Question -31-

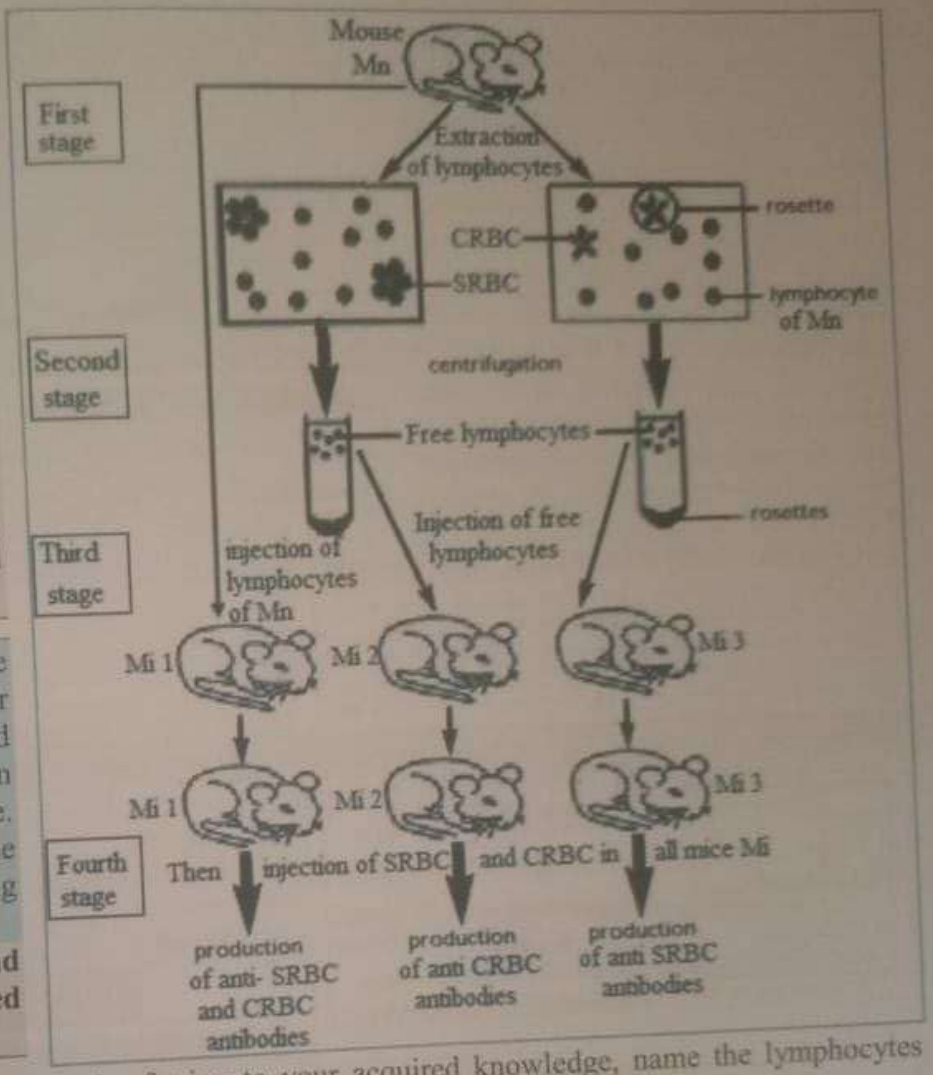
Specific recognition of foreign (non self) agents in the organism is required to achieve a truly effective immune response.

After few days of the injection of sheep red blood cells (SRBC) and chicken red blood cells (CRBC) into a lot of normal mouse, the mice secrete anti-SRBC and anti-CRBC antibodies.

Other mice are subjected to a treatment with immunosuppressors. This treatment renders these mice immunodeficient (Mi).
When these mice are injected with sheep red blood cells (SRBC) and chicken red blood cells (CRBC), they never secrete anti-SRBC and anti-CRBC antibodies.

An experiment is done on mice (histocompatible) that have never received an injection of sheep red blood cells (SRBC) and chicken red blood cells (CRBC) before. The experimental protocol and the results are shown in the following document:

Note: In rosettes we find lymphocytes binding to red blood cells



1- Based on the given experiments and referring to your acquired knowledge, name the lymphocytes found in rosettes in both cases. Justify your answers.

2- Describe the experimental steps and list the results.

3- Name the involved immune response organized or mounted against the mentioned antigens (SRBC'S and CRBC'S). Justify.

Question -32- Some aspects of functioning of the immune system.

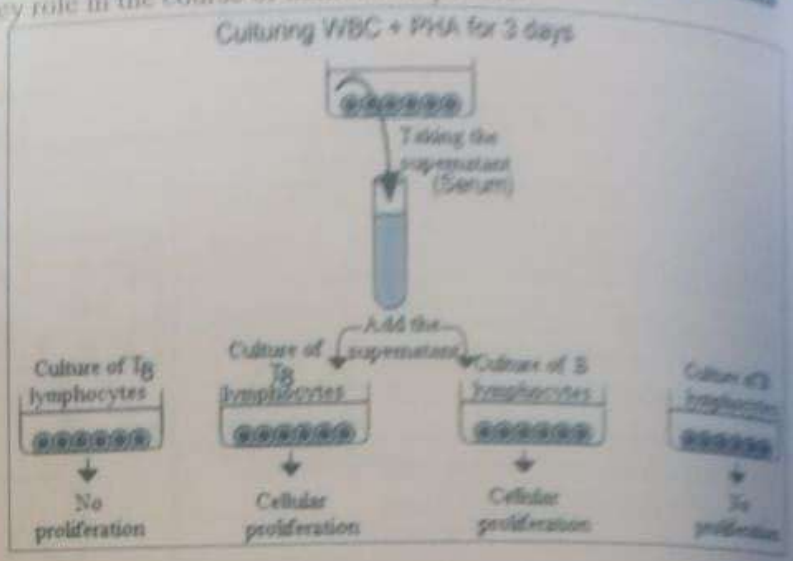
Among immune cells, T4 cells have a key role in the course of immune responses.

Document 1: Experiment done by Morgan and Ruscetti (1975)

From a blood sample taken from a healthy individual, a mixture of WBC enriched with T_4 lymphocytes is prepared by centrifugation.

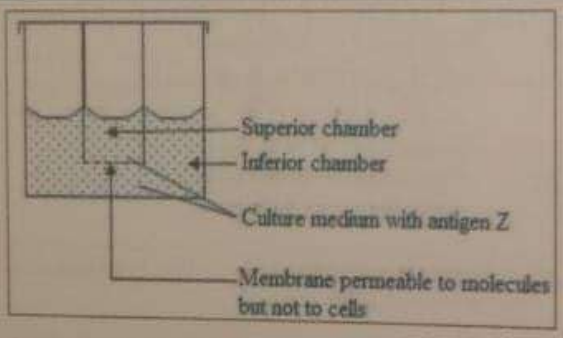
The cells are cultured in the presence of a substance, PHA, which acts as an antigen. The supernatant of this culture is collected and introduced into cultures of T_8 or B lymphocytes that do not divide before the introduction of serum.

Note: the supernatant doesn't contain cells, only molecules found in the culture solution.



1- Interpret the obtained results, what can you conclude?

Document 2: Culture device in Marbrook chamber and results:



The results of the different cultures are shown in the table below:

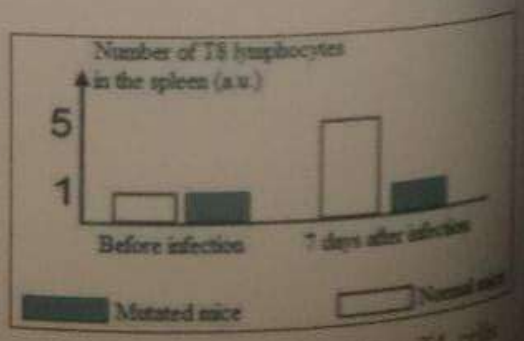
Cultures	Nature of sensitized lymphocytes placed in the chamber		Number of plasmocytes secreting anti-Z in the inferior chamber
	superior	Inferior	
1	-	T_4+B	960 x10
2	-	B	72 x10
3	T_4	B	1011 x10

2- Interpret the obtained results.

Document 3: Histogram showing the variation of the number of T_8 lymphocytes in the spleen of two mice after an infection with a virus.

⇨ **Mice-1: Mutant deficient mice having no interleukins**

⇨ **Mice-2: Normal mice.**



3- Compare the obtained results, what can you conclude?

4- Referring to the obtained results and based on your acquired knowledge, explain how T4 cells interfere in the secretion of antibodies.

5- Convert the results given in document 3 into a table form.

Question -33-

Malaria is an infectious disease due to development, in the body cells, a parasite called Plasmodium falciparum. The attacks of malaria vary from one individual to another. Adults who grew up in an area affected by malaria show symptoms less severe than in children or adults who have not grown in these regions.

Serum of three lots of monkeys are obtained after purification of blood plasma:

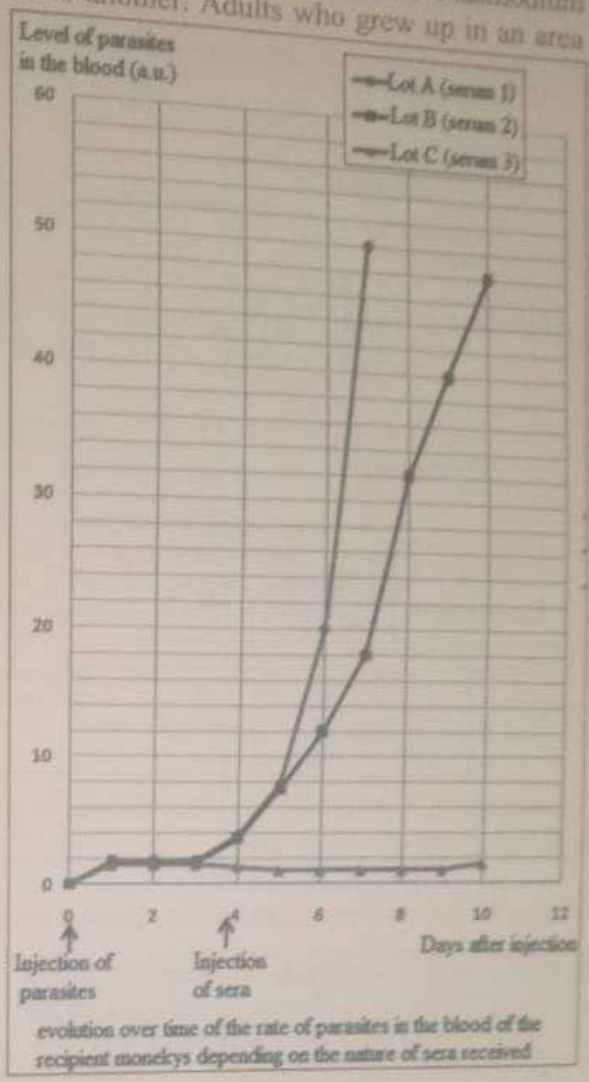
- Serum 1, is taken from monkeys never infected with Plasmodium
- Serum 2, taken from monkeys infected with Plasmodium one time
- Serum 2, taken from monkeys infected with Plasmodium two times.

Three new lots of monkeys who have never been in contact with Plasmodium falciparum are taken and labeled A, B and C. Three days after the infection with the parasites, the three lots of monkeys are injected respectively with three sera:

Serum 1 into lot A
Serum 2 into lot B
Serum 3 into lot C

Then we measure the amount of parasites in their blood for 10 days. The results of these experiments are shown in the adjacent graph.

Recall that the serum is obtained after purification of blood plasma and doesn't contain blood cell but contains antibodies specific for infectious agents previously encountered.

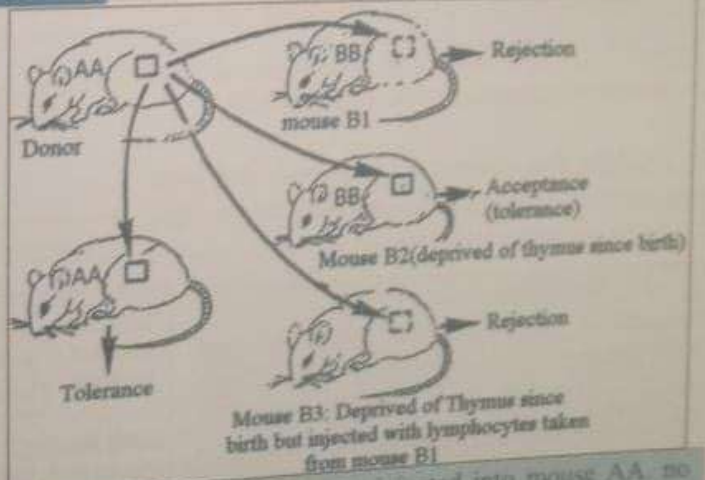


evolution over time of the rate of parasites in the blood of the recipient monekys depending on the nature of sera received

1- Explain the results obtained.

Question -34-

Experiments are realized on mice of pure lineage designated as AA & BB (A & B correspond to molecules equivalent to HLA markers found in human cells). The adjacent figure illustrates the obtained results.



1- Explain why mouse B2 tolerated the graft whereas mouse B1 rejected it?
2- Referring to your acquired knowledge and to the document, name the cells of the immune system that are involved in graft rejection.
3- Conclude the role for the thymus was revealed by the experiments.

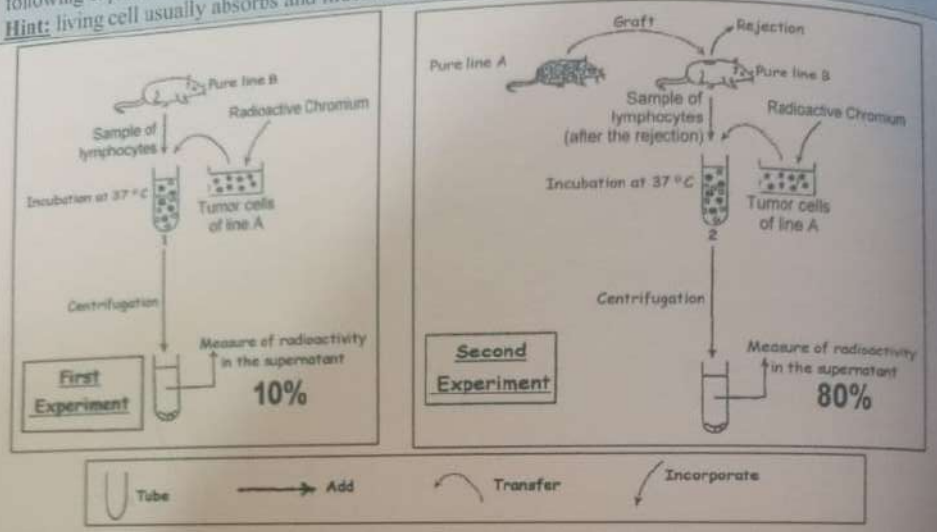
• In the course of another study, the lymphocytes, extracted from mouse AA, are injected into mouse AA, no immune reaction is noticed. On the other hand, some of the extracted lymphocytes are submitted to enzymatic treatment that modifies the peptides presented with the help of MHC molecules (A and B molecules) on the surface of these lymphocytes. Then, the modified lymphocytes are reintroduced into another recipient mouse (AA); the injected lymphocytes are destroyed.

4- Indicate why the immune cells of the recipient destroy the modified lymphocytes.
5- Predict the consequences (acceptance or rejection) will be observed if we transfer a graft from mouse AA into another mouse (AB)? Justify your answer.

Question -35- Immune responses and cancer.

A-In the framework of studying the reaction of the organism against cancer cells, we perform the following experiment (doc-1):

Hint: living cell usually absorbs and hides all the chromium from the supernatant.

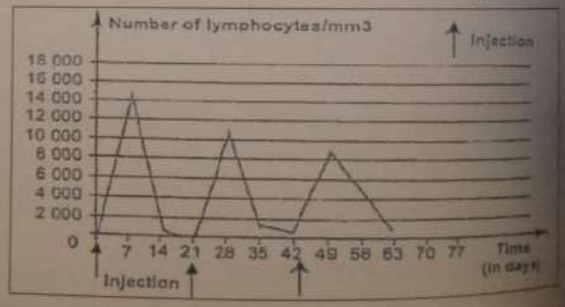


1- Describe in few lines the experiments done specifying their results (document 1).

2- Interpret the obtained results.

3- Specify the type or nature of the immune response revealed in the experiments shown in document-1.

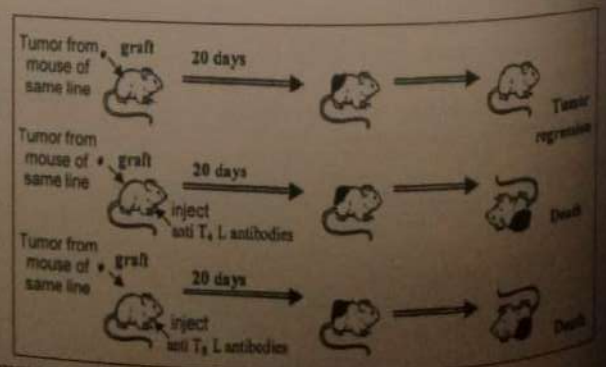
B- Some researchers tried to treat a patient affected by cancer of pigmented cells. The patient received injections of interleukin (IL-2), every 21 days. The results of the first three injections are shown in the following graph (document-2→).



4- Interpret the results obtained (doc-2).

5- Explain the observed variations and pick one of the reasons of the inefficiency of the immune response against cancer.

C- In the body, the immune system recognizes and destroys the abnormal cells among which the cancer cells. These cells present on their surface, specific antigens or markers of the cancer cells. The following document presents some aspects on this response. **Document-3: experimental modules of tumor.**



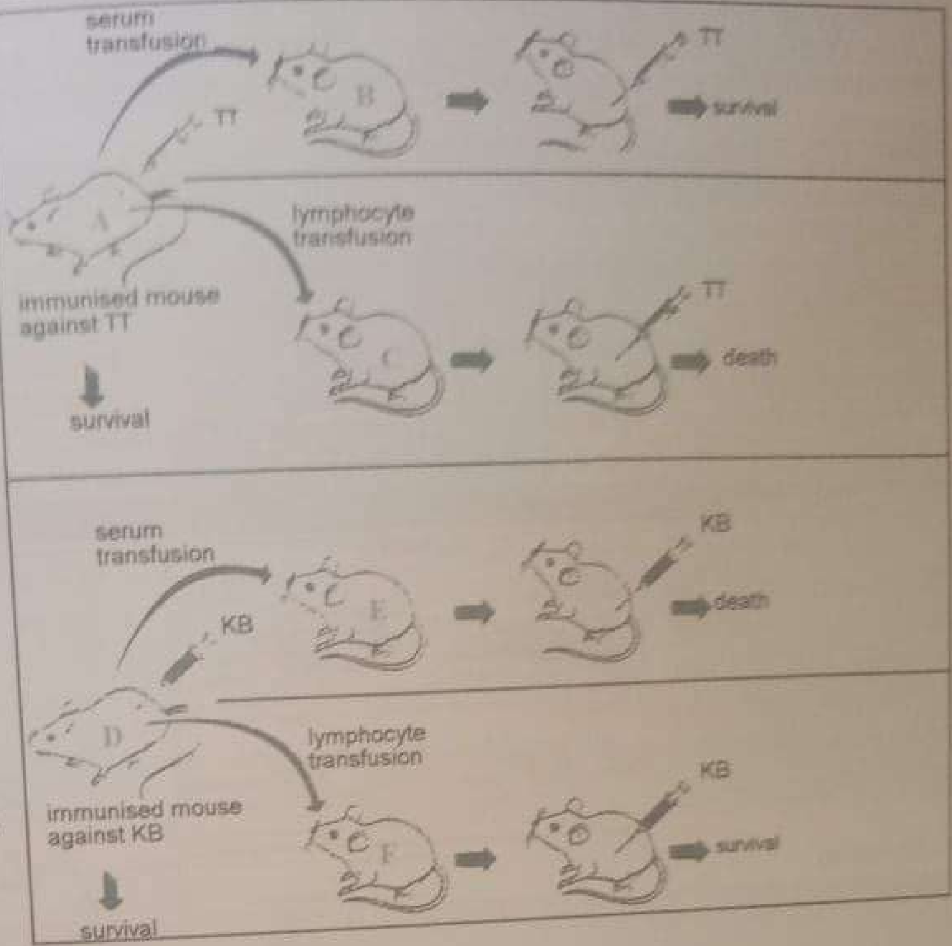
6- Interpret the results of the experiments shown document 3.

7- Based on the experiments shown in document 3 and referring to your acquired knowledge, explain the how the immune cells cooperate to destroy the cancer cells.

Question -16-:

A toxin is a harmful substance produced by a living being, often a bacterium, and that can be neutralized by the immune system.

We have a lot of mice in which some individuals are immunized against the tetanus toxin TT, and others no. In a second lot, some mice are immunized against Koch bacillus KB, and others no. We achieve the following experiment to understand how the immune system neutralizes the effect of each of these bacteria.



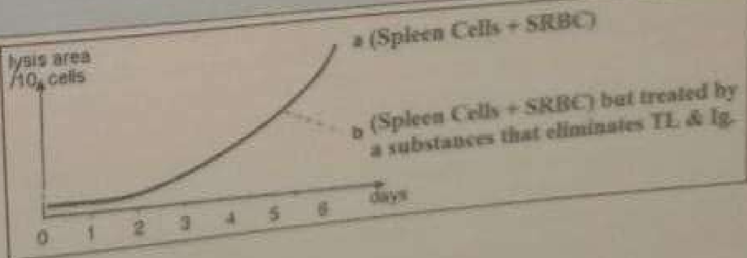
1- Pose the problem studied by this experiment.

2- Interpret these two experiments.

3- Indicate the type of immune response involved against every bacterium.

We obtain from a mouse spleen cells. These are put in culture with sheep red blood cells in different conditions. We count during 7 days, the number of area of lysis by million cells; the results are represented in the graph below.

4- Name the immune cells of the spleen.



5- Analyze the graph below, what can you conclude?

6- Indicate the type of immune response at the origin of the areas of lysis and that requires complement. Describe briefly the process of lysis of the red blood cells with the help of the complement.

7- How can we explain that the addition of a substance eliminating the helper lymphocytes T_4 or the antibodies has the same effect on the progress of the immune response?

Question -37-

The test that allows detecting an early pregnancy is based on the presence of human HCG (chorionogonadotrophic hormone). This hormone is secreted by the placenta at the tenth day of pregnancy and culminates at the tenth week. It is excreted by kidneys. Its presence is therefore detected in the urine of a pregnant woman.

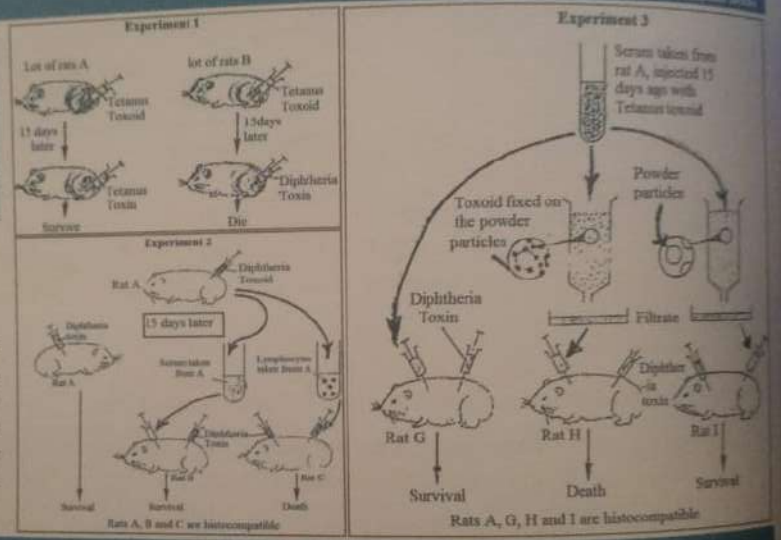
1. We inject a rabbit with human HCG. One week later, anti-HCG antibodies appear in the animal's serum. We call this serum R_1.
2. A technique allows the fixation of human HCG on sheep red blood cells suspended in a physiological liquid. This medium is called R_2.
3. If we mix R_1 and R_2, we notice that the sheep red blood cells are agglutinated.
4. Adding urine from a non-pregnant woman to serum R_1, before adding R_2 does not modify the reaction; there is no agglutination.
5. Adding urine from a pregnant woman to serum R_1, before adding R_2, modifies the reaction: there is no agglutination of red blood cells.

1- Explain briefly the origin of anti-HCG antibodies in the rabbit.

2- Explain the positive test in experiment-5 taking into account the results of experiment-4.

Question -38-

In the course of determining the nature of the immune response evolved by rats against Diphtheria toxin, the following experiments are done:



1- Describe experiments 1 and 2.

2- Interpret the results of the experiments done and then deduce the nature of the immune response evolved by rats against diphtheria toxin.

Question -39-

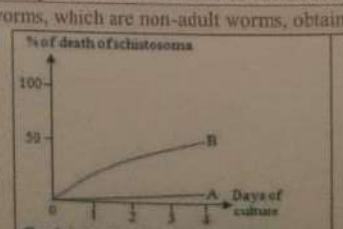
Specificity of immune response

Many experiments are done in order to study a serious human disease (the bilharzias) caused by a parasite called Schistosoma (mature adult Schistosomas live and reproduce in the veins of the abdominal region).

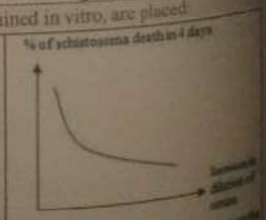
1st series of experiments: Schistosomules, young worms, which are non-adult worms, obtained in vitro, are placed:
- In the serum of a normal person
- In the serum of a bilharzias person
- In different dilutions of the serum of a person affected with bilharzias.

If lesions are seen on the surface of worms, this leads to their death. The results of these experiments are presented in the curves:

1- What can you conclude after analyzing the results shown in the adjacent curves?



Graph 1: % of death of shistosoma in the serum of a normal person "A" and in the serum of a sick person "B"



Graph 2: Effect of dilution of the serum on the mortality (death) of schistosoma

2nd series of experiments Living schistosomas of species X are put in the serum of an individual infected with parasites X and in the serum of an individual infected with parasites Y. In the first case, schistosomas die whereas in the second case, they don't. On the other hand, living adult schistosomas of species X are put in the serum of an individual infected with parasites X, they live and show no lesions on their surfaces.

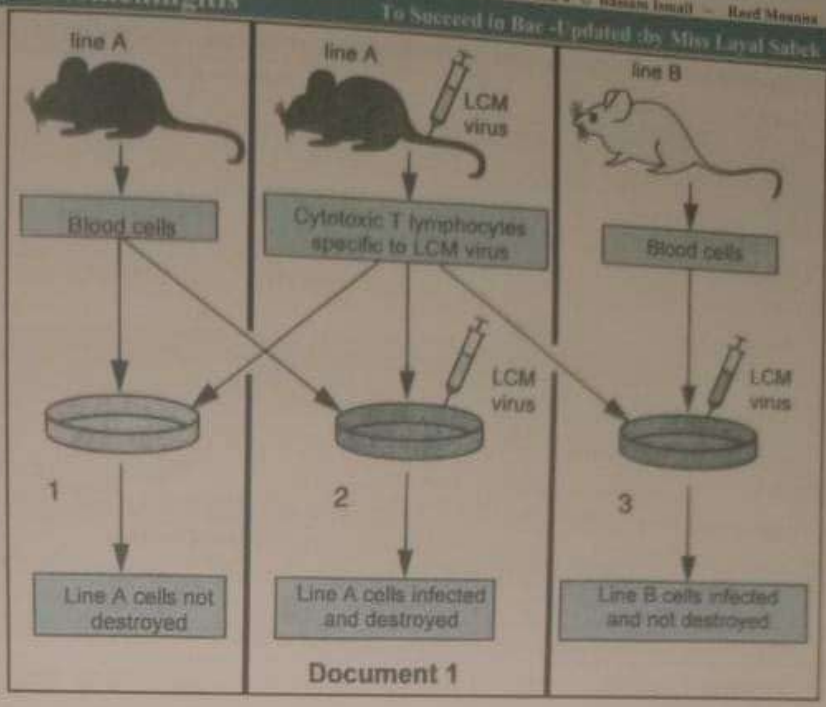
2- What conclusions can you draw out?

3- Formulate two hypotheses to explain the destruction of larvae and not adults of schisostoma.

Question- 42-

We inject into a mouse, LCM virus. After few days, we find in the blood cytotoxic lymphocytes that have destroyed the cells infected by the virus.

We use two strains of mice (A and B) and the experiments described in document 1 are performed. We observe in the petri dishes, the action of cytotoxic T lymphocytes on blood cells from different mice. We can make sure that the LCM virus put in the presence of cells of mice A (dish 2) or B (dish 3) will contaminate them rapidly.



Document 1

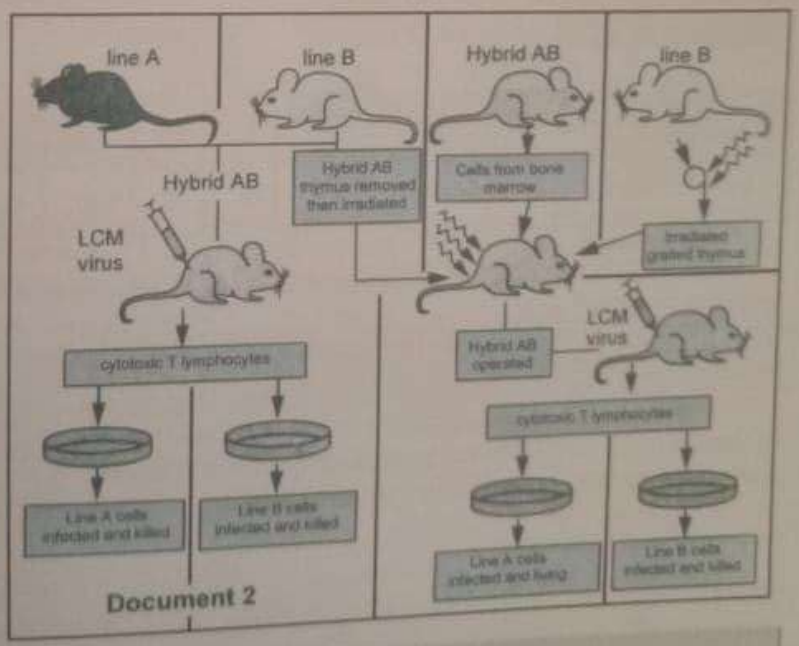
1-1. Analyze the obtained results.

1-2. What can you conclude?

2- Propose a 4th experiment to confirm the specificity of the response carried by the cytotoxic TL.

3- Specify the type of the immune response revealed.

We cross two mice, one of line A with another of line B and we obtain hybrids (AB). The thymus is removed from AB and then irradiated (irradiation that kills the proliferating cells of bone marrow). This irradiated animal is then subjected to thymus graft originating from mouse of strain B. After few hours, the animal receives an injection of bone marrow (containing stem cells originating from a hybrid AB issued from the same parent).



Document 2

LCM virus is injected into the prepared mouse. Few days later, the cytotoxic T lymphocytes are collected.

As in document 1, in Petri dishes, cytotoxic T lymphocytes are mixed with blood cells from mice of strain A or B that are all infected by LCM virus. The results are summarized in document 2.

4- Deduce, from the operated hybrid AB, the role of the thymus.

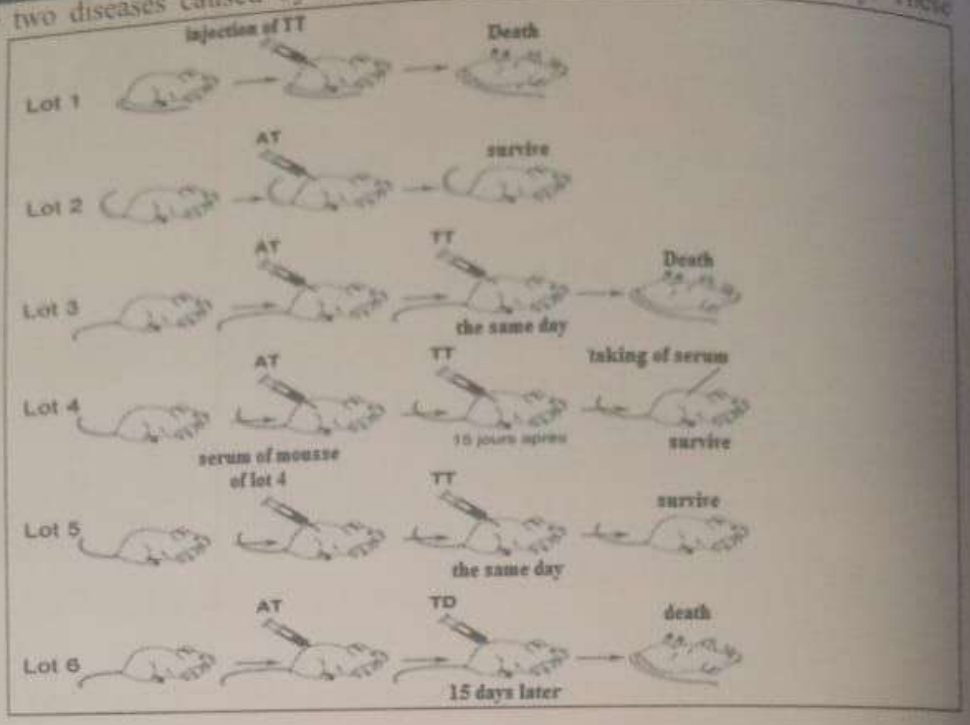
5- Explain the results obtained.

Immune Responses & Immunological Memory.

Question-43-

Tetanus and diphtheria are two diseases caused by bacteria that release toxins into the body. These diseases could be fatal.

Six groups of mice that have never previously been in contact with tetanus toxin (TT), diphtheria toxin (DT) or tetanus toxoid / Anatoxin (AT) are subjected to different injections. Doc-1: some experimental results.



1- Interpret the obtained results for the 1st four lots.

2- Explain using your knowledge, the results of lots 5 & 6.

Document- 2: Concerning the tetanus vaccination.

Document- 2a: evolution of the amount of anti-tetanus antibodies of an animal.

This animal has never been in contact with the bacteria responsible for tetanus

injection of identical doses of tetanus toxoid — 1st injection ↓ — 2nd injection ↓ — 3rd injection ↓

Dates : day from the first injection	J-1	J 0	J+7	J+14	J+21	J+35	J+42	J+50	J+365
Quantity of tetanus antibodies in the blood (U LmL^{-1})	0	0	0,02	0,03	0,08	0,2	0,3	12	5

UI = international unit

we estimate that the quantity of anti- tetanus antibodies in the blood must be at least 0,05 U LmL^{-1} for the body to be protected properly

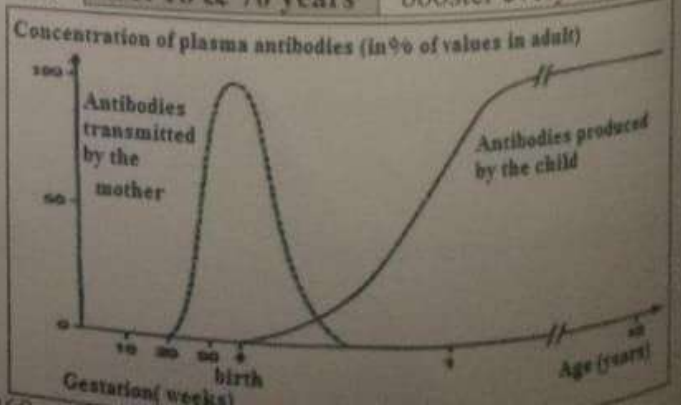
Document 2b : extract from the vaccine schedule recommended for tetanus

Age	Vaccine against tetanus
2 months	1st injection
3 months	2nd injection
4 months	3rd injection
Bet 16 & 18 month	1st booster
6 years	2nd booster
Bet 11 & 13 years	3rd booster
Bet 18 & 70 years	booster every 10 years

3- Trace the graph showing the variation of the quantity of anti-tetanus antibodies in function of time (days), showing the different injections.(document 2a).

4- Referring to your acquired knowledge and the analysis of document-2a, justify the vaccine schedule represented in document- 2b.

Document-3: Concentration of antibodies in the blood of a fetus and a child.



5- Analyze the results of document-3. What can you conclude?

Question 44: Immunity of an organism — Tn-updated

On studying certain aspects of the immune response mounted against antigen X, we realize the following experiments:

First experiment: At an initial time, we put cells C_1, extracted from the spleen of a control mouse, in the presence of an antigen X. The microscopic observation of apart or zone of the studied culture medium reveals the association of certain cells with antigen X while other cells remain free (not linked or associated or bounded with antigen X).

1- Based on the result of the first experiment, Identify the type(s) of cells C_1.

Second experiment: By the help of a special technique, we extracted the cells C1 adhered to the antigen X. Then the isolated cells C1 were cultured in two separate culture media:
one containing antigen X (culture A)
while the other contains antigen Y (culture Y).
The table of document 1 shows the experiments and the obtained results.

Culture	Composition of the culture medium	Results
A	Physiological fluid+ cells C1 isolated from antigen X + antigen X	Association of C1 with antigen X
B	Physiological fluid + cells C1 isolated from antigen X + antigen Y	No association between C1 & antigen X

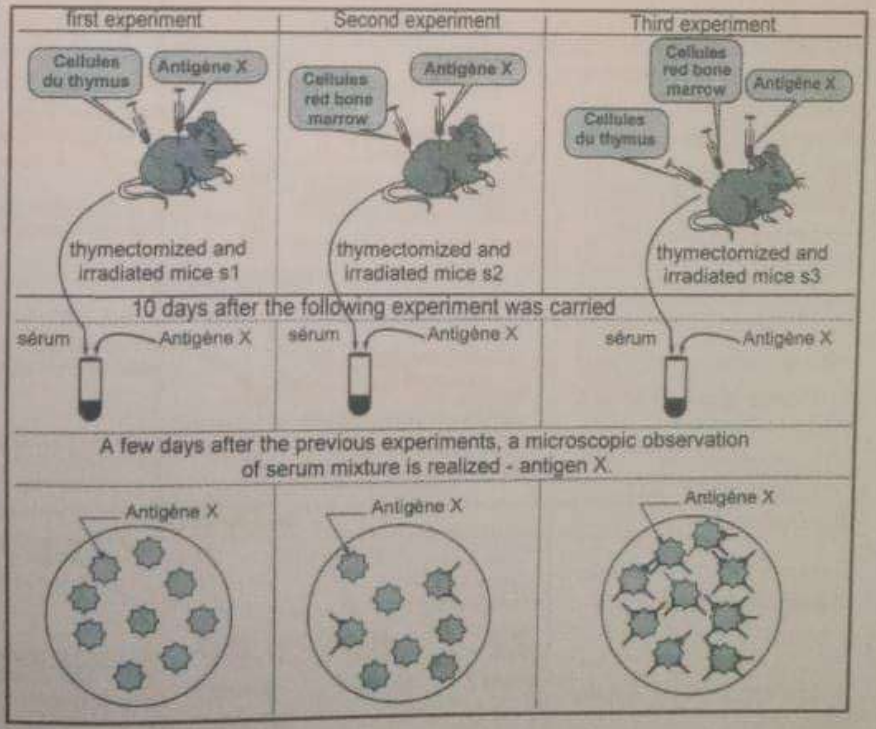
2- Based on document 1 and referring to your knowledge, specify the nature of the cells C1. **Document 1**

3-1. Determine the phase of the immune response revealed by the experiments of document 1.

3-2. Name the phases that follow the phase mentioned in part 3-1.

To determine the nature of the immune response mounted against antigen X and the origin of the implicated cells, we realize on three mice S1, S2 and S3 subjected to the irradiation of the bone marrow and ablation of the thymus, injections of cells (extracted from the bone marrow and the thymus) histocompatibility with the treated mice and also to the injection of antigen X.
The experiments and the obtained results are shown in the following document.

Document-2



4- Referring to document2:
4.1-Describe the three experiments.

4.2-Specify the nature of the immune response mounted against antigen X.

4.3-Referring to your acquired knowledge, explain the mechanism that requires the cooperation between different immune cells and aids in the elimination of formed immune complex.

Question 45: Immunity Against Antigens

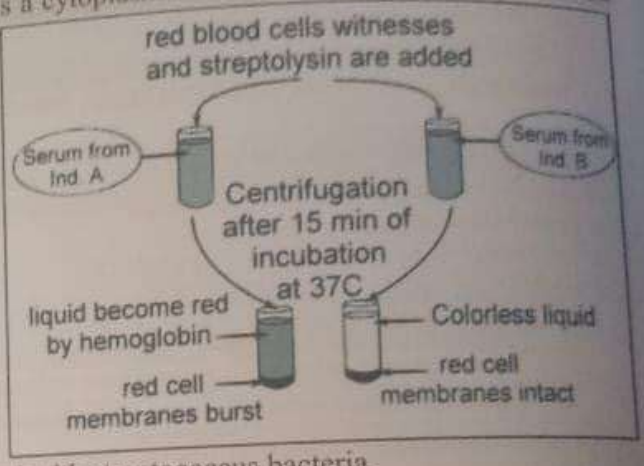
Tn-updated

In the course of infection with a bacterium called streptococci, such bacterium liberates a toxin known as streptolysine which is involved in the perforation (creates pores or opening or holes) in the membrane of erythrocytes (red blood cells) in the infected subject leading to the liberation or release of hemoglobin to the extracellular medium (knowing that hemoglobin is a cytoplasmic hemo- protein found within the red blood cells).

To demonstrate that the immune response mounts an immune response against streptococcus bacteria, we realize the following experiments:

First series of experiments:

Serum was extracted from two individuals A and B and added to normal red blood cells and streptococcus bacteria. The experiments and their results are given in document 1. →



1- From the analysis of the results obtained for the two individuals A and B (after centrifugation):

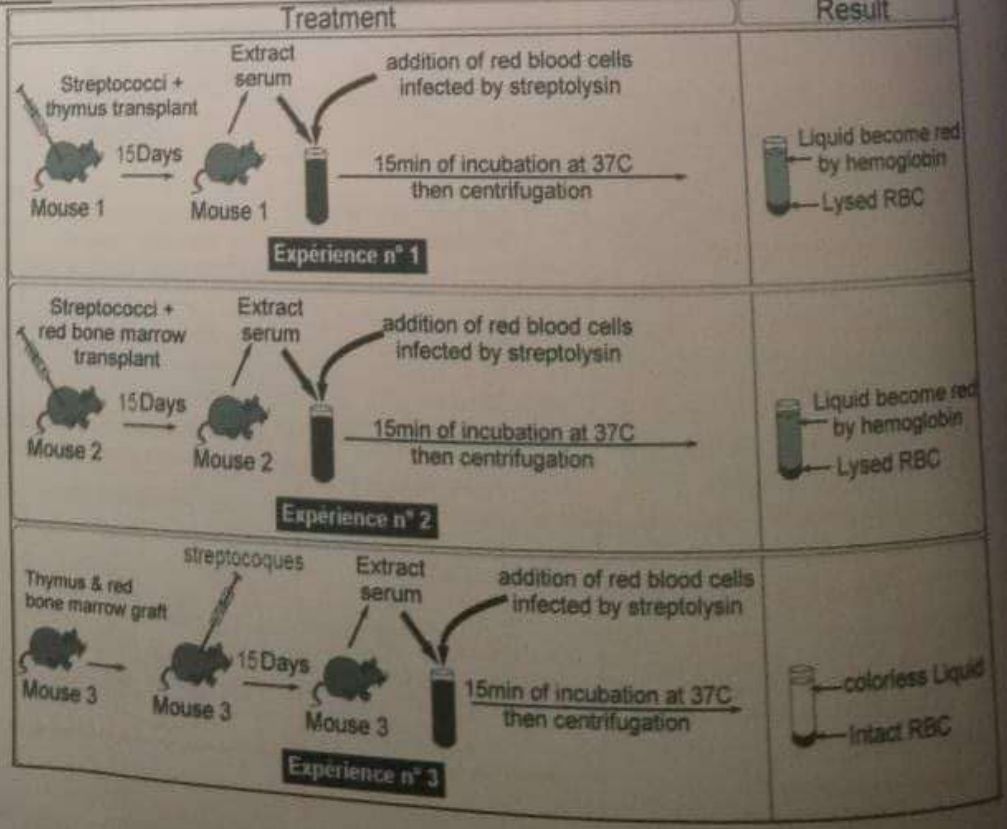
1-1. Deduce which of the two individuals is infected with streptococcus bacteria.

1-2. Indicate the nature of the immune response mounted against this bacterium.

Second series of experiments:

We realize a test, similar to that done on the cells of the two individuals A and B shown in document 1, on three immunosuppressed or immune depressed (without bone marrow and without thymus) mice donated as 1, 2 and 3, subjected to different treatments.

The experiments and their results are given in document 2. →



2- Describe the experiments done.

3- Interpret the results obtained.

4- Explain the mechanism of the immune response mounted against

Immune response

Tn-updated

Question 46:

In order to determine the immune response intervening in case of graft rejecting:

We realize skin transplantation experiments between mice of different strains (A, B & C).

The results of these experiments are presented in document 1.

	Donor	Recipient	Result
Exp N°1	Mouse A	Mouse A' genetically identical to A	Graft Accepted
Exp N°2	Mouse A	Graft → Mouse B1	Graft rejected after 12 hrs
Exp N°3	Mouse A Mouse C	2nd Graft → Mouse B1 Graft → Mouse B1	Graft (A) rejected after 3 hrs Graft (C) rejected after 12 hrs
Exp. N°4	Mouse A	Exp.4 a: Mouse B2 genetically identical to mouse B1, & it was injected by lymphocytes from B1 after rejecting garft A in exp.2	Graft (A) rejected after 3 hrs
		Exp.4 b: Mouse B3 genetically identical to mouse B1, & it was injected by serum from B1 after rejecting garft A in exp.2	Graft (A) rejected after 12 hrs
		Exp.4 c: Mouse B4 genetically identical to mouse B1, & it suffered from thymus ablation at birth	Graft Accepted

1- Interpret the first three experiments.

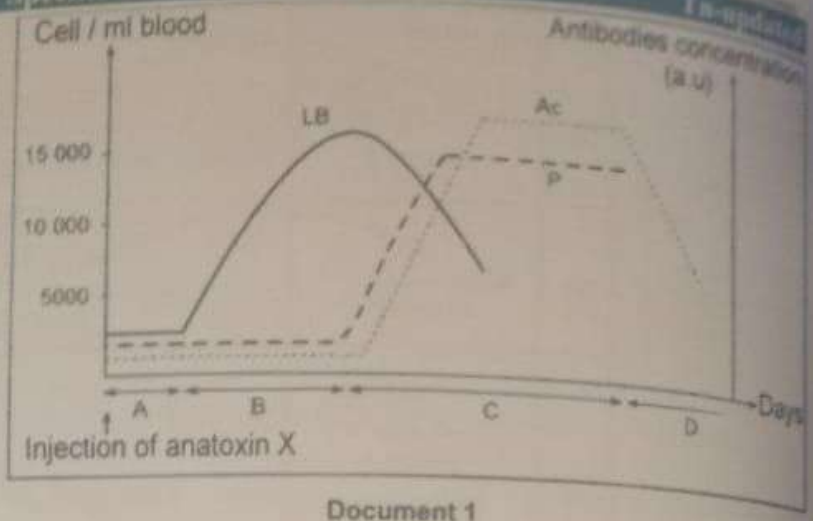
2- Explain the results of the 4th experiment.

3- Deduce the type of immune response.

Question 47:

To specify certain aspects in the protocol of the specific immune response, we realize the following experiments.

Several days after the injection an animal with an attenuated toxin X (anatoxin X), we count the number of lymphocytes B (LB) and the number of plasmocytes (P) per milliliter of blood and measure the dosage of liberated ant-toxin X antibodies (Ab) in the blood of this animal. Document 1 represents the obtained results.



Document 1

1- Determine the nature of the immune response represented in document 1.

2- Explain, based on your acquired knowledge, the quantitative evolution in the elements shown in the graph of document 1.

3- Identify each of the phases A, B, C and D of the studied immune response.

To precise the necessary conditions for the production of anti- toxin X antibodies (Ab), we inject anatoxin X to three mice of the same species: normal mouse 1, thymectomized mouse 2 (exposed to the ablation of the thymus) and thymectomized mouse 3 but subjected to the injection with T lymphocytes taken from the normal mouse 1. 15 days later, serum was extracted from each of the three mice and put in the presence of anatoxin or antigen X. Document 2 shows the obtained results.

Doc-2	Experiment 1	Experiment 2	Experiment 3
Exp	Serum of mouse 1+ toxin X	Serum of mouse 2+ toxin X	Serum of mouse 3+ toxin X
Results	Formation of immune complex	No formation of immune complex	Formation of immune complex

4- Referring to document 2, explain the obtained results.

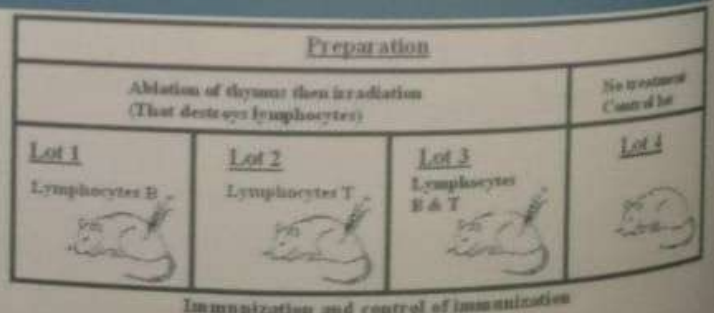
5- Propose an experiment to demonstrate the necessity of the macrophage in the immune response against toxin X or in the production of anti-toxin X antibodies.

Question 48:

The following experiment is done:

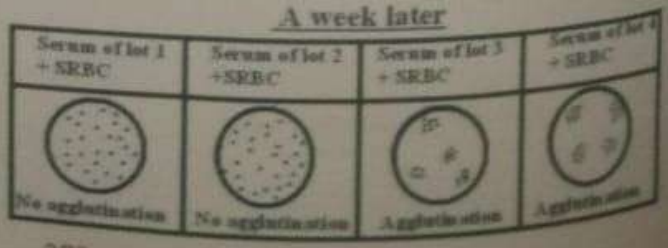
Cells of thymus and bone marrow are sampled from normal mice and cultured in a physiological medium.

At birth, some mice from same strain as the normal mice got an ablation of the thymus and an irradiation that destroys the bone marrow.



Immunization and control of immunization

• Injection of SRBC (sheep red blood cell)



1- What can you deduce from the analysis of the results concerning the immune response?

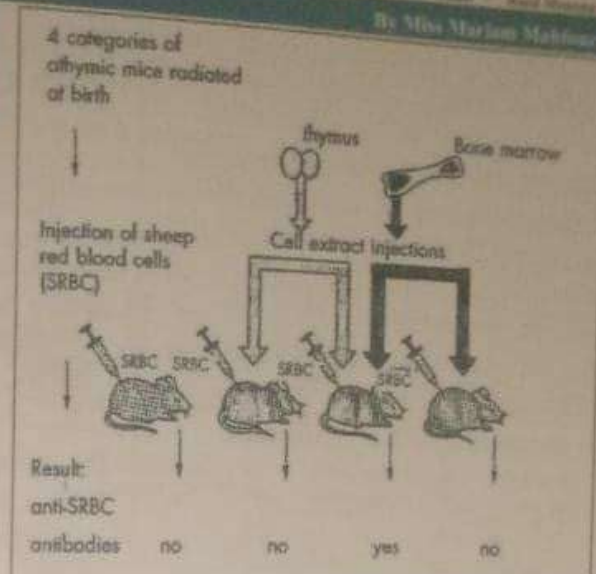
Question 49: Properties of leucocytes

By Miss Mariam Mahfoud

An in vitro experiment is realized to study the necessary conditions for the production of antibodies; it is presented in document 1.

1- Describe this experiment.

2- Interpret this experiment.



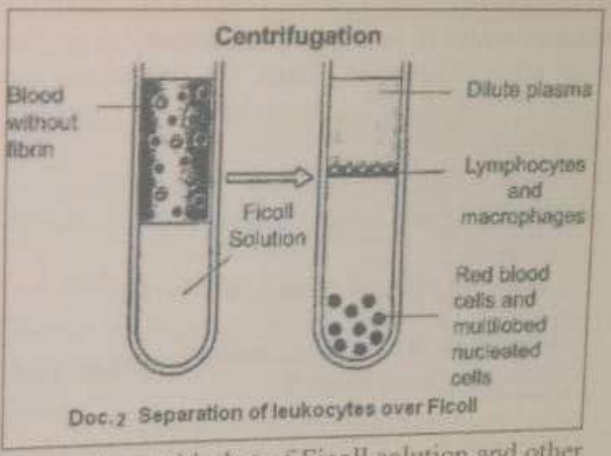
Doc.1: In vitro study of athymic radiated mice

3- Based on the results of the experiments and referring to your acquired knowledge, determine the necessary condition for the production of antibodies.

In the study of leukocytes' properties, a research team achieved a set of experiments, which permits to obtain populations of leukocytes that can be easily separated and collected: phagocytes (macrophages and multilobed nucleated cells), B lymphocytes (producers of antibodies) and T lymphocytes.

Centrifugation allows separating different constituents of a mixture according to their density: the more dense elements are nearer to the bottom of the tube.

Performing blood centrifugation in the presence of Ficoll solution. The results are shown in the Doc. 2.



Doc.2 Separation of leukocytes over Ficoll

4- Draw out the density of multilobed nucleated cells in comparison with that of Ficoll solution and other leukocytes.

The mixture macrophages- lymphocytes is transferred into another tube that contains serum. Iron fillings addition (inert substratum) permits, after a short time, to remove all macrophages by means of a magnet.

5- Deduce an important property of macrophages.

Sheep's red blood cells (SRBC) are mixed with the obtained lymphocytes from the previous treatments.

Microscopic observation shows some rosette forms: a human lymphocyte surrounded by SRBC. (Document 3). The centrifugation of the mixture with Ficoll allows us to separate it in two fractions of which only one contains SRBC and rosettes. Knowing that we can get rosettes with same kind of lymphocytes before any contact with the antigen.

Doc-3

6- Identify the lymphocytes present in the previous mixture and deduce an important property of lymphocytes.

Remark: Ficoll solution facilitates the separation of blood components

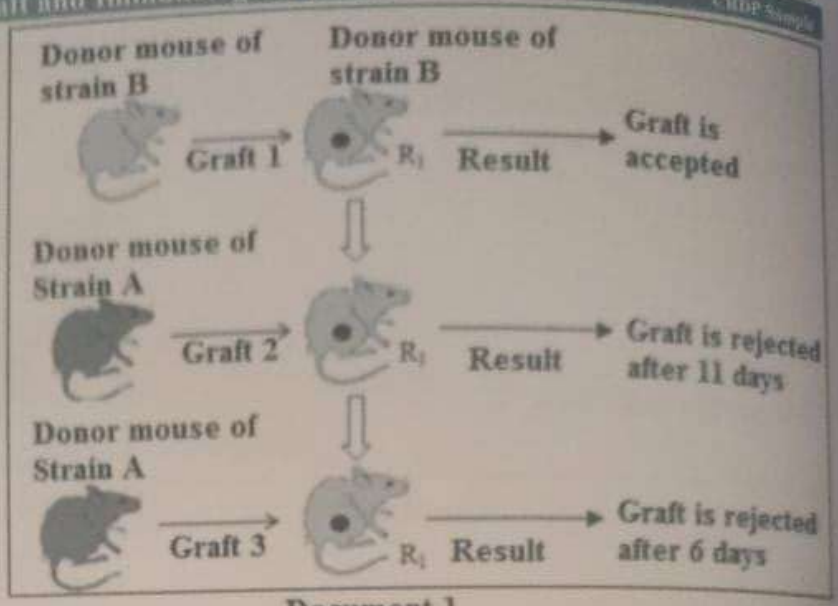
Graft and Immunological Memory

Question-50-

A study is performed to specify the mechanism of immunity involved in the rejection of skin graft in mice.

Skin grafts are performed between different strains of mice, strain A and strain B. Document 1 shows the experimental conditions as well as the obtained results.
The receiver mouse R1 is the same in the three cases of grafting.

1. Interpret the obtained results.



Document 1

In order to explain the results of the third graft, two hypotheses are proposed:

Hypothesis 1: Mice B possess memory T lymphocytes against the antigens carried by the cells of mice A.
Hypothesis 2: Mice B possess antibodies against the antigens carried by the cells of mice A.

Mice of strain B are hyper-immunized by grafting them for three times by, three weeks apart, by skin from mice of strain A. Then, the researchers extracted from these hyper-immunized mice of strain B serum (blood plasma) on one hand and lymphoid cells from lymphatic ganglia close to the graft on the other hand.

An experiment is performed on mice of strain B called "Nude" (named NB), which are not subjected to any prior treatment. The conditions and the results are shown in document 2.

Day 1 : Injection of mice NB	Day 3 : Grafts done on mice NB	Result
Serum from the hyper-immunized mice of strain B	Skin from mice of strain A	On Day 6: Acceptance of the graft On day 11: Rejection of the graft
Alive lymphoid cells from the hyper-immunized mice of strain B	Skin from mice of strain A	On day 6: Rejection of the graft
Dead lymphoid cells from the hyper-immunized mice of strain B	Skin from mice of strain A	On day 6: Acceptance of the graft On day 11: Rejection of the graft

Document 2

2. Verify, by referring to doc.1 and doc.2, which of the preceding formulated hypotheses is valid.

The analysis of the lymphoid cells, responsible for graft rejection, present in the hyperimmunized mice gives the results presented in document 3.

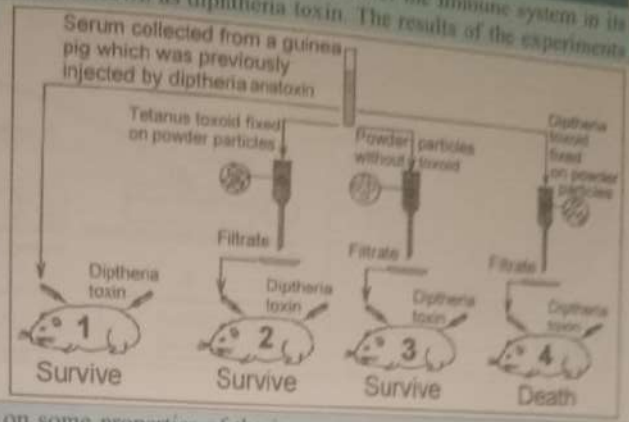
3. Identify the cells X and Y in document 3.
4. Explain, by referring to all what precedes, the result of graft 3 in document 1.

	Hyper-immunized mice	
	Lymphoid cells X	Lymphoid cells Y
Percentage	95 %	5 %
Life Span	few days to few dozens of days	few months to few dozen of years
Proliferation	No	Yes

Question-51- Neutralizing Properties of Antibodies.

Several experiments were done to determine the nature and mode of action of the immune system in its reaction against a serious and even fatal toxin known as diphtheria toxin. The results of the experiments are shown in the following doc:

1- Interpret the experiments done. What can you conclude concerning the nature or type of the immune response organized or mounted against the diphtheria toxin?



Further experiments are done to focus on some properties of the immune system in its reaction against diphtheria toxin. The results of the experiments are shown below:

-The injection of animal-1 by diphtheria toxin six months later after its first injection causes its death.

-The injection of the survived animal-3 by tetanus toxin leads to its death.

2- Explain the results of the experiments done.

Question-52- Immunity of the newborn

Several studies intended to explain the weakness of immune reaction of the newborn, certain microorganisms like those of Listeria kind, Candida or Herpes, are normally destroyed by the phagocyte cells multilobed nucleated cells (granulocyte) and Macrophages.

These latter approaches the microorganism and phagocytes & eliminates it. The newborn's macrophages don't show any activity against these micro-organisms

1- What consequences this absence of activity could have on the immune response?

Cultures A, B and C have been performed to study phagocytosis by the multilobed nucleated cells(doc-1):

Culture	Content	% of Phagocytes relative to normal
A	Multilobed nucleated cells of an adult + Serum of same adult	100
B	Multilobed nucleated cells of a fetus + Serum of same fetus	35
C	Multilobed nucleated cells of an fetus + Serum of adult	98

2- Interpret these experiments A, B and C and conclude the cause of the results observed in culture B.

The opsonization is to establish binding (molecular bridge) between phagocytes and the antigen; it is performed by the activity of proteins, of complement, and of antibodies.

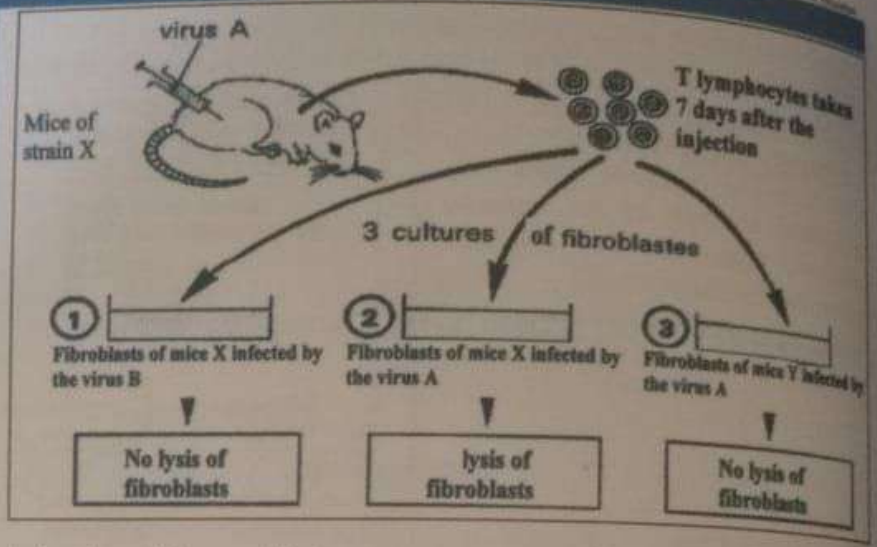
In the newborn, the concentration of complement corresponds to 65% of that in an adult.

3- Formulate a hypothesis that explains the results observed in culture-B.

4- Propose an experiment that allows us to test the previous hypothesis.

Question-53-

In order to determine the role of T cells in elimination of a virus and the conditions required for its functioning the following experiment represented in document 1 was performed.



1- Specify the type of the lymphocytes used in this experiment.

2- Explain briefly the steps of the induction of the specific immune response against virus A.

3- Describe this experiment.

4- Justify the necessity of a cell-mediated immune response to eliminate the virus.

5- Interpret the obtained; what do you conclude concerning the conditions of functioning of the T lymphocytes.

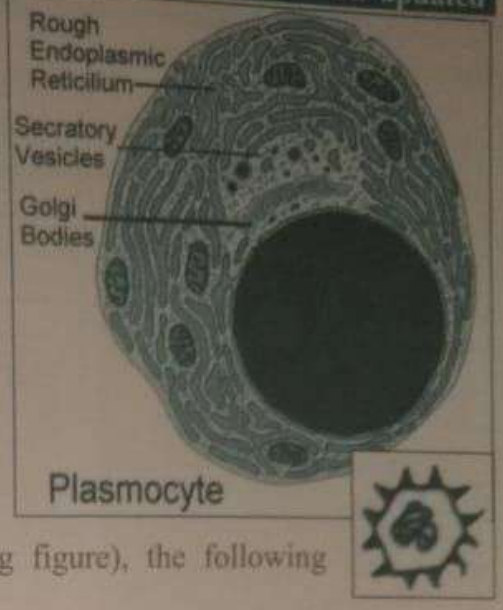
Specific Immune Response

Tn-updated

Exercise 64:

A study was done to determine certain actors involved in the immune response. Document 1 shows an electronography of an active plasmocyte. **Document 1→**

1- Indicate the origin of this cell.



2- Specify, referring to document 1 and based on your acquired knowledge, the characteristics (structural) of plasmocyte in relation with its activity.

To find out the type of immune response against a viral antigen (V virus in question is represented as shown in the following figure), the following experiments were performed:

1st series of experiments: B lymphocytes, T4 lymphocytes and macrophages were taken from the spleen of a healthy mouse. The table of document 2 summarizes the composition of different culture media and indicates whether or not B- lymphocytes differentiate in the presence of virus V. **Document 2**

Experiments	Results
Lymphocytes B + virus	No differentiation of B lymphocytes
Lymphocytes B + virus + Macrophages	No differentiation of B lymphocytes
Lymphocytes B + virus + Macrophages + Lymphocytes T4	Differentiation of B lymphocytes

3- Explain the mechanism involved in induction of B lymphocyte's differentiation.

Second series of experiments: Mice, which have undergone different treatments as shown in document 3, are infected by the same virus V. **Document 3**

Experiment	Treatment of the different mice	Results
1	Mouse without thymus	Multiplication of the virus
2	Thymectomised mouse receiving serum from another mouse immunized against the studied virus	Virus stopped its multiplication but do not disappear
3	Mouse with thymus but without lymphocytes	Disappearance of the virus

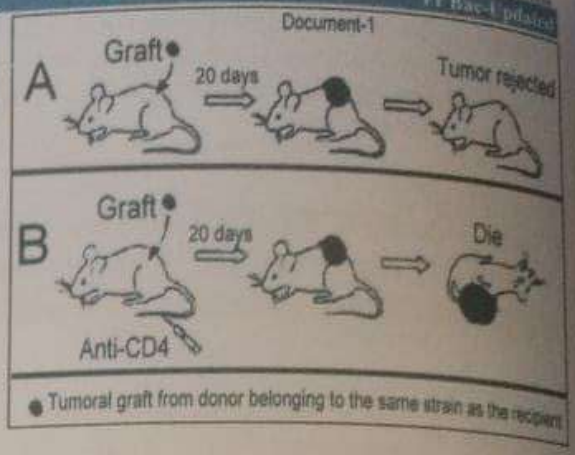
4- Interpret the results of these experiments.

5- Referring to the results given in document 3 & based on your acquired knowledge explain the mechanisms leading on one hand stopping the spread of viruses & on the other share in their disappearance.

6- Using your knowledge and the previous experiments, present with a functional diagram (scheme) the immune responses leading to the elimination of viral antigen.

Question -55-

In the body, the immune system recognizes and destroys abnormal cells, including tumor (cancerous) cells.
The latter have at their surface specific antigens not presented by normal cells. Document-1 illustrates a certain aspect of the immune response.



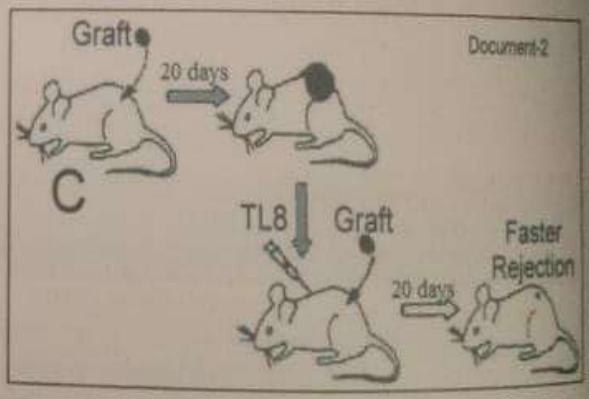
1-1. Interpret the obtained results.

1-2. Do the obtained results enable us to determine the type of immune response mounted against the tumor? Justify.

2- Propose a new experiment to eliminate the ambiguity (uncertainty). Explain.

Document 2: Mechanism of regression of the tumor.

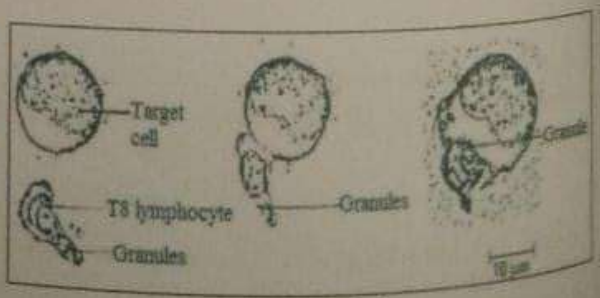
In this experiment, the first animal is subjected to a tumor graft, and then its T8 lymphocytes are taken and transferred to another animal that receives a second tumor graft.



3-1. Interpret the obtained results.

3-2. Draw out the property of the immune response.

Document 3: Photomicrographs showing cell interactions in a graft regression *(3 photos taken during an interval of 10 minutes).*



4- Referring to all what precedes and to document 3 & acquired knowledge, explain the cell interaction that leads to the elimination of the tumor cells.

Question -56-

A new weapon to fight against Staphylococcus aureus

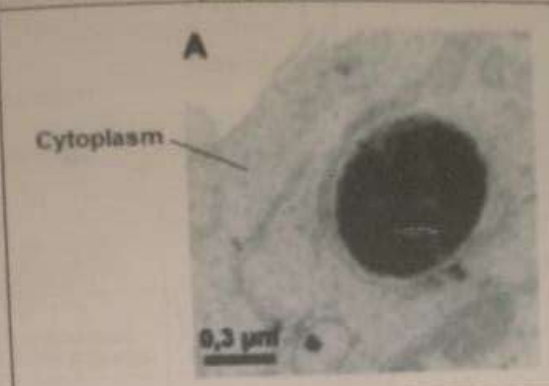
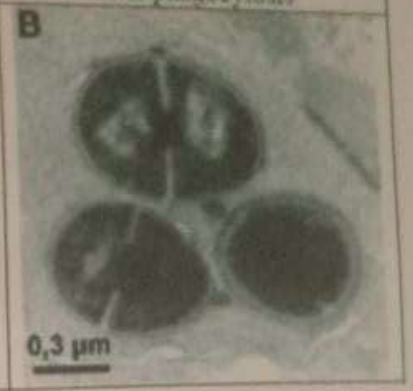
By Mr. Raed Mansour

Staphylococcus is a bacterium found on the skin and in the nasal passages of human being. Sometimes, virulent staphylococcus strains can cause an infection, most often local but which can also be generalized and potentially life-threatening when bacteria enter the blood circulation and spread to other organs.

To fight against this bacterium, we have antibiotics, chemical substances that can destroy bacteria or prevent their development; but they are sometimes ineffective and recurrence of infection may occur.

Researchers have tried to improve anti biotic treatment by combining them with antibodies.

Document 1 shows a photograph taken under an electron microscope of a macrophage having phagocytized staphylococcus 1 hour and 24 hours after phagocytosis .

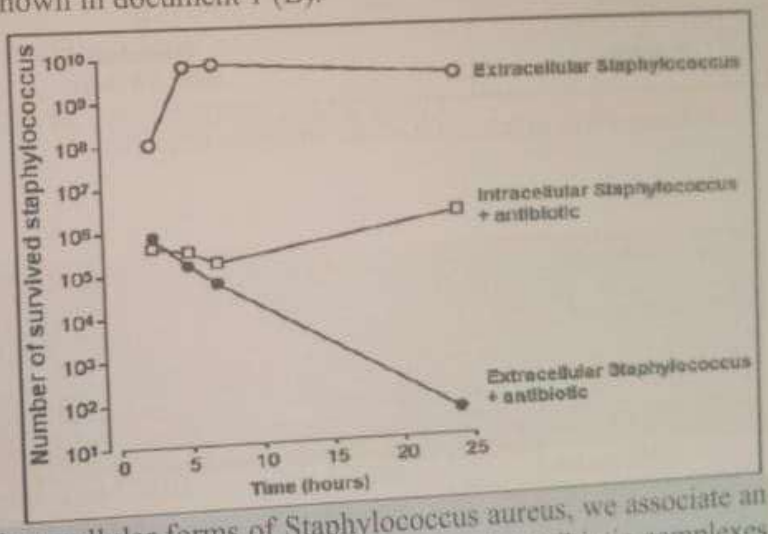
Staphylococcus aureus inside the cytoplasm of a macrophage1h after phagocytosis	Staphylococci aureus inside the cytoplasm of a macrophage 24h after phagocytosis
	

1- Determine, based on document 1, the effectiveness of the macrophage against staphylococcus.

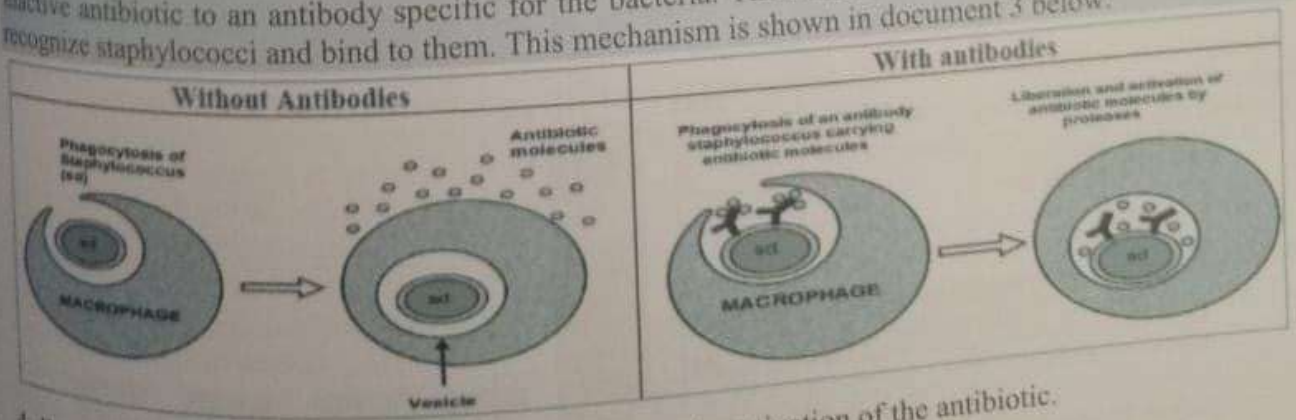
2- Name 2 causes that may lead to the result shown in document 1 (B).

The graph of document 2 shows the action of an antibiotic, injected at t = 0, on staphylococcus aureus present at outside cells (extracellular medium) or interior (intracellular medium) in cell cultures of macrophages.

3- Interpret the results of document 2.



To improve the antibiotic treatment against intracellular forms of Staphylococcus aureus, we associate an inactive antibiotic to an antibody specific for the bacteria. These inactive antibody-antibiotic complexes recognize staphylococci and bind to them. This mechanism is shown in document 3 below:

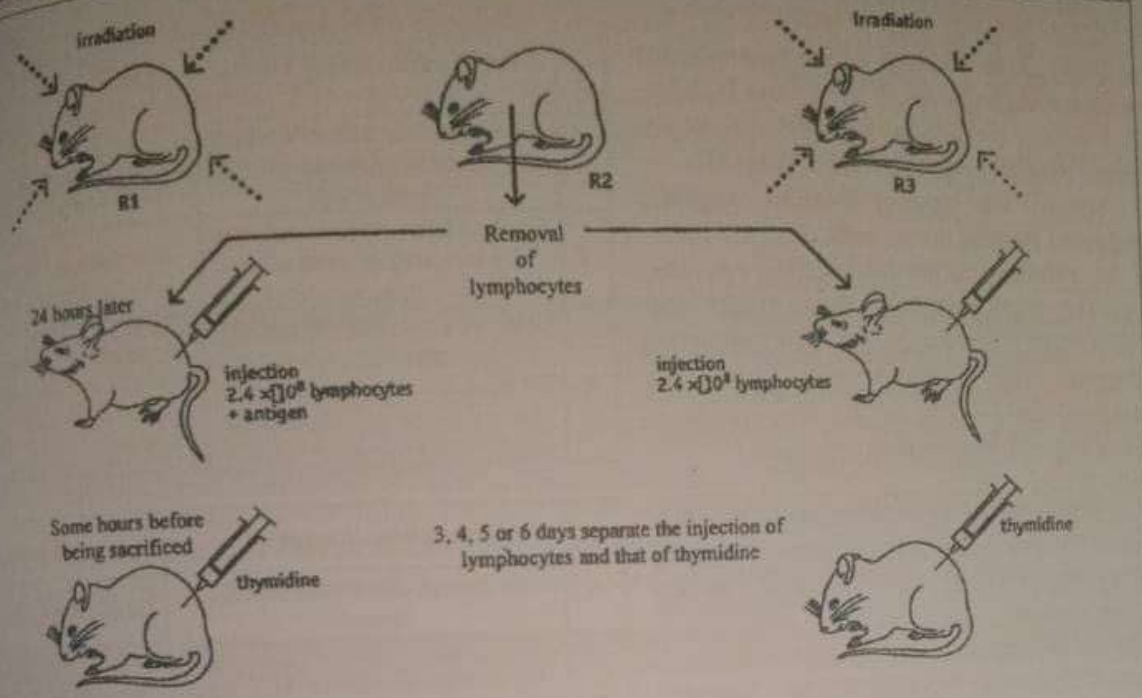


4- Based on document 3, indicate the steps that lead to the activation of the antibiotic.

5- Show that based on document 3, the intracellular bacteria can only be destroyed by antibody antibiotic complex.

Steps of Antibodies Production

Question 62-
Spleen is a lymph organ inside which immune cells proliferate. This organ is composed of two parts: the white pulp and the red pulp. The red pulp encircles the white pulp.
To find the steps of antibodies production, the following experiments are realized.



Experimental protocol n° 1

Experimental protocol

Experiment is realized with three lots of spleens R1, R2 and R3 that belong to the same strain i.e. possessing identical genomic characteristics. The spleens R1 and R3 are irradiated; this leads to the destruction of the whole cells that intervene in the immune response.

Results: In the spleen of the sacrificed animals, we measure the quantity of incorporated radioactive thymidine (nucleoside that contains thymine at nitrogenous base) & we search for the presence of cells producing antibodies:

Observations	Number of days between the injection of the antigen and that of thymidin							
	3 days		4 days		5 days		6 days	
	W	R	W	R	W	R	W	R
Quantity of incorporated thymidine by:								
R1	++++ +	-	++++	-	++	+	+	+
R3	+	-	+	-	+	-	+ -	-
Quantity of cells producing antibodies anti-x in R1						+		++++

1- Analyze experiment 1 .Why does lot R3 represent the control group in this experiment?

2- Use the table to precise the events taking place in each of the white and the red part separately justify.

3- Propose an explanation by naming the steps in the production of antibodies illustrated here.