This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls — Loueizeh - Baabda

Stage Exam 05
27APR2026

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 :		

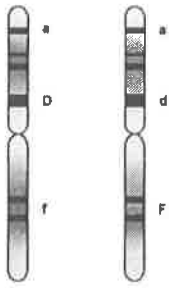
- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise 1 (14.5 points)

DNA replication is a fundamental biological process that occurs in all living organisms. It is the process of duplicating a cell's genome before a mitotic or a meiotic division. During DNA replication, there are many enzymes that interfere to duplicate the DNA from one strand to two strands. The table below shows the variation of the quantity of DNA in a culture of human germ cells undergoing division.

Time (hrs)	0	3	6	9	12	12	15	15	18
DNA Quantity (a.u.)	5.3	5.3	8	10.6	10.6	5.3	5.3	2.65	2.65

1. Convert this table into a graph. (2)
2. Name the division observed in the table above. Justify your answer. (1)
3. Indicate on the graph of question (1) the different phases of this division from time 0 till 18 hrs. (2.75)
4. One of the strands of a DNA molecule has the following sequence: ATGCCT. Determine the sequence of the second strand. (0.5)
5. Somewhere between 0 and 9 hrs, the process of DNA replication occurs. Name in order the enzymes involved in this process and briefly mention their function. (3)
6. What is the mode of replication that the DNA will follow? Explain it using a small figure showing 1 cell having 1 chromosome made of 1 chromatid evolving from time 0 till 9 hrs in a culture medium containing radioactive thymine. (2)
7. After finishing interphase, DNA starts undergoing an important process. Name it and in **one sentence,** describe its first step. (2.25)
8. Following the process of question 7, crossing over occurs. The figure below shows a pair of homologous chromosomes present in a cell at time 0 hrs. Draw the different types of cells obtained at the end of the 18 hrs if crossing over occurred at the level of gene 3. (gene 1: allele a, gene 2: alleles D and d, gene 3: alleles F and f). (1)



Exercise 2 (6 points)

DNA is a complex molecule that carries the genetic information of all living organisms. It's a long double-stranded helix composed of repeated units called nucleotides. In our search for the location of the DNA inside a cell, Feulgen technique was applied.

Conditions	Results
1. Put the cells on a slide with HCl	Appearance of a red color inside the nucleus only
2. Add Schiff reagent	

Document 1

1. Pose the problem studied in this exercise. (1)
2. Interpret the experiment of document 1. (1.5)

The table of document 2 shows the percentage of nitrogenous bases in the cells of a human liver.

Nitrogenous Base	A	G	C	T
Percentage (%)	35.5	14.5	14.5	35.5

Document 2

3. a. Compare the different percentages given in document 2. (1)
   b. What can you conclude? (0.5)
4. Draw and label the structure of a nucleotide. (1)
5. The percentage of G was found to be 23% in the liver cells of a cow. Determine the percentages of all the other nitrogenous bases. (1)

Exercise 3 (4.5 points)

Hemochromatosis is a genetic disease characterized by an excessive absorption of iron in the organism, leading to the accumulation of iron in different organs, among which the liver, the heart and the pancreas. The symptoms might include fatigue, articular pain and hepatic troubles. The origin of the disease is more likely a change in the DNA sequence of the HFE gene responsible for the synthesis of the HFE protein secreted by the liver in the blood. This protein is responsible for the regulation of the absorption of iron at the level of the intestine.

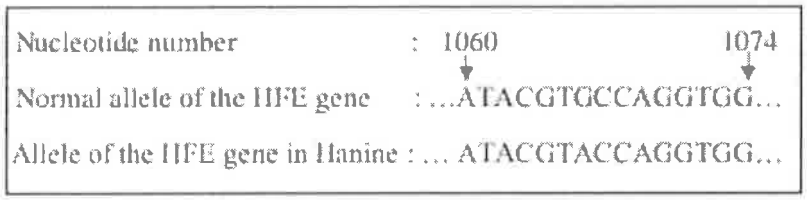
Hanine presents the symptoms of hemochromatosis. She consulted a physician who prescribed a blood test. The results are in document 1.

	Quantity of iron absorbed per day at the level of the intestine (mg)	**Quantity of iron stored in the organs (g)**
Hanine	7	12
Healthy individual	1.5	4

Document 1

1. Compare the results obtained in document 1. (1.5)

The physician completes the diagnosis with DNA analysis of the HFE gene in Hanine. Document 2 presents a fragment of the DNA strand of the normal allele and that of the allele of the HFE gene in Hanine.



Document 2

2. Compare the 2 sequences of nucleotides. (1)
3. Explain, according to your acquired knowledge and all what precedes, how the modifications at the level of the nucleotide sequence of the allele lead to the appearance of Hanine's symptoms. (2)

Answer Key for SE05 11S1S2

Exercise 1 (14.5 points)

1. (2)
2. Meiosis. (0.5) It consists of 2 consecutive divisions/ The genetic material is not conserved; it's divided into half. (0.5)
3. Each phase is 0.25.
4. TACGGA. (0.5) A and T are complementary, C and G are complementary. (0.5)
5. Helicase: breaks the hydrogen bonds to separate the 2 strands and untwist the DNA double helix. DNA polymerase: creates the new strand by reading the nucleotide on the template strand and adding the complementary nucleotide. Ligasè: adds the hydrogen bonds to twist back the 2 strands into a double helix. (each name: 0.5 and each function: 0.5)
6. Semi-conservative (0.5)
7. DNA condensation (0.5). 147 bp of DNA wraps itself around a histone octamer to create a nucleosome that will be attached to the next one through a linker DNA where H1 protein will be attached. (2)
8. Each cell 0.25.

Exercise 2 (6 points)

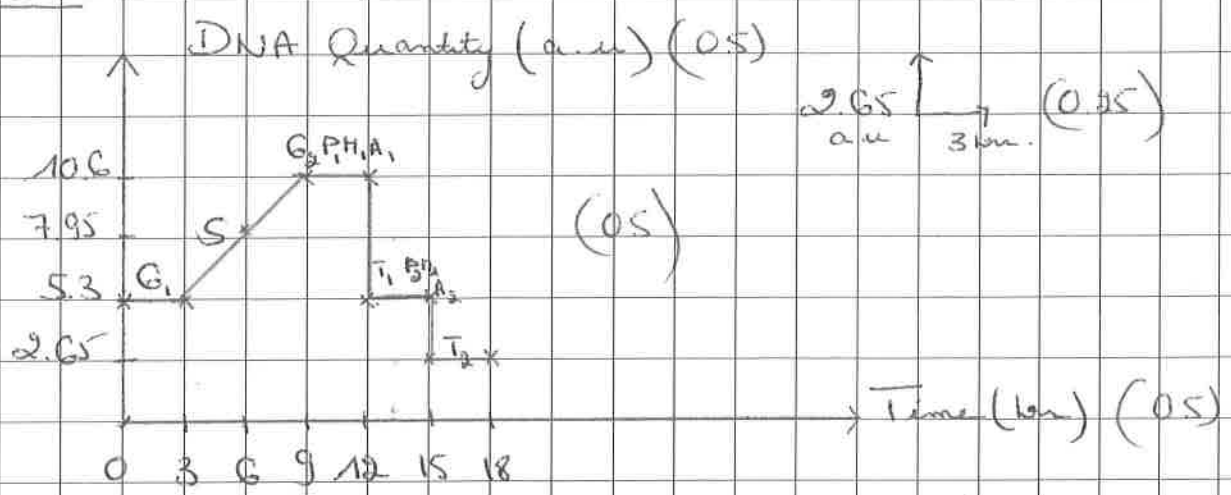
1. Where is the DNA located inside a cell? (1)
2. When the cells were put on a slide with HCl followed by addition of Schiff reagent, a red color appeared only in the nucleus. (0.75) This indicates that the DNA is located in the nucleus. (0.75)
3. a. The percentage of A is 35.5% which is equal to that of T. This percentage is greater than that of C which is 14.5% which is equal to that of G. (1)
   b. A and T are complementary; C and G are complementary. (0.5)
4. (1)
5. % of G=% of C= 23% since G and C are complementary.
   % of A=5 of T= 100-46/2= 27% since A and T are complementary. (1)

Exercise 3 (4.5 points)

1. The quantity of iron absorbed per day at the level of the intestine is 7 mg in Hanine which is greater than that of the healthy individual which is 1.5g. The quantity of iron stored in the organs of Hanine is 12g which is greater than that of the healthy individual which is 4g. (1.5)
2. Both alleles have the same sequence of nucleotides at all positions except at nucleotide 1066 where G in the normal allele was replaced by A in the allele of Hanine. (1)
3. The change in the DNA sequence leads to a change at the level of RNA sequence which changes the amino acid sequence of the protein making it non-functional. The non-functional HFE protein cannot regulate iron absorption at the level of the intestine, thus we observe an increase in the quantity of iron absorbed per day and the quantity stored in the organs. This causes an accumulation of iron in various organs which leads to the symptoms of Hanine. (2)

Ex 1

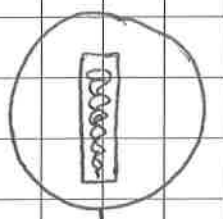
1)



(0.25)

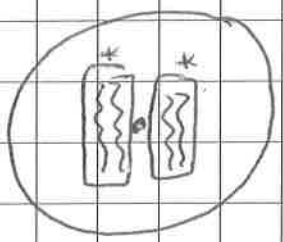
Title: A Graph showing the variation of the DNA quantity as a function of time

6)



(0.25)

↓ DNA Replication



(0.5)

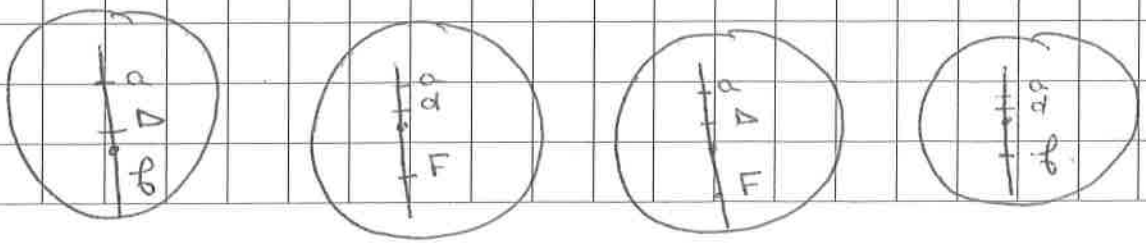
Legend: (0.5)
___ : Old strand
___ : new strand

(0.25)

Title: Figure showing the semi-conservative mode of replication

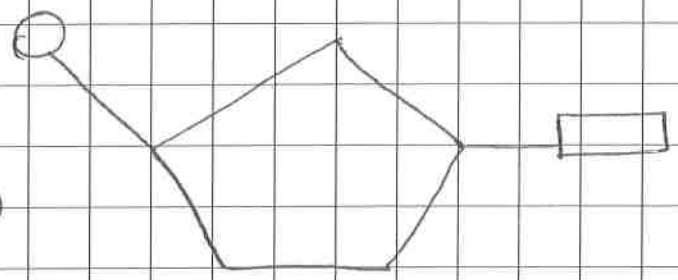
each 0.25

8)



Ex2 :

4.



(0.25).

Title : Figure showing the structure of a nucleotide