

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

FACULTY OF APPLIED SCIENCES  
BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS  
DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

**THEORY: GENERAL MICROBIOLOGY LSBB 1207**

MAY 2005

2 HOURS (100 marks)

**INSTRUCTIONS**

Answer **Four (4)** Questions, **Two (2)** from each section. Each question carries **25** marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams.

**SECTION A**

- 1.(a) What contribution did Robert Koch make to microbiology and what is the significance of his contributions? (5 marks)
- (b) What discovery led to the understanding and current basis of
- (i) antiseptics (4 marks)
  - (ii) vaccination (4 marks)
- (c) Explain what is studied in the following fields of microbiology
- (i) Industrial microbiology (1 mark)
  - (ii) Public Health (1 mark)
- (d) Explain the differences between Gram positive and Gram negative cell walls. (4 marks)
- (e) Bacterial cells assume three major shapes. Give major shapes using appropriate examples and diagrams. (3 marks)
- (f) What is the value of a capsule for the following bacteria.
- (i) A pathogenic bacterium (1 mark)
  - (ii) A soil bacterium where soil is periodically subjected to drought conditions. (1 mark)
  - (iii) A bacterium living in a flowing stream. (1 mark)
- 2.(a) Define the following terms:
- (i) culture media (1 mark)
  - (ii) pure culture (1 mark)
  - (iii) general purpose media (1 mark)
- (b) List the properties of agar which make it an ideal solidifying agent for microbial culture media and give the concentration normally used. (4 marks)
- (c) Briefly explain what developments led to the currently used culture media. (5 marks)
- (d) List any four measurable properties of a growing bacterial culture. (4 marks)
- (e) What are the differences between viable and total cell count. (2 marks)
- (f) If 106 and 98 colonies are obtained when 0.1 ml of a  $10^{-5}$  dilution of a water sample is plated on duplicate plates of suitable agar medium, calculate the viable count of the sample. (4 marks)
- (g) Name one electronic method for calculating viable count and give an advantage and disadvantage for the named method. (3 marks)

- 3.(a) Define the following terms used in microscopy:
- (i) Resolution (2 marks)
  - (ii) Numerical aperture (2 marks)
- (b) Name one fixative used in electron microscopy. What features of microbial cells are generally revealed by scanning electron microscopy. (5 marks)
- (c) Which objective lens in the light microscope is called the immersion oil lens? Why is immersion oil used with this lens? (5 marks)
- (d) What bacterial structures can be demonstrated by the following stains:
- (i) Malachite green (1 mark)
  - (ii) India Ink (1 mark)
  - (iii) Ziel-Neelsen (1 mark)
- Explain how each of these stains work. (3 marks)
- (e) List the stains and reagents and the sequence they are used in a Gram stain. (5 marks)

#### **SECTION B**

- 4.(a) Explain the mechanism behind the following ways of physical destruction of microorganisms and its application.
- (i) steam under pressure (2 marks)
  - (ii) boiling (2 marks)
  - (iii) hot air (2 marks)
  - (iv) incineration (2 marks)
- (b) Name three antibiotics and discuss their mechanism of action. (6 marks)
- (c) Distinguish between the following methods of chemical destruction of microorganisms.
- (i) disinfectants and antiseptics (2 marks)
  - (ii) sanitizer and bactericide (2 marks)
- (d) Describe the potential factors that affect the effectiveness of antimicrobial agents. (4 marks)
- (e) Describe the consequences of uncontrolled use of antibiotics. (3 marks)
- 5.(a) What is classification and which kingdoms contain microorganisms. (2 marks)
- (b) What are coliforms? Name the classical species and state why they are used traditionally as indicators of food and water sanitary quality. (5 marks)
- (c) Describe the features of actinomycetes and their economic importance. (4 marks)

- (d) The following bacteria are associated with some important aspects in microbiology, describe them;
- (i) *Escherichia coli* (1 mark)
  - (ii) mycoplasmas (1 mark)
  - (iii) the spirochaete, *Treponema pallidum* (1 mark)
  - (iv) *Clostridium* and *Bacillus* spp (1 mark)
  - (v) *Pseudomonas* spp (1 mark)
- (e) Name two *Clostridium* spp of medical importance. (2 marks)
- (f) List three principles used in numerical taxonomy (3 marks)
- (g) Discuss the principle and method of using the 'melting' temperature [T<sub>m</sub>] of an isolate of DNA sample for estimating its G + C content. (4 marks)
- 6.(a) Describe the experiments that led to the discovery of viruses. (5 marks)
- (b) Distinguish between lytic and lysogenic cycles in viral replication (8 marks)
- (c) Explain how a plaque assay is performed and the significance of the technique. (4 marks)
- (d) Give two examples of fungi and their industrial applications. (4 marks)
- (e) Name two pathogenic protozoa important in Zimbabwe and the diseases they cause. (4 marks)

**END OF EXAMINATION QUESTION PAPER**