مسابقة في مادة علوم الحياة

المدة: ثلاث ساعات

(إنكليزي)

الاسم:.....

الرقم:.....

Exercise 1 (5 points) **Transmission of Two Genetic Anomalies**

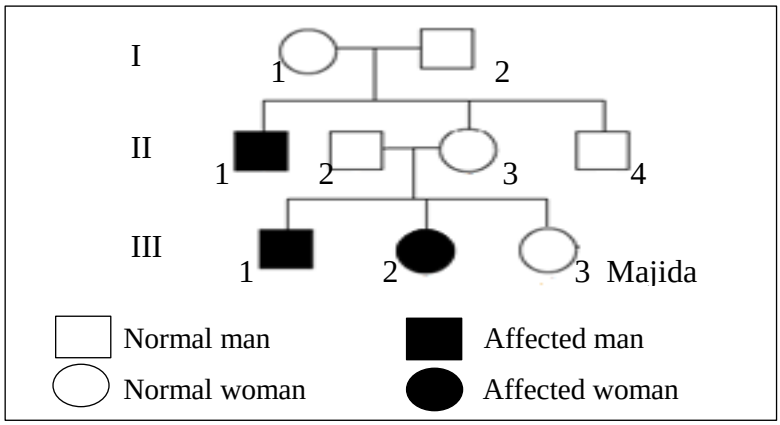
Majida and Tarek wish to marry.

Majida belongs to a family whose some members are affected by albinism.

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.



Document 1

1- **Indicate** whether the allele of albinism is dominant or recessive.

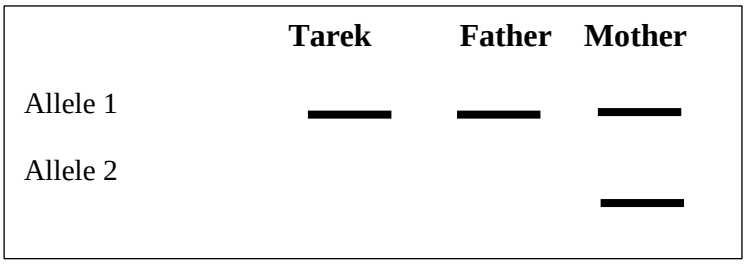
Justify the answer, by referring to the couple II2 and II3 (normal mother and father) that have affected children.

2- **Show that** the gene responsible for this anomaly is located on an autosome chromosome**.**

The gene of daltonism is localized on the non- homologous segment of chromosome X and exists in two allelic forms:

- One normal allele.
- The other is 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.



Document 2

3- **Show that** the allele responsible for the disease is recessive.

4- **Choose** the correct answer to specify which of the two alleles , 1 or 2, is responsible for this anomaly:

a- Allele 2 is responsible for this anomaly, because Tarek and his father that are of normal phenotype possess one band corresponding to the allele 1 which is normal.

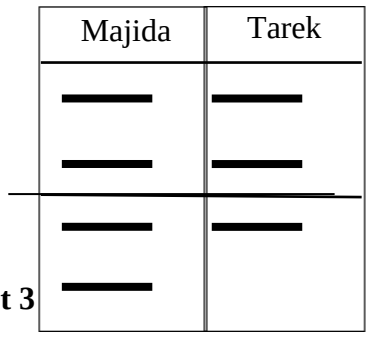
b- Allele 1 is responsible for this anomaly, , because Tarek and his father that are of normal phenotype possess one band corresponding to the allele 1.

c- Allele 1 is responsible for this disease, because the mother of normal phenotype possesses two bands.

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.

Gene of albinism	Normal allele Mutant allele
Gene of daltonism	Normal allele Mutant allele



Document 3

5- - Let **A** be the symbol of the normal allele which is dominant with respect to the mutant allele of albinism.

- Let **a** be the symbol of the mutant albino allele which is recessive with respect to the normal allele.

- Let **D** be the symbol of the normal allele which is dominant with respect to the mutant allele of daltonism.

- Let **d** be the symbol of the mutant daltonian allele which is recessive with respect to the normal allele.

Write , referring to document 3, the genotype of Majeda and that of Tarek for the two studied genes.

6- **6.1- Indicate** the four types gametes produced by Majida.

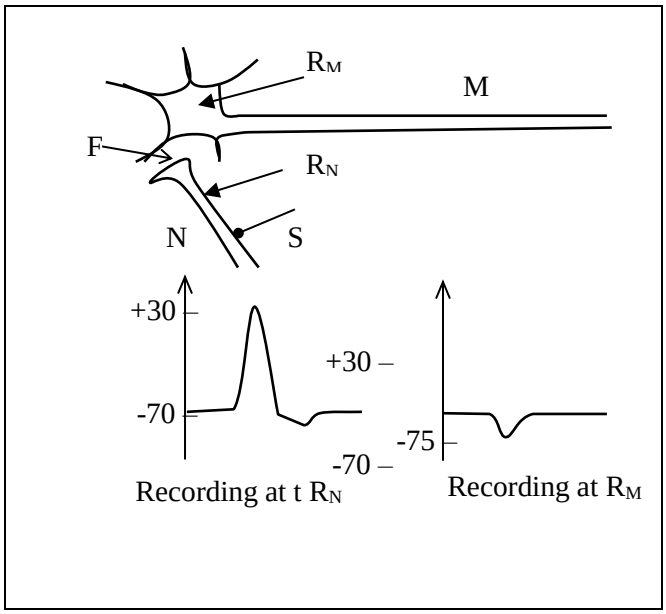
6.2- Indicate the four types gametes produced by Tarek.

7- This couple could have a child affected by the two studied anomalies at the same time. **Justify your answer.**

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 $\mathbf{R_N}$ at the level of axon of neuron N, and that recorded by the oscilloscope connected to the recording electrode $\mathbf{R_M}$ at the level of the cell body of the motor neuron M.



Document 1

1- **1.1- Indicate** the nature of the synapse between neuron N and the motor neuron M.

1.2- Justify your answer.

2- **Arrange** in order the following listed steps of the synaptic transmission:

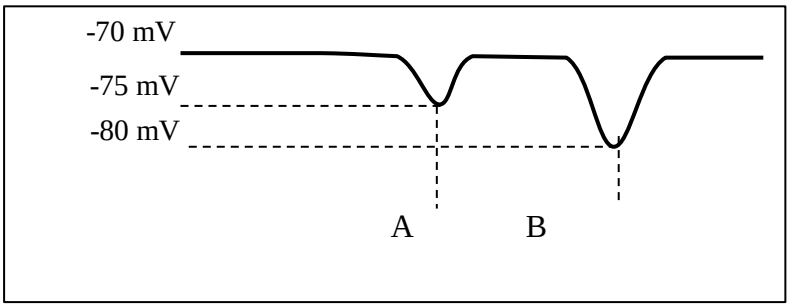
- Appearance of PSP at the level of the postsynaptic element.
- Liberation of neurotransmitters by exocytosis.
- Arrival of presynaptic action potential.
- Fixation of the neurotransmitters on the postsynaptic receptors.
- Opening of calcium channels and entrance of calcium ions through the presynaptic membrane.
- Opening of chemical dependent channels.
- Recapturing or degradation of the neurotransmitters.

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 $\mathbf{R_M}$ are presented in document 2.



Document 2

3- 3.1- Analyze the obtained results in document 2.

3.2- What can you conclude?

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

4- Define chemical-dependent channels.

5- The Cl^- **ions** diffuse from a medium of high concentration to a medium of low concentration.

5.1- Indicate the direction of movement of Cl^- ion across the postsynaptic membrane of the motor neuron M following the opening of the Cl^- channels.

5.2- Justify the answer.

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.

	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

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.

6- **6.1- Compare** the duration of the opening of Cl^- channels in the situation A and in the situation B.

6.2- Compare the number of the opening of the Cl^- channels in the situation A and in the situation B.

6.3- What do you **conclude**?

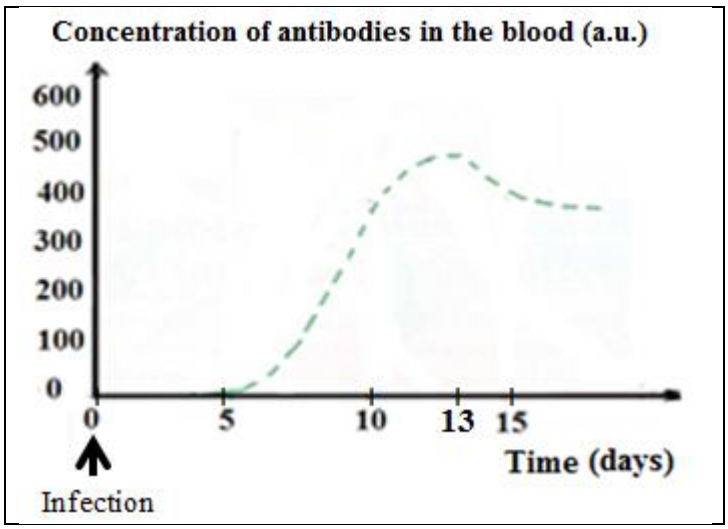
Exercise 3 (5 points) **Immune Responses Against Flu Virus**

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.

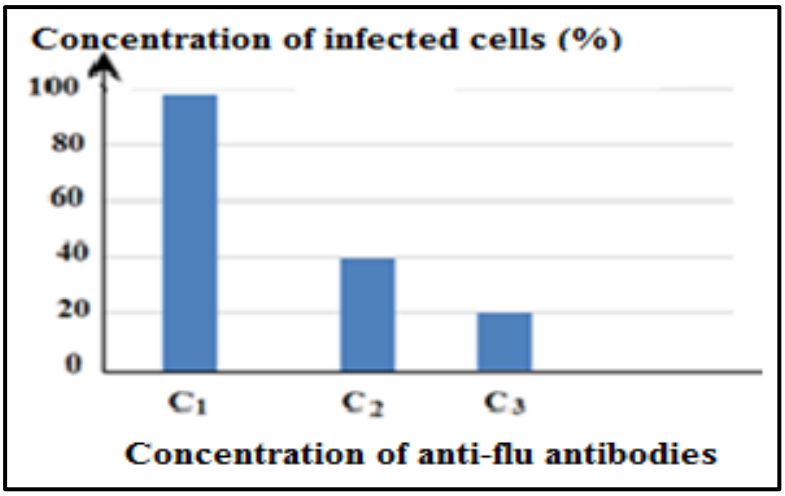
Second observation: Document 1 presents the variation of the concentration of anti-flu virus antibodies as a function of time, following the infection by the flu virus.



Document 1

2- **Show that** the specific immune response revealed by the results of document 1 is humoral immune response.

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- **3.1- Analyze** the obtained results.
3.2- What do you **conclude**?

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 (Tc) 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 Tc 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 Tc cells as a function of time.

5- **Show that** the specific immune response revealed by the results of document 3 is cell mediated immune response.

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- 6.1- **Name** :

— the cells infected by the HIV virus.

— the cells implicated in each of the immune responses against the flu virus

6.2- **Indicate** the role of T4.

6.3. **Explain** why the absence of T4 affect the immune response against the flu virus.

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.
- Absence of menstruation.

To know the origin of these symptoms the doctor demands :

- The hormonal concentration.
- The Biopsies of the ovaries

The results of the concentration of estradiol in blood 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- Explain, using this information, (the absence of primary follicular development), the low level of estrogen of Sara.

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

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

3- **Complete** by FSH or LH the following statement:

…….stimulate the transformation of the follicle into yellow body.

…….stimulate the follicular development and the maturation of the cavitary follicle.

4- **Compare** referring to document 2:

4.1- The level of **LH** of Sara and that of the normal girl of 16 years old.

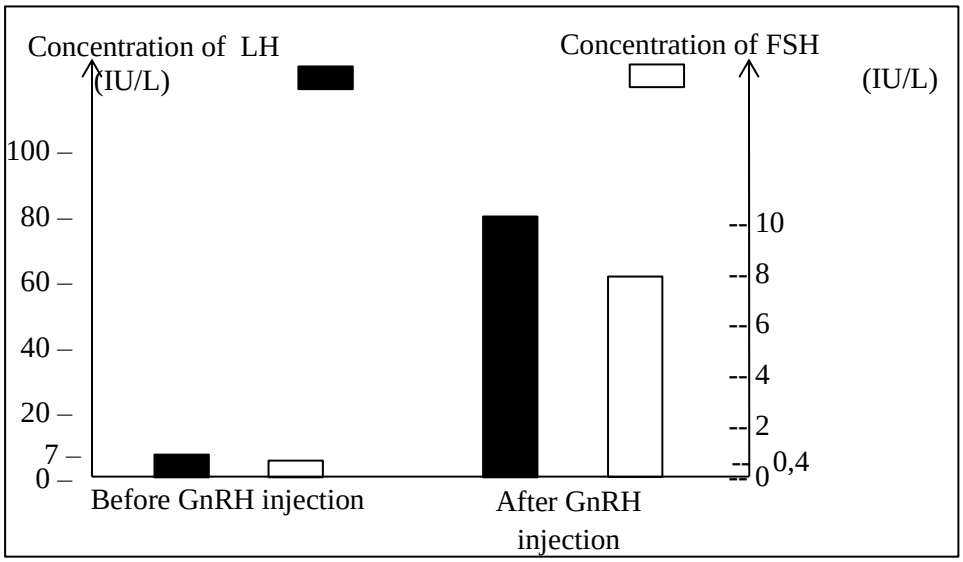
4.2- The level of **FSH** of Sara and that of the normal girl of 16 years old.

The origin of these hormonal results could be:

1- Due to a defect in the secretion of GnRH by the hypothalamus.

2- Due 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 concentration 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- Show that hypothesis 1 validates the results of document 3.