



Northern Cape Department of Education

**PROVINSIALE VOORBEREIDENDE EKSAMEN/
PROVINCIAL PREPARATORY EXAMINATION**

GRAAD/GRADE 12

LEWENSWETENSKAPPE/LIFE SCIENCES

VRAESTEL/PAPER 2

SEPTEMBER 2026

PUNTE/MARKS: 150

TYD/TIME: 2½ uur/hours

**Hierdie vraestel bestaan uit 15 bladsye./
This question paper consists of 15 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. Make ALL drawings in pencil and label them in blue or black 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 The position of a gene on a chromosome is called ...

- A a locus.
- B an allele.
- C a centromere.
- D a chiasma.

1.1.2 Crossing over is a mechanism which allows homologous chromosome pairs to ...

- A arrange themselves on the equator.
- B reduce genetic variation.
- C exchange DNA.
- D pair off with each other.

1.1.3 The evolutionary theory of punctuated equilibrium was proposed by ...

- A Darwin and Wallace.
- B Lamarck and Darwin.
- C Eldredge and Gould.
- D Wallace and Mendel.

1.1.4 The structure of DNA was determined by using X-ray pictures produced by ...

- A Watson and Crick.
- B Franklin and Wilkins.
- C Watson and Franklin.
- D Crick and Franklin.

1.1.5 The following statements are characteristics of DNA:

- (i) Double-stranded helix
- (ii) Sugar molecule is deoxyribose
- (iii) Found in the chloroplast
- (iv) Consists of T, A, G and C nitrogenous bases

Which of the statements are characteristics of DNA in plants?

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

1.1.6 Study the list below and answer the question.

- (i) Down syndrome
- (ii) Sickle cell anaemia
- (iii) Haemophilia
- (iv) Colour blindness

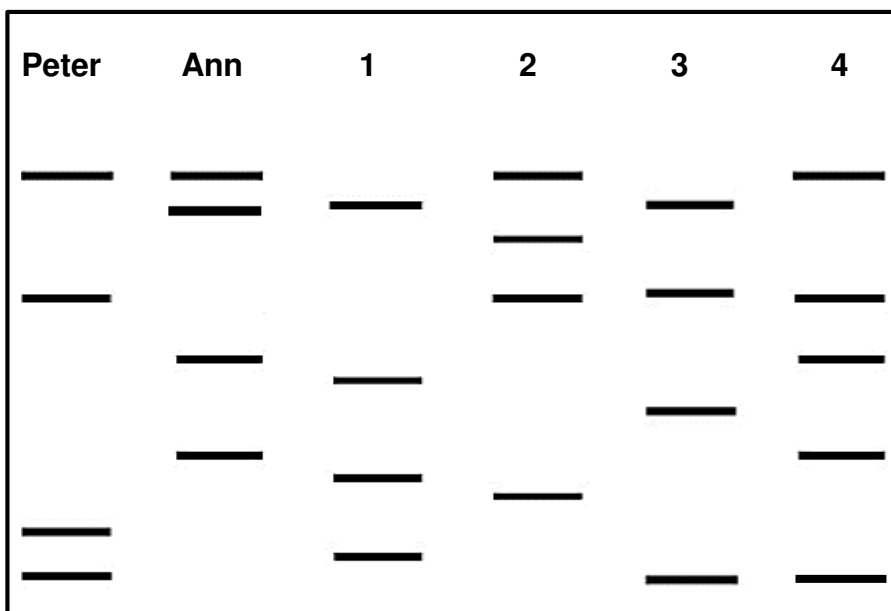
Which ONE of the following represents a sex-linked inheritance trait?

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

1.1.7 Ann and Peter's son passed away under circumstances where visual identification was not possible. DNA profiling was used as the most reliable method to confirm his identity.

The diagram below shows the DNA profiles of Peter, Ann and the four victims (1, 2, 3 and 4).

Which ONE of the following DNA profiles represents Ann and Peter's son?



- A 1
- B 2
- C 3
- D 4

1.1.8 Which ONE of the following describes the significance of DNA replication?

- A It ensures variation amongst offspring.
- B It ensures that the chromosome number remains constant.
- C It prevents the doubling of DNA at the end of meiosis.
- D It forms strands that are not identical to each other.

QUESTIONS 1.1.9 AND 1.1.10 REFER TO THE FOLLOWING GENETIC CROSSING:

In humans, having freckles (**F**) is dominant to not having freckles (**f**). Green eyes (**G**) are considered to be dominant over blue eyes (**g**). The inheritance of these traits is represented in the Punnet square below.

	 Male genotype FfGg				
 Female genotype Ffgg	Gametes	FG	Fg	fG	fg
	Fg	FFGg	FFgg	FfGg	1
	fg	2	Ffgg	3	4

1.1.9 Child number **2** would be ...

- A homozygous for having freckles and heterozygous for eye colour.
- B homozygous for both traits.
- C heterozygous for both traits.
- D homozygous for having no freckles and heterozygous for eye colour.

1.1.10 Which child has freckles and blue eyes?

- A **1**
- B **2**
- C **3**
- D **4**

(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 1.2.8) in the ANSWER BOOK.

- 1.2.1 The natural shape of RNA
- 1.2.2 The phase of the cell cycle during which DNA replication occurs
- 1.2.3 The building blocks that form DNA and RNA
- 1.2.4 A change in the sequence of nitrogenous bases resulting in the formation of a different protein
- 1.2.5 The nucleic acid inherited from mothers
- 1.2.6 The sugar present in RNA
- 1.2.7 The nitrogenous base which is present in RNA but not in DNA
- 1.2.8 A genetic inheritance where neither allele is dominant (8 x 1) **(8)**

1.3 Indicate whether each of the descriptions in COLUMN I apply 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	The type of variation where there is a range of intermediate phenotypes	A: Discontinuous B: Continuous
1.3.2	Influences the number of species on Earth	A: Extinction B: Speciation
1.3.3	The bond between two nitrogenous bases	A: Hydrogen bond B: Peptide bond

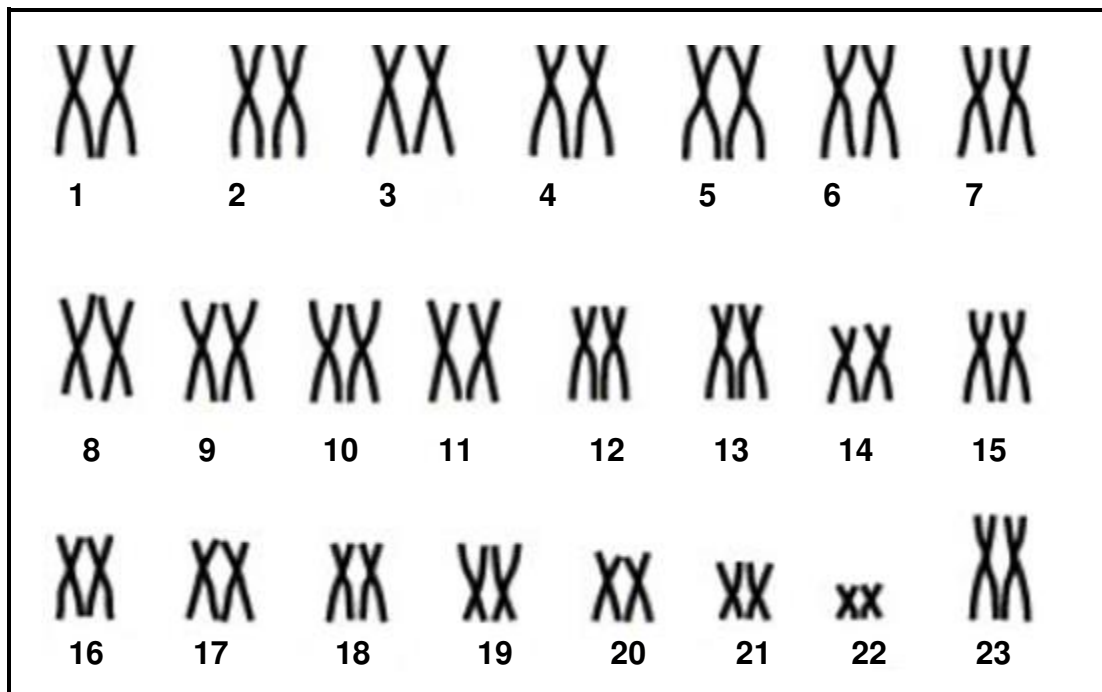
(3 x 2) **(6)**

- 1.4 The table below shows the blood groups of three brothers and their parents. Use the table to answer the questions that follow.

PERSON	BLOOD GROUPS
Keagan	B
Denwion	A
Ethan	O
Father	A
Mother	Not stated

- 1.4.1 How many alleles control the blood groups? (1)
- 1.4.2 Give the phenotype of the mother's blood group. (1)
- 1.4.3 Provide the genotype for the blood group of:
- (a) Keagan (1)
- (b) Denwion (1)
- 1.4.4 Name ALL the individuals who is/are ...
- (a) homozygous recessive. (1)
- (b) heterozygous for blood group **A**. (2)
- 1.4.5 Identify the type of dominance expressed in the blood groups as shown in the table above. (1)
- 1.4.6 A fourth child is born to this family.
- What is the chance in percentage of him/her having blood group **AB**? (1)
- (9)

- 1.5 The diagram below represents the set of chromosomes of a human somatic cell.



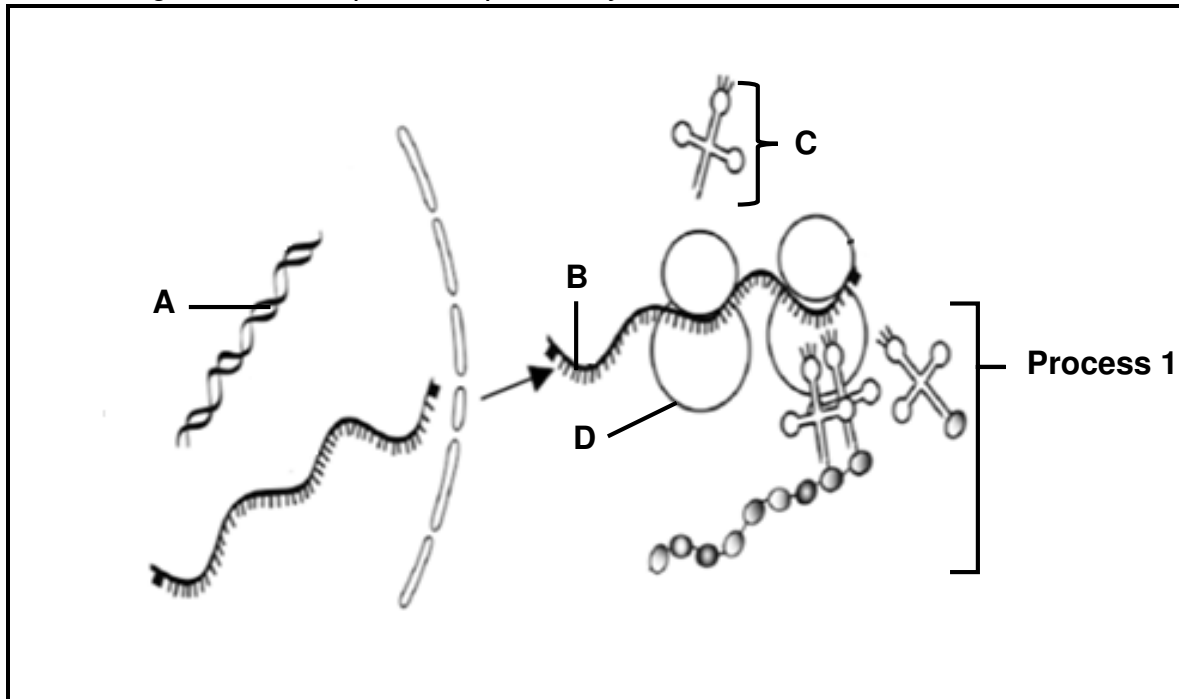
- 1.5.1 Name the type of diagram. (1)
- 1.5.2 How many autosomes are there in the nucleus of this cell? (1)
- 1.5.3 How will chromosome pair 23 differ if this was a cell of a male? (1)
- 1.5.4 If this individual had Down syndrome, give the number of:
- (a) The chromosome pair in the diagram that will be affected. (1)
 - (b) Chromosomes that will be at the position mentioned in QUESTION 1.5.4 (a). (1)
- 1.5.5 What is the biological term used when chromosome pairs do not separate during meiosis? (1)
- 1.5.6 Name the type of reproductive cell that results from meiosis in humans. (1)

(7)

TOTAL SECTION A: 50

SECTION B**QUESTION 2**

2.1 The diagram below represents protein synthesis.



2.1.1 Identify:

(a) Molecule **A** (1)

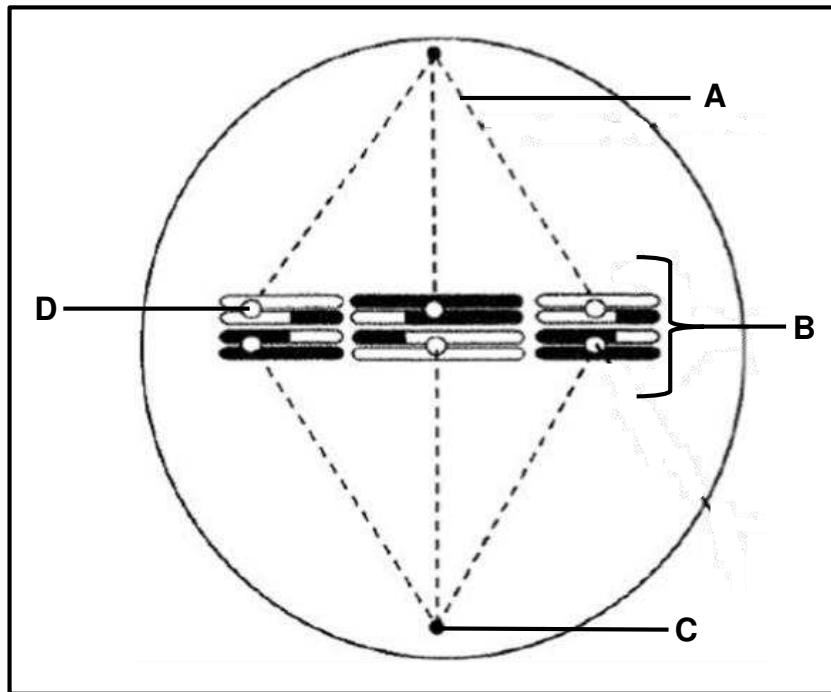
(b) Organelle **D** (1)

2.1.2 Where in the cell does **Process 1** take place? (1)

2.1.3 Explain the importance of molecule **C** during **Process 1**. (2)

2.1.4 Tabulate TWO differences between *transcription* and *DNA replication*. (5)
(10)

2.2 The diagram below represents a phase in meiosis.



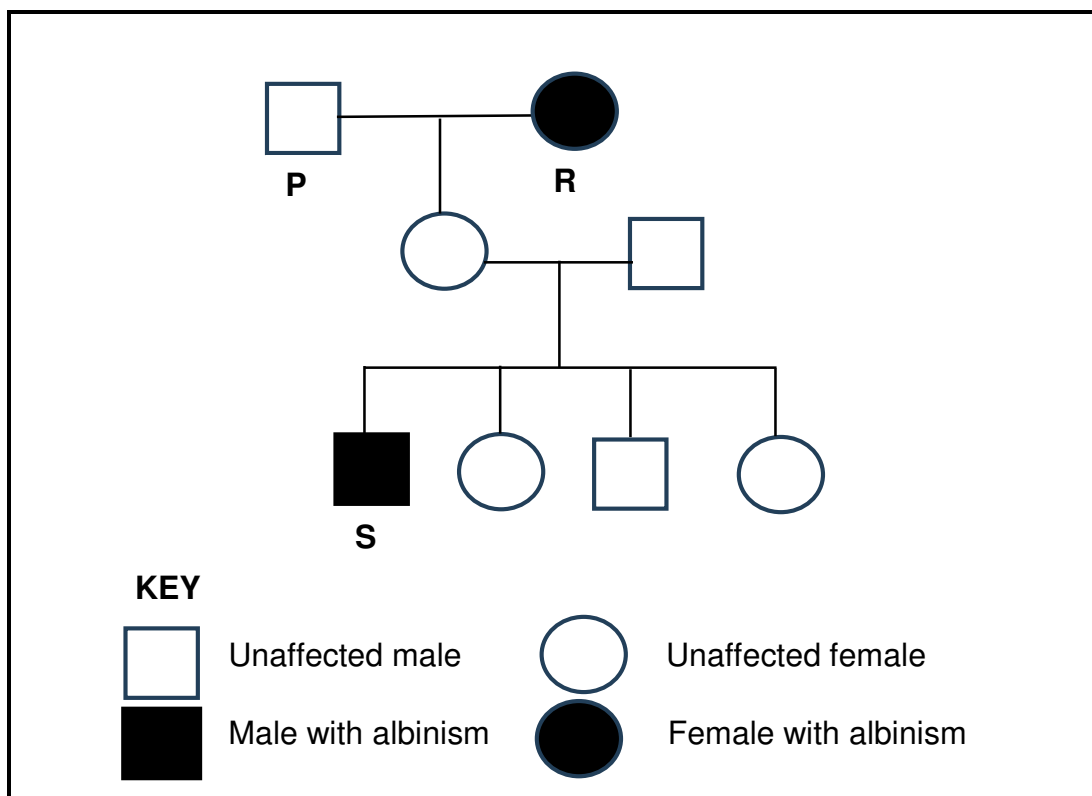
- 2.2.1 Give the LETTER and the NAME of the structure that will pull the chromosomes towards the opposite poles. (2)
- 2.2.2 Identify the phase of meiosis shown in the diagram. (1)
- 2.2.3 Provide ONE visible reason for the answer to QUESTION 2.2.2. (2)
- 2.2.4 Explain how the phase of meiosis, shown in the diagram, contributes to natural selection in species. (5)
- 2.2.5 Assume that a specific cell has FOUR chromosomes.

Draw TWO labelled diagrams to differentiate between Anaphase 1 and Anaphase 2 of meiosis in **this** cell.

DO NOT provide a label for structure **A** in your diagrams. (5)
(15)

- 2.3 Albinism is a genetic condition that is not sex-linked. People with albinism are unable to produce the pigment melanin in their skin cells. Melanin is the pigment that gives colour to the skin, hair and eyes. Albinism is caused when an individual is homozygous recessive for this characteristic.

The diagram below shows the inheritance of albinism in a family.



- 2.3.1 Indicate if the individuals below are homozygous dominant, homozygous recessive or heterozygous.

(a) **S** (1)

(b) **P** (1)

- 2.3.2 Explain how you reached your conclusion to QUESTION 2.3.1 (b). (3)

- 2.3.3 Calculate the percentage of the males in the family with albinism. (3)
(8)

- 2.4 Use a genetic cross to show how gender in human offspring is determined. (6)

- 2.5 Pea plants may be infected by viruses, thereby reducing the yield of pea seeds. A virus-resistant variety of pea plant was developed through genetic modification.

Two varieties of the same species of pea plants were grown:

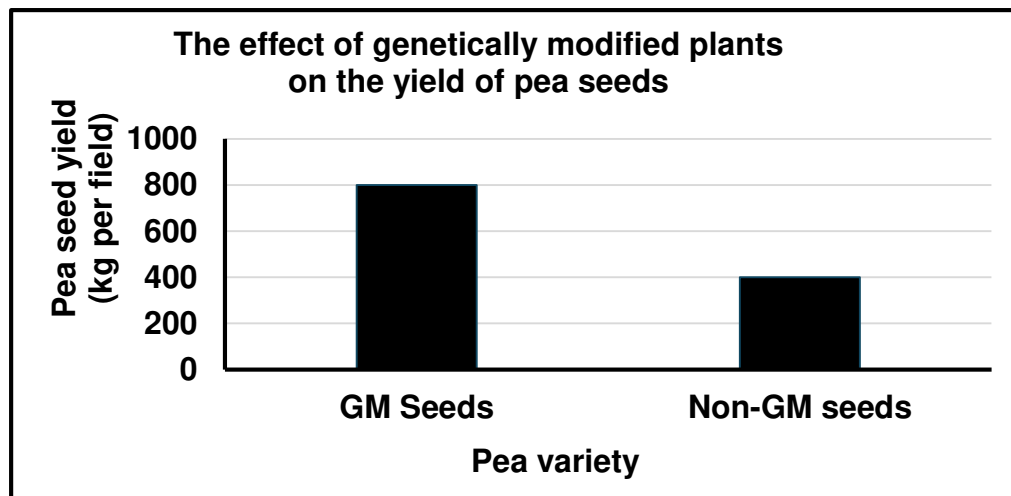
- The genetically modified pea seeds (**GM seeds**)
- Non-genetically modified pea seeds (**Non-GM seeds**)

Scientists wanted to investigate whether the genetically modified plants affect the yield of pea seeds.

The following method was used:

- Both seed types were grown in two separate fields of the same size.
- 400 pea seeds were grown in each field for each type of pea.
- 80 kg of NPK fertiliser was applied in each field.

The results of the investigation are shown in the graph below.



- 2.5.1 State the aim of this investigation. (2)
- 2.5.2 Give:
- (a) The dependent variable for this investigation. (1)
 - (b) ONE way in which the reliability of this investigation was ensured. (1)
 - (c) TWO factors that were kept constant during this investigation. (2)
- 2.5.3 Explain why the non-genetically modified seeds were included in the investigation. (3)
- 2.5.4 Give a conclusion based on the results of this investigation. (2)

(11)
[50]

QUESTION 3

- 3.1 In pea plants (*Pisum sativum*), purple flowers (**F**) are dominant over white flowers (**f**) and tall stems (**T**) are dominant over short stems (**t**).

A plant that is heterozygous for purple flowers and heterozygous for tall stems is crossed with a plant that has white flowers and short stems.

- 3.1.1 Identify the type of crossing represented in the scenario above. (1)

- 3.1.2 What is the genotype of the plant with white flowers and short stems? (1)

- 3.1.3 Two plants which are both heterozygous for both characteristics pollinate each other.

Give:

- (a) ALL possible gametes for the parent plants (2)

- (b) The phenotype of a plant with the genotype **FFtt** (1)
(5)

- 3.2 Read the extract below and answer the questions.

Today, capuchin monkeys spend most of their time moving through the upper parts of the forest trees. They have long, flexible tails that help them grip branches and maintain balance while climbing, which helps protect them from predators on the ground. Scientists believe that their early ancestors had much shorter tails and were less adapted to life high in the trees.

- 3.2.1 Give ONE advantage that capuchin monkeys with longer tails have. (1)

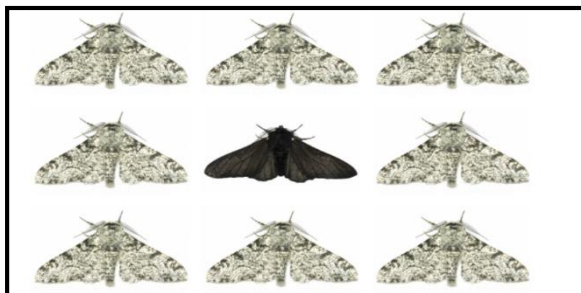
- 3.2.2 Using Lamarck's theory of evolution, explain the difference in the length of the tail of the capuchin monkey. (4)

- 3.2.3 Why were Lamarck's theories rejected? (2)
(7)

- 3.3 Describe how fossil evidence is used to support the 'Out of Africa' hypothesis. (5)

- 3.4 The following text describes how natural selection was observed in the peppered moth.

'JUMPING GENE' TOOK PEPPERED MOTHS TO THE DARK SIDE



The peppered moth (*Biston betularia*) demonstrated rapid evolution due to the Industrial Revolution. The Industrial Revolution took place when manual labour was replaced with machines and air pollution was introduced on Earth. As a result of increased air pollution, tree trunks and buildings became black in colour.

The moths were originally light-coloured but evolved to a darker form during the Industrial Revolution in the 19th century. In the 20th century, the lighter moth became common again as laws were introduced to reduce air pollution created by factories.

Only in 2016 did scientists discover that the dark colour was caused by a *jumping gene* mutation. A *jumping gene* is a specific segment of DNA that changes its position, through which the gene 'jumps' to a different location within a genome.

[Source: doi:10.1038/nature17951]

- 3.4.1 What is meant by a *biological species*? (2)
- 3.4.2 (a) Name the type of mutation which occurred in the pepper moth. (1)
- (b) Explain why this type of mutation is regarded as a useful mutation. (2)
- 3.4.3 Explain how the increase of air pollution benefited the dark-coloured moths in their competition for survival according to Darwin's evolution theory. (4)
- 3.4.4 Using the theory on natural selection describe why the light-coloured moths became increased in numbers during the 20th century. (2)
- (11)**

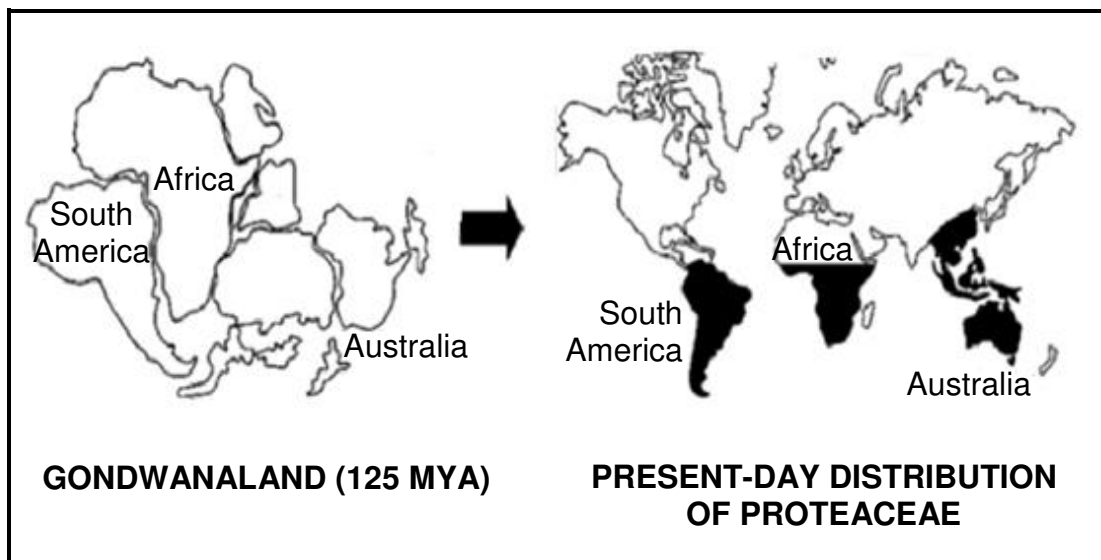
3.5 There are physical (anatomical) differences between African apes and humans. There are also characteristics that they share.

3.5.1 Name ONE characteristic of the hand of the African apes that they share with humans. (1)

3.5.2 Explain the significance of THREE evolutionary changes to the human skull. (6)

3.5.3 Explain the difference between the size of the teeth of humans and the African apes. (4)
(11)

3.6 Different species of *Proteaceae* can be found in the Southern Hemisphere. As illustrated in the diagram below, the waratah is found in Australia, the protea in South Africa and the Chilean Firebush in South America.



3.6.1 Explain how it happened that the plants were distributed across the Southern Hemisphere. (2)

3.6.2 Explain how speciation through geographic isolation took place in the *Proteaceae*. (7)

3.6.3 Describe how scientists would determine that the plants are different species. (2)
(11)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150