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EXAMINATION	NATIONAL SENIOR CERTIFICATE
GRADE	12
DATE	NOVEMBER 2024
SUBJECT	LIFE SCIENCES
PAPER	2
MARK TOTAL	150
DURATION (HOURS)	2½
NUMBER OF PAGES	19

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions:

1. Answer **ALL** questions.
2. Write **ALL** the answers in your **ANSWER BOOK**.
3. Start the answers to each question at the top of a **NEW** page.
4. Number the answers according to the numbering system used in the question paper.
5. Present your answers according to the instructions of each question.
6. **ALL** drawings should be done in pencil and labelled only 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. You may use non-programmable calculators, protractors and compasses.
10. Write neatly and legibly, **ONLY** in blue ink.

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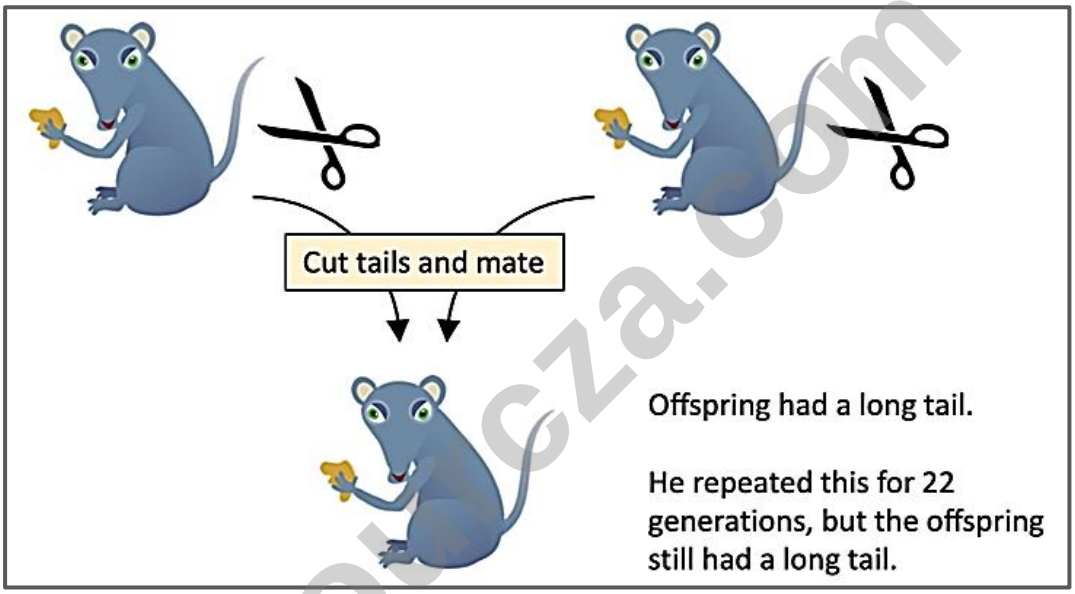
SECTION A

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 to D) next to the question numbers (1.1.1 to 1.1.10), for example 1.1.11. D.

1.1.1 The diagram below illustrates an investigation done by a scientist called Weismann.



Which one of the following statements is a correct description of the aim of Weismann's investigation?

A To disprove Lamarck's law of use and disuse

B To proof Darwin's theory of survival of the fittest

C To disprove Lamarck's law of inheritance of acquired features

D To proof James Hutton's theory of gradualism (2)

1.1.2 Genetics is the study of …

A protein synthesis.

B inheritance.

C gamete production.

D DNA replication. (2)

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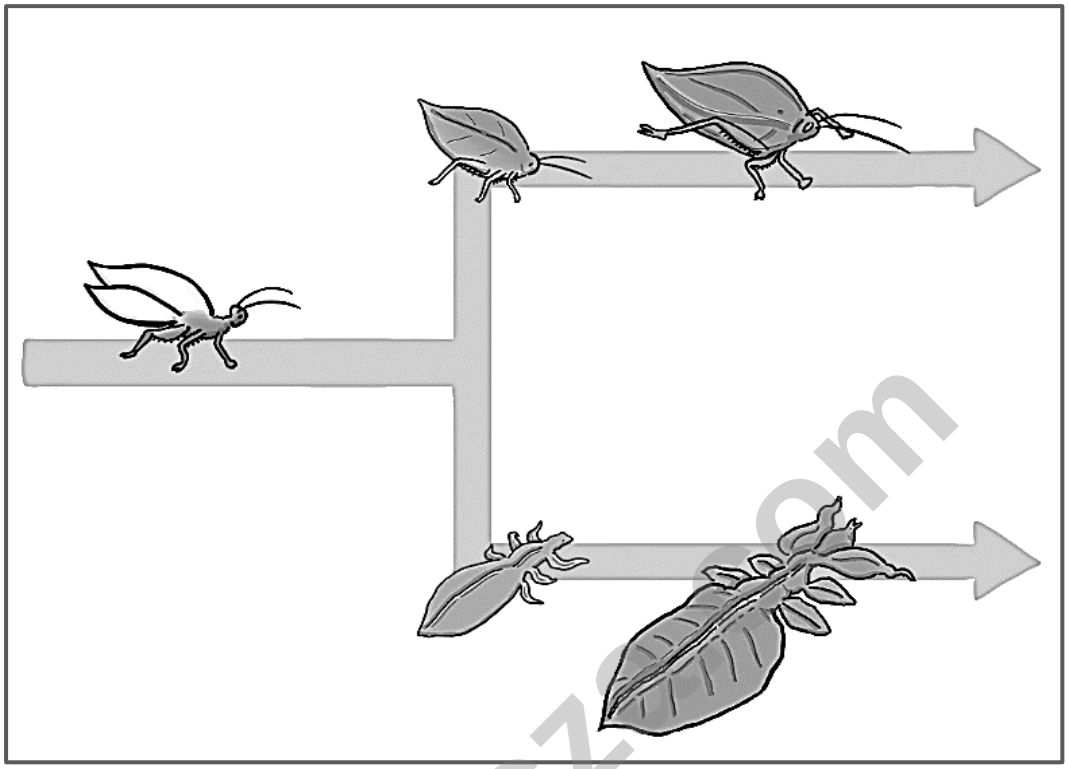
1.1.3 The diagram below illustrates a process that occurs during evolution.



The process illustrated in the diagram is:

A Gradualism

B A behavioural pattern

C Punctuated equilibrium

D Anagenesis (2)

1.1.4 Consider the list of features below:

i) Short and wide pelvis
ii) Wide ribcage
iii) Binocular/stereoscopic vision
iv) Freely rotating arms
v) Short arms in relation to body

Which of the above statements are applicable to gorillas?

A i), ii) and iv)

B ii), iii) and iv)

C ii) and iv)

D i), iii) and v) (2)

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1.1.5 Plasmids are used in genetic engineering due to their ability to …

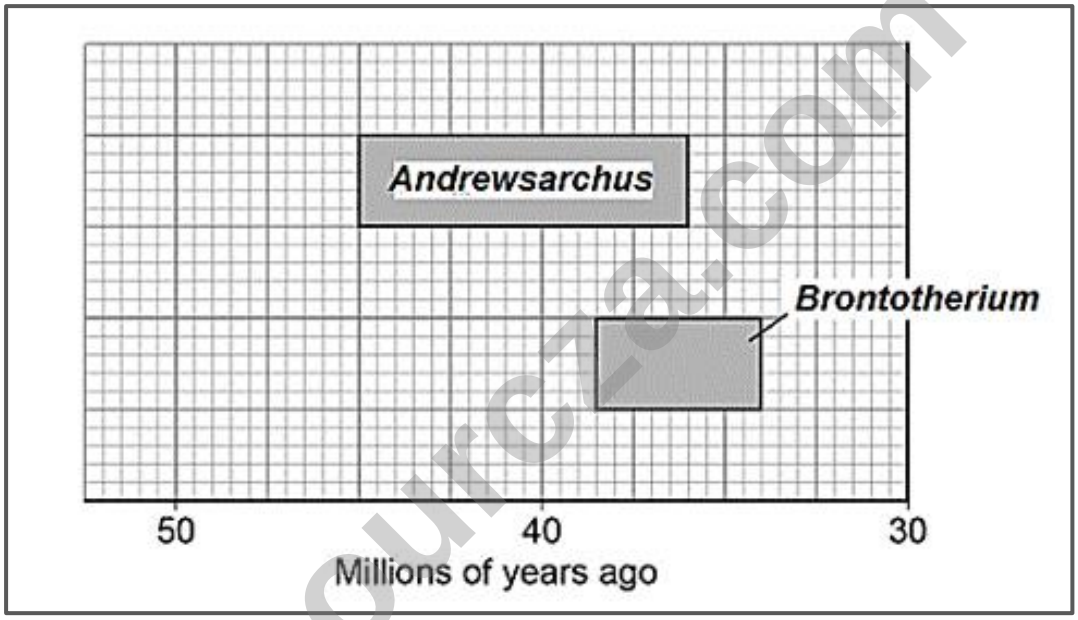
A cut a gene very precisely.

B change their shape.

C connect a foreign gene to an existing gene.

D carry foreign genes into a cell. (2)

1.1.6 The diagram below illustrates the period when two mammals existed in Asia.



For how many years did *Andrewsarchus* and *Brontotherium* exist together?

A 2,5 million years

B 4,5 million years

C 250 000 years

D 3 million years (2)

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1.1.7 In cats the alleles TT yields a cat with a normal long tail. A heterozygous cat will be born with a short or absent tail and is called a Manx cat. The presence of a homozygous recessive condition is lethal to an embryo.

Which row below is the correct description of the phenotypes of the offspring from the breeding of two Manx cats?

	Cat with tail	Manx cat	No development to birth
A	0%	25%	50%
B	50%	0%	50%
C	25%	50%	25%
D	50%	50%	0%

(2)

1.1.8 The chromosome composition of a human individual who inherits an X chromosome from the father is:

A 44 and XX

B 46 and XX

C 44 and XY

D 46 and XY (2)

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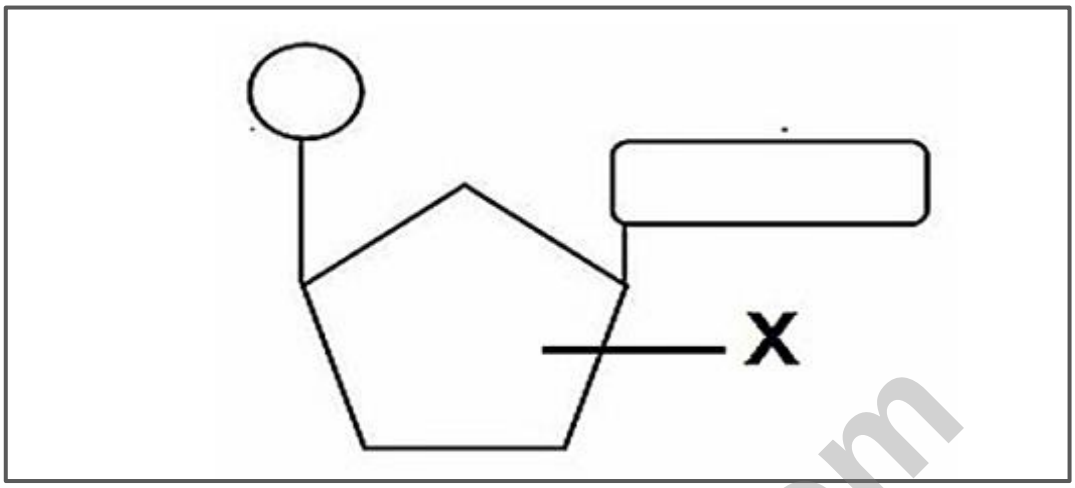
1.1.9 The diagram below illustrates the structure of a DNA nucleotide.



Structure **X** is:

A Ribose

B Deoxyribose

C A phosphate group

D A nitrogenous base (2)

1.1.10 Which one of the following was the first *Homo* species to move out of Africa?

A *Homo sapiens*

B *Homo neanderthalensis*

C *Homo ergaster*

D *Homo erectus* (2)

(10x2) **[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 1.2.7) in the ANSWER BOOK.

1.2.1 The study of the distribution of species in specific geographic regions over geological time

1.2.2 Digits such as the human thumb and forefinger which can be used to make a precision grip

1.2.3 The bonds that hold amino acids together in a protein

1.2.4 The most widely accepted hypothesis as explanation about the origins of modern humans

1.2.5 The range of species and the number of organisms making up each species within communities

1.2.6 The fossil known as Handy man

1.2.7 The scientist who is regarded as the "Father of Genetics" (7x1) **[7]**

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 1.3.5), in the ANSWER BOOK.

	COLUMN I		COLUMN II
1.3.1	The type of cell division that takes place in flowering plants	A	Meiosis
		B	Mitosis
1.3.2	Evidence used to support the origin of human evolution by tracing the maternal lineage	A	Mitochondrial DNA
		B	Y chromosome
1.3.3	Inheritance is linked to a sex chromosome	A	Sickle cell anaemia
		B	Colour blindness
1.3.4	Produce new alleles	A	Mutation
		B	Meiosis
1.3.5	Cells that undergo meiosis I	A	Haploid cells in the ovary
		B	Liver cells

(5x2) **[10]**

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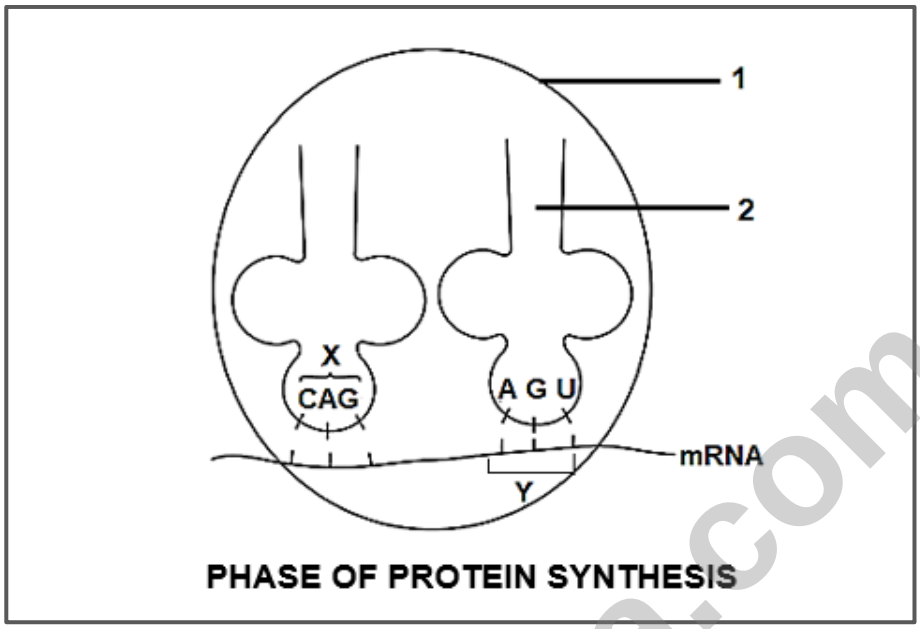
1.4 The diagram below illustrates a phase of protein synthesis. Study the diagram and answer the questions that follow.



1.4.1 Identify the phase of protein synthesis illustrated in the diagram above. (1)

1.4.2 Identify the parts numbered:

a) **1** (1)

b) **2** (1)

1.4.3 Give the name for the three consecutive nitrogen bases labelled **X**. (1)

1.4.4 Write down the sequence of the nitrogen bases on the part labelled **Y**. (1)

1.4.5 Give the full name for the abbreviation *mRNA*. (1)

1.4.6 Explain the function of mRNA in protein synthesis. (3)

1.4.7 Tabulate TWO differences in the **physical structure** of a DNA molecule and a mRNA molecule. (4)

[13]

TOTAL SECTION A: [50]

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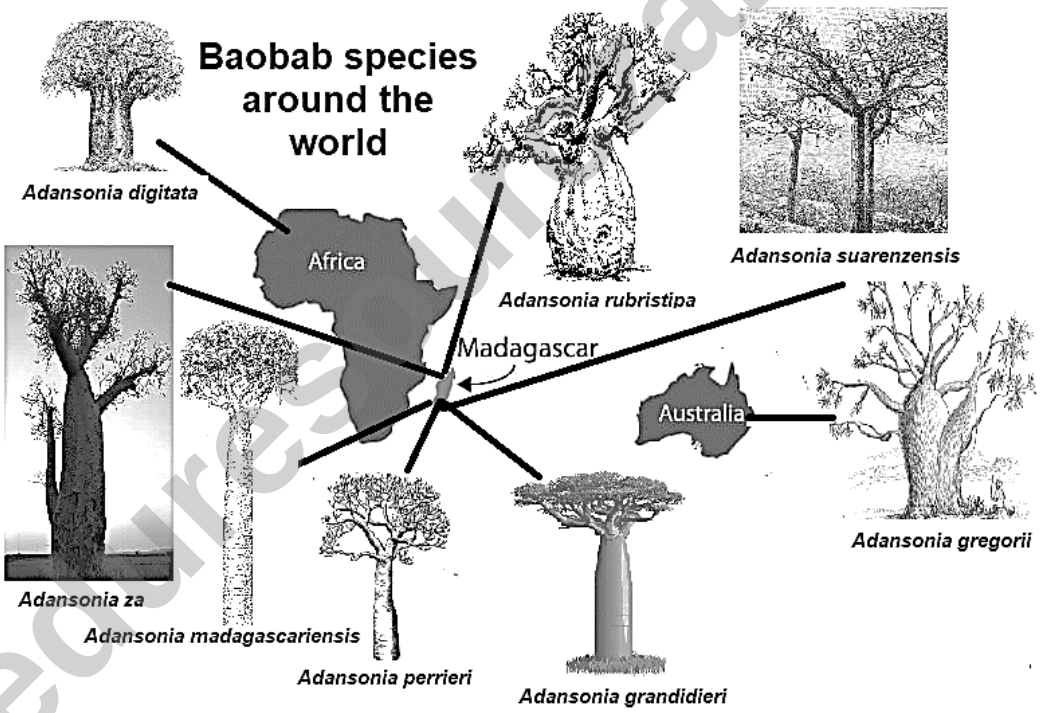
SECTION B

QUESTION 2

2.1 Read the following information on speciation and answer the questions that follow.

There are 8 different species of baobab trees, 6 of which are native to Madagascar, one to Africa and one to Australia. There's a lot of controversy about where the baobab tree originated. It's been estimated that the divergence between the African *Adansonia digitata* and the Madagascan trees occurred about 10 million years ago dating well after the breakup of Gondwana and the separation of Madagascar from Africa which happened about 100 million years ago.

Research from 2009 suggested that the centre of origin of all baobab trees was in West Africa. But an article from research (published in April 2024) used genome comparison to prove that Madagascar should be considered the centre of the origin of the baobab trees. This research also proposes that some of the species of baobab trees in Madagascar emerged due to different flowering times that established reproductive barriers.



SPECIATION OF BAOBAB TREES

2.1.1 Define the term *species*. (2)

2.1.2 Use evidence from the above information to prove that true speciation occurred in the baobab trees from Africa and Australia. (2)

2.1.3 Identify the type of speciation that occurred to produce the different species of baobab trees in Madagascar and Australia. (1)

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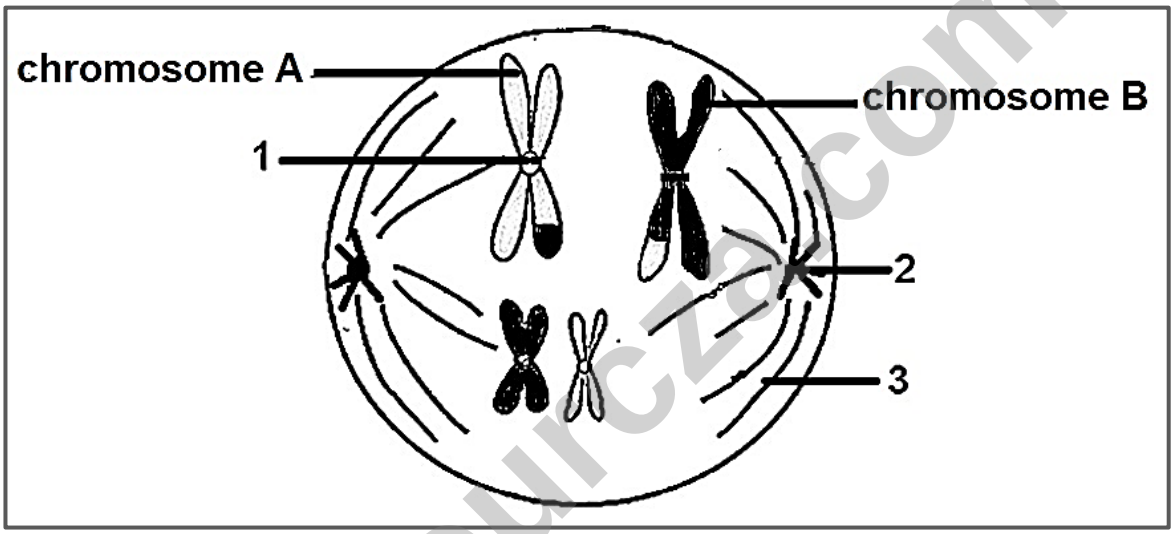
2.1.4 Describe how the speciation of the baobab trees in Madagascar and Australia took place. (6)

2.1.5 Some of the species of baobab trees in Madagascar developed in the same area due to reproductive barriers. Name the type of reproductive isolation that occurs due to different flowering times of the baobab trees. (1)

[12]

2.2 The diagram below illustrates an error that occurs during a phase of meiosis. Study the diagram and answer the questions that follow.



2.2.1 Identify the phase of meiosis illustrated in the above diagram. (1)

2.2.2 Identify the structures numbered:

a) **1** (1)

b) **2** (1)

c) **3** (1)

2.2.3 a) Give the name of the error that is illustrated in the diagram above. (1)

b) Describe the cause of the error illustrated in the diagram. (3)

2.2.4 Predict how many daughter cells will be produced by the cell in the diagram at the end of meiosis. (1)

2.2.5 Describe how the **number of chromosomes** in each daughter cell produced by the cell in the diagram will be affected at the end of meiosis. (2)

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2.2.6 Name ONE condition that occurs in humans due to the error during meiosis as illustrated in the diagram. (1)

2.2.7 Explain the difference in appearance (black and white areas) of chromosome **A** and chromosome **B**. (3)

2.2.8 Explain why meiosis is important for evolution to take place. (2)

[17]

2.3 Read the following information about *Homo naledi* and answer the questions that follow.

***Homo naledi's* surprisingly young age opens more questions on where we come from.**

On 13 September 2013, hundreds of fossil bones in the Dinaledi cave close to Johannesburg were discovered. With funding from National Geographic, Professor Lee Berger gathered some 60 scientists to help analyse the bones.
The shoulders of *Homo naledi* were apish, the fingers long and remarkably curved, but the bottom of the pelvis looked like a modern human's. The feet were virtually indistinguishable from our own. To Berger and his team, it clearly belonged in the *Homo* genus, but it was unlike any other member. They had no choice but to name a new species. They called it *Homo naledi*, tipping a hat to the cave where the bones had been found; in the Sesotho language, *naledi* means "star".

DIAGRAM 1: JAW, FRONT AND SIDE VIEW OF *HOMO NALEDI'S* SKULL

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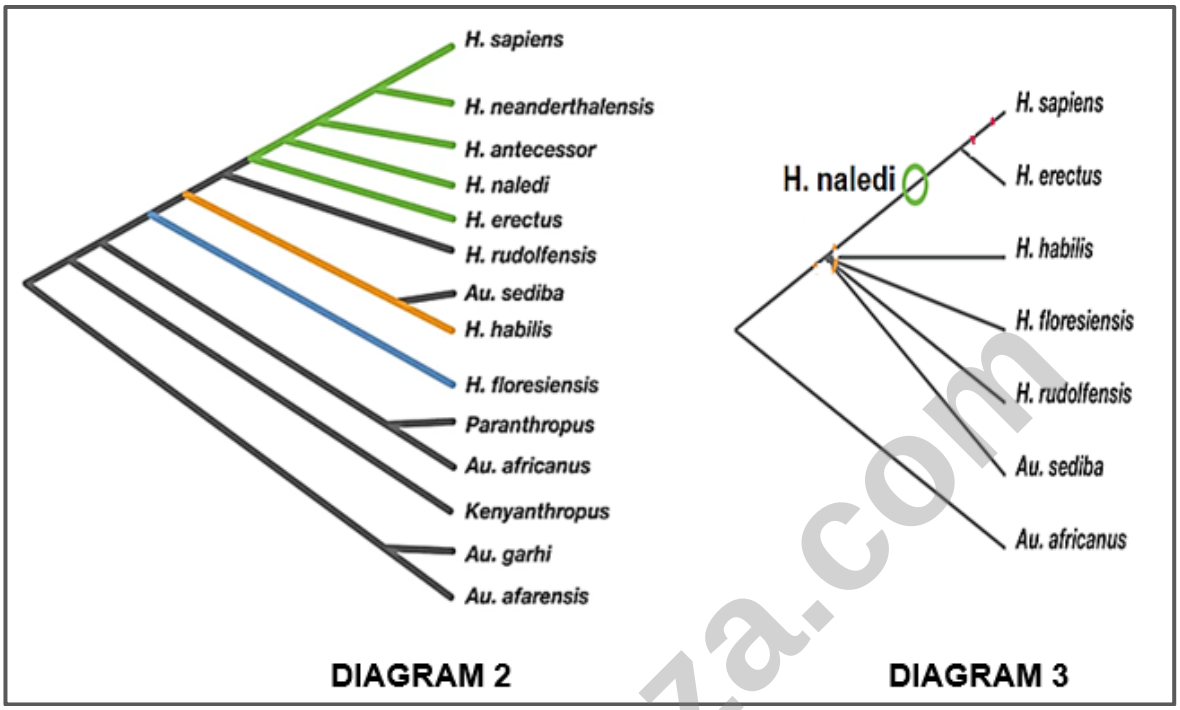
Diagram 2 and **3** below illustrate different scenarios for the position of *H. naledi* in the sequence of human evolution.



2.3.1 Name the Heritage Site where the remains of *Homo naledi* was discovered. (1)

2.3.2 Give the term for a scientist like Professor Berger that studies fossils. (1)

2.3.3 Give the scientific name of the fossil named Karabo that was discovered by Professor Berger and his son. (1)

2.3.4 Identify the type of diagram illustrated in Diagram **2** and **3**. (1)

2.3.5 Describe how the position of *Homo naledi* in the sequence of human evolution differs between Diagram **2** and **3**. (2)

2.3.6 The feet of *Homo naledi* were similar in structure to modern humans' feet. Explain TWO adaptations of the feet of modern humans and *Homo naledi* to walk over long distances. (4)

2.3.7 Name ONE fossil that belongs to the group of *Australopithecus afarensis*. (1)

2.3.8 The remains of *Homo naledi* are being displayed in a tourist centre. Do you think it is ethically correct to display these human remains? Explain your answer. (2)

2.3.9 Do you agree with the classification of *Homo naledi* as a *Homo* species? Give TWO visible reasons for your answer by using the information illustrated in Diagram **1**. (2)

[15]

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2.4 Read the following information and answer the questions that follow.

Some game reserves in Southern Africa sterilise the male lions to limit inbreeding. They would introduce new male lions from other areas of Southern Africa to increase the gene pool of their lion population.

2.4.1 Define the term *inbreeding.* (2)

2.4.2 Explain why inbreeding of lions is a problem that occur in many game reserves. (2)

2.4.3 Explain why inbreeding might be a threat to the survival of species. (2)

[6]

TOTAL QUESTION 2: [50]

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QUESTION 3

3.1 Read the following information on the public's opinion on the use of DNA profiles and answer the questions that follow.

Forensic DNA testing is a powerful tool used to identify, convict and acquit individuals charged of criminal offenses, but there are different views on its benefits.

In a survey done in 2001 in the USA the public (between age 20 and 60 years) was asked to answer the following question:

Do you think that DNA profile evidence is completely reliable, very reliable, somewhat reliable or not reliable at all?

The outcome of the survey was as follows:

Completely reliable: 15%
Very reliable: 49%
Somewhat reliable: 33%
Not reliable at all: 3%

This survey was repeated in 2005 and the outcome was as follows:

Completely reliable: 18%.
Very reliable: 54%
Somewhat reliable: 24%
Not reliable at all: 4%

3.1.1 Use a table to illustrate the results of the two surveys. (6)

3.1.2 DNA profiling is sometimes called DNA fingerprinting. Explain TWO ways in which the use of a DNA profile and a normal fingerprint are similar. (2)

3.1.3 Name TWO uses of DNA profiles other than in forensic investigations. (2)

3.1.4 Explain ONE reason why the public in the USA might not consider DNA profiles as reliable evidence in forensic cases. (2)

[12]

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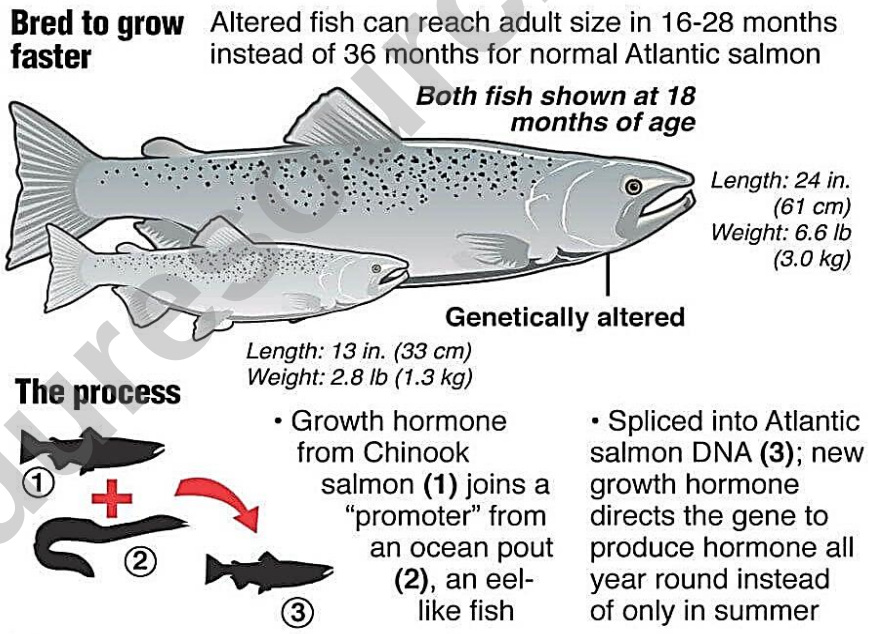
3.2 Read the following information on genetically modified salmon and answer the questions that follow.

GM salmon the first genetically engineered animal to be approved for human consumption.

Genetically modified salmon was developed by inserting genes from a Chinook salmon and an ocean pout into an Atlantic salmon. The introduction of GM salmon has the potential to make the fishing industry more sustainable at a time when worldwide fishing stocks have plunged in response to overfishing and pollution of the oceans.

In September 2010, an FDA advisory panel indicated that the fish is "highly unlikely to cause any significant effects on the environment" and that it is "as safe as food from conventional Atlantic salmon". In October 2010, 39 lawmakers asked the FDA to reject the application. Other groups requested that the salmon carry a label identifying its transgenic origin.

After an arduous process that took more than 25 years from time of conception to commercialisation, the GM salmon was finally marketed to consumers in 2021 in the USA and Canada. The FDA requires this salmon to be grown in physically contained land-based facilities.



GENETICALLY MODIFIED SALMON

3.2.1 Explain why the GM salmon is a transgenic organism. (3)

3.2.2 Describe how the salmon can be changed by selective breeding to grow faster. (3)

3.2.3 Explain how the GM salmon can make the fishing industry more sustainable. (2)

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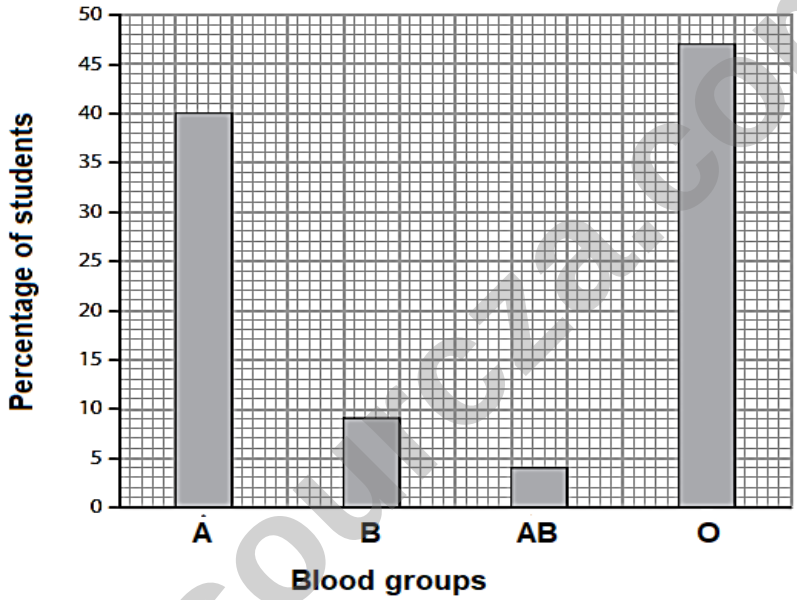
3.2.4 Name TWO reasons why certain groups are against the farming and selling of the GM salmon. (2)

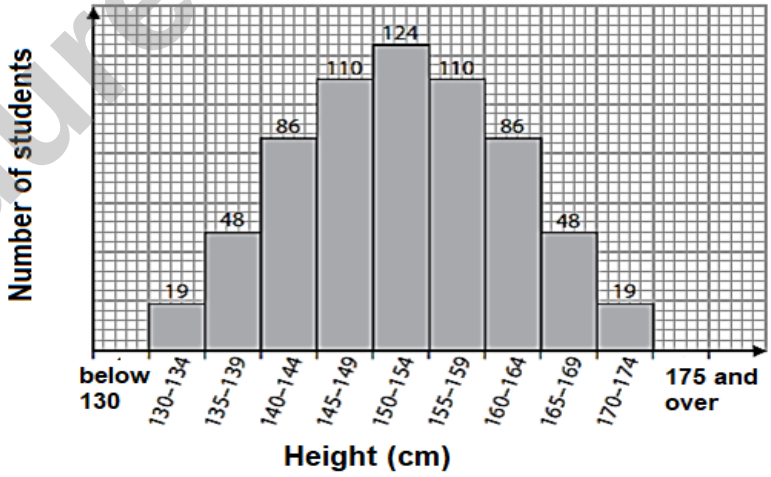
3.2.5 Do you think that it is necessary to label the products of the GM salmon clearly as a GM product? Explain your answer. (2)

[12]

3.3 A group of Life Sciences learners investigated the variation in blood groups and height of 650 students. The graphs below show the results of their investigation. Study the graphs and answer the questions that follow.



GRAPH 1: VARIATION IN BLOOD GROUPS IN STUDENTS



GRAPH 2: VARIATION IN HEIGHT IN STUDENTS

3.3.1 Calculate how many of the learners have blood group **AB**. Show ALL calculations. (3)

3.3.2 Explain why the inheritance of blood groups is an example of co-dominance. (2)

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3.3.3 Name another type of graph the Life Sciences learners could use to effectively illustrate the results of their investigation for blood groups. (1)

3.3.4 Use a genetic cross to illustrate how it is possible for a female with blood group **B** and a male with blood group **A** to have a child with blood group **O**. Show the percentage of phenotypes of their offspring. (6)

3.3.5 a) Identify the type of variation illustrated in Graph **2**. (1)

b) Give a reason for your answer to QUESTION 3.3.5 a) (1)

3.3.6 The gene for blood groups occurs on chromosome **9**.

a) Give the term for the position of a gene on a chromosome. (1)

b) Which type of chromosome is chromosome **9**? (1)

3.3.7 Name TWO precautions the learners had to follow to make the results of the variation in height accurate. (2)

[18]

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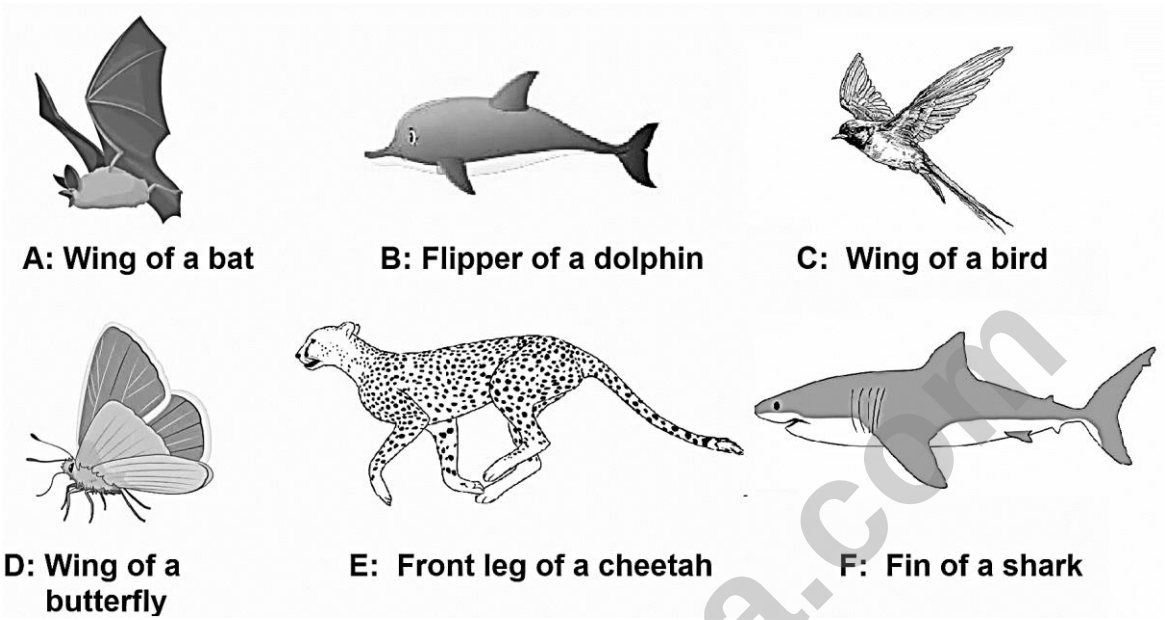
3.4 The diagrams below illustrate different structures in different organisms (labelled **A** to **F**). Study the diagram and answer the questions that follow.



DIFFERENT STRUCTURES IN DIFFERENT ORGANISMS

3.4.1 Define the term *homologous structure*. (2)

3.4.2 Write down the letters of THREE structures in the diagram above that are analogous. (3)

3.4.3 Explain how homologous structures are used as evidence for evolution. (3)

[8]

TOTAL QUESTION 3: [50]

TOTAL SECTION B: [100]

GRAND TOTAL: [150]

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