Immune system exam Q

OCR

Immunity and vaccination can be confusing. Which of the following statements are true and which are false?

Statement	True	False
Antibodies are cells		
Antibodies clone themselves by mitotic division		
Lymphocytes passing from mother to foetus is an example of natural passive immunity		
Artificial passive immunity is the same as vaccination		
The human body produces its own antibodies via passive immunity		
Antibodies remain in the blood plasma following an infection and confer immunity to a disease		
All antigens are foreign cells		

Immunity and vaccination can be confusing. Which of the following statements are true and which are false?

Statement	True	False
Antibodies are cells		✓
Antibodies clone themselves by mitotic division		✓
Lymphocytes passing from mother to foetus is an example of natural passive immunity		✓
Artificial passive immunity is the same as vaccination		✓
The human body produces its own antibodies via passive immunity		✓
Antibodies remain in the blood plasma following an infection and confer immunity to a disease		✓
All antigens are foreign cells		✓

1a

2 marks

Define the term **antigen**.

The term antigen can be defined as...

- A protein/glycoprotein/glycolipid found on the cell surface membrane (and the surface of viruses); [1 mark]
- A molecule that identifies a cell as self or non-self/foreign; [1 mark]

[Total: 2 marks]

1b

2 marks

Give **two** examples of places where non-self antigens might occur inside an organism.

Non-self antigens might be found in the following places...

Any **two** of the following:

- (Surface of invading) pathogens; [1 mark]
- Toxins; [1 mark]
- (Surface of) infected body cells; [1 mark]
- (Surface of) cancerous/tumour cells; [1 mark]
- (Surface of) cells from another individual (after a transplant or transfusion); [1 mark]

[Total: 2 marks]

1c

2 marks

One well-known example of antigens in humans is the ABO system of blood typing. **Table 1** below contains some information about the antigens involved in ABO blood types.

Table 1

Blood group	Antigens present on the surface of red blood cells	Could receive a blood transfusion from blood group(s):
A	Type A	A or O
B	Type B	**1**
AB	Types A and B	**2**
O	None	O

Complete **Table 1** by filling in the gaps marked **1** and **2**.

Gaps **1** and **2** would contain. . .

- **1** = B or O; [1 mark]
- **2** = A, B, or O; [1 mark]

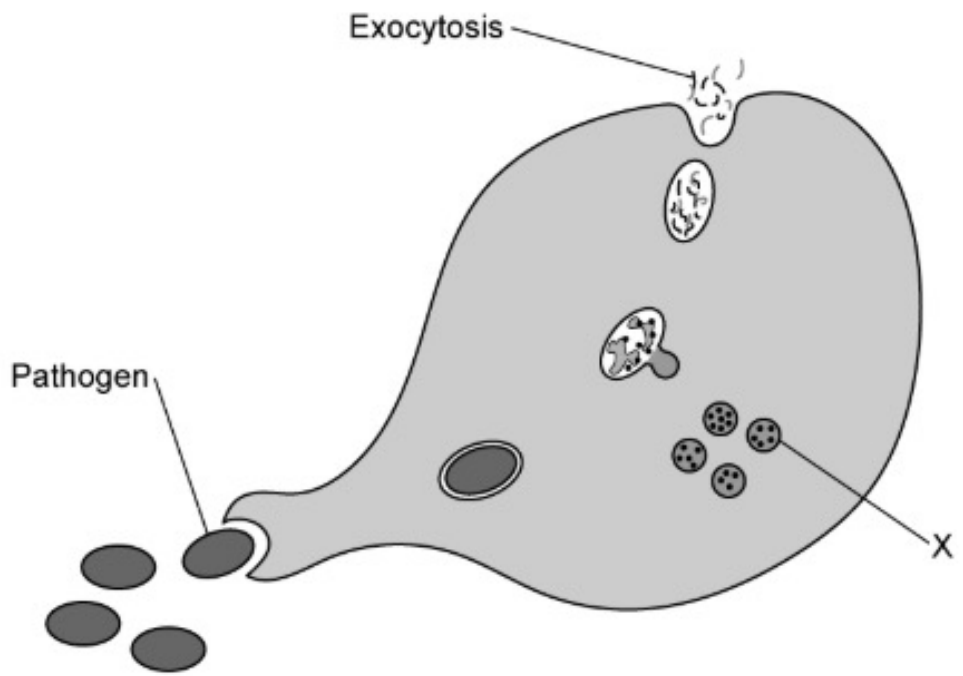
[Total: 2 marks]

2a

1 mark

Figure 1 shows one role of white blood cells during an immune response.

Figure 1



Name the process shown in **Figure 1**.

The process shown in **Figure 1** is called...

- Phagocytosis; [1 mark]

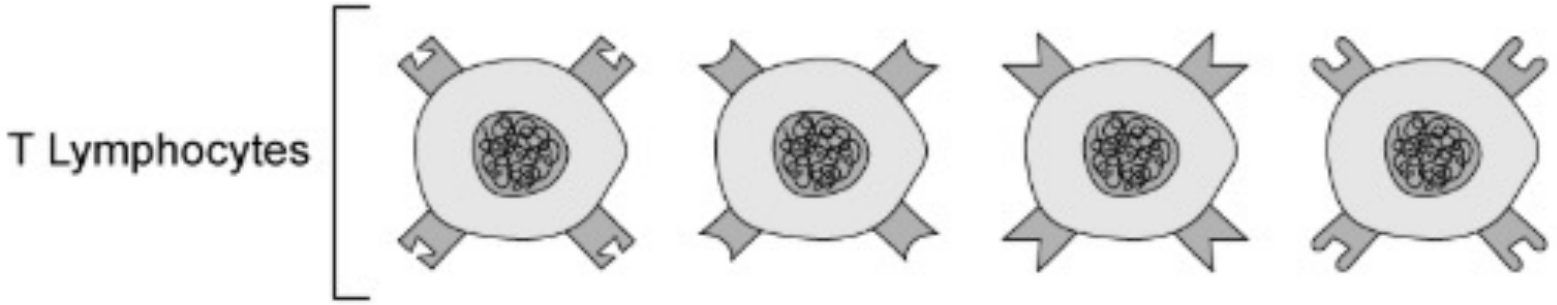
[Total: 1 mark]

3a

2 marks

Figure 1 below shows a series of mature T lymphocytes, each with different specific receptors on their surface membranes.

Figure 1



State why it is important to have T lymphocytes with different specific receptors.

It is important to have T lymphocytes with different specific receptors because...

- Each is specific/complementary to a different antigen; [1 mark]
- The immune system is able to recognise/respond to many different pathogens/toxins; [1 mark]

[Total: 2 marks]

T lymphocytes are produced by the bone marrow and then they mature in the thymus (hence 'T' cells), where they differentiate to have many different types of cell surface receptors. Each of these different receptors will be specific to a different pathogen/toxin/abnormal cell, meaning that they can recognise many different kinds of pathogens and launch an immune response.

3b

2 marks

Describe what happens to a T lymphocyte when it comes into contact with the right pathogen.

- The lymphocyte receptor binds/attaches to the complementary antigen; [1 mark]
- The T-lymphocyte is activated/stimulated/sensitised; [1 mark]

[Total: 2 marks]

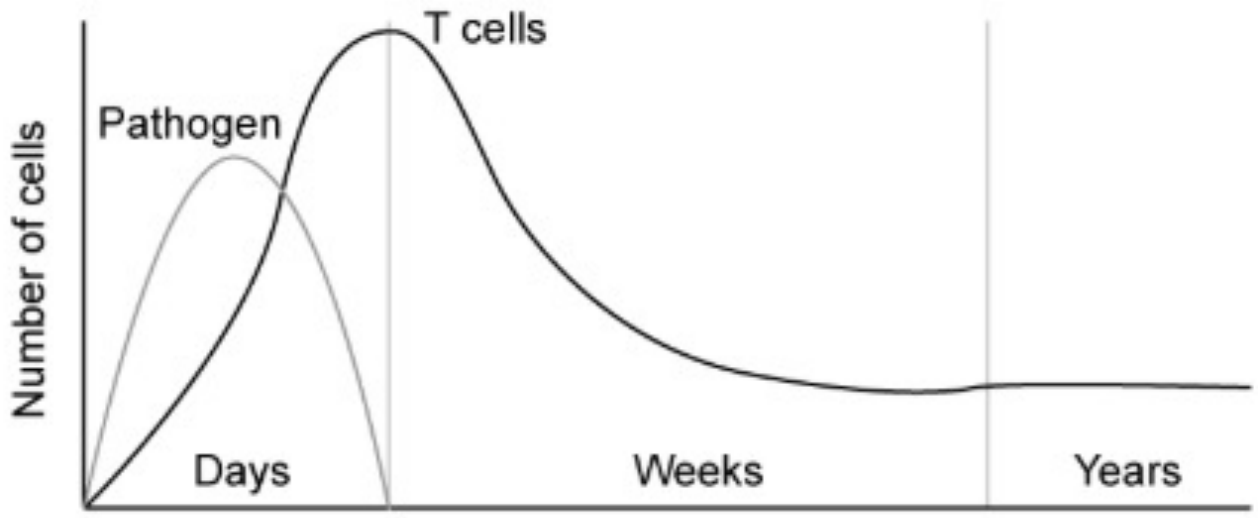
This question could potentially have quite an extended answer, but there are only 2 marks available, giving you a clue that you don't need to go into too much detail. You should instead focus on the events that take place immediately after coming into contact with a matching pathogen.

3c

1 mark

Figure 2 shows changes in T cell and pathogen number after an infection begins.

Figure 2



Explain what is happening to the T cell numbers in **Figure 2** during the early days after the start of an infection.

During the early days after infection, T cells are carrying out...

- Clonal expansion / mitosis / cloning themselves; [1 mark]

[Total: 1 mark]

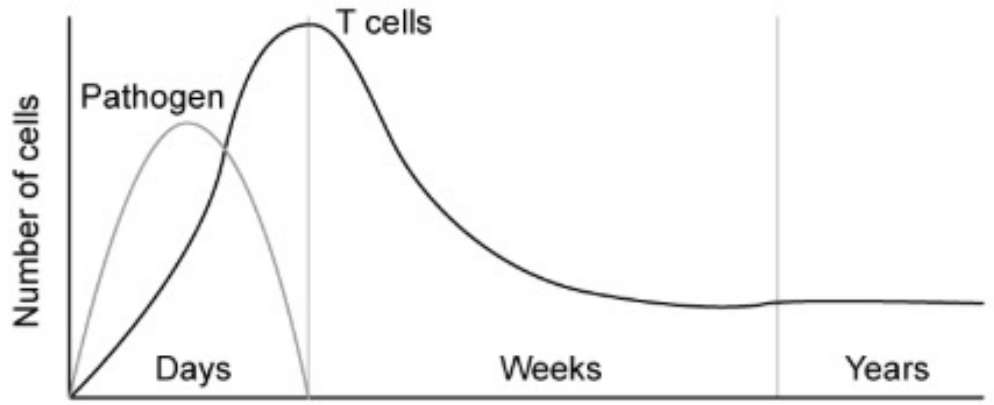
After T cells are activated by their complementary pathogens, they begin to produce identical copies, or clones, of themselves by the process of mitosis. This process is called clonal expansion.

3c

1 mark

Figure 2 shows changes in T cell and pathogen number after an infection begins.

Figure 2



Explain what is happening to the T cell numbers in **Figure 2** during the early days after the start of an infection.

3d

2 marks

Explain the relationship between T cell numbers and pathogen numbers in **Figure 2** during the early days after infection.

Increasing T cell numbers lead to decreased pathogen numbers because...

- Increased helper T cell numbers lead to increased production of cytokines / stimulation of B lymphocytes / plasma cell production / antibody production / activity of phagocytes; [1 mark]
- Increased killer/cytotoxic T cell numbers lead to more destruction of pathogen cells / toxins secreted into pathogens / holes punched in the cell membranes of pathogens; [1 mark]

[Total: 2 marks]

1 If a person is bitten by a venomous snake, the immediate treatment is normally to inject the person with the appropriate antibodies.

This is an example of which type of immunity?

A artificial active immunity

B artificial passive immunity

C natural active immunity

D natural passive immunity

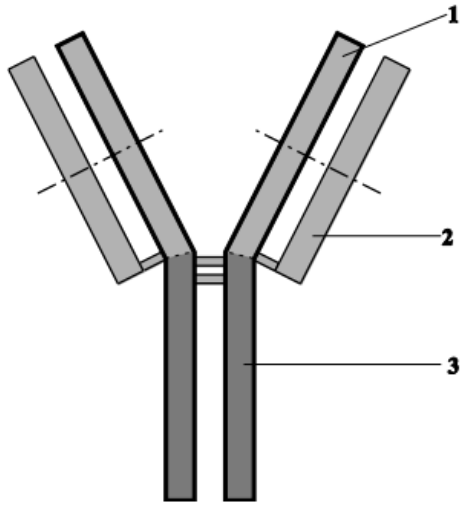
Your answer ☐ **[1]**

The correct answer is B

This is an example of artificial immunity because the antibodies are given to the patient in the form of an injection and it is passive because the patient has not produced the antibodies themselves.

The other answers are incorrect because it is not an example of active immunity or natural immunity.

13 The diagram represents the general structure of an antibody.



Which of the following numbered part(s) of the diagram represent the part of the antibody that has the same sequence of amino acids in all antibodies?

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

The correct answer is C

The part labelled 2 on the diagram is the light polypeptide chain and the part labelled 3 is the heavy polypeptide chain. These two parts represent the constant regions of the antibody which are the same for all antibodies. Part 1 represents the unique variable region which gives the antibody specificity and matches up with the epitope of antigens.

A, B and D are all incorrect as they suggest that 1 might be the same for all antibodies.

16 There will be outbreaks of new infectious diseases in the future. They will arise from mutations in the genomes of existing organisms. The mutating organisms may not at present be pathogenic, or they may be animal pathogens that mutate to become able to infect humans.

(a) What feature of a pathogen such as *Mycobacterium tuberculosis* could be altered by a mutation, making a vaccine ineffective?

.....

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

(b) **(i)** Outline the processes that lead to the production of antibodies against an unfamiliar bacterium.

.....

.....

.....

.....

..... **[3]**

(ii) Explain how helper T cells act to speed up these processes.

.....

.....

.....

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

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(a) What feature of a pathogen such as *Mycobacterium tuberculosis* could be altered by a mutation, making a vaccine ineffective?

The antigen shape caused by DNA mutations and alteration of amino acids

[1]

(b) **(i)** Outline the processes that lead to the production of antibodies against an unfamiliar bacterium.

Neutrophil activation, phagocytosis, APC, T cell activation And messaging via cytokines to B lymphocytes/clonal Expansion/antibody production

[3]

(ii) Explain how helper T cells act to speed up these processes.

T cells bind to APC's and signal B cells to start cell division Via mitosis

[2]

(c) **Fig. 16.1** shows the concentration of new antibodies in the blood of a person infected for the first time by a pathogen, on day 0. This is their 'primary response'.

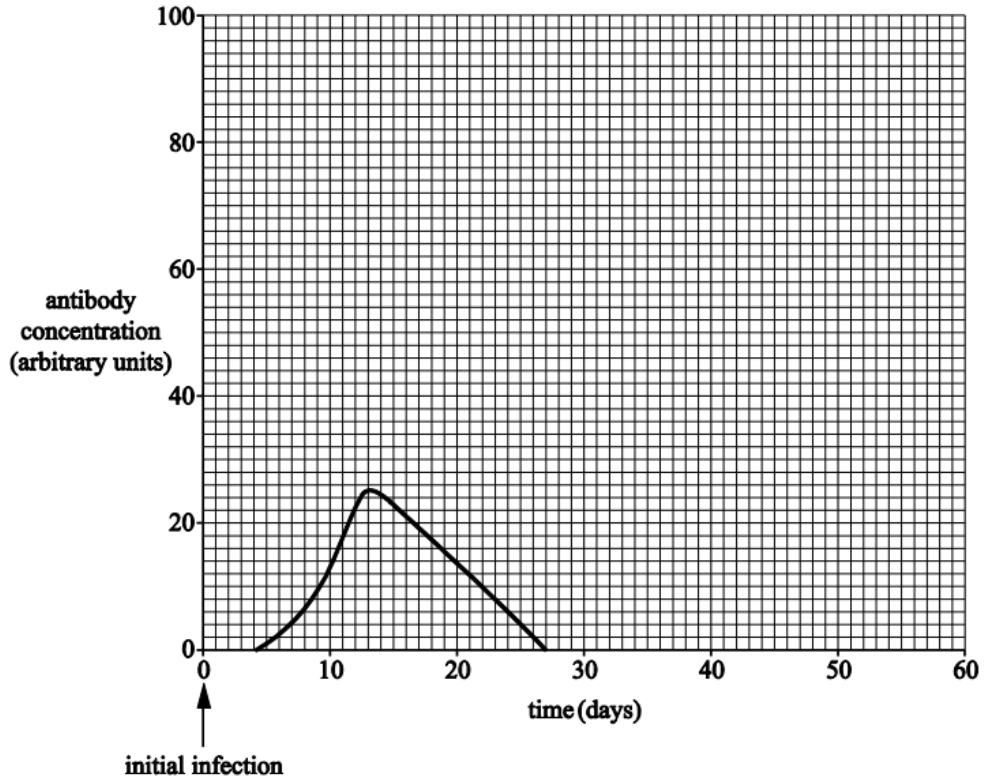


Fig. 16.1

(i) On day 30, this individual was again infected with the same pathogen. Sketch a line **on Fig. 16.1** to show the antibody concentration from day 30 onwards.

[2]

(ii) Explain how memory cells caused the differences between the two lines on the graph.

.....

.....

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

(c) **Fig. 16.1** shows the concentration of new antibodies in the blood of a person infected for the first time by a pathogen, on day 0. This is their 'primary response'.

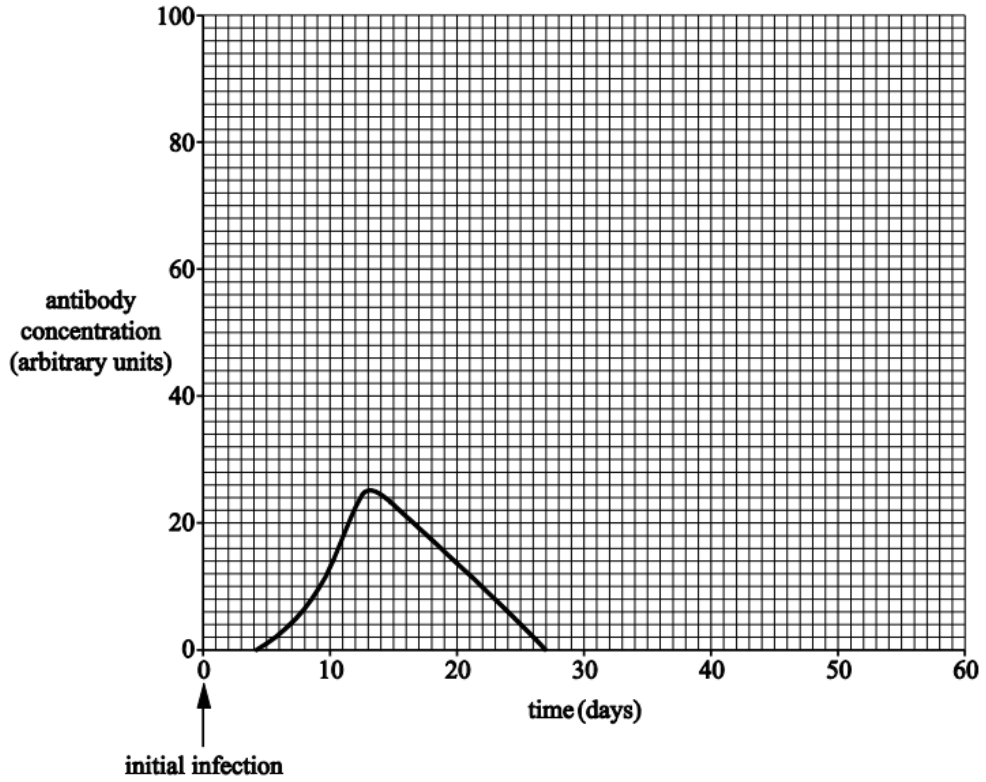


Fig. 16.1

(i) On day 30, this individual was again infected with the same pathogen. Sketch a line **on Fig. 16.1** to show the antibody concentration from day 30 onwards.

Line drawn with steeper gradient and twice the height [2]

(ii) Explain how memory cells caused the differences between the two lines on the graph.

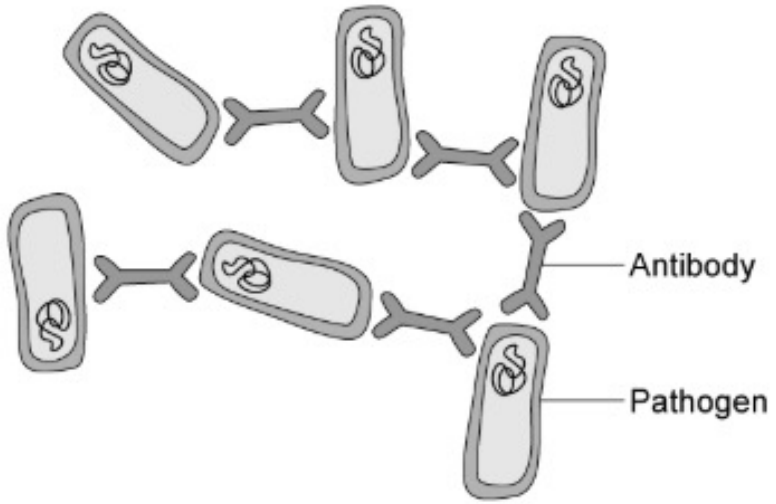
Memory cells circulating in blood plasma activated By secondary infection/Helper T cell binds, causes Immediate cloning of B lymphocytes ..... [2]

5c

2 marks

Figure 2 below shows one way in which antibodies can defend the body against pathogens.

Figure 2



Name the process shown in **Figure 2** and explain how it helps to fight infection.

The process shown in **Figure 2** is...

- Agglutination; [1 mark]

It helps to fight infection because...

- It causes pathogens to clump/stick together, making it less likely that they will infect body cells / making it easier for phagocytes to engulf many pathogens at once; [1 mark]

[Total: 2 marks]

There are several ways that antibodies can help to fight pathogens, but agglutination, shown here, is the only one that you are expected to know about.

3 Which of the following changes of lifestyle is/are likely to reduce the spread of a disease that is transmitted by droplets of moisture?

1 Clean drinking water
2 Fewer people living together in the same house
3 Housing with improved ventilation

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

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2 Fewer people living together in the same house
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A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer C

[1]

1 Young mammals receive antibodies in their mother's milk.

This is an example of which type of immunity?

A artificial active immunity

B artificial passive immunity

C natural active immunity

D natural passive immunity

Your answer ☐

[1]

1 Young mammals receive antibodies in their mother's milk.

This is an example of which type of immunity?

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B artificial passive immunity

C natural active immunity

D natural passive immunity

Your answer [D]

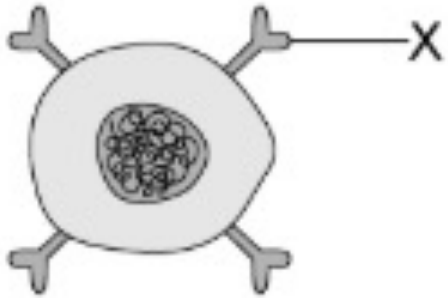
[1]

4a

1 mark

Figure 1 below shows a representation of a mature B lymphocyte.

Figure 1



Identify the molecule marked **X**.

The molecule marked **X** is...

- An antibody / antibody receptor; [1 mark]

[Total: 1 mark]

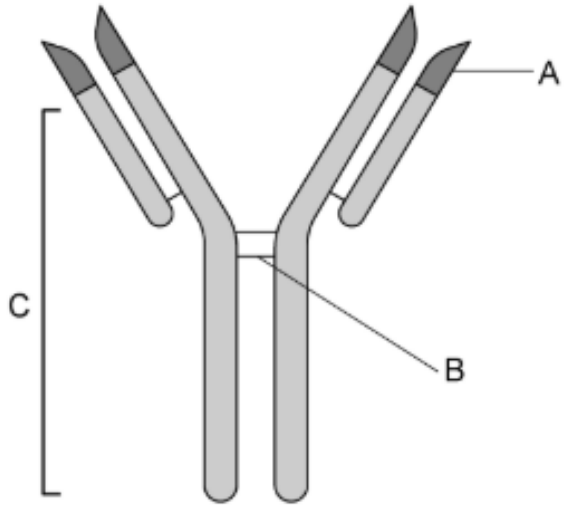
The antibodies on the surface of B lymphocytes act in the same way as the cell surface receptors on T lymphocytes. Each B cell has a different type of antibody on its cell surface membrane, and each type of antibody is specific to a different pathogen.

5a

3 marks

Figure 1 below shows a representation of an antibody.

Figure 1



Identify the sections marked **A–C** in **Figure 1**.

Sections **A–C** in **Figure 1** are...

- **A** = Variable region / antigen binding site; [1 mark]
- **B** = Disulfide bond/bridge; [1 mark]
- **C** = Constant region; [1 mark]

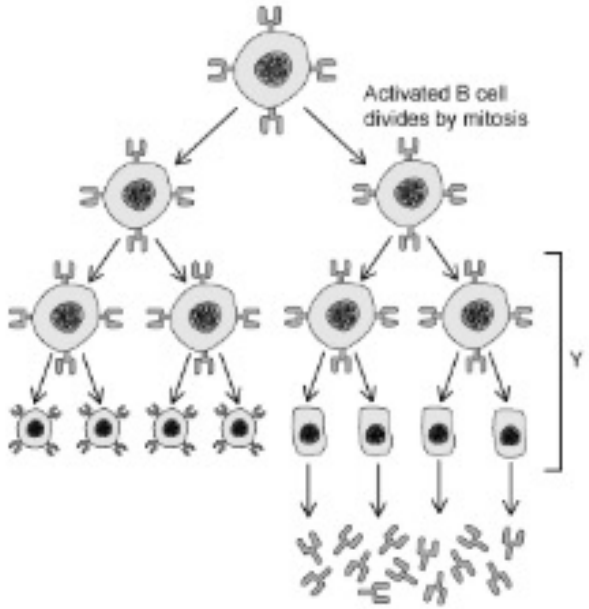
[Total: 3 marks]

4c

2 marks

Figure 2 shows part of the B lymphocyte response to infection.

Figure 2



Describe what is happening at the stage labelled **Y** in **Figure 2**.

Stage **Y** in **Figure 2** shows...

- The B cells are differentiating / specialising / developing into different cell types; [1 mark]
- Memory cells **AND** plasma cells form; [1 mark]

[Total: 2 marks]

When an activated B cell begins to divide by mitosis, the daughter cells differentiate into B memory cells and plasma cells.

1

1 mark

Pathogens are disease-causing organisms in plants and animals. Many microorganisms are pathogens.

Which of the following correctly links the type of pathogen and the disease caused by it in animals?

	Bacteria	Viruses	Fungi	Protoctists
A	Tuberculosis	Influenza	Athlete's foot	Malaria
B	Athlete's foot	Malaria	Tuberculosis	Influenza
C	Tuberculosis	Influenza	Malaria	Athlete's foot
D	Athlete's foot	Influenza	Tuberculosis	Malaria

Choose your answer

A B C D

The correct answer is A.

B is incorrect because athlete's foot is caused by a fungus, malaria is caused by protoctists, tuberculosis is caused by bacteria, and influenza is caused by a virus

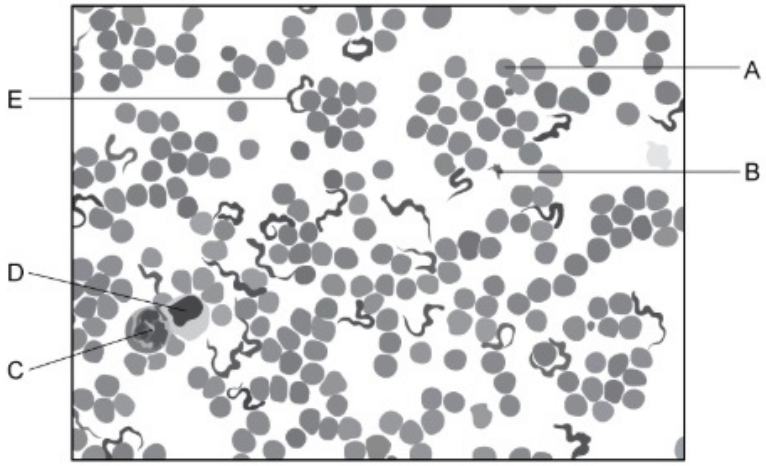
C is incorrect because athlete's foot is caused by fungi, and malaria is caused by protoctists

D is incorrect because fungi cause athlete's foot, and bacteria cause tuberculosis

3

1 mark

The image below shows a human blood smear.



The cell labelled **C** is a neutrophil.

Which of the following statements correctly describes the neutrophil?

1	They are released in large numbers when a pathogen attacks
2	They are long-lived cells
3	They carry out the process of phagocytosis

A. 1,2, and 3

B. 1 and 2 only

C. 1 and 3 only

D. 3 only

The correct answer is C because:

- Statement 1 is correct as
  - Neutrophils are released in a large number from their stores during an infection
- Statement 2 is incorrect:
  - Neutrophils are short-lived
- Statement 3 is correct:
  - Neutrophils like other types of phagocyte, carry out the process of phagocytosis

A is incorrect because neutrophils are short-lived cells

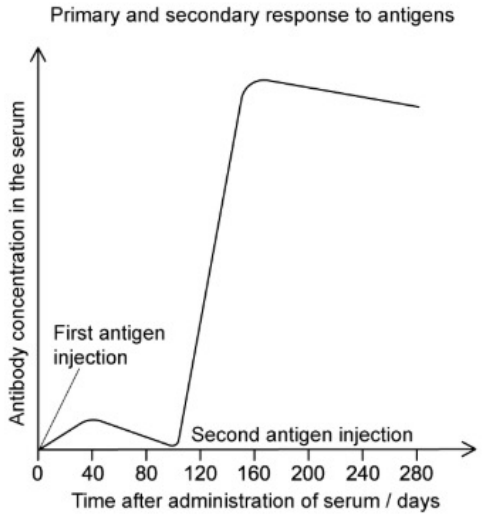
B is incorrect because the life span of neutrophils is short

D is incorrect because statement 1 also supports describes the neutrophil and it carries out the process of phagocytosis

4

1 mark

The diagram shows the primary and secondary responses to an antigen.



Which of the following statements describes the secondary response if the same pathogen attacks?

1	The antibody concentration in the blood takes one to two weeks to increase
2	The antibody concentration in the blood increases quickly due to the presence of memory cells
3	Many symptoms of the disease will develop during the secondary response

A. 1,2, and 3

B. 1 and 2 only

C. 1 and 3 only

D. 2 only

Choose your answer

A B C D

The correct answer is D because

- Statement 2 is correct:
  - The memory cells that formed after the primary immune response will quickly divide and differentiate into plasma cells which can then produce many antibodies

A is incorrect because statement 1 refers to the time delay during the primary response to an antigen while statement 3 is incorrect as the pathogen is usually destroyed before symptoms of a disease can develop

B is incorrect as statement 1 refers to the primary response, not the secondary response

C is incorrect because both statements 1 and 3 are incorrect as described above

1. Lymphocytes form an important part of the specific immune system in humans. They can be classified into B lymphocytes and T lymphocytes.

(a) For each of the statements in the table below, use **ticks or crosses** to identify whether thestatement belongs to B lymphocytes, or to T lymphocytes, or to both B and T lymphocytes.

The first one has been done for you.

Statement	B lymphocytes	T lymphocytes
Matured in bone marrow	✓	✗
Form part of immune response		
Differentiate into memory cells		
Produce chemicals that can cause lysis of infected cells		
Form plasma cell clones		

[4]

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Statement	B lymphocytes	T lymphocytes
Matured in bone marrow	✓	✗
Form part of immune response	✓	✓
Differentiate into memory cells	✓	✓
Produce chemicals that can cause lysis of infected cells	✗	✓
Form plasma cell clones	✓	✗

[4]

2d

1 mark

Phagocytosis of a rhinovirus leads to presentation of its antigens. State where the antigens would be presented.

After phagocytosis of a virus, the antigens would be presented:

- On the cell surface membrane / plasma membrane; [1 mark]

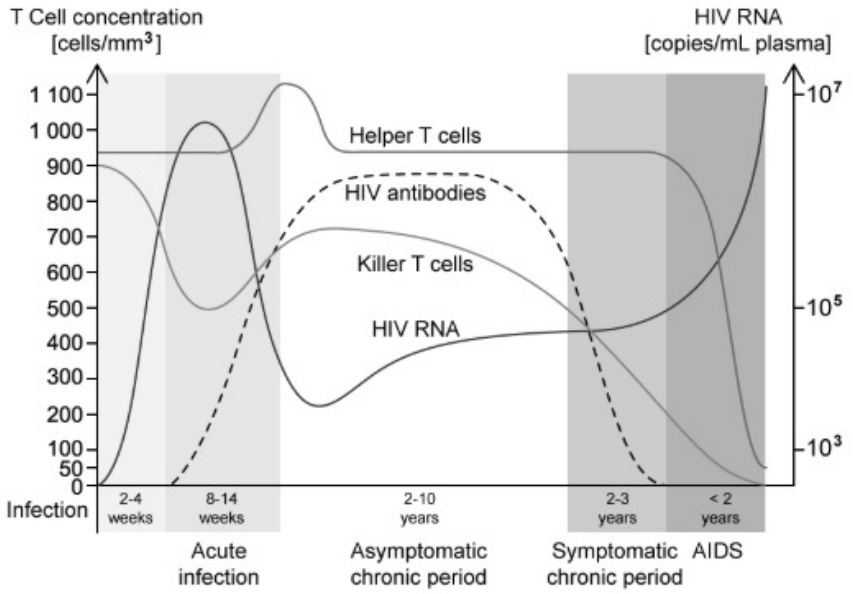
[Total: 1 mark]

A **macrophage** is a type of **phagocytic cell**. Once a macrophage has ingested and partly digested a pathogen, it may transfer some of the pathogen's antigens to its own cell surface membrane, at which point it becomes an **antigen-presenting cell**.

1

1 mark

The graph below shows the effect of HIV on the T cells in the blood of an individual.



Using the information in the graph and your own knowledge. Which of the following statements is true?

A. A decrease in Helper T cells results in an increase in HIV RNA

B. HIV sufferers are unlikely to live beyond 2 years of contracting HIV

C. A decrease in killer T cells results in a decrease of antibodies in the blood

D. The immune system is unable to activate B cells, this leads to the onset of AIDS in patients

Choose your answer

A B C D

HIV RNA plasma copies increase during the first 8 weeks because:

- HIV infects host cells and uses their protein synthesis mechanisms to produce more copies of itself / produce more copies of its genetic material/RNA; [1 mark]

HIV RNA plasma copies decrease between 8–14 weeks because:

- An increase in killer T cells leads to the destruction of infected cells; [1 mark]
- An increase in HIV antibodies leads to phagocytosis of infected cells; [1 mark]

[Total: 3 marks]

There is a lot going on in this graph, so be sure to focus on the events that are taking place in the first 14 weeks. Remember to explain and not describe.