



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

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### FIRST OPPORTUNITY EXAMINATIONS

QUALIFICATION : <b>BACHELOR of SCIENCES HONOURS</b>	
QUALIFICATION CODE: <b>08BOSC</b>	LEVEL: <b>8</b>
COURSE: <b>ADVANCED MICROBIOLOGY</b>	COURSE CODE: <b>AMB821S</b>
DATE: <b>NOVEMBER 2024</b>	SESSION: <b>1</b>
DURATION: <b>3 HOURS</b>	MARKS: <b>100</b>

EXAMINER: *Mr Petrus Tuhafeni Paulus*

MODERATOR: *Prof Jane Misihairabgwi*

### INSTRUCTIONS

1. Answer all questions in section A and any **two** questions from section B.
2. Each question must be answered on the separate answer sheet.
3. Please write neatly and legibly.
4. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
5. No books, notes and other additional aids are allowed.
6. Mark all answers clearly with their respective question numbers.

### PERMISSIBLE MATERIALS

1. Non-Programmable Calculator

**This PAPER consists of 6 pages including this front page**

## **SECTION A: [60 MARKS]**

### **QUESTION 1 (20)**

1. In 1872, Frans Schrandinger proposed that *E.coli* could be used to indicate that water is contaminated with faeces.

1.1.1 Briefly outline the main reason why *E. coli* was chosen as a test microorganism for the presence of contaminants in faeces. (3)

1.1.2 Propose a method that could be used for the isolation and enumeration of coliforms from contaminated water. (4)

1.1.3 Testing for coliforms is sometimes accompanied by biochemical test such as IMViC. What is the principle underlying the IMViC test in microorganisms? (7)

1.1.4 Discuss how a selective and differential media can be combined in the identification of bacteria by biochemical methods. (6)

### **QUESTION 2 (20)**

2.1 Jane is fourth year B.Sc. Honours student, and she did an experiment to analyse the microbial load of water samples using the Most Probable Number (MPN) method in her laboratory. Jane used the MPN table (illustrated in table 1) and got an MPN of 9.2 per 100 ml.

Table1: Table of the most Probable Number (MPN) per 100ml of sampling using three tubes of each dilution

Number of positive tubes in dilutions			
10 ml	1 ml	0.1 ml	MPN per 100 ml
0	0	0	
0	1	0	3
0	0	3	6
0	1	0	3
0	1	1	6.1
0	1	2	9.2
0	1	3	12

2.1.1 Briefly describe the principle and procedure of MPN that she used to arrive at an MPN of 9.2 per 100 ml. (8)

2.1.2 What are the disadvantages of MPN method as a diagnostic tool in microbiological samples. (3)

2.2 Outline the principle of protein evolution in industrial microbiology. (9)

### QUESTION 3 (20)

3.1 You wish to determine the number of bacteria in an actively growing broth culture of *E. coli*. To do this you remove 1.0 ml of the culture from the flask and dilute this in 9 ml of nutrient broth to obtain  $10^{-1}$  dilution. You then serial dilute the sample further

until you obtain a range of dilutions between  $10^{-2}$  and  $10^{-6}$ . From each dilution you then spread plate 0.1 ml of suspension onto the nutrient agar and incubate overnight. The next morning you have the following results.

Plate number	Dilution	Colonies on plate
1	Neat	Too many to count
2	$10^{-1}$	Too many to count
3	$10^{-2}$	Too many to count
4	$10^{-3}$	280
5	$10^{-4}$	27
6	$10^{-5}$	2
7	$10^{-6}$	0

Determine how many bacteria per ml there were in the original sample taken from the overnight culture. (5)

- 3.2 You adjust the density of the cell suspension so that there are  $1 \times 10^6$  bacteria per ml in broth and add 1 ml of this to a new culture flask. Assuming exponential growth and a doubling time of 30 minutes, how many bacteria will be in the flask after 5 hours. Show your working. (5)

- 3.3 A minimum inhibitory concentration (MIC) test was carried out using the overnight results and the MIC was found to be 3.1  $\mu\text{g}/\text{mL}$  of Ampilicin drug. Briefly detail how the test is performed. (10)

## SECTION B [40 MARKS]

Answer only two questions from this section. Each question carries 20 marks

### QUESTION 4 (20)

- 4.1 Outline the main characteristics to be considered when selecting an organism for industrial use. (4)
- 4.2 Briefly define the term coliforms and their role in the diagnostics of wastewater treatment. (8)
- 4.3 Discuss how protoplast fusion has been used to manipulate microorganism genetically for industrial use. (8)

### QUESTION 5 (20)

- 5.1 The basic reproductive number, ( $R_0$ ), defines the mean number of individuals directly infected by an infectious case through the total infectious period, when introduced to a susceptible population is given by the equation
- $R_0 = p \cdot c \cdot d$
- Define the terms p, c, d and how they can be used to combat infections such sexually transmitted diseases (STI). (4)
- 5.2 Briefly evaluate the implication of  $R_0$  as used in epidemiology. (6)
- 5.3 Discuss five factors leading to the emerging of infectious diseases in the 21<sup>st</sup> century.

**QUESTION 6 (20)**

- 6.1 Outline the benefits of human gut microbiome. (10)
- 6.2 Briefly describe the changes in antibody concentrations following the initial dose of Covid-19 jab and how that leads to conferment of long-lasting immunity to an individual. (10)

**QUESTION 7 (20)**

- 7.1 Discuss the role of lactic acid bacteria in the production of hard cheese such as Gouda. (10)
- 7.2 A conglomerate Mine in Southern part of Namibia has been mining, copper, gold, manganese and iron for the past 60 years using conventional open pit and later underground mining methods. The management of the mine are contemplating the closure of the mine since the minerals are now of low grade. However, one the directors of the mine still believes that the life of the mine can be extended by 50 years if they venture into other methods of mining. You have been hired as a consultant to give advice on how they can utilize other methods to mine the low-grade ores and extend the life of the mine. Detail the advice you will give to the mine authorities to convince them to continue to mine at the same premises. (10)

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**END OF EXAM**