education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION

GRADE 12

LIFE SCIENCES P2

SEPTEMBER 2024

MARKS: 150

TIME: 2½ HOURS

This question paper consists of 20 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 for each question.
6. ALL drawings should 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 compass, where necessary.
11. Write neatly and legibly.

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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 1.1.9) in the ANSWER BOOK, for example, 1.1.10 D.

1.1.1 When a cell divides by meiosis, it will result in …

A four genetically different haploid gametes.
B two genetically different haploid gametes.
C four genetically different haploid somatic cells.
D two genetically different haploid somatic cells.

1.1.2 Dog breeders selected desirable traits to develop particular characteristics in domestic dogs such as the flat face of a bulldog.

Bulldogs suffer from breathing problems because of their set-back noses and shortened air passages.



Bulldog with a flat face

These issues in bulldogs are due to …

A mutations.
B genetic disorders.
C artificial selection.
D natural selection.

1.1.3 Evidence supporting the evolution theory is obtained by studying the structure of vertebrate forelimbs.

This type of evidence for evolution is best described as …

A genetic evidence.
B DNA evidence.
C biogeography.
D descent with modification.

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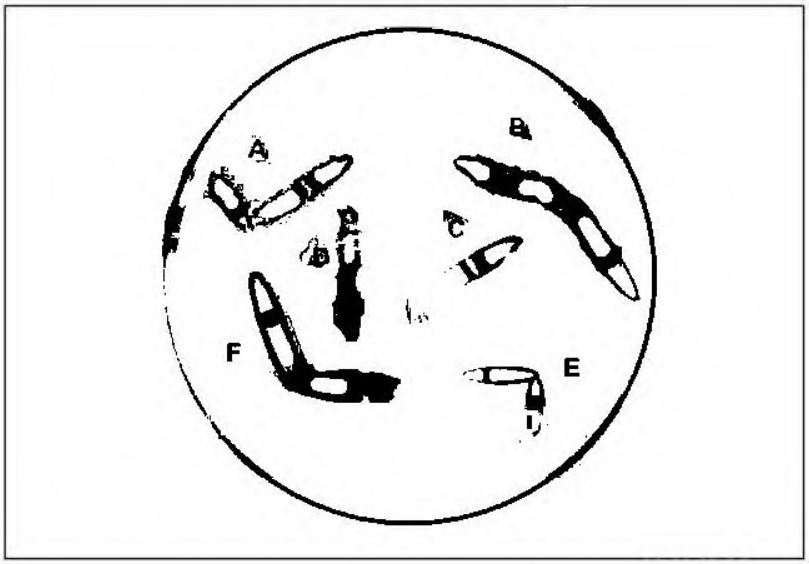
1.1.4 Which hominin species had the smallest brain capacity?

A *Homo habilis*
B *Australopithecus sediba*
C *Ardipithecus ramidus*
D *Homo sapiens*

1.1.5 If a DNA molecule consisting of 250 nitrogen bases has 25 adenine bases, what is the ratio of adenine to guanine in the same molecule?

A 1:1
B 4:1
C 1:3
D 1:4

1.1.6 The following diagram shows <u>six chromosomes</u> (labelled **A** to **F**) from a diploid cell.



Which of the following combinations represents the three pairs of homologous chromosomes?

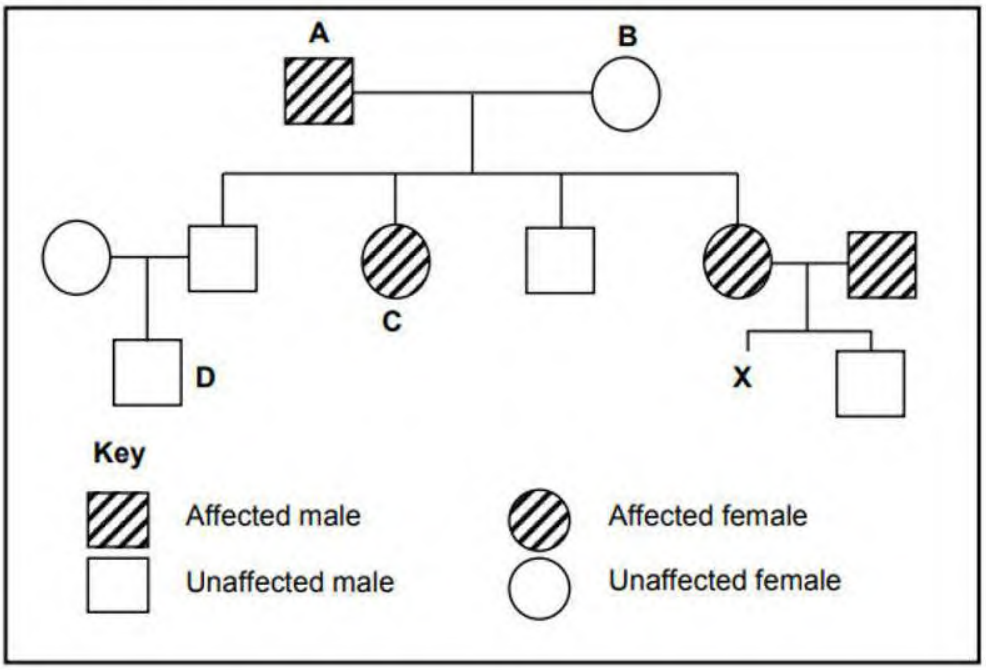
	Homologous pair 1	Homologous pair 2	Homologous pair 3
A	**C** and **D**	**A** and **F**	**B** and **E**
B	**A** and **C**	**D** and **E**	**B** and **F**
C	**A** and **E**	**C** and **D**	**B** and **F**
D	**A** and **D**	**B** and **C**	**E** and **F**

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QUESTIONS 1.1.7 AND 1.1.8 REFER TO THE PEDIGREE DIAGRAM BELOW.

A scientist gathered information about the affected and unaffected individuals for a certain genetic disorder. A dominant allele causes the genetic disorder. The findings of the scientist are represented in the pedigree diagram below.

The letter **R** is used to represent the dominant allele and **r** to represent the recessive allele.



1.1.7 The genotype of individual **C**:

A Rr
B RR
C rr
D X^rX^r

1.1.8 Which statement is correct for the phenotype of individual **X**?

A 100 % chance of being unaffected
B 50% chance of being unaffected
C 25 % chance of being affected
D 75% chance of being affected

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1.1.9 If the mother is heterozygous for blood type B, and the father is blood type O, the first generation's only possible blood type(s) (F_1) will be …

A AB and O.
B B and O.
C only B.
D only O.

(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 numbers (1.2.1 to 1.2.8) in the ANSWER BOOK.

1.2.1 More than two alleles that influence one characteristic

1.2.2 The complete set of genes of an organism

1.2.3 The division of cytoplasm during meiosis

1.2.4 The gap between the teeth of apes

1.2.5 The permanent disappearance of a species from Earth

1.2.6 Chromosomes in the human karyotype that are not associated with sex determination

1.2.7 The type of dominance is where both alleles of a gene are equally dominant and both alleles express themselves in the phenotype in the heterozygous condition

1.2.8 The family that *Homo Sapiens* belong to

(8)

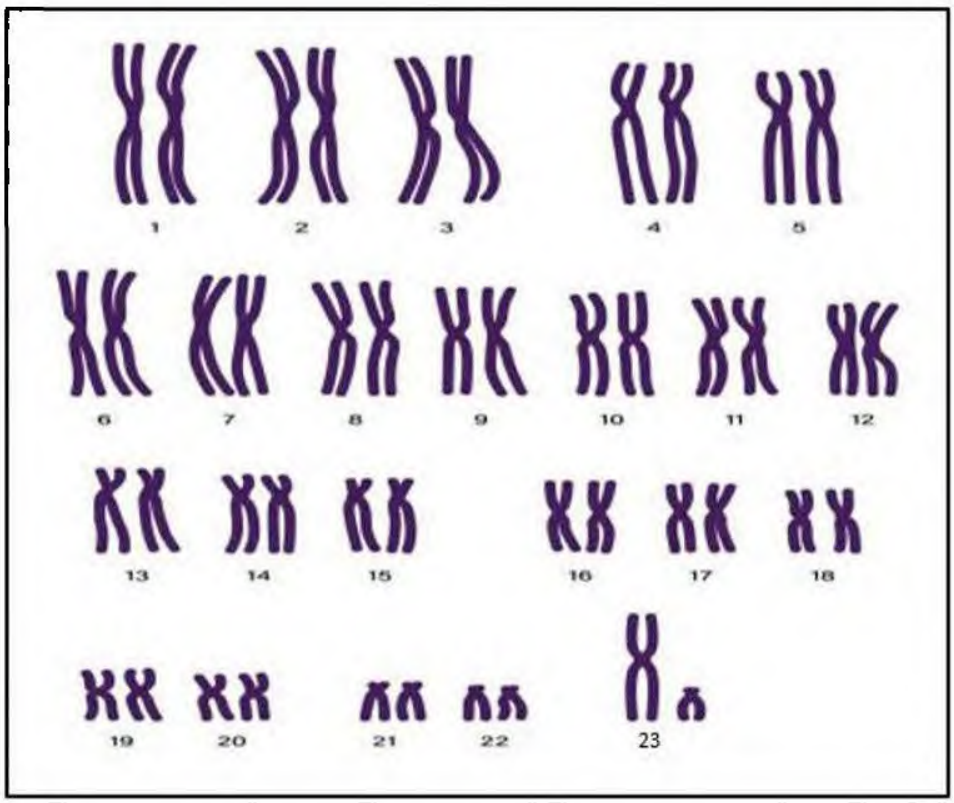
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1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Variation within a population in which there is a range of intermediate phenotypes	A: Discontinuous variation B: Continuous variation
1.3.2	Down syndrome	A: 2n + 1 B: 2n + n
1.3.3	A homozygous tall plant is crossed with a homozygous short plant; the offspring will be 100% tall plants	A: Mendel's law of dominance B: Mendel's law of segregation

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

1.4 The diagram below represents all the chromosomes from a human somatic cell.



1.4.1 Identify the type of diagram shown above. (1)

1.4.2 State the gender of the person represented in this diagram. (1)

1.4.3 Give ONE reason for your answer in QUESTION 1.4.2. (2)

1.4.4 Name the phase of meiosis during which the above chromosomes were possibly photographed. (1)

1.4.5 If a person has a genetic condition that results in only 43 autosomes, how many chromosomes will there be in their somatic cells? (2)
(7)

1.5 A maize farmer crossed two maize plants and investigated two traits in this crossing.

Yield ability:	Few cobs (**F**)	Many cobs (**f**)
Draught resistance:	High (**H**)	Low (**h**)

One parent plant is homozygous dominant for both traits, and the other is homozygous recessive for both traits.

1.5.1 Give the genotypes of both parents in the P1-generation. (2)

1.5.2 The parents in the P2-generation are crossed, and the offspring genotypes are shown in the Punnett diagram below.

	FH	**Fh**	**fH**	**fh**
FH	FFHH	FFHh	FfHH	FfHh
Fh	FFHh	FFhh	FfHh	Ffhh
fH	FfHH	FfHh	ffHH	FfHh
fh	FfHh	Ffhh	ffHh	ffhh

Give:

(a) The dominant phenotype for drought resistance (1)

(b) The recessive allele for yield ability (1)

(c) The phenotype of **Ffhh** (2)

(d) The ratio of the offspring phenotypes in maize plants with few heads and a high drought resistance to maize plants with many heads and a low drought resistance (2)

(e) The percentage of offspring that is homozygous for both characteristics. Show your calculations (3)
(11)

TOTAL SECTION A: 50

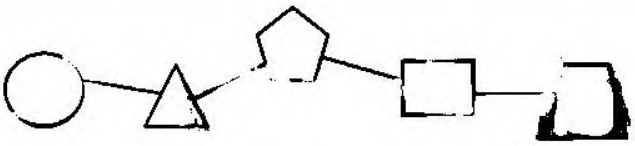
SECTION B

QUESTION 2

2.1 Insulin is a peptide hormone produced by the beta cells of the pancreatic islets encoded in humans by the INS gene.

In most animals, including humans, a single gene for insulin is found. The human gene for insulin is located on the short arm of chromosome 11 at position 15.5.

The diagrams below represent a section of the human INS GENE that codes for insulin. Strand **A** is a normal insulin strand, and strand **B** is a mutated strand.



Strand A: Normal insulin strand



Strand B: Insulin strand with mutation

The table below presents the key for the amino acids as represented in strands **A** and **B**

Key	Amino acid
	Phenylalanine (Phen)
	Tyrosine (Tyr)
	Threonine (Thr)
	Proline (Pro)
	Lysine (Lys)
	Methionine (Met)

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2.1.1 According to the information given, what is the locus of the human insulin gene? (2)

2.1.2 What type of mutation is illustrated in this diagram? (1)

2.1.3 Identify the amino acid that caused the mutation in strand **B**. (2)

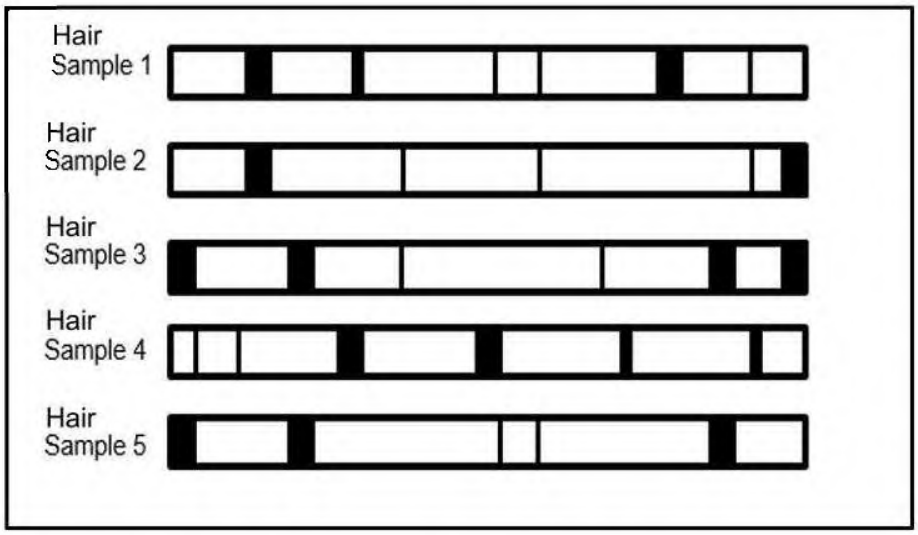
The table below shows the amino acid and their corresponding codes.

Amino acid	Codon
Phenylalanine (Phen)	UUC
Tyrosine (Tyr)	UAU
Threonine (Thr)	ACG
Proline (Pro)	CCG
Lysine (Lys)	AAA
Methionine (Met)	AUG

2.1.4 Give the codon for the last amino acid in strand **B**. (1)

2.1.5 Identify the DNA base triplet for the third amino acid in the NORMAL insulin strand. (2)
(8)

2.2 Forensic scientists collected multiple hair samples at a crime scene in a family home. Four family members live in the house. The diagram below shows the respective DNA profiles from the different hair samples found in the house.

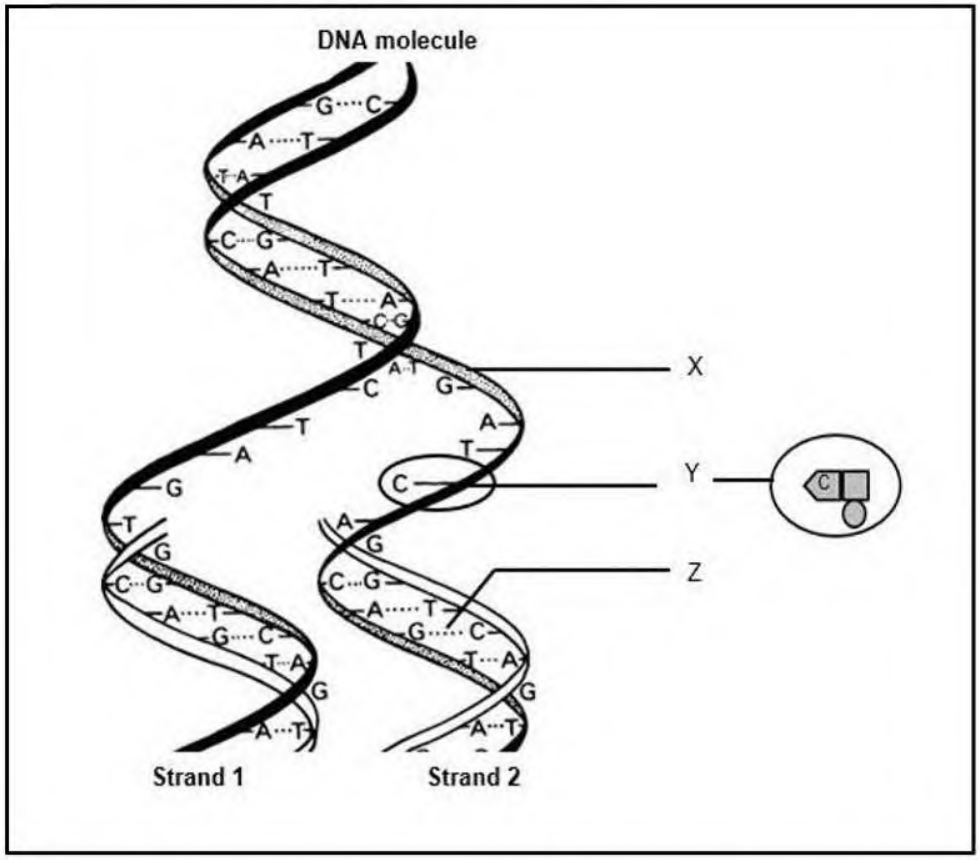


2.2.1 Identify which hair sample could be that of the suspect. (1)

2.2.2 Explain your answer to QUESTION 2.2.1. (3)

2.2.3 The possibility exists that the hair sample identified in QUESTION 2.2.1 is NOT that of the suspect.
Explain this statement. (2)
(6)

2.3 The diagram below represents DNA replication.



2.3.1 Give TWO visible reasons why this diagram represents DNA replication. (2)

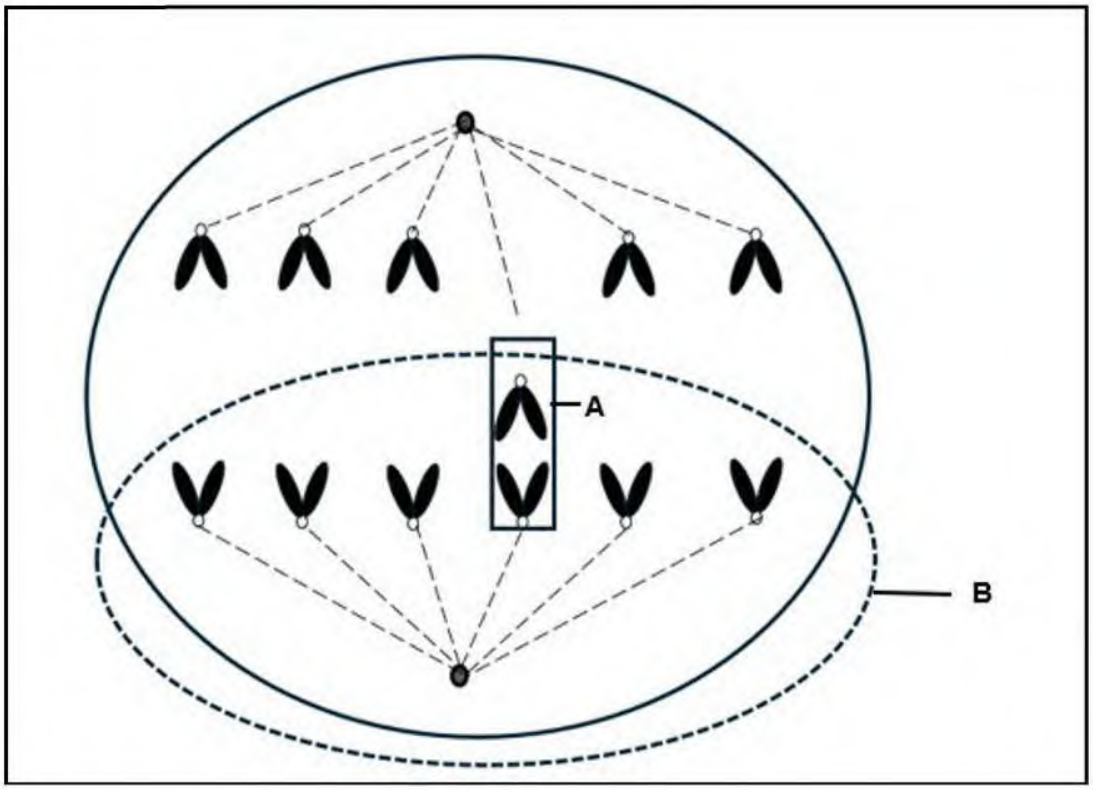
2.3.2 Identify:

(a) Monomer **Y** (1)
(b) The sugar in structure **X** (1)
(c) Bond **Z** (1)

2.3.3 Give TWO reasons why DNA replication is of biological significance. (2)
(7)

2.4 Tabulate TWO structural differences between mRNA and tRNA. **(5)**

2.5 The diagram below represents one cell in a phase of meiosis.



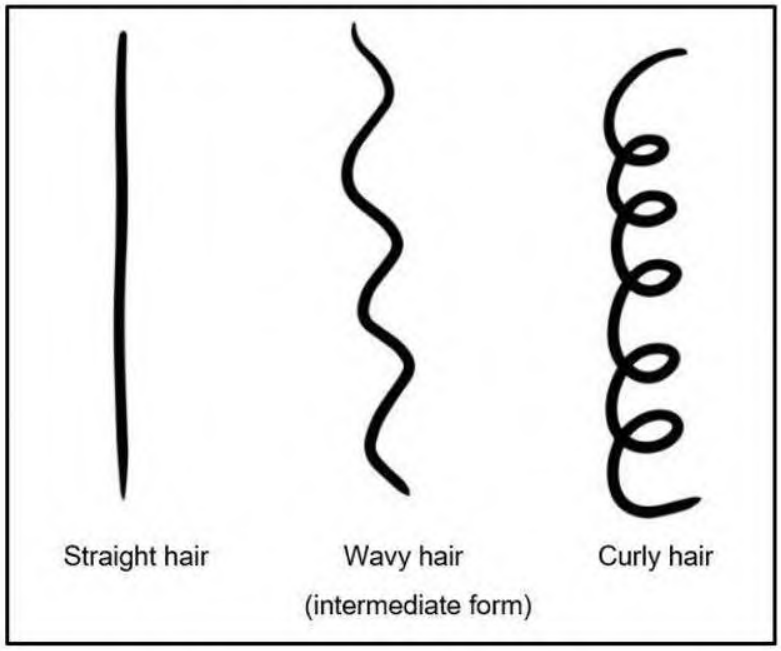
2.5.1 Identify the phase of meiosis illustrated in the diagram. (1)

2.5.2 Identify the process that took place at **A**. (1)

2.5.3 If gamete **B**, results from the process identified in QUESTION 2.5.2, is involved in fertilisation with a normal gamete, explain how the new zygote will be affected. (2)

2.5.4 Draw a labelled diagram of gamete **B** as it would appear in telophase II. (5)
(9)

2.6 Two alleles determine the texture of human hair. An allele that results in curly hair (R) and an allele that results in straight hair (T). In a heterozygous condition, the hair texture will be wavy in the phenotype.



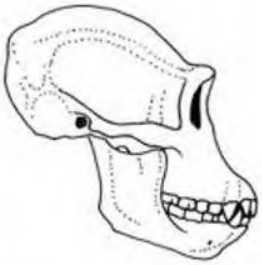
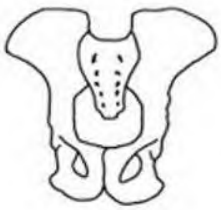
2.6.1 What type of dominance occurs in human hair texture? (1)

2.6.2 How many genes control the texture of human hair? (1)

2.6.3 Mr Anderson has curly hair, and Mrs Anderson has wavy hair.

Use a genetic cross to show the percentage of possible phenotypes of Mr and Mrs Andersons' children. (6)
(8)

2.7 The table contains diagrams representing the body parts of different primate species.

 A	 B	 C
 D	 E	 F

2.7.1 Which diagram represents the pelvis of a bipedal organism? (1)

2.7.2 Give ONE reason for your answer in QUESTION 2.7.1. (1)

2.7.3 What type of grip is possible due to the structure of body part **F**? (1)

2.7.4 Give all the LETTERS of the body parts that belong to a chimpanzee. (2)

2.7.5 Describe ONE difference between the teeth of organisms **B** and **D**. (2)
(7)

[50]

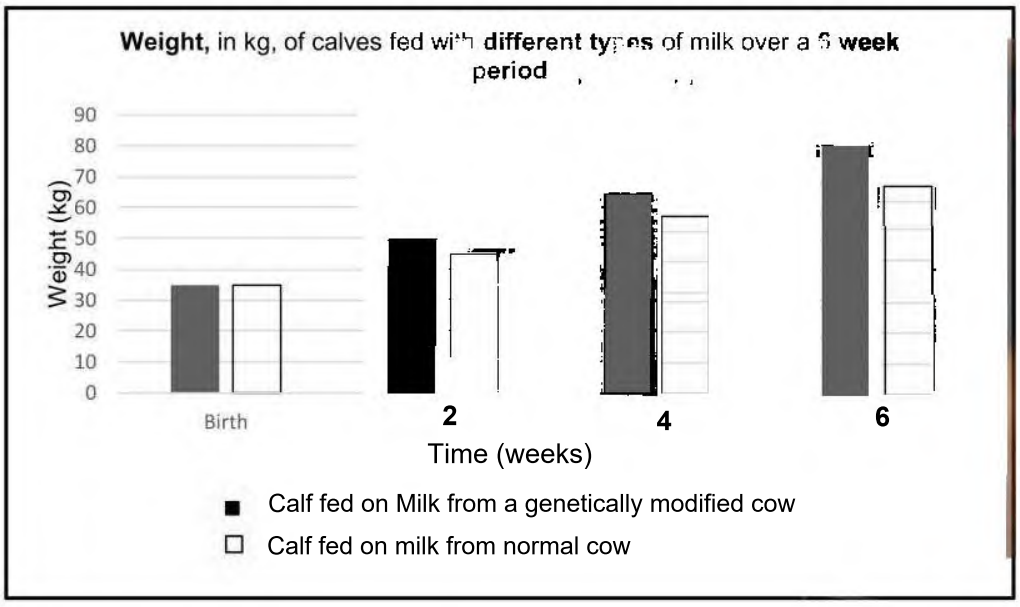
QUESTION 3

3.1 An investigation was done on the weight gain of two calves over six weeks. The cows abandoned both calves at birth; both were hand-raised with bottle feeds for six weeks.

The investigation was done to determine the effect of the type of milk used for feeding on the weight of the calves. One calf was fed on milk from a genetically modified cow – and the other on milk from a normal cow.

The calves are from the same breed of cattle and had the same weight at the beginning of the investigation.

The graph below represents the weight gain of each calf during the investigation.



3.1.1 Define the term *genetic manipulation*. (2)

3.1.2 Give TWO reasons why this is not a reliable investigation. (2)

3.1.3 Which calf had the highest weight gain at the end of the six weeks? (1)

3.1.4 By studying the results of this investigation, describe the advantages to farmers in the meat industry when calves are fed on milk produced by genetically modified cows. (3)

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3.1.5 What type of graph was used to illustrate the data in this investigation? (1)

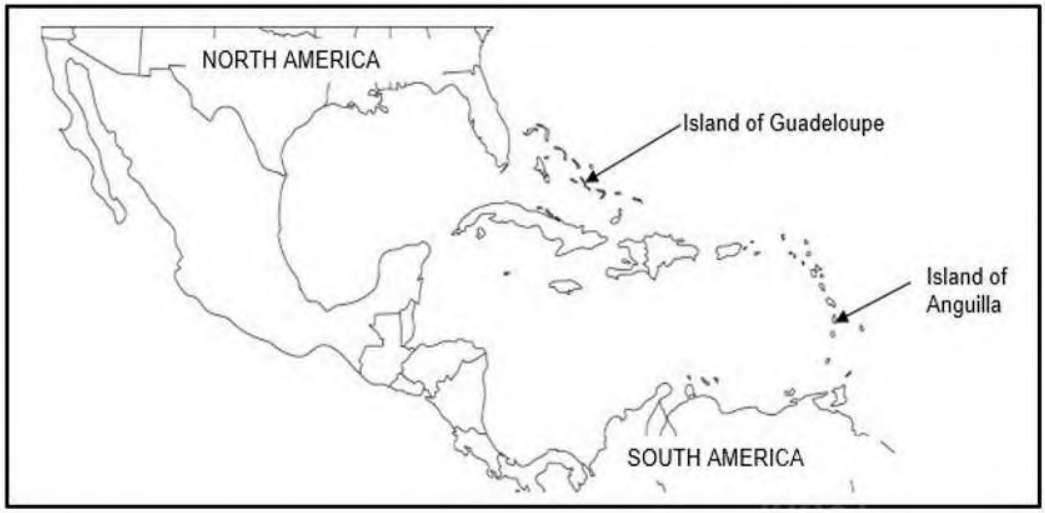
3.1.6 Draw a table to represent the information in the graph. (6)
(15)

3.2 Read the extract below.

SPECIATION IN ACTION

In the summer of 1995, at least 15 iguanas from the island of Guadeloupe survived Hurricane Marilyn on a raft of uprooted trees. They rode the high seas for a month before colonising the Caribbean island of Anguilla. These few individuals were the first of their species, *Iguana iguana*, to inhabit the island of Anguilla.

Scientists were eager to discover what would happen next: would the colonising iguanas die out? Would they survive and change only slightly, or would they become reproductively isolated from other *Iguana iguanas* and become a new species?



3.2.1 What is the geographical barrier in this case study? (1)

3.2.2 If the iguanas survive, how will scientists determine whether they remain the same species or become a new species? (2)

3.2.3 If speciation did occur, how would the reproductive isolated new species of iguana differ from the original species? (2)

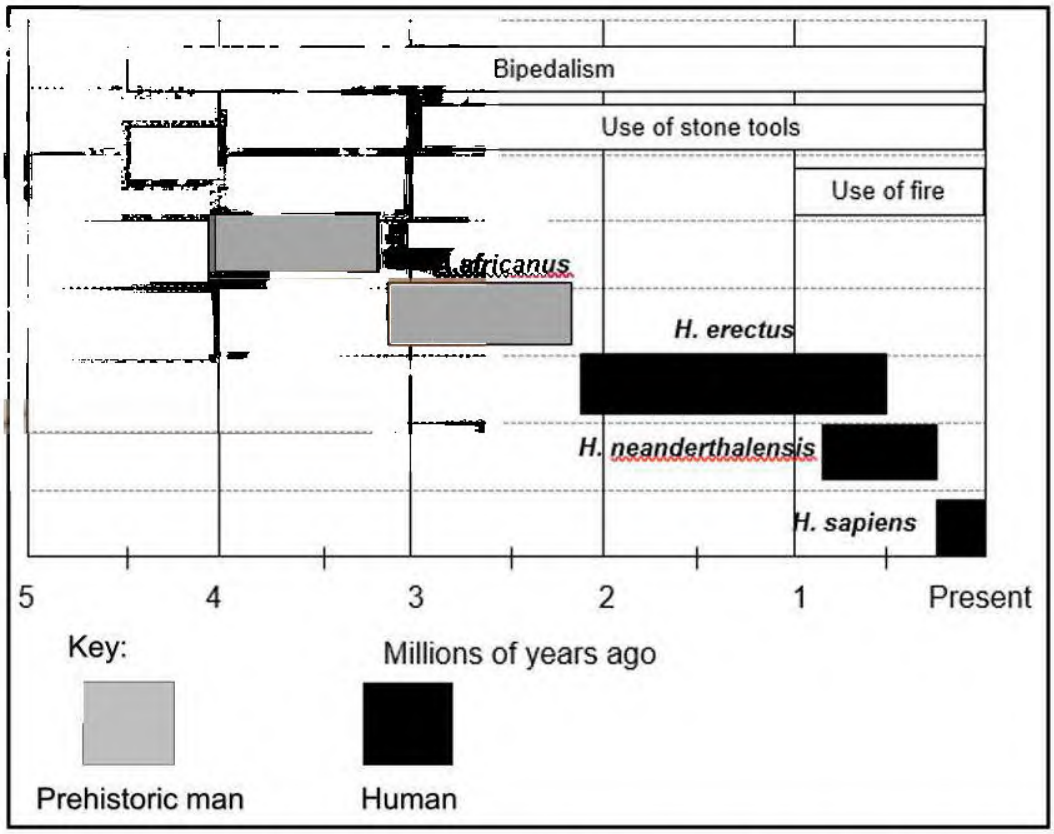
3.2.4 Name TWO reproductive isolated mechanisms by which the iguanas on Anguilla Island could have become reproductively isolated. (2)

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3.2.5 Natural selection is an important part of speciation. List FOUR observations that Charles Darwin made around the Galapagos islands that led to his theory of natural selection. (4)

(11)

3.3 The diagram below represents the possible evolution of humans, including the timeline for the advancement of bipedalism, applying fire and utilising tools.



3.3.1 Identify TWO bipedal species that did not use stone tools or have the ability to make fire. (2)

3.3.2 State THREE advantages of bipedalism. (3)

3.3.3 When did the ability to make fire develop? (1)

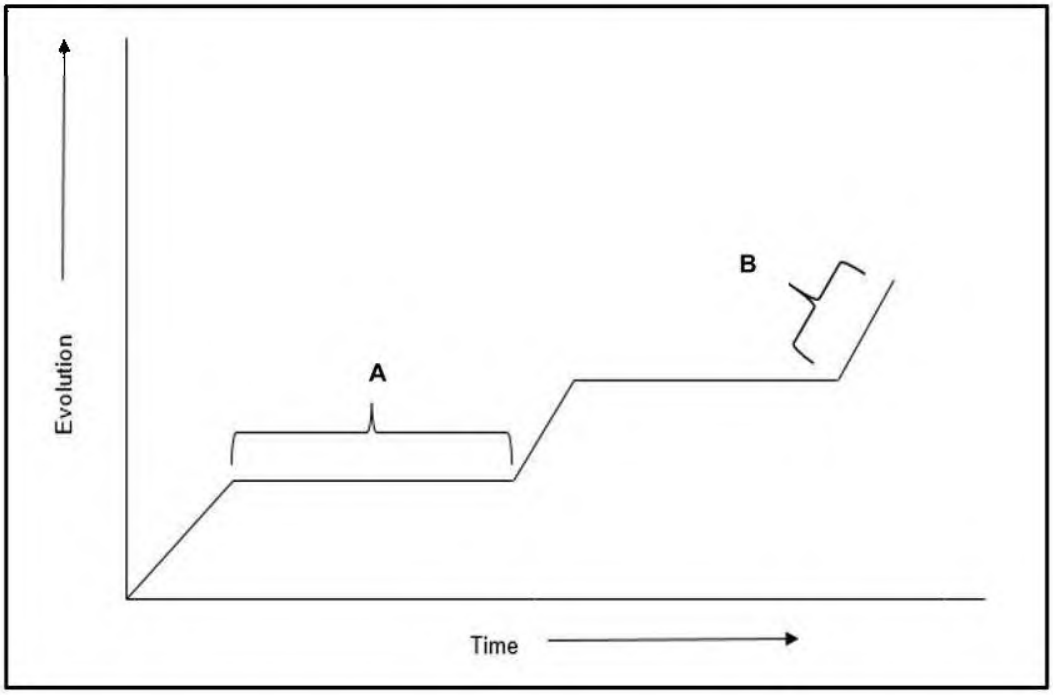
3.3.4 Name TWO *A. africanus* fossils that have been found in the Cradle of Humankind. (2)

3.3.5 Explain the correlation between the size of the cranium and the ability of the Homo species to make and use stone tools. (3)

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3.4 Except for fossils, mitochondrial DNA can also be used as evidence to support the 'Out of Africa' hypothesis. Explain this statement. (4)
(15)

3.5 The graph below shows the rate at which evolution occurs in a mosquito species.



3.5.1 Identify the type of evolution theory that is represented by this graph. (1)

3.5.2 Name the TWO scientists who proposed the theory in QUESTION 3.5.1 in 1972. (2)

3.5.3 What type of environmental conditions would result in period **A**? (2)

3.5.4 Explain what happens during period **B**. (2)

3.5.5 Explain why mosquitoes are good examples to study this evolution theory. (2)
(9)

[50]

TOTAL SECTION B: 100
GRAND TOTAL 150

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