

UNIVERSITY OF SWAZILAND
FACULTY OF HEALTH SCIENCES

MAIN EXAMINATION PAPER – MAY, 2019

TITLE OF PAPER : INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY

COURSE CODE : EHS110

TIME : 2 HOURS

MARKS : 100

INSTRUCTIONS : ANSWER QUESTION 1 AND ANY THREE QUESTIONS

: EACH QUESTION CARRIES 25 MARKS

: NO FORM OF PAPER SHOULD BE BROUGHT INTO NOR TAKEN OUT OF THE EXAMINATION ROOM

: BEGIN THE ANSWER TO EACH QUESTION ON A SEPARATE SHEET OF PAPER

: CALCULATORS MAY BE USED BUT THEY MUST BE THE SILENT TYPE

: ALL CALCULATIONS/WORK-OUT DETAILS SHOULD BE SUBMITTED WITH YOUR ANSWER SHEET

This question paper consists of 6 printed pages including this one

QUESTION 1

- a. Write down the letter corresponding to your chosen answer to illustrate your response to each of the items in this question. (20)
- i. Which microorganism(s) among the following perform photosynthesis by utilising light?
 - A. Cyanobacteria
 - B. Fungi
 - C. Viruses
 - D. Cyanobacteria, Fungi, Viruses
 - E. Rickettsia and Chlamydia

 - ii. Growth of microbes on solid media is identified by the formation of:
 - A. pellicle at top of media
 - B. colonies
 - C. sediment at the bottom
 - D. turbidity
 - E. All of the above

 - iii. During gram-staining, iodine is used as a
 - A. fixative
 - B. dye
 - C. mordant
 - D. solubliser
 - E. stainer

 - iv. The portion of the growth curve where rapid growth of bacteria is observed is known as
 - A. Lag phase
 - B. Logarithmic phase
 - C. Stationery phase
 - D. Decline phase
 - E. None of the above

 - v. Among the following, which one is the most effective method for killing microorganisms?
 - A. High temperature
 - B. Freezing for a long time
 - C. High temperature, high moisture
 - D. Low temperature, high moisture
 - E. Dehydration

 - vi. Which one of the following occurs due to low temperature?
 - A. Coagulation of proteins
 - B. Death of microorganisms

- C. Rate of metabolism is reduced
 - D. Proteins are denatured
 - E. DNA of microorganisms undergoes mutation
- vii. A plasma cell secretes:
- A. antibody of a single specificity related to that on the surface of the parent B cell
 - B. antibody of two specificities
 - C. the antigen it recognises
 - D. many different types of antibody
 - E. lysozyme
- viii. Intracellular parasites within macrophages are killed more readily in the presence of:
- A. antibody
 - B. kinins
 - C. properdin
 - D. gamma-interferon
 - E. anaphylatoxin
- ix. Secondary antibody responses are better because:
- A. they produce defence against many unrelated antigens
 - B. the antibody can be made by both T and B cells
 - C. Complement-fixing antibodies are made
 - D. They do not require T-cell help
 - E. They are stronger and faster
- x. An immune response against grass pollen often involves:
- A. pathogen-associated molecular patterns
 - B. breakdown of self-tolerance
 - C. a hypersensitivity reaction
 - D. reaction against MHC
 - E. persistent infection by the pollen
- b. Write **T** (for True) or **F** (for False) to indicate your response to the items in this question. (5)
- i. All bacteria are single-celled organisms consisting of prokaryotic cells
 - ii. Algae contain chlorophyll that supports photosynthetic process in them
 - iii. Some bacteria have colour but cannot be seen with the naked eye because of their size hence requiring staining prior to observation
 - iv. Each virus contains both DNA and RNA genetic materials inside its nucleus
 - v. The adaptive immune response provides immediate and maximal response to infecting microbes

[25 MARKS]

QUESTION 2

- a. Explain briefly the work conducted by each of the scientists below to contribute in the current understanding of the "Germ Theory of Disease".
- i. Fracastorius (2)
 - ii. Anton van Leeuwenhoek (3)
 - iii. John Snow (3)
 - iv. Joseph Lister (3)
- b. Towards the end of the 19th century, the German physician Robert Koch, made further contributions to the Germ Theory of Disease through what later became known as Koch's postulates. State each of the four postulates of Dr Robert Koch and briefly explain how it contributed to the current understanding of the Germ Theory of Disease. (8)
- c. Not all microorganisms are pathogenic. Some perform important activities that support animal and human lives. Briefly describe the contribution of each of the bacteria listed below in the nitrogen cycle.
- i. Nitrogen-fixing bacteria (2)
 - ii. Nitrifying bacteria (2)
 - iii. Denitrifying bacteria (2)

[25 MARKS]**QUESTION 3**

- a. Define the following terms as used in Microbiology:
- i. Pathogenicity (2)
 - ii. Virulence (2)
 - iii. LD₅₀ (2)
- b. A laboratory technologist wants to determine whether a gram-positive bacteria is present in a patient's sample. He decides to fix the bacteria before staining.
- i. What purpose is served by fixing the bacteria before staining? (3)
 - ii. Outline the staining procedure the laboratory technologist has to follow to reach a conclusion. (5)
 - iii. If the bacteria was gram-negative, what difference would the laboratory technologist expect in order to assist its viewing. (2)
- c. A microbiologist wants to visualize *Mycobacterium tuberculosis* cells in a sample of a host sputum to determine if infection is present.
- i. Outline the steps the microbiologist has to follow in the laboratory to visualize the cells. Explain why these steps are chosen as opposed to those chosen by the laboratory technologist in b(i)? (3)
 - ii. What colour will the *Mycobacterium tuberculosis* show when successfully visualized in the method suggested in (i) above. (1)
 - iii. Name one other bacterium that may be identified using the same procedure and reagents? (1)

- iv. Treatment for *Mycobacterium tuberculosis* infection requires a long and laborious method compared to enteric bacteria such as *Salmonella typhi*. Explain why the difference. (3)

[25 MARKS]

QUESTION 4

- a. In 1796, Edward Jenner made significant contribution to the current understanding of immunology. Explain briefly the work done by Edward Jenner. (3)
- b. The Russian scientist, Elie Metchnikoff (1882) conducted experiments that contributed to the early understanding of immunology and was awarded the Nobel Prize in 1908. Describe the experiments conducted by Elie Metchnikoff and explain how they contributed to the current understanding of immunology. (6)
- c. The French chemist, Louis Pasteur (1879) is regarded as the "Father of Immunology". Describe the work conducted by Louis Pasteur in relation to immunology which contributed to him achieving this title. (4)
- d. Louis Pasteur also contributed to the Germ Theory of Disease. Describe Louis Pasteur's contribution to the Germ Theory of Disease. (4)
- e. Louis Pasteur also developed the process of pasteurisation which was later named after him.
- i. Explain what you understand by the term "pasteurisation" (2)
- ii. How does pasteurisation differ from sterilization? (2)
- f. Describe two processes that use dry heating to achieve sterilisation of some named items. (4)

[25 MARKS]

QUESTION 5

- a. Granulocytes (neutrophils, basophils and eosinophils) perform an important role to support the inflammatory response during infection with microorganisms.
- i. Describe the process of production of granulocytes in the body of the human host. (2)
- ii. Explain the role of these cells in the inflammatory response. (5)
- b. Explain why neutrophils, basophils and eosinophils are referred to as "granulocytes". (2)
- c. Eosinophils are said to be best suited in the destruction of large microorganisms such as parasites.
- i. Explain why eosinophils are best suited compared to neutrophils and basophils in the destruction of parasitic worms. (2)
- ii. Describe the process engaged by eosinophils to result in the complete destruction of infecting worms in the body of the human host. (6)
- d. What eventually happens to granulocytes that have not been recruited to take part in destruction of microorganisms? (2)
- e. Monocytes are developed through the same lineage as granulocytes. However, they have a different appearance to granulocytes in blood.
- i. How does the appearance of monocytes differ from that of granulocytes when viewed under the microscope? (4)
- ii. What is the general function of monocytes in the immune response? (2)

[25 marks]

QUESTION 6

- a. Several influenza viruses enter the body of a human host through the respiratory tract. Describe the first-line defence mechanisms the body is likely to utilise to reduce numbers of the influenza viruses. (6)
- b. Suppose some viruses finally evaded the first-line defences and entered the bloodstream of the human host to encounter second-line defence mechanisms.
- i. Name the cells that first identify the viruses in the second-line defence mechanisms. (1)
 - ii. Describe the process of recognition and entry of viruses into the cells mentioned in b (i) above. (2)
 - iii. Outline all the second-line defence mechanisms that are elicited against the influenza viruses. (13)
 - iv. Explain why the individual has the ability to withstand future infection with the same influenza viruses for some time. (3)

[25 marks]