الامتحان الوطني الموحد للبكالوريا
المسالك الدولية
الدورة العادية 2021
- عناصر الإجابة -

SSSSSSSSSSSSSSSSSSSS | NR 32E

المملكة المغربية
وزارة التربية الوطنية
والتكوين المهني
والتعليم العالي والبحث العلمي
المركز الوطني للتقويم والامتحانات

3h	مدة الإنجاز	علوم الحياة والأرض	المادة
7	المعامل	شعبة العلوم التجريبية مسلك علوم الحياة والأرض (خيار أنجليزية)	الشعبة أو المسلك

Key and marking scale

Questions	Response elements	Scores
	Section I : Knowledge Retrieval (5 pts)	
I	**definition** (accept any correct definitions) **a- Mitosis:** Cell division that allows to obtain, from a mother cell, two genetically identical daughter cells carrying the same genetic information as the mother cell. **b- Restriction enzyme:** enzyme that allows of cutting the DNA in specific locations.	0.5 0.5
II	(1, a) ; (2, b) ; (3, a) ; (4, c) …………	0.5x4
III	1- false 2- true 3- false 4- false …………	0.25x4
IV	(1, c) ; (2, d) ; (3, b) ; (4, a) …………	0.25x4
	Section II : Scientific reasoning and communication in graphic and written modes (15 pts)	
	Exercise 1 (5.5 pts)	
1	**Description :** **+Variation in the concentration of O_2**………… -before adding pyruvate, the concentration of O_2 is constant at about 90%. -after adding pyruvate (t_1), the concentration of O_2 decreases then stabilizes at 70%. -after adding ADP +Pi (t_2), the concentration of O_2 decrease to reach 30%. **+Variation in the concentration of ATP**………… -before adding pyruvate, the concentration of ATP is constant at about 37 UA. -after adding pyruvate (t_1), the concentration of ATP increases to reach 50 UA. -after adding ADP +Pi (t_2), the concentration of ATP increase to reach more than 90UA. ***N.B: accept values close to that of the response elements*** **Deduction** ………… The pyruvate and ATP + Pi activate the consumption of O_2 and the ATP production at the mitochondrion level. (**Accept**: the pyruvate and ADP +Pi activate the mitochondrial respiration).	0.5 0.5 0.5
2	**Description:** ………… -Before O_2 injection, the concentration of H^+ is zero in the medium. -Just after the injection of O_2, the concentration of H^+ increase to reach maximal value (more than 40.10^{-9}mol/L) and decreases to reach its initial value after 240s. **Deduction of the effect of O_2 injection on the direction of movement of protons H^+:** ………… The O_2 activates the exit of H^+ from the matrix to external medium through the mitochondrial inner membrane.	0.5 0.5

3	**Explanation of the variation of the concentrations of O_2, H^+ and ATP:** - Adding pyruvate to mitochondrial suspension → degradation of pyruvate in the matrix → reduction of electron and proton transporters …………………………. → Oxidation of reduced transporters in the respiratory chain coupled to reduction of O_2→ consumption of O_2. (Figure a document 1)……………………………….. → Pumping (expulsion) protons H^+ from the matrix to the inter-membrane space →increase the concentration of H^+ in inter-membrane space and formation proton H^+ gradient on either side of the mitochondrial inner membrane.(Figure b document 2) → return of H^+ protons to the matrix (decrease in the concentration of H^+ protons in the external medium) through the ATP synthase → phosphorylation of ADP and ATP synthesis (Figure b document 1)……………………………………………...	0.5 0.5 0.5 0.5
4	**Explanation of asphyxiation due to exposure to the HCN: …………………....** Exposure to hydrocyanic (HCN) inhibits the transporter T_6 → the electrons do not arrive to final acceptor that is O_2 (no reduction of O_2) which explain the stop of consumption of O_2→ stop the oxidative phosphorylation which explain the stop of ATP synthesis => the cells are unable to use O_2 even in its presence from where asphyxiation.	1
	Exercise 2 (6.5 pts)	
1	**Protein-trait relationship:** - **in healthy individual:** The enzyme (HEX-A) is functional → degradation of ganglioside GM2 in GM3 + GNA → no accumulation of GM2 in lysosomes of nerve cells→ normal nerve cell→ healthy individual ………………………………………. - **in affected individual:** The enzyme (HEX-A) is non-functional → no degradation of ganglioside GM2 → accumulation of GM2 in lysosomes of nerve cells→ degeneration of nerve cell→ individual raffected by Tay-Sachs …………………………………….. The modification in the protein (enzyme HEX-A) causes a modification in the phenotype of individual (healthy or sick individual) from where the protein-trait relationship………………………………………………………………………………	0.25 0.25 0.25
2	**mRNA and amino acids sequences corresponding to each two alleles: ………..** - Fragment of normal allele: …………………………………………………….. **mARN :** CGU - AUA- UCC- UAU- GCC- CCU- GAC **Peptide :** Arg - Ile - Ser - Tyr - Ala - Pro - Ac.asp - Fragment of abnormal allele: …………………………………………….. **mARN :** CGU - AUA- UCU- AUC- CUA- UGC- CCC - UGA- C **Peptide :** Arg - Ile - Ser - Ile - Leu - Cys - Pro **The Genetic origin of disease:** Mutation by addition of four untranscribed strand (DNA) has changed the reading frame → synthesis of RNAm modified include codon Stop compared to RNA normal→ synthesis abnormal protein →enzyme HEX-A non-functional →the Tay-sachs disease appear …………………………………………………………… **Accept any correct mutation such as:**	0.25x2 0.25x2 0.5

- **Addition of TCTA betwen nucleotides 1275 and 1276.**
- **Addition of TATC betwen nucleotides 1273 and 1274.**
- **Addition of TATC betwen nucleotides 1277 and 1278.**
- **Addition of CTAT betwen nucleotides 1276 and 1277.**

3

The mode of transmission of this diseases: (accept any logical answer)

- The responsible allele for disease is recessive………………………………….. **0.25**

Justification: The parents **I₁** and **I₂** (or **II₄** and **II₅**) are healthy and gave birth to a sick girl **II₃** (or a sick boy **III₃**)…………………………………………………… **0.25**

- The responsible gene for disease is carried by autosome……………………….. **0.25**

Justification: the disease is dominant, the girl **II₃** is affected and descends from a healthy father **I₂** ………………………………………………………………….. **0.25**

4

a. **Genotypes of individuals I₂, II₂ et III₃ with justification:**

I₂: N//n **because** the individual is healthy and gave birth to a sick girl. **0.25**
II₂: N//n or N//N **because** she is healthy and descends from heterozygous parents **0.5**
III₃: n//n **because** he is affected. **0.25**

b. **The probability that the couple (II₄ and II₅) give birth to a healthy child with justification:**

[N] **II₄** x **II₅** [N]

N//n   N//n
↓   ↓
½ N/ ; ½ n/   **½ N/ ; ½ n/** **0.25**

Punnet square : **0.25**

Gametes of parents	½ N/	½ n/
½ N/	**¼ N//N** [N]	**¼ N//n** [N]
½ n/	**¼ N//n** [N]	**¼ n//n** [n]

The probability that the couple (**II₄ and II₅**) give birth to a healthy child is ¾. **0.25**

5

a. The frequency of two alleles N and n in these populations: …………………..

we have : since the population is in equilibrium f (**n//n**) = 1/3600 = q^2

So

- Normal allele frequency is: f (n) = q= **0.0166**…………………………… **0.5**
- Abnormal allele frequency is: f (N) = p = 1- q = **0.9834**…………………… **0.5**

N.B : accept also numerical applications :

- Normal allele frequency is: f (n) = q= **0.0141**
- Abnormal allele frequency is: f (N) = p = 1- q = **0.9859**

b. deduction:…………………………………………………………………………… **0.5**

the healthy carrier individuals are heterozygous of genotype (N//n)→ the frequency of healthy carrier individuals in these populations is:

f (N//n) = 2pq = 2× 0.0166×0.9834 ≈ **0.0326**

N.B : accept also numerical applications :

f (N//n) = 2pq= 2× 0.0141×0.9859 ≈**0.0278**

Exercise 3 (3 pts)

1

According to the first and second cross, we deduce that:

- the parents are from pure lineage in each of the two crosses ……………………. **0.25**
- The responsible allele for black coat is dominant (R) and responsible allele for red coat is recessive (r)……………………………………………………………… **0.25**
-The responsible allele for united coat is dominant (B) and responsible allele for

	spotted is recessive (b)………………………………………………………….. - Genes responsible for the color and the type of coat are carried by autosomes (two study traits are not sex linked)…………………………………………………...........	0.25 0.25
2	the two studied genes are independents: because the cross 3 is a test cross which gives four different and equiprobable phenotypes (with equal percentage)	0.5
3	**a. genotypes of parents with justification:** + the parent with dominant phenotype (black and united coat) is heterozygous: R //r B//b **Justification:** the parent has descendants double-recessives with red and spotted coat……………………...…………………………………………………………… +the parent with red and united coat is homozygote for coat color but heterozygous for coat type: r//r B//b **Justification:** the parent has a recessive phenotype for the color and it gave spotted descendants………………………………………………………………………….	0.25 0.25
	b. Interpretation of results : Phenotypes : [R, B] × [r, B] Genotypes : R //r B//b r//r B//b Gametes : ¼ R/B/ ; ¼ r/b/ ; ¼R/b/ ; ¼ r/B/ — ½ r/B/ ; ½ r /b/ Punnet square :	0.25 0.25

gametes	¼ R/B/	¼ r/b/	¼ R/b/	¼ r/B/
½ r/B/	R //r B//B **1 /8 [R, B]**	r //r B//b **1 /8 [r, B]**	R //r B//b **1 /8 [R,B]**	r //r B//B **1 /8 [r, B]**
½ r /b/	R //r B//b **1 /8 [R, B]**	r //r b//b **1 /8 [r, b]**	R //r b//b **1 /8 [R, b]**	r //r B//b **1 /8 [r, B]**

Results: **3 /8 [R, B]** **3 /8 [r, B]** **1 /8 [r, b]** **1 /8 [R, b]**……………………… 0.25

The theoretical results are identical to experimental results…………………………. 0.25