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DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS
LEFAPHA LA THUTO
ISEBE LEZEMFUNDO

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.

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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.

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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.

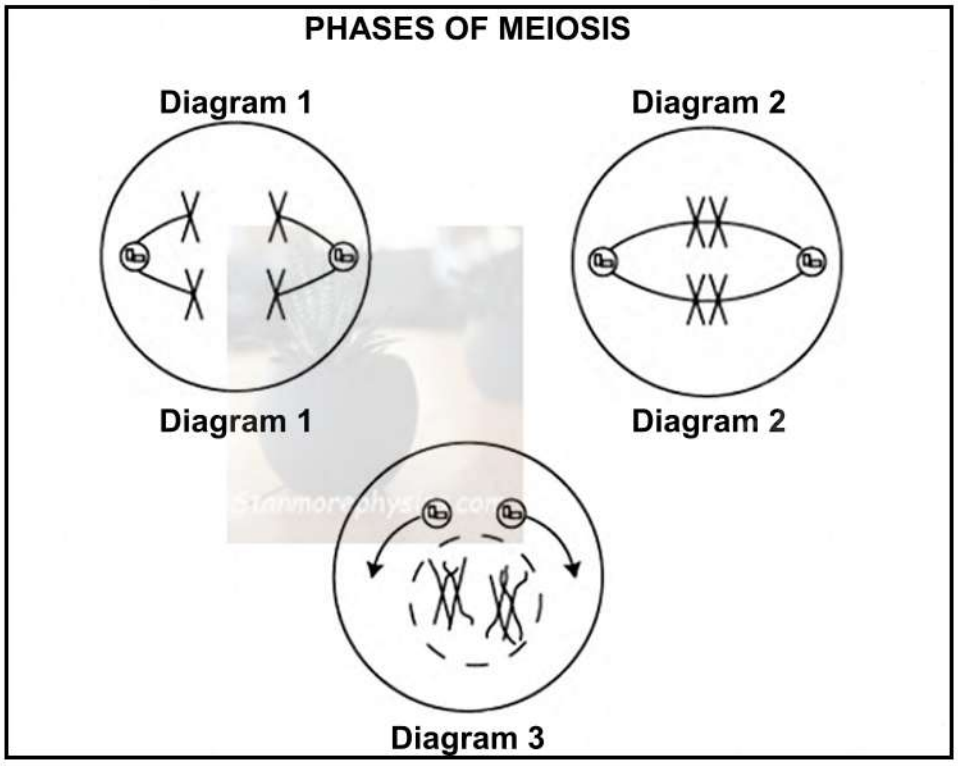
1.1.1 DNA is found in the…

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**

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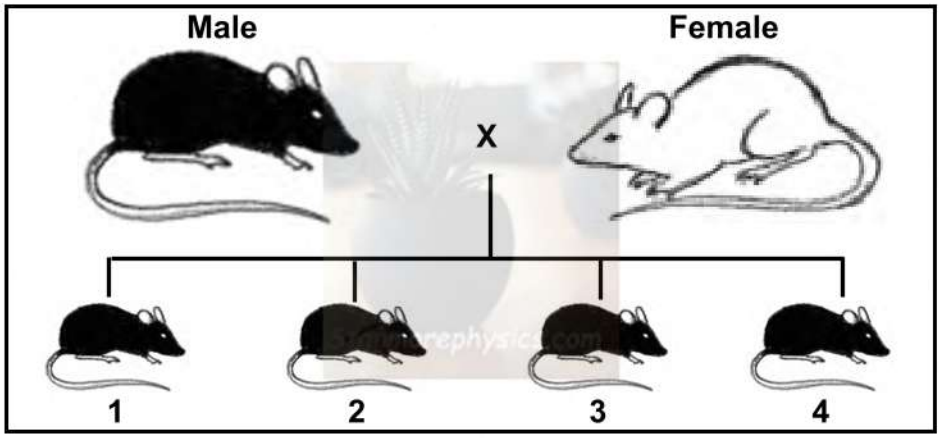
1.1.4 The diagram below shows a crossing between a homozygous black mouse and a homozygous white mouse.



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

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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)**

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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)**

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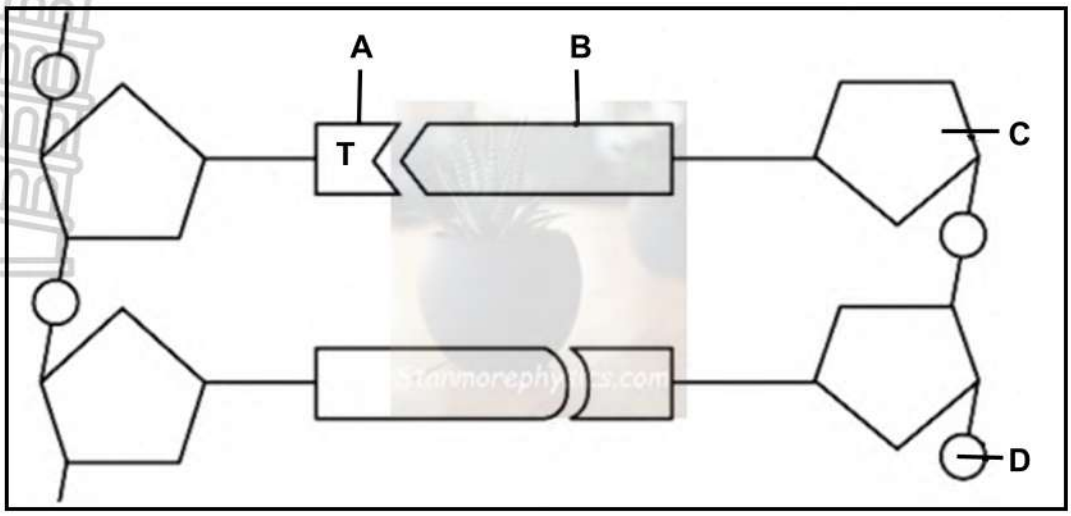
1.4 The diagram below represents a short section of a DNA molecule.



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)

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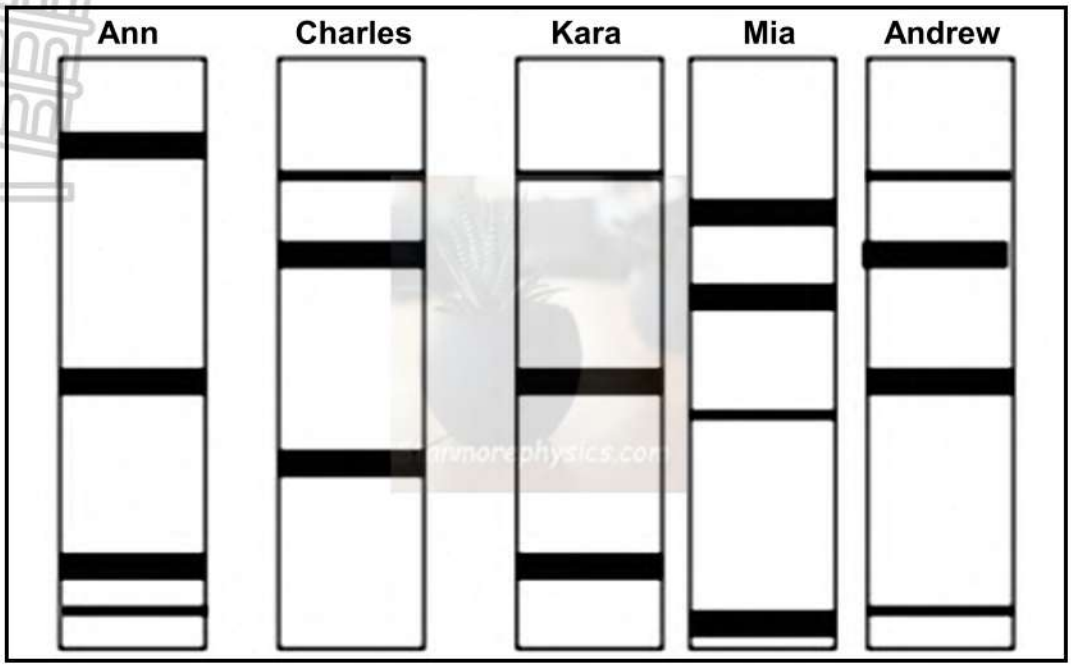
1.5 The diagram below represents the DNA profiles of three children (Kara, Mía and Andrew) and their parents (Ann and Charles). Only two of the children are the parents' biological children and one is adopted.



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 $\mathbf{X^k}$ 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

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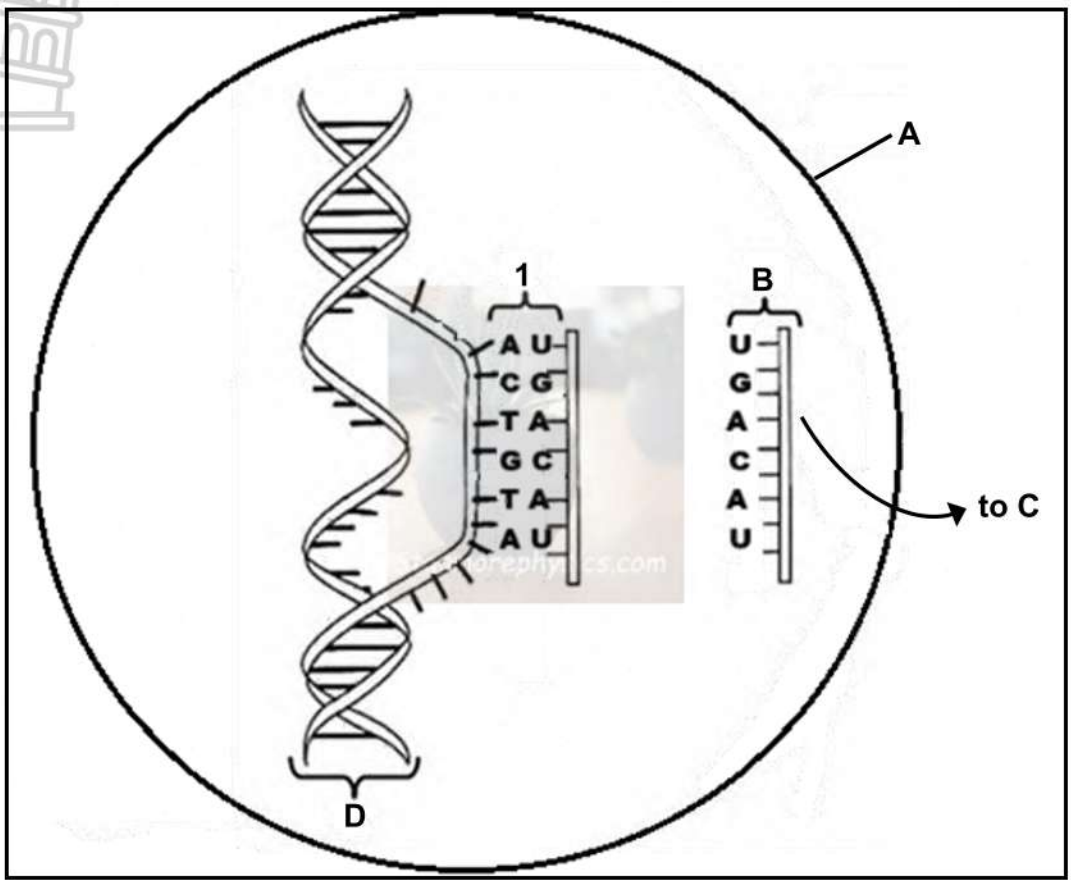
SECTION B

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)

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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)

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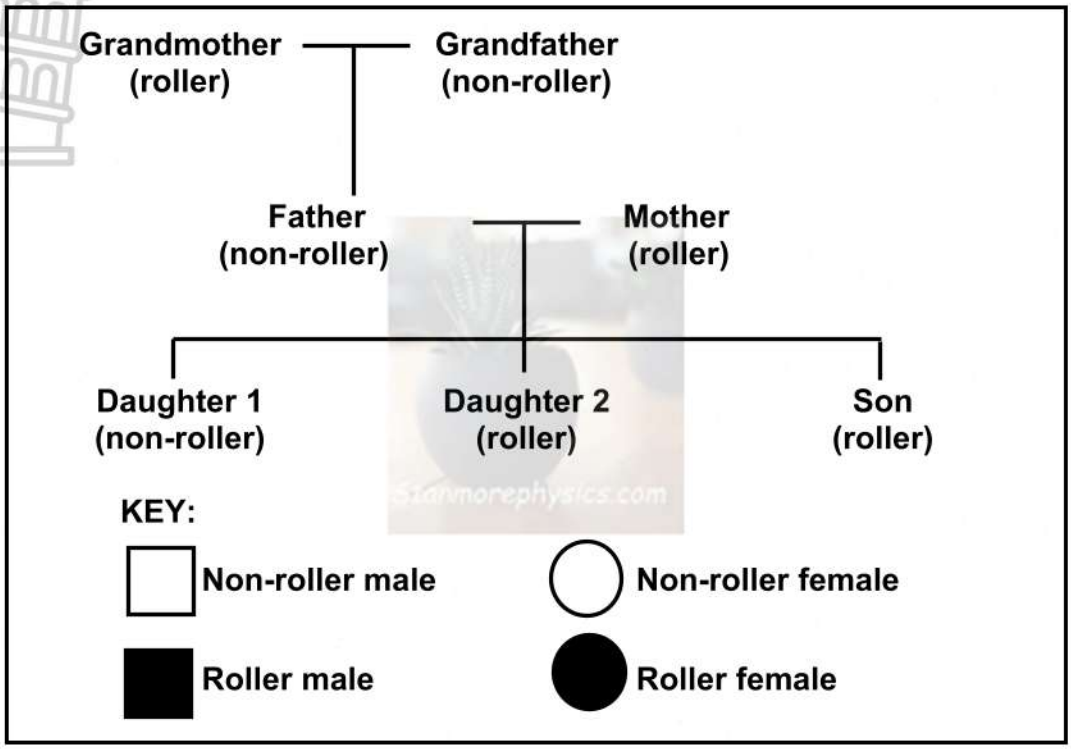
2.3 The diagram below shows the inheritance of being able to roll your tongue (rollers) and not being able to roll your tongue (non-rollers) over three generations. The gene for rolling your tongue (**R**) is dominant over the gene for not being able to roll your tongue (**r**).



2.3.1 Give the genotype of the following individuals in the diagram:

(a) **Father** (1)

(b) **Daughter 2** (1)

2.3.2 What is the chance that next child of **Father** and **Mother** can be another daughter? Express your answer as a percentage. (1)

2.3.3 Name the type of dominance shown by the inheritance of tongue rolling. (1)

2.3.4 Draw the pedigree diagram for this family illustrating the inheritance of tongue rolling according to the key. (4)
(8)

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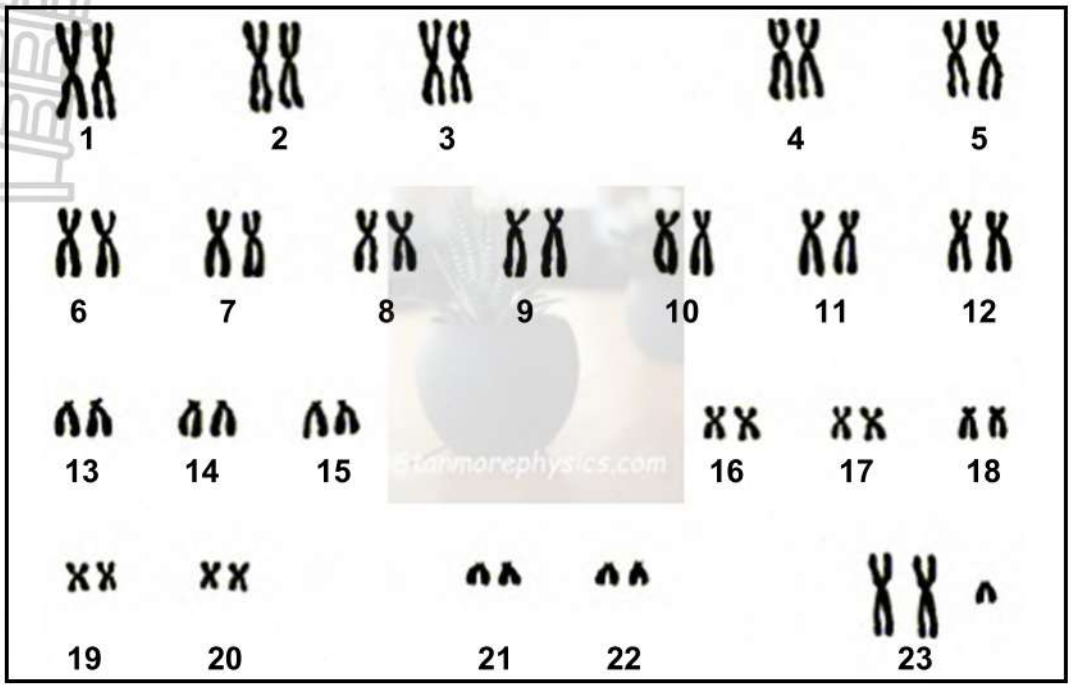
2.4 The diagram below represents a karyotype of a somatic cell of a human with a genetic disorder called Klinefelter syndrome. Klinefelter syndrome affects the sex chromosomes.



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]

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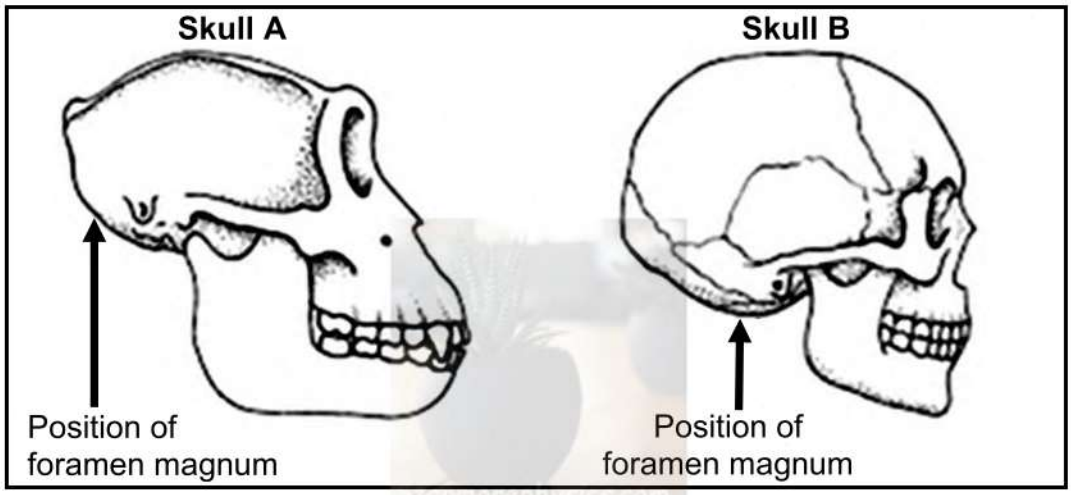
QUESION 3

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)

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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)**

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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:

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

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)

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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

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PROVINCIAL PREPARATORY EXAMINATION

GRADE 12

LIFE SCIENCES

PAPER 2

SEPTEMBER 2025

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 14 pages.

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PRINCIPLES RELATED TO MARKING LIFE SCIENCES

1. **If more information than marks allocated is given**
   Stop marking when maximum marks is reached and put a wavy line and 'max' in the right-hand margin.

2. **If, for example, three reasons are required and five are given**
   Mark the first three irrespective of whether all or some are correct/incorrect.

3. **If whole process is given when only a part of it is required**
   Read all and credit the relevant part.

4. **If comparisons are asked for, but descriptions are given**
   Accept if the differences/similarities are clear.

5. **If tabulation is required, but paragraphs are given**
   Candidates will lose marks for not tabulating.

6. **If diagrams are given with annotations when descriptions are required**
   Candidates will lose marks.

7. **If flow charts are given instead of descriptions**
   Candidates will lose marks.

8. **If sequence is muddled and links do not make sense**
   Where sequence and links are correct, credit. Where sequence and links are incorrect, do not credit. If sequence and links become correct again, resume credit.

9. **Non-recognised abbreviations**
   Accept if first defined in answer. If not defined, do not credit the unrecognised abbreviation, but credit the rest of the answer if correct.

10. **Wrong numbering**
    If answer fits into the correct sequence of questions, but the wrong number is given, it is acceptable.

11. **If language used changes the intended meaning**
    Do not accept.

12. **Spelling errors**
    If recognisable, accept the answer, provided it does not mean something else in Life Sciences or if it is out of context.

13. **If common names are given in terminology**
    Accept, provided it was accepted at the provincial memo discussion meeting.

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14. **If only the letter is asked for, but only the name is given (and vice versa)**
Do not credit.

15. **If units are not given in measurements**
Candidates will lose marks. Memorandum will allocate marks for units separately.

16. **Be sensitive to the sense of an answer, which may be stated in a different way.**

17. **Caption**
All illustrations (diagrams, graphs, tables, etc.) must have a caption.

18. **Code-switching of official languages (terms and concepts)**
A single word or two that appear(s) in any official language other than the learner's assessment language used to the greatest extent in his/her answers should be credited, if it is correct. A marker that is proficient in the relevant official language should be consulted. This is applicable to all official languages.

19. **Changes to the memorandum**
No changes must be made to the memorandum without the approval of the examiner and moderator.

20. **Official memoranda**
Only memoranda bearing the signatures of the provincial internal moderator and distributed by the Provincial Education Department via the districts must be used.

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SECTION A

QUESTION 1

1.1	1.1.1	B ✓✓		
	1.1.2	A ✓✓		
	1.1.3	D ✓✓		
	1.1.4	D ✓✓		
	1.1.5	A ✓✓		
	1.1.6	C ✓✓		
	1.1.7	C ✓✓		
	1.1.8	A ✓✓		
	1.1.9	C ✓✓		
	1.1.10	B ✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Cytokinesis ✓		
	1.2.2	Genome ✓		
	1.2.3	Haemophilia ✓		
	1.2.4	Homologous structures ✓		
	1.2.5	Continuous ✓ variation		
	1.2.6	Homologous chromosomes ✓		
	1.2.7	Theory ✓		
	1.2.8	Phenotype ✓		
	1.2.9	Spindle fibres ✓/spindle threads/spindle fibrils		
	1.2.10	Allele ✓ (not multiple alleles)	(10 x 1)	**(10)**
1.3	1.3.1	A only ✓✓		
	1.3.2	Both A and B ✓✓		
	1.3.3	None ✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) **B** – Adenine ✓		(1)
		(b) **C** – deoxyribose ✓ sugar		(1)
		(c) **D** – phosphate ✓ molecule		(1)
	1.4.2	(weak) hydrogen ✓/H bond		(1)
	1.4.3	Interphase ✓		(1)
				(5)

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1.5	1.5.1	- **Identify** bodies ✓/victims of disasters/crime - **Identify** inherited disorders ✓/organ donor - **Identify** criminal suspect ✓/forensic evidence pointing to possible suspect/exonerate falsely accused individuals - **Identify** different pathogens ✓/strands of viruses and bacteria - **Identify** animal/plants species ✓/manage conservation - **Trace** family history ✓/discover family relationships /genealogy - **Trace** wildlife populations ✓ **(Mark first TWO only)**	(2)
	1.5.2	Genes ✓/alleles	(1)
	1.5.3	Mia ✓	(1) **(4)**
1.6	1.6.1	Gene ✓ mutation	(1)
	1.6.2	46 ✓ chromosomes/23 (chromosome) pairs	(1)
	1.6.3	Males ✓	(1)
	1.6.4	X^KX^k ✓✓	(2) **(5)**
		TOTAL SECTION A:	**50**

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SECTION B

QUESTION 2

2.1 2.1.1

(a) **A** – nucleus ✓ (1)
(b) **B** – mRNA ✓/messenger RNA (1)
(c) **C** – ribosome ✓ (1)
(d) **1** – transcription ✓ (1)

2.1.2

- Carries hereditary characteristics ✓
- Controls the function of cells ✓
- Controls the synthesis (making/producing) of proteins ✓/ acts as a template for formation of mRNA

(Mark first ONE only) Any 1 (1)

2.1.3 (James) Watson, (Francis) Crick and (Maurice) Wilkens ✓✓ (2)

2.1.4

- Translation ✓*
- Each tRNA carries a **specific** amino acid. ✓
- When the anticodon on the tRNA ✓
- **matches** the codon on the mRNA ✓
- Then tRNA brings the required amino acid to the ribosome. ✓
- Amino acids become attached to each other by peptide bonds ✓
- to form the **required** protein. ✓

*1 compulsory mark + Any 5 (6)
(13)

2.2 2.2.1

- Production of **haploid** gametes ✓/cells
- The halving effect of meiosis overcomes the doubling effect of fertilisation ✓/maintaining a constant chromosome number
- Contributes to/ensures genetic variation ✓

(Mark first THREE only) (3)

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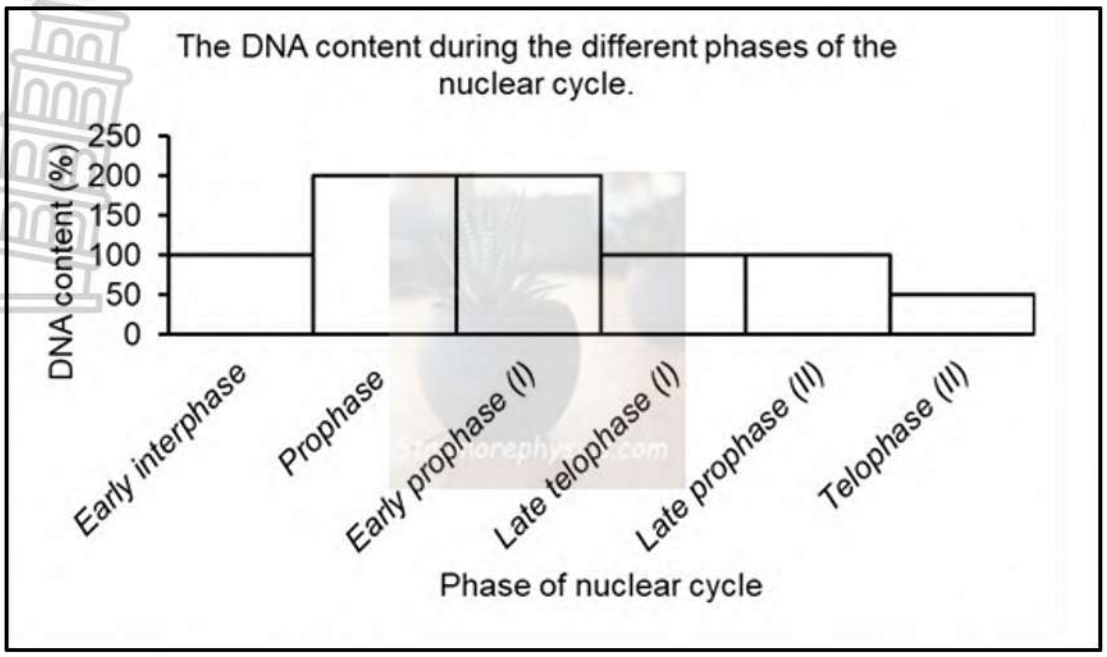
2.2.2



Guideline for assessing the graph:

SKILL	SYMBOL	MARK
Type of graph: histogram	**T**	**1**
Caption for graph: includes both variables ○ The relative amounts of DNA during **mitosis and meiosis** ○ The DNA content during the different phases of the nuclear cycle	**C**	**1**
Scale for Y-axis and width of bars on X-axis	**S**	**1**
Label for X-axis: Label and names of phases (accept if given in a key) Label for Y-axis: Label and unit	**L**	**1**
Drawing of bars	**B**	**1**: 1–5 correct bars **2**: All bars correct

NOTE:

If the wrong type of graph is drawn:	- Marks will be lost for type **(T)**
If axes are transposed:	-Marks will be lost for labeling **(L)** -Marks will be lost for scale **(S)**

(6)

2.2.3 (a) - DNA replication will take place ✓
- and the DNA content will double ✓/100 to 200 **(not increase)** (2)

(b) - The number of chromosomes will be halved ✓/ 100 to 50 chromosome pairs split (divide)
- during anaphase I ✓ /anaphase of meiosis I (2)

(13)

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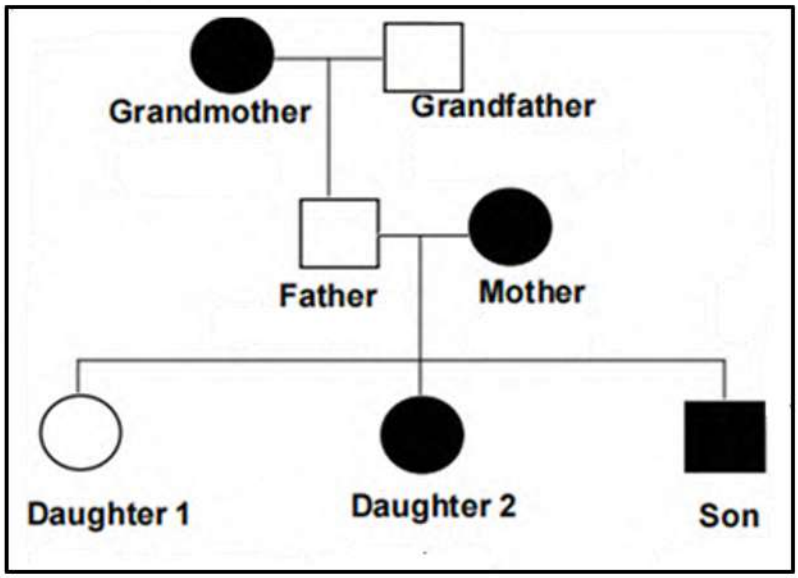
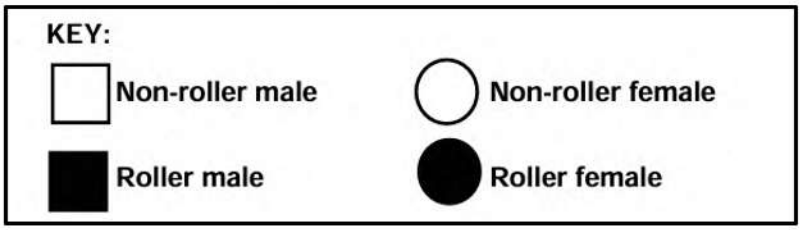
2.3 2.3.1 (a) rr ✓ (1)
(b) Rr ✓ (1)

2.3.2 50 ✓% (1)

2.3.3 Complete ✓ dominance (1)

2.3.4





Guideline for assessing the pedigree diagram:

SKILL	SYMBOL	MARK
Generation 1: Correct shapes and shading of connected grandparents	**G**	1
Generation 2: Correct shapes and shading of connected parents	**P**	1
Generation 3: Correct shapes and shading of connected children	**C**	1
Names of all individuals supplied **OR** **No names given: Key included** **OR** **Correct caption**	**N**	1

(4)
(8)

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2.4 2.4.1
- An organism possesses two alleles ✓/'factors' which separate (segregate) so that
- each gamete contains only one of these alleles ✓/'factors' (2)

2.4 2.4.2 Autosomes ✓ (1)

2.4.3 Male ✓ (1)

2.4.4
- The gonosomes ✓/chromosome pair number 23
- are not identical ✓/XY

OR

- There is a Y ✓/smaller chromosome
- at 23rd ✓ position/pair (2)

2.4.5
- During Anaphase ✓(1 or 2)
- the chromosomes pair number 23 ✓/gonosomes
- of the (female/male) parent does not separate ✓/there is non-disjunction in the person/parent
- A **gamete** with XX ✓/XY-chromosome formed ✓.
- During fertilisation the abnormal gamete/sperm/ovum fused with a normal gamete/sperm/ovum ✓
- to form the **zygote** with XXY ✓/47 chromosomes Any 4 (4)

(10)

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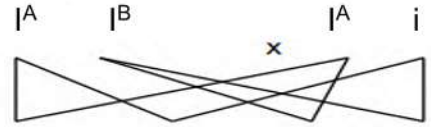
2.5 P_1 phenotype (Blood group) AB X (blood group) A ✓
Do not refer to heterozygous/homozygous

genotype I^AI^B X I^Ai ✓

Meiosis

Gametes/G

Fertilisation



F_1 genotype I^AI^A I^Bi I^AI^B I^Ai ✓

F_1 phenotype
(2/50%) blood group **A**
(1/25%) blood group **B**
(1/25%) blood group **AB** ✓

P_1 and F_1 ✓
Meiosis and fertilisation ✓ Any 6

OR

P_1 phenotype (Blood group) AB X (blood group) A ✓
Do not refer to heterozygous/homozygous

genotype I^AI^B X I^Ai ✓

Meiosis

Gametes	I^A	I^B
I^A	I^AI^A	I^AI^B
i	I^Ai	I^Bi

1 mark for correct gametes
1 mark for correct genotypes

Fertilisation

F_1 phenotype
(2/50%) blood group **A**
(1/25%) blood group **B**
(1/25%) blood group **AB** ✓

P_1 and F_1 ✓
Meiosis and fertilisation ✓ Any 6 **(6)**
[50]

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QUESTION 3

3.1
- The insulin producing gene is cut/isolated from the DNA of a human/ healthy pancreas ✓ and
- is inserted into the gene of bacterial DNA ✓/DNA of *E. coli*/plasmid
- this is recombinant DNA ✓/this bacterium is genetically modified
- and causes the bacterium/*E. coli*/culture to produce insulin ✓ **(4)**

3.2 3.2.1 *Homo sapiens* ✓ (1)

3.2.2 (Skull) **B** ✓ (1)

3.2.3
- Allows total awareness ✓of the environment/sees further over high grass
  to sense danger ✓/look for food
- Enables hands to be free ✓
  to use implements ✓/carry objects/protect offspring
- Exposes a large surface area ✓
  for thermoregulation ✓/losing body heat to surroundings in hot conditions/reduces overheating/uses less water
- Small surface area exposed to the sun, ✓
  reducing overheating ✓/use less water
- Displays (male/female) sex organs ✓
  as part of courtship behaviour ✓

(Mark first THREE only) Any 3 x 2 (6)

3.2.4

(Organism) A/Gorilla	(Organism) B/*Homo Sapiens*/ Humans
Cranial ridge ✓present	No cranial ridge ✓ present
Small(er) cranium ✓	Large(r) cranium ✓ **(Not 'brain/skull')**
Browridge well developed ✓	Browridge less developed ✓ **(Not 'no browridge')**
Large/well developed canines ✓ /fangs	Small/underdeveloped canines ✓ /no fangs
Jaws are prognathous ✓/Longer jaws/More protruding jaws	Jaws are non-prognathous ✓/ Shorter jaws/Less protruding jaws **(Not 'less prognathous')**
More pronounced zygomatic arches ✓	Less pronounced zygomatic arches ✓
Foramen magnum is more backward ✓	Foramen magnum is more forward ✓
Sloping face ✓/forehead	Flat face ✓/forehead

(Mark first THREE only) 1 ✓ Table + Any 3 x 2 (7)
(15)

3.3 3.3.1 - The change in characteristics of a species ✓
- over time ✓ (2)

3.3.2 - Squirrels with sparse hair ✓ resulted in lower(cooler) body temperatures ✓

- Good digging claws ✓ enabled them to dig (make tunnels) in the deep/cool sand. ✓ (4)

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3.3.3
- The original/ancestral **population** of the (ground) squirrels ✓
- became separated by the canyon ✓*/Grand Canyon/deep eroded Colorado River
- the population split into two ✓/divided into a north and south population
- the squirrels stopped crossing the canyon because there was no shelter ✓/shade/temperature too high/desert habitat
- there is no gene flow between the north and south population ✓/between the two squirrel populations
- In the south side it was warmer, with less shade ✓/the squirrels were exposed to heat
- in the north side it was cooler with more shade ✓/the squirrels were less exposed to heat/the exposure to heat differed in the north and south side
- natural selection occurs independently in each of the two populations ✓
- such that the individuals of the two populations **become different** ✓ from each other
- genotypically and phenotypically ✓
- even if the two populations were to mix again ✓
- they will not be able to interbreed ✓
- the two populations are the Abert and Kaibab squirrels ✓/are different species

*1 compulsory mark + Any 7 (8)

3.3.4
- Breeding at different times of the year ✓
- Species-specific courtship behavior ✓
- Plant adaptation to different pollinators ✓
- Infertile offspring ✓

(Mark first TWO only) Any 2 (2)

3.4
- There is a great deal of variation amongst the offspring ✓
- Some had favourable characteristics and some did not ✓
- There is a change in the environmental conditions ✓
- Whilst organisms with unfavourable characteristics, which made them less suited, died ✓
- Whilst organisms with favourable characteristics made them more suited, survived ✓ and
- Reproduce(d) ✓
- the allele for favourable characteristic is passed on to their offspring ✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristics ✓

Any 7 (7)

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3.5 3.5.1 (a) (Exposure to) DDT ✓/insecticide (1)

(b) Resistance of mosquitoes ✓ (1)

3.5.2 (a)
- **Decide on** the duration ✓ of the investigation
- **Decide on** the area ✓ to capture mosquitoes
- **Decide on** the sample size ✓
- **Decide on** date ✓/time of capturing mosquitoes
- **Decide on** the concentration of DDT ✓ used
- **Decide how** long the mosquitoes must be exposed to DDT ✓
- **Decide how** to record the results ✓/on the form to record the results
- **Decide on** type of mosquitoes ✓/species of mosquitoes
- **Ask permission** ✓ (from authorities/land-owner) to conduct the investigation
- **Select** apparatus ✓ to capture mosquitoes
- **Train** research assistants ✓

(Mark first TWO only) Any 2 (2)

(b)
- **Same** time (1 hour per day) ✓ for the duration of the investigation
- **Same** laboratory conditions ✓ for the full period of the investigation
- **Same** dose (4%) of DDT ✓ for the full period of the investigation
- **All** mosquitos must be healthy ✓ for the full period of the investigation

(Mark first TWO only) Any 2 (2)

(c)
- Mosquitoes developed a resistance to DDT ✓✓/ resistance to DDT will increase over time

OR

- DDT is an not an effective insecticide to control the spread of mosiquitoes ✓✓ (2)

(8)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

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