



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

DEGREE IN ENVIRONMENTAL HEALTH SCIENCES
DEGREE IN COMMUNITY HEALTH SCIENCE
DEGREE IN GENERAL NURSING SCIENCE

MAIN EXAMINATION PAPER MAY 2018

TITLE OF PAPER : INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY

COURSE CODE : EHS 110

DURATION : 2 HOURS

MARKS : 100

INSTRUCTIONS : READ THE QUESTIONS & INSTRUCTIONS CAREFULLY

: QUESTION ONE IS COMPULSORY, THEN ANSWER ANY OTHER THREE QUESTIONS

: EACH QUESTION CARRIES 25 MARKS.

: WRITE NEATLY & CLEARLY

: NO PAPER SHOULD BE BROUGHT INTO 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 STUDENTS MUST ANSWER THIS QUESTION

- (a) **MULTIPLE CHOICE:** Write down the letter corresponding to your chosen response among the choices listed for each question. (20)
- i. The semi-permeable structure controlling transport of materials between the cell and its external environment is the:
 - A. cell membrane
 - B. cell wall
 - C. cytoplasm
 - D. nuclear membrane
 - E. pilli

 - ii. Which of the following nitrogenous bases IS NOT found in an RNA molecule?
 - A. Adenine
 - B. Guanine
 - C. Thymine
 - D. Uracil
 - E. Cytocine

 - iii. Some bacteria stain Gram-positive and others stain Gram-negative as a result of the differences in the structure of their:
 - A. capsule
 - B. mitochondria
 - C. cell wall
 - D. cell membrane
 - E. ribosomes

 - iv. When placed in hypertonic solution, a bacterial cell will:
 - A. burst
 - B. lyse
 - C. shrink
 - D. swell
 - E. take in more water than it releases

 - v. Which one of the following IS NOT a common mechanism by which antimicrobial agents kill bacteria or inhibit growth of bacteria?
 - A. Damage to cell membrane
 - B. Destruction of capsules
 - C. Inhibition of cell wall synthesis
 - D. Inhibition of protein synthesis
 - E. Inhibition of nucleic acid synthesis

 - vi. Sterilisation may be accomplished by the use of:
 - A. an autoclave
 - B. disinfectants

- C. antiseptics
 - D. pasteurisation
 - E. dessication
- vii. Antibodies are secreted by
- A. neutrophils
 - B. macrophages
 - C. stem cells
 - D. plasma cells
 - E. T helper cells
- viii. Which one of the following order of events below shows the correct sequence in the inflammatory response?
- A. Vasodilation → chemotaxis → increased permeability → emigration of leukocytes → phagocytosis
 - B. Vasodilation → increased permeability → emigration of leukocytes → chemotaxis → phagocytosis
 - C. Vasodilation → emigration of leukocytes → phagocytosis → chemotaxis → increased permeability
 - D. Chemotaxis → vasodilation → increased permeability → phagocytosis → emigration of leukocytes
 - E. Chemotaxis → phagocytosis → increased permeability → emigration of leukocytes → vasodilation
- ix. Of the following, which is least likely to be involved in cell-mediated immunity?
- A. Antibodies
 - B. Cytokines
 - C. Macrophages
 - D. T cells
 - E. None of the above
- x. Which one of the following liquids/fluids produced in the human body DOES NOT contain antibodies?
- A. tears
 - B. colostrum
 - C. urine
 - D. blood plasma
 - E. saliva

(b) TRUE OR FALSE: Write **T** (for true) or **F** (for false) to indicate your responses to each of the items below: (5)

- i. Many archaea bacteria are extremophiles that can live in extreme environments
- ii. All antimicrobial agents are antibiotics
- iii. Yeasts are unicellular, whereas moulds are multicellular
- iv. Unstained living microorganisms are best observed using a phase-contrast microscope

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- v. Type IV hypersensitivity reactions involve antibody mediated mechanisms and not cell-mediated immune reactions

[25 marks]

QUESTION 2

- (a) Carefully consider each of the statements listed below and write down the name of the process described:
- (i) The process by which information in a single gene is used to make a mRNA molecule (1)
 - (ii) Uptake of DNA fragments of another bacterium from the same growth medium (1)
 - (iii) The transfer of bacterial genetic material from one bacterial cell to another by a bacterial virus or phage (1)
 - (iv) The transfer of genetic material from one bacterial cell to another through a sex pilus (1)
 - (v) The process by which genetic information within an mRNA molecule is used to make specific proteins (1)
- (b) A health worker attends to a patient infected with yellow fever, a viral disease of humans and prescribes penicillin, a broad spectrum antibiotic, to cure the yellow fever. Was the prescription of the health worker correct? Explain your answer. (3)
- (c) A laboratory technologist wants to enhance the fermentation of malt into beer and decides to increase the supply of oxygen in the malt. Is this a good decision? Explain your answer. (3)
- (d) After bacteria are inoculated onto growth medium during culture, they must be incubated.
- i. Explain why the bacterial culture must be incubated. (2)
 - ii. Name THREE types of incubators used in the microbiological laboratory. (3)
- (e) For the diagnosis of bacterial infections to be accurate, laboratory technologists have to ensure that their cultures are pure.
- i. Explain what a pure culture is. (2)
 - ii. What precautions must the laboratory technologist take in order to ensure that the bacterial culture remains pure? (2)
- (f) Microbiologists often have to determine the number of bacterial cells present in a culture of liquid material.
- i. Explain why it is important for microbiologists to maintain knowledge of the number of bacterial cells present in a particular liquid (e.g. milk, drinking water or other foods) at any given time? (2)
 - ii. Explain how a spectrophotometer works to estimate the number of bacteria in a liquid culture. (3)

[25 marks]

QUESTION 3

- (a) Write down the shape of each one of the viruses listed below:
- i. Ebola virus (1)
 - ii. Poliovirus (1)
 - iii. Human Immunodeficiency Virus (HIV) (1)
 - iv. Zika virus (1)
 - v. Influenza virus (1)

- (b) Many viral epidemics of humans were first identified in animals before they were reported to cause infections in humans. Where and when were the following viruses first reported in humans?
- i. Zika virus (1)
 - ii. Ebola virus (1)
- (c) Infection of host cells by viruses is dependent on recognition and successful attachment. Explain how the following viruses are able to enter specific human cells to result in infection:
- (i) Human immunodeficiency virus (HIV) (3)
 - (ii) Influenza A virus (2)
 - (iii) Explain what type of bacteria are called bacteriophages? (2)
 - (iv) What is the shape of a bacteriophage? (1)
 - (v) What type of bacteria are usually referred to as L-forms? (2)
- (d) Two vaccines have been developed and are currently used to immunize children against polioviruses, the attenuated and inactivated vaccines.
- i. What is the difference between an attenuated and an inactivated vaccine? (4)
 - ii. Why has the World Health Organisation recommended a switch from the attenuated Oral Polio Vaccine (Sabin) to the Inactivated Polio Vaccine (Salk)? (4)

[25 marks]

QUESTION 4

- (a) Obligate intracellular pathogens such as viruses, Rickettsias and Chlamydias do not grow on artificial (synthetic) media.
- i. Explain why viruses cannot grow on artificial media? (2)
 - ii. Explain how microbiologists are able to obtain large numbers of these microorganisms from a small sample when required for diagnostic or research purposes? (3)
- (b) Explain the major difference between catabolic and anabolic reactions. (4)
- (c) In certain environments, it is necessary or desirable to inhibit growth and multiplication of microbes.
- i. Explain why growth and multiplication of microbes should be inhibited in hospitals? (2)
 - ii. Explain why growth of microbes is often inhibited in food and beverages processing plants? (4)
- (d) To prevent poliomyelitis complications among children, they are vaccinated during the early years of their development. Vaccination against poliovirus is conducted at ages 0, 6 months, 10 months, 14 months and 18 months.
- i. Explain what you understand by the term "vaccination". (2)
 - ii. Describe the antibody response likely to occur in a child following administration of the first two doses of oral polio vaccine at birth and after 6 months. (4)
- (e) What is the difference between acquired immunity and passive acquired immunity? (4)

[25 marks]

QUESTION 5

- (a) The Russian scientist, Elie Metchnikoff in 1882, was the first to make observations that contributed to the early understanding of the presence of an immune response against microbes. Describe the experiments conducted by Elie Metchnikoff that led to this initial understanding of immune responses. (6)
- (b) Louis Pasteur is regarded the Father of Immunology. What contributions did Louis Pasteur make in order to gain himself this title? (4)
- (c) Later it became known that the respiratory tract had mechanisms that protected it from foreign materials. Describe three mechanisms that function to remove or destroy microorganisms from the respiratory tract of humans. (6)
- (d) Normal flora of many host organisms is technically not part of the immune system but they participate in protection against microorganisms. List FOUR ways normal flora provide protection against microorganisms. (4)
- (e) A laboratory technologist performs the analysis of the blood sample of a patient to determine the number of neutrophils.
- Why is it important to determine the number of neutrophils in the patient's blood? (2)
 - What morphological features would the laboratory technologist use to identify the neutrophils? (1)
 - Why are the neutrophils called so? (2)

[25 marks]

QUESTION 6

- (a) Macrophages perform important functions with regard to the initiation of an immune response towards an infecting microorganism.
- Explain how macrophages identify microorganisms following an infection. (2)
 - Explain the role of macrophages in antigen processing and presentation. (5)
 - Macrophages are sometimes involved in the phagocytosis of microorganisms but require activation for them to destroy the internalised microorganisms. Explain the process of activation of macrophages, including a clear description of the processes involved in destruction of the microorganisms. (5)
- (b) Antibodies are involved in humoral immunity against antigenic elements.
- Explain what antibodies are. (2)
 - Explain what an antigen is. (2)
 - What cells are responsible for secretion of antibodies? (1)
 - Which antibody is capable of crossing the placenta and providing protection to the foetus? (1)
 - Which antibody plays a major role in allergic responses? (1)
 - Which antibody binds to mast cells and facilitate their action against large infecting microbes such as helminths or worms? (1)
 - Explain FIVE ways by which antigen-antibody interactions are able to bring about an immune response and protection against infecting microorganisms. (5)

[25 marks]