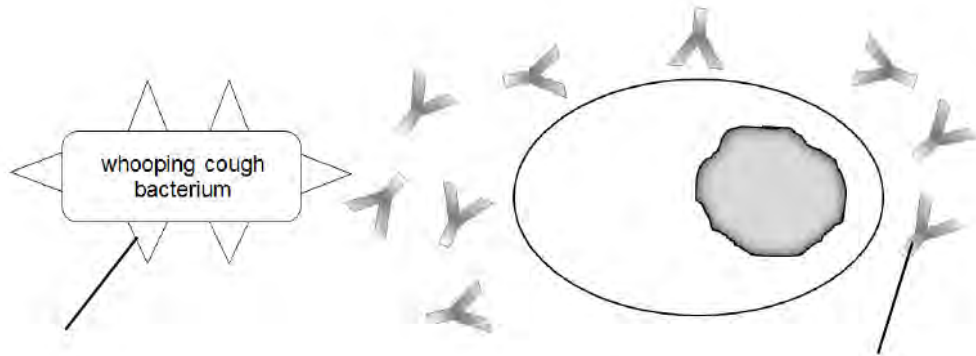


1. Whooping cough is a non-communicable bacterial infection.

The diagram below shows the blood of a person infected with whooping cough.

Label the two structures in the diagram.



(i) .....

(ii) .....

[2]

(iii) People can be vaccinated against whooping cough.

There are two types of vaccine:

Type 1 uses whole bacterial cells

Type 2 uses parts of bacterial cells.

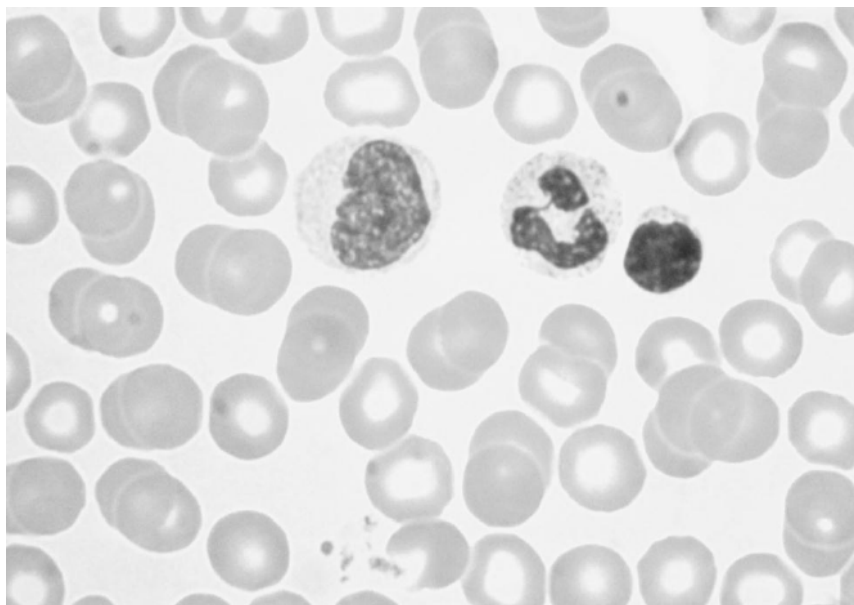
Some people are concerned about using the Type 1 vaccine with whole bacterial cells.

Suggest why.

.....  
..... [1]

2. Blood is made up of cells, plasma and platelets.

The picture below is of blood cells as seen down a microscope.

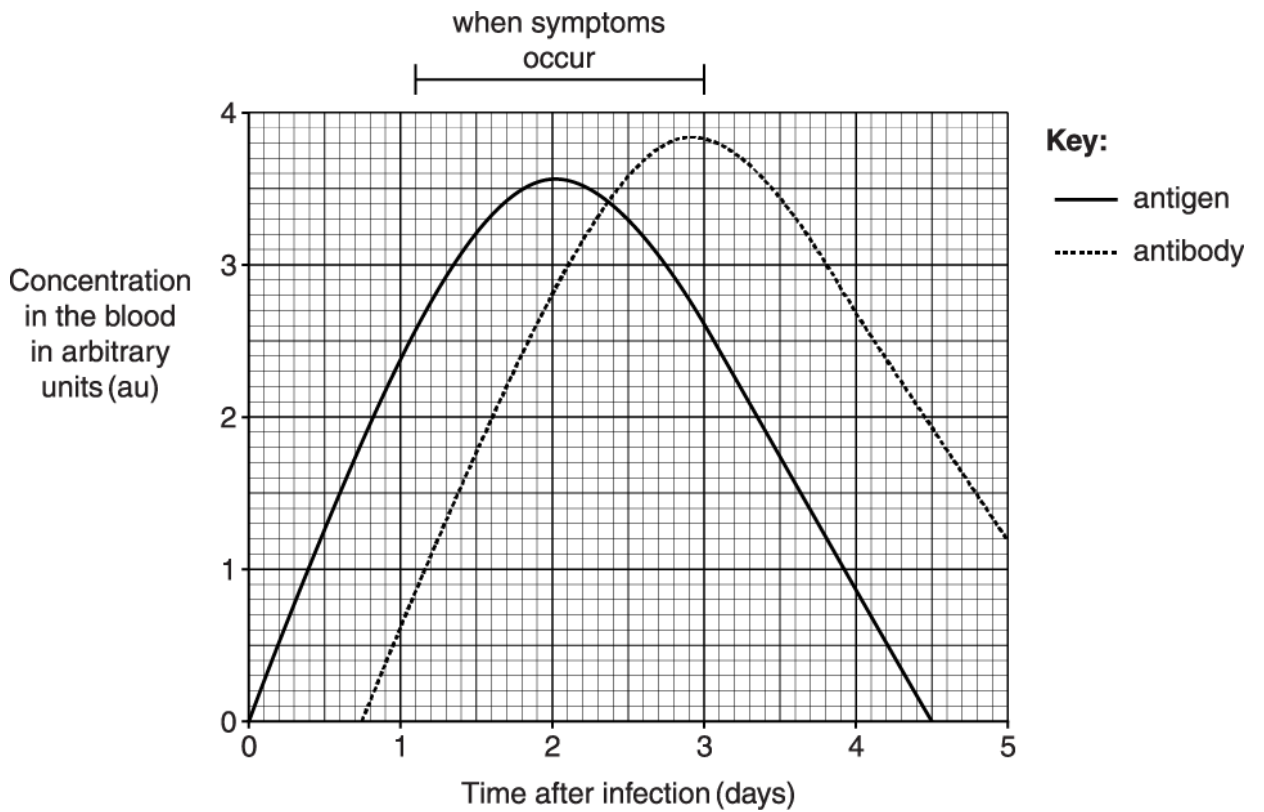


Draw a labelled scientific drawing of a white blood cell in the space below.

Label the nucleus and cell membrane.

[4]

3(a). The graph shows data collected from a person infected with a microorganism.



Why does the concentration of **antigen** increase during the first two days after infection?

-----  
 ----- [1]

Use the graph to help you answer the following questions.

(b). For how many days does the infection last?

answer = \_\_\_\_\_ days [1]

(c). Describe the relationship between the concentration of **antigen** and the presence of symptoms.

-----  
 -----  
 ----- [1]

(d). What is the minimum concentration of **antibody** required to destroy microorganisms at a faster rate than they are produced?

concentration = \_\_\_\_\_ au [1]

4(a). Human blood contains four main components.

One of these is red blood cells.

Name and explain the functions of the other **three** main components.

1

---

---

2

---

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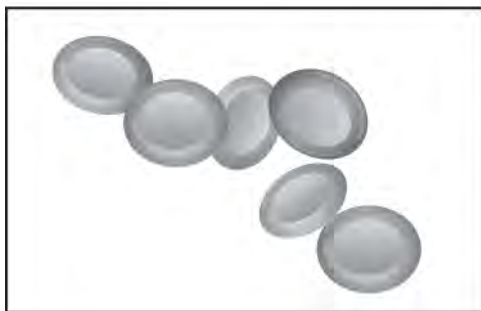
3

---

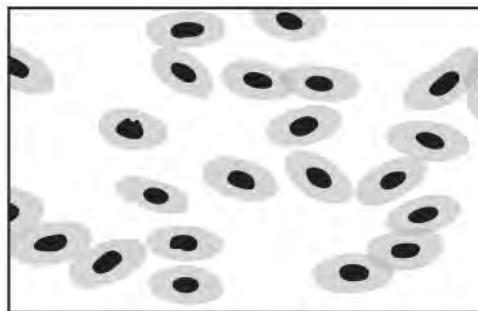
---

[3]

(b). Look at the diagrams.  
show human red blood cells and frog red blood cells.



Human red blood cells



Frog red blood cells

Human red blood cells are better adapted to the job that they do than frog red blood cells.

Use the diagrams to suggest how.

-----  
-----  
-----

[2]

5. Blood consists of many different components.

The table shows the normal level of three different blood components.

It also shows the level in three different people, A, B and C.

	Red blood cell haemoglobin g per 100 cm <sup>3</sup>	White blood cells per mm <sup>3</sup>	Platelets per mm <sup>3</sup>
normal level	15	8500	250 000
person A	15	3000	255 000
person B	9	9000	245 000
person C	15	8000	130 000

What is the consequence of this data for the health of each person?

Explain your answer.

person A .....

-----

person B .....

-----

person C .....

-----

[3]

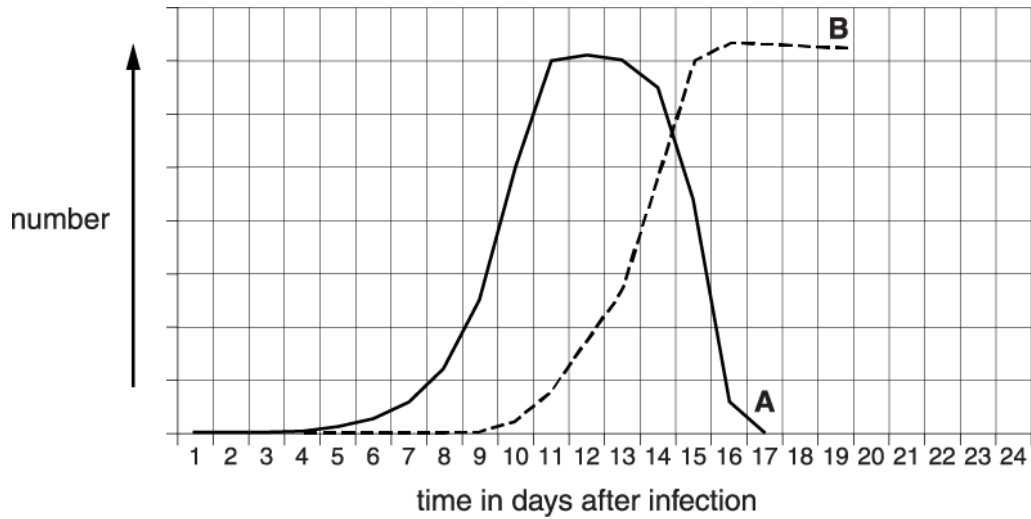
6(a). When harmful bacteria entered Jake's body, he responded by producing antibodies to destroy these bacteria.

Jake had not come into contact with this type of bacteria before.

The graph shows the number of bacteria and antibodies in Jake's blood over a twenty-four-day period.

One line shows the number of bacteria.

The other line shows the number of antibodies.



Which line, A or B, shows the number of bacteria?

Explain your answer.

-----  
-----  
-----

[1]



(b). Jake's white blood cells are used to destroy the invading bacteria.

How can Jake's white blood cells do this?

Put ticks (✓) in the boxes next to the correct answers.

engulf the bacteria

stop the bacteria entering the body

cause the bacteria to mutate

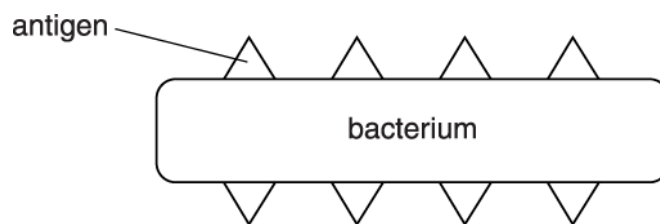
cause the bacteria to reproduce

digest the bacteria

produce antibodies against the bacteria

[2]

(c). The diagram shows one of the bacteria that entered Jake's body.



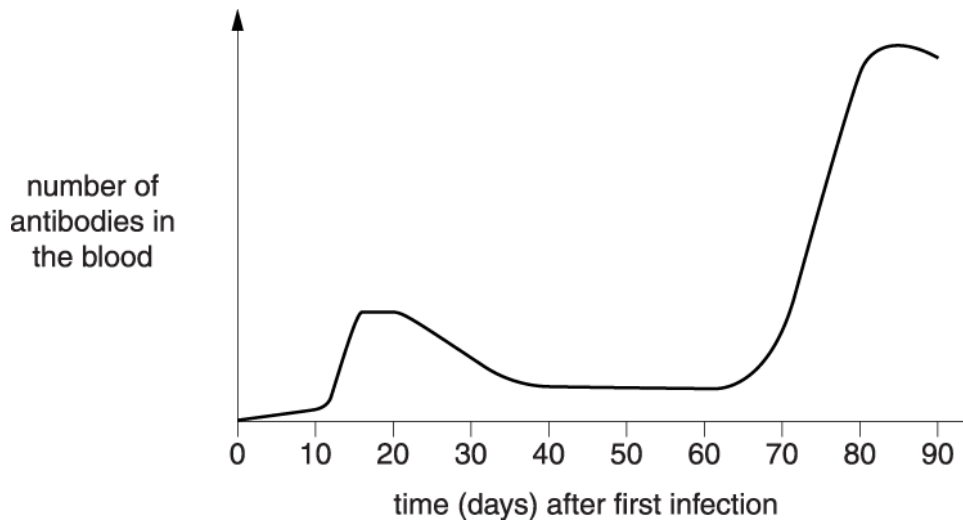
In the space below, draw a diagram of an antibody that Jake would produce to destroy the bacteria.

Explain your answer.

----- [2]

(d). Sometime later, Jake gets a second infection of the same bacteria.

The graph shows the level of antibodies in Jake's blood.



(i) How many days after the first infection did Jake get the second infection?

..... days [1]

(ii) Name the type of cell that enables a much stronger response to the second infection.

..... [1]

(iii) A student looked at Jake's graph.

He made these conclusions.

After the first infection, Jake was immune to the harmful bacteria.  
The doctor gave Jake some antibiotics on day 83.

Evaluate the conclusions made by the student and explain the reasons for your judgement.

.....  
.....  
.....  
..... [2]

7. Plants can be infected by communicable diseases, so they need to protect themselves against pathogens.

Describe **one** chemical defence and **one** physical defence that plants have against pathogens.

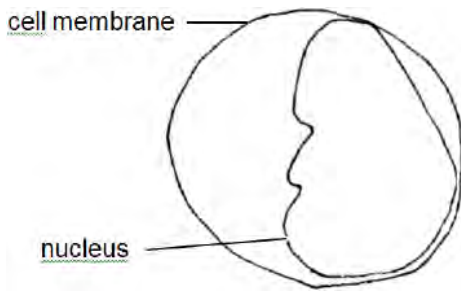
Chemical defence -----

Physical defence -----

[2]

**END OF QUESTION PAPER**

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	Antigen ✓	1	
		ii	Antibody ✓	1	
		iii	Whole cell could cause disease ✓	1	
			<b>Total</b>	<b>3</b>	
2			Correct cell drawn ✓ Continuous, unfeathery lines, no shading ✓ Label lines drawn with a ruler ✓ Nucleus AND cell membrane correctly labelled ✓	4	Drawing should take up approximately 50% of space e.g. 
			<b>Total</b>	<b>4</b>	
3	a		microorganisms / bacteria / pathogens are reproducing / dividing / multiplying	1	<p><b>accept</b> idea that there is not yet enough antibody to fight the infection</p> <p><b>do not credit</b> "it / they" unqualified (as this refers to the antigen)</p> <p><b>accept</b> asexual reproduction</p> <p><b>Examiner's Comments</b></p> <p>This was a challenging question. Candidates found it difficult to link increasing antigen concentration to the reproduction of microorganisms.</p>
	b		4.5 (days)	1	<p><b>Examiner's Comments</b></p> <p>The majority of candidates could identify how long the infection lasted.</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	c	symptoms only occur when antigen concentration is above 2.6 (au) / ORA	1	<p>accept 2.5</p> <p><b>Examiner's Comments</b></p> <p>This question was difficult as students had to be able to interpret the graph to describe the relationship.</p>
	d	2.8	1	<p>accept any concentration between 2.8 and 3.0</p> <p><b>Examiner's Comments</b></p> <p>This was a challenging question which relied on candidates being able to interpret the 2 lines to identify the correct antibody concentration.</p>
		<b>Total</b>	<b>4</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
4	a	White blood cells fight infection / fight microbes / produce antibodies; Platelets clot blood; Plasma transports or carries (substances / cells);	3	<b>Examiner' Comments</b>  Although this question was answered well by most candidates, a significant number failed to score all three marks. Credit was not given for simply naming the parts. Good answers stated that white blood cells fought infection, platelets clot blood and plasma transported nutrients around the body. Answers that referred to red blood cells did not score.
	b	No nucleus; Concave / bi concave / large surface area;	2	<b>Examiner' Comments</b>  This question was surprisingly well answered and most candidates were not put off by the context. Many candidates scored both marks for realising that a lack of a nucleus provided extra space for haemoglobin and the shape gave a large surface area for the absorption of oxygen.
		<b>Total</b>	<b>0</b>	
5		A – (low white blood cell count), likely to get infection / disease / weak immune system (1)  B – (low haemoglobin so) anaemic / get tired easily / less oxygen / breathless (1)  C – (low platelets so) blood not clot as quickly / bleed for longer (1)	3	<b>ignore illness</b>  <b>ignore pale</b>  <b>ignore scabs / wounds not healing</b>  <b>Examiner's Comments</b>  This question discriminated well and stronger candidates scored all three marks on this question. Regarding A, credit was not given for reference to illness and to score candidates had to refer to disease, infection, or the immune system. In C credit was not given for reference to scabs or wounds not healing.
		<b>Total</b>	<b>0</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance												
6	a	<p>'A' because bacteria stimulate antibodies production / once antibodies B are produced A goes down</p>	1	<p>ignore reference to antibodies 'engulfing' bacteria</p> <p><b>Examiner's Comments</b></p> <p>Most candidates correctly identified A as the line showing the number of bacteria but some then failed to use the graph to explain their reasoning but simply stated a fact about bacteria and so failed to gain credit. The commonest explanation was that the number of bacteria went down as the number of antibodies increased.</p>												
	b	<table border="1"> <tr> <td>engulf the bacteria</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>stop the bacteria entering the body</td> <td></td> </tr> <tr> <td>cause the bacteria to mutate</td> <td></td> </tr> <tr> <td>cause the bacteria to reproduce</td> <td></td> </tr> <tr> <td>digest the bacteria</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>produce antibodies against the bacteria</td> <td style="text-align: center;">✓</td> </tr> </table>	engulf the bacteria	✓	stop the bacteria entering the body		cause the bacteria to mutate		cause the bacteria to reproduce		digest the bacteria	✓	produce antibodies against the bacteria	✓	2	<p>3 correct = 2 marks 2 correct = 1 mark</p> <p><b>Examiner's Comments</b></p> <p>Most candidates scored at least one mark here knowing that white blood cells produce antibodies and engulf bacteria, fewer also knew that white blood cells digest the bacteria and managed to gain both marks.</p>
engulf the bacteria	✓															
stop the bacteria entering the body																
cause the bacteria to mutate																
cause the bacteria to reproduce																
digest the bacteria	✓															
produce antibodies against the bacteria	✓															
	c	<p>V; idea that shape fits</p>	2	<p>explanation must make reference to shape <b>accept</b> "same shape" / lock and key idea do not allow just the idea that they 'stick' together</p> <p><b>Examiner's Comments</b></p> <p>Most candidates understood that antibodies have to fit the antigen and a great variety of appropriate shapes were drawn. A significant number of candidates drew a white blood cell engulfing the bacteria. Some lost the second mark by not clearly indicating the need for a complementary shape for the antibody to attach to the antigen.</p>												



### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	d	i	60–65	1	<p><b>Examiner's Comments</b></p> <p>Common wrong answers here were 10 or 20 days referring to the first rather than the second infection, perhaps thinking that the graph showed three infections at day 0, then at day 10 and day 65.</p>
		ii	memory	1	<p><b>Examiner's Comments</b></p> <p>Only slightly more than half the candidates knew the role memory cells play in responding to second infections by the same microorganism. White blood cell was a common answer.</p>
		iii	<p>first conclusion correct and second incorrect (1)</p> <p>(first conclusion correct as) <b>higher / faster</b> level of antibody response after second infection (1)</p> <p>(second conclusion incorrect as) no information provided about antibiotics / explanation that because of high antibody level Jake does not need antibiotics (1)</p>	2	<p><b>accept</b> implications that first statement is correct and second incorrect</p> <p>maximum 2 marks</p> <p><b>Examiner's Comments</b></p> <p>Only the best candidates recognised that there were two distinct conclusions that they needed to comment on and so gave answers suggesting that the student was either correct or incorrect and so failed to gain credit. A significant number of candidates clearly thought that as Jake has a second infection he could not be immune and failed to realise the rapid large scale production of antibodies shown in the graph was evidence for immunity. Many attributed the fall in antibodies round day 83 to Jake taking antibiotics, or that antibiotics were making Jake immune suggesting a confusion between the roles of antibodies and antibiotics.</p>
			<b>Total</b>	<b>9</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7			chemical defence – antimicrobials ✓  physical defence – cell walls/ leaf cuticle/ waxy cuticle ✓	2 (AO 1.1 x 2)	ALLOW any correct chemical defence  <u>Examiner's Comments</u>  Question 4 (b) and 4 (c) tested new content to the biology specification. Both questions did not score as well as may have been anticipated. In 4 (c) very few candidates gained both marks, those that did gain one mark often did so for stating a physical defence. Examples of chemical defences were seen less often.
			Total	2	