



UNIVERSITY OF SWAZILAND

Faculty of Health Sciences

Department of Environmental Health Science

MAIN EXAMINATION PAPER DECEMBER 2019

TITLE OF PAPER : INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY
COURSE CODE : EHS 127
DURATION : 2 HOURS
MARKS : 100

INSTRUCTIONS : READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
: ANSWER **QUESTION 1 AND ANY THREE OTHER** QUESTIONS
: EACH QUESTION **CARRIES 25** MARKS.
: 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 COMPULSORY – ALL STUDENT MUST ANSWER THIS QUESTION

- a. **MULTIPLE CHOICE:** Indicate your responses to the items this question by writing the letter corresponding to your chosen answer. (20)

- i. Which one of the following scientists contributed to the Germ Theory of Disease by suggesting that microorganisms were responsible for the conversion of sugar into lactic acid causing fermentation of substances?
- A. John Snow
 - B. Louis Pasteur
 - C. Joseph Lister
 - D. Anton Van Leuwenhoek
 - E. Robert Koch
- ii. Four scientists contributed to the early understanding of the Cell Theory or Microorganisms. Which one of the five below did not make any such contribution?
- A. Robert Hooke
 - B. Robert Brown
 - C. Robert Koch
 - D. Mathias Schleiden
 - E. Theodor Shwann
- iii. A microbiologist identifies the bacterium shown below and uses to arrangement of the flagella to characterize it and determines that the bacterium has flagella all over the cell.



He is likely to conclude that the bacterium is:

- A. monotrichous
 - B. lophotrichous
 - C. amphitrichous
 - D. peritrichous
 - E. amphilotrichous
- iv. A microbiologist observes a bacterium using the oil immersion lens and a 10x eyepiece. What is the maximum magnification of the bacterium?
- A. 100x
 - B. 110x
 - C. 1000x
 - D. 10x
 - E. 20x

- v. Which one of the statements about viruses below IS NOT true?
- A. Viruses possess genes and evolve by natural selection
 - B. Viruses reproduce by creating multiple copies of themselves through self-assembly
 - C. Viruses do not have their own metabolism, and require a host cell to make new products.
 - D. Viruses are much smaller than the smallest cell known
 - E. Viruses have a cell membrane that lacks enclosed organelles like prokaryotes and eukaryotes
- vi. The following statements show differences between bacteria and viruses EXCEPT ONE. Which one is it?
- A. Viruses always live as intracellular parasites, bacteria generally are not
 - B. Viruses possess both DNA and RNA, bacteria do not possess both
 - C. Bacteria have ribosomes where proteins are manufactured, viruses do not have ribosomes
 - D. Bacteria reproduce asexually through binary fission, viruses do not
 - E. Viruses are sensitive to interferon, bacteria are not
- vii. The process where growth media gets contaminated with DNA fragments from another bacterium not intended to be cultured resulting in alteration of the bacterium being cultured is called:
- A. transduction
 - B. conjugation
 - C. translation
 - D. transformation
 - E. genetic engineering
- viii. Solutes may be passed into a bacterial cell by all of the following EXCEPT:
- A. simple diffusion
 - B. channel mediated diffusion
 - C. carrier mediated diffusion
 - D. active transport
 - E. All of the above
- ix. Which one of the following consist of enzymes found in saliva, tears, mucous, blood, and in any fluid that bathes tissues and is responsible for degrading the peptidoglycan layer of gram-positive bacteria?
- A. Lysozyme
 - B. Peroxydases
 - C. Lactoferrins
 - D. Defensins
 - E. Transferrin

- x. Which chemical(s) among those listed below is secreted by phagocytic cells of the immune system and facilitates to promote inflammation by causing vasodilation and increasing vascular permeability?
- Leukotrienes
 - Prostaglandins
 - Histamines
 - All of the above
 - Only leukotrienes and prostaglandins
- b. Write **T** (for true) or **F** (for false) to indicate your responses to each item in this question (5).
- All Eukaryotes have a DNA that is enclosed inside a nuclear membrane
 - Bacteria consist of both unicellular and multicellular organisms
 - Some viruses can multiply in wastewater (sewage) or in food substances
 - All microorganisms require small amounts of carbon for growth
 - Killer T-cells require helper T-cells for activation and killing of body cells infected with specific antigen

[25 marks]

QUESTION 2

- a. Explain briefly how the following scientists contributed to the "Germ Theory of Disease".
- Plenciz (3)
 - Joseph Lister (3)
- b. Edward Jenner (3)
- c. The general structure of a virus consists of three parts. Name and describe the three parts. (3)
- d. Explain what a bacteriophage is. (2)
- e. Bacteriophages replicate through two cycles, the lysogenic and lytic cycles. Describe the two cycles explaining clearly how they differ. (11)

[25 marks]

QUESTION 3

- a. Microbiologists routinely apply different stains on patient samples in order to aid visualization and diagnosis of bacterial infections.
- Explain why sample materials from patients likely to be infected with bacteria should be stained during identification? (2)
 - What is the difference between simple staining and differential staining? (4)
 - Endospore staining techniques are sometimes used to characterize bacterial endospores into three types. Name the three types endospores likely to be described. (3)
 - Outline the steps followed during staining of bacteria for endospore identification and characterization. (9)
- b. The Gram stain technique is never used during identification of *Mycobacterium tuberculosis* bacteria in patients suspected of having TB.

- i. Explain why the gram stain technique is not used during diagnosis of *Mycobacterium tuberculosis* infections. (2)
- ii. Name the method commonly used to confirm infection with *Mycobacterium tuberculosis*. (1)
- iii. Name the primary stain used during the staining method mentioned in b (ii) above. (1)
- iv. What is used as a mordant during the staining technique mentioned in b (i) above? (1)
- v. At the end of the staining procedure for *Mycobacterium tuberculosis*, how does the slide appear if the patient is infected? (2)

[25 marks]

QUESTION 4

- a. Explain what you understand by the term "microbistatic agents" in the control of microbial growth. (2)
- b. Explain how the following microbistatic agents or processes contribute to preservation of materials such as food and preventing them from going bad or rotting:
 - i. Dessication/drying (2)
 - ii. Freezing (2)
 - iii. Concentrated salt or sugar solutions (3)
- c. Antibiotics have contributed immensely in disease control since the discovery of the first one.
 - i. Explain what you understand by the term "antibiotic". (2)
 - ii. Explain how the first antibiotic was discovered. (4)
 - iii. Can antibiotics be used to treat viral infections? Explain your answer. (3)
 - iv. A private practitioner prescribes antibiotics and analgesics for a patient with severe flu, showing with fever and headache. Was the private practitioner correct in prescribing antibiotics to the patient? Explain your answer. (3)
- d. List FOUR desired properties of an antimicrobial agent. (4)

[25 marks]

QUESTION 5

- a. Write down the functions of the cells listed below towards the immune response of an infecting microbe:
 - i. Cytotoxic T cells (2)
 - ii. Helper T cells (3)
 - iii. Suppressor T cells (2)
 - iv. Memory T cells (2)
- b. The Fab and Fc regions are important parts of an antibody during enhancement of the humoral immune response to microbes.
 - i. Explain what antibodies are? (2)
 - ii. List FOUR main methods by which antibodies inactivate antigens. (4)
 - iii. What is the function of the Fab and Fc regions of an antibody molecule? (4)
- c. Name the antibody referred to in each of the statements below: (6)
 - i. Predominant antibody in sero-mucous secretions (1)
 - ii. Larger than all other immunoglobulins (1)

- iii. Responsible for autoimmune responses such as against allergens (1)
- iv. Predominant antibody in mother's milk (1)
- v. Major immunoglobulin in normal human serum (1)
- vi. Makes only about 0.002% of human serum (1)

[25 marks]

QUESTION 6

- a. The inflammatory response provides a good opportunity for the body to destroy and remove infecting microorganisms.
 - i. Describe THREE major events that take place during the inflammatory response. (5)
 - ii. During the inflammatory response, macrophages serve as antigen presenting cells. Describe the process engaged by macrophages from arrival at an infected site until the infecting antigens are destroyed the appropriate partner immune cells. (9)
 - iii. The inflammatory response finally terminates with a release of suppressor T lymphocytes and platelets into the inflammatory lesion. What are the functions of suppressor T lymphocytes and platelets at this stage? (4)
- b. Apart from acting as antigen presenting cells in the initiation of an immune response, macrophages affect the course of parasitic infections in two ways. Describe the two ways. (4)
- c. Helper T lymphocytes, also known as CD4 cells, also perform important functions in conjunction with macrophages. What is the main role of activated helper T lymphocytes? (3)

[25 marks]