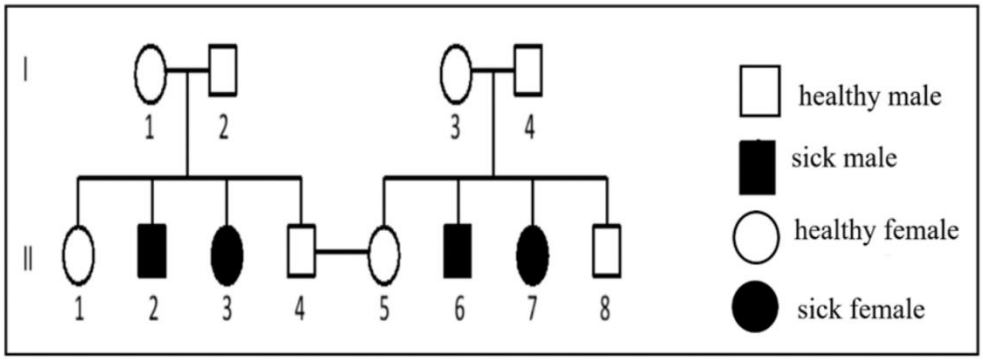
Amal Educational Institutions Educational Department	Common Exam BIOLOGY	Date: /02 / 2022	
Name:	Grade: 12 LS	Duration:	

Exercise 1 (6pts) Inheritance of a genetic disease

Document 1 represents the pedigree tree of a family affected by an autosomal disease.

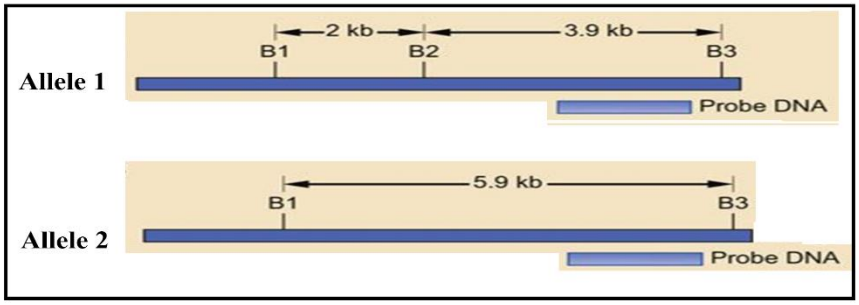


Document 1

1. Indicate if the allele of the disease is dominant or recessive. Justify your answer.
2. Show that this gene is not carried by a sex chromosome.
3. Specify the genotypes of II1 and II3.
4. Couple II4 and II5 are expecting a child. Calculate the risk for this couple to have an affected child.

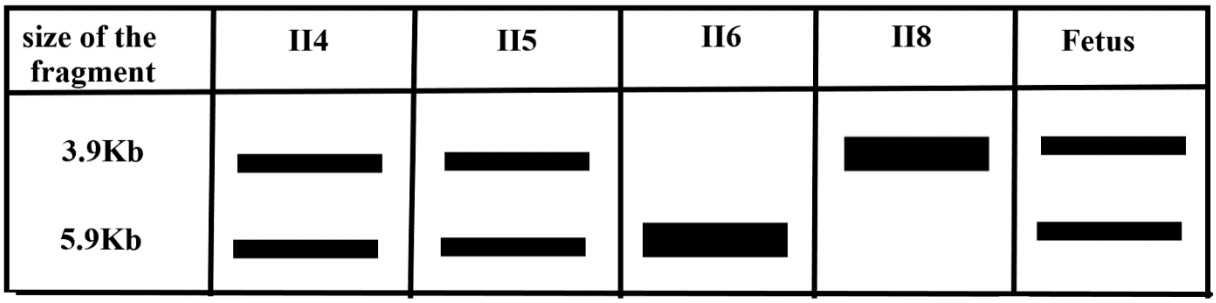
Document 2 reveals the cleavage sites at the level of a part of two alleles of this gene. A radiactive probe is used which is complementary to a specific sequence of the gene.

5. Indicate, for each of the two alleles, the number and the length of the restriction fragments obtained after cleavage with the restriction enzyme.



Document 2

Document 3 represents the electrophoresis obtained on the DNA of some family members.



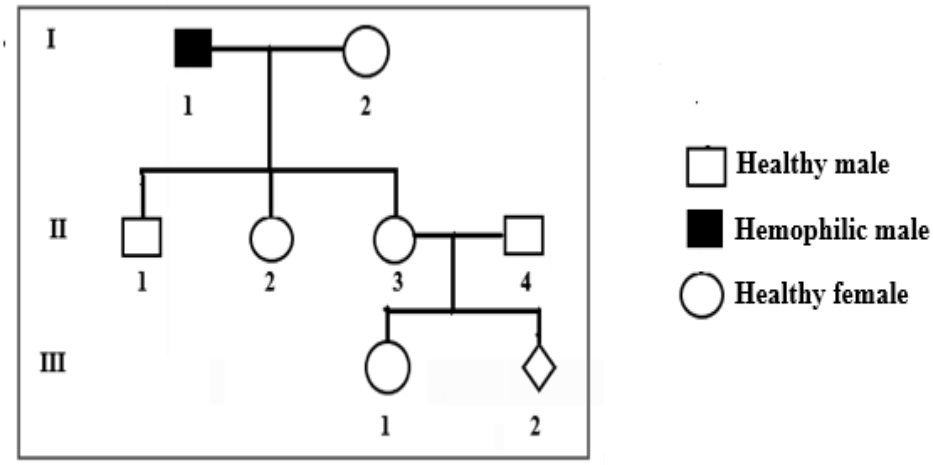
Document 3

6. Explain the absence of the 2Kb fragment in the electrophoresis presented in document 3.
7. Identify the normal and the mutant allele.
8. Establish a diagnosis of the fetus.

Exercise 2 (7 pts)

A chromosomal anomaly

Hemophilia B is a recessive lethal genetic disease characterized by the absence of blood clotting factor IX, which may lead to significant hemorrhage. This factor is the expression of a gene located on the non-homologous segment of the X chromosome. We designate, by **h**, the allele responsible for the disease and by **N** the normal allele. Document 1 shows the pedigree of a family that expresses the disease.



Document 1

1. Justify that the disease is recessive.

2. Specify the genotypes of I2, II1 and II3.

Couple II3 and III4 asked for a prenatal diagnosis of their fetus. To clarify the diagnostic problem of hemophilia in the fetus, ultrasound scan was done to determine the sex of the fetus. It revealed that it is a boy.

3. Show that the ultrasound scan result does not solve the diagnosis problem.

The doctor then prescribed the analysis of the DNA of chromosome X by Southern technique. The probe used permits to distinguish the mutated and the normal alleles of the implicated gene. Document 2 shows the nature and the number of alleles in some members of the family.

	Individual I1	Individual I2	Individual II3	Individual II4	Fetus
Number of allele responsible for the normal character	0	2	1	1	0
Number of allele responsible for the hemophilia disease	1	0	1	0	2

Document 2

4.1 Draw out the genotype of individual I2.

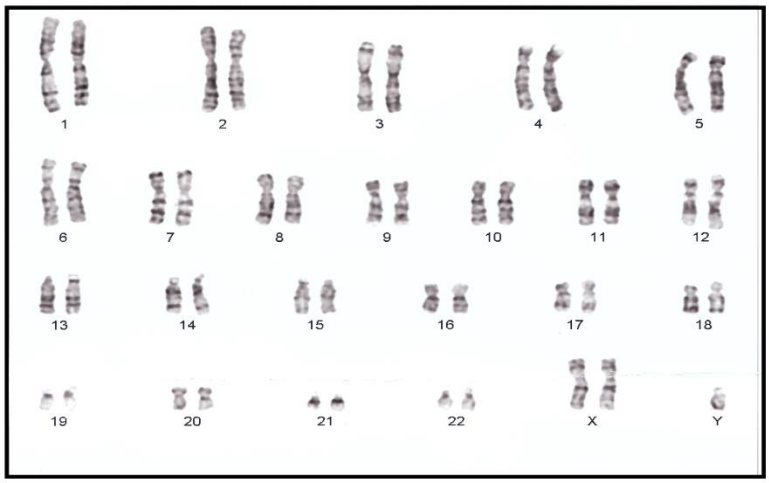
4.2 What advantage does a Southern technique provide?

5. Pose the problem that arises from the study of the result of the fetus.

The doctor supposes the existence of a chromosomal anomaly in the fetus and completed the diagnosis by establishing the karyotype of the fetus shown in document 3.

6. With reference to documents 2 and 3, verify the hypothesis formulated by the doctor.

7. Determine the parent responsible for the abnormality.



Document 3

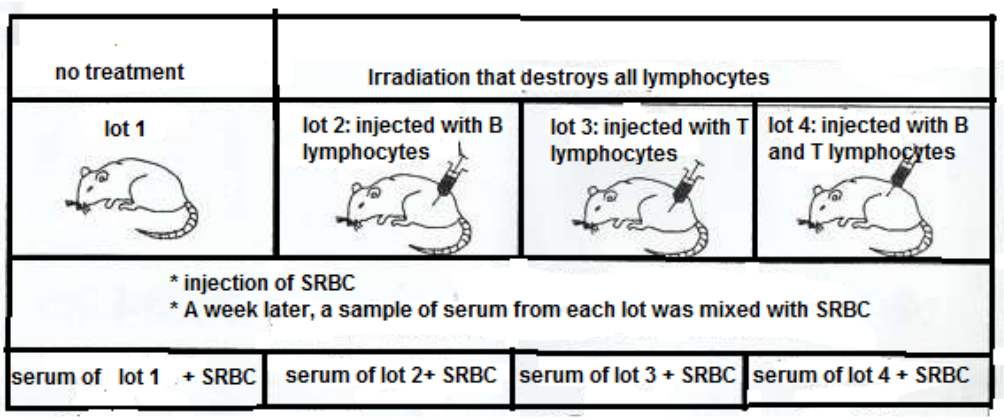
Exercise 3 (7 pts) Different aspects in the functioning of the immune system

A series of studies were performed to understand the different aspects in the functioning of the immune system observed upon contact with an antigen.

Study 1

To determine the conditions for the production of antibodies during the immune response, a series of experiments were performed on mice of the same strain.

Document 1 show the experimental procedure followed.



Document 1

The results obtained after the addition of the serum and of the SRBC are represented in document 2:

Lot of mice	**1**	**2**	**3**	**4**
Percentage of agglutination	**95**	**0**	**0**	**95**

Document 2

1. Represent in the form of a histogram the obtained results of document 2.

2. Indicate the aim of destroying the cells of the immune system before starting the experiment.

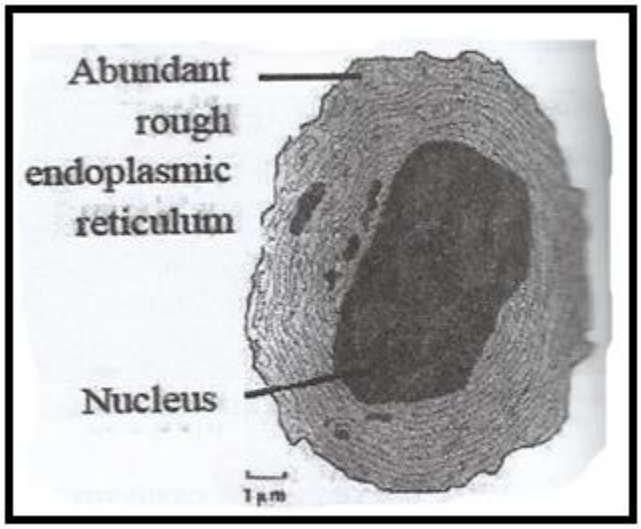
3.1 Analyze the results of the experiment.

3.2 Draw out the condition needed for antibody production.

Document 3 represents an electronography of an antibody secreting cell.

4.1 Name this cell.

4.2 Explain how this cell is adapted to the secretion of antibodies.



Document 3

Study 2

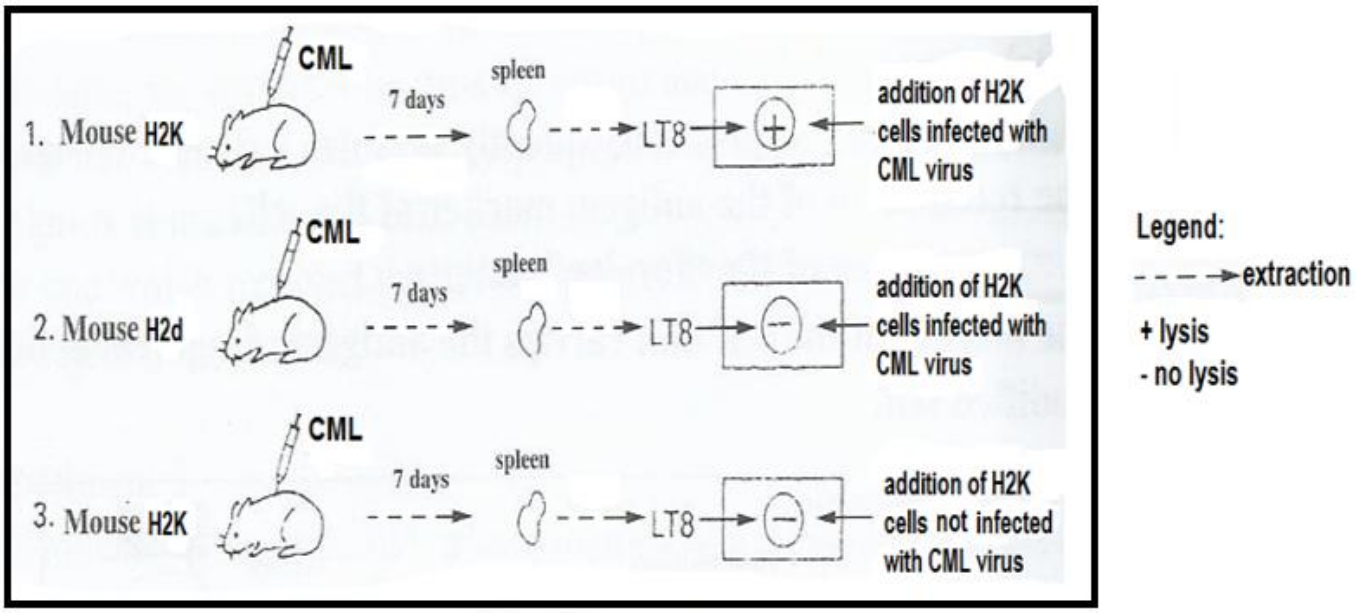
To investigate antibody action in contrast to TCR, some researchers succeeded in obtaining antibodies and TCR of the same antigen.

They added the antibodies to a solution of the antigens and agglutination was observed. On the contrary, the addition of the TCR to a solution of the antigens showed no reaction.

5. Explain the observed results.

Study 3: In mice as in humans, the nucleated cells carry on their surface,i.e within their cytoplasmic membrane, proteins that are called antigens which give the cells identity markers. These proteins form the MHC (major histocompatibility complex).

Choriomeningitis virus (CML) is a virus transmitted by rodents. It is not lethal to mice. To better understand the immune mechanism responsible for the lysis of cells, the experiments of document 4 were performed with two groups of mice carrying either the marker H2k or the marker H2d.



Document 4

6. Determine the mode of action of LT8.

7. Specify the type of immune response manifested against CML virus.

Good Work