This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 03

10FEB2026

Do NOT write in this box. Your MARK will be placed here.

Subject :	Biology	
Class :	11S1 and 11S2	
Teacher :	Christine Khalil	
Duration :	1 hour	
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise 1 (3.5 points)

Choose the correct answer.

1. **An abnormal increase or decrease in chromosome number is called:**
   a. Monosomy
   b. Trisomy
   c. Aneuploidy
   d. Translocation

2. **Which sequence correctly represents the steps of karyotyping?**
   a. Hypotonic solution → Culture the cells → Adding colchicine → Staining
   b. Culture the cells → Adding colchicine → Hypotonic solution → Fixation & staining
   c. Adding colchicine → Hypotonic solution→ Culture the cells → Staining
   d. Culture the cells → Hypotonic solution → Staining → Adding colchicine

3. **During mitosis, the stage at which chromosome number temporarily doubles is:**
   a. Prophase
   b. Metaphase
   c. Anaphase
   d. Telophase

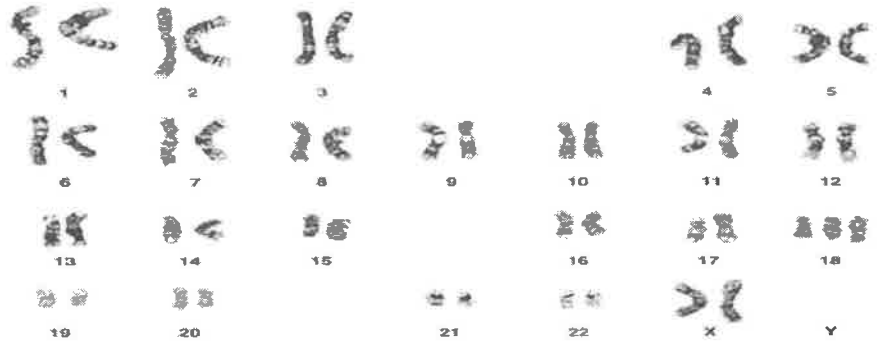
4. **Cytokinesis differs in plant and animal cells because plants:**
   a. Have centrosomes
   b. Form a cell plate
   c. Divide through a cleavage furrow
   d. Undergo meiosis only

5. **A female is phenotypically normal but has repeated miscarriages. Her karyotype analysis would MOST likely reveal:**
   a. Aneuploidy
   b. Translocation
   c. Gonosomal trisomy
   d. Autosomal monosomy

The following questions will be answered based on document 1 (on the next page).

6. **This karyotype shows:**
   a. A diploid male cell.
   b. A cell taken from a male having 2n+1
   c. A cell taken from female having 2n+1
   d. A diploid female cell.

7. **This karyotype results from the fertilization of:**
   a. A gamete with a normal karyotype by a gamete carrying 2 chromosomes 21
   b. 2 gametes each carrying a deletion on chromosome 18
   c. One egg and two sperm cells
   d. A gamete with a normal karyotype and a gamete with an extra chromosome 18



Document 1

Exercise 2 (15.5 points)

Alain, son of a healthy couple Riad and Samar, suffers from a disease characterized by mental retardation.

1. Formulate a hypothesis explaining the cause of the mental retardation of Alain. (1)

In order to understand the possible origin of this mental retardation, the following studies are performed.

Part I:

Blood analysis of Alain and his parents were performed to check the level of a substance called purines. (Document 2)

Individual	Samar	Riad	Alain
Blood level of purines (mmol/L)	79	79	118.5

Document 2

2. a. Compare the blood level of purines in these 3 individuals. (1)
   b. What can you conclude concerning the cause of Alain's mental retardation? (1)

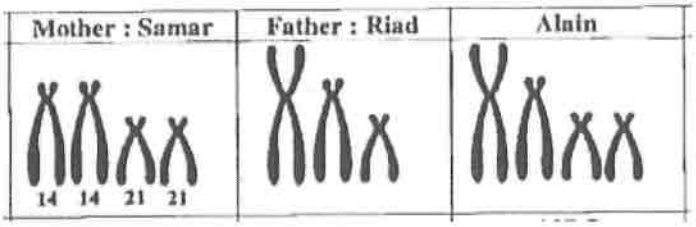
To better understand the link between purines and Alain's condition, we cultured neurons (cells of the nervous system) in a medium containing moderate levels of purines. Neurons remained alive. We cultured neurons in a medium rich in purines. Neurons died.

3. Interpret the results of this experiment. (1.5)

Part II:

The doctor requested a karyotype for Alain and his family. (Document 3)

4. Compare the karyotypes of the mother, the father and Alain. (3.5)
5. Justify the healthy appearance of the father. (1)
6. What is the condition of Alain shown in document 3? Justify your answer. (1)



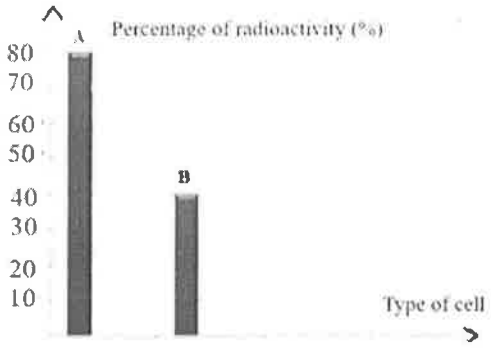
Document 3

7. Based on parts I and II, explain to the parents the origin of the disease in Alain and how it ends up leading to mental retardation. (1.5)
8. This couple is expecting a second child and wishes to know whether he will be affected like his brother. What is the risk that the second child will also be affected? (4)

Exercise 3 (6 points)

Part A

To better understand the changes underwent by the genetic material during a cell cycle, two cells (A and B), located at two different points of the cell cycle, were cultured. Through a specific technique, their DNA was made radioactive in such a way that the radioactivity shown by a cell would be proportional to the quantity of DNA located in it. (Document 4)



Document 4

1. Pose the problem studied in this exercise. (1)
2. a. Compare the percentage of radioactivity in cells A and B. (1)
   b. Deduce the phase of the cell cycle where each cell is located. (1)

Part B

We measure the evolution of DNA quantity as a function of time in a group of cells. (Document 5)

Time (h)	0	3	5	8	9	11	16	18	20	23	25
DNA Quantity (a.u)	5.1	6.5	6.6	3.3	3.3	3.3	4	5.1	6.5	6.6	6.6

Document 5

3. Determine based on the table above the duration of a cell cycle. Justify your answer. (1)
4. Schematize a chromosome at t=9h and t=25 h. (1)
5. At 0h, we started the culture with 10 cells. Calculate the number of cells obtained if the culture lasted for 90h. (1)

Answer Key for SE03 11S1S2

Exercise 1 (each 0.5 points)

1. C 2. B 3. C 4. B 5. B 6. C 7. D

Exercise 2 (15.5 points)

1. Hypothesis: Alain has a chromosomal abnormality. (1)
2. a. Samar has a blood level of purines of 79 mmol/L which is equal to that of Riad but less than that of Alain which is 118.5 mmol/L. (1)
   b. Alain's mental retardation is caused by a high level of purines. (1)
3. Neurons remained alive when cultured in a medium having moderate levels of purines. However, they died when cultured in a medium rich in purines. High levels of purines provoke neuron death. (1.5)
4. The mother has 2 chromosomes 14 of identical length and 2 chromosomes 21 of identical length. The father has 2 chromosomes 14, 1 identical to the mother and the other taller. He also has 1 chromosome 21 identical to the mother. Alain has 2 chromosomes 14, 1 identical to the mother and the other taller and he has 2 chromosomes 21 identical to the mother. (3.5)
5. The father has a translocation of chromosome 21 to chromosome 14, his genetic material is conserved. (1)
6. Alain has trisomy 21 since he has 2 free chromosomes 21 and an additional one attached to chromosome 14. (1)
7. Alain has trisomy 21. The gene leading to the synthesis of purines must be located on chromosome 21 since purines are present in high levels in people with trisomy 21. High levels of purines lead to the death of neurons which ends up leading to mental retardation. (1.5)
8. (4)

Exercise 3 (6 points)

1. What are the changes underwent by the genetic material during a cell cycle? (1)
2. a. The percentage of radioactivity in cell A is 80% which is higher than that in cell B which is 40%. (1)
   b. Cell A is in interphase while cell B is in mitosis. (1)
3. It is 18 h since it's the time taken for the cell to go back to the level of DNA it started with at 0h (5.1 a.u.). (1)
4. (1)
5. 18 h correspond to 1 cell cycle. 90/18= 5 cell cycles. In each cycle the number of cell doubles, 10x2x2x2x2x2= 320 cells. (1)

SE03. 118.

Ex 2

8. Father: $14\ 14^{21}\ 21$ ___ (0.25) Mother: $14\ 14\ 21\ 21$ (0.25)

Gametes: $14\ 21$ / 14 ___ / $14^{21}\ 21$ / 14^{21} ___ (0.25 each, percentage 0.25)

25% each

$14\ 21$ (0.25) 100% (0.25)

Children: $14\ 14\ 21\ 21$ / $14\ 14\ 21$ ___ / $14\ 14^{21}\ 21\ 21$ / $14\ 14^{21}\ 21$ ___ 0.25 each

25% each. (0.25)

Accept 50% affected

25% affected like his brother. 0.5

Ex 3:

4. t - 9l : 7 (0.5)

t - 25h. X (0.5)