

2h	مدة الإنجاز	علوم الحياة والأرض	المادة
3	المعامل	شعبة العلوم الرياضية (أ) (خيار إنجليزية)	الشعبة أو المسلك

Section I : Knowledge Retrieval (5 pts)

Questions	Response elements	Scores
I	<p>- The reductional division: Accept all correct answers from the following suggestions:</p> <ul style="list-style-type: none"> * 1st division of meiosis which divides the amount of DNA and gives 2 cells with n chromosomes from a mother cell with 2n chromosomes. * 1st division of meiosis that results in 2 haploid daughter cells from a diploid mother cell. (0.5 pt) <p>- Test-cross: Accept all correct answers from the following suggestions:</p> <ul style="list-style-type: none"> * A cross performed between an individual with a dominant phenotype and another with a recessive phenotype to determine the genotype of the individual with the dominant phenotype ; * A cross performed between an individual with a dominant phenotype and another with a recessive phenotype to test for independence or linkage between two genes. (0.5 pt) 	1pts
II	(1; a) ; (2 ; c) ; (3 ; b) ; (4 ; a).....(0.5pt x 4)	2pts
III	(a; false) (b; false) (c; true) (d; true).....(0.25pt x4)	1pt
IV	(1; b) ; (2 ; d) ; (3 ; a) ; (4 ; c).....(0.25pt x 4)	1pt

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

Exercise 1 : (3 pts)

Questions	Response elements	Scores
1	<p>- Meiosis: takes place at the level of thallus III. (accept : at the level of the element f).(0.25 pt)</p> <p>- Fertilization : takes place at the level of thallus II .....(0.25 pt)</p>	0.5pt
2	<p>- The thallus I; male gametophyte results from the development of the spore (g) and produces the male gametes (a) .....(0.5 pt)</p> <p>- The thallus II; female gametophyte results from the development of the spore (g) and produces the female gametes (b). .....(0.5 pt)</p> <p>- Thallus III; sporophyte results from the development of the zygote (c) and produces spores (g).....(0.5 pt)</p>	1.5pt
3	<p>- The chromosome cycle:.....(0.75 pt)</p> <div style="text-align: center;"> </div> <p style="text-align: right;"> — Haplophase = Diplophase </p>	1pt
	<p>- Type of cycle : haplodiplontic.....(0.25 pt)</p>	

Exercise2 : (4.25 pts)

1	<p>First cross:</p> <ul style="list-style-type: none"> - The responsible allele for the presence of the pedicel is dominant (J) and responsible allele for the absence of the pedicel is recessive (j)..... (0.25 pt) - The responsible allele for the presence of hair is dominant (V) and responsible allele the absence of hair is recessive (v) (0.25 pt) <p>Second cross:</p> <ul style="list-style-type: none"> - The two studied genes are linked..... (0.25 pt) 	0.75pt
----------	--	---------------

2	<p>• Chromosomal interpretation of result of first cross:</p> <p>Phenotypes $[J, v] \times [j, v]$</p> <p>Genotypes $\frac{J \ v}{J \ v} \times \frac{j \ V}{j \ V}$</p> <p>Gametes 100% $\frac{J \ v}{j \ V}$ 100% (0.25 pt)</p> <p>Fertilization 100% $\frac{J \ v}{j \ V} [J, V] F_1$ (0.25 pt)</p> <p>• Chromosomal interpretation of result of second cross:</p> <p>F1 $[J, V]$ X homozygous recessive individual $[j, v]$</p> <p>Phenotypes $[J, V] \times [j, v]$</p> <p>Genotypes $\frac{J \ v}{j \ V} \times \frac{j \ v}{j \ v}$</p> <p>Gametes $\frac{J \ v}{39,81\%} \frac{j \ V}{39,81\%} \frac{J \ V}{9,83\%} \frac{j \ v}{10,55\%}$ X $\frac{j \ v}{100\%}$ (0.25 pt)</p> <p>Punnet square (0.75 pt)</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">$\frac{J \ v}{j \ v}$ 100%</td> <td style="padding: 5px;">$\frac{J \ v}{39,81\%}$</td> <td style="padding: 5px;">$\frac{j \ V}{39,81\%}$</td> <td style="padding: 5px;">$\frac{J \ V}{9,83\%}$</td> <td style="padding: 5px;">$\frac{j \ v}{10,55\%}$</td> </tr> <tr> <td style="padding: 5px;"></td> <td style="padding: 5px;">$\frac{J \ v}{j \ v}$ $[J, v]$ 39,81%</td> <td style="padding: 5px;">$\frac{j \ V}{j \ v}$ $[j, V]$ 39,81%</td> <td style="padding: 5px;">$\frac{J \ V}{j \ v}$ $[J, V]$ 9,83%</td> <td style="padding: 5px;">$\frac{j \ v}{j \ v}$ $[j, v]$ 10,55%</td> </tr> </table>	$\frac{J \ v}{j \ v}$ 100%	$\frac{J \ v}{39,81\%}$	$\frac{j \ V}{39,81\%}$	$\frac{J \ V}{9,83\%}$	$\frac{j \ v}{10,55\%}$		$\frac{J \ v}{j \ v}$ $[J, v]$ 39,81%	$\frac{j \ V}{j \ v}$ $[j, V]$ 39,81%	$\frac{J \ V}{j \ v}$ $[J, V]$ 9,83%	$\frac{j \ v}{j \ v}$ $[j, v]$ 10,55%	1.5pt
$\frac{J \ v}{j \ v}$ 100%	$\frac{J \ v}{39,81\%}$	$\frac{j \ V}{39,81\%}$	$\frac{J \ V}{9,83\%}$	$\frac{j \ v}{10,55\%}$								
	$\frac{J \ v}{j \ v}$ $[J, v]$ 39,81%	$\frac{j \ V}{j \ v}$ $[j, V]$ 39,81%	$\frac{J \ V}{j \ v}$ $[J, V]$ 9,83%	$\frac{j \ v}{j \ v}$ $[j, v]$ 10,55%								

3	<p>Chromosomal interpretation of crossing results:</p> <p style="text-align: center;">hybrid individual \times homozygous recessive individual</p> <p>Phenotypes $[J, A] \times [j, a]$</p> <p>Genotypes (0.25 pt) $\frac{J \ A}{j \ a} \times \frac{j \ a}{j \ a}$</p> <p>Gametes (0.25 pt) $\frac{J \ A}{32,4\%} \frac{j \ a}{32,4\%} \frac{J \ a}{17,6\%} \frac{j \ A}{17,6\%}$ X $\frac{j \ a}{100\%}$</p>	1
----------	---	----------

Punnet square (0.5 pt)

	γ F ₁	$\frac{J}{j}$ A	$\frac{j}{j}$ a	$\frac{J}{j}$ a	$\frac{j}{j}$ A
γ		32,4%	32,4%	17,6%	17,6%
	$\frac{j}{j}$ v	$\frac{J}{j}$ A	$\frac{j}{j}$ a	$\frac{J}{j}$ a	$\frac{j}{j}$ A
	100%	$\frac{J}{j}$ A	$\frac{j}{j}$ a	$\frac{J}{j}$ a	$\frac{j}{j}$ A
		[J, A]	[j, a]	[J, a]	[j, A]

Descendants F₂:

64,8%
35,2%
 Parental phenotypes Recombinant phenotypes

Realization of the map gene:

◆ **Between the two pairs of alleles (J/j) et (V/v):**

- calculation of the % of recombinant phenotype = 20.38 %(0,25 pt)

- determination of the distance in cM (d= 20.38 cM).(0,25 pt)

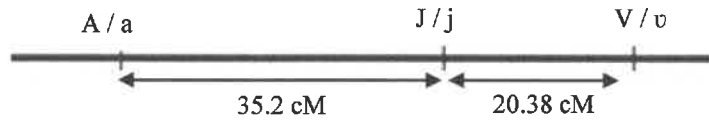
◆ **Between the two pairs of alleles (J/j) et (A/a):**

we know that the distance between the two gene is = 35.2 cM;

- the possible gene maps are (scale must be respected) :

4

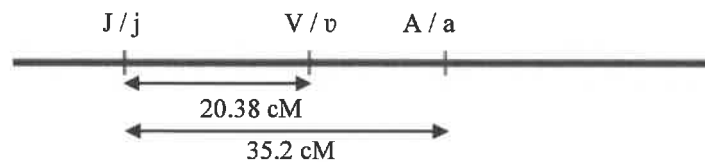
1st case



.....(0.25pt)

1pt

2nd case



.....(0.25pt)

Exercise3 : (3.75 pts)

a.

The responsible allele for disease is recessive: healthy parents give birth to sick children

0.25pt

1

b.

- The responsible allele for disease is not carried by the Y chromosome: II₃ is a sick girl

.....(0.25pt)

- The responsible allele for disease is not carried by the X chromosome: II₃ is a sick girl while her father is healthy.....(0.25pt)

- The responsible allele for disease is carried by an autosome.(0.25pt)

(Accept any other correct answer)

0.75pt

2

Genotype of individuals:

II₁: N/r, a healthy male but his child is sick.....(0.25pt)

II₂: N/r, a healthy female but her child is sick.....(0.25pt)

III₁: r/r sick individual and the disease is recessive(0.25pt)

0.75pt

3

a-

Effective genotype of parents II₁ and II₂:

- Father II₁ carries two normal alleles, his genotype is: N/N.....(0.25pt)

- The mother II₂ carries two different alleles (a normal allele and a morbid allele), her genotype is: N/r.....(0.25pt)

0.5pt

b-

The child III₁ carries only one allele (the morbid allele) because he received this allele from his mother and he did not receive the normal allele from his father hence the appearance of Retinoblastoma in son III₁.

Accept any answer which shows that there is an abnormal meiosis in the father during gamete formation.

0.5pt

4

Exploitation of the document:

- The homologous chromosomes 13 in parents II₁ and II₂ are normal, while one of the two chromosomes 13 in son III₁ is abnormal (shorter).....(0.25pt)

- Absence of gene 14 on paternal chromosome 13 in son III₁.....(0.25pt)

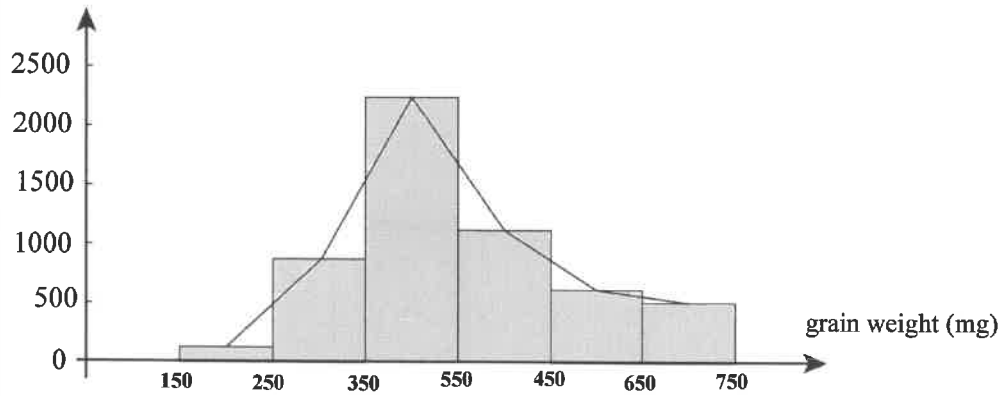
This is a structural chromosomal anomaly.....(0.25 pt)

1pt

Explanation:
 During gamete formation in the father II₁ there is a deletion of gene 14 on chromosome 13. This gene is transmitted from the father to the son III₁ and consequently the morbid allele carried by the maternal chromosome (r), is expressed in the son(0. 25pt)

Exercise 4: (4 pts)

Realization of a histogram and a correct frequency polygon according to the scale proposed in the exercise. (0,5 pt)



1

0.5pt

2 - Frequency polygon is unimodal (mode = 400 mg, or the class [350-450[).....(0.5pt)
 - The hypothesis: the sample is homogeneous.(0.25pt)
Accept: the sample is heterogeneous (great dispersion).

2

0.75pt

Classes	Class centre (x _i)	f _i	x _i x f _i	x _i - \bar{X}	(x _i - \bar{X}) ²	f _i x (x _i - \bar{X}) ²
[150-250[	200	125	25000	-250	62500	7812500
[250-350[	300	875	262500	-150	22500	19687500
[350-450[	400	2250	900000	-50	2500	5625000
[450-550[	500	1125	562500	50	2500	2812500
[550-650[	600	625	375000	150	22500	14062500
[650-750[	700	500	350000	250	62500	31250000
Total		5500	2475000			81250000

3

1.25 pts

Correct application table for the calculation of statistical parameters..... (0.5pt)
 Arithmetic mean : $\bar{X}=450$ mg.....(0.25pt)
 Standard deviation : $\sigma = 121,543$ mg(0.25pt)
 Confidence interval : [328.457 ; 571.543](0.25pt)

Comparison:
 - The mode of subpopulation P₁ is larger than that of population P.....(0.25pt)
 - The arithmetic mean (\bar{X}) of subpopulation P₁ is larger than that of population P.....(0.25 pt)
 - The standard deviation (σ) of subpopulation P₁ is smaller than that of population P ... (0.25pt)
 - In population P₁ the dispersion of variables is clustered around the mean.....(0.25 pt)
Hypothesis testing: Selection is efficient so population P is heterogeneous: the proposed hypothesis is false.(0.5pt)
Accept hypothesis true if the candidate has proposed that the population P is heterogeneous.

4

1.5pt