

الصفحة	الامتحان الوطني الموحد للبكالوريا المسالك الدولية الدورة العادية 2021 - الموضوع -		الجمهورية المغربية وزارة التربية الوطنية والتعليم العالي والبحث العلمي المركز الوطني للتقويم والامتحانات
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2h	مدة الإنجاز	علوم الحياة والأرض	المادة
3	المعامل	شعبة العلوم الرياضية (أ) (خيار إنجليزية)	الشعبة أو المسلك

Candidates may use non-programmable calculators

Section I: Knowledge Retrieval (5 pts)

I. Define: -The reductional division; - Test-cross. (1pt)

II. For each of the propositions numbered from 1 to 4, there is only one correct suggestion in each set. Copy down these pairs (1 ; ..), (2 ; ..), (3 ; ..), (4 ; ..), and match each number with its corresponding letter. (2pts)

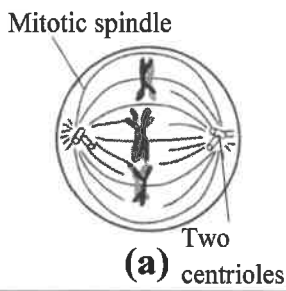
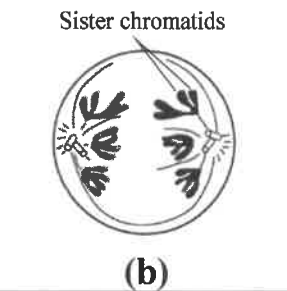
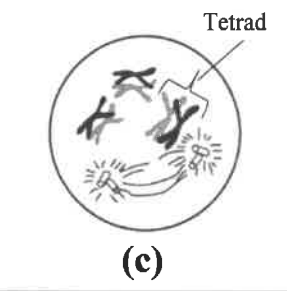
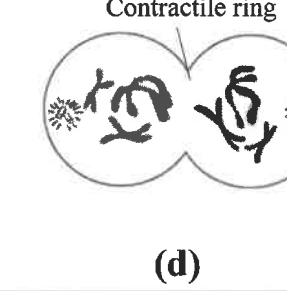
1. The chromosome of prophase I is formed : a. of two condensed chromatids ; b. of one condensed chromatid ; c. of two decondensed chromatids; d. of a single decondensed chromatid.	2. The crossing over is a phenomenon that takes place during : a. the metaphase I; b. the metaphase II; c. the prophase I; d. the prophase II.
3. From a mother cell with 2n chromosomes and following equational division, the daughter cells: a. retain 2n chromosomes following the separation of the chromatids of each chromosome ; b. receive n chromosomes following the separation of the chromatids of each chromosome; c. retain 2n chromosomes following the separation of homologous chromosomes; d. receive 2n chromosomes following the separation of homologous chromosomes.	4. The diplontic life cycle is characterized by: a. a phase with n chromosomes which is limited to the gametes ; b. a phase with 2n chromosomes which is limited to the zygote; c. a meiosis which leads to the formation of spores; d. a zygote cell which undergoes meiosis directly to give gametes.

III. Copy down the letter corresponding to each proposition and Write whether the statement is “true” or “false”. (1pts)

a	Meiosis gives haploid cells whose number of chromosomes varies from one daughter cell to another.
b	Meiosis makes it possible to preserve the chromosomal formula of the mother cell.
c	Fertilization allows the genetic diversity of egg cells.
d	Somatic cells in diploid individuals are characterized by a stable number of 2n chromosomes.

IV. Copy on your production sheet the pairs (1,); (2,); (3,); (4,) and address to each phase of meiosis in group 1 the letter of the corresponding diagram in group 2. (1pt)

Group 1			
1. Anaphase I	2. Telophase I	3. Metaphase I	4. Prophase I

Group 2			
 <p>Mitotic spindle Two centrosomes (a)</p>	 <p>Sister chromatids (b)</p>	 <p>Tetrad (c)</p>	 <p>Contractile ring (d)</p>

Section II: Scientific reasoning and communication in graphic and written modes (15 pts)

Exercise 1 : (3 pts)

To highlight the role of meiosis and fertilization in maintaining karyotype stability, we suggest the following data:

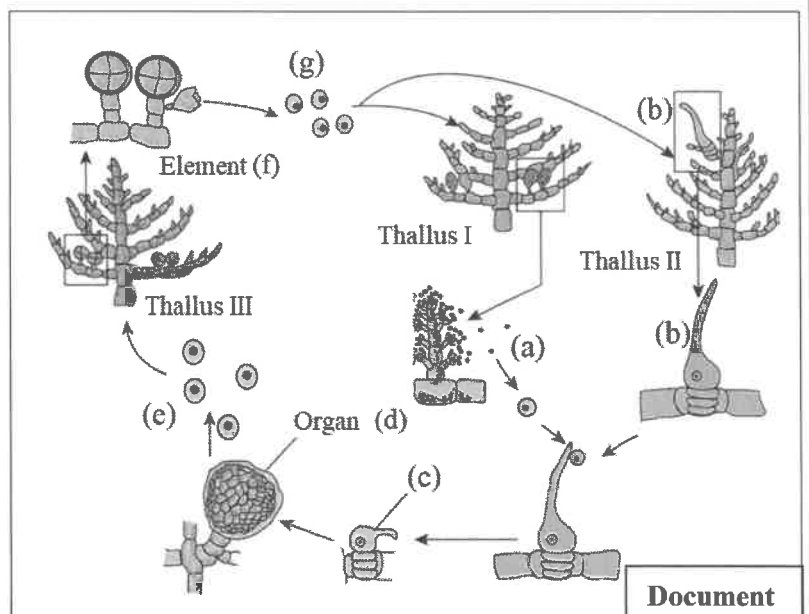
The vegetative apparatus in a red alga (*Antithamnion plumata*) is known as three types of thalli:

- the thallus I carries organs that produce several small haploid cells (a).
- the thallus II produces haploid cells (b) of elongated forms.

After its release in water, the cell (a) germinates on the cell (b) then the two cells unite to give the cell (c). After several mitoses this, cell (c) gives the organ (d). This last organ remains fixed on the thallus II and produces cells (e) which are released in the sea water and develop by mitoses to give a new individual represented by the thallus III.

- The thallus III produces the elements (f).
- Each of these elements release, 4 cells (g).
- Each of these cells develops to give the thallus I or the thallus II.

The document opposite shows the stages of development of this red algae (*Antithamnion plumata*).



1. Determine the thallus where meiosis takes place and the thallus where fertilization takes place. (0.5pt)

2. Give the type of each thallus I, II and III. Justify your answer using structures (a), (b), (c) and (g). (1.5pt)

3. Represent schematically the chromosomal cycle of this alga and deduce its type. (1pt)

Exercise 2 : (4.25 pts)

To study the transmission of genetic information in tomato, studies have revealed the presence of two pairs of alleles:

- A pair of alleles responsible for the presence or absence of the pedicel;
- A pair of alleles responsible for the presence or absence of hair on the stem of the plant.

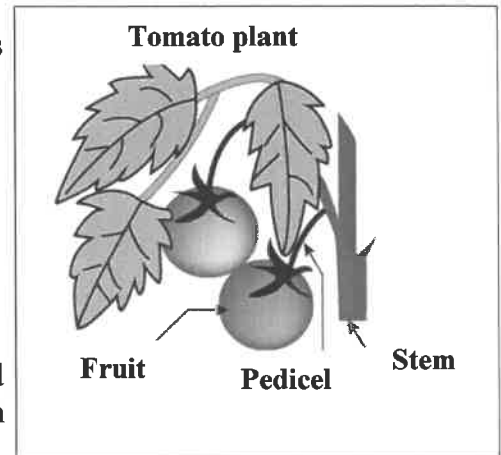
In order to study the mode of transmission of these two hereditary traits, the following crosses were performed:

- **First cross:** between plants pure-breed with pedicel fruit and hairless stem and plants pure-breed with non-pedicel fruit and with hairy stem.

After germination of the seeds from this cross, we obtain a 1st generation F₁, formed only of plants with pedicel fruit and hairy stem.

- **Second cross:** between plants (F₁) and plants with non-pedicel fruit and hairless stem. We obtain a 2nd generation F'₂ formed of:

296 plants with pedicel fruit and hairy stem.	318 plants with non-pedicel fruit and hairless stem.
1200 plants with non-pedicel fruit and hairy stem.	1200 plants with fruit and hairless stem.



1. What do you **deduce** from the results of the 1st and 2nd crosses? (0.75 pt)

2. Using the Punnett square, **give** the chromosomal interpretation of the results of the 1st and 2nd cross. (1.5 pt)
 Use the following symbols:

- *J* and *j* for alleles responsible for the presence or absence of pedicels.
- *V* and *v* for alleles responsible for the presence or absence of hair on the stem.

Scientific research has shown the existence of a third gene responsible for the synthesis of a natural pigment in the tomato "Anthocyanin". On the same chromosome this gene is located at a distance of 35.2 cM from the gene responsible for the presence or absence of the pedicel. The gene responsible for the synthesis of the pigment "Anthocyanin" is determined by a pair of alleles (A and a). The dominant allele "A" is responsible for the synthesis of a natural pigment in the tomato "Anthocyanin" and the recessive allele "a" is responsible for the absence of this pigment.

3. Using the Punnett square, **give** the chromosomal interpretation of the results of a cross between a hybrid plant for both hereditary traits with genotype $\left(\frac{J A}{j a}\right)$ and a double recessive plant for both characters. (1 pt)

4. **Realize** possible factorial maps of the three genes studied by **specifying** the steps to calculate the distance. Use: 1 cm for 5 cM. (1 pt)

Exercise 3 : (3.75 pts)

In order to determine the mode of transmission of a hereditary disease in humans and to explain the consequences of chromosomal abnormalities in the occurrence of certain unpredictable diseases (occurring during the formation of gametes in parents), the following data are proposed:

- Retinoblastoma is a rare form of cancer that appears in children before the age of 5, characterized by the appearance of a tumor in the retina of the eye.

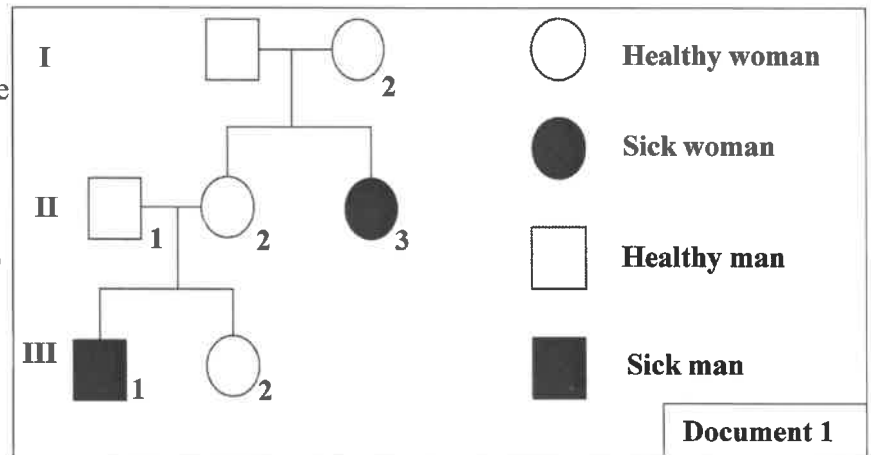
Document1 presents a pedigree of a family whose members are affected by Retinoblastoma disease.

1. Based on document 1:

a. **Demonstrate** that the allele responsible for the disease is recessive. **Justify** your answer. (0.25 pt)

b. **Show** if the gene is carried by an autosome or a sex chromosome. (0.75 pt)

2. **Give** the genotype of the individuals II₁, II₂ and III₁. **Justify** your answer (0.75 pt)



Document 1

Use the symbol (N) or (n) for the allele responsible for the normal phenotype and the symbol (R) or (r) for the allele responsible for the disease.

- The analysis of DNA by the electrophoresis technique allows to detect the DNA fragment of the gene responsible for this disease (the morbid allele). Document 2 presents the results obtained in some members of this family.

Individuals in the family	II ₂ and III ₂	III ₁	II ₁	
Initial deposit of samples	→	→	→	<div style="text-align: right;">↓</div> Direction of migration
Position of the normal allele	→	→	→	
Position of the morbid allele	→	→	→	
* The thickness of the bands is relative to the density of the DNA.				Document 2

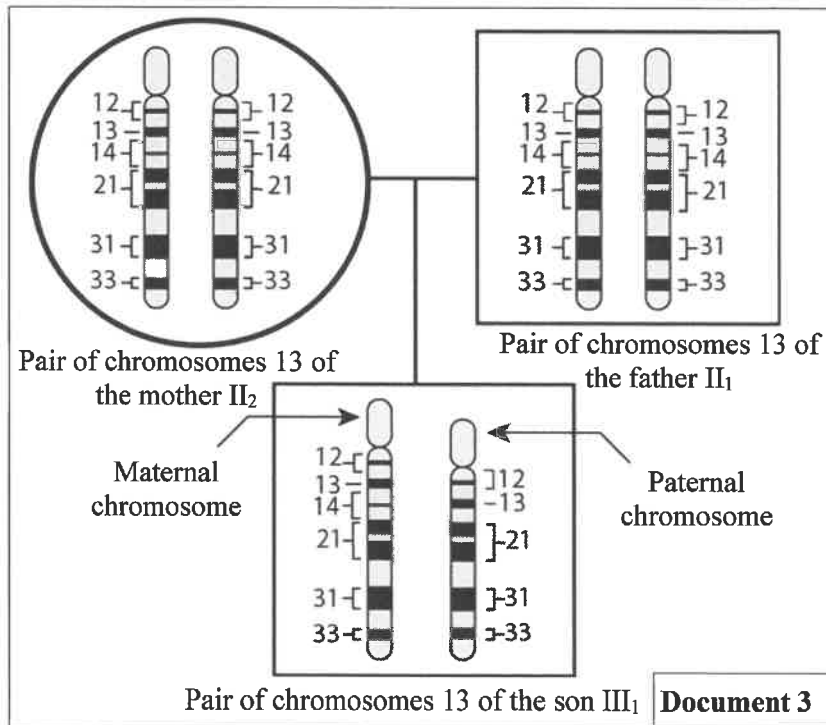
3. By using document 2.

a. **Give** the effective genotypes of parents II₁ and II₂. (0.5 pt)

b. **Propose** an explanation for the appearance of Retinoblastoma in son III₁. (0.5pt)

- The Retinoblastoma gene is carried by **chromosome 13**. To search for the cause of Retinoblastoma in son III₁, the gene sequence was established at chromosome 13 pair in parents II₁ and II₂ and their son III₁. Document 3 represents the results obtained (the location of the genes is indicated by the numbers).

4. Using the data in document 3, **determine** the type of chromosomal abnormality observed in son III₁ and then **explain** why he has Retinoblastoma disease. (1 pt)



Exercise 4 : (4 pts)

In a population P of wheat, a large number of ears were harvested and the weight of 5500 wheat kernels was measured.

The following table shows the statistical results of the distribution of the number of wheat grains according to their weights.

Classes: grain weight (mg)	[150-250[[250-350[[350-450[[450-550[[550-650[[650-750[
Number of grains	125	875	2250	1125	625	500

1. On your writing sheet, **make** the histogram and the frequency polygon of the weight distribution of wheat grains. (0.5pt)

Use: 1cm for each class and 1cm for 500 grains.

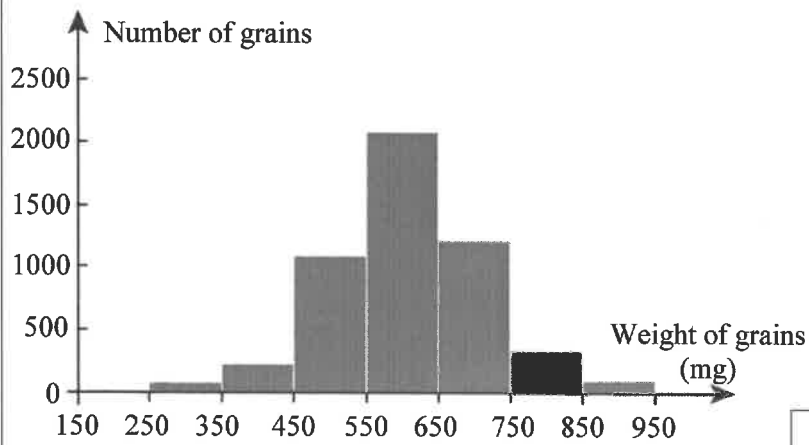
2. **Describe** the results presented by the frequency polygon and **propose** a hypothesis about the homogeneity of the population P. (0.75 pt)

3. **Calculate** the arithmetic mean, the standard deviation and the confidence interval $[\bar{X} - \sigma, \bar{X} + \sigma]$ of this distribution, based on an application table for the calculation of the statistical parameters. (1.25 pts)

Use the following formula:

$$\sigma = \sqrt{\frac{\sum_i f_i (x_i - \bar{x})^2}{n}} \quad \text{and} \quad \bar{x} = \frac{\sum_i (f_i x_i)}{n}$$

To test the hypothesis proposed in answer to question 2, a sub-population P₁ was isolated which belongs to the class [650 -750]. By studying the frequency distribution of the weight of the grains, the frequency histogram presented in document 1 was produced and the statistical parameters of this sub-population were calculated. Document 2 shows the results obtained.



Document 1

	Sub-population P ₁
The mode (M)	600 mg
The arithmetic mean (\bar{X})	605.63 mg
The standard deviation (σ)	113.69 mg

Document 2

4. Compare the mode, the arithmetic mean and the standard deviation of subpopulation P₁ to those of population P. What do you deduce about the proposed hypothesis? (1.5 pt)