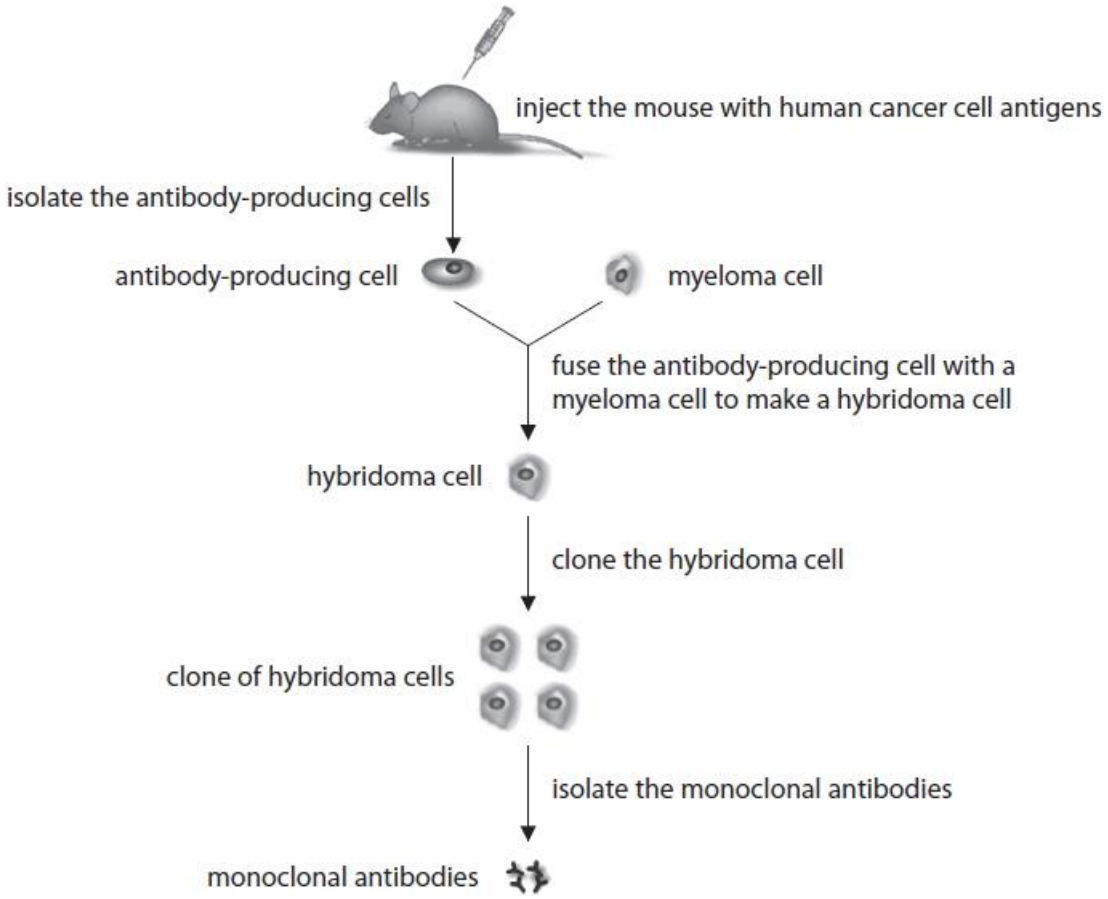
Questions

Q1.

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.

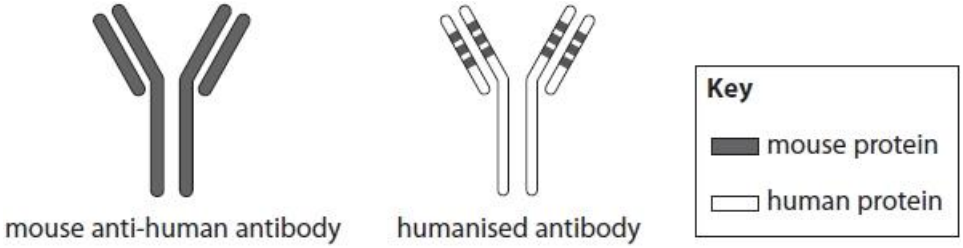
The diagram shows some of the steps involved in making monoclonal antibodies against human cancer cell antigens.



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.

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

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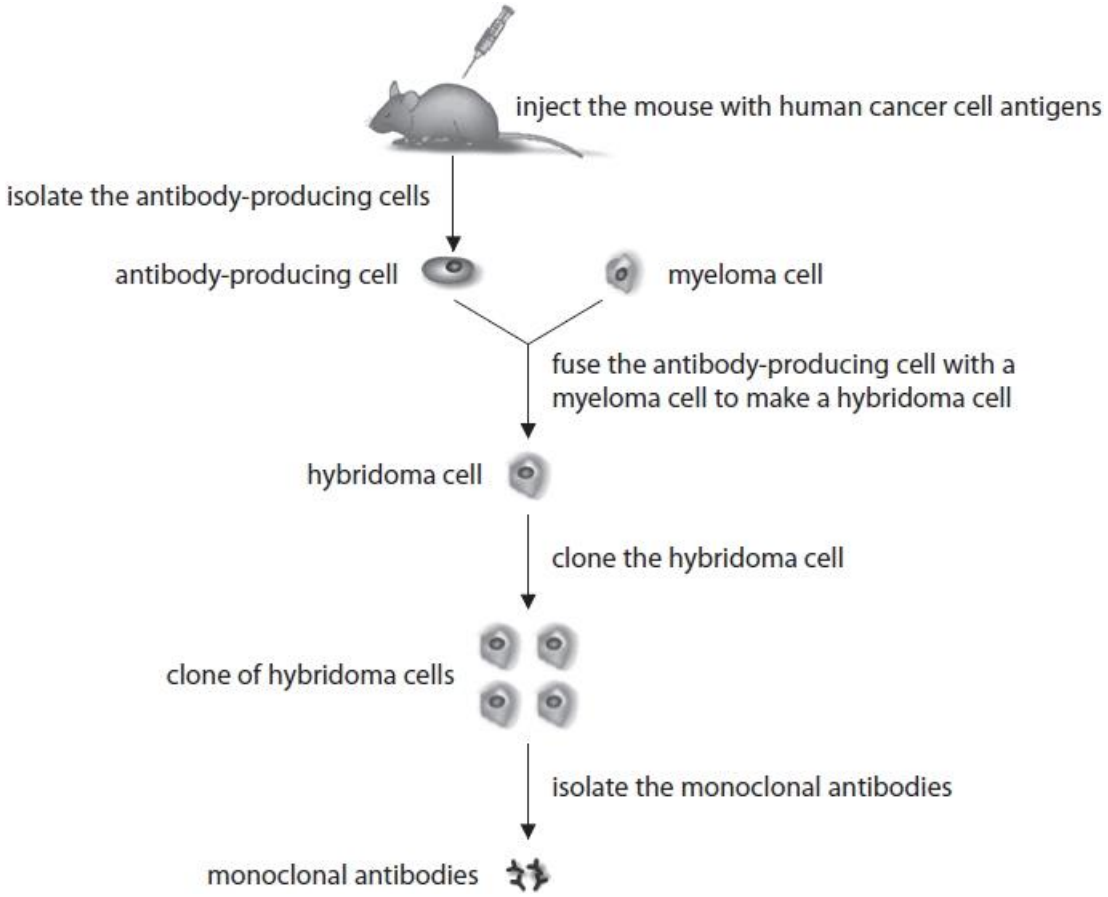
(Total for question = 9 marks)

Q2.

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)

Q3.

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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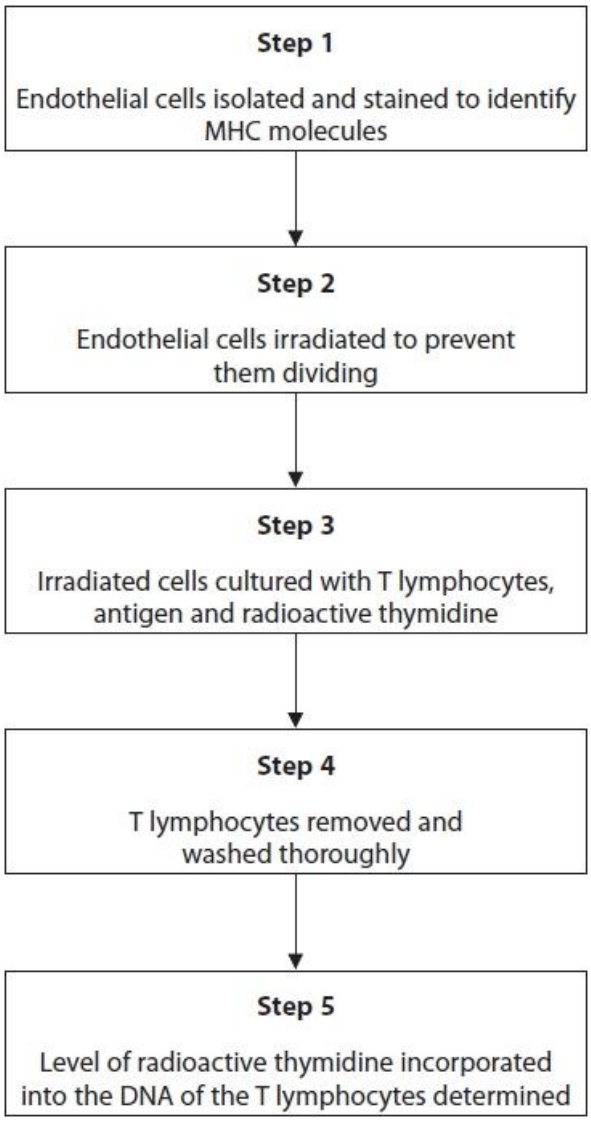
(Total for question = 5 marks)

Q4.

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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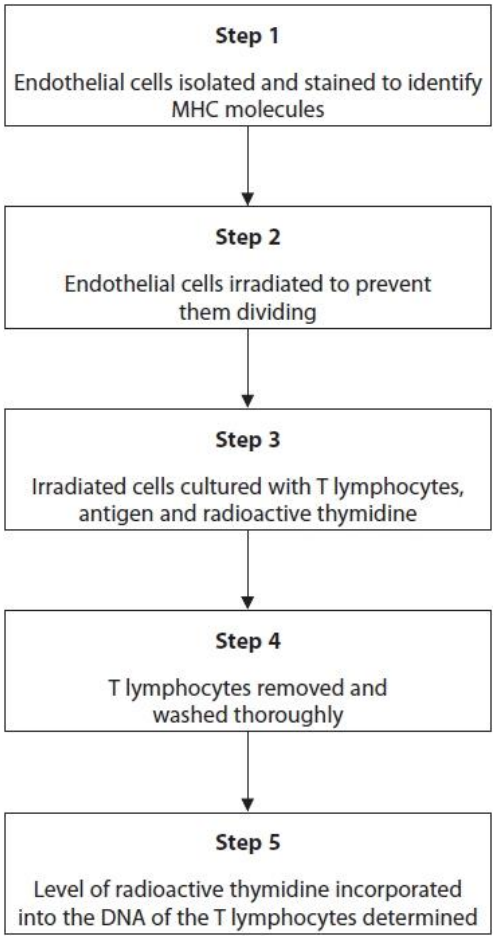
(Total for question = 2 marks)

Q5.

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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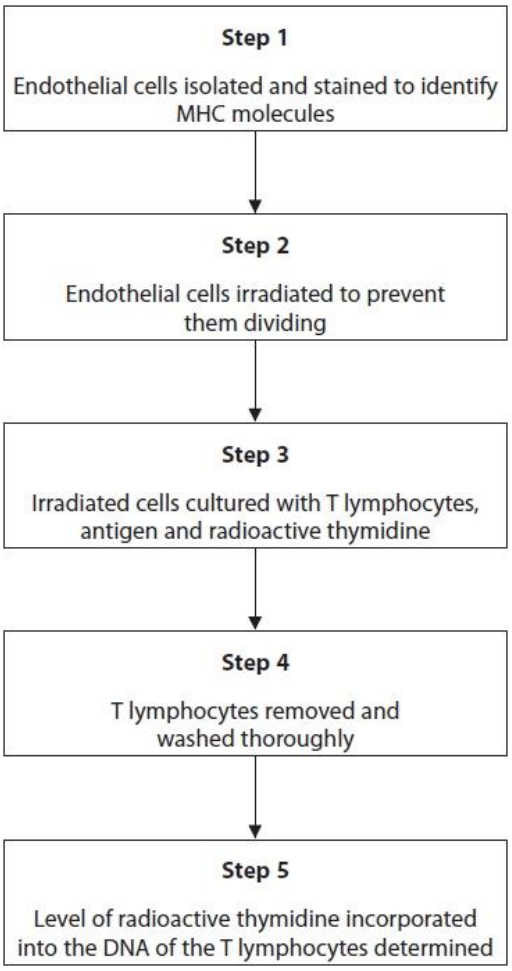
(Total for question = 2 marks)

Q6.

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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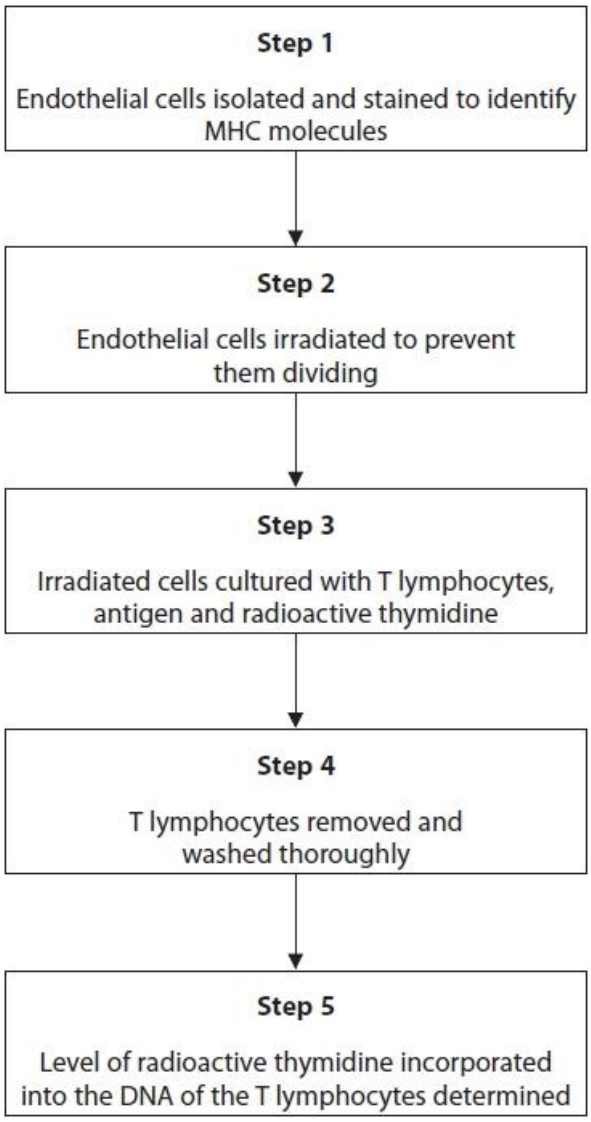
(Total for question = 2 marks)

Q7.

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.

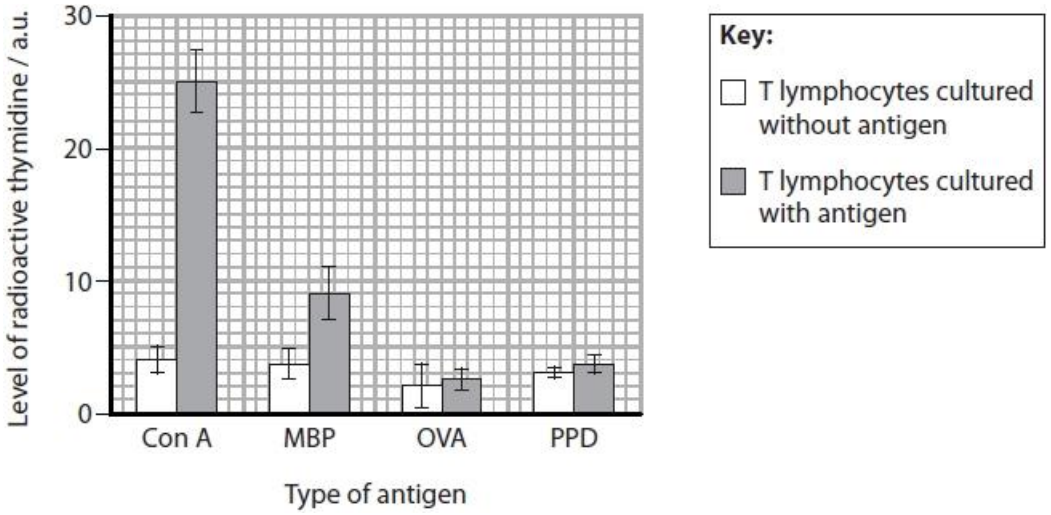


In this investigation, the ability of the endothelial cells to present four different types of antigen was assessed.

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.

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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)

Q8.

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.

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

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

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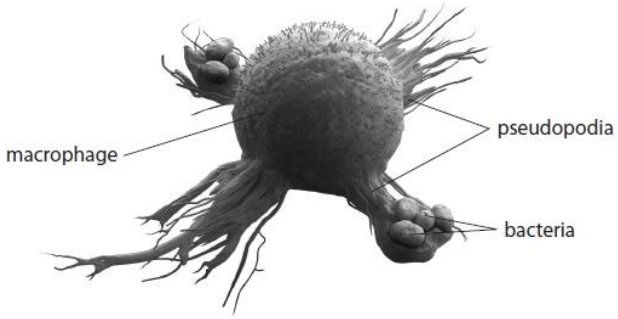
(Total for question = 9 marks)

Q9.

Macrophages are involved in response to infection.

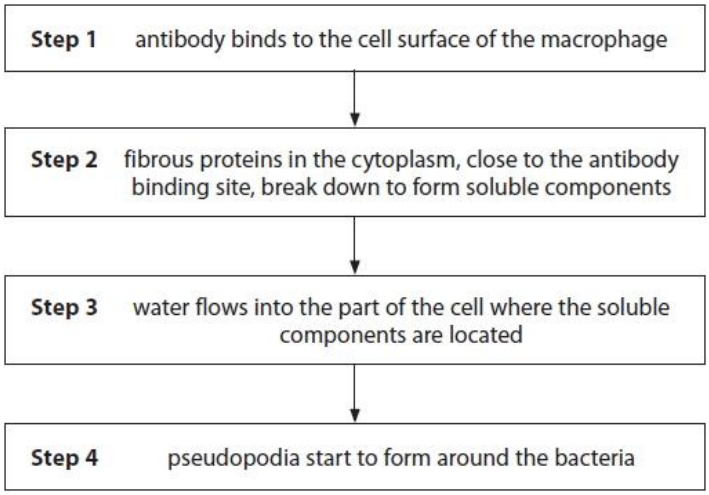
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



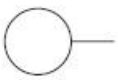
(Source: © urfin/Shutterstock)

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

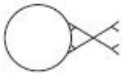


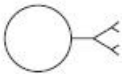
(i) Which diagram shows one antibody binding to the surface of a macrophage (**Step 1**)?

(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**).

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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**).

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(Total for question = 7 marks)

Q10.

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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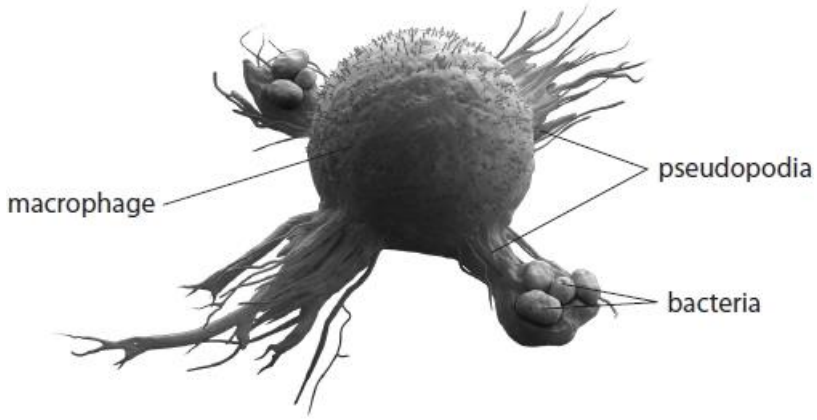
(Total for question = 2 marks)

Q11.

*Macrophages are involved in response to infection.

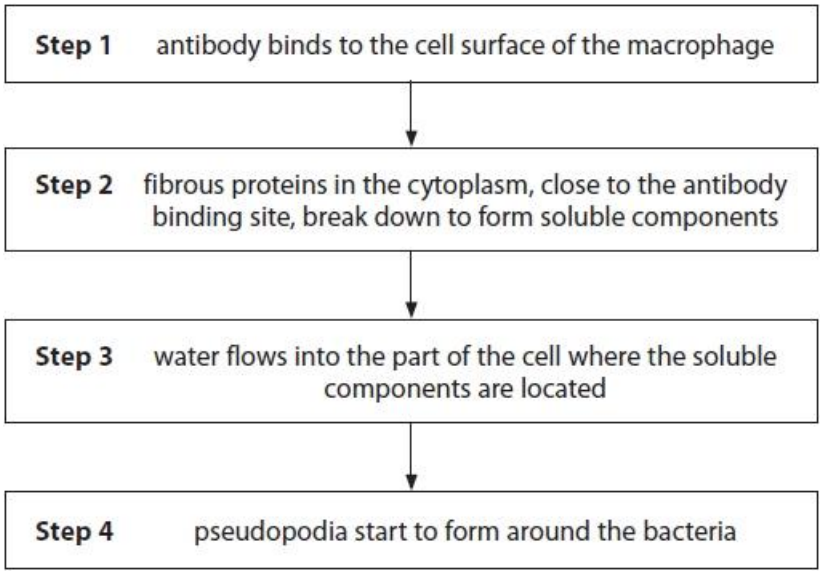
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



(Source: © urfin/Shutterstock)

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



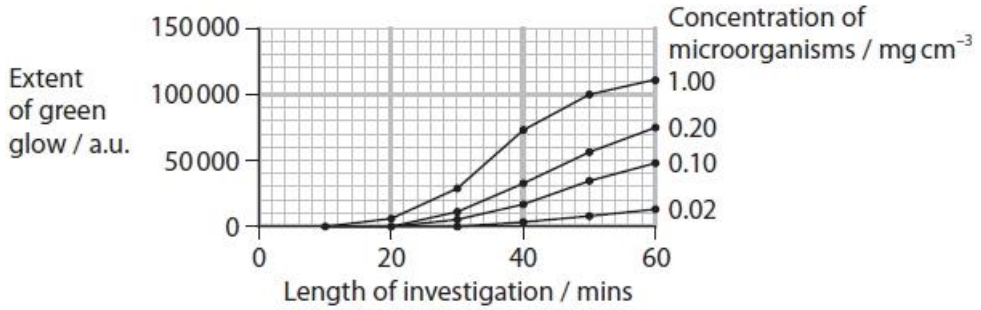
Phagocytosis by macrophages is affected by a number of factors.

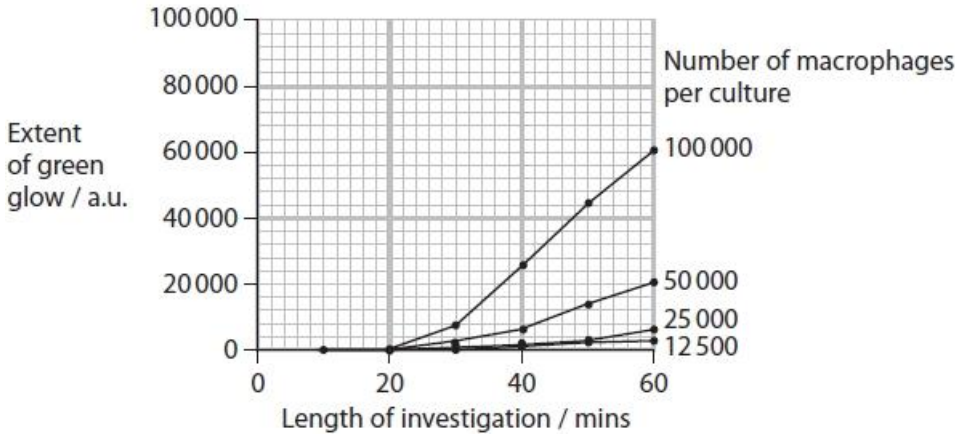
Microorganisms with a fluorescent green dye attached to them were used to measure phagocytosis by macrophages.

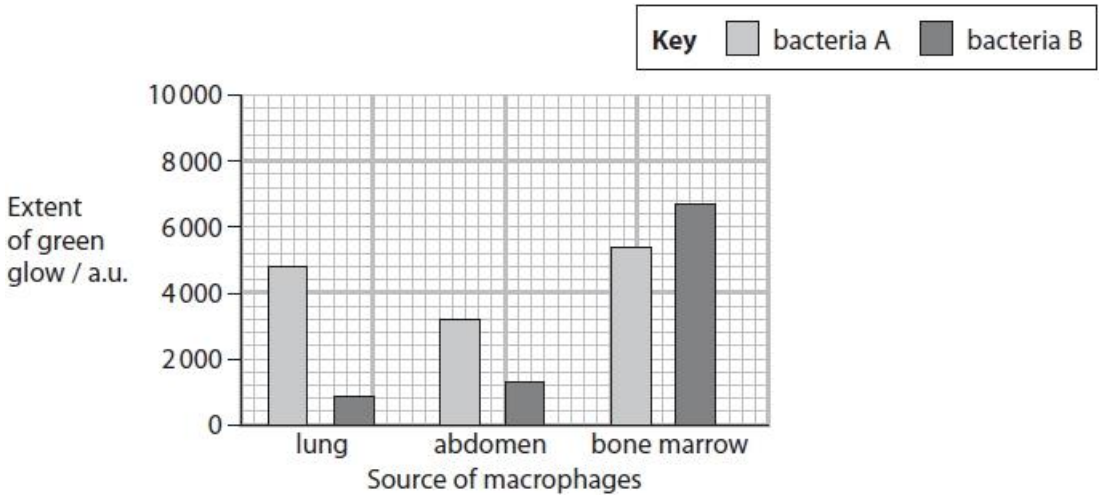
The microorganisms were added to the macrophages and incubated. The macrophages were then washed and the extent to which they glowed green was determined.

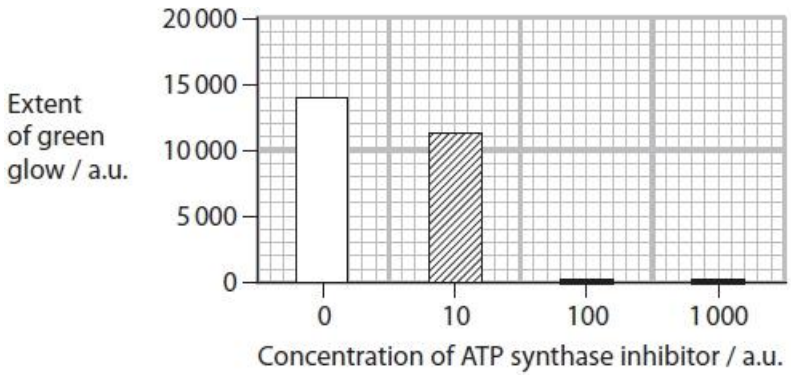
The extent of the green glow is proportional to the number of microorganisms engulfed by the macrophages.

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









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

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(Total for question = 6 marks)

Q12.

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.

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

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

Analyse the data to criticise the validity of this claim.

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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)

Q13.

Infections caused by *Chlamydia* and human papillomavirus (HPV) are sexually transmitted.

The HPV is a non-enveloped DNA virus.

Chlamydia infection is caused by the bacterium, *Chlamydia trachomatis*.

Some people with HPV infections have no symptoms but others develop warts and some types of cancer.

Over 99% of cervical cancers are caused by HPV.

Girls in the UK are offered an HPV vaccine.

(i) Explain how an HPV vaccine protects girls from developing cervical cancer.

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(ii) Explain why the HPV vaccine will not protect girls from infection with *Chlamydia*.

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*(iii) The HPV vaccination programme is being extended to boys.

Explain the advantages of offering the HPV vaccine to boys, as well as girls, in schools.

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(Total for question = 12 marks)

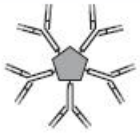
Q14.

The rubella virus stimulates the production of antibodies in humans but usually causes only mild infections.

However, infection of pregnant women can cause serious problems for the developing fetus.

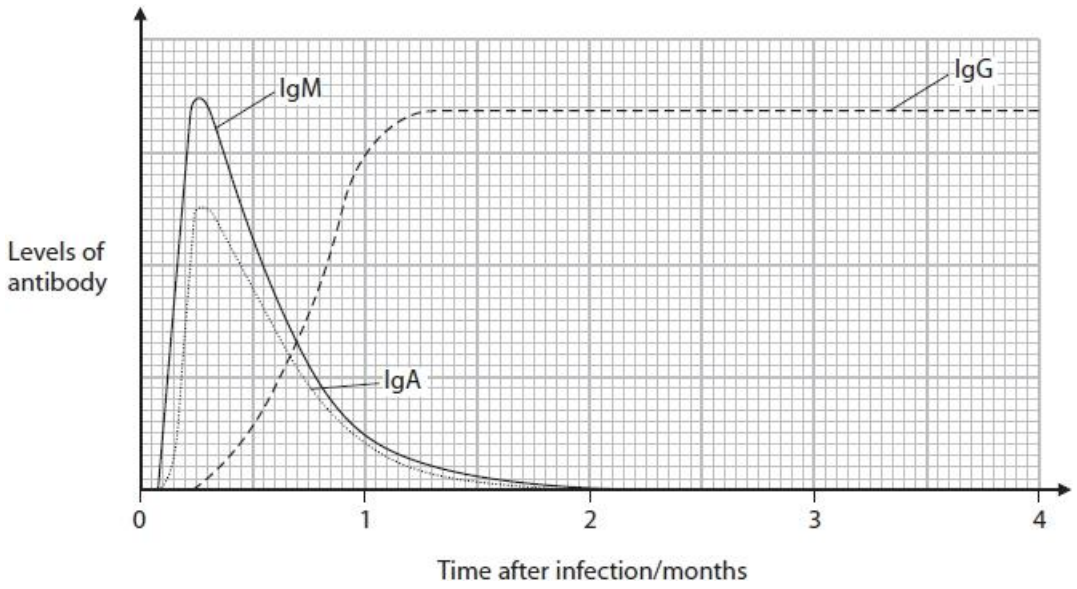
*Antibodies can be divided into five classes.

The table gives some information about these classes of antibody.

Information	Class of antibody				
	IgM	IgA	IgG	IgD	IgE
Shape					
Number of antigen binding sites	10	4	2	2	2
Can cross the placenta	no	no	yes	no	no
Other details	secreted into the blood	secreted into mucus, tears, saliva, colostrum[1]	secreted into the blood	attached to the surface of B cells	involved in allergy and parasitic infections

[1]Colostrum is the first type of milk produced by the mother following birth.

The graph shows the levels of three of these classes of antibody produced in response to infection with the rubella virus.



Analyse the information in the table and the graph to assess the role of these five classes of antibody in the immune response to the rubella virus.

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(Total for question = 6 marks)

Q15.

Vaccination against rubella has helped to reduce the incidence of infection.

Explain the importance of vaccinating as many people as possible against rubella.

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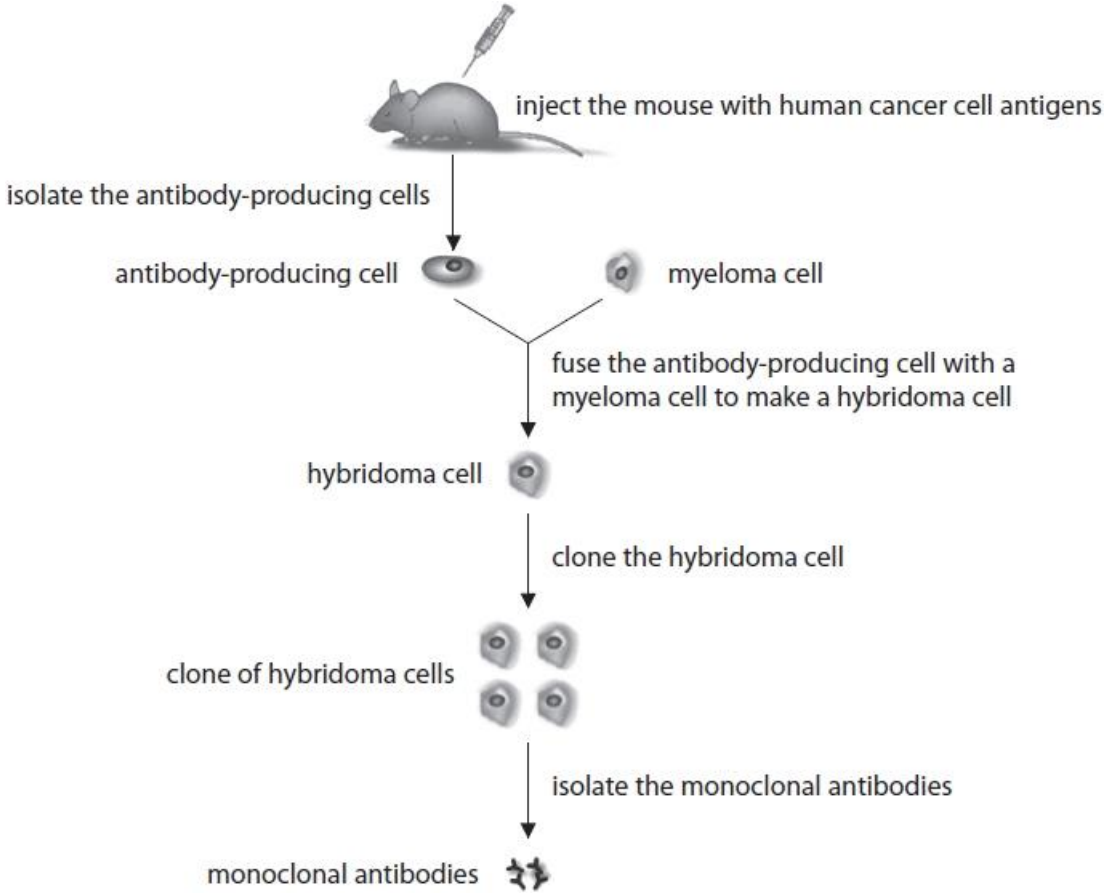
(Total for question = 2 marks)

Q16.

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.



Myeloma cells have the potential to divide indefinitely.

Explain why myeloma cells are used in the production of monoclonal antibodies.

(2)

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(Total for question = 2 marks)

Mark Scheme

Q1.

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)**

Q2.

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

Q3.

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)**

Q4.

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	

Q5.

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	

Q6.

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	

Q7.

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	

Q8.

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)

Q9.

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

Q10.

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)**

Q11.

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	

Q12.

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 *Plasmodium* / 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)**

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • vaccine contains the HPV antigens (1) • which stimulates the production of memory cells (1) • therefore (secondary) immune response destroys HPV before it causes cancer (1)	**ACCEPT** {attenuated / inactive / harmless / fragments of} {virus / pathogen **DO NOT ACCEPT** contains dead virus **ACCEPT** a description e.g. antibodies releasedfaster so macrophages destroy HPV before it damages cells **DO NOT ACCEPT** antibodies destroy virus virus is killed	(3)
(ii)	An explanation that makes reference to the following: • because the immune response is specific (1) • so on infection with Chlamydia there will not be memory cells present (specific to Chlamydia) (1) • and another (primary) immune response will need to be initiated(1) • therefore the Chlamydia will not be destroyed before it causesdisease (1)	**ACCEPT** Chlamydia has different antigen to {HPV / the virus / the vaccine} **ACCEPT** no antibodies (against Chlamydia) present	(3)

Question Number	Indicative content	
* (iii)	Answers will be credited according to candidates' deployment of knowledge and understandingof 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 allthe material which is indicated as relevant. Additional content included in the response mustbe scientific and relevant. Indicative content: Advantages of vaccinating girls and boys • protects students from becoming infected • virus less likely to get passed on • as there will be no virus to pass on during intercourse • because the virus will be destroyed before infections caused • the more girls vaccinated the fewer cases of cervical cancer and other conditions caused by HPV ingirls • the more boys vaccinated the fewer cases of other conditions caused by HPV in boys because of {memory cells / active immunity} Advantages of vaccination in schools • more {boys / girls} likely to be vaccinated • because they are not reliant on a doctor's appointment being {made / available} • do not have to miss school for the appointment • seeing others being vaccinated might encourage others to get vaccinated • inoculating school children is likely to be before they become sexually active Points that can apply in either context (but only creditable once)	**Level 1** 1 mark = 1 comment 2 marks = 3 comments **Level 2 :** 3 marks = 4 comments 4 marks = 5 comments **Level 3** **NB** must include points on advantages of vaccinatingboys **AND** vaccinating in school 5 marks = 5 comments 6 marks = 6 comments
	• greater chance of developing herd immunity • therefore fewer infected people to pass virus onto uninfected people • help to protect those who cannot be infected	

Q14.

Question Number	Indicative content
*	Answers will be credited according to candidates' 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. Indicative content: • IgM produced early in response (D) • has multiple antigen-binding sites (D) • involved in agglutination of the viruses (R) • IgA produced early in response (D) • can bind two antigens (D) • so involved in agglutination of the viruses (R) • involved in opsonisation (R) • to enhance phagocytosis by phagocytes (R) • is present in {eyes / nasal passages} (D) • to prevent entry of pathogen through {eyes / nose} (R) • can provide passive immunity to newborn baby (R) • IgG persists in body for a few months (D) • providing immunity to virus (R) • has two antigen-binding sites (D) • involved in agglutination of the viruses (R) • involved in opsonisation (R) • to enhance phagocytosis (R) • can cross the placenta to provide passive immunity to the fetus (R)

	• IgD will be involved in B cell activation (R) • as it will bind virus to B cell (R) • activated B cells will differentiate into plasma cells that will produce antibody (R) • IgE not involved as Rubella infection {is not a parasitic infection / does not result in an allergic response} (R) **Level 1 :** 1 mark = description of antibodies from either the graph or the table 2 marks = description of antibodies from both the graph and the table / role of one class of antibody described **Level 2 :** 3 marks = role of two classes of antibody described 4 marks = role of three classes of antibody described **Level 3 :** 5 marks = role of four classes of antibody described 6 marks = role of all five classes of antibody described

Level	Marks	
0	0	No awardable content
1	1-2 (1-3)	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4 (4-6)	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.
3	5-6 (7-9)	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Q15.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • because it results in herd immunity (1) • therefore there will be fewer infected people to pass virus onto uninfected people (1) • protect people who cannot become immune (1)	**ACCEPT** large number of people immunised reduces the chance of someone not immune getting infected e.g. allergic to vaccines, immunodeficient, immunosuppressed, HIV	(2)

Q16.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • to produce lots of {genetically identical / hybridoma} cells **(1)** • so that lots of antibodies (of one type) can be produced (by hybridoma cells) **(1)** • so that the hybridoma cells can divide **(1)**	**Accept** because a {fully-differentiated / antibody-producing / plasma} cell cannot divide	**(2)**