basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2015

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 pages.

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.

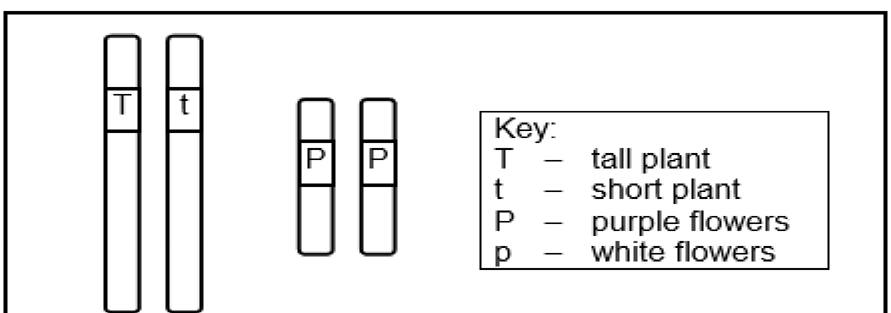
1.1.1 The shape of the DNA molecule was discovered by ...

A Franklin, using evidence obtained from Watson and Crick.
B Franklin, working independently of anyone else.
C Watson and Crick, working independently of anyone else.
D Watson and Crick, using some evidence obtained from Franklin.

1.1.2 Scientists have created a genetically modified zebrafish, a 'GloFish'. This fish has a gene that makes it glow in the dark. This gene was introduced into the species by ...

A interbreeding with another species of fish that is able to glow.
B removing the gene from a glowing fish and inserting it into a chromosome of the zebrafish.
C the process of natural selection.
D inbreeding.

1.1.3 The diagram below shows the alleles for height and flower colour in a flowering plant.



Alleles for height and colour

The plant is ...

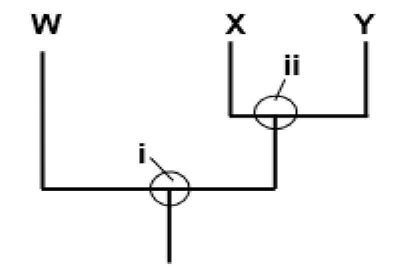
A homozygous dominant for height and heterozygous for flower colour.
B heterozygous for height and homozygous dominant for flower colour.
C homozygous recessive for height and homozygous dominant for flower colour.
D heterozygous for height and heterozygous for flower colour.

1.1.4 A phylogenetic tree represents ...

A the number of species on Earth.
B only species that belong to the same genus.
C only organisms that are now extinct.
D possible evolutionary relationships.

1.1.5 The diagram below shows a generalised phylogenetic tree.

The different ancestors in the phylogenetic tree are represented by **i** and **ii**.



Phylogenetic tree

Which ONE of the following is the most appropriate conclusion that can be made from the phylogenetic tree?

A **ii** is a common ancestor of **X** and **Y** only.
B **i** is a common ancestor of **W** and **X** only.
C **W** and **X** are more closely related than **X** and **Y**.
D **X** and **Y** belong to the same species.

1.1.6 A messengerRNA (mRNA) molecule consists of 300 nitrogenous bases. The maximum number of amino acids that it can code for is ...

A 300.
B 150.
C 100.
D 30.

1.1.7 Which ONE of the following resulted from Gregor Mendel's experiments with pea plants?

A The 'law' of inheritance of acquired characteristics
B The principle of independent assortment
C The 'law' of use and disuse
D The theory of evolution

1.1.8 The modern human skull ...

A has small canines.
B has pronounced brow ridges.
C is prognathous.
D has a U-shaped arrangement of teeth on each jaw.

1.1.9 Which ONE of the following represents the correct order for the evolution of modern humans?

A *Ardipithecus* → *Australopithecus* → *Homo*
B *Australopithecus* → *Ardipithecus* → *Homo*
C *Homo* → *Australopithecus* → *Ardipithecus*
D *Ardipithecus* → *Homo* → *Australopithecus*

1.1.10 Which ONE of the following represents a trend in human evolution?

A More developed brow ridges
B Increased size of canines
C More developed cranial ridges
D More forward position of the foramen magnum (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 1.2.10) in the ANSWER BOOK.

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

1.2.2 The complete set of chromosomes in the cell of an organism

1.2.3 A bar code pattern formed from DNA

1.2.4 The condition that results from the absence of skin pigmentation

1.2.5 The bonds formed between amino acids

1.2.6 A representation of the number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell

1.2.7 Openings in the nuclear membrane that allow mRNA to leave the nucleus

1.2.8 A copy of an organism that is genetically identical to the original organism

1.2.9 A tentative explanation of a phenomenon that can be tested

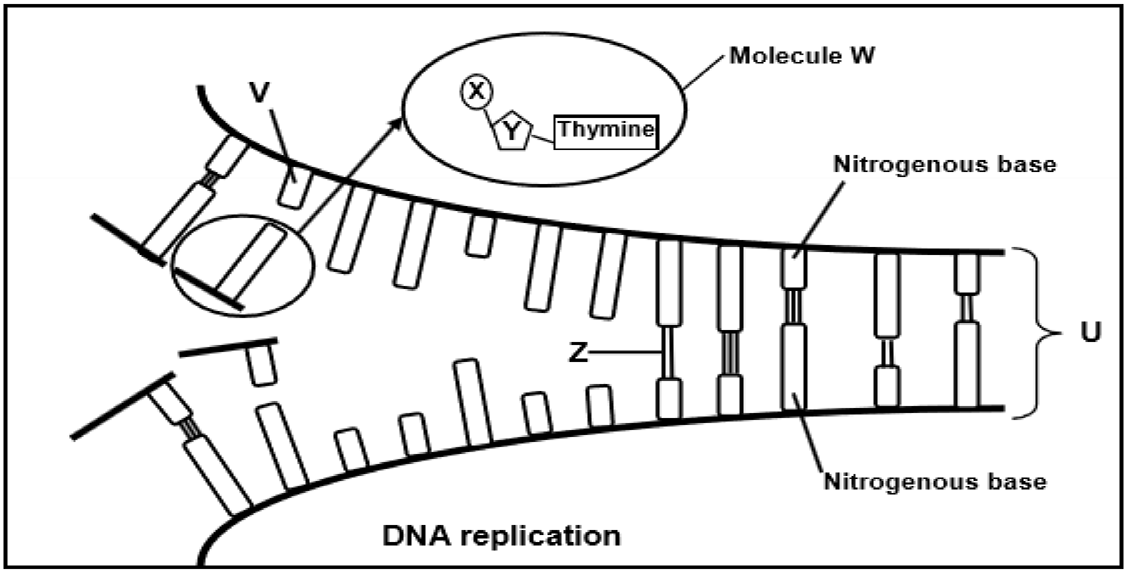
1.2.10 The distribution of species in different parts of the world (10 x 1) **(10)**

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 number (1.3.1 to 1.3.6) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Evidence for evolution	A: fossils B: genetics
1.3.2 Used as evidence for the 'Out of Africa' hypothesis	A: cultural evidence (tool making) B: mitochondrial DNA
1.3.3 The code for an amino acid on mRNA	A: codon B: anticodon
1.3.4 Example of a reproductive isolating mechanism	A: breeding at the same time of the year B: adaptation to different pollinators
1.3.5 Distinctive difference between the apes and the hominids	A: shape of the jaw B: shape of the spinal column
1.3.6 An example of discontinuous variation in humans	A: skin colour B: height

(6 x 2) **(12)**

1.4 The diagram below represents DNA replication.



1.4.1 Identify the following:

(a) Molecules **W** and **U** (2)

(b) Parts of molecule **W** labelled **X** and **Y** (2)

(c) Bond **Z** (1)

(d) Nitrogenous base **V** (1)

1.4.2 Where in the cell does this process take place? (1)

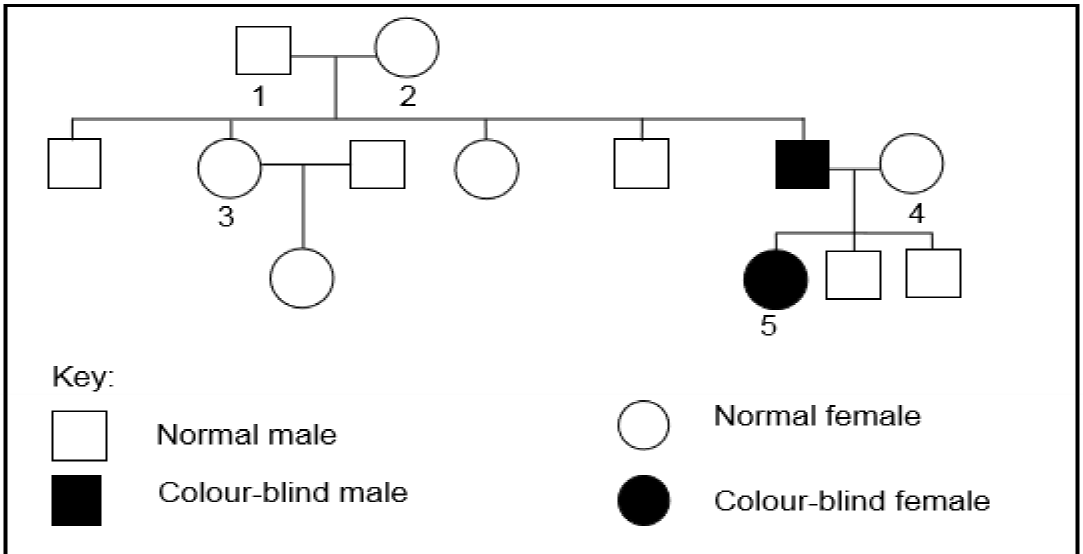
1.4.3 Name the phase of the cell cycle where replication takes place. (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The pedigree diagram below shows the inheritance of colour-blindness (Daltonism) in a family. Colour-blindness is sex-linked and is caused by a recessive allele (**d**). The ability to see colour normally is caused by a dominant allele (**D**).



Inheritance of colour-blindness

2.1.1 How many of the male offspring of parents **1** and **2** were normal? (1)

2.1.2 State the genotype of:

(a) Individual **2** (2)

(b) Individual **5** (2)

2.1.3 A person with a recessive allele for colour-blindness may not be colour-blind. Explain why males with an allele for colour-blindness are always colour-blind. (4)

2.1.4 If individual **5** marries a normal male, what percentage of their daughters will have an allele for colour-blindness, but will NOT be colour-blind? (2)
(11)

2.2 In humans the allele for short fingers (brachydactyly), represented by **B**, is dominant over the allele for normal fingers (**b**). The allele for curly hair (**H**) is dominant over the allele for straight hair (**h**).

Andrew, with genotype **Bbhh**, married Susan, with genotype **bbHh**.

2.2.1 State how the phenotypes of Andrew and Susan differ from each other. (2)

2.2.2 Give ALL the possible genotypes of the gametes produced by Andrew. (2)
(4)

2.3 Mr and Mrs Phonela are concerned that their baby girl does not appear to resemble either of them. They suspect that the baby they were given at the hospital was not theirs. Mr Phonela is blood type **AB**, Mrs Phonela is blood type **B** and the baby they were given is blood type **O**.

2.3.1 Give the possible genotypes of:

(a) Mrs Phonela (2)

(b) The baby girl (1)

2.3.2 Explain why the baby girl with blood type **O** cannot be Mr and Mrs Phonela's daughter. (3)

2.3.3 Explain why the use of blood type for paternity testing is not conclusive. (2)

2.3.4 Using your knowledge of sex chromosomes, explain why the sex of a child is determined by the male gamete. (5)
(13)

2.4 An investigation was conducted by a scientist to determine if two plant populations, Population 1 and Population 2, belonged to the same species. The scientist collected seeds from each of the populations.

He used the following steps in his investigation:

- He planted 20 seeds from Population 1 and 20 seeds from Population 2 in two separate plots close to each other.
- The stamens of all the flowers of Population 1 were removed.
- Pollen from the flowers of Population 2 was used to pollinate the flowers of Population 1.
- The scientist harvested the seeds of the plants in Population 1.
- He grew these seeds under ideal conditions in a laboratory.
- None of the seeds germinated.

2.4.1 Explain the advantage of removing the stamens from the flowers of Population 1. (2)

2.4.2 What evidence indicates that the two populations do not belong to the same species? (1)

2.4.3 State TWO factors that the scientist would have kept constant in the laboratory. (2)

2.4.4 State ONE way in which the scientist could increase the reliability of his results. (1)
(6)

2.5 Describe how new species may form through geographic isolation. **(6)**
[40]

QUESTION 3

3.1 An investigation was conducted on the chances of women of different ages having a baby with Down syndrome as a result of errors in Meiosis I and Meiosis II.

The results of the investigation are shown in the diagram below.

Maternal age (years)	Incidence of Down syndrome (per 1 000 births)	
	Error in Meiosis I	Error in Meiosis II
<25	0,4	0,1
25–29	0,5	0,2
30–34	0,8	0,3
35–39	1,2	0,5
40+	5,9	1,9

[Adapted from *Developmental Biology Online: Human Meiosis 2014*]

3.1.1 Draw a histogram to represent the information in the table above regarding the error occurring in Meiosis II that leads to Down syndrome. (6)

3.1.2 Name the error during meiosis that could eventually result in a child with Down syndrome. (1)

3.1.3 According to the information in the table, is the error mentioned in QUESTION 3.1.2 more likely to occur during Meiosis I or Meiosis II? (1)

3.1.4 Over a five-year period a hospital recorded a total of 44 Down syndrome babies born to mothers who were forty years and older. How many of these babies were likely to have had the error that caused Down syndrome occurring during Meiosis II? Show ALL working. (3)
(11)

3.2 The table below shows a partial DNA sequence from a human, as well as a codon table that can be used to determine which amino acids are required to make a protein.

Base triplet number	1	2	3	4	5	6	7
Human DNA sequence	ATG	TGT	CCA	TTA	ACG	TGC	ACA

CODON TABLE	
Valine	GUU, GUG, GUA
Cysteine	UGU, UGC
Proline	CCA, CCU
Leucine	UUG, CUC, CUG, UUA
Threonine	ACG, ACA
Tyrosine	UAC, UAU

3.2.1 State ONE way in which the DNA molecule is biologically important. (1)

3.2.2 Name the codon that is formed from base triplet number **2** on the DNA sequence. (1)

3.2.3 Write down the names of the amino acids coded for by base triplets **6** and **7**. (2)

3.2.4 If a mutation changes base triplet **1** from ATG to ATA, why will this not change the protein formed? (2)

3.2.5 Describe the process of translation in protein synthesis. (5)
(11)

3.3 A farmer has an orchard of apple trees. Each apple produced expressed red and yellow colour equally (red-yellow apples). To extend his apple orchard, the farmer collected seeds from the red-yellow apples and grew them.

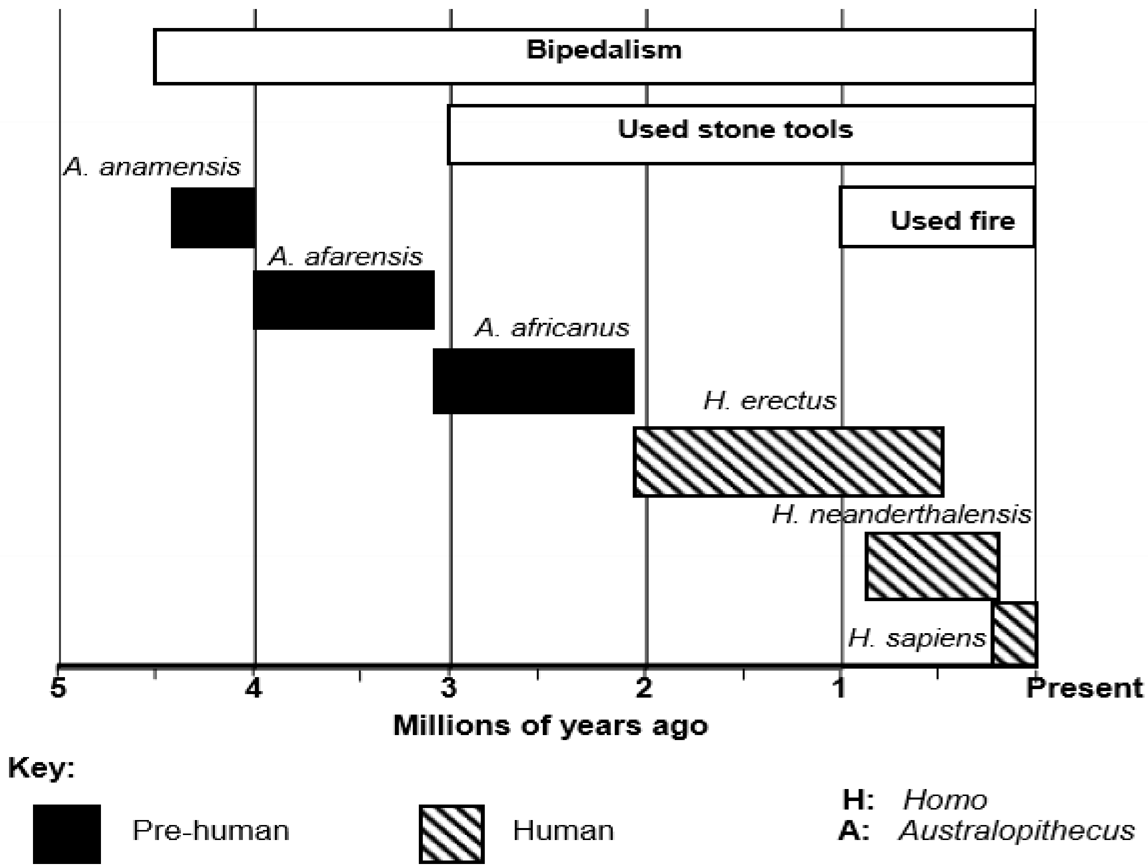
When the new trees matured, he found that some of the trees produced red apples (**R**), others produced yellow apples (**Y**) and the rest produced apples that were red-yellow.

3.3.1 Use a genetic cross to explain his results in the F_1 generation. (6)

3.3.2 What proportion of apples in the F_1 generation will be red-yellow apples? (1)

3.3.3 The farmer saw that the red-yellow apples sell the best. Name the phenotypes of the trees that he should cross in the future in order to ensure that any new trees will definitely produce only red-yellow apples. (2)
(9)

3.4 The diagram below represents the possible evolution of humans, as well as the time period for the development of bipedalism, the use of fire and the use of tools.



Possible evolution of humans in millions of years

3.4.1 Use the diagram above and identify TWO bipedal organisms that did not use stone tools or fire. (2)

3.4.2 How long after developing the ability to walk on two feet did pre-humans develop the ability to use stone tools? Show ALL working. (3)

3.4.3 Explain the significance of the characteristic of the skull which allowed for the development of the ability to use tools in the *Homo* species. (2)

3.4.4 Explain the relationship between the use of fire and changes in dentition in the *Homo* species. (2)

(9)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe how Lamarck and Darwin explained evolution, and compare Darwin's ideas to the ideas of Punctuated Equilibrium.

Content: **(17)**
Synthesis: **(3)**

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

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GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2015

MEMORANDUM

MARKS: 150

This memorandum consists of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	B✓✓		
	1.1.3	B✓✓		
	1.1.4	D✓✓		
	1.1.5	A✓✓		
	1.1.6	C✓✓		
	1.1.7	B✓✓		
	1.1.8	A✓✓		
	1.1.9	A✓✓		
	1.1.10	D✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Homologous✓		
	1.2.2	Genome✓		
	1.2.3	DNA profile✓/fingerprint		
	1.2.4	Albinism✓		
	1.2.5	Peptide✓ bonds		
	1.2.6	Karyotype ✓/Karyogram		
	1.2.7	Nuclear pores✓		
	1.2.8	Clone✓		
	1.2.9	Hypothesis✓		
	1.2.10	Biogeography✓	(10 x 1)	**(10)**
1.3	1.3.1	Both A and B ✓✓/Both/A and B		
	1.3.2	Both A and B ✓✓/Both/A and B		
	1.3.3	A only✓✓		
	1.3.4	B only✓✓		
	1.3.5	Both A and B ✓✓/Both/A and B		
	1.3.6	None✓✓	(6 x 2)	**(12)**

1.4 1.4.1 (a) W – Nucleotide✓
U – DNA✓ (2)

(b) X – Phosphate✓/phosphate ion
Y – Deoxyribose✓sugar (2)

(c) Z – Hydrogen✓ bond (1)

(d) V – Adenine✓ (1)

1.4.2 Nucleus ✓ (1)

1.4.3 Interphase ✓ (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1	2.1.1	2✓	(1)
	2.1.2	(a) X^DX^d✓✓	(2)
		(b) X^dX^d✓✓	(2)
	2.1.3	Since the allele is found only on the X-chromosome✓ A male only has one allele✓ that is either dominant✓ (normal) or recessive✓ (colour-blind) and therefore will always be colour blind✓ (if recessive allele inherited) (Any 4)	(4)
	2.1.4	100%✓✓	(2) **(11)**
2.2	2.2.1	- Andrew has short fingers while Susan has normal fingers✓ - Andrew has straight hair while Susan has curly hair✓	(2)
	2.2.2	Bh✓, bh✓	(2) **(4)**
2.3	2.3.1	(a) I^BI^B✓ of I^Bi✓	(2)
		(b) ii✓	(1)
	2.3.2	- The baby inherited one allele for type O blood/i from each parent✓ since - her genotype is ii✓ - Mr Phonela does not have an allele for O blood/i✓	(3)
	2.3.3	Blood type can be used to exclude a particular man✓ as the parent but it cannot confirm that a particular man is the father✓ Since a large portion of the population have the same blood type✓ (Any 2)	(2)
	2.3.4	- Normal females have two X✓ chromosomes - Normal males have one X and one Y✓ - The female always provides X in the egg✓ - If an egg cell is fertilized by an X bearing sperm✓ a female/girl✓is formed - If an egg is fertilized by a Y bearing sperm✓ - a male/boy✓ is formed (Any 5)	

OR

Gametes		male gamete✓	
		X	Y
female gamete✓	X	XX✓	XY✓

2 XX : 2 XY
Female ✓ Male✓ (Any 5) (5)
(13)

2.4 2.4.1 - To prevent the flowers in Population 1✓ from self-pollination✓
OR
- To ensure cross-pollination✓ between the flowers of Population 1 and Population 2✓ (2)

2.4.2 - The seeds produced did not germinate✓ (1)

2.4.3
- Type of soil✓
- Amount of water✓
- Temperature✓
- pH✓
- Exposure to sunlight✓
- Depth of sowing in soil✓

(Mark first TWO only) (Any 2) (2)

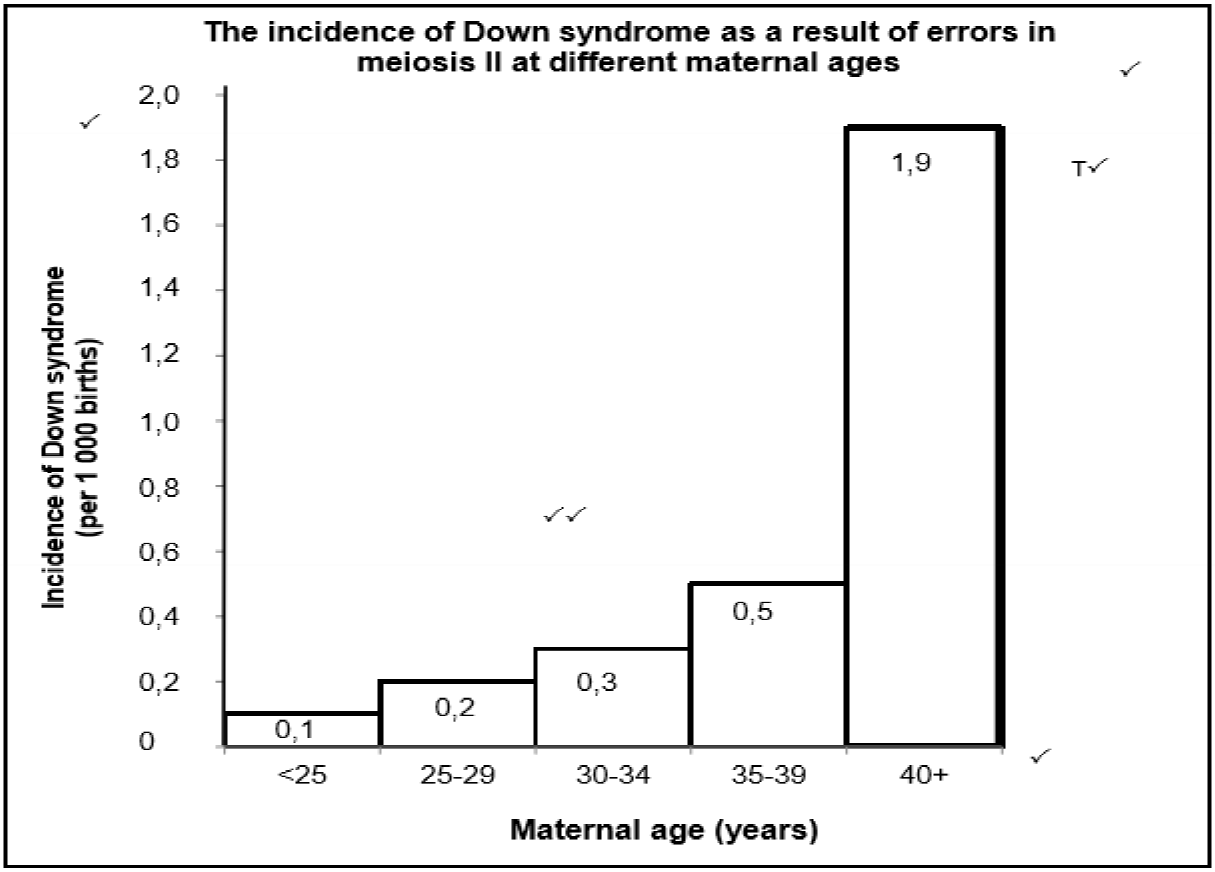
2.4.4 Repeat the investigation✓
Increase the sample size ✓/number of seeds/number of plots/ number of plants
(Mark first ONE only) (Any 1) (1)
(6)

2.5
- A population of a particular species may split into two populations✓
- because of a geographic barrier✓
- There will be no gene flow between the two separated populations✓
- Due to the difference in environmental conditions✓
- Natural selection✓will occur independently
- Making them genotypically✓ and
- Phenotypically✓different over a period of time.
- Even if the two populations mixed at a later stage, they will not be able to interbreed again✓ resulting in a new species (Any 6) **(6)**

[40]

QUESTION 3

3.1 3.1.1



Criterion	Elaboration	Mark
Type of graph	Histogram is drawn of Meiosis II	1
Caption	Including both variables: 'Incidence of Down syndrome and Maternal age'	1
X-axis	Correct label and units for X-axis: Maternal Age (years); Equal width of bars	1
Y-axis	Correct label, unit and scale for Y-axis: Incidence of Down syndrome (per 1 000 births)	1
Plotting of the bars	1 – 4 bars plotted correctly – 1 mark 5 bars correctly plotted – 2 marks	2

(6)

NOTE:
If axes are transposed:
- Marks will be lost for labelling of 'X-axis' and 'Y-axis'.

3.1.2 Non-disjunction✓ (1)

3.1.3 Meiosis I✓ (1)

3.1.4 Number of Down syndrome babies = $\frac{1,9}{7,8}$✓x 44✓
= 10,71✓/11 babies (3)
(11)

3.2 3.2.1
- DNA carries hereditary information✓
- DNA contains coded information for protein synthesis✓

(Mark first ONE only) (Any 1) (1)

3.2.2 ACA ✓ (1)

3.2.3 Threonine✓; Cysteine✓ (must be in correct order) (2)

3.2.4
- Both ATG and ATA✓
- Code for the same amino acid/tyrosine✓ (2)

3.2.5
- The anticodon on the tRNA matches the codon on the mRNA✓
- tRNA brings the required amino acid✓
- to the ribosome✓
- amino-acids are joined by peptide bonds✓
- to form the required protein✓ (Any 5) (5)

(11)

3.3 3.3.1

P_1	phenotype	red-yellow	X	red-yellow✓
	genotype	RY	X	RY✓
Meiosis				
G/gametes		R, Y	X	R, Y✓
Fertilisation				
F_1 genotype		RR, RY, RY, YY✓		
	phenotype	red apples	red-yellow apples	yellow✓ apples

P_1 and F_1✓
Meiosis and fertilisation✓ (Any 6)

OR

P_1	phenotype	red-yellow	X	red-yellow✓
	genotype	RY	X	RY✓

Meiosis

Fertilisation

Gametes	R	Y
R	RR	RY
Y	RY	YY

1 mark for correct gametes
1 mark for correct genotypes

F_1	genotype	RR,	RY, RY,	YY✓
	phenotype	red apples	red-yellow apples	yellow✓ apples

P_1 and F_1✓
Meiosis and fertilisation✓ (Any 6) (6)

3.3.2 50%✓/half (1)

3.3.3 A tree with red apples✓ should be crossed with a tree that produces yellow apples✓ (2)
(9)

3.4 3.4.1 *A. anamensis*✓ *and A. afarensis*✓
(Mark first TWO only) (2)

3.4.2 (4,5mya – 3mya)✓ = 1,5✓mya✓ (3)

3.4.3 The cranium increased in size✓ so it could accommodate a larger brain✓ (2)

3.4.4 Smaller teeth✓/canines in *Homo* species, can chew food that was cooked✓/made soft using fire

OR

Larger teeth/canines are not necessary ✓ because the food is softer ✓ because of cooking with fire. (2)
(9)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

4.1 <u>Evolution according to Lamarck</u>

Lamarck explained evolution using the following two 'laws':

The law of use and disuse: ✓
- As an organism uses a structure or organ more regularly✓, it becomes better developed or enlarged in that organism✓.
- If an organism does not use a structure or organ frequently✓, it becomes less developed or reduced in size and may disappear altogether in that organism✓

The inheritance of acquired characteristics: ✓
- Characteristics developed during the life of an individual✓
- (Acquired characteristics) can be passed on to their offspring. ✓ (Max 5) (5)

<u>Evolution according to Darwin</u>

- Organisms produce a large number of offspring✓
- There is a great deal of variation✓ amongst the offspring
- Some have favourable characteristics✓
- and some do not✓
- When there is a change in the environmental conditions✓/or
- there is competition
- Then organisms with characteristics which are more favourable survive✓
- Whilst organisms with less favourable characteristics die✓
- This is called natural selection✓
- The organisms that survive reproduce✓
- And thus pass on the favourable characteristics to their offspring✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristics✓ (Max 8) (8)

<u>Darwin's ideas about gradualism compared to Punctuated Equilibrium</u>

- Darwin believed that evolution takes place through an
- accumulation of small✓
- gradual changes that occur over a long period of time✓
- supported by transitional forms in fossil record✓
- Punctuated equilibrium suggested that evolution sometimes involves long periods of time where species do not change✓/very little change occurs
- This alternates with short periods of time where rapid changes occur✓
- New species are formed in a short period of time✓/relative to the long period of no/little change
- supported by the absence of transitional forms✓ (Max 4) (4)

Content: **(17)**
Synthesis: **(3)**

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay	There is no irrelevant information. Only information relating to the theories of Lamarck and/or Darwin and/or Punctuated Equilibrium is/are given.	The information provided for each of the theories of Lamarck and/or Darwin and/or Punctuated Equilibrium is/are arranged logically.	At least three points included on **each** of the 3 theories: Lamarck, Darwin and Punctuated Equilibrium
Mark	1	1	1
	R	L	C

TOTAL SECTION C: 20
GRAND TOTAL: 150

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GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2016

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 pages.

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 number (1.1.1 to 1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

1.1.1 Which ONE of the following combinations results in genetic variation in organisms?

A Mitosis; sexual reproduction; mutations
B Meiosis; asexual reproduction; mutations
C Mitosis; meiosis; sexual reproduction
D Meiosis; sexual reproduction; mutations

1.1.2 The inheritance of one trait does not depend on the inheritance of another trait. This represents …

A Mendel's law of dominance.
B the law of codominance.
C the principle of variation.
D Mendel's principle of independent assortment.

1.1.3 In bees, females are diploid and males are haploid. Females and males produce haploid gametes.

This means that …

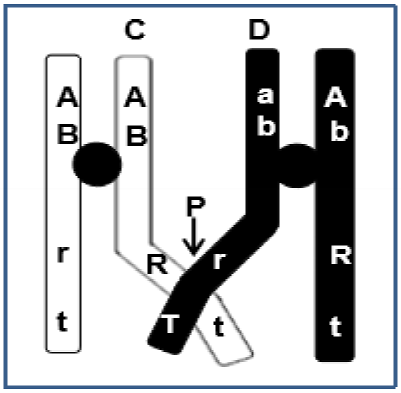
A females produce gametes by mitosis.
B males produce gametes by meiosis.
C males produce gametes by mitosis.
D females have half the number of chromosomes that males have.

1.1.4 In mice, the genotype **yy** produces grey fur and **Yy** produces yellow fur. The genotype **YY** results in death during the early embryonic stages.

A yellow female mouse is mated with a yellow male mouse. Which of the following shows the correct ratio of yellow to grey offspring that could be born alive?

A 1 : 1
B 1 : 3
C 2 : 1
D 3 : 1

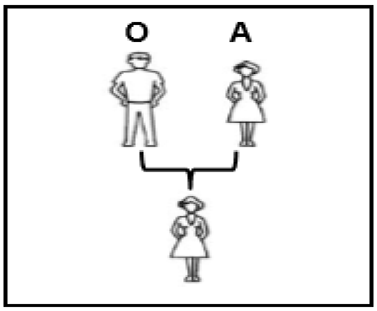
1.1.5 The diagram below shows crossing over.



Which ONE of the following combinations of alleles would be present in chromatid **C** after crossing over occurred at point **P**?

A Aart
B abrT
C ABRt
D ABRT

1.1.6 The diagram below shows the blood types of two parents.



The only possible blood type(s) of the offspring of the first generation (F_1) is/are ...

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

1.1.7 The structure of DNA was determined by using X-ray pictures produced by ...

A Watson and Crick.
B Franklin and Wilkins.
C Watson and Franklin.
D Crick and Franklin.

1.1.8 Brown eye colour in humans is dominant over blue eye colour. A man with brown eyes marries a woman with blue eyes. They have a son with brown eyes and a daughter with blue eyes.

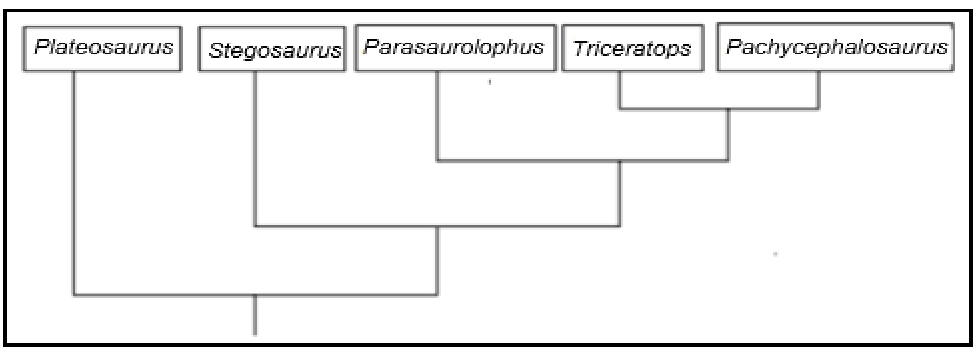
We can conclude that …

A the man is not the true father of the children.
B the man is heterozygous for eye colour.
C eye colour is sex-linked.
D both parents are homozygous for eye colour.

1.1.9 A possible explanation for an observation that can be tested is known as a ...

A fact.
B law.
C theory.
D hypothesis.

1.1.10 Common structural characteristics between groups of dinosaurs were used to construct the phylogenetic tree below.



The two groups of dinosaurs with the most characteristics in common are …

A *Triceratops* and *Pachycephalosaurus*.
B *Parasaurolophus* and *Triceratops*.
C *Stegosaurus* and *Parasaurolophus*.
D *Plateosaurus* and *Stegosaurus*. (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 1.2.10) in the ANSWER BOOK.

1.2.1 The type of inheritance where the dominant allele masks the expression of the recessive allele in the heterozygous condition

1.2.2 The process by which genetically identical organisms are formed using biotechnology

1.2.3 A group of organisms of the same species in a specific habitat

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

1.2.5 The family to which humans belong

1.2.6 A human disorder caused by non-disjunction of chromosome pair 21

1.2.7 The stage of protein synthesis during which mRNA forms from DNA

1.2.8 Structures in different organisms that have a similar basic plan which suggests that they share a common ancestor

1.2.9 The position of a gene on a chromosome

1.2.10 The type of variation in a population with no intermediate phenotypes (10 x 1) **(10)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Reproductive isolating mechanisms in plants	A: Flowering at different times of the year B: Adaptation to different pollinators
1.3.2	Evidence for evolution	A: Biogeography B: Fossil record
1.3.3	Found in African apes and humans	A: Claws instead of nails B: An opposable thumb

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

1.4 The size and colour of unripe fruit in a plant species is genetically controlled. The allele for small fruit (**b**) is recessive to the allele for big fruit (**B**). The allele for yellow fruit colour (**g**) is recessive to the allele for green fruit (**G**).

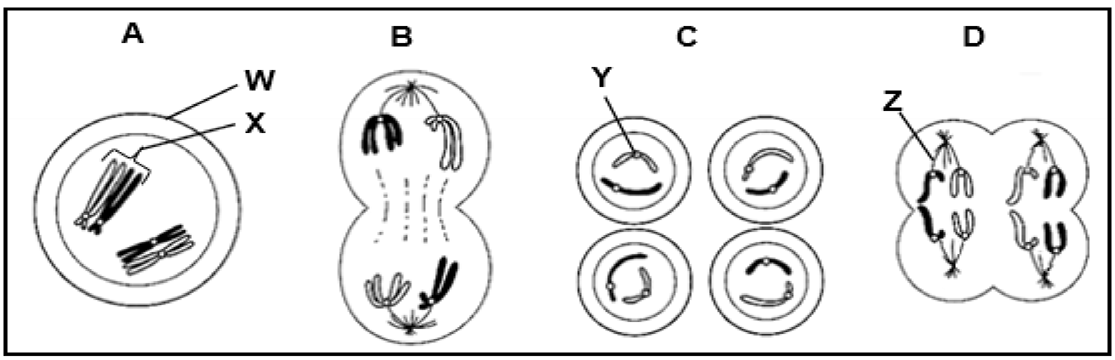
1.4.1 State:

(a) The phenotype of the plant with the genotype **BbGg** (2)

(b) ALL possible genotypes of the gametes produced by the plant mentioned in QUESTION 1.4.1(a) (2)

1.4.2 In a cross between two plants with genotypes **BBGG** and **bbgg** what percentage of the offspring will be homozygous for both characteristics? (2)
(6)

1.5 The diagrams below show different phases in meiosis.



1.5.1 Label structures **W** and **X**. (2)

1.5.2 How many chromosomes are present in each cell in:

(a) Phase **A** (1)

(b) Phase **C** (1)

1.5.3 Give only the LETTER of the diagram that represents anaphase II. (1)

1.5.4 State the function of structure **Y** and structure **Z**. (2)

1.5.5 Identify phase **C**. (1)
(8)

TOTAL SECTION A: 50

SECTION B

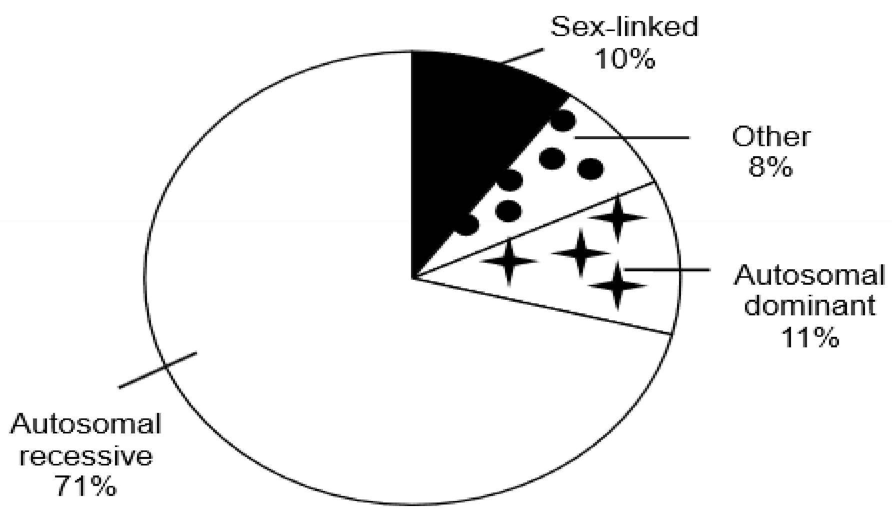
QUESTION 2

2.1 Scientists wanted to determine which type of inheritance accounted for most of the selected genetic disorders in dogs.

To do this they sequenced the genomes of a large number of dogs of the same breed that suffered from the genetic disorders.

The results of the investigation are shown below.

Pie chart showing the type of inheritance for genetic disorders in dogs



[Source: http://www.instituteofcaninebiology.org]

2.1.1 If 2 000 dogs were studied in this investigation, how many dogs had disorders that were caused by autosomal dominant inheritance? Show ALL calculations. (3)

2.1.2 State TWO ways in which the scientists could improve the reliability of their results. (2)

2.1.3 State ONE factor that was kept constant in this investigation. (1)

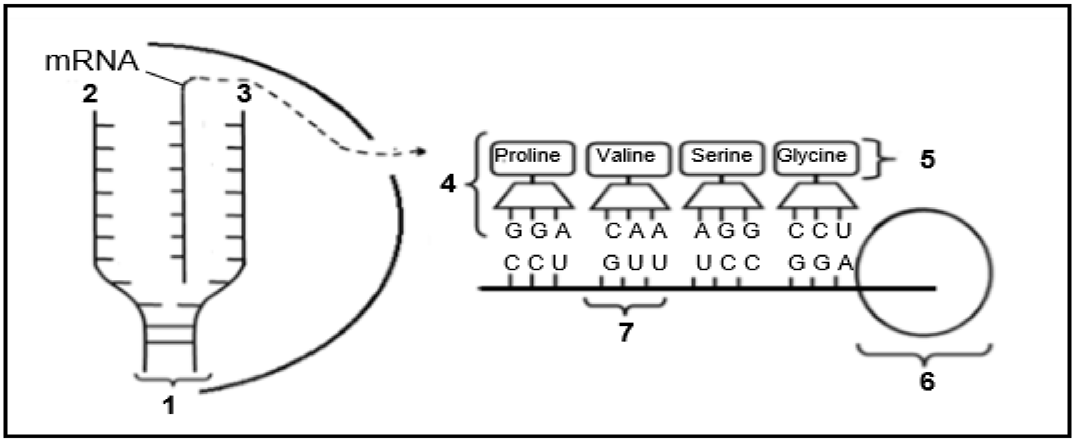
2.1.4 Explain why there is no need to keep the age of the dogs constant in this type of investigation. (2)

2.1.5 Provide a conclusion for this investigation. (2)
(10)

2.2 In dogs rough hair (**H**) is dominant to smooth hair (**h**). A heterozygous rough-haired dog is mated with a smooth-haired dog.

Represent a genetic cross to show the phenotypic ratio of the puppies. **(6)**

2.3 The diagram below represents two stages of protein synthesis.



2.3.1 Provide labels for:

(a) Molecule **1** (1)

(b) Organelle **6** (1)

2.3.2 Give only the NUMBER of the part which represents a:

(a) DNA template strand (1)

(b) Monomer of proteins (1)

(c) Codon (1)

2.3.3 Describe *translation* as it occurs at organelle **6**. (4)

2.3.4 Provide the:

(a) DNA sequence that codes for glycine (2)

(b) Codon for proline (2)

2.3.5 State TWO differences between a *DNA nucleotide* and an *RNA nucleotide*. (4)
(17)

2.4 Read the passage below and answer the questions that follow.

USE OF STEM CELLS

Dr Orly Lachan-Kaplan of Monash Immunology and Stem Cell Laboratories has used stem cell manipulation to create an ovary-like structure containing ova. Although it is not yet clear if the cells of this ovary-like structure are functional, she hopes that this method can be used to develop functional human ova.

[Source: http//monash.edu/news/releases/308]

2.4.1 Name ONE source of stem cells. (1)

2.4.2 Explain why the characteristics of stem cells make them useful in treating some disorders. (3)

2.4.3 Explain ONE possible advantage of creating an ovary-like structure. (3)
(7)
[40]

QUESTION 3

3.1 Errors that occur during DNA replication may sometimes lead to mutations.

3.1.1 Describe *DNA replication*. (5)

3.1.2 Describe how an error in DNA replication may lead to a gene mutation. (2)
(7)

3.2 The passage below refers to human evolution.

> Research, using DNA evidence, suggests that all modern humans arose from a single group of *Homo sapiens* that migrated from Africa 2 000 generations ago and spread throughout Europe and Asia over thousands of years.
>
> [Source: http://images.sciencedaily.com]

3.2.1 Name the hypothesis on human evolution that is described in the passage. (1)

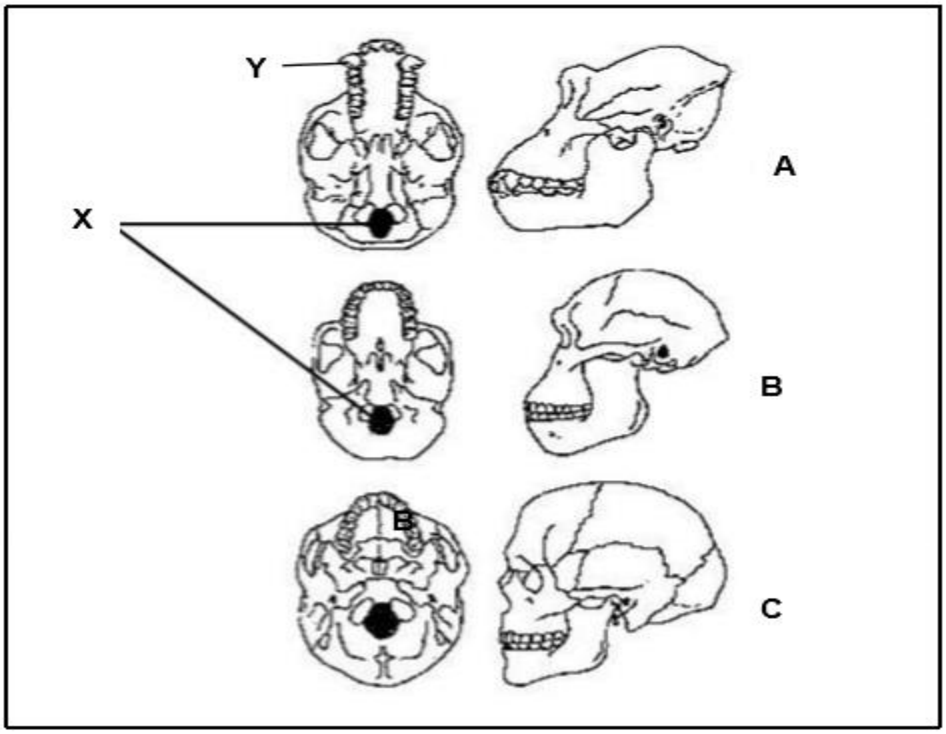
3.2.2 Name the type of DNA outside the nucleus that is analysed in support of the hypothesis named in QUESTION 3.2.1. (1)

3.2.3 Explain how the type of DNA named in QUESTION 3.2.2 is used to provide evidence for the hypothesis named in QUESTION 3.2.1. (3)

3.2.4 Apart from DNA evidence, state ONE other line of evidence that may be used to support the hypothesis mentioned in QUESTION 3.2.1. (1)
(6)

3.3 Describe how a new species is formed through geographic isolation. **(6)**

3.4 The diagram below represents the fossilised skulls of three different species of primates. They were either bipedal or quadrupedal (organisms that habitually walk on all four limbs).



3.4.1 Label part **X** and the type of teeth at **Y**. (2)

3.4.2 Explain the significance of the location of structure **X** in organism **C**. (3)

3.4.3 Which of the skulls (**A**, **B** or **C**) belongs to:

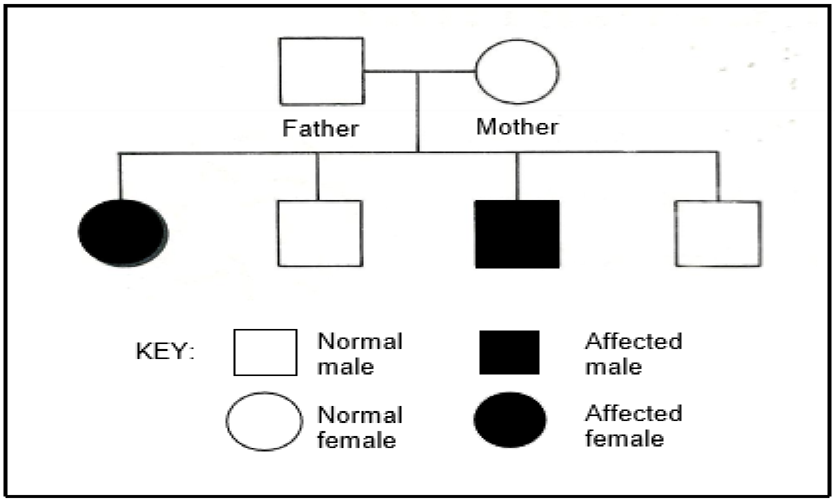
(a) An *Australopithecine* (1)

(b) A quadrupedal primate (1)

3.4.4 Explain how the change in the skull from **B** to **C** could indicate a change in intelligence. (3)

3.4.5 Tabulate TWO observable differences, other than those mentioned in QUESTIONS 3.4.2 and 3.4.4, between skulls **B** and **C** that represent trends in human evolution. (5)
(15)

3.5 The pedigree diagram below shows the pattern of inheritance of a certain genetic disorder controlled by a recessive allele. The dominant allele is represented by **N** and the recessive allele by **n**.



3.5.1 Explain why both parents must be heterozygous for this characteristic. (2)

3.5.2 Give the possible genotype(s) of the normal children. (2)

3.5.3 Provide evidence from the pedigree diagram to show that this characteristic is not sex-linked. (2)

(6)

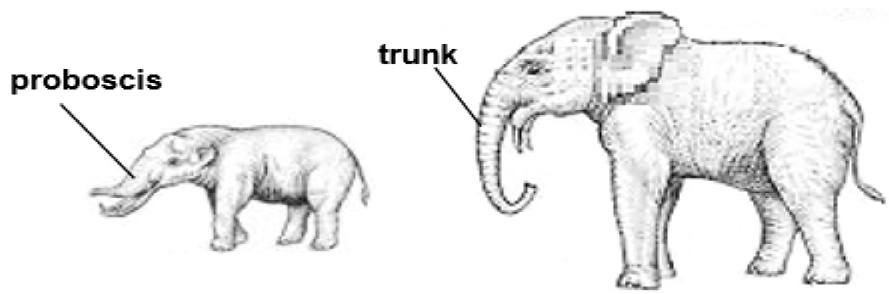
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

An ancestor of the elephant, *Phiomia,* had a long nose-like structure called a proboscis which evolved into the trunk of the elephant. The proboscis was used to gather leaves as food. The proboscis of *Phiomia* and the trunk of the elephant are shown below. The diagrams have been drawn to scale.



Ancestor of elephant (*Phiomia*) **Elephant**

Explain the evolution of the elephant's trunk in terms of Lamarckism and Darwinism as well as the way in which an increase in the length of the trunk of the elephant could be achieved through artificial selection.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

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Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2016

MEMORANDUM

MARKS: 150

This memorandum consists of 9 pages.

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	D✓✓		
	1.1.3	C✓✓		
	1.1.4	C✓✓		
	1.1.5	D✓✓		
	1.1.6	B✓✓		
	1.1.7	B✓✓		
	1.1.8	B✓✓		
	1.1.9	D✓✓		
	1.1.10	A✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Complete dominance✓		
	1.2.2	Cloning✓		
	1.2.3	Population✓		
	1.2.4	Stereoscopic✓/Binocular		
	1.2.5	Hominidae✓/Hominids		
	1.2.6	Down syndrome✓/ trisomy 21		
	1.2.7	Transcription✓		
	1.2.8	Homologous✓		
	1.2.9	Locus✓		
	1.2.10	Discontinuous variation✓	(10 x 1)	**(10)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Big✓ and green✓ fruit		(2)
		(b) BG, Bg, bG, bg✓✓		(2)
	1.4.2	0✓ %✓		(2) **(6)**
1.5	1.5.1	W Cell membrane ✓/ Plasmalemma		(1)
		X Homologous chromosomes✓/Bivalent		(1)
	1.5.2	(a) 4✓		(1)
		(b) 2 ✓		(1)
	1.5.3	D✓		(1)
	1.5.4	Y Holds the sister chromatids together✓		
		Z Pulls chromosomes/chromatids to the poles✓		(2)
	1.5.5	Telophase II✓		(1)
				(8)

TOTAL SECTION A: **[50]**

SECTION B

QUESTION 2

2.1 2.1.1 (11/100) ✓ x 2000✓ = 220✓ (3)

2.1.2
- Repeat✓the investigation
- Use a larger sample size✓/more dogs

(Mark first TWO only) Any 2 (2)

2.1.3 The breed of the dogs✓
(Mark first ONE only) (1)

2.1.4
- The disorders are inherited ✓
- and therefore does not change with age✓ (2)

2.1.5 Autosomal recessive inheritance causes most of the genetic disorders in dogs✓✓ (2)
(10)

2.2.

P_1	Phenotype	Rough hair	x	Smooth hair✓
	Genotype	Hh	x	hh✓
Meiosis				
	G/gametes	H h	x	h h✓
Fertilisation				
F_1	Genotype	Hh Hh		hh hh ✓
	Phenotypic ratio	1 rough hair	:	1 smooth hair ✓

P_1 and F_1✓
Meiosis and fertilisation✓ Any 6

OR

P_1	Phenotype	Rough hair	x	Smooth hair✓
	Genotype	Hh	x	hh✓

Meiosis

Fertilisation

Gametes	H	h
h	Hh	hh
h	Hh	hh

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotypic ratio 1 rough hair : 1 smooth hair ✓

P_1 and F_1✓
Meiosis and fertilisation✓ Any 6 **(6)**

2.3 2.3.1 (a) DNA✓ (1)

(b) Ribosome✓ (1)

2.3.2 (a) 2✓ (1)

(b) 5✓ (1)

(c) 7✓ (1)

2.3.3
- The mRNA attaches to the ribosome✓
- When each codon✓ of the mRNA
- matches with the anticodon ✓on the tRNA
- the tRNA brings the required amino acid to the ribosome✓
- When the different amino acids are brought in sequence✓
- adjacent amino acids are linked by peptide bonds✓
- to form the required protein✓/polypeptide Any 4 (4)

2.3.4 (a) CCT✓✓ (2)

(b) CCU✓✓ (2)

2.3.5

DNA	RNA
Has deoxyribose✓ sugar	Has ribose✓ sugar
Has nitrogen base thymine (T)✓/ A, C, G and T	Has nitrogen base uracil(U)✓/ A, C, G and U

(Mark first TWO only) (2 x 2) (4)
TABLE NOT REQUIRED

(17)

2.4.1 Embryos✓/Blastocysts
Umbilical cord✓/ Placenta
Bone marrow✓
(Mark first ONE only) Any 1 (1)

2.4.2
- Stem cells are undifferentiated ✓
- and have the potential to develop into any type of cell✓
- to replace the affected/defective cells✓causing the disorder (3)

2.4.3
- To produce ova✓ which could be used
- in cases where females do not have functional ovaries✓
- and are therefore infertile✓ and thereby
- allowing them to have children✓ Any 3 (3)

(7)
[40]

QUESTION 3

3.1 3.1.1
- The DNA molecule unwinds✓
- Hydrogen bonds between the two strands break✓/ the molecule unzips
- Each strand serves as a template✓
- Free nucleotides✓ attach to the individual strands
- with complementary nitrogen bases✓ pairing
- Two identical DNA molecules✓ are formed
- Process is controlled by enzymes✓ Any 5 (5)

3.1.2
- If the incorrect nitrogen base✓ attaches to the original strand/if a nitrogen base is added or deleted
- the sequence✓/order of the bases changes on the new DNA molecule
- resulting in a change in the gene structure✓ Any 2 (2)

(7)

3.2 3.2.1 'Out of Africa' hypothesis✓ (1)

3.2.2 Mitochondrial DNA✓/mtDNA (1)

3.2.3
- The mitochondrial DNA is only inherited from the mother✓
- Any mutation✓on this DNA
- can be traced✓ along the maternal line only (3)

3.2.4 Fossil evidence✓
Archaeological evidence✓ Any 1 (1)
(***Mark first ONE only)*** **(6)**

3.3
- A population of a species becomes separated✓ by a geographical barrier
- then the population splits into different populations✓
- There is no gene flow✓ between the populations
- Each population may be exposed to different environmental conditions✓
- Natural selection occurs independently✓ in each population
- The individuals of each population become different from each other✓ over time
- genotypically and phenotypically✓
- Even if the two populations were to mix again✓
- they would not be able to reproduce with each other✓and are thus different species Any 6 **(6)**

3.4.1 X - Foramen magnum✓ (1)
Y - Canine✓ (1)

3.4.2
- The foramen magnum is located in a more forward position✓below the skull
- showing that organism C is bipedal✓
- This allows for the vertebral column/spine to extend vertically✓from the base of the skull
- to balance the body weight in upright walking✓ Any 3 (3)

3.4.3 (a) B✓ (1)

(b) A✓ (1)

3.4.4
- There is an increase✓
- in the cranium size✓ from organism **B** to organism **C**
- This will allow it to house a larger brain✓/cerebrum which suggests greater intelligence (3)

3.4.5

Skull B	Skull C
Brow ridges pronounced✓	Brow ridges are not as pronounced✓
More protruding jaws✓/larger jaws	Less protruding jaws✓/ smaller jaws

(***Mark first TWO only)*** Table1 + (2 x 2) (5)
(15)

3.5 3.5.1
- Because they were normal they must each have one dominant allele✓
- and in order for their children to be affected each parent must have one recessive allele✓ (2)

3.5.2 NN✓ or Nn✓ (2)

3.5.3
- The father would have been affected✓ if it was sex-linked
- in order for the daughter to be affected✓ (2)

(6)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Lamarckism
- The ancestral elephant stretched its proboscis✓
- to get leaves✓ in trees/further from the body
- The more it used the proboscis✓,
- the longer it became✓
- The offspring then inherited the acquired longer proboscis ✓
- Over many generations the length of the proboscis increased✓
- until it became a trunk✓ as in the modern elephant Any 5 (5)

Darwinism
- There was a great deal of genetic variation✓ amongst the offspring
- Some had long proboscis✓
- and some had short proboscis✓
- There was a change in environmental conditions✓/competition amongst the animals for food
- They had to reach higher in the trees to get leaves✓
- The animals with shorter proboscis died✓
- Those individuals with the longer proboscis survived✓
- They then reproduced✓
- and passed on this characteristic to their offspring✓
- The next generation of animals had a greater proportion✓ of animals with longer proboscis Any 9 (9)

Artificial selection
- Humans✓ select the elephants with
- desirable characteristics✓/long trunk
- and mate them to produce offspring with longer trunks✓
- Those that are pure breeding✓ for long trunks
- are further selected to mate to produce offspring with further longer trunks✓ Any 3 (3)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the explanations in terms of Lamarckism, Darwinism and artificial selection are provided	Explanations in terms of Lamarckism, Darwinism and artificial selection are provided in a logical and sequential manner.	At least **3** correct points for the explanation using Lamarckism, **6** correct points for the explanation using Darwinism and **2** correct points using artificial selection
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

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Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2017

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Write down the question number (1.1.1–1.1.8), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:				
1.1.9	**A**	**B**	**C**	~~**D**~~

1.1.1 The process where one DNA molecule produces two identical DNA molecules is called …

A reproduction.
B replication.
C translation.
D protein synthesis.

1.1.2 A difference between DNA and RNA:

A RNA is double-stranded and DNA is single-stranded.
B DNA has a sugar-phosphate frame, whereas RNA does not.
C There are weak hydrogen bonds in DNA, but not in RNA.
D RNA has a helix structure and DNA is straight.

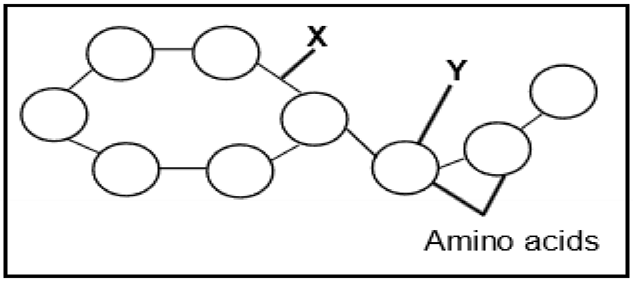
1.1.3 A pedigree diagram shows …

A how organisms evolve.
B the inheritance of characteristics over many generations.
C sex-linked characteristics only.
D the number of children in a family only.

1.1.4 A red flowering plant is crossed with a white flowering plant. All the offspring have pink flowers. When the two pink flowering plants are crossed, the next generation of flowering plants will have flowers that are …

A pink only.
B red only.
C white only.
D pink, red and white.

1.1.5 The diagram below represents the chemical structure of a protein.



X represents a ...

A hydrogen bond.
B nitrogen base.
C peptide bond.
D mRNA molecule.

1.1.6 The difference between nucleic acids and nucleotides is that ...

A nucleic acids are building blocks of nucleotides.
B nucleotides are building blocks of nucleic acids.
C nucleotides are larger than nucleic acids.
D nucleic acids are found in the nucleus and nucleotides are found in the cytoplasm.

1.1.7 Which ONE of the following events occurs during metaphase I of meiosis?

A Homologous chromosomes arrange themselves at the equator
B Centrioles move to opposite poles
C Chromosomes arrange themselves singly at the equator
D Splitting of the cytoplasm

1.1.8 Comparisons of the amino acid sequences in a protein have been made between humans and a number of other organisms. The number of differences is shown in the table below.

ORGANISM	SHARK	KANGAROO	FISH	COW	LIZARD
Number of differences in amino acid sequences in a protein compared to humans	79	27	68	17	62

[Adapted from *AQA Biology 1998*]

The type of evidence for evolution in the table above is ...

A fossil evidence.
B biogeography.
C cultural evidence.
D genetic evidence. (8 x 2) **(16)**

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 1.2.7) in the ANSWER BOOK.

1.2.1 A sudden change in the sequence/order of nitrogenous bases of a nucleic acid

1.2.2 Explanation of an observation that is supported by facts, models and laws

1.2.3 The breeding of organisms over many generations in order to achieve a desirable phenotype

1.2.4 The type of sugar found in an RNA molecule

1.2.5 Type of evolution involving long periods of time when species do not change and short periods of rapid change

1.2.6 The hypothesis which supports migration of human ancestors from the point of origin

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

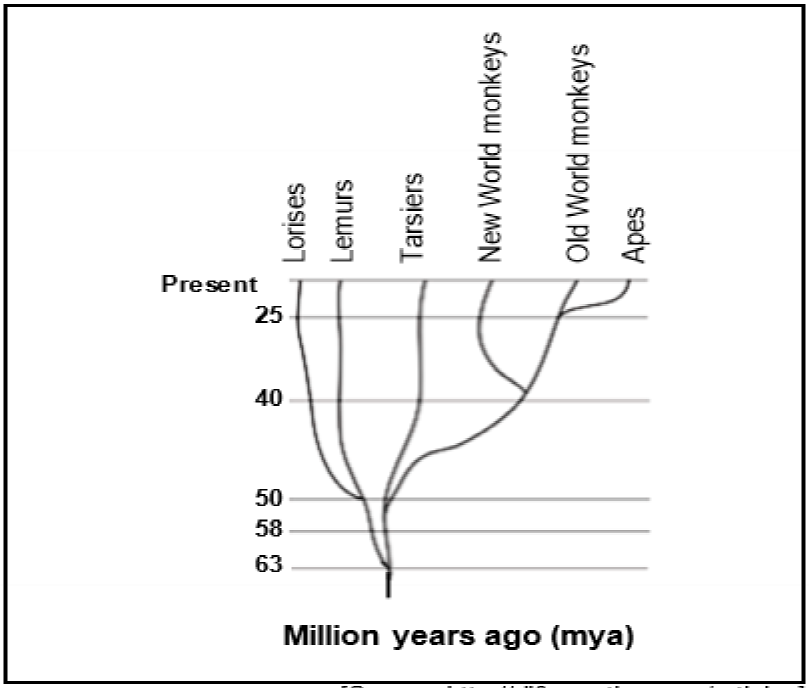
(7 x 1) **(7)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Occurs during telophase of meiosis I	A: Dividing of the cytoplasm B: Centrioles move to the opposite poles
1.3.2 Location of DNA	A: Nucleus B: Mitochondria
1.3.3 Found in African apes and humans	A: Claws instead of nails B: An opposable thumb

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

1.4 The diagram below shows possible evolutionary relationships among primates.



[Source: http://dl0.creation.com/articles]

1.4.1 How many million years ago did the:

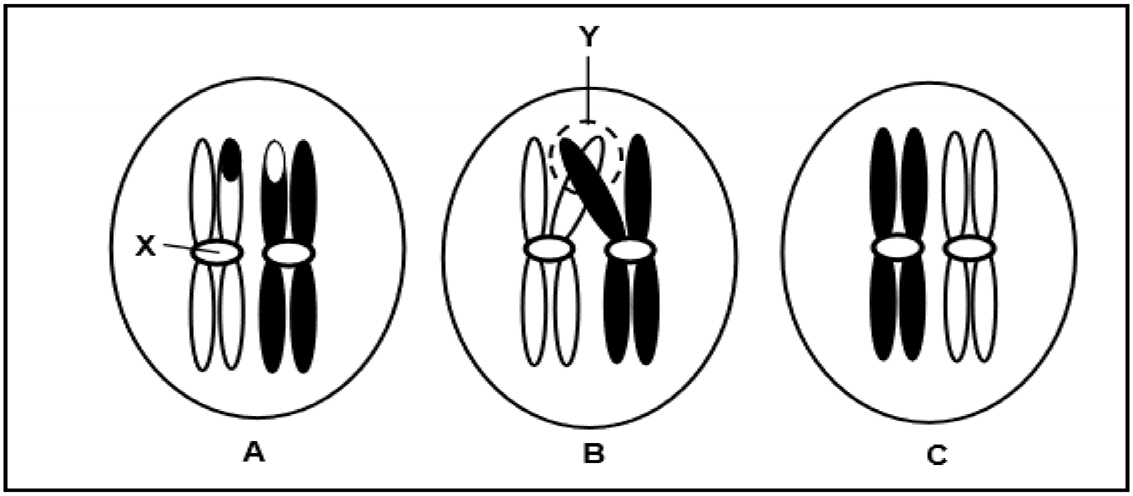
(a) Apes appear on Earth (1)

(b) Common ancestor evolve to form the Tarsiers and Lemurs (1)

1.4.2 Which TWO species share the most recent common ancestor? (2)

1.4.3 Which species is most closely related to the Lemur? (1)
(5)

1.5 The diagrams below represent a chromosome pair in a female human cell. The cells (**A**, **B** and **C**) show different events in a phase of meiosis, which are not necessarily in the correct sequence.



1.5.1 How many pairs of chromosomes occur in a normal human cell? (1)

1.5.2 Give labels for:

(a) Structure **X** (1)

(b) Area **Y** (1)

1.5.3 Name the organ in the human female where meiosis occurs. (1)

1.5.4 Name the:

(a) Process occurring in diagram **B** (1)

(b) Phase represented by the diagrams above (1)

(c) Type of cells that would result from meiosis of this cell (1)

1.5.5 Arrange the letters **A**, **B** and **C** to show the correct sequence of the events. (1)
(8)

1.6 Coat colour in mice is controlled by two alleles, black (**B**) and grey (**b**). Tail length is controlled by two alleles, long (**T**) and short (**t**).

The Punnett square below shows a part of the cross between two mice. Genotype **(i)** has been left out.

Parent 1 (columns); **Parent 2** (rows)

Gametes	**BT**	**Bt**	**bT**	**bt**
Bt	BBTt	BBtt	BbTt	Bbtt
Bt	BBTt	BBtt	BbTt	Bbtt
Bt	BBTt	BBtt	**(i)**	Bbtt
Bt	BBTt	BBtt	BbTt	Bbtt

1.6.1 Give the:

(a) Genotype of parent **1** (2)

(b) Phenotype of parent **2** (2)

(c) Genotype of offspring **(i)** (1)

1.6.2 What percentage of the offspring above is grey with short tails? (1)

1.6.3 State the genotypes of TWO gametes from the table above that will result in offspring that are heterozygous for both traits, if fertilisation occurs. (2)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Read the passage below.

NEW HOMININ SPECIES DISCOVERED

On 13 September 2013 scientists discovered fossils in the Sterkfontein Caves in South Africa which appeared to belong to a previously unknown species of hominins.

The fossils were classified as a new species, *Homo naledi*. The physical characteristics of *H. naledi* are described as having traits similar to the genus *Australopithecus*, mixed with traits more characteristic of the genus *Homo*. It appeared that *H. naledi* represented a transitional fossil.

An analysis of *H. naledi*'s skeleton suggests that it stood upright and was bipedal. The structure of the pelvis is similar to the Australopithecines, but its legs, feet and ankles are more similar to the genus *Homo*.

Four skulls were discovered, each with approximately half the volume of modern human skulls. The *H. naledi* skulls are closer in cranial volume to the skull of *Australopithecus,* but the cranium structure is more similar to those found in the genus *Homo*.

The teeth are much smaller than those of *Australopithecus* and similar to the teeth of modern humans.

[Adapted from https://humanorigins.si.edu/evidence]

2.1.1 Define the term *transitional fossil*. (2)

2.1.2 Name a characteristic from the passage that *Homo naledi* shared with both *Australopithecus* and *Homo*. (1)

2.1.3 State ONE other characteristic from the passage that *Homo naledi* shared only with *Australopithecus*. (1)

2.1.4 Explain TWO characteristics of a skeleton which are adaptations for bipedalism. (4)

2.1.5 Give ONE possible reason why there was a change to smaller teeth in modern humans. (3)
(11)

2.2 Study the table below that shows the change in antibiotic resistance in three strains of bacteria (MRSA, VRE and FQRP) over a period of 20 years.

YEAR	ANTIBIOTIC RESISTANCE (%)		
	MRSA	VRE	FQRP
1981	2	0	0
1985	10	0	0
1989	15	2	0
1993	40	5	5
1997	40	20	10
2001	60	20	25

[Source: http://wallace.genetics.uga.edu/groups/evol]

2.2.1 Which bacterial strain was the:

(a) Most resistant to antibiotics over the years (1)

(b) Last to develop antibiotic resistance (1)

2.2.2 Calculate the percentage increase in antibiotic resistance in VRE from 1993 to 1997. (3)

2.2.3 Draw a line graph to show the development of antibiotic resistance in the bacterial strain MRSA. (6)
(11)

2.3 The diagram below represents nitrogen-base sequences of a part of a nucleic acid that codes for making insulin. Insulin is necessary for the uptake of sugar from the blood.

The sequences below are from two individuals and are read from left to right. Sequence **1** is from a normal person and sequence **2** is from a person who shows a mutation and cannot produce insulin.

TWO NITROGEN-BASE SEQUENCES OF A PART OF A NUCLEIC ACID									
Sequence 1	TAG	CCA	CAC	GTT	ACA	ACG	TGA	AGG	TAA
Sequence 2	TAT	CCA	CAC	GTT	ACA	ACG	TGA	AGG	TAA

[Source: www.biologyjunction.com]

2.3.1 Which nucleic acid is represented in both sequences? (1)

2.3.2 Where did the mutation in the second sequence occur? (1)

The table below shows the amino acids coded for by different DNA base triplets.

AMINO ACID	**DNA BASE TRIPLET**
Glycine	CCG
	CCT
	CCC
Valine	CAT
	CAC
Histidine	GTA
	GTG
Proline	GGA
	GGC
Isoleucine	TAA
	TAT

2.3.3 Give the:

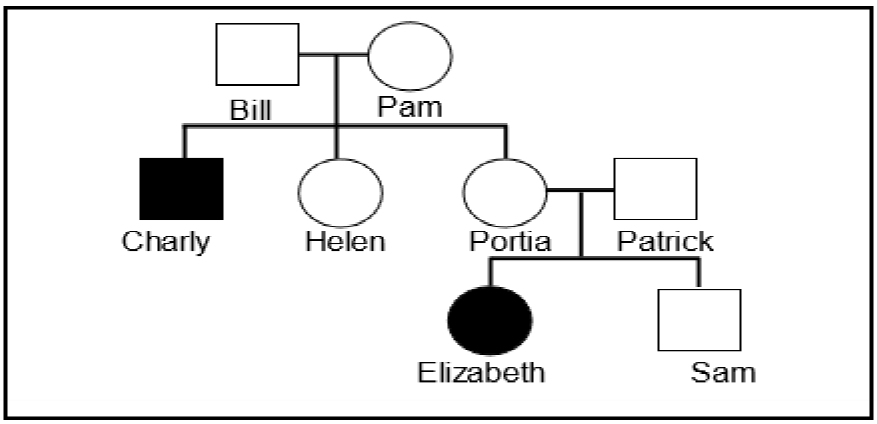
(a) Anticodon of the fourth base triplet on sequence **2** (2)

(b) Amino acid coded for by the first base triplet in sequence **2** (2)
(6)

2.4 Describe the process of *transcription in protein synthesis*. **(4)**

2.5 Tay-Sachs disease is caused by an autosomal recessive allele (**n**). Children with Tay-Sachs disease lose motor skills and mental functions. Over time, the children become blind, deaf, mentally retarded and paralysed. Tay-Sachs children die by the age of five.

The pedigree diagram below shows the inheritance of Tay-Sachs disease in a family.



[Source: www.tay-sachs.org]

2.5.1 Give:

(a) Charly's phenotype (2)

(b) Portia's genotype (2)

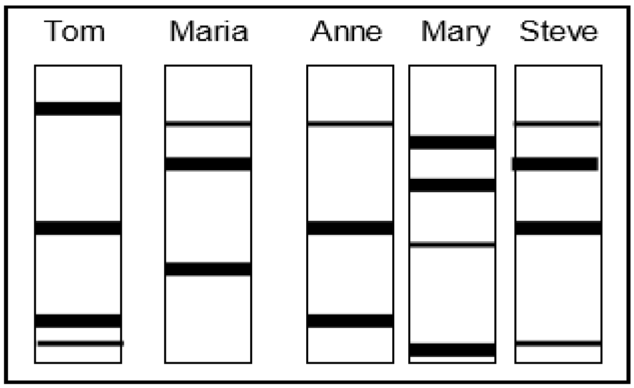
(c) Bill's genotype (2)

2.5.2 Explain why Patrick is normal, but a carrier of Tay-Sachs disease. (2)
(8)
[40]

QUESTION 3

3.1 Tom and Maria have three children. One of the three children was adopted. A DNA profile for each member of the family was prepared to determine if Tom is the father of all three children (Anne, Mary and Steve).

The DNA profiles are given below.



3.1.1 Which ONE of the children has been adopted? (2)

3.1.2 Explain your answer to QUESTION 3.1.1. (2)
(4)

3.2 Human blood groups are controlled by multiple alleles.

3.2.1 How many alleles control blood groups? (1)

3.2.2 Which TWO alleles are codominant in the inheritance of blood groups? (2)

3.2.3 A man is heterozygous for blood group A and marries a woman who has blood group O. Use a genetic cross to show the phenotypic ratio of their offspring. (7)
(10)

3.3 Haemophilia is a genetic disorder caused by a recessive allele on the X chromosome.

A haemophiliac female marries a normal male. Explain why all their sons will be haemophiliacs. **(4)**

3.4 Finches of the species *Geospiza fortis* are found on one of the Galápagos Islands. There was variation in the size of their beaks.

All the finches used to feed on small, soft seeds which were plentiful on the island. Then the island was affected by a severe drought which made food scarce.

Many of the plants on the island died. The small, soft seeds were all gone. Only hard, woody seeds remained.

Scientists conducted an investigation to determine the relationship between beak size and survival of the finches before and during the drought.

The table below shows the results of part of the investigation.

BEAK SIZE (mm)	TOTAL NUMBER OF FINCHES BEFORE THE DROUGHT	TOTAL NUMBER OF FINCHES DURING THE DROUGHT
7,3	2	0
7,8	12	2
8,3	30	4
8,8	48	4
9,3	45	6
9,8	40	8
10,3	25	10

[Adapted from *Excerpt Evolution*, Roberts et al.]

3.4.1 List FOUR steps that the scientists followed to obtain their results. (4)

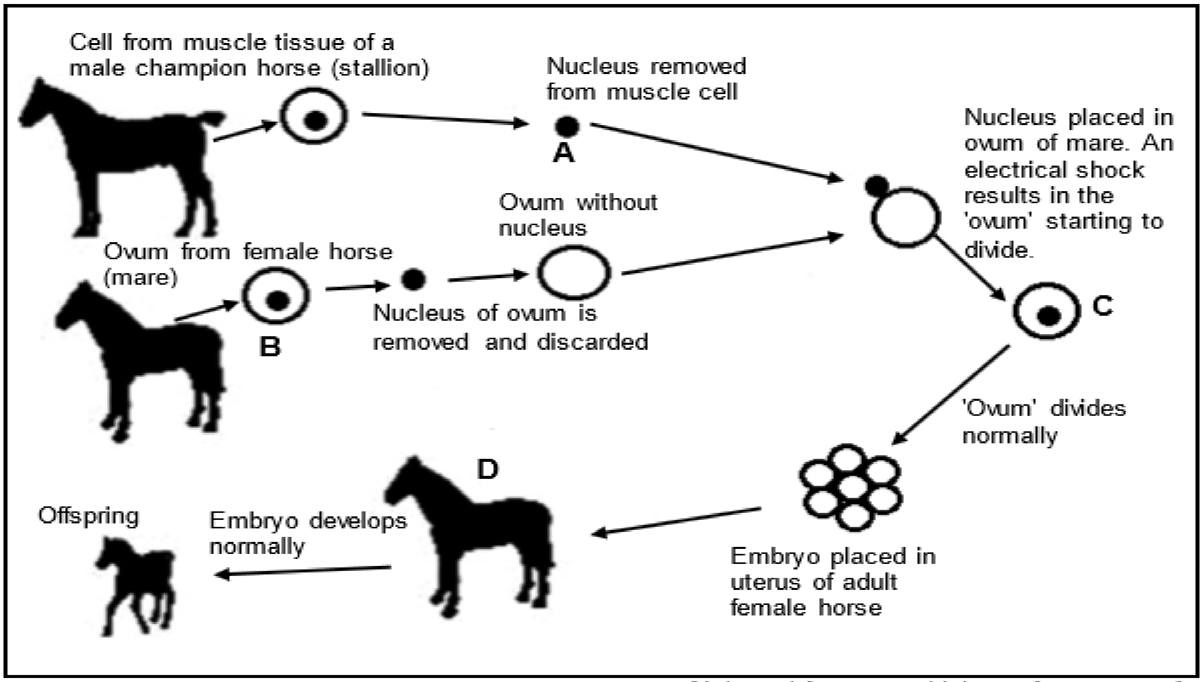
3.4.2 Name the independent variable of this investigation. (1)

3.4.3 Describe the relationship between the number of finches during the drought and beak size. (2)

3.4.4 Give a possible reason for the relationship in your answer to QUESTION 3.4.3. (3)

3.4.5 Predict which beak size(s) would be present in the population if the drought continued. (1)
(11)

3.5 The diagram below shows a genetic engineering process. A donor cell was taken from the muscle cell of a male champion horse (stallion) to create a new offspring.



[Adapted from www.biologyreference.com]

3.5.1 Name the:

(a) Genetic engineering process shown in the diagram above (1)

(b) Process that produced ovum **B** (1)

3.5.2 Why is the donor cell extracted from a champion horse? (2)

3.5.3 Explain why only the nucleus of the donor cell is used. (2)

3.5.4 A somatic cell in a horse contains 64 chromosomes.

How many chromosomes would there be in:

(a) Structure **A** (1)

(b) Ovum **B** (1)

(c) A muscle cell in organism **D** (1)

3.5.5 Explain why the 'ovum' labelled **C** cannot be considered a gamete. (2)
(11)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

The anole lizard of the Caribbean Islands represents a group of about 150 closely related species, which evolved within the past 50 million years from a single species.

Use this example to describe how natural selection led to the process of speciation that gave rise to the 150 different species of lizards.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2017

MARKING GUIDELINE

MARKS: 150

This memorandum consists of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	B✓✓		
	1.1.2	C✓✓		
	1.1.3	B✓✓		
	1.1.4	D✓✓		
	1.1.5	C✓✓		
	1.1.6	B✓✓		
	1.1.7	A✓✓		
	1.1.8	D✓✓	(8 x 2)	**(16)**
1.2	1.2.1	(Gene) mutation✓		
	1.2.2	Theory✓		
	1.2.3	Artificial selection✓/Selective breeding		
	1.2.4	Ribose✓sugar		
	1.2.5	Punctuated equilibrium✓		
	1.2.6	Out of Africa✓hypothesis		
	1.2.7	Fossils✓	(7 x 1)	**(7)**
1.3	1.3.1	A only✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) 25✓ mya (accept 24 to 25)		(1)
		(b) 63✓ mya		(1)
	1.4.2	Old World monkeys✓ and apes✓ **(MARK FIRST TWO ONLY)**		(2)
	1.4.3	Lorises✓		(1) **(5)**
1.5	1.5.1	23✓		(1)
	1.5.2	(a) Centromere✓		(1)
		(b) Chiasma✓/chiasmata		(1)
	1.5.3	Ovary✓		(1)
	1.5.4	(a) Crossing over✓		(1)
		(b) Prophase I✓		(1)
		(c) ova✓/gametes/sex cells		(1)
	1.5.5	C→ B→ A✓(correct sequence)		(1) **(8)**

1.6	1.6.1	(a)	BbTt✓✓	(2)
		(b)	Black coat✓ short tail✓	(2)
		(c)	BbTt✓	(1)
	1.6.2		0✓%	(1)
	1.6.3		Bt✓ bT✓ **(MARK FIRST TWO ONLY)**	(2) **(8)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 A transitional fossil shows characteristics✓ of two✓/between genera/species (2)

2.1.2 Bipedalism✓/stood upright (1)

2.1.3
- Structure of the pelvis✓
- Cranial volume✓

(MARK FIRST ONE ONLY) Any 1 (1)

2.1.4
- The foramen magnum is located more forward beneath the skull✓, so that
- the vertebral column extends beneath✓ the skull.
- The spine is S-shaped ✓to
- support an upright posture✓
- The pelvis is shorter and wider✓
- to support the body above✓the pelvis

(MARK FIRST TWO ONLY) Any (2 x 2) (4)

2.1.5
- There was a change in diet✓
- from tough✓/raw to
- softer✓/cooked food (3)

(11)

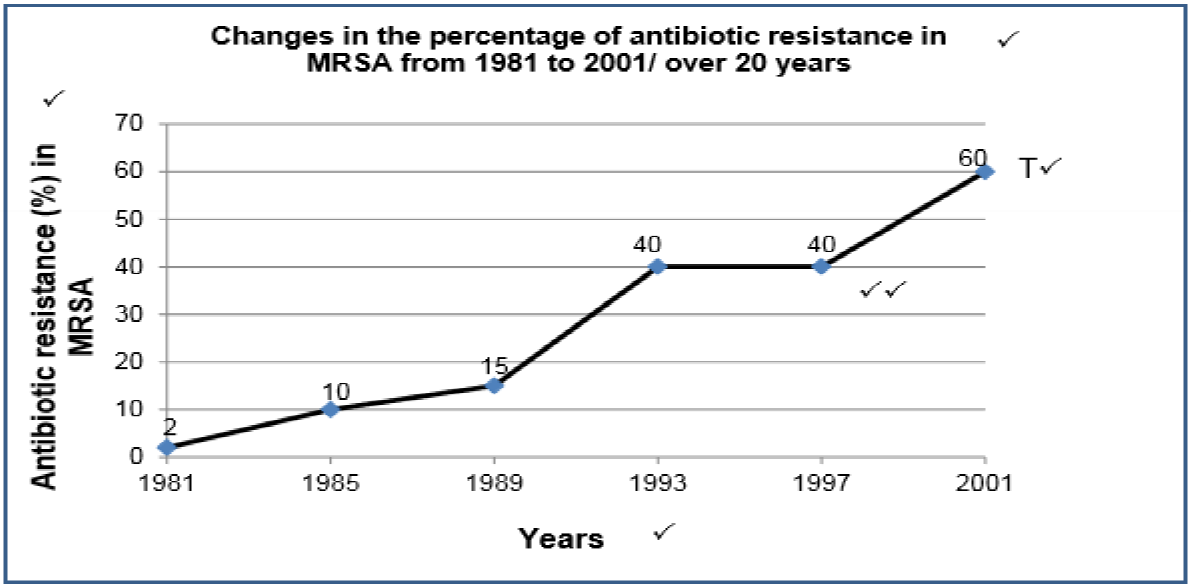
2.2 2.2.1 (a) MRSA✓ (1)

(b) FQRP✓ (1)

2.2.2 $\frac{(20-5)✓}{5} \times \frac{100✓}{1}$ **OR** $\frac{(15)✓}{5} \times \frac{100✓}{1}$

. = 300✓% (3)

2.2.3



Mark allocation for the graph

Criteria	Mark Allocation
Correct type of graph (line graph)	1
Title of graph including both variables	1
Correct label and scale for X-axis	1
Correct label and scale for Y-axis	1
Plotting of points	1 – 1 to 5 points plotted correctly 2 – all 6 points plotted correctly

NOTE:
If the wrong type of graph is drawn, marks will be lost for:

- 'Correct type of graph'
- 'Plotting of points'

If the axes are transposed:
The learner will lose 2 marks for correct label and scale for x and y axes

If learners draw all 3 graphs on the same system of axes:

- Learners will lose the mark for the title
- Learners will lose 1 mark for correct label and scale for y axis
- If all three graphs drawn are labelled, mark the correct MRSA graph
- If all three graphs drawn are not labelled, marks for plotting will be lost

If learners draw three graphs separately mark the first graph

(6)
(11)

2.3 2.3.1 DNA✓ (1)

2.3.2 First triplet base✓/ TAT /TAG became TAT (1)

2.3.3 (a) GUU✓✓ (2)

(b) Isoleucine✓✓ (2)
(6)

2.4
- Double-stranded DNA unwinds✓
- and unzips✓
- when the hydrogen bonds break✓
- 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 4 **(4)**

2.5 2.5.1 (a) Male✓ with Tay Sachs disease✓/all 4 symptoms must be given blind, deaf, mentally retarded and paralysed/ lose motor skills and mental functions (2)

(b) Nn✓✓ (2)

(c) Nn✓✓ (2)

2.5.2
- Since Elizabeth has Tay-Sachs disease✓/nn she had to inherit one recessive allele from each of her parents✓/Portia and Patrick.
- Patrick's genotype is Nn✓/heterozygous which means he is a carrier but normal. (Any 2) (2)

(8)
[40]

QUESTION 3

3.1 3.1.1 Mary✓✓
(MARK FIRST ONE ONLY) (2)

3.1.2 There are no matching bands✓/bars/pattern/DNA profile with both parents✓ (2)
(4)

3.2 3.2.1 Three✓/3 (1)

3.2.2 I^A✓ and I^B✓ (2)
(MARK FIRST TWO ONLY)

3.2.3

P_1	Phenotype	Blood group A	x	Blood group O✓
	Genotype	I^Ai	x	ii✓
Meiosis				
	G/gametes	I^A, i	x	i, i✓
Fertilisation				
F_1	Genotype	I^Ai; I^Ai;		ii; ii ✓
	Phenotype	2 blood group A	:	2 blood group O✓

Phenotypic ratio is **1 : 1***✓

P_1 and F_1✓
Meiosis and fertilisation✓

*__1 compulsory mark__ + Any 6

OR

P_1	Phenotype	Blood group A	x	Blood group O✓
	Genotype	I^Ai	x	ii✓

Meiosis

Fertilisation

Gametes	I^A	i
i	I^Ai	ii
i	I^Ai	ii

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype 2 blood group A : 2 blood group O✓
Phenotypic ratio is **1 : 1***✓

P_1 and
F_1✓
Meiosis and fertilisation✓ (7)
(10)

*__1 compulsory mark__ + Any 6

3.3
- An individual inherits one allele from each parent✓
- The Y chromosome was inherited from the father✓
- and the recessive allele/X^h was inherited from the mother✓
- since the mother has two recessive alleles✓/X^h X^h
- A son only needs to get one recessive allele to be haemophiliac✓since the
- Y-chromosome does not carry any allele to mask the haemophilia allele✓

Any 4 **(4)**

3.4 3.4.1
- Determine time/day to collect data✓
- Selected an area✓on the island
- randomly captured✓ a number of birds of the same species
- **measured their beaks✓**
- **before the drought✓**
- **and during the drought✓**
- recorded✓ the number of birds with each beak size

(MARK FIRST FOUR ONLY) Any 4 (4)

3.4.2 Number of finches before and during the drought✓/(beak size) (1)

3.4.3 During the drought there were more finches with larger beaks✓✓

OR

During the drought there were fewer finches with smaller beaks✓✓ (2)

3.4.4
- During the drought only hard woody seeds remained✓
- Finches with bigger beaks could crack open the seeds more easily✓
- had sufficient food✓
- and survived✓ and reproduced

OR

- During the drought, there were no small, soft seeds✓
- Finches with smaller beaks could not crack open the hard woody seeds✓
- and had no food✓
- did not survive✓to reproduce

Any 3 (3)

3.4.5 Range (9,8 – 10,3✓) mm/larger (1)

(11)

3.5 3.5.1 (a) Cloning✓ (1)

(b) Oogenesis✓/gametogenesis/ meiosis (1)

3.5.2
- The donor horse has the desired characteristics✓
- that need to be copied✓
- and be present in the offspring✓/next generation Any 2 (2)

3.5.3
- The nucleus contains all the genetic information✓✓/ hereditary characteristics/chromosomes of the champion horse (2)

3.5.4 (a) 64✓ (1)

(b) 32✓ (1)

(c) 64✓ (1)

3.5.5
- A gamete is generally haploid✓
- This ovum is diploid✓ since
- it has the nucleus of a somatic cell ✓ Any 2 (2)

(11)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Natural selection and speciation

- The original species of anole lizards was separated✓^{S}
- into different populations✓^{S}
- by a geographical barrier✓^{S}
- which is the sea✓^{S}
- There was no gene flow✓^{S}
- between the separated populations✓^{S}
- Each population was exposed to different environmental conditions✓^{N} on each island
- Because there is variation✓^{N} amongst the lizards
- Natural selection occurred independently✓^{N} in each population
- Some had favourable characteristics✓^{N} to survive on a specific island
- while others did not✓^{N}
- The ones that did not have the favourable characteristics died✓^{N}
- The ones with the favourable characteristic survived✓^{N}
- and reproduced✓^{N}
- to pass the gene for the favourable characteristics✓^{N}
- to the next generation✓^{N}
- And over many generations the favourable characteristic becomes more frequent in the population✓^{N}
- each population became different from the other✓^{S} over time
- genotypically ✓^{S}
- and phenotypically✓^{S}
- Even if the populations were to mix again✓^{S}
- they would not be able to reproduce/interbreed with each other✓^{S} Max 17

NOTE: ✓^{S} = SPECIATION
✓^{N} = NATURAL SELECTION

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic.	Ideas arranged in a logical sequence.	Answered all aspects required by the essay.
In this essay (Q4)	Only information relevant to the description of natural selection and speciation is given.	The descriptions for natural selection and speciation are logical and sequential.	At least 6 correct points in the description of natural selection and 6 correct points on speciation are given.
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2018

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

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

1.1.1 A molecule of RNA is copied from DNA by the process of …

A transcription.
B mitosis.
C mutation.
D translation.

1.1.2 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 biogeography.
B modification by descent.
C DNA evidence.
D genetic evidence.

1.1.3 What is the percentage chance of a woman having a female child?

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

1.1.4 A small section of mRNA has the following sequence of bases that codes for different amino acids:

G C U C G U U A A

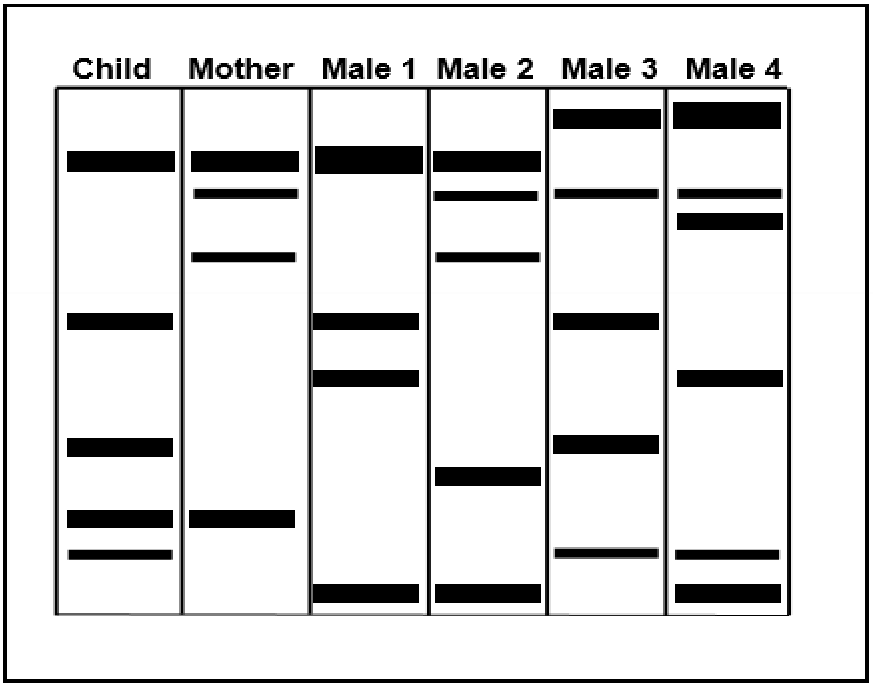
Which ONE of the following is the CORRECT representation of the anticodons and number of amino acids coded for by this section?

	ANTICODONS	NUMBER OF AMINO ACIDS
A	C G A G C A A U U	9
B	C G A G C A A U U	3
C	C G A G C A A T T	9
D	C G A G C A A T T	3

1.1.5 If a recessive allele on the X-chromosome is passed on to the offspring it is an example of …

A sex-linked inheritance.
B incomplete dominance.
C multiple alleles.
D co-dominance.

1.1.6 The diagram below shows the DNA profiles of a child, her mother and four males. There is uncertainty about who the biological father is. To establish paternity, DNA profiling was conducted.



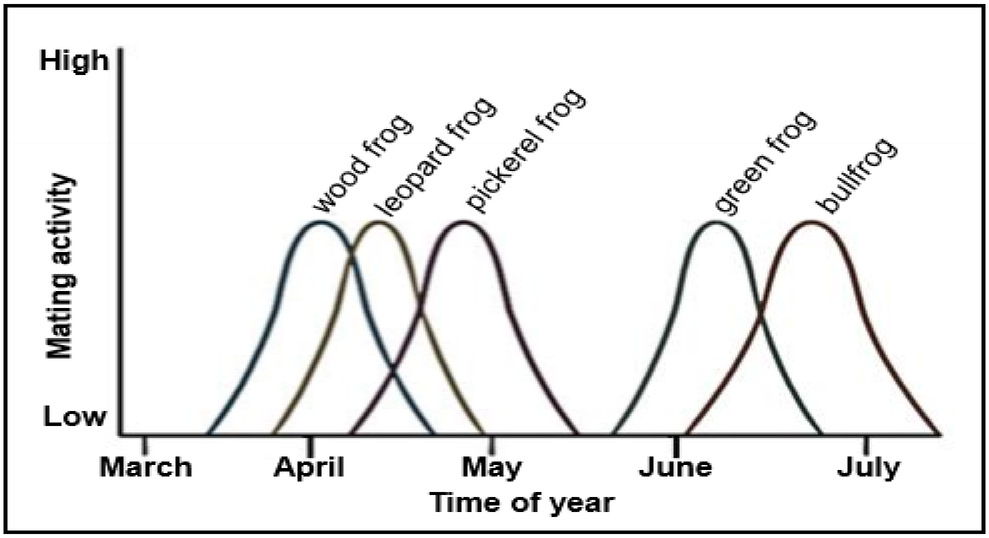
Which male is the biological father of this child?

A Male 1
B Male 2
C Male 3
D Male 4

1.1.7 Which ONE of the following is the correct genus and scientist for the discovery of the 'Taung Child' fossil?

A *Ardipithecus*; Raymond Dart
B *Ardipithecus*; Tim White
C *Australopithecus*; Raymond Dart
D *Australopithecus*; Tim White

1.1.8 Different frogs, which all belong to the genus *Lithobates*, are found in the same forest. The graph below shows their mating activity.



Based on the information, what kind of isolating mechanism is most likely keeping the bullfrogs and wood frogs as separate species?

A Geographic isolation through the presence of geographic barriers
B Reproductive isolation through species-specific courtship behaviour
C Reproductive isolation through breeding at different times of the year
D Reproductive isolation through the production of infertile offspring

1.1.9 Which ONE of the following statements is CORRECT for the 'Out of Africa' hypothesis?

A All modern humans originated in Africa and migrated to other parts of the world.
B All modern humans evolved from African apes and then migrated to other parts of the world.
C The most developed artefacts (tools; cutlery; art) were found in Africa.
D An analysis of mutations on the mitochondrial DNA shows that the oldest male ancestors were located in Africa. (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 type of RNA containing anticodons

1.2.2 The process during which genetically identical organisms are formed using biotechnology

1.2.3 Undifferentiated animal cells that can form any type of tissue

1.2.4 Type of inheritance where none of the two alleles is dominant over the other and an intermediate phenotype is produced

1.2.5 The breeding of organisms by humans to achieve a desirable phenotype

1.2.6 The point of crossing over between two adjacent chromosomes

1.2.7 The organelle in a cell where translation occurs

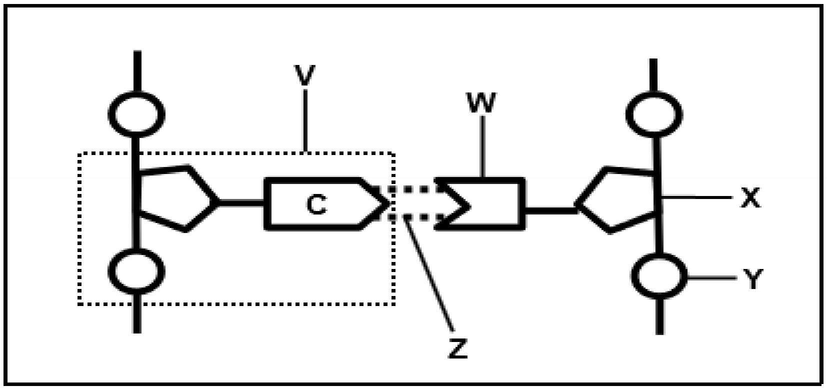
1.2.8 The variety of living organisms on Earth (8 x 1) **(8)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Contains the sugar ribose	A: DNA B: RNA
1.3.2	Chromosomes align at the equator	A: Metaphase **I** B: Metaphase **II**
1.3.3	Produced the first X-ray image of the DNA molecule	A: Rosalind Franklin B: Watson and Crick

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

1.4 The diagram 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 **V** (1)

(b) Nitrogenous base **W** (1)

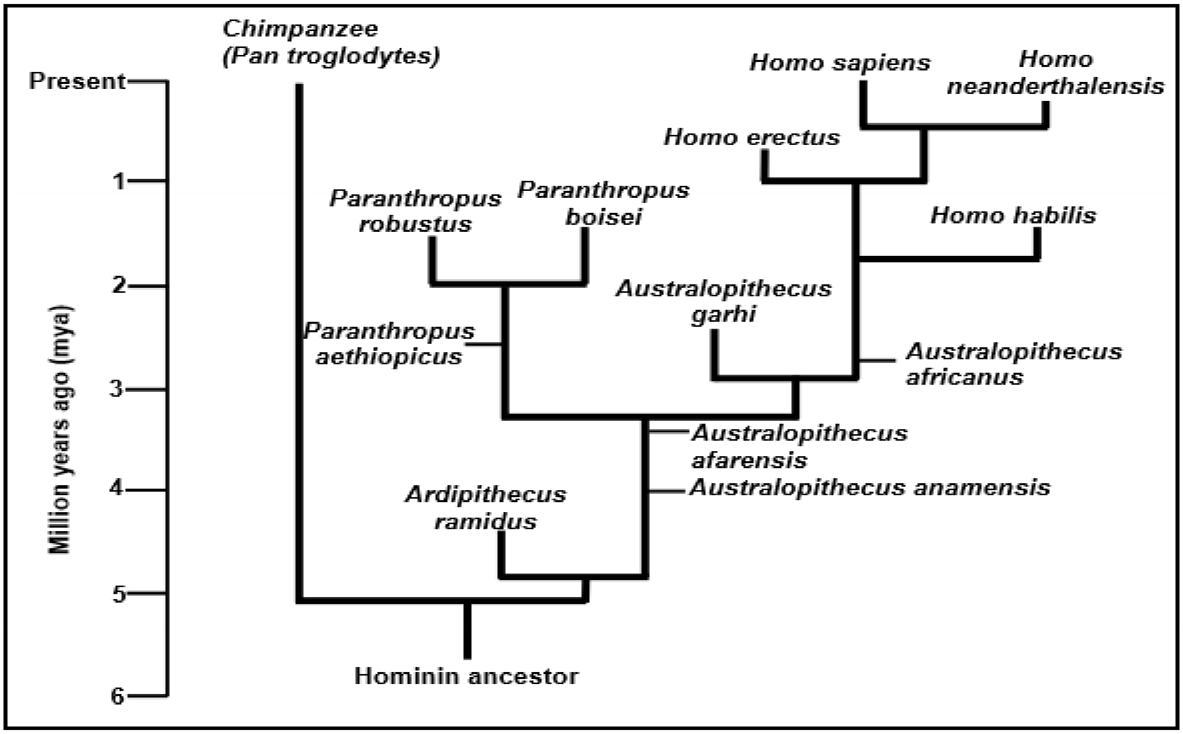
(c) Molecule **Y** (1)

(d) Bond **Z** (1)

1.4.4 What is the natural shape of this molecule? (1)

1.4.5 Name the process during which this molecule makes a copy of itself. (1)
(9)

1.5 The diagram below shows possible evolutionary relationships among some hominids.



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

1.5.2 How many of EACH of the following are represented in the diagram:

(a) Genera (1)

(b) *Homo* species (1)

1.5.3 Name the species that have *Paranthropus aethiopicus* as a common ancestor. (2)

1.5.4 When did:

(a) *Ardipithecus ramidus* become extinct (1)

(b) *Homo erectus* first appear (1)

1.5.5 Name the:

(a) Hominid species that existed at the same time as *Homo sapiens* (1)

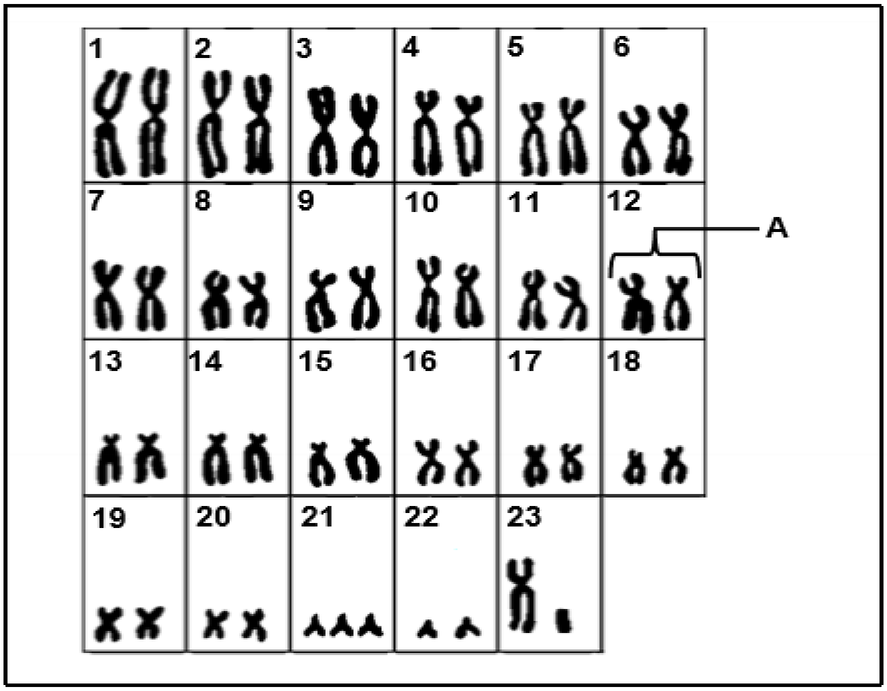
(b) First *Homo* species to use tools (1)
(9)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The karyotype below shows the chromosomes of a person with Down syndrome.



2.1.1 Give the label for **A**. (1)

2.1.2 How many autosomes are there in a nucleus of this cell? (1)

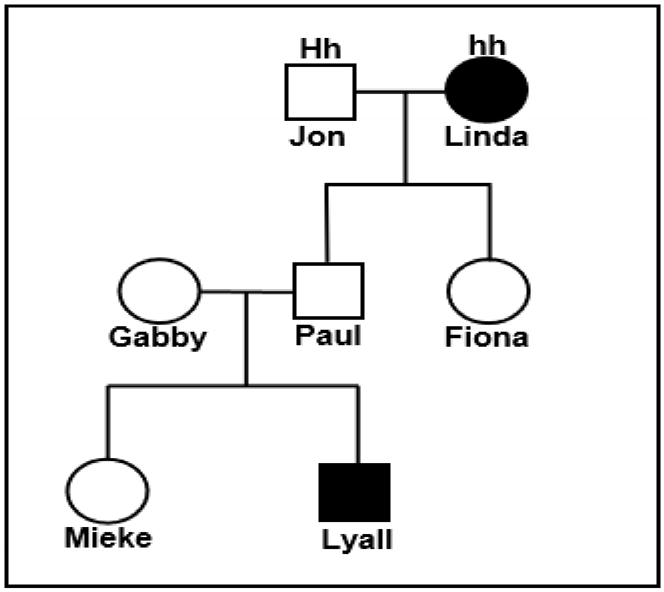
2.1.3 Name the type of chromosomes at position **23**. (1)

2.1.4 What evidence suggests that this is a karyotype of a male? (1)

2.1.5 Name the type of mutation represented in the diagram. (1)

2.1.6 Describe the events that led to Down syndrome. (6)
(11)

2.2 The diagram below shows the pattern of inheritance of deafness in a family. The letter **H** represents the allele for hearing and **h** represents the allele for deafness.



2.2.1 How many of EACH of the following are represented in this diagram?

(a) Males (1)

(b) Generations (1)

2.2.2 Give the:

(a) Phenotype of Jon (1)

(b) Genotype of Paul (1)

2.2.3 Both Lyall's parents can hear, yet he is deaf.

Explain how he inherited deafness. (2)

2.2.4 Lyall marries a woman who is homozygous dominant for hearing. Use a genetic cross to show the percentage chance of them having a deaf child. (7)
(13)

2.3 The extract below is about human evolution.

> In 2004 scientists in Indonesia discovered the first fossil of the species *Homo floresiensis* along with stone tools and animal remains. The fossil was made up of a nearly complete skull and skeleton, including hand and foot bones and a pelvis.
>
> Dating of the tools suggests that *H. floresiensis* may have lived from as early as 95 000 years ago until about 12 000 years ago.
>
> Researchers closely analysed three wrist bones and found that they more closely resembled those of apes than modern humans. This finding implied that *H. floresiensis* was indeed a separate species from modern humans.
>
> They had skulls that resembled early *Homo* species. This included a flat forehead and a short, flat face; however, their teeth and jaws more closely resembled *Australopithecus*.
>
> The scans of the skull suggested that the brain volume of *H. floresiensis* was about 426 cm^3; around one-third the size of the modern human brain which has an average volume of about 1 300 cm^3. The findings suggested that *H. erectus* may be the ancestor of *H. floresiensis*, as *H. erectus* had brains about 860 cm^3 in size or, alternatively, it may have evolved from *H. habilis*, whose brains were about 600 cm^3 in size.

2.3.1 Name the TWO lines of evidence for human evolution that is referred to in the extract above. (2)

2.3.2 How long did *Homo floresiensis* exist on Earth? (1)

2.3.3 Name ONE *Homo* ancestor mentioned in the extract. (1)

2.3.4 State THREE features of the jaw of *H. floresiensis* that might have led scientists to believe that it resembled that of *Australopithecus*, rather than of a *Homo* species. (3)

2.3.5 Describe ONE feature of the skull that can be used as evidence for bipedalism. (2)

2.3.6 State TWO similarities between the hands of African apes and modern humans. (2)

2.3.7 Draw a table to show the brain volumes of the different *Homo* species, using information from the extract. (5)

(16)
[40]

QUESTION 3

3.1 The table below shows the percentage of the populations with different blood groups for two countries.

BLOOD GROUP	**PERCENTAGE OF POPULATION**	
	COUNTRY Q	**COUNTRY R**
O	40	20
A	10	35
B	45	40
AB	5	5

3.1.1 Which blood group shows the greatest percentage difference between the two countries? (1)

3.1.2 The population size of country **Q** is 5 million people.

Calculate the number of people who have blood group **O**. Show ALL your working. (3)

3.1.3 Explain how the inheritance of blood group **AB** is an example of co-dominance. (2)

3.1.4 Explain why blood groups are considered an example of discontinuous variation. (2)

3.1.5 In the inheritance of blood groups, give the:

(a) Recessive allele (1)

(b) Phenotype of an individual who is homozygous recessive (1)
(10)

3.2 Read the extract below.

> The red-bellied black snake (*Pseudechis porphyriacus)* and the green tree snake (*Denderelaphis punctulatus*) are predators that sometimes feed on cane toads (*Bufo marinus*) that contain a toxin that may kill them.
>
> The snakes consume the toads by swallowing them whole. A decrease in the average jaw size of the snakes has been observed over a period of 70 years. Some scientists believe that this may be an example of punctuated equilibrium. With this change it was also noted that the snakes could no longer swallow the large cane toads. This has resulted in an increase in the survival of the snakes.

3.2.1 Define *punctuated equilibrium*. (3)

3.2.2 What characteristic of the toad species protects it from predation? (1)

3.2.3 Explain how the change in jaw size helped the snakes to survive. (3)

3.2.4 How would Lamarck have explained the development of a small jaw size in the snakes? (4)
(11)

3.3 In a plant species two characteristics, flower colour and plant height, were studied. Each of these characteristics has two variations: flowers may be red or white in colour and the plants may be tall or short.

Plants that are heterozygous for flower colour have red flowers and plants that are homozygous recessive for plant height are short.

The alleles for each characteristic are shown in the table below.

CHARACTERISTIC	DOMINANT ALLELE	RECESSIVE ALLELE
Flower colour	F	f
Plant height	H	h

3.3.1 What is the term given for a genetic cross involving two characteristics? (1)

3.3.2 Give the:

(a) Dominant phenotype for flower colour (1)

(b) Recessive phenotype for plant height (1)

(c) Phenotype of a plant that is heterozygous for flower colour and homozygous dominant for plant height (2)

(d) Genotype of a white flowering, short plant (2)

3.3.3 State Mendel's Law of Dominance. (3)
(10)

3.4 Study the extract and the information provided.

> An insecticide is used by farmers to control insect populations of *Plodia interpunctella* which feeds on stored grain. Farmers treat the grain with the insecticide to prevent an insect infestation.
>
> This insecticide is extremely poisonous to certain insects, yet causes little or no harm to humans and beneficial insects.
>
> In recent years it has been noticed that this insecticide is no longer effective in controlling insect populations of *Plodia interpunctella*.

Scientists hypothesised that insect populations that had previously been exposed to the insecticide had a higher survival rate when the grain was treated again.

In an investigation to test this hypothesis, they:

- Identified storage bins that had previously been treated with the insecticide and bins that had never been treated with the insecticide
- Collected a sample of 300 insects from each bin
- Kept each sample in a separate container of equal size and the same conditions
- Sprayed the same concentration and volume of insecticide over both containers
- Allowed 24 hours for the insecticide to take effect
- Counted the number of insects that survived in each container

The results are given in the table below:

PREVIOUS EXPOSURE TO INSECTICIDE	NUMBER OF INSECTS THAT SURVIVED
With previous exposure to insecticide	182
No previous exposure to insecticide	66

3.4.1 Give the:

(a) Independent variable (1)

(b) Dependent variable (1)

3.4.2 State THREE factors that were kept constant in this investigation. (3)

3.4.3 Give TWO reasons why the scientists' results may not be reliable. (2)

3.4.4 State a conclusion for this investigation. (2)
(9)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe how a gene mutation may influence the structure of a protein. Also use ONE example to describe the role of mutations in evolution in present times.

Content: (17)
Synthesis: (3)

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2018

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 11 pages.

SECTION A

QUESTION 1

1.1	1.1.1	A✓✓		
	1.1.2	B✓✓		
	1.1.3	C✓✓		
	1.1.4	B✓✓		
	1.1.5	A✓✓		
	1.1.6	C✓✓		
	1.1.7	C✓✓		
	1.1.8	C✓✓		
	1.1.9	A✓✓	(9 x 2)	**(18)**
1.2	1.2.1	tRNA✓/transfer RNA		
	1.2.2	Cloning✓		
	1.2.3	Stem✓cells		
	1.2.4	Incomplete dominance✓		
	1.2.5	Artificial selection✓/selective breeding		
	1.2.6	Chiasma✓		
	1.2.7	Ribosome✓		
	1.2.8	Biodiversity✓	(8 x 1)	**(8)**
1.3	1.3.1	B only✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	A only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	DNA✓/Deoxyribonucleic acid		(1)
	1.4.2	Nucleus✓/chromosome Mitochondria✓ **(Mark first TWO only)**		(2)
	1.4.3	(a) Nucleotide✓		(1)
		(b) Guanine✓		(1)
		(c) Phosphate✓		(1)
		(d) Hydrogen✓ bond		(1)
	1.4.4	Double helix✓		(1)
	1.4.5	DNA replication✓		(1) **(9)**

1.5	1.5.1	Phylogenetic✓	(1)
	1.5.2	(a) 5✓	(1)
		(b) 4✓	(1)
	1.5.3	*(Paranthropus) robustus*✓ and *(Paranthropus) boisei*✓	(2)
	1.5.4	(a) Accept any value in the range 4,3 to 4,5 million years ago✓/mya	(1)
		(b) 1 mya✓	(1)
	1.5.5	(a) *Homo neanderthalensis*✓	(1)
		(b) *Homo habilis*✓	(1)
			(9)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1	2.1.1	Homologous chromosomes✓	(1)
	2.1.2	45✓	(1)
	2.1.3	Gonosomes✓	(1)
	2.1.4	The presence of a Y chromosome✓/XY chromosome	(1)
	2.1.5	Chromosome✓mutation	(1)
	2.1.6	- Non-disjunction occurred✓/A homologous pair of chromosomes failed to separate - at position 21✓ - during Anaphase✓ - resulting in one gamete with 24 chromosomes✓/an extra chromosome/2 chromosomes at position 21 - The fertilisation of this gamete with a normal gamete✓/gamete with 23 chromosomes/1 chromosome at position 21 - results in a zygote with 47 chromosomes✓ - There are 3 chromosomes✓/an extra chromosome at position 21/ this is Trisomy 21 Any 6	(6) **(11)**

2.2 2.2.1 (a) 3✓ (1)
(b) 3✓ (1)

2.2.2 (a) Hearing✓/Normal (1)
(b) Hh✓ (1)

2.2.3 - Lyall inherited one recessive allele✓
- from each parent✓ (2)

2.2.4 **P_1** Phenotype Hearing x Deaf✓
Genotype HH x hh✓
Meiosis
G/gametes H H x h h✓
Fertilisation
F_1 Genotype Hh Hh Hh Hh✓

Phenotype All hearing✓
0% deaf✓*

P_1 and F_1✓
Meiosis and fertilisation✓

***1 Compulsory mark** + Any 6

OR

P_1 Phenotype Hearing x Deaf ✓
Genotype HH x hh ✓

Meiosis

Fertilisation

Gametes	H	H
h	Hh	Hh
h	Hh	Hh

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype All hearing✓
0% deaf ✓*

P_1 and F_1✓
Meiosis and fertilisation✓

***1 Compulsory mark** + Any 6 (7)
(13)

2.3 2.3.1 - Fossil✓/ 'the first fossil'
- Cultural✓/ 'stone tools'/'animal remains' (2)
(Mark first TWO only)

2.3.2 83 000 years✓ (1)

2.3.3 *Australopithecus*✓ (1)
(Mark first ONE only)

2.3.4 - The jaw was more prognathous✓/protruding and
- larger✓ than in humans
- The jaw was more rectangular✓
- The palate shape was less rounded✓/U-shaped/rectangular
- The canines were larger✓
- Large spaces✓/diastema between the teeth Any 3 (3)
(Mark first THREE only)

2.3.5 - A more forward✓position
- of the foramen magnum✓ (2)
(Mark first ONE only)

2.3.6 - Opposable thumbs✓
- Bare fingertips✓
- Nails✓instead of claws
- Pentadactyl✓hand Any 2 (2)
(Mark first TWO only)

2.3.7

HOMO SPECIES✓	BRAIN VOLUME✓(cm^3)
H. floresiensis	426
H. habilis	600
H. erectus	860
H. sapiens/modern humans	1300

Guideline for assessing the table

Correct table format (separation of columns)	1
Column headings	2
Data entered	1: 1 to 3 data sets correctly entered 2: All 4 data sets correctly entered

(5)
(16)
[40]

QUESTION 3

3.1	3.1.1	Blood group A✓	(1)
	3.1.2	$\frac{40}{100}$ ✓ x $\frac{5\ 000\ 000}{1}$ ✓ = 2 000 000✓/2 million	(3)
	3.1.3	- The alleles I^A and I^B✓ - are equally dominant✓	(2)
	3.1.4	- When phenotypes fit into separate or distinct categories✓ - with no intermediate phenotypes✓	(2)
	3.1.5	(a) i✓ (b) Blood group O✓	(1) (1) **(10)**
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 form✓	(3)
	3.2.2	They contain toxins✓ which kill the snakes **OR** Too large✓ to be swallowed Any 1	(1)
	3.2.3	- Having a smaller jaw✓ - means cane toads cannot be consumed✓ - thereby protecting the snakes from ingesting the toxins✓	(3)
	3.2.4	- Since the snakes' jaws were used less ✓/not used - the snakes developed smaller jaws✓ - This characteristic (of a smaller jaw) was inherited by the offspring✓ - Over many generations the jaw of the snake became smaller✓	(4) **(11)**

3.3 3.3.1 Dihybrid✓ cross (1)

3.3.2 (a) Red✓ (1)
(b) Short✓ (1)
(c) Red✓ and Tall✓ (2)
(d) ffhh✓✓ (2)

3.3.3
- When two organisms with pure breeding✓
- contrasting traits✓are crossed
- all the individuals of the F_1 generation will display the dominant trait✓

OR

- If an organism is heterozygous✓
- the dominant allele✓
- will determine the phenotype✓ (3)

(10)

3.4 3.4.1 (a) Exposure to insecticide✓ (1)
(b) Number of insects that survived✓/survival rate of insects (1)

3.4.2
- Sample size✓/300 insects
- Size of containers✓
- Conditions✓
- Concentration of insecticide✓
- Volume of insecticide✓
- Time period✓/24 hours Any 3 (3)

(Mark first THREE only)

3.4.3
- They only conducted the investigation once✓/did not repeat
- They used a small sample/only 300 insects✓
- They used only two storage bins✓ Any 2 (2)

(Mark first TWO only)

3.4.4 Insects that were previously exposed to the insecticide had a higher survival rate✓✓

OR

Insects that were not previously exposed to the insecticide had a lower survival rate✓✓ (2)

(9)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

MUTATIONS AND PROTEIN SYNTHESIS
- A mutation is a change in the nucleotide/nitrogenous base sequence✓
- of a DNA molecule✓/a gene
- since mRNA is copied from the DNA molecule✓
- during transcription✓
- This will result in a change in the codons✓
- As a result, different tRNA✓ molecules
- carrying different amino acids✓ will be required
- The sequence of amino acids changes✓
- resulting in the formation of a different protein✓
- If the same amino acid ✓is coded for
- there will be no change✓in the protein structure Any 9 (9)

MUTATIONS AND EVOLUTION IN PRESENT TIMES
- In a population of insects✓/bacteria/HI viruses/Galápagos' finches
- mutations are a source of variation✓
- which may make some organisms more resistant✓/better suited
- to insecticides✓/antibiotics/antiretroviral medication/ drought
- Those individuals that are not resistant/suited will die✓ whereas
- those that are resistant/ well suited, will survive✓
- to pass the resistant allele/resistance on to their offspring✓
- This is known as natural selection✓
- As a result, individuals of the future generations will be resistant to the insecticides✓/antibiotics/antiretroviral medication/adapted to drought Any 8 (8)

Content (17)
Synthesis (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	**Relevance (R)**	**Logical sequence (L)**	**Comprehensive (C)**
Generally	All information provided is relevant to the question.	Ideas are arranged in a logical sequence.	All aspects of the essay have been sufficiently addressed.
In this essay in Q4	Only provided information relevant to: - Mutations and protein synthesis - Mutations and evolution in present times. There is no irrelevant information.	Information on: - Mutations and protein synthesis - Mutations and evolution in present times is presented in a logical sequence	At least the following marks should be obtained: - Mutations and protein synthesis **(7/9)** - Mutations and evolution in present times **(5/8)**
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2016

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

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.

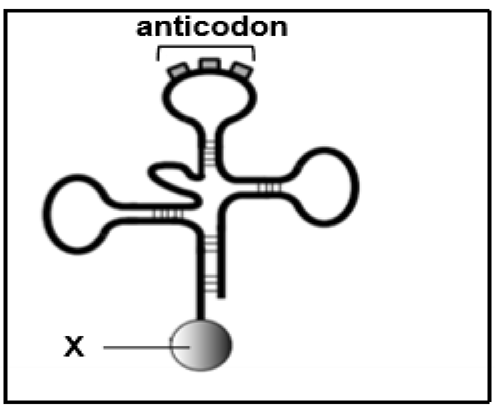
1.1.1 When a cell divides by meiosis it results in …

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

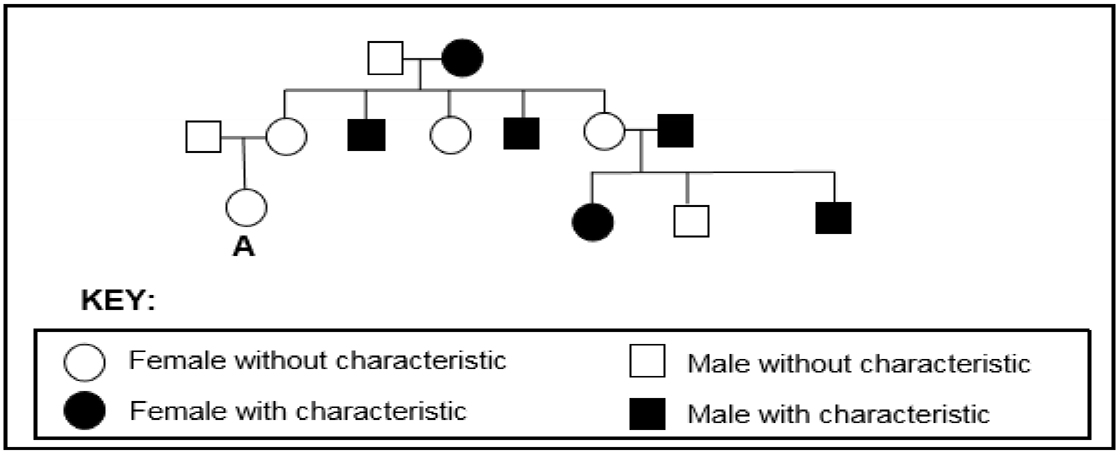
1.1.7 A bacterial infection was treated with a new drug and all the treated patients recovered. One week later the infection returned in some patients.

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 ...

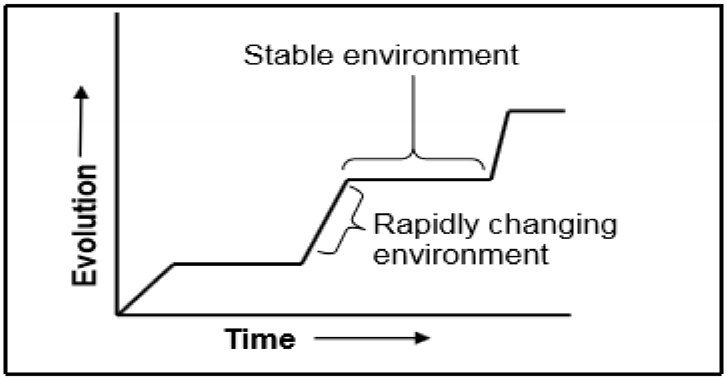
A X^NX^n only.
B X^NX^N only.
C X^NX^N and X^NX^n.
D X^NX^N and X^nX^n.

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.

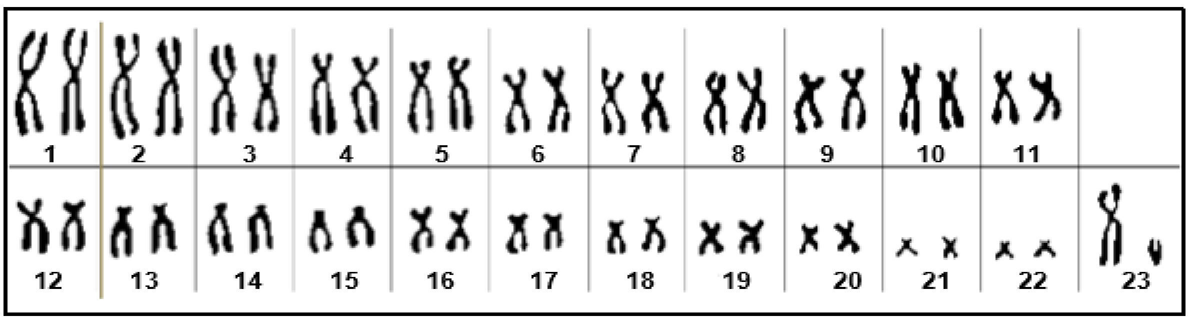
PARENTS	BABIES	BLOOD GROUPS OF PARENTS AND BABIES		
		Mother	**Father**	**Baby**
Mr and Mrs Pule	X	B	A	A
Mr and Mrs Chaka	Y	AB	B	O
Mr and Mrs Tau	Z	O	B	AB

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)

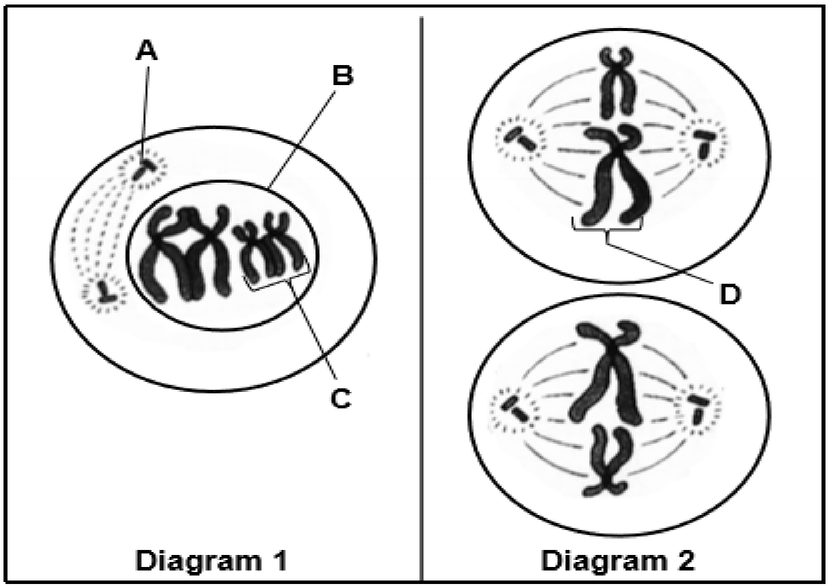
(b) Autosomes (1)

(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:

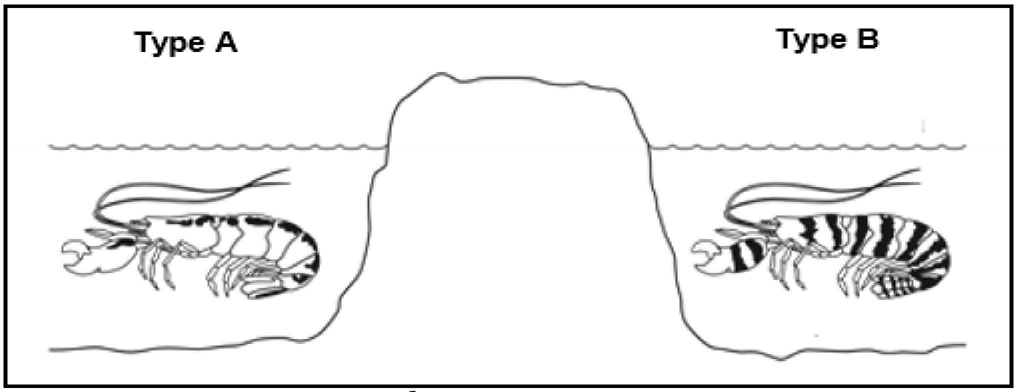
(a) Pure-bred

(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)

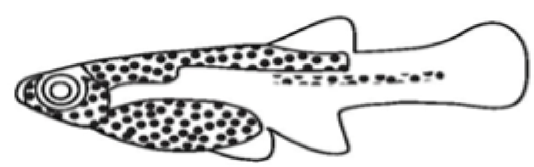
2.3 Describe how speciation occurs through geographic isolation. **(5)**

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:

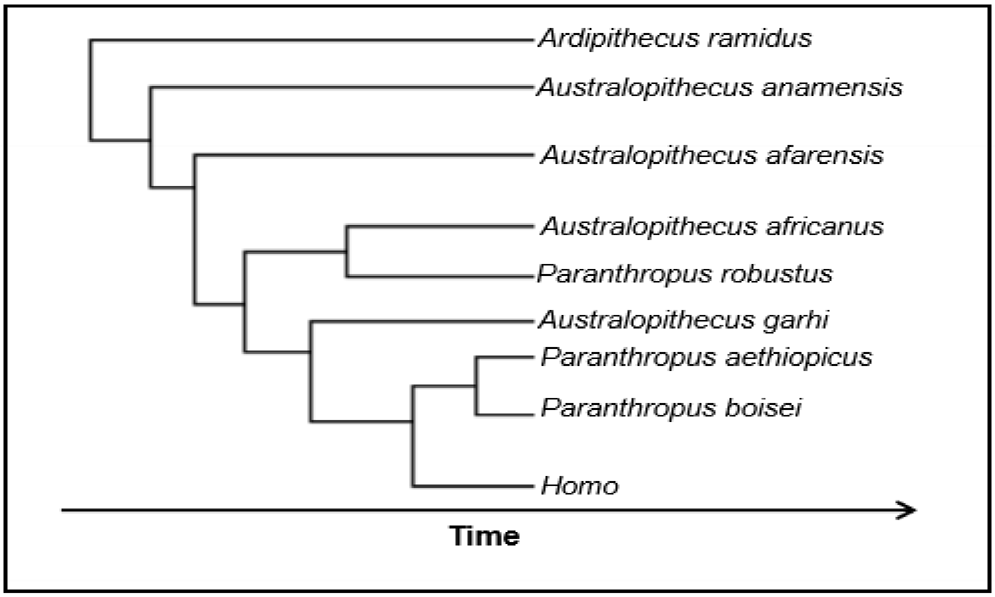
(a) Independent variable (1)

(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)

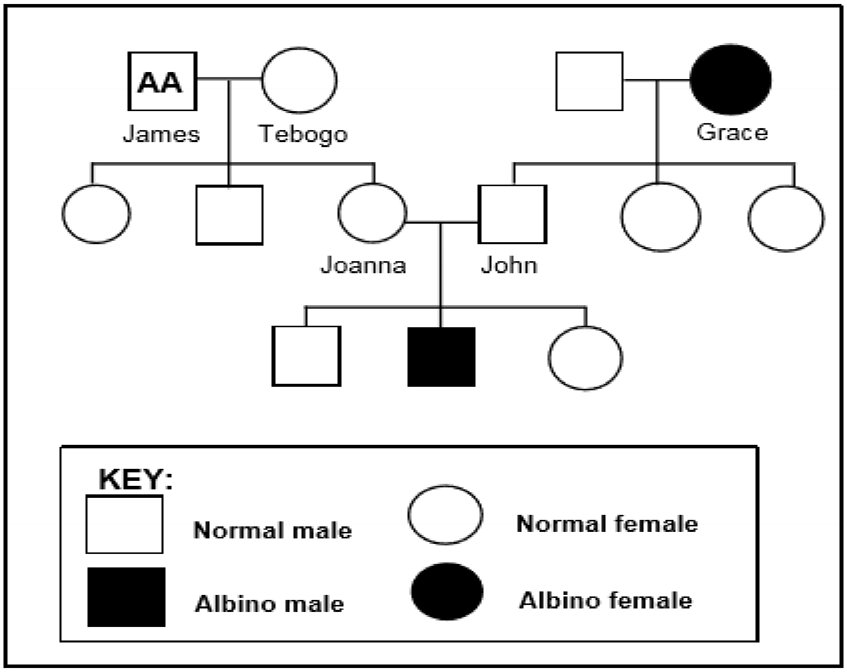
3.3.2 Describe how each of the following structures is different between humans and apes:

(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

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2016

MEMORANDUM

MARKS: 150

This memorandum consists of 11 pages.

SECTION A

QUESTION 1

1.1	1.1.1	A✓✓		
	1.1.2	D✓✓		
	1.1.3	C✓✓		
	1.1.4	B✓✓		
	1.1.5	A✓✓		
	1.1.6	C✓✓		
	1.1.7	D✓✓		
	1.1.8	C✓✓		
	1.1.9	C✓✓		
	1.1.10	C✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Dihybrid✓		
	1.2.2	Biodiversity✓		
	1.2.3	Foramen magnum✓		
	1.2.4	Population✓		
	1.2.5	Hypothesis✓		
	1.2.6	Haemophilia✓		
	1.2.7	Extinction✓		
	1.2.8	Gene✓		
	1.2.9	Bipedalism✓	(9 x 1)	**(9)**
1.3	1.3.1	Y✓and Z✓ ***(Mark first TWO only)***		(2)
	1.3.2	Y – Tau✓ Z – Chaka✓		(2)
	1.3.3	I^AI^A✓ I^Ai✓ ***(Any order)***		(2) **(6)**
1.4	1.4.1	(a) 46✓		(1)
		(b) 44✓		(1)
		(c) 2✓		(1)
	1.4.2	23✓		(1)
	1.4.3	Male✓		(1) **(5)**

1.5	1.5.1	(a)	Prophase I✓	(1)
		(b)	Metaphase II✓	(1)
	1.5.2	(a)	Centriole✓	(1)
		(b)	Nuclear membrane✓/(nucleus)	(1)
		(c)	Homologous pair✓/Bivalent	(1)
	1.5.3	(a)	- Forms spindle✓✓fibres	(2)
		(b)	Carries genetic✓/hereditary material	(1)
	1.5.4		Haploid✓	(1)
	1.5.5		Crossing over✓	(1) **(10)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) White✓fur (1)

(b) Black✓fur (1)

2.1.2 (a) 1✓ and 3✓ (2)
(Mark first TWO only)

(b) 1✓ (1)
(Mark first ONE only)

2.1.3

$\mathbf{P_1}$	Phenotype	Black	X	White✓
	Genotype	BB	X	bb✓
Meiosis				
	G/gametes	B, B	X	b, b✓
Fertilisation				
$\mathbf{F_1}$	Genotype	Bb; Bb, Bb; Bb ✓		
	Phenotype	All black ***0**✓%white		

P_1 and F_1✓
Meiosis and fertilisation✓

(*compulsory mark + 5)

OR

$\mathbf{P_1}$	Phenotype	Black	X	White✓
	Genotype	BB	X	bb✓

Meiosis

Fertilisation

Gametes	B	B
b	Bb	Bb
b	Bb	Bb

1 mark for correct gametes
1 mark for correct genotypes

$\mathbf{F_1}$	Phenotype	All black ***0**✓% white

P_1 and
F_1✓
Meiosis and fertilisation✓

(* compulsory mark + 5) (6)
(11)

2.2 2.2.1 The two types of shrimp/ type A and B did not belong to the same species✓/ were different species
(Mark first ONE only) (1)

2.2.2
- Individuals that belong to the same species✓ are able to interbreed✓
- the two types of shrimps did not mate with each other✓ and therefore were unable to interbreed✓ Any (1 x 2) (2)

(Mark first ONE only)

2.2.3 To ensure that the results would be reliable✓ (1)
(4)

2.3
- The original population is separated✓ into two populations
- by a **geographical barrier**✓
- There is no gene flow✓/no interbreeding between the populations
- Each population is exposed to different environmental conditions✓
- Natural selection occurred independently✓ in each population
- and the individuals of each population became different from each other✓ over time
- genotypically and phenotypically✓
- Even if the two populations were to mix again✓
- they would not be able to reproduce with each other✓

Any **(5)**

2.4 2.4.1
- Ponds 1 and 2 should have identical✓environmental✓/ biological/physical conditions/examples
- Equal numbers✓ of predatory fish✓ in both ponds

(Any 1 x 2) (2)

2.4.2 (a) The **type** of predators✓ (1)

(b) The **number** of spots✓ (1)

2.4.3
- As a control✓/to compare the results between the ponds.
- To ensure that any changes that occurred✓ were due to the
- presence of the predator✓/independent variable (3)

2.4.4
- There is variation✓ amongst the male guppies
- Some have more spots✓
- while others have fewer spots✓
- The ones that have more spots attract predators✓
- and are eaten✓/killed by predators
- The ones with fewer spots survived✓ and reproduced
- to pass the gene for fewer spots on to the next generation✓

Over a period of time, pond 1 with predators had guppies with fewer spots Any (5)
(12)

2.5 2.5.1 Phylogenetic tree✓ (1)

2.5.2 4✓ (1)

2.5.3 (a) *Paranthropus*✓ (1)

(b) *Ardipithecus*✓ (1)

(c) *Paranthropus robustus*✓ (1)

2.5.4 Mrs Ples✓
Taung Child✓
Little Foot✓
(*Mark first ONE only*) (Any 1) (1)

2.5.5 *H. habilis*✓
H. erectus✓
H. naledi✓
(*Mark first TWO only*) (Any 2) (2)
(8)
[40]

QUESTION 3

3.1 3.1.1 High yield✓
Short stem✓ (2)

3.1.2 hT✓ (1)
(*Mark first ONE only*)

3.1.3 HHtt✓, Hhtt✓ (2)
(*Mark first TWO only*)

3.1.4 Does not break easily in windy conditions✓/to carry a bigger yield/ easier to harvest Any (1)

3.1.5 The plant breeder must cross✓ plants of variety A (HHtt) with plants of variety A✓(HHtt) (2)
(8)

3.2 **T** ✓

Lamarckism	**Darwinism**
1 Variation of the offspring occurs when individuals in the population change✓	1 Variation in the offspring is inherited✓
2 Change occurs because of adaptation to the environment✓/Law of use and disuse/ deterministic theory	2 Natural selection – individuals best suited to the environment survive✓
3 Individuals in the population change✓	3 The population as a whole changes✓
4 Acquired characteristics are inherited by offspring✓	4 Characteristic are passed on from generation to generation to enable individuals to survive in the environment✓

(Mark first THREE only) (Any (3 x 2) + 1 for table) **(7)**

3.3 3.3.1
- Olfactory brain centres reduced✓/ reduced sense of smell
- Eyes in front✓/ Binocular vision / stereoscopic vision
- Eyes with cones✓/ colour vision
- Freely rotating arms✓
- Elbow joints allowing rotation of forearm✓
- Flat nails instead of claws✓/ bare, sensitive finger tips
- Opposable thumbs✓/precision grip
- Bipedal✓/ upright posture / foramen magnum in a more forward position
- Sexual dimorphism✓/ distinct differences between males and females
- Two teats✓
- Parts of the brain that process information from the hands and eyes are enlarged✓
- Long **upper** arms✓
- Large brains✓ / skulls compared to their body mass
- Five digits per limb✓ Any (5)

(Mark first FIVE only)

3.3.2 (a) More curved spine✓/S-shape in humans
less curved✓/ C-shaped in apes (2)

(b) **Short and wide**✓ pelvis in humans
long and narrow✓ pelvis in apes (2)

3.3.3
- Canines/teeth have changed from large to small✓✓
- This is due to a change from eating raw✓ food
- to eating cooked✓food (4)

(13)

3.4 3.4.1 2✓ (1)

3.4.2 (a) Albino female✓ (1)

(b) Aa✓✓ (2)

3.4.3 (a) 50%✓ (1)

(b) 25%✓ (1)

(6)

3.5
- A gene mutation affects the sequence of nitrogen bases✓/ change in the individual nitrogen bases
- in DNA✓
- This changes transcription✓
- Resulting in a changed mRNA✓/codon
- which changes the order of the code✓ on the DNA and the RNA/the order of the nitrogen bases
- A different amino acid✓ may be coded for
- by tRNA✓ leading to the formation of a different protein (Any 6) **(6)**

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Location, structure and function

- The DNA is located in the nucleus✓/chromosome/genes/mitochondria

- DNA is a nucleic acid✓
- It has a double✓stranded
- helix✓ configuration
- consisting of building blocks called nucleotides✓
  The three components of a nucleotide are as follows:
- Nitrogenous bases✓
- Phosphate portion✓
- Deoxyribose sugar portion✓(in DNA)
- 4 nitrogenous bases are A,T,C,G✓ of DNA:
- adenine (A) bonds with thymine (T)✓
- cytosine (C) bonds with guanine (G)✓
- by hydrogen bonds✓

- Sections of DNA carry hereditary✓ information
- DNA contains coded information for protein synthesis✓ Max (10)

Replication✓

- The double helix unwinds✓
- Double stranded DNA unzips✓
- as the weak hydrogen bonds break✓
- Each original DNA strand serves as a template✓
- Free nucleotides✓build
- a new DNA strand✓onto each of the original DNA strands
- by attaching to their complementary✓nitrogenous bases/(A to T, and C to G)
- this results in two identical✓DNA molecule Max (7)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question.	Ideas are arranged in a logical/cause-effect sequence.	Answered all aspects required by the essay in sufficiently detail.
In this essay in Q4	All the information provided is relevant to the location, structure, functions of DNA and the replication process. There is no irrelevant information	The information given regarding the location, structure, functions of the DNA and the replication process is arranged in a logical and sequential manner.	At least the following marks should be obtained for: - location, structure and functions of the DNA **(7/10)** - DNA replication (**4/7**)
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2017

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Write down the question number (1.1.1–1.1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:				
1.1.11	A	B	C	~~D~~

1.1.1 A genetic cross where both alleles of a gene are equally dominant is an example of …

A codominance.
B a dihybrid cross.
C incomplete dominance.
D complete dominance.

1.1.2 The list below describes features of evolutionary theories.

(i) Involves long periods of time during which species do not change
(ii) Is always a gradual process
(iii) Is supported by the absence of transitional fossils
(iv) New species are formed in a short period of time

Which combination of features gives the correct characteristic of punctuated equilibrium?

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

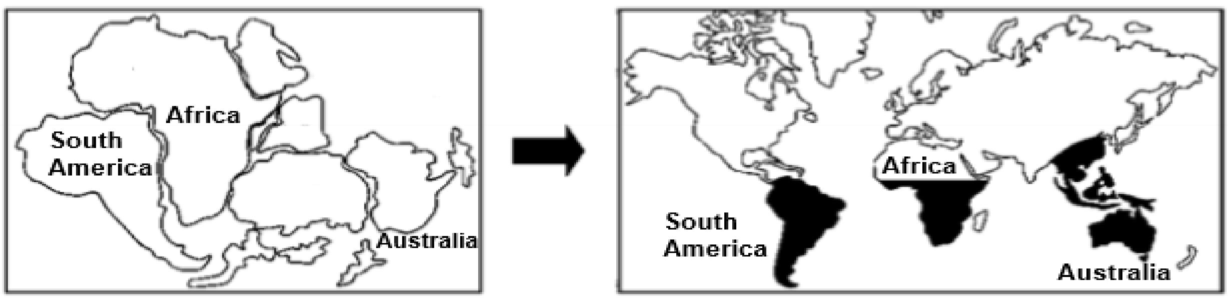
1.1.3 The principles of inheritance were first outlined by …

A Gregor Mendel.
B Charles Darwin.
C Robert Broom.
D Watson and Crick.

1.1.4 Which ONE of the following is an example of non-disjunction?

A Colour-blindness
B Gene mutations
C Down syndrome
D Haploid gametes

QUESTIONS 1.1.5 AND 1.1.6 ARE BASED ON THE DIAGRAM BELOW.



GONDWANALAND (125 MYA) PRESENT-DAY DISTRIBUTION OF PROTEACEAE

Shrubs of the family Proteaceae (for example waratahs and proteas) can be found in Australia, South America, Indo-China and parts of Africa.

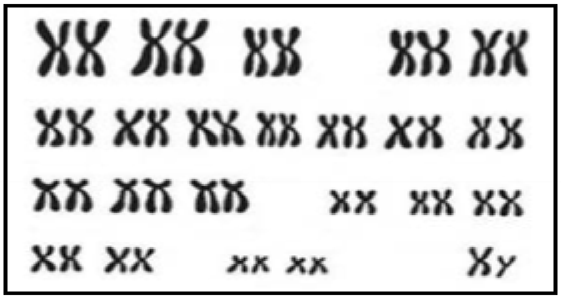
1.1.5 This type of evidence for evolution is called …

A the 'Out of Africa' hypothesis.
B fossil evidence.
C biogeography.
D cultural evidence.

1.1.6 It is evident from the diagram that all proteas …

A belong to the same species.
B are found in the Southern Hemisphere.
C became extinct when Gondwanaland separated.
D are equally distributed on all continents.

1.1.7 The diagram below shows the karyotype of an organism.



Study the following descriptions:

(i) There are 46 chromosomes.
(ii) There are 46 autosomes.
(iii) The 2 gonosomes are different from each other.
(iv) The 2 gonosomes are identical.

Which combination of descriptions can be used to identify this karyotype as belonging to a normal, human male?

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

QUESTIONS 1.1.8 AND 1.1.9 ARE BASED ON THE GENETIC CROSS BELOW.

Two rose plants with pink flowers were crossed and it was found that although most of the offspring had pink flowers, some had red and some had white flowers.

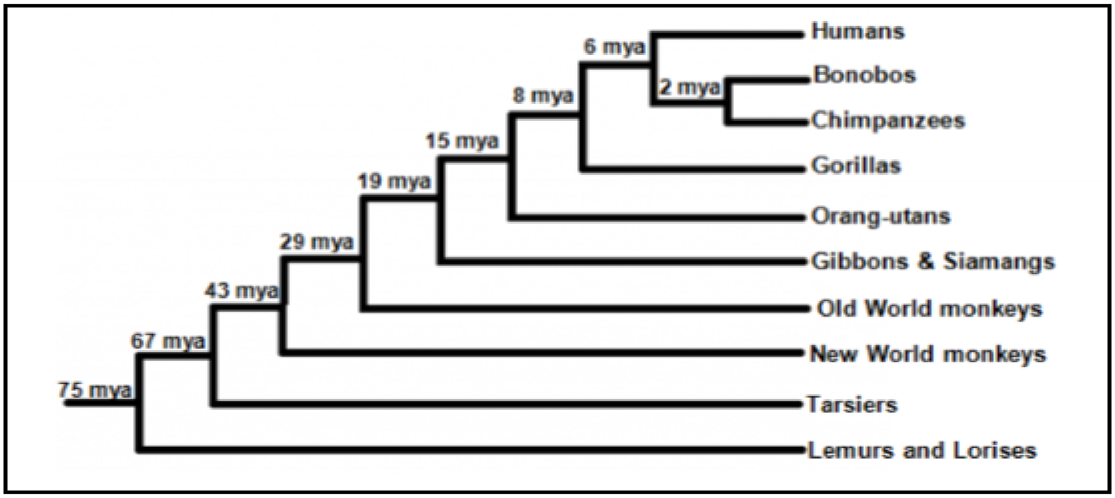
1.1.8 If 152 plants were produced in the F_1-generation, how many of these plants were expected to have pink flowers?

A 38
B 114
C 76
D 152

1.1.9 Breeders prefer to produce red roses. If the allele for red is **R** and the allele for white is **W**, which ONE of the following crosses would give the highest proportion of red roses?

A RR x WW
B RW x RW
C WW x RW
D RR x RW

1.1.10 The diagram below shows a phylogenetic tree of some primates.



According to the phylogenetic tree, the most recent common ancestor of ...

A humans and chimpanzees became extinct 2 million years ago.
B humans and gorillas became extinct 15 million years ago.
C humans and chimpanzees became extinct 6 million years ago.
D gorillas and chimpanzees became extinct 2 million years ago.

(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 1.2.8) in the ANSWER BOOK.

1.2.1 The position of a gene on a chromosome

1.2.2 The genus of the fossil 'Little Foot'

1.2.3 A diagram showing the inheritance of genetic disorders over many generations

1.2.4 The bond that forms between two amino acids

1.2.5 The phase in the cell cycle during which DNA replication occurs

1.2.6 The first *Homo* species to use tools

1.2.7 Undifferentiated cells that can develop into any cell type

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

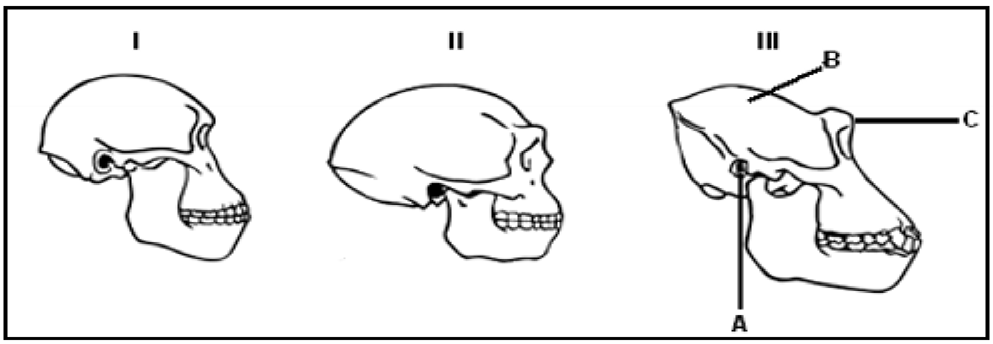
(8 x 1) **(8)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Proposed by Lamarck	A: 'Law' of use and disuse B: 'Law' of inheritance of acquired characteristics
1.3.2 Inheritance of haemophilia	A: Sex-linked inheritance B: Complete dominance
1.3.3 Results in genetic variation	A: Mitosis B: Cloning

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

1.4 The diagram below shows the skulls of three primate genera and is NOT drawn to scale.



1.4.1 Name parts **B** and **C** respectively. (2)

1.4.2 Name the type of teeth that is larger in genus **III** compared to that of genera **I** and **II**. (1)

1.4.3 Give only the NUMBER(S) (**I**, **II** or **III**) of the skull(s) that:

(a) Most likely belongs to a bipedal primate (2)

(b) Has the largest brain size (1)

(c) Is attached to a C-shaped vertebral column (1)

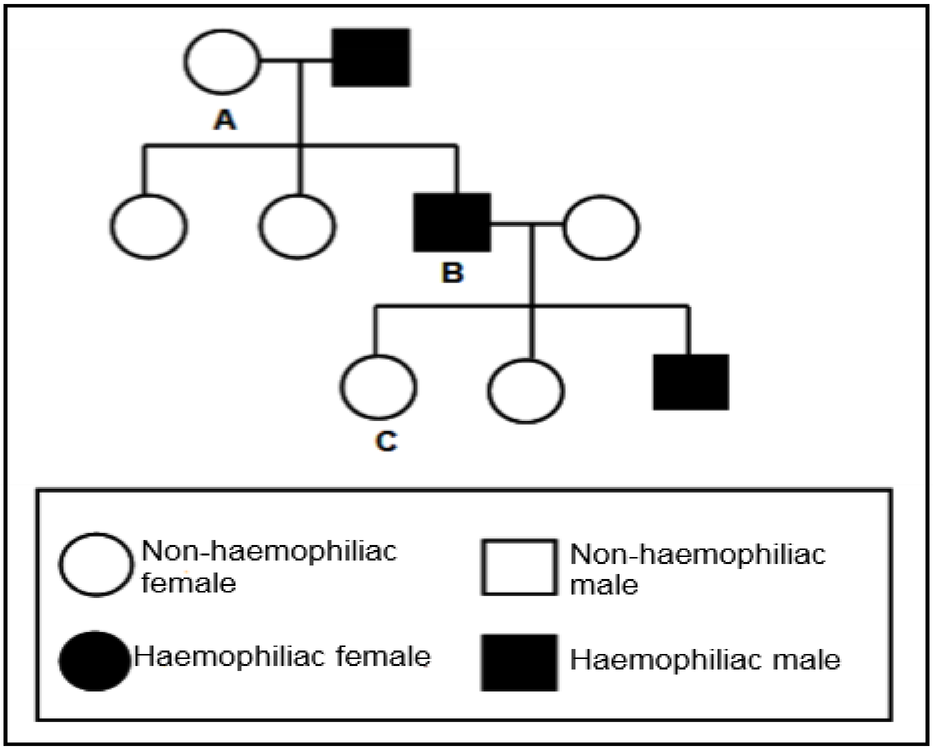
(d) Is most prognathous (1)

1.4.4 Give only the LETTER of the structure that is more pronounced in organism **III** than in organisms **I** and **II**. (1)

1.4.5 Give the correct sequence of the organisms (**I**, **II** and **III**), from most primitive to most evolved. (2)
(11)

1.5 Haemophilia is a genetic disorder resulting in the abnormal clotting of blood. It is caused by a recessive allele that is carried on the **X**-chromosome. The allele for normal clotting is $\mathbf{X^H}$ and the allele for haemophilia is $\mathbf{X^h}$.

The inheritance of haemophilia in a family is shown in the diagram below.



1.5.1 Give the percentage of the males with haemophilia in this family. (1)

1.5.2 Give the phenotype for individual **A**. (1)

1.5.3 Give the genotype for individual:

(a) **B** (1)

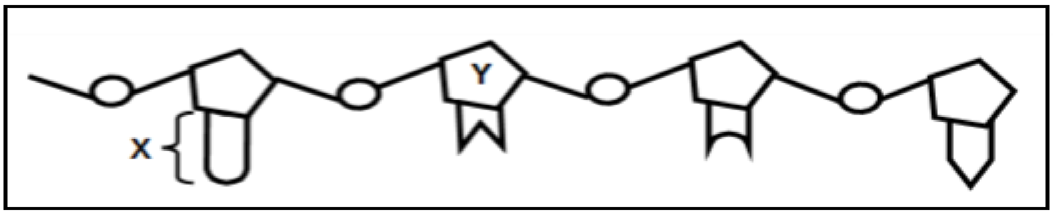
(b) **C** (2)
(5)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents a single-stranded nucleic acid found in the nucleus.



2.1.1 Identify the molecule represented in the diagram. (1)

2.1.2 Identify:

(a) Part **X** (1)

(b) Sugar **Y** (1)

2.1.3 Describe the process of *transcription*. (5)
(8)

2.2 Mutations result in genetic variation.

2.2.1 Give THREE other sources of genetic variation in a species. (3)

2.2.2 Differentiate between *continuous variation* and *discontinuous variation*. (2)
(5)

2.3 A species of bacteria contains a type of protein, called protein **1**. A mutation occurred which resulted in the formation of a second type of protein called protein **2**, instead of protein **1.**

Scientists determined the amino acid sequence of each protein. They then used the amino acid sequence to find the DNA base sequences that coded for portions of these proteins**.**

The results are shown in the tables below.

PORTION OF PROTEIN 1				
AMINO ACID SEQUENCE	Lysine	Serine	Proline	Cysteine
DNA BASE SEQUENCE	TTT	TCA	GGT	ACG

PORTION OF PROTEIN 2				
AMINO ACID SEQUENCE	Lysine	Serine	Proline	Tryptophan
DNA BASE SEQUENCE	TTT	TCA	GGT	ACC

2.3.1 Give the:

(a) DNA triplet for the third amino acid from the left in the sequence for protein **2** (1)

(b) Codon for lysine (1)

(c) Anticodon for serine (1)

2.3.2 Protein **1** is made up of 66 amino acids.

How many of EACH of the following is involved in the formation of this protein?

(a) Genes (1)

(b) RNA nucleotides (1)

(c) Codons (1)

2.3.3 Describe how the mutation caused a change in the structure of the protein. (4)
(10)

2.4 Study the extract and the information below.

> A species of the clover plant (*Trifolium repens)* developed a mutation that caused the poison, cyanide, to form in the plant's cells. This gives the clover a bitter taste to herbivores that feed on them. However, in a colder climate, some cells burst, releasing the cyanide into the plants' tissues, thereby killing the plants.

Scientists observed that there were more clover plants of this species in warmer areas than in colder areas. They formulated a hypothesis that more clover plants survive at higher temperatures.

They conducted the investigation on the survival of clover plants at different temperatures as follows:

- They placed 200 clover plants in a greenhouse with the temperature controlled at 5 °C and 200 clover plants in a greenhouse with the temperature controlled at 25 °C.
- They controlled all other variables.
- They allowed a period of time for the plants to grow and counted the number of clover plants that survived in each greenhouse.
- Then they calculated the percentage survival of clover plants.

The results of the investigation are shown in the table below.

TEMPERATURE	PERCENTAGE SURVIVAL OF CLOVER PLANTS
5 °C	13
25 °C	72

2.4.1 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

2.4.2 State TWO ways in which the scientists could have improved the reliability of the investigation. (2)

2.4.3 Describe how the scientists calculated the percentage survival of clover. (2)

2.4.4 Explain if the hypothesis will be accepted or rejected. (3)

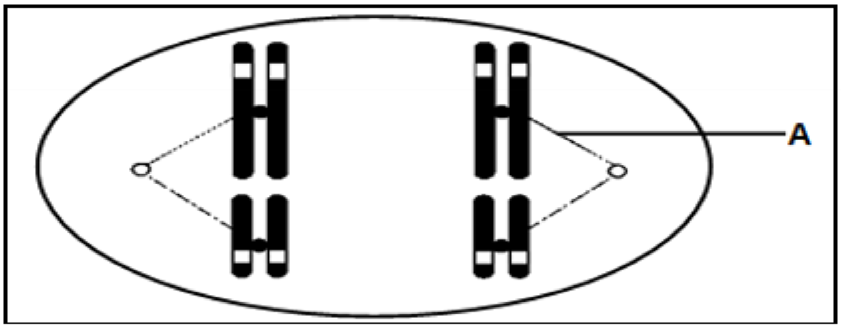
2.4.5 Based on information in the passage, apart from temperature, explain ONE other way in which the survival rate of clover plants is increased. (2)

2.4.6 Refer to Darwin's theory of natural selection and explain how the mutation affected the survival of the clover plants at lower temperatures. (6)

(17)
[40]

QUESTION 3

3.1 The diagram below shows the arrangement of two pairs of homologous chromosomes in a cell undergoing meiosis.



3.1.1 State TWO characteristics of homologous chromosomes. (2)

3.1.2 Identify structure **A**. (1)

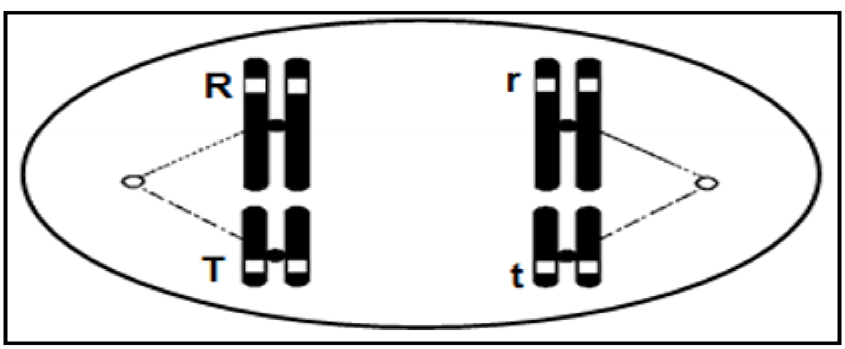
3.1.3 How many of EACH of the following is present in the diagram?

(a) Chromatids (1)

(b) Centromeres (1)

3.1.4 Draw a labelled diagram to show ONE of the cells that would be formed at the end of telophase **I**. (6)

3.1.5 The diagram below shows some of the alleles during the formation of gametes.



Give the genotype of the:

(a) Individual represented in the diagram (1)

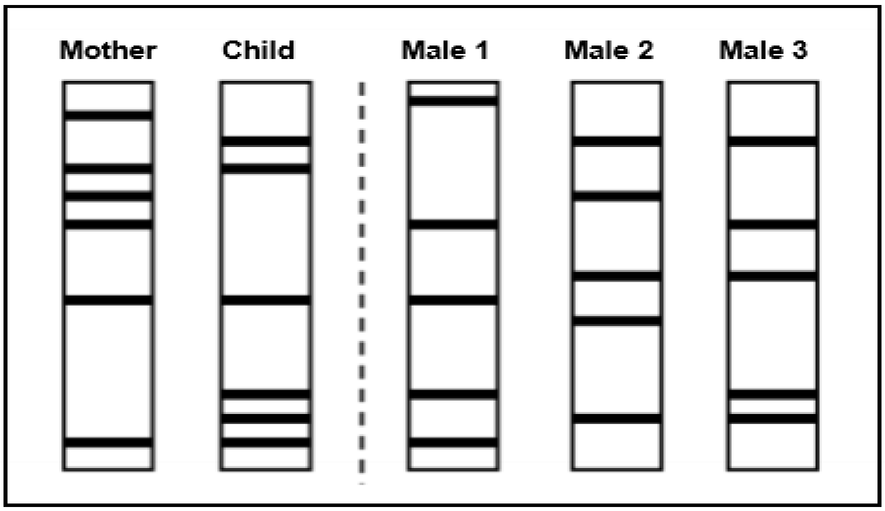
(b) Possible gametes resulting from the arrangement of alleles represented in the diagram (2)

(14)

3.2 A man has blood type **AB** and his sister has blood type **O**.

Determine the genotypes and phenotypes of their parents by doing a genetic cross. **(6)**

3.3 The diagram below shows a technique used in paternity testing.



3.3.1 Identify the technique shown above. (1)

3.3.2 Which male is the biological father of the child? (1)

3.3.3 Explain your answer to QUESTION 3.3.2. (3)

3.3.4 State TWO other uses of this technique. (2)
(7)

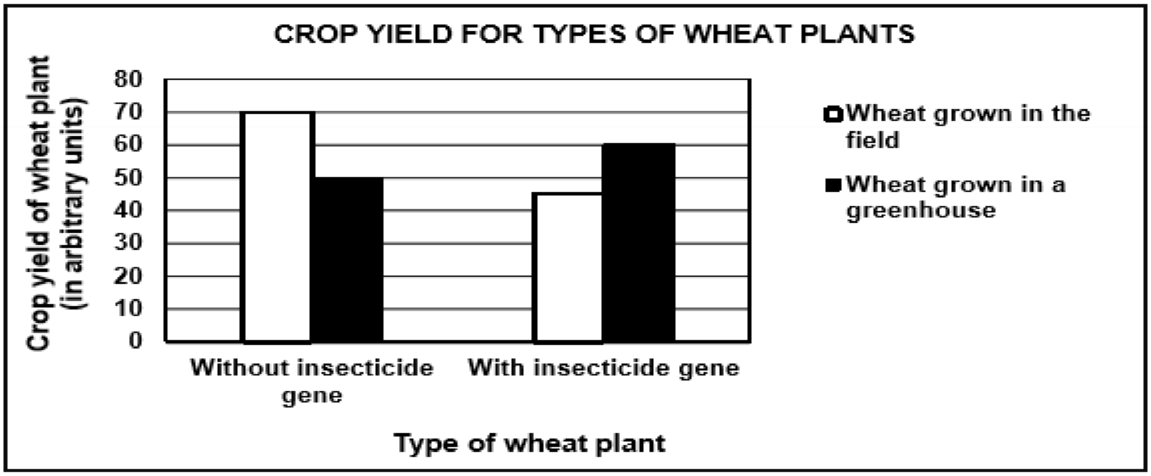
3.4 Farmers use insecticides to kill insects that damage their crops. In this way they are able to increase their crop yield.

They found a bacterium which contains a gene that produces insecticides. Scientists transferred the insecticide gene to wheat plants and wanted to investigate the effectiveness of this process in increasing crop yield.

Below are some of the steps they followed.

- Wheat plants with the insecticide gene were grown in a field and in a greenhouse.
- Wheat plants without the insecticide gene were grown in a field and in a greenhouse.
- The crop yield of the wheat plants was measured.

The results are shown in the graph below.



3.4.1 What is the process called where wheat plants are altered by the insertion of genes? (1)

3.4.2 Insecticides are expensive and add to the cost of produce.

State ONE other disadvantage of using insecticides. (1)

3.4.3 State TWO ways in which scientists could have improved the validity of this investigation. (2)

3.4.4 What was the crop yield, in arbitrary units, of wheat plants without the insecticide gene grown in a greenhouse? (1)

3.4.5 Calculate the difference in yield between the wheat with the insecticide gene and the wheat without the insecticide gene grown in the field. Show ALL working. (2)

3.4.6 Describe the difference in results for the wheat with the insecticide gene grown in a greenhouse and the wheat grown in a field. (2)

3.4.7 Suggest ONE possible reason for the difference described in QUESTION 3.4.6. (2)

3.4.8 Give TWO possible reasons why farmers may be against the use of these insecticide-producing plants. (2)
(13)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Differentiate between a *population* and a *species*, describe speciation by geographic isolation and explain how speciation and extinction affect biodiversity.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2017

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 11 pages.

SECTION A

QUESTION 1

1.1	1.1.1	A✓✓		
	1.1.2	B✓✓		
	1.1.3	A✓✓		
	1.1.4	C✓✓		
	1.1.5	C✓✓		
	1.1.6	NO CORRECT ANSWER		
	1.1.7	D✓✓		
	1.1.8	C✓✓		
	1.1.9	D✓✓		
	1.1.10	C✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Locus✓		
	1.2.2	*Australopithecus*✓		
	1.2.3	Pedigree✓ diagram		
	1.2.4	Peptide✓ bond		
	1.2.5	Interphase✓		
	1.2.6	*(Homo) habilis*✓		
	1.2.7	Stem✓/ meristematic cells		
	1.2.8	Artificial selection✓/selective breeding	(8 x 1)	**(8)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	None✓✓	(3 x 2)	**(6)**
1.4	1.4.1	B- Cranium ✓ C- Brow ridge✓		(2)
	1.4.2	Canine✓		(1)
	1.4.3	(a) I✓ ; II✓	**(Mark first TWO only)**	(2)
		(b) II✓	**(Mark first ONE only)**	(1)
		(c) III✓	**(Mark first ONE only)**	(1)
		(d) III✓	**(Mark first ONE only)**	(1)
	1.4.4	C✓		(1)
	1.4.5	III → I → II✓✓		(2) **(11)**
1.5	1.5.1	100✓%		(1)
	1.5.2	Non-haemophiliac female ✓/Normal female		(1)
	1.5.3	(a) X^hY ✓		(1)
		(b) $X^H X^h$ ✓✓		(2) **(5)**

TOTAL SECTION A: 50

QUESTION 2

2.1	2.1.1	mRNA✓/messenger RNA		(1)
	2.1.2	(a) Nitrogenous base✓		(1)
		(b) Ribose✓		(1)
	2.1.3	- The double stranded DNA molecule unwinds✓ - and unzips✓/separates - when the hydrogen bonds break ✓ - One strand is used as a template✓ - to form mRNA✓ - using free RNA nucleotides✓ from the nucleoplasm - The mRNA is complementary to the DNA✓/A-U, C-G - This process is controlled by enzymes✓	Any 5	(5) **(8)**
2.2	2.2.1	- Crossing over✓ - Random arrangement of chromosomes✓/ Independent/random assortment of chromosomes } OR meiosis✓ - Random fertilisation✓ - Random mating✓ **(Mark first THREE only)**	Any 3	(3)
	2.2.2	- Continuous variation occurs when there is a range of phenotypes for the same characteristic✓/has intermediate forms, - whereas discontinuous variation occurs when phenotypes fit into separate or distinct categories✓/with no intermediate forms		(2) **(5)**
2.3	2.3.1	(a) GGT✓		(1)
		(b) AAA✓		(1)
		(c) UCA✓		(1)
	2.3.2	(a) 1✓		(1)
		(b) 198✓		(1)
		(c) 66✓		(1)
	2.3.3	- One of the base triplets on the DNA has changed✓ - from ACG to ACC✓ - The triplet ACG codes for the amino acid cysteine✓ - while the triplet ACC codes for the amino acid tryptophan✓ - resulting in a change in the sequence of amino acids✓	Any 4	(4) **(10)**

2.4 2.4.1 (a) Temperature✓ (1)
(b) Number of clover plants that survived✓/percentage survival (1)

2.4.2
- Repeat the investigation✓
- Set up more greenhouses✓ at each temperature
- Use a larger sample of clover plants✓
- Increase the period of the investigation✓ Any 2 (2)

(Mark first TWO only)

2.4.3 They counted the number of clover plants that survived and divided it by the original number✓/200
then multiplied it by 100✓ (2)

2.4.4
- The hypothesis will be accepted✓
- because there are more✓ clover plants/higher percentage survival
- at the higher temperature✓

OR

- The hypothesis will be accepted✓
- because there are fewer✓ clover plants/ lower percentage survival
- at the lower temperature✓ (3)

2.4.5
- The bitter taste✓of the cyanide in the clover plants
- prevents herbivores/predators✓ from feeding on them (2)

2.4.6
- The mutation caused variation✓ amongst the clover plants
- Some produce cyanide✓ and
- others do not produce cyanide✓
- The cyanide-producing plants are killed at lower temperatures✓
- The non-cyanide-producing plants survive at the lower temperatures✓ and reproduce
- The allele for cyanide production is not passed on to the next generation✓
- decreasing the number of cyanide producing clover plants✓ in the next generation Any 6 (6)

(17)
[40]

QUESTION 3

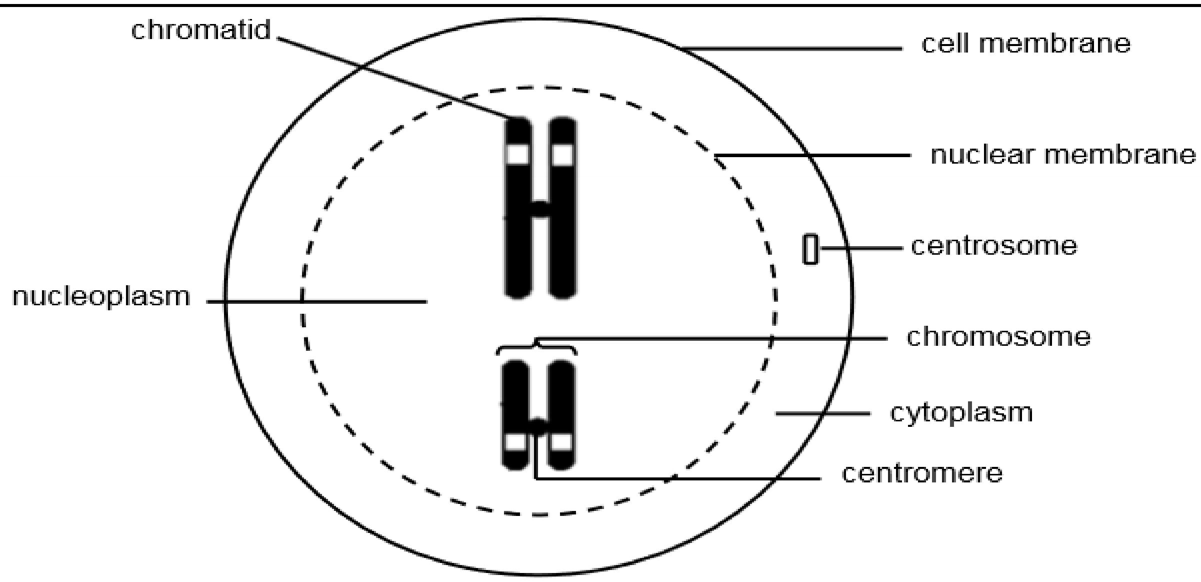
3.1 3.1.1 - A pair of chromosomes that are similar in length✓
- Carry genes for the same characteristics✓
- Have alleles at the same loci✓
- Have the same centromere position✓
- One is obtained from each parent✓ Any 2 (2)

(Mark first TWO only)

3.1.2 Spindle fibre✓ (1)

3.1.3 (a) 8✓ (1)
(b) 4✓ (1)

3.1.4



Telophase I

Criteria to mark diagram

Single cell is drawn (S)	1
Only 2 replicated chromosomes in drawing (T)	1
One replicated chromosome longer than the other (L)	1
Caption	1
Any TWO correct labels	2

(6)

3.1.5 (a) RrTt✓ (1)

(b) RT, rt✓✓ (2)

(14)

3.2

P_1	Phenotype	Blood type A	x	Blood type B✓*
	Genotype	I^Ai	x	I^Bi✓*
Meiosis				
	G/gametes	I^A, i	x	I^B, i ✓
Fertilisation				
F_1	Genotype	I^AI^B; $I^A i$;		I^Bi ii✓
	Phenotype	Blood type AB		Blood type O ✓

P_1 and F_1✓
Meiosis and fertilisation✓

OR

P_1	Phenotype	Blood type A	x	Blood type B✓*
	Genotype	I^Ai	x	I^Bi✓*

Meiosis

Fertilisation

Gametes	I^A	i
I^B	I^AI^B	I^Bi
i	$I^A i$	ii

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype Blood type AB and Blood type O ✓

P_1 and
F_1✓
Meiosis and fertilisation✓ **(6)**

*compulsory 2 + any 4

3.3 3.3.1 DNA profiling✓ (DNA fingerprinting) (1)

3.3.2 Male 3✓ (1)

3.3.3
- The bands of the child's DNA is a combination of the DNA from each parent ✓
- Three bands are identical to that of the mother✓
- The remaining (three) bands correspond with that of male 3✓ (3)

3.3.4
- To investigate crimes✓/resolve disputes
- To identify organisms from their remains✓
- To identify missing persons✓
- To identify family relationships other than paternity✓ e.g. siblings or cousins
- To test for the presence of specific alleles✓/genes that cause a genetic disorder
- To establish matching tissues for organ transplants✓ Any 2 (2)

(Mark first TWO only) **(7)**

3.4	3.4.1	Genetic engineering✓/modification/manipulation/recombinant DNA technology		(1)
	3.4.2	- Can kill other useful insects✓ - Can cause pollution✓ - May cause harm to consumers of the produce✓ - Development of insecticide-resistant organisms✓ **(Mark first ONE only)**	Any 1	(1)
	3.4.3	- Use the same field✓/greenhouse - Use the same number of plants✓ - Use the same species of wheat✓ - Measure the crop yield over the same period✓ - Use same techniques of measuring the crop yield✓ **(Mark first TWO only)**	Any 2	(2)
	3.4.4	50✓		(1)
	3.4.5	Difference in yield: (70 – 45)✓ = 25✓		(2)
	3.4.6	- In the greenhouses high yield✓ - In the fields low yield✓		(2)
	3.4.7	- The conditions in the greenhouse can be controlled ✓ - whereas there are many variations in the conditions for wheat grown in fields✓ OR The environmental conditions✓/ (examples) in the greenhouse may have differed✓from that in the field		(2)
	3.4.8	- Expensive✓/research money could be used for other needs - Potential health impacts✓ - Interfering with nature✓ - Not sure of long-term effects✓ - Did not increase the yield✓ **(Mark first TWO only)**	Any 2	(2)
				(13) **[40]**

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Differences
- A species is a group of organisms with similar characteristics ✓^{D}
- that are able to interbreed ✓^{D}
- to produce fertile offspring ✓^{D}
- A population is a group of organisms of the same species ✓^{D}
- found in the same habitat ✓^{D}
- at the same time ✓^{D}

Speciation by geographic isolation
- A population of organisms becomes split ✓^{S}
- by a geographical barrier ✓^{S}/example of a geographical barrier.
- The two populations cannot interbreed ✓^{S}/there is no gene flow between the two.
- Natural selection occurs independently ✓^{S} in each population.
- Due to different environmental conditions ✓^{S} on either side of the barrier,
- the two populations become genotypically and phenotypically✓^{S}
- different ✓^{S} from each other.
- Even if the geographical barrier is removed, the individuals will not be able to interbreed ✓^{S}
- We say that the original population has now become two separate species✓^{S}

Effect of speciation and extinction on biodiversity
- Since there is an increase in the number of species ✓^{B}
- speciation increases ✓^{B} biodiversity
- Extinction results in the loss of the number of species ✓^{B}
- therefore results in a decrease ✓^{B} in biodiversity

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

Criterion	**Relevance (R)**	**Logical sequence (L)**	**Comprehensive (C)**
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the differences between population and species; the description of speciation and effect of speciation and extinction on biodiversity is given	All the information regarding the differences between population and species, the description of speciation and the effect of speciation and extinction on biodiversity is given in a logical manner	At least: - **4** correct points for the differences, - **5** for the description of speciation and - **2** for effects of speciation and extinction on biodiversity
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2018

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

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 numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, e.g. 1.1.10 D.

1.1.1 Which ONE of the following is a mechanism of reproductive isolation?

A Extinction
B Breeding at different times of the year
C Mutation
D Independent assortment

1.1.2 Who formulated the law of use and disuse?

A Lee Berger
B Rosalind Franklin
C Gregor Mendel
D Jean Baptiste de Lamarck

1.1.3 Which ONE of the following features is found in BOTH humans and African apes?

A Short upper arms
B Claws instead of nails
C Opposable thumbs
D Small brain

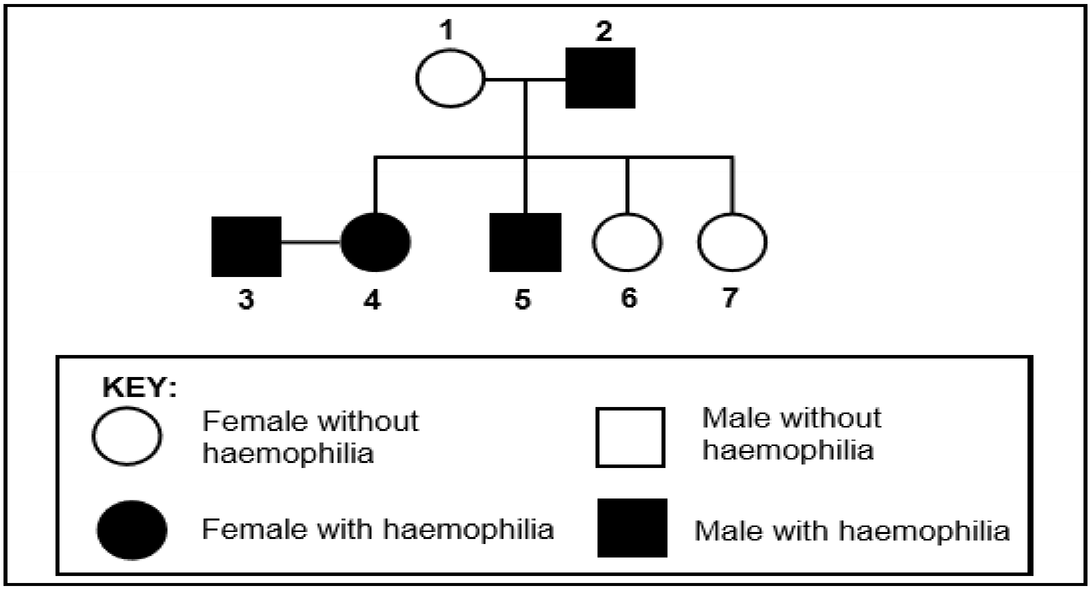
1.1.4 Scientists made an observation that some species of butterfly are more numerous during wet summers than dry summers. In order to investigate this, the next step would be to …

A record the results.
B state a hypothesis.
C measure the results.
D draw a conclusion.

1.1.5 Which ONE of the following is the CORRECT definition of a species? A group of …

A similar organisms that live in the same habitat at the same time
B similar organisms that have the same chromosome number
C organisms that are similar in size, shape and colour
D similar organisms that are able to interbreed to produce fertile offspring

QUESTIONS 1.1.6 AND 1.1.7 REFER TO THE DIAGRAM BELOW SHOWING THE INHERITANCE OF HAEMOPHILIA IN A FAMILY.



1.1.6 Which ONE of the combinations in the table below is CORRECT for BOTH individuals **1** and **5**?

	PHENOTYPE OF INDIVIDUAL 1	GENOTYPE OF INDIVIDUAL 5
A	Female without haemophilia	X^hX^h
B	Female without haemophilia	X^hY
C	Female with haemophilia	X^HX^h
D	Female without haemophilia	X^HY

1.1.7 What is the percentage chance that individuals **3** and **4** would have a child with haemophilia?

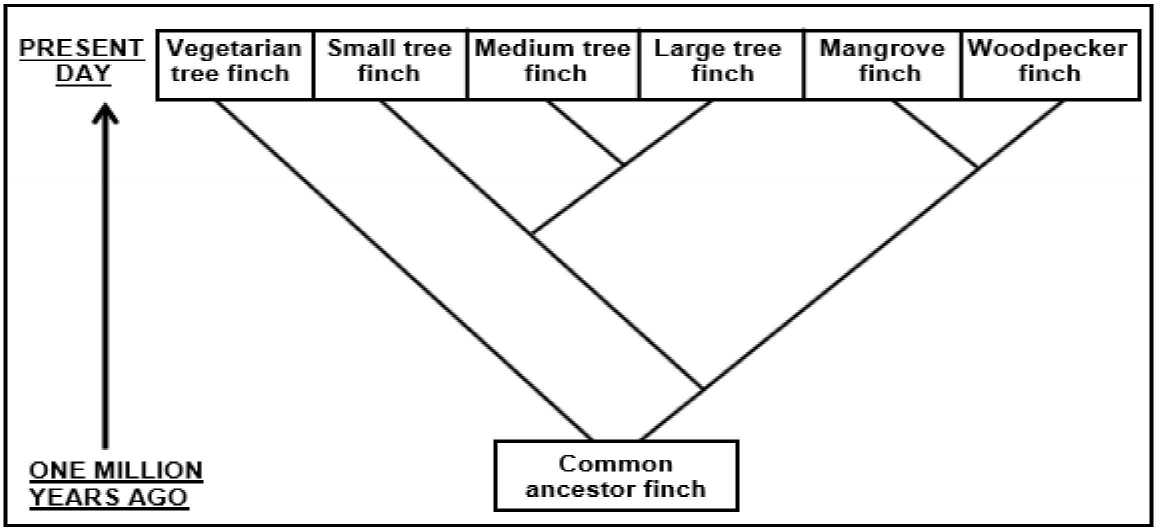
A 100%
B 75%
C 25%
D 0%

1.1.8 A dye stains a particular type of nucleic acid red. When this dye was used to identify which organelles in a cell contain this nucleic acid, only the nucleus and ribosomes stained red.

This result shows that the dye stains structures that contain …

A DNA.
B RNA.
C DNA and protein.
D both DNA and RNA.

1.1.9 Study the diagram below.



Which present-day finch is LEAST related to all the others?

A Woodpecker finch
B Large tree finch
C Mangrove finch
D Vegetarian tree finch (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 A diagrammatic representation of possible evolutionary relationships amongst species

1.2.2 The splitting of the cytoplasm during cell division

1.2.3 The process whereby DNA makes an exact copy of itself

1.2.4 A type of variation where there is a range of phenotypes for the same characteristic

1.2.5 The present-day distribution of living organisms

1.2.6 The failure of chromosome pairs to separate during meiosis

1.2.7 Similar structures in different species that show modification by descent

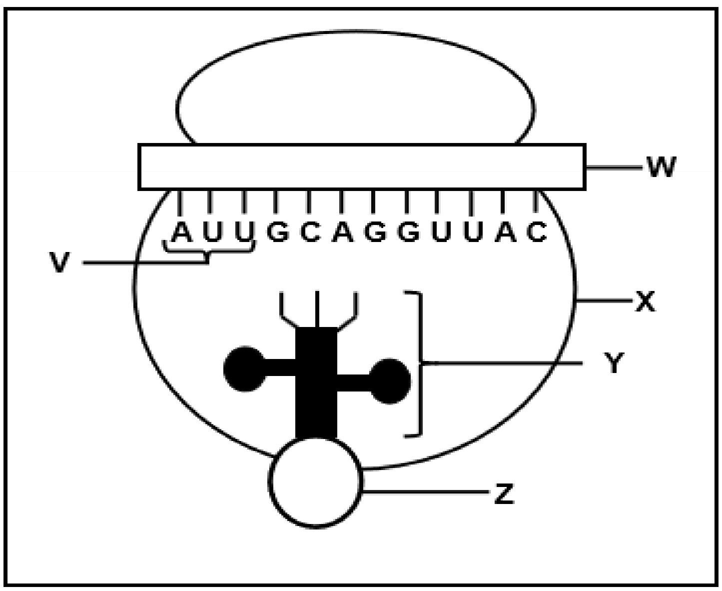
1.2.8 An individual having two non-identical alleles for a characteristic (8 x 1) **(8)**

1.3 Indicate whether each of the descriptions in COLUMN I apply 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	Law of inheritance of acquired characteristics	A: Darwinism B: Modification by descent
1.3.2	Humans select the characteristics when breeding organisms	A: Artificial selection B: Natural selection
1.3.3	A testable statement that may be accepted or rejected	A: Theory B: Law

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

1.4 The diagram below represents the process of translation.



1.4.1 Name:

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

(b) Molecules **W** and **Y** (2)

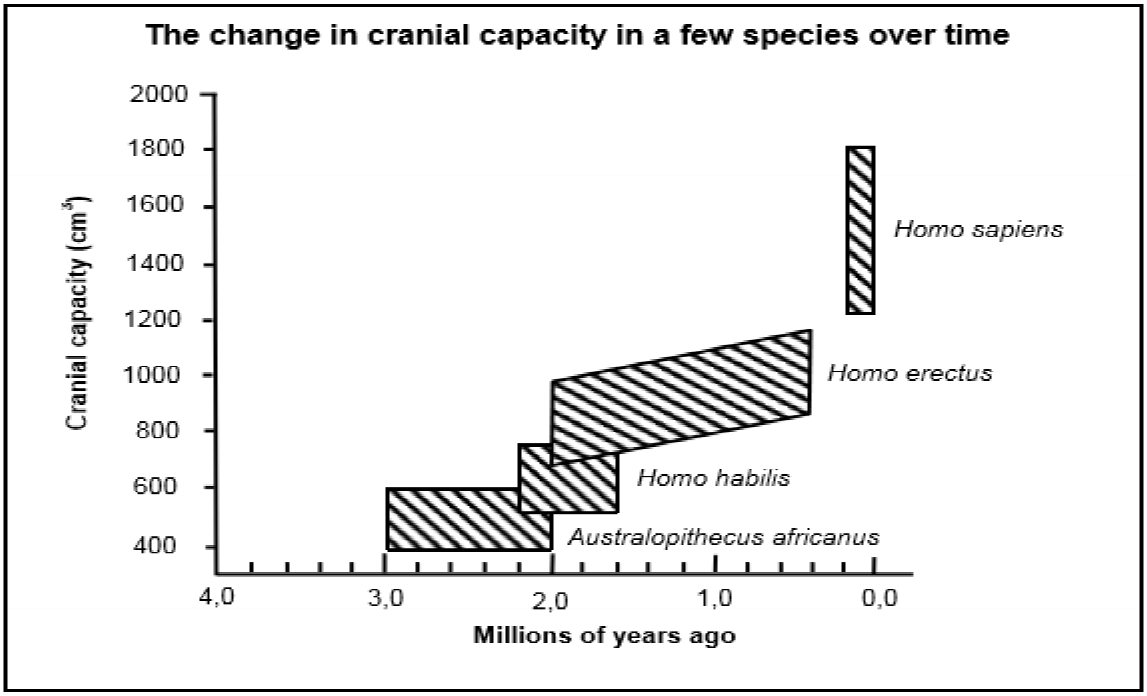
(c) The monomer of molecule **W** (1)

1.4.2 Where in the cell is:

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

(b) Molecule **W** formed (1)
(6)

1.5 Study the graph below.



1.5.1 Name the family to which all these species belong. (1)

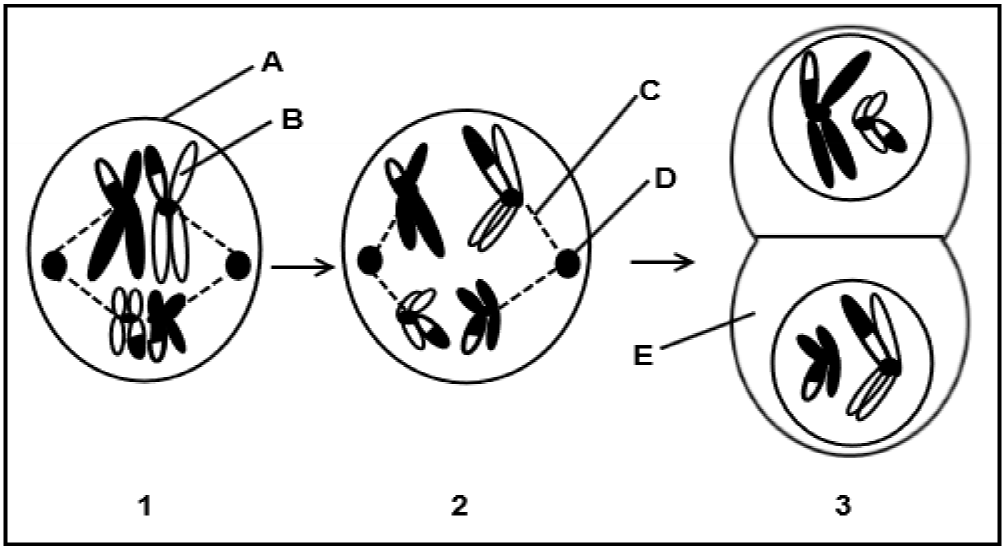
1.5.2 What is the largest cranial capacity (in cm^3) of *Australopithecus africanus*? (1)

1.5.3 When did *Homo habilis* become extinct? (1)

1.5.4 Name TWO *Australopithecus* fossils found in South Africa. (2)

1.5.5 Which of the organisms represented above has the greatest range in cranial capacity? (1)
(6)

1.6 Diagrams **1** to **3** below represent some of the phases of meiosis shown in the correct order.



1.6.1 Identify the phase represented by diagram:

(a) **1** (1)

(b) **3** (1)

1.6.2 Give the LETTER only of the part that:

(a) Contains DNA (1)

(b) Attaches to the centromeres of chromosomes (1)

(c) Forms the spindle fibres (1)

1.6.3 Name the organ in a human male where meiosis occurs. (1)
(6)

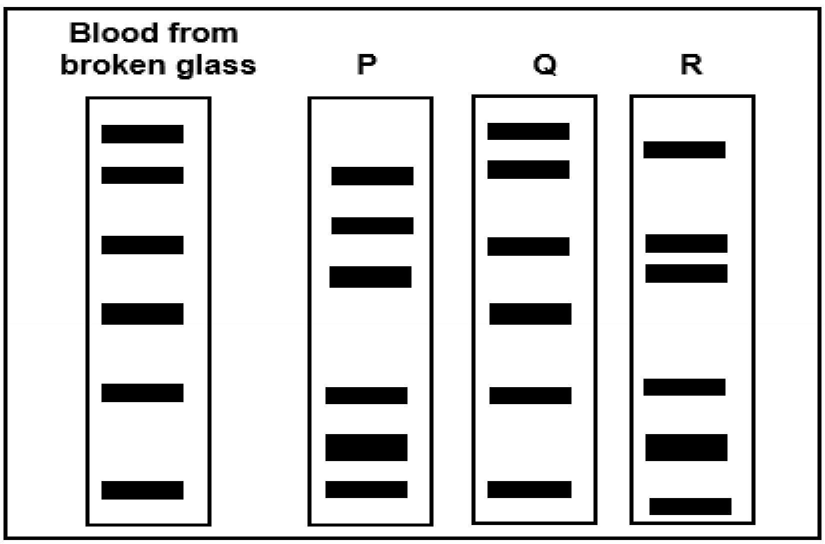
TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 When a thief broke into a car he cut his arm on the broken glass. Scientists extracted DNA from the blood found on the broken glass. They analysed this DNA sample and compared it to the DNA from three suspects, **P**, **Q** and **R**.

The table below shows the results of the analysis for the DNA from each source.



2.1.1 What do the diagrams above represent? (1)

2.1.2 Which suspect is most likely the thief? (1)

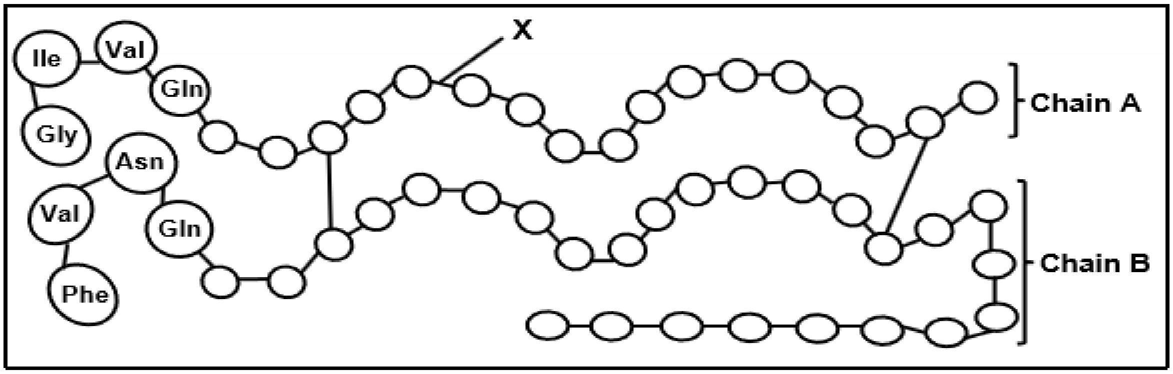
2.1.3 Give a reason for your answer to QUESTION 2.1.2. (1)

2.1.4 State TWO possible disadvantages of using this evidence in a court of law. (2)

(5)

2.2 Insulin is one of the hormones responsible for the control of blood glucose levels in humans. It is made up of two long amino acid chains, **A** and **B**, which are joined. Chain **A** is made up of 21 amino acids and chain **B** of 30 amino acids.

The diagram below represents the amino acids present in each chain.



2.2.1 Name the process whereby insulin is produced in a normal human cell. (1)

2.2.2 Identify bond **X**. (1)

2.2.3 How many nitrogenous bases in a DNA molecule code for the amino acids in chain **A**? (1)

2.2.4 The table below shows the mRNA codons that code for some amino acids.

mRNA CODON	AMINO ACID
UUC	Phenylalanine (Phe)
AUC	Isoleucine (Ile)
AAU	Asparagine (Asn)
GAA	Glutamic acid (Glu)
GUA	Valine (Val)
CAG	Glutamine (Gln)
CAU	Histidine (His)
GGA	Glycine (Gly)

(a) Name the nitrogenous base represented by **G** in the mRNA codon CAG. (1)

(b) Read the chains from left to right and give the:

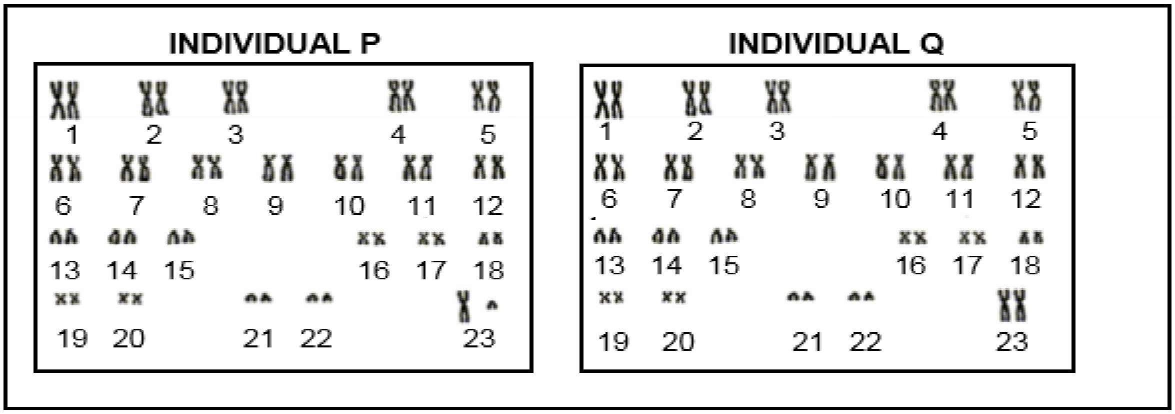
(i) Codon for the fourth amino acid in chain **B** (1)

(ii) DNA base triplet that codes for the first amino acid in chain **A** (1)

(c) Give the anticodon for **valine**. (1)
(7)

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

2.4 The diagram below shows the karyotypes of two individuals.



2.4.1 What term is given to the chromosomes numbered:

(a) **1** to **22** (1)

(b) **23** (1)

2.4.2 State the gender of individual **P**. (1)

2.4.3 Give ONE observable reason for your answer to QUESTION 2.4.2. (2)

2.4.4 Each of the pairs shown is a homologous pair of chromosomes.

State the origin of each chromosome in a homologous pair of chromosomes. (2)
(7)

2.5 Lindiwe has two sons and she is now pregnant for the third time.

Use a genetic cross to show the percentage chance that this child could be a boy. **(6)**

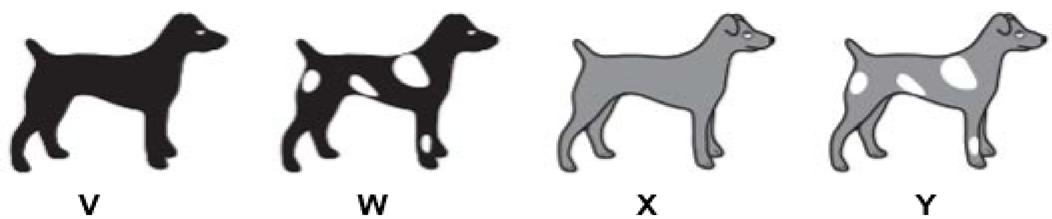
2.6 In dogs, coat appearance is controlled by two genes; one for coat colour and one for coat pattern (presence or absence of white patches).

The alleles for each characteristic are shown in the table below.

CHARACTERISTIC	ALLELES	
Coat colour	Black **(B)**	Grey **(b)**
Coat pattern	Without white patches **(T)**	With white patches **(t)**

In a cross between two dogs, the four offspring, **V**, **W**, **X** and **Y**, had the phenotypes as shown in the diagram below.

Phenotypes of the F_1 generation



2.6.1 What is the term given to a genetic cross involving two characteristics? (1)

2.6.2 Give the phenotype of:

(a) The dominant coat colour (1)

(b) Dog **V** (1)

(c) A dog that is homozygous recessive for both characteristics (1)

2.6.3 Explain why all dogs with the phenotype of dog **W** may not have the same genotype. (2)

2.6.4 The two characteristics are inherited in accordance with Mendel's principle of independent assortment.

State this principle. (3)
(9)
[40]

QUESTION 3

3.1 Read the extract below.

> Stem cell surgery has been performed for the first time in South Africa at a Cape Town hospital. A patient became paralysed in a diving accident. He had no movement or feeling in any of his limbs because his nerve cells were damaged. Embryonic stem cells were used in an attempt to correct a defect in the spinal cord of the patient. He has now developed partial sensation throughout the body.

3.1.1 Explain why stem cells are suitable cells to use for the treatment of this patient. (3)

3.1.2 Explain why some people prefer the use of umbilical cords as a source of stem cells rather than the use of human embryos. (2)
(5)

3.2 A baby was kidnapped from a hospital immediately after she was born. Fifteen years later it was discovered that Mr and Mrs Thomas, who were raising her, were not her biological parents. Mr and Mrs George, whose baby was born around the same time, claimed that she was their child.

The blood groups of both families are shown in the table below.

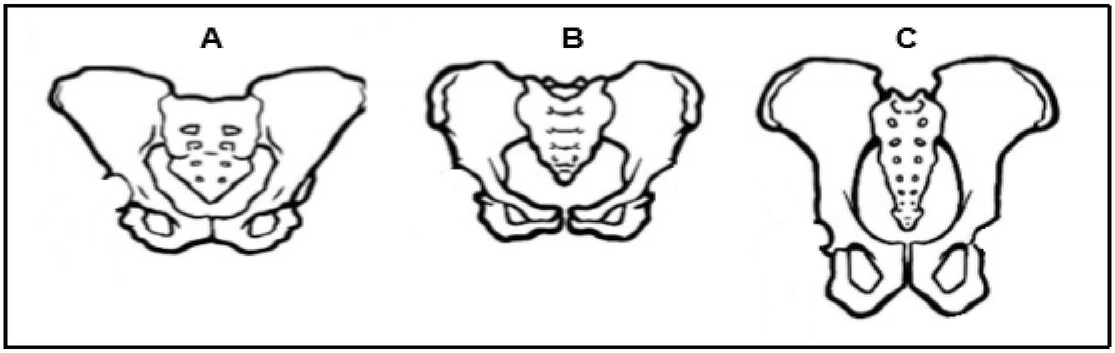
INDIVIDUAL	BLOOD GROUPS
Child	O
Mr Thomas	O
Mrs Thomas	AB
Mr George	B
Mrs George	A

3.2.1 How many genes control the inheritance of blood groups? (1)

3.2.2 Name the individual whose blood group shows co-dominance. (1)

3.2.3 Explain why Mr and Mrs George could possibly be the parents of this child. (3)
(5)

3.3 In a study to establish the mode of locomotion of some species, scientists compared the pelvic structure of their fossils. They established that two of these species had the ability to walk upright permanently. The diagrams (**A**, **B** and **C**) below show the pelvic structure of three species, drawn to scale.



3.3.1 What term is used to describe organisms that are able to walk upright permanently? (1)

3.3.2 Which TWO diagrams above represent the pelvis of the organisms in QUESTION 3.3.1? (2)

3.3.3 Explain your answer to QUESTION 3.3.2. (2)

3.3.4 State ONE feature of the spine of the organism represented by **C**. (1)
(6)

3.4 Tabulate THREE differences between the skulls of humans and African apes. **(7)**

3.5 Read the extract below.

Brine shrimp are small arthropods found in saltwater lakes. During favourable conditions female shrimps produce eggs that hatch into live young. However, when conditions are unfavourable, the shrimp produce cysts. Each cyst contains the embryo covered with a hard, protective covering. In this state the embryo stops growing and is said to be dormant. The embryo can remain in this dormant state for many years and the cyst will only hatch at the optimum salt concentration.

Scientists wanted to investigate which salt concentration resulted in the highest percentage of hatched cysts.

They did the following:

- Prepared salt solutions of different concentrations: 0%, 0,5%, 1%, 1,5% and 2%
- Placed 30 mℓ of each solution into one of five beakers
- Took samples of brine shrimp cysts using a dropper
- Counted the number of cysts in each sample
- Recorded this as the initial number of cysts
- Placed the samples into each of the five beakers
- Left the beakers at room temperature for 48 hours
- Recorded the number of cysts that hatched in each beaker
- Calculated the percentage of cysts that hatched

The results are shown in the table below.

SALT CONCENTRATION (%)	NUMBER OF CYSTS USED AT THE START	NUMBER OF CYSTS THAT HATCHED	PERCENTAGE OF CYSTS THAT HATCHED
0	54	0	0
0,5	34	2	6
1	40	6	15
1,5	40	1	2,5
2	53	1	**X**

3.5.1 State TWO planning steps to consider before collecting the samples. (2)

3.5.2 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

3.5.3 Calculate the value of **X** in the table. Show ALL working. (3)

3.5.4 State THREE factors that were kept constant in order to ensure the validity of this investigation. (3)

3.5.5 Which salt concentration resulted in the highest percentage of hatched cysts? (1)

3.5.6 Use the theory of evolution through natural selection to explain how the ability to produce cysts led to the survival of the brine shrimp. (6)
(17)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

There was variation in neck length in a population of Galapagos tortoises. The original population from the mainland was separated onto two islands with different environmental conditions. Many years later it was established that speciation of the tortoises had occurred.

Describe how mutations and meiosis lead to variation within a population and the role of variation in the speciation of the tortoises.

Content: (17)
Synthesis: (3)

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2018

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 10 pages.

SECTION A

QUESTION 1

1.1	1.1.1	B✓✓		
	1.1.2	D✓✓		
	1.1.3	C✓✓		
	1.1.4	B✓✓		
	1.1.5	D✓✓		
	1.1.6	B✓✓		
	1.1.7	A✓✓		
	1.1.8	B✓✓		
	1.1.9	D✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Phylogenetic tree✓/cladogram		
	1.2.2	Cytokinesis✓		
	1.2.3	(DNA) Replication✓		
	1.2.4	Continuous✓variation		
	1.2.5	Biogeography✓		
	1.2.6	Non-disjunction✓		
	1.2.7	Homologous✓ structures		
	1.2.8	Heterozygous✓	(8 x 1)	**(8)**
1.3	1.3.1	None✓✓		
	1.3.2	A only✓✓		
	1.3.3	None✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Ribosome✓		(1)
		(b) W – mRNA✓ Y – tRNA✓		(2)
		(c) Nucleotide ✓		(1)
	1.4.2	(a) Cytoplasm✓/endoplasmic reticulum		(1)
		(b) Nucleus✓ /nucleoplasm		(1)
				(6)
1.5	1.5.1	Hominidae✓		(1)
	1.5.2	600✓ cm^3		(1)
	1.5.3	1,6 million years ago✓/mya		(1)
	1.5.4	Taung child✓/ } *A.africanus* Mrs Ples✓/ } Karabo✓/*A.sediba* Little foot✓/*A.prometheus* **(Mark first TWO only)**	Any 2	(2)
	1.5.5	*Homo sapiens*✓		(1)
				(6)

1.6	1.6.1	(a) Metaphase I✓	(1)
		(b) Telophase I✓	(1)
	1.6.2	(a) B✓	(1)
		(b) C✓	(1)
		(c) D✓	(1)
	1.6.3	Testis✓	(1)
			(6)

TOTAL SECTION A: 50

QUESTION 2

2.1	2.1.1	DNA profile✓	(1)
	2.1.2	Q✓	(1)
	2.1.3	All the DNA bands match the DNA bands of the blood on the broken glass✓	(1)
	2.1.4	- Human error could give incorrect results✓ - Only a small amount of DNA was used✓and may not be reliable - Framing✓/planting false evidence - Suspect can have an identical twin✓ with the same DNA profile **(Mark first TWO only)** Any 2	(2) **(5)**
2.2	2.2.1	Protein synthesis✓	(1)
	2.2.2	Peptide✓ bond	(1)
	2.2.3	63✓	(1)
	2.2.4	(a) Guanine✓	(1)
		(b) (i) CAG✓	(1)
		(ii) CCT✓	(1)
		(c) CAU✓	(1) **(7)**
2.3		- The double helix DNA unwinds✓ - The double-stranded DNA 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✓ - mRNA now has the coded message for protein synthesis✓ Any 6	**(6)**
2.4	2.4.1	(a) Autosomes✓ (b) Gonosomes✓ /sex chromosomes	(1) (1)
	2.4.2	Male✓	(1)
	2.4.3	- There is a Y-chromosome✓/XY chromosomes - at chromosome pair 23✓	(2)
	2.4.4	One comes from the male parent✓ and the other comes from the female parent✓ **OR** One comes from the sperm✓ and the other comes from the ovum✓	(2) **(7)**

2.5

P_1	Phenotype	Male	x	Female✓
	Genotype	XY	x	XX✓

Meiosis

Fertilisation

Gametes	X	Y
X	XX	XY
X	XX	XY

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype ***50% males**✓ / 50% females

P_1 and F_1✓
Meiosis and fertilisation✓ ***Compulsory 1** + Any 5

OR

P_1	Phenotype	Male	x	Female✓
	Genotype	XY	x	XX✓
Meiosis				
	G/gametes	X, Y	x	X, X✓
Fertilisation				
F_1	Genotype	XX; XX;		XY XY✓
	Phenotype	***50% males**✓ / 50% females		

P_1 and F_1✓ **(6)**
Meiosis and fertilisation✓ ***Compulsory 1** + Any 5

2.6 2.6.1 Dihybrid✓ cross (1)

2.6.2 (a) Black✓ (1)
(b) Black without white patches✓ (1)
(c) Grey with white patches✓ (1)

2.6.3
- They can be homozygous dominant for coat colour✓/ have the genotype BBtt
- or heterozygous for coat colour✓/have the genotype Bbtt (2)

2.6.4
- Alleles of a gene for one characteristic segregate independently✓
- of the alleles of a gene for another characteristic✓
- The alleles for each gene will therefore come together randomly✓ during gamete formation (3)

(9)
[40]

QUESTION 3

3.1 3.1.1
- Stem cells are undifferentiated✓
- and have the potential to develop into any type of cell✓
- to replace the nerve cells that are damaged✓ (3)

3.1.2
- An embryo is a potential life✓/could develop into a baby
- It poses moral or ethical issues✓

OR

- Umbilical cords are discarded✓
- Do not pose a moral or ethical issue✓

(2)
(5)

3.2 3.2.1 One✓/ 1 (1)

3.2.2 Mrs Thomas✓ (1)

3.2.3
- The child has the genotype ii✓/ is homozygous recessive and
- if both parents are heterozygous✓/ have the genotypes I^Ai or I^Bi
- she inherits one recessive allele from each parent✓ (3)

(5)

3.3 3.3.1 Bipedal✓ (1)

3.3.2 A✓ and B✓ (2)
(Mark first TWO only)

3.3.3 Both have a short✓and wide✓ pelvis (2)

3.3.4 Less curved spine✓/C-shaped spine (1)
(Mark first ONE only) **(6)**

3.4

Differences between the skulls
T✓

Humans	African apes
Large cranium✓	Small cranium✓
No cranial ridge✓	Cranial ridge across the top of the cranium✓
Brow ridges are not well developed✓	Brow ridges well developed✓
Foramen magnum in a forward position✓	Foramen magnum in a backward position✓
Jaws less protruding /less prognathous✓	Jaws more protruding/more prognathous✓
Smaller jaws✓	Larger jaws✓
Palate shape more rounded✓	Palate shape more rectangular✓
Teeth arranged on a gentle (round) curve✓	Teeth arranged in a less curved way✓
Smaller spaces between the teeth✓	Larger spaces between the teeth✓
Small canines✓	Large canines✓

(Mark first THREE only) Table1+ Any 3 x 2 **(7)**

3.5 3.5.1 - Obtain permission from the relevant authority✓
- Plan when to do the investigation✓
- Get all the equipment✓
- Decide where to obtain shrimp cysts✓
- Decide on the different concentrations of solution to use✓
- Decide on how to record the data✓
- Decide on where to do the investigation✓ Any 2 (2)

(Mark first TWO only)

3.5.2 (a) Salt concentration✓ (1)

(b) Number of cysts that hatched/ percentage of cysts hatched✓ (1)

3.5.3 % Hatched = $\left[\frac{1}{53}\right]$✓ × 100✓

= 1,9✓% (accept range 1,88 to 2) (3)

3.5.4 - Temperature✓
- The volume of solution✓ used/30ml solution was used
- Duration✓/the amount of time/ left the beakers for 48 hours
- Cysts from the same type of shrimp✓ Any 3 (3)

(Mark first THREE only)

3.5.5 1%✓salt solution (1)

3.5.6 - There was variation amongst the brine shrimp✓
- Some had the ability to produce cysts✓
- and some did not✓
- When the salt concentration became unfavourable✓
- the brine shrimp which were unable to produce cysts died✓
- Those which were able to produce cysts survived✓
- and reproduced✓
- The allele for producing cysts was passed on to their offspring✓
- The next generation therefore had a higher proportion of brine shrimp with the ability to produce cysts✓ Any 6 (6)

(17)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Mutations (Mu)

- A mutation is a change in the DNA✓/ gene/nucleotide sequence or
- a change in the number✓/size of a chromosome
- Mutations introduce new alleles✓ which results in
- new genotypes✓ and hence
- new phenotypes✓ from one generation to another Any 4 (4)

Meiosis (M)

- In prophase I✓ of meiosis
- crossing over✓ occurs
- between homologous chromosomes✓
- resulting in the exchange of genetic material✓
- leading to chromosomes with a mixture of maternal and paternal genetic material✓
- In metaphase✓ of meiosis
- random arrangement of chromosomes occur✓
- leading to chromosomes moving into gametes in different combinations✓ Any 5 (5)

Role of variation in speciation (S)

- Speciation occurred through geographical isolation✓
- The original population was separated by the sea✓/a body of water
- and there was no gene flow✓ between the two populations
- **There was variation in neck length within each population✓ ***
- Each population was exposed to different environmental conditions✓ and
- underwent natural selection independently✓
- Over a long period of time the two populations became different✓
- genotypically and phenotypically✓
- When the two populations were mixed again✓
- they were unable to interbreed to produce fertile offspring✓
- thus indicating the formation of a new species✓ ***Compulsory 1** + Any 7 (8)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the description of mutations and meiosis as sources of variation and the role of variation in speciation is given. There is no irrelevant information.	All the information regarding description of mutations and meiosis as sources of variation and the role of variation in speciation is given in a logical manner	Correct points as follows: - **2/4** for mutations, - **3/5** for meiosis and - **6/8** for the role of variation in speciation
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2019

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

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 numbers (1.1.1 to 1.1.8) in the ANSWER BOOK, e.g. 1.1.9 D.

1.1.1 Which ONE of the following characteristics applies to bipedal organisms?

A A more backwards position of the foramen magnum
B A short, narrow pelvis
C A long, wide pelvis
D An S-shaped spine

1.1.2 Which ONE of the following statements about biodiversity is CORRECT?

A Speciation increases biodiversity.
B Biodiversity is the number of organisms in a population.
C Extinction increases biodiversity.
D Speciation and extinction have no effect on biodiversity.

1.1.3 Which ONE of the following compounds contains amino acids?

A RNA
B Protein
C Glucose
D DNA

1.1.4 Thando and Mary gave the four characteristics below about themselves.

	THANDO	MARY
P	I am a boy.	I am a girl.
Q	I am 150 cm tall.	I am 153 cm tall.
R	I have attached earlobes.	I have attached earlobes.
S	My blood group is A.	My blood group is AB.

Which statements describe the characteristics of discontinuous variation?

A P, Q and S only
B P, R and S only
C Q, R and S only
D P, Q, R, and S

1.1.5 Which ONE of the following is the genotype of a person with haemophilia?

A X^HX^h
B X^HY
C X^HX^H
D X^hY

1.1.6 A child has blood group AB and her mother's blood group is A.

We can reasonably conclude that the …

A mother's genotype is I^Ai.
B child's genotype is I^AI^B and the mother's genotype is ii.
C father's genotype is I^AI^B or I^BI^B or I^Bi.
D father's genotype is I^AI^B and the mother's genotype is ii.

1.1.7 Refer to a list of Mendel's laws below:

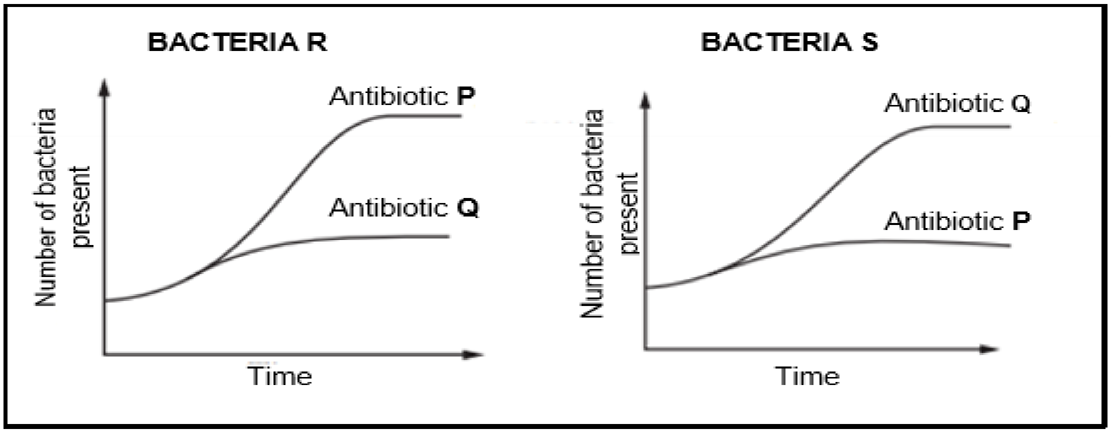
(i) Law of dominance
(ii) Principle of independent assortment
(iii) Principle of segregation

A scientist crossed a red-eyed fruit fly with a white-eyed fruit fly and all the F_1 offspring were red-eyed.

Which of the laws of Mendel can be used to explain this result?

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

1.1.8 The graphs below show the effect of two antibiotics, **P** and **Q**, on two different species of bacteria, **R** and **S**.



What conclusion can be drawn from the graphs?

A Bacteria **R** is less resistant to antibiotic **P** than **Q**.
B Bacteria **R** is more resistant to antibiotic **P** than **Q**.
C Antibiotic **Q** is equally effective on bacteria **R** and **S**.
D Antibiotic **P** is equally effective on bacteria **R** and **S**. (8 x 2) **(16)**

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 1.2.6) in the ANSWER BOOK.

1.2.1 The analysis of DNA samples to identify individuals that may be related

1.2.2 The sugar found in RNA

1.2.3 The structure in an animal cell that forms spindle fibres

1.2.4 Undifferentiated animal cells that can give rise to specialised cell types

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

1.2.6 A diagram representing possible evolutionary relationships between species (6 x 1) **(6)**

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 Jaw of African apes	A: No spaces between teeth B: Large canines
1.3.2 Increases genetic variation	A: Cloning B: Crossing over
1.3.3 All the genes in a species	A: Genome B: Genotype

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

1.4 A section of a DNA molecule has the following base sequence:

C T T   A C A

1.4.1 Name the nitrogenous base represented by **C** in the DNA molecule. (1)

1.4.2 The percentage of guanine in this DNA molecule is 30%.

Give the percentage of thymine in the same molecule. (2)

1.4.3 Give the mRNA sequence, from left to right, for this segment of DNA. (2)

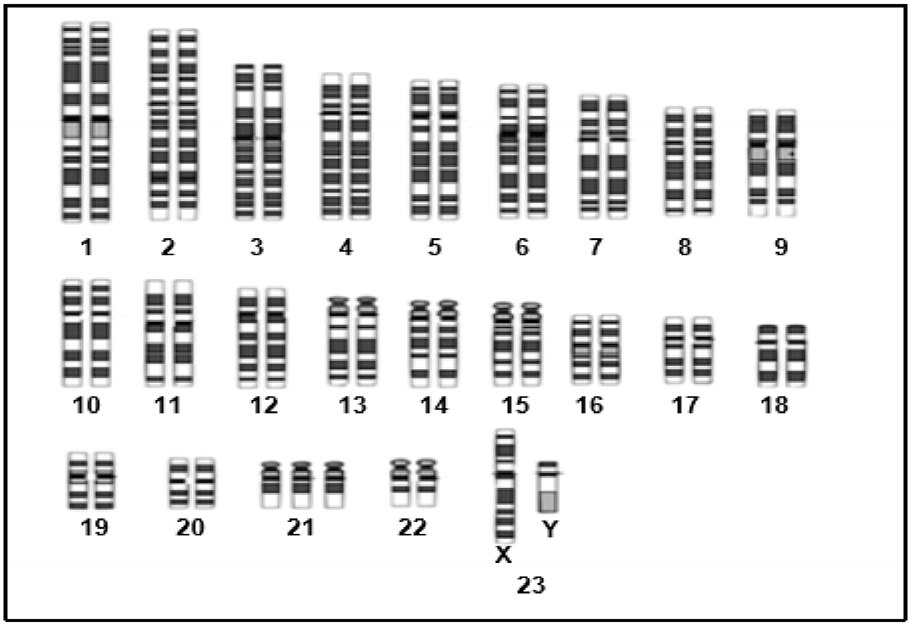
1.4.4 The table below shows the DNA triplets that code for some amino acids.

DNA TRIPLET	AMINO ACID
ACA	Cysteine
CTT	Glutamic acid
TGT	Threonine
TTA	Asparagine
GAA	Leucine
TAC	Methionine

Give the sequence of amino acids that would be coded for by the section of DNA above. (2)

1.4.5 Give the anticodon for the amino acid methionine. (1)
(8)

1.5 The diagram below shows the karyotype of an individual with a disorder caused by non-disjunction.



1.5.1 Name:

(a) This disorder (1)

(b) The phase in meiosis when non-disjunction occurs (1)

(c) The type of mutation that is a result of non-disjunction (1)

1.5.2 Identify the type of chromosomes numbered **1** to **22**. (1)
(4)

1.6 The table shows the evolution of cranial capacity in some species.

SPECIES	PERIOD OF EXISTENCE (MILLION YEARS AGO)	AVERAGE CRANIAL CAPACITY (cm^3)
Sahelanthropus	7,0–6,0	450
Australopithecus africanus	3,0–2,0	480
Homo habilis	2,2–1,6	650
Homo erectus	2,0–0,4	900
Homo neanderthalensis	0,4–0,04	1 500
Homo sapiens	0,2–0	1 450

1.6.1 Name:

(a) TWO hominid genera in the table above (2)

(b) TWO fossils of *A. africanus* that were found in South Africa (2)

(c) The genus that appeared first on Earth as shown in the table (1)

1.6.2 Which hominid had a cranial capacity closest to that of *Homo sapiens*? (1)

1.6.3 Give the smallest cranial capacity (in cm^3) of a *Homo* species. (1)

1.6.4 When did *Australopithecus africanus* become extinct? (1)

1.6.5 Fossils are used as evidence of hominid evolution.

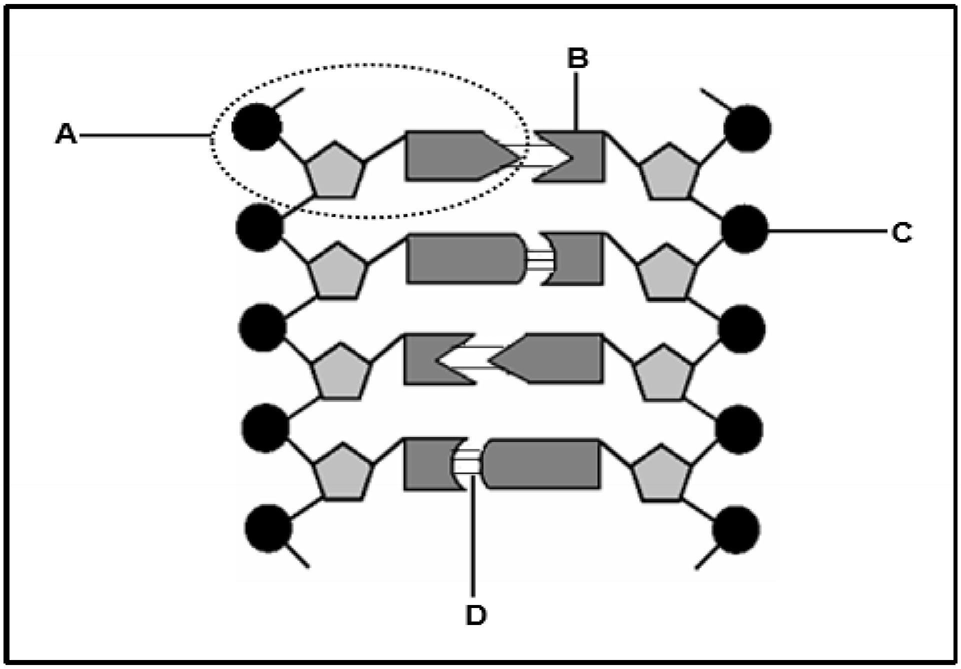
Name TWO other lines of evidence. (2)
(10)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents a portion of a DNA molecule.



2.1.1 Identify **B** and **C**. (2)

2.1.2 Name:

(a) Monomer **A** (1)

(b) TWO scientists who received a Nobel prize for discovering the DNA molecule (2)

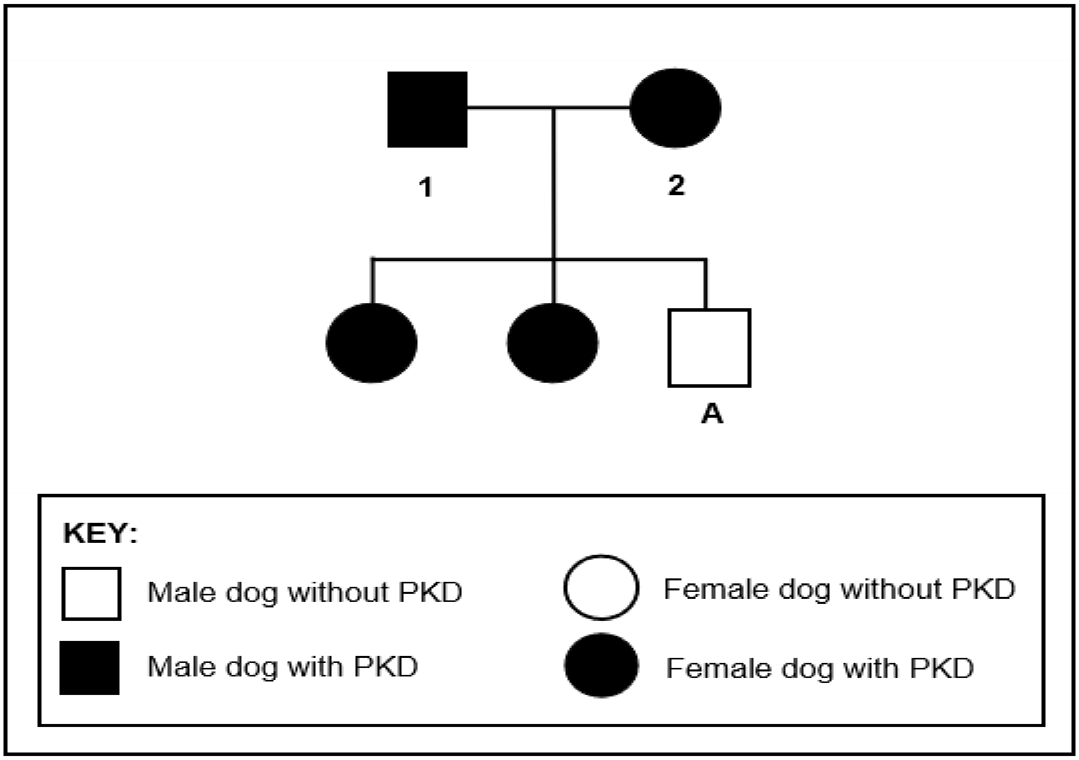
(c) ONE organelle in a cell where DNA is located (1)

2.1.3 Describe how a mutation on DNA may change the structure of a protein. (4)

2.1.4 Tabulate TWO structural differences between a monomer of RNA and a monomer of DNA. (5)
(15)

2.2 Polycystic kidney disease (PKD) in dogs is caused by a dominant allele **(H)**.

The pedigree diagram below shows the offspring produced by two dogs, **1** and **2**.



2.2.1 How many offspring are affected by PKD? (1)

2.2.2 Explain how the genotype of offspring **A** shows that both parents are heterozygous. (4)
(5)

2.3 Read the following extract on artificial selection.

> Broccoli, brussel sprouts and cauliflower are edible plants in the cabbage family. They are different varieties of the same species (*Brassica oleracea)*. They produce a cluster of yellow or white flowers. Each flower has four petals, four sepals, six anthers and a single stigma, style and ovary.
>
> The somatic cells of these plants have a diploid chromosome number of 18. The chromosome number is reduced from diploid to haploid during gamete production, specifically during anaphase **I** of meiosis.
>
> The size of the cabbage head was always important in artificial selection projects, but now the focus is on increasing resistance to various insects and diseases and on improving the nutritional content of cabbage.

2.3.1 Define a *species*. (2)

2.3.2 Name TWO structures in a flower where meiosis takes place. (2)

2.3.3 How many of each of the following structures is present in each cell of *Brassica oleracea* in the process of meiosis:

(a) Chromosomes at the end of telophase **II** (1)

(b) Chromatids during metaphase **I** (1)

2.3.4 Describe the events of anaphase **II**. (3)

2.3.5 Explain why the focus is now on increasing resistance to insects and diseases. (2)
(11)

2.4 A species of fish has three phenotypes for fin length: elongated, short and medium. Heterozygous fish have medium fins.

The characteristic is under the control of one gene with two alleles: elongated (**E**) and short (**S**).

2.4.1 Name and describe the type of dominance shown here. (3)

2.4.2 Use a genetic cross to show the percentage chance of two fish with medium fins having offspring with short fins. (6)
(9)
[40]

QUESTION 3

3.1 A group of students observed that the mating calls of a population of frogs at the local dam had recently become much louder. The dam is close to a highway, where traffic noise has increased over the years.

They wanted to investigate if the increase in traffic noise from the highway had an evolutionary effect on the loudness of the frogs' mating calls in the mating season.

They recorded the following:

- Average level of traffic noise over a period of 6 years
- Average loudness of the frogs' mating calls during the same period

The results are shown in the table below:

YEAR	AVERAGE LOUDNESS OF TRAFFIC NOISE (dB)	AVERAGE LOUDNESS OF MATING CALLS (dB)
2006	30	36
2007	32	38
2008	36	40
2009	40	48
2010	55	68
2011	62	74

3.1.1 Explain the advantage of a louder mating call. (2)

3.1.2 State why these results may be considered to be reliable. (1)

3.1.3 State a conclusion for this investigation. (2)

3.1.4 Give TWO variables that should be kept constant in this investigation. (2)

3.1.5 Draw line graphs on the same set of axes to show the change in average loudness of traffic noise and mating calls for the period 2006 to 2009. (7)

(14)

3.2 In holly trees, red fruit (**R**) is dominant over white fruit (**r**) and spiny leaves (**L**) are dominant over smooth leaves (**l**).

The Punnett square below shows the possible results of a cross between two individual plants. The genotype at **X** is not given.

GAMETES	**RL**	**Rl**	**rL**	**rl**
RL	**X**	RRLl	RrLL	RrLl
Rl	RRLl	RRll	RrLl	Rrll
rL	RrLL	RrLl	rrLL	rrLl
rl	RrLl	Rrll	rrLl	rrll

3.2.1 Give the:

(a) Genotype of **X** (1)

(b) Phenotype of the parents (2)

3.2.2 In a population of 128 plants, how many plants with red fruit and smooth leaves are expected from the Punnett square above? Show ALL working. (3)

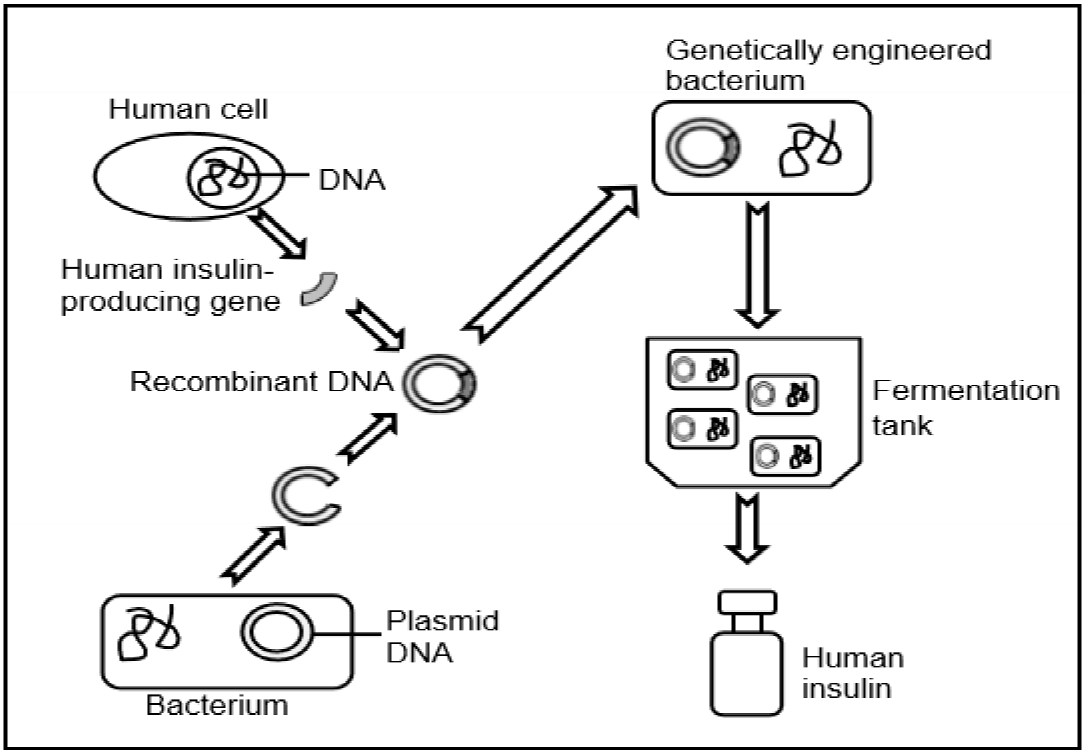
3.2.3 A farmer wanted to produce plants with only white fruit and spiny leaves.

Give the genotype of the plants that he should use in the cross. (2)

(8)

3.3 Synthetic insulin is used to treat diabetes and is produced by genetic engineering technology.

The diagram below represents the process.



3.3.1 Define *genetic engineering*. (2)

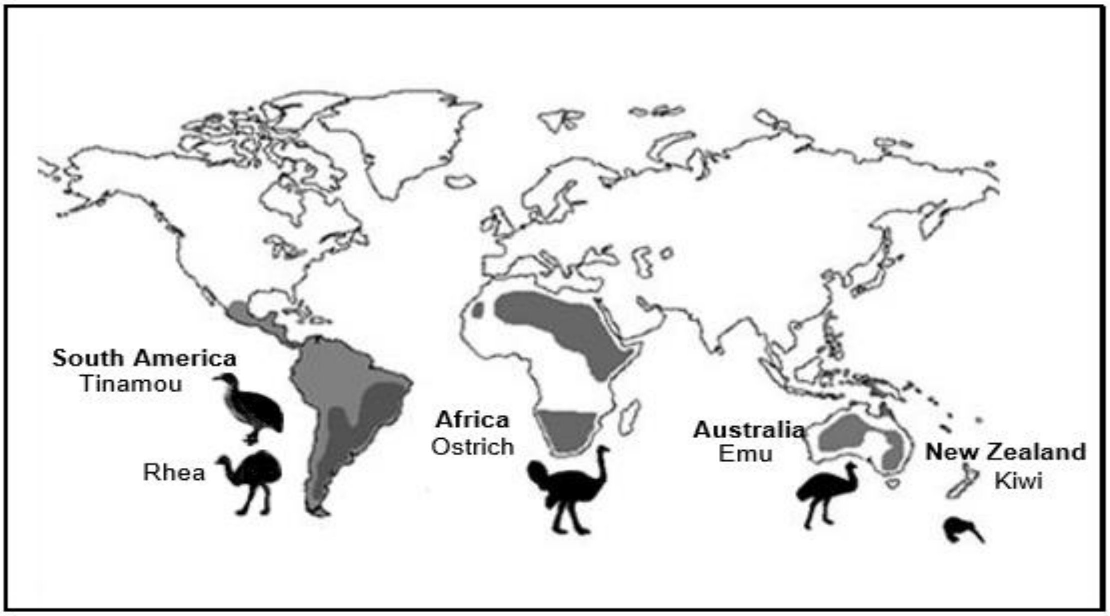
3.3.2 Describe the steps involved in producing the recombinant DNA. (4)

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

3.3.4 Suggest THREE objections that some people might have to genetic engineering. (3)

(11)

3.4 Flightless bird species that are currently distributed across different continents are shown in the picture below.



Scientists hypothesise that these species of flightless birds arose from a single common ancestor that was able to fly.

3.4.1 Describe how Lamarck would have explained the evolution of flightless birds. (4)

3.4.2 Name THREE reproductive isolation mechanisms that keep species separate. (3)

(7)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe natural selection and punctuated equilibrium. Also state THREE ways in which natural selection differs from artificial selection.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2019

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 13 pages.

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	A✓✓		
	1.1.3	B✓✓		
	1.1.4	B✓✓		
	1.1.5	D✓✓		
	1.1.6	C✓✓		
	1.1.7	C✓✓		
	1.1.8	B✓✓	(8 x 2)	**(16)**
1.2	1.2.1	DNA profiling✓		
	1.2.2	Ribose✓		
	1.2.3	Centriole✓/centrosome		
	1.2.4	Stem✓cells		
	1.2.5	Cytokinesis✓		
	1.2.6	Phylogenetic tree✓/cladogram	(6 x 1)	**(6)**
1.3	1.3.1	B only✓✓		
	1.3.2	B only✓✓		
	1.3.3	A only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	Cytosine✓		(1)
	1.4.2	20✓✓%		(2)
	1.4.3	G A A✓ U G U✓		(2)
	1.4.4	Glutamic acid✓ - Cysteine✓ (in that order)		(2)
	1.4.5	UAC✓		(1) **(8)**
1.5	1.5.1	(a) Down syndrome✓/ Trisomy 21		(1)
		(b) Anaphase✓ **I/ II**		(1)
		(c) Chromosomal✓ mutation		(1)
	1.5.2	Autosomes✓		(1) **(4)**

1.6 1.6.1 (a)
- *Sahelanthropus*✓
- *Australopithecus*✓
- *Homo*✓ Any 2 (2)

(Mark first TWO only)

(b)
- Taung child✓
- Mrs Ples✓
- (Little foot)✓ Any 2 (2)

(Mark first TWO only)

(c) *Sahelanthropus*✓ (1)

1.6.2 *Homo neanderthalensis*✓ (1)

1.6.3 650✓cm^3 (1)

1.6.4 2,0 mya✓/2 000 000 years ago (1)

1.6.5 Genetic✓ evidence
Cultural✓ evidence
(Mark first TWO only) (2)
(10)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 B – Nitrogenous base✓
C – Phosphate✓ (2)

2.1.2 (a) Nucleotide✓ (1)

(b) - (James) Watson✓
- (Francis) Crick✓
- (Maurice) Wilkins✓ Any 2 (2)

(Mark first TWO only)

(c) Nucleus✓/ Mitochondrion/ Chloroplast Any 1 (1)
(Mark first ONE only)

2.1.3
- The DNA code will change✓
- leading to different mRNA✓/codons
- which will match with different tRNA✓/anticodons
- resulting in different amino acids✓ being brought to the ribosome leading to a different protein (4)

2.1.4

Monomer of RNA	Monomer of DNA
Contains the sugar ribose✓	Contains the sugar deoxyribose✓
Contains the nitrogenous base uracil✓	Contains the nitrogenous base thymine✓

(Mark first TWO only) ✓ table (5)
(15)

2.2 2.2.1 2✓ (1)

2.2.2
- For **A** to be without PKD, it has to be homozygous recessive✓/hh
- **A** would therefore receive a recessive allele from each parent✓
- Each parent has PKD✓
- hence each parent has one dominant allele✓/H/genotype Hh

OR

- Each parent has PKD✓
- If the parents were homozygous✓
- then all the offspring would have PKD✓
- and there would be no possibility of genotype at **A**✓/offspring without PKD/homozygous recessive (4)

(5)

2.3	2.3.1	Organisms that are able to interbreed and produce fertile offspring✓✓	(2)
	2.3.2	Anthers✓ Ovary✓/ Ovule **(Mark first TWO only)**	(2)
	2.3.3	(a) 9✓	(1)
		(b) 36✓	(1)
	2.3.4	- The spindle fibres contract✓ - The centromere of each chromosome splits into two✓ - The chromatids move to opposite poles✓	(3)
	2.3.5	- Fewer crops will be destroyed by insects and diseases✓ which - will increase the crop yield✓/food security/ decrease expenses on pesticides	(2) **(11)**
2.4	2.4.1	- Incomplete dominance*✓ - Neither of the alleles are dominant✓/neither E nor S is dominant - leading to an intermediate phenotype✓/offspring with medium fins 1 compulsory* + 2	(3)

2.4.2 **P_1** Phenotype Medium fins x Medium fins✓
Genotype ES x ES✓

Meiosis

Fertilisation

Gametes	E	S
E	EE	ES
S	ES	SS

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype 25% short fins✓*; ***Compulsory**
50% medium fins; 25% elongated fins

P_1 and F_1✓
Meiosis and fertilisation✓ 1 Compulsory + Any 5

OR

P_1 Phenotype Medium fins x Medium fins✓
Genotype ES x ES✓

Meiosis

G/gametes E S x E S✓

Fertilisation

F_1 Genotype EE; ES; ES SS✓

Phenotype 25% short fins✓*; ***Compulsory**
50% medium fins; 25% elongated fins

P_1 and F_1✓
Meiosis and fertilisation✓ 1 Compulsory + Any 5 (6)
(9)
[40]

QUESTION 3

3.1 3.1.1
- The mating call can be easily heard✓/can be heard over a distance
- to ensure that a mate is attracted✓ (2)

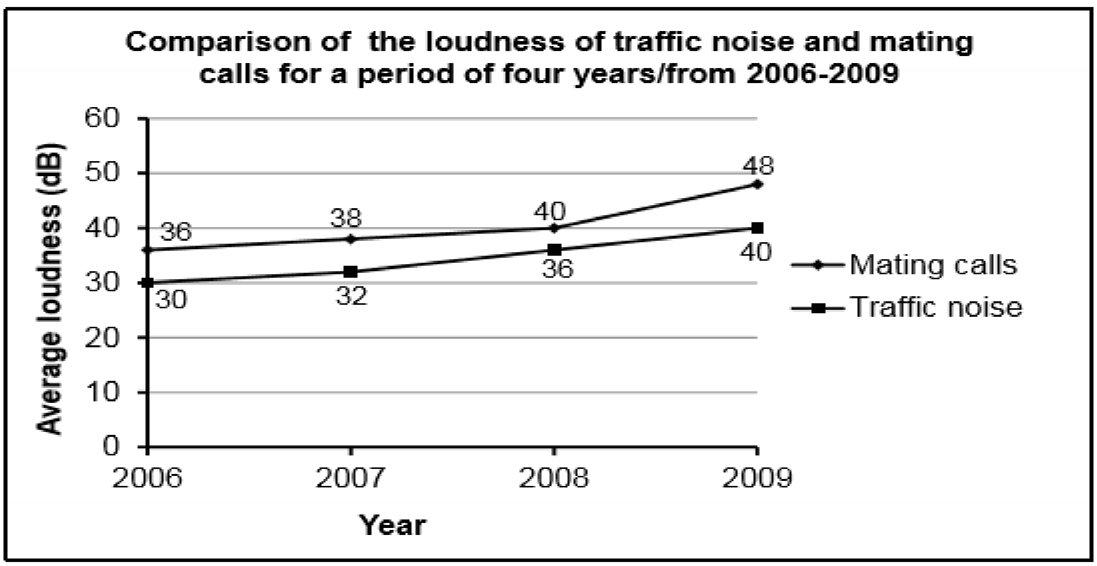
3.1.2
- The investigation was done over a long period✓/6 years
- Many recordings were done in each year✓/ an average was calculated Any 1 (1)

3.1.3 As the traffic noise increased, the loudness of frogs' mating calls increased ✓✓ (2)

3.1.4
- Type of apparatus used✓
- Time of recordings✓
- Distance recordings are taken from✓
- Person taking measurements✓ Any 2 (2)

(Mark first TWO only)

3.1.5



CRITERION	ELABORATION	MARKS
TYPE	Two line graphs on the same set of axes (T)	1
KEY	A key or labels for each graph is present (K)	1
TITLE	Title of graph includes 3 variables	1
SCALE	Correct scale for X-axis and Y-axes (S)	1
LABELS	Correct label and unit for X-axis and Y-axis (L)	1
PLOTTING	Correct plotting of points	1: 1 to 7 points plotted correctly 2: Graph drawn for **required years** only, with all 8 points plotted correctly.

(7)
(14)

3.2 3.2.1 (a) RRLL✓ (1)

(b) Red fruit✓ and spiny leaves✓ (2)

3.2.2 $\left\{\frac{3}{16}\right\}$ ✓ x 128✓ = 24✓ (3)

3.2.3
- rrLL✓✓

OR

- One parent is rrLL and the other parent is rrLl✓✓ (2)

(8)

3.3 3.3.1
- 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)

3.3.2
- A plasmid/ circular DNA is removed from the bacterial cell✓
- It is cut✓ using enzymes
- The insulin gene is removed from a human cell✓ and
- inserted into the plasmid✓to form the recombinant DNA (4)

3.3.3
- 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)

3.3.4
- Expensive✓/ research money could be used for other needs
- Interfering with nature✓/ immoral
- Potential health impacts✓
- Unsure of long-term effects✓ Any 3 (3)

(Mark first THREE only) **(11)**

3.4 3.4.1
- As the wings were used less✓
- they became reduced in size✓/less developed
- and could not be used for flying✓
- This acquired characteristic was passed on to the offspring✓ (4)

3.4.2
- Breeding at different times of the year✓
- Species-specific courtship behaviour✓
- Adaptation to different pollinators✓
- Infertile offspring✓
- Prevention of fertilization✓ Any 3 (3)

(Mark first THREE only) **(7)**
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Natural selection

- Organisms produce a large number of offspring✓
- There is variation✓ amongst the offspring
- Some have favourable characteristics and some do not✓
- When there is a change in the environmental conditions✓/ there is competition
- organisms with characteristics which make them more suited during the changed conditions, survive✓
- whilst organisms with unfavourable characteristics, which make them less suited, die✓
- The organisms that survive, reproduce✓
- and pass on the allele for the favourable characteristic to their offspring✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristic✓ Any 7 (7)

Punctuated equilibrium

- Punctuated equilibrium explains the speed at which evolution occurs✓
- It involves long periods of time✓
- where species do not change✓/change gradually through natural selection
- known as equilibrium✓
- alternating with short periods of time✓
- where rapid changes✓ occur through natural selection Any 4 (4)

Differences between natural and artificial selection

- In natural selection, nature selects the characteristics✓ whereas
- in artificial selection humans select a desired characteristic✓

- In natural selection, the characteristic gives the population an evolutionary advantage✓/improves survival whereas
- in artificial selection, a human need✓is fulfilled

- In natural selection, breeding is random✓ whereas
- in artificial selection, humans select organisms to breed✓

- Natural selection involves only one species✓ whereas
- artificial selection may involve more than one species✓

- In natural selection, the characteristics of a population change✓ whereas
- in artificial selection, the characteristics of the population do not necessarily change✓ Any 3 x 2 (6)

(Mark first THREE only)

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

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to: - natural selection, - punctuated equilibrium and - differences between natural and artificial selection is given. There is no irrelevant information	The description of: - natural selection, - punctuated equilibrium and - differences between natural and artificial selection is logical and sequential.	At least: - **5/7** for the description of natural selection (N) - **2/4** for the description of punctuated equilibrium (P) - **4/6** for differences between natural and artificial selection (D)
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS**

LIFE SCIENCES P2
2021

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 pages.

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 numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D.

1.1.1 Which ONE of the following is a reproductive isolation mechanism?

A Breeding at the same time of the year
B Adaptation to the same pollinators
C Prevention of fertilisation
D Sharing the same habitat

1.1.2 The scientists who won the Nobel Prize for the discovery of the structure of DNA were …

A Watson and Franklin.
B Wilkins and Franklin.
C Crick and Wilkins.
D Watson and Crick.

1.1.3 In a dihybrid cross, an animal with long ears (**E**) and red fur (**R**) was crossed with an animal with short ears (**e**) and black fur (**r**).

Which ONE of the following could represent the genotypes of the parents?

A EERR x eerr
B EeRr x EeRr
C eeRR x eerr
D Eerr x EERr

1.1.4 Which ONE of the following reduces genetic variation in the offspring?

A Mutations
B Random mating
C Cloning
D Random fertilisation

1.1.5 Meiosis is best explained as a process that produces … daughter cells.

A two haploid
B two diploid
C four diploid
D four haploid

1.1.6 Colour-blindness is a disorder caused by a recessive allele on the X chromosome. Which ONE of the following is the genotype of a colour-blind person?

A X^DX^D
B X^DY
C X^DX^d
D X^dY

1.1.7 The study of the inheritance of mutations in mitochondrial DNA is an example of …

A fossil evidence.
B genetic evidence.
C modification by descent.
D cultural evidence. (7 x 2) **(14)**

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 1.2.9) in the ANSWER BOOK.

1.2.1 The bonds that hold the two strands of a DNA molecule together

1.2.2 A genetic cross involving one gene and its alleles

1.2.3 Undifferentiated cells that may form any other cell in the human body

1.2.4 The structures in the cell that form the spindle fibres

1.2.5 The phase of meiosis when chromosomes are aligned at the equator of the cell

1.2.6 A genetic disorder where blood does not clot

1.2.7 The formation of new species

1.2.8 Evolution characterised by long periods of no change alternating with short periods of rapid change

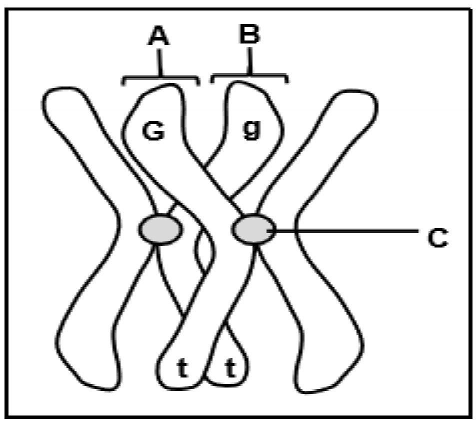
1.2.9 The study of heredity and variation in organisms (9 x 1) **(9)**

1.3 Indicate whether each of the descriptions in COLUMN I apply 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	Found in the nucleus	A: DNA B: RNA
1.3.2	Random arrangement of chromosomes	A: Anaphase II B: Metaphase I
1.3.3	Site of meiosis in humans	A: Testis B: Somatic cells

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

1.4 The diagram below represents a pair of homologous chromosomes in a plant cell. The alleles for two characteristics, seed colour (**G** and **g**) and plant height (**T** and **t**), are indicated on the chromosomes.



1.4.1 Give the term used to describe the position of an allele on a chromosome. (1)

1.4.2 Identify parts **A** and **C**. (2)

1.4.3 Name the process during which parts **A** and **B** exchange genetic material. (1)

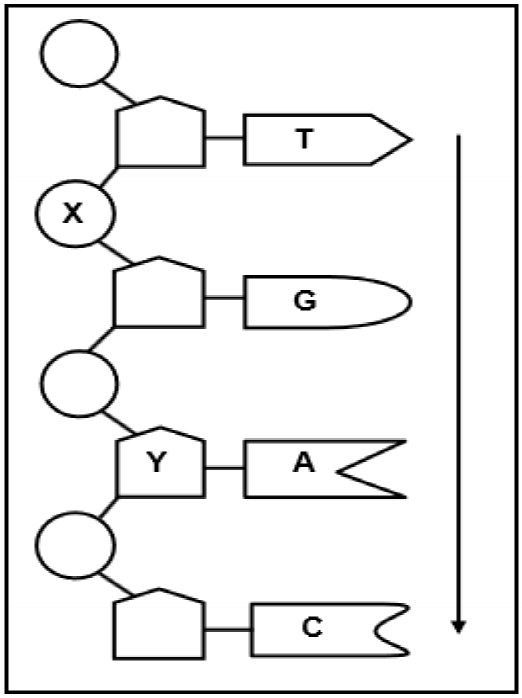
1.4.4 During which phase of meiosis does the process named in QUESTION 1.4.3 take place? (1)

1.4.5 State the following for this plant:

(a) Genotype (2)

(b) The characteristic that is homozygous recessive (1)
(8)

1.5 The diagram below represents some nucleotides in a single strand of DNA.



1.5.1 Give the LETTER of the part that represents a:

(a) Sugar molecule (1)

(b) Phosphate molecule (1)

1.5.2 How many nucleotides are represented in the diagram? (1)

1.5.3 Write down the nitrogenous bases (from top to bottom as indicated by the arrow) of the complementary DNA strand of this molecule. (1)

1.5.4 Name TWO processes that require the two strands of a DNA molecule to separate into single strands as shown in the diagram. (2)
(6)

1.6 The table below shows the blood groups of the members of a family. Two of the children are biological offspring of the parents and one child is adopted.

FAMILY MEMBER	BLOOD GROUP
Father	A
Mother	AB
Daughter	A
Son 1	O
Son 2	B

1.6.1 How many:

(a) Different phenotypes for blood group appear in this family (1)

(b) Possible genotypes are there for blood group AB (1)

1.6.2 Give the genotype of the father. (2)

1.6.3 Which member of the family:

(a) Has the genotype ii (1)

(b) Has co-dominant alleles (1)

(c) Is adopted (1)
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Haemoglobin is a protein found in blood that carries oxygen to all the cells of the body. A portion of this protein is called a beta chain. If the sequence of amino acids in this chain changes, then a different form of haemoglobin, called haemoglobin S, is formed. Haemoglobin S cannot transport oxygen as efficiently as normal haemoglobin.

Position of amino acids in the beta chain	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Normal haemoglobin	Val	His	Leu	Thr	Pro	Glu	Glu
Haemoglobin S	Val	His	Leu	Thr	Pro	Val	Glu

The table below shows the DNA base triplets coding for some amino acids.

DNA BASE TRIPLET	AMINO ACID
CAC	Val
GTG	His
GAC	Leu
TGA	Thr
GGA	Pro
CTC	Glu

2.1.1 Give the:

(a) DNA base triplet for amino acid **3** (1)

(b) mRNA codon for amino acid **4** (2)

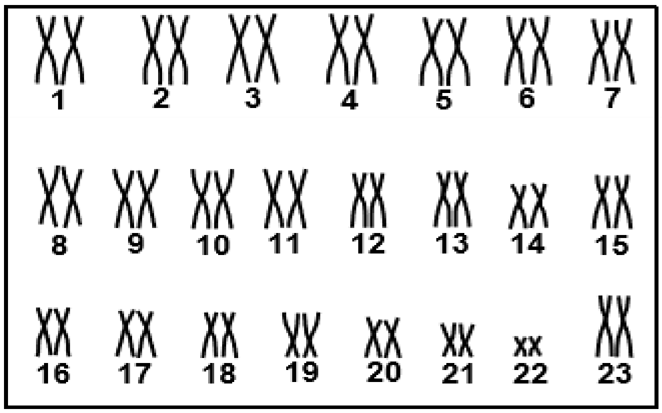
2.1.2 What is a change in the sequence of DNA base triplets called? (1)

2.1.3 Use the information in the tables to explain how a change in the sequence of the DNA base triplets results in the formation of haemoglobin S, rather than normal haemoglobin. (4)

2.1.4 Describe how a person with haemoglobin S would be affected. (2)
(10)

2.2 Describe the process of translation during protein synthesis. **(6)**

2.3 The karyotype below represents the chromosomes of a person.



2.3.1 Give the collective term for the chromosomes numbered 1 to 22. (1)

2.3.2 State the gender of this person. (1)

2.3.3 Give ONE observable reason for your answer to QUESTION 2.3.2. (2)

2.3.4 State Mendel's principle of segregation. (2)

2.3.5 Describe how the karyotype of a person with Down syndrome would differ from the one above. (2)
(8)

2.4 In rabbits, fur colour may be black, white or grey. The inheritance of fur colour is controlled by two alleles namely:

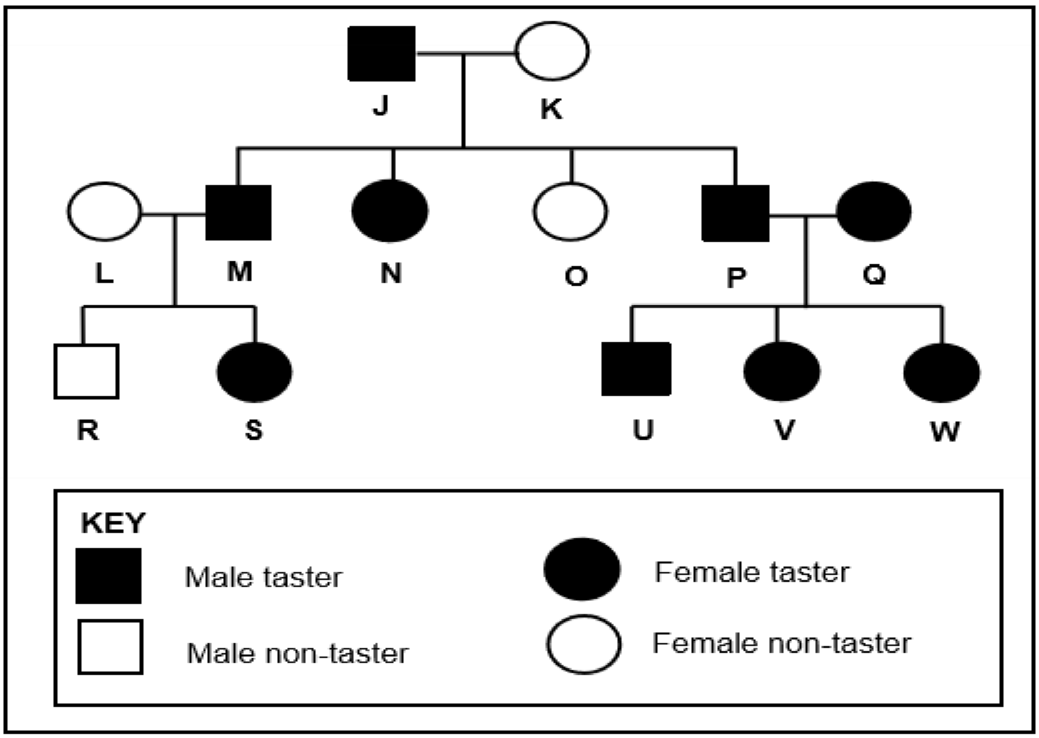
Black fur (**B**) and White fur (**W**)

2.4.1 Explain why fur colour in rabbits is an example of inheritance with incomplete dominance. (2)

2.4.2 Use a genetic cross to show the expected genotypes and phenotypes of the offspring when a grey male mates with a black female. (6)
(8)

2.5 In humans, the ability to taste a certain substance is inherited and is controlled by the dominant allele **T**. People who are able to taste this substance are called tasters, while those who cannot, are called non-tasters.

The pedigree diagram below shows the inheritance of this trait in a family.



2.5.1 What does the term *dominant allele* mean? (2)

2.5.2 Give the:

(a) LETTER of a female in the F_1-generation who is a taster (1)

(b) Genotype of individual **J** (1)

2.5.3 Use evidence from the diagram to support your answer to QUESTION 2.5.2(b). (4)
(8)
[40]

QUESTION 3

3.1 There are anatomical differences between African apes and humans. There are also characteristics that they share.

3.1.1 Name ONE characteristic of the hand that African apes share with humans. (1)

3.1.2 Tabulate THREE differences between the skulls of African apes and humans. (7)

3.1.3 Give TWO characteristics of the pelvis of a bipedal organism. (2)
(10)

3.2 The fat content of cow's milk may vary between 2,6% and 5%.

A farmer has found that there is a high demand for low-fat milk (milk with a fat content of 3% or less).

He determined the fat content in the milk produced by the cows on his farm.

The results of his survey are given in the table below.

FAT CONTENT (%)	NUMBER OF COWS
2,6–3,0	11
3,1–3,5	66
3,6–4,0	93
4,1–4,5	61
4,6–5,0	15

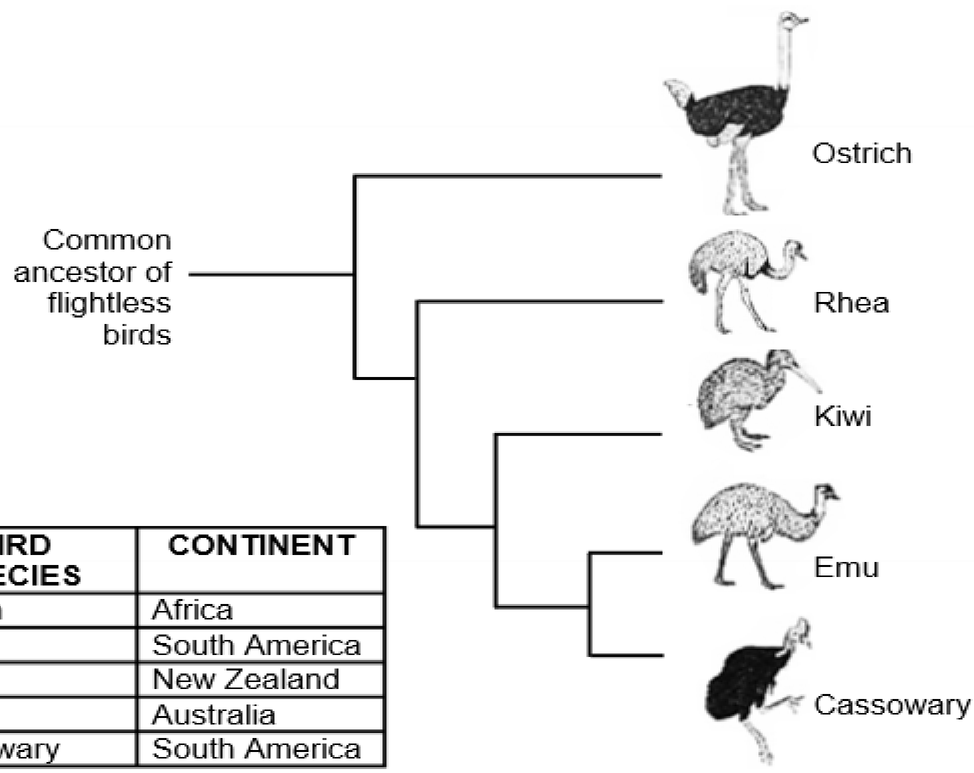
3.2.1 Draw a histogram to represent the results of the survey. (6)

3.2.2 Calculate the percentage of the farmer's cows that produce low-fat milk. Show ALL your working. (3)

3.2.3 State the type of variation that occurs in the cows, based on the evidence in the table. (1)

3.2.4 Give an explanation for your answer to QUESTION 3.2.3. (1)
(11)

3.3 The diagram below represents the evolution of the flightless birds and the continents on which they exist at present.



BIRD SPECIES	CONTINENT
Ostrich	Africa
Rhea	South America
Kiwi	New Zealand
Emu	Australia
Cassowary	South America

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

3.3.2 Name the TWO species that share the most recent common ancestor. (2)

3.3.3 Use information in the diagram to describe how biogeography supports the theory of evolution. (4)

3.3.4 Describe how it can be proven that ostriches and rheas are different species. (2)
(9)

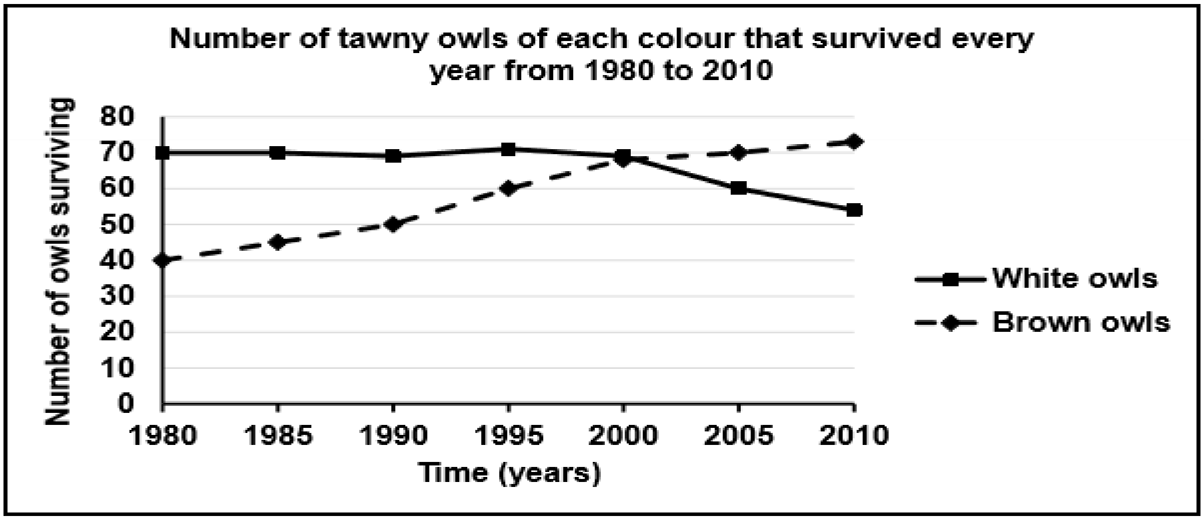
3.4 There is variation in tawny owls. Some are white and others are brown in colour.

Scientists studied these owls over a period of 30 years, from 1980 to 2010, to determine the effect of climate change on the survival of the owls. During this time, climate change caused increasing global temperatures with less snow falling each year.

The scientists:

- Conducted the investigation over the same four months of winter each year
- Observed the same population of tawny owls each year
- Determined the number of tawny owls of each colour that survived every year

The results are shown in the graph below:



3.4.1 Identify the dependent variable in this investigation. (1)

3.4.2 What conclusion can be made about the suitability of each colour owl to survive in more snow? (2)

3.4.3 Explain the results obtained from 2000 to 2010 for the white owls. (3)

3.4.4 Describe how the scientists determined the number of owls that survived each year. (3)

3.4.5 Name ONE variable that was kept the same. (1)
(10)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Modern spider monkeys live high up in trees. They have very long tails which they use to hold on to branches. This reduces their risk of falling to the ground where they could be attacked by predators. The ancestor of spider monkeys had a much shorter tail.

Use Lamarck and Darwin's theories to explain why all spider monkeys have long tails and how artificial selection could have produced the same result.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS**

LIFE SCIENCES P2

2021

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 13 pages.

SECTION A

QUESTION 1

1.1	1.1.1	C✓✓		
	1.1.2	C✓✓/D		
	1.1.3	A✓✓		
	1.1.4	C✓✓		
	1.1.5	D✓✓		
	1.1.6	D✓✓		
	1.1.7	B✓✓	(7 x 2)	**(14)**
1.2	1.2.1	Hydrogen✓bond		
	1.2.2	Monohybrid✓cross		
	1.2.3	Stem✓ cells		
	1.2.4	Centriole✓/Centrosome		
	1.2.5	Metaphase✓I/II		
	1.2.6	Haemophilia✓		
	1.2.7	Speciation✓		
	1.2.8	Punctuated equilibrium✓		
	1.2.9	Genetics✓	(9 x 1)	**(9)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	B only✓✓		
	1.3.3	A only✓✓ 2)	(3 x	**(6)**
1.4	1.4.1	Locus✓		(1)
	1.4.2	A - chromatid✓ C - centromere✓		(2)
	1.4.3	Crossing over✓		(1)
	1.4.4	Prophase I✓		(1)
	1.4.5	(a) Ggtt✓✓		(2)
		(b) (Plant) height✓		(1) **(8)**

	1.5.1	(a)	Y✓	(1)
		(b)	X✓	(1)
	1.5.2	4✓/Four		(1)
	1.5.3	A; C; T; G✓ (must be in correct order)		(1)
	1.5.4	- (DNA) replication✓ - Transcription✓/Protein synthesis **(Mark first TWO only)**		(2) **(6)**
1.6	1.6.1	(a)	4✓/Four	(1)
		(b)	1✓/One	(1)
	1.6.2	I^Ai✓✓		(2)
	1.6.3	(a)	Son 1✓	(1)
		(b)	Mother✓	(1)
		(c)	Son 1✓	(1) **(7)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) GAC✓ (1)

(b) ACU✓✓ (2)

2.1.2 (Gene) mutation✓ (1)

2.1.3
- CTC on the DNA changed to CAC✓
- Codons (on the mRNA) changed✓/GAG changed to GUG
- Anticodons (on tRNA) changed✓/CUC replaced by CAC
- which resulted in a different amino acid✓/ Val (4)

2.1.4
- The cells will not receive enough oxygen✓
- resulting in reduced cellular respiration✓/ a person lacking energy/becoming tired/ anaemia (2)

(10)

2.2
- Each tRNA carries an amino acid✓
- When the anticodon on the tRNA✓
- matches the codon on the mRNA✓
- the tRNA brings the (required) amino acid to the ribosome✓
- Amino acids become attached by peptide bonds✓
- to form the (required) protein✓ **(6)**

2.3 2.3.1 Autosomes✓ (1)

2.3.2 Female✓ (1)

2.3.3
- The gonosomes✓/chromosome pair 23
- are identical✓/XX (2)

(Mark first ONE only)

2.3.4 The factors/alleles that control a characteristic separate✓ (during meiosis) so that only one is present in each gamete✓ (2)

2.3.5
- A person with Down syndrome will have 3 chromosomes✓
- at position number 21✓ (2)

(8)

2.4 2.4.1
- The grey fur colour is an intermediate phenotype✓/a blend of black and white
- This indicates that neither of the alleles is dominant✓ (2)

2.4.2

P_1	Phenotype	Grey	x	Black✓
	Genotype	BW	x	BB✓
Meiosis				
	G/gametes	B, W	x	B, B✓
Fertilisation				
F_1	Genotype	BB, BB,		BW, BW✓*
	Phenotype	Black		Grey✓*

P_1 and F_1✓
Meiosis and fertilisation✓

*2 compulsory marks + any 4

OR

P_1	Phenotype	Grey	x	Black✓
	Genotype	BW	x	BB✓

Meiosis

Fertilisation

Gametes	B	W
B	BB	BW
B	BB	BW

1 mark for correct gametes
1 mark for correct genotypes*

F_1	Phenotype	Black	Grey ✓*

P_1 and F_1✓
Meiosis and fertilisation✓

*2 compulsory marks + any 4 (6)
(8)

2.5 2.5.1
- The dominant allele is always expressed (in the phenotype) when in the heterozygous condition✓✓

OR

- The dominant allele masks/hides the (phenotype of the) recessive allele✓✓ (2)

2.5.2 (a) N✓ (1)

(b) Tt✓ (1)

2.5.3
- J is a taster and therefore must have one dominant allele✓/T
- Individual K is tt✓
- Individual O is a non-taster✓/is homozygous recessive/tt
- She must have inherited a recessive allele/t from each parent✓
- Therefore, J must have one recessive allele✓/t

OR

- J is a taster and therefore must have one dominant allele✓/T
- If J is homozygous dominant✓/TT
- and K is homozygous recessive✓/tt
- then it is not possible to have child (O) who is homozygous recessive✓/ tt
- as she must have inherited a recessive allele/t from each parent✓ Any (4)

(8)
[40]

QUESTION 3

3.1 3.1.1
- Bare fingertips✓/nails instead of claws
- Opposable thumbs✓/ gripping ability
- Fingerprints✓
- Five fingers✓ Any (1)

(Mark first ONE only)

3.1.2

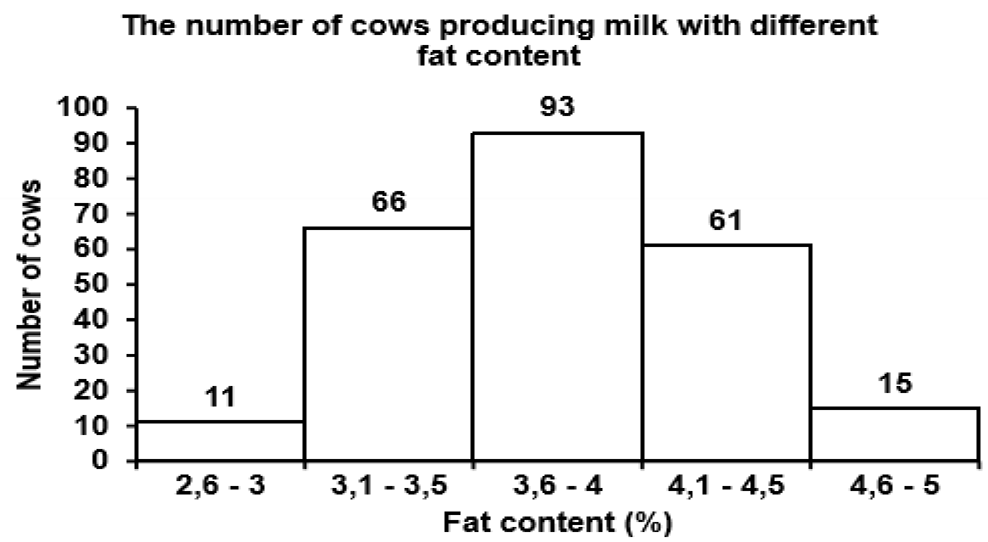
Differences between African apes and humans	
African apes	**Humans**
- Small cranium✓	- Large cranium✓
- Brow ridges are well developed✓	- Brow ridges are not well developed✓
- Large canines✓	- Small canines✓
- Palate is long and rectangular✓ / U-shaped	- Palate is small and semi-circular✓/ C-shaped
- Large jaws✓	- Small jaws✓
- More protruding jaws✓/ prognathous	- Less protruding jaws✓/non-prognathous
- Cranial ridges present✓	- No cranial ridge✓
- Foramen magnum in a backward position✓	- Foramen magnum in a forward position✓
- Sloping face✓	- Flat face✓
- Less developed zygomatic arch✓	- More developed zygomatic arch✓
- Less developed chin✓	- More developed chin✓
- Diastema between the teeth✓	- No diastema between the teeth✓

(Mark first THREE only) Table 1 + (3 x 2)
(7)

3.1.3
- Short✓ and
- wide✓/broad
- Cup-shaped✓ Any (2)

(Mark first TWO only) **(10)**

3.2 3.2.1



(6)

Guideline for assessing the graph

CRITERIA	**ELABORATION**	**MARK**
Correct type of graph **(T)**	Histogram 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 4 bars plotted correctly All 5 bars plotted correctly	1 2

3.2.2 $\frac{11}{246}$✓ x 100✓ = 4,47✓% (Accept 4,5) (3)

3.2.3 Continuous✓ variation (1)

3.2.4 There is a range of intermediate phenotypes✓/the fat content % is a range (1)
(11)

3.3 3.3.1 Phylogenetic tree✓/cladogram (1)

3.3.2 Emu✓ and Cassowary✓ (2)
(Mark first TWO only)

3.3.3
- A flightless common ancestor✓
- existed on one continent✓
- Due to continental drift the original population split✓
- and each population evolved independently✓
- as they experienced different environmental conditions✓
- Each continent now has a different species of flightless bird✓

Any (4)

3.3.4
- Allow time for them to interbreed✓/try to interbreed
- If they produce infertile offspring✓/cannot interbreed, they are different species

OR

- Conduct DNA analysis✓ and
- check for differences✓ (2)

(9)

3.4 3.4.1 Survival of the owls✓ (1)

3.4.2 The brown owls are less suited to survive than the white owls✓✓
OR
The white owls are more suited to survive than the brown owls✓✓ (2)

3.4.3
- There is a decrease in the number of white owls✓ because
- there is less snow✓ and
- white owls will not be camouflaged✓/will be more visible to predators (3)

3.4.4
- They counted/sampled the number of owls at the beginning✓ of the 4-month period
- and again, at the end✓
- Then they calculated the difference✓between the two numbers (3)

3.4.5 (Same):
- Time period✓/4 months
- Population✓
- Season✓/winter
- Method of calculation✓ Any (1)

(Mark first ONE only) **(10)**
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

<u>Lamarck **(J)**</u>
- He would use his law of use and disuse✓
- and law of inheritance of acquired characteristics✓
- The ancestor of spider monkeys had short tails✓
- The ancestors continually stretched✓/used their tails
- to be able to hold on to tree branches✓
- As a result, their tails became longer✓
- and this characteristic was passed on to the next generation✓ Any (6)

<u>Darwin **(D)**</u>
- Evolution occurs by natural selection✓
- There was variation in the ancestral population✓
- Some spider monkeys had short tails✓
- and some had long tails✓
- Those with short tails could not hold onto tree branches✓/fell on the ground
- They died✓/were attacked by predators
- The spider monkeys with long tails were able to hold on to tree branches✓/did not fall to the ground
- and survived ✓/were not attacked by predators
- and reproduced✓
- The characteristic for long tails was passed to the offspring✓ Any (8)

<u>Artificial selection **(A)**</u>
- Humans select✓ the spider monkeys with
- the long tails✓
- and mate them to produce offspring with long tails✓
- This is repeated over many generations✓ Any (3)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to describing the evolution of long tails in spider monkeys in terms of: - Lamarck - Darwin - Artificial selection is included. There is no irrelevant information.	The description of the evolution of long tails in spider monkeys for each of: - Lamarck - Darwin - Artificial selection is logical and sequential.	At least the following are provided when describing the evolution of long tails in spider monkeys: - Lamarck **(J: 4/6)** - Darwin **(D: 5/8)** - Artificial selection **(A: 2/3)**
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS**

LIFE SCIENCES P2

2022

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

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, e.g. 1.1.11 D.

1.1.1 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.

1.1.2 During which stage of meiosis do spindle fibres begin to form?

A Prophase
B Metaphase
C Anaphase
D Telophase

1.1.3 An individual has Down syndrome. In the karyotype there is an abnormal number of chromosomes at chromosome pair …

A 13.
B 18.
C 21.
D 23.

1.1.4 An individual that has received an identical allele from each parent is described as being …

A homologous.
B dominant.
C homozygous.
D heterozygous.

1.1.5 A plant species has a diploid chromosome number of 12.

Which ONE of the following is the haploid chromosome number for this species?

A 24
B 12
C 6
D 36

1.1.6 Inheritance by *multiple alleles* in genetics refers to …

A two alleles that influence two characteristics.
B more than two alleles that influence one characteristic.
C one allele that influences more than one characteristic.
D more than two alleles that influence two characteristics.

1.1.7 Which ONE of the following is a reproductive isolation mechanism?

A Breeding at the same time of the year
B Infertile offspring
C Plant adaptation to the same pollinators
D Improved fertilisation

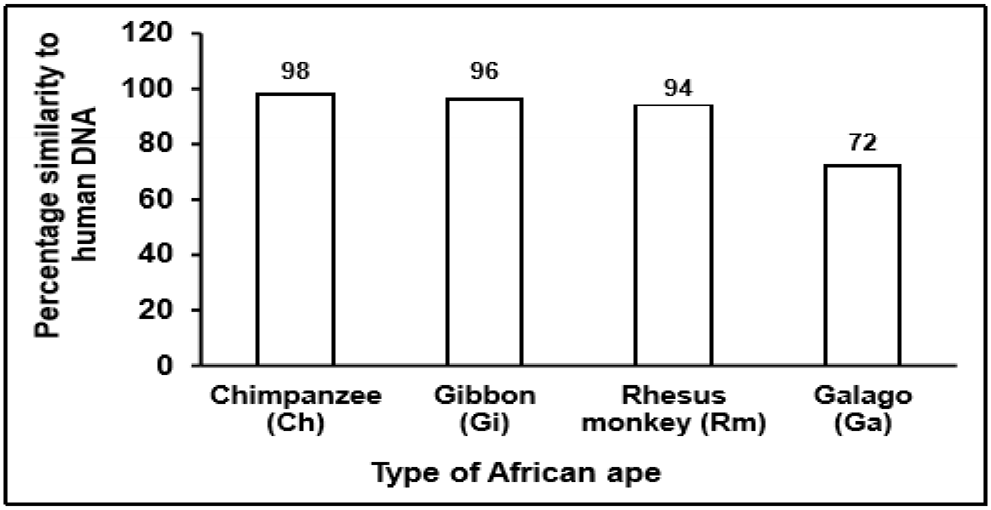
1.1.8 Normal human ova have …

A 22 autosomes and an X chromosome.
B 23 autosomes and an X chromosome.
C 22 autosomes and a Y chromosome.
D 23 autosomes and a Y chromosome.

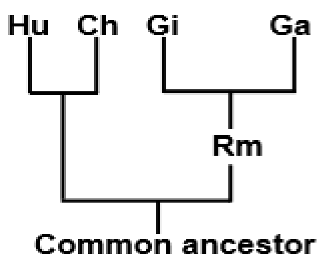
1.1.9 Which ONE of the following occurs in mitosis but NOT in meiosis?

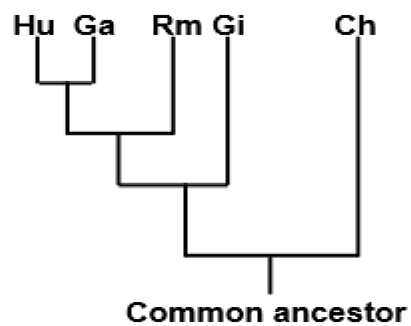
A Two cells are formed at the end of the division
B Crossing over takes place
C Homologous chromosomes arrange at the equator
D Centrioles form at the poles of the cell

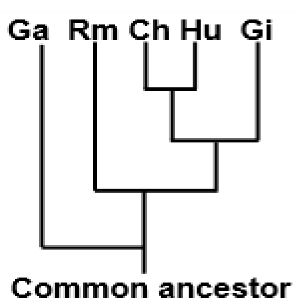
1.1.10 The graph below shows the percentage similarity between human (Hu) DNA and the DNA of some species of African apes.

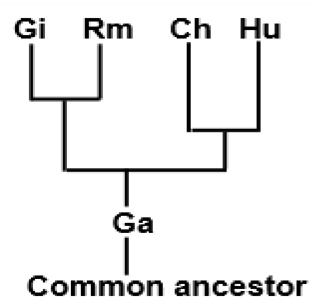


Which ONE of the following phylogenetic trees best represents the information in the graph?

A


B


C


D


(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 1.2.10) in the ANSWER BOOK.

1.2.1 Division of the cytoplasm of a cell during meiosis

1.2.2 The sugar molecule present in a nucleotide of RNA

1.2.3 The position of a gene on a chromosome

1.2.4 The process during which a DNA molecule makes an exact copy of itself

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

1.2.6 Mendel's principle which states that an organism possesses two factors which separate so that each gamete contains only one of these factors

1.2.7 The evolutionary theory that proposes long periods where species do not change, alternating with short periods where rapid changes occur

1.2.8 A tangled network of DNA and protein located within the nucleus

1.2.9 The natural shape of the DNA molecule

1.2.10 The phase in the cell cycle during which cell growth occurs

(10 x 1) **(10)**

1.3 Indicate whether each of the statements in COLUMN I apply 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 A group of similar organisms that occurs in a particular place at a particular time with the ability to interbreed	A: Population B: Species
1.3.2 The manipulation of biological processes to satisfy human needs	A: Biogeography B: Biotechnology
1.3.3 Discovered the structure of the DNA molecule	A: Francis Crick B: James Watson

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

1.4 In tomato plants, tall stems (**T**) are dominant over short stems (**t**) and red fruit (**R**) is dominant over yellow fruit (**r**).

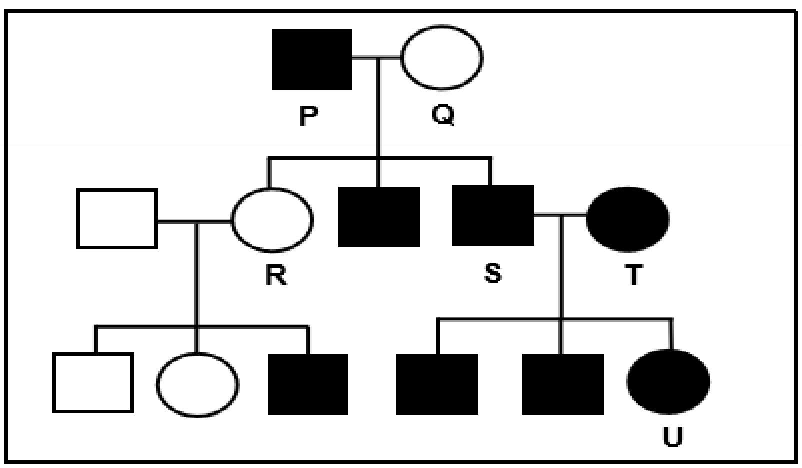
A farmer crosses a homozygous tall, yellow tomato plant with a plant that is heterozygous for both characteristics.

1.4.1 Name this type of genetic cross. (1)

1.4.2 Give the genotype of a homozygous tall, yellow tomato plant. (2)

1.4.3 List the genotypes of ALL the possible gametes for a plant that is heterozygous for both characteristics. (4)
(7)

1.5 Haemophilia is a sex-linked recessive trait **(X^h)**. The pedigree diagram below shows the inheritance of haemophilia in a family.



1.5.1 State what is represented by the squares on a pedigree diagram. (1)

1.5.2 State the number of:

(a) Generations represented in this pedigree diagram (1)

(b) Offspring of individuals **P** and **Q** (1)

1.5.3 Give the:

(a) LETTERS only, of females who have haemophilia (2)

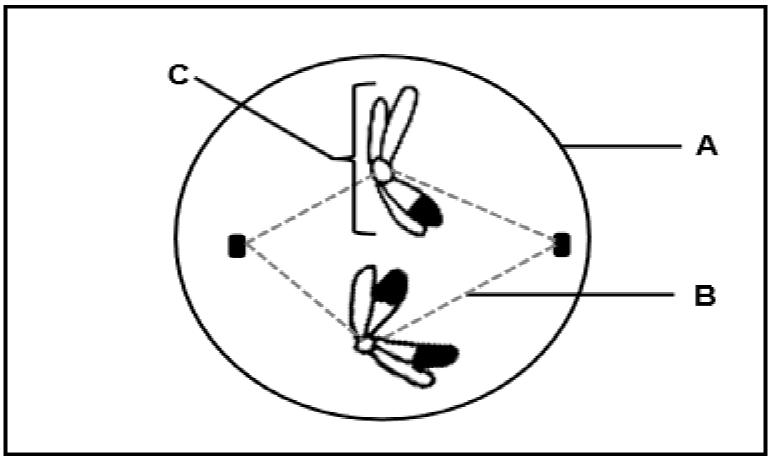
(b) Genotype of individual **R** (2)
(7)

TOTAL SECTION A: [50]

SECTION B

QUESTION 2

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



2.1.1 Identify the phase of meiosis shown. (1)

2.1.2 Give ONE observable reason for your answer to QUESTION 2.1.1. (2)

2.1.3 Identify structure:

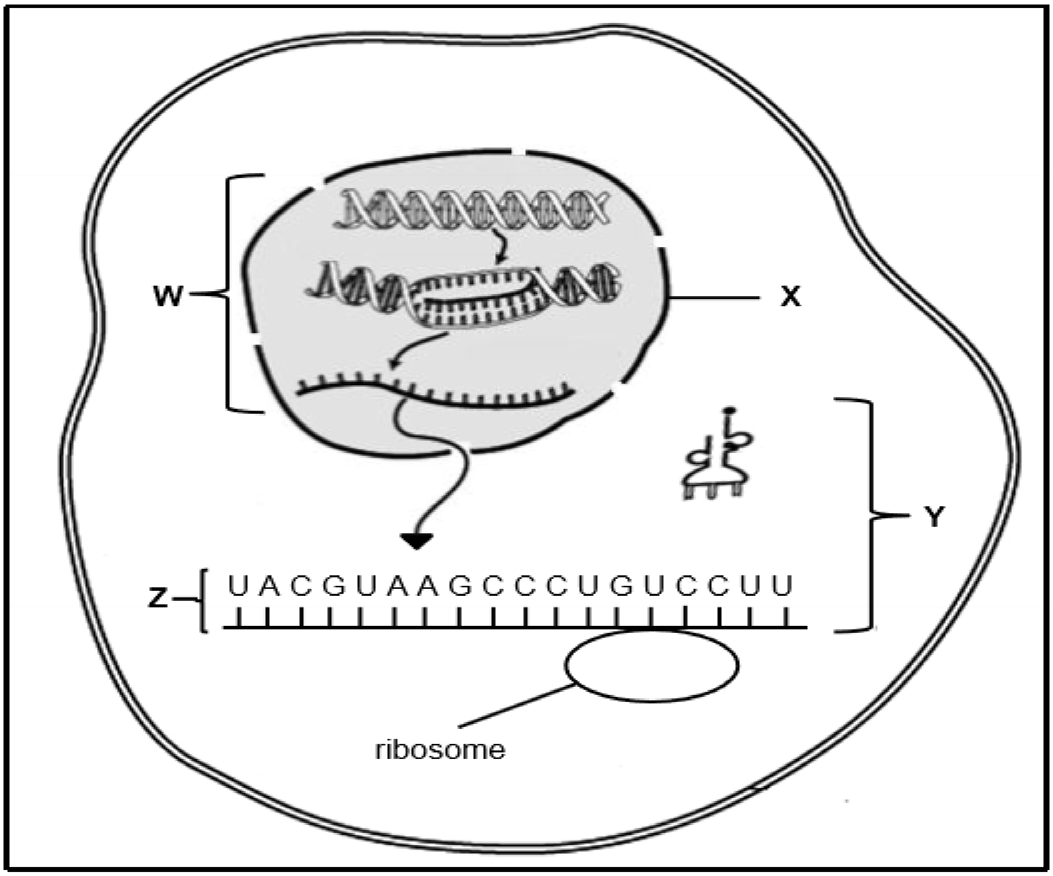
(a) **A** (1)

(b) **B** (1)

2.1.4 Describe the role of part **B** in the movement of chromosomes during meiosis. (2)

2.1.5 Draw a labelled diagram of structure **C** as it would appear in the final phase of this meiotic division. Show the correct shading. (4)
(11)

2.2 The diagram below represents the process of protein synthesis in a cell.



2.2.1 Name the process which occurs at:

(a) **W** (1)

(b) **Y** (1)

2.2.2 Identify:

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

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

2.2.3 State TWO locations of DNA in a cell, other than in the nucleus. (2)

2.2.4 Describe the process at **W.** (7)

The table below shows some tRNA anticodons with their corresponding amino acids.

tRNA ANTICODON	AMINO ACID
CAG	Valine
GAA	Leucine
AUG	Tyrosine
GGA	Proline
UCG	Serine
CAU	Valine

2.2.5 Name the:

(a) DNA base triplet 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)

2.2.6 What is the change in the sequence of nitrogenous bases in a DNA molecule called? (1)

2.2.7 The codon CUU (last codon) on molecule **Z** changed to CCU.

Explain the effect it would have on this particular protein molecule. (3)
(20)

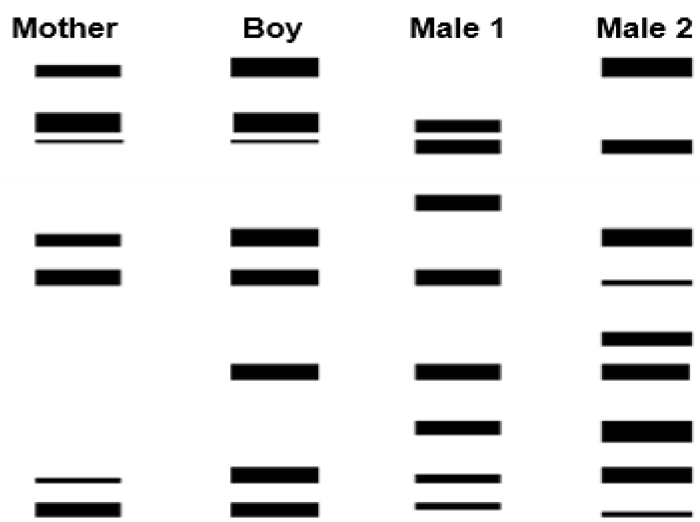
2.3 A family wanted to identify the biological father of a boy. The mother of the boy is known. Blood groups and DNA profiles of the mother, the boy and two males were used to determine paternity.

The data below shows the results of the two procedures.

BLOOD GROUPS

Mother	Boy	Male 1	Male 2
O	B	AB	B

DNA PROFILES



2.3.1 Explain why paternity of the boy could not be established using blood groups only. (5)

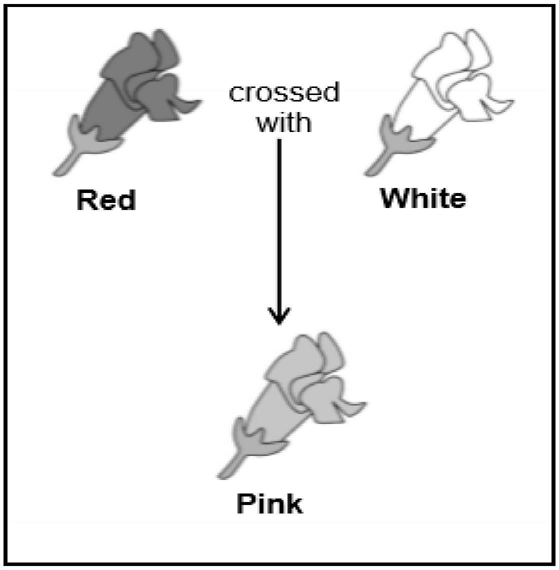
2.3.2 Who is the biological father of the boy according to the DNA profiles? (1)

2.3.3 Explain your answer to QUESTION 2.3.2. (3)

2.3.4 State ONE other use of DNA profiling. (1)
(10)

2.4 The diagram below shows the inheritance of flower colour in snapdragon plants.

The two alleles controlling flower colour are red **(R)** and white **(W)**.



2.4.1 State the type of dominance shown by the snapdragon plants. (1)

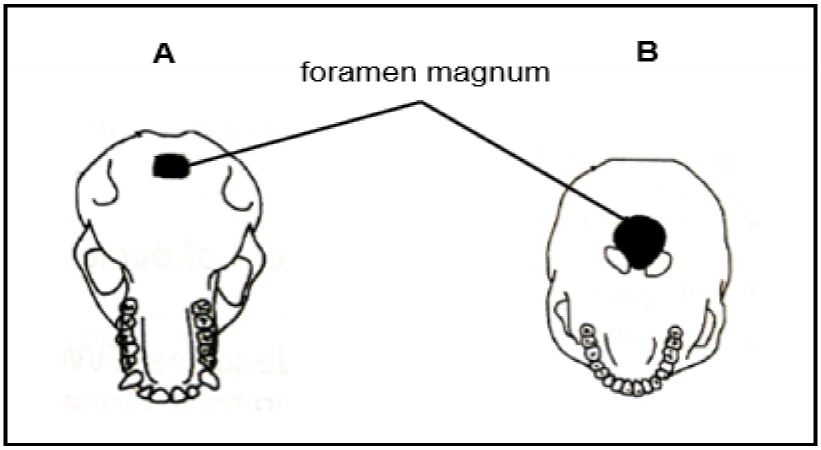
2.4.2 Give a reason for your answer to QUESTION 2.4.1. (2)

2.4.3 A gardener crossed two pink-flowered snapdragon plants.

Use a genetic cross to show the ratio of the expected phenotypes in the offspring. (6)
(9)
[50]

QUESTION 3

3.1 Diagrams **A** and **B** show the ventral (bottom) view of the skulls of two organisms. The diagrams are NOT drawn to scale.



3.1.1 Which diagram represents the skull of a bipedal organism? (1)

3.1.2 Give ONE visible reason for your answer to QUESTION 3.1.1. (2)

3.1.3 Tabulate TWO visible differences between the upper jaws in diagrams **A** and **B** that represent trends in human evolution. (5)

3.1.4 Explain the significance of the shape of the spine that is associated with the skull in diagram **B.** (2)

(10)

3.2 The herbicide glyphosate is used to control weeds in maize fields. The herbicide kills the weeds, but it can also kill the maize plants. It has been found that some weeds developed resistance to glyphosate treatment.

Scientists carried out an investigation to determine the development of glyphosate resistance in the weeds. The weeds were treated with the same concentration of glyphosate each year from 2009 to 2016 and the percentage of glyphosate resistant weeds in the field was recorded every year.

The results are shown in the table below.

YEAR	GLYPHOSATE RESISTANT WEEDS (%)
2009	10
2010	20
2011	32
2012	42
2013	53
2014	58
2015	65
2016	65

3.2.1 Describe the change in glyphosate resistance over the time of the investigation. (3)

3.2.2 Calculate the percentage increase in glyphosate resistant weeds from 2010 to 2015. Show ALL your working. (3)

3.2.3 Scientists isolated the gene for glyphosate resistance from the weeds and used it to genetically modify the maize plants.

Explain the economic benefit of making the maize plants resistant to glyphosate. (3)

3.2.4 Draw a bar graph to illustrate the results of the investigation in the first four years. (6)
(15)

3.3 A population of lizards on an island, Island **A,** were well suited to feed mainly on insects. Scientists moved five adult pairs of this lizard species to a neighbouring island, Island **B**. Here they reproduced and a new population formed. Island **B** has a large supply of plants with tough fibrous leaves and fewer insects. Exposure to this new environment may have caused the lizards to undergo evolution.

Thirty-six years later, scientists returned to Island **B** to conduct further investigations on the lizard population there. They observed that the jaw size of the lizards had increased. Scientists also analysed the stomach content of the lizards and found that it was mainly plant-based. They also confirmed that the two populations still belong to the same species.

3.3.1 Describe how the scientists could confirm that there was a change in jaw size between the lizards of Island **A** and the lizards of Island **B**. (3)

3.3.2 Explain how the larger jaws of the lizards on Island **B** would be structurally suited to eat tough fibrous leaves. (3)

3.3.3 How did the scientists determine that the two populations of lizards on both islands still belong to the same species? (2)

3.3.4 Explain the possible effect that the evolution of the lizards has on biodiversity. (2)

3.3.5 Use Darwin's theory of natural selection to explain the evolution of lizards with larger jaws. (7)
(17)

3.4 The 'Out of Africa' hypothesis is one explanation of the evolution of modern humans.

3.4.1 State the 'Out of Africa' hypothesis. (2)

3.4.2 Name the family to which modern humans belong. (1)

3.4.3 What genetic evidence is used to support the 'Out of Africa' hypothesis? (1)

3.4.4 Describe how fossil evidence is used to support the 'Out of Africa' hypothesis. (4)
(8)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2022

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 11 pages.

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	A✓✓		
	1.1.3	C✓✓		
	1.1.4	C✓✓		
	1.1.5	C✓✓		
	1.1.6	B✓✓		
	1.1.7	B✓✓		
	1.1.8	A✓✓		
	1.1.9	A✓✓		
	1.1.10	C✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Cytokinesis✓		
	1.2.2	Ribose✓		
	1.2.3	Locus✓		
	1.2.4	(DNA) replication✓		
	1.2.5	Stem✓ cells		
	1.2.6	Segregation✓		
	1.2.7	Punctuated equilibrium✓		
	1.2.8	Chromatin✓network		
	1.2.9	Double helix✓		
	1.2.10	Interphase✓	(10 x 1)	**(10)**
1.3	1.3.1	A only✓✓		
	1.3.2	B only✓✓		
	1.3.3	Both A and B✓✓	(3 x 2)	**(6)**
1.4	1.4.1	Dihybrid✓ cross		(1)
	1.4.2	TTrr✓✓		(2)
	1.4.3	TR✓, Tr✓, tR✓, tr✓		(4)
		(Mark first FOUR only)		**(7)**
1.5	1.5.1	Males✓		(1)
	1.5.2	(a) 3✓/Three		(1)
		(b) 3✓/Three		(1)
	1.5.3	(a) T✓		
		U✓		(2)
		(b) X^HX^h✓✓		(2)
				(7)

TOTAL SECTION A: 50

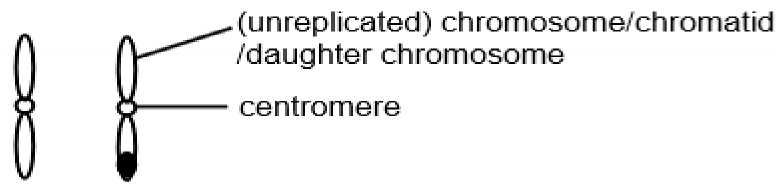
SECTION B

QUESTION 2

2.1	2.1.1	Metaphase II✓	(1)
	2.1.2	<u>Individual</u> chromosomes line up at the equator✓✓ of the cell **(Mark first ONE only)**	(2)
	2.1.3	(a) Cell membrane✓	(1)
		(b) Spindle fibre✓	(1)
	2.1.4	- It contracts✓/shortens - to pull the chromosomes✓/ daughter chromosomes/chromatids to opposite poles of the cell	(2)

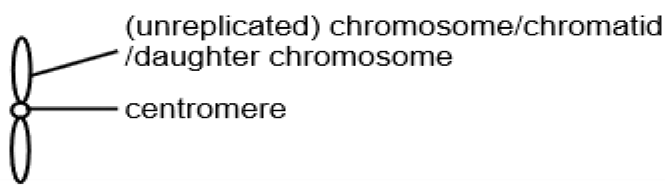
2.1.5

Structure C in the final phase of Meiosis/ Telophase II



OR

Structure C in the final phase of Meiosis/ Telophase II



Guideline for assessing the drawing

CRITERIA		ELABORATION	MARK
Heading	(H)	- Structure **C** in the final phase of meiosis/Telophase II	1
Correct drawing	(D)	- Daughter chromosome/ unreplicated chromosome/ chromatid/s drawn from structure **C** <u>only</u>	1
Correct shading	(S)	- One unshaded - One with a shaded tip } **OR** one unshaded	1
Labels	(L)	- Any 1 correct label	1

(4)
(11)

2.2 2.2.1 (a) Transcription✓ (1)
(b) Translation✓ (1)

2.2.2 (a) Nucleus✓ (1)
(b) mRNA✓ (1)

2.2.3 Chloroplasts✓
Mitochondria✓ (2)
(Mark first TWO only)

2.2.4
- The double helix DNA unwinds✓ and
- (the double-stranded DNA) 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✓/ (A-U, G-C)
- mRNA now has the coded message for protein synthesis✓

Any (7)

2.2.5 (a) TCG✓ (1)

(b) Tyrosine✓
Valine✓ **(in this sequence)** (2)
(Mark first TWO only)

2.2.6 Gene mutation✓ (1)

2.2.7
- The anticodon will be GGA✓/not GAA
- The last amino acid would be proline instead of leucine✓
- resulting in a different protein✓/ no protein at all (3)

(20)

2.3 2.3.1
- Either **male 1** or **male 2** could be the father✓ of the boy
- since both males have the I^B allele✓/ **male 1** I^AI^B and **male 2** I^BI^B or I^Bi
- The mother's blood group is O and must have the genotype ii✓/homozygous recessive
- The boy would have inherited the recessive allele/i from the mother✓
- and he would have the genotype I^Bi✓ (5)

2.3.2 Male 2✓ (1)

2.3.3
- Four/some bands of the boy's✓DNA profile
- match with those of the mother's✓ profile
- The remaining bands of the boy match with the bands of male **2**'s✓ DNA profile/fewer bands match with male **1**'s DNA profile (3)

2.3.4
- Tracing missing persons✓
- Identification of genetic disorders✓
- Establishing family relations✓
- Matching tissues for organ transplants✓
- Identifying dead persons✓/criminals/suspects Any (1)

(Mark first ONE only) **(10)**

2.4 2.4.1 Incomplete dominance✓ (1)

2.4.2
- The pink flower colour is an intermediate phenotype✓/ a blend of red and white
- indicating that neither of the alleles is dominant✓ (2)

2.4.3

P_1 /P_2	Phenotype	Pink	x	Pink✓
	Genotype	RW	x	RW✓
Meiosis				
	G/gametes	R, W	x	R, W✓
Fertilisation				
F_1 /F_2	Genotype	RR; RW;		RW; WW✓
	Phenotype	1 Red: 2 Pink: 1 White✓*		

P_1 & F_1✓/
P_2 & F_2
Meiosis and fertilisation✓

OR

P_1 /P_2	Phenotype	Pink	x	Pink✓
	Genotype	RW	x	RW✓

Meiosis

Fertilisation

Gametes	R	W
R	RR	RW
W	RW	WW

1 mark for correct gametes
1 mark for correct genotypes

F_1 /F_2 Phenotype 1 Red: 2 Pink: 1 White✓*
P_1 & F_1✓/
P_2 & F_2
Meiosis and fertilisation✓

(6)

1* **compulsory** + Any 5 **(9)**

[50]

QUESTION 3

3.1 3.1.1 B✓ (1)

3.1.2 - The foramen magnum is in a more forward position✓✓ (2)
(Mark first ONE only)

3.1.3

	A		B
1	Larger canines✓/teeth	1	Smaller canines✓/teeth
2	Jaws with teeth in a rectangular/U shape✓	2	Jaws with teeth on a gentle/round curve✓
3	More protruding jaw✓/ prognathous	3	Less protruding jaw✓/non-prognathous
4	Diastema present✓	4	No diastema✓

(Mark first TWO only) Table 1 + Any (2 x 2) (5)

3.1.4
- The spine is S-shaped✓*
- to support upper body weight✓
- for shock absorption✓
- for flexibility✓ 1* compulsory + Any 1 (2)

(10)

3.2 3.2.1
- Glyphosate resistance increased✓
- from 2009 to 2015✓
- and remained constant in 2016✓ (3)

3.2.2 $\left.\frac{45}{20}\right\}$ ✓ x 100✓ **OR** $\left.\frac{65-20}{20}\right\}$ ✓ x 100✓

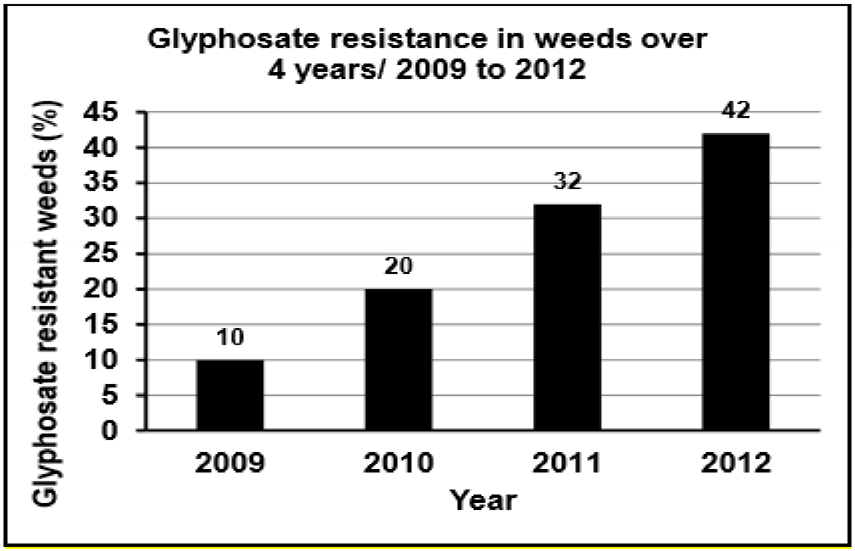
= 225✓% (3)

3.2.3
- The glyphosate will not kill the maize✓
- A greater yield✓ of maize
- means greater profit✓

OR

- Application of the glyphosate does not have to be selective✓
- This will save on labour✓/time/costs which
- means greater profit✓ (3)

3.2.4



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)	- Equal space and width of bars for X-axis and - Correct scale for Y-axis	1
Plotting of co-ordinates (P)	- 1 to 3 co-ordinates plotted correctly - The 4 <u>required</u> co-ordinates plotted correctly	1 2

(6)
(15)

3.3 3.3.1
- They measured the jaw size of lizards on both islands✓ and
- determined the average jaw size for each population✓
- They compared the difference✓ between the two (3)

3.3.2
- A larger jaw allows for better muscle attachment✓/more teeth /larger teeth
- Thereby increasing the bite force✓/ability
- to break down✓the fibrous plant material (3)

3.3.3
- They allowed the lizards of the two islands to mate✓
- and determined that they were able to interbreed✓ and
- give rise to fertile offspring✓ Any (2)

3.3.4
- Biodiversity remains the same✓/there is no effect
- because the number of species remains the same✓/a new species has not been formed

OR

- Biodiversity decreases✓
- because some species of plants eaten on Island **B** could become extinct✓ (2)

3.3.5
- There is variation in the size of the lizards' jaws✓
- Some have small jaws and others have large jaws✓
- Due to the larger supply of (fibrous) plants✓/fewer insects
- those with smaller jaws will be unable to feed✓
- and die✓
- The lizards with the larger jaws will have more food✓
- and survive✓
- to reproduce✓
- The allele for larger jaws will be passed on to the offspring✓
- The next generation will have a higher proportion of lizards with larger jaws✓ Any (7)

(17)

3.4 3.4.1
- (Modern) humans originated in Africa✓ and
- then migrated to other continents✓ (2)

3.4.2 Hominidae✓ (1)

3.4.3 Mitochondrial DNA✓ (1)

3.4.4
- Fossils of *Ardipithecus* were found in Africa <u>only</u>✓
- Fossils of *Australopithecus* were found in Africa <u>only</u>✓
- Fossils of *Homo habilis* were found in Africa <u>only</u>✓
- The <u>oldest</u> fossils of *Homo erectus* were found in Africa✓
- The <u>oldest</u> fossils of *Homo sapiens* were found in Africa✓

Any (4)

(8)

[50]

TOTAL SECTION B: 100

GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2023

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 pages.

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, e.g. 1.1.10 D.

1.1.1 According to Lamarck's theory for evolution, …

A acquired characteristics are not inherited.
B organisms evolve because they adapt to their environment.
C there is variation amongst offspring.
D environmental changes have no influence on species diversity.

1.1.2 The genotype for a specific characteristic …

A contains two chromosomes.
B is the physical appearance of an individual.
C is the composition of a gene pair.
D is represented by one allele.

1.1.3 After the discovery of a fossil, scientists classified it as an African ape because it had a …

A large cranium, a prognathous jaw and large canines.
B small cranium, a non-prognathous jaw and large canines.
C small cranium, a prognathous jaw and large canines.
D large cranium, a prognathous jaw and small canines.

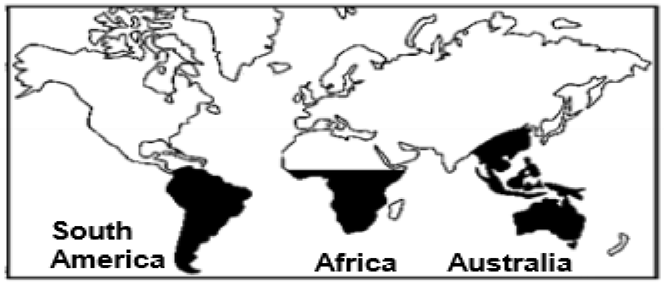
1.1.4 The statements below describe the steps in the process of cloning an animal.

(i) The embryo is implanted into the uterus of an adult female for development.
(ii) The nucleus from a somatic cell of the donor is extracted.
(iii) The nucleus from the somatic cell is inserted into the ovum.
(iv) The nucleus from the ovum of another individual is removed.
(v) The ovum with the new nucleus is given an electric shock to stimulate cell division and the formation of the embryo.

Which combination shows the CORRECT order of the steps?

A (ii)→ (iv)→ (iii)→ (v)→ (i)
B (ii)→ (iii)→ (iv)→ (v)→ (i)
C (i)→ (ii)→ (iii)→ (iv)→ (v)
D (ii)→ (iv)→ (v)→ (iii)→ (i)

1.1.5 Shrubs of the family Proteaceae (e.g. Waratahs and proteas) can be found in Australia, South America, Indo-China and parts of Africa as shown on the map below.

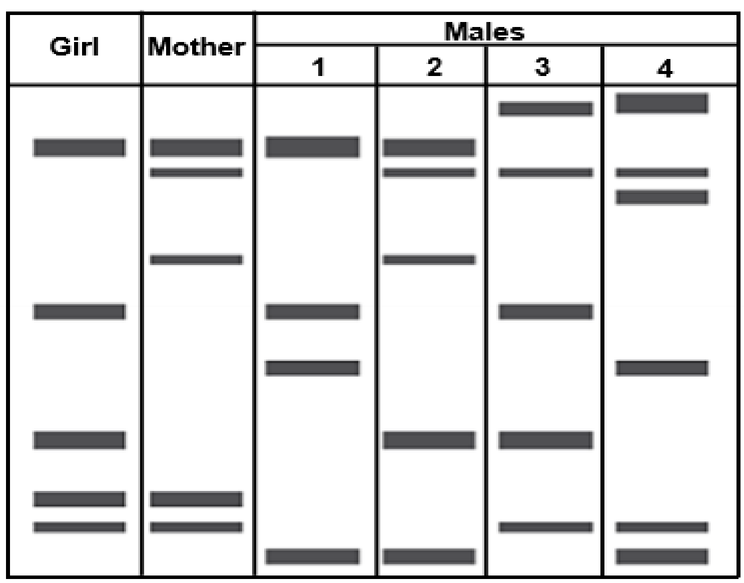


It is hypothesised that all continents were once one large continent called Pangaea and that they separated due to continental drift.

This is evidence that the family Proteaceae …

A all belong to the same species.
B are equally distributed on all continents.
C became extinct when Pangaea separated.
D arose from a common ancestor when Pangaea separated.

1.1.6 The diagram below shows the DNA profiles of a girl, her mother and four males.



Which male is the girl's biological father?

A 1
B 2
C 3
D 4

1.1.7 The following are characteristics of a group of animals:

(i) Able to interbreed
(ii) Occupy the same habitat
(iii) Produce infertile offspring
(iv) Belong to the same species

Which combination CORRECTLY represents a *population*?

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

1.1.8 During Anaphase II of meiosis, the two chromatids of a chromosome are pulled apart, each moving towards opposite poles at a rate of 1 micrometre per second.

The distance, in micrometres, between the chromatids after 20 seconds is …

A 10.
B 20.
C 30.
D 40.

1.1.9 Which ONE of the following indicates the type of variation for each of the human characteristics given?

	Height	**Skin colour**	**Ear lobe types**
A	discontinuous	continuous	discontinuous
B	continuous	continuous	discontinuous
C	discontinuous	discontinuous	continuous
D	discontinuous	continuous	continuous

(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 1.2.7) in the ANSWER BOOK.

1.2.1 The type of inheritance which produces an intermediate phenotype

1.2.2 The point where adjacent chromatids overlap during crossing over

1.2.3 The process whereby information is copied from DNA to RNA in the nucleus of a cell

1.2.4 The sugar found in a DNA molecule

1.2.5 The bond that occurs between nitrogenous bases in a DNA molecule

1.2.6 The manipulation of an organism's genes to obtain a desired characteristic

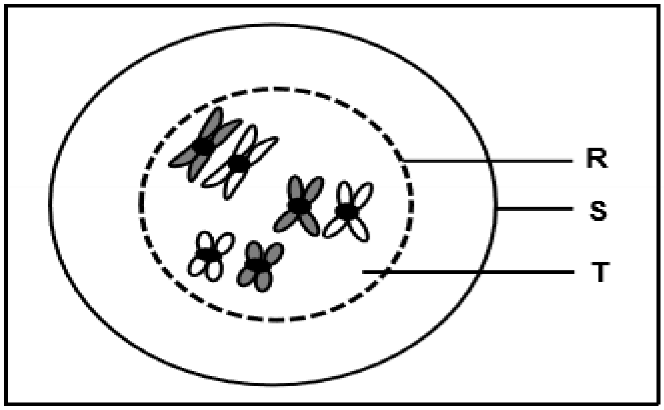
1.2.7 The representation showing the arrangement of a diploid set of chromosomes (7 x 1) **(7)**

1.3 Indicate whether each of the descriptions in COLUMN I apply 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	Source of variation in a species	A: random mating B: random fertilisation
1.3.2	An organism possesses two factors which separate so that each gamete contains only one of these factors	A: law of dominance B: principle of independent assortment
1.3.3	Reproductive isolating mechanism in species	A: breeding in the same season of the year B: infertile offspring

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

1.4 The diagram below represents a cell in an early stage of meiosis.



1.4.1 Give the:

(a) Phase of meiosis represented (1)

(b) Number of chromatids shown (1)

(c) Number of homologous chromosome pairs (1)

1.4.2 Identify structure:

(a) **R** (1)

(b) **S** (1)

(c) **T** (1)

1.4.3 Name TWO organs in an animal where meiosis occurs. (2)
(8)

1.5 The brinjal plant carries edible fruit. Scientists have been studying the inheritance of two genes, one for stem texture and the other for fruit shape.

The stems can be smooth **(N)** or prickly (**n**), while the fruit shape can be round **(R)** or elongated **(r)**.

1.5.1 Name the type of cross that studies two characteristics. (1)

1.5.2 State the:

(a) Dominant characteristic for stem texture (1)

(b) Recessive characteristic for fruit shape (1)

1.5.3 Give the:

(a) Genotype of a plant with a prickly stem and elongated fruit (2)

(b) Phenotype of a plant with the genotype NnRR (2)
(7)

1.6 The table below shows information on selected hominid fossils.

Common name of the fossil	Species	Fossil site	Scientists responsible for discovery
P	*Australopithecus sediba*	Malapa Cave in the Cradle of Humankind	**Q**
Taung Child	**R**	Sterkfontein Caves	**S**

1.6.1 Name fossil **P**. (1)

1.6.2 Identify the species at **R**. (1)

1.6.3 Give the name of the scientist at:

(a) **Q** (1)

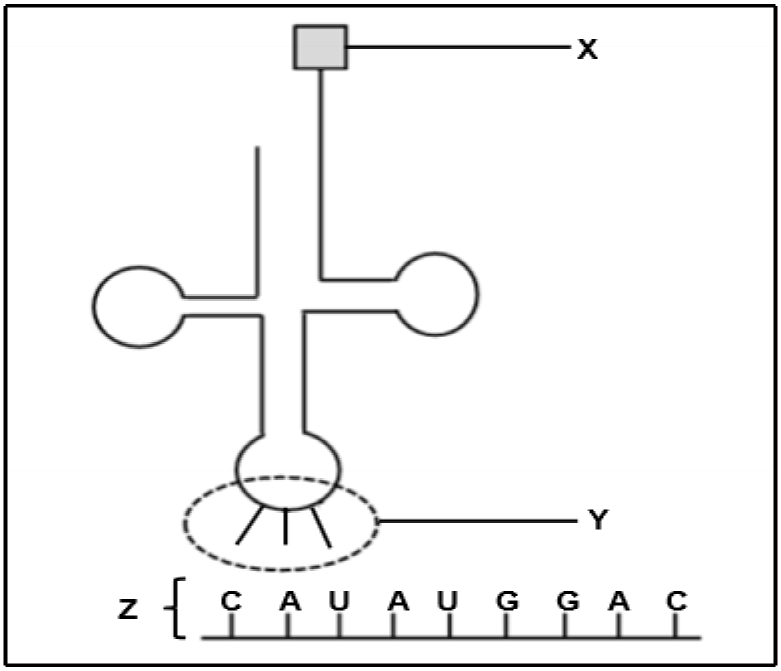
(b) **S** (1)
(4)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents a process that occurs during protein synthesis.



2.1.1 Identify molecule:

(a) **X** (1)

(b) **Z** (1)

2.1.2 Give the nitrogenous base sequence of:

(a) The DNA base triplet complementary to the middle codon on molecule **Z** (2)

(b) **Y** (1)

2.1.3 Name and describe the process shown in the diagram during the formation of a protein. (7)
(12)

2.2 The table below shows the codons that code for some amino acids.

mRNA codon	Amino acid
AUG	methionine
CAU	histidine
CUA	leucine
GUA	valine
GAC	aspartic acid
GAG	glutamic acid
GAU	aspartic acid

A mutation caused a DNA base triplet to change from CTG to CTA.

Describe the effect of this mutation on the protein formed. **(4)**

2.3 Tabulate TWO differences between *DNA* and *RNA nucleotides*. **(5)**

2.4 Down syndrome is the result of an individual having an extra copy of chromosome 21.

Two genetic variations that can cause Down syndrome are:

- Trisomy 21
  All the somatic cells in an individual have three copies of chromosome 21 due to an abnormal process that occurs during gamete production.
- Mosaic Down syndrome
  The individual has only some cells with an extra copy of chromosome 21 which is caused by an abnormal process during cell division after fertilisation.

2.4.1 Name the:

(a) Type of mutation that leads to Trisomy 21 (1)

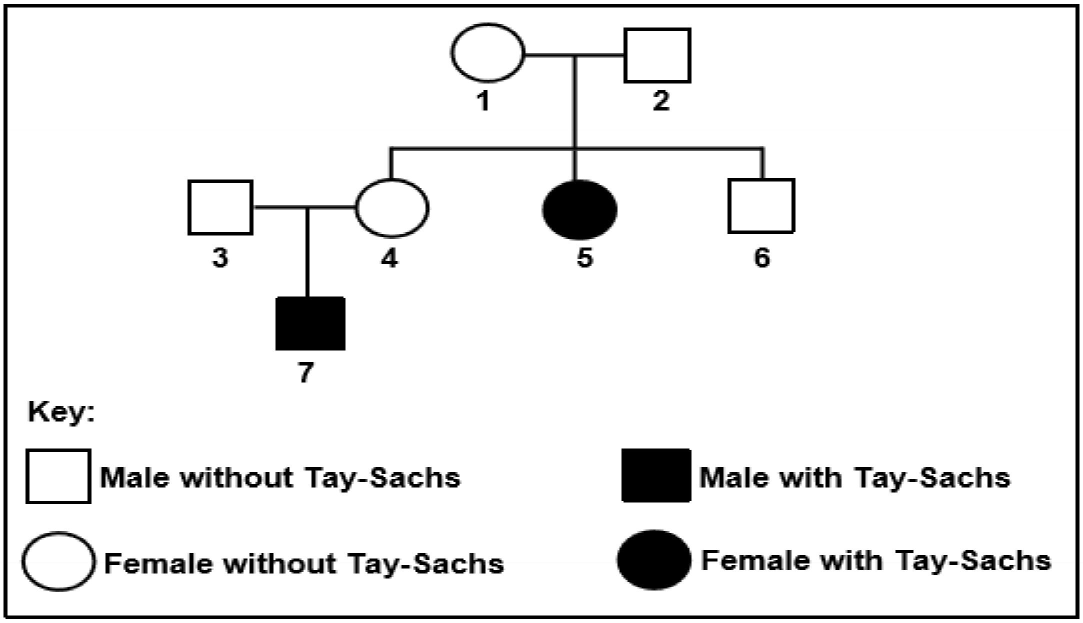
(b) Abnormal process during gamete production that leads to three copies of chromosome 21 (1)

(c) Type of cell division that occurs after fertilisation (1)

2.4.2 Describe how the process in QUESTION 2.4.1(b) leads to Trisomy 21. (5)

2.4.3 Describe TWO differences between *Trisomy 21* and *Mosaic Down syndrome*. (4)
(12)

2.5 The diagram below shows the inheritance of Tay-Sachs, a rare disease which leads to the destruction of neurons. It is inherited as an autosomal disorder, controlled by two alleles, **(T)** and **(t)**.



2.5.1 Describe what is meant by an *autosomal disorder*. (2)

2.5.2 How many sons do individuals **1** and **2** have? (1)

2.5.3 Using individuals **3**, **4** and **7**, explain why it can be concluded that Tay-Sachs disease is controlled by a recessive allele. (5)

2.5.4 Individuals **1** and **2** can produce children with three possible genotypes.

List ALL the genotypes that have a 25% chance of being produced. (2)
(10)

2.6 In humans, haemophilia is caused by a recessive allele on the X-chromosome (**X^h**).

A woman, who is heterozygous for haemophilia, marries a man with haemophilia.

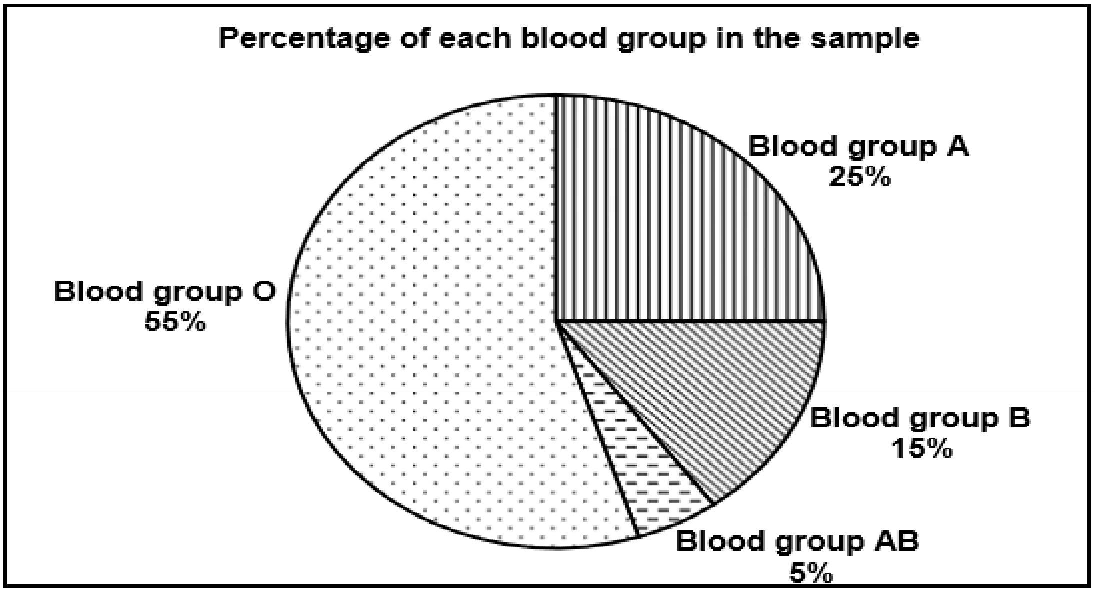
Use a genetic cross to show the percentage chance of the couple having a *daughter* who is homozygous for normal blood clotting. **(7)**
[50]

QUESTION 3

3.1 Learners conducted an investigation to determine which blood group was the most common in their community.

They collected information about the blood groups of 200 blood donors in each of the three blood donor clinics in their community. They did not include first-time donors in the investigation.

The pie chart below shows the results of the investigation.



3.1.1 State the aim of the investigation. (2)

3.1.2 Answer the following questions:

(a) State THREE planning steps to consider when conducting this investigation. (3)

(b) State ONE way in which the learners ensured the reliability of the results. (1)

(c) Give ONE reason why they did not include first-time donors. (1)

3.1.3 Calculate the number of participants that had blood group **B**. Show ALL workings. (3)

3.1.4 Name the blood group which:

(a) Has only recessive alleles in the genotype (1)

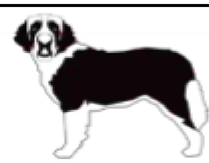
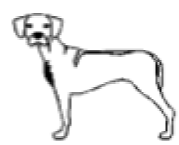
(b) Is a result of co-dominance (1)

3.1.5 Give ALL the possible genotypes of the blood group represented by 25% of the donors. (2)
(14)

3.2 Dogs have been selected and bred over many years to produce approximately 340 different dog breeds. They have been bred for certain characteristics desirable to humans.

An analysis of 736 base pairs of the cytochrome-b gene showed that grey wolves are the only direct ancestor to present-day dog breeds. All dog breeds belong to the species *Canis familiaris*.

The table below shows some dog breeds and their desirable characteristics.

Grey wolf	Dog breeds	Characteristics
	 **Poodle**	Intelligent
	 **Pug**	Loving, affectionate and playful
	 **Saint Bernard**	Outgoing and adventurous
	 **Rhodesian ridgeback**	Strong, athletic and fast

3.2.1 Name the process whereby the different breeds of dogs were produced. (1)

3.2.2 Describe how humans carried out the process named in QUESTION 3.2.1. (3)

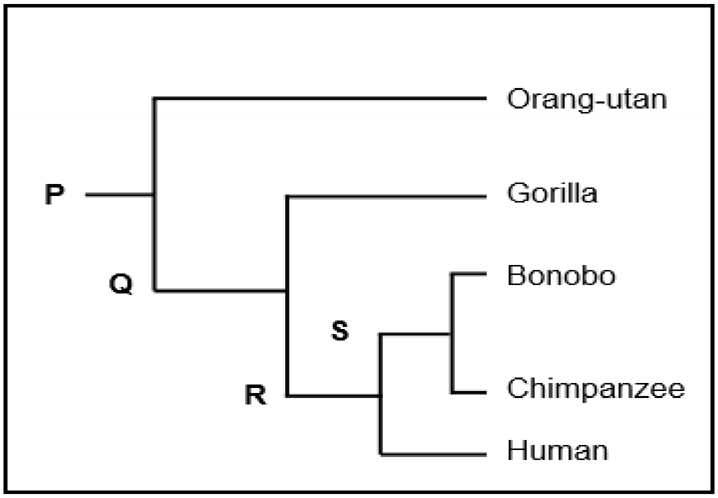
3.2.3 Explain how it can be confirmed that all these dog breeds belong to the same species. (2)

3.2.4 Explain which of the dog breeds shown would best be used for hunting. (2)

3.2.5 Explain how present-day dog breeds may be disadvantaged in relation to their common ancestor. (3)
(11)

3.3 Describe the process of *speciation* through geographic isolation. **(7)**

3.4 The diagram below represents the evolution of the family Hominidae.



3.4.1 Name the type of diagram represented above. (1)

3.4.2 Give the LETTER of the organism which:

(a) Is the common ancestor of all hominids (1)

(b) Shares the most recent common ancestor with the gorilla (1)

3.4.3 Name TWO organisms that:

(a) Have **S** as a common ancestor (2)

(b) Are quadrupedal (2)

3.4.4 Describe THREE anatomical features of the skeleton of a quadrupedal hominid. (3)
(10)

3.5 Fossil evidence is used to support the 'Out-of-Africa' hypothesis.

3.5.1 State the 'Out-of-Africa' hypothesis. (2)

3.5.2 Describe how fossil evidence is used to support the 'Out-of-Africa' hypothesis. (6)
(8)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS

LIFE SCIENCES P2

2023

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 11 pages.

SECTION A

QUESTION 1

1.1	1.1.1	B✓✓		
	1.1.2	C✓✓		
	1.1.3	C✓✓		
	1.1.4	A✓✓		
	1.1.5	D✓✓		
	1.1.6	C✓✓		
	1.1.7	B✓✓		
	1.1.8	D✓✓		
	1.1.9	B✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Incomplete dominance✓		
	1.2.2	Chiasma✓/chiasmata		
	1.2.3	Transcription✓		
	1.2.4	Deoxyribose✓		
	1.2.5	Hydrogen✓ (bond)		
	1.2.6	Genetic engineering✓		
	1.2.7	Karyotype✓	(7 x 1)	**(7)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	None✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Prophase I✓		(1)
		(b) Twelve✓/12		(1)
		(c) Three✓/3		(1)
	1.4.2	(a) Nuclear membrane✓		(1)
		(b) Cell membrane✓/plasmalemma/plasma membrane		(1)
		(c) Nucleoplasm✓		(1)
	1.4.3	- Testes✓		(1)
		- Ovaries✓		(1)
		(Mark first TWO only)		
				(8)

	1.5.1	Dihybrid✓ cross		(1)
	1.5.2	(a)	Smooth✓ stem	(1)
		(b)	Elongated✓ fruit	(1)
	1.5.3	(a)	nnrr✓✓/nrnr/ rrnn	(2)
		(b)	Smooth stem round fruit✓✓	(2) **(7)**
1.6	1.6.1	Karabo✓		(1)
	1.6.2	*Australopithecus africanus*✓		(1)
	1.6.3	(a)	(Lee) Berger✓	(1)
		(b)	(Raymond) Dart✓	(1) **(4)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) Amino acid✓ (1)

(b) mRNA✓ (1)

2.1.2 (a) TAC✓✓ (2)

(b) GUA✓ (1)

2.1.3 Translation✓*
- Each tRNA carries a specific amino acid✓
- When the anticodon on the tRNA✓/GUA
- matches the codon on the mRNA✓/CAU
- then tRNA brings the required amino acid to the ribosome✓
- Amino acids become attached to each other by peptide bonds✓
- to form the required protein✓ **1* compulsory +** 6 (7)

(12)

2.2
- Codon GAC✓ (on the mRNA)
- changed to GAU✓
- Both these codons code for the same amino acid✓/Aspartic acid
- therefore there will be no effect✓ on the protein formed **(4)**

2.3

DNA	RNA
Has deoxyribose✓ sugar	Has ribose✓ sugar
Has thymine✓/nitrogenous base T	Has uracil✓/nitrogenous base U

(Mark first TWO only) Table 1 + (2 x 2) **(5)**

2.4 2.4.1 (a) Chromosomal✓mutation (1)

(b) Non-disjunction✓ (1)

(c) Mitosis✓ (1)

2.4.2
- The chromosome pair/chromatids failed to separate✓
- at position 21✓
- during anaphase✓(I or II)
- resulting in one daughter cell having an extra chromosome✓/ 24 chromosomes
- Fusion of a gamete with 24 chromosomes✓
- and a normal gamete✓/gamete with 23 chromosomes
- results in a zygote with 47 chromosomes✓/extra chromosome at position 21 Any (5)

2.4.3
- In Trisomy 21 there is an extra chromosome/three copies of chromosome 21 in each somatic cell✓
  In Mosaic Down syndrome there is an extra chromosome only in some cells✓
- Trisomy 21 occurs during meiosis✓/before fertilisation
  Mosaic Down syndrome occurs during mitosis✓/after fertilisation (2 x 2) (4)

(Mark first TWO only)

(12)

2.5 2.5.1
- The disorder is controlled by alleles✓/genes that
- are located on the autosomes✓ (2)

2.5.2
- One✓/1 (1)

2.5.3
- Individuals 3 and 4 are both without Tay-Sachs disease✓
- The child has Tay-Sachs✓/Individual 7 has Tay-Sachs
- which is only expressed in the phenotype in a homozygous condition✓
- Each parent must carry a recessive allele✓/be heterozygous
- The child has two recessive alleles✓
- One was received from each parent✓

OR

- Individuals 3 and 4 are both without Tay-Sachs disease✓
- If it was caused by a dominant allele✓
- then individual 3 or 4 would *have* Tay Sachs✓
- and still have a child with Tay-Sachs✓/individual 7 has Tay-Sachs
- who could be heterozygous✓ Any (5)

2.5.4
TT✓
tt✓ (2)

(10)

2.6 **P_1** Phenotype: Woman without haemophilia x Man with haemophilia✓

Genotype: X^HX^h x X^hY✓

Meiosis

G/gametes: X^H, X^h x X^h, Y✓

Fertilisation

F_1 Genotype: X^HX^h, X^HY, X^hX^h, X^hY✓

Phenotype: 1 daughter without haemophilia, 1 daughter with haemophilia, 1 son without haemophilia, 1 son with haemophilia✓

0%✓*chance of a daughter homozygous for normal blood clotting

P_1 and F_1✓
Meiosis and fertilisation✓

*1 **compulsory mark** + any 6

OR

P_1 Phenotype: Woman without haemophilia x Man with haemophilia✓

Genotype: X^HX^h x X^hY✓

Meiosis

Fertilisation

Gametes	X^H	X^h
X^h	X^HX^h	X^hX^h
Y	X^HY	X^hY

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype: 1 daughter without haemophilia, 1 daughter with haemophilia, 1 son without haemophilia, 1 son with haemophilia✓

0%✓* chance of a daughter homozygous for normal blood clotting

P_1 and F_1✓
Meiosis and fertilisation✓

*1 **compulsory mark**+ any 6 **(7)**

[50]

QUESTION 3

3.1 3.1.1 To determine which blood group was the most common in their community✓✓ (2)

3.1.2 (a)
- Obtain permission from the school✓/clinic to conduct the investigation
- Decide on the sample size✓
- Decide on the method for recording results✓
- Decide on time✓/date to collect data from the clinic (3)

(Mark first THREE only)

(b)
- Sampled 3✓/all blood donor clinics in the community
- 200 donors per clinic sampled✓/600 donors Any (1)

(Mark first ONE only)

(c) First time donors' blood groups are not known yet✓/ not in the database (1)

3.1.3 $\left.\frac{15}{100}\right\}$✓x 600✓= 90✓ participants (3)

3.1.4 (a) (Blood group) O✓ (1)

(b) (Blood group) AB✓ (1)

3.1.5 $I^A I^A$ ✓
$I^A i$✓ (2)
(14)

3.2 3.2.1 Artificial selection✓/selective breeding (1)

3.2.2
- They chose dogs with desirable traits✓
- and interbred✓ them to
- produce offspring with these traits✓ (3)

3.2.3
- Allow them to interbreed with each other✓
- and see whether they produce fertile offspring✓

OR

- Analysis of DNA✓
- to check for matching sequences✓ (2)

3.2.4
- Rhodesian ridgeback✓
- is strong, athletic and fast✓
- is able to catch the prey✓ Any (2)

3.2.5
- Due to reduction in gene pool✓/variation
- they will not be able to hunt✓/find shelter/defend themselves
- as well as wolves are able to✓
- therefore unable to survive in the wild✓

(3)
(11)

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✓
- The two populations are now different species✓

Any **(7)**

3.4 3.4.1 Phylogenetic tree✓/cladogram (1)

3.4.2 (a) P✓ (1)

(b) R✓ (1)

3.4.3 (a) Bonobo✓
Chimpanzee✓ (2)
(Mark first TWO only)

(b) Orang-utan✓
Gorilla✓
Bonobo✓
Chimpanzee✓ Any (2)
(Mark first TWO only)

3.4.4
- Foramen magnum at a more backward position✓
- C-shaped spine✓
- Pelvis long and narrow✓ (3)

(**Mark first THREE only)**

(10)

3.5 3.5.1 (Modern) humans originated in Africa✓ and migrated to other parts of the world✓ (2)

3.5.2
- Fossils of *Ardipithecus* were found in Africa only✓
- Fossils of *Australopithecus* were found in Africa only✓
- Fossils of *Homo habilis* were found in Africa only✓
- The oldest fossils of *Homo erectus* were found in Africa✓while the younger fossils of *Homo erectus* were found in other parts of the world✓
- The oldest fossils of *Homo sapiens* were found in Africa✓while
- the younger fossils of *Homo sapiens* were found in other parts of the world✓ Any (6)

(8)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2015

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

SECTION A

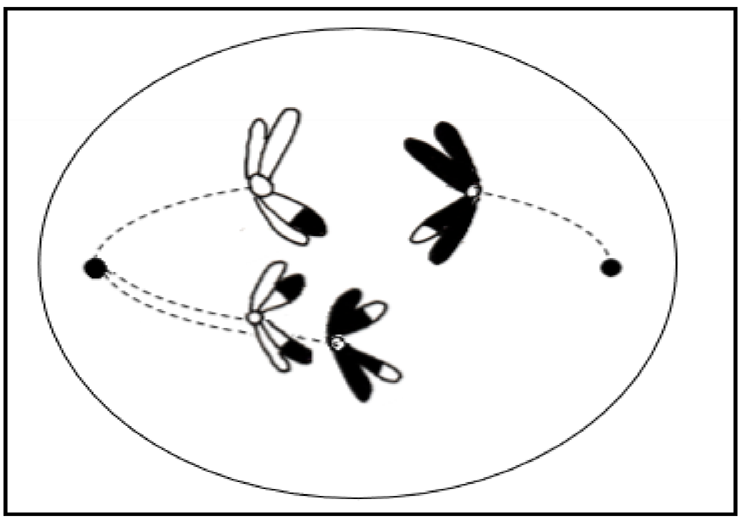
QUESTION 1

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 number (1.1.1 to 1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1.1 Cells that can differentiate into any type of cell are called ...

A sex cells.
B daughter cells.
C stem cells.
D haploid cells.

1.1.2 The diagram below shows a cell undergoing meiosis.



The diagram above shows ...

A non-disjunction in metaphase II.
B a chromosomal aberration that results in haemophilia.
C a chromosomal aberration involving chromosome pair number 23, leading to Down syndrome.
D non-disjunction in anaphase I.

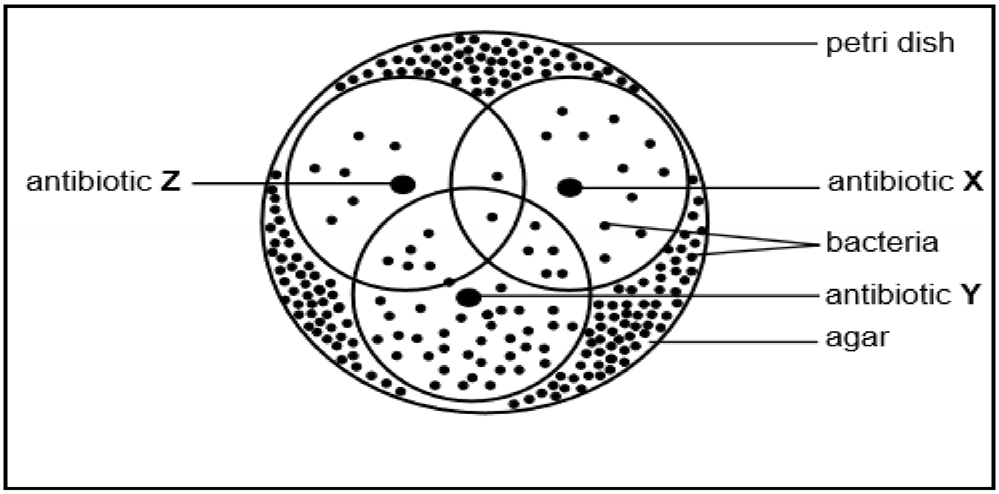
1.1.3 The DNA of different species only differs in the ...

A components of the nucleotides.
B sequence of the nucleotides.
C type of bond between the nitrogenous bases.
D type of sugar that it contains.

1.1.4 One strand of a DNA molecule has 60 adenine and 20 thymine molecules. How many adenine molecules are present in the double-stranded DNA molecule?

A 60
B 150
C 80
D 300

1.1.5 The diagram below shows the effect of three different types of antibiotic (**X**, **Y** and **Z**) on a single strain of bacterium growing on agar (nutrient jelly) in a petri dish. The three circles indicate the distance to where each antibiotic spread.



The correct order of the antibiotics, from most effective to least effective, is ...

A Z, X and Y.
B X, Y and Z.
C X, Z and Y.
D Z, Y and X.

1.1.6 A trait that has a range of phenotypes is an example of ...

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

1.1.7 In the most stable freshwater environments populations of *Daphnia* are almost entirely female and reproduce asexually. However, males are observed in low-oxygen environments or when food is scarce.

Based on these observations, a researcher suggests at the start of an experiment that:

Male *Daphnia* only develop in response to unfavourable environmental conditions.

This is an example of a/an …

A conclusion.
B hypothesis.
C theory.
D aim.

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE INFORMATION BELOW.

In pea plants yellow seed colour (Y) is dominant over green seed colour (y). Smooth seed texture (S) is dominant over wrinkled seed texture (s).

A student crossed a plant which had yellow wrinkled seeds with a plant which had green smooth seeds.

1.1.8 Which ONE of the following shows possible alleles present in a gamete that is produced by the plant with yellow wrinkled seeds?

A YYss
B yySS
C yS
D Ys

1.1.9 Which ONE of the following is a possible representation of the genotypes of the P_1 generation?

A YYSS x yyss
B Yyss x yySs
C YYSS x yySs
D Yyss x YySs (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 1.2.9) in the ANSWER BOOK.

1.2.1 Chromosomes that carry the same set of genes

1.2.2 Two or more alternative forms of a gene at the same locus

1.2.3 The structure responsible for pulling chromosomes to the poles of an animal cell during cell division

1.2.4 A phase in the cell cycle that occurs before cell division

1.2.5 A diagrammatic representation showing possible evolutionary relationships among different species

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

1.2.7 A genetic cross involving two characteristics

1.2.8 A genetic disorder characterised by the absence of a blood-clotting factor

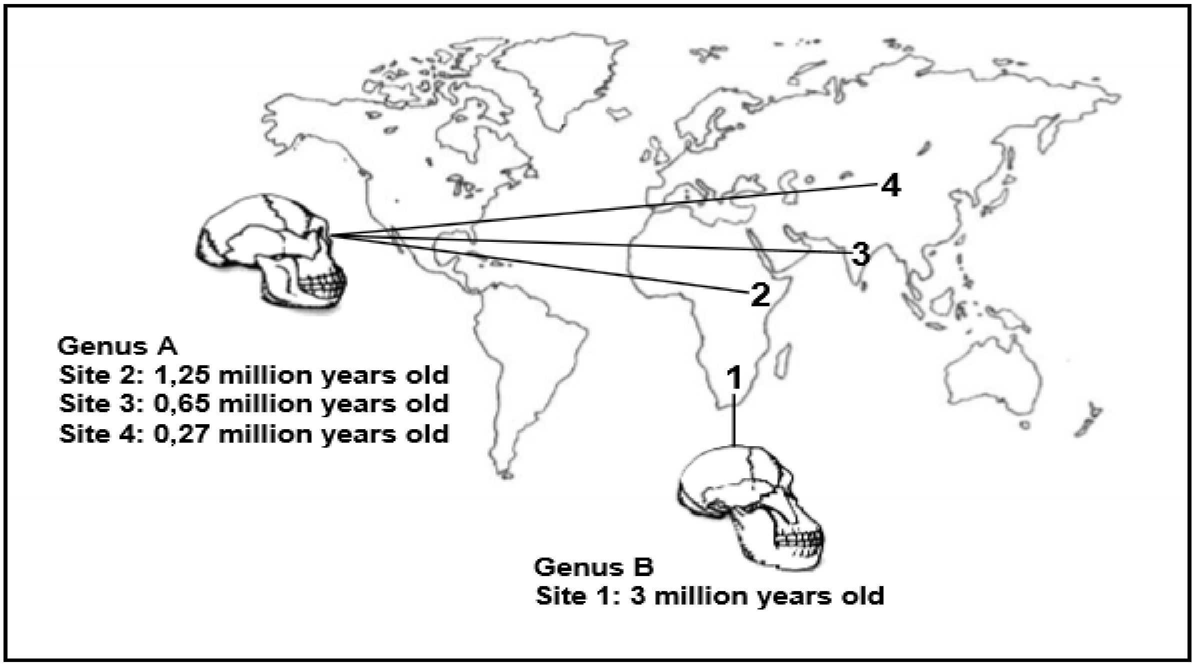
1.2.9 The present-day distribution of organisms **(9)**

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 1.3.4) in the ANSWER BOOK.

COLUMN I		COLUMN II	
1.3.1	Produced the first X-ray pictures of DNA	A: B:	Watson Franklin
1.3.2	An example of biotechnology	A: B:	Genetic modification Cloning
1.3.3	Law of inheritance of acquired characteristics	A: B:	Darwin Lamarck
1.3.4	All the genes in all the chromosomes of a species	A: B:	Genome Genotype

(4 x 2) **(8)**

1.4 The diagram below shows a world map indicating four sites (**1** to **4**) where hominid fossils, representing two different genera, have been found. Genus **A** was found at three sites and genus **B** at one site. The age of each fossil was determined using radiometric dating.



[Adapted from www.biologyreference.com]

1.4.1 Which genus (**A** or **B**):

(a) Represents *Australopithecus* (1)

(b) Had a more prognathous skull (1)

(c) Had smaller canines (1)

(d) Is more closely related to *Homo sapiens* (1)

1.4.2 Name TWO examples of fossils of genus **B** found at site **1** in South Africa. (2)

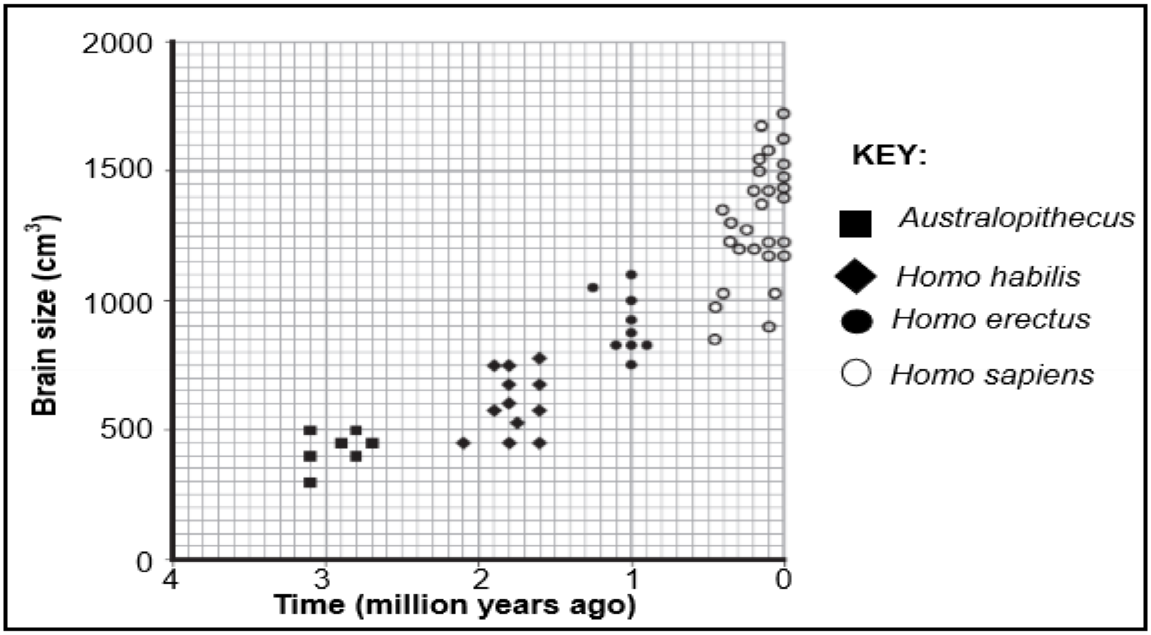
1.4.3 At which site, **1** to **4**, were the youngest fossils found? (1)

1.4.4 Other than fossil evidence, what other evidence can be used to support the Out of Africa hypothesis? (1)
(8)

1.5 Scientists estimated the brain sizes of *Australopithecus, Homo habilis, Homo erectus* and *Homo sapiens* by using the cranial capacity of fossil specimens. They then compared their results to the time that each hominid existed on earth.

The graph below represents the range of brain size and the time period that the hominid existed according to fossil evidence.

The results of the investigation are shown on the graph below.



[Adapted from *AQA-BLY1B-W-QP-NOV07 Unit 1b*]

1.5.1 According to the graph:

(a) When did the first *Australopithecus* appear (2)

(b) Which of the species shows the greatest variation in brain size (1)

1.5.2 Give the size (in cm^3) of the:

(a) Largest brain of *Australopithecus* (1)

(b) Smallest brain of *Homo sapiens* (1)

1.5.3 State TWO types of evidence, other than fossils, that support the idea that all hominids evolved from a common ancestor. (2)
(7)

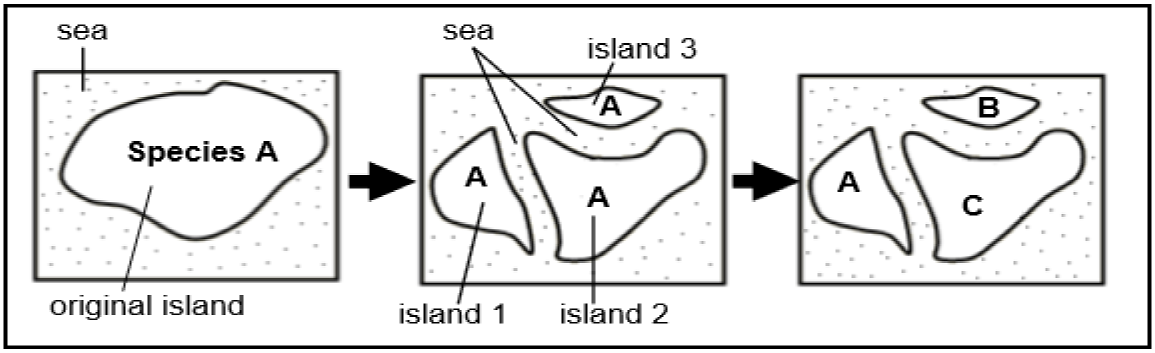
TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagrams below represent the process of speciation in tortoises.

Over a period of time species **B** and **C** evolved from species **A**.



2.1.1 Explain why species **A** continued to exist on island **1**. (2)

2.1.2 Describe how species **B** and **C** evolved from species **A**. (6)
(8)

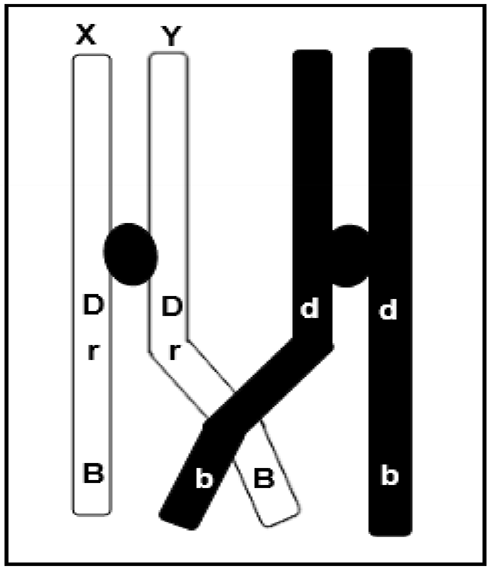
2.2 The father of a child can be determined by analysing blood groups.

2.2.1 Explain how an analysis of blood groups can be used to determine paternity. (5)

2.2.2 A man and a woman both have blood group **B**.

Use a genetic cross to show how it is possible for them to have a child with blood group **O**. (6)
(11)

2.3 The diagram below shows crossing over during meiosis.



2.3.1 Name the phase of meiosis during which the process represented above takes place. (1)

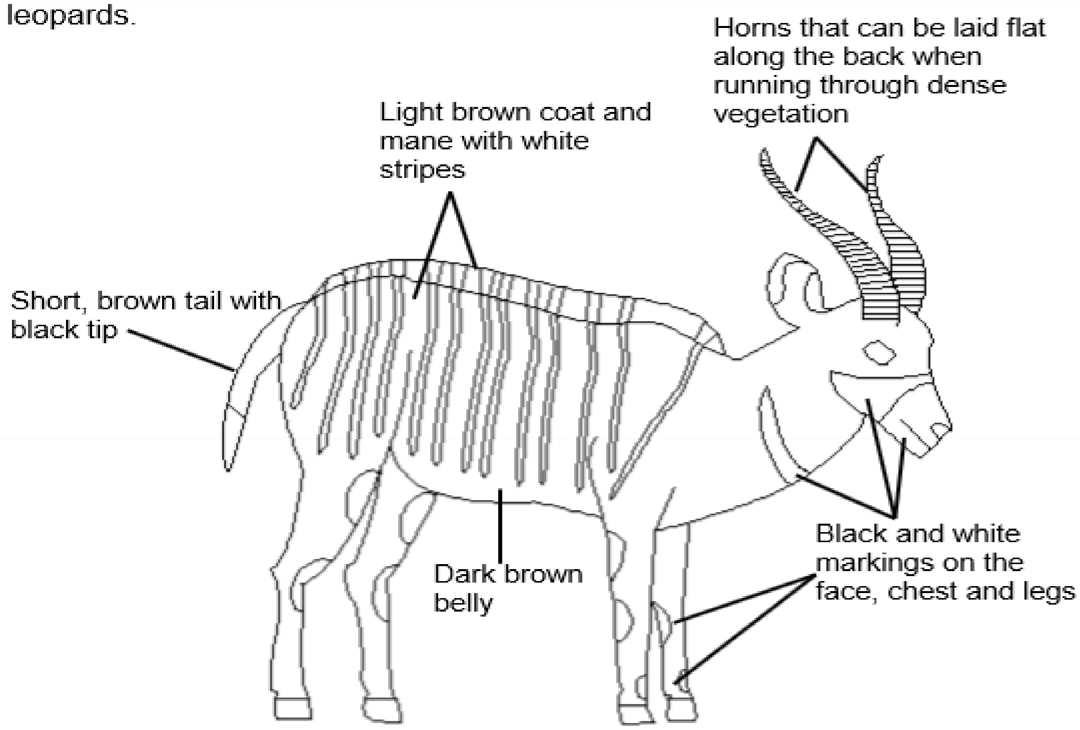
2.3.2 Describe the process of *crossing over*. (3)

2.3.3 Explain the importance of crossing over. (2)

2.3.4 Draw a diagram, giving the position of the alleles, to show the structure of chromatid **Y** after crossing over. (2)
(8)

2.4 The extract and the diagram below provide information about a type of antelope called a Bongo.

The Bongo is a large antelope species that is active at night and found in the dense jungles and forests of Africa. The dense forests have very little ground vegetation so the Bongo feeds in forest openings where new herbs and shrubs grow closer to the ground. They are preyed on by lions and leopards.



2.4.1 State TWO characteristics that help the Bongo to camouflage themselves in the dense jungle. (2)

2.4.2 Use your knowledge of natural selection and explain how the Bongo's ability to lay its horns along its back could have developed over the years. (5)
(7)

2.5 The characteristics of organisms can be changed through selective breeding and the genetic engineering process.

2.5.1 State TWO similarities between the *selective breeding process* and the *genetic engineering process*. (2)

2.5.2 Explain TWO reasons why some people may be against the use of genetic engineering. (4)
(6)
[40]

QUESTION 3

3.1 Read the extract below.

> The recent Ebola outbreak has international medical organisations on high alert. The Ebola virus is deadly because it causes uncontrolled bleeding. The virus is only spread through direct contact with body fluids. There is, however, concern as to whether the Ebola virus could mutate, thereby enabling it to be transmitted through the air. If this happens, the virus would spread more easily.
>
> This virus contains RNA only and when RNA is copied, many more mistakes are made than when DNA is copied. The Ebola virus, therefore, displays high mutation rates that generate lots of genetic variation.
>
> [Adapted from https://www.evolution.berkeley.edu]

3.1.1 State why viruses that contain only RNA show more genetic variation than viruses containing DNA. (2)

3.1.2 Use ONE example from the extract above to explain how mutations could increase the survival rate of the virus. (2)
(4)

3.2 The questions below are based on nucleic acids.

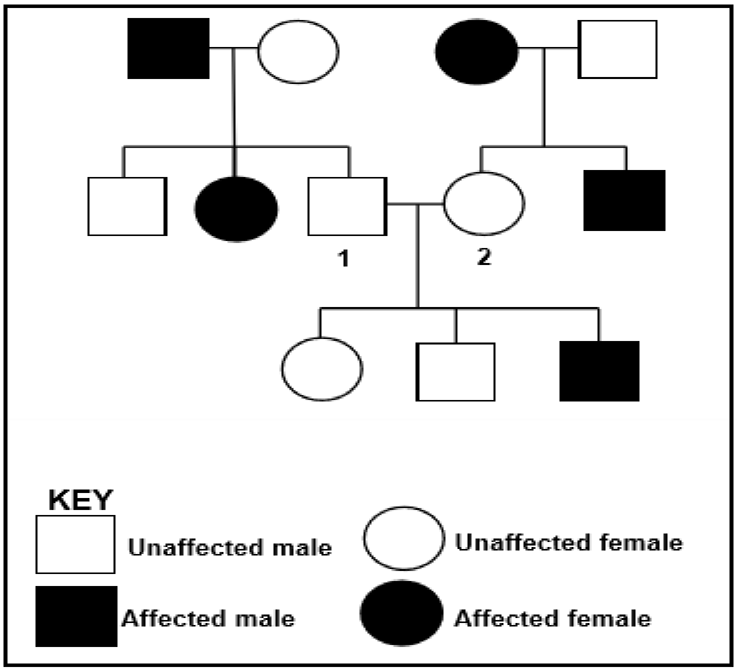
3.2.1 Tabulate THREE structural differences between DNA and RNA. (7)

3.2.2 State TWO uses of DNA profiling. (2)

3.2.3 Give TWO views against the use of DNA profiling. (2)
(11)

3.3 A lack of immunity to infections (agammaglobulinemia) is a sex-linked recessive genetic disorder in humans. The dominant allele is represented by $\mathbf{X^A}$ and the recessive allele is represented by $\mathbf{X^a}$.

An individual with the disorder is described as affected and an individual without it is described as unaffected. The pedigree diagram below illustrates inheritance of this disorder.



3.3.1 Name the genotypes of individuals:

(a) **1** (2)

(b) **2** (2)

3.3.2 What percentage of the males in this pedigree diagram is affected? Show ALL working. (2)

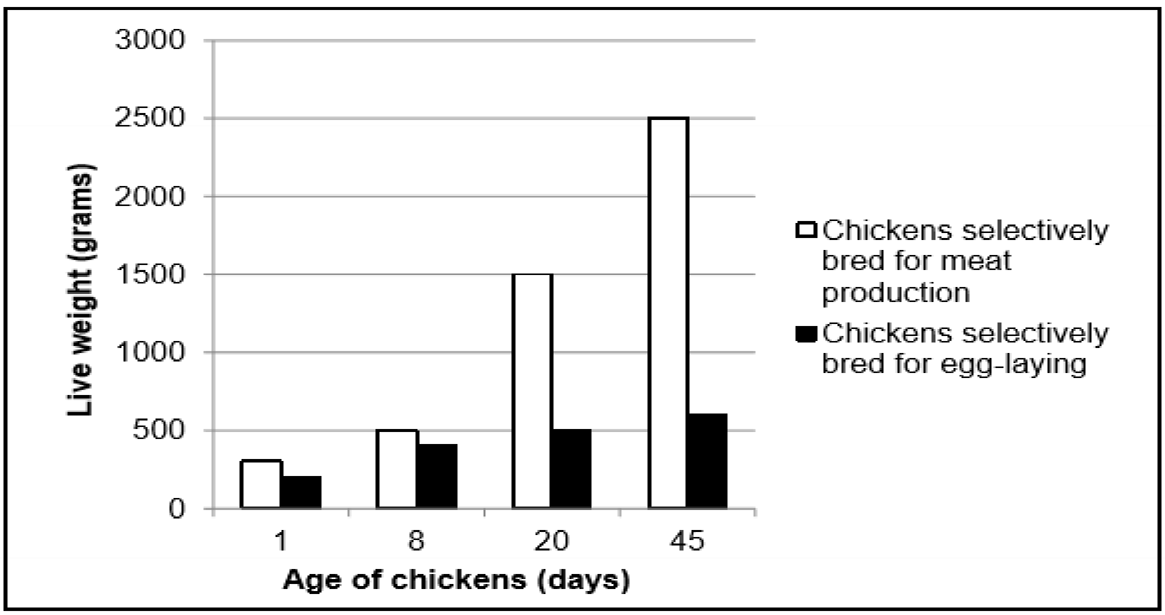
3.3.3 Explain why any son of an affected female will always have this disorder. (3)
(9)

3.4 An investigation was done by Grade 12 learners to determine which chickens grow faster: chickens that are selectively bred for laying eggs or chickens that are selectively bred for meat production.

The following steps were carried out:

1. The learners bought 30 one-day-old chickens from a commercial supplier. Fifteen of the chickens had been selectively bred for laying eggs and 15 of the chickens had been selectively bred for meat production.
2. All the chickens were kept under the same environmental conditions. This included being fed the same chicken feed, made mostly from cereal grains and protein sources.
3. The chickens were weighed regularly for a period of 45 days.

The results of the investigation are shown in the graph below.



[Adapted from www.chicken.org.au]

3.4.1 Formulate a hypothesis for this investigation. (2)

3.4.2 State the independent variable in this investigation. (1)

3.4.3 Calculate the percentage weight increase of the chickens that were selectively bred for meat between day 8 and day 45. Show ALL working. (2)

3.4.4 State ONE advantage of repeating the investigation with 100 chickens. (2)

3.4.5 State THREE factors that the learners should keep constant in this investigation. (3)

3.4.6 Write a suitable conclusion for the investigation based on the results in the graph. (2)

3.4.7 State TWO benefits of the selective breeding of chickens, other than for increasing meat production. (2)

3.4.8 Explain ONE reason why selective breeding of chickens for better meat production may not be an advantage for the chickens if they were to live in the wild. (2)
(16)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe the process of protein synthesis and the way in which this process would be affected by a gene mutation.

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

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2015

MEMORANDUM 2015

MARKS: 150

This memorandum consists of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	C✓✓		
	1.1.2	D✓✓		
	1.1.3	B✓✓		
	1.1.4	C✓✓		
	1.1.5	A✓✓		
	1.1.6	A✓✓		
	1.1.7	B✓✓		
	1.1.8	D✓✓		
	1.1.9	B✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Homologous✓/homologues/bivalent		
	1.2.2	Alleles✓/Multiple alleles		
	1.2.3	Spindle fibres✓/spindle threads/spindle apparatus		
	1.2.4	Interphase✓		
	1.2.5	Phylogenetic tree✓/cladogram		
	1.2.6	Binocular✓/stereoscopic		
	1.2.7	Dihybrid✓cross		
	1.2.8	Haemophilia✓		
	1.2.9	Biogeography✓	(9 x 1)	**(9)**
1.3	1.3.1	B only✓✓		
	1.3.2	Both A and B ✓✓		
	1.3.3	B only✓✓		
	1.3.4	A only✓✓	(4 x 2)	**(8)**
1.4	1.4.1	(a) B✓		(1)
		(b) B✓		(1)
		(c) A✓		(1)
		(d) A✓		(1)
	1.4.2	Mrs Ples✓ } *A. africanus* Taung Child✓ } *A. africanus* Little Foot✓/ *A. prometheus* Karabo✓/ *A. sediba* **(*Mark first TWO only*)**	Any 2	(2)
	1.4.3	Site 4✓		(1)
	1.4.4	Mitochondrial DNA✓/mtDNA/genetic evidence/ Y-chromosome/cultural evidence **(*Mark first ONE only*)**		(1) **(8)**

1.5	1.5.1	(a) 3,1✓ mya✓ (Accept 3,05 to 3,15 mya)		(2)
		(b) *Homo sapiens*✓/*H. sapiens*		(1)
	1.5.2	(a) 500✓ cm^3 (Accept 495 to 505 cm^3)		(1)
		(b) 850✓ cm^3 (Accept 845 to 855 cm^3)		(1)
	1.5.3	Genetic evidence✓/mitochondrial DNA/mtDNA Cultural evidence✓/tool making Comparative anatomy✓ between living hominids **(*Mark first TWO only*)**	Any 2	(2) **(7)**

TOTAL SECTION A: 50

QUESTION 2

2.1 2.1.1
- Conditions/example on the island probably remained the same✓
- so they experienced the same selection pressure✓
- species A was already suited to those conditions✓ Any 2 (2)

2.1.2
- The original species was separated✓ into three/different populations
- **by the sea✓***
- which acted as a geographical barrier✓
- There was no gene flow✓ between the populations
- Each population was exposed to different environmental conditions✓
- Natural selection occurred independently✓ in each population
- and the individuals of each population became different✓ from each other over time
- genotypically✓/phenotypically
- Even if the three populations were to mix again✓
- they would not be able to reproduce with each other✓/interbreed 1 *Compulsory mark + Any 5 (6)

(8)

2.2 2.2.1
- The blood groups of the mother, possible father and the child must be compared✓.
- If this shows that it is not possible that these parents can produce a child with his/her blood group✓
- then this man is not the father✓
- If this shows that it is possible that these parents can produce a child with his/her blood group✓
- then he may/may not be the father✓
- because other males have the same blood group✓

Any 5 (5)

2.2.2

P_1	Phenotype	Blood group B	x	Blood group B✓
	Genotype	I^Bi	x	I^Bi✓
Meiosis				
	G/gametes	I^B , i	x	I^B , i ✓
Fertilisation				
F_1	Genotype	I^BI^B; I^Bi; I^Bi; ii ✓		
	Phenotype	3 blood group B : 1 blood group O ✓		

P_1 and F_1✓
Meiosis and fertilisation✓

Any 6

OR

P_1	Phenotype	Blood group B	x	Blood group B✓
	Genotype	I^Bi	x	I^Bi✓

Meiosis

Fertilisation

Gametes	I^B	i
I^B	I^BI^B	I^Bi
i	I^Bi	ii

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype 3 blood group B : 1 blood group O ✓

P_1 and
F_1✓
Meiosis and fertilisation✓ (6)

Any 6 **(11)**

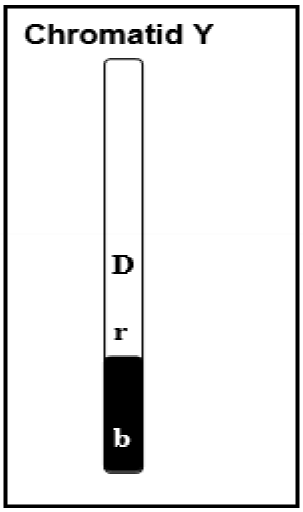
2.3 2.3.1 Prophase I✓ (1)

2.3.2
- Homologous chromosomes lie next to each other✓
- Chromatids overlap✓/touch
- at points called chiasmata✓
- and genetic information is exchanged✓/swapped

Any 3 (3)

2.3.3
- Crossing over introduces genetic variation✓ in gametes
- It may lead to new characteristics which are favourable✓
- or new characteristics which are unfavourable✓
- therefore affecting the chances of survival of the organism✓/ natural selection. Any 2 (2)

2.3.4



ASSESSING THE DIAGRAM	
CRITERIA	**MARKS**
Chromatid Y represented (must be labelled if a whole chromosome is represented)	1
Alleles indicated correctly	1

(2)
(8)

2.4 2.4.1
- Coat is light brown✓ on the upper side
- Dark brown belly✓
- White stripes on the back and mane✓
- Black and white patches on the rest of the body✓
- The tip of the tail is black✓

(Mark first TWO only) Any 2 (2)

2.4.2
- There is variation✓ amongst the Bongo population
- Some have horns that can be laid on their backs✓
- while others do not have horns that can be laid on their backs✓
- The antelope must move through dense vegetation✓ without their horns getting entangled in the vegetation
- Those with horns that cannot be laid on their backs become entangled✓/ die
- Those with horns that can be laid on their backs do not become entangled and escape predators✓/survive
- Those with horns that can be laid back will reproduce✓
- and pass the gene for horns that can be laid on their backs to the next generation✓
- Over many years the proportion of animals that are able to lay their horns on their backs, increases✓

Any 5 (5)
(7)

2.5

2.5.1
- Characteristics that are desirable/beneficial to humans✓ are being selected
- The characteristics are chosen by humans✓/It is an artificial process
- It is not necessarily beneficial for the organism✓

(*Mark first TWO only*) Any 2 (2)

2.5.2
- The long-term effects on health are unknown✓ which could lead to health problems in the future✓
- The long-term effects on the environment are unknown✓ leading to environmental damage✓/loss of biodiversity/ damaging ecosystems/nature
- People are morally opposed✓ as humans are interfering with nature✓/playing God/interfering with the rights of every species
- Initially it is an expensive process✓ and many people/countries may not be able to afford it✓

(*Mark first TWO only*) (Any 2 x 2) (4)
(6)
[40]

QUESTION 3

3.1 3.1.1
- More mistakes are made✓/high rates of mutation
- when RNA is copied✓/than when DNA is copied (2)

3.1.2
- A mutation could allow the virus to be transmitted through the air✓
- This would allow the virus to be spread more easily✓ (2)

(4)

3.2 3.2.1

DNA	RNA
1. Double stranded✓ molecule	1. Single stranded✓ molecule
2. Has a helix✓ shape	2. Is a straight molecule✓
3. One of the nitrogen bases is thymine✓	3. The nitrogen base uracil✓ in place of thymine
4. Contains deoxyribose✓ sugars	4. Contains ribose✓ sugars
5. A longer ✓molecule	5. A shorter✓ molecule
6. Paired bases✓	6. Unpaired bases✓

(Mark first THREE only) (Any 3 x 2)
table +1 (7)

3.2.2 Helps to:
- Solve crimes✓/criminal investigations
- Identify organisms from their tissues✓
- Identify family relationship✓
- Test for specific alleles that can cause a genetic disorder✓
- Establish matching tissues for organ transplants✓
- Used in research into variation in populations ✓

(Mark first TWO only) Any 2 (2)

3.2.3
- Samples containing DNA can be planted✓/person was framed
- Human error✓ during DNA profiling process
- Costly procedure✓
- Invasion of privacy✓

(Mark first TWO only) Any 2 (2)

(11)

3.3 3.3.1 (a) X^AY✓✓ (2)

(b) X^AX^a✓✓ (2)

3.3.2 $\left[\frac{3}{7} \times 100\right]$ ✓ = 42,86✓/42,9/43% (2)

3.3.3
- An affected female carries two/only recessive alleles✓/X^aX^a
- Sons/males inherit one X chromosome✓ from their mothers
- Sons/males need only one recessive allele to be affected✓
- And therefore must inherit X^a from their mother✓

Any 3 (3)

(9)

3.4 3.4.1
- The meat/egg chickens will grow faster/slower than the egg/meat chickens✓✓

OR

- There will be no difference in the rate of growth of the two types of chicken✓✓ (2)

3.4.2 The type✓/age of chicken. (1)

3.4.3 $\left[\frac{2500 - 500}{500} \times 100\right]$✓ = 400✓% (2)

3.4.4 Increase✓ the reliability✓ (2)

3.4.5
- The same person must weigh the chicks✓ to get accurate results
- The same scale✓ must be used to weigh the chicks
- The chicks must be weighed at the same time of day✓
- Same environmental conditions✓/example
- Same type of food✓
- The same amount of food✓
- The same feeding time✓
- Cages must be the same size✓
- Chickens must be female✓
- Age of the chickens✓
- Same number of chickens in each sample group✓
- ***(Mark first THREE only)*** Any 3 (3)

3.4.6 The chickens that underwent selective breeding for meat production grow faster than chickens bred for egg laying✓✓

OR

The chickens that underwent selective breeding for egg laying grow slower than chickens bred for meat production✓✓

OR

The weight of the chickens increases with age✓✓/time (2)

3.4.7
- Products produced more quickly✓
- Increased resistance to diseases✓
- Improved quality of (chicken) products✓
- Improved yield of (chicken) products✓ Any 2 (2)

3.4.8
- The chickens are larger✓/heavier so they cannot run away from predators✓
- The chickens are larger✓ and is more visible to predators✓
- Decreased variation✓ therefore more susceptible to diseases✓

(Mark first ONE only) Any 1 x 2 (2)

(16)

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

PROTEIN SYNTHESIS

Transcription✓ (T)

- Double stranded DNA unwinds ✓
- and unzips when✓
- the hydrogen bonds break✓
- and this is controlled by enzymes✓
- One strand is used as a template✓
- to form mRNA✓
- using free RNA nucleotides from the nucleoplasm✓
- The mRNA is complementary to the DNA✓
- mRNA now has the coded message for protein synthesis✓

Translation✓ (S)

- mRNA moves from the nucleus✓/to the ribosome
- Each tRNA carries an amino acid✓
- tRNA carries the amino acid to the ribosome✓
- When the anticodon on the tRNA✓
- matches the codon on the mRNA✓
- Amino acids become attached✓ in the sequence determined by the mRNA
- by peptide bonds✓
- to form the required protein✓ Max 13

EFFECTS OF A MUTATION (M)

- A gene mutation affects arrangement/type of the nitrogen bases✓/nucleotides
- This changes the code on the DNA ✓
- which changes the code on the RNA✓
- A different amino acid✓ may be coded for
- which causes a change in the amino acid sequence✓ in the protein
- leading to the formation of a different/alternate/no protein Max 4

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	**Relevance (R)**	**Logical sequence (L)**	**Comprehensive (C)**
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the description of protein synthesis and the effects of mutation on the process is given	The description of protein synthesis and the effects of mutation on the process given are logical and sequential	At least **5** correct points in the description of transcription and **5** correct points in the description of translation and **2** correct points on the effects of mutation
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2016

MARKS: 150

TIME: 2½ hours

This question paper consists of 18 pages.

SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Write down the question number (1.1.1 to 1.1.9), choose the answer and make a cross (X) over the letter (A to D) of your choice in the ANSWER BOOK.

EXAMPLE:

1.1.10	A	B	C	~~D~~

1.1.1 The theory of evolution by natural selection was first described by …

A Gregor Mendel.
B Watson and Crick.
C Jean Baptiste de Lamarck.
D Charles Darwin.

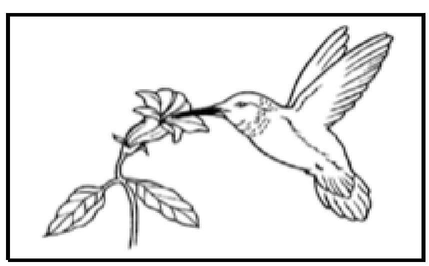
1.1.2 When an individual that is homozygous dominant for a particular characteristic is crossed with an individual that is homozygous recessive for the characteristic, all the offspring would be ...

A homozygous dominant.
B homozygous recessive.
C heterozygous.
D pure-bred.

1.1.3 The absence of the protein melanin results in the disorder called …

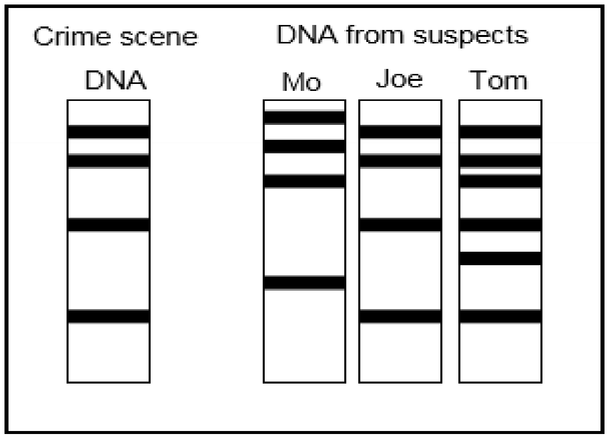
A haemophilia.
B colour-blindness.
C albinism.
D Down syndrome.

1.1.4 A hummingbird uses its long beak to feed on the nectar in flowers. The reason that Lamarck would have provided for the long beak of the hummingbird is that …



A all hummingbirds have the same beak length.
B there is natural variation in beak length and some birds are therefore better suited to feed on nectar.
C the more the hummingbird used its beak, the longer it grew.
D hummingbirds with shorter beaks were more fit for survival.

QUESTIONS 1.1.5 TO 1.1.7 ARE BASED ON THE DIAGRAM BELOW, SHOWING THE RESULTS OF A PARTICULAR PROCEDURE.



1.1.5 The procedure shown above is called …

A cloning.
B DNA replication.
C DNA profiling.
D fingerprinting.

1.1.6 The evidence in the diagram shows that …

A only Tom was present at the scene of the crime.
B Tom and Joe were 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.

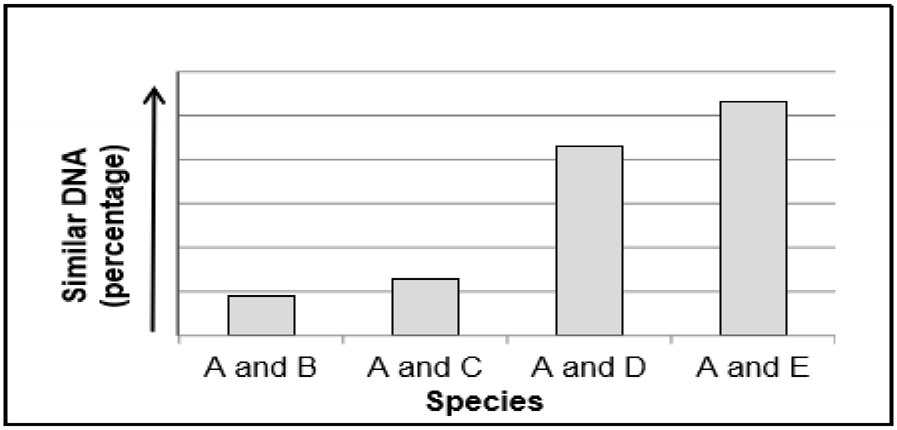
1.1.7 Below is a list of possible uses of the procedure shown in the diagram above:

(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)

QUESTIONS 1.1.8 AND 1.1.9 ARE BASED ON THE GRAPH BELOW, WHICH SHOWS THE COMPARISON OF DNA BETWEEN SPECIES A AND SPECIES B, C, D AND E.



1.1.8 Which statement is a valid conclusion that can be drawn from this graph?

Species **A** is most closely related to …

A species **B**.
B species **C**.
C species **D**.
D species **E**.

1.1.9 The percentage DNA similarities between species could be used to show the following:

(i) Similarities in protein synthesis
(ii) Evidence for evolution
(iii) Common ancestry

Which combination shows the CORRECT application of the use of similarities in DNA between species?

A (i), (ii) and (iii)
B Only (i) and (ii)
C Only (ii) and (iii)
D Only (i) and (iii) (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 1.2.7) in the ANSWER BOOK.

1.2.1 The organelle in the cytoplasm which is the site of protein synthesis

1.2.2 The name of the bond that forms between amino acids in a protein molecule

1.2.3 The process by which a DNA molecule makes identical copies of itself

1.2.4 The name of the process when homologous chromosome pairs fail to separate during meiosis

1.2.5 The permanent disappearance of a species from earth

1.2.6 A testable statement that may be accepted or rejected

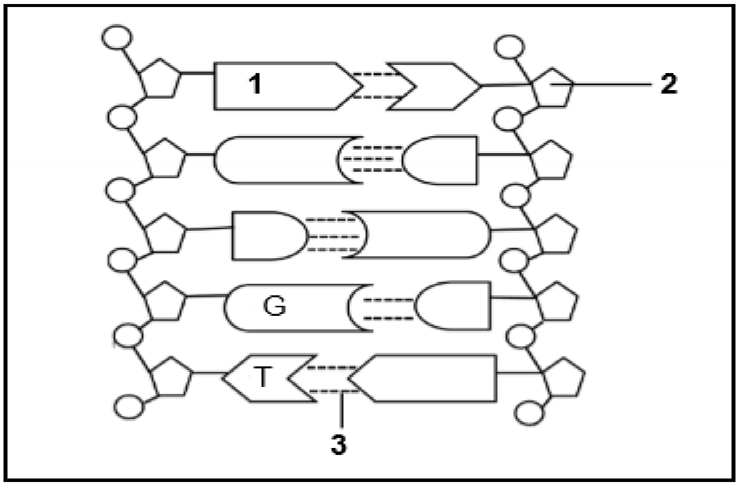
1.2.7 The type of nucleic acid that carries a specific amino acid (7 x 1) **(7)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 The selection and breeding of organisms with desirable characteristics by humans	A: Natural selection B: Artificial selection
1.3.2 An allele that is not shown/expressed in the phenotype when found in the heterozygous condition	A: Dominant B: Recessive
1.3.3 Pairing of nitrogenous bases	A: DNA B: RNA

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

1.4 The diagram below shows a part of a DNA molecule.



1.4.1 Provide labels for:

(a) **1** (1)

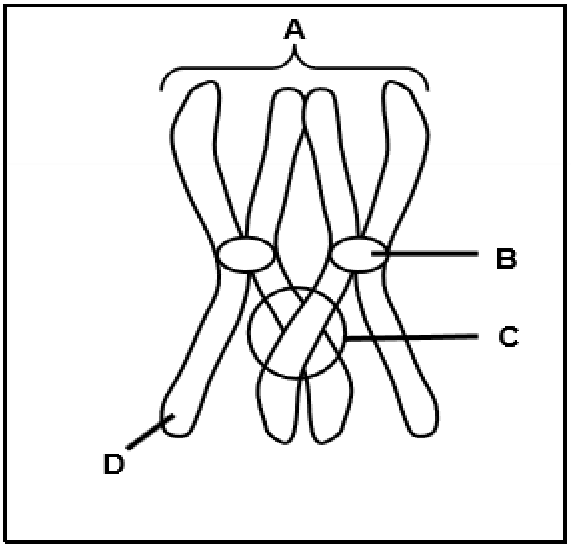
(b) **2** (1)

(c) **3** (1)

1.4.2 Give the number of nucleotides shown in the diagram. (1)

1.4.3 Give ONE difference between the nitrogenous bases found in DNA molecules and those found in RNA molecules. (2)
(6)

1.5 The diagram below represents a process that occurs during meiosis.



1.5.1 Provide labels for:

(a) **A** (1)

(b) **B** (1)

(c) **D** (1)

1.5.2 Give the function of the structure labelled **B**. (1)

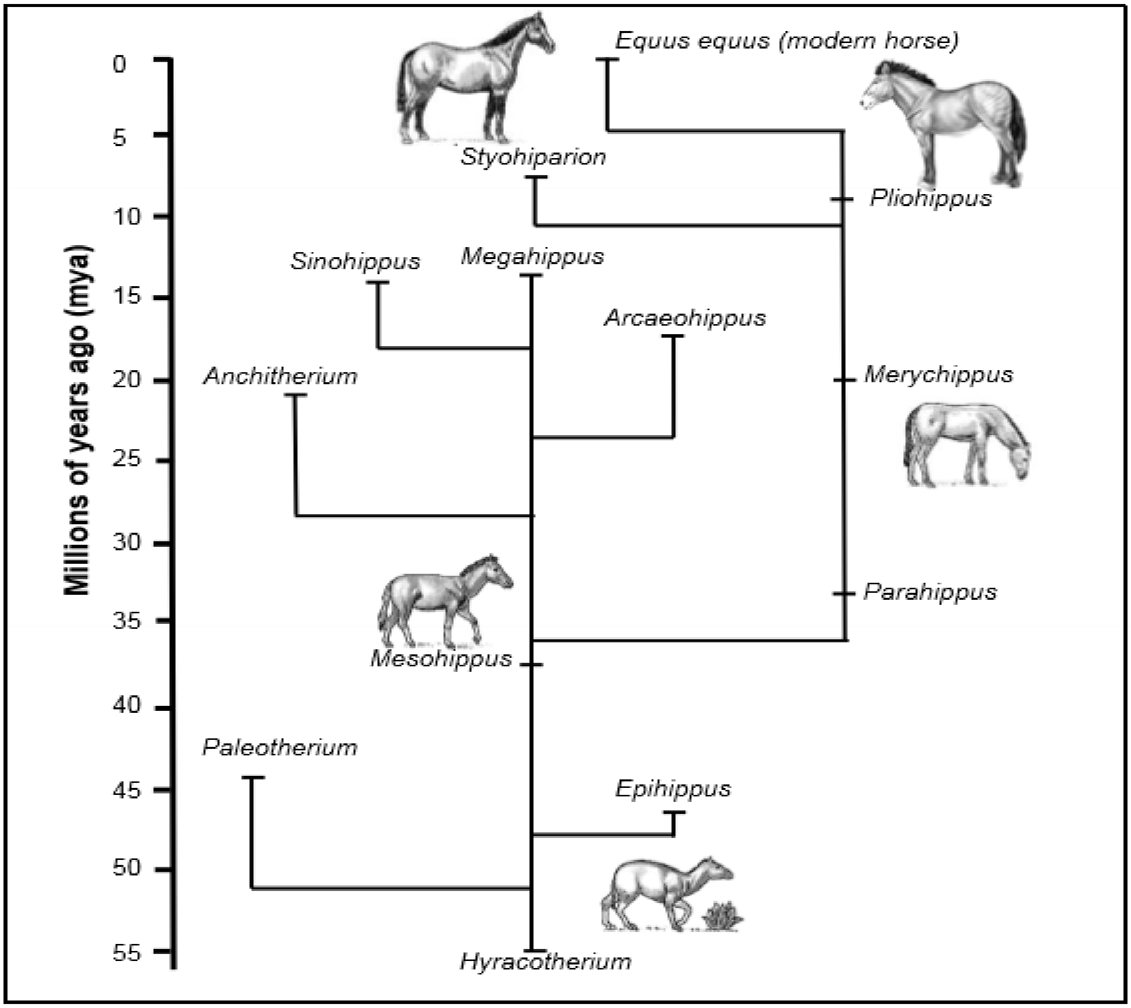
1.5.3 Name:

(a) The process occurring at **C** (1)

(b) The phase in meiosis during which the process at **C** occurs (1)

1.5.4 State ONE reason why process **C** is significant. (1)
(7)

1.6 The diagram below represents the possible evolution of the horse.



[Adapted from http://archaeologyinfo.com]

1.6.1 Name the:

(a) Common ancestor of all horses (1)

(b) Genus most closely related to *Megahippus* (1)

1.6.2 When did *Paleotherium* become extinct? (2)

1.6.3 How long did it take for the modern horse to evolve from *Hyracotherium*? (2)
(6)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The leaf colour in a plant is controlled by two alleles, green (**G**) and yellow (**g**). Thorns on plant stems are controlled by two alleles, presence of thorns (**T**) and no thorns (**t**).

Two plants with the genotypes **GGTT** and **ggtt** were crossed. Their offspring were then left to pollinate each other.

The table below shows the possible genotypes of the offspring of the second generation. Genotypes **(i)** and **(ii)** have been left out.

Gametes	**GT**	**Gt**	**gT**	**gt**
GT	GGTT	GGTt	GgTT	GgTt
Gt	GGTt	GGtt	**(i)…**	Ggtt
gT	GgTT	GgTt	ggTT	ggTt
gt	GgTt	Ggtt	ggTt	**(ii)…**

2.1.1 Give the:

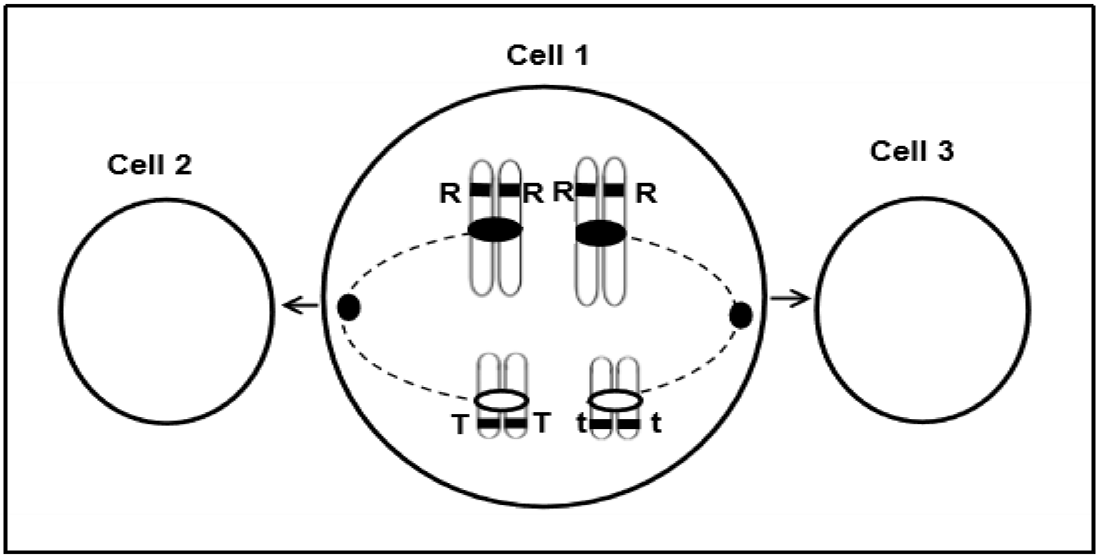
(a) Genotype of **(i)** (1)

(b) Phenotype of **(ii)** (2)

2.1.2 List the FOUR genotypes of the offspring of the second generation that would be phenotypically different from the original pair of parents. (4)
(7)

2.2 The diagram below represents a phase in meiosis.

Cell **1** undergoes division to give rise to cells **2** and **3**. Some alleles are indicated by letters.



2.2.1 Explain why cell **1** does NOT belong to a human. (2)

2.2.2 How many chromosomes would be present in:

(a) Cell **2** at the end of telophase **I** (1)

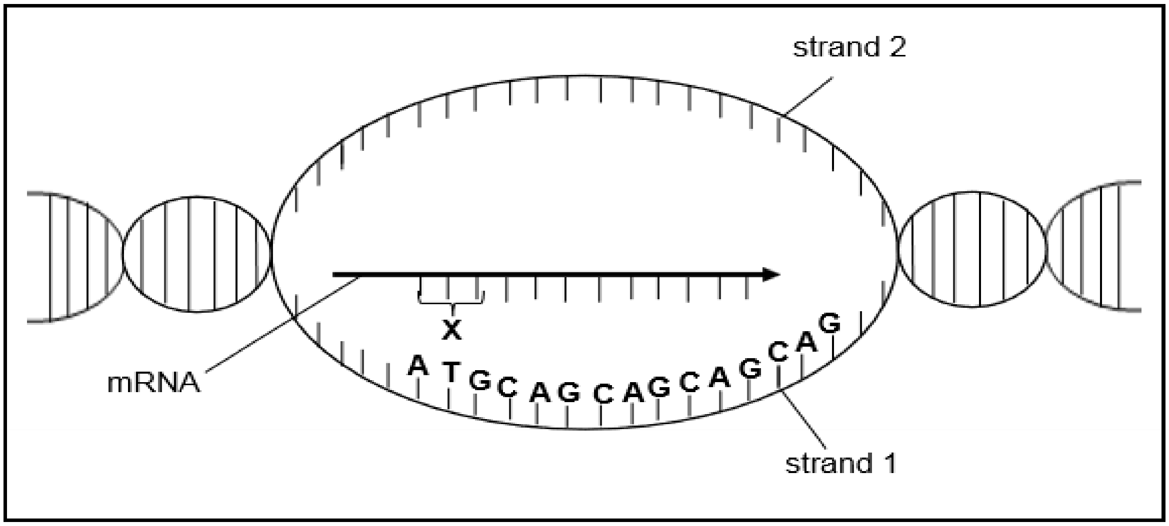
(b) The daughter cells produced by cell **3** after meiosis **II** (1)

2.2.3 Draw a labelled diagram of a gamete that will result from cell **2**. (5)
(9)

2.3 State Mendel's law of segregation. **(3)**

2.5 The mutation that causes Huntington's chorea occurs when the **CAG** base triplet on the DNA molecule is repeated more than **35** times. This mutation results in the formation of a 'Huntington's protein', which causes the degeneration of neurons in the brain.

The diagram below shows the process whereby an mRNA molecule is formed from the DNA molecule.



[Adapted from www.shutterstock.com]

2.5.1 Name the process represented in the diagram. (1)

2.5.2 Where in the cell does this process occur? (1)

2.5.3 Give the:

(a) Complementary bases on DNA strand **2** for a **CAG** triplet (1)

(b) Sequence of bases at **X** (1)

The table below shows the amino acids coded for by mRNA codons.

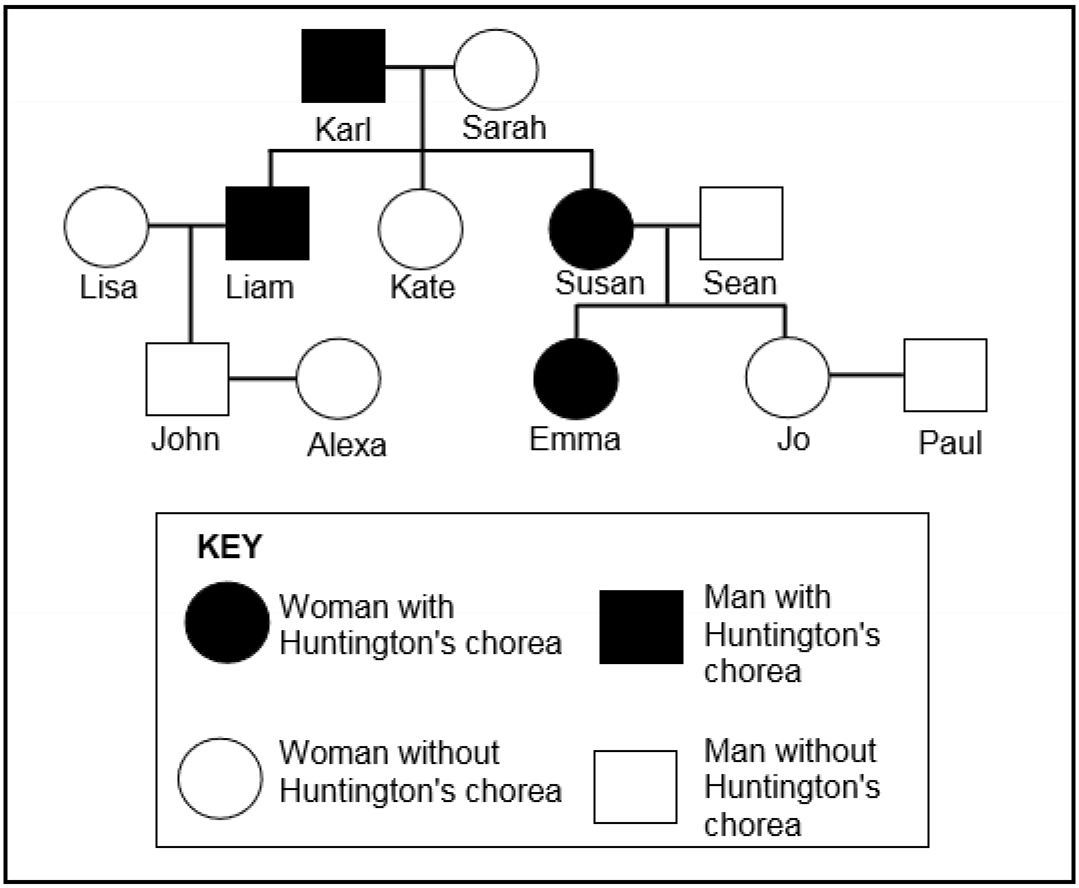
mRNA CODON	AMINO ACID
UAC	Tyrosine
AUG	Methionine
CAG	Glutamine
GUC	Valine

2.5.4 Which amino acid will occur more than 35 times in a 'Huntington's protein'? (2)

2.5.5 Explain how a mutation results in the formation of a different protein. (3)
(9)

2.4 Huntington's chorea is a disease caused by a gene mutation that results in the degeneration of brain tissue. It is caused by a dominant allele (**H**).

The pedigree diagram below shows the inheritance of this disorder in a family.



2.4.1 What is:

(a) Susan's phenotype (1)

(b) Sarah's genotype (1)

2.4.2 Emma plans to have a baby. What must the father's genotype be so that there is a 50% chance that their child will not have Huntington's chorea? (1)

2.4.3 Explain your answer to QUESTION 2.4.2. (3)

(6)

2.6 You have two rose plants, both with pink flowers. You cross them and find that, while most of the offspring are pink, some are red and some are white.

Use a genetic cross to show how breeding two pink flowering plants can result in pink, red and white flowering plants.

Use the letter **R** for the red allele and **W** for the white allele. **(6)**
[40]

QUESTION 3

3.1 Read the passage below.

GENETIC MODIFICATION OF CROPS

Genetic modification (GM) of crops began with the discovery that the soil bacterium *Agrobacterium* could be used to transfer useful genes from unrelated species into plants.

The gene called **Bt**, which produces a pesticide toxin that is harmless to humans, but is capable of killing insect pests, is one of the genes most commonly inserted into crop plants. Many new GM crops, such as maize, potatoes and tomatoes, are modified to be pest, disease or weed-killer resistant.

GM foods could have unforeseen effects. Toxic proteins may be produced or antibiotic-resistance genes may be transferred to human gut bacteria. Modified crops could become weed-killer resistant 'super weeds'. Modified crops could also 'accidentally' breed with wild plants or other crops.

[Adapted from GM Organisms www.newscientist.com]

3.1.1 According to the passage, how did genetic modification of crops begin? (1)

3.1.2 Explain why a plant, which is modified to be weed-killer resistant, could be a problem for farmers. (2)

3.1.3 Give TWO examples in the passage of the use of GM crops that may be a potential threat to human health. (2)
(5)

3.2 Lizards of a certain species on an island are usually brown in colour. A mutation in one gene for body colour results in red or black lizards. Black lizards camouflage well against the dark rocks and warm up faster on cold days which will give them energy to avoid predators.

Scientists investigated the relationship between the colour of lizards in a population and their survival rate on an island.

They conducted the investigation as follows:

- They selected a group of lizards of a certain species in a habitat.
- They recorded the percentage of each colour (brown, red or black) in the selected group.
- They repeated the investigation over a period of 30 generations of offspring.

The results of the investigation are shown in the table below.

COLOUR OF LIZARDS	PERCENTAGE (%) OF EACH COLOUR IN THE POPULATION			
	Initial population	10^{th} generation	20^{th} generation	30^{th} generation
BROWN	80	80	70	40
RED	10	0	0	0
BLACK	10	20	30	60

[Adapted from http//.hhmi.org/biolactive]

3.2.1 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

3.2.2 Explain the effect of the mutation on the survival of the red lizards. (2)

3.2.3 Explain why the scientists had to conduct this investigation over 30 generations. (2)

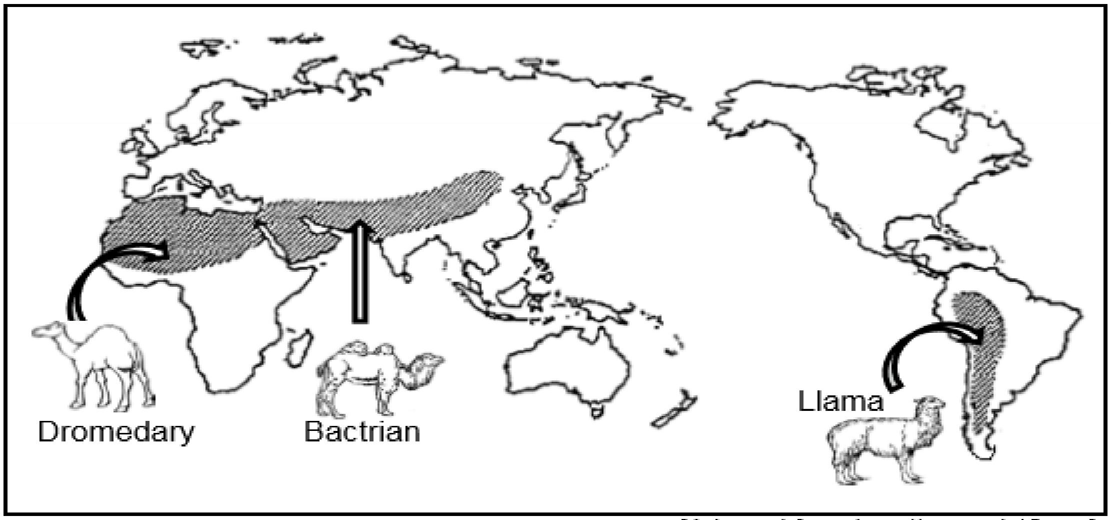
3.2.4 State TWO ways in which the scientists could have improved the validity of the investigation. (2)

3.2.5 Use the theory of natural selection to explain the higher percentage of black lizards in the population of the 30^{th} generation. (6)

3.2.6 Draw a bar graph to compare the percentage of the brown and the black lizards in the initial population and the 30^{th} generation. (6)

(20)

3.3 The diagram below shows the distribution of members of the camel family on the different continents. The arrows indicate the current distribution of the animals.



[Adapted from http://www.ck12.org]

Explain how speciation of camels may have occurred. **(6)**

3.4 Human blood groups are controlled by multiple alleles.

3.4.1 Name ALL the alleles that control human blood groups. (3)

3.4.2 How many of the alleles named in QUESTION 3.4.1 can any individual inherit? (1)

3.4.3 Give a reason for your answer to QUESTION 3.4.2. (2)

3.4.4 A man has blood group **A** and his wife has blood group **B**. Their first child has blood group **AB** and the second child has blood group **O**.

What can one conclude about the blood groups of their future children? (3)

(9)

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Fossils of the bipedal primates *Ardipithecus*, *Australopithecus* and early *Homo* species are used to support the 'Out of Africa' hypothesis.

State the 'Out of Africa' hypothesis. Describe the evidence that supports the 'Out of Africa' hypothesis and the evidence that shows that the three primate genera mentioned above, were all bipedal.

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

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2016

MEMORANDUM

MARKS: 150

This memorandum consists of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	C✓✓		
	1.1.3	C✓✓		
	1.1.4	C✓✓		
	1.1.5	C✓✓		
	1.1.6	No correct answer		
	1.1.7	B✓✓		
	1.1.8	D✓✓		
	1.1.9	A✓✓	(8 x 2)	**(16)**
1.2	1.2.1	Ribosome✓		
	1.2.2	Peptide✓		
	1.2.3	Replication✓		
	1.2.4	Non-disjunction✓		
	1.2.5	Extinction✓		
	1.2.6	Hypothesis✓		
	1.2.7	tRNA✓/transfer RNA	(7 x 1)	**(7)**
1.3	1.3.1	B only✓✓		
	1.3.2	B only✓✓		
	1.3.3	A only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Adenine✓/A		(1)
		(b) Deoxyribose✓sugar		(1)
		(c) Hydrogen bond✓		(1)
	1.4.2	10✓		(1)
	1.4.3	- DNA has the nitrogen base thymine✓ whereas RNA has the nitrogen base uracil✓ **(Mark first ONE only)**		(2) **(6)**
1.5	1.5.1	(a) Homologous chromosomes✓/Bivalent		(1)
		(b) Centromere✓		(1)
		(c) Chromatid✓		(1)
	1.5.2	- It holds the (two) chromatids together✓ - Attaches the chromosome to the spindle fibres✓	Any	(1)
	1.5.3	(a) Crossing over✓		(1)
		(b) Prophase 1✓		(1)
	1.5.4	Introduces variation✓/different gametes		(1) **(7)**

1.6	1.6.1	(a) *Hyracotherium*✓	(1)
		(b) *Sinohippus*✓	(1)
	1.6.2	44✓mya✓ (44 – 44,5)	(2)
	1.6.3	55✓/50 /46 million years✓/my	(2) **(6)**

TOTAL SECTION A: 48

QUESTION 2

2.1 2.1.1 (a) GgTt✓ (1)

(b) Yellow✓ leaves no thorns✓ (2)

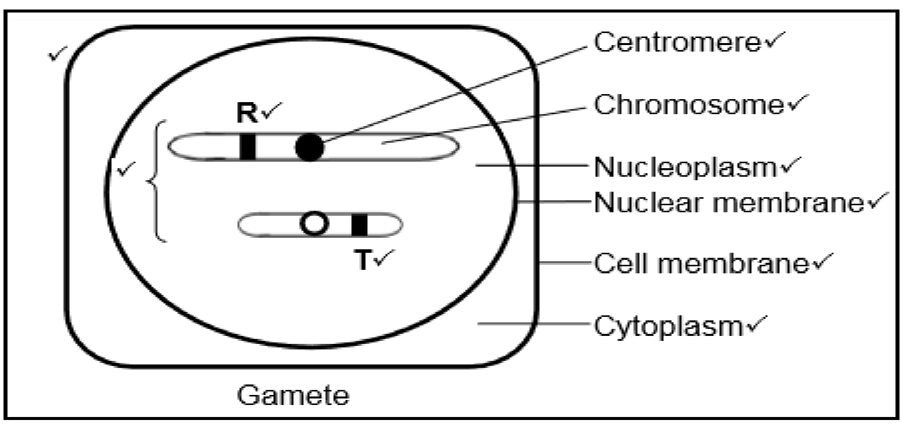
2.1.2 GGtt✓
Ggtt✓
ggTT✓
ggTt✓
(Mark first FOUR only) (4)
(7)

2.2 2.2.1 Human somatic cells have 23 pairs✓/46 chromosomes and this cell has only 2 pairs✓/4 chromosomes (2)

2.2.2 (a) 2✓ (1)

(b) 2✓ (1)

2.2.3



Criteria to mark diagram

Single cell is drawn	1
Only 2 unreplicated chromosomes in drawing	1
Short unreplicated chromosome indicating T	1
Long unreplicated chromosome indicating R	1
Any ONE correct label	1

(5)
(9)

2.3
- The pair of alleles✓on homologous chromosomes separate
- during meiosis✓/anaphase/ gamete formation, so that
- only one allele of each pair is present in the gamete✓/ offspring can acquire one allele from each parent **(3)**

2.4	2.4.1	(a) Suffers from Huntington's✓chorea	(1)
		(b) hh✓	(1)
	2.4.2	hh✓	(1)
	2.4.3	- Emma's genotype is Hh✓/heterozygous - The father's genotype has to be hh✓/homozygous recessive - a cross between only these two genotypes✓/(Hh and hh) will ensure that there is 50% chance of the child not inheriting the disease - The child inherits one recessive allele from each parent✓	(3) **(6)**
	2.5.1	Transcription✓	(1)
	2.5.2	Nucleus✓/nucleoplasm	(1)
	2.5.3	(a) GTC✓	(1)
		(b) UAC✓	(1)
	2.5.4	Valine✓✓	(2)
	2.5.5	- A mutation affects the nucleotide sequence✓/nitrogen base sequence/gene structure - Resulting in a changed mRNA✓/codon - A different amino acid✓ may be coded for - by tRNA✓/anticodon Any 3	(3) **(9)**

2.6 2.6.1

P_1	Phenotype	Pink	x	Pink✓
	Genotype	RW	x	RW✓
Meiosis				
	G/gametes	R, W	x	R, W ✓
Fertilisation				
F_1	Genotype	RR; RW; RW; WW ✓		
	Phenotype	Red Pink White ✓		

P_1 and F_1✓
Meiosis and fertilisation✓

Any 6

OR

P_1	Phenotype	Pink	x	Pink ✓
	Genotype	RW	x	RW ✓

Meiosis

Fertilisation

Gametes	R	W
R	RR	RW
W	RW	WW

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype Red : Pink : White ✓

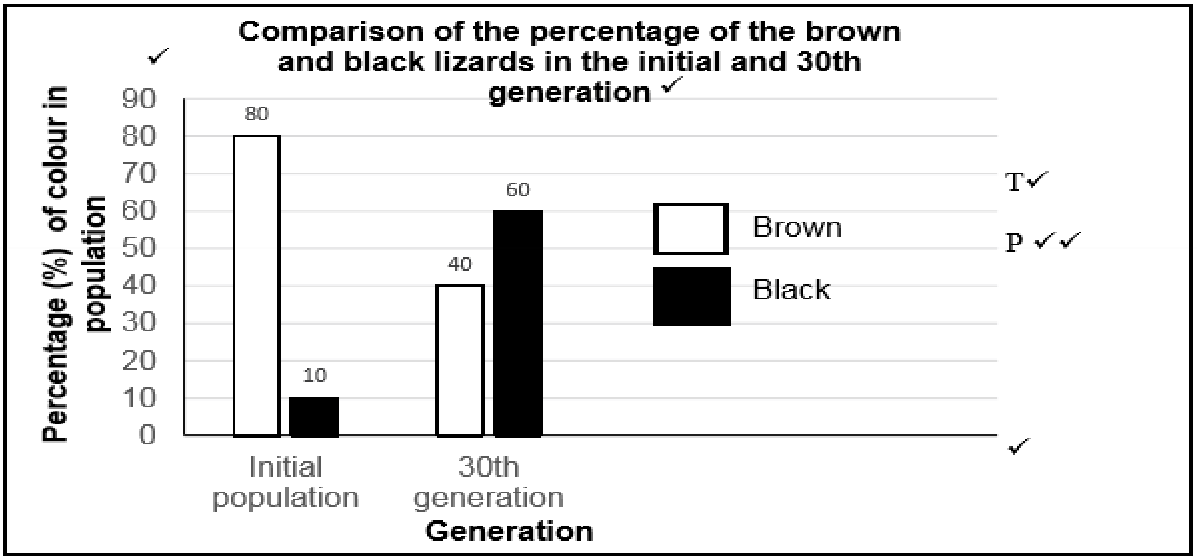
P_1 and
F_1✓
Meiosis and fertilisation✓ **(6)**

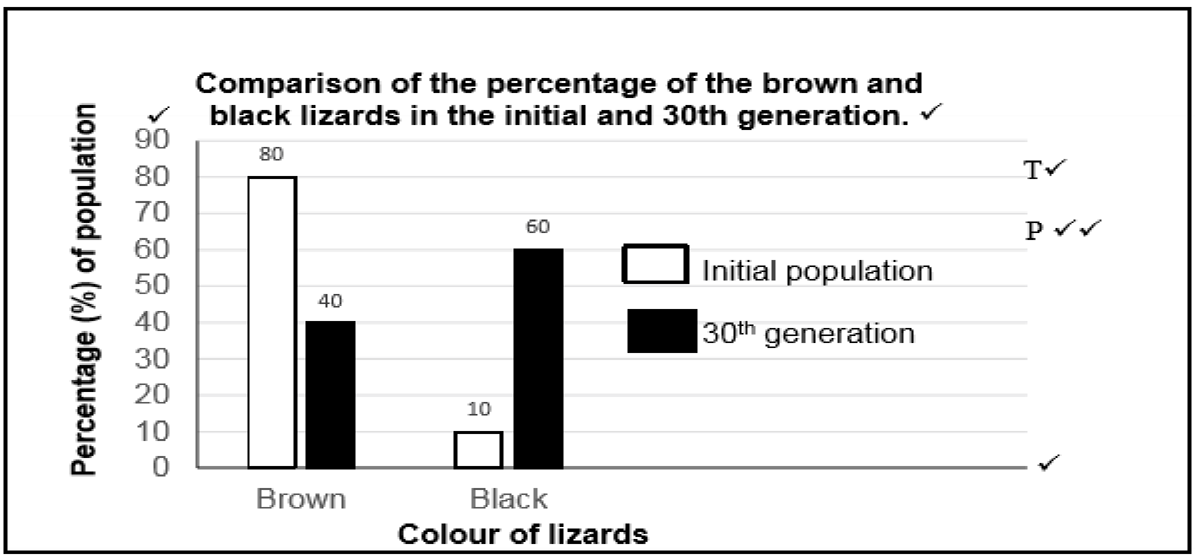
Any 6 **[40]**

QUESTION 3

3.1	3.1.1	With the discovery that the soil bacterium *Agrobacterium* could be used to transfer useful genes from unrelated species into plants✓	(1)
	3.1.2	- Modified crops may become super-weeds✓/accidently breed with other plants to become super-weeds - They are difficult/expensive to kill✓ - and could outcompete the original crop✓/other crops Any	(2)
	3.1.3	- Toxic proteins might be produced✓ - Antibiotic-resistance genes may be transferred to human gut bacteria✓ **(Mark fist TWO only)**	(2) **(5)**
3.2	3.2.1	(a) colour of lizard✓	(1)
		(b) survival rate of the lizards✓	(1)
	3.2.2	- It decreases survival✓/lizards may die/is harmful/is lethal to the red lizards as - they will be seen✓ on the black rock by the predators **OR** - They could not escape predators✓/catch prey on cold days - as red lizards did not warm up fast on cold days✓ Any 1 x 2	(2)
	3.2.3	- To allow enough time for reproduction✓ and survival to be able to calculate the percentage to ensure reliability✓ of results **OR** - A change in population proportions will not be seen over a shorter time period✓ to ensure reliability✓ of results Any 1 x 2	(2)
	3.2.4	- Conduct the investigation in the same habitat✓/environment - Use the same sampling technique✓ - Capture the same number of lizards in each sampled generation ✓ - Take each sample at the same time of day✓/weather conditions **(*Mark first TWO only*)** Any 2	(2)
	3.2.5	- There is variation✓in colour amongst the lizards - ***Red and brown**✓ lizards - ***are not camouflaged✓/cannot warm up fast enough to have energy to run away** - are killed by predators✓ - ***The black lizards✓** - ***are better camouflaged✓/warm up faster to have energy to avoid predators** - and survive✓/reproduce - The allele for black colour is passed on to the next generation✓ - to produce more black lizards✓ in the next generation Any 2+***4 compulsory marks**	(6)

3.2.6





Guideline for the assessing the graph

Bar graph for the required data	1
Title of graph	1
Correct label and scale for X-axis	1
Correct label and scale for Y-axis	1
Drawing of bars	1: 1 to 3 bars plotted correctly 2: All 4 bars plotted correctly

(6)

NOTE:
If the wrong type of graph is drawn, marks will be lost for:
- 'Bar graph'
- 'Drawing of bars'

If two graphs are drawn mark the first ONE only

(20)

3.3
- The common ancestor✓/original camel population
- was separated✓ into different populations
- ***by the sea✓/due to continental drift**
- There was no gene flow✓ between the populations
- Each population was exposed to different environmental conditions✓/selection pressures
- Natural selection occurred independently✓ in each population
- The individuals of each population became different✓ from each other over time
- genotypically and phenotypically✓
- Even if the three populations were to mix again✓
- they would not be able to interbreed✓

Any 5+***1 compulsory mark** **(6)**

3.4

3.4.1 I^A✓, I^B✓, i✓ (3)

3.4.2 2✓ (1)

3.4.3
- Any individual inherits one allele✓
- from each parent✓ (2)

3.4.4
- Each child✓
- has an equal✓/25% chance of having
- any blood group✓/ A, B, AB, or O. (3)

(9)
[40]

SECTION C

QUESTION 4

HYPOTHESIS
- **All modern humans**✓*/*Homo sapiens*
- **originated in Africa**✓*
- and migrated to other parts✓ of the world **2(*compulsory)** +1 **(3)**

FOSSIL EVIDENCE✓
- 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)

GENETIC EVIDENCE✓
- Mitochondrial DNA✓
- Is inherited only from the maternal line✓
- Analysis of mutations ✓ on this mitochondrial DNA
- shows that the oldest female ancestor were located in Africa✓
- and that all humans descended from her✓/mitochondrial Eve
- The Y chromosome shows the paternal line✓ Max (4)

CULTURAL EVIDENCE✓
- The **OLDEST**/most primitive artefacts (tools, cutlery, art etc.)
- were found in Africa✓ (2)

TOTAL FOR EVIDENCE (8)

BIPEDALISM
The fossils of all three genera indicate that:
- The foramen magnum✓
- is located in a more forward position✓

- The pelvis✓
- is wider and shorter✓

- The spine✓
- is S-shaped✓ **(6)**

Content (17)
Synthesis (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question.	Ideas are arranged in a logical sequence.	All aspects of the essay have been sufficiently addressed.
In this essay in Q4	Only information relevant to the 'Out of Africa' hypothesis and bipedal fossils of the three genera are described. No irrelevant information included.	The description of the evidence for the 'Out of Africa' hypothesis and the evidence of bipedalism is presented in a logical and sequential manner.	At least the following marks should be obtained: - **7/11** for the 'Out of Africa' hypothesis and the evidence - **4/6** on evidence for bipedalism.
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2017

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

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.

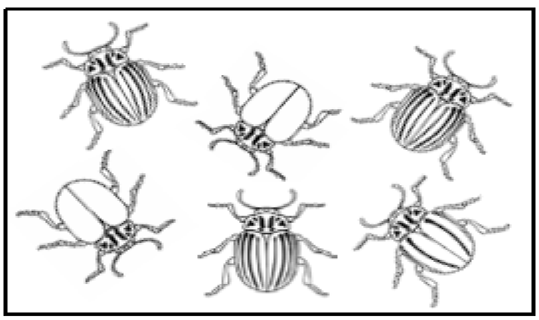
1.1.1 In a DNA molecule …

A guanine pairs with adenine.
B adenine pairs with thymine.
C cytosine pairs with adenine.
D guanine pairs with thymine.

1.1.2 The genotype for an individual with blood group A is …

A I^AI^A only.
B I^AI^A or ii.
C I^Ai only.
D I^AI^A or I^Ai.

1.1.3 Charles Darwin based the theory of evolution through natural selection on many observations.



Which ONE of his observations is represented in the diagram above?

A Limited environmental resources
B Populations remain stable over time
C Individuals within a population may vary widely
D Only the fittest will survive

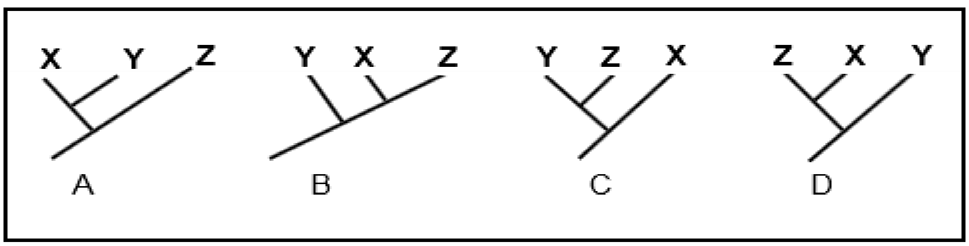
1.1.4 Antibiotic resistance in bacteria is an example of evolution in present times.

Which ONE of the following is a CORRECT explanation for this evolution?

A The bacteria acquire resistance to the antibiotic by being exposed to it.
B There is variation in the bacteria and the resistant bacteria survive.
C The greater the number of bacteria, the higher the resistance.
D The greater the number of bacteria, the lower the resistance.

1.1.5 Three related species, **X**, **Y** and **Z**, share a common ancestor. Species **Y** and **Z** share the MOST RECENT common ancestor.

Which phylogenetic tree most accurately represents their evolutionary relationship?



1.1.6 Study the statements about alleles below:

(i) Alternate forms of a gene are called alleles.
(ii) There is always only two alleles for a given characteristic.
(iii) The alleles for a particular characteristic are given in a genotype.
(iv) Alleles are found at corresponding positions on homologous chromosomes.

Which combination of statements is CORRECT?

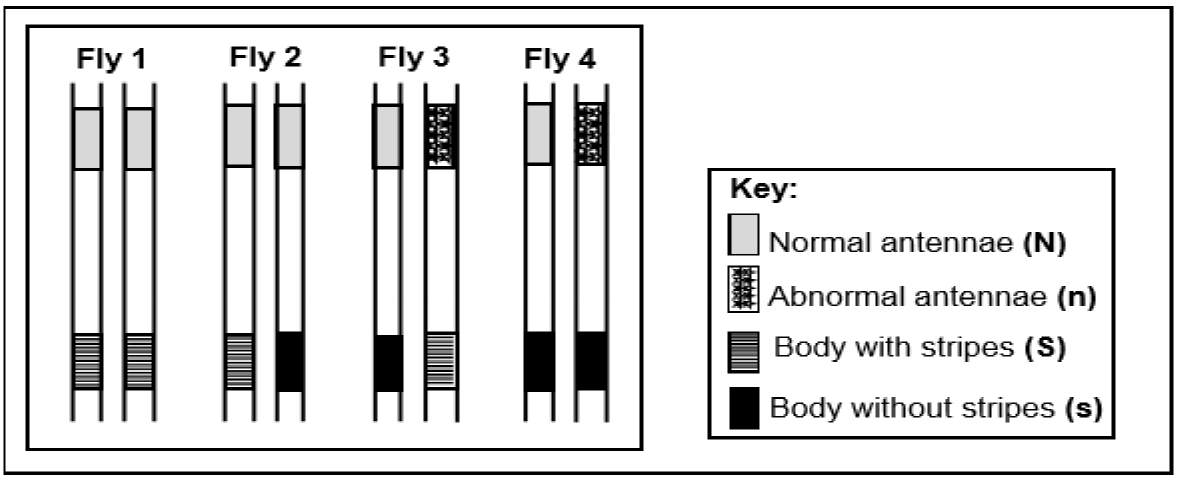
A (i), (ii), (iii) and (iv)
B (i), (iii) and (iv) only
C (i), (ii) and (iv) only
D (ii) and (iv) only

1.1.7 Which ONE of the following is a reproductive isolating mechanism?

A Breeding at different times of the year
B Same pollinators for different species of plants
C Absence of a geographic barrier
D Cloning

QUESTIONS 1.1.8 TO 1.1.10 ARE BASED ON THE DIAGRAM BELOW.

The diagram shows one pair of homologous chromosomes found in each of four fruit flies. The alleles for antenna shape (normal or abnormal) and body pattern (with stripes or without stripes) are indicated on the chromosomes.



1.1.8 Which fly is homozygous for antennae shape and heterozygous for body pattern?

A Fly **4**
B Fly **3**
C Fly **2**
D Fly **1**

1.1.9 What is the genotype of Fly **3**?

A NnSS
B NNSs
C NnSs
D NNss

1.1.10 Which ONE of the following will represent the possible gametes for Fly **4**?

A Ns, NS
B NS
C nS
D Ns, ns (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 Nitrogenous base found only in RNA molecules

1.2.2 The use of biological processes, organisms or systems to improve the quality of human life

1.2.3 Type of variation within a population in which there is a range of intermediate phenotypes

1.2.4 An upright posture and walking only on two legs

1.2.5 A sugar molecule found in a nucleotide of DNA

1.2.6 Genetic disorder resulting in the abnormal clotting of blood

1.2.7 Study of fossils

1.2.8 Present-day distribution of living organisms across the continents

1.2.9 Family to which humans belong (9 x 1) **(9)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	**COLUMN II**
1.3.1 Feature of chimpanzee skulls	A: Prognathism B: Forward position of foramen magnum
1.3.2 Similarity between humans and African apes	A: Opposable thumb B: A short and wide pelvis
1.3.3 Discovered the fossil called 'Little Foot'	A: Raymond Dart B: Ron Clarke

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

1.4 Mendel observed some characteristics of the pea plant (*Pisum sativum)* which he suggested were controlled by inherited factors. He conducted a series of experiments in which he crossed pea plants with contrasting phenotypes to obtain the offspring of the **F_1** generation. At first his crosses were simple and involved only one pair of characteristics.

Mendel counted the number of offspring showing each of the variations.

His results are shown in the table below.

PLANT PART	CHARACTERISTIC	P_1 GENERATION	F_1 GENERATION
Seed	Seed texture	Round x wrinkled	All round
	Seed colour	Yellow x green	All yellow
Pod	Pod texture	Full x constricted	All full
	Pod colour	Green x yellow	All green
Flowers	Flower colour	Violet x white	All violet
Stem	Location of flower on stem	Axial x terminal	All axial
	Height of stem	Tall x short	All tall

1.4.1 Give the term for:

(a) The *inherited factors* that Mendel referred to (1)

(b) A cross involving only ONE characteristic (1)

1.4.2 Name the female structure of the flower where meiosis occurs. (1)

1.4.3 Use the information in the table above to give the NUMBER of EACH of the following:

(a) Characteristics of pods (1)

(b) Alleles for seed characteristics (1)

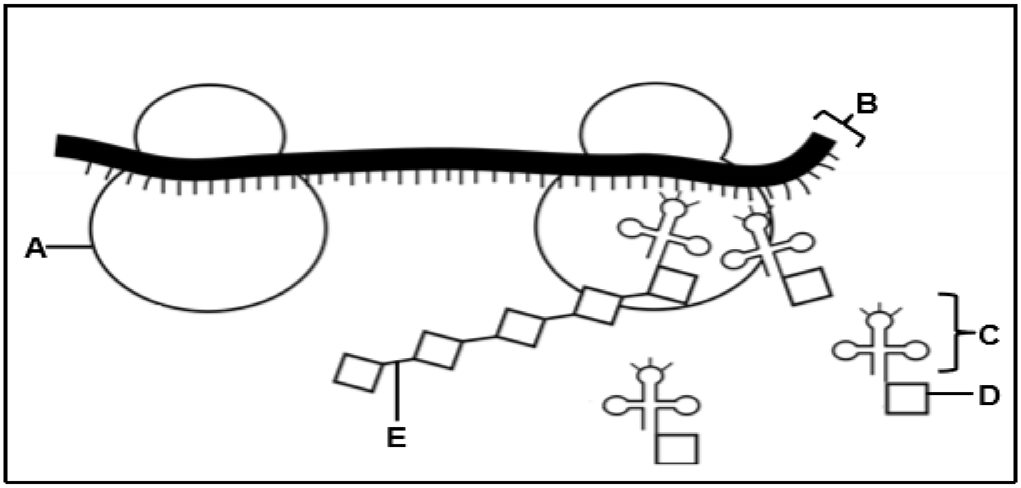
1.4.4 Give the characteristic that is:

(a) Dominant for flower colour (1)

(b) Recessive for stem height (1)

1.4.5 If the individuals of the **F_1** generation are crossed, how many phenotypes for seed colour would be expected in the **F_2** generation? (1)
(8)

1.5 The diagram below represents a process that occurs during protein synthesis.



1.5.1 Identify the process above. (1)

1.5.2 Identify:

(a) Organelle **A** (1)

(b) Molecule **B** (1)

(c) The bond at **E** (1)

1.5.3 Give only the LETTER of the molecule that:

(a) Carries the amino acid (1)

(b) Is copied from DNA (1)

(c) Is the monomer/building block of proteins (1)
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The sequence of amino acids in a protein molecule is coded for by DNA and RNA. The table below shows some mRNA codons and the corresponding amino acids.

mRNA CODONS	AMINO ACID
AGC	Serine
GAU	Aspartate
CUA	Leucine
UAU	Tyrosine
UUC	Phenylalanine
AGU	Serine
GAC	Aspartate
UUU	Phenylalanine
CUC	Leucine
GAG	Glutamic acid

2.1.1 According to the table, how many codons code for phenylalanine? (1)

2.1.2 What is the anticodon for glutamic acid? (1)

2.1.3 A section of mRNA has the following base sequence and is read from left to right:

GAU CUC GAC AGC AUG ACC

Give the:

(a) DNA base triplet for the LAST codon on this section of mRNA (1)

(b) FIRST amino acid coded for by this section of mRNA (1)

2.1.4 A mutation occurred which resulted in the following base sequence on the mRNA molecule:

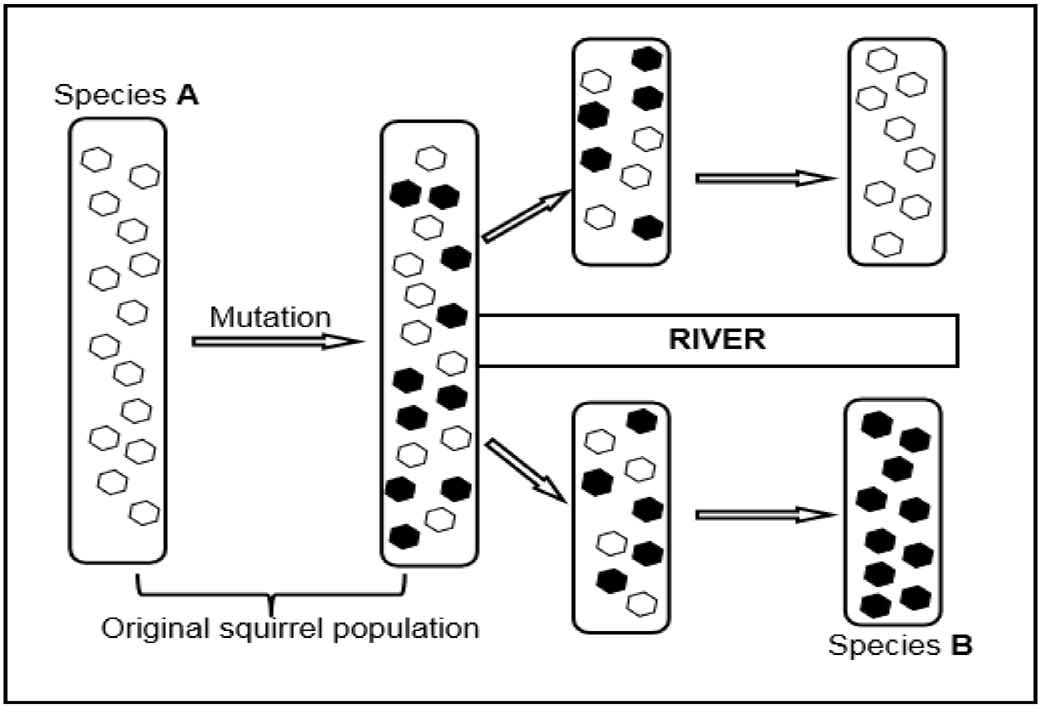
GAU CUC GAC AGU AUG ACC

(a) Describe the mutation that occurred. (2)

(b) Explain the effect that the mutation described in QUESTION 2.1.4(a) will have on the resulting protein. (2)

2.1.5 Name and describe the process occurring in the nucleus which results in the formation of an mRNA molecule. (6)
(14)

2.2 A mutation occurred within a population of squirrels. This population was then separated by a river. Many years later it was discovered that the original population had undergone speciation. The process of speciation is shown in the diagram below.



2.2.1 Define a *population*. (2)

2.2.2 Other than mutations, give THREE causes of variation in a population. (3)

2.2.3 Explain why there were eventually more squirrels with the mutation on one side of the river. (3)

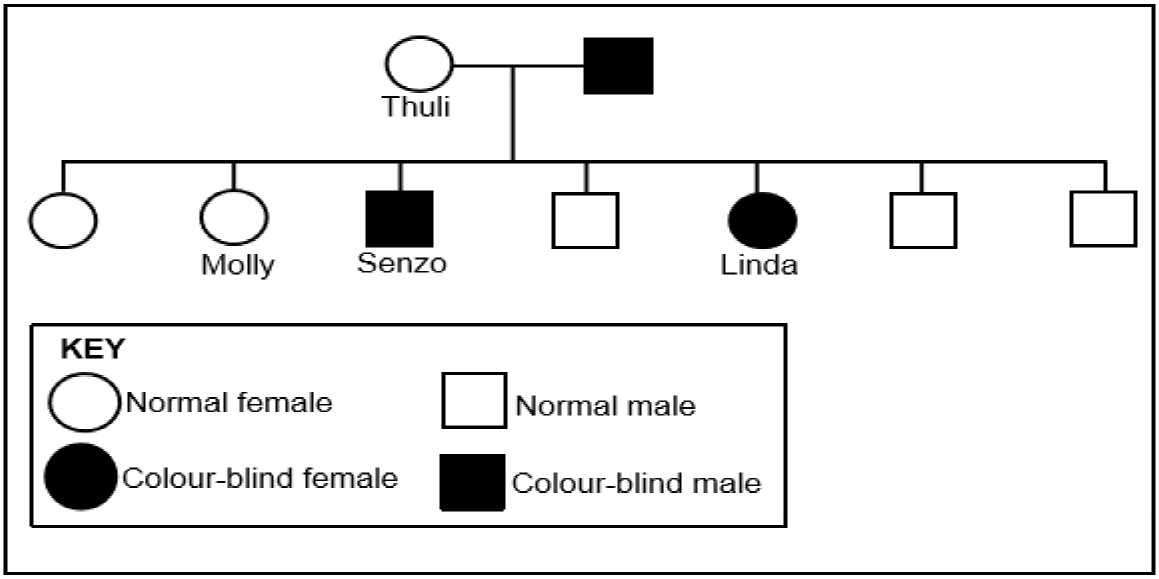
2.2.4 Explain what effect the process above has on the biodiversity in this ecosystem. (2)

2.2.5 It was discovered that species **A** and **B** were TWO separate species.

Describe what can be done to confirm that the squirrels belong to two different biological species. (2)
(12)

2.3 Colour-blindness (Daltonism) is a sex-linked disorder caused by a recessive allele (X^d).

The diagram below shows the inheritance of this disorder in a family.



2.3.1 Give the:

(a) Phenotype of Senzo (1)

(b) Genotype of Thuli (1)

2.3.2 Describe how Linda inherited colour-blindness. (2)

2.3.3 Explain why there are generally more males than females with colour-blindness in a population. (4)

2.3.4 Molly married a 'normal male'. Use a genetic cross to show the possible genotypes and phenotypes of their children. (6)

(14)

[40]

QUESTION 3

3.1 Scientists use fossils as evidence for human evolution. The brain volume of some extinct primates has been estimated from their fossils and have been compared to the brain volumes of living primates.

The results are shown in the table below.

PRIMATE	PERIOD OF EXISTENCE (million years ago)	AVERAGE BRAIN VOLUME (cm^3)
Ardipithecus ramidus	5,8 to 4,4	400
Australopithecus afarensis	4 to 2,7	450
Australopithecus africanus	3 to 2	450
Homo habilis	2,2 to 1,6	750
Homo erectus	2 to 0,4	1 000
Homo neanderthalensis	0,3 to 0,23	1 500
Homo sapiens	0,2 to present	1 400
Modern apes	0,2 to present	500

3.1.1 Apart from fossil evidence, give TWO other types of evidence for human evolution. (2)

3.1.2 Which primate became extinct first? (1)

3.1.3 The brain of an organism is not preserved as a fossil.

How do scientists determine the brain volume of extinct primates? (2)

3.1.4 Calculate the difference in brain volume (in cm^3) between the two living primates. Show ALL calculations. (2)

3.1.5 Give evidence in the table that suggests that:

(a) *Homo habilis* and *Homo erectus* may have existed at the same time (1)

(b) *Ardipithecus* was the most primitive of all the primate genera (1)

3.1.6 Draw a bar graph to show the average brain volume of EACH of the species of the genus *Homo*. (6)
(15)

3.2 Read the extract below.

> Long before the development of agricultural crops, South African villagers would pick the sweetest and largest fruits of the marula tree and scatter them around their camps. The seeds of these fruit would germinate and grow into fruit-bearing trees. The best fruit would then be chosen from these trees and the process would be repeated.
>
> In recent times, farmers use a process called marcotting. This involves peeling away the bark in one area around a branch. This area is stimulated to form roots. The branch is then removed from the tree and planted in the soil to produce more marula trees.

3.2.1 Name the characteristics that the villagers were selecting. (2)

3.2.2 Explain how this practice is an example of artificial selection. (3)

3.2.3 Give ONE environmental factor that could affect the characteristics named in QUESTION 3.2.1. (1)

3.2.4 Explain ONE disadvantage of a plantation of marula trees grown through marcotting compared to a population of marula trees that have reproduced naturally. (2)

3.2.5 Explain whether the fruits from marcotted marula trees could be classified as genetically modified (GM). (2)

3.2.6 State TWO benefits of genetic modification. (2)
(12)

3.3 A species of mice have different fur colours in different habitats. Scientists observed that there were more mice with a lighter fur colour in a beach habitat where the sand was lighter in colour. Also, there were more mice with a darker fur colour in the mainland habitat where the sand was darker in colour. Owls attack and prey on the mice.

Scientists wanted to investigate how the colour of the fur affects the chances of the mice being attacked. They conducted a simulation where they used models to represent the mice.

While conducting the investigation they:

- Made clay models of the mice
- Painted 200 clay models to resemble the lighter fur colour and 200 models to resemble the darker fur colour
- Placed an equal number of mice of each colour randomly in the beach habitat and in the mainland habitat
- Allowed enough time for predators to attack the mice models
- Collected all the models and recorded the number that were damaged after being attacked

The results of the investigation are shown in the diagram below.

HABITAT	FUR COLOUR	NUMBER OF MODELS ATTACKED
Mainland	Lighter	80
	Darker	20
Beach	Lighter	26
	Darker	78

3.3.1 State TWO independent variables. (2)

3.3.2 How many mice with a lighter fur colour were placed in the beach habitat? (1)

3.3.3 State TWO ways in which the scientists ensured the reliability of the results. (2)

3.3.4 Give a conclusion for the investigation conducted in the mainland habitat. (2)

3.3.5 Explain the results obtained for the beach habitat. (4)

3.3.6 Explain why the simulation may not be an accurate representation of the survival of the mice. (2)
(13)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe the structure and arrangement of chromosomes making up the normal human karyotype. Also describe the behaviour of the chromosomes during the different phases of meiosis I.

Content: (17)
Synthesis: (3)

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2017

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 10 pages.

SECTION A

QUESTION 1

1.1	1.1.1	B✓✓		
	1.1.2	D✓✓		
	1.1.3	C✓✓		
	1.1.4	B✓✓		
	1.1.5	C✓✓		
	1.1.6	B✓✓		
	1.1.7	A✓✓		
	1.1.8	C✓✓		
	1.1.9	C✓✓		
	1.1.10	D✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Uracil✓		
	1.2.2	Biotechnology✓/genetic engineering/genetic manipulation/genetic modification		
	1.2.3	Continuous✓variation		
	1.2.4	Bipedalism✓/bipedal		
	1.2.5	Deoxyribose✓		
	1.2.6	Haemophilia✓		
	1.2.7	Palaeontology✓		
	1.2.8	Biogeography✓		
	1.2.9	Hominidae✓	(9 x 1)	**(9)**
1.3	1.3.1	A only✓✓		
	1.3.2	A only✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Genes✓/alleles		(1)
		(b) Monohybrid✓		(1)
	1.4.2	Ovary✓/gynaecium/pistil/ovule		(1)
	1.4.3	(a) 2✓/Two		(1)
		(b) 4✓/Four		(1)
	1.4.4	(a) Violet✓		(1)
		(b) Short✓		(1)
	1.4.5	2✓/Two		(1)
				(8)
1.5.1	1.5.1	Translation✓		(1)
	1.5.2	(a) Ribosome✓		(1)
		(b) mRNA✓/messenger RNA		(1)
		(c) Peptide✓		(1)
	1.5.3	(a) C✓		(1)
		(b) B✓		(1)
		(c) D✓		(1)
				(7)
			TOTAL SECTION A :	**[50]**

SECTION B

QUESTION 2

2.1	2.1.1	2✓	(1)
	2.1.2	CUC✓	(1)
	2.1.3	(a) TGG✓ (b) Aspartate✓	(1) (1)
	2.1.4	(a) - C was replaced by U✓ on the 4th codon✓/AGC **OR** - AGC✓/the 4th codon changed to AGU✓	(2)
		(b) - It codes for the same amino acid✓/serine - Therefore there will be no effect✓/same protein formed	(2)
	2.1.5	- The process is **transcription**✓*** Compulsory mark** - The double helix DNA molecule unwinds✓ - When the hydrogen bonds break✓ - the DNA molecule unzips✓/2 DNA strands separate - One strand is used as the template ✓to form mRNA - using free RNA nucleotides✓from the nucleoplasm - The mRNA is complementary to DNA✓/A-U, C-G - This process is controlled by enzymes✓ 1* + Any 5	(6) **(14)**
2.2	2.2.1	- A population is a group of organisms of the same species✓/that can interbreed to produce fertile offspring and - occupy a given area at a certain time✓	(2)
	2.2.2	- Crossing over✓ } **OR** meiosis✓ - Random arrangement✓ of chromosomes } - Random fertilisation✓ - Random mating✓ Any 3 **(Mark first THREE only)**	(3)
	2.2.3	- The squirrels with favourable characteristics✓ caused by the mutation - survive✓/natural selection occurs - since they are better suited✓ to the environmental conditions - These characteristics are passed on to future generations✓ Any 3	(3)
	2.2.4	- Since there are now two✓ species/a new species of squirrels - the biodiversity has increased✓	(2)
	2.2.5	- Allow them to interbreed✓/reproduce/mate - They will not produce fertile offspring✓/check if they produce fertile offspring **OR** - Conduct DNA tests✓ of both species - and compare them✓	(2) **(12)**

2.3 2.3.1 (a) Colour blind male✓/male with Daltonism (1)

(b) X^DX^d✓ (1)

2.3.2 - Linda inherited one recessive allele/X^d from her father✓
- and one recessive allele/X^d from her mother✓ (2)

2.3.3 - Males only have one X-chromosome✓
- If this chromosome carries the recessive allele✓/X^d
- the male will be colour blind✓
- Females have 2 X-chromosomes✓
- They need to have two recessive alleles✓/X^d X^d to be affected
- A dominant allele on the other X-chromosome will mask the effect✓

Any 4 (4)

2.3.4

P_1	Phenotype	Normal female	x	Normal male ✓
	Genotype	X^DX^d	x	X^DY ✓
Meiosis				
	G/gametes	X^D, X^d	x	X^D,Y✓
Fertilisation				
F_1	Genotype	X^DX^D X^DY X^DX^d X^dY✓ *		
	Phenotype	Normal females, Normal male, Colour blind male ✓ *		

P_1 and F_1✓
Meiosis and fertilisation✓

OR

P_1	Phenotype	Normal female	X	Normal male ✓
	Genotype	X^DX^d	X	X^DY ✓

Meiosis

Fertilisation

Gametes	X^D	Y
X^D	X^DX^D	X^DY
X^d	X^DX^d	X^dY

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

F_1 Phenotype Normal females, Normal male, Colour blind male ✓ *

P_1 and F_1✓
Meiosis and fertilisation✓

(6)

*__Compulsory__ 2 + Any 4 **(14)**

[40]

QUESTION 3

3.1 3.1.1
- Genetic✓/mitochondrial DNA /Y chromosome
- Cultural✓ (2)

(Mark first TWO only)

3.1.2 *Ardipithecus ramidus*✓ (1)
(Mark first ONE only)

3.1.3
- They would measure the volume✓
- of the cranium✓of the fossil (2)

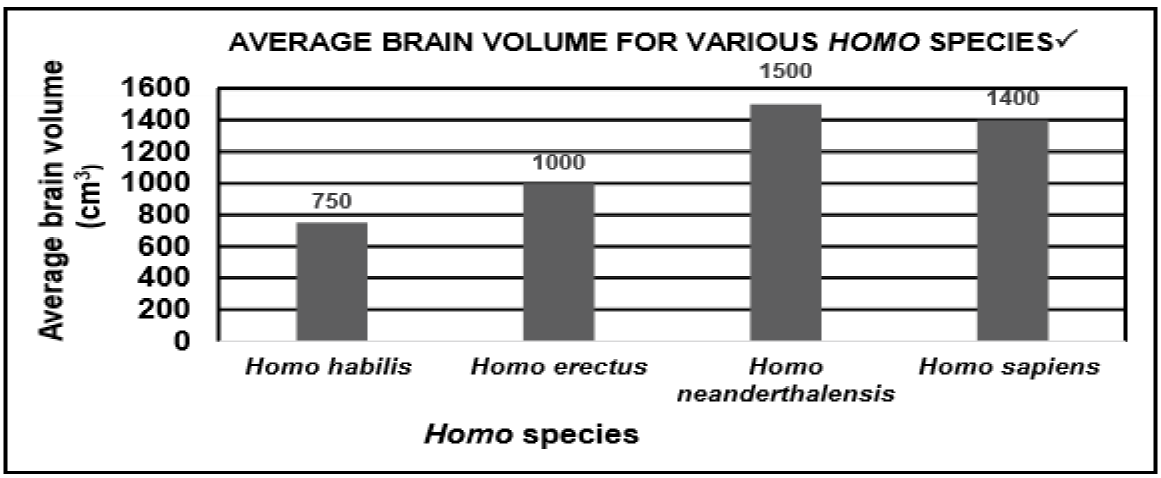
3.1.4 (1400 - 500)✓
= 900✓cm^3 (2)

3.1.5 (a) There is an overlap in their period of existence✓/they both existed between 2 and 1,6 mya (1)

(b) - It has the smallest brain volume✓
- It appeared first✓/is the oldest Any 1 (1)

3.1.6

L✓
S✓
B✓✓



✓

Guideline for assessing the graph:

Bar graph drawn	1
Title of graph includes both variables	1
Correct label for X-axis Correct label and unit for Y-axis (cm^3) (L)	1
Equal width and interval of bars Correct scale for Y axis (S)	1
Required bars drawn (B)	1 Only **REQUIRED** bars drawn
Drawing of bars (B)	1 All 4 **REQUIRED** bars drawn correctly

(6)
(15)

3.2 3.2.1
- Taste✓/sweetness
- Size✓/largest fruits (2)

3.2.2
- Humans✓/villagers
- select the fruits with desirable characteristics✓/sweetest and largest fruits
- and scatter✓/grow them/use them to form the next generation of offspring (3)

3.2.3
- Climate✓
- Temperature✓
- Water✓
- Soil✓
- Light✓
- Humidity✓
- Gases✓ Any 1 (1)

(Mark first ONE only)

3.2.4
- If trees are produced through marcotting there would be no variation within the plantation✓/trees would be genetically identical
- Any change in the environment/diseases/insects affecting one tree will probably destroy the whole plantation✓ /no other characteristics will be introduced

(Mark first ONE only) (2)

3.2.5
- No✓/ the fruits cannot be labelled as genetically modified (GM)
- because no gene transfer✓/introduction in the marcotting process took place (2)

3.2.6
- Production of medication/resources cheaply✓
- Control pests with specific genes inserted into a crop✓
- Using specific genes to increase crop yields✓/food security
- Introduction of genes to improve human health✓
- Selecting genes to increase shelf-life of plant products✓
- Improving the quality of the crop✓
- Allows a faster production time✓
- Developing resistance to drought✓
- Developing resistance to pests✓
- Developing resistance to herbicides✓
- Developing resistance to diseases✓ Any 2 (2)

(Mark first TWO only)

(12)

3.3	3.3.1	- Habitat✓/colour of sand - Fur colour✓ **(Mark first TWO only)**	(2)
	3.3.2	100✓	(1)
	3.3.3	- They used a large sample size✓/200 models per habitat/ 200 models per fur colour/ 400 models in total - Allowed enough time for predators to attack the models✓ - Placed mice randomly in each habitat✓ Any 2 **(Mark first TWO only)**	(2)
	3.3.4	The darker coloured models were attacked less✓✓ than the lighter coloured models **OR** The lighter coloured models were attacked more✓✓ than the darker coloured models	(2)
	3.3.5	- More mice/78 models with dark fur colour were attacked✓ in the beach habitat - as they were more visible✓/less camouflaged against the light coloured sand - Fewer mice with light fur colour/26 models were attacked✓ in the beach habitat - as they are less visible✓ /well camouflaged against the light coloured sand	(4)
	3.3.6	- The clay models are not able to escape✓ from predators - and therefore they would be attacked more frequently✓ **OR** - The owls will not recognise the models as prey✓and - therefore will attack less frequently✓ **OR** -If the models showed signs of an attack✓ -it doesn't give an indication of their survival ✓	(2) **(13)** **[40]**

TOTAL SECTION B: 80

SECTION C
QUESTION 4

STRUCTURE AND ARRANGEMENT OF CHROMOSOMES

- Each chromosome comprises two chromatids✓
- held together by a centromere✓
- There are 23 pairs✓/46 chromosomes in
- human somatic cells✓/body cells
- which are arranged into homologous pairs✓
  - that are similar in length✓
  - carry genes for the same characteristics✓
  - have alleles of a particular gene at the same loci✓and
  - have the same centromere position✓
- Each somatic cell has 22 pairs/44 autosomes✓and
- a pair/2 gonosomes✓/sex chromosomes/X and Y chromosomes
- Autosomes are arranged in pairs from largest to smallest✓ in a karyotype
- Males have XY chromosomes✓
- Females have XX chromosomes✓
- The X chromosome is larger than the Y chromosome✓ Max 8 (8)

BEHAVIOUR OF CHROMOSOMES IN MEIOSIS I
- During prophase✓ **I**
- chromosomes pair✓up/homologous pairs/bivalents form
- Crossing over✓/exchange of genetic material occurs
- between chromatids✓/adjacent chromosome pairs
- During metaphase✓ **I** of meiosis
- homologous chromosomes✓/chromosome pairs are arranged
- at the equator✓ of the cell
- in a random✓ way
- with the chromosome attached to the spindle fibre✓
- During anaphase✓ **I**
- chromosome pairs separate✓/chromosomes move to opposite poles
- During telophase✓ **I**
- the chromosomes reach the poles of the cell✓ Max 9 (9)

Content (17)
Synthesis (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question.	Ideas are arranged in a logical sequence.	All aspects of the essay have been sufficiently addressed.
In this essay in Q4	Only information relevant to structure and arrangement of human chromosomes and their behaviour in the different phases of meiosis **I** is given. No irrelevant information included.	The description of structure and arrangement of human chromosomes and their behaviour in the different phases of meiosis **I** is given in a logical and sequential manner.	At least the following marks should be obtained - **5/8** for the structure and arrangement of human chromosome - **6/9** for behaviour during meiosis **I**
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2018

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

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 numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, e.g. 1.1.10 D.

1.1.1 What is the scientific name of the fossil, Mrs Ples?

A *Homo erectus*
B *Homo habilis*
C *Australopithecus africanus*
D *Australopithecus afarensis*

1.1.2 Which ONE of the following is a structural feature of a bipedal organism?

A Long, narrow pelvis
B Short, wide pelvis
C C-shaped vertebral column
D Longer arms

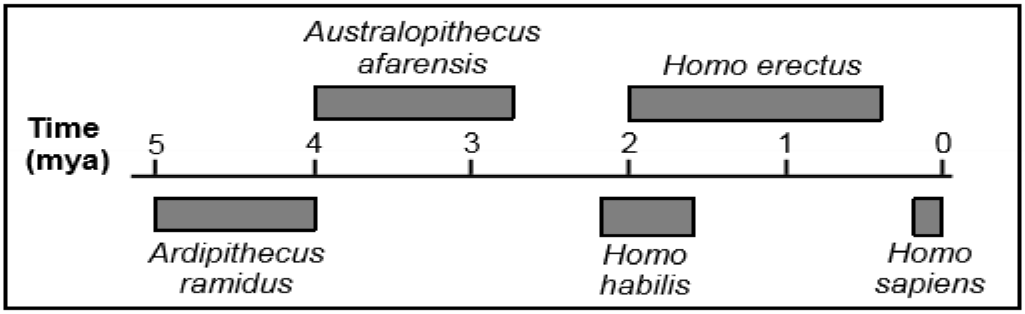
1.1.3 A mother has blood group **B** and a father has blood group **O**. They have three biological children and an adopted child. The blood groups of all the children are represented in the table below.

CHILDREN	BLOOD GROUP
Nobuhle	O
William	B
Milly	AB
Patrick	O

Which child is adopted?

A Nobuhle
B William
C Milly
D Patrick

QUESTIONS 1.1.4 AND 1.1.5 ARE BASED ON THE TIMELINE BELOW SHOWING THE POSSIBLE EVOLUTION OF SOME HOMINIDS.



1.1.4 Which species inhabited the Earth for the longest period of time?

A *Australopithecus afarensis*
B *Homo erectus*
C *Homo habilis*
D *Homo sapiens*

1.1.5 How many years ago did the genus *Homo* first appear?

A 2,2 mya
B 2,0 mya
C 1,6 mya
D 0,2 mya

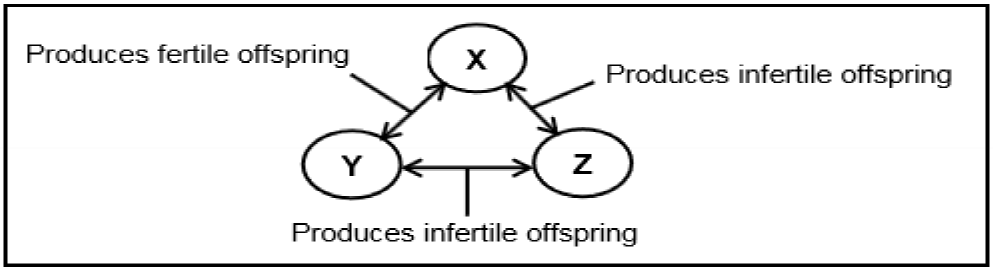
1.1.6 The list below describes some evolutionary events.

(i) Each population undergoes natural selection differently and independently.
(ii) There is no gene flow between the two populations.
(iii) A population becomes separated.
(iv) A geographical barrier forms.
(v) The two populations become different phenotypically and genotypically.

Which ONE of the following combinations gives the CORRECT sequence of these events?

A (v) → (iii) → (ii) → (i) → (iv)
B (iv) → (v) → (ii) → (i) →(iii)
C (iv) → (iii) → (ii)→ (i) → (v)
D (ii) → (iii) → (iv) → (i) → (v)

1.1.7 The diagram below shows the fertility of the offspring produced when three populations of mice, **X**, **Y** and **Z**, interbreed.



Which ONE of the following statements is CORRECT?

A All three populations are of the same species.
B Populations **X** and **Z** are of the same species, but populations **X** and **Y** are different species.
C Populations **Y** and **Z** are different species, but populations **X** and **Y** are of the same species.
D Populations **X** and **Y** are different species, but populations **Y** and **Z** are of the same species.

QUESTIONS 1.1.8 AND 1.1.9 ARE BASED ON THE INFORMATION BELOW.

In a certain species of rabbits, body colour is controlled by two alleles where black (**B**) is dominant to white (**b**). Ear shape is controlled by a second gene. The allele for wide ears **(E)** is dominant to the allele for narrow ears **(e)**.

1.1.8 What is the possible genotype for a black rabbit with narrow ears?

A BbEe
B bbee
C BBEe
D Bbee

1.1.9 What is the possible genotype of gametes produced by a white rabbit with narrow ears?

A bbee
B be
C BE, Be, bE and be
D bE and be (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 1.2.9) in the ANSWER BOOK.

1.2.1 The bonds between nitrogenous bases in a DNA molecule

1.2.2 All the genes that make up an organism

1.2.3 The type of evidence for human evolution that includes tool-making

1.2.4 The process whereby new species are formed

1.2.5 An inherited disorder where blood fails to clot properly

1.2.6 The opening in the base of the skull through which the spinal cord passes

1.2.7 Two or more alternative forms of a gene at the same locus

1.2.8 The type of variation in a population with no intermediate phenotypes

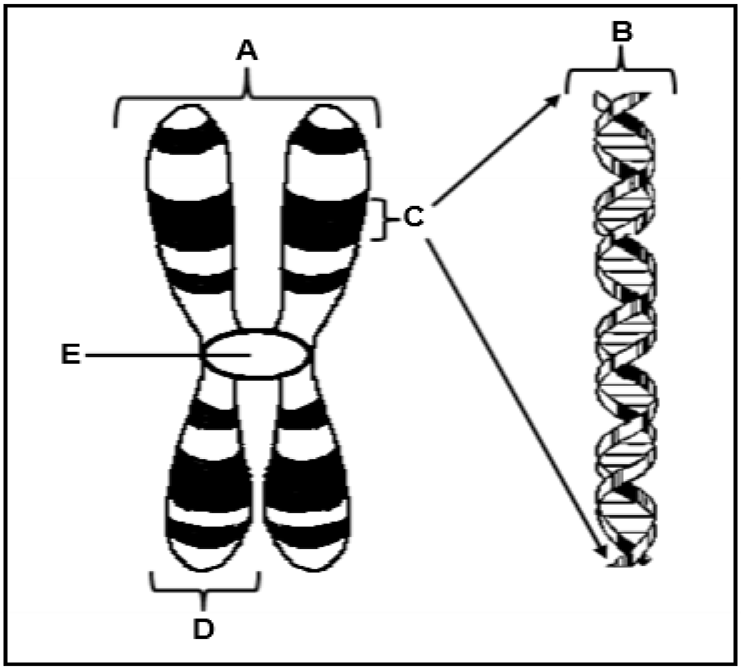
1.2.9 Chromosomes involved in sex determination (9 x 1) **(9)**

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	Type of inheritance where both alleles are expressed equally in the phenotype	A: B:	Co-dominance Complete dominance
1.3.2	Evidence of evolution	A: B:	Modification by descent Fossil record
1.3.3	Discovered the structure of the DNA molecule	A: B:	Watson and Crick White and Dart

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

1.4 The diagram below shows the structure of a chromosome.



1.4.1 Identify parts **D** and **E**. (2)

1.4.2 How many pairs of chromosomes are found in a normal human somatic cell? (1)

1.4.3 Give only the LETTER of the part that:

(a) Attaches to the spindle fibres during cell division (1)

(b) Represents a gene (1)

1.4.4 Name:

(a) TWO organelles in an animal cell where DNA is found (2)

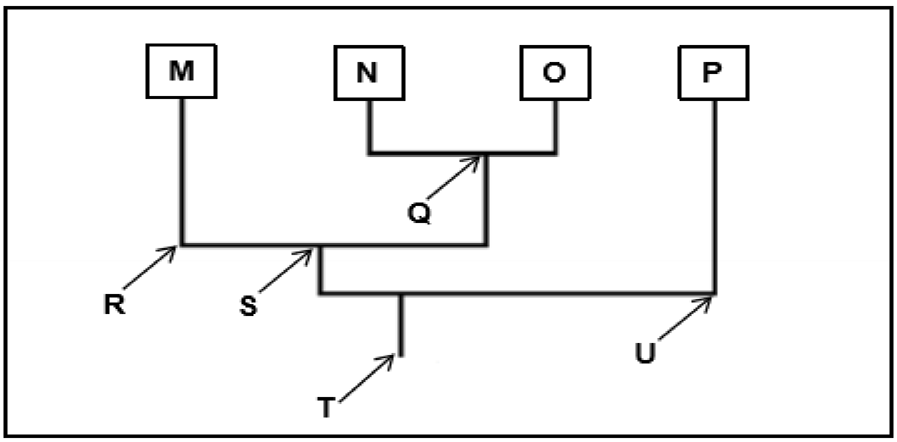
(b) The natural shape of a DNA molecule (1)

(c) The process whereby DNA makes an identical copy of itself (1)
(9)

1.5 Read the extract below.

> Trilobites are an extinct group of marine arthropods. Many of their fossils have been discovered. They had a tough exoskeleton and they are thought to be closely related to three other phyla of extinct arthropods, namely helmetids, tegopeltids and naraoids.
>
> The tegopeltids and helmetids are the two most closely related phyla and are more closely related to trilobites than to naraoids.

Study the diagram below, which illustrates the possible evolutionary relationships among the four phyla, represented by the letters **M**, **N**, **O** and **P**.



1.5.1 Name the type of diagram illustrated. (1)

1.5.2 What structural feature of trilobites, described in the extract, improved the chances of fossilisation? (1)

1.5.3 Give only the LETTER of the most recent common ancestor for phyla:

(a) **M** and **O** (1)

(b) **M**, **N**, **O** and **P** (1)

1.5.4 Which of the extinct arthropods (trilobites, helmetids, tegopeltids or naraoids) are represented by phylum:

(a) **M** (1)

(b) **N** (1)

(c) **O** (1)

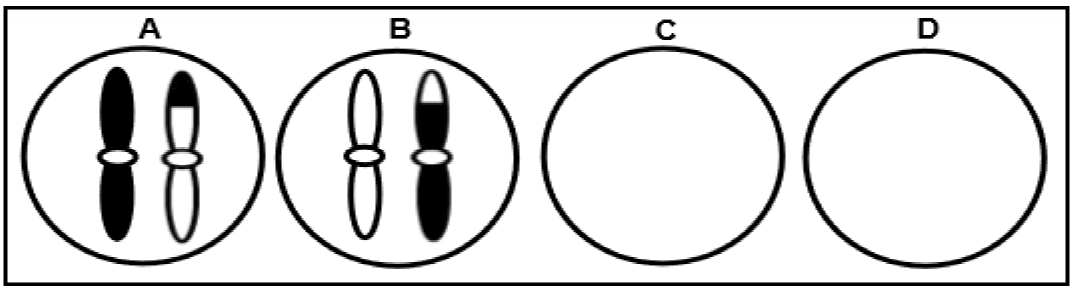
(d) **P** (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagrams below represent the distribution of chromosome pair 21 as it appears in gametes at the end of meiosis **II** in a human male.



2.1.1 Explain why the gametes represented by diagrams **C** and **D** do not have any chromosomes. (3)

2.1.2 If gamete **A** is involved in fertilisation, describe how this may result in Down syndrome. (3)

2.1.3 Due to the process of crossing over, the chromosomes in diagrams **A** and **B** appear different to each other.

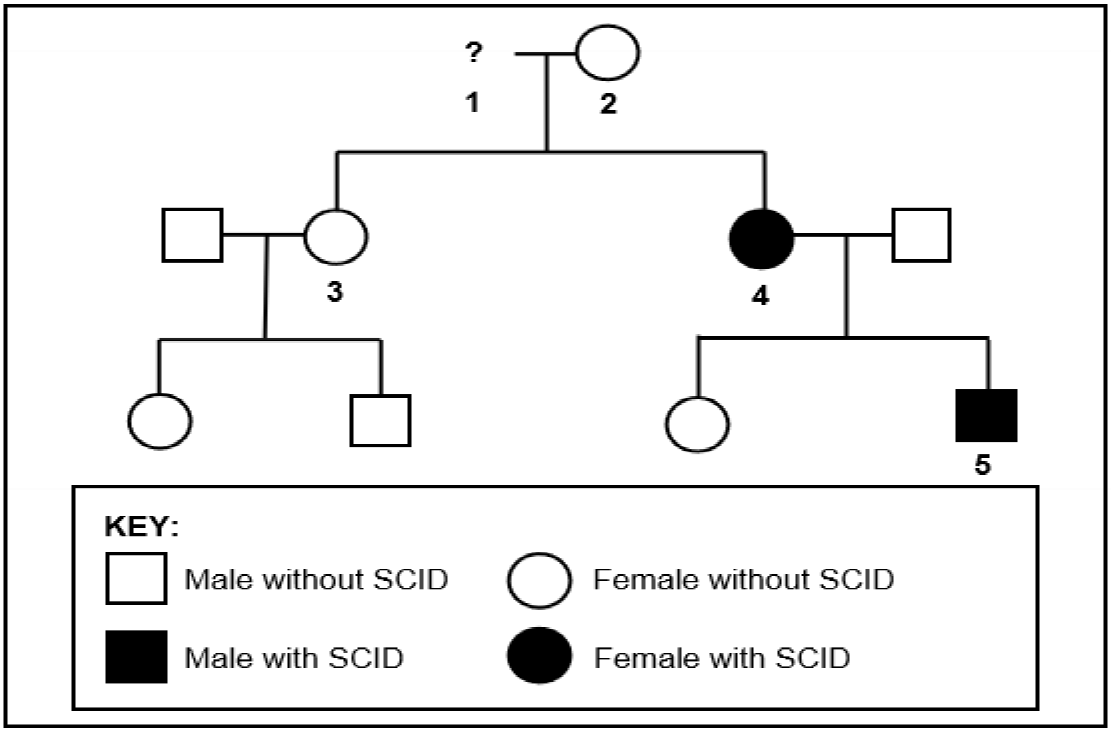
(a) Identify the phase of meiosis during which crossing over occurs. (1)

(b) Describe the events during crossing over. (3)

(c) Explain the significance of crossing over in natural selection. (3)
(13)

2.2 Severe combined immune deficiency syndrome (SCID) is a disorder affecting the immune system. It is caused by a sex-linked recessive allele (**X**^{d}).

The diagram below shows the inheritance of the disorder in a family. It is not known if individual **1** has the disorder or not.



2.2.1 Give the:

(a) Phenotype of individual **2** (1)

(b) Phenotype of individual **1** (1)

(c) Genotype of individual **3** (2)

2.2.2 Explain how individual **5** inherited the disorder. (2)
(6)

2.3 Read the extract below.

The first cloned animal in Africa, a calf named Futhi, was born in North West in South Africa on 19 April 2003. No fertilisation was involved in the production of Futhi. She was produced from a single cell taken from the ear of a donor cow named LMJC 865. The donor cow had a high average milk yield of 78 litres a day. Cloning allows for the production of organisms with desired characteristics.

Some people argue that cloning reduces genetic variation in the offspring, with no further genetic improvement. Cloning is an expensive procedure and may not be economical for commercial agriculture.

2.3.1 According to the extract, state ONE:

(a) Advantage of cloning (1)

(b) Disadvantage of cloning (1)

2.3.2 State why the donor cell was taken from LMJC 865 and not from any other cow. (1)

2.3.3 State why an ear cell was used and not an ovum. (2)

2.3.4 Briefly describe the process of *cloning*. (4)
(9)

2.4 Flower colour (purple or white) in a particular plant species is controlled by two alleles, **D** and **d**.

Four crosses were carried out to determine which allele is dominant. Forty (40) offspring were produced in each cross. The phenotypes of the parents and offspring in each cross were recorded.

The results are shown in the table below.

CROSS	PHENOTYPE		
	PARENT 1	PARENT 2	OFFSPRING
1	purple	white	40 purple
2	purple	purple	31 purple, 9 white
3	white	white	40 white
4	purple	white	21 purple, 19 white

2.4.1 State the dominant flower colour. (1)

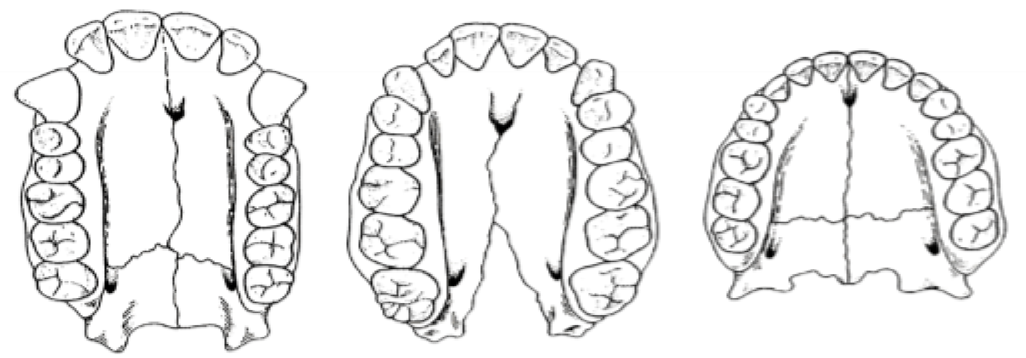
2.4.2 Use cross **1** to explain your answer to QUESTION 2.4.1. (2)

2.4.3 State Mendel's Law of Segregation. (3)

2.4.4 Use a genetic cross to show how the crossing of two purple flowering plants can produce white offspring, as in cross **2**. (6)
(12)
[40]

QUESTION 3

3.1 The diagrams below show the upper jaws of some fossils. These diagrams are drawn to scale.



Chimpanzee ***Australopithecus afarensis*** ***Homo sapiens***

3.1.1 Describe ONE visible difference between the jaw of a chimpanzee and that of *Homo sapiens* which show trends in human evolution. (2)

3.1.2 Based on the differences in dentition, what conclusion can be made about the change in diet from *Australopithecus afarensis* to *Homo sapiens*? (2)

3.1.3 *Australopithecus* may be described as a transitional species between the chimpanzee and *Homo sapiens*.

(a) Define a *transitional species*. (1)

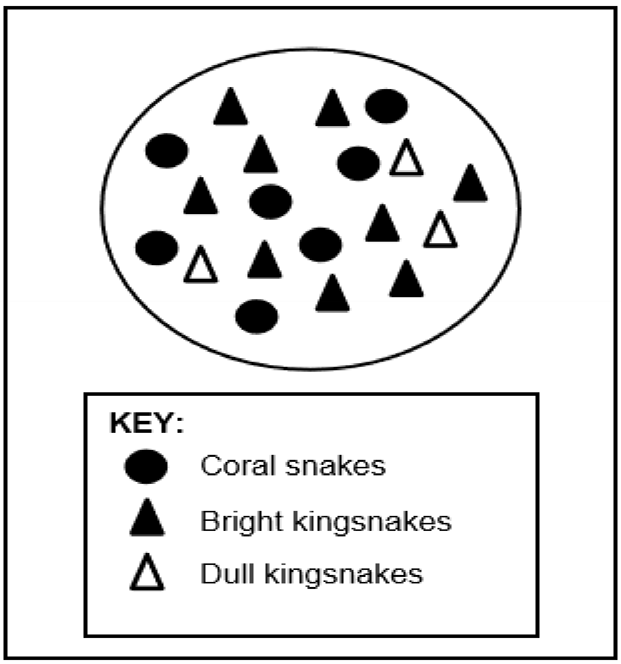
(b) Use ONE visible feature of the jaw to explain why *A. afarensis* may be described as a transitional species. (2)
(7)

3.2 There are two variations in the colour of kingsnakes. Some have a bright colourful pattern and others have a dull pattern. Kingsnakes are non-poisonous to their predators.

Coral snakes also have a bright colour pattern, but are poisonous to their predators. This is a defence mechanism as predators avoid them.

Scientists observed that where kingsnakes shared the same habitat with coral snakes, there were more kingsnakes that had bright colourful patterns.

The diagram below represents the distribution of the snakes.

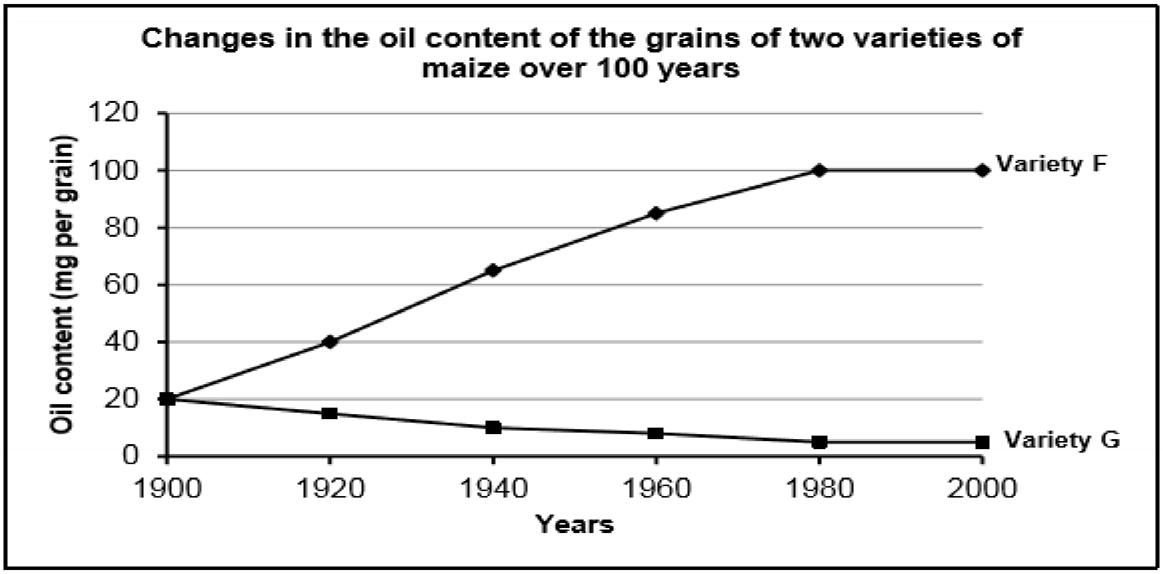


3.2.1 Explain how the bright colour pattern of coral snakes influences their survival. (3)

3.2.2 Use Darwin's theory of evolution through natural selection to explain why there are more brightly coloured kingsnakes in this habitat. (6)
(9)

3.3 Artificial selection programmes have produced two varieties of maize. The one has grains with a high oil content (**Variety F**) and the other has grains with a low oil content (**Variety G**).

The graph below shows the changes in the oil content of the grains of the two varieties over 100 years of artificial selection.



3.3.1 In which year did the two maize varieties have the same oil content? (1)

3.3.2 Calculate the percentage increase in the oil content of **Variety F** over the 100-year period. Show ALL working. (3)

3.3.3 Tabulate TWO differences between natural selection and artificial selection. (5)
(9)

3.4 Weeds are problematic to farmers because they invade farm fields and outcompete crop plants for space. This reduces the crop yield.

Farmers spray their fields with chemicals, known as herbicides, to kill the weeds. Some weeds, however, have evolved to be resistant to herbicides.

Scientists investigated the time it took for a species of weed to develop resistance to five types of herbicides. The results are shown in the table below.

TYPES OF HERBICIDE	TIME TAKEN FOR WEEDS TO DEVELOP RESISTANCE (YEARS)
2,4-D	9
Dalapon	9
Picloran	25
Dicloflop	7
Trifluralin	26

3.4.1 Refer to the passage above and state how weeds act to reduce crop yield. (1)

3.4.2 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

3.4.3 Name the herbicide:

(a) To which the weeds developed resistance the fastest (1)

(b) That remained effective for the longest period of time (1)

3.4.4 The scientists used the same weed species when investigating resistance to the different herbicides.

(a) Describe how the scientists would have determined the resistance of the weeds to the herbicides. (2)

(b) Explain how the use of the same weed species improved the validity of the investigation. (2)

3.4.5 Draw a bar graph to show the time taken for the evolution of resistance to the herbicides. (6)

(15)

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe the structure of RNA in a cell and the involvement of the different types of RNA in protein synthesis.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2018

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 9 pages.

SECTION A

QUESTION 1

1.1	1.1.1	C ✓✓		
	1.1.2	B✓✓		
	1.1.3	C✓✓		
	1.1.4	B✓✓		
	1.1.5	A✓✓		
	1.1.6	C✓✓		
	1.1.7	C✓✓		
	1.1.8	D✓✓		
	1.1.9	B✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Hydrogen✓bonds		
	1.2.2	Genome✓		
	1.2.3	Cultural✓evidence		
	1.2.4	Speciation✓		
	1.2.5	Haemophilia✓		
	1.2.6	Foramen magnum✓		
	1.2.7	Alleles✓		
	1.2.8	Discontinuous✓variation		
	1.2.9	Gonosomes	(9 x 1)	**(9)**
1.3	1.3.1	A only✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	A only✓✓	(3 x 2)	**(6)**

1.4 1.4.1 D- Chromatid✓
E- Centromere✓ (2)

1.4.2 23✓ pairs (1)

1.4.3 (a) E✓ (1)
(b) C✓/B (1)

1.4.4 (a) Nucleus✓
Mitochondrion✓ (2)
(Mark first TWO only)

(b) Double helix✓ (1)

(c) (DNA) Replication✓ (1)
(9)

1.5 1.5.1 Phylogenetic tree✓/ cladogram (1)

1.5.2 An exoskeleton✓ (1)

1.5.3 (a) S✓ (1)
(b) T✓ (1)

1.5.4 (a) Trilobites✓ (1)
(b) Helmetids✓ (1)
(c) Tegopeltids✓ (1)
(d) Naraoids✓ (1)
OR (b) Tegopeltids✓ (c) Helmetids✓
(8)

TOTAL SECTION A: 50

QUESTION 2

2.1 2.1.1
- Due to non-disjunction✓/ Non-separation of a chromosome pair
- during Anaphase **I**✓
- Two chromosomes moved to the one pole✓ and
- none moved to the other pole✓ Any (3)

2.1.2
- Gamete **A** will have 24 chromosomes✓/an extra chromosome
- and when it fertilises a normal ovum✓/gamete with 23 chromosomes
- the zygote will have 3 chromosomes at position 21✓/ 47 chromosomes (3)

2.1.3 (a) Prophase **I**✓ (1)

(b)
- Adjacent chromatids of homologous chromosomes cross✓
- at a point called the chiasma✓
- There is an exchange of DNA segments✓/genetic material (3)

(c)
- Crossing over introduces genetic variation✓ in gametes
- Genetic variation may result in favourable characteristics✓
- that ensure a better chance of survival✓
- when environmental conditions change✓

OR

- Crossing over introduces genetic variation✓ in gametes
- Genetic variation may result in unfavourable
- characteristics✓
- that reduce the chance of survival✓
- when environmental conditions change✓ Any (3)

(13)

2.2 2.2.1
(a) Female without SCID✓ (1)
(b) Male with SCID✓ (1)
(c) X^DX^d✓✓ (2)

2.2.2
- He inherited the recessive allele✓ /X^d
- from the mother✓/individual 4 (2)

(6)

2.3 2.3.1 (a) It allows for the production of organisms with desired characteristics✓/ high average milk yield (1)
(Mark first ONE only)

(b)
- It reduces genetic variation✓ in offspring
- It results in no further genetic improvement✓
- It is expensive✓
- It may not be economical for commercial agriculture✓

(Mark first ONE only) Any (1)

2.3.2 LMJC 865 had a high average milk-production yield✓/ produced 78 litres per day/ had the desired characteristic (1)

2.3.3
- A diploid cell✓/ a cell with all the genetic information is needed
- An ovum is a haploid cell✓/ only contains half of the genetic information (2)

2.3.4
- The nucleus of an ovum is removed✓ and replaced with
- the nucleus of a somatic donor cell✓/ diploid donor cell
- The zygote is stimulated✓
- for mitosis✓ to occur
- The embryo is then placed into the uterus of an adult female✓

OR

- Plants may be cloned by vegetative reproduction✓/asexual reproduction /tissue culture/grafting
- A plant with the desired characteristics is selected✓
- A vegetative part of the "parent" plant structure is removed✓/(examples) and
- placed inside a growth medium✓/(examples)
- and allowed to grow✓

Any 4 (4)
(9)

2.4 2.4.1 Purple✓ (1)

2.4.2
- When purple-flowering plants and white-flowering plants are crossed ✓
- all the offspring have purple flowers✓ /have no white flowers (2)

2.4.3
- The two alleles for a characteristic✓
- separate during meiosis✓ so that
- each gamete contains only one allele✓ for that characteristic (3)

2.4.4

P_1	Phenotype	Purple	x	Purple✓
	Genotype	Dd	x	Dd✓
Meiosis				
	G/gametes	D, d	x	D, d✓
Fertilisation				
F_1	Genotype	DD; Dd; Dd		dd✓
	Phenotype	Purple :		White✓*

P_1 and
F_1✓
Meiosis and fertilisation✓

*Compulsory 1 + Any 5

OR

P_1	Phenotype	Purple	x	Purple✓
	Genotype	Dd	x	Dd✓

Meiosis

Fertilisation

Gametes	D	d
D	DD	Dd
d	Dd	dd

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype Purple: White✓*

P_1 and
F_1✓
Meiosis and fertilisation✓ (6)

(12)

*Compulsory 1 + Any 5 **[40]**

QUESTION 3

3.1 3.1.1

- The jaw is large in the chimpanzee✓and small in *Homo sapiens*✓
- The jaw/ palate is rectangular in the chimpanzee✓and rounded in *Homo sapiens*✓
- Large spaces between the teeth in the chimpanzee✓ and small/no spaces in *Homo sapiens*✓
- Large canines/teeth in the chimpanzee✓ and small canines/teeth in *Homo sapiens*✓ Any 1 x 2 (2)

(Mark first ONE only)

3.1.2

- The diet changed from eating raw food✓ in *Australopithecus*
- to a diet of cooked food✓ in *Homo sapiens* (2)

3.1.3 (a) A transitional species shows intermediate characteristics between two genera/species✓

OR

It has characteristics common to both the ancestor species and the species that follows✓ (1)

(b) The jaw is smaller than that of the chimpanzee but larger than that of *Homo sapiens*✓✓

OR

The canines/ teeth are smaller than those of the chimpanzee but larger than those of *Homo sapiens*✓✓

OR

The jaw/ palate shape is more rounded than that of the chimpanzee but less rounded than that of *Homo sapiens*✓✓
Any 1 x 2 (2)

(Mark first ONE only)

(7)

3.2 3.2.1
- The bright colour pattern is associated with being poisonous✓
- thus reducing predation✓ and
- improving the chances of survival✓ (3)

3.2.2
- There is variation in the colour of kingsnakes✓
- Some are bright in colour✓/resemble the coral snakes and
- the others are dull in colour✓
- Those with dull colours are killed✓ by predators
- Those with bright colours are not eaten✓
- so they survive✓and reproduce,
- passing on the allele for bright colour to the next generation✓

Any 6 (6)
(9)

3.3 3.3.1 1900✓ (1)

3.3.2 $\left\{\frac{80}{20}\right\}$✓ x 100✓ = 400✓%

OR

$\left\{\frac{(100-20)}{20}\right\}$✓ x 100✓ = 400✓% (3)

3.3.3

T✓

Natural selection	Artificial selection
The environment or nature is the selective force✓	Humans represent the selective force✓
Selection is in response to suitability to the environment✓	Selection is in response to satisfying human needs✓
Occurs within a species✓	May involve one or more species✓ (as in cross breeding)

1 for Table + Any 2 x 2 (5)

(Mark first TWO only) **(9)**

3.4 3.4.1
- They invade farm fields✓
- They outcompete the crop plants for space✓ Any (1)

3.4.2 (a) Type of herbicide ✓ (1)
(b) Time taken for development of resistance✓ (1)

3.4.3 (a) Dicloflop✓ (1)
(b) Trifluralin✓ (1)

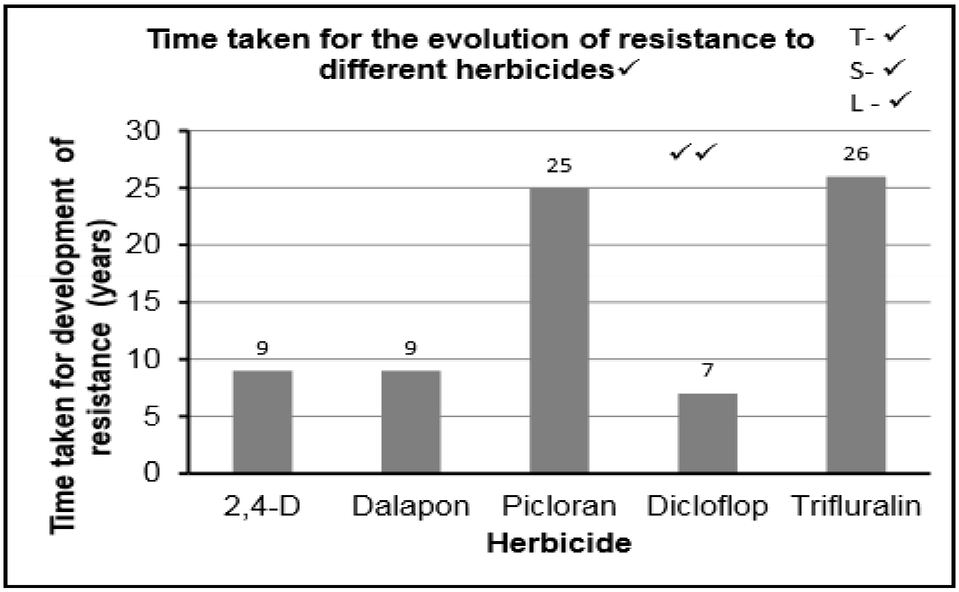
3.4.4 (a)
- They would apply the herbicide to the weed✓ and
- observe if the weed survives✓ over many generations (2)

(b)
- They used the same weed species as other weed species may have developed resistance to that herbicide✓
- Each weed species may respond differently✓ to a herbicide

OR

- It allows for a single variable✓
- to which all results can be attributed✓ (2)

3.4.5



Guideline for assessing the graph

Type: Bar graph drawn **(T)**	1
Title of graph	1
Correct: – **Scale** for Y-axis and **(S)** – Width and interval of bars on X-axis	1
Correct: – **Label** for X-axis and – **Label** and unit for Y-axis **(L)**	1
Plotting of bars	1- 1 to 4 bars plotted correctly 2- All 5 bars plotted correctly

(6)
(15)

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Structure (S)
- RNA is single stranded✓
- and is made up of nucleotides✓which comprise:
- ribose✓ sugar
- phosphate✓group
- nitrogenous bases✓ which are
- adenine, uracil, guanine and cytosine✓/ (A, U, G and C)
- The phosphate group is attached to the ribose sugar✓
- and the nitrogenous base is attached to the ribose sugar✓
- Bases on RNA are arranged in triplets✓
- as codons on mRNA✓
- and anticodons on tRNA✓
- tRNA has a clover-leaf✓/hairpin structure
- tRNA has a place of attachment for an amino acid✓ Any (9)

Involvement in protein synthesis (P)
- mRNA✓ forms
- during transcription✓/by copying the coded message from DNA
- and moves out of the nucleus✓
- and attaches to the ribosome✓
- During translation✓
- the anticodon matches the codon✓
- tRNA✓
- brings the required amino acid✓ to the ribosome
- Amino acids become attached by peptide bonds✓
- to form the required protein✓ Any (8)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	**Relevance (R)**	**Logical sequence (L)**	**Comprehensive (C)**
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the: - structure of RNA and - involvement of the different types of RNA in protein synthesis is given There is no irrelevant information	All the information regarding the - structure of RNA and - the involvement of the different types of RNA in protein synthesis is given in a logical manner	At least: – **6/9** correct points for the structure of RNA **(S)** – **5/8** for the involvement in protein synthesis **(P)**
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2019

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 pages.

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 numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, e.g. 1.1.10 D.

1.1.1 Which ONE of the following refers to a gradual change in the structure of organisms over time?

A Natural selection
B Mutation
C Evolution
D Speciation

1.1.2 Study the mechanisms below:

(i) Species-specific courtship behaviour
(ii) Infertile offspring
(iii) Adaptation to different pollinators
(iv) Breeding at the same time of the year

Which ONE of the following combinations represents reproductive isolating mechanisms?

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

1.1.3 A sample of DNA has 60 guanine bases and 30 adenine bases.

How many phosphate molecules would you expect in this sample of DNA?

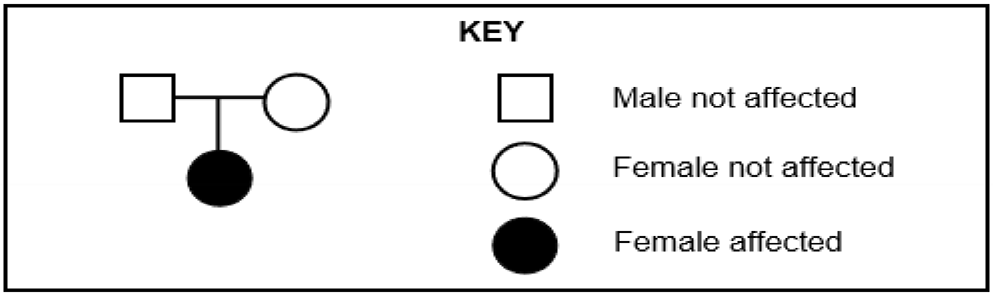
A 30
B 90
C 180
D 270

1.1.4 The theory of evolution has been supported by a comparative study of the structure of vertebrate forelimbs from the fossil record.

Which ONE of the following represents the statement above?

A Genetic evidence
B Modification by descent
C Natural selection
D Biogeography

1.1.5 The diagram below shows the pattern of inheritance of a disorder.



One can conclude that the disorder is caused by a …

A recessive allele, with both parents heterozygous.
B dominant allele, with both parents heterozygous.
C recessive allele, with one parent homozygous recessive while the other is heterozygous.
D dominant allele, with one parent heterozygous while the other is homozygous recessive.

1.1.6 The table below compares the rate of extinction of mammal species over two different time periods.

TIME PERIOD (YEARS)	RATE OF EXTINCTION (PER 100 YEARS)
1500–1900	4,5
1900–2000	90

What is the ratio between the rate of extinction from 1500 to 1900 compared to the rate of extinction from 1900 to 2000?

A 1 : 20
B 1 : 2
C 2 : 1
D 20 : 1

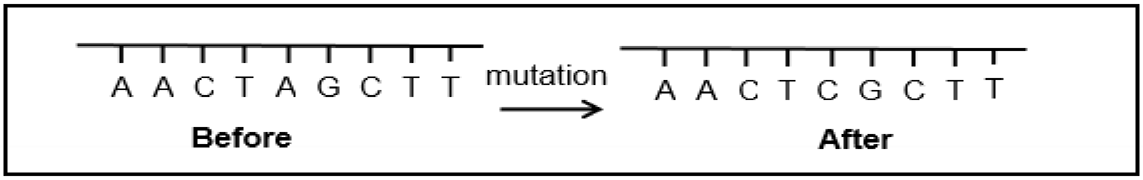
1.1.7 Study the following effects:

(i) The double helix DNA will not unwind during DNA replication
(ii) mRNA will not form
(iii) DNA replication will not take place
(iv) Translation in protein synthesis will not take place

Which ONE of the following combinations of effects will result if the hydrogen bonds in DNA were strong?

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

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE DIAGRAM BELOW SHOWING PART OF A DNA MOLECULE BEFORE AND AFTER A MUTATION.



1.1.8 The mutation …

- A will result in an extra chromosome.
- B will produce the same protein if a different amino acid is coded for.
- C will produce a different protein if a different amino acid is coded for.
- D is the result of an extra chromosome.

1.1.9 Which ONE of the following best describes the mutation?

- A More than one nitrogenous base was changed.
- B Adenine was changed to cytosine.
- C Adenine was changed to thymine.
- D Cytosine was changed to adenine. (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 nitrogenous base found in messenger RNA but not in DNA

1.2.2 An explanation describing evolution as consisting of long phases of little change alternating with short phases of rapid change

1.2.3 The permanent disappearance of a species from Earth

1.2.4 Genus to which Little Foot and Mrs Ples belongs

1.2.5 The cell organelle to which mRNA attaches during protein synthesis

1.2.6 The position of a gene on a chromosome

1.2.7 The sugar that forms part of a nucleotide in RNA

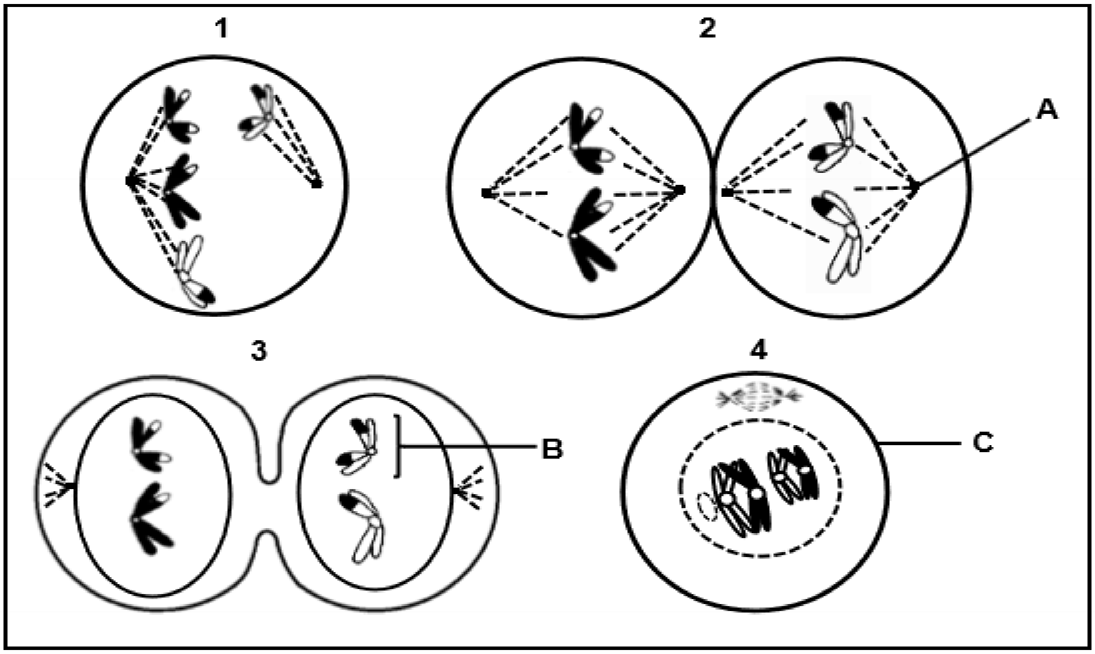
1.2.8 The use of living organisms and their biological processes to improve the quality of human life (8 x 1) **(8)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Location of DNA in a human	A: Mitochondrion B: Nucleus
1.3.2 Inheritance of acquired characteristics	A: Mendel B: Darwin
1.3.3 First to discover the double helix structure of DNA	A: Mendel and Watson B: Watson and Crick

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

1.4 The diagrams below represent different phases of meiosis.



1.4.1 Identify part:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

1.4.2 Give the NUMBER and NAME of the phase which shows the following:

(a) Random arrangement of chromosomes at the equator (2)

(b) Crossing over (2)

(c) Non-disjunction (2)

1.4.3 How many chromosomes will be found in:

(a) The cells at the end of meiosis shown in the diagrams (1)

(b) A normal, human sperm (1)

(c) The somatic cells of a normal mother who has a son with Down syndrome (1)
(12)

1.5 A certain plant species has the following alleles for each characteristic:

Number of seeds per pod **P**: one seed
p: three seeds

Leaf shape **L**: normal shape
l: wrinkled shape

The table below shows the results of the offspring produced by a genetic cross between two plants of this species.

PHENOTYPE	NUMBER OF OFFSPRING
One seed and wrinkled leaves	100
One seed and normal leaves	290
Three seeds and wrinkled leaves	32
Three seeds and normal leaves	96

1.5.1 How many genes of the plant are considered here? (1)

1.5.2 Name the dominant phenotypes of the plant. (2)

1.5.3 Give the:

(a) Genotype of each parent (2)

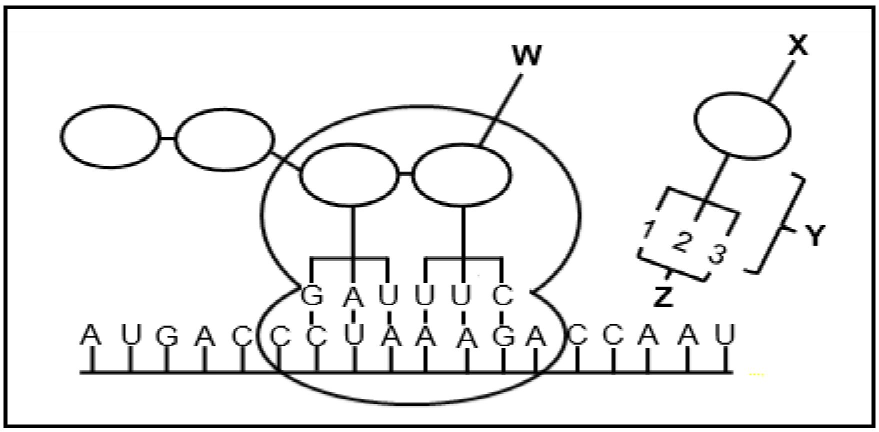
(b) Number of offspring that are homozygous recessive for both characteristics (1)
(6)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

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



2.1.1 Identify:

(a) Molecule **Y** (1)

(b) The group of nitrogenous bases **Z** (1)

2.1.2 If **X** is the next amino acid required after **W**, then identify:

(a) Nitrogenous bases **1, 2** and **3** (2)

(b) The DNA base triplet that codes for **X** (2)
(6)

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

2.3 In certain marine invertebrates the colour of the shell is under the control of one gene with three alleles. In different combinations, the three alleles produce four phenotypes: orange, yellow, orange-yellow and black.

The table below shows the results of the offspring produced from crosses involving parents of different phenotypes.

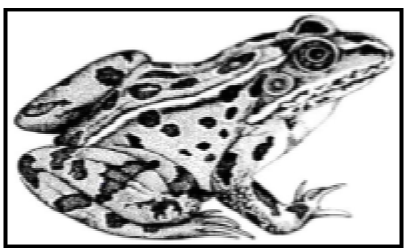
CROSS	PHENOTYPES OF SHELLS	
	PARENTS	**OFFSPRING**
1	Yellow x yellow	27 yellow: 9 black
2	Black x black	All black
3	Orange x orange	30 orange: 10 black
4	Orange x yellow	All orange-yellow

2.3.1 Name and describe the type of dominance shown by cross **4**. (3)

2.3.2 Which shell colour is controlled by the recessive allele? (1)

2.3.3 Use information in the table to support your answer to QUESTION 2.3.2. (2)
(6)

2.4 The back of the leopard frog *(Rana pipiens)* can be spotted, as shown below, or be without spots.



Spotted frogs were allowed to interbreed and they produced 150 spotted offspring and 50 offspring without spots.

2.4.1 Which phenotype is dominant? (1)

2.4.2 Explain your answer to QUESTION 2.4.1. (2)

2.4.3 A frog that is heterozygous for spotted back was crossed with a frog without spots.

Using the letters **D** and **d**, represent a genetic cross to show the expected genotypes and phenotypes of the F_1 generation. (6)
(9)

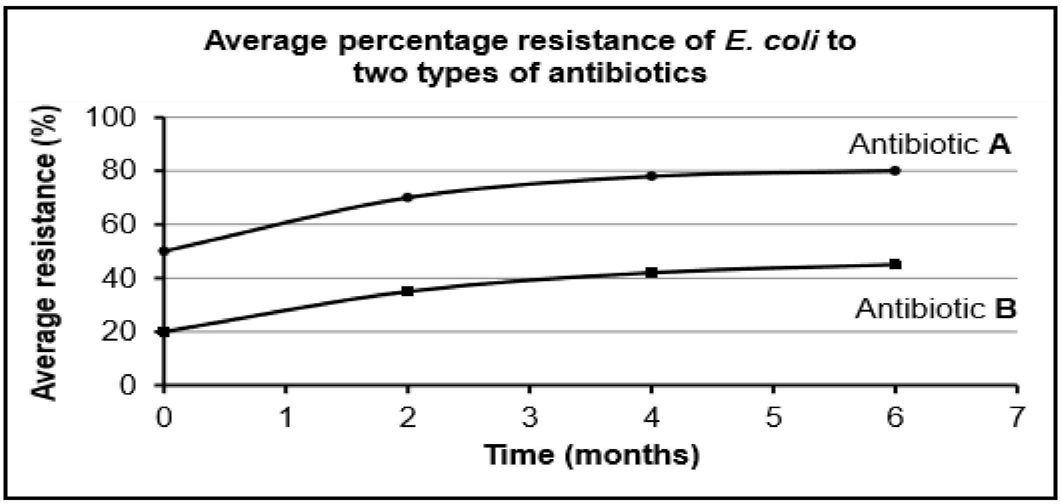
2.5 The *E. coli* bacterium lives in the intestines of pigs where they reproduce rapidly. Certain strains of *E. coli* cause diarrhoea in young pigs (piglets).

Scientists carried out an investigation using 100 piglets to determine the resistance of *E. coli* to two antibiotics, **A** and **B**.

The scientists:

- Injected the piglets with antibiotic **A** and antibiotic **B**
- Took a sample of *E. coli* from the intestines of each piglet a week later and placed them in separate petri dishes
- Allowed the bacteria to grow for 24 hours
- Added antibiotic **A** to one petri dish and antibiotic **B** to the other petri dish
- Measured the growth of the bacteria in each petri dish after 24 hours
- Used the growth measurement as an indication of the resistance of the bacteria to each antibiotic
- Repeated the process over a period of six months
- Calculated the average percentage resistance to both antibiotics

The results are shown in the graph below.



2.5.1 Identify the independent variable in this investigation. (1)

2.5.2 Identify TWO factors that should be kept constant during the investigation. (2)

2.5.3 State TWO ways in which the scientists ensured the reliability of the investigation. (2)

2.5.4 Which antibiotic will you recommend for controlling *E. coli* in piglets? (1)

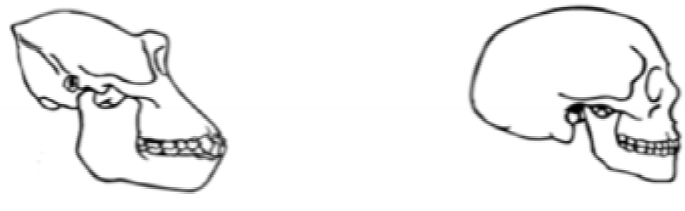
2.5.5 Support your answer to QUESTION 2.5.4 using evidence in the graph. (2)

2.5.6 Explain the results that are shown in the graph for antibiotic **A** in terms of natural selection. (5)

(13)
[40]

QUESTION 3

3.1 The diagrams below show the skulls of two species of primates.



3.1.1 Tabulate THREE observable differences between skull **1** and skull **2** that show trends in human evolution. (7)

3.1.2 Give FOUR characteristics of the upper limbs that humans share with other primates. (4)

3.1.3 Explain how an increase in cranial volume is related to intelligence. (3)
(14)

3.2 Humans are bipedal organisms.

3.2.1 What is meant by *bipedalism*? (2)

3.2.2 Explain how each of the following skeletal structures have contributed to bipedalism in humans:

(a) Foramen magnum (2)

(b) Pelvic girdle (2)

(c) Spine (2)
(8)

3.3 Describe the process of speciation through geographical isolation. **(6)**

3.4 Read the following extract.

MUTATION IN GENE ALLOWS TIBETANS TO SURVIVE AT HIGH ALTITUDE

It is possible to cope with the low oxygen content at high altitudes.

One way is for the body to produce more red blood cells in response to an increase in altitude.

Another way of coping has developed in Tibetans as a result of a gene mutation that they inherited from their ancestors. The mutant gene helps them to use the low amount of oxygen present more efficiently. The mutant gene was found in 87% of the Tibetan population but only in 9% of the Han population that live at a lower altitude than the Tibetans.

3.4.1 A gene mutation caused variation between the Tibetan population and the Han population.

Name THREE other sources of variation in a human population. (3)

3.4.2 Give evidence in the extract which suggests that the survival of people living at high altitudes could be:

(a) Due to a genetically inherited trait (1)

(b) Caused by an environmental factor (1)

3.4.3 Explain the advantage of producing more red blood cells. (2)

3.4.4 Describe how Lamarck would have explained the survival of Tibetans at high altitudes. (5)
(12)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Sometimes the paternity of a son or a daughter is disputed.

Describe sex determination in humans and explain how blood grouping and DNA profiling are used in paternity testing.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2019

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	C✓✓		
	1.1.2	C ✓✓		
	1.1.3	C ✓✓		
	1.1.4	B✓✓		
	1.1.5	A ✓✓		
	1.1.6	A ✓✓		
	1.1.7	C✓✓		
	1.1.8	C✓✓		
	1.1.9	B✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Uracil✓		
	1.2.2	Punctuated equilibrium✓		
	1.2.3	Extinction✓		
	1.2.4	*Australopithecus*✓		
	1.2.5	Ribosome✓		
	1.2.6	Locus✓		
	1.2.7	Ribose✓		
	1.2.8	Biotechnology✓	(8 x 1)	**(8)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	None✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Centriole✓/centrosome		(1)
		(b) Chromosome✓		(1)
		(c) Cell membrane✓/plasma membrane/plasmalemma		(1)
	1.4.2	(a) 2✓- Metaphase **II**✓		(2)
		(b) 4✓- Prophase **I**✓		(2)
		(c) 1✓- Anaphase **I**✓		(2)
	1.4.3	(a) 2✓/ 3 and 1		(1)
		(b) 23✓		(1)
		(c) 46✓		(1)
				(12)
1.5	1.5.1	2✓		(1)
	1.5.2	- Normal leaf✓/normal shape - One seed✓ per pod		(2)
	1.5.3	(a) PpLl✓✓ **OR** PpLl✓ x PpLl✓ /PpLl✓ ; PpLl✓		(2)
		(b) 32✓		(1)
				(6)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1	2.1.1	(a)	tRNA✓/transfer RNA	(1)
		(b)	Anticodon✓	(1)
	2.1.2	(a)	UGG✓✓ (in correct order)	(2)
		(b)	TGG✓✓ (in correct order)	(2) **(6)**

2.2
- 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 **(6)**

2.3 2.3.1 Co-dominance✓

- The phenotypes/alleles of the parents are equally dominant✓ (orange and yellow)
- and are both expressed in the phenotype of the offspring✓ (3)

2.3.2 Black✓ (1)

2.3.3
- In cross 1 both parents are yellow✓/none of the parents are black
- but black appears in the phenotype of the offspring✓

OR
- In cross 3 both parents are orange✓/ none of the parents are black
- but black appears in the phenotype of the offspring✓

OR
- The ratio of the offspring in cross 1 (yellow and yellow)/cross 3 (orange and orange) is 3 yellow/orange :1 black✓
- The smaller proportion represents the recessive allele/black✓ (2)

(6)

2.4 2.4.1 Spotted✓back (1)

2.4.2 Spotted frogs produced offspring without spots✓✓

OR

The spotted offspring were three times more than offspring without spots✓✓ / ratio of spotted offspring to offspring without spots is 3:1 (2)

2.4.3

P_1	Phenotype	Spotted	x	No spots✓
	Genotype	Dd	x	dd✓
Meiosis				
	G/gametes	D , d	x	d , d ✓
Fertilisation				
F_1	Genotype	Dd ; Dd	:	dd ; dd✓*
	Phenotype	(2) spotted	:	(2) without spots✓*

P_1 and F_1✓
Meiosis and fertilisation✓ **2 Compulsory** + Any 4 others

OR

P_1	Phenotype	Spotted	x	No spots✓
	Genotype	Dd	x	dd✓

Meiosis

Fertilisation

Gametes	D	d
d	Dd	dd
d	Dd	dd

1 mark for correct gametes
1 mark for correct genotypes*

F_1 Phenotype (2) spotted : (2) without spots✓*
P_1 and F_1✓
Meiosis and fertilisation✓ **2 Compulsory** + Any 4 others (6)
(9)

2.5 2.5.1 Type of antibiotic✓ (1)

2.5.2 Same:

- Environmental conditions✓/example

- Amount of antibiotic✓
- Concentration of antibiotic✓
- Time of initial injection of antibiotics✓

- Age of the piglets✓
- Species of piglets✓
- Type food given to piglets✓
- Amount of food given to piglets✓
- Size/mass of piglets✓

- Size of petri dishes✓
- Growth medium in both sets of petri dishes✓
- Sample size of *E. coli* ✓
- Method of measurement✓
- Person doing the measurements✓
- Time interval for measurements✓

Any 2
(Mark the first TWO only) (2)

2.5.3
- Investigation was done over a period of six months✓
- Took many measurements✓/calculated the average resistance
- Used a large sample size✓/100 piglets Any 2 (2)

(Mark the first TWO only)

2.5.4 Antibiotic **B**✓ (1)

2.5.5
- The average percentage resistance of *E.coli* to antibiotic **B** is lower✓ than its resistance to antibiotic **A** therefore
- more *E. coli* bacteria die in the presence of antibiotic **B**✓ (2)

2.5.6
- There was variation✓ in the population of *E. coli* bacteria
- Some were resistant to antibiotic **A**✓
- others were not resistant✓
- Those *E. coli* bacteria which were not resistant to antibiotic **A** were killed✓
- Those which were resistant to antibiotic **A** survive✓/reproduced
- passing on the alleles for resistance to their offspring✓
- Over time, the resistance to antibiotic **A** increased✓/the percentage of *E. coli* bacteria dying decreased Any 5 (5)

(13)
[40]

QUESTION 3

3.1 3.1.1

Skull 1	Skull 2
Brow ridges pronounced✓	Brow ridges less pronounced✓
More protruding jaws✓/prognathous	Less protruding jaws✓/non-prognathous
Larger jaws✓	Smaller jaws✓
Smaller cranium size✓	Larger cranium size✓
Larger teeth✓/ canines	Smaller teeth✓/canines
Poorly developed chin✓	Well developed chin✓
Sloping face✓	Flat face✓

(Mark first THREE only) Table 1 + (3 x 2) (7)

3.1.2
- Freely rotating arms✓
- Long upper arms✓
- Rotation around elbow joints✓
- Rotation around the wrists✓
- Opposable thumbs✓
- Bare fingertips✓/ nails instead of claws
- Five fingers✓/pentadactyl limb
- Fingerprints present✓ Any 4 (4)

(Mark first FOUR only)

3.1.3
- Since the cranium houses the brain✓
- a large cranial volume indicates a larger brain✓/more brain cells
- which suggests greater intelligence✓ (3)

(14)

3.2 3.2.1 Walking on two legs✓✓ (2)

3.2.2 (a)
- Foramen magnum moved to a more forward position✓
- to allow the spinal cord to enter vertically✓ (2)

(b)
- Pelvic girdle is short and wide✓/broad (2)
- to support the upper body✓

(c)
- Spine is more curved✓/S shaped (2)
- to absorb shock✓/allow flexible movement/support **(8)**

3.3
- A population of a particular species becomes separated✓
- by a geographical barrier✓
- There is no gene flow between the separated populations✓
- Natural selection occurs independently in each population✓
- due to exposure to different environmental conditions✓/selection pressures
- The populations become very different✓from each other
- genotypically and phenotypically✓
- Even if the populations were to mix again✓
- they will not be able to interbreed✓
- The different populations are now new species✓ Any 6 **(6)**

3.4

3.4.1
- Crossing over✓ } meiosis✓
- Random arrangement of chromosomes✓ } meiosis✓
- Random mating✓
- Random fertilisation✓
- Chromosomal mutation✓

(Mark first THREE only) (3)

3.4.2 (a) Mutant gene✓/Inherited from their ancestors (1)

(b) Influenced by altitude✓ /level of oxygen (1)

3.4.3
- More haemoglobin present✓
- to allow for maximum absorption of the available oxygen✓

OR
- More oxygen will be available✓
- to meet their energy needs✓ (2)

3.4.4
- Originally the amount of red blood cells was similar in all humans✓/the Tibetans did not produce a large number of red blood cells
- As a result of the low oxygen content at high altitudes✓
- the red blood cells tried to increase the amount of oxygen absorbed✓
- As a result ancestral Tibetans produced more red blood cells✓/developed ways of using oxygen more efficiently
- to increase the availability of oxygen to the body✓
- This acquired characteristic✓
- was then passed on to their offspring✓
- All Tibetans now produce more red blood cells✓/use oxygen more efficiently to survive at high altitudes Any (5)

(12)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Sex determination (S)

- Females have XX chromosomes✓
- thus produce an ovum which will always carry the X chromosome✓
- Males have XY chromosomes✓
- thus a sperm will either carry X✓
- or Y✓ chromosome
- If a sperm carrying the X chromosome fertilises the ovum carrying the X chromosome✓
- then a female child results✓
- If a sperm carrying the Y chromosome fertilises the ovum carrying the X chromosome✓
- then a male child results✓
- Therefore it is the father's gamete carrying X or Y chromosome that determines the sex of the child✓
- There is a 50% chance that the child can be a boy or a girl✓ Any 7 (7)

Blood grouping (B)

- The blood group of a child is determined by the alleles received from both parents✓
- The blood group of the mother, the child and the possible father is determined✓
- If the blood group of the mother and possible father cannot lead to the blood group of the child✓
- the man is not the father✓
- If the blood group of the mother and the possible father can lead to the blood group of the child✓
- the man might be the father✓
- This is not conclusive✓
- because many men have the same blood group✓ Any 5 (5)

DNA profiling (P)

- A child received DNA from both parents✓
- The DNA profiles of the mother, child and the possible father are determined✓
- A comparison of the DNA bands of the mother and the child is made✓
- The remaining DNA bands are compared to the possible father's DNA bands✓
- If all the remaining DNA bands in the child's profile match the possible father's DNA bands✓
- then the possible father is the biological father✓
- If all the remaining DNA bands in the child's profile does not match the possible father's DNA bands✓
- then the possible father is not the biological father✓ Any 5 (5)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to: - Sex determination - Blood grouping and paternity - DNA profiling and paternity is given There is no irrelevant information.	The description for each of: - Sex determination - Blood grouping and paternity - DNA profiling and paternity is logical and sequential.	At least the following are provided: - Sex determination **S** (**5/7**) - Blood grouping and paternity **B** (**3/5**) - DNA profiling and paternity **P** (**3/5**)
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/
NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2020(2)

MARKS: 150

TIME: 2½ hours

This question paper consists of 17 pages.

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 number (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D.

1.1.1 Which ONE of the following may result in Down syndrome in humans?

A A gene mutation on chromosome 21
B Failure of chromosome pair 21 to separate during anaphase I
C Failure of the gonosomes to separate during meiosis II
D A gene mutation occurs on the X chromosome

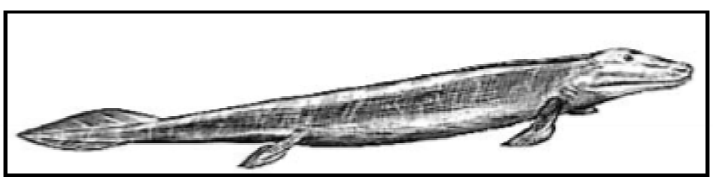
1.1.2 Variation within a species is introduced through …

A random mating and asexual reproduction.
B mitosis and random fertilisation.
C random mating and random fertilisation.
D mitosis and meiosis.

1.1.3 African apes and humans are similar. Both have …

A small jaws and well-developed brow ridges.
B opposable thumbs and bare fingertips.
C gaps between their teeth and eyes in front.
D an upright posture and a cranial ridge.

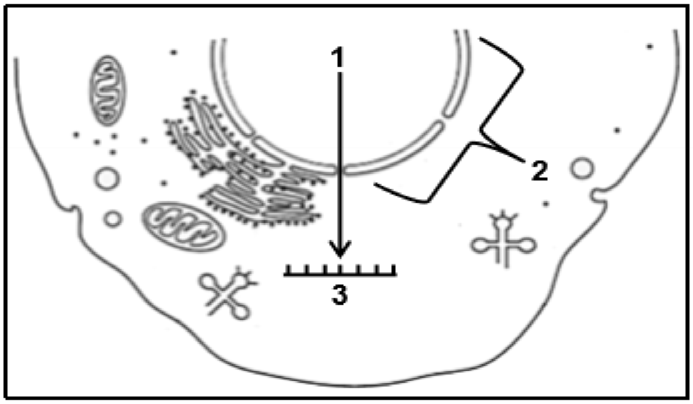
1.1.4 The diagram below shows *Tiktaalik roseae,* a fish that may be the ancestor of the first organisms to live on land.



According to Lamarck, this species of fish may have evolved the ability to 'walk' on land by …

A undergoing natural genetic mutations which caused the fins to develop into legs.
B the process of natural selection.
C passing on the acquired characteristic of fins to their offspring.
D stretching its fins and using them for 'walking'.

1.1.5 The diagram below shows some of the processes, molecules and structures that are involved in protein synthesis in a cell.



Which ONE of the following is the CORRECT labels for **1**, **2** and **3** in the diagram?

	PROCESS 1	STRUCTURE 2	MOLECULE 3
A	transcription	ribosome	tRNA
B	translation	ribosome	mRNA
C	transcription	nucleus	mRNA
D	translation	nucleus	tRNA

1.1.6 A homozygous purple flowering plant (**P**) is crossed with a pink flowering plant (**p**) to produce the F_1-generation. One of the F_1-plants is crossed with the pink flowering parent to produce the F_2-generation.

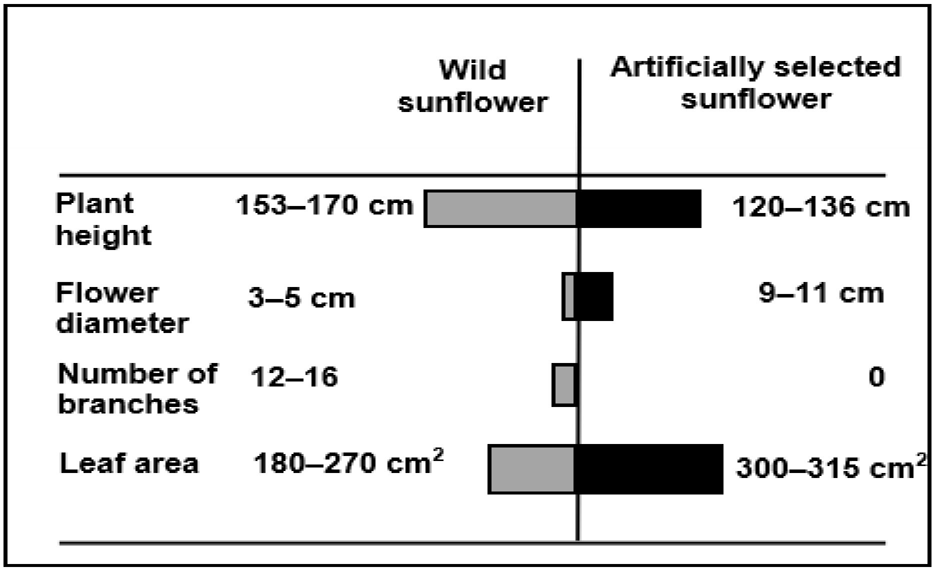
Which ONE of the following is the CORRECT phenotypic ratio of the F_2-generation?

A 1 purple : 1 pink
B 1 purple : 3 pink
C 3 purple : 1 pink
D 1 purple : 2 pink

1.1.7 Which ONE of the following scientists discovered fossils of *Homo sapiens* and *Ardipithecus sp*?

A Raymond Dart
B Lee Berger
C Louis Leakey
D Tim White

1.1.8 The diagram below compares characteristics of wild sunflowers with sunflowers that have been artificially selected.



Which ONE of the following characteristics was found undesirable by humans?

A Number of branches and leaf area
B Plant height and leaf area
C Plant height and flower diameter
D Plant height and number of branches

1.1.9 Punctuated equilibrium suggests the following:

A Evolution is always a slow and gradual process.
B Natural selection does not explain evolution.
C New species can appear quickly, over a relatively short period of time.
D Artificial selection is the only mechanism that causes evolution.

1.1.10 A group of students observed that the long-term use of antibiotics results in the decreased control of bacterial infections.

From this observation the students stated that:

Antibiotic resistance in bacteria is caused by the long-term use of antibiotics.

This statement is a/an …

A theory.
B aim.
C hypothesis.
D conclusion.

(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 1.2.7) in the ANSWER BOOK.

1.2.1 Similar structures in different organisms indicating descent with modification

1.2.2 Large, pointed teeth in African apes that are used for tearing food

1.2.3 The part of the skull that houses the brain

1.2.4 The non-sex chromosomes in humans

1.2.5 The network of genetic material found in the nucleus during interphase

1.2.6 The number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell

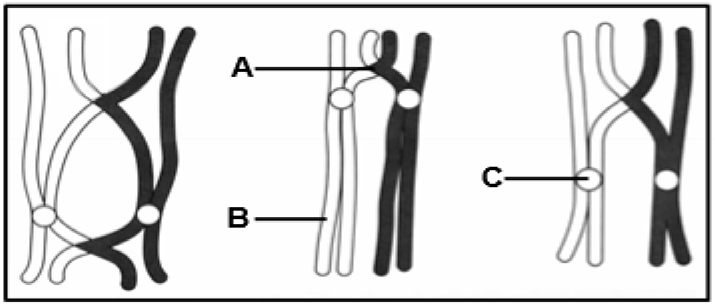
1.2.7 Having a protruding jaw (7 x 1) **(7)**

1.3 Indicate whether each of the statements in COLUMN I apply 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 Long and narrow pelvis	A: African apes B: Humans
1.3.2 The point of attachment of two overlapping chromatids	A: Locus B: Chiasma
1.3.3 Variation in human height	A: Continuous B: Discontinuous

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

1.4 The diagram below represents ALL the chromosomes in a cell that is undergoing normal cell division.



1.4.1 Name the:

(a) Type of cell division that is occurring in the cell in the diagram (1)

(b) Phase of cell division during which the chromosomes behave as shown in the diagram (1)

1.4.2 Where in the human female body would the type of cell division named in QUESTION 1.4.1(a) take place? (1)

1.4.3 Give the LETTER and NAME of the structure that attaches to the spindle fibres. (2)

1.4.4 How many chromosomes will be found in each daughter cell at the end of this cell division? (1)

(6)

1.5 There is variation in the characteristics of fur colour and fur texture in cats.

The table below shows the alleles that control these two characteristics.

CHARACTERISTIC	ALLELE	PHENOTYPE
Fur colour	**B**	Black
	b	White
Fur texture	**R**	Rough
	r	Smooth

The Punnett square below shows the inheritance of these alleles in a genetic cross.

All possible gametes from female

All possible gametes from male

	BR	Br	bR	br
bR	BbRR	BbRr	**X**	bbRr

1.5.1 Name the:

(a) Dominant phenotype for fur colour (1)

(b) Recessive phenotype for fur texture (1)

1.5.2 Give the:

(a) Genotype of offspring **X** (1)

(b) Phenotype of the female parent (2)

(c) Genotype of the male parent (1)

1.5.3 State the phenotype that ALL the offspring of this genetic cross have in common. (1)
(7)

1.6 Scientists compare the number of differences in the amino acid sequence to see how closely related species are. Fewer differences in the amino acid sequence mean the species are more closely related.

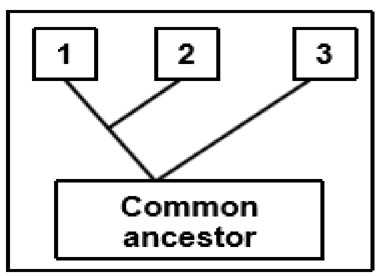
Cytochrome C is a protein that occurs in many species. The amino acid sequence of this protein differs between species.

The table below shows the number of differences in the amino acid sequences of three species, **A**, **B** and **C**.

	SPECIES B	**SPECIES C**
SPECIES A	11	3
SPECIES B		10

1.6.1 What type of evidence for evolution is being used in this table? (1)

1.6.2 Give the LETTER of the species, **A**, **B** and **C**, that should appear at positions **1**, **2** and **3** in the diagram below.



(3)
(4)

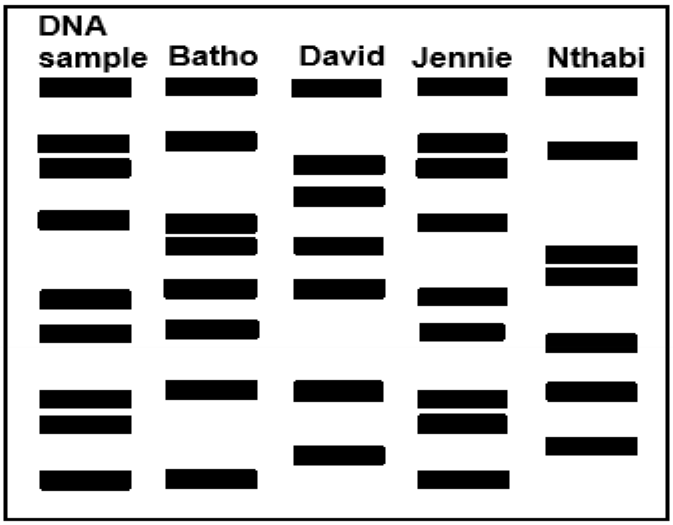
TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Detectives were investigating a crime scene and found blood on a broken window. They suspected that the blood was that of the criminal. To identify the criminal, they analysed a DNA sample from the blood and compared it to that of four suspects.

The diagram below was produced:



2.1.1 Name the technique that was used to identify the criminal. (1)

2.1.2 Who is the possible criminal? (1)

2.1.3 Explain your answer to QUESTION 2.1.2. (2)

2.1.4 State ONE other use of the technique identified in QUESTION 2.1.1. (1)
(5)

2.2 A farmer decided to have his best meat-producing bull cloned.

The following steps were used in the process:

- A muscle cell was taken from the bull and the nucleus was removed.
- An ovum was taken from a cow and the nucleus was removed and discarded.
- The nucleus from the muscle cell was placed in the empty ovum.
- The ovum was given an electric shock to stimulate normal cell division to produce an embryo.
- The embryo was placed in the uterus of a surrogate cow where it developed into the clone.

2.2.1 What is *cloning*? (1)

2.2.2 Explain why the nucleus of a muscle cell was used and not the nucleus of a sperm cell. (2)

2.2.3 Explain why the nucleus of the ovum was removed. (2)

2.2.4 State ONE benefit of cloning. (1)
(6)

2.3 A man with blood group **AB** and a woman who is heterozygous for blood group **B** plan to have children.

2.3.1 How many alleles control the inheritance of blood groups? (1)

2.3.2 Describe the type of dominance that occurs in the inheritance of blood group **B** in the woman. (3)

2.3.3 Use a genetic cross to show all the possible genotypes and phenotypes of their children. (6)
(10)

2.4 Sickle cell disease is caused by a recessive allele and first appeared in humans as a result of a gene mutation.

The table below shows the number of children born with sickle cell disease in some regions in a particular year.

REGION	NUMBER OF CHILDREN BORN WITH SICKLE CELL DISEASE
Democratic Republic of Congo	39 746
United States of America	90 128
Nigeria	91 011
United Kingdom	13 221
Tanzania	11 877
Other	59 750
Worldwide total	**305 733**

2.4.1 What is a *gene mutation*? (2)

2.4.2 Which region had the highest number of children born with sickle cell disease in that year? (1)

2.4.3 What percentage of the worldwide total of children born with sickle cell disease came from the Democratic Republic of Congo? Show ALL calculations. (3)

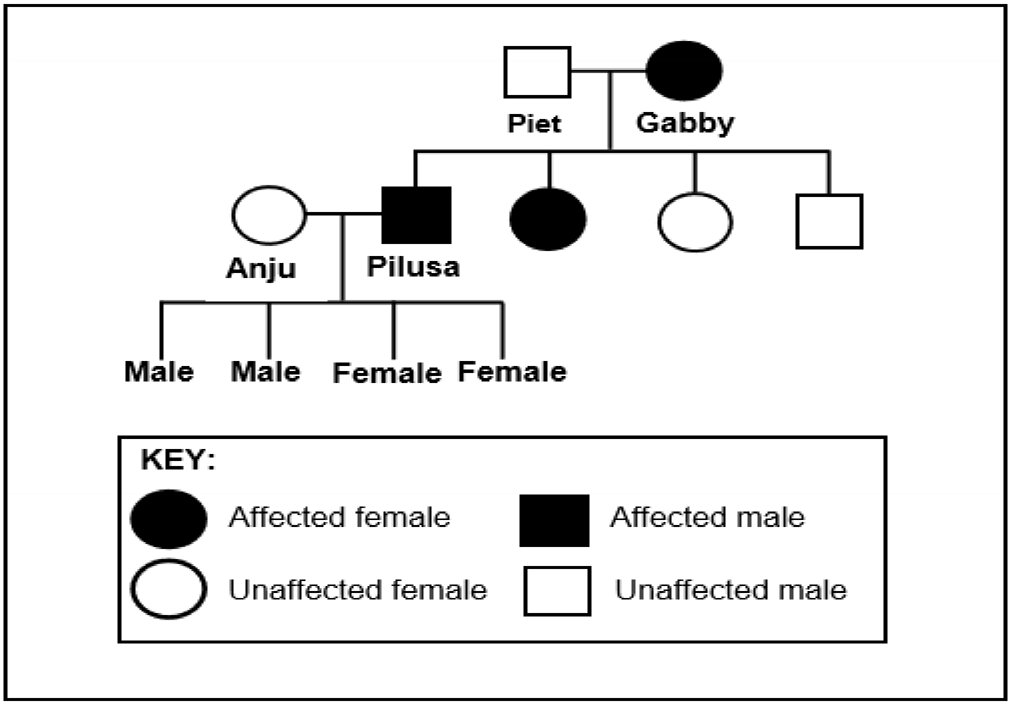
2.4.4 Use the letters **D** and **d** to give the genotype of a person who:

(a) Suffers from sickle cell disease (1)

(b) Carries the allele but does not suffer from the disease (1)
(8)

2.5 Goltz syndrome is a sex-linked genetic disorder. It is caused by a dominant allele X^G.

The diagram below shows the inheritance of Goltz syndrome in a family.



2.5.1 Name the type of diagram shown. (1)

2.5.2 How many:

(a) Females are in this family (1)

(b) Males in the F_1-generation have Goltz syndrome (1)

2.5.3 Give Gabby's genotype. (2)

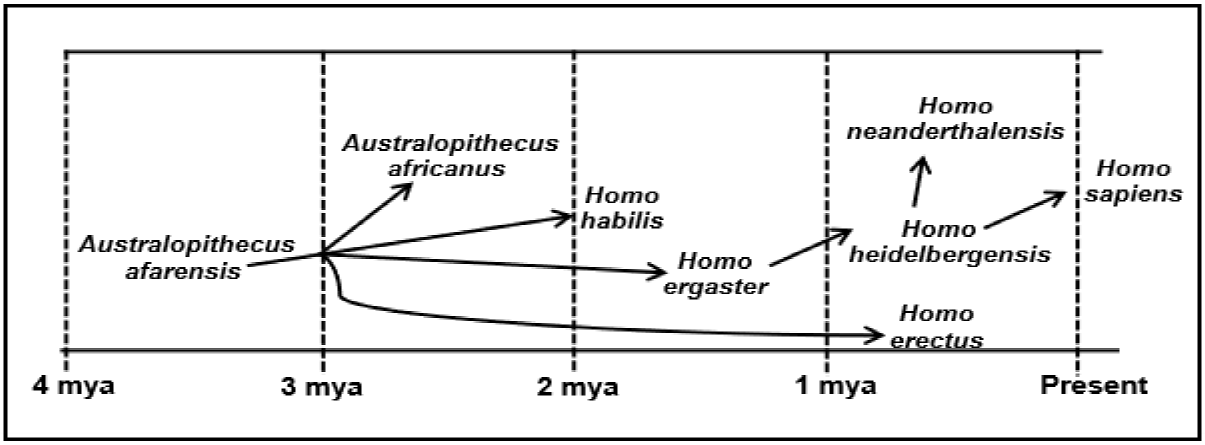
2.5.4 Anju and Pilusa have four children. Give the phenotype of their sons. (2)

2.5.5 Explain your answer to QUESTION 2.5.4. (4)
(11)
[40]

QUESTION 3

3.1 Describe the process of natural selection. **(7)**

3.2 Fossil evidence for humans may be interpreted in different ways. One possible model of human evolution is shown below.



3.2.1 Name the family to which all of the represented organisms belong. (1)

3.2.2 Describe how cultural evidence is used to support the theory of human evolution. (2)

3.2.3 How long ago did the most recent common ancestor of *H. erectus* and *H. heidelbergensis* exist on earth? (1)

3.2.4 Explain a possible reason why *H. ergaster* was placed between *A. afarensis* and *H. heidelbergensis* on the model. (2)

3.2.5 Explain how the fossils of organisms that existed from **4** mya to present time are used to support the 'Out of Africa' hypothesis. (3)
(9)

3.3 Male long-tailed widowbirds have extremely long tail feathers that they use in mating displays to attract females.

Scientists conducted an investigation to determine the relationship between the length of the male long-tailed widowbird's tail and its mating success.

The procedure was as follows:

- A total of 27 male long-tailed widowbirds was sampled and divided into 3 equal groups.
- The tail feathers of the birds in each group were treated in the following way:
  - Group **1** – Cut short
  - Group **2** – Made longer by adding artificial feathers
  - Group **3** – Left unchanged
- The 3 groups of male long-tailed widowbirds, along with female long-tailed widowbirds, were released into an environment suitable for mating.
- Each time a pair mated successfully they produced a nest and all the nests were counted.
- The average number of nests produced by each group was calculated and used as an indication of mating success.

The results are shown in the table below.

GROUP	AVERAGE NUMBER OF NESTS PRODUCED
1	0,5
2	2,5
3	1

3.3.1 Name the:

(a) Reproductive isolating mechanism that occurs in long-tailed widowbirds (1)

(b) Independent variable in this investigation (1)

3.3.2 Explain why 27 long-tailed widowbirds were used in the investigation instead of only 3. (2)

3.3.3 Explain why Group **3** was included in the investigation. (2)

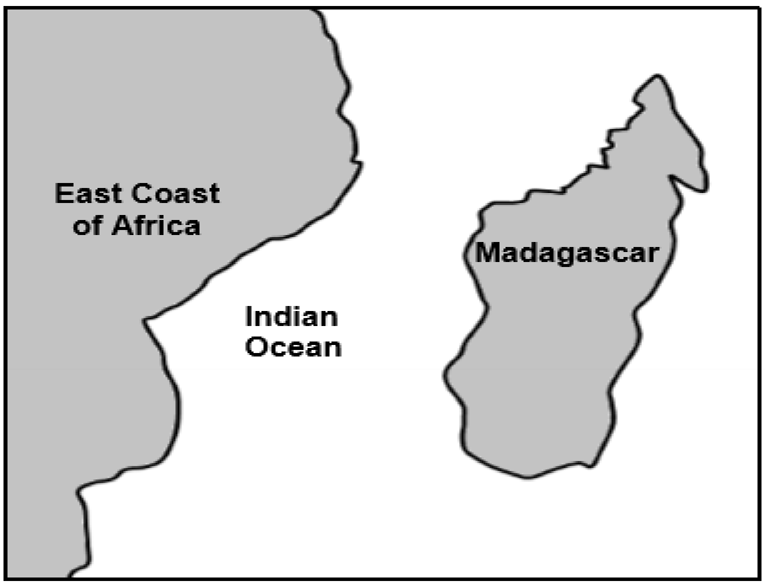
3.3.4 Draw a bar graph to represent the results of this investigation. (6)

3.3.5 State a conclusion for this investigation. (2)
(14)

3.4 Pottos and lemurs are small mammals.

Scientists believe that pottos and lemurs share a common ancestor that existed in Africa. Presently pottos only occur in Africa while lemurs are only found in Madagascar.

Madagascar is an island off the East coast of Africa as shown in the diagram below.



3.4.1 Explain how continental drift could have affected the distribution of the common ancestor. (4)

3.4.2 Describe the speciation of the pottos and lemurs to become different species. (6)
(10)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe the location and structure of DNA, the process of DNA replication and the significance of this process for mitosis.

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

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE/
NATIONAL SENIOR CERTIFICATE**

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2020(2)

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	B✓✓		
	1.1.2	C✓✓		
	1.1.3	B✓✓		
	1.1.4	D✓✓		
	1.1.5	C✓✓		
	1.1.6	A✓✓		
	1.1.7	D✓✓		
	1.1.8	D✓✓		
	1.1.9	C✓✓		
	1.1.10	C✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Homologous✓structures		
	1.2.2	Canines✓		
	1.2.3	Cranium✓		
	1.2.4	Autosomes✓		
	1.2.5	Chromatin✓		
	1.2.6	Karyotype✓		
	1.2.7	Prognathous✓	(7 x 1)	**(7)**
1.3	1.3.1	A only✓✓		
	1.3.2	B only✓✓		
	1.3.3	A only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Meiosis✓/Meiosis I		(1)
		(b) Prophase I✓		(1)
	1.4.2	Ovary✓		(1)
	1.4.3	C✓- centromere✓		(2)
	1.4.4	3✓/Three		(1)
				(6)
1.5	1.5.1	(a) Black✓fur		(1)
		(b) Smooth✓texture		(1)
	1.5.2	(a) bbRR✓		(1)
		(b) White (fur) with rough (texture)✓✓		(2)
		(c) BbRr✓		(1)
	1.5.3	Rough✓ texture		(1)
				(7)
1.6	1.6.1	Genetic✓ evidence		(1)
	1.6.2	1 - A✓ C 2 - C✓ **OR** A 3 - B✓ B		(3)
				(4)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 DNA profiling✓ (1)

2.1.2 Jennie✓ (1)

2.1.3
- Jennie's DNA profile✓/ bands
- matches the DNA profile/ bands of the sample✓from the crime scene (2)

2.1.4
- Proof of paternity✓
- Tracing missing persons✓
- Identification of genetic disorders✓
- Establishing family relations✓
- Matching tissues for organ transplants✓
- Identifying dead persons✓/animals Any (1)

(Mark first ONE only) **(5)**

2.2 2.2.1 The production of (genetically) identical organisms✓ (1)

2.2.2
- A muscle cell contains all the genetic material✓ of the bull/ is diploid whereas
- a sperm cell has only half of the genetic material✓/ is haploid (2)

2.2.3
- To remove the genetic material of the cow✓
- so that only the genetic material from the (best meat producing) bull is present✓ (2)

2.2.4
- To produce organisms with desired traits✓e.g. health; appearance; nutritious; yield; shelf-life; etc
- Conservation of threatened species✓
- To create tissues/organs for transplant✓

(Mark first ONE only) Any (1)

(6)

2.3 2.3.1 3✓/ Three (1)

2.3.2
- Complete dominance✓
- The allele for blood group B/ I^B is dominant✓ and
- the allele for blood group O/ i is recessive✓ (3)

2.3.3

P_1	Phenotype:	Blood group AB	x	Blood group B✓
	Genotype:	I^AI^B	x	I^Bi✓
Meiosis				
	G/gametes	I^A I^B	x	I^B i✓
Fertilisation				
F_1	Genotype:	I^AI^B I^A i		I^B I^B I^B i✓*
	Phenotype:	Blood group: AB; A;		B✓*

P_1 and F_1✓
Meiosis and fertilisation✓

Compulsory 2*+ Any 4

OR

P_1	Phenotype:	Blood group AB	x	Blood group B✓
	Genotype:	I^AI^B	x	I^Bi✓

Meiosis

Fertilisation

Gametes	I^A	I^B
I^B	I^AI^B	I^B I^B
i	I^A i	I^B i

1 mark for correct gametes
1 mark for correct genotypes*

F_1 Phenotype: Blood group:
AB; A; B✓*

P_1 and F_1✓
Meiosis and fertilisation✓

Compulsory 2*+ Any 4 (6)
(10)

2.4 2.4.1
- A change in the sequence ✓of
- nitrogenenous bases✓/nucleotides in a gene (2)

2.4.2 Nigeria✓ (1)

2.4.3 $\frac{39\ 746}{305\ 733}$ ✓ x 100✓ = 13✓% (3)

2.4.4 (a) dd✓ (1)

(b) Dd✓ (1)
(8)

2.5 2.5.1 Pedigree✓ diagram (1)

2.5.2 (a) 6✓ (1)

(b) 1✓ (1)

2.5.3 X^GX^g✓✓ (2)

2.5.4 Unaffected✓✓/without Goltz syndrome (2)

2.5.5
- Pilusa is affected✓/ X^GY
- Anju is unaffected✓/ X^gX^g
- Males inherit the Y chromosome from Pilusa✓
- and inherit X^g from Anju✓ (4)

(11)
[40]

QUESTION 3

3.1
- Organisms produce a large number of offspring✓
- There is variation✓ amongst the offspring
- Some have favourable characteristics and some do not✓
- When there is a change in the environmental conditions✓/ there is competition
- organisms with favourable characteristics, survive✓
- whilst organisms with unfavourable characteristics, die✓
- The organisms that survive, reproduce✓
- and pass on the allele for the favourable characteristic to their offspring✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristic✓ Any **(7)**

3.2 3.2.1 *Hominidae*✓ (1)

3.2.2
- Evidence such as tools✓ /weapons/ language/ artefacts
- is used to show advances✓ in human development (2)

3.2.3 3 mya✓ (1)

3.2.4
- *H. ergaster* shows characteristics of both✓*A. afarensis* and *H. heidelbergensis*
- therefore it is a transitional✓ species (2)

3.2.5
- The fossils of *Australopithecus* were ONLY found in 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✓
- This suggests that (the ancestors of) *Homo sapiens* originated in Africa✓* ***1 Compulsory** + Any 2 (3)

(9)

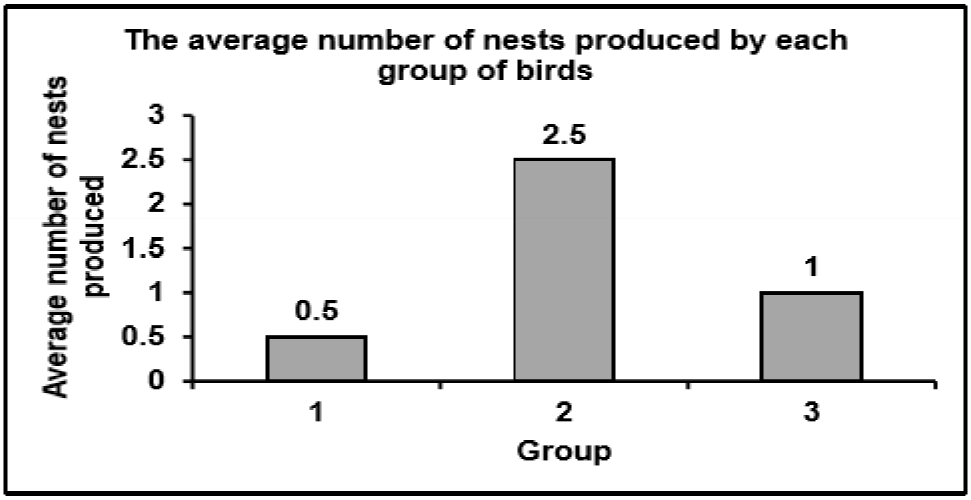
3.3 3.3.1 (a) (Species-specific) courtship behaviour✓ (1)

(b) Length of the (male long-tailed widowbird's) tails✓ (1)

3.3.2
- A larger sample size✓
- increases the reliability✓ of the investigation (2)

3.3.3
- To serve as a control✓
- so that it can be compared✓with the other groups
- and show that the tail length is the only factor that affects the results✓/improves the validity of the investigation Any (2)

3.3.4



(6)

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	1
Scale for X- and Y-axis **(S)**	- Equal space between bars and width of bars for X-axis and - Correct scale for Y-axis	1
Plotting of bars **(P)**	1 to 2 bars plotted correctly All 3 bars plotted correctly	1 2

3.3.5 The longer the (male long-tailed widowbird's) tail, the higher the mating success✓✓

OR

The shorter the (male long-tailed widowbird's) tail, the lower the mating success✓✓ (2)

(14)

3.4 3.4.1

- There was once one large continent✓ and
- the common ancestor existed throughout this continent✓
- When Madagascar separated✓
- the common ancestor was found in both✓ regions (4)

3.4.2

- The common ancestor became separated into two **groups** by the ocean✓*
- There was no gene flow between the two **groups**✓
- Each **group** experienced different environmental conditions✓
- and underwent natural selection independently✓
- The individuals in each **group** became different✓
- genotypically and phenotypically✓
- to form the pottos and lemurs✓*
- Eventually if the two groups are mixed again, they cannot interbreed✓/produce fertile offspring. ***2 Compulsory** + Any 4 (6)

(10)

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Location (P)

- The DNA is located in the nucleus✓
- and mitochondria✓ and
- chloroplasts✓ Any (2)

Structure (S)

- DNA is a double-stranded✓molecule that
- forms a helix✓
- It is made up of nucleotides✓
- Each nucleotide has a deoxyribose sugar✓molecule
- a phosphate group✓ and
- a nitrogenous base✓
- The bases are A, T, C and G✓
- which join to form complementary pairs✓/ (A to T and C to G)
- held by hydrogen bonds✓ Any (7)

DNA replication (D)

- The DNA (double helix) unwinds✓ and
- unzips✓/hydrogen bonds break
- to form two separate strands✓
- Both DNA strands serve as templates✓
- to build a complementary DNA✓/(A to T and C to G)
- using free (DNA) nucleotides✓ from the nucleoplasm
- This results in two identical (DNA) molecules✓
- Each molecule consists of one original strand and one new strand✓ Any (6)

Significance of DNA replication for mitosis (M)

- The genetic material/DNA is doubled✓
- so that each cell receives the same amount of DNA✓
- to ensure that all the daughter cells are (genetically) identical✓ Any (2)

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

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to: - Location and structure of DNA - Process of DNA replication - Significance of DNA replication for mitosis There is no irrelevant information	The description for each of: - Location and structure of DNA - Process of DNA replication - Significance of DNA replication for mitosis Is logical and sequential	At least the following marks should be obtained for: - Location of DNA **(P:1/2)** - Structure of DNA (**S:5/7)** - Process of DNA replication **(D:4/6)** - Significance of DNA replication for mitosis **(M:1/2)**
Mark	1	1	1

TOTAL SECTION C: 20
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2021

MARKS: 150

TIME: 2½ hours

This question paper consists of 17 pages.

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 numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, e.g. 1.1.10 D.

1.1.1 DNA and RNA are examples of …

A amino acids.
B enzymes.
C nucleic acids.
D proteins.

1.1.2 Which ONE of the following is a product of meiosis?

A Muscle cell
B Ovary
C Nerve cell
D Ovum

1.1.3 An individual is heterozygous for a harmful recessive allele but is unaffected by it.

Which ONE of the following best represents the genetic composition of this individual?

A Two dominant normal alleles
B One harmful recessive allele and one harmful dominant allele
C One harmful recessive allele and one normal dominant allele
D One harmful dominant allele and one normal recessive allele

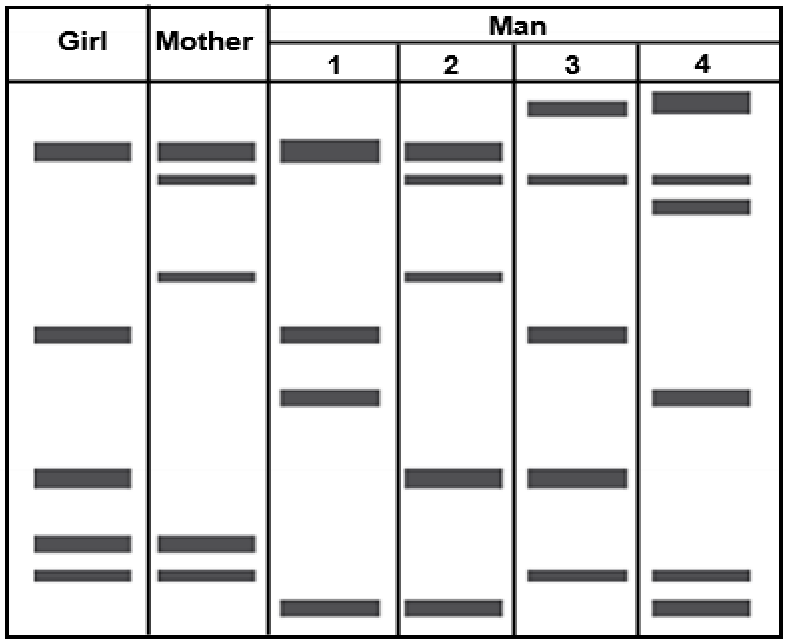
1.1.4 A person has the genotype $\mathbf{I^Ai}$ for blood type.

What is this person's blood group?

A A
B B
C O
D AB

1.1.5 In a car accident, the biological father of a girl and three other men were killed. The men could not be identified due to their injuries. DNA profiling was used to identify the girl's father.

The diagram below shows the DNA profiles of the girl, her mother and the four men.



Which ONE of the men is most likely to have been the father of the girl?

A 4
B 3
C 2
D 1

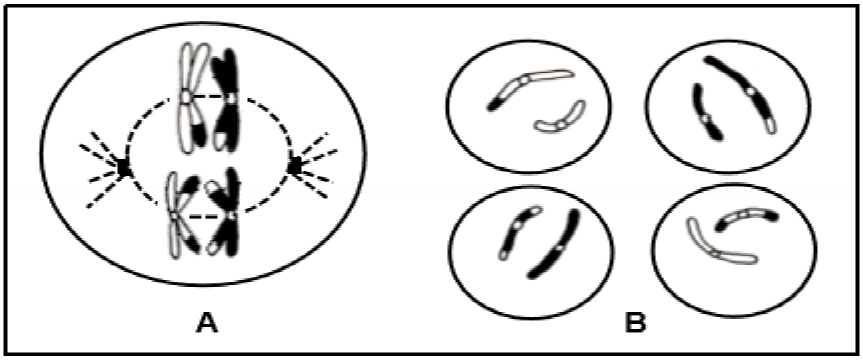
1.1.6 A DNA template strand codes for the amino acid serine with any of the following base triplets:

AGA AGG AGT TCA TCG AGC

The anticodon that codes for the amino acid serine is …

A AGT.
B UGA.
C TCG.
D UCG.

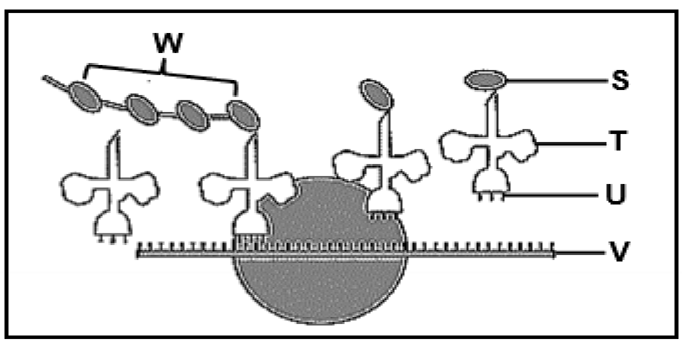
1.1.7 The diagram below represents two phases of meiosis.



Which ONE of the following represents the correct sequence of phases between phase **A** and phase **B**?

A Anaphase I, Metaphase I, Prophase II and Telophase II
B Metaphase I, Telophase I, Prophase II and Metaphase II
C Anaphase I, Telophase I, Prophase II, Metaphase II and Anaphase II
D Prophase I, Telophase I, Prophase II, Metaphase II and Telophase II

1.1.8 The diagram below represents a process that occurs during protein synthesis.



Which ONE of the following is CORRECT?

A **S** represents an anticodon
B **W** represents mRNA
C **T** represents tRNA
D **U** represents an amino acid

1.1.9 Evidence of hominid cultural evolution can be found in the fossil record.

This evidence would include the …

A position of the attachment of the spine to the head.
B length of the upper limbs compared to the length of the lower limbs.
C number of teeth present in the skull.
D presence of stone tools.

(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 1.2.6) in the ANSWER BOOK.

1.2.1 A diagrammatic representation showing possible evolutionary relationships between different species

1.2.2 The type of bond found between amino acids

1.2.3 The theory that describes evolution as consisting of long periods of little/no change alternating with short periods of rapid change

1.2.4 Similar structures that perform different functions in different organisms

1.2.5 The breeding of plants and animals by humans for desired characteristics

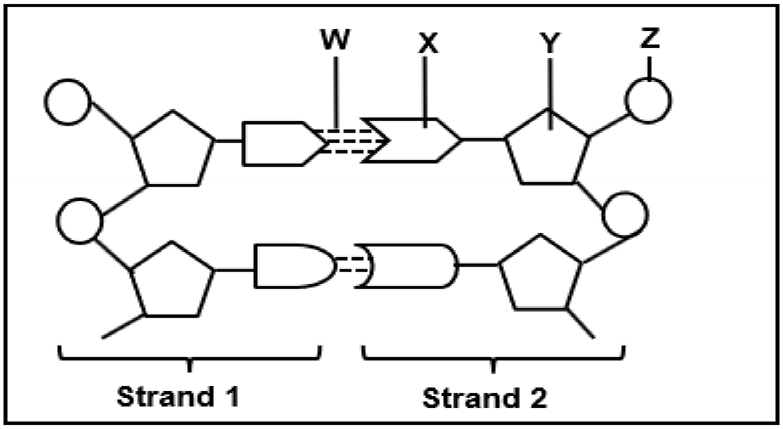
1.2.6 The type of dominance where both alleles of a gene are expressed in the phenotype in the heterozygous condition (6 x 1) **(6)**

1.3 Indicate whether each of the statements in COLUMN I apply 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 Mechanisms of reproductive isolation	A: Species-specific courtship behaviour B: Breeding at different times of the year
1.3.2 Fossils found in South Africa	A: Little Foot B: Taung Child
1.3.3 Proposed the 'law' of use and disuse'	A: Eldredge B: Gould

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

1.4 The diagram below represents part of a DNA molecule.



1.4.1 Identify the:

(a) Molecule **X** (1)

(b) Sugar at **Y** (1)

(c) Bond **W** (1)

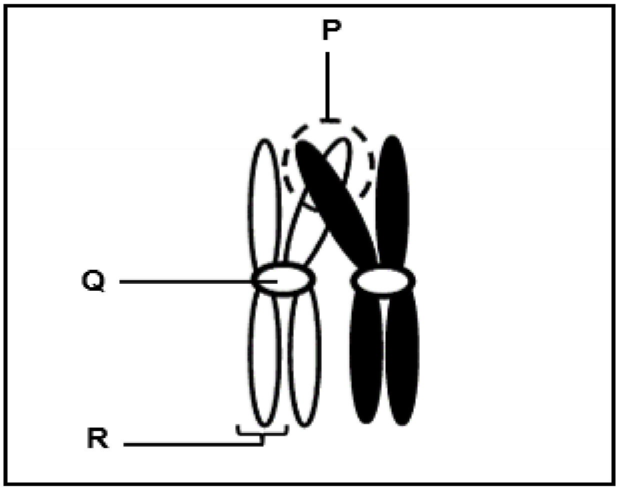
1.4.2 Give the collective name of parts **X**, **Y** and **Z**. (1)

1.4.3 State the natural shape of the DNA molecule. (1)

1.4.4 Name the process whereby DNA makes a copy of itself. (1)

1.4.5 Name TWO places in an animal cell where DNA is located. (2)
(8)

1.5 The diagram below represents a chromosome pair undergoing a process during meiosis.



1.5.1 Name the:

(a) Organ in the human male where meiosis occurs (1)

(b) Process represented in the diagram (1)

1.5.2 Label:

(a) Area **P** (1)

(b) Structure **Q** (1)

(c) Structure **R** (1)
(5)

1.6 In humans, short fingers (**F**) and a widow's peak (**H**) are dominant over long fingers and continuous hairline. A man and a woman, both heterozygous for the two characteristics, plan on having a child.

The table below shows the possible genotypes of the offspring.

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

1.6.1 State the genotype at **Z**. (1)

1.6.2 Give the:

(a) Genotype of the parents (2)

(b) Number of genotypes that could result in offspring with short fingers and a continuous hairline (1)

(c) Allele for a continuous hairline (1)

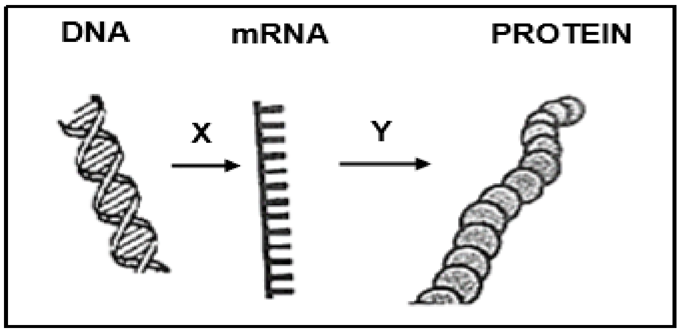
(d) Phenotype of a child who is homozygous recessive for both characteristics (2)
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents two processes that occur during protein synthesis.



2.1.1 Where in the cell does EACH of the following processes occur?

(a) **X** (1)

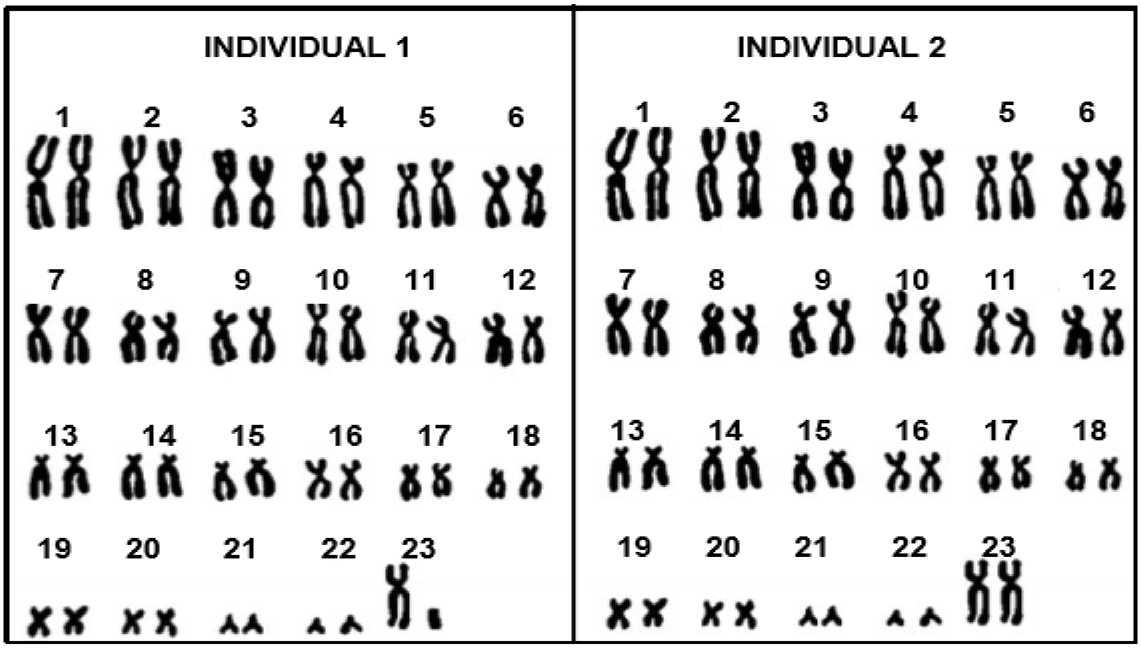
(b) **Y** (1)

2.1.2 State ONE difference between the types of nitrogenous bases found in DNA and RNA. (2)

2.1.3 Name and describe process **X**. (6)
(10)

2.2 Describe how non-disjunction may lead to Down syndrome. **(5)**

2.3 The diagram below represents the chromosomes from the human somatic cells of two individuals who are twins.



2.3.1 What are *somatic cells*? (1)

2.3.2 Name the specific type of chromosomes numbered 1 to 22. (1)

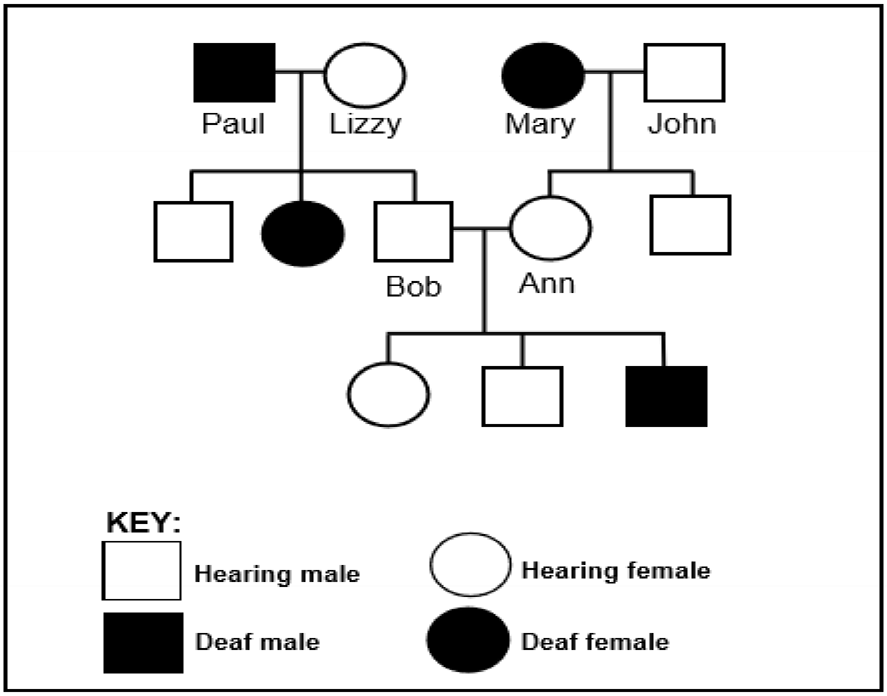
2.3.3 Each of the pairs shown is a homologous pair of chromosomes.

(a) State the origin of each chromosome in a homologous pair during zygote formation. (2)

(b) List THREE characteristics that chromosomes in a homologous pair have in common. (3)

2.3.4 Explain ONE observable reason why the two individuals are not identical twins. (3)
(10)

2.4 One type of deafness in humans is carried on a single allele. The diagram below shows the inheritance of deafness in a family.



2.4.1 How many:

(a) Generations are represented in this pedigree diagram (1)

(b) Children of Paul and Lizzy are able to hear (1)

2.4.2 Which phenotype is dominant? (1)

2.4.3 Use the offspring of Bob and Ann to explain your answer to QUESTION 2.4.2. (4)

2.4.4 Use the letter '**A**' to represent the dominant allele and the letter '**a**' for the recessive allele to give ALL the possible genotypes for a hearing individual. (2)

(9)

2.5 Use a genetic cross to show how gender in human offspring is determined by the sex chromosomes of the parents. **(6)**

2.6 Read the extract below.

Researchers have discovered that members of a particular family have high bone density that may be caused by a gene mutation. High bone density reduces the risk of bone fractures. Twenty members of the family had their bone density measured and DNA samples taken. Seven had high bone density. The high bone density occurred throughout their bodies but especially in the spine and hips.

2.6.1 From the extract, identify TWO areas in the body where bone density can mainly be measured. (2)

2.6.2 Describe what a *gene mutation* is. (2)

2.6.3 Explain why it was necessary for the researchers to collect DNA samples. (2)

2.6.4 State the effect of this mutation. (1)

2.6.5 Calculate the percentage of the family members who had normal bone density. Show ALL your workings. (3)
(10)
[50]

QUESTION 3

3.1 Some horses have straight hair and others have curly hair. A scientist wanted to clone a straight-haired male horse to meet the demand for horses with straight hair.

The scientist used the following procedure:

- The nucleus of a somatic cell was taken from a straight-haired male horse (horse **S**).
- An unfertilised ovum was removed from a curly-haired female horse (horse **T**).
- The nucleus from the somatic cell of horse **S** was placed into the ovum taken from horse **T**.
- This ovum was then placed into the uterus of a female surrogate horse (horse **R**).

3.1.1 Explain why a somatic cell and NOT a sperm cell from horse **S** would provide the nucleus for the procedure. (3)

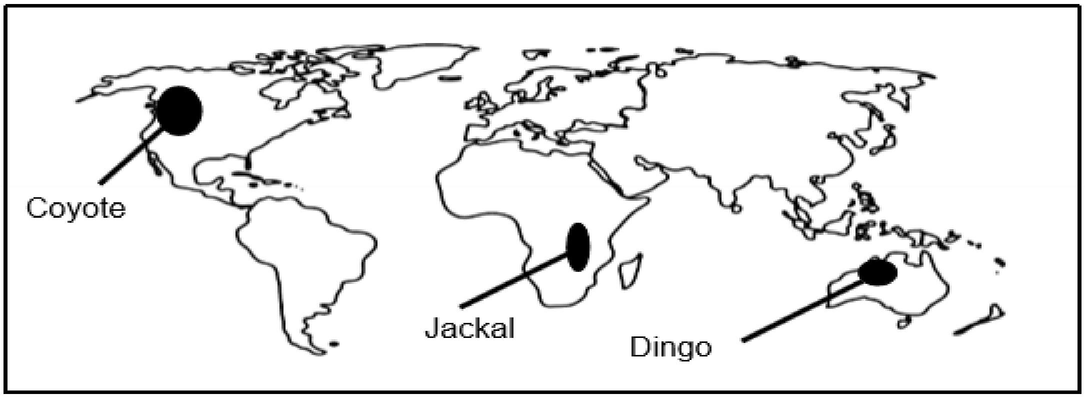
3.1.2 Before inserting the nucleus from the somatic cell of horse **S**, the nucleus from the ovum of horse **T** was removed.

Explain the significance of this procedure. (2)

3.1.3 To which of the three horses (**S**, **T** or **R**) will the cloned offspring be genetically identical? (1)

3.1.4 State TWO benefits of cloning. (2)
(8)

3.2 The present-day distribution of three closely related species of the dog family, the coyote, jackal and dingo, is shown on the world map below.



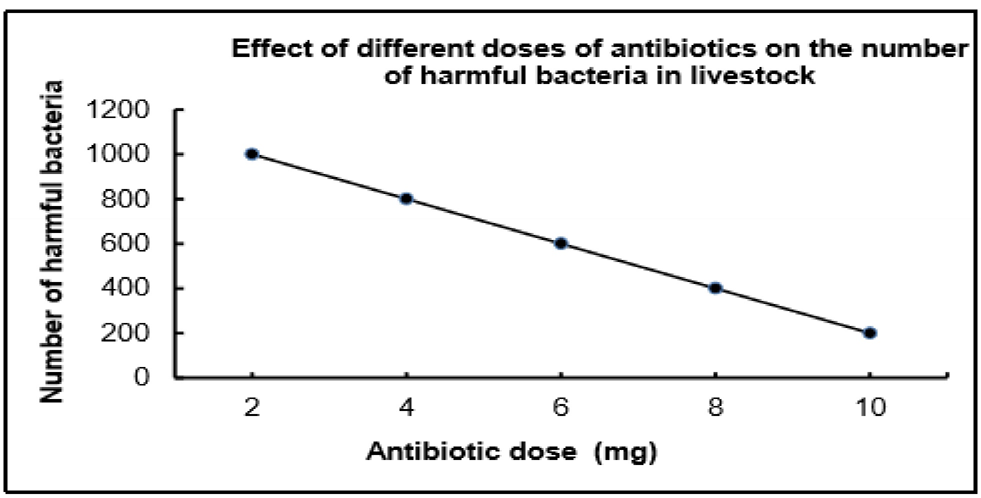
3.2.1 What type of evidence for evolution is represented here? (1)

3.2.2 What is a *biological species*? (3)

3.2.3 Describe how these three species could have evolved from a common ancestor. (7)
(11)

3.3 Some farmers add low doses of antibiotics to the feed for cattle. The use of antibiotics in cattle feed could result in the evolution of antibiotic-resistant bacteria.

The graph below shows the effect of different doses of antibiotics on the number of harmful bacteria in the cattle.



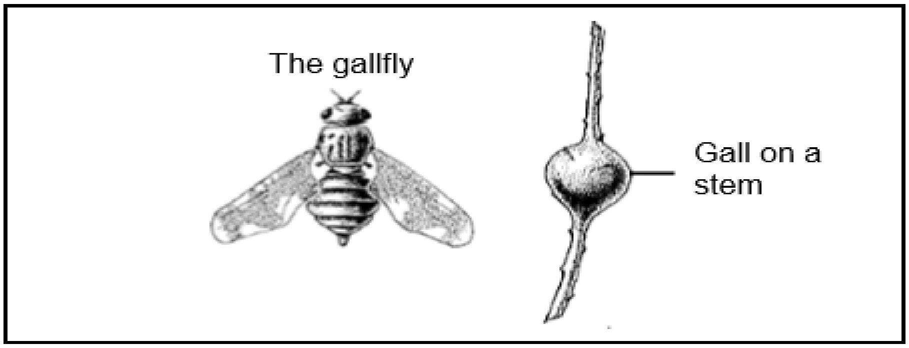
3.3.1 Use evidence from the graph to explain why higher doses of antibiotics will benefit the farmer economically. (4)

3.3.2 Explain how the use of antibiotics in animal feed may result in the evolution of antibiotic resistant bacteria. (6)
(10)

3.4 Female gallflies lay eggs on the stems of plants. The eggs hatch to form larvae that secrete a substance into the plant tissue. The secretions cause the plant cells to grow and form ball-like structures, called galls, which are high in nutrients. Predatory birds feed on the larvae in the galls.

The size of the galls produced actually depends on genetic variation in the gallfly.

The diagram below shows the gallfly and a gall on a plant stem.



Scientists wanted to investigate whether the size of the galls had an effect on the percentage of gallfly larvae killed by predatory birds.

The table below shows the results of their investigation.

Gall size (mm)	Gallfly larvae killed by predatory birds (%)
10	1
15	0
20	1
25	2
30	10

3.4.1 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

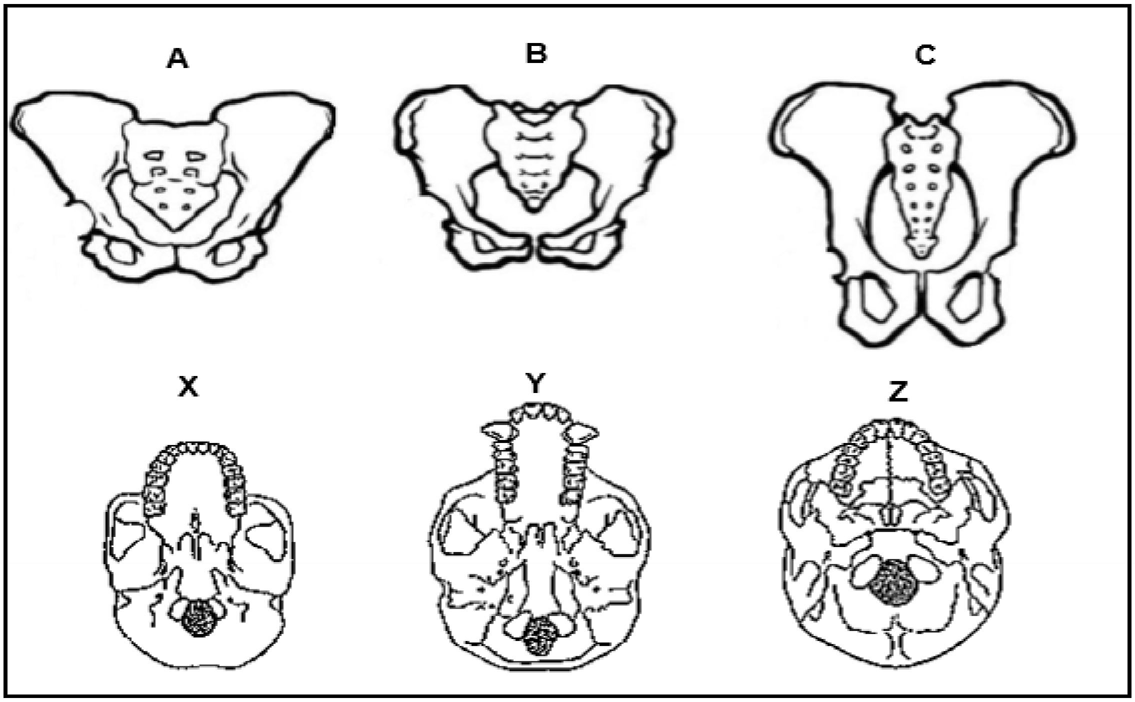
3.4.2 Give ONE advantage of the gall to the gallfly larvae. (1)

3.4.3 State why the size of the galls produced is an example of continuous variation. (1)

3.4.4 Explain how the percentage of gallfly larvae killed by predatory birds is influenced by the size of the gall. (3)

3.4.5 Draw a line graph to represent the information in the table. (6)
(13)

3.5 The diagram below represents the pelvic structure and the ventral view of the skulls of three organisms. The diagrams are drawn to scale.



3.5.1 Write down the LETTER(S) of the diagram(s) that represent the:

(a) Skulls of bipedal organisms (2)

(b) Pelvic structure of a quadrupedal organism (1)

3.5.2 Give a reason for your answer to QUESTION 3.5.1(b). (2)

3.5.3 Describe ONE other structural difference between a *bipedal* and a *quadrupedal* organism. (3)
(8)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2021

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	C✓✓		
	1.1.2	D✓✓		
	1.1.3	C✓✓		
	1.1.4	A✓✓		
	1.1.5	B✓✓		
	1.1.6	D✓✓		
	1.1.7	C✓✓		
	1.1.8	C✓✓		
	1.1.9	D✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Phylogenetic tree✓/cladogram		
	1.2.2	Peptide✓bond		
	1.2.3	Punctuated equilibrium✓		
	1.2.4	Homologous✓ structures		
	1.2.5	Artificial selection✓/selective breeding		
	1.2.6	Co-dominance✓	(6 x 1)	**(6)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	None✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Nitrogenous base✓/Guanine/Cytosine		(1)
		(b) Deoxyribose✓sugar		(1)
		(c) Hydrogen✓ bond		(1)
	1.4.2	Nucleotide✓		(1)
	1.4.3	Double helix✓		(1)
	1.4.4	(DNA) Replication✓		(1)
	1.4.5	- Nucleus✓ /Chromosome/Chromatid/ Chromatin/ Nucleoplasm		
		- Mitochondria✓		(2)
		(Mark first TWO only)		**(8)**

1.5	1.5.1	(a)	Testis✓	(1)
		(b)	Crossing over✓	(1)
	1.5.2	(a)	Chiasma✓	(1)
		(b)	Centromere✓	(1)
		(c)	Chromatid✓	(1)
				(5)
1.6	1.6.1		ffHh✓	(1)
	1.6.2	(a)	FfHh✓✓	(2)
		(b)	3✓	(1)
		(c)	h✓	(1)
		(d)	Long fingers and continuous hairline✓✓	(2)
				(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) Nucleus✓/nucleoplasm (1)
(b) Ribosome✓/cytoplasm (1)

2.1.2 DNA contains thymine✓/T whereas RNA contains uracil✓/U (2)
(Mark first ONE only)

2.1.3 Transcription✓*
- The double helix (DNA) molecule unwinds✓
- The double-stranded DNA 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✓/ A-U, G-C
- mRNA now has the coded message for protein synthesis✓

***1 compulsory mark** + Any 5 (6)
(10)

2.2
- When chromosome pair 21/chromosome 21 fails to separate✓
- during Anaphase✓
- the daughter cells (gametes) will have 24 chromosomes✓/ an extra chromosome
- When this gamete is fertilised by a normal gamete✓ with 23 chromosomes
- the zygote will have 47 chromosomes✓/3 chromosomes at position 21/ Trisomy 21

(5)

2.3 2.3.1 Body cells✓/cells in the body except the sex cells (1)

2.3.2 Autosomes✓ (1)

2.3.3 (a)
- One chromosome comes from the sperm✓/father
- and the other comes from the ovum✓/mother (2)

(b)
- Shape✓
- Size✓/length
- Position of genes✓/alleles
- Genes coding for same characteristic✓
- Location of centromere✓ Any (3)

(Mark first THREE only)

2.3.4
- Gonosomes are not identical✓/chromosomes at position 23 are not identical
- Individual 1 has XY gonosomes✓/is a male
- Individual 2 has XX gonosomes✓/is a female (3)

(10)

2.4 2.4.1 (a) 3✓/Three (1)
(b) 2✓/Two (1)

2.4.2 Hearing✓ (1)

2.4.3
- Bob and Ann can both hear✓
- They have a child who is deaf✓/who has the genotype aa
- This means that each parent carries an allele for deafness✓/are heterozygous/Aa
- but it is masked✓by the dominant allele/which is for hearing (4)

2.4.4 AA✓ and Aa✓ (2)
(9)

2.5

P_1	Phenotype	Male	x	Female✓
	Genotype	XY	x	XX✓
Meiosis				
	G/gametes	X, Y	x	X, X✓
Fertilisation				
F_1	Genotype	XX; XX;		XY; XY✓
	Phenotype	female	:	male✓

P_1 and F_1✓
Meiosis and fertilisation✓

OR

P_1	Phenotype	Male	x	Female✓
	Genotype	XY	x	XX✓

Meiosis

Fertilisation

Gametes	X	Y
X	XX	XY
X	XX	XY

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype female: male✓
P_1 and F_1✓
Meiosis and fertilisation✓ Any **(6)**

2.6 2.6.1
- Spine✓
- Hips✓ (2)

(Mark first TWO only)

2.6.2
- A change in the sequence✓
- of nitrogenous bases✓/nucleotides in DNA (2)

2.6.3
- To check for the gene mutation✓
- and if it results in the high bone density✓ (2)

2.6.4 Produces high bone density✓/reduces the risk of bone fractures (1)

2.6.5 $\frac{13}{20}$✓ x 100✓ = 65✓% **OR** $\frac{7}{20}$ x 100✓ = 35%

(100 – 35)✓ = 65✓% (3)

(10)

[50]

QUESTION 3

3.1 3.1.1
- The nucleus of the somatic cell is diploid✓/ has a full set of chromosomes/has all the genetic material whereas
- the nucleus of the sperm cell is haploid✓/contains half the set of chromosomes/ has half the genetic material
- The somatic cell carries the desired characteristic✓/straight hair (3)

3.1.2 To ensure that:
- The DNA (of the ovum)/characteristic of curly hair is removed✓
- Only the desired DNA is present in the clone✓
- Correct number of chromosomes is present in the clone✓ Any (2)

3.1.3 (Horse) S✓ (1)

3.1.4
- To produce organisms with desired traits✓ e.g. health, appearance, nutritious, yield, shelf life etc.
- Conservation of threatened species✓
- To create tissue/organs for transplant✓ Any (2)

(Mark first TWO only) **(8)**

3.2 3.2.1
- Biogeography✓ (1)

3.2.2
- Similar organisms✓
- that can interbreed✓
- to produce fertile offspring✓ (3)

3.2.3
- The original population /common ancestor once lived on a large continent✓
- and became separated by continental drift✓/oceans
- There was no gene flow amongst the three populations✓*
- Each population experienced different environmental conditions✓
- and underwent natural selection independently✓
- The individuals in each population became different✓
- genotypically and phenotypically✓
- Even if the (three) populations are mixed again✓
- they would not be able to interbreed✓/produce fertile offspring
- forming the different species, the coyote, jackal and dingo ✓*

2 compulsory* + any 5 (7)
(11)

3.3.1
- It decreases the number of harmful bacteria the most✓
- thereby preventing disease in cattle✓/resulting in less medical expenses
- Decreasing mortality✓/maintaining the number of cattle
- to sell✓/breed /increase profit (4)

3.3.2
- Natural selection✓ occurs
- There is variation✓/mutation in the population of bacteria
- Some are resistant to antibiotics, some are non-resistant✓
- When antibiotic is added✓ to the animal feed
- The bacteria that are non-resistant are killed by the antibiotic✓
- Those that are resistant survive and reproduce✓
- The characteristic for resistance to antibiotics is passed on to the offspring✓
- The next generation will have a higher proportion of antibiotic resistant bacteria✓ Any (6)

(10)

3.4

3.4.1 (a) Gall size✓ (1)

(b) Percentage of gallfly larvae killed✓ (1)

3.4.2
- Nutrition✓/food
- Protection✓
- Space✓ Any (1)

(Mark first ONE only)

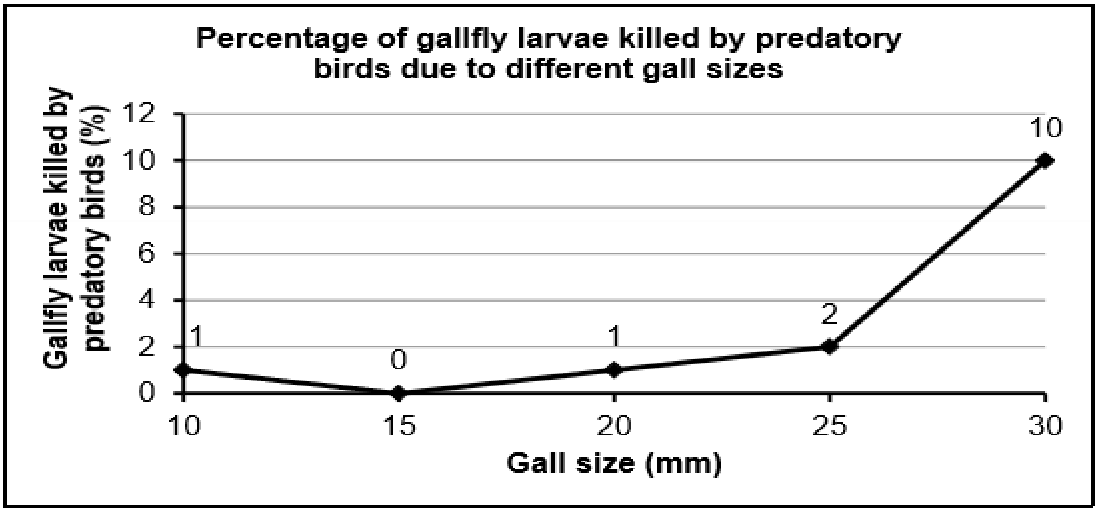
3.4.3
- There is a range of (intermediate) values✓in gall size (1)

3.4.4
- Larvae in 30mm galls are eaten more✓
- since they are more visible✓ to birds and
- contain more/larger larvae✓

OR

- Larvae in galls that are 25mm and smaller are eaten less✓
- since they are less visible✓ to birds and
- contain fewer/smaller larvae✓ (3)

3.4.5



Guideline for the assessing of the graph

CRITERIA	ELABORATION	MARK
Correct type of graph **(T)**	Line graph drawn	1
Caption of graph **(C)**	Both variables included	1
Axes labels **(L)**	Correct labels and units on X- and Y-axes	1
Scale for X- and Y-axes **(S)**	Equal spacing between intervals for each axis	1
Plotting of points **(P)**	1 to 4 points plotted correctly All 5 points plotted correctly	1 2

(6)
(13)

3.5	3.5.1 (a)	X✓, Z✓ **(in any order)** **(Mark first TWO only)**	(2)
	3.5.1 (b)	C✓	(1)
	3.5.2	- The pelvis is long✓ - and narrow✓	(2)
	3.5.3	- The spine✓ - is S-shaped for the bipedal organism✓ - and C-shaped for the quadrupedal organism✓ **OR** - The foramen magnum✓ - is in a more forward position in bipedal organisms✓ - and in a backward position in quadrupedal organisms✓ **(Mark first ONE only)**	(3) **(8)** **(50)**

TOTAL SECTION B: 100

GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2022

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

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, e.g. 1.1.10 D.

1.1.1 The scientist who discovered the fossil 'Karabo' (*A. sediba)*:

A Robert Brown
B Lee Berger
C Raymond Dart
D Ronald Clarke

1.1.2 Which ONE of the following is a source of variation that occurs during normal meiosis?

A Random mating
B Random arrangement of chromosomes
C Chromosomal mutations
D Cloning

1.1.3 How many sex chromosomes does a normal human female inherit from her mother?

A 1
B 2
C 23
D 46

1.1.4 During which phase of meiosis does the nuclear membrane disappear?

A Metaphase
B Telophase
C Prophase
D Anaphase

1.1.5 Which ONE of the following is an example of discontinuous variation in humans?

A Height
B Heart rate
C Gender
D Weight

1.1.6 For a particular characteristic, the offspring inherits …

A one allele from the mother and one allele from the father.
B both alleles from the father.
C both alleles from the mother.
D the alleles from either the mother or the father randomly.

1.1.7 Which ONE of the following is CORRECT for speciation through geographic isolation?

A The populations undergo phenotypic changes only.
B Each population undergoes natural selection independently.
C The conditions on each side of the geographic barrier are the same.
D The new species formed are genotypically the same as the original species.

1.1.8 Below is a list of events that occur during cell division.

(i) Homologous chromosomes line up at the equator of the cell.
(ii) Chromatids are pulled to opposite poles of the cell.
(iii) Chromosome pairs arrange themselves randomly at the equator of the cell.
(iv) Individual chromosomes line up at the equator of the cell.

Which ONE of the following combinations occur in both meiosis and mitosis?

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

1.1.9 A short piece of DNA, containing 19 nucleotides in each strand, was analysed. The number of some of the different nitrogenous bases in each strand is shown below.

	Number of nitrogenous bases			
	A	**T**	**G**	**C**
Strand 1	8	-	-	-
Strand 2	-	8	3	4

How many nucleotides containing thymine (**T**) were present in strand **1**?

A 8
B 4
C 6
D 2 (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 1.2.9) in the ANSWER BOOK.

1.2.1 The process of change in the characteristics of biological species over time

1.2.2 The type of bonds between nitrogenous bases in a DNA molecule

1.2.3 The structure that joins two chromatids of a chromosome

1.2.4 The division of the cytoplasm of a cell during cell division

1.2.5 The process during meiosis where there is an exchange of genetic material between chromatids

1.2.6 The structures in animal cells that give rise to spindle fibres during cell division

1.2.7 Similar structures that are inherited from a common ancestor and are modified for different functions

1.2.8 The phase in the cell cycle during which DNA replication takes place

1.2.9 The organelle where translation occurs during protein synthesis

(9 x 1) **(9)**

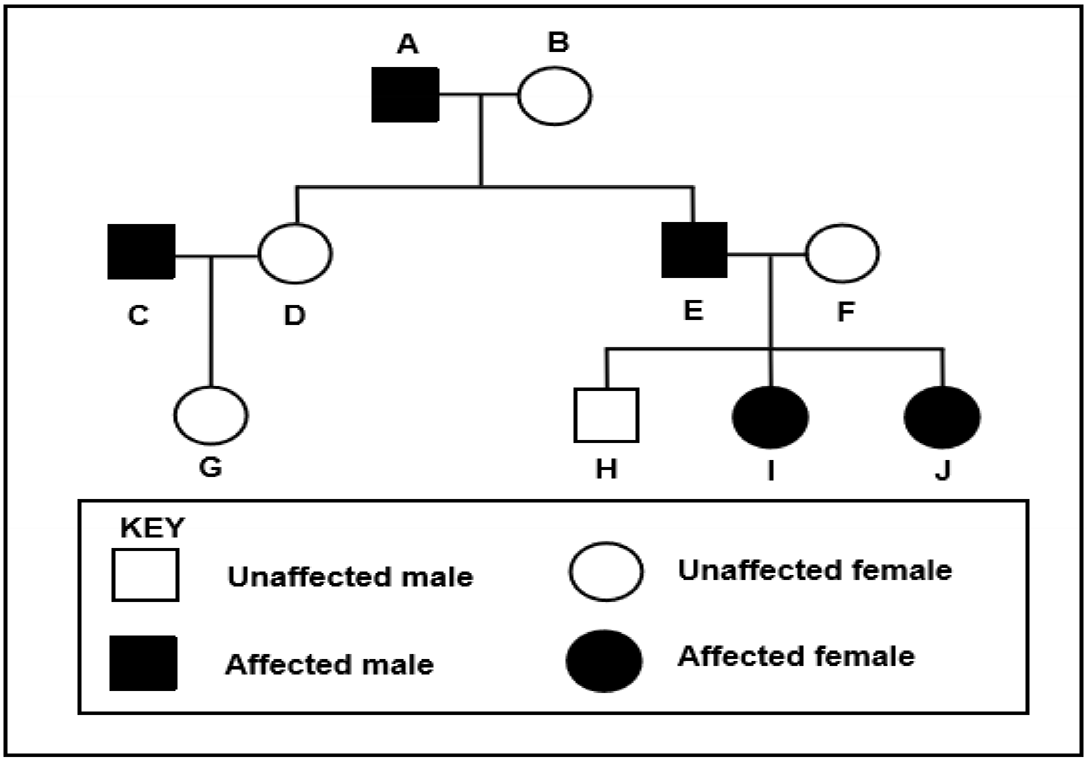
1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Type of evolution characterised by long periods of little or no change alternating with short periods of rapid change	A: Artificial selection B: Punctuated equilibrium
1.3.2	A plant with white flowers that is crossed with a plant with red flowers and produces offspring with pink flowers	A: Incomplete dominance B: Complete dominance
1.3.3	The separation of alleles during gamete formation	A: Law of Dominance B: Principle of Segregation

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

1.4 Moyamoya is a disorder caused by a dominant allele (**R**). This disorder damages the arteries supplying blood to the brain.

The pedigree diagram below shows the inheritance of Moyamoya in a family.



1.4.1 How many generations are represented in the diagram? (1)

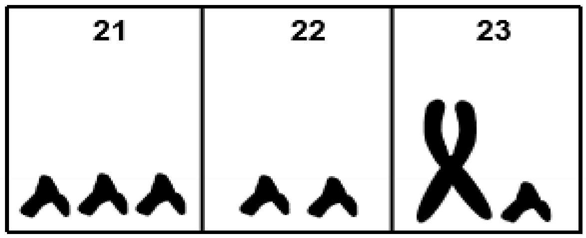
1.4.2 Give the:

(a) LETTER(S) of unaffected males (1)

(b) Genotype of individual **A** (1)

(c) LETTER(S) of individuals not biologically related to **A** and **B** (2)
(5)

1.5 The diagram below represents part of an abnormal human karyotype.



1.5.1 How many autosomes are shown in the diagram? (1)

1.5.2 Name the type of chromosomes represented by pair **23**. (1)

1.5.3 Name the:

(a) Disorder represented in the diagram (1)

(b) Process during anaphase of meiosis that resulted in the abnormal number of chromosomes in this karyotype (1)

1.5.4 State the gender of the person represented in this karyotype. (1)
(5)

1.6 In rabbits, brown fur (**B**) is dominant to white fur (**b**) and long ears (**E**) is dominant to short ears (**e**).

A rabbit, that is heterozygous for both characteristics, is crossed with a white rabbit with short ears.

1.6.1 Name the type of cross represented. (1)

1.6.2 Give the:

(a) Phenotype of a rabbit that is dominant for both characteristics (2)

(b) Genotype of the white rabbit with short ears (2)

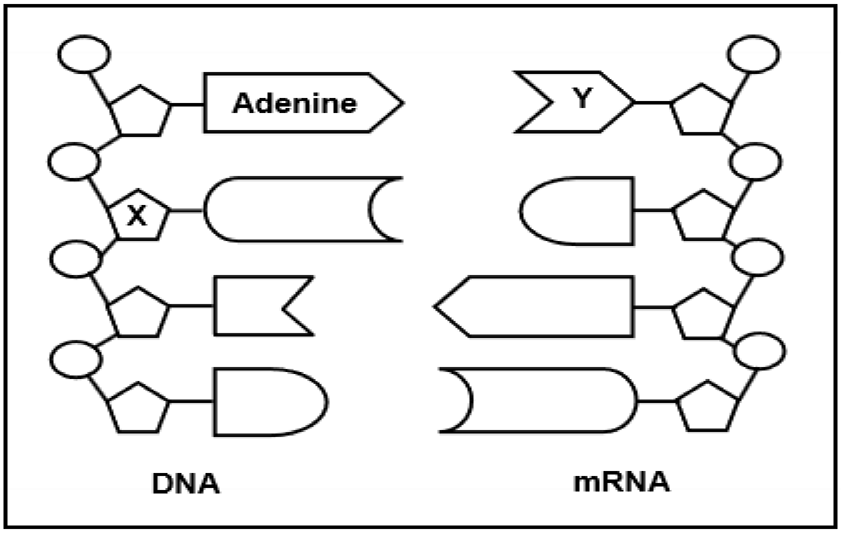
(c) Genotype of the gametes of a heterozygous brown rabbit with short ears (2)
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents transcription during protein synthesis.



2.1.1 Name the part of the cell where this process occurs. (1)

2.1.2 Identify:

(a) Sugar **X** (1)

(b) Nitrogenous base **Y** (1)

2.1.3 Tabulate TWO differences between *transcription* and *DNA replication*. (5)
(8)

2.2 A mutation has occurred on a section of an mRNA molecule as shown below.

Original sequence	AUG GAA AUA CCG CCA GGA
Mutated sequence	AUG GAA AUA CUG CCA GGA

2.2.1 Name the type of mutation that has occurred. (1)

2.2.2 Give a reason for your answer to QUESTION 2.2.1. (1)

2.2.3 The table below shows some mRNA codons and the amino acids that they code for.

mRNA codon	Amino acid
AUA	Isoleucine
AUG	Methionine
CCA	Proline
CCG	Proline
CUG	Leucine
GAA	Glutamic acid
GGA	Glycine

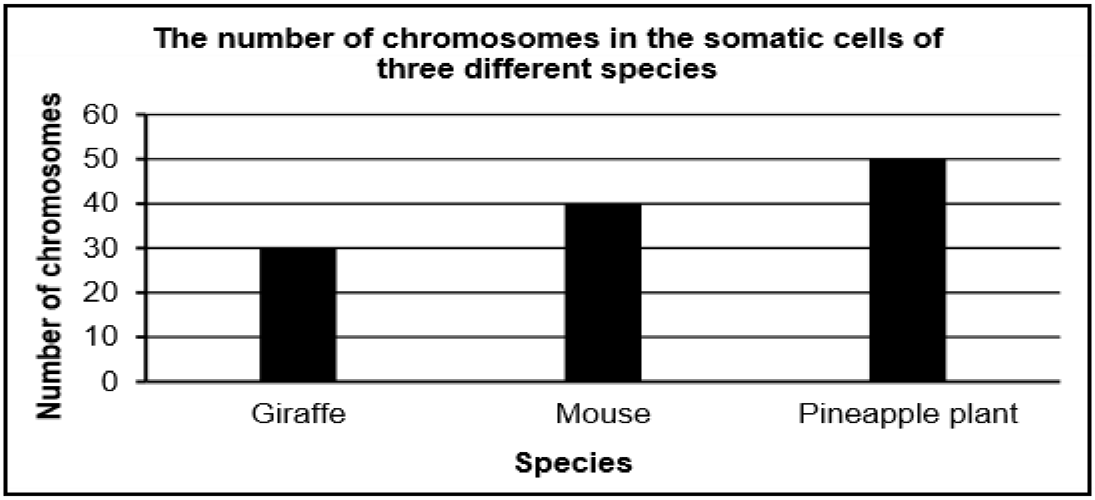
(a) State the number of different amino acids coded for by the original sequence of the mRNA molecule given above. (1)

(b) Give the anticodon on the tRNA molecule that carries the amino acid isoleucine. (1)

(c) Use information in the table to describe the effect of the mutation on the protein formed. (4)
(8)

2.3 The number of chromosomes in the somatic cells of organisms differs from species to species.

The graph below shows the number of chromosomes in each somatic cell of THREE different species.



2.3.1 How many chromosomes will be present in:

(a) Mouse cells during Telophase II of meiosis (1)

(b) A leaf cell of a pineapple plant (1)

2.3.2 Explain why the sperm cell of a giraffe has 15 chromosomes. (4)

2.3.3 Name the phase of meiosis where the halving of the chromosome number begins. (1)

2.3.4 Describe the events in the phase named in QUESTION 2.3.3. (3)
(10)

2.4 The table below shows information about blood groups in a certain population.

BLOOD GROUP	NUMBER OF PEOPLE	PERCENTAGE OF THE POPULATION
O	954 000	53
A	X	34
B	180 000	10
AB	54 000	3

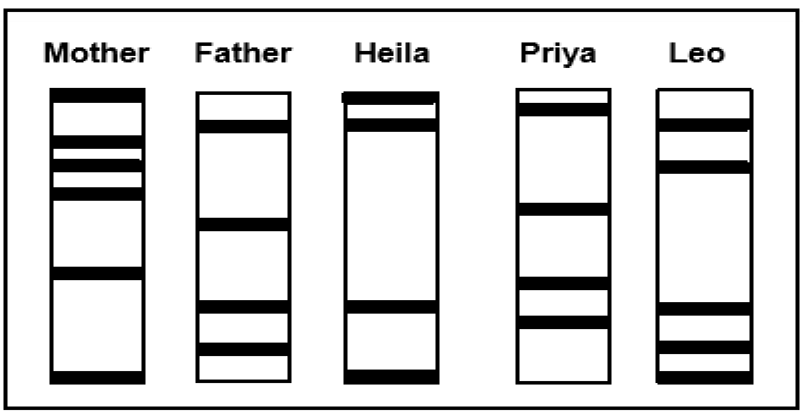
2.4.1 How many people have the genotype ii? (1)

2.4.2 The population size is 1 800 000.

Calculate the value of **X**. Show ALL working. (3)

2.4.3 Describe how a child inherits the blood group represented by 3 per cent of this population. (3)
(7)

2.5 The diagram below represents the DNA profiles of three children and their parents. Only two of the children are their biological children and one is adopted.



2.5.1 Identify the TWO biological children. (2)

2.5.2 Explain your answer to QUESTION 2.5.1. (2)

2.5.3 State THREE other uses of DNA profiling. (3)
(7)

2.6 Brown enamel of the teeth is a sex-linked trait. A dominant allele on the **X** chromosome causes brown teeth in humans.

2.6.1 Explain why more males than females have white teeth. (4)

2.6.2 A man with brown teeth married a woman with white teeth.

Use a genetic cross to show the possible phenotypic ratios of their children. Use $\mathbf{X^B}$ for brown teeth and $\mathbf{X^b}$ for white teeth. (6)
(10)
[50]

QUESTION 3

3.1 Read the extract below.

> When a child is born, the umbilical cord is cut and stem cells can be obtained from it. Many people think that the stem cells for treating human conditions should be obtained from umbilical cords, rather than from human embryos.
>
> Recently, stem cells have also been obtained from bone marrow. These stem cells are used to treat conditions such as heart disease and spinal injuries.

3.1.1 Name THREE sources of stem cells mentioned in the extract. (3)

3.1.2 Explain why the characteristics of stem cells make them useful for treating some disorders. (2)

3.1.3 Name ONE condition in the extract that can be treated with stem cells. (1)
(6)

3.2 Read the extract below.

> Samango and vervet are two species of monkeys that occupy the same habitat. Researchers have recently discovered that a population of samango monkeys were able to interbreed with vervet monkeys to produce offspring. These offspring were infertile.

3.2.1 Define the term *population*. (3)

3.2.2 Give ONE reason why samango and vervet monkeys are considered to be two different species. (1)

3.2.3 List THREE mechanisms of reproductive isolation that are NOT mentioned above. (3)
(7)

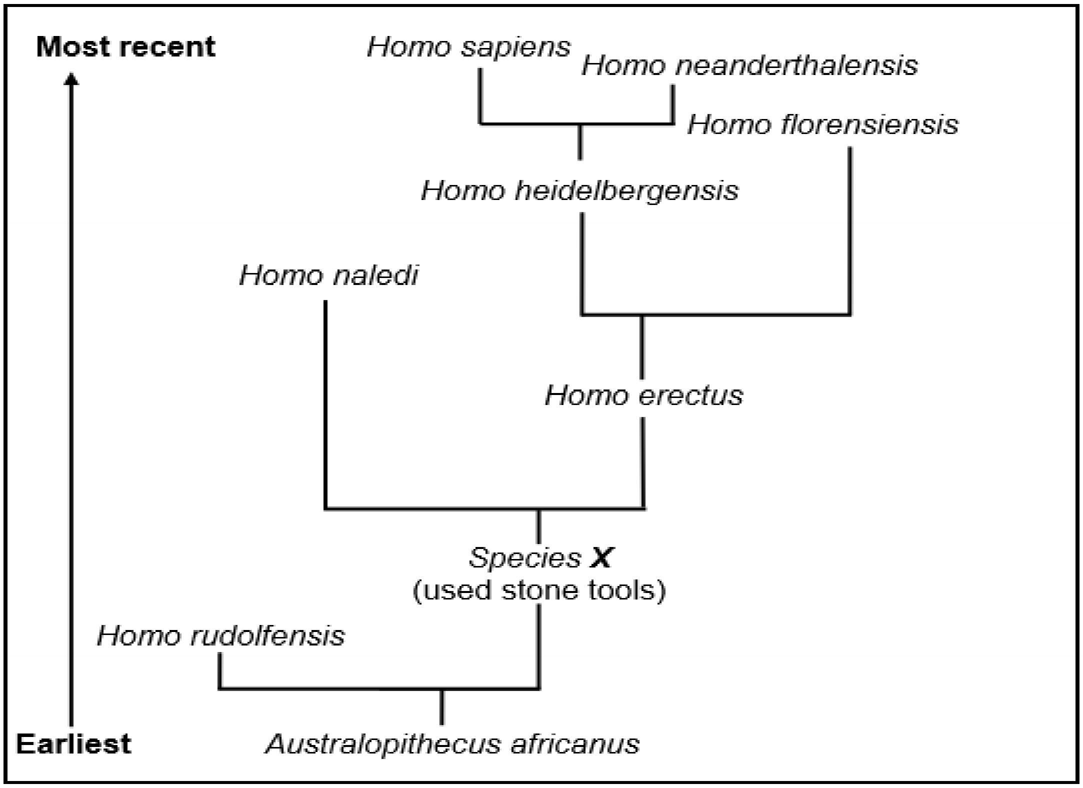
3.3 Scientists find evidence for human evolution by comparing humans to other hominids. The upper limbs of humans and African apes show similar characteristics, whereas there are differences between the dentition (teeth) of the two.

3.3.1 Why do scientists look for similarities between humans and African apes? (1)

3.3.2 Explain the importance of the positioning of the thumbs for humans and African apes. (2)

3.3.3 State ONE difference between the teeth of humans and African apes. (2)
(5)

3.4 The diagram below represents one model of the evolution of some hominids.



3.4.1 Identify the type of diagram shown. (1)

3.4.2 How many genera are represented by the diagram? (1)

3.4.3 Name the species:

(a) Represented by **X** on the diagram (1)

(b) That shares a common ancestor with *Homo erectus* (1)

3.4.4 Which species of the genus *Homo* is the only one in existence today? (1)

3.4.5 Name TWO forms of evidence that would have been used to support the information in the diagram. (2)

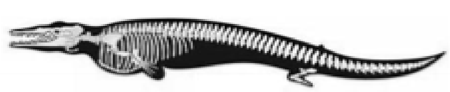
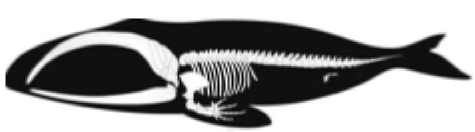
3.4.6 The average cranial capacity of *Homo sapiens* is 1 500 cm^3 compared to 520 cm^3 in *Australopithecus africanus*.

Explain the significance of the difference in cranial capacity. (3)

3.4.7 Explain how the fossils of *Australopithecus africanus*, *Species **X*** and *Homo erectus* are used to support the 'Out of Africa' hypothesis. (4)

(14)

3.5 Modern-day whales are aquatic mammals, spending their entire lives in the ocean. They are thought to have evolved from four-legged ancestors, as represented below.

SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
Pakicetus 	50 mya	Quadrupedal carnivore
Ambulocetus 	48 mya	Flipper-like large feet and tail for swimming
Dorudon 	40 mya	Large flippers in front and very small hind limbs
***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

3.5.1 Which ancestor of whales most likely lived both in water and on land? (1)

3.5.2 Give ONE reason for your answer to QUESTION 3.5.1. (2)

3.5.3 Explain why *Ambulocetus* and *Dorudon* may be considered as transitional species in the evolution of whales. (2)

3.5.4 Explain, according to Lamarck, why modern-day whales do not have legs. (3)
(8)

3.6 Patients infected with the HI virus (HIV) are treated with antiretroviral drugs. When they miss their treatment, it can increase the chances (probability) of the virus developing resistance to the drug.

Scientists conducted an investigation to determine the effect of the number of missed treatments on the probability of the HI virus developing resistance to antiretroviral drugs.

The results are shown in the table below.

Number of missed treatments (in days)	**Probability of the HI virus developing resistance to antiretroviral drugs (%)**
2	0
7	20
14	35
21	40
37	60

3.6.1 State the following for this investigation:

(a) The dependent variable (1)

(b) The independent variable (1)

3.6.2 Based on the results, state ONE precaution for patients receiving antiretroviral treatment. (1)

3.6.3 State a conclusion for this investigation. (2)

3.6.4 Describe the evolution of resistance to antiretroviral medication in the HI virus. (5)
(10)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2022

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 11 pages.

SECTION A

QUESTION 1

1.1	1.1.1	B✓✓		
	1.1.2	B✓✓		
	1.1.3	A✓✓		
	1.1.4	C✓✓		
	1.1.5	C✓✓		
	1.1.6	A✓✓		
	1.1.7	B✓✓		
	1.1.8	D✓✓		
	1.1.9	B✓✓	(9 x 2)	**(18)**
1.2	1.2.1	(Biological) evolution✓		
	1.2.2	Hydrogen✓bonds		
	1.2.3	Centromere✓		
	1.2.4	Cytokinesis✓		
	1.2.5	Crossing over✓		
	1.2.6	Centrosomes✓/Centrioles		
	1.2.7	Homologous✓structures		
	1.2.8	Interphase✓		
	1.2.9	Ribosome✓	(9 x 1)	**(9)**
1.3	1.3.1	B only✓✓		
	1.3.2	A only✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	3✓/Three		(1)
	1.4.2	(a) H✓		(1)
		(b) Rr✓		(1)
		(c) C✓and F✓		(2) **(5)**

1.5	1.5.1	5✓/Five		(1)
	1.5.2	Gonosomes✓/Sex chromosomes		(1)
	1.5.3	(a)	Down syndrome✓/Trisomy 21	(1)
		(b)	Non-disjunction✓	(1)
	1.5.4	Male✓		(1) **(5)**
1.6	1.6.1	Dihybrid✓cross		(1)
	1.6.2	(a)	Brown✓ fur and long ears✓	(2)
		(b)	bbee✓✓	(2)
		(c)	Be✓ be✓	(2) **(7)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 Nucleus✓/nucleoplasm (1)

2.1.2 (a) Deoxyribose✓ (1)

(b) Uracil✓/U (1)

2.1.3

Transcription	DNA replication
Only one strand acts as a template✓	Both strands act as templates✓
(Free) RNA nucleotides✓ are complementary	(Free) DNA nucleotides✓ are complementary
Adenine complements uracil✓/(A complements U)	Adenine pairs with thymine✓/ (A pairs with T)
A mRNA molecule is formed✓	Two identical DNA molecules are formed✓
Only a short section of DNA✓ is used	The whole DNA molecule✓ is used
DNA unwinds and unzips partially✓	DNA unwinds and unzips completely✓

(Mark first TWO only) 1 mark for table + (Any 2 x 2) (5)
(8)

2.2 2.2.1 Gene✓ mutation (1)

2.2.2 - There is a change in the sequence (of nitrogenous bases) from CCG to CUG✓ (1)

2.2.3 (a) 5✓/Five (1)

(b) UAU✓ (1)

(c)
- The codon CCG changed to CUG✓/ 4th codon has changed
- The anticodon/tRNA sequence changed✓
- The amino acid proline✓
- was replaced by leucine✓
- This resulted in a different protein✓/no protein being formed

Any (4)
(8)

2.3 2.3.1 (a) 20✓ (1)

(b) 50✓ (1)

2.3.2
- A sperm cell is a gamete✓
- formed by meiosis✓
- and must be haploid✓
- to overcome the doubling effect of fertilisation✓ (4)

2.3.3
- Anaphase I✓ (1)

2.3.4
- Spindle fibres shorten✓/contract
- Chromosome pairs separate✓and
- move to the opposite poles✓ (3)

(10)

2.4 2.4.1 954 000✓ (1)

2.4.2 1 800 000✓ – (954 000 + 180 000 + 54 000)✓
= 612 000✓people

OR

1 800 000✓ - 1 188 000✓
= 612 000✓people

OR

$\frac{34}{100}$ ✓ x 1 800 000✓ = 612 000✓people (3)

2.4.3
- The allele for blood group A/ I^A is inherited from one parent✓ and
- the allele for blood group B/ I^B is inherited from the other parent✓ therefore
- the child has blood group AB✓/genotype I^AI^B (3)

(7)

2.5 2.5.1 Heila✓ and Leo✓ (2)
(Mark first TWO only)

2.5.2
- All of the (DNA) bands from Heila and Leo✓
- match with the (DNA) bands of the mother and the father✓

OR

- None of the (DNA) bands from Priya✓
- match with the (DNA) bands of the mother and the father✓ (2)

2.5.3
- Tracing missing persons✓
- Identification of genetic disorders✓
- Identification of suspects in a crime✓
- Matching tissues for organ transplants✓
- Identifying dead persons✓ Any (3)

(Mark first THREE only) **(7)**

2.6 2.6.1
- Males have only one X chromosome✓/The Y-chromosome does not have this allele and
- have to inherit only one recessive allele✓ to have white teeth
- whereas females have two X chromosomes✓ and have to
- inherit two recessive alleles to have white teeth✓ (4)

2.6.2

P_1	Phenotype	Male with brown teeth	x	Female with white teeth✓
	Genotype	X^BY	x	X^bX^b✓
Meiosis				
	G/gametes	X^B, Y	x	X^b, X^b✓
Fertilisation				
F_1	Genotype	X^BX^b, X^BX^b, X^bY, X^bY✓		
	Phenotype	1 female with brown teeth: 1 male with white teeth✓*		

P_1 and F_1✓
Meiosis and fertilisation✓

***1 compulsory mark** + Any 5

OR

P_1	Phenotype	Male with brown teeth	x	Female with white teeth✓
	Genotype	X^BY	x	X^bX^b✓

Meiosis

Fertilisation

Gametes	X^B	Y
X^b	X^BX^b	X^bY
X^b	X^BX^b	X^bY

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype 1 female with brown teeth: 1 male with white teeth✓*

P_1 and F_1✓
Meiosis and fertilisation✓

***1 compulsory mark** + Any 5 (6)
(10)
[50]

QUESTION 3

3.1 3.1.1
- Embryos✓
- Umbilical cord✓
- Bone marrow✓ (3)

(Mark first THREE only)

3.1.2
- Stem cells are undifferentiated✓
- and have the potential to develop into any type of cell✓
- to replace affected/defective cells✓ causing a disorder Any (2)

3.1.3
- Heart disease✓
- Spinal injuries✓ Any (1)

(Mark first ONE only) **(6)**

3.2 3.2.1
- A group of organisms of the same species✓
- occupying the same habitat✓
- at the same time✓ (3)

3.2.2 They produce infertile offspring✓ (1)

(Mark first ONE only)

3.2.3
- Breeding at different times of the year✓
- Species-specific courtship behaviour✓
- Adaptation to different pollinators✓
- Prevention of fertilisation✓ Any (3)

(Mark first THREE only) **(7)**

3.3 3.3.1
- To show a possible common ancestor✓
- To identify trends in evolution✓ Any (1)

3.3.2
- Both have opposable thumbs✓
- to allow for a power grip✓/precision grip/ any example thereof (2)

3.3.3
- Humans have small teeth✓/canines whereas African apes have large teeth✓/canines
- There are no gaps✓/diastema between the teeth in humans whereas African apes have gaps✓ /diastema between the teeth

(Mark first ONE only (Any 1 x 2) (2)
(5)

3.4 3.4.1 Phylogenetic tree✓/cladogram (1)

3.4.2 2✓/Two (1)

3.4.3 (a) *Homo habilis*✓ (1)

(b) *(Homo) naledi*✓ (1)

3.4.4 *(Homo) sapiens*✓ (1)

3.4.5
- Fossil✓evidence
- Cultural✓ evidence
- Genetic✓ evidence Any (2)

(Mark first TWO only)

3.4.6
- *A* large cranial capacity✓ in *Homo sapiens*
- indicates a larger brain✓
- leading to greater intelligence✓

OR

- A small cranial capacity✓in *Australopithecus africanus*
- indicates a smaller brain✓
- leading to lower intelligence✓ (3)

3.4.7
- Fossils *of Australopithecus spp*. were found in Africa only✓ and
- fossils of s*pecies* ***X***/*Homo habilis* were found in Africa only✓
- The oldest fossils of *Homo erectus* were found in Africa✓ /the younger fossils were found elsewhere
- indicating that modern humans originated in Africa and migrated out of Africa✓ (4)

(14)

3.5 3.5.1 *Ambulocetus*✓ (1)

3.5.2 It had flipper-like large feet and a tail✓✓ (2)
(Mark first ONE only)

3.5.3
- They share characteristics✓/have intermediate characteristics
- of the ancestor/*Pakicetus* <u>and</u> the present-day species✓/ *Balaena*

OR

- They have legs like *Pakicetus*✓ and
- flippers of the present day *Balaena*✓ (2)
-

3.5.4
- Ancestral species of whales all had legs✓/lived on land
- As more time was spent in the water✓in search of food
- the legs were used less✓ and disappeared
- the acquired characteristic was passed on to the next generation✓ Any (3)

(8)

3.6 3.6.1 (a) Probability of developing resistance✓to antiretroviral drugs (1)

(b) Number of missed treatments✓ (1)

3.6.2 Treatment must not be missed✓ (1)

3.6.3 The probability of HIV developing resistance to antiretroviral drugs increases with the increase in the number of missed treatments✓✓

OR

The more the days of missed treatment, the greater the probability of the virus developing resistance to antiretroviral drugs✓✓ (2)

3.6.4
- There is variation in the resistance✓ of the HI virus to antiretroviral drugs
- Some viruses are resistant✓ to the drugs and
- others are not resistant✓
- Those that are not resistant do not survive✓
- When treatments are missed✓,
- the resistant viruses survive and reproduce✓
- passing the resistance to their offspring✓ Any (5)

(10)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2023

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

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, e.g. 1.1.11 D.

1.1.1 The base pairing in DNA was discovered by …

A Watson and Wilkins.
B Franklin and Wilkins.
C Franklin and Crick.
D Crick and Watson.

1.1.2 A gene codes for the production of …

A a chromosome.
B an allele.
C DNA.
D a protein.

1.1.3 Which ONE of the following is a characteristic of stem cells?

A They are easily obtained from any organ.
B They divide by meiosis.
C They are haploid.
D They can be stimulated to form any type of cell needed.

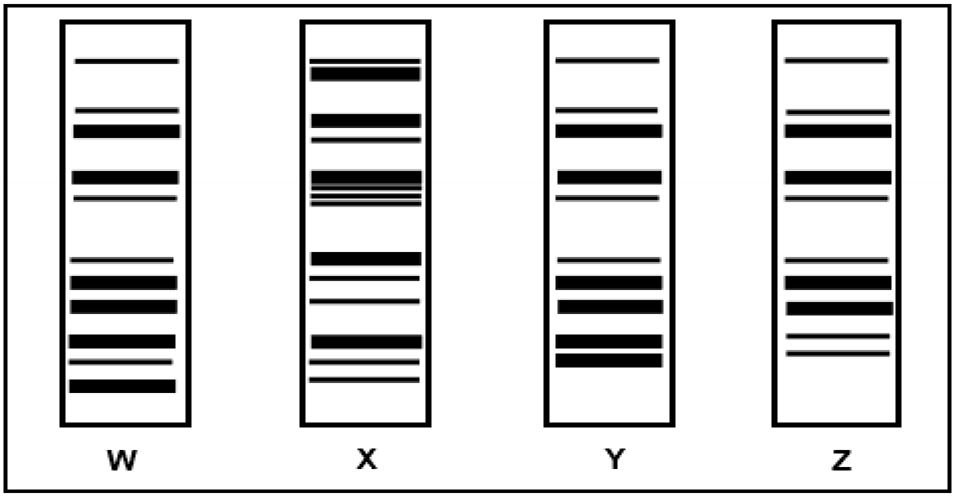
1.1.4 The chances of having a female child in humans is …

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

1.1.5 Which ONE of the following is part of the reason why colour-blindness is more common in males than in females?

A The allele for colour-blindness is recessive and located on the X-chromosome.
B Colour-blind males have two copies of the allele for colour-blindness.
C The allele for colour-blindness is recessive and located on the Y-chromosome.
D Fathers pass the allele of colour-blindness to their sons only.

1.1.6 The DNA profile of four individuals are given below.



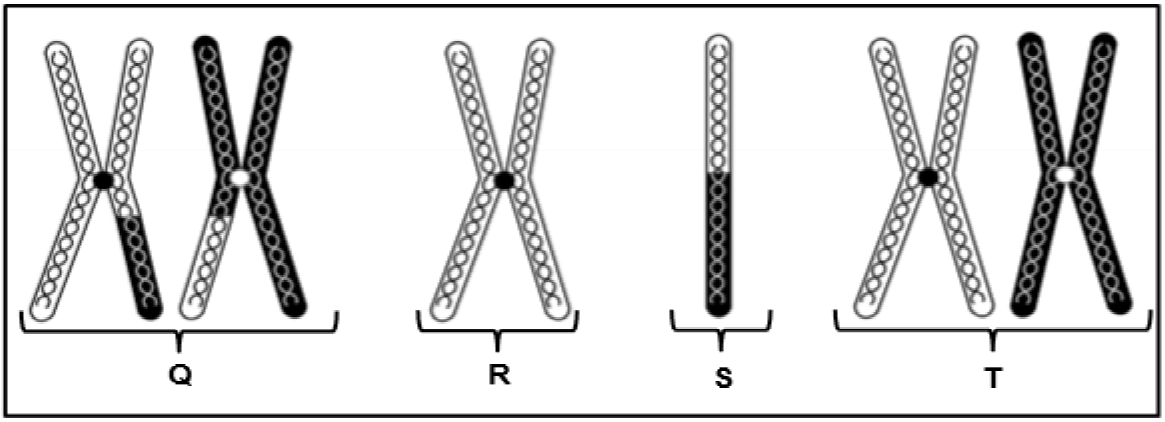
Which individuals are possible members of the same family?

A X and Z only
B X, Y and Z only
C W, Y and Z only
D W, X and Y only

1.1.7 When two plants heterozygous for a characteristic are crossed, the expected ratio is:

	Dominant phenotype		**Recessive phenotype**
A	3	:	1
B	1	:	3
C	1	:	2
D	1	:	1

1.1.8 The diagram below represents the structure of chromosomes at different stages of meiotic cell division.



Which ONE of the following chromosomes would be found in a cell during late Anaphase II?

A **Q**
B **R**
C **S**
D **T**

1.1.9 The scientist who discovered Little Foot is …

A Lee Berger.
B Raymond Dart.
C Ron Clarke.
D Robert Broom. (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 1.2.10) in the ANSWER BOOK.

1.2.1 The position of a gene on a chromosome

1.2.2 The type of evolution characterised by long periods of little or no change followed by short periods of rapid change

1.2.3 The natural shape of a DNA molecule

1.2.4 The type of bond found between two amino acids

1.2.5 The type of vision shared in primates that allows for depth perception

1.2.6 The type of dominance which results in an intermediate phenotype in the heterozygous condition

1.2.7 The fluid of the nucleus where free nucleotides are found

1.2.8 A tangled mass of chromosomes located within the nucleus

1.2.9 The division of the cytoplasm after a nuclear division

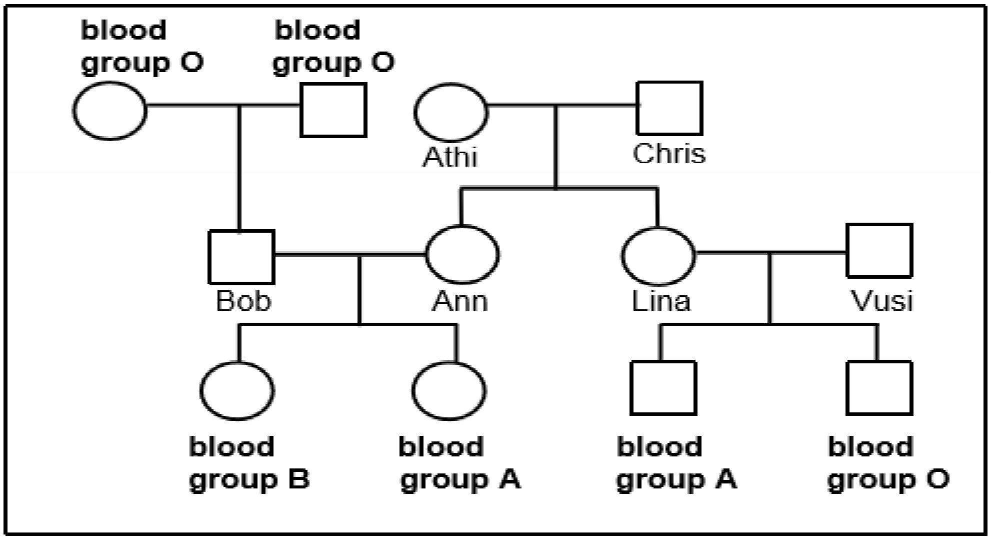
1.2.10 The name for the X and Y sex chromosomes in humans (10 x 1) **(10)**

1.3 Indicate whether each of the descriptions in COLUMN I apply 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	A genetic disorder caused by a chromosomal mutation	A: Haemophilia B: Colour-blindness
1.3.2	The importance of meiosis	A: Formation of gametes B: Halving of the chromosome number
1.3.3	The organelle where DNA is found in plants	A: Mitochondria B: Chloroplast

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

1.4 The diagram below shows the inheritance of blood groups in a family.



1.4.1 Name the type of diagram shown. (1)

1.4.2 Give the number of alleles that control blood groups. (1)

1.4.3 How many generations are represented in the diagram? (1)

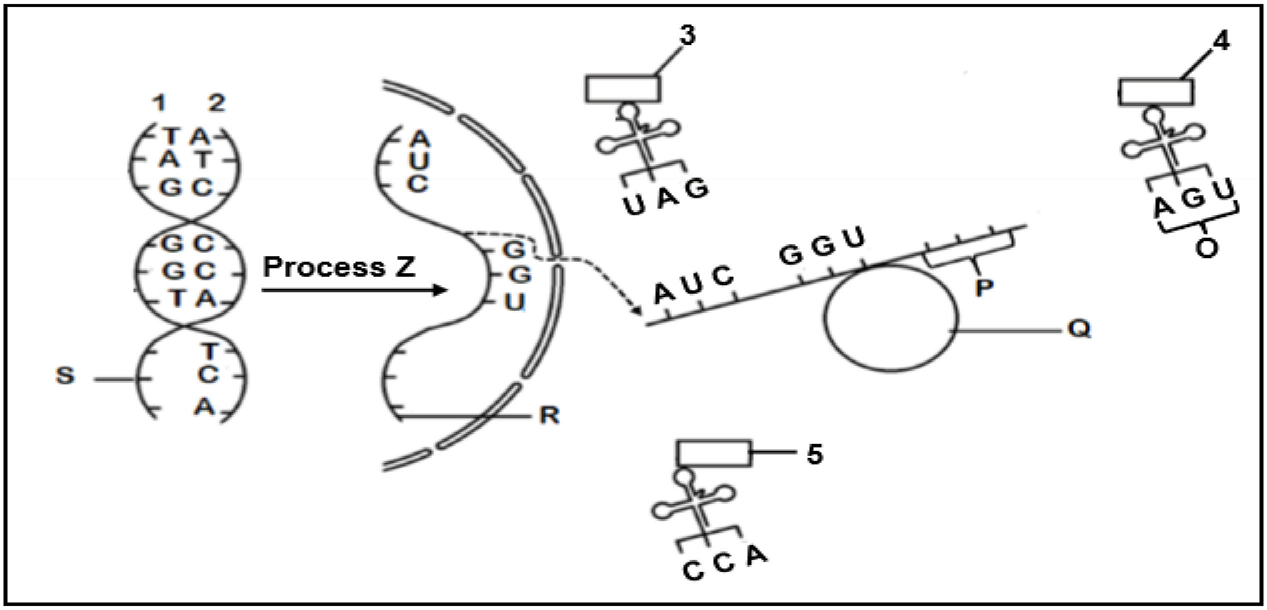
1.4.4 Lina's genotype is $I^A i$.

State ALL the possible genotypes of Vusi. (2)

1.4.5 Give the genotype of Bob. (1)

1.4.6 Give the name of the individual which displays co-dominance. (2)
(8)

1.5 The diagram below is a schematic representation of protein synthesis.



1.5.1 Identify:

(a) Process **Z** (1)

(b) Molecule **R** (1)

(c) Organelle **Q** (1)

1.5.2 Give the collective name of nitrogenous bases **O**. (1)

1.5.3 Determine the sequence of the nitrogenous bases at area **S**. (1)

1.5.4 Which strand (**1** or **2**) was used as a template for the formation of molecule **R**? (1)

1.5.5 Which amino acid (**3**, **4** or **5**) will be brought to area **P**? (1)

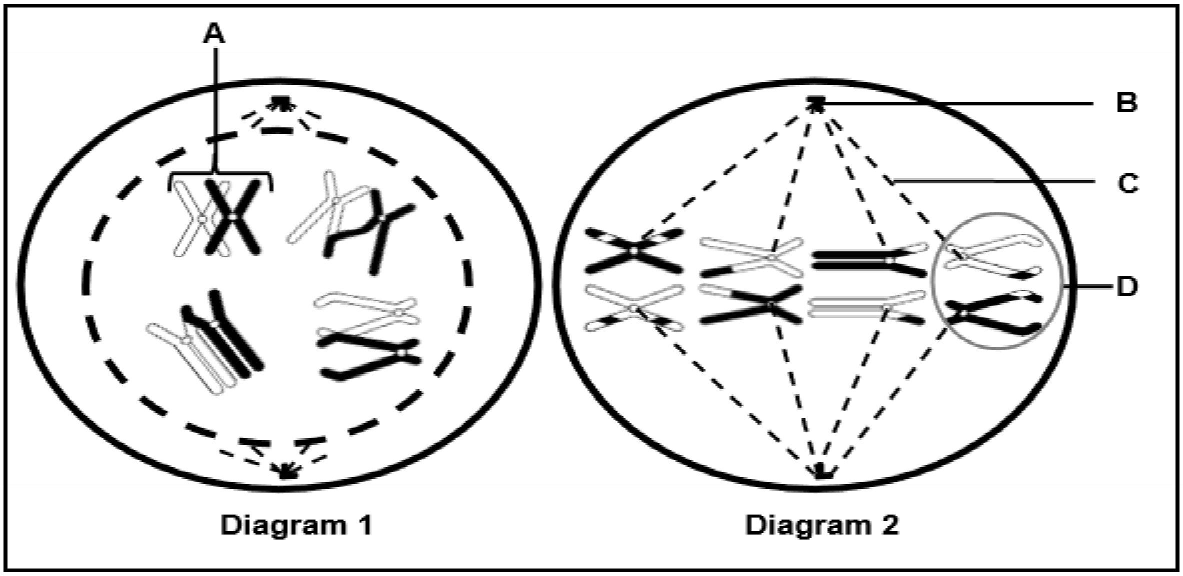
1.5.6 Name the type of sugar that forms part of the structure of molecule **R**. (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagrams below represent two stages of meiotic cell division.



2.1.1 Name structure:

(a) **B** (1)

(b) **C** (1)

2.1.2 Identify the phase represented in Diagram **1**. (1)

2.1.3 Give THREE reasons for your answer to QUESTION 2.1.2. (3)

2.1.4 Describe the process taking place at **A**. (3)

2.1.5 (a) Identify the phase represented in Diagram **2**. (1)

(b) Describe the difference in the events that take place in the phase mentioned in (a) and the same phase during mitosis. (2)

2.1.6 Describe the results at the end of meiosis if the chromosomes at **D** failed to separate. (3)
(15)

2.2 Describe the process of DNA replication. **(6)**

2.3 Read the information below.

> A gene, VKORC1, codes for a blood-clotting factor in humans. This gene is made up of 163 amino acids.
>
> A mutation occurred that affected amino acid 128 and 139, the sequence CTG changed to CAG and the TAT became TCT. This mutation has been transmitted as an autosomal dominant characteristic through the generations.
>
> The mutation has resulted in resistance to Warfarin drugs in humans. Warfarin is used in the treatment of thrombosis. Thrombosis results in the formation of a blood clot in the artery. Warfarin causes the thinning of blood to break down the blood clot.

2.3.1 Give ONE piece of evidence from the information that shows that the mutation for this gene occurred in the DNA molecule. (1)

2.3.2 How many nitrogenous bases code for the VKORC1 gene? (2)

2.3.3 Describe what is meant by an *autosomal dominant allele*. (3)

2.3.4 The table below shows the amino acids and their corresponding codons.

CODONS	AMINO ACID
GAC	Leu
UCU	Ser
AUA	Try
GUC	Gln
AGA	Arg
ACA	Trp
CAG	Gln
UAU	Phe

Explain:

(a) How the mutation on the VKORC1 gene resulted in resistance to Warfarin in humans (5)

(b) The effect of this mutation on humans with thrombosis (3)
(14)

2.4 Polydactyly is a condition that leads to extra fingers or toes. It is caused by a dominant allele.

A man who is heterozygous for polydactyly has a wife who is not polydactyl.

Using the letters **R** and **r**, do a genetic cross to show the percentage chance that their children will have polydactyly. **(6)**

2.5 In summer squash plants, white fruit colour **(B)** is dominant over yellow fruit colour **(b)**, and round fruit **(D)** is dominant over oval fruit **(d)**.

A summer squash plant that is homozygous for white and round fruit is crossed with a plant that is homozygous for yellow and oval fruit.

2.5.1 State the:

(a) Genotypes of the P_1-parents (2)

(b) Phenotypes of the F_1-generation (2)

2.5.2 Two plants that are heterozygous for both characteristics were crossed.

(a) Give ALL the possible genotypes in the **gametes** that will be formed. (2)

(b) How many plants in the next generation are likely to have yellow and oval fruit? (1)

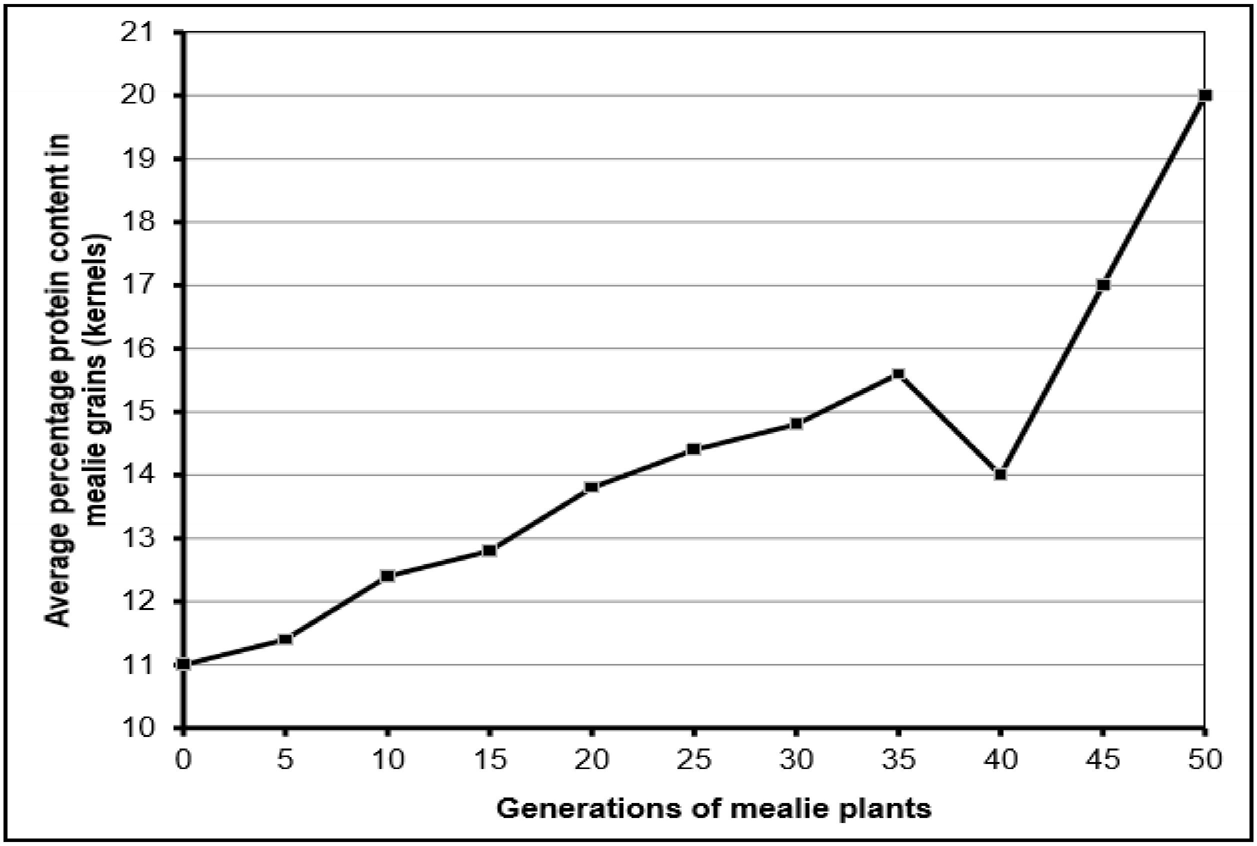
2.5.3 Give the possible genotypes of both parents that must be crossed if a farmer wants summer squash that are white with oval fruit only. (2)

(9)

[50]

QUESTION 3

3.1 The graph below shows the results of artificial selection for protein content in mealie plants over 50 generations.



3.1.1 Describe how this farmer did artificial selection of the mealie plant. (3)

3.1.2 What was the average percentage of the protein content in the mealie grains (kernels) at the 15th generation? (1)

3.1.3 By how many times did the average percentage of the protein content in the mealie grains (kernels) increase between the 40th and 50th generation? Show ALL working. (2)

3.1.4 Describe ONE way in which the process of artificial selection is different from genetic engineering. (2)
(8)

3.2 Describe Darwin's theory of evolution by natural selection. **(7)**

3.3 An investigation was done to determine the relationship between the height of the head and bite force in lizards.

The procedure was as follows:

- The scientists collected 120 lizards with similar characteristics that were around the same reproductive age in different habitats.
- Their body characteristics and DNA were analysed to determine if they belonged to the same species.
- 40 lizards belonged to species **A**, 36 to species **B** and 44 to species **C**.
- Each species was kept in its cage with environmental conditions similar to their habitats.
- The height of the head was measured for each lizard and averages calculated for each species.
- Using a Kistler force, the bite force of each lizard in each species was measured five times and the average calculated for each lizard and each species.

The results are shown in the table below.

Species	**Height of the head (mm)**	**Bite force (N)**
A	10,3	12,4
B	10,7	14,3
C	13,2	20,4

3.3.1 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

3.3.2 State TWO factors that were kept constant for this investigation. (2)

3.3.3 Apart from the sample size, state ONE way in which the reliability of the results was ensured for this investigation. (1)

3.3.4 The height of the head was different in each species of lizard.

Name the type of variation displayed by this characteristic. (1)

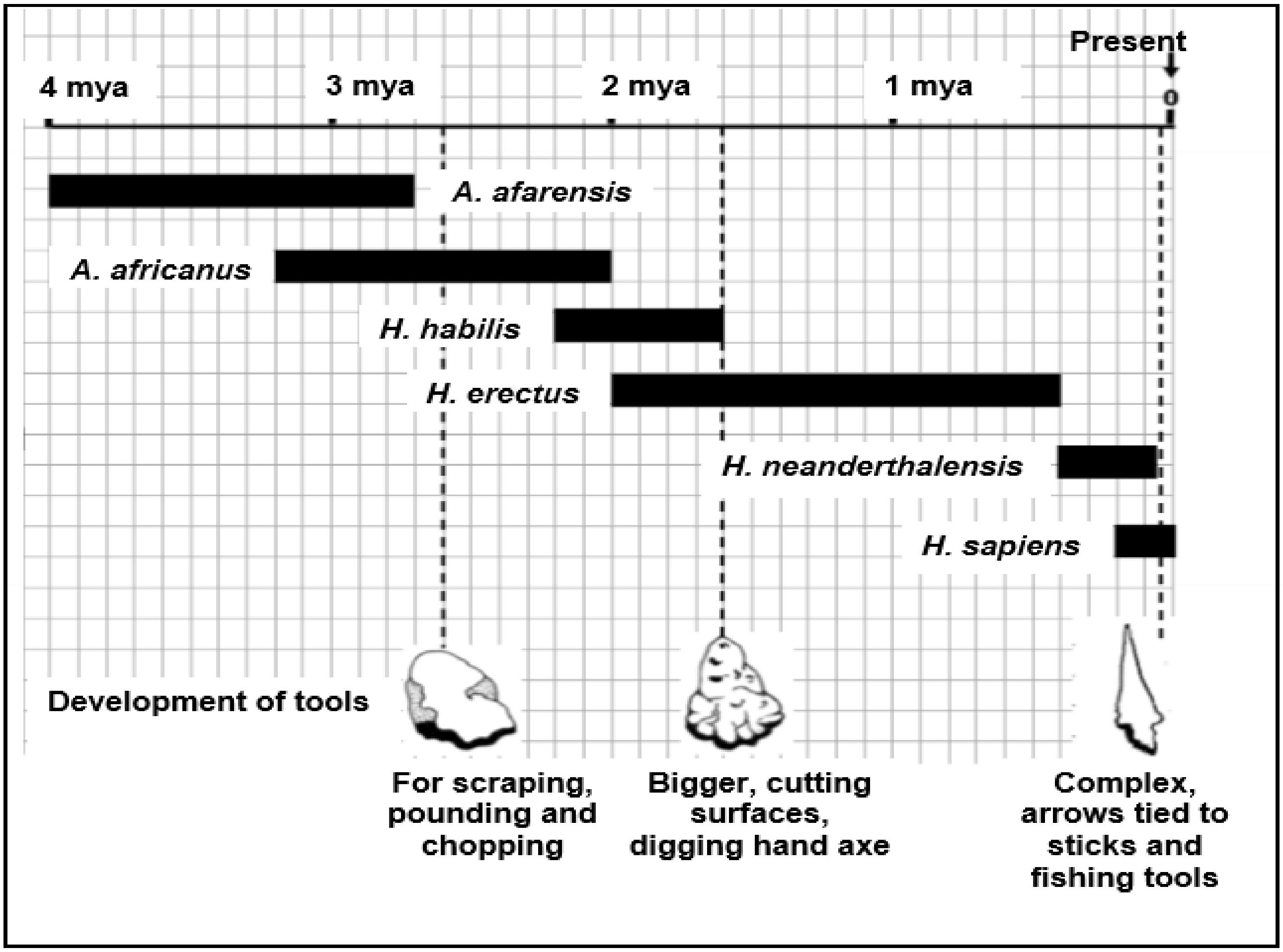
3.3.5 Describe the relationship between the height of the head of the lizards and the bite force. (2)

3.3.6 Which species (**A**, **B** or **C**) would be expected to be feeding mainly on tough fibrous plants? (1)

3.3.7 Explain your answer to QUESTION 3.3.6. (2)

3.3.8 Which species (**A**, **B** or **C**) would be most suited to live in narrow areas between the rocks? (1)
(12)

3.4 The diagram below shows a timeline of different hominid species and the development of tools.



3.4.1 Which species in the diagram above existed/survived for the longest period of time? (1)

3.4.2 Calculate the period (million years) in which the *A. afarensis* and *A. africanus* coexisted. Show ALL working. (2)

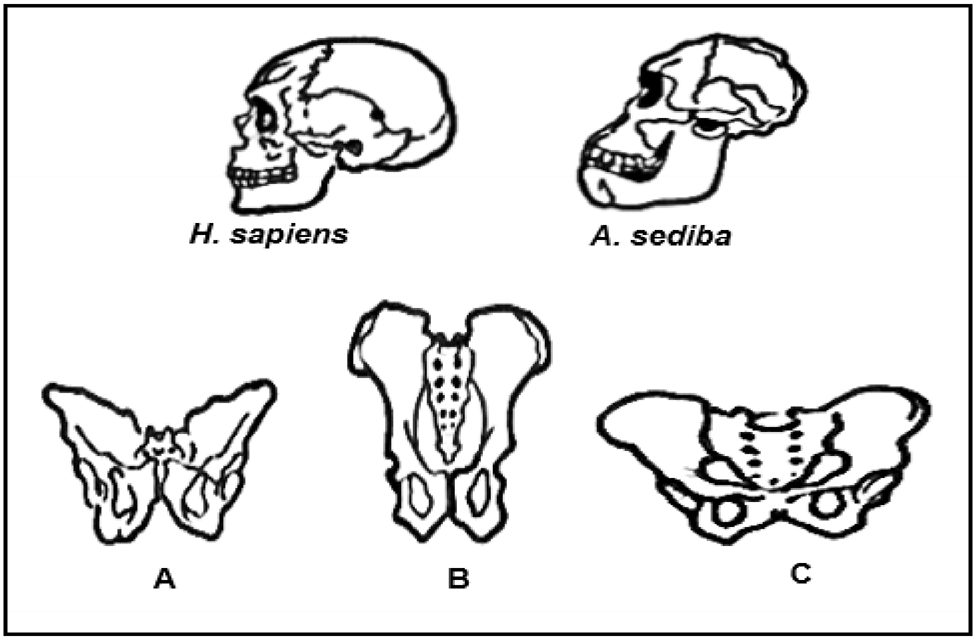
3.4.3 Name the species that was also known as the handyman. (1)

3.4.4 State TWO uses of the tool that was developed 2,6 mya. (2)

3.4.5 Identify TWO species that used the most complex tools. (2)

3.4.6 Explain how the changes in brain size over time relates to the development of tools. (3)
(11)

3.5 The diagrams below show the skulls and pelvises of different hominids.



3.5.1 State the genus name of *A. sediba*. (1)

3.5.2 Describe the shape of the spine of *H. sapiens*. (1)

3.5.3 *A. sediba* is thought to be a transitional species.

State what is meant by a *transitional species*. (2)

3.5.4 Give the LETTER of the pelvis that would be representative of *A. sediba*. (1)

3.5.5 Explain your answer to QUESTION 3.5.4. (2)

3.5.6 Explain the significance of the change in prognathism from *A. sediba* to *H. sapiens*. (5)
(12)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2023

MARKING GUIDELINE

MARKS: 150

These marking guidelines consist of 10 pages.

SECTION A

QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	D✓✓		
	1.1.3	D✓✓		
	1.1.4	B✓✓		
	1.1.5	A✓✓		
	1.1.6	C✓✓		
	1.1.7	A✓✓		
	1.1.8	C✓✓		
	1.1.9	C✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Locus✓		
	1.2.2	Punctuated equilibrium✓		
	1.2.3	Double helix✓		
	1.2.4	Peptide✓bond		
	1.2.5	Stereoscopic✓ / binocular vision		
	1.2.6	Incomplete✓dominance		
	1.2.7	Nucleoplasm✓		
	1.2.8	Chromatin network✓		
	1.2.9	Cytokinesis✓		
	1.2.10	Gonosomes✓	(10 x 1)	**(10)**
1.3	1.3.1	None✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	Both A and B✓✓	(3 x 2)	**(6)**
1.4	1.4.1	Pedigree✓diagram		(1)
	1.4.2	3✓/Three		(1)
	1.4.3	3✓/Three		(1)
	1.4.4	$\left.\begin{array}{l} I^Ai \\ I^Bi \\ ii \end{array}\right]$ ✓✓		(2)
	1.4.5	ii✓		(1)
	1.4.6	Ann✓✓		(2) **(8)**
1.5	1.5.1	(a) Transcription✓		(1)
		(b) mRNA✓/messenger RNA		(1)
		(c) Ribosome✓		(1)
	1.5.2	Anticodon✓		(1)
	1.5.3	AGT✓		(1)
	1.5.4	1✓		(1)
	1.5.5	4✓		(1)
	1.5.6	Ribose✓		(1) **(8)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) Centriole✓/centrosome (1)

(b) Spindle fibre✓ (1)

2.1.2 Prophase I✓ (1)

2.1.3
- Pairing of homologous chromosomes is visible✓/ bivalents are visible
- Development of spindle fibres✓
- Crossing over is taking place✓
- Centriole/ centrosome moved to opposite poles✓
- Disintegration of the nuclear membrane✓ Any (3)

(Mark first THREE only)

2.1.4
- Parts of the homologous chromosomes overlap✓ and
- DNA/genetic material is exchanged✓
- at points called chiasmata✓/chiasma (3)

2.1.5 (a) Metaphase I✓ (1)

(b)
- In Metaphase I/Meiosis I chromosomes are arranged in pairs at the equator✓
- In mitosis the chromosomes are arranged singly at the equator✓ (2)

2.1.6
- Four (daughter) cells will be formed✓of which
- two will each have five chromosomes✓ and
- the other two will each have three chromosomes✓ (3)

(15)

2.2
- The (DNA) double helix unwinds✓and
- unzips✓/hydrogen bonds break
- to form two separate strands✓
- Both (DNA) strands serve as templates✓
- to build a complementary (DNA) strand✓/ A pairs with T and C pairs with G
- using free (DNA) nucleotides✓ from the nucleoplasm
- This results in two identical (DNA) molecules✓ Any **(6)**

2.3 2.3.1 The presence of T✓/thymine in the original sequence (1)

2.3.2 489✓✓ (2)

2.3.3
- A form of a gene✓
- that is carried on chromosome 1 to 22✓ and
- is always expressed in the phenotype✓ of an individual
- in the heterozygous✓ condition Any (3)

2.3.4 (a)
- The codon changed from GAC to GUC✓
- resulting in amino acid Leu replaced by Gln✓
- The other codon changed from AUA to AGA✓
- resulting in amino acid Try replaced by Arg✓
- This changed the sequence of amino acids✓
- A different protein was formed✓ Any (5)

(b)
- Harmful✓ effect
- The blood clot is not broken down✓
- Leading to blockage of arteries✓ /oxygen and nutrients are not transported to cells (3)

(14)

2.4 **P_1** Phenotype With polydactyly x Without polydactyly✓
Genotype Rr x rr✓

Meiosis

G/gametes R , r x r, r✓

Fertilisation

F_1 Genotype Rr, Rr, rr, rr✓

Phenotype 2 polydactyly ; 2 without polydactyly✓

50✓*% chance of polydactyl child

P_1 and F_1✓
Meiosis and fertilisation✓

*__1 compulsory mark__ + Any 5

OR

P_1 Phenotype With polydactyly x Without polydactyly✓
Genotype Rr x rr✓

Meiosis

Fertilisation

Gametes	R	r
r	Rr	rr
r	Rr	rr

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype 2 polydactyly ; 2 without polydactyly✓

50✓*% chance of polydactyl child

P_1 and F_1✓
Meiosis and fertilisation✓

*__1 compulsory mark__ + Any 5 **(6)**

2.5 2.5.1 (a) BBDD✓
bbdd✓ (2)

(b) White, round fruit✓✓ (2)

2.5.2 (a) BD, bD, Bd, bd ✓✓ (2)

(b) One✓/1 (1)

2.5.3 BBdd and BBdd✓✓

OR

BBdd and Bbdd✓✓

OR

BBdd and bbdd✓✓ (2)

(9)

[50]

QUESTION 3

3.1 3.1.1
- The farmer interbred✓
- mealie plants with a high protein content✓
- over 50/many generations✓ (3)

3.1.2 12,8✓ % (Accept 12,7 - 12,9%) (1)

3.1.3 $\frac{20✓}{14}$ = 1,43✓ times (2)

3.1.4
- Artificial selection: organisms with a desired characteristic are interbred✓
- Genetic engineering: genes coding for the desired characteristic are inserted into an organism✓ (2)

(Mark first ONE only) **(8)**

3.2
- There is variation amongst the offspring in a population✓
- Some have favourable characteristics and some do not✓
- When there is a change in the environmental conditions✓/there is competition
- organisms with a favourable characteristic survive✓
- whilst organisms with an unfavourable characteristic die✓
- The organisms that survive, reproduce✓
- and pass on the allele for the favourable characteristic to their offspring✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristic✓ Any **(7)**

3.3	3.3.1	(a) Height of the head✓		(1)
		(b) Bite force✓		(1)
	3.3.2	- Similar characteristics✓ - (Same) reproductive age✓ - (Same) measuring tool/ for bite force✓/ Kistler force used to measure bite force - Each species kept in environmental conditions similar to their habitats✓ - Lizards of the same species in each group✓ **(Mark first TWO only)**	Any	(2)
	3.3.3	Five measurements of the bite force✓ **(Mark first ONE only)**		(1)
	3.3.4	Continuous✓ variation		(1)
	3.3.5	Lizards with an increased head height have a stronger bite force✓✓ **OR** Lizards with a decreased head height have a weaker bite force✓✓		(2)
	3.3.6	C✓		(1)
	3.3.7	- Has the strongest bite force✓/20,4 N - to break down✓ tough fibrous plant material		(2)
	3.3.8	A✓		(1) **(12)**
3.4	3.4.1	*H. erectus*✓		(1)
	3.4.2	3,2 – 2,7✓ = 0,5✓ my		(2)
	3.4.3	*H. habilis*✓		(1)
	3.4.4	- Scraping✓ - Pounding✓ - Chopping✓ **(Mark first TWO only)**	Any	(2)
	3.4.5	- *H. sapiens*✓ - *H. neanderthalensis*✓ **(Mark first TWO only)**		(2)
	3.4.6	- Increased brain size✓led to - increased intelligence✓ leading to - the development of complex tools✓		(3) **(11)**

3.5 3.5.1 *Australopithecus*✓ (1)

3.5.2 S✓-shaped spine (1)

3.5.3
- An organism that has intermediate/common characteristics✓
- between two genera✓/species (2)

3.5.4 A✓ (1)

3.5.5
- **A** has a pelvis that is intermediate✓/ transitional between **B** and **C**✓

OR

- **A** has a shorter and wider pelvis than **B**✓ but not as short and wide as **C**✓

OR

- **A** has a longer and narrower pelvis than **C** ✓ but not as long and narrow as **B**✓ (2)

3.5.6
- *A. sediba* was prognathous✓/ more prognathous while
- *H. sapiens* are non-prognathous✓/ less prognathous
- This is due to a smaller jaw✓
- with smaller teeth✓ and
- reduced chewing muscles✓
- caused by a changed diet to eating soft/cooked food✓ (5)

Any **(12)**

[50]

TOTAL SECTION B: 100

GRAND TOTAL: 150