UNIVERSITY OF SWAZILAND

Faculty of Health Sciences
Department of Environmental Health Science

RE-SIT EXAMINATION PAPER JANUARY 2020

TITLE OF PAPER	:	INTRODUCTION TO MICROBIOLOGY & 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.

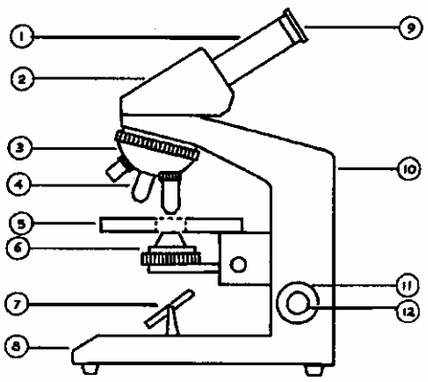
QUESTION 1 COMPULSORY – ALL STUDENT MUST ANSWER THIS QUESTION

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

i. Which one of the statements below about viruses IS NOT correct?

A. Viruses maintain their genetic information inside DNA
B. Viruses are obligatory intracellular parasites of their hosts
C. Viruses may remain as viable crystals outside host cells that regain multiplicative form when returned into host cells
D. Viruses are smaller than the smallest bacterial cells
E. Each virus contain both DNA and RNA as their nucleic acid material

ii. Shown below is the diagram of a light microscope.



Which one of the parts marked is responsible for enlargement of the object?

A. 1
B. 3
C. 4
D. 6
E. 7

iii. Most bacteria move by

A. cilia
B. pseudopodia
C. flagella
D. pilli
E. lysosomes

iv. *Mycoplasma* are bacteria that produce little or no cell walls. Which one of the statements below is NOT true about Mycoplasma?

A. *Mycoplasma* appear in various pleomorphic shapes
B. *Mycoplasma* reproduce very slowly
C. *Mycoplasma* are relatively fragile
D. *Mycoplasma* are susceptible to changes in osmotic pressure
E. *Mycoplasma* are susceptible to antibiotics

v. Which one of the following nitrogenous bases IS NOT found in an RNA molecule?

A. Adenine
B. Guanine
C. Cytosine
D. Thymine
E. Uracil

vi. Which of the equations below illustrates the process by which photoautotrophic bacteria make energy required for metabolic processes?

A. $6CO_2 + 12H_2S \longrightarrow C_6H_{12}O_6 + 6H_2O$
B. $NH_4 + 2O_2 \longrightarrow NO_2 + 2H_2O +$ Energy
C. $4FeCO_3 + 6H_2O + O_2 \longrightarrow 4Fe(OH)_3 + 4CO_2 +$ Energy
D. $2H_2S + O_2 \longrightarrow 2S + 2H_2O +$ Energy
E. All of the above

vii. In 1908 a Russian scientist was awarded the Nobel Prize after he published a paper describing phagocytosis. The name of the scientist was:

A. Elie Metchnikoff
B. Louis Pasteur
C. Fracastorius
D. Plenciz
E. Anton van Leuwenhoek

viii. Which antibody populates the saliva, tears, breast milk and mucous secretions of the gastrointestinal, respiratory and genitourinary tracts?

A. IgA
B. IgD
C. IgE
D. IgG
E. IgM

ix. Which one of the cells below are responsible for the processing and presentation of foreign antigens to phagocytic cells during an immune response?

A. Neutrophils
B. Eosinophils
C. Dendritic cells
D. T – helper cells

E. Natural Killer cells

x. An exaggerated or inappropriate immune response may lead to various hypersensitivity disorders (Type I, II, III or IV). Which one of the following disorders results from Type II hypersensitivity?
   A. Asthma
   B. Blood transfusion reaction
   C. Rheumatoid arthritis
   D. Allograft rejection
   E. Systemic lupus erythematosus (SLE)

b. Write **T** (for true) or **F** (for false) to indicate your responses to each item in this question. (5)
   i. All viruses contain an envelope on which spikes project out to facilitate attachment onto host cells
   ii. Autoclaves inactivate bacteria and viruses from patient samples such as bandages, vomitus, blood, faeces resulting in any material that have been in contact with a patient safe when it comes in contact with other people or animals
   iii. High-efficiency particulate air (HEPA) filters have the ability to remove all microbes from a substance resulting to it gaining sterility
   iv. Microbistatic agents have the ability to destroy or remove microorganisms from a substance
   v. Plasma cells are responsible for the production of antibodies that can recognize the antigen that activated B cells to replicate

[25 marks]

QUESTION 2

a. What is the difference between cyanobacteria and archaeabactera? (4)
b. Explain the meaning of each of the following:
   i. "The Germ Theory of Fermentation", and (2)
   ii. "The Germ theory of Disease". (2)
c. Describe the contributions of Louis Pasteur to the development of two theories stated in (a) above. (10)
d. Louis Pasteur further developed the laboratory process later known as "pasteurization", named after him.
   i. Explain the meaning of pasteurization. (3)
   ii. Describe TWO human practices that employ the process of pasteurization. (4)

[25 marks]

QUESTION 3

a. Define the following terms as used in Microbiology:
   i. Pathogenicity (2)
   ii. Virulence (2)
   iii. LD_{50} (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 *Mycobactrium 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)

[25marks]

QUESTION 4

a. The structure of a virus may be described as helical, polyhedral or complex. Which one of these structures represents the structure of the human immunodeficiency virus (HIV)? (1)
b. Describe the process of recognition, attachment and release of the influenza virus on human host cells. (4)
c. Describe the process of recognition and attachment of HIV and the human CD4 cell to facilitate endocytosis. (3)
d. Explain the function of mRNA in the replication cycle of the HIV. (2)
e. The HIV contains three enzymes inside its capsid region.
   i. Name the three enzymes. (3)
   ii. What function is served by each of the enzymes mentioned in (i) above in the replication cycle of the HIV? (6)
f. The HIV leaves the CD4 cell through budding. Describe the process of budding, explaining how the process enhances survival of HIV progenies while outside the CD4 cell. (3)
g. Untreated HIV infection commonly results in the development of AIDS or death. Explain how HIV infection leads to development of AIDS in untreated human hosts. (3)

[25 marks]

QUESTION 5

a. The diagram shown below is that of a macrophage.

i. Explain how these cells differ from other immune cells in the blood of human hosts. (4)

ii. What is the function of these cells in the immune response against microorganisms? (3)

iii. Describe the process by which these cells function to execute their function against infecting microorganisms? (9)

b.

QUESTION 6

a. Explain what you understand by the term "antibody". (2)

b. What cells produce antibodies? (1)

c. What is the importance of antibodies in the immune response? (5)

d. A child receives two doses of the oral polio vaccine at birth and at 6 months. Draw and label the antibody responses likely to be elucidated in the blood of the child following receipt of these doses. (6)

e. Antibodies also prevent pathologic effects of toxins. Explain how antibodies achieve this. (2)

f. Interferons are an important class of cytokines that are important in the immune response to viruses.

i. What cells secrete inteferons? (1)

ii. List THREE functions of inteferons. (3)

g. Explain what immunological memory is and how it is effected following encounter with a pathogen that has not been encountered before. (5)

[25 marks]