

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 6: MICROBIOLOGY AND PATHOGENS
RESPONSE TO INFECTION

SCORE

/102

PERCENTAGE

%

STEMUP

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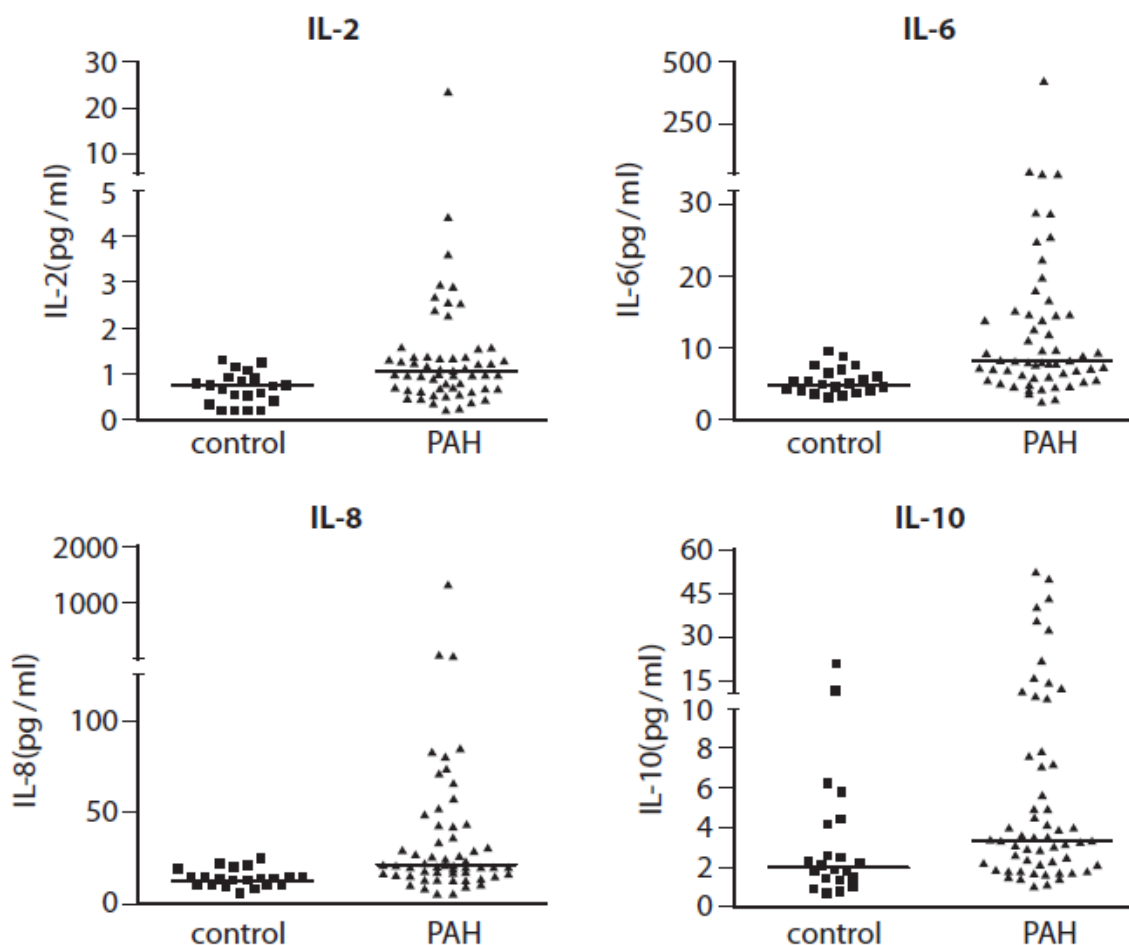
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Q1.

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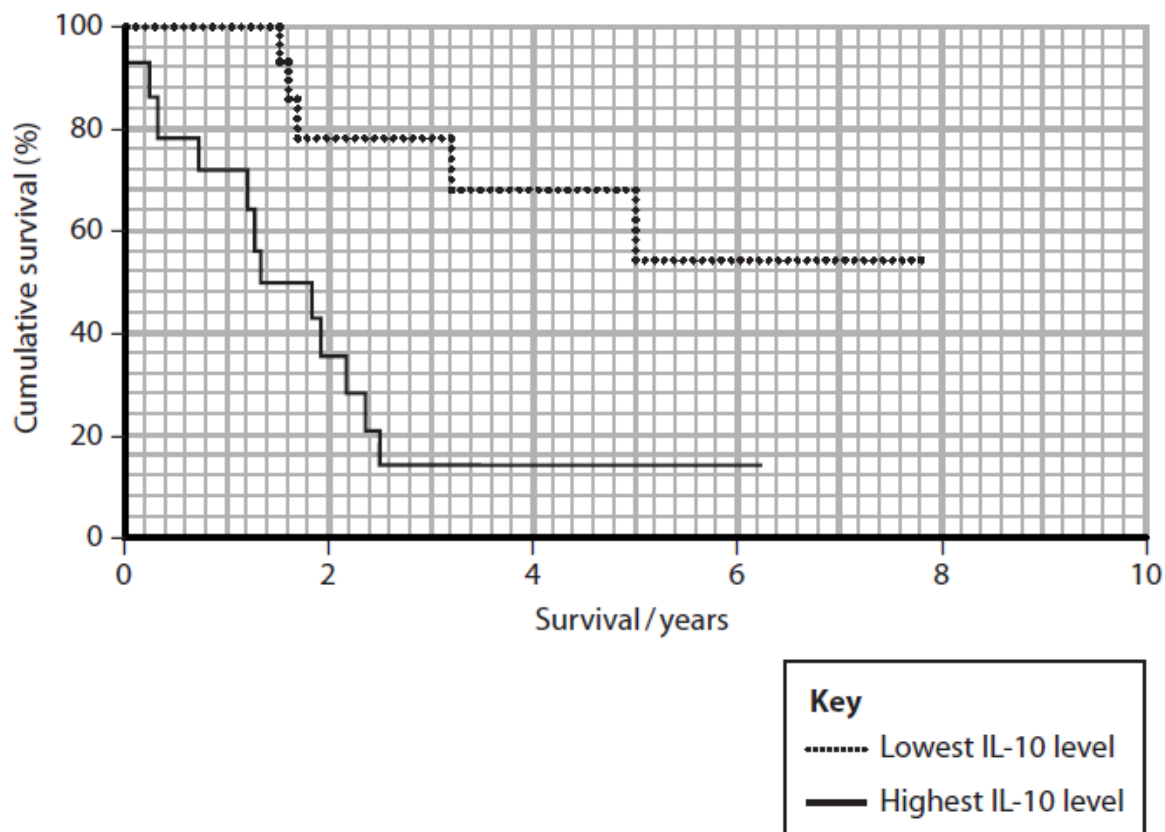
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(iv) The graph shows the survival rates for PAH patients with raised cytokine IL-10 levels.



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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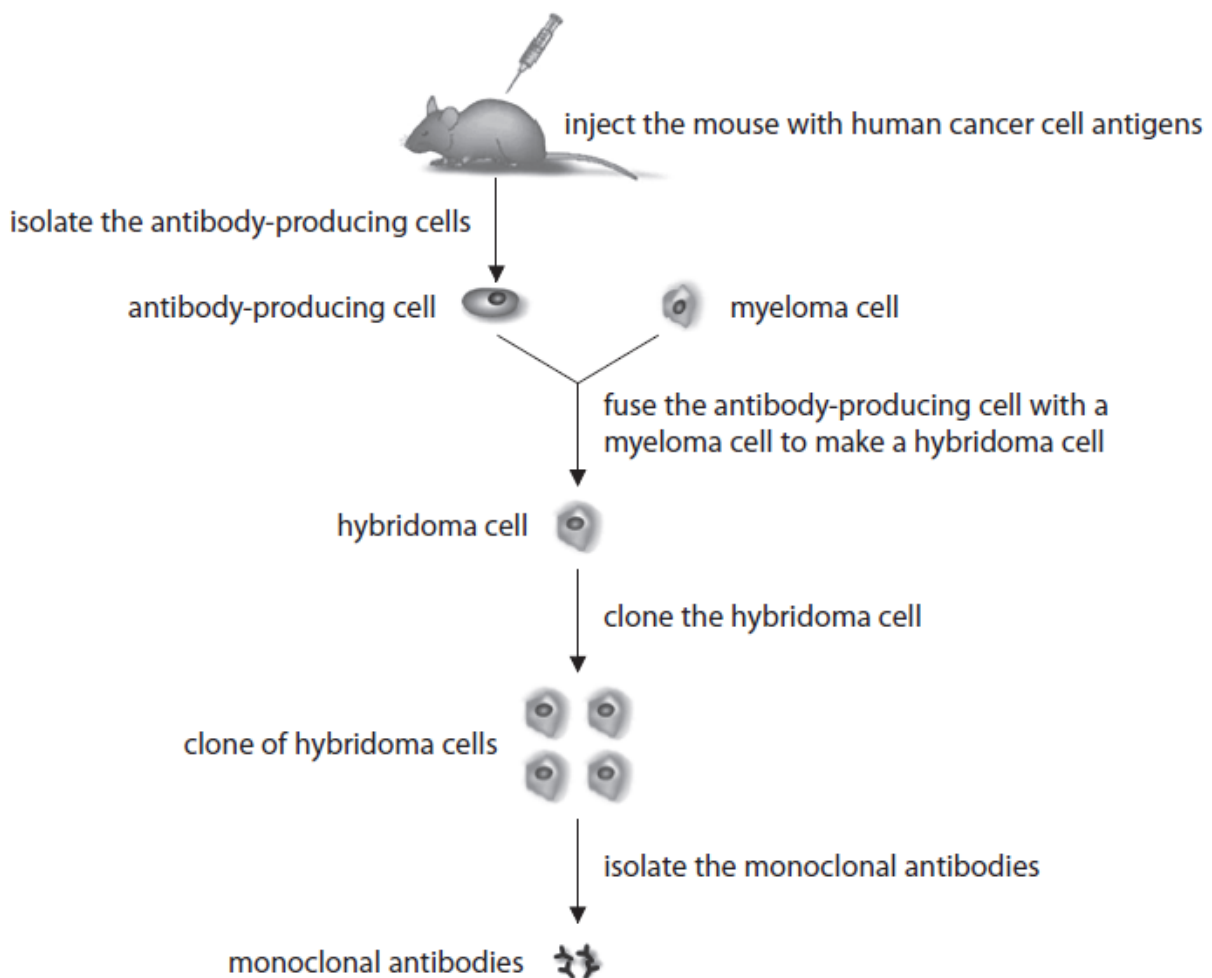
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Q3.

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.

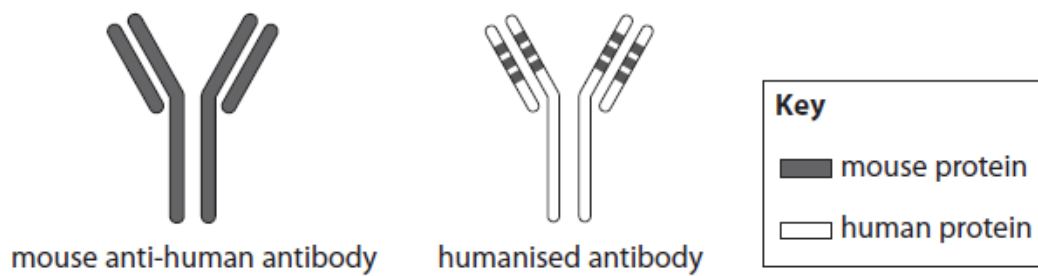
The diagram shows some of the steps involved in making monoclonal antibodies against human cancer cell antigens.



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.



(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.

(6)

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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.

(4)

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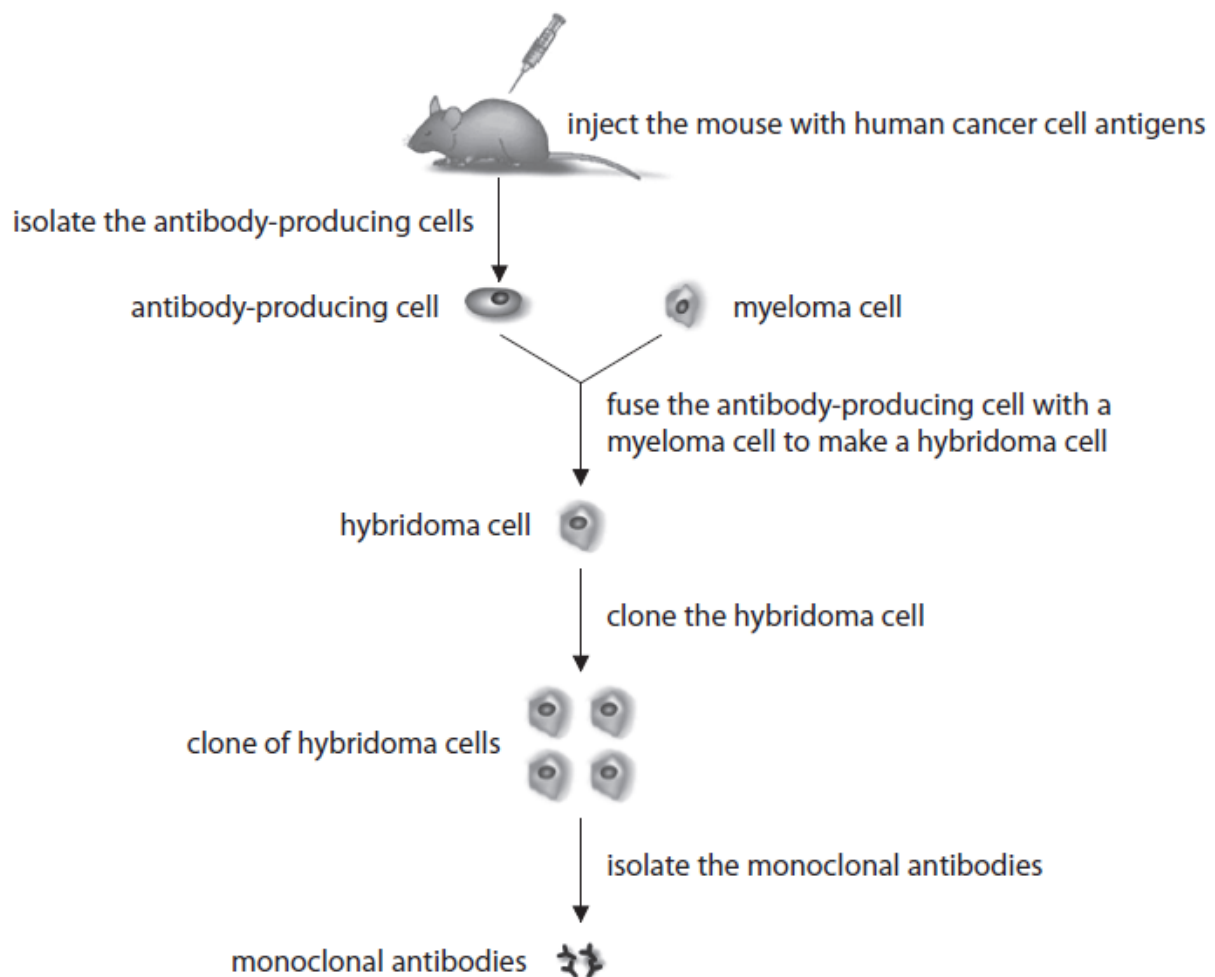
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Q5.

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

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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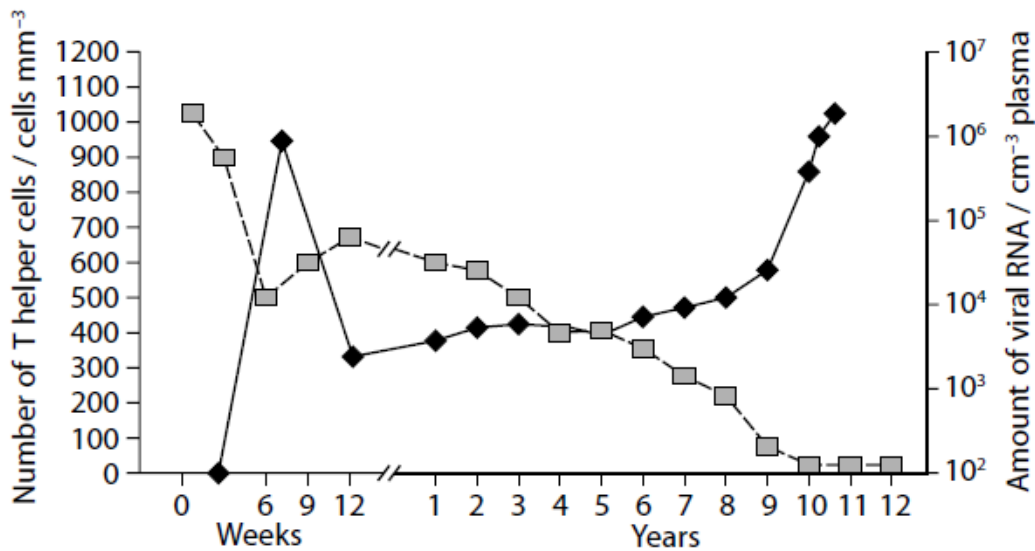
(Total for question = 5 marks)

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.

(5)

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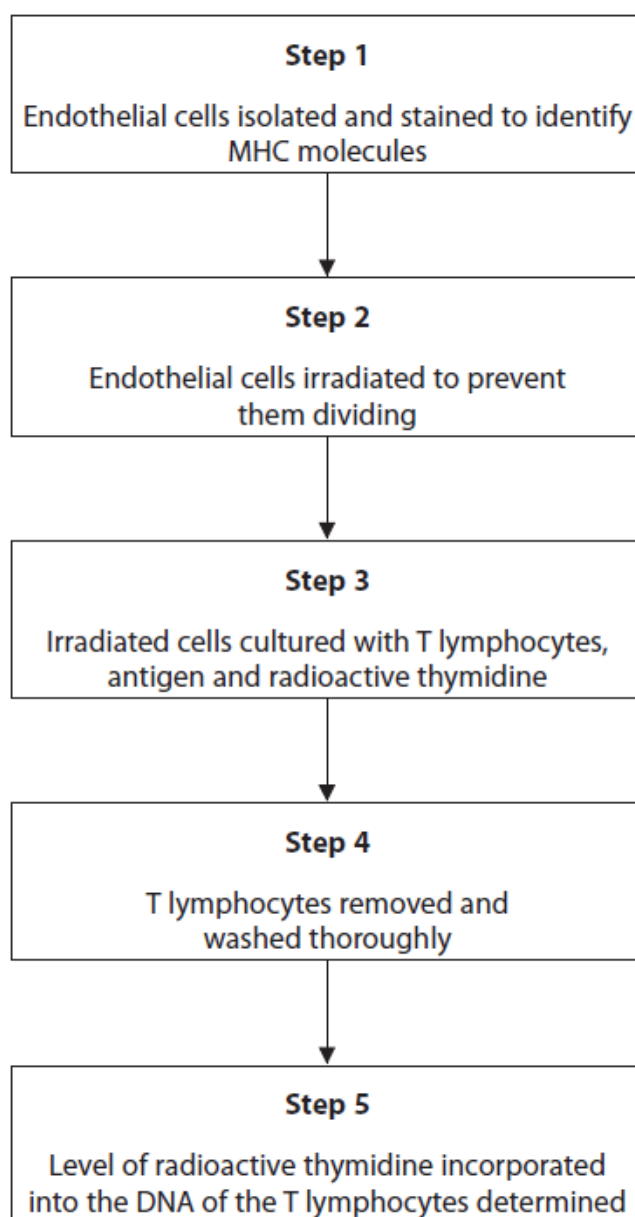
(Total for question = 7 marks)

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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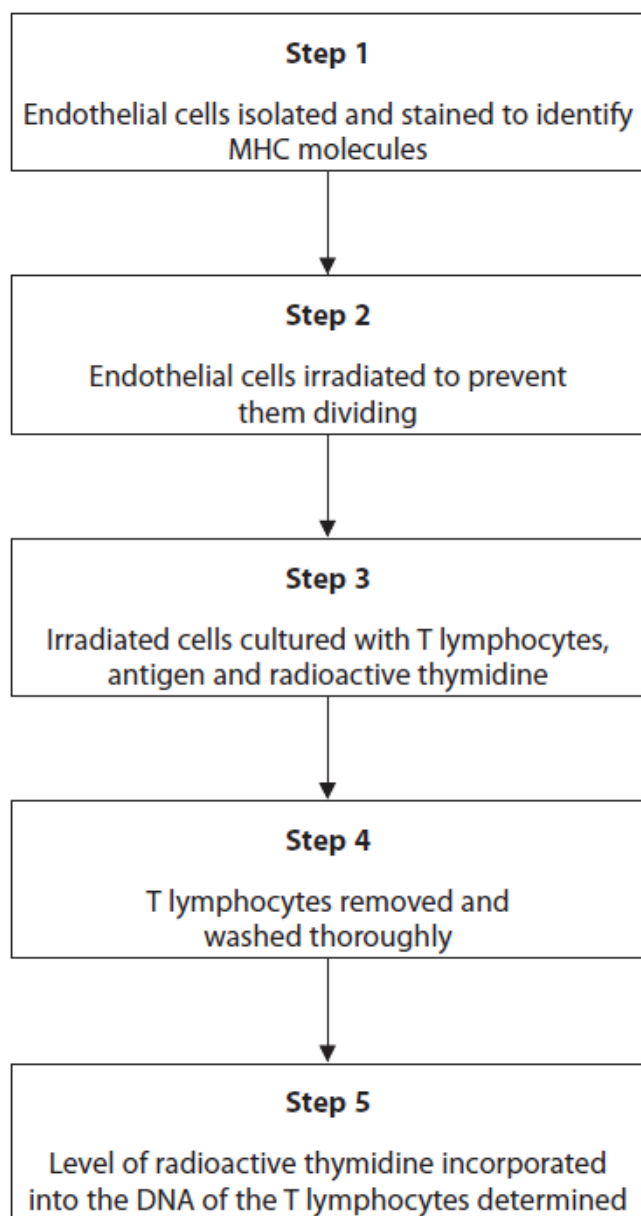
(Total for question = 2 marks)

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.

(2)

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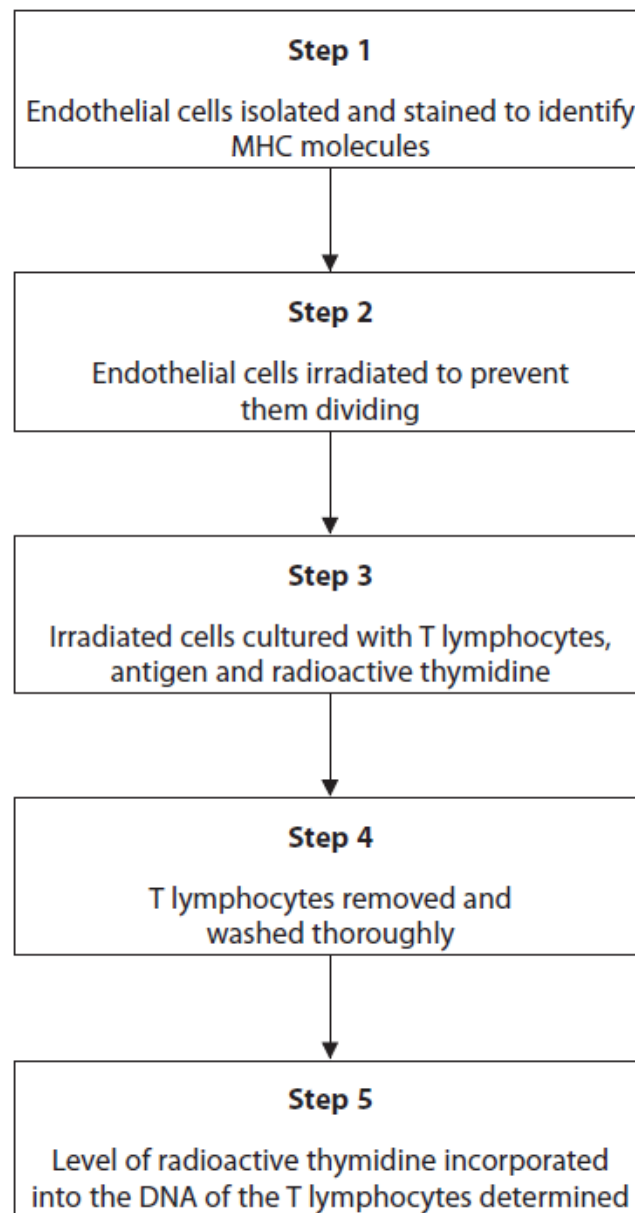
(Total for question = 2 marks)

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.

(2)

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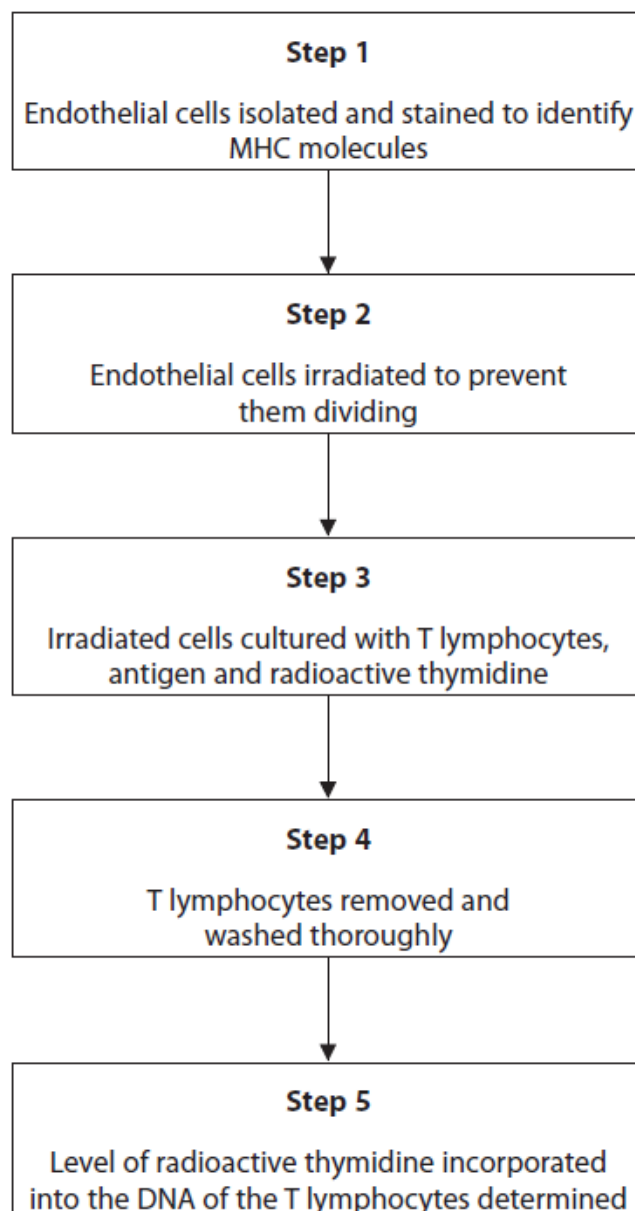
(Total for question = 2 marks)

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.

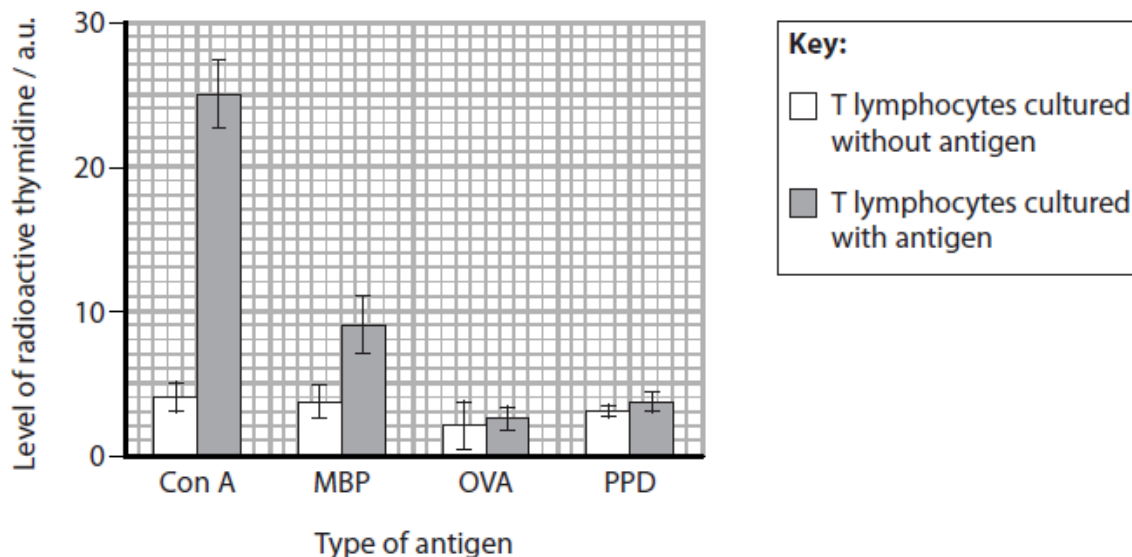


In this investigation, the ability of the endothelial cells to present four different types of antigen was assessed.

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.

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(Total for question = 9 marks)

Q15.

Macrophages are involved in response to infection.

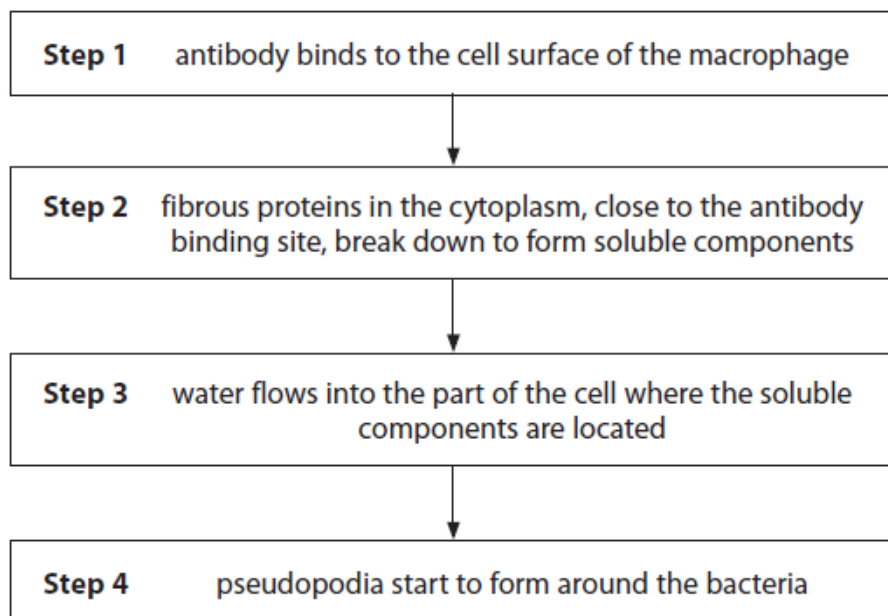
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



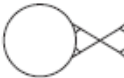
(Source: © urfin/Shutterstock)

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.

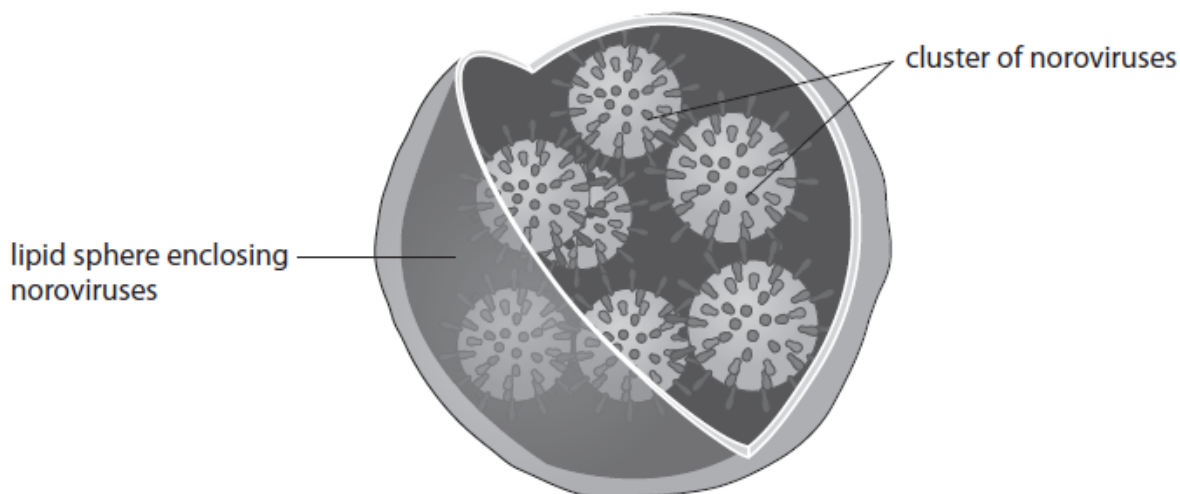
Norovirus is a single-stranded RNA, non-enveloped virus.

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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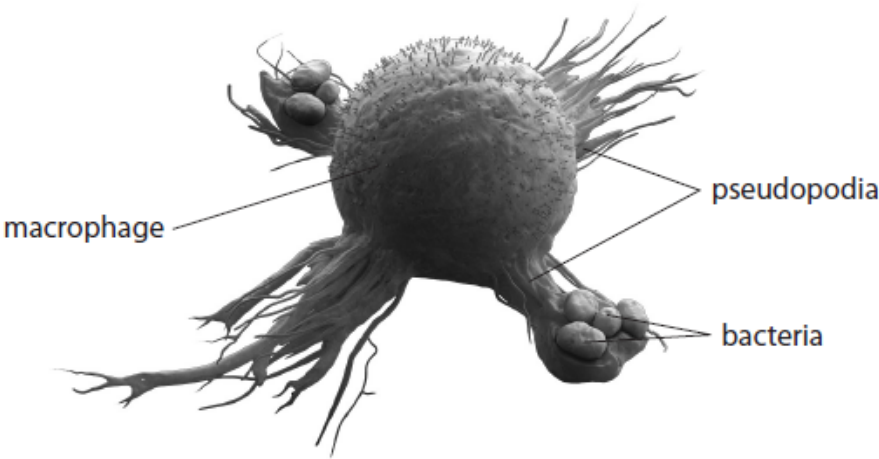
(Total for question = 5 marks)

Q18.

*Macrophages are involved in response to infection.

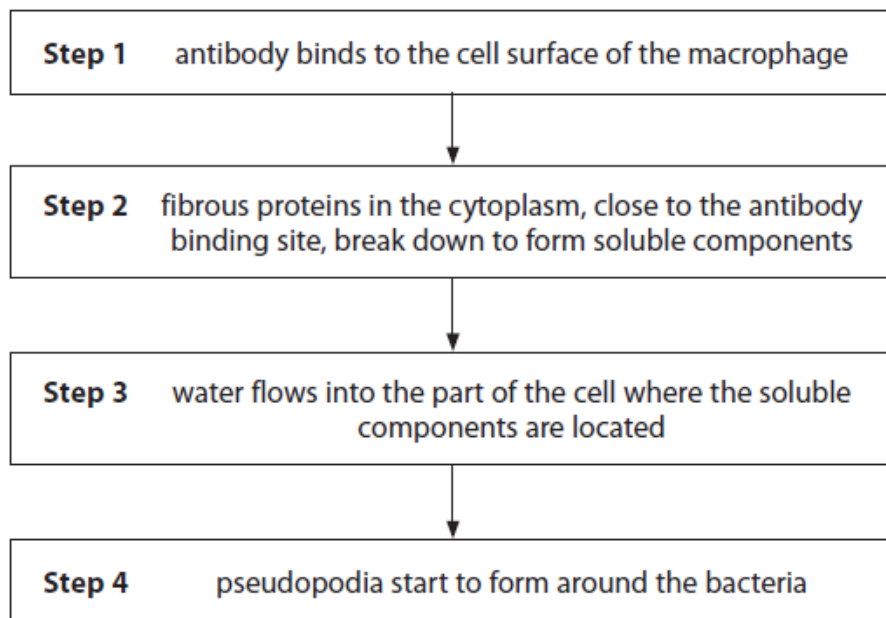
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



(Source: © urfin/Shutterstock)

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



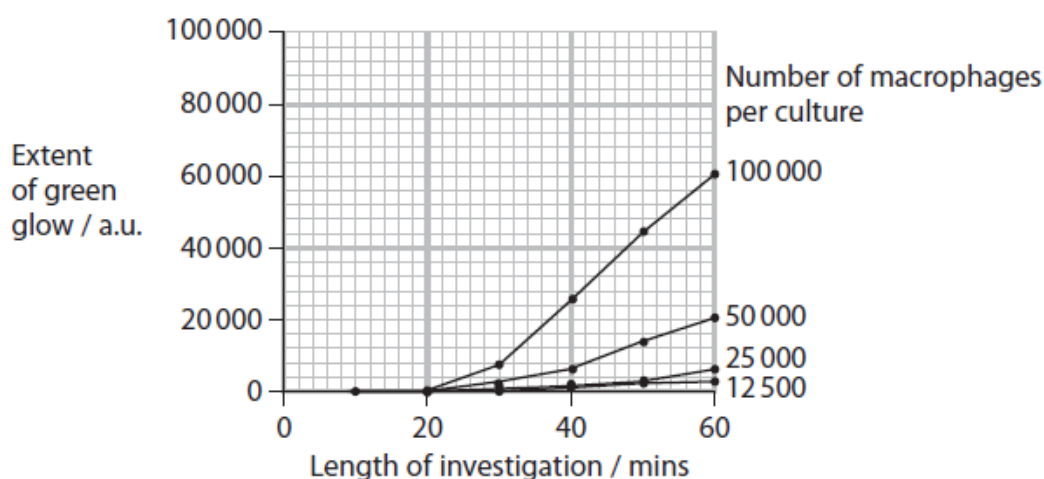
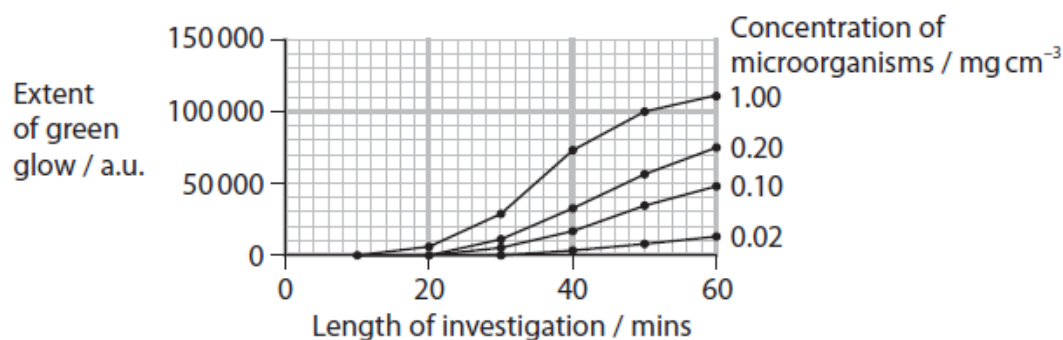
Phagocytosis by macrophages is affected by a number of factors.

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.



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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)

Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	An answer that makes reference to the following: • correct reading from graph for IL-10 (1) • correct calculation of increase (1)	<u>Example of calculation</u> IL-10 is $3.4 - 2.0 = 1.4$ Allow 3.3 to 3.5 $(1.4 \times 100) \div 2.0 = 70\%$ Allow 65% to 75%	(2)

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: - one group treated with { placebo / inert substance / saline } (1) - one group with no intervention (1)		(2)

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: - the vaccine is very effective against PV2 and PV3, supporting widespread use (1) - there is no alternative vaccine or treatment, so the 60-70% protection against PV1 is still useful (1) - allergic reaction is (very) rare given the size of the study (1) - the effects of polio are serious and there is no cure, therefore benefits of vaccination are greater than { risks / costs } (1)		(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: - humanised antibodies will not trigger an immune response / mouse antibodies could trigger an immune response (1) - antibodies would {bind to cancer cells so that macrophages could destroy the cancer cells / opsonise the cancer cells} (1) - the antibodies are target specific (1) - reducing the need for other {treatments / named treatment} (1)	Accept humanised antibodies will not be recognised as {foreign / as an antigen} / mouse antibodies could be recognised as {foreign / as an antigen} Accept antibodies will bind only to cancer cells Accept have less {side effects / named side effects}	(3)

Question Number	Indicative content
* (ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Description: - mouse antibody is made of all mouse components - humanised antibody consists mostly of human components - mouse antibody recognised by the patient's immune system (rejection) - mouse protein acts as an antigen Consequence: - mouse antibody could be destroyed - mouse antibodies would not persist in the body - macrophages may not bind to mouse antibody - so phagocytosis of the cancer cells would not be enhanced - humoral / B cell immune response could be initiated - macrophages may phagocytose the mouse antibody Immunology: - details of how macrophage destroys antibody - macrophage becomes an antigen-presenting cell - T helper cells become activated - antibodies against the mouse antibodies could be produced (by plasma cells) Accept converse for humanised antibody throughout

Level 0	0	No awardable content
Level 1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. Description of mouse antibody resulting in rejection (Accept converse for humanised antibody throughout)
Level 2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure. Details given on why the mouse antibodies may not be effective in treating the cancer (Accept converse for humanised antibody throughout)
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured. Explanation of how the mouse antibody could be destroyed by the immune system (Accept converse for humanised antibody throughout)

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • inactivated poliovirus has antigens on surface that bind to complementary B cell receptor (1) • therefore B cells become { antigen-presenting cells / APCs } (1) • complementary T helper cells bind to { B cells / APCs } and produce cytokines (1) • therefore B cells differentiate into plasma cells that secrete antibodies (1)		(4)

Q5.

Question Number	Answer	Mark
	The only correct answer is D <i>A is not correct because macrophages do not produce antibody</i> <i>B is not correct because memory cells do not produce antibody</i> <i>C is not correct because neutrophils do not produce antibody</i>	(1)

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• calculation of percentage decrease (1)	<u>Example of Calculation:</u> $\left(\frac{400,000 - 291}{400,000} \times 100 = \right) 99.9\%$	(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	- calculation of 85% of 196 million but only 95% of this population is actually immune (1) • correct answer to the nearest million (1)	$(196\,000\,000 \times 0.85) / 0.95$ OR $(196\,000\,000 / 0.95) \times 0.85$ = 175 million Allow full marks for correct answer with no working	(2)

Q7.

Question Number		Additional Guidance	Mark
	An answer that makes reference to five of the following: - use mice not exposed to the {virus / antigen} (1) - mice given vaccine and mice {not given vaccine / saline / placebo} / GM plant and normal plant} (1) - assess {antibodies / white blood cells / named white blood cell} (1) {large number of mice / 10+ mice} for each treatment (1) - control {sex / age / species} of mice (1)	ACCEPT range of vaccine concentration if one is zero ACCEPT (infection with virus and) {observe symptoms / ill / diseased / survive} DO NOT ACCEPT group	(5)

Q8.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	$(10^6 - 10^2) \div 10^2$ $\times 100$ (1) 999900 % (1)	Correct answer gains full marks with no working	(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: • overall the T helper cell count falls from {week 0 / initial HIV infection} and the amount of viral RNA increases (1) • between week 6 and week 12 the amount of viral RNA falls, therefore the T helper cell count increases (1) plus any three of the following: • virus attaches to (CD4) surface receptors (1) • virus genetic material / RNA enters T helper cell (1) • virus genetic material produces virus proteins / new virus particles (1) • T helper cells lyse (1) • T killer cells attack infected T helper cells / phagocytosis by macrophages (1)		(5)

Q9.

Question Number	Indicative content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. For vaccination: • vaccination does protect against influenza and vulnerable groups will need protection • there are many strains of influenza • the World Health Organisation may not have had time to create vaccines against the latest virus type • the vaccine will protect against other varieties of influenza which may also be circulating • vaccinating as many people as possible will help to develop herd immunity • alarmist headlines will put people off being vaccinated for other diseases Against vaccination: • anti-viral drugs could also be used • influenza viruses are always mutating • most of the deaths will be in older people • vaccination programmes are not cost effective • vaccination programmes ineffective unless everyone immunised

Level	Marks	
Level 0	0	No awardable content
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: - because stops DNA replication in endothelial cells (1) - dividing cells {take up / use} the (radioactive) thymidine (1) - so that any radioactive thymidine uptake will be by the T cells (only) (1)	N.B. 'They' or 'cells' refers to the endothelial cells ACCEPT DNA synthesis uses thymidine ACCEPT only T cell division can be measured	

Q11.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: - MHC needed if endothelial cells were to {present antigen / be antigen presenting cells} (1) - antigen binds to MHC molecules (1) - MHC-antigen complex involved in activation of T helper cells (1)	ACCEPT antigens presented on MHC ACCEPT MHC-antigen complex binds to (CD4) receptor on T helper cells	

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: - to remove any thymidine (not taken up) (1) - which would result in an over estimate of the {number of T cells / thymidine present} (1)	ACCEPT {inaccurate / not valid} result for the T cells	

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: to determine any passive uptake of radioactive thymidine / to see if T cells take up thymidine without antigen present (1)	ACCEPT to compare the thymidine with and without antigen	
	to show that antigen is stimulating the T cells (to divide) (1)	ACCEPT to see the effect of antigen (on T cells)	

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: - endothelial cells are best at presenting Con A (and MBP) / Con A (and MBP) are presented (1) - endothelial cells are least effective at presenting OVA (and PPD) / OVA (and PPD) are not presented (1) - because there is very little difference between antigen and {no antigen / control} (1) - because {error bars for Con A and MBP are not overlapping / error bars for OVA and PPD are overlapping} with the control (1)		
		N.B. Con A (and MBP) have the highest level of thymidine and OVA (and PPD) the least = 1 mark if no other marks awarded	

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: - to prevent DNA {replication / unwinding / unzipping} (1) - so that macrophages could not {divide / carry out mitosis} (1) - so that any division could be attributed to the T cells only / radioactive thymidine incorporate into T cells only (1)	ACCEPT separating ACCEPT number of macrophages remains constant ACCEPT no thymidine incorporated into the macrophage	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: {complementary to / binds to / forms H bonds with} adenine (on the DNA) (1) - forming phosphodiester bonds (with adjacent nucleotides) (1)	ACCEPT formation of a sugar-phosphate backbone	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to four of the following: - most (radioactive) thymidine incorporated into T cells that were the same strain as the macrophages (1) - because these cells are dividing more (1) - because {the (MHC and CD4) receptors bind together better / antigen presentation improved} (1) - due to genetic compatibility (1) - strain 2 {macrophages are better antigen presenters / T cell proliferate faster than strain 13} (1)	ACCEPT converse throughout ACCEPT more T cells if antigen is presented by macrophages from same {strain / number} guinea pig description ACCEPT faster mitosis ACCEPT better recognition ACCEPT self-antigens ACCEPT antigen presentation is more effective	(4)

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	The only correct answer is D A is incorrect because antibodies have two antigen binding sites B is incorrect because the two binding sites attach to the antigen and not the macrophage C is incorrect because there is only one macrophage binding site		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(ii)	The only correct answer is B A is incorrect because hydrolysis reactions breakdown molecules C is incorrect because nucleotides are the monomers of polynucleotides not proteins D is incorrect because nucleotides are the monomers of polynucleotides not proteins		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • (because water enters part of cell) by osmosis (1) • from a high water potential to a low water potential / because the osmotic potential inside the cell is lower / from a low solute concentration to a higher solute concentration (1)	ACCEPT more concentrated cytoplasm solute potential for osmotic potential IGNORE concentration gradient unqualified water concentration	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iv)	A description that makes reference to three of the following: • bacteria engulfed and {digested / broken down} (1) • antigen attached to MHC antigen (1) • macrophage becomes an antigen-presenting cell (to the T helper cell) (1) • CD4 (antigen) of T (helper) cell binds to {antigen / macrophage} (1)	ACCEPT macrophage presents the antigen (to the T helper cell) NB CD4 (antigen) of T (helper) cell binds to {antigen-MHC complex = 2 marks	(3) EXP

Q16.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: - antigen on {surface / membrane} of macrophage (1) - binding of antigen to {CD4 / receptor} on T helper cell (1)	ACCEPT antigen on MHC on macrophage	(2)

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: - because more viruses delivered (1) - because {lipid / sphere} can pass through cell membrane / no need to bind to (cell) receptors / can bind to any cell (1) - because {lipid / sphere} protects viruses from {enzymes / stomach acid / phagocytes / immune system} (1) - credit a link between one reason and the information given (1)	e.g. more cells infected so symptoms develop faster more cells infected so symptoms are worse virus particles not destroyed so more cells infected	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: - because the lipids could be {targetted / broken down} (1) - by an enzyme (that breaks down lipid) (1) - resulting in {fewer virus particles arriving at cells (in one go) / exposure to immune system} (1)	ACCEPT using a drug that can penetrate the lipid ACCEPT therefore destroying the viruses ACCEPT {fewer / no} viruses (arriving at the cells)	(2)

Q18.

Question Number	Indicative content		Mark
*	Indicative content: Graph 1 (concentration of bacteria) - as time increases the number of bacteria taken up increases - the more microorganisms present the more enhanced the uptake is - but this is not proportional to number present - effect only seen after 10 minutes Graph 2 (number of macrophages) - the more macrophages present the more uptake of bacteria - but this difference is only marked with 100 000 macrophages present - effect only seen after 30 minutes Graph 3 (source of macrophages) - source of macrophages affects how many bacteria are taken up - bone marrow cells take up more of both types of bacteria - type of bacteria affects how many bacteria are taken up - combination of both affects uptake	Level 1: 1 mark = 1 comment on one set of data 2 marks = two sets of data commented on Level 2: Comments must relate to phagocytosis ie not just a description of green glow 3 marks = three sets of data commented on 4 marks = four sets of data commented on Level 3: 5 marks = four sets of data commented on, with an extended comment on one set 6 marks = four sets of data commented on, with an extended comment on at least two sets of data	6 EXP

	Graph 4 (concentration of ATP synthase inhibitor) • presence of ATP synthase inhibitor reduces uptake of bacteria • as there is no ATP available for phagocytosis • but differences only really seen are concentrations of 100 a.u. and above	NB extended comment = two or more points made about a set of data	
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Q19.

Question Number	Answer	Additional guidance	Mark
(i)	B (T helper cell)		(1)

Question Number	Answer	Additional guidance	Mark
(ii)	D (proteins that activate T killer cells)		(1)

Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • to {kill / attenuate / inactivate / weaken / prevent reproduction} (1) • therefore less risk of {infection / disease / malaria} (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	• vaccinate with {no <i>Plasmodium</i> / saline / water}	ACCEPT placebo	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to three of the following: • effective for {group B / high dose} because zero infected / not effective for {group A/ low dose} as some infected (1) • sample size of {group B / high dose} was {small / only 6 people} / sample sizes were small (1) • {group A / low dose} result similar to the {control / group C} (1) • (sample selection unknown so) no information about {gender / age / culture / health / prior infection} (1)	ACCEPT 100% effective for group B	(3)

Question Number	Answer	Additional Guidance	Mark
(iv)	A description that makes reference to five of the following: • antigen presenting cells / MHCs (1) • APC binds to {T cell / CD4 receptors} (1) • production of T memory cells (1) • (activated) T cells {stimulate B cells / release cytokines} (1) • production of B memory cells (1) • plasma cells release antibodies (1)		(5)