This is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Loucizeh - Baabda

Mock Exams : Pt1

9, 10, 11 MAY022

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

Subject :	Biology
Class :	12E
Teacher :	Christine Khalil
Duration :	2 hours

Please write your answers on a separate sheet of paper.

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 (7.5 points)

A. We perform the following experiments on an adult female monkey.

Experiment 1: The ablation of pituitary gland provokes multiple troubles, especially the disappearance of the ovarian cycle and the uterine cycle.

Experiment 2: The repeated injections of the extract of the anterior lob of the pituitary gland into this female restore the activity of the ovaries and the uterus.

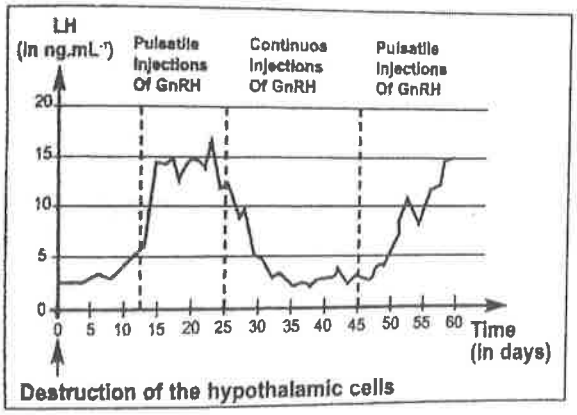
Experiment 3: The repeated injections of the extract of the anterior lobe of the pituitary gland into the same female after the ablation of the ovaries do not restore the uterine cycle.

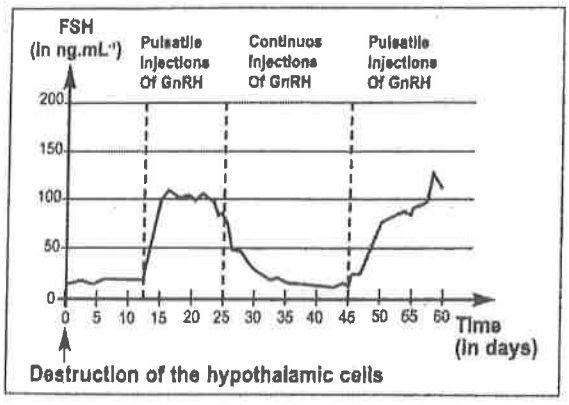
Experiment 4: When the anterior lobe of the pituitary is isolated and placed in an appropriate nutritive medium, the medium becomes enriched with FSH and LD.

a. Interpret these experiments. What can you deduce? (2.5)

B. Experiment 5: In another female monkey, we destroy certain specific hypothalamic cells. This female does not present any ovarian cycle or ovulation.

Experiment 6: We inject this female monkey with a substance (GnRH) extracted from the specific hypothalamic cells of another female monkey. The results, concerning the secretion of the pituitary are shown in the document below.





b. Interpret experiments 5 and 6. (1)

c. Referring to the information provided by the experiments of parts A and B, show how the ovary is under the control of the hypothalamus. (1)

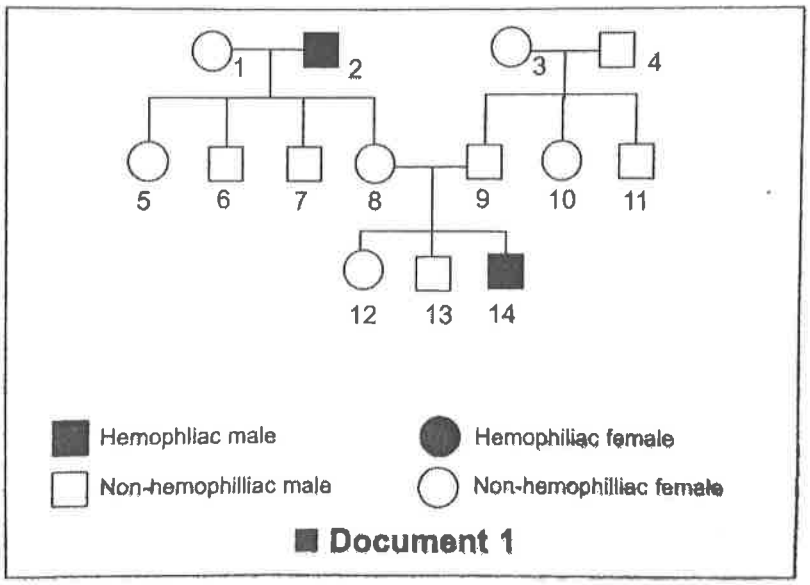
d. Explain how ovulation in women requires the intervention of ovarian hormones. (1)

e. Make a functional diagram to illustrate the hormonal mechanism that permits ovulation. (2)

Exercise 2 (9.5 points)

Parts A and B are independent.

A. Document 1 represents the pedigree of a family whose certain members, colored in black are affected by hemophilia B. This disease is observed only in male individuals. The presence of this gene in two copies in a genotype provokes the death of the embryo.



Document 1

a. Is the allele responsible for this disease dominant or recessive? Justify the answer. (1)

b. Is this gene sex linked? Justify the answer. (2)

c. Indicate the genotype of each of the individuals 8, 13 and 14. Justify, for each genotype, the answer. (1.5)

d. Make the necessary analysis to determine the possible proportions of the descendants of female 5 in each of the following cases:

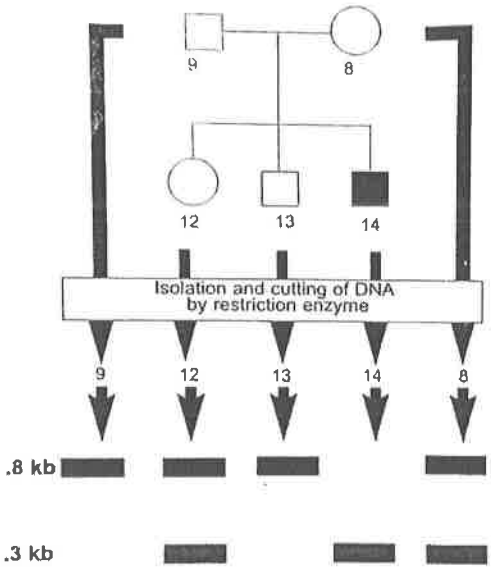
1. If her husband is not affected by hemophilia. (0.75)

2. If her husband is affected. (0.75)

We performed a special technique for the analysis of DNA of the couple 8-9 and their children 12,13, and 14.

We obtained different DNA fragments of variable lengths measured in kilo bases (document 2).

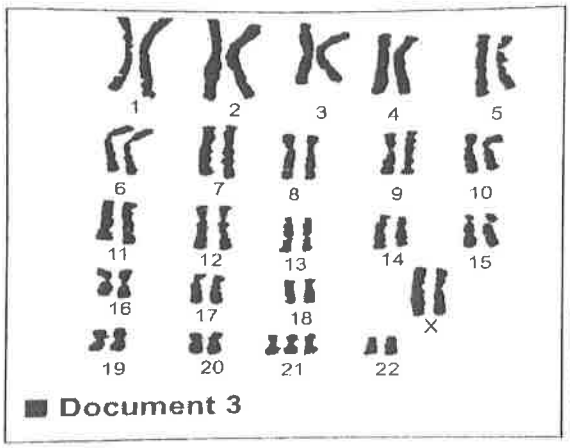
e. By referring to document 2, identify the allele of the hemophilia B. (1.5)



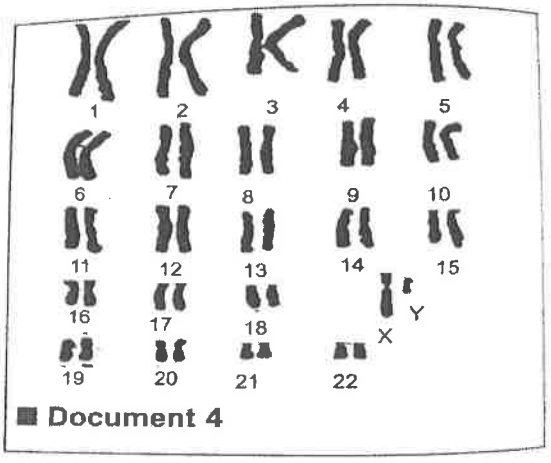
Visualization of DNA by a radioactive probe

■ Document 2

B. Document 3 presents the karyotype of an individual with an abnormality while document 4 presents the karyotype of a normal individual.



■ Document 3

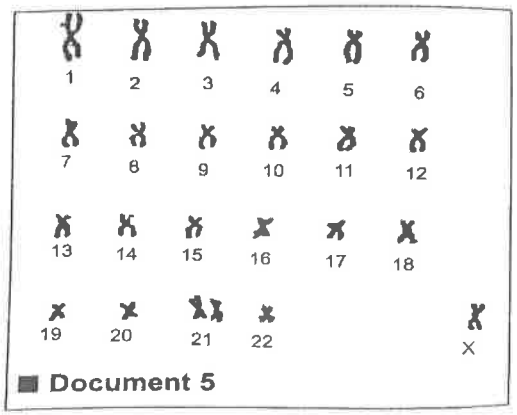


■ Document 4

f. Compare these two karyotypes. What is the abnormality revealed? (1)

Document 5 presents the karyotype of a spermatocyte II that is identical to that, which has allowed the birth of the individual affected by the abnormality in document 3.

g. Make a labeled diagram of the anaphase stage of the division that produces this type of spermatocyte II (draw only the sex chromosomes X and Y and the pair of chromosomes concerned with the disease). (1)



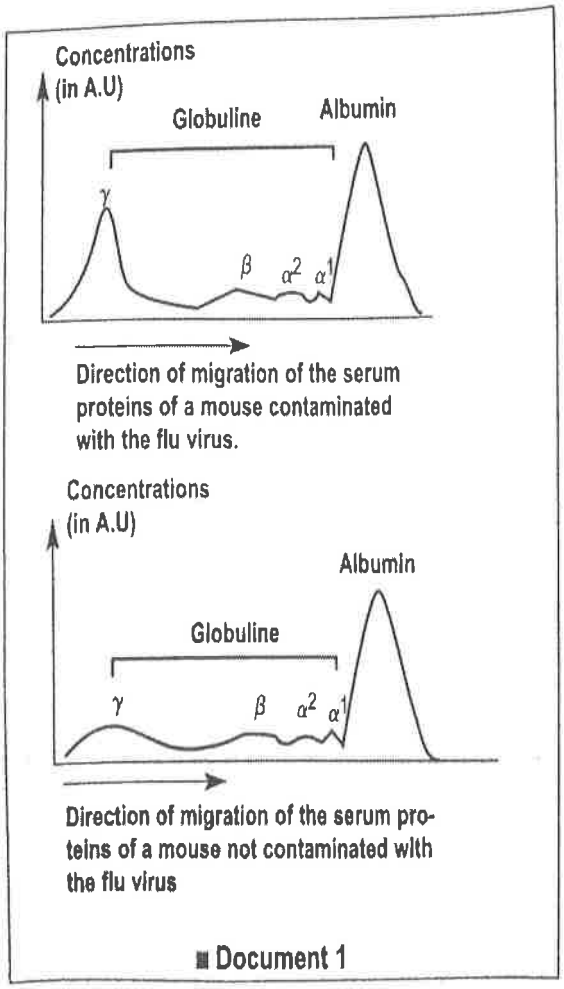
■ Document 5

Exercise 3

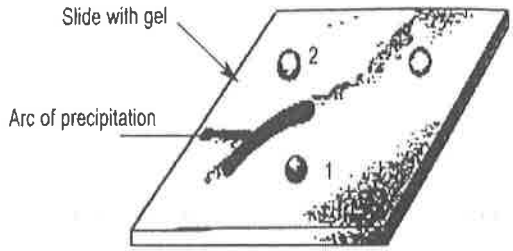
Mice are capable of fighting the flu virus. The following documents are related to the immune reactions of a mouse after it has been infected with the flu virus.

Document 1 represents the results of the separation, by electrophoresis, of the serum proteins of a mouse not contaminated with the flu virus and the serum proteins of another mouse contaminated with the flu virus.

Document 2 shows the result of immune diffusion on gel. The precipitation arc reveals the formation of an immune-complex between an antigen and the corresponding antibody.



■ Document 1

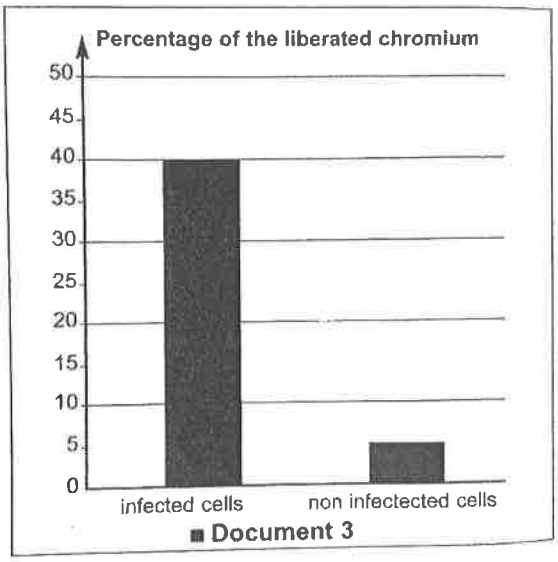


Well 1: globulin of a mouse mouse contaminated with the flu virus.
Well 2: solution of an antigen of the flu virus
Well 3: solution of an antigen of the hepatitis B virus

■ Document 2

We put some lymphocytes, taken from the spleen of a mouse contaminated with the flu virus since many days, in two different culture media. One medium contains cells infected by this virus and the other medium contains non-infected cells. All the cells are obtained from mice of the same strain. We previously incorporate in these cells (infected and non-infected) a small amount of radioactive chromium 51. The lysis of the target cells leads to the liberation of chromium into the culture medium. The quantity of liberated radioactivity is measured; it is proportional to the number of the destroyed cells.

Document 3 presents the result of this test (cytotoxicity test).



Document 3

Interpret the obtained results presented in the documents 1, 2 and 3.

Answer Key for Mocks Pt1 12E

Exercise 1 (7.5 points)

A. a. Experiment 1 shows that without a pituitary gland, the ovarian cycle and the uterine cycle disappear. This implies a functional relationship between the pituitary gland, the ovaries and the uterus. (0.5)

Experiment 2 shows that the injection of pituitary extracts permits the restoration of the cycles. Thus, the pituitary gland has an action on the ovaries and the uterus via an intermediate chemical substance. (0.5)

Experiment 3 shows that in a female deprived from her ovaries, the injections do not restore the uterine cycle. Thus, the pituitary gland has no direct effect on the uterus. (0.5)

Experiment 4 shows that the nutritive medium becomes enriched with FSH and LH which implies that the cells of the anterior lobe of pituitary gland secrete the hormones FSH and LH. (0.5)

The pituitary gland acts directly on the ovaries by the means of the hormones LH and FSH and indirectly on the uterus by the ovaries. (0.5)

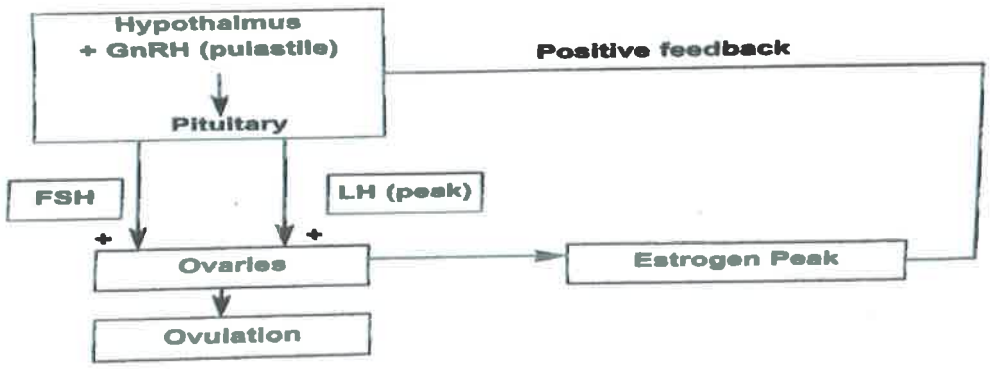
B. b. Experiment 5 shows that the destruction of certain cells of the hypothalamus results in the disappearance of the ovarian cycle and ovulation in the female monkey. Thus, the hypothalamus acts on the ovaries. (0.5)

The graphs in experiment 6 indicate that pulsatile injections of GnRH provoke an increase in the secretion of FSH and LH whereas the continuous injections do not have an effect on the secretion of these two hormones. Thus, GnRH secretion by the hypothalamus is pulsatile. (0.5)

c. The hypothalamus stimulates the pituitary gland by pulsatile secretion of GnRH (part B). The pituitary gland increases the secretion of FSH and LH that stimulate the activity of the ovaries (part A). (1)

d. At the 10^{tn} day, due to the growth of the follicle, the estrogen concentration peaks that results in the peaking of LH by positive feedback directly before ovulation. The hypothalamo-pituitary complex is then stimulated and the LH peak that appears is responsible for ovulation. (1)

e. Functional diagram of the mechanism of ovulation (2)



Exercise 2 (9.5 points)

A. a. The allele responsible for hemophilia is recessive because individual 14 is hemophiliac and his parents; 8 and 9 are healthy. The defective allele is present in the parents but is not expressed. Symbols: h for hemophilia recessive and N for healthy or non-hemophilia. (1)

b. Yes, because the presence of this gene in two copies provokes the death of the embryo. The hemophiliac boys thus, possess one allele h which is possible only if the inheritance is sex-linked and not autosomal. Therefore, this gene is found on a segment of sex chromosome, which has no homologous segment on the other chromosome.

If the gene responsible for the disease is on the non-homologous segment of the Y chromosome, the individual 14 (X Y^h) would have inherited Y^h from his father 9 who should be (XY^h) and should be affected, but this is not the case. Therefore, the gene is localized on the non-homologous segment of the X chromosome. (2)

c. Individual 8 is $X^N X^h$ since she is healthy. Being healthy, she must have the allele N, but since her father is sick, he gives her an X^h.

Individual 13 is $X^N Y$ since he is healthy, his chromosome X carries allele N.

Individual 14 is $X^h Y$ since he is sick, his chromosome X carries allele h. (1.5)

d. The genotype of female 5 is the same as that of female 8 $X^N X^h$ since her father is sick.

1st cas: genotypes: X^N/X^h x X^N/Y

gametes: 1/2 X^N 1/2 X^h 1/2 X^N 1/2 Y

Table

	1/2 X^N	1/2 Y
1/2 X^N	1/4 $X^N X^N$	1/4 $X^N Y$
1/2 X^h	1/4 $X^N X^h$	1/4 $X^h Y$

Analysis of table

1/4 $X^N X^h$ healthy carrier girl

1/4 $X^N X^N$ healthy girl

1/4 $X^N Y$ healthy boy

1/4 $X^h Y$ hemophilic boy

(3/4 pt)

2nd case: genotypes: X^N/X^h x X^h/Y

gametes: 1/2 X^N 1/2 X^h 1/2 X^N 1/2 Y

Table

	1/2 X^h	1/2 Y
1/2 X^N	1/4 $X^N X^h$	1/4 $X^N Y$
1/2 X^h	1/4 $X^h X^h$	1/4 $X^h Y$

Analysis of table

$X^h X^h$ hemophilic girl: born dead

1/3 $X^N X^h$ healthy carrier girl

1/3 $X^N Y$ healthy boy

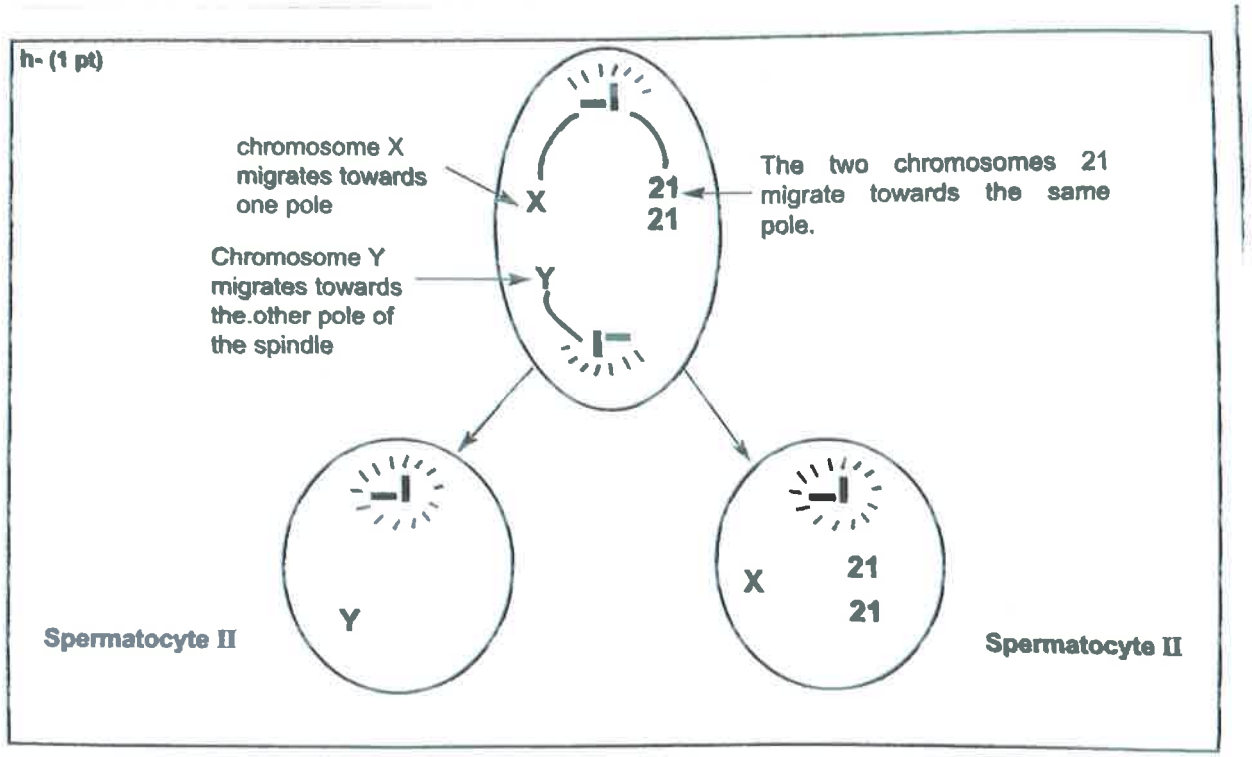
1/3 $X^h Y$ hemophilic boy

(3/4 pt)

e. The comparison between electrophoreses 9 and 13 of healthy men on one hand and the electrophoresis of individual 14, hemophiliac man, on the other hand, permits to say that the radioactive band of 1.3 kb, which characterizes the allele h, is responsible for hemophilia B. (1.5)

f. The karyotype of the normal individual shows the sex chromosomes X and Y. All its autosomes are present in pairs. The karyotype of the affected individual shows the sex chromosomes X and X. All its autosomes are present in pairs except chromosome 21 that exists in three copies (trisomy 21). (1)

g.



Exercise 3 (3 points)

The concentration of γ-globulins in the mouse contaminated with the flu virus is considerably elevated compared to the non-contaminated mouse. On the contrary, the concentration of the β, α^1 and α^2 globulins and that of albumin are identical in the two mice. That reveals that the production of the γ-globulins is linked to the sickness (reaction to the infection), document 1. (1)

The γ-globulins of the contaminated mouse, deposited in the central well 1 on the slide of immunodiffusion on gel, formed a precipitation arc with the solution of the flu virus antigen deposited in well 2. A reaction had taken place between the anti-flu virus γ-globulins and the antigen of the virus; which indicates that γ-globulins are antibodies. On the contrary, the absence of a precipitation arc between wells 1 and 3, shows that the anti-flu virus γ-globulins had not bound to the antigen of hepatitis B virus, which indicates that these γ-globulins have a specific action (document 2) (1).

Document 3 reveals that the percentage of liberated chromium is 8 times greater in the case of infected cells (40%) than in the case of non-infected cells (5%). Since the percentage of the liberated chromium is proportional to the number of destroyed cells, therefore the infected cells only are destroyed significantly by the lymphocytes taken from the spleen of the contaminated mice. (1)