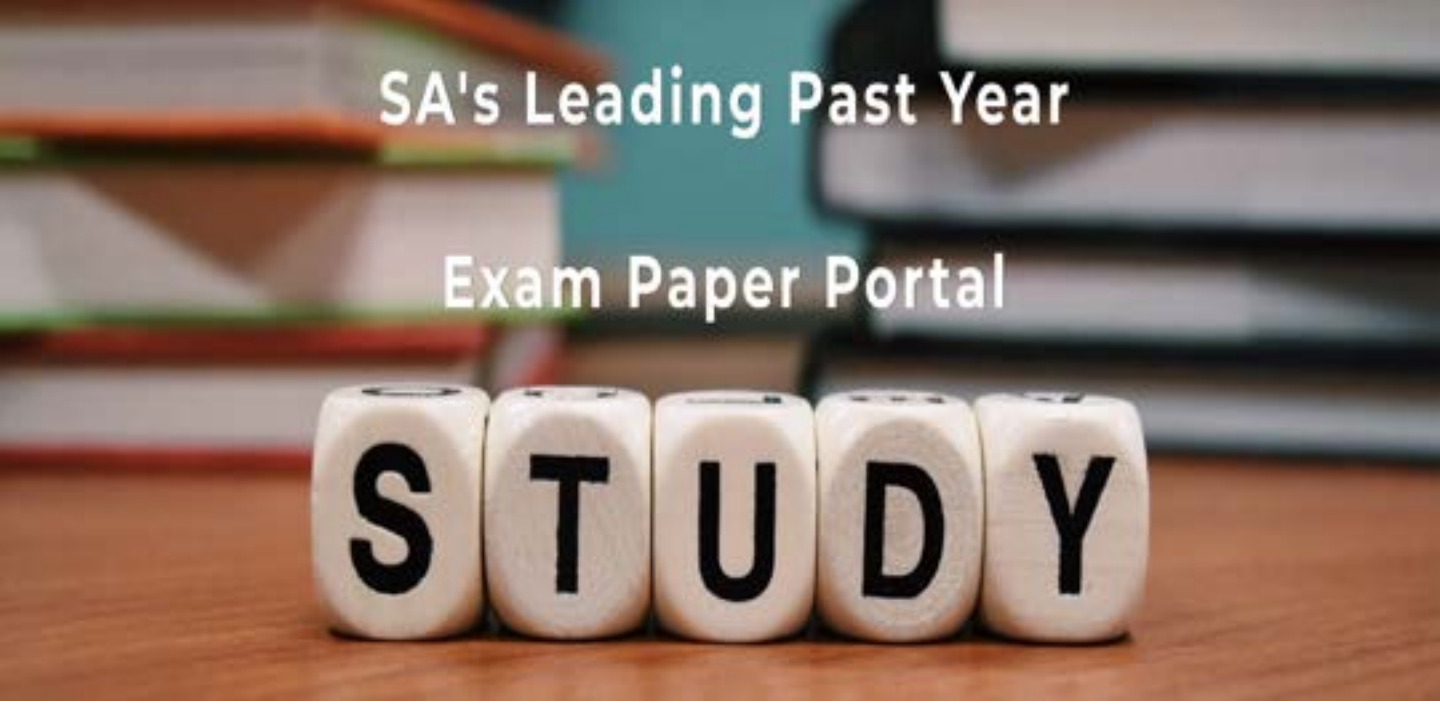

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SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2016

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 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 answer 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. ALL drawings must be done in pencil and labelled in blue or black ink.
7. Draw diagrams, flow charts or tables 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 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 to D) next to the question number (1.1.1 to 1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

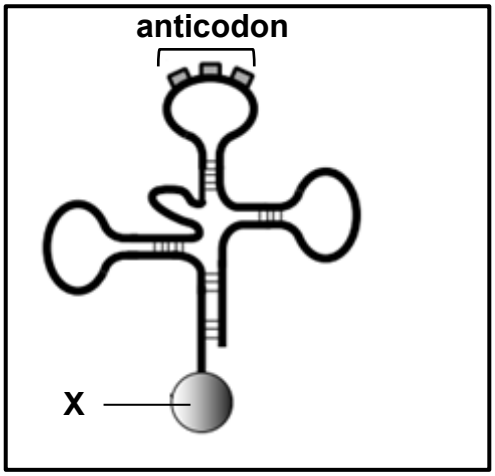
1.1.1 When a cell divides by meiosis it results in …

A four haploid gametes.
B two diploid gametes.
C four haploid somatic cells.
D two haploid somatic cells.

1.1.2 Individuals of the same species may show genetic variation due to …

A mitosis and meiosis only.
B meiosis only.
C mutations, random mating and random fertilisation only.
D meiosis, mutations, random mating and random fertilisation.

QUESTIONS 1.1.3 AND 1.1.4 ARE BASED ON THE DIAGRAM BELOW, WHICH REPRESENTS A tRNA MOLECULE.



1.1.3 The structure above is involved in the process of …

A transcription.
B replication.
C translation.
D crossing over.

1.1.4 Molecule **X** represents …

A DNA.
B an amino acid.
C a nucleic acid.
D three nucleotides.

QUESTIONS 1.1.5 AND 1.1.6 ARE BASED ON THE INFORMATION AND TABLE BELOW.

The wild sunflower has been cultivated (grown) by humans over several generations. During that time, certain characteristics were artificially selected. A comparison of some of the characteristics of wild sunflowers and cultivated sunflowers is given in the table below.

CHARACTERISTIC	WILD SUNFLOWER	CULTIVATED SUNFLOWER
Fruit weight	9–10 mg	55–65 mg
Plant height	150–170 cm	120–136 cm
Flower size (radius)	3–5 cm	9–11 cm
Number of branches	12–16	0
Leaf area	180–270 cm^2	300–315 cm^2

[Adapted from http://journals.plos.org/plosone/article/figure/image]

1.1.5 A possible reason for selecting sunflowers with a greater fruit weight is to …

A provide a greater yield of seeds.
B improve the chances of fertilisation.
C have genetic variation.
D allow the plant to grow taller.

1.1.6 Below are possible reasons for selecting each characteristic.

(i) A larger leaf area increases the rate of photosynthesis.
(ii) A shorter plant will result in more effective harvesting.
(iii) A larger flower will increase yield.
(iv) More branches will increase flower yield.

Which combination gives the correct reasons for the characteristics selected?

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

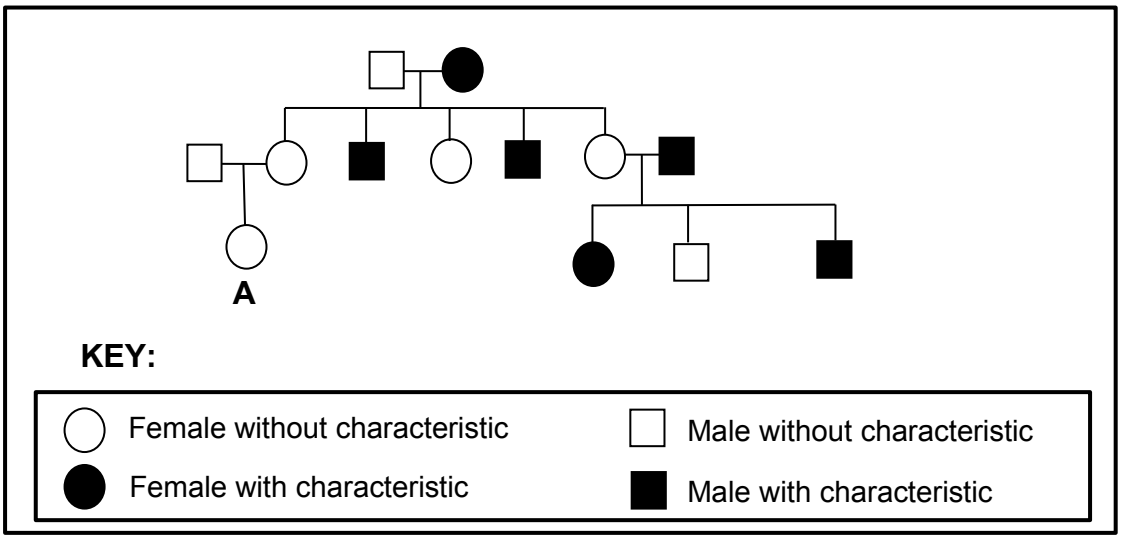
1.1.7 A bacterial infection was treated with a new drug and all the treated patients recovered. One week later the infection returned in some patients.

From these observations one can reasonably conclude that …

A the patients developed resistance to the drug.
B the bacteria developed resistance to the drug through natural selection and their numbers increased.
C the decrease in the infection allowed the bacteria to develop resistance to the drug.
D a few of the resistant bacteria were present at the start of treatment and that natural selection increased their numbers.

QUESTION 1.1.8 IS BASED ON THE PEDIGREE DIAGRAM BELOW.

The pedigree diagram shows inheritance of a certain characteristic.



1.1.8 Use $\mathbf{X^N}$ and $\mathbf{X^n}$ to represent the relevant alleles of the characteristic. The possible genotype(s) of individual **A** will be …

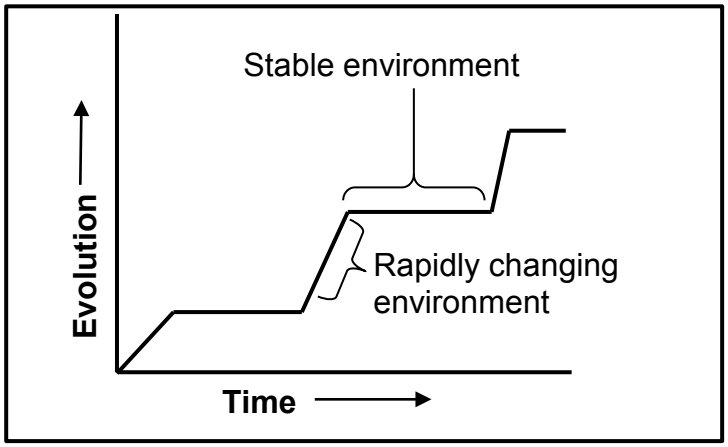
A X^NX^n only.
B X^NX^N only.
C X^NX^N and X^NX^n.
D X^NX^N and X^nX^n.

1.1.9 A man with blood group **A** and a woman with blood group **B** have children. Their first child has blood group **AB** and the second child has blood group **O**.

Which prediction about the blood groups of future children is CORRECT?

A Future children have a 50% chance of having blood group **AB** and a 50% chance of having blood group **O**.
B All will have blood group **A** or **B**.
C Each future child will have an equal chance of having blood group **A**, **B**, **AB** or **O**.
D None of the future children will have blood group **A**.

1.1.10 The graph below shows the pace at which evolution occurs in a species of butterfly.



The type of evolution represented above is …

A speciation.
B inheritance of acquired characteristics.
C punctuated equilibrium.
D artificial selection. (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 number (1.2.1 to 1.2.9) in the ANSWER BOOK.

1.2.1 A genetic cross involving two different characteristics

1.2.2 The variety of life forms that exist on Earth

1.2.3 The opening in the skull through which the spinal cord enters

1.2.4 A group of organisms of the same species living in the same habitat at the same time

1.2.5 A testable statement that can be accepted or rejected

1.2.6 A genetic disorder resulting in the non-production of the clotting factor in blood

1.2.7 Total disappearance of a species from Earth

1.2.8 A segment of a chromosome that codes for a particular characteristic

1.2.9 The ability of an organism to walk on two limbs (9 x 1) **(9)**

1.3 THREE babies (**X**, **Y** and **Z**) from three different sets of parents were born in a hospital. TWO of the babies were accidentally swopped. Blood groups of the parents were used to establish which baby belonged to which set of parents.

The blood groups of the parents and the babies are shown in the table below.

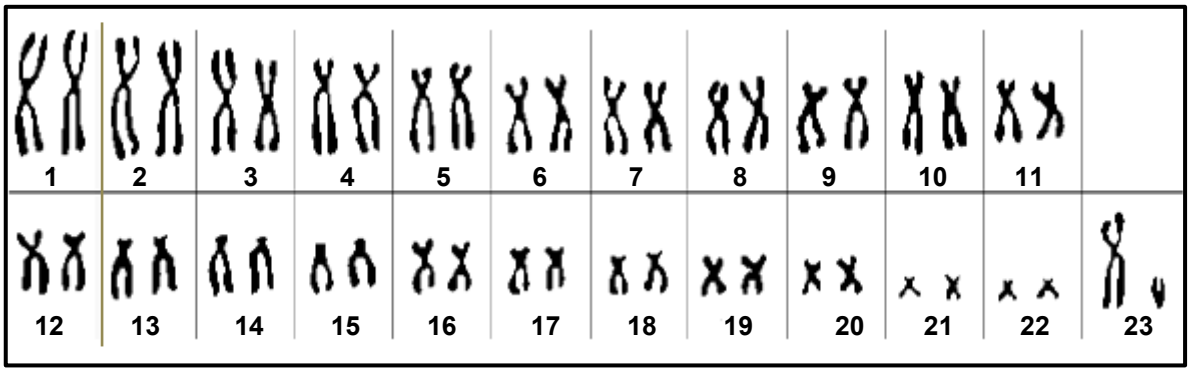
PARENTS	BABIES	BLOOD GROUPS OF PARENTS AND BABIES		
		Mother	Father	Baby
Mr and Mrs Pule	X	B	A	A
Mr and Mrs Chaka	Y	AB	B	O
Mr and Mrs Tau	Z	O	B	AB

1.3.1 Which TWO babies (from **X**, **Y** and **Z**) were swopped? (2)

1.3.2 Give the surnames of the biological parents of the two babies that were swopped. Write the correct surnames of the parents next to the letter (**X**, **Y** or **Z**). (2)

1.3.3 Give the possible genotype(s) of Mr Pule that could have produced baby **X**. (2)
(6)

1.4 The diagram below shows a karyotype.



1.4.1 How many of the following are present in the karyotype:

(a) Chromosomes (1)

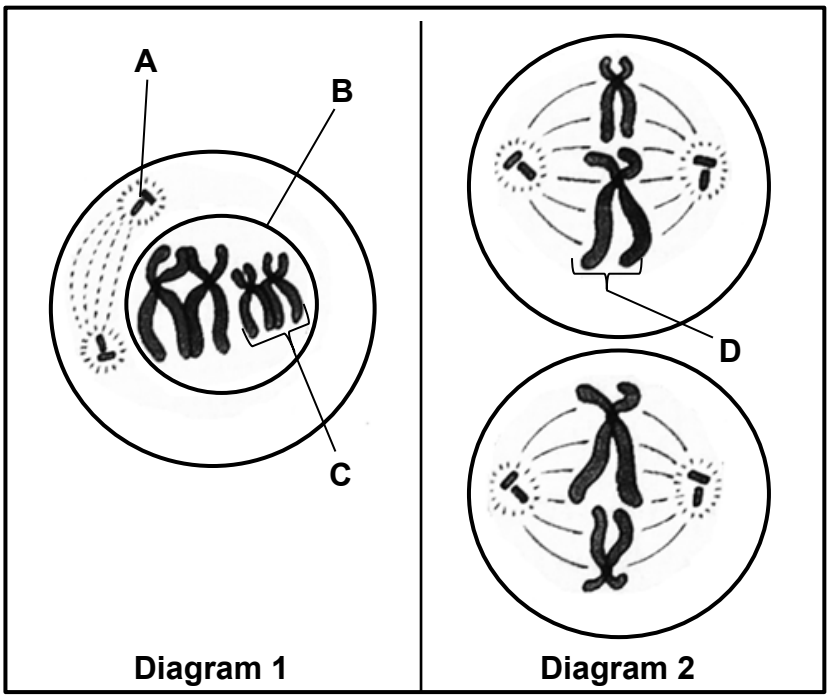
(b) Autosomes (1)

(c) Gonosomes (1)

1.4.2 How many chromosomes would be present in the gametes produced by this individual? (1)

1.4.3 Is the karyotype in the diagram that of a male or a female? (1)
(5)

1.5 The diagrams below represent a cell in two different phases of meiosis.



1.5.1 Which phase is represented in:

(a) Diagram **1** (1)

(b) Diagram **2** (1)

1.5.2 Provide labels for:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

1.5.3 Give the functions of the parts labelled:

(a) **A** (2)

(b) **D** (1)

1.5.4 Are the cells in Diagram **2** haploid or diploid? (1)

1.5.5 Name the process that would have caused variation in structure **D**. (1)
(10)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 In rabbits, black fur is produced by the allele (**B**) and white fur by the allele (**b**).

The table below shows the genotypes of some rabbits.

RABBIT	GENOTYPE
1	BB
2	Bb
3	bb

2.1.1 What is the phenotype:

(a) Produced by the recessive allele (1)

(b) Of rabbit **2** (1)

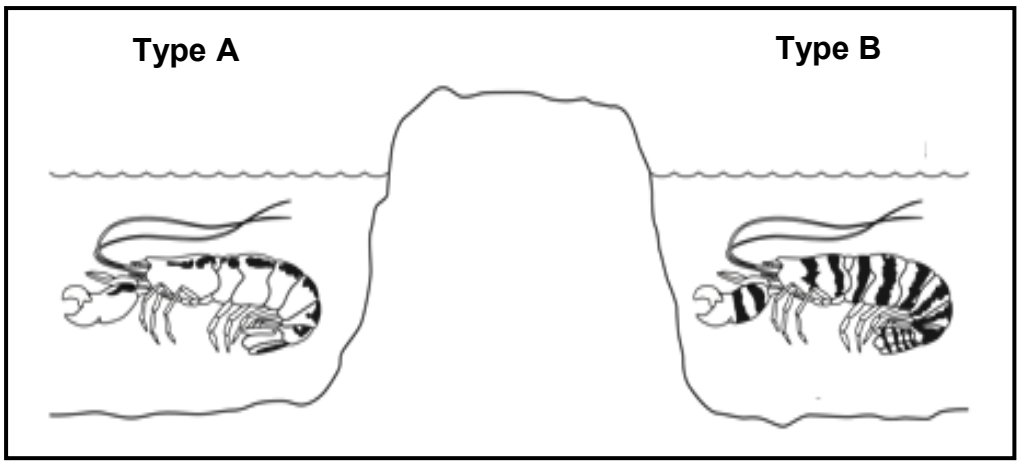
2.1.2 Give the NUMBER only (**1**, **2** or **3**) of the rabbit(s) that is/are:

(a) Pure-bred

(b) Homozygous dominant (3)

2.1.3 Use a genetic cross to show the percentage chance of rabbits **1** and **3** having offspring with white fur. (6)
(11)

2.2 The diagram below represents two types of shrimp. Each type lives in shallow seas on opposite sides of a strip of land.



[Adapted from www.pbs.org/wgbh/evolution/library]

In an investigation to determine whether the two types of shrimp were from one species, scientists placed type **A** shrimps and type **B** shrimps together in a tank of seawater.

Although the shrimps mated with their own types, the two types of shrimp did not mate with each other. The scientists repeated the investigation several times and obtained the same result each time.

2.2.1 Give ONE conclusion the scientists came to after the investigation. (1)

2.2.2 Explain your answer to QUESTION 2.2.1. (2)

2.2.3 Why did the scientists repeat the investigation? (1)
(4)

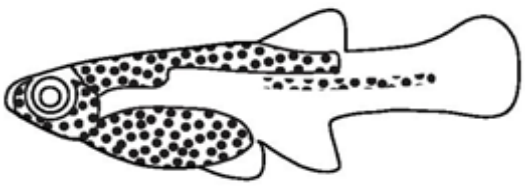
2.3 Describe how speciation occurs through geographic isolation. **(5)**

2.4 A scientist used guppies (*Poecilia reticulata*) in an investigation to test Darwin's theory of natural selection.

Male guppies have brightly coloured spots to attract females, but these spots also attract predators.

It was previously observed that males living in streams where there were many predatory fish tended to have fewer spots. This reduced their risk of being eaten.

Those males living in streams with fewer predators had more spots.



The guppy showing spots

[Adapted from http://www.decodedscience.org]

The procedure of the investigation was as follows:

- Equal numbers of male and female guppies were put in two ponds (pond **1** and pond **2**).
- In pond **1**, predatory fish that prey on guppies were introduced.
- In pond **2**, predatory fish that do not feed on guppies were introduced.
- The guppies were allowed to breed for 20 months, representing several generations of guppies. (Guppies reproduce when they are about three months old.)

The result of the investigation was:

The male guppies in pond **2** had significantly more spots than the male guppies in pond **1**.

2.4.1 How could the validity of this investigation be increased? (2)

2.4.2 Identify the:

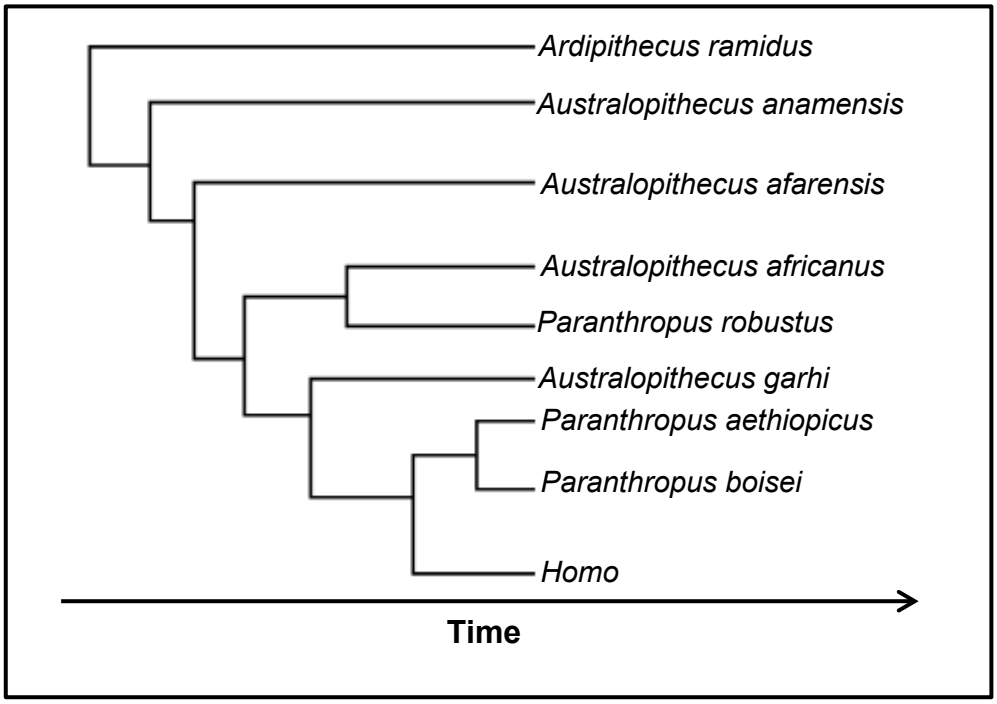
(a) Independent variable (1)

(b) Dependent variable (1)

2.4.3 Explain why the scientist included pond **2** in this investigation. (3)

2.4.4 Describe how Darwin's theory of natural selection can be used to explain why the guppies in pond **1** had fewer spots. (5)
(12)

2.5 The diagram below shows possible evolutionary relationships between hominids.



[Source: http://tolweb.org/tree]

2.5.1 What is this type of diagram called? (1)

2.5.2 How many genera are shown in the diagram above? (1)

2.5.3 According to this diagram, which:

(a) Genus is most recently evolved (1)

(b) Genus is the oldest (1)

(c) Hominid share a common ancestor with *Australopithecus africanus* (1)

2.5.4 Give ONE example of an *Australopithecus africanus* fossil found in South Africa. (1)

2.5.5 Name TWO *Homo* species, besides *Homo sapiens,* that were found in Africa. (2)
(8)
[40]

QUESTION 3

3.1 In rice plants the allele for high yield (**H**) is dominant over the allele for low yield (**h**). The allele for a tall stem (**T**) is dominant over the allele for a short stem (**t**).

There are two varieties of rice plants, **A** and **B**.
The genotype of variety **A** is **HHtt**.
The genotype of variety **B** is **hhTT**.

A plant breeder wants to produce a rice plant variety with a high yield and a short stem.

3.1.1 Give the phenotype of variety **A**. (2)

3.1.2 Give ALL the possible genotypes of the gametes of variety **B**. (1)

3.1.3 Give the genotype(s) of the variety the plant breeder wants to produce. (2)

3.1.4 Explain why the plant breeder would want to produce a rice plant with a short stem. (1)

3.1.5 Describe how the plant breeder would be able to produce rice plants with a high yield and short stems only. (2)
(8)

3.2 Tabulate THREE differences between *Lamarckism* and *Darwinism*. **(7)**

3.3 Humans and African apes share many characteristics, yet each is a distinct species.

3.3.1 Name FIVE characteristics that humans share with African apes. (5)

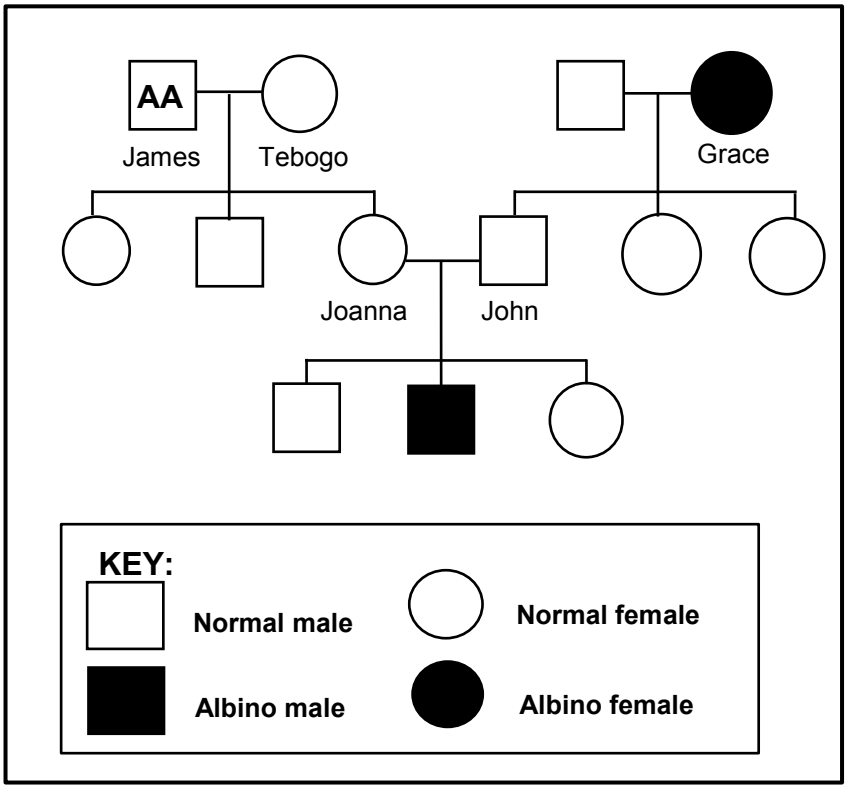
3.3.2 Describe how each of the following structures is different between humans and apes:

(a) Spine (2)

(b) Pelvic girdle (2)

3.3.3 Explain the significance of the changes to the teeth of humans that show progression in evolution. (4)
(13)

3.4 Albinism is an inherited condition caused by a recessive gene mutation. This mutation results in the absence of the protein melanin in the skin. The pedigree diagram below shows the inheritance of albinism in a family. The genotype of James is shown in the diagram.



3.4.1 How many grandsons do James and Tebogo have? (1)

3.4.2 What is:

(a) Grace's phenotype (1)

(b) John's genotype (2)

3.4.3 John and Joanna wish to have another child. What is the percentage chance that the child will:

(a) Be a girl (1)

(b) Have albinism (1)
(6)

3.5 Describe how a gene mutation may result in the formation of a protein that is different from the one that is required. **(6)**
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe the location, structure and functions of the DNA molecule and the process whereby copies of this molecule are made.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

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