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VCE Biology ¾

The Innate Immune System [3.2]

Test

37 Marks. 1 Minute Reading. 30 Minutes Writing.

Results:

Test	_____ / 37

Section A: Test (37 Marks)

Question 1 (5 marks)

Tick whether the following statements are **true** or **false**.

Statement	True	False
a. The innate immune system is fast and non-specific, responding similarly to any pathogen.	✓	
b. Pattern Recognition Receptors (PRRs) on immune cells detect specific antigens on pathogens.		✗
c. Neutrophils eliminate pathogens only by engulfing them through phagocytosis.		✗
d. Natural Killer (NK) cells target your own infected or cancerous cells by detecting abnormal or missing MHC markers.	✓	
e. Mast cells are primarily responsible for releasing histamine and initiating the inflammatory response.	✓	
f. Complement proteins are activated by pathogens and contribute to opsonisation, chemotaxis, and lysis.	✓	
g. Interferons directly destroy viruses by punching holes in their membranes.		✗
h. Eosinophils are involved in targeting large parasites and contribute to allergic reactions.	✓	
i. The inflammatory response involves vasoconstriction to reduce blood flow and limit infection spread.		✗
j. PAMPs and DAMPs are molecular patterns recognised by the innate immune system to identify pathogens and damaged cells, respectively.	✓	

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Question 2 (1 mark)

The first line of defence against pathogens includes the:

A. Activation of *T* helper cells.

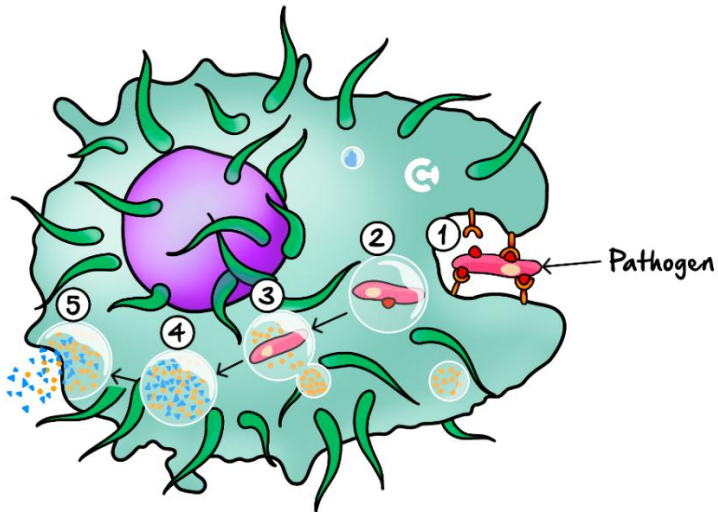
B. Presence of acid in the stomach. → chemical barrier

C. Release of toxic mediators from eosinophils.

D. Activation of complement proteins.

Question 3 (1 mark)

The diagram below shows the process of phagocytosis. This process is vital for immunity against extracellular infections.



What is happening at position 3?

A. Enzymes that break down the microorganism are released into the vesicle.

B. Antibodies are added to the vesicle to kill the microorganism.

C. The cell is sampling the vesicle for antigen presentation.

D. Intracellular microbes are attacking the microorganism.

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Question 4 (1 mark)

Mast and basophil cells:

A. Are involved in the allergic response to foreign particles.

B. Use immunoglobulin A (IgA) antibodies to bind to foreign particles.

C. Release chemicals that reduce inflammation.

D. Are responsible for the relaxation of smooth muscles.

Question 5 (1 mark)

Complement proteins:

A. Can coat and lyse bacteria ready for phagocyte ingestion.

B. Are secreted by some cells when they are infected by virus particles.

C. Are produced by none of the immune system cells.

D. Kill body cells that have been infected by virus particles.

Question 6 (1 mark)

Which of the following outlines the function of dendritic cells?

using MHC II to display foreign antigen

A. Communicate with foreign particle's MHC.

B. Communicate with accessory cells.

C. Form an important role as an antigen-presenting cell.

D. All of the above.

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Question 7 (1 mark)

Viruses are described as non-cellular pathogens because they:

A. Do not contain any nucleic acids.

B. Cannot reproduce outside a host cell.

C. Are unable to produce antigenic proteins.

D. Do not have membrane-bound organelles.

Question 8 (1 mark)

Lysosomes are organelles found in the cytoplasm of some eukaryotic cells. These organelles contain enzymes enclosed by a membrane.

Large numbers of lysosomes would be most likely to occur in cells that are:

A. Carrying out mitosis.

B. Producing antibodies.

C. Carrying out apoptosis.

D. Carrying out phagocytosis.

digestive enzymes to kill pathogens

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Question 9 (1 mark)

An unknown disease caused severe symptoms in one particular human. An epidemiologist took a sample of diseased tissue from the patient and analysed it to determine the cause. The table below shows the results of the analysis:

Test	Test type	Findings
1	Microscopic analysis	No pathogenic cells were found in the sample
2	Denaturing any nucleic acid in the sample	The sample was still infectious
3	Denaturing any nucleic acid and protein in the sample	The sample was no longer infectious
4	Denaturing the proteins only within the sample	The sample was no longer infectious

Based on the results of the tests, the disease could be caused by a:

A. Prion

B. Virus

C. Bacteria

D. Protozoan

Question 10 (1 mark)

The complement system causes lysis of bacteria and enables more effective removal of pathogens.

The complement system involves:

A. *B* cells and the action of *T* cells.

B. *T* cells and the action of phagocytes.

C. Antibodies and the action of phagocytes.

D. Large blood proteins and the action of phagocytes.

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Question 11 (1 mark)

Phagocytes:

A. Are specialised red blood cells.

B. Are involved in the humoral response.

C. Engulf eukaryotic cells such as fungi.

D. Are produced by lymph nodes.

Question 12 (1 mark)

Which of the following matches a cell correctly with its role in the immune response?

	Cell	Role
A.	Macrophage	Stimulates inflammation by secreting interferon
B.	Dendritic cell	Presents fragments of antigens to *T* helper cells
C.	Mast cell	Engulfs bacteria and debris
D.	Neutrophil	Secretes antibodies

Question 13 (1 mark)

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'Complement' is the term applied to a set of over 30 different proteins that play a role in the immune system.

Which one of the following identifies a role played by complement proteins?

A. They trigger clonal expansion.

B. They facilitate the production of antibodies.

C. They facilitate and enhance the process of phagocytosis. → opsonisation

D. They act as a barrier, preventing pathogens from entering cells.

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Question 14 (7 marks)

While gardening, Priya accidentally pierces her palm with a rusted nail. Within hours, the site becomes red, swollen, and painful. A doctor notes pus forming under the skin and prescribes a topical antiseptic.

a. Explain the role of mast cells in the development of Priya's symptoms. (2 marks)

b. Describe the cellular events that lead to the formation of pus. (2 marks)

c. Connect each of Priya's symptoms (redness, swelling, pain) to a specific physiological process. (3 marks)

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Question 15 (8 marks)

A study tracks interferon levels and NK cell activity in three patients (A, B, and C) over the first five days of viral infection. All patients were infected with the same respiratory virus.

Day	Patient A- Interferon (pg/mL)	Patient A- NK Cell Activity (%)	Patient B- Interferon (pg/mL)	Patient B- NK Cell Activity (%)	Patient C- Interferon (pg/mL)	Patient C- NK Cell Activity (%)
1	15	65	5	25	0	10
2	20	72	10	40	2	12
3	25	80	12	45	3	15

a. Describe the relationship between interferon levels and NK cell activity in Patient A. (2 marks)

_____

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b. Compare the immune responses of Patient B and Patient C. What does this suggest about their ability to fight the infection? (2 marks)

_____

_____

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_____

c. Explain why interferons help stimulate NK cell activity during viral infections. (2 marks)

_____

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d. Based on the data, predict which patient is most likely to experience severe symptoms and justify your reasoning. (2 marks)

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Question 16 (5 marks)

A child is enrolled in a clinical trial testing gene therapy for a congenital complement protein C5 deficiency. C5 is needed to form the membrane attack complex (MAC). Before treatment, the child experienced recurrent bacterial infections, especially meningococcal, which is caused by gram-negative bacteria neisseria meningitidis.

a. Explain how the MAC normally defends against bacteria. (1 mark)

_____

_____

b. Identify two other functions of the complement system that may still be active in this child. (2 marks)

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c. Explain why a lack of MAC specifically increases susceptibility to meningococcal infections. (2 marks)

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