Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2023

LIFE SCIENCES P2

MARKS: **150**

TIME: **2½ hours**

This question paper consists of 15 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

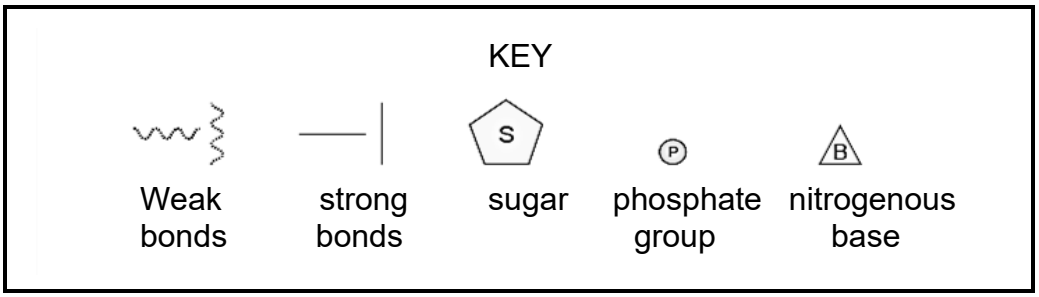
1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answer to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. ALL drawings MUST be done in pencil and labelled in blue or black ink.
7. Draw diagrams, 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. All calculations to be rounded off to TWO decimal spaces.
12. Write neatly and legibly.

SECTION A

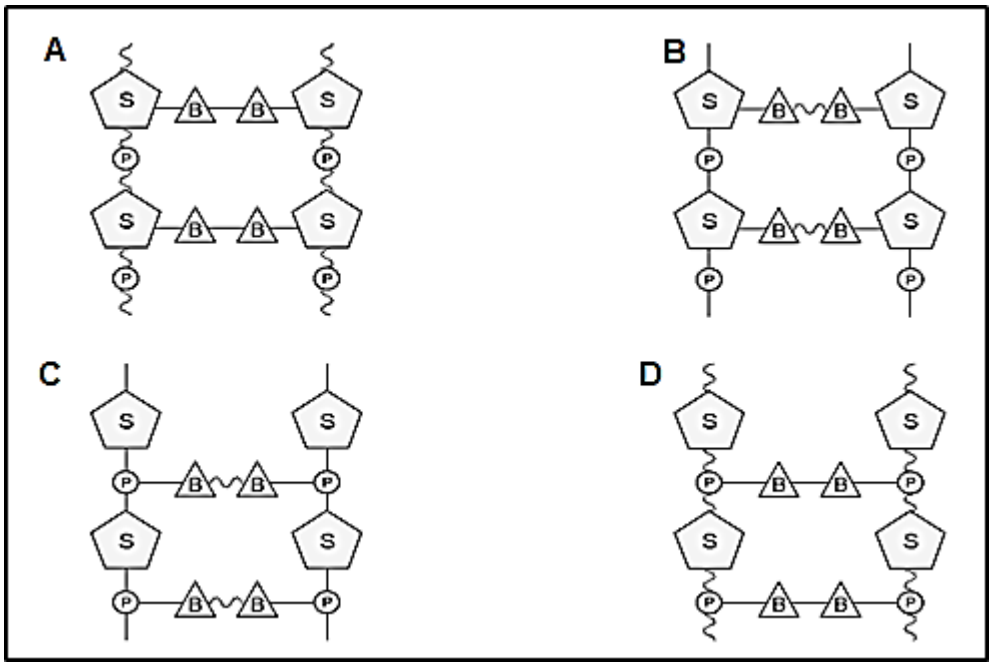
QUESTION 1

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

1.1.1 The key below shows the main components of a DNA molecule and the strength of the bonds that hold them together.



Which ONE of the following diagrams shows the correct combination of components of a DNA molecule?



1.1.2 Lamarck's 'laws' of use and disuse and inheritance of acquired characteristics are ...

A rejected, because only characteristics that benefit offspring can be inherited.
B not rejected, because evidence shows that acquired characteristics can be inherited.
C rejected, because only characteristics that are coded for in the DNA can be inherited.
D not rejected, because Darwin's theory supports Lamarck's ideas.

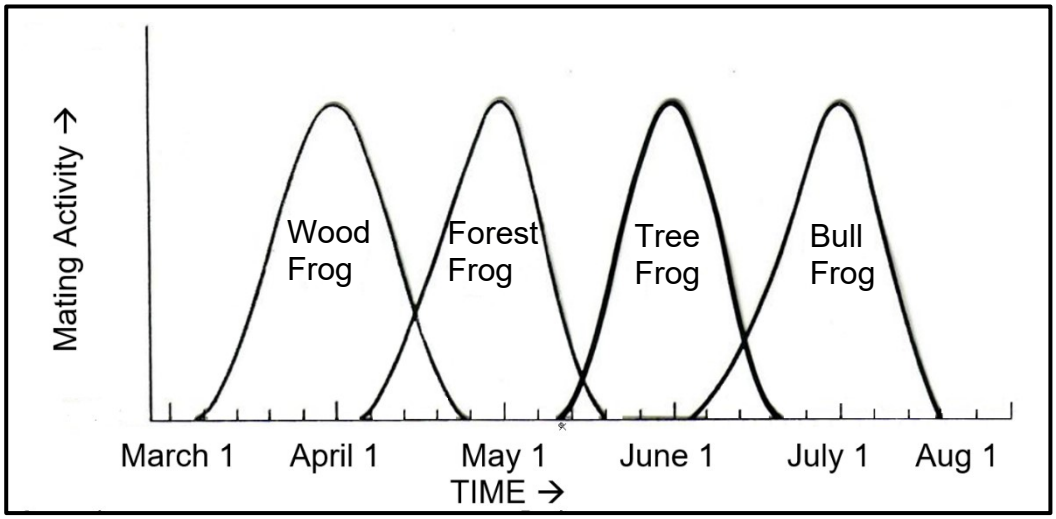
1.1.3 A trait that has a range of phenotypes is an example of …

A continuous variation.
B discontinuous variation.
C complete dominance.
D codominance.

1.1.4 Down Syndrome is the result of:

A A gamete with no chromosome 21 fusing with a normal gamete
B A normal gamete fusing with a gamete with an extra chromosome 21
C Two gametes each with an extra chromosome 21 fusing together
D There are 3 chromosome 21s in the gamete

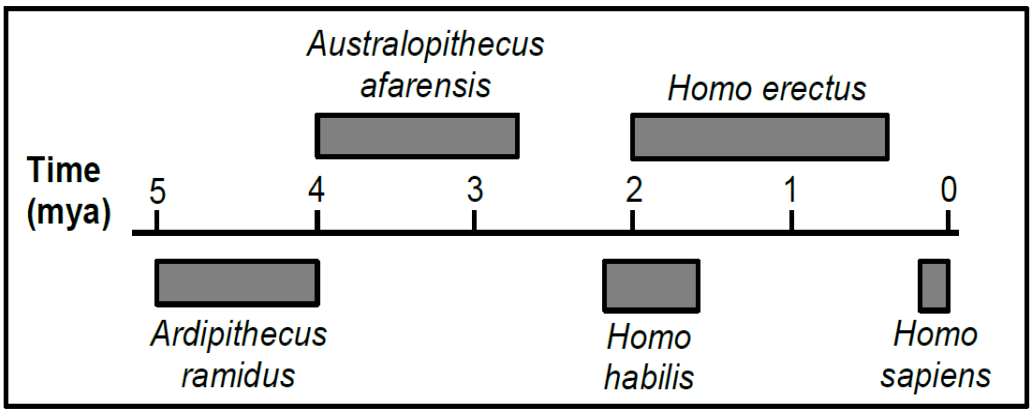
1.1.5 The graph below shows the breeding times for different species of frog.



The above graph shows an example of …

A biogeography.
B natural selection.
C speciation.
D reproductive isolation.

1.1.6 Which species of hominin spent the longest time on Earth according to the timeline below?



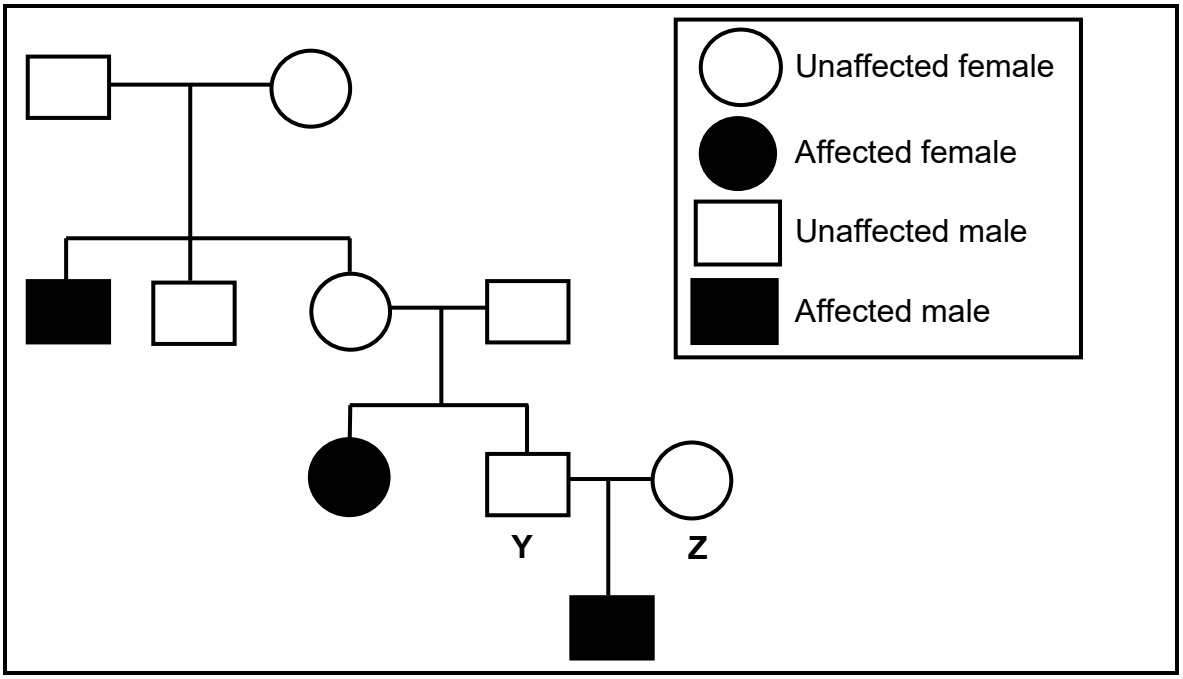
A *Homo erectus*
B *Ardipithecus ramidus*
C *Australopithecus afarensis*
D *Homo sapiens*

1.1.7 In mice, brown fur is dominant over white fur. If a heterozygous brown mouse is mated several times with a white mouse and 80 offspring are produced, how many would be expected to be white?

A 80
B 40
C 0
D 20

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE FOLLOWING PEDIGREE DIAGRAM

Albinism is a skin disorder caused by a recessive allele on an autosome.
The pedigree diagram below represents the inheritance of albinism in a family.



1.1.8 How many generations are represented by the above diagram?

A 1
B 2
C 3
D 4

1.1.9 The probability of individuals **Y** and **Z** having a child with albinism is …

A 25%
B 50%
C 75%
D 100%

1.1.10 Homologous structures indicate that the …

A structures are found on both chromatids.
B organisms received the same allele from both parents.
C organisms have a common ancestor.
D organisms use the structure for the same function.

(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 Structures found in the nucleus that are made up of a DNA molecule and proteins

1.2.2 A section of a DNA molecule that codes for a specific characteristic

1.2.3 The scientist who proposed the principle of independent assortment

1.2.4 The bond that forms between two amino acids

1.2.5 The building blocks (monomers) of DNA

1.2.6 Undifferentiated animal cells that have the ability to change into any cell type

1.2.7 Having an upper or lower jaw that projects abnormally forward

1.2.8 The explanation that species experience long periods without physical change, followed by short periods of rapid physical change

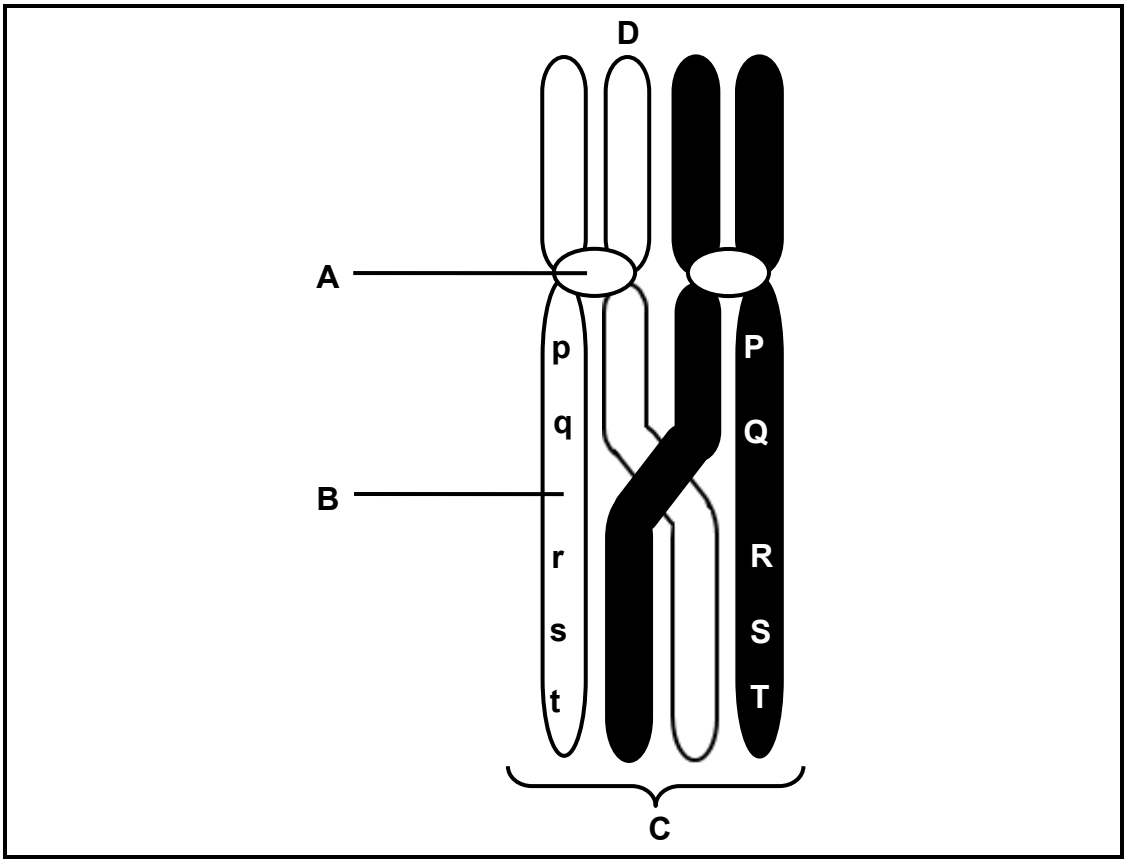
(8 x 1) (8)

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	Caused by a gene mutation	A:	Haemophilia
		B:	Down Syndrome
1.3.2	Somatic cell	A:	Haploid
		B:	Skin cell
1.3.3	Alleles that are expressed only when two copies are present	A:	Recessive
		B:	Heterozygous

(3 x 2) (6)

1.4 Study the diagram of two chromosomes below.



1.4.1 Name the process taking place in the diagram above. (1)

1.4.2 During which phase of meiosis does the process occur? (1)

1.4.3 Provide labels for the following parts:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

1.4.4 Draw chromatid **D** at the end of meiosis. (3)

1.5 In rabbits the inheritance of two characteristics were studied, hair colour and eye colour. Each of these characteristics have two variations.

Hair may be grey or white and eyes may be black or red in colour. The symbols **G** and **g** are used for the two variations in hair colour and the symbols **B** and **b** are used for the two variations in eye colour.

When two rabbits that were heterozygous for hair colour and eye colour were crossed, the following results were obtained:

Number of offspring	Characteristic
Grey hair and Black eyes	9
Grey hair and Red eyes	3
White hair and Black eyes	3
White hair and Red eyes	1

1.5.1 State the term for a genetic cross that involves two characteristics. (1)

1.5.2 Give all the possible gametes of the parents. (2)

1.5.3 Give the:

(a) Dominant allele for hair colour (1)

(b) Genotype for a white haired, red eyed rabbit (2)

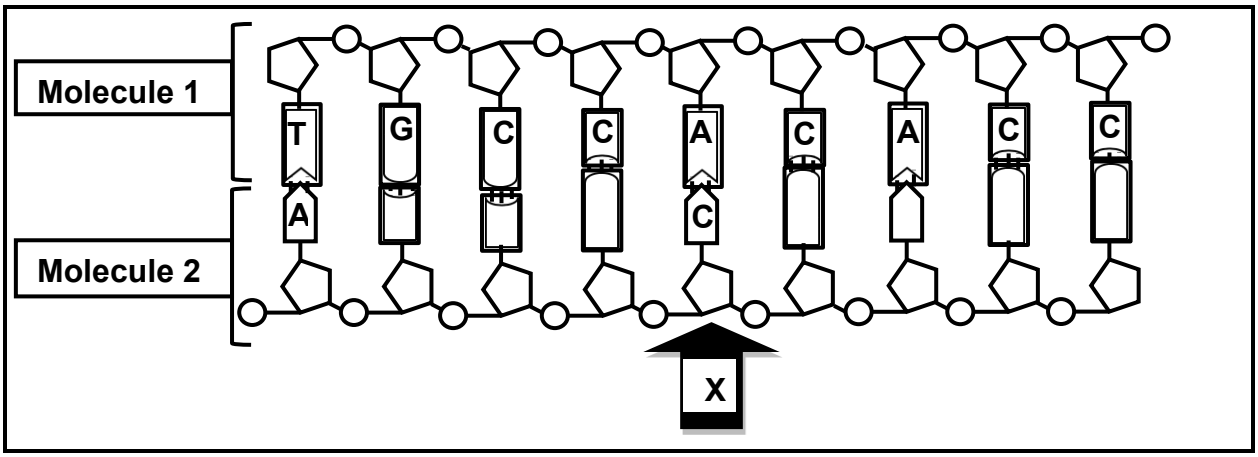
(c) Phenotype of a rabbit that is heterozygous for hair colour and homozygous dominant for eye colour (2)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below shows a part of the process involved in making a protein.



2.1.1 Provide the name of:

(a) Molecule 1 (1)

(b) Molecule 2 (1)

2.1.2 Name the process shown in the diagram above. (1)

2.1.3 In which organelle in the cell does the process mentioned in QUESTION 2.1.2 take place? (1)

2.1.4 Give the nucleotide sequence for molecule 2. Write out the complete sequence from left to right (starting with the given base **A**). (3)

The table below shows the amino acids coded for by each tRNA anticodon.

tRNA anticodon	Amino Acid
GAA	Leucine
CUU	Lycine
GGA	Glycine
UGC	Cystine
CGC	Alanine
UAC	Tyrosine
AGG	Arginine
CAC	Valine
ACC	Threonine

2.1.5 Use the table to determine the amino acid sequence, from left to right, coded for by **molecule 1**. (3)

2.1.6 Explain how the error at point **X** on **molecule 2** will change the protein that forms. (4)

2.2 Read the extract below.

Congenital night blindness is a sex-linked disorder. It is caused by a recessive gene on the X-chromosome. People with this disorder struggle to see clearly at night and experience other visual problems like short-sightedness and loss of visual sharpness. Use (N) for normal night vision and (n) for congenital night blindness.

2.2.1 State the:

(a) Genotype of the allele that causes congenital night blindness (1)

(b) Genotype of a female with congenital night blindness (2)

2.2.2 Give TWO reasons why people with this disease may not be able to get a driver's licence. (2)

2.2.3 A man with congenital night blindness has a son with a woman who does not carry the allele.

(a) Give the phenotype of their son. (1)

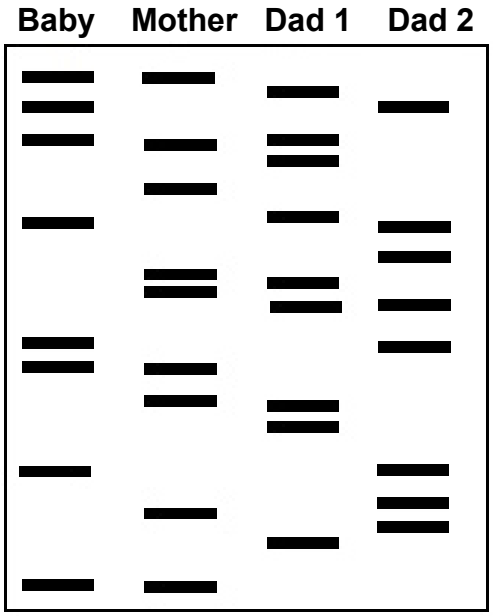
(b) Explain your answer in QUESTION 2.2.3 (a). (3)

2.3 A woman identified two possible men that could be the father of her child. Below are the results of a DNA profile paternity test and a blood paternity test.

Blood Test Results

	Blood Type
Baby	O
Mother	B
Dad 1	AB
Dad 2	A

DNA Profile results



2.3.1 Using the DNA profiling results, explain why **Dad 2** is the father of the baby. (3)

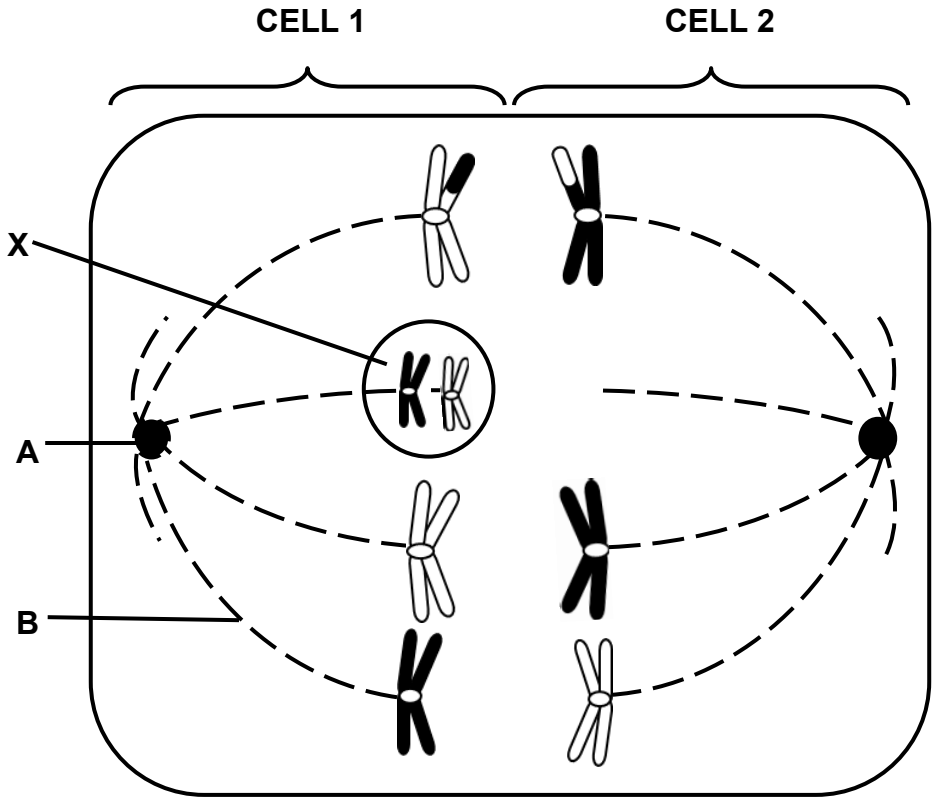
2.3.2 Explain why **Dad 1** cannot be the father of the child using the blood test results. (3)

2.3.3 Use a genetic cross to show the percentage chance for the mother and **Dad 2**, to have a baby with blood type O. (6)

2.3.4 Explain why blood test results are not reliable to determine paternity. (2)

2.3.5 Name TWO other uses of DNA profiling besides paternity tests. (2)

2.4 The diagram below shows a cell undergoing meiosis.



2.4.1 Give the phase of meiosis shown in the diagram above. (1)

2.4.2 Give ONE reasons for your answer in QUESTION 2.4.1. (1)

2.4.3 Give the functions of the following parts in meiosis:

(a) **A** (1)

(b) **B** (1)

2.4.4 Name the type of chromosomal mutation occurring at **X**. (1)

2.4.5 Explain TWO processes shown in the diagram that leads to variation in the offspring. (4)

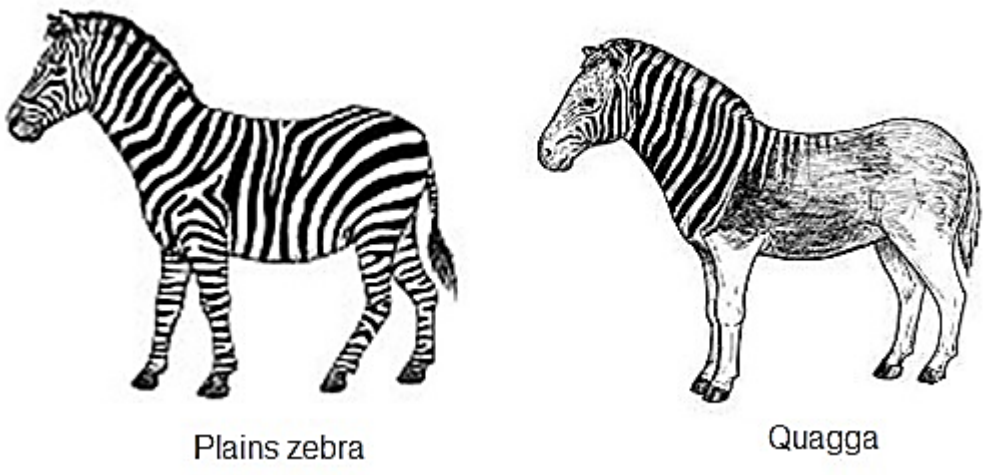
2.4.6 How many chromosomes will be found in CELL 2 at the end of meiosis? (2)

[50]

QUESTION 3

3.1 Read the extract below.

The quagga was a subspecies of the plains zebra. They were hunted to extinction in the 19th century. They had shorter and wider bodies than the plains zebra and had pale brown fur with black markings. The plains zebras has white fur with black markings across the whole body. The quagga only had stripes on the front part of their bodies. Scientists have been interbreeding plains zebras with characteristics similar to those of the quagga and have now produced about 200 animals that resembles the extinct quagga in South Africa.



3.1.1 Name the process used by scientists to breed the quagga. (1)

3.1.2 From the extract, give TWO characteristics that scientists are looking for in the plains zebra that they are interbreeding. (2)

3.1.3 How can scientists determine if the quagga is still the same species as the plains zebra? (2)

3.1.4 Explain how extinction can have a positive effect on biodiversity. (2)

3.2 In 2012, Professor Lee Berger discovered a new species of hominin, which was named *Australopithecus sediba*. Three years later, in 2015, another new hominin species was discovered.
This new species was named *Homo naledi*. Fossils of both these hominin species were found in an area of South Africa known as the 'Cradle of Humankind'.

		
Australopithecus sediba	*Homo naledi*	*Homo sapiens*

3.2.1 Which of the two fossils (*Australopithecus sediba* or *Homo naledi)* is thought to be more closely related to modern humans? (1)

3.2.2 Give ONE reason for your answer in QUESTION 3.2.1. (1)

3.2.3 Describe THREE anatomical features that Professor Berger would have looked for when he examined the fossils, to determine that *Australopithecus sediba* was bipedal. (3)

3.2.4 Give the scientific name of ONE other hominin species of which fossils were discovered in the Cradle of Humankind. (1)

3.2.5 Why is this area named, the 'Cradle of Humankind'? (2)

3.2.6 Explain how mitochondrial DNA is used to prove that modern humans originated in Africa. (4)

3.3 The theory of evolution is based on many lines of evidence.

3.3.1 Define *biological evolution*. (2)

3.3.2 Why is the Theory of Evolution regarded as a scientific theory? (2)

3.3.3 Tabulate ONE difference between a theory and a hypothesis. (3)

3.3.4 Name TWO sources where scientists find evidence for evolution. (2)

3.4 Maize plants are affected by the European corn borer which is a small worm that feeds on the maize plant and causes destruction of whole crops for farmers.
The Bt gene which is found in bacteria produces a poison which kills the European corn borer without harming humans. Scientists have managed to extract this gene from the bacteria and insert it into the DNA of maize plants. When the European corn borer eats the maize plant, it will die very quickly.

3.4.1 Name the process by which the genetic makeup of an organism is altered to include a new characteristic. (1)

3.4.2 Give the term that refers to DNA to which a gene was added. (1)

3.4.3 Explain ONE way in which corn with the Bt gene can benefit farmers economically. (2)

3.4.4 Explain ONE reason why using Bt genes in maize plants may have a negative effect on the environment. (2)

3.5 In South Africa tuberculosis bacteria became resistant to many of the usual treatments for TB. Rifampicin is currently the most effective drug used to treat TB. There are however a number of tuberculosis bacterium strains that have become resistant to this drug as well. Rifampicin-resistant bacteria may be treated with bedaquiline.

Two types of bedaquiline treatments are available:
- Tablets which can be taken at home daily
- An injection where the patient must go back to the clinic every week for the injection

Scientist wanted to determine which treatment would have the highest survival rate after 24 months.

- A group of 200 participants with rifampicin-resistant TB were selected.
- All participants were aged 18 years or older.
- 100 patients were given the tablet treatment for 9 months.
- 100 patients were given the injection treatment for 9 months.
- Their health status was measured 24 months after they started the treatment.

The table below shows the success rate of the two treatments.

Treatment	Number of participants that had recurrence of TB	Number of participants that did not complete the treatment	Number of participants that died of TB	Number of Participants that were cured of TB
Tablets	1	4	24	71
Injection	2	12	28	**X**

3.5.1 Give the independent variable. (1)

3.5.2 Give ONE reason why this study may be considered reliable. (1)

3.5.3 Calculate the number of participants that took the injection treatment, that were cured of TB. (3)

3.5.4 Explain ONE possible reason why more people did not complete the injectable-containing treatment. (2)

3.5.5 Explain how tuberculosis bacteria may have developed resistance to rifampicin according to Darwin's Theory of Natural Selection. (5)

3.5.6 Give TWO ways in which the scientists could improve the validity of this study. (2)

3.5.7 Explain why the health status of the participants was only recorded after 24 months of taking the treatments. (2)

[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150