

Active immunity: Humoral immunity practice exam questions

SECTION A - Multiple-choice questions

Question 1 (1 mark)

The BrkA molecule is found on the surface of *Bordetella pertussis*. It can trigger an immune response in humans. This molecule can be described as:

- A Self
- B An antigen
- C A hormone
- D Complement









Question 2 (1 mark)

To stimulate an adaptive immune response, BrkA needs to be:

- A Presented by a Dendritic cell
- B Secreted by the bacteria
- C Completely denatured
- D Similar in shape to other common bacterial molecules

Question 3 (1 mark)

The table below shows antibody structures and a possible antigen they will bind to:

	Antibody	Antigen
A		
B		
C		
D		

The row that has an antibody and the antigen it is specific for is:

- A Row A
- B Row B
- C Row C
- D Row D

Question 4 (1 mark)

A person accidentally cut themselves with scissors and experiences a bacterial infection in the wound. Antibodies targeting a surface antigen on the bacteria are detected in the person's blood after a number of days have passed. Which of the following has occurred?

- A The differentiation of Plasma cells into Memory B cells
- B Helper T cells presenting antigen to Dendritic cells
- C Dendritic cells secreting antibody
- D B cells cloning and differentiating into Plasma cells

SECTION B - Written responses

Question 1 (9 marks)

Mycobacterium avium is a common, slowly growing environmental bacterium that enters the lungs and gastrointestinal tract via the mouth. Most individuals produce antibodies that enable the immune system to clear the bacterium so that infection by *M. avium* tends to be harmless. *M. avium* infection is potentially lethal, however, for patients with AIDS (acquired immunodeficiency syndrome). AIDS is caused by the human immunodeficiency virus (HIV), which infects helper T cells.

1a. Define "antigen" in the context of infection by *Mycobacterium avium*. (1 mark)

1b. Outline the key events in the lymphatic system that result in the production of antibodies. (4 marks)

1c. Explain how the molecular features of antibodies enable them to help target and clear the pathogen. (2 marks)

1d. With reference to the humoral immune response, explain why AIDS patients are more vulnerable to lethal infections by normally harmless microorganisms, such as *M. avium*. (2 marks)

Suggested responses begin on the next page.

Humoral immunity written responses: Suggested responses

In general, note the command terms: define, outline, explain, (explain) why.

1a. Define “antigen” in the context of infection by *Mycobacterium avium*.
(1 mark)

Response you wrote:

Suggested response:

A molecule or substance produced by *Mycobacterium avium* that generates an immune response.

Tips for answering this question: The command term is “define” so the examiner is seeking a precise meaning for the term. For 1 mark, provide the examiner with a concise, single-sentence response. Note that antigen is derived from “antibody generator” so the response can refer to the production of antibodies but take care to not add additional information that may create contradictions in the response.

1b. Outline the key events in the lymphatic system that result in the production of antibodies. (4 marks)

Response you wrote:

Suggested response:

- Antigen presenting cells activate helper T cells
- Helper T cells activate B cells that are presenting antigen
- B cells undergo clonal expansion (are stimulated to divide)
- B cell clones differentiate into plasma cells that secrete antibodies

Tips for answering this question: The command term is “outline” so the student is required to give a brief summary of the key events, rather than a detailed description of the process. Four marks indicates four points that the student is required to make. In this case, consider the key cells involved (antigen presenting cells, helper T cells, B cells, and plasma cells) and record their role for each mark. Note that some B cell clones also differentiate into memory cells but these are not required for antibody production in the primary immune response. Care must be taken if providing additional details in case they add incorrect or conflicting information that distracts from the answer.

1c. Explain how the molecular features of antibodies enable them to help target and clear the pathogen. (2 marks)

Response you wrote:**Suggested response:**

- The shape at the tips of the antibodies are specific for the shape of antigens on the pathogen so antibodies bind to the antigen
- The antibodies act as flags that attract macrophages that clear the pathogen by phagocytosis

Tips for answering this question: The command term is “explain” so the student is required to provide the reason(s) or the cause(s) for an observation or an event. In this case, the question invites the student to communicate logical relationships between features of antibodies and the process of clearing the pathogen. Some students may focus on other molecular features of antibodies, such as two binding sites or the flexibility of the antibody’s arms for forming antigen-antibody complexes. This would be acceptable so long as they explain how it helps clear the pathogen. Two marks indicates two key points that the student is required to make.

1d. With reference to the humoral immune response, explain why AIDS patients are more vulnerable to lethal infections by normally harmless microorganisms, such as *M. avium*. (2 marks)

Response you wrote:

Suggested response:

- HIV infects and impairs helper T cells, which disrupts the interaction required to stimulate B cells to undergo clonal expansion and differentiate into plasma cells
- Without plasma cells, antibodies against microorganisms are not produced so the microorganisms are not removed by phagocytes

Tips for answering this question: The command term is “explain” so the student is required to provide the reason(s) or the cause(s) for an observation or an event. In this case, the question invites the student to communicate logical relationships between HIV infection and the lethal infection by normally harmless microorganisms. The information provided in the question cues the student to consider the role of helper T cells (which are infected by HIV) and their role in the humoral immune response (the context for question 1d). Two marks indicates two key points that the student is required to make. For each mark, the suggested answer includes a mechanism and a consequence.