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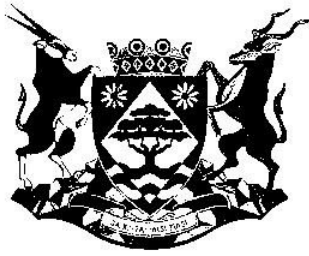
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DEPARTMENT OF EDUCATION
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**PROVINSIALE VOORBEREIDENDE EKSAMEN/
PROVINCIAL PREPARATORY EXAMINATION**

GRAAD 12/GRADE 12

LEWENSWETENSKAPPE/LIFE SCIENCES

VRAESTEL/PAPER 2

SEPTEMBER 2025

PUNTE/MARKS: 150

TYD/TIME: 2½ uur/hours

**Hierdie vraestel bestaan uit 16 bladsye./
This question paper consists of 16 pages.**



INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Do ALL drawings in pencil and label them in blue ink.
7. Draw diagrams, tables or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass, where necessary.
11. Write neatly and legibly.

SECTION A**QUESTION 1**

- 1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D.

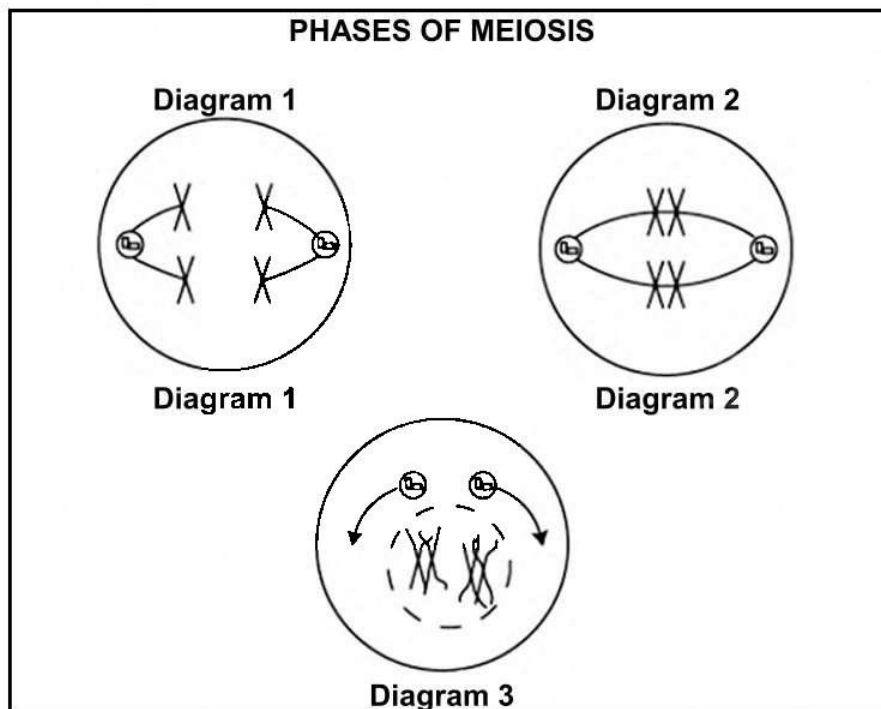
1.1.1 DNA is found in the...

- A nucleolus.
- B chromatin network.
- C ribosomes.
- D cytoplasm.

1.1.2 The present-day distribution of organisms is referred to as ...

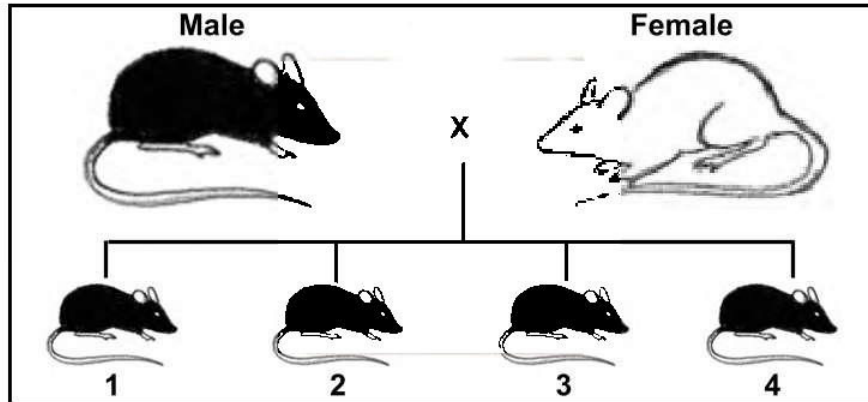
- A biogeography.
- B biodiversity.
- C biochemistry.
- D mutations.

1.1.3 The correct sequence for the part of meiosis I shown below is ...



- A Diagram 1, Diagram 2, Diagram 3
- B Diagram 2, Diagram 3, Diagram 1
- C Diagram 3, Diagram 1, Diagram 2
- D Diagram 3, Diagram 2, Diagram 1

- 1.1.4 The diagram below shows a crossing between a homozygous black mouse and a homozygous white mouse.



The possible genotypes for the mice are:

- (i) BB
- (ii) Bb
- (iii) bb

The genotype for the offspring is ...

- A Only (i)
- B Only (i) and (ii)
- C Only (ii) or (iii)
- D Only (ii)

- 1.1.5 Give the sequence of nitrogenous bases on the mRNA molecule that the following part of a DNA strand codes for:

GAT CCA

- A CUA GUU
- B CTA GTT
- C AGC TGG
- D AGC UGG

- 1.1.6 DNA was taken from the cells of *Saccharomyces cerevisiae* and tested for its nitrogen bases. It was found that 17% of the bases are cytosine. What percentage of the bases are adenine?

- A 17
- B 34
- C 33
- D 51



1.1.7 Which ONE on the following evidence supports the 'Out-of-Africa' hypothesis by tracing the maternal lineage?

- A Y chromosome
- B X chromosome
- C Mitochondrial DNA
- D Cultural evidence

QUESTIONS 1.1.8 TO 1.1.10 ARE BASED ON THE DIHYBRID CROSSING BELOW.

DIHYBRID CROSSING IN WOLVES

Fur colour in wolves is controlled by two alleles, grey (**G**) and black (**g**). Eye colour is controlled by two alleles, yellow (**Y**) and blue (**y**).

The following combinations represent possible phenotypic traits observed in wolves:

- (i) Grey fur with yellow eyes
- (ii) Black fur with blue eyes
- (iii) Black fur with yellow eyes
- (iv) Grey fur with blue eyes

1.1.8 If the male wolf has the genotype **GgYY** and the offspring has the genotype **ggYY**, which ONE of the above combinations could represent the phenotype of the she-wolf?

- A Only (i) and (iii)
- B Only (i) and (ii)
- C Only (ii) and (iv)
- D Only (iii) and (iv)

1.1.9 Give the genotype of a black wolf with blue eyes.

- A GgYy
- B ggYY
- C ggyy
- D Ggyy

1.1.10 Which ONE of the following represents the gametes produced by a black wolf with yellow eyes?

- A Gy ; gY
- B gY ; gy
- C gg ; Yy
- D GY ; gy

(10 x 2) (20)



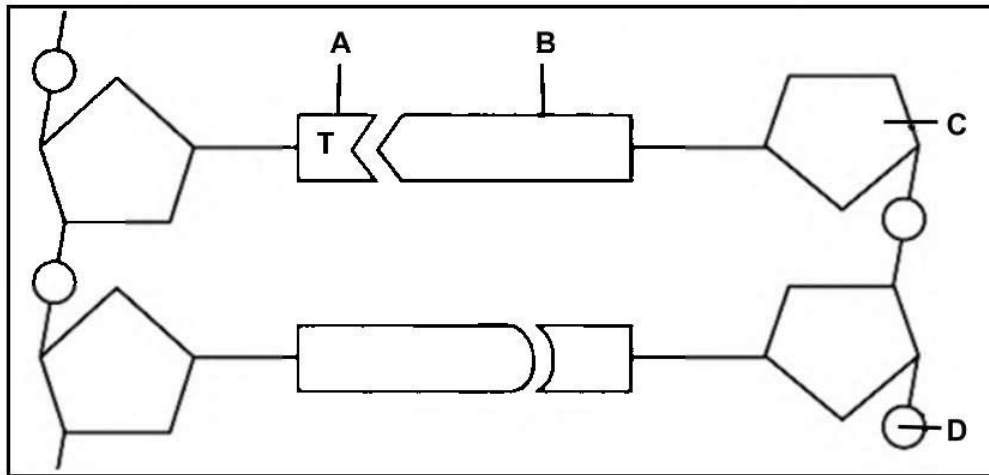


- 1.2 Give the correct **biological term** for EACH of the following descriptions. Write only the term next to the question numbers (1.2.1 to 1.2.10) in the ANSWER BOOK.
- 1.2.1 The division of the cytoplasm during cell division
 - 1.2.2 All the genes of a particular species
 - 1.2.3 The inability of blood to clot due to lack of a blood clotting factor
 - 1.2.4 Similar structures that descend from a common ancestor
 - 1.2.5 The type of variation which has a range of intermediate phenotypes for a particular trait
 - 1.2.6 A pair of chromosomes, one inherited from each parent, that have the same genes at the same loci
 - 1.2.7 An explanation for something that has been observed in nature, and which can be supported by facts, laws and tested hypotheses
 - 1.2.8 The physical and functional expression of a gene
 - 1.2.9 A network of filaments which are formed during both mitosis and meiosis that help in the movement of chromosomes
 - 1.2.10 Different forms of a gene which occur at the same locus on homologous chromosomes (10 x 1) **(10)**
- 1.3 Indicate whether each of the descriptions 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 numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II	
1.3.1	Organisms have an inherent/internal drive to change	A: Lamarck	B: Darwin
1.3.2	Influences the inheritance of blood groups	A: Co-dominance	B: Multiple alleles
1.3.3	Mutation that increases biodiversity	A: Neutral	B: Lethal

(3 x 2) **(6)**

1.4 The diagram below represents a short section of a DNA molecule.



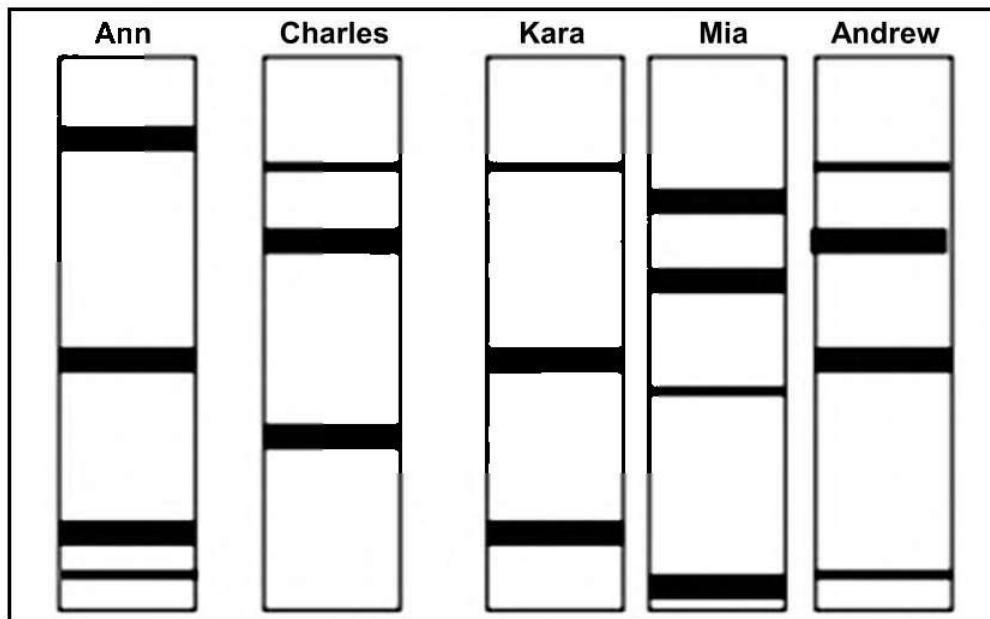
1.4.1 Identify:

- (a) The full name for nitrogenous base **B** (1)
- (b) Molecule **C** (1)
- (c) Molecule **D** (1)

1.4.2 Name the type of bond that joins **A** to **B**. (1)

1.4.3 During which phase of the cell cycle will an identical copy of this molecule be made? (1)
(5)

- 1.5 The diagram below represents the DNA profiles of three children (Kara, Mía and Andrew) and their parents (Ann and Charles). Only two of the children are the parents' biological children and one is adopted.

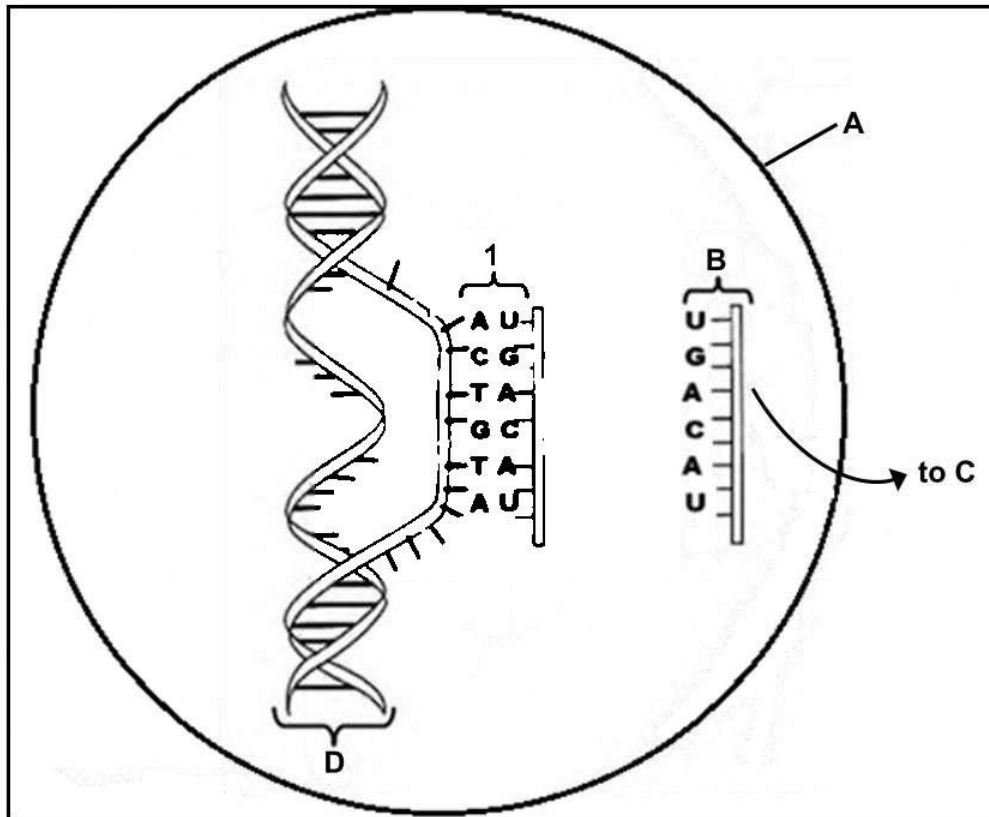


- 1.5.1 Give TWO other ways in which DNA-profiling is used. (2)
- 1.5.2 What do the black bars in the DNA profiles represent? (1)
- 1.5.3 Which ONE of the children has been adopted? (1)
(4)
- 1.6 McLeod Syndrome is a disorder that affects red blood cells and may also result in red-green colour blindness. Use the allele X^k to express this condition.
- 1.6.1 What type of mutation leads to colour blindness? (1)
- 1.6.2 How many chromosomes will a person with colour blindness have in each somatic cell? (1)
- 1.6.3 Which gender is more likely to have this disorder? (1)
- 1.6.4 Give the genotype of a carrier for colour blindness. (2)
(5)

TOTAL SECTION A: 50

SECTION B**QUESTION 2**

2.1 The diagram below represents protein synthesis.



2.1.1 Identify:

- (a) Organelle **A** (1)
- (b) Structure **B** (1)
- (c) Organelle **C** (1)
- (d) Process **1** (1)

2.1.2 Give ONE function of molecule **D**. (1)

2.1.3 Name ALL THREE scientists who received the Nobel Prize in 1962 for discovering the molecular shape of molecule **D**. (2)

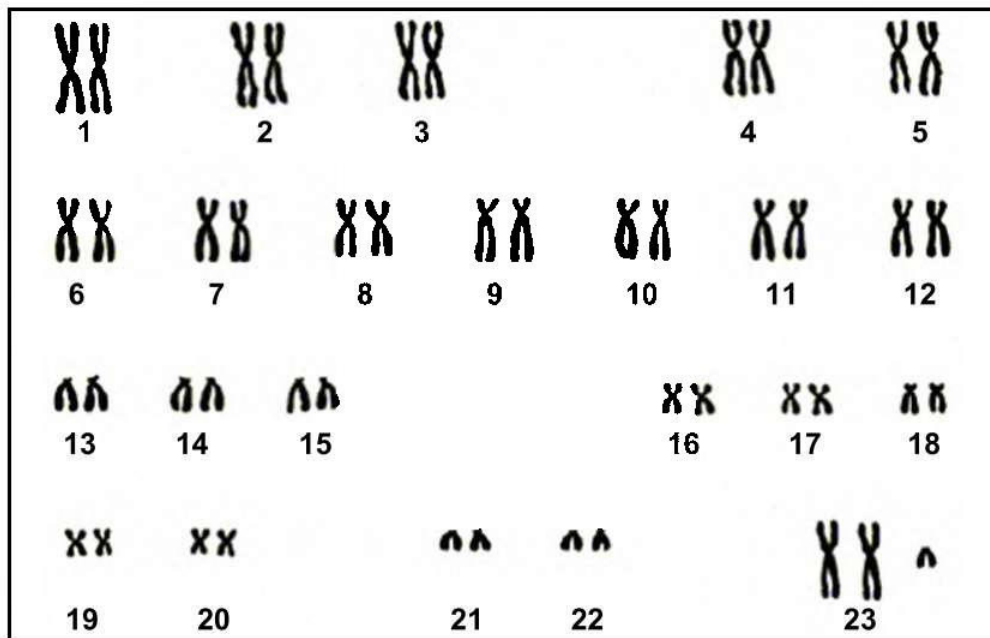
2.1.4 Name and describe the process that occurs at organelle **C**. (6)
(13)

- 2.2 The relative amounts of DNA were measured in the cells of a domestic dog during mitosis and meiosis. The results are shown in the table below.

PHASE OF NUCLEAR CYCLE		DNA CONTENT (%)
Mitosis	Early interphase	100
	Prophase	200
Meiosis I	Early prophase	200
	Late telophase	100
Meiosis II	Late prophase	100
	Telophase	50

- 2.2.1 Give THREE reasons why meiosis is biologically important. (3)
- 2.2.2 Using the information in the table, draw a histogram representing the DNA content during the different phases of the nuclear cycle. (6)
- 2.2.3 Explain the following:
- (a) The amount of DNA in early interphase differs from the amount of DNA in prophase. (2)
- (b) Early prophase of meiosis **I** has a different amount of DNA than late prophase of meiosis **II**. (2)
- (13)**

- 2.4 The diagram below represents a karyotype of a somatic cell of a human with a genetic disorder called Klinefelter syndrome. Klinefelter syndrome affects the sex chromosomes.



- 2.4.1 What is Mendel's principle of segregation? (2)
- 2.4.2 Give the collective term for the chromosomes numbered 1 to 22. (1)
- 2.4.3 Identify the gender of the individual represented in the diagram. (1)
- 2.4.4 Give ONE visible reason for your answer to QUESTION 2.4.3. (2)
- 2.4.5 Use your knowledge of abnormal meiosis to explain how Klinefelter syndrome is caused. (4)
- (10)
- 2.5 The ABO system classifies human blood groups into four types: A, B, AB and O.
- A woman with heterozygous blood group A marries a man with blood group AB. Use a genetic cross to show the possible blood groups of their offspring. (6)
- [50]

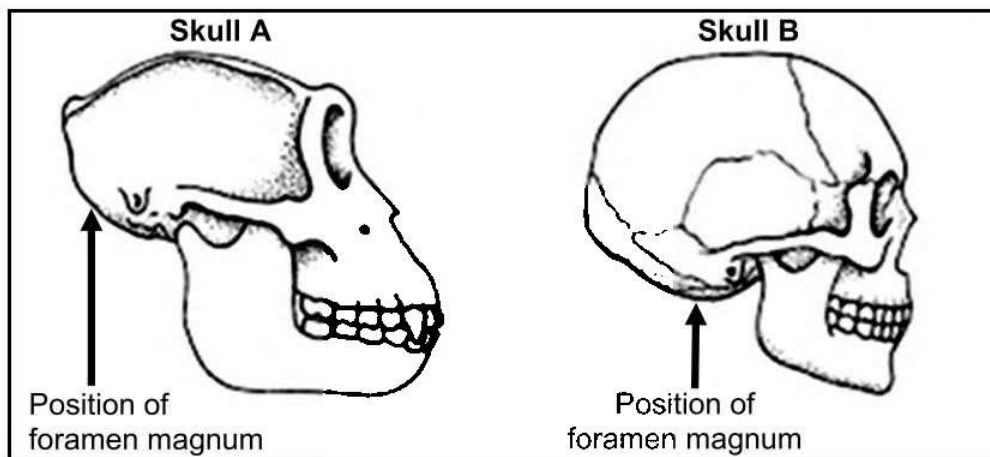
QUESTION 3

- 3.1 Insulin is a hormone used to regulate blood sugar levels. People with Type 1 diabetes do not produce insulin and rely on insulin injections. Modern biotechnology makes it possible to produce human insulin. Genetically modified bacteria is used to produce insulin on a large scale.

Give FOUR steps in the production of insulin using recombinant DNA technology.

(4)

- 3.2 The diagrams below represent the skulls of two organisms, namely a gorilla and a modern human. Each arrow indicates the position of the foramen magnum. The diagrams are not drawn to scale.



- 3.2.1 Give the scientific name of the organism with skull **B**. (1)
- 3.2.2 Which skull (**A** or **B**) represents a bipedal organism? (1)
- 3.2.3 Explain THREE possible advantages of bipedalism. (6)
- 3.2.4 Tabulate THREE visible differences between skull **A** and **B** as illustrated in the diagram above. (7)

(15)

3.3 Read the passage below.

THE EVOLUTION OF THE GRAND CANYON SQUIRRELS

In the southwestern part of the United States, there are two kinds of similar ground squirrels, the Abert and the Kaibab ground squirrels. It is believed that they shared a common ancestor 10 000 years ago.

As time passed in their desert habitat, the Colorado River continued to erode deeper into the ground, eventually forming a big canyon. This canyon was very deep, and the squirrels stopped crossing the canyon.

Over time the habitat to the north of the canyon became more shaded and the vegetation increased since it wasn't as hot. To the south of the canyon, the area became warmer with less shade. Squirrels with sparse hair and good digging claws were able to make tunnels to reach the deeper, cooler sand. These squirrels reproduced successfully.

[Source: https://en.wikipedia.org/wiki/Kaibab_squirrel]

- 3.3.1 Define the term *biological evolution*. (2)
- 3.3.2 Explain the favourable adaptations of the Abert squirrel living on the southern side of the canyon. (4)
- 3.3.3 Describe the speciation of the Abert and Kaibab squirrels. (8)
- 3.3.4 Name TWO other types of reproductive isolating mechanisms. (2)
- (16)**
- 3.4 Describe the process of natural selection. (7)

- 3.5 Scientists investigated the resistance of mosquitoes to the insecticide DDT over a period of 16 months.

The procedure was as follows:

- Mosquitoes were collected in a natural environment
- The mosquitoes which were collected were kept in a controlled environment in an insect laboratory.
- The laboratory provided suitable living conditions such as temperature, humidity and food to ensure that the mosquitoes stayed alive and healthy so that they could reproduce.
- Every day, the mosquitoes were exposed to **4% DDT** for **1 hour**.
- Every **2 months**, the scientists tested a sample of the mosquitoes to check whether they were becoming resistant to DDT.
- Resistance was measured by observing how many mosquitoes survived the DDT exposure.
- A high number of deaths shows low resistance.
- Percentage mortality was calculated as follows:

$$\frac{\text{Number of mosquitoes that died}}{\text{Total number of mosquitoes tested}} \times \frac{100}{1}$$

The results are shown in the table below.

MORTALITY RATE OF THE MOSQUITOES OVER A PERIOD OF 16 MONTHS	
TIME (in months)	MORTALITY OF MOSQUITOES (%)
0	95
2	87
4	80
6	69
8	60
10	54
12	35
14	27
16	22

- 3.5.1 Identify the:

- (a) Independent variable (1)
- (b) Dependent variable (1)

**3.5.2 State:**

- (a) TWO planning steps that the investigators had to take before the investigation was conducted (2)
 - (b) TWO ways in which the validity of this investigation was ensured (2)
 - (c) The conclusion for this investigation (2)
- (8)**
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

