PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 6: MICROBIOLOGY AND PATHOGENS

RESPONSE TO INFECTION

SCORE	PERCENTAGE
/102	%

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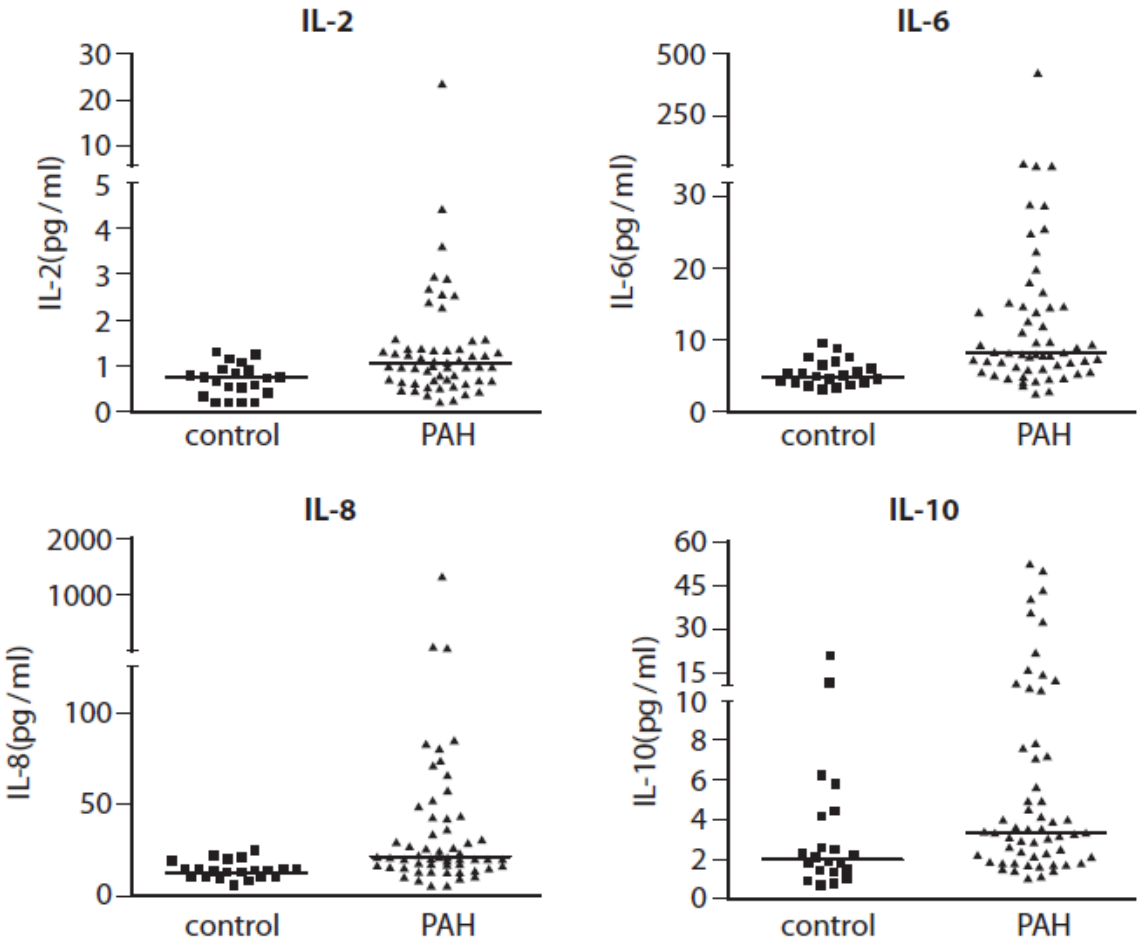
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Q1.

The diagram shows the levels of four different cytokines in the blood of patients with PAH.

The horizontal lines represent the means.



(i) Calculate the percentage increase in the mean levels of IL-10 in patients with PAH.

(2)

Answer ..... %

(ii) The mean levels of all four cytokines were higher in PAH patients. A statistical test of difference was used.

The table shows the *p* values obtained.

Cytokine	*p* value
IL-2	0.0008
IL-6	0.0001
IL-8	0.0001
IL-10	0.0140

Analyse the data in the graphs and in this table to explain the value of *p* for IL-10.

(2)

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(iii) PAH causes damage to the pulmonary arteries, leading to failure of the right side of the heart and death.

Explain how PAH leads to failure of the right side of the heart.

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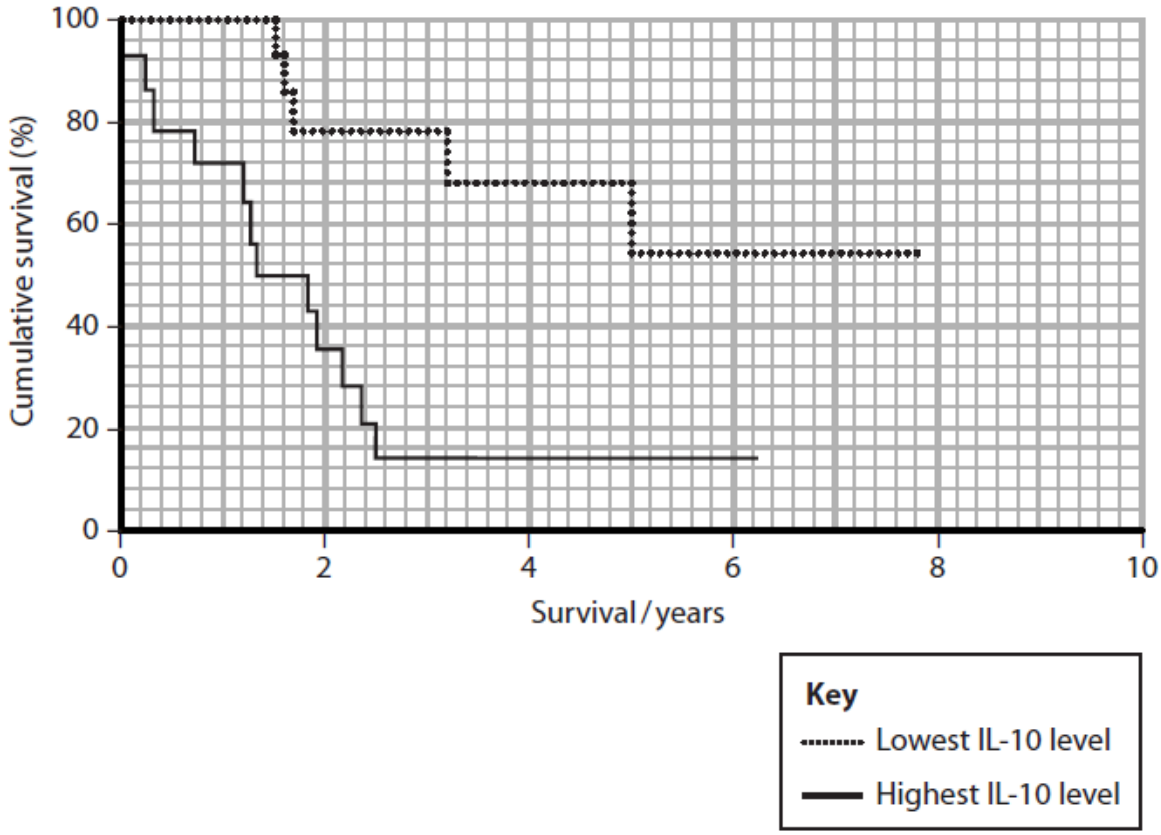
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(iv) The graph shows the survival rates for PAH patients with raised cytokine IL-10 levels.



Calculate how many times worse the survival rate is for those patients with the highest levels of IL-10 after 3 years.

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Q2.

Poliomyelitis is a serious disease that can lead to muscle weakness, paralysis and death. There is no cure.

Poliomyelitis is caused by poliovirus.

The first poliovirus vaccine was tested in a study using 1.8 million children.

These children were divided into three groups.

Children in group 1 were treated with the vaccine.

(i) Devise suitable treatments for the children in group 2 and group 3.

(2)

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(ii) There are three types of poliovirus: PV1, PV2 and PV3. Each type causes poliomyelitis.

The table shows the results of the study for each type of poliovirus for children in group 1.

Type of poliovirus	Effectiveness of vaccine (%)
PV1	60–70
PV2	>90
PV3	>90

A few children had a severe allergic reaction to the vaccine.

Comment on the extent to which this study supports the widespread use of this vaccine.

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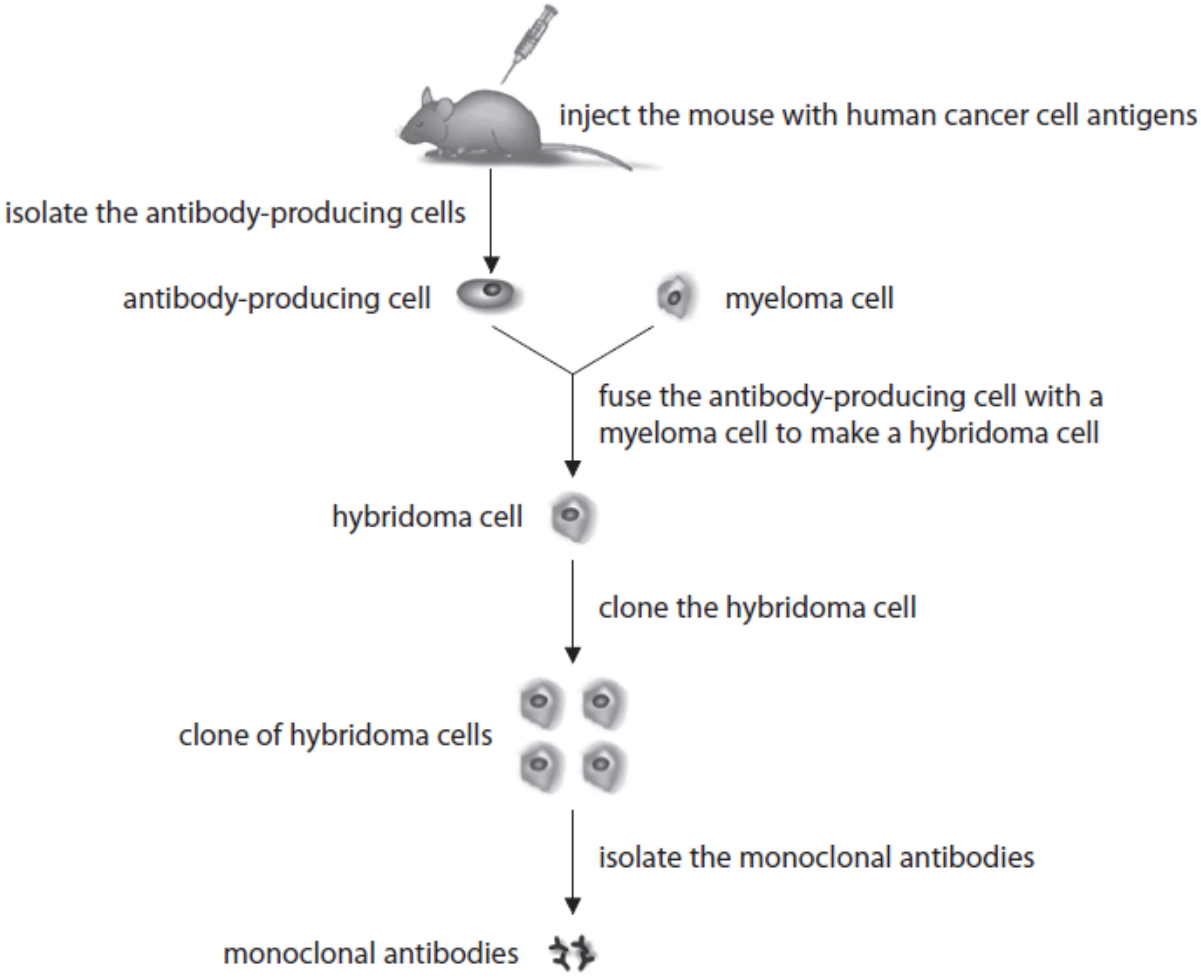
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Q3.

Monoclonal antibodies can be made against a wide range of different antigens. They are used in research and medicine.

Monoclonal antibodies are made by fusing an antibody-producing cell with a myeloma cell.

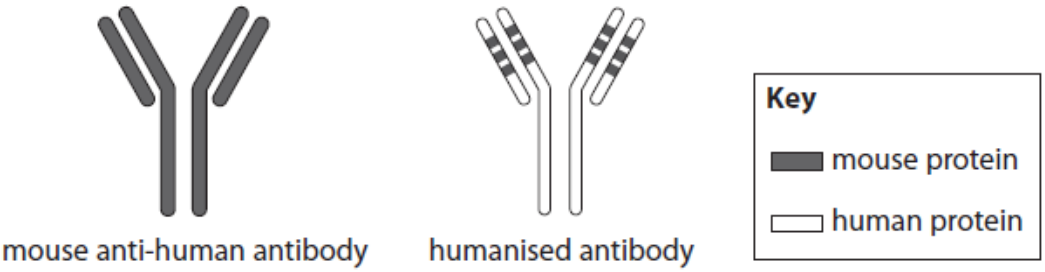
The diagram shows some of the steps involved in making monoclonal antibodies against human cancer cell antigens.



The antibodies made by this method are called 'mouse anti-human antibodies'. These antibodies are made by a mouse but are specific to human antigens.

Mouse anti-human antibodies are humanised using recombinant DNA methods.

The diagram shows a mouse anti-human antibody and a humanised antibody.



mouse anti-human antibody humanised antibody

(i) Explain the advantages of using humanised antibodies in the treatment of cancer.

(3)

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* (ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.

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(Total for question = 9 marks)

Q4.

One type of vaccine contains inactivated poliovirus.

A scientist took blood samples from people who had received this vaccine. The blood samples contained antibodies to poliovirus.

Explain how treatment with inactivated poliovirus cause the body to produce antibodies to poliovirus.

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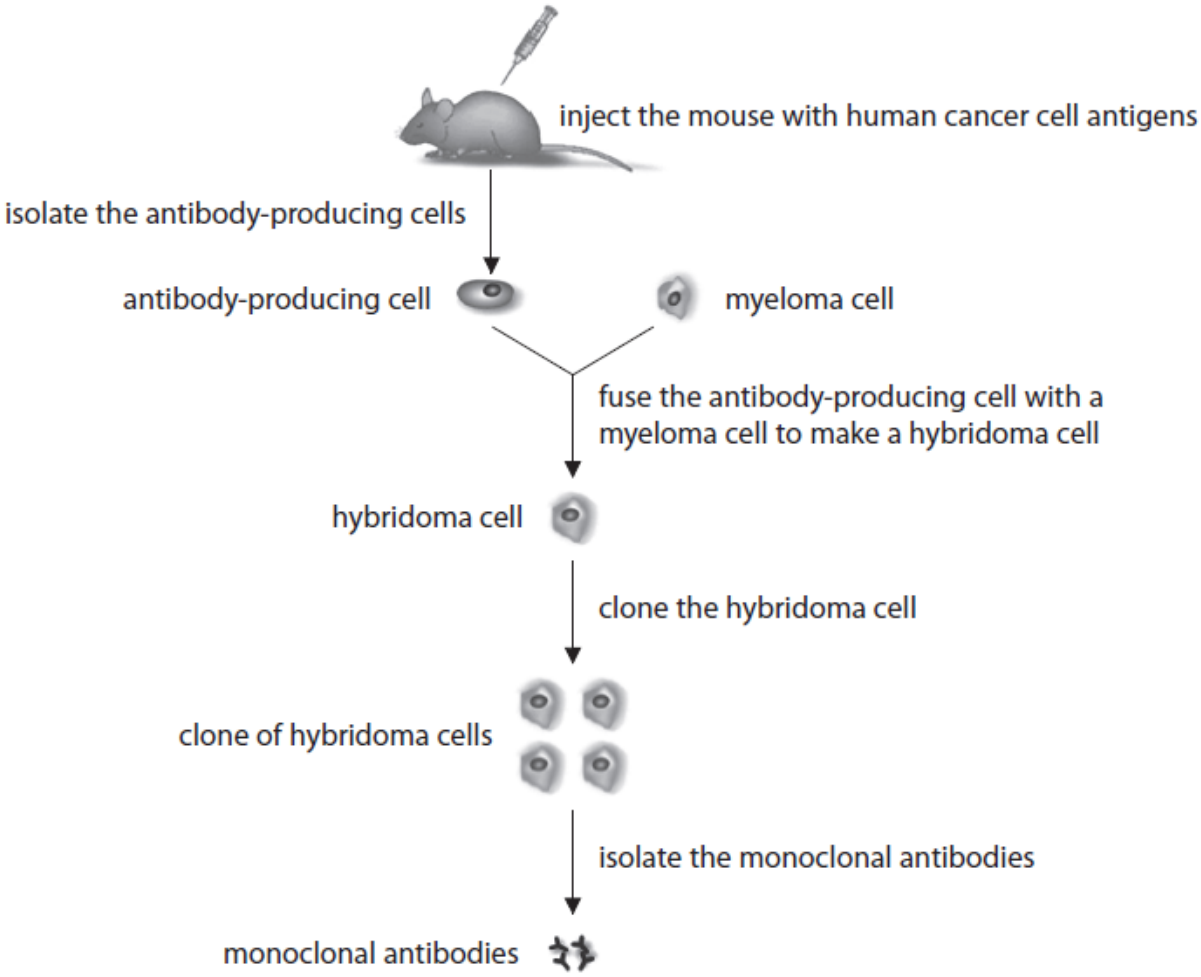
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Q5.

Monoclonal antibodies can be made against a wide range of different antigens. They are used in research and medicine.

Monoclonal antibodies are made by fusing an antibody-producing cell with a myeloma cell.

The diagram shows some of the steps involved in making monoclonal antibodies against human cancer cell antigens.



What is the name of the antibody-producing cell?

(1)

☒ **A** macrophage

☒ **B** memory cell

☒ **C** neutrophil

☒ **D** plasma cell

(Total for question = 1 mark)

Q6.

(a) Newer vaccines against poliovirus are now widely used.

In 1980, there were an estimated 400 000 cases of poliomyelitis worldwide.

In 2012, there were 291 recorded cases in a few countries.

Calculate the percentage decrease in cases from 1980 to 2012.

(1)

Answer ..... %

(b) Pakistan still has cases of poliomyelitis. The population of Pakistan is 196 million people.

After vaccination, 95% of people successfully develop immunity.

Herd immunity is achieved when 85% of the population is immune.

Calculate the number of people in Pakistan, to the nearest million, who must be vaccinated in order to achieve herd immunity.

(2)

Answer .....

Q7.

Some plants have been genetically modified to express viral antigens.

These plants are used as edible vaccines and stimulate immunity when eaten.

Devise an investigation that a scientist could use to measure the effectiveness of this vaccine in mice.

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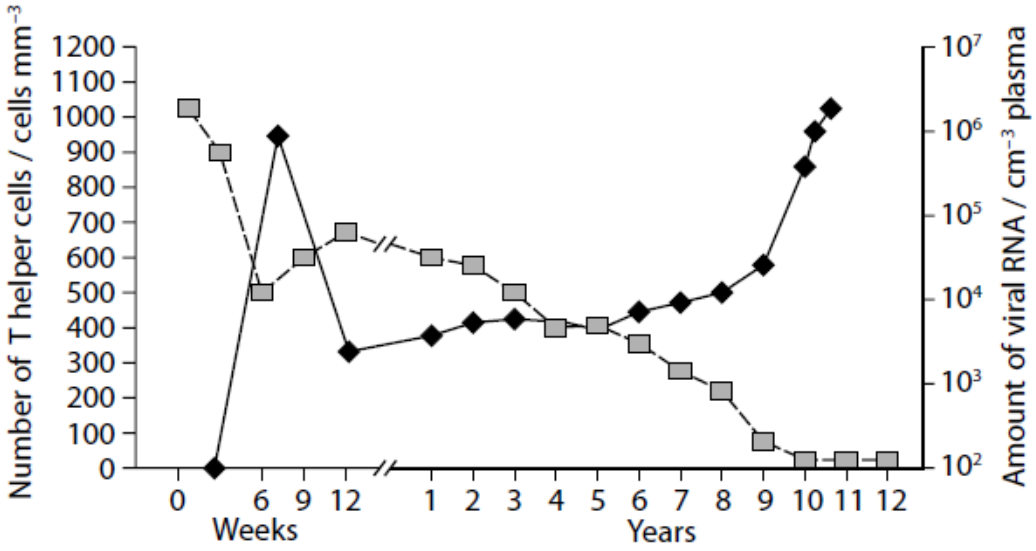
(Total for question = 5 marks)

Q8.

The Human Immunodeficiency Virus (HIV) causes an infection called Acquired Immune Deficiency Syndrome (AIDS).

The virus attacks T helper cells in the body and eventually leads to death, usually as a result of opportunistic infections.

The graph below shows changes in the T helper cell count and in the amount of viral RNA in a person during a period from initial HIV infection to death.



(a) Calculate the percentage change in viral RNA from week two to week six.

(2)

Answer .....

(b) Analyse the data to explain the changes in the T helper cell count from initial HIV infection until death.

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(Total for question = 7 marks)

Q9.

* Antibiotics are not an effective treatment for viral infections such as influenza.

Influenza infections can be prevented by vaccination.

In February 2015, BBC News reported:

"The current death rate in England and Wales is running about one-third higher than its normal rate for this time of year. A combination of influenza and very cold weather may be responsible."

In the same month, the Daily Telegraph and the Daily Mail newspapers used the following headlines:

"The 'flu jab given to millions is useless"

"The 'flu jab is a waste of time"

The National Health Service (NHS) responded by describing these newspaper headlines as irresponsible.

Evaluate the NHS response to these newspaper headlines.

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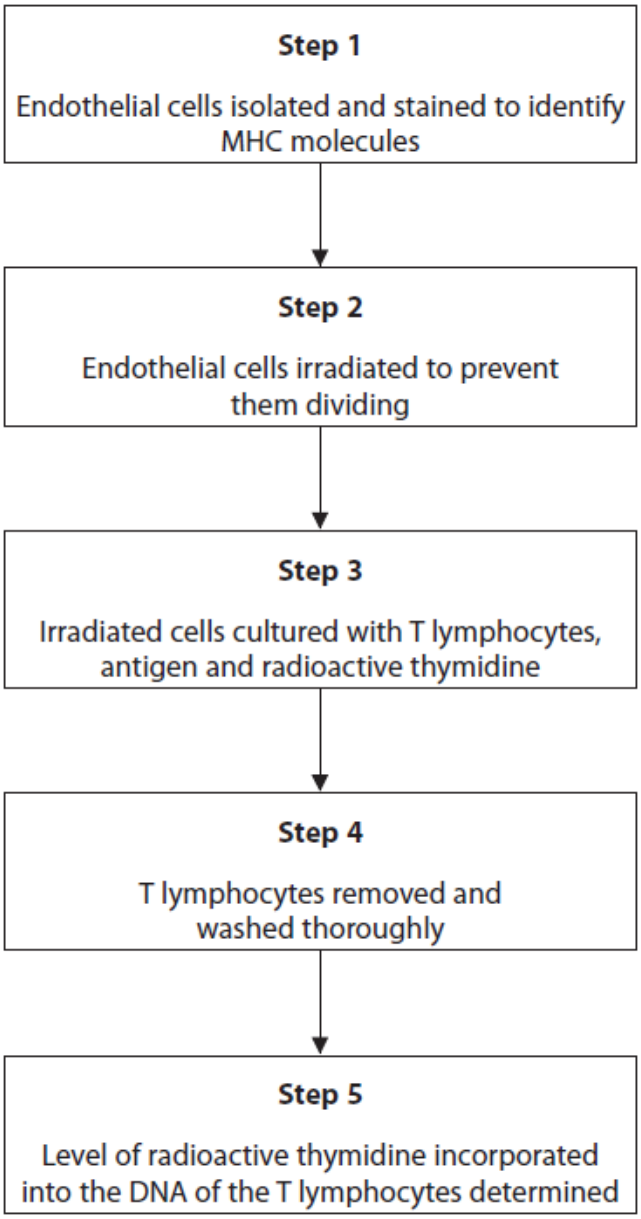
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Q10.

Cell division can be measured using radioactive thymidine. This molecule is used in the synthesis of new DNA molecules.

A scientist investigated the ability of endothelial cells to present antigens.

The flow chart shows some of the steps involved in this investigation.



Irradiation prevents cells from dividing.

Explain why the endothelial cells were irradiated in Step 2, before they were cultured with T lymphocytes and antigen.

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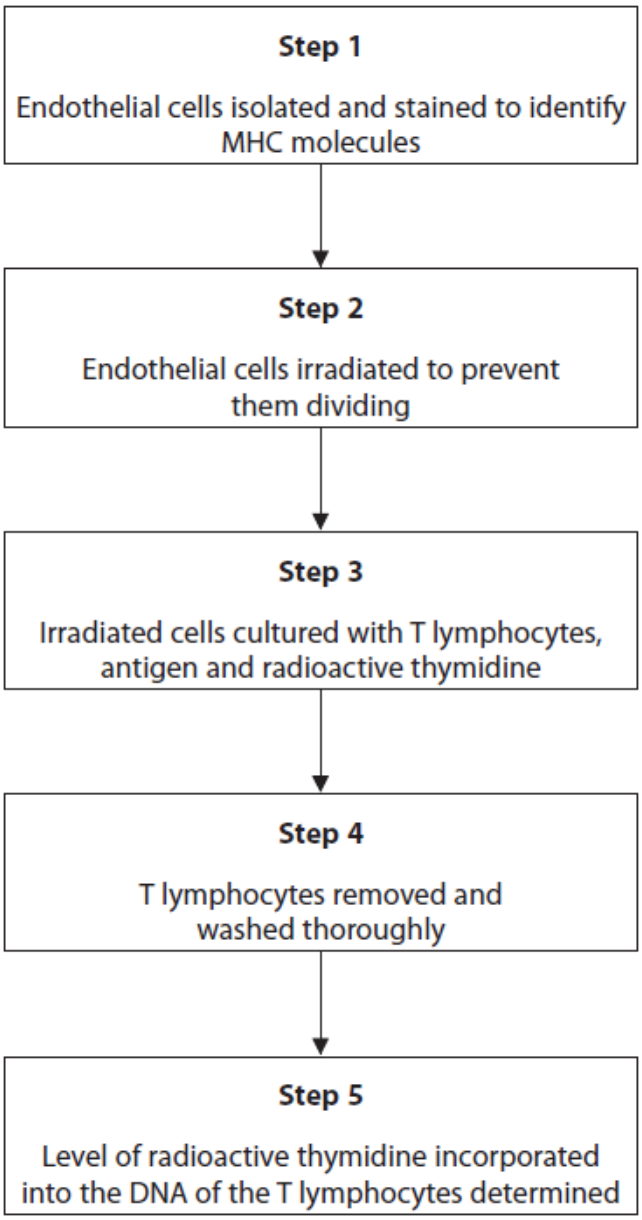
(Total for question = 2 marks)

Q11.

Cell division can be measured using radioactive thymidine. This molecule is used in the synthesis of new DNA molecules.

A scientist investigated the ability of endothelial cells to present antigens.

The flow chart shows some of the steps involved in this investigation.



Explain why the scientist looked for the presence of MHC molecules on the endothelial cells, in Step 1.

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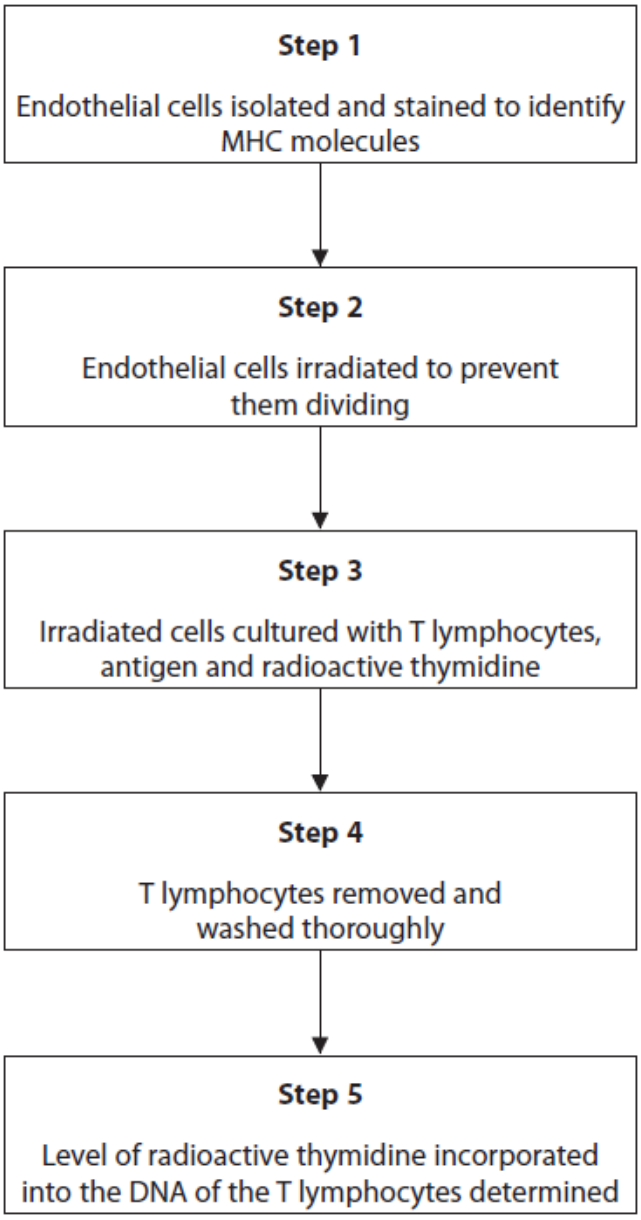
(Total for question = 2 marks)

Q12.

Cell division can be measured using radioactive thymidine. This molecule is used in the synthesis of new DNA molecules.

A scientist investigated the ability of endothelial cells to present antigens.

The flow chart shows some of the steps involved in this investigation.



Explain why the T lymphocytes needed to be washed thoroughly in Step 4.

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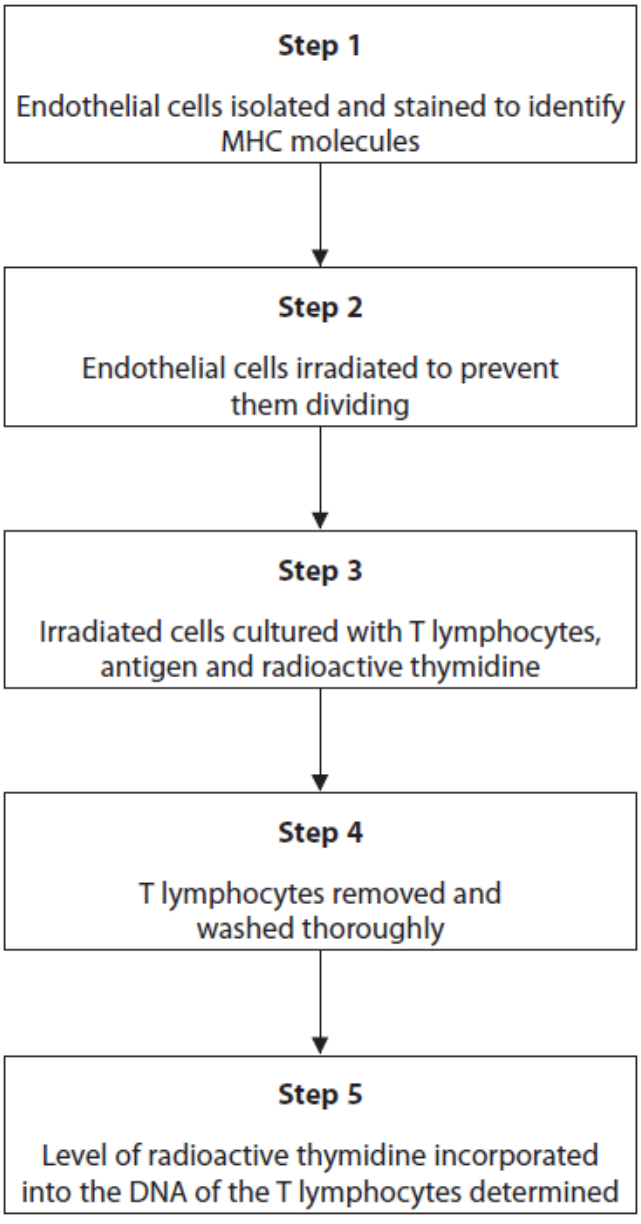
(Total for question = 2 marks)

Q13.

Cell division can be measured using radioactive thymidine. This molecule is used in the synthesis of new DNA molecules.

A scientist investigated the ability of endothelial cells to present antigens.

The flow chart shows some of the steps involved in this investigation.

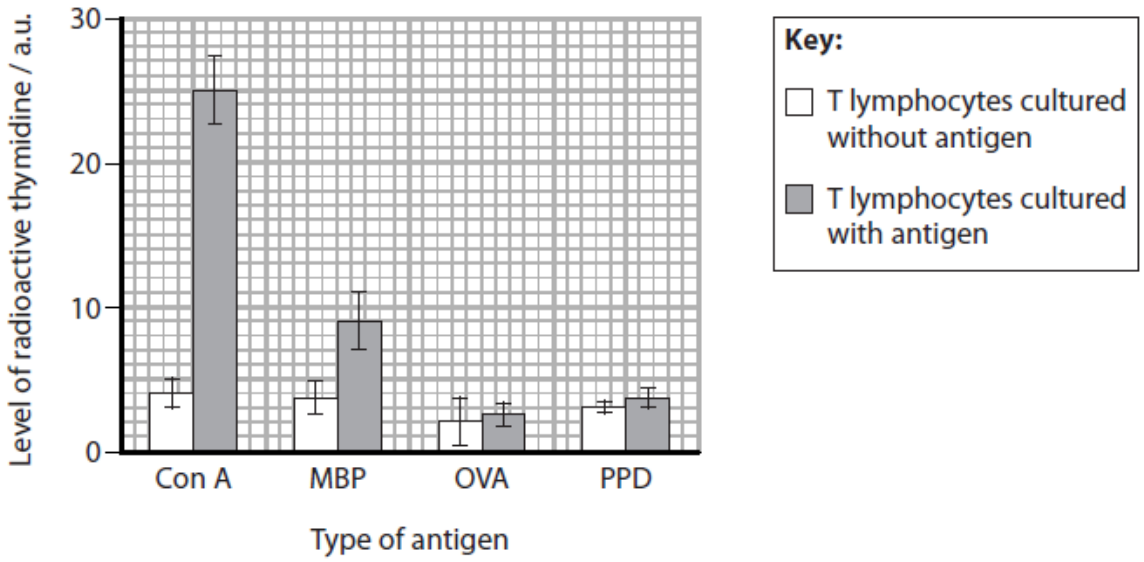


In this investigation, the ability of the endothelial cells to present four different types of antigen was assessed.

T lymphocytes were cultured with endothelial cells and antigen.

This was repeated using T lymphocytes cultured with endothelial cells and no antigen.

The graph shows the results of this investigation.



(i) Explain why T lymphocytes were cultured with and without the antigen.

(2)

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(ii) Analyse the data to explain the conclusions that can be drawn from this investigation.

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(Total for question = 5 marks)

Q14.

During the development of active immunity, macrophages present antigens to T helper cells.

In an investigation into clonal selection, macrophages and T cells were isolated from two strains of guinea pig, strain 2 and strain 13.

The macrophages from each strain of guinea pig were exposed to an antigen and treated with mitomycin.

Mitomycin forms cross links between complementary strands of DNA.

These macrophages were then cultured with T cells from each of the strains of guinea pig for 72 hours.

Radioactive thymidine was included in the culture. This molecule will become incorporated into DNA during DNA replication instead of thymine.

The table shows the results of this investigation.

Source of macrophages	Level of radioactive thymidine incorporated into T cells / a.u.	
	T cells from strain 2 guinea pigs	T cells from strain 13 guinea pigs
strain 2	180	13
strain 13	17	59

(i) Explain why the macrophages were treated with mitomycin.

(3)

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(ii) Explain how radioactive thymidine becomes incorporated into the DNA.

(2)

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(iii) Analyse the data to explain the results of this investigation.

(4)

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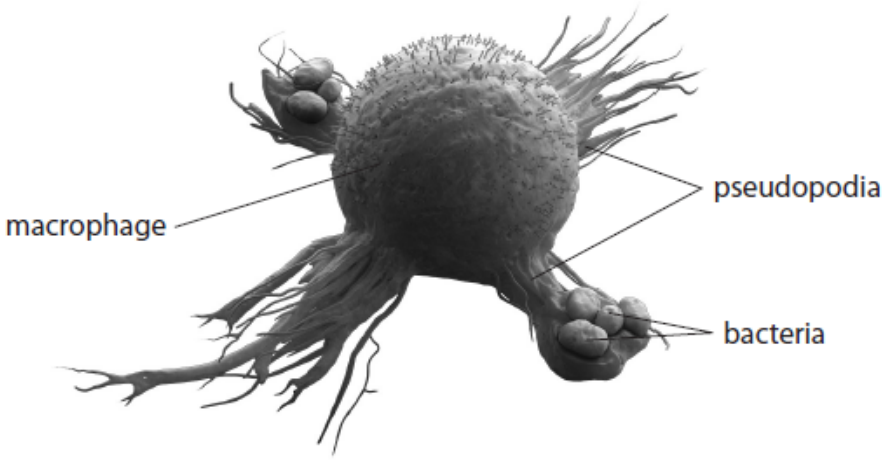
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Q15.

Macrophages are involved in response to infection.

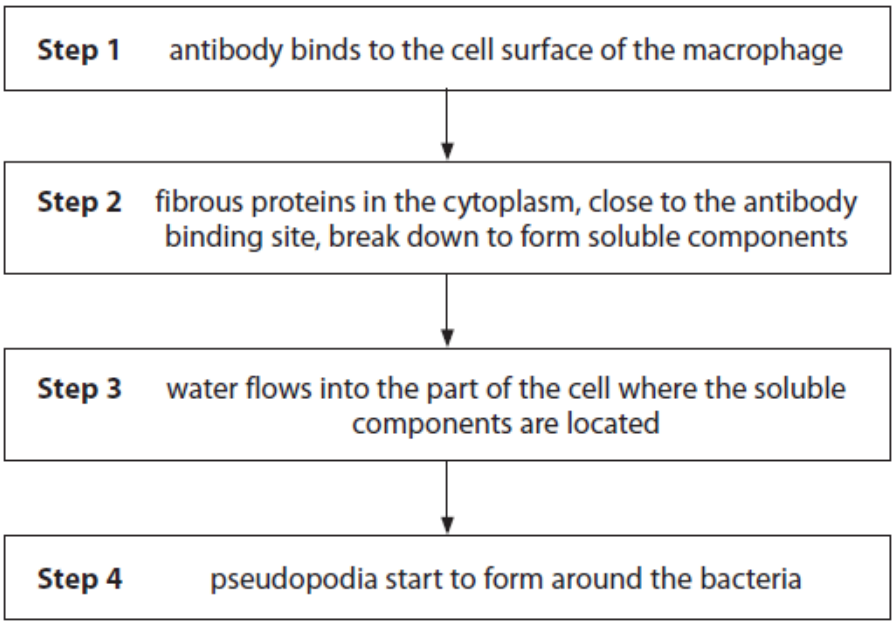
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



(Source: © urfin/Shutterstock)

The flow chart shows one theory for the formation of pseudopodia.

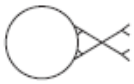


(i) Which diagram shows one antibody binding to the surface of a macrophage (**Step 1**)?

(1)

☒ A 

☒ B 

☒ C 

☒ D 

(ii) Actin is a fibrous protein.

Which row of the table describes the breakdown of actin (**Step 2**)?

(1)

	monomer formed	process by which bond is broken
☒ A	amino acid	condensation
☒ B	amino acid	hydrolysis
☒ C	nucleotide	condensation
☒ D	nucleotide	hydrolysis

(iii) Explain why water flows into the part of the cell where the soluble components are located (**Step 3**).

(2)

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(iv) Describe the events that take place resulting in T helper cell activation, following the formation of pseudopodia by the macrophages (**Step 4**).

(3)

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(Total for question = 7 marks)

Q16.

During the development of active immunity, macrophages present antigens to T helper cells.

Describe how macrophages present antigens to T helper cells.

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(Total for question = 2 marks)

Q17.

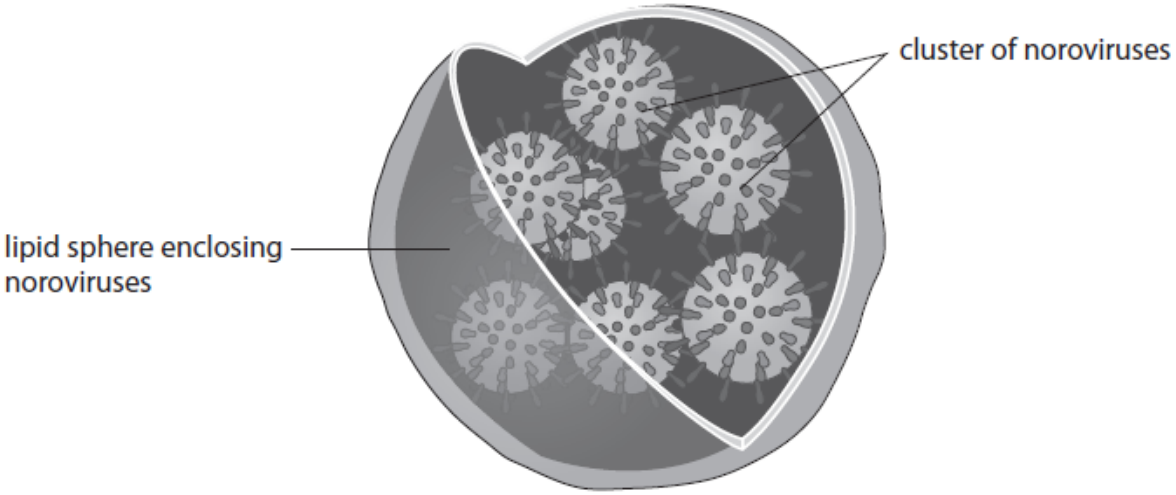
Norovirus is a single-stranded RNA, non-enveloped virus.

Norovirus is the most common cause of gastroenteritis.

Noroviruses can infect an animal as individual viruses or as a cluster of viruses inside a lipid sphere.

A cluster of viruses inside a lipid sphere is called a stealth sphere.

The diagram shows a stealth sphere.



(i) Animals infected with stealth spheres develop gastroenteritis very quickly and with severe symptoms.

Animals infected with individual noroviruses develop gastroenteritis more slowly and with less severe symptoms.

Analyse the information to explain these findings.

(3)

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(ii) Scientists are hoping that new treatments for norovirus infections can be developed to target the stealth sphere.

Analyse the information to explain how targeting the stealth sphere could be used to treat these infections.

(2)

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(Total for question = 5 marks)

Q18.

*Macrophages are involved in response to infection.

Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



(Source: © urfin/Shutterstock)

The flow chart shows one theory for the formation of pseudopodia.

Step 1 antibody binds to the cell surface of the macrophage

↓

Step 2 fibrous proteins in the cytoplasm, close to the antibody binding site, break down to form soluble components

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Step 3 water flows into the part of the cell where the soluble components are located

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Step 4 pseudopodia start to form around the bacteria

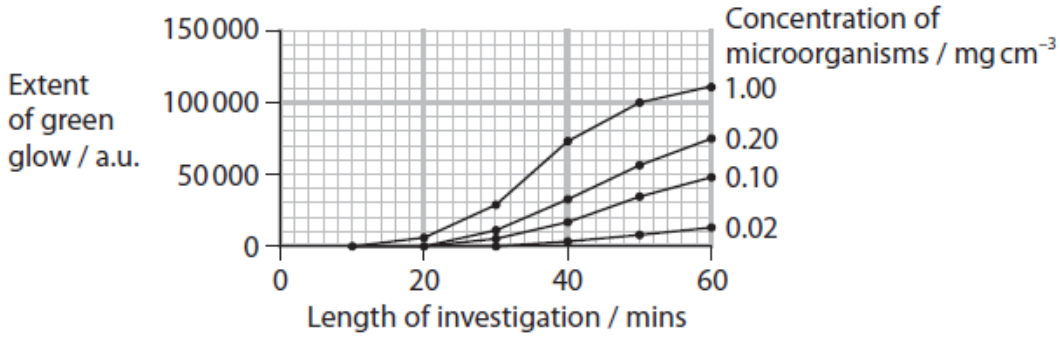
Phagocytosis by macrophages is affected by a number of factors.

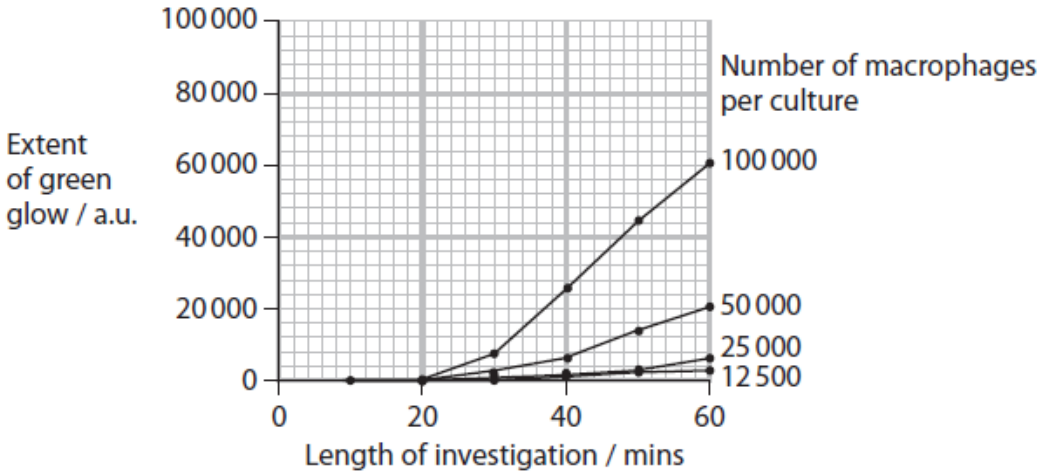
Microorganisms with a fluorescent green dye attached to them were used to measure phagocytosis by macrophages.

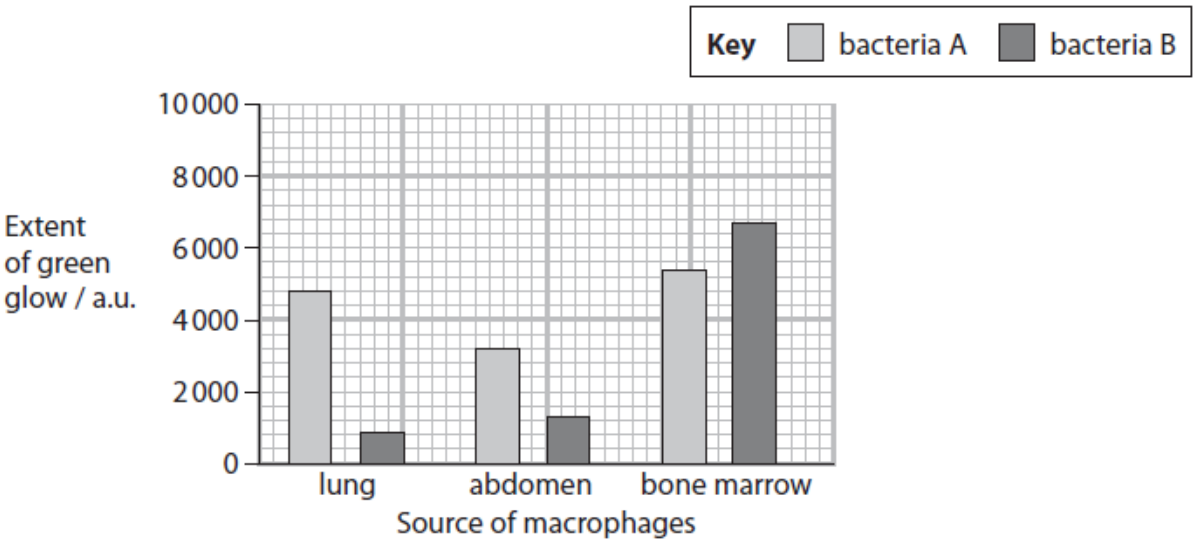
The microorganisms were added to the macrophages and incubated. The macrophages were then washed and the extent to which they glowed green was determined.

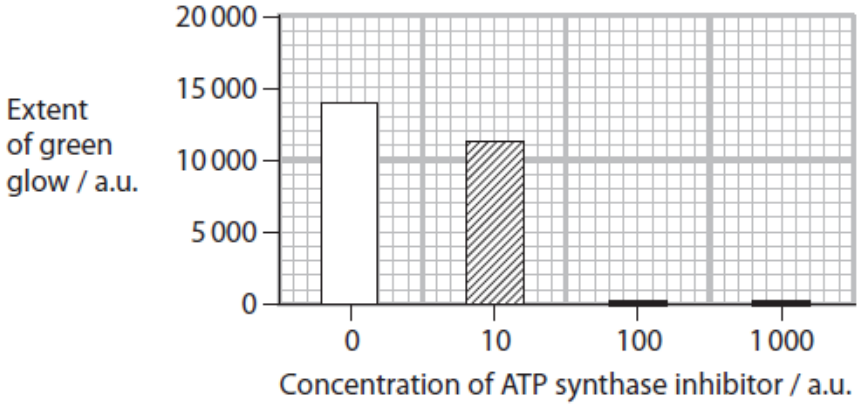
The extent of the green glow is proportional to the number of microorganisms engulfed by the macrophages.

The graphs show the results of investigations into phagocytosis by macrophages.









Analyse the data to discuss the factors that affect phagocytosis by macrophages.

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(Total for question = 6 marks)

Q19.

Inflammation helps to destroy microbes.

Measurement of cytokine levels in the blood may be used to assess the severity of pulmonary arterial hypertension (PAH) in patients waiting for a heart transplant.

(i) Which type of cell produces cytokines?

(1)

☒ **A** B effector cell

☒ **B** B memory cell

☒ **C** T helper cell

☒ **D** T killer cell

(ii) Which of the following is a correct statement about cytokines?

(1)

☒ **A** lipids that destroy host-infected cells

☒ **B** lipids that activate T killer cells

☒ **C** proteins that destroy host-infected cells

☒ **D** proteins that activate T killer cells

Q20.

Malaria is caused by *Plasmodium*, a pathogenic microorganism.

Vaccination is one of many methods being used to control malaria.

In a study, the effectiveness of a vaccine for malaria was tested.

The following method was used:

- samples of *Plasmodium* were exposed to radiation and used to make a vaccine
- two groups of people, A and B, were given different doses of the vaccine
- a third group of people, C, was used as a control
- one month after vaccination, all three groups of people were exposed to mosquitoes known to contain live *Plasmodium*
- the number of people in each group with malaria was recorded.

The results are shown in the table.

Group	Treatment with the vaccine	Number of people in each group	Number of people with malaria
A	low dose	17	16
B	high dose	6	0
C	control	12	11

(i) Explain why the samples of *Plasmodium* were exposed to radiation.

(2)

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(ii) State the control treatment that was given to people in group C.

(1)

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(iii) It was claimed that this vaccine was 100% effective.

Analyse the data to criticise the validity of this claim.

(3)

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(iv) Describe how vaccination enabled the people in group B to have active artificial immunity against malaria.

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(Total for question = 11 marks)