SECTION C

QUESTION 4

Discuss the role that carrying capacity, competition and predation play in regulating the size of a population.

Content: (17)
Synthesis: (3)

NOTE: No marks will be awarded for answers in the form of flow charts, tables or diagrams.

TOTAL SECTION C: [20]
GRAND TOTAL: [100]

SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question number (1.1.1 – 1.1.5) in the answer book, for example 1.1.6 D.

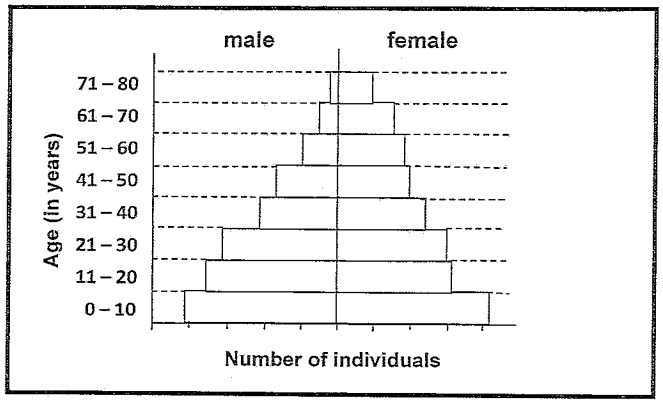
1.1.1 The mark-recapture-mark method of population size estimation can be considered reliable only if ...

A. animals become trap-shy and cannot be caught.
B. animals are left for a year before recapture.
C. no immigration occurs.
D. markings are temporary.

1.1.2 Our rate of breathing is regulated by the medulla oblongata mainly according to the ...

A. carbon dioxide level of the blood.
B. oxygen level of the blood.
C. blood pressure.
D. volume of the blood.

1.1.3 Study the following pyramid.



Which of the following is a correct interpretation of the population represented above?

A. Rapidly growing population; characteristic of a developing country
B. Declining population; characteristic of a developing country
C. Stable population; characteristic of a developed country
D. Declining population; characteristic of a developed country

1.1.4 The sequence of processes responsible for the composition and volume of urine is ...

A. reabsorption, excretion and filtration.
B. excretion, filtration and reabsorption.
C. excretion, reabsorption and filtration.
D. filtration, reabsorption and excretion.

1.1.5 Which of the following contain two factors that contribute to an INCREASE in population size?

A. Natality and emigration
B. Immigration and natality
C. Emigration and immigration
D. Mortality and natality

(5 x 2 = 10)

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 – 1.2.8) in the ANSWER BOOK.

1.2.1 The sum of the factors inhibiting population growth as a result of current conditions in a habitat

1.2.2 Type of symbiosis whereby one benefits without harming the other

1.2.3 Determination of the size of human populations by the actual counting of all its members

1.2.4 The blood vessel which transports blood out of the kidney

1.2.5 The process by which oxygen passes from the alveolus into the blood capillary during gaseous exchange

1.2.6 The part of the renal tubule in which the sodium pump operates

1.2.7 The killing of elephants through hunting in order to regulate their population size

1.2.8 The inherent ability of a population to increase in size

(8 x 1 = 8)

1.3 Indicate whether each of the statements in COLUMN I, applies to **A ONLY, B ONLY, BOTH A and B**, or **NONE** of the items in COLUMN II. Write **A ONLY, B ONLY, BOTH A and B**, or **NONE** next to the question number in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Doubling of the population size at different intervals	A: Geometric growth B: Natality
1.3.2 Competition for resources between individuals of different species	A: Interspecific competition B: Intraspecific competition
1.3.3 Function of the nephron	A: Excretion B: Osmoregulation
1.3.4 The type of epithelium that lines the trachea	A: Ciliated epithelium B: Squamous epithelium
1.3.5 Transports urine to the bladder	A: Urethra B: Ureter
1.3.6 The series of changes in an ecosystem community from bare rock to forest.	A: Succession B: Resource partitioning

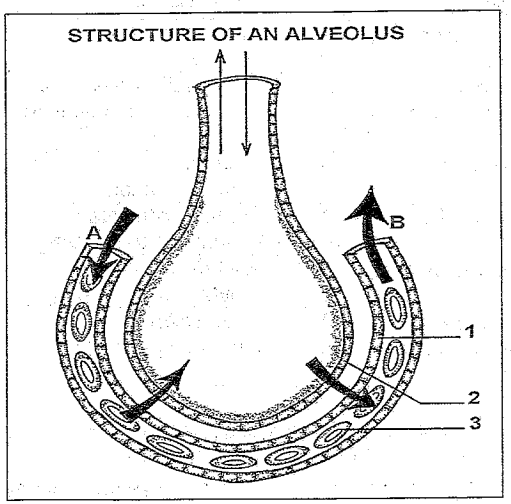
(6 x 2 = 12)

TOTAL SECTION A: [30]

SECTION B

QUESTION 2

2.1 Study the diagram below and answer the questions that follow.



2.1.1 Name the type of epithelial tissue numbered **1**. (1)

2.1.2 Identify the blood cell numbered 3. (1)

2.1.3 Name the pigment found in the cell mentioned in 2.1.2 above. (1)

2.1.4 Which type of blood:

(i) Enters the capillary at A? (1)

(ii) Leaves the capillary at B? (1)

2.1.5 Explain TWO structural adaptations of the alveoli that make them well suited for gaseous exchange. (4)

2.1.6 The disease emphysema can be caused by excessive cigarette smoke. Explain how emphysema affects gaseous exchange. (2)

(11)

2.2 The table below shows the results of an investigation involving a person who was fit and healthy.

The person was given air to breathe that had different concentrations of carbon dioxide while the oxygen concentration remained the same throughout the investigation.

During the investigation the rate and depth of breathing of this person was measured.

Concentration of CO_2 breathed in (%)	Rate of breathing (number of breaths per minute)	Depth of breathing per minute (litres)
0,04	13	9,4
0,08	14	10,3
1,50	15	11,9
2,30	15	13,7
3,10	15	18,5
5,50	20	29,5
6,00	27	56,8

2.2.1 Suggest an aim for this investigation. (2)

2.2.2 State ONE factor that was kept constant during the investigation. (1)

2.2.3 Describe the trend shown by the results for the rate of breathing. (3)

2.2.4 State TWO ways in which the reliability of the investigation could be increased. (2)

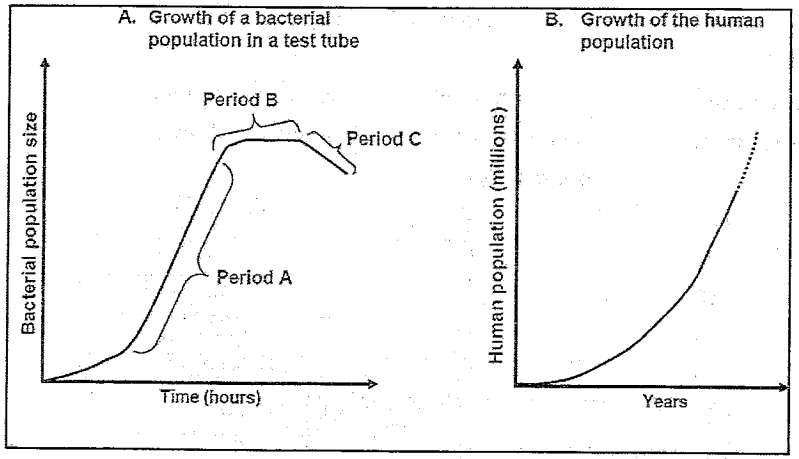
2.2.5 Describe the homeostatic mechanism that causes the rate and depth of breathing to increase when a person engages in strenuous exercise. (6)

(14)

[25]

QUESTION 3

3.1 Graph A below represents the number of bacteria in a growth culture over a period of time. Graph B shows changes in the human population size over a period of time.



3.1.1 Explain the pattern of growth during period **A** in Graph **A**. (2)

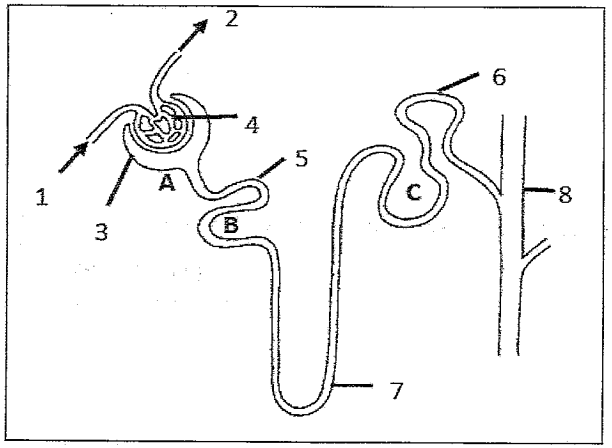
3.1.2 Explain the pattern of growth during the first few hours of the investigation, before period **A** in Graph **A**. (2)

3.1.3 In what way is the growth of human population (Graph **B**) similar to that of bacterial population(Graph **A**)? (1)

3.1.4 Explain why it might take the human population longer to reach the type of growth shown by bacteria population in period **B**. (2)

3.1.5 State TWO precautionary measures that may be implemented in South Africa to slow down the growth in the population. (2)
(9)

3.2 Study the diagram below and answer the questions that follow.



3.2.1 Name the above structure. (1)

3.2.2 Label parts numbered **1**, **2**, **3** and **7**. (4)

3.2.3 Identify the tissue lining the tubule at **5**. (1)

3.2.4 Explain ONE way in which the tissue named in QUESTION 3.2.3 is adapted for its function. (2)

3.2.5 Which hormone is responsible for the re-absorption of water at the part numbered **8**? (1)

3.2.6 Describe how the hormone named in QUESTION 3.2.5 plays its role in the re-absorption of water when there is a shortage of water in the body. (3)

3.2.7 Kidneys can become so damaged that they no longer function properly, and we say that the person has renal failure. People with renal failure can have their blood purified artificially by a process of dialysis using a kidney machine. In the kidney machine, blood and dialysis fluid circulates through the series of fine tubes in opposite directions.

(i) Explain why the dialysis fluid must be kept fresh by replacing it often. (2)

(ii) Give TWO reasons why a successful kidney transplant would be better for a patient than regular dialysis treatment. (2)
(16)

[25]

TOTAL SECTION B: [50]

SECTION C

QUESTION 4

Role of carrying capacity

- Carrying capacity refers to the maximum number of individuals✓
- that can be supported by an environment✓
- based on the amount of resources available✓
- This prevents unlimited increase of natural populations✓
- If a population size increase past the carrying capacity✓,
- environmental resistance will build up✓
- Once a population has reached its maximum size✓
- It fluctuates around the carrying capacity✓

any 5

Role of competition

- This factor comes into play when animals compete for limited resources e.g. food✓
- Competition may occur among members of the same species✓/intraspecific competition
- allowing the fittest to survive✓
- Competition may also involve different species✓/interspecific competition
- where one species may eliminate another species✓
- One species may therefore increase the size of their population✓
- whilst the other species will have a decreased population size✓
- due to mortality✓/emigration

any 5

Role of predation

- When one species kills and feeds on members of another species✓
- the population size of the other species will decrease✓
- It includes carnivorism, herbivorism, etc✓
- If the predator population grows, more food is needed✓
- and therefore more prey is caught and killed✓
- This causes the prey population to decrease✓
- When there is less prey, the predator population decreases✓
- thus allowing the prey population to increase✓
- This brings about a balance in predator-prey interaction✓
- to ensure natural stable populations✓

any 7

Synthesis

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q 4.	Only carrying capacity, competition and predation are described. No other factors (irrelevant information) are included.	Each aspect (carrying capacity, competition and predation) are described in logical sequence/ cause-effect.	At least THREE points included for each of the THREE aspects (carrying capacity, competition and predation).
Mark	1	1	1

Content: (17)
Synthesis: (3)
(20)

SECTION A

QUESTION 1

1.1

1.1.1 C ✓✓
1.1.2 A ✓✓
1.1.3 A ✓✓
1.1.4 D ✓✓
1.1.5 B✓✓

(5 x 2 = 10)

1.2

1.2.1 Environmental resistance✓
1.2.2 Commensalism✓
1.2.3 Census/ Direct technique✓
1.2.4 Renal vein✓
1.2.5 Diffusion✓
1.2.6 Loop of Henle✓
1.2.7 Culling✓
1.2.8 Natality✓

(8 x 1 = 8)

1.3

1.3.1 A only ✓✓
1.3.2 A only✓✓
1.3.3 Both A and B✓✓
1.3.4 A only✓✓
1.3.5 B only✓✓
1.3.6 A only✓✓

(6 x 2 = 12)

TOTAL SECTION A: [30]

SECTION B
QUESTION 2

2.1

2.1.1 Squamous epithelium✓/ Endothelium (1)

2.1.2 Erythrocyte✓/Red blood cell (1)

2.1.3 Haemoglobin✓ (1)

2.1.4 (a) Deoxygenated blood✓ (1)
(b) Oxygenated blood✓ (1)

2.1.5

- Lobed alveoli✓ provide a large surface area✓
- Covered by a layer of moisture✓ to prevent drying of gas exchange surface✓
- Alveolus wall is thin✓ to facilitate easy diffusion of gases✓
- Rich supply of blood capillaries✓ for the transport of absorbed gases✓

any 2 x 2 (4)

(Mark FIRST TWO answers only)

2.1.6

- Excessive smoking causes torn walls of alveoli✓
- Blood capillaries disintegrate✓and
- Gaseous exchange becomes increasingly difficult✓
- This leads to a feeling of suffocation✓

any (2)
(11)

2.2

2.2.1 To determine the effect of different concentrations of carbon dioxide✓ on the rate and depth of breathing ✓ (2)

2.2.2 Oxygen concentration✓ (1)
(Mark FIRST answer only)

2.2.3 - With a low CO_2 concentration, there is a gradual increase✓ in the rate
- then it becomes constant✓
- with a further increase in the CO_2 concentration it increases sharply✓ (3)

2.2.4 - Increase sample size✓
- Calculate average rate and depth of breathing✓
- Repeat the investigation✓

any (2)
(Mark FIRST TWO answers only)

2.2.5

- During strenuous exercise the carbon dioxide level in the blood increases✓
- Sensory cells in the carotid arteries✓/aortic arches are stimulated
- The medulla oblongata✓ sends impulses to the heart
- causing the heart to beat faster✓
- thus carbon dioxide is transported faster✓to the lungs from the tissues.
- The medulla also sends impulses to the intercostal muscles, diaphragm and abdominal muscles ✓
- Contraction of the abdominal muscles pushes the diaphragm with more force✓
- Causing the breathing movements to speed up✓
- Carbon dioxide is thus removed quickly and oxygen is taken up more rapidly✓

any (6)
(14)
[25]

QUESTION 3

3.1

3.1.1

- Growth is rapid✓
- Due to the absence of limiting factors✓/presence of sufficient resources/absence of predators. (2)

3.1.2

- Growth is slow✓
- Because the bacteria are still acclimatizing✓ to the new environment (2)

3.1.3 Growth starts slowly and then increases rapidly✓ (1)

3.1.4 Humans are able to increase food production✓
using modern technology✓
OR
Humans continue to clear natural vegetation✓
to create space for more homes✓ (2)

3.1.5

- Regulation of population growth by proper family planning✓
- Allocation of subsidies/incentives to people that have small families✓
- Educate the population on the need to limit family size✓

any (2)
(Mark FIRST TWO answers only)

(9)

3.2

3.2.1 Nephron✓ (1)

3.2.2 1 – Afferent arteriole✓
2 – Efferent arteriole✓
3 – Bowman's capsule✓
7 – Loop of Henle✓/ascending limb of loop of Henle (4)

3.2.3 Cuboidal epithelium✓ (1)

3.2.4 Large number of mitochondria✓/microvilli to assist in absorption✓ (2)

3.2.5 Antidiuretic hormone ✓/ADH (1)

3.2.6

- Makes collecting duct ✓/distal convoluted tubule
- more permeable to water✓
- allowing more water to be reabsorbed✓ (3)

3.2.7 (i) To maintain✓ a concentration gradient✓ (2)
(ii)

- Dialysis is time consuming✓unpleasant process
- It will permanently reduce financial costs✓
- Patient does not need to stay close to a hospital with a dialysis machine✓/ regular travel to hospital/expensive to pay for home dialysis
- A human kidney functions more effectively than a dialysis machine✓

any (2)
(Mark FIRST TWO answers only)

(16)
[25]

TOTAL SECTION B: 50

