

الاسم: مسابقة في مادة علوم الحياة
الرقم: المدة: ثلاث ساعات

Exercise 1 (5 points)

Transmission of Two Genetic Anomalies

Majida and Tarek wish to marry. Majida belongs to a family whose some members are affected by albinism, while Tarek has in his family affected cousins by another anomaly, daltonism. This couple consults a doctor to determine the risk of having children affected by the two concerned anomalies.

Document 1 represents the pedigree of Majida's family.

- 1- Indicate whether the allele of albinism is dominant or recessive. Justify the answer.
- 2- Determine the chromosomal localization of the gene responsible for this anomaly.

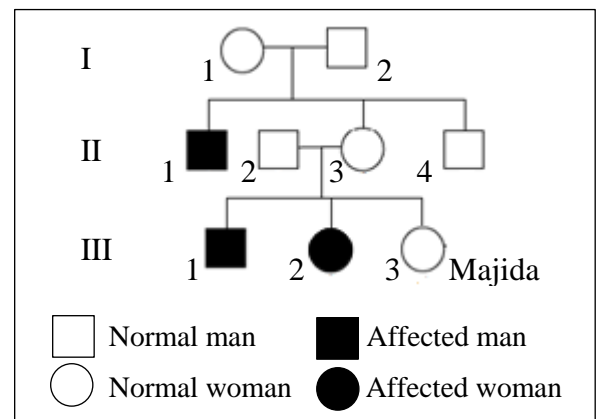
The gene of daltonism is localized on the non- homologous segment of chromosome X and exists in two allelic forms, a normal allele and a mutant allele responsible for daltonism. Document 2 shows the obtained results of the electrophoresis performed on the two alleles of the daltonism gene of Tarek and his parents who are all non daltonian.

- 3- Show that the allele responsible for daltonism is recessive.
- 4- Specify which of the two alleles, 1 or 2, is responsible for this anomaly.

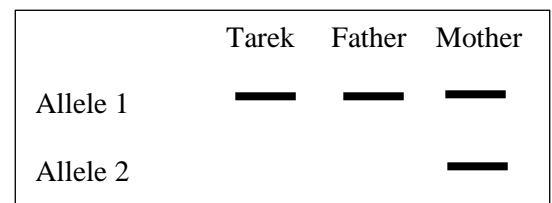
The doctor requests several tests to detect the presence of the mutant allele of albinism and the mutant allele of daltonism for Majida and Tarek.

The results are represented in document 3.

- 5- Write, referring to document 3, the genotype of Majida and that of Tarek for the two studied genes.
- 6- Indicate the gametes produced by Majida and those produced by Tarek.
- 7- Verify if this couple could have a child affected by the two studied anomalies at the same time.



Document 1



Document 2

		Majida	Tarek
Gene of albinism	Normal allele	—	—
	Mutant allele	—	—
Gene of daltonism	Normal allele	—	—
	Mutant allele	—	

Document 3

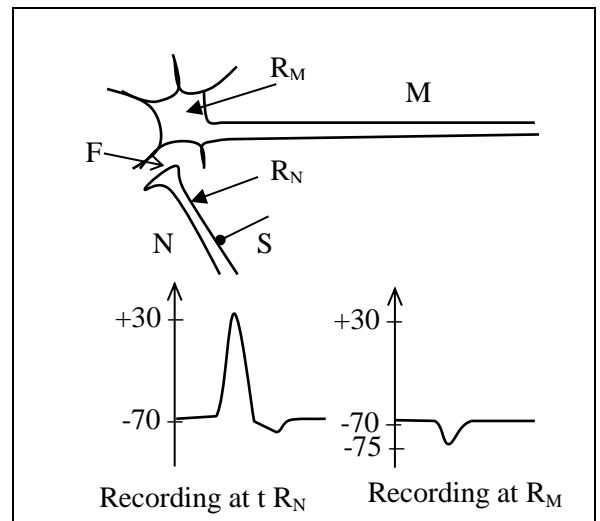
Exercise 2: (5points)

Mode of Action of a Relaxant: Valium

To determine the mode of action of valium, a relaxant prescribed against anxiety, the following experiments are performed.

An effective stimulation **S** is applied on neuron **N**.

Document 1 shows the utilized experimental set-up and the results recorded by the oscilloscope connected to the recording electrode **R_N** at the level of axon of neuron **N**, and that recorded by the oscilloscope connected to the recording electrode **R_M** at the level of the cell body of the motor neuron **M**.



Document 1

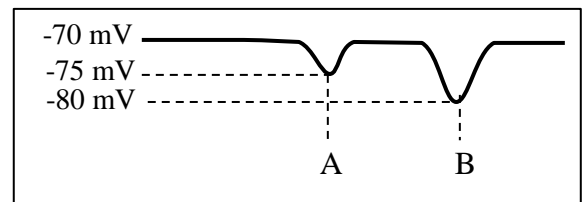
- 1- Specify the nature of the synapse between neuron **N** and the motor neuron **M**.
- 2- List the steps of the synaptic transmission.

In the absence of any stimulation, we inject in the synaptic cleft **F**:

Situation A: a dose **D** of a neurotransmitter, GABA.

Situation B: the same dose **D** of GABA with an equivalent dose of valium.

The recordings obtained at level of **R_M** are presented in document 2.



Document 2

- 3- Interpret the obtained results in document 2.

The postsynaptic membrane of the motor neuron **M** has chemical-dependent channels of **Cl⁻** ions. Document 3 shows the ionic concentrations of **Cl⁻** ions in the intracellular and extracellular media of this motor neuron in the absence of any stimulation.

	Extracellular medium	Intracellular medium
Ionic concentration of Cl⁻	560 mol.L ⁻¹	40 mol.L ⁻¹

Document 3

The state of chemical-dependent **Cl⁻** channels of the postsynaptic membrane of the motor neuron **M** is monitored in the two previously listed experimental situations, **A** and **B**. Document 4 reveals the obtained results.

Valium fixes on specific sites of the **Cl⁻** channel receptors. This binding activates the fixation of GABA on other sites of the same **Cl⁻** channel receptors.

	Duration of the opening of Cl⁻ channels (ms)	Number of opening of Cl⁻ channels per second
Situation A	23	48
Situation B	29	92

Document 4

- 6- Determine the mode of action of valium.

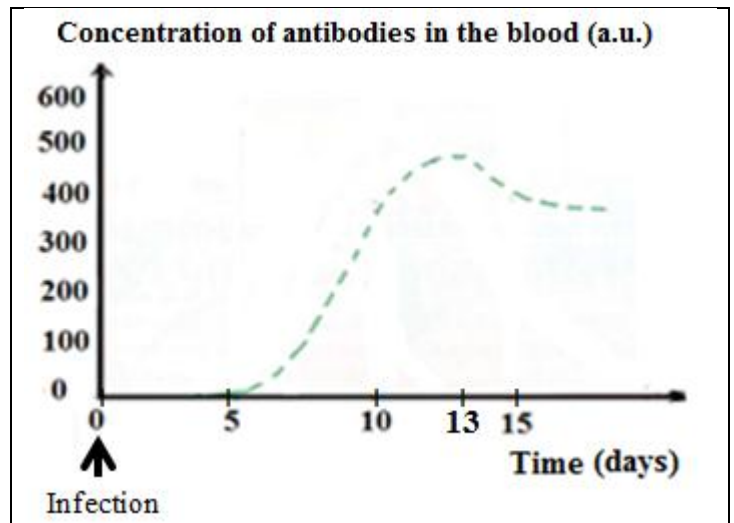
Exercise 3 (5 points) Immune Responses Against Flu Virus

In the framework of studying the immune responses against the flu virus, several observations and experiments are performed.

First observation: Individuals who are infected by the flu virus show signs of an inflammatory reaction.

- 1- List the four signs of the inflammatory reaction.

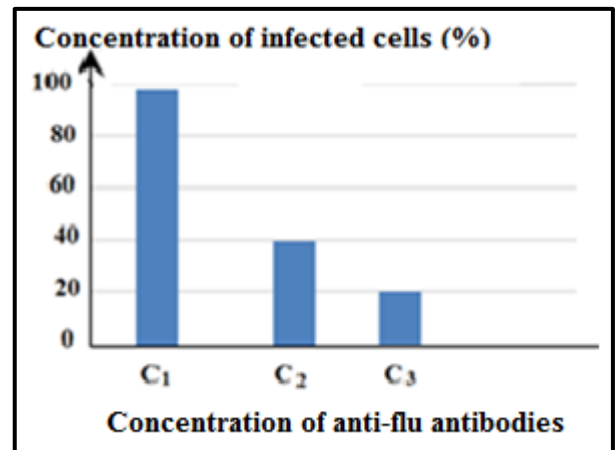
Second observation: Document 1 presents the variation of the concentration of anti-flu antibodies as a function of time, following the infection by the flu virus.



Document 1

- 2- Identify the type of the specific immune response revealed by the results of document 1.

Experiment 1: The flu virus and anti-flu antibodies of increasing concentrations, C_1 , C_2 and C_3 , are added to different culture media containing human cells. The concentration of the infected cells is measured and the obtained results are presented in document 2.



Document 2

- 3- Interpret the obtained results.

Experiment 2: The action of antibodies does not permit the elimination of the cells infected by the flu virus. The monitoring of the number of cytotoxic T lymphocytes (T_c) and the infected cells in an individual infected by the flu virus shows the results presented in document 3.

Time (days)	0	3	7	9	13	15
Number of T_c cells	0	0	300	500	100	50
Number of infected cells	50	100	200	150	10	0

Document 3

- 4- Draw the graph showing the variation of the number of infected cells and that of T_c cells as a function of time.
- 5- Specify the type of the specific immune response revealed by the results presented in document 3.

Third observation:

Clinical observations show that the flu virus may be fatal in some individuals showing deficiency in T_H lymphocytes (case of AIDS).

- 6- Explain this observation.

Exercise 4 (5 points)

Hormonal Origin of a Disease

Sara, a 16 year-old girl consults a doctor to check the cause of the following symptoms: absence of breast development and absence of menstruation. The doctor requests hormonal tests and biopsies for Sara's ovaries to know the origin of these symptoms. The results of the blood concentration of estradiol during 28 days are presented in document 1.

	Sara	16 year-old normal girl (control)
Concentration of estrogen (Estradiol) (Pg / mL)	Around 15	Follicular phase : 30 to 90 Ovulatory peak : 90 to 400 Luteal phase : 50 to 20.

Document 1

- 1- Draw out, referring to document 1, a possible cause of the observed symptoms.

The results of biopsies performed on Sara's ovaries at different time intervals reveal the presence of only primary follicles.

- 2- How do the results of the biopsies explain the concentration of estradiol noticed in Sara's blood?

Blood concentration of hormones	Sara	16 year-old normal girl (control)
LH (IU/L)	5 to 7	Follicular phase: 1.5 to 10 Ovulatory Peak: 18 to 90 Luteal phase: 1 to 16
FSH (IU/L)	< 0.5	Follicular phase : 2 to 17 Ovulatory peak : 9 to 26 Luteal phase : 2 to 8

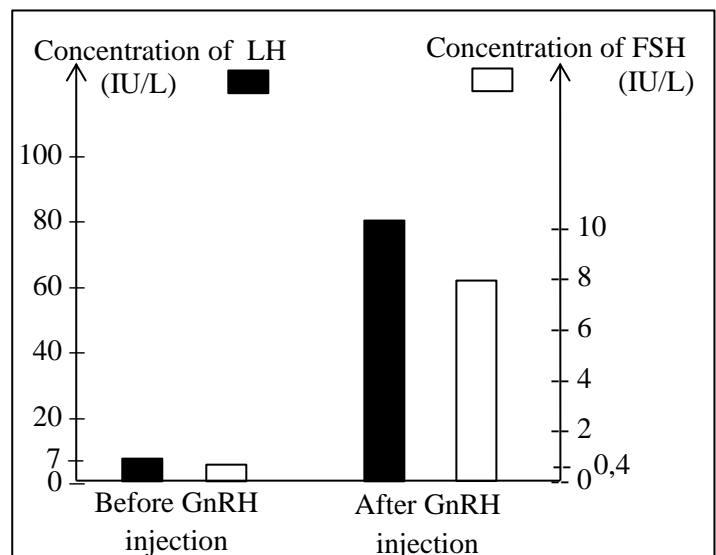
Document 2

The FSH and LH concentrations in the blood are measured during 28 days. The results are shown in document 2.

- 3- Indicate the roles of FSH and LH hormones.
- 4- Analyze the obtained results.

The origin of these hormonal results could be due to either a defect in the secretion of GnRH by the hypothalamus or to a defect in the receptors specific to GnRH located at the level of the anterior pituitary gland.

To determine the origin of these hormonal troubles, the concentrations of FSH and LH in Sara's blood are measured before the injection of 100 microgram of GnRH and 30 minutes following this injection. The results are shown in document 3.



Document 3

- 5- Pick out the formulated hypotheses.
- 6- Which hypothesis is validated by the results of document 3? Justify the answer.