Western Cape Government
Education

Quality Education For All
THE LEADERSHIP COLLEGE

METRO CENTRAL EDUCATION DISTRICT

THE LEADERSHIP COLLEGE

GRADE 12

LIFE SCIENCES

PREPARATORY EXAMINATION

PAPER 2

19 SEPTEMBER 2022

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 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. 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 a compass, where necessary.
11. Write neatly and legibly.

SECTION A

QUESTION 1

1.1 Various options are given 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.

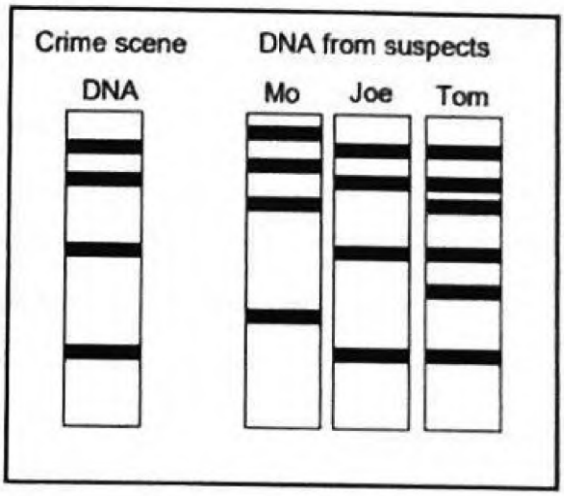
1.1.1 An RNA nucleotide consists of a ...

A ribose sugar, three nitrogenous bases and a phosphate group.
B phosphate group and a nitrogenous base.
C deoxyribose sugar and four nitrogenous bases.
D ribose sugar, a nitrogenous base and a phosphate group.

1.1.2 The components of a DNA molecule that provide the code for protein synthesis are the ...

A sugars.
B phosphates.
C hydrogen bonds.
D nitrogenous bases.

QUESTIONS 1.1.3 AND 1.1.4 ARE BASED ON THE DIAGRAM BELOW, SHOWING THE RESULTS OF A PARTICULAR PROCEDURE.



1.1.3 The evidence in the diagram shows that ...

A Tom and Mo were present at the scene of the crime.
B Joe was definitely present at the scene of the crime.
C only Mo was present at the scene of the crime.
D none of the three individuals were at the scene of the crime.

1.1.4 Below is a list of possible uses of the procedure shown in the diagram above:

(i) Paternity testing
(ii) Matching of tissues for organ transplants
(iii) Identification from fingerprints
(iv) Screening for genetic disorders

Which combination shows the CORRECT uses of the procedure?

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

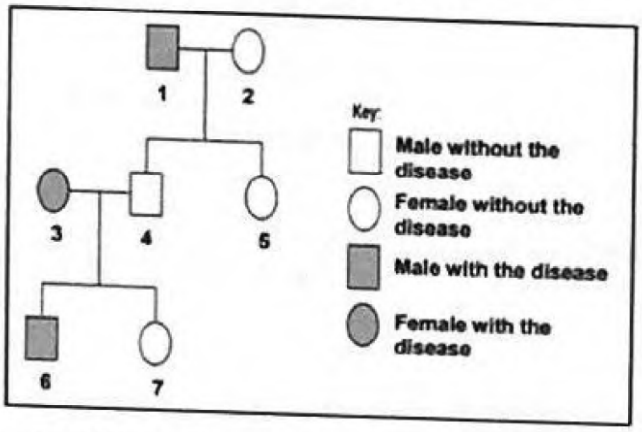
1.1.5 Two red-eyed fruit fies were mated and they produced 450 flies with red eyes and 148 flies with white eyes. From this information we can reasonably conclude that ...

A white-eyed condition is recessive and both parents are heterozygous.
B red-eyed condition is dominant and both parents are homozygous for red eyes.
C white-eyed condition is recessive and both parents are homozygous for re eyes.
D red-eyed condition is recessive and both parents are heterozygous.

1.1.6 During meiosis ...

A two daughter cells are formed.
B all the daughter cells are identical to each other.
C the chromosome number is doubled.
D two divisions of the nucleus occur.

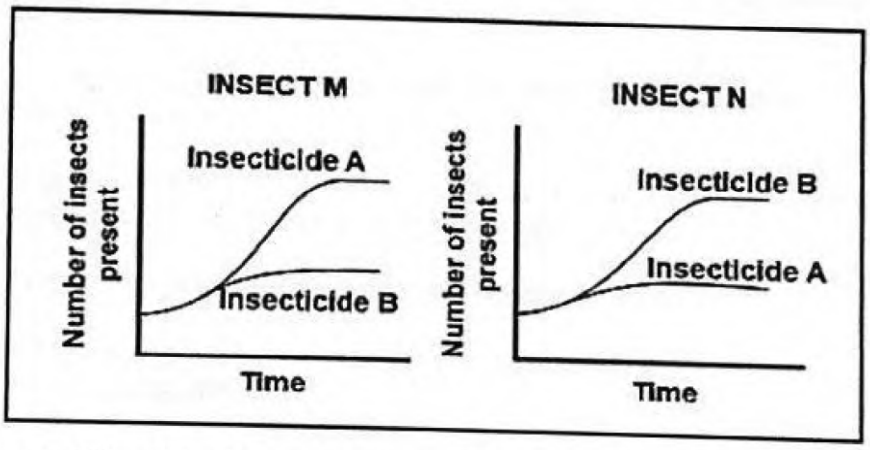
1.1.7 The diagram below shows a family in which some members suffer from a disease caused by a recessive allele.



Identify TWO family members who must be heterozygous for the gene.

A 5 and 7
B 3 and 6
C 2 and 3
D 1 and 4

1.1.8 The graphs below show the effect of two insecticides, A and B, on two different species of insects, **M** and **N**.



Which ONE of the following is the conclusion that can be drawn from the graphs?

A Insecticide **A** is equally effective on insect **M** and **N**
B Insect **M** is less resistant to insecticide **A** than **B**
C Insect **N** is less resistant to insecticide **A** than **B**
D Insecticide **B** is equally effective on insect **M** and **N**

1.1.9 Scientists recovered the body of a woolly mammoth from the frozen soil of Siberia. The DNA sequence of the woolly mammoth was very similar to the DNA sequence of the African elephant. Which of the following is a conclusion for this data?

A The woolly mammoth and African elephant have a common ancestor
B The woolly mammoth is not related to the African elephant
C The woolly mammoth has the same number of chromosomes as the African elephant
D The woolly mammoth and the African elephant should be classified as the same species

(9 x 2) **(18)**

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 1.2.8) in the ANSWER BOOK.

1.2.1 The mineralised remains of organisms that have lived in the past

1.2.2 Undifferentiated cells that may be stimulated to develop into any type of body cell

1.2.3 The division of the cytoplasm after a cell nucleus has divided

1.2.4 Similar structures on different organisms that suggest they have a common ancestor

1.2.5 The type of vision shared by apes and humans that allows for depth perception

1.2.6 A group of similar organisms that occurs in a particular place at a particular time with the ability to interbreed

1.2.7 The permanent disappearance of a species from earth

1.2.8 A breeding process used for the domestication of plants and animals.

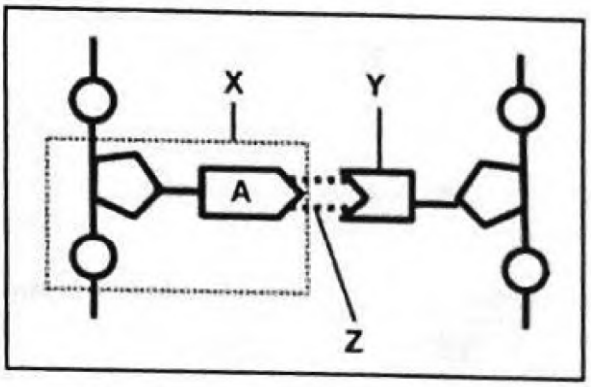
(8)

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Discovered the structure of the DNA molecule	A: Watson and Crick B: White and Dart
1.3.2	Pronounced brow ridges	A: African apes B: Homo sapiens
1.3.3	Type of inheritance where both alleles are expressed equally in the phenotype	A: Incomplete dominance B: Complete dominance

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

1.4 The diagram below represents a portion of a nucleic acid.



1.4.1 Name the nucleic acid. (1)

1.4.2 Name TWO places in animal cells where this nucleic acid may be found. (2)

1.4.3 Identify:

(a) Portion X (1)

(b) Nitrogenous base Y (1)

(c) Bond Z (1)
(6)

1.5 Flower colour in plants is controlled by two alleles, red (**R**) and yellow (**r**). Height is controlled by two alleles, Tall (T) and short (**t**). The Punnett square below shows the offspring obtained when two plants were crossed.

Genotype of the parents has been left out.

RRTT	RRTt	RrTT	RrTt
RRTt	RRtt	RrTt	Rrtt
RrTT	RrTt	rrTT	**rrTt**
RrTt	Rrtt	rrTt	rrtt

1.5.1 State the name of the crossing represented in the diagram. (1)

1.5.2 Identify:

(a) The genotype of the parents (2)

(b) The phenotype of the offspring with the genotype **rrTt** (1)

(c) All the gametes of ONE parent (2)
(6)

1.6 The table below shows the results of an investigation into the frequency of blood groups in a small human population.

Frequency of blood groups in a small human population

Blood group	Percentage
AB	5
A	40
B	10
O	45

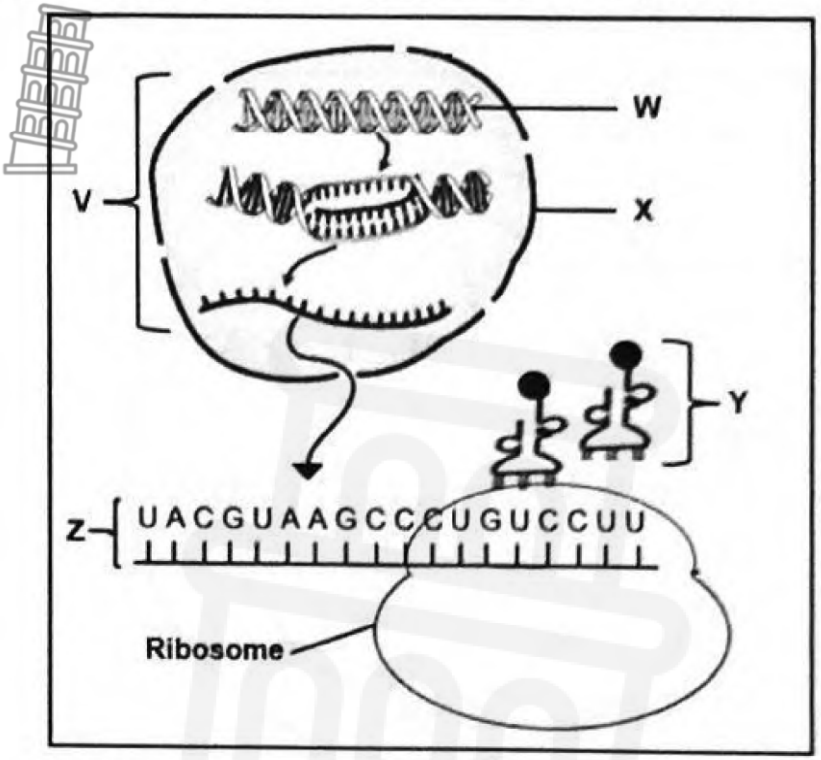
Draw a bar-graph to represent data on the table. **(6)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents the process of protein synthesis.



2.1.1 Identify:

(a) Organelle **X** (1)

(b) Molecule **Z** (1)

2.1.2 Describe the process of *transcription*. (6)

2.1.3 The table below shows the DNA base triplets with their corresponding amino acids.

DNA BASE TRIPLET	AMINO ACID
CAG	Valine
GAA	Leucine
ATG	Tyrosine
GGA	Proline
TCG	Serine
CAT	Valine

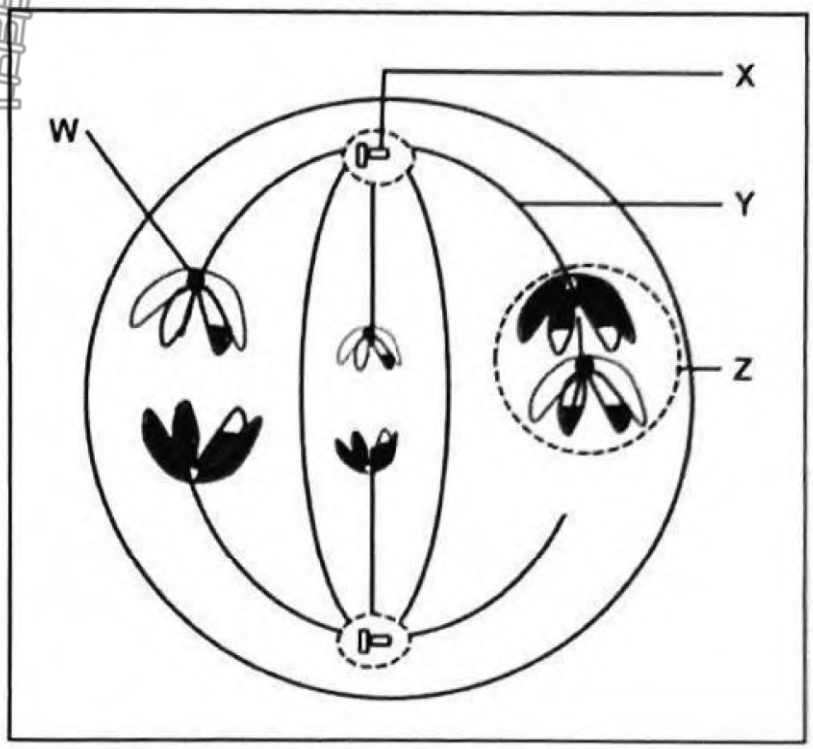
Name the:

(a) tRNA base sequence that codes for serine. (1)

(b) First TWO amino acids coded for by molecule **Z** in the diagram (the molecule is read from left to right). (2)

2.1.4 The codon GUC (second last codon) on the molecule **Z** changed to **GUA**. Explain the effect it would have on this particular protein molecule. (2)
(13)

2.2 The diagram below represents a cell during meiosis.



2.2.1 Identify the phase illustrated. (1)

2.2.2 Give an observable reasons for your answer to QUESTION 2.2.1. (1)

2.2.3 Label part:

(a) **W** (1)

(b) **X** (1)

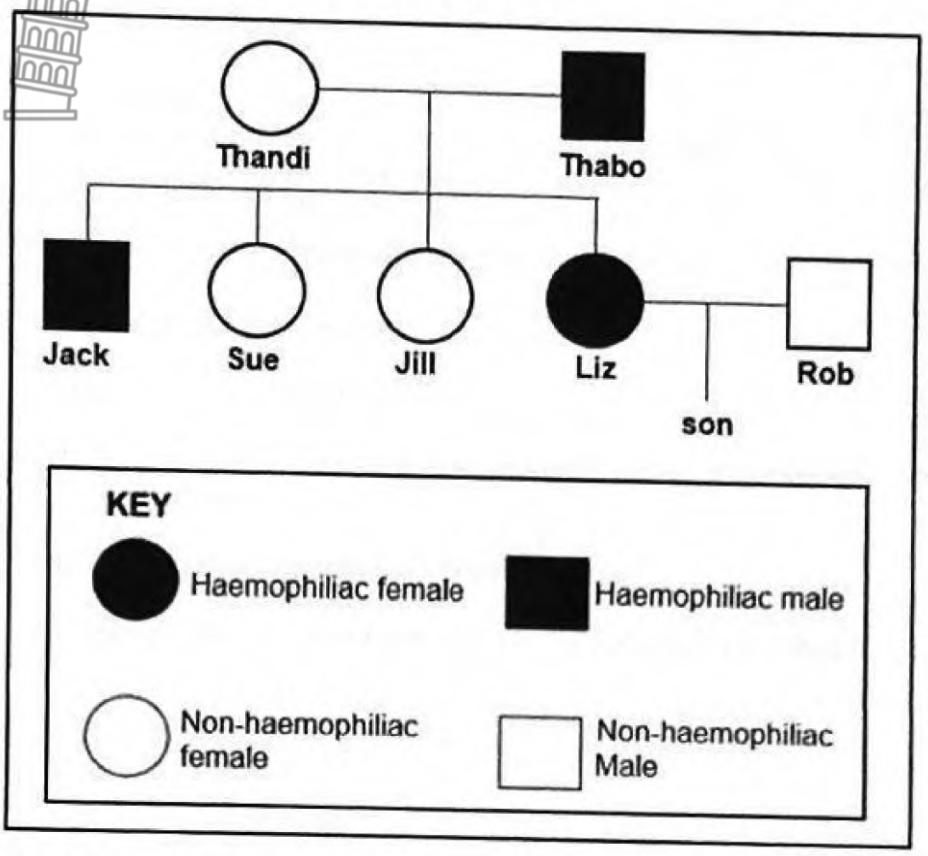
(c) **Y** (1)

2.2.4 Explain the disorder that a child will have as a result of the mistake occurring at **Z**, if it would represent chromosome pair 21. (3)

2.2.5 Describe TWO ways in which meiosis contribute to genetic variation in a population. (8)
(16)

2.3 Haemophilia is a sex-linked genetic disorder that causes excessive bleeding in people who are affected. The **X** chromosome carries either the recessive allele (X^h) for haemophilia or the dominant allele (X^H) for normal blood clotting.

The pedigree diagram below shows inheritance of haemophilia in a family. Study the diagram and answer the questions that follow.



2.3.1 What percentage of females in this pedigree diagram is affected? Show ALL working. (2)

2.3.2 Give the genotype for:

(a) Thandi (1)

(b) Jack (1)

2.3.3 Explain why females have a smaller chance of suffering from haemophilia. (2)

2.3.4 Represent a genetic cross to show the percentage chance of Liz and Rob having a haemophiliac son. (7)
(13)

2.4 Read the extract below.

> Through recombinant DNA techniques, a type of genetic engineering technology, bacteria have been created that are capable of synthesizing human insulin, human growth hormone, and other medically useful substances. Plants may be genetically adjusted to enable them to fix nitrogen, and genetic diseases. Genes for toxins that kill insects have been introduced in several species of plants, including corn and cotton.
>
> Special concern has been focused on genetic engineering for fear that it might result in the introduction of unfavourable and possibly dangerous traits into micro-organisms that were previously free of them, e.g., resistance to antibiotics, production of toxins, or a tendency to cause disease.
>
> *[Adapted from: https://www.britannica.com/science/genetic-engineering/Process-and-techniques]*

2.4.1 Define Genetic engineering. (2)

2.4.2 According to the extract, explain how:

(a) people with diabetes can benefit from recombinant DNA techniques (2)

(b) Farmers can benefit from financially. (2)

2.4.3 Explain why bacteria are most suitable for genetic engineering. (2)
(8)

[50]

QUESTION 3

3.1 An investigation was done to determine the variation in the volume of milk produced by a herd of cows in one year.

The procedure was done as follows:

- 40 cows of the same breed and age were used
- They were all artificially inseminated with the sperm from the same bull until they were pregnant
- They were then kept under the same conditions until they gave birth
- The calves were separated from their mothers during the night
- Every morning they were all milked, and the volume of milk recorded for each cow for the whole year

3.1.1 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

3.1.2 State THREE steps that must be considered when planning this investigation. (3)

3.1.3 Mention TWO factors that should have been kept constant during the investigation. (2)

3.1.4 List TWO ways on how reliability of the investigation can be achieved. (2)
(9)

3.2 Read the article below and answer the questions that follow.

In Brazil there are different lizard species that feed on termites. Termites are small ant-like insects. They vary in size. Lizard species with bigger body size have larger heads and can eat larger termites.

In 1996 a dam in a series of valleys in Brazil flooded creating several islands. These islands each had a variety of different species of lizards.

The lizard species with bigger body size died out on the islands, because there was not enough food for them to survive. But a very small lizard species, *Gymnodactylus amarali*, was able to survive. There were plenty of termites for them to eat. Some scientists believe that this might be an example of punctuated equilibrium.

But there was a problem: *Gymnodactylus amarali* lizards had small heads and some of the termites were nearly the same size as them. However, some of the *Gymnodactylus amarali* lizards had slightly larger heads and were able to eat these termites.

When scientists visited these islands 15 years later they found that the *Gymnodactylus amarali* lizards on the islands had heads that were four percent larger than those found on the main land.

***Gymnodactylus amarali* lizards**

[Adapted:http://atlasobscura.com]

3.2.1 Define punctuated equilibrium. (3)

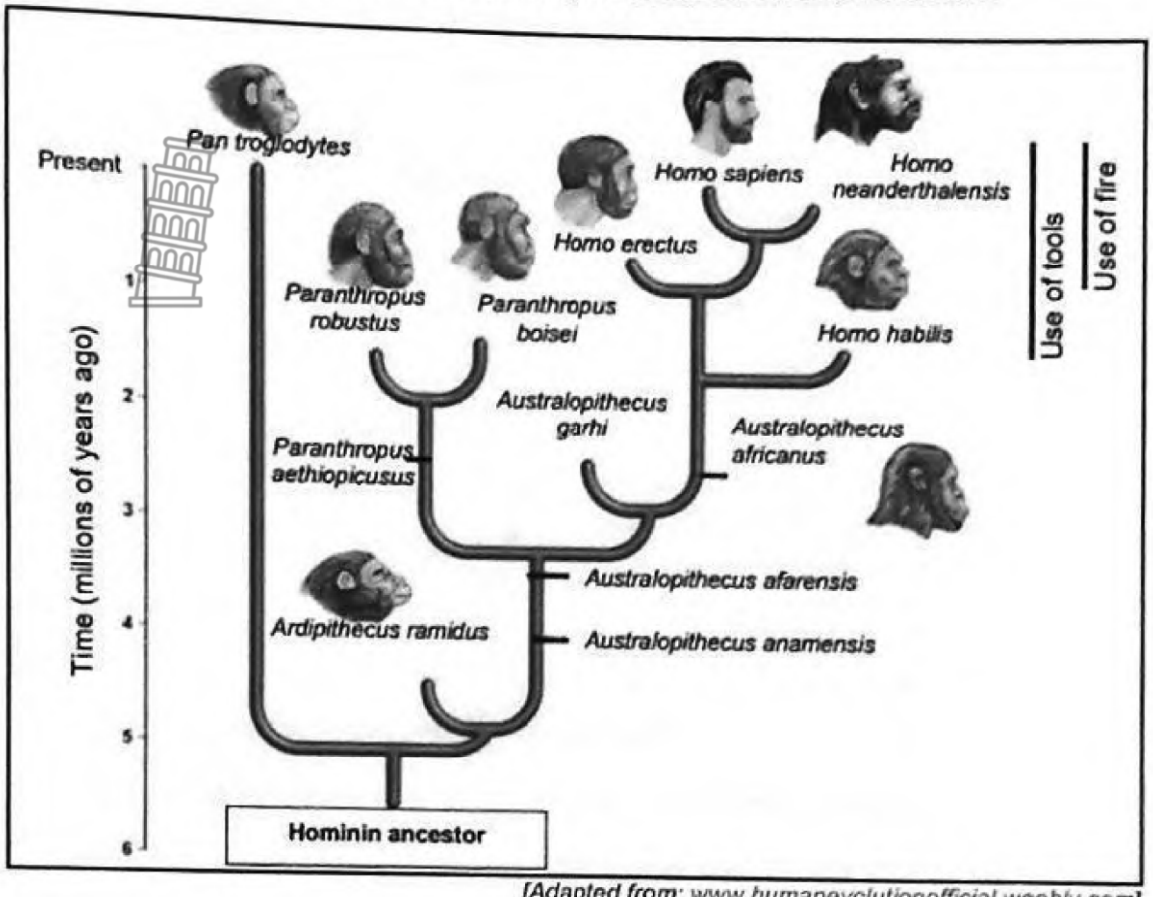
3.2.2 State why the species of lizards with larger body size did not survive on the small islands. (1)

3.2.3 Describe how it can be proven that the species of lizard on the different islands are the same species as that on the mainland. (2)

3.2.4 How would Lamarck have explained the development larger heads in the surviving *Gymnodactylus amarali* lizard population? (4)
(10)

3.3 Describe how speciation occurs through geographic isolation. **(6)**

3.4 The diagram below shows a possible representation of human evolution.



[Adapted from: www.humanevolutionofficial.weebly.com]

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

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

3.4.3 According to this diagram, which:

(a) Genus is most recently evolved (1)

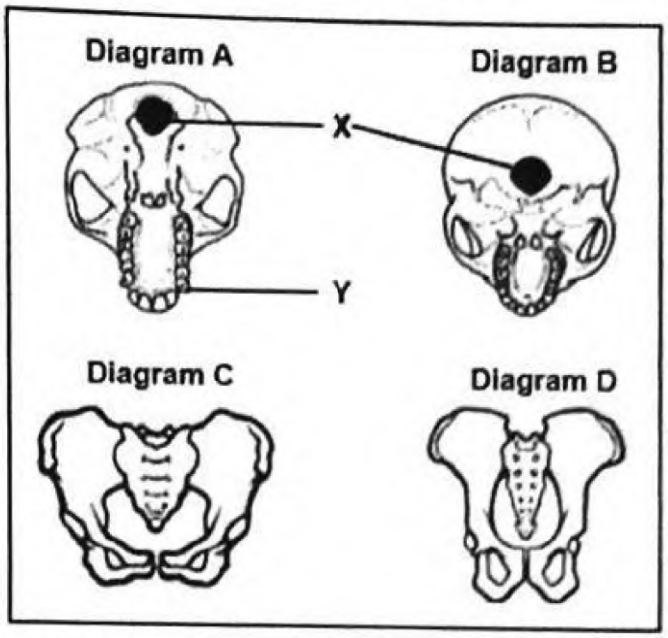
(b) Species is the direct ancestor of *Homo sapiens* (1)

3.4.4 Give ONE example of a *Australopithecus africanus* fossil discovered in South Africa. (1)

3.4.5 Identify any TWO species that used both tools and fire. (2)

3.4.6 Desribe how fossil evidence can be used to support the "Out of Africa" hypothesis. (4)
(11)

3.5 Study the diagrams below showing the different anatomical structures of two primate genera. The diagrams are not drawn to scale.



3.5.1 Label for **X** and the type of teeth at **Y**. (2)

3.5.2 Which pelvis, **C** or **D**, is that of a quadrapedal primate? (1)

3.5.3 Give an observable reason for your answer to QUESTION 3.5.2. (2)

3.5.4 Give the LETER ONLY of the diagram that represents:

(a) The skull with the larger brain capacity (1)

(b) A more prognathous skull (1)

3.5.5 Account for the position of **X** in the skull of diagram **B**. (2)

3.5.6 Explain the significance of the shape of the spine that is associated with the pelvis in diagram **C**. (2)

3.5.7 Explain how the change in the skull, in the organisms from **diagram A** to diagram **B**, could indicate a change in intelligence. (3)

(14)

[50]

TOTAL SECTION B: 100

GRAND TOTAL: 150

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GRADE 12

LIFE SCIENCES P2

SEPTEMBER 2022

MARKING GUIDELINES

150 MARKS

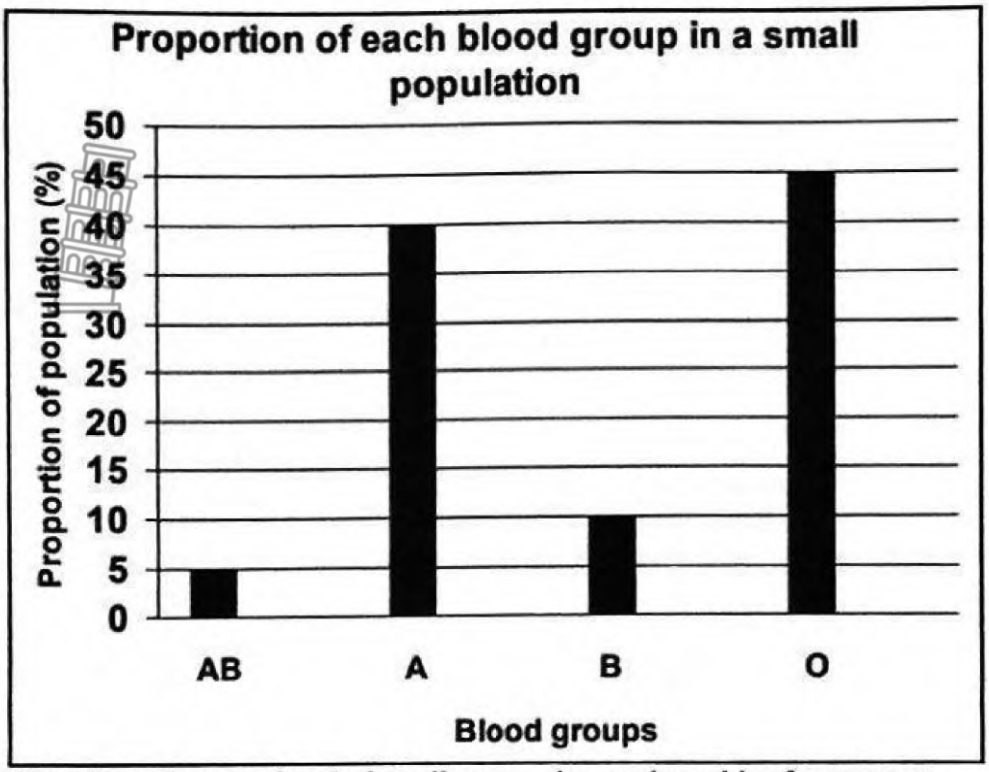
THESE GUIDELINES CONSIST OF 12 PAGES

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	D✓✓		
	1.1.3	B✓✓		
	1.1.4	B✓✓		
	1.1.5	A✓✓		
	1.1.6	D✓✓		
	1.1.7	A✓✓		
	1.1.8	C✓✓		
	1.1.9	A✓✓	(9 x 2)	**18**
1.2	1.2.1	Fossil/s✓		
	1.2.2	Stem cells✓		
	1.2.3	Cytokinesis✓		
	1.2.4	Homologous✓ structures		
	1.2.5	Binocular vision✓ / Stereoscopic vision		
	1.2.6	Population✓		
	1.2.7	Extinction✓		
	1.2.8	Selective breeding✓ / Artificial selection		**(8)**
1.3	1.3.1	A only ✓✓		
	1.3.2	A only✓✓		
	1.3.3	None✓✓	(2 x 2)	**(6)**
1.4	1.4.1	DNA✓		(1)
	1.4.2	Nucleus✓		(1)
		Mitochondria✓		(1)
	1.4.3 (a)	Nucleotide✓		(1)
	(b)	Thymine✓		(1)
	(c)	Hydrogen✓ bond / Weak hydrogen bond		(1)
				(6)
1.5	1.5.1	Dihybrid✓		(1)
	1.5.2 (a)	(Both) RrTt✓✓ or RrTt and RrTt		(2)
	(b)	Yellow (flowers) and Tall✓		(1)
	(c)	RT; Rt; rT; rt✓✓		(2)
				(6)

1.6



NB: Heading: Proportion in heading can be replaced by frequency
Y-axis label: can be percentage only

Guideline for assessing the graph:

CRITERIA	ELABORATION	MARK
Correct type of graph (T)	Bar-graph drawn	1
Caption of graph (C)	Both variables included	1
Axes labels (L)	X- and Y-axis correctly labelled with units	1
Scale for X- and Y-axis (S)	- Same width of bars for X-axis and - Correct scale for Y-axis	1
Plotting of bars (P)	1 to 3 bars plotted correctly All 4 bars plotted correctly	2

(6)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) Nucleus✓ (1)

(b) mRNA✓ / messenger RNA (1)

2.1 2.1.2
- The double helix DNA unwinds✓and
- unzips✓/weak hydrogen bonds break
- to form two separate strands✓
- One strand is used as a template✓
- to form mRNA✓
- using free RNA nucleotides from the nucleoplasm✓
- The mRNA is complementary to the DNA✓
- The coded message for protein synthesis is thus copied onto mRNA✓

Any **(6)**

2.1.3 (a) UCG✓ (1)

(b) Tyrosine✓
Valine✓ (in this order only) (2)

2.1.4. Both mRNA codes GUC and GUA codes for the amino acid Valine✓.
Therefore, the protein molecule will remain the same✓ (no change). (2)

2.2 2.2.1 Anaphase 1✓ (1)

2.2.2 (Homologous) Chromosomes moved to the opposite poles✓ /
(Homologous) Chromosomes at Z moves together (1)

2.2.3 (a) Centromere✓ (1)

(b) Centriole✓ (1)

(c) Spindle fibre✓ (1)

2.2.4 - Non-disjunction✓ occurred at Z
-This will result in an extra copy of chromosome number 21✓ in the gamete and resulting zygote✓/child
-The child will suffer from Down's Syndrome✓ (3 only) (3)

2.2.5 **Crossing-over** ✓
- During Prophase I✓
- Homologous chromosomes✓/bivalents pair up
- Each chromosome has 2 chromatids✓
- Non-sister chromatids of the homologous pair overlap✓/cross over
- Points at which crossing-over takes place are referred to as chiasma/chiasmata✓
- Genetic material is exchanged✓
- between non-sister chromatids✓
- After the process of crossing-over chromosomes have genes from its homologous partner✓
- This means that each gamete formed will have a mix of genes from maternal and paternal parents✓ Max 5

Random arrangement of chromosomes at the equator ✓
- During Metaphase I✓
- Each pair of homologous chromosomes✓
- *may line up either way✓/randomly on the equator of the spindle
- *Randomly / Independently / Separately of what the other pairs are doing✓

OR

- During Metaphase II✓
- Each individual chromosome✓
- *may line up either way✓/flipped on the equator of the spindle
- *This means that gametes will have differing number/mix of maternal and paternal chromosomes✓/chromatids Max 3
(at least 1 of the *compulsory and any 4 which could include compulsory points)

(8)
(16)

2.3 2.3.1 ¼✓ = 25%✓ (2)

2.3.2 (a) X^HX^h✓ (1)

(b) X^hY✓ (1)

2.3.3 -Chromosome pair 23 in females consists of two X-chromosomes✓.
-If females inherit one recessive allele✓ (X^h) for haemophilia, they would be able to mask the effect of the recessive allele with a dominant allele✓ on the second X-chromosome (females are carriers).
Any (2)

2.3.4 **P_1** Phenotype Affected female x Unaffected male✓
Genotype $X^h X^h$ x $X^H Y$ ✓

Meiosis

Fertilisation

Gametes	X^h	X^h
X^H	$X^H X^h$	$X^H X^h$
Y	$X^h Y$	$X^h Y$

1 mark for correct gametes✓
1 mark for correct genotypes✓

F_1 Phenotype Unaffected female; Unaffected female; Affected male; Affected male✓
100% chance for having a haemophiliac son✓*

P_1 and F_1✓
Meiosis and fertilisation✓

OR

P_1 Phenotype Affected female x Unaffected male✓
Genotype $X^h X^h$ x $X^H Y$ ✓

Meiosis

G/gametes X^h , X^h x X^H , Y✓

Fertilisation

F_1 Genotype $X^H X^h$ $X^h Y$ $X^H X^h$ $X^h Y$✓
Phenotype Unaffected female; Unaffected male; Unaffected female; Affected male✓
100% chance for having a haemophiliac son✓*

P_1 and F_1✓
Meiosis and fertilisation✓

✓*compulsory mark + 6 (7)
(13)

[50]

2.4 2.4.1 - The manipulation of genetic material✓
- to produce a genetically different✓/identical organism/repair tissues and organs

OR

- The manipulation of genetic material✓
- to produce something of benefit to humans✓/society (2)

2.4.2 (a) -Bacteria have been created that are capable of synthesizing human insulin✓
-needed to treat people who are suffering from diabetes✓ (2)

(b) -Genes for toxins that kill insects have been introduced in several species of plants✓
-lowers the cost/s to eradicate pests✓/saves money (2)

2.4.3 - Bacteria reproduce very rapidly✓,
- forming many copies of the gene✓ in a short period of time

OR

- Bacteria reproduce asexually✓/by mitosis,
- forming identical copies of itself✓

OR

- The bacterial DNA is in the form of a plasmid✓,
- for easy insertion of genes✓

OR

- Bacteria exist everywhere✓,
- so they can be obtained with no difficulty✓/expense

OR

- Bacteria are simple organisms✓,
- so their use is unlikely to raise ethical issues✓ Any 1 x 2 (2)

(8)

[50]

QUESTION 3

3.1 3.1.1 (a) Herd of cows✓ (1)

(b) (Variation) in Volume of milk produced✓ (1)

3.1.2 - Decide on sample size✓
- Decide of the place to conduct the investigation✓
- Duration✓
- Person to administer the investigation✓
- decide how to measure results/apparatus to be used ✓
- recording tools/ method of presenting data ✓
(Mark first THREE only) Any (3)

3.1.3 -The same type of feed✓/ type of food given to the cows
-The same amount of food given to the cows
-All the cows exposed to the same environmental conditions/climate
Any (2)

3.1.4 - Repeat the investigation✓
- Increase sample size✓
- Calculate the average✓ Any (2)
(9)

3.2 3.2.1 - It is characterised by long periods of little or no change✓
-alternating with short periods of rapid change✓
-during which new species may be formed✓ (3)

3.2.2 There was not enough food for them to eat✓ (1)

3.2.3 - If the island species can interbreed with the mainland species✓
- and produce fertile offspring they are the same species✓ / if they do not produce fertile offspring, they are not the same species (2)

3.2.4 -Since the lizards' heads were used more✓
-the lizards developed larger heads✓
-This characteristic (of larger heads) was inherited by the offspring✓
-Over many generations (15 years) the heads of the lizards became larger✓ (4)
(10)

3.3 - If a population of a single species becomes separated by a geographical barrier✓ (sea, river, mountain, lake)
- then the population splits✓ into two
- There is now no gene flow✓ between the two populations
- Since each population may be exposed to different environmental conditions✓/the selection pressure may be different
- natural selection occurs independently✓in each of the two populations
- such that the individuals of the two populations become very different✓ from each other
- genotypically and phenotypically✓
- Even if the two populations were to mix again✓
- they will not be able to interbreed✓ / reproductively isolated
- The two populations are now different species✓ Any **(6)**

3.4 3.4.1 Phylogenetic tree✓ / cladogram (1)

3.4.2 5✓ (1)

3.4.3 (a) *Homo*✓ (1)

(b) *Homo erectus*✓ (1)

3.4.4 Mrs Ples✓
Taung Child✓
Little Foot✓
(*mark first ONE only*) (1)

3.4.5 *Homo erectus* ✓
Homo sapiens ✓
Homo neanderthalensis ✓
MARK FIRST TWO ONLY Any (1) (2)

3.4.6 -Fossils of Ardipithecus were found ONLY in Africa✓/Rift Valley/Ethiopia/South Africa
-Fossils of Australopithecus were found ONLY in Africa✓/Rift Valley/Ethiopia/South Africa
-The fossils of Homo habilis were ONLY found in Africa✓
-The OLDEST fossils of Homo erectus were found in Africa✓
-The OLDEST fossils of Homo sapiens were found in Africa✓ Max (4)
(11)

3.5 3.5.1 X - Foramen magnum✓
Y - Canine✓ (2)

3.5.2 D✓ (1)

3.5.3 The pelvis is longer✓ than it is narrow✓ (2)

3.5.4 (a) B✓ (1)

(b) A✓ (1)

3.5.5 -The foramen magnum/**X** is located in a more forward✓ position in the skull
Organism is bipedal✓/since the spinal cord enters vertically (2)

3.5.6 -The spine is S-shaped✓
-to balance the weight above the hips✓/to support the weight of a bipedal organism (2)

3.5.7 -There is an increase✓
-in the cranium size✓shown from diagram **A** to **B**
This will allow it to house a bigger brain✓/cerebrum which suggests greater intelligence (3)
(14)

[50]

TOTAL SECTION B: 100