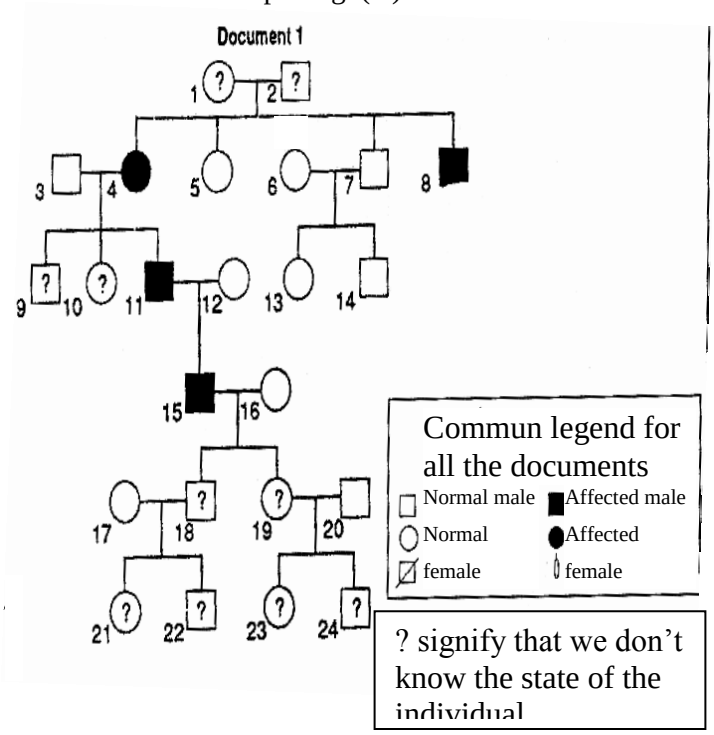
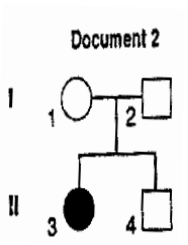
Class: 3 rd. Secondary (L. S.) **Final Exam** **Points:** 20 pts.
Subject: Biology **Duration:** 180 min.

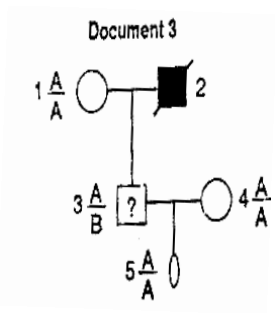
Exercise I: A hereditary disease, Huntington Chorea (5 pts)

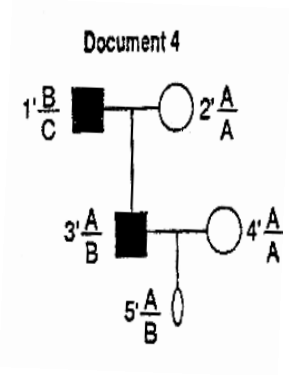
Huntington Chorea of is a rare hereditary disease, characterized by involuntary movements, progressive intellectual deficits, and various mental health disorders. But these symptoms generally appear, at a person, between 40 or 50 years of age.
The pedigrees below show the transmission of this disease in several families.

1- Is there a risk for a 60 year old individual to be affected by Huntington chorea? Justify your answer. (½)
2- Show that the pedigree of document 1 permits to prove that the mode of transmission of this disease is dominant autosomal. (1)
3- Determine the risk to be affected for individual 21 of document 1. (½)
4- Bearing in mind that this disease appears only at certain age, explain why the pedigree of document 2 is surprising. (½)









In certain families the determination for a fetus to be carrier of the allele of the disease can be done by the method of the genetic markers. There exists, near the locus of the gene intervening in the disease, a portion (P) of DNA which can exist in four allelic forms noted A, B, C and D; the portion P can easily be revealed during an examination of the chromosomes.
Sometimes the study in a family affected by the disease, of the transmission of the alleles of the portion P, in parallel to the transmission of the normal and mutant alleles, let possible to associate one of the four allelic forms (A, B, C, or D) with the mutant allele.
The results of this method done in two families are represented on Docs. 3 and 4.

5- Pick up from the text the statement that indicates that the gene of the disease and the portion P are linked. $(\frac{1}{2})$

6- Write in chromosomal form the genotypes of the individuals 1, 2, 1', and 2' from the documents 3 and 4 concerning at the same time the gene of Huntington chorea and the portion P. (½)

7- Explain why the fetus of the family of document 4 is likely to be affected by Huntington chorea while the fetus of the family of document 3 is not. (½)

8- Knowing that the genetic distance between the gene of the disease and the portion P is of 4 cM; make the necessary factorial analysis to determine the chance of this fetus (5' of document 4) to be normal. (1)

Exercise II: Regulation of glycemia (6pts)

In order to precise the role of insulin, the following experiments are realized.

A- A muscular tissue is placed in a convenient culture medium; we measure the amount of glucose absorbed by this tissue and its level of glycogen every 10 minutes.

Glucose absorbed (mg of glucose/g of muscle/10min)		Level of glycogen (in mg/g of muscle/10 min)	
Medium without insulin	Medium with insulin	Medium without insulin	Medium with insulin
1,43	1,88	2,45	2,85

Document 1: Behavior of muscle in a medium with or without insulin.

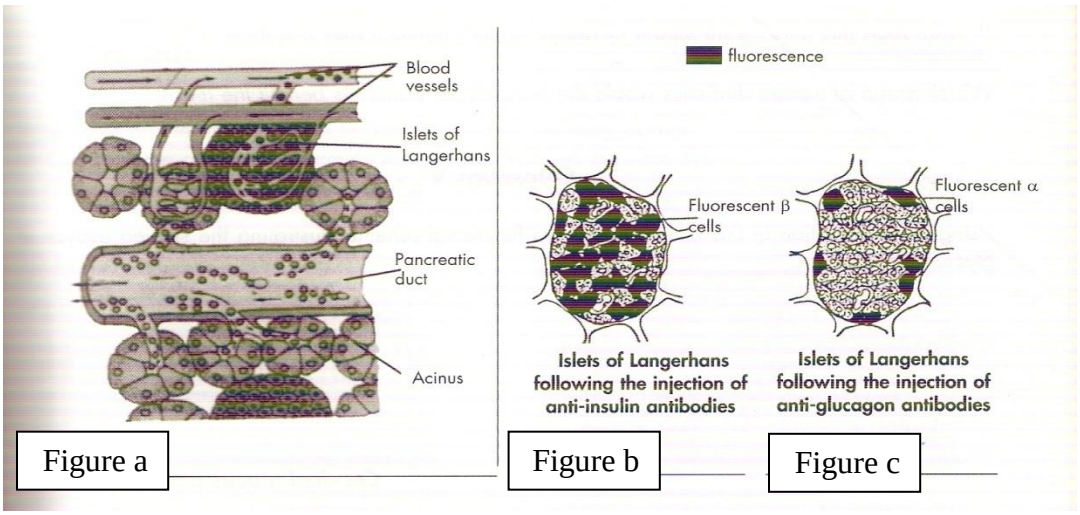
1- Construct a histogram that represents the results of glucose and glycogen in the two media (document 1).

B- We know that a diet rich in sugar puts on weight. In an animal submitted to an experimental diabetes (by destruction of cells secreting insulin), we notice that the formation of lipids in the adipose tissue is reduced to 90%.

C- Living tissues are placed in a culture medium containing radioactive glucose (having radioactive ^{14}C). We notice that these tissues consume oxygen gas and liberate radioactive carbon dioxide(^{14}C), and that this releasing of $^{14}CO_2$ increases if we add insulin to the culture medium.

2- Interpret the results of the experiments A, B and C and deduce the role of insulin.

D- Rabbit insulin is injected into a guinea pig that starts to produce rabbit anti-insulin antibodies. The antibodies are labeled in the immunized guinea pig's serum by attaching a fluorescent molecule. The islets of Langerhans taken from a rabbit's pancreas and put with these labeled antibodies indicate a fluorescence in the β cells(document 2,figure b).
Using the same technique, anti-glucagon antibodies labeled with the fluorescent molecule are fixed on α cells (figure c).



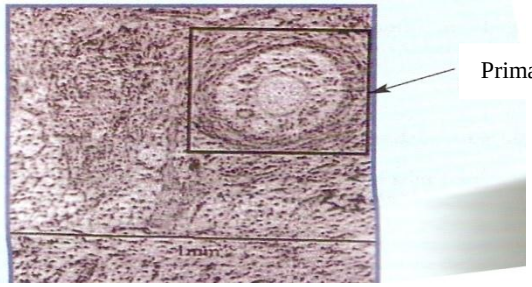
Document 2: results of fluorescence test on pancreatic cells

3- Analyze these experiments and draw out the role of the cells of the pancreas (α and β).

Exercise III: Regulation of the female sexual hormones. (5pts)

A- A young girl of 16 years old, of karyotype XX, presents the following symptoms:
-No development of breasts and an absence of menstruations.
The echography of the two ovaries reveals that they are of normal size. The biopsy of the ovaries of the patient at many times presents only the structures of document 1.

Document 1: morphologic and histological given



1- Formulate a hypothesis that explains the only presence of the structures found in document 1 and the absence of other types of structures in the ovaries of this young girl.

B- The hormonal dosages were done **during 28 days** in the blood of the young girl (the patient) and in the blood of a control woman which doesn't present these troubles. The results are in the document 2.

	In the blood of the patient	in the blood of a control woman which doesn't present these troubles
LH(in UI/L)	20 to 22	follicular Phase: 1,5 to 10 ovulatory peak: 18 to 90 luteal phase: 1 to 16
FSH (in UI/L)	< 0,5	follicular Phase: 2 to 17 ovulatory peak: 9 to 26 luteal phase: 2 to 8
Oestrogens (oestradiol) (in pg/ml)	24 to 26	follicular Phase: 30 to 90 ovulatory peak: 90 to 400 luteal phase: 50 to 20

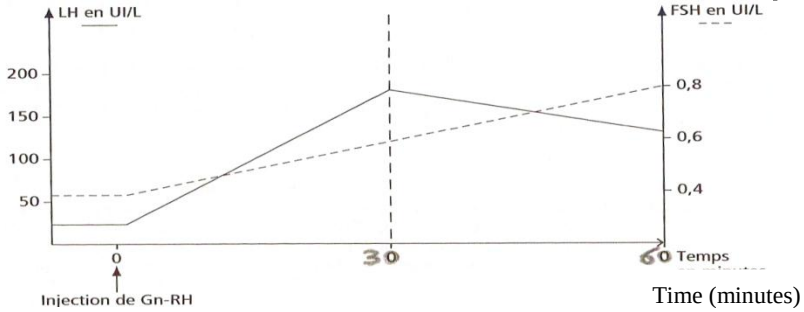
Document 2: Hormonal dosages during 28 days

2- Interpret the results of the hormonal dosages of document 2.

3- By referring to documents 1 and 2 and to your acquired knowledge, explain the origin of the symptoms observed in this young girl (no development of breasts and the absence of menstruations).

C- We realize an injection of 100 micrograms of GnRH. The results of this test are presented in the graph of document 3.

Document 3: Measures done in a hormonal test of stimulation on the patient.



4-Analyze the document 3 and deduce the convenient treatment of this girl.

Exercise IV: The specifis immune response (6pts)

From the spleen of a non-immunized mouse against Ag 1 (SRBC), Ag2, Ag3, an extract of millions of lymphocytes is removed.

These lymphocytes are placed in a medium containing many molecules of antigen Ag1, fixed on gelatin. Around **<u>0.01% of lymphocytes</u>** are fixed in this medium; the others are eliminated by Washing.

a- Precise the role of the spleen in the immune system.

b- Why do 0.01 % only of the lymphocytes fix on the antigens Ag1?

The retained lymphocytes are cultured with interleukins in microchambers 1, 2, 3 to which molecules of antigens Ag1 (SRBC), Ag2, Ag3 are introduced respectively as shown in the figure below. After few days, these cultures show the results of the table of document 1:

c- What is the importance of the interleukins added to the culture? In what conditions are they secreted in the body?

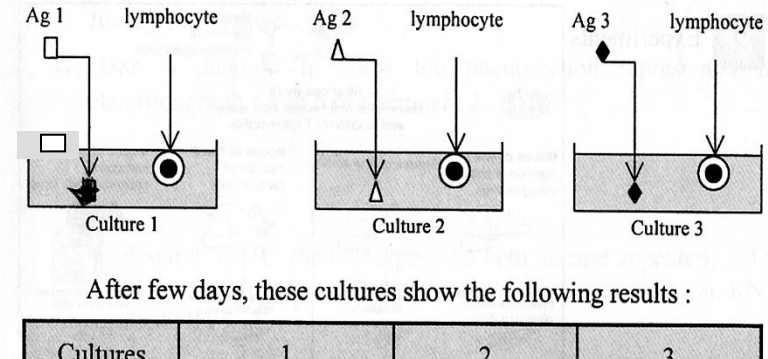
d- Analyze the obtained results. What can you deduce?

e- Why the retained lymphocytes can not be considered as LT?

For more information, an extract (E) is taken from microchamber 1. After it is placed in the presence of antigen Ag l and in different experimental conditions we observe the obtained results.

f- What do we name the result shown in the document 2-a? make an interpretation drawing.

g- Explain the results of the document 2-



After few days, these cultures show the following results :

Cultures	1	2	3
Results	Many cells	No change	No change

Document 1

a E + complement

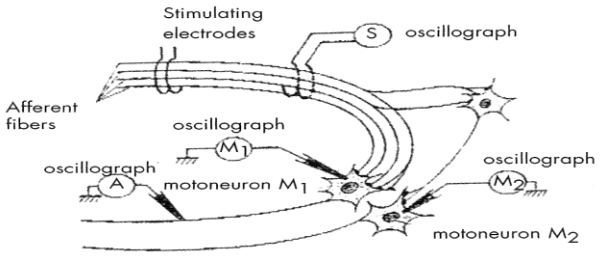
b E+ Macrophages

c E alone

and 2-c.

Exercise V: Integrating afferent impulses in the spinal cord (3pts)

A microelectrode is introduced in a motoneuron M1 and another in a motoneuron M2 both located in a mammal's spinal cord. These microelectrodes are respectively connected to oscillographs 1 and 2 to record the motoneurons' activity.
An oscilloscope A records the activity of the axon in the motoneuron M1.
An oscilloscope S records the action potentials from a series of fibers afferent to motoneurons M1 and M2 (document 1).



Document 1: Experimental set up

A- First set of experiments:
The afferent sensory nerve fibers are stimulated with increasing intensities of stimulations.
The results are shown in document2.

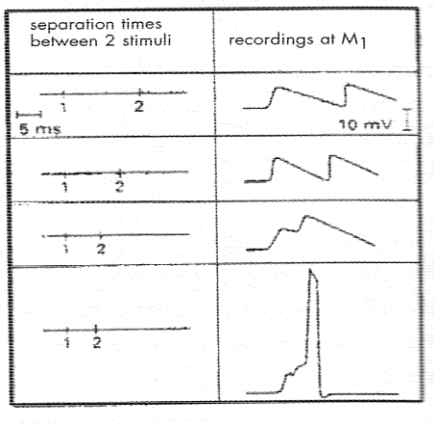
Recordings at S upon stimulation	Recordings at M_1	Recordings at A	Recordings at M_2
as stimulation 1	20 mV, −70 mV	20 mV, 0	10 mV, −70 mV
as stimulation 2	−70	0	−70
as stimulation 3	−70	0	−70
as stimulation 4	−70	0	−70
as stimulation 5	−70	0	−70, −74 mV

Document 2: results of stimulations

1- Interpret these experiments.

B- Second set of experiments:

The afferent fibers are subjected to two successive stimulations of the same intensity as that of document 2. The delay between the 2 stimulations of the same intensity varies. The responses are registered by the oscilloscope M1 and are illustrated in document 3.



Document 3:

2- Analyze the experiments of document 3 and deduce the integrating role of motoneuron.

Good Work