UNIVERSITY OF SWAZILAND

FACULTY OF HEALTH SCIENCES

SPECIAL EXAMINATION PAPER – JULY 2016

TITLE OF PAPER	:	INTRODUCTION TO MICROBIOLOGY AND IMMUNOLOGY
COURSE CODE	:	EHS 110
TIME	:	2 HOURS
MARKS	:	100

INSTRUCTIONS	:	ANSWER **QUESTION 1** AND **ANY OTHER THREE** QUESTIONS
	:	EACH QUESTION CARRIES 25 MARKS
	:	NO FORM OF ANY PAPER SHOULD BE BROUGHT INTO NOR TAKEN OUT OF THE EXAMINATION ROOM WITHOUT THE PERMISSION OF THE CHIEF INVIGILATOR
	:	BEGIN THE ANSWER TO EACH QUASTION ON A SEPARATE PAGE
	:	CALCULATORS MAY BE USED BUT THEY MUST BE THE SILENT TYPE
	:	ALL CALCULATIONS AND WORKING MUST SUBMITTED WITH YOUR ANSWER SHEET

DO NOT OPEN THE QUESTION PAPER UNTIL PERMISSION IS GIVEN TO DO SO BY THE INVIGILATOR

QUESTION 1 MULTIPLE CHOICE (All Students MUST answer this question)

a. Indicate your response to the question below by wirting the letter corresponding to your chosen answer. (20)

i. The organism which obtain their energy from chemicals are designated as
   A. prototrophs
   B. chemotrophs
   C. organotrophs
   D. autotrophs
   E. heterotrophs

ii. The organism which grows best above 45°C are called
   A. psychrophilic
   B. mesosphilic
   C. thermophilic
   D. halophilic
   E. None of these

iii. A spore differs from an actively replicating bacterium in that the spore
   A. is produced during a process involving asymmetric division
   B. is able to withstand more extreme conditions than the replicating cell
   C. is metabolically inactive
   D. can withstand high temperatures but not high pH
   E. all of the above

iv. Generation time is
   A. time required for the population to double
   B. time required for the initial adjustment
   C. obtained by expression t/n, where t = time interval, n = number of generation
   D. both (a) and (c)
   E. none of the above

v. What are the extrinsic factors for the microbial growth?
   A. humidity
   B. storage temperature
   C. composition of gas phase
   D. pH
   E. all of these

vi. Which of the following statements is true about the adaptive immunity response?
   A. Exposure is antigen-dependent
   B. There is a lag time between exposure and maximal response
   C. Exposure does create immunologic memory
   D. Response is not antigen-specific
   E. Response is not antibody-dependent

vii. Which one of then following is a first-line defence against an infectious foreign orgnism?
   A. mucous membranes
   B. lysozymes
   C. normal flora
   D. defensins
   E. All of the above

viii. Which one of the following statements is true about granulocytes?
   A. They consist of granules capable of killing microbes
   B. They consist of macrophages and dendritic cells
   C. They also function as antigen-presenting cells
   D. They are produced in the thymus
   E. They consist of T cells and B cells

ix. Which one of the following statements does not describe a step in the inflammatory response?
   A. Blood flow to the damaged area is increased
   B. Capillaries leak releasing phagocytes and clotting factor into the wound
   C. Platelets move out of capillary to seal the wounded area
   D. Phagocytes angulf bacteria, dead cells and cell debris in the wound
   E. B cells attach to bacteria leading to T cell cytotoxicity

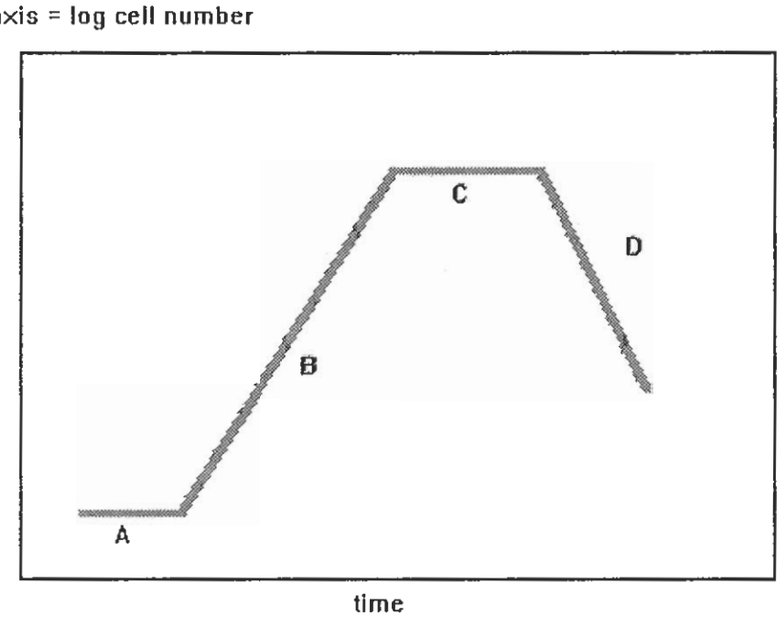
x. A mite, Sarcoptes scabiei, penetrates the skin of a child into the bloodstream. After a few days, the whole body of the child shows with a pruritic rash. This is an example of:
   A. Type I hypersentitivity
   B. Type II hypersentitivity
   C. Type III hypersentitivity
   D. Type IV hypersentitivity
   E. Anaphylaxis

b. Write **T** (for true) or **F** (for false) in response to each of the items below: (5)
   i. Some bacteria are responsible for human health problems such as strep throat and food poisoning
   ii. Rickettsia may live and multiply inside endothelial cells but are sometimes free-living

iii. Macrophages phagocytose and kill invading microorganisms or present them to granulocytes
iv. Insulin dependent diabetes mellitus is NOT an autoimmune disease
v. The majority of lymphocytes (B and T cells) circulate in the lymph system rather than in the bloodstream

QUESTION 2

a. Other than availability of essential nutrients, list three factors that influence the growth of microorganisms *in vivo* and *in vitro*. (3)
b. Some microrganisms are said to be heterotrophs while others are autrotrophs.
   i. What type of organisms are heterotrophs? (2)
   ii. What type of organisms are autotrophs? (2)
c. All bacterial growth requires six major elements. List them. (6)
d. What is the importance of the following elements in the growth of bacteria.
   i. Nitrogen (3)
   ii. Calcium (2)
e. Other microbes require iron for growth. What is the function of the iron? (2)
f. The diagram below represents the growth curve of bacteria. Use the diagram to answer the questions that follow:



i. What is the term used to describe bacterial growth at time "A"? (1)

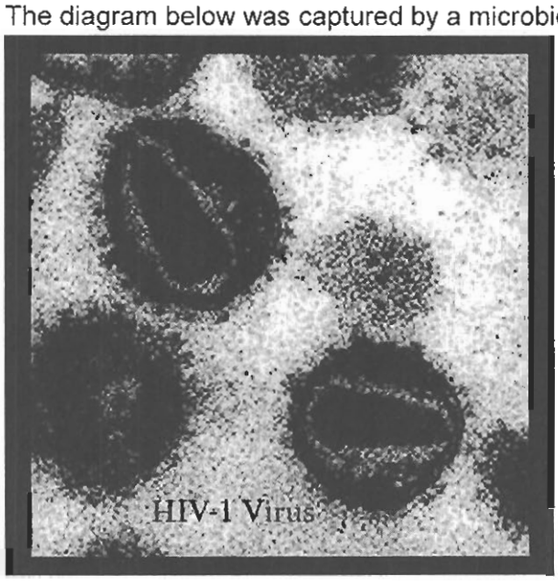
ii. What is the term used to describe bacterial growth at time "B"? (1)

iii. What is the cause of the population decline observed at time "D"? (3)

[25 marks]

QUESTION 3

a. The diagram below was captured by a microbiologist.



i. What type of microscope did the microbiologist most likely use to capture the image? Explain your response. (3)

ii. The microbiologist uses a light microscope to view an organism through an eye piece of 5x magnification. If the objective lens used is 40X, what is the total magnification of the organism? (2)

iii. List FOUR differences between a light microscope and the microscope mentioned in (i) above. (4)

b. Attachment of the human immunodeficiency virus (HIV) into human cells during replication requires the presence of certain glycoproteins.

i. Name the two glycoprotein essential for attachment of the HIV onto host cells. (2)

ii. Name the host cells commonly parasitized by HIV. (1)

c. Some current HIV treatments focus on the action of reverse transcriptase. What role does this enzyme fulfill in HIV replication? (2)

d. Microbial growth may be achieved through disinfection or sterilization. What is the difference between disinfection and sterilization. (2)

e. List FOUR methods that may be used to achieve sterilization of objects. (4)

f. A healthcare worker advices a nurse to use a disinfectant to clean the wound of a patient.

i. Is the advice good? Explain your answer. (3)

ii. What was supposed to be the advice? Explain your response. (2)

[25 marks]

QUESTION 4

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 determine whether the bacteria is gram-negative or gram-positive. (5)

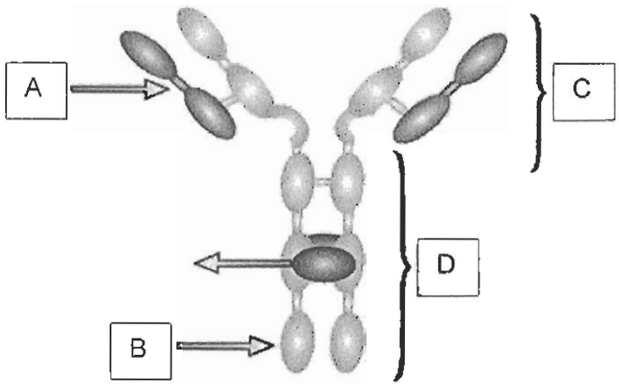
   iii. If the bacteria was gram-negative, what difference would the laboratory technologist expect in order to assist its viewing. (3)

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 5

a. Shown below is the structure of an antibody. Label the parts marked A – D. (4)



b. Name TWO <u>different</u> types of immune cells that bear the part marked D. (2)

c. List FOUR ways by which this antibody may inactivate an antigen in the body of an infected host that has been pre-immunized. (4).

d. Some antibody types predominate during the primary immune response while other predominate during the secondary immune response.
   i. Name one antibody that is predominately secreted during the primary response. (1)
   ii. Name one antibody that is predominately secreted during the secondary response. (1)
   iii. Which antibody can cross the placenta and is responsible for protection of newborns? (1)
   iv. Which antibody is responsible for allergies such as arthritis? (1)
   v. Explain how the antibody mentioned in (iv) causes allergic reactions resulting to hypersentitivity. (3)

e. Opportunistic infections such as candidiasis occur in individuals with immunodeficiency syndrome.
   i. Explain why *Candida albicans*, the pathogen that causes candidiasis, is an important normal flora of the human body. (4)
   ii. Why is candidiasis normally a problem among AIDS patients? (2)
   iii. What advice would you give to an individual who is infected by HIV to prevent development of candidiasis? (2)

[25 marks]

QUESTION 6

a. A viral cell infects one of the human body cells, a macrophage. Outline the steps that are likely to occur to finally result in the destruction of the virus and the infected body cell. A diagram may be utilized to make the description of the processes clearer. (8)

b. Macrophage are often involved in antigen presentation and bacterial killing. Name the cytokine often released by helper T cells that activates microphages to kill a bacterial cell that has been engulfed by phagocytosis. (1)

c. FOUR immune substances commonly combine in the innate and adaptive responses to kill viruses inside infected body cells. List them. (4)

d. Immunity against helminthes involves a Th2 response. Discuss the involvement of IL-4 and IL-5 in the Th2 response against helminthes. A diagram may be utilized if it makes the description of the processes clearer. (6)

e. Autoimmune diseases include insulin-dependent diabetes mellitus and rheumatoid arthritis.
   i. Explain the autoimmune process that results in insulin-dependent diabetes mellitus. (3)
   ii. Explain the process that results in rheumatoid arthritis. (3)

[25 marks]