



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH, APPLIED SCIENCES AND RESOURCES SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION : BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 7
COURSE: ECOLOGY	COURSE CODE: ECO701S
DATE: JUNE 2022	SESSION: 1st OPPORTUNITY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER (S)	Dr Norman Muzhinji
MODERATOR	Prof Isaac Mapaure

INSTRUCTIONS	
<ol style="list-style-type: none">1. All examination RULES apply2. Answer ALL questions in the spaces provided3. Read all the questions carefully before answering4. Marks are indicated at the end of each question5. Write clearly and neatly.6. All written work MUST be done in BLUE or BLACK ink.	

PERMISSIBLE MATERIALS

Non-programmable calculators

ATTACHMENTS

None

**THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES
(INCLUDING THIS FRONT PAGE)**

1. The Kuiseb River had a large population of various kinds of fish. After farmers in the area started using nitrogenous fertilizers on their fields, rainwater washed excess fertilizer into the river. After a few months, the amount of algae in the river increased greatly, while the local fish community decreased dramatically.
 - a. What is the term that describes the process where an increase in the availability of nutrients results in an increase in algae? [1]
 - b. Why did the fish population/community decrease? [2]
 - c. The presence of algae is a biotic factor influencing the fish population. Name **ONE** more biotic and **TWO** abiotic factors that can influence the fish population. [3]
2. A population of springbok is suddenly separated when a highway is built that splits the population's habitat in two. After many years, the highway is abandoned, and the two populations are reunited. However, individuals are now unable to breed across the different populations. They can only breed with individuals from their own group. What type of a speciation is that, and explain it in detail? [4]
3.
 - a. Describe any four (4) biotic characteristics and four (4) abiotic characteristics of woodland and desert biomes found in Namibia. [8]
 - b. State at least four (4) threats to the biomes you described in (3a). [4]
 - c. As a renowned ecologist/biologist working in the Department of Environment, what are the solutions that you can suggest to manage the threats you identified in (3b). [4]
4. Define population genetics? Explain why understanding population genetics is important to an ecologist like you. [4]
5. With the aid of a well labelled diagrams, differentiate between exponential growth and logistic growth of populations. [6]
6. Suppose you were tasked with counting the number of Mopane trees in a small portion of Bwabwata National Park, which is half an acre in size (one acre = 4000 m²). Using a square quadrat of 2 m in length and you obtain the numbers shown in the table below

Quadrat number	1	2	3	4	5	6	7	8	9	10
Mopane Tree count	4	5	2	4	1	5	3	2	5	3

- a. Estimate the total number of Mopane trees in a small portion of Bwabwata National Park mentioned above. Show your working. [5]

- b. Determine the dispersion pattern of the Mopane trees in the Bwabwata National Park [4]
- c. List any three assumptions of the method you have used. [3]
7. Compare and contrast density-dependent growth regulation with density-independent growth regulation. Give an example of each as they might affect a caterpillar population. [4]
8. An ecological system is any set of components, living or non-living, that are tied together by regular interactions. An ecological system is made up of one or more organisms (biotic), together with the non-living environment (non-biotic) with which they interact. Ecological systems exist at several different levels of organization. An ecological system can be a single organism and its surroundings, a population or set of interacting populations in a certain habitat, or the entire community together with the abiotic environment with which these species interact, a unit termed an ecosystem.

Describe different research methods that ecologists use to study ecosystems, highlighting the advantages and disadvantages of each method. [20]

9. As part of a new development, a concert venue consisting of a stage and open grassy areas for sitting, and parking areas is constructed in a formerly wooded area.
- a. Predict the consequence on the local plant community that is likely to result during the preparation and construction of the venue. Justify your prediction. [4]
- b. To maintain the grassy area, large quantities of water and chemicals are applied regularly. Predict the effect on the local animal community that might result from regular use and maintenance of the grassy area. Justify your prediction. [4]
10. Species 1 and 2 compete; community dynamics follows the Lotka-Volterra competition equations:

$$\text{Species 1: } \frac{dN_1}{dt} = r_1 N_1 \left(\frac{K_1 - N_1 - \alpha N_2}{K_1} \right)$$

$$\text{Species 2: } \frac{dN_2}{dt} = r_2 N_2 \left(\frac{K_2 - N_2 - \beta N_1}{K_2} \right)$$

Competition coefficients:

α : the effect an individual of species 2 has on the population growth of species 1

β : the effect an individual of species 1 has on the population growth of species 2

$$\alpha = \alpha_{12}$$

$$\beta = \alpha_{21}$$

N_1 is a density, population for species 1,

r_1 is an intrinsic rate of increase ($r_1 > 0$),

K_1 is a carrying capacity, and α_{12} is the competitive effect of an individual of species 2 on the growth of species 1 ($0 < \alpha_{12} \leq 1$).

Suppose $K_1 = 1000$, $K_2 = 800$, $\alpha = 0.5$, and $\beta = 0.1$.

a. If $N_2 = 100$, what value of N_1 falls on the 0-isocline of species 1 (where $dN_1/dt = 0$)? [5]

b. Suppose two species, S_1 and S_2 (species 2) compete for a common limiting resource. The two-species dynamics follows the Lotka-Volterra competition model (logistic competition). Analyze the 0-isoclines and predict the outcome of the competition when $K_1 = 150$, $K_2 = 220$, $K_1 \alpha_{12} = 70$, and $K_2 \alpha_{21} = 400$. [5]

11. Deforestation has devastated the balance of carbon on the planet, being the second leading cause of rising atmospheric CO_2 levels behind fossil fuel combustion.

a. Given this information, what MAJOR role do forests play in the carbon cycle? [2]

b. The Nitrogen cycle alone is responsible for an increase in atmospheric concentrations of greenhouse gases.

i. With the aid of a diagram, describe the Nitrogen cycle [4]

ii. State at least (4) human activities that interfere with the Nitrogen cycle. [4]