1.5g/L greater than that of the normal individual X which is nil (0.g/L), thus individual Y has a damage in the nephrons.	**1**

Part of the ex	Answer key (5.5 points) The Cell cycle	Mark
1	The two phases of the cell cycle are: the interphase and the mitosis	1
2	At the beginning of interphase the mass of chromosomal material is 4 a.u. It increases to reach 8a.u (doubles) at the end of interphase. Thus the chromosomic material duplicates during interphase.	1
3-1	The mass of chromosomic material is the same 4 a.u at the beginning of interphase and at the end of mitosis.	1
3-2	Therefore, the mass of chromosomic material is conserved	0.5
4	 4-1 A chromosome of two chromatids at the beginning of mitosis  4-2 A chromosome of one chromatid at the end of mitosis	2

Part of the ex	Answer Key (5.5 points) Sensitivity to PTC	Mark
1	Why do certain persons taste PTC bitter while others do not? OR How could some persons be not tasting the PTC?	1
2	Individuals II_3 and II_4, are both "sensitive to PTC"; and gave birth to children III_5, and III_7 who are both "non sensitive to PTC". Thus, the allele coding for the " non sensitive to PTC" is present in the parents and masked by the allele coding for the "sensitive to PTC" . Therefore, the allele coding for the "sensitive to PTC" is dominant over its recessive allele "non sensitive to PTC",	1
3	Let "S" be the symbol of the dominant allele coding for the sensitive to PTC . Let "n" be the symbol of the recessive allele coding for the non-sensitive to PTC.	0.5
4	The genotype of $I_1$is n//n; The genotype of II_1 is S//n. The genotype of III_3 is S//S or S//n.	1
5	Phenotypes of the parents: ♀[S] X ♂ [S] Genotypes of the parents: ♀ S//n X ♂S//n Gametes γ : 50% S , 50% n 50% S, 50%n Table of cross ♂ / ♀ | 50 % S | 50% n S 50% | S//S25% | S//n 25% n 50% | S//n25% | n//n 25% Phenotypic percentages [S] 75% [n] 25 % The theoretical results verify the phenotypes of the descendants of this couple.	2