NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

**FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES**

**DEPARTMENT OF CLINICAL HEALTH SCIENCES**

| **QUALIFICATION : BACHELOR OF MEDICAL LABORATORY SCIENCES** | |
|---|---|
| **QUALIFICATION CODE:** 08BMLS | **LEVEL:** 5 |
| **COURSE CODE:** IMY521S | **COURSE NAME:** IMMUNOLOGY |
| **SESSION:** **NOVEMBER 2024** | **PAPER:** THEORY |
| **DURATION:** 3 HOURS | **MARKS:** 100 |

| **FIRST OPPORTUNITY EXAMINATION PAPER** | |
|---|---|
| **EXAMINER(S)** | **Mr FILIPPUS TSHAVUKA** |
| **MODERATOR:** | **Ms FREDRIKA ENGELBRECHT** |

| **INSTRUCTIONS** |
|---|
| 1. Answer ALL the questions.<br>2. Write clearly and neatly.<br>3. Number the answers clearly.<br>4. For section A, use the zip-grade answer sheet provided and use a pencil to fill-out one correct answer |

**THIS QUESTION PAPER CONSISTS OF 13 PAGES** (Including this front page).

## SECTION A: MULTIPLE CHOICE QUESTIONS [30 MARKS]

**QUESTION 1** **[30]**

Evaluate the statements in each numbered section and select the most appropriate answer or phrase from the given possibilities. **Answer all your questions on the ZiP-grade answer sheet attached to the back of question paper.**

1.1. What role did the English physician Edward Jenner played in the evolution of immunology? (1)

A. He is the father of pasteurisation.
B. He is the father of variolation.
C. He developed a vaccine against smallpox from milkmaids suffering from cowpox.
D. He discovered the complement system.

1.2. Which statement is true of the adaptive, but not the innate immune response? (1)

A. Pathogens have evolved to fight it.
B. The receptors are highly specific.
C. Many cells work together to coordinate the response.
D. It fights both viruses and bacteria.

1.3. Monocytes move from the systemic circulatory system into general connective tissues, where they differentiate into what phagocytic cell type? (1)

A. Neutrophil
B. Macrophage
C. Plasma cell
D. T cell

1.4. Which of the following cell types of the innate immune system does not perform phagocytosis? (1)

A. Basophil
B. Neutrophil
C. Macrophages
D. Eosinophils

1.5. Myeloid leukaemia are caused by the cancerous production of innate (non-specific) immune system cells. Identify the tissue in which such production is most likely to occur. (1)

A. Thymus
B. Spleen
C. Lymph nodes
D. Bone marrow

1.6. Recognition of self vs. non-self by the adaptive immune system in humans is accomplished in which of the following ways? (1)

A. Exposure of B cells to the body's own antigens in the thymus
B. Exposure of B cells to the body's own antigens in the bursa of fabricius.
C. Exposure of T cells to the body's own antigens in the bursa of fabricius.
D. Exposure of T cells to the body's own antigens in the thymus.

1.7. Which portion of an antibody provides antigen-binding sites? (1)

A. Light chain
B. Heavy chain
C. Variable region
D. Constant region

1.8. Which of the following is a feature of Natural killer cells? (1)

A. They secrete natural IgM antibodies.
B. Upon activation they secrete abundant IL4.
C. They kill virally infected cells by a perforin-granzyme dependent mechanism.
D. They are activated by recognizing microbial peptides presented by MCH class I.

1.9. What happens when immune cells fail to eradicate *Mycobacterium tuberculosis*? (1)

A. The immune cells completely destroy the bacteria.
B. The immune system forms a granuloma.
C. The bacteria immediately die.
D. The immune system releases antibodies to neutralize the bacteria.

1.10. The percentage of human peripheral blood T-cells bearing a gamma delta T-cell receptor is: (1)

A. 30 – 80%
B. 5% - 10%
C. 100%
D. 0%
E. Only present during mycobacterial tuberculosis infections.

1.11. The T-cell receptor (TCR) antigen recognition signal is transduced by: (1)

A. TCR alpha chain
B. TCR beta chain
C. CD2
D. CD3

1.12. Antigen-recognizing receptors differ in their affinity for antigens, which can be expressed in terms of their dissociation constant (Kd). Higher Kd values indicate lower affinity for antigens. Given the following dissociation constants (Kd) for different receptors, which one demonstrates the highest affinity for its antigen? (1)

A. Antibody (IgG): Kd = $10^{-9}$ M
B. T-cell receptor (TCR): Kd = $10^{-6}$ M
C. MHC Class I molecule: Kd = $10^{-5}$ M
D. MHC Class II molecule: Kd = $10^{-4}$ M

1.13. A hapten is: (1)

A. An epitope
B. A carrier
C. A Molecule that is too small to elicit an immune response
D. An immunogen that can elicit immune response

1.14. The following CD marker is found on surfaces of both B- and T- lymphocytes. (1)

A. CD11b
B. CD4
C. CD5
D. CD8

1.15. The following statements about the functions of cell markers are true EXCEPT: (1)

A. Cell markers are responsible for directly neutralizing pathogens during immune responses.
B. Cell markers help identify the lineage of a particular immune cell.
C. Cell markers play a role in the activation, communication and signalling of immune cells.
D. Cell markers are used to distinguish between different stages of cell maturation.

1.16. Which of the following is an example of a pathogen-associated molecular pattern (PAMP) recognized by the innate immune system? (1)

A. Double-stranded RNA from replicating viruses.
B. MHC molecules on mammalian cells.
C. Immunoglobulin G (IgG) antibodies.
D. T-cell receptors (TCRs) on lymphocytes.

1.17. Which of the following is not one of the three main antigen-presenting cell types? (1)

A. Dendritic cells
B. Kupffer cells
C. Natural Killer cells
D. Macrophages

1.18. Central tolerance refers to which of the following processes? (1)

A. Destruction of lymphocytes that are not specific for self-antigens.
B. Production of self-antigens that are specific for lymphocytes.
C. Destruction of self-antigens that are specific for lymphocytes.
D. Destruction of lymphocytes that are specific for self-antigens.

1.19. Some forms of autoimmune disease result from autoantibodies that bind to receptors on the cell surface. Antibodies that bind to these receptors can cause disease by: (1)

A. Activating complement and causing cell lysis.
B. Blocking normal ligand binding to the receptor.
C. Providing persistent stimulation through the receptor that is not regulated normally.
D. All of the above.
E. None of the above.

1.20. What is the effect of increased recruitment of regulatory T cells (Tregs) in the tumour microenvironment? (1)

A. Enhances the immune system's ability to destroy tumour cells.
B. Stimulates cytotoxic T cells to attack the tumour.
C. Suppresses the immune response, allowing tumour cells to evade immune detection.
D. Increases inflammation and draws more immune cells to the tumour.

1.21. The intermolecular forces which contribute to the interaction between antibody and antigen: (1)

A. Are all electrostatic.
B. Are all van der Waals.
C. Are all hydrophobic.
D. Are all hydrogen bonds.
E. Rely on a combination of the above.

1.22. A patient with a MHC class II deficiency (an example is the Bare Lymphocyte syndrome): (1)

A. will experience decreased viral susceptibility.
B. will have an excess of activated complement that binds to MHC class II+ cells.
C. will experience declines in T helper/Antigen Presenting Cells interactions and a resulting immunodeficiency.
D. will develop an autoimmune disease called Bare Lymphocyte Adenopathy (BLA).
E. will have decreased insulin levels.

1.23. Antigen processing for presentation by MHC class I molecules involves: (1)

A. TAP1 and TAP2
B. Endocytosis of extracellular pathogen
C. Degraded peptide in the ranges of 10-20 amino acids
D. Associated with CLIP and DM molecules

1.24. Examples of Major histocompatibility complex (MHC) class II is: (1)

A. HLA-A
B. HLA-DR
C. HLA-F
D. CD4

1.25. With regards to inheritance of MHC genes, what is meant by linkage disequilibrium? (1)

A. When a pair of alleles linked at a locus within the MHC are sometimes inherited at a greater frequency than expected from the product of their individual frequencies.
B. When an individual inherits 2 sets of chromosomes for MHC: one from the father and one from the mother.
C. When a pair of MHC alleles at two different loci segregate independently.
D. When a pair of alleles at two different loci segregate independently.

1.26. Which of the following is required for an effective adaptive immune response? (1)

A. Activation of resting neutrophils.
B. Activation of resting lymphocytes.
C. Activation of resting macrophages.
D. Activation of resting platelets.

1.27. What is an example of a cytokine acting in a paracrine manner? (1)

A. Interleukin-2 (IL-2) stimulating T cells in the local environment.
B. Tumour Necrosis Factor-alpha (TNF-α) acting systemically on distant tissues.
C. Interferon-alpha (IFN-α) inducing an antiviral state in the same cell that produces it.
D. Interleukin-10 (IL-10) inhibiting the same cell that secretes it.

1.28. Which cytokine receptor family is involved in the JAK-STAT signaling pathway? (1)

A. Tumour Necrosis Factor (TNF) receptor superfamily
B. Chemokine receptor family
C. Class I and Class II cytokine receptor families
D. Toll-like receptor family

1.29. Inflammation is one of the first signs of damage or infection. Which cells do you expect to be the most numerous in a new inflammation? (1)

A. Natural Killer cells
B. Neutrophils
C. Common myeloid progenitor
D. B cells

1.30. Which of the following is an example of damage-associated molecular patterns released by dying or damaged self cells? (1)

A. Lipopolysaccharide (LPS)
B. Heat shock protein (HPS)
C. Lipoteichoic acid
D. Mannose-rich oligosaccharides

## SECTION B: STRUCTURED QUESTIONS [70 MARKS]

### QUESTION 2 [18]

Provide detailed notes and explanations on the following terms:

2.1. Inflammation (2)

2.2. Hypersensitivity (2)

2.3. The principles of vaccination in immunology and the types of vaccines. (4)

2.4. Cytokines (2)

2.5. Pleiotropism of cytokines (2)

2.6. Autocrine properties of cytokines (2)

2.7. Positive selection of T lymphocytes (2)

2.8. Somatic recombinations (2)

### QUESTION 3 [6]

Indicate whether the following cells belong to the innate or adaptive immune system:

3.1. Langerhans cells (1)

3.2. Plasma cells (1)

3.3. Kupffer cells (1)

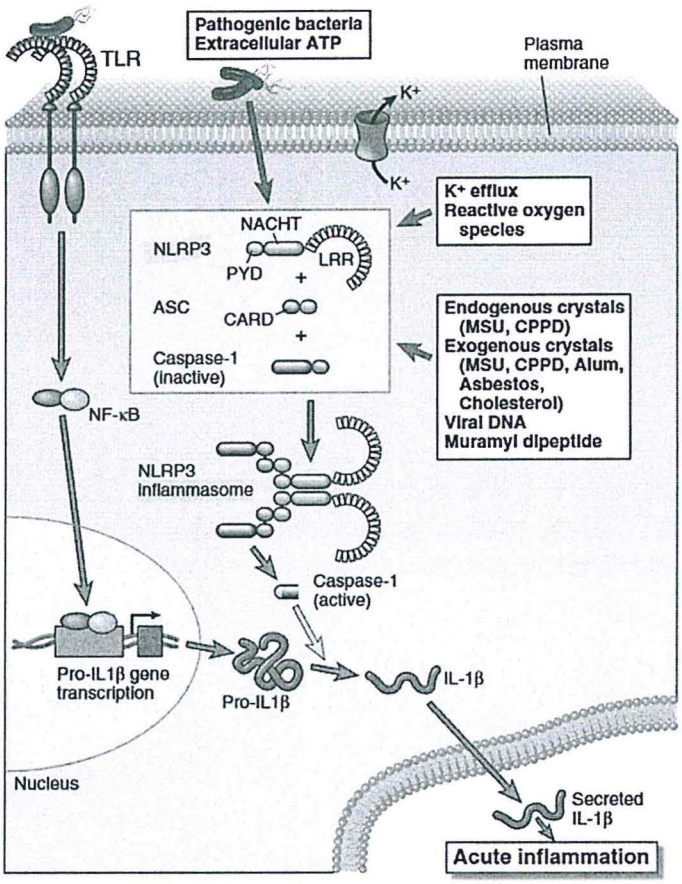
3.4. T helper 17 (1)

3.5. Dendritic cells (1)

3.6. Basophils (1)

### QUESTION 4 [21]

Toll-like receptors, scavenger receptors and complement receptors are all pattern recognition receptors of the innate immunity. With the aid of the diagram below, answer the following questions.




4.1. What are the functions of Pattern Recognition Receptors (PRRs)? (4)

4.2. Tabulate the cellular locations of pattern recognition receptors of the innate immune system and the type of pathogen associated molecular patterns which can be recognised in each location, under the following headings: (9)

| Location | PRR | PAMP / DAMP |
|---|---|---|
| | | |
| | | |
| | | |

4.3. Discuss how the NOD-like (NLRP3) inflammasome is formed in the correct order, and how it mediates acute inflammation. (8)

**QUESTION 5** **[10]**

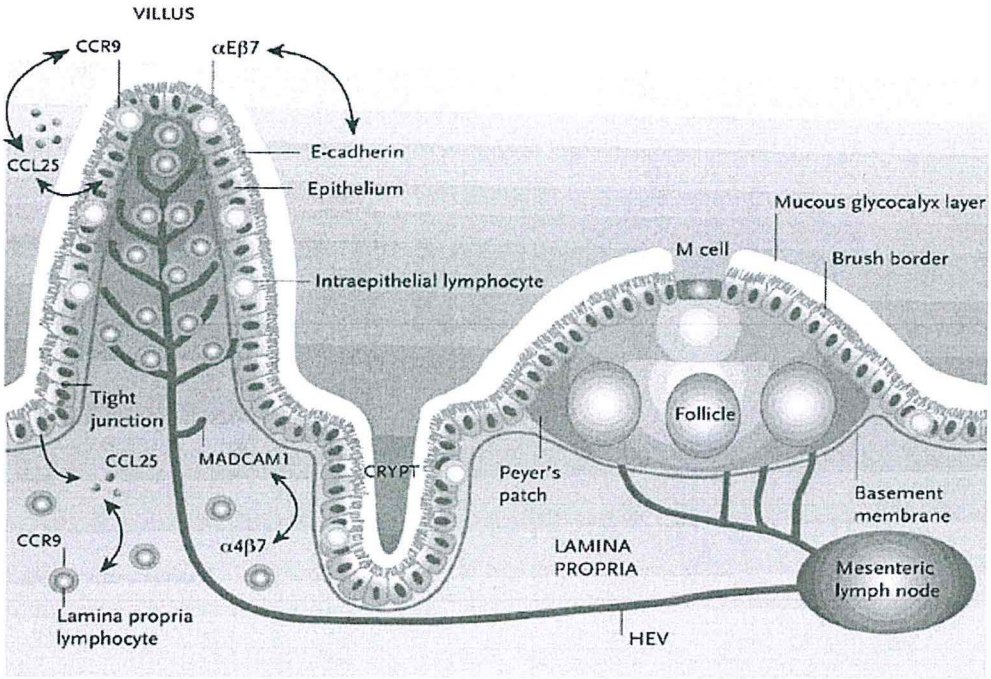
Before a microbe or parasite can invade the host and cause infection, it must first successfully fight off the first line defence mechanisms of the body and penetrate the surface epithelial layers, to establish disease. Explain what forms part of the first line defence. (10)

**QUESTION 6** **[6]**

The thymus is a primary lymphoid organ. In HIV infection, the adaptive immune system is compromised due to infected immune cells. Why do immune cells die or become dysfunctional because of HIV infection? (6)

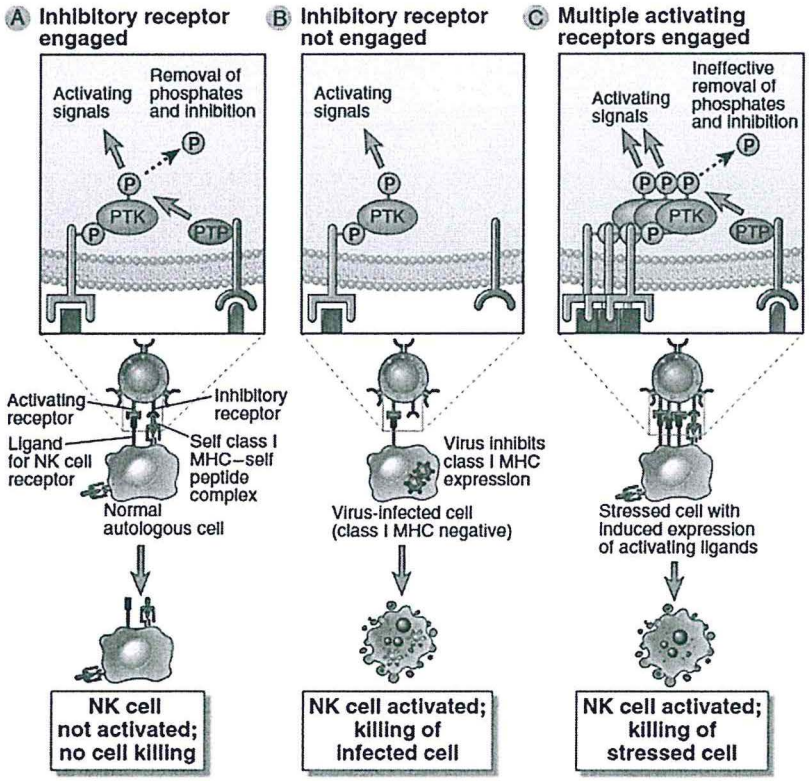
**QUESTION 7** **[4]**

The image below is a representation of the mucosa-associated lymphoid tissue (MALT) of the stomach. Using this image as a guide, briefly describe the arrangement and components of lymphoid tissue in MALT. (4)

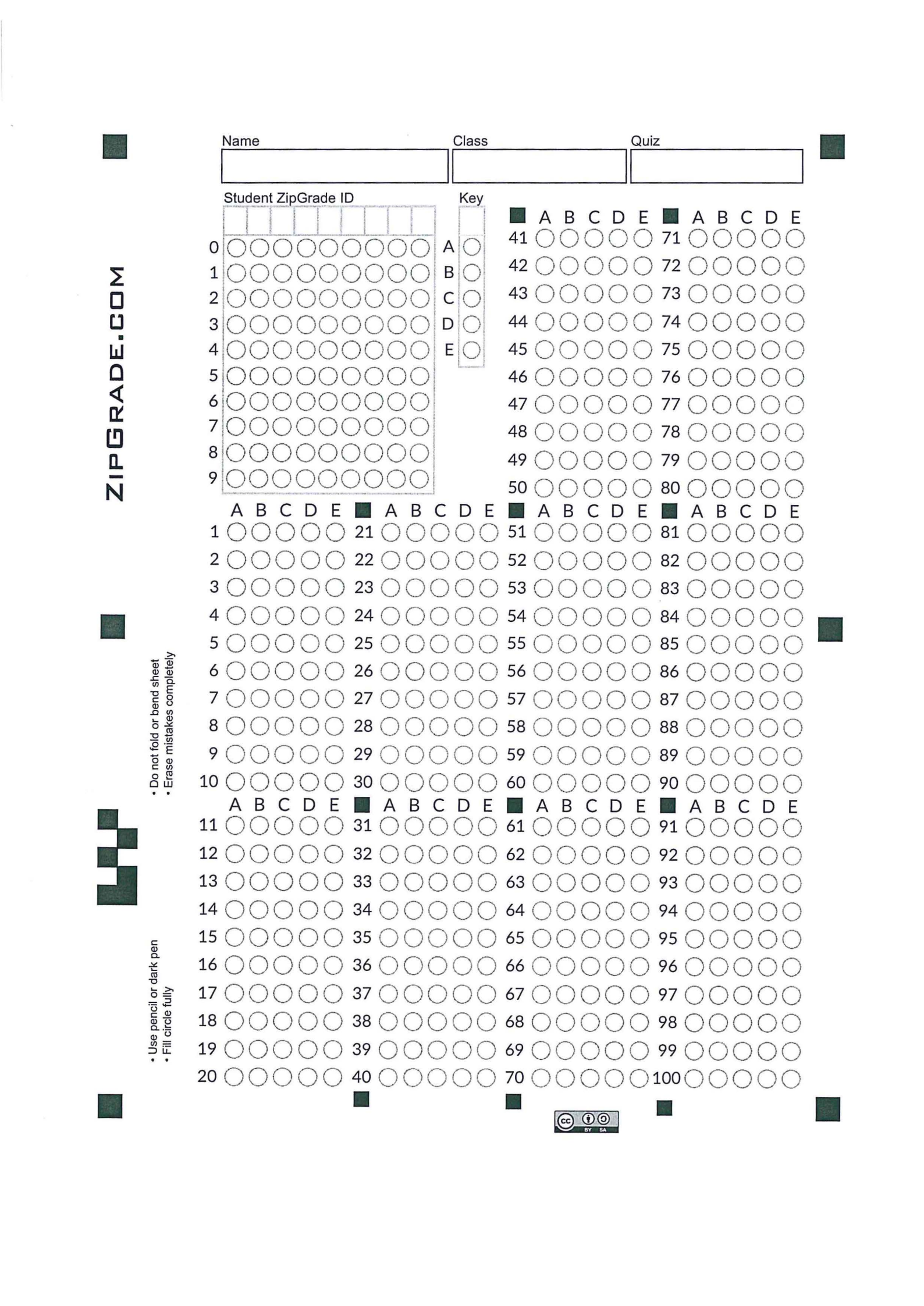


**QUESTION 8** **[5]**

Natural killer (NK) cells are lymphocytes distinct from T and B cells that play important roles in immune responses. Using the image below, explain two ways in which inhibitory roles of NK cells play a role in tissue homeostasis. (5)




**THE OF EXAMINATION PAPER [100 MARKS TOTAL]**


Name
Class
Quiz
Student ZipGrade ID
Key
A B C D E
0 1 2 3 4 5 6 7 8 9
A B C D E
ZIPGRADE.COM
• Do not fold or bend sheet
• Erase mistakes completely
• Use pencil or dark pen
• Fill circle fully