



UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

MAIN EXAMINATION PAPER DECEMBER 2018

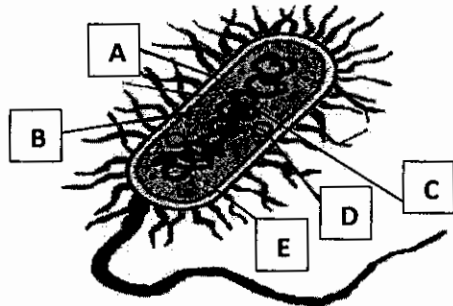
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| TITLE OF PAPER | : | INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY |
| COURSE CODE | : | EHS127 |
| DURATION | : | 2 HOURS |
| MARKS | : | 100 |
| INSTRUCTIONS | : | READ THE QUESTIONS & INSTRUCTIONS CAREFULLY |
| | : | ANSWER <u>QUESTION 1 AND ANY THREE OTHER QUESTIONS</u> |
| | : | EACH QUESTION <u>CARRIES 25 MARKS</u> . |
| | : | WRITE NEATLY & CLEARLY |
| | : | NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM. |
| | : | BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER. |

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION 1 MULTIPLE CHOICE

- a. Indicate your response to the items in this question by writing the letter of your chosen answer. (20)

Shown below is the structure of a bacterial cell. Use the diagram to answer questions (i) and (ii).



- i. Which of the sites A – E is the site where proteins are synthesised?
- ii. Which of the sites A – E determines whether the bacterium is gram-positive or gram-negative?
- iii. Use the options provided below to answer this question.
 - A. Robert Hooke
 - B. Mathias Schleiden
 - C. Theodor Schwann
 - D. Robert Brown

The scientists that contributed to the current understanding of the cell structure are:

- A. All of the above
 - B. B and C
 - C. A, B and C
 - D. B, C and D
 - E. A and D
- iv. Which one of the following IS NOT one of the physical factors required by bacteria for growth and multiplication?
 - A. Temperature
 - B. Oxygen
 - C. pH
 - D. Osmotic pressure
 - E. Moisture content
 - v. Which one of the following steps occurs during the multiplication of animal viruses, but not during the multiplication of bacteriophages?
 - A. assembly

- B. biosynthesis
 - C. penetration
 - D. uncoating
 - E. None of the above
- vi. Which one of the following substances is found in saliva, tears, mucous, or any fluid that bathes tissues and has antimicrobial properties that degrade the peptidoglycan layer of gram-positive bacteria resulting in their destruction?
- A. Peroxydase enzymes
 - B. Lactoferrins
 - C. Transferrins
 - D. Lysozymes
 - E. Defensins
- vii. The cytokine secreted by T helper cells and responsible for activation of T cytotoxic cells to destroy virally infected cells is known as:
- A. Inteleukin-1
 - B. Interleukin-2
 - C. Tumour Necrosis Factor alpha
 - D. Interferon-gamma
 - E. Interferon-alpha
- viii. Which one of the bacteria below is the one represented in the diagram.



- A. *Staphylococcus aureus*
 - B. *Nisseria gonorrhoea*
 - C. *Trepanema pallidum*
 - D. *Streptococcus pneumonia*
 - E. *Bacillus anthracis*
- ix. Which one of the statements about viruses is NOT CORRECT?
- A. Viruses do not multiply unless they are inside specific host cells
 - B. A virus contains either DNA or RNA molecule
 - C. They can survive outside the body of a host for long periods
 - D. Viruses do not have a cellular structure
 - E. Viruses can have a lipid envelope derived from the host cell
- x. Immunity that develops as a result of an actual infection is called:
- A. artificial active acquired immunity
 - B. artificial passive acquired immunity
 - C. natural active acquired immunity

- D. natural passive acquired immunity
- E. natural active or passive acquired immunity

- b. **TRUE OR FALSE:** Write **T** (for true) or **F** (for false) to indicate your response to the items in this section of the question. (5)
- i. Ammonification refers to the process through which nitrogen present in nitrates and nitrites in the soil is returned back to the atmosphere
 - ii. Viruses only contain RNA and not DNA as their genetic material
 - iii. An autoclave is an instrument that is able to sterilise materials likely to contain infective pathogens following use in hospital
 - iv. CD155 is a receptor on host cells that is identified and attaches to polioviruses to facilitate entry and infection
 - v. Macrophages are immune cells that function in the phagocytosis of foreign microbes in the host's body and they have no other function

[25 marks]

QUESTION 2

- a. Bacteria have to be fixed and stained prior to identification under the 100x immersion oil lens of the microscope.
 - i. Give THREE reasons why bacteria should be fixed before staining. (3)
 - ii. Discuss TWO methods that may be used to fix bacteria. (4)
 - iii. Explain why bacteria have to be stained before viewing under the microscope. (2)
- b. What is the difference between simple staining and differential staining of bacteria? (2)
- c. Simple staining may be divided into two, positive and negative staining. Explain the principle involved in each of the two types of staining techniques. (4)
- d. Differential staining of bacteria serves two purposes. What are the two purposes? (2)
- e. During unfavourable conditions (especially when carbon or nitrogen become unavailable), bacteria may form endospores within different areas of the vegetative cell. Describe the staining technique commonly used to identify and characterise endospores in a bacterium. (8)

[25 marks]

QUESTION 3

- a. Shown below is the typical structure of the endoplasmic reticulum of a bacterial cell.



- i. Is this a smooth or rough endoplasmic reticulum? Explain your answer. (2)

- ii. What is the function of the rough endoplasmic reticulum? (2)
- iii. List FIVE functions of the smooth endoplasmic reticulum. (5)
- b. Bacteriophages are sometimes used in medicine.
 - i. What is a bacteriophage? (2)
 - ii. Of what use are bacteriophages in medicine? (2)
- c. Explain briefly what is meant by the phrase "transplant rejection". (2)
- d. List TWO methods commonly used in health facilities to reduce "transplant rejection" (2)
- e. Define the following types of grafts:
 - i. isograft (2)
 - ii. autograft (2)
 - iii. xenograft (2)
 - iv. allograft (2)

[25 marks]

QUESTION 4

- a. Define the following as they apply to bacterial cells and explain what happens when a bacterial cell is exposed to each.
 - i. Isotonic solution (2)
 - ii. Hypotonic solution (2)
 - iii. Hypertonic solution (2)
- b. Explain what halophiles are. (2)
- c. All bacteria require nitrogen, phosphorus and iron among other elements for growth and multiplication. Explain the importance played by each of the three elements in the growth and multiplication of bacteria. (6)
- d. Heterotrophic bacteria are either saprophytic, symbiotic or parasitic. What type of bacteria are referred to as:
 - i. heterotrophic (2)
 - ii. saprophytic, and explain how saprophytic bacteria benefit the ecosystem. (4)
- e. Sterilisation is a method commonly used in medical facilities and food establishments to ensure safety of personnel and workers.
 - i. What is sterilisation? (1)
 - ii. List FOUR methods commonly used in medical facilities and food establishments to sterilise objects and other materials to ensure safety of humans. (4)

[25 marks]

QUESTION 5

- a. In 1884, a Russian scientist, Elie Metchnikoff was awarded a Nobel Prize for his studies on immunity.
 - i. Describe the experiments Elie Metchnikoff's conducted to prove the concept of phagocytosis. (4)
 - ii. Name FOUR cells of the immune system that are involved in phagocytosis. (4)
 - iii. Using one of the cells mentioned in (ii) above, describe how the cell uses the process of phagocytosis to destroy invading microorganisms such as bacteria. (4)

- b. Cytokines are important substances in ensuring an effective immune response against infecting microbes.
- i. What are cytokines? (2)
 - ii. What are cytokines released by T and B cells called? (1)
 - iii. What is the importance of colony-stimulating factors in the immune response? (2)
 - iv. List THREE functions of interleukin-2. (5)
 - v. What is the function of interferon gamma? (3)

[25 marks]

QUESTION 6

- a. Antibodies are a flexible adaptor that facilitates recognition and attachment of microorganisms to phagocytic cells.
- i. Explain why phagocytes are not adequate in facilitating recognition and attachment to infecting microbes? (3)
 - ii. Draw the general structure of an antibody and label the following parts: antigen binding site, light chain, heavy chain and the phagocyte binding site. (6)
 - iii. List FOUR ways through which antibodies inactivate antigens on microorganisms resulting in protection of infected hosts. (4)
- b. Though antibodies have the same function, there exist some structural differences between them and there are differences in the sites where they are released.
- i. Which antibody is dominant during the primary immune response? (1)
 - ii. Name the antibody that is capable of crossing the placenta to render immune protection to the foetus. (1)
 - iii. IgE antibody is important in protection against parasitic worms. Explain how IgE facilitates this protection. (6)
 - iv. What are the main functions of IgD? (4)

[25 marks]