Education

KwaZulu-Natal Department of Education

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

PREPARATORY EXAMINATION

SEPTEMBER 2018

MARKS: 150

TIME: $2^1/_2$ hours

N.B. This question paper consists of 13 pages including this page.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Make ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, tables or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass, where necessary.
11. Write neatly and legibly.

SECTION A

QUESTION 1

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

1.1.1 Which ONE of the following represents molecules that make up a single nucleotide?

A Phosphate, sugar and a nitrogenous base
B Sugar, protein and phosphate
C Nitrogenous base, phospholipid and sugar
D Adenine, sugar and a nitrogenous base

1.1.2 The wings of a bat and the human arm are examples of …

A vestigial structures.
B homologous structures.
C different ancestory.
D hindlimbs.

1.1.3 Scientists recovered the body of a woolly mammoth from the frozen soil of Siberia. The DNA sequence of the woolly mammoth was very similar to the DNA sequence of the African elephant.

Which ONE of the following is a possible conclusion from this data?

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

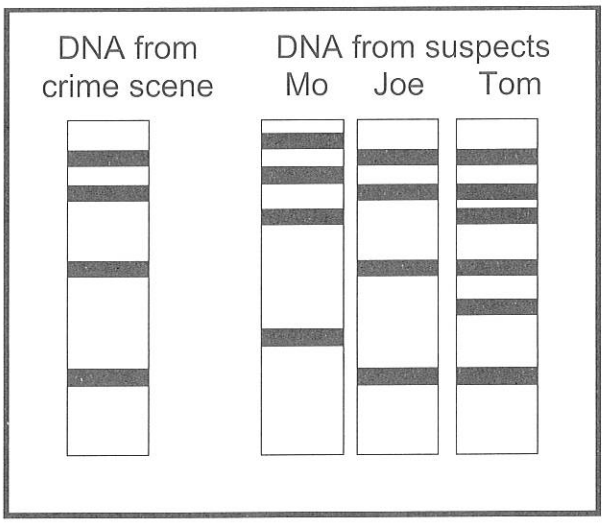
1.1.4 Which ONE of the following refers to the current-day distribution of species in the world?

A Biochemistry
B Biogeography
C Palaeontology
D Archaeology

1.1.5 When two parents which are both heterozygous for a trait are crossed, what are the chances of them having an offspring that is heterozygous for the same trait?

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

1.1.6 The diagram below shows the results of a particular procedure.



The procedure shown above is called …

A genetic modification.
B DNA replication.
C DNA profiling.
D cloning.

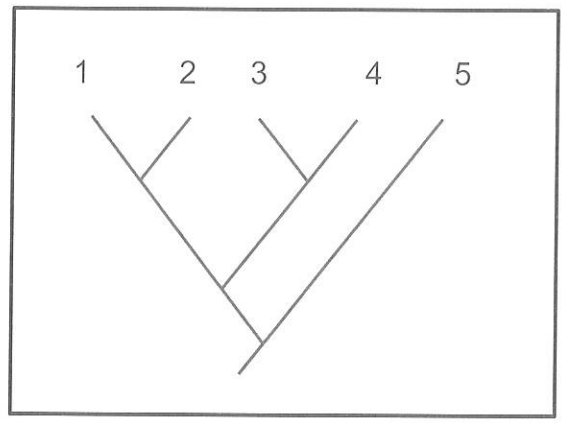
1.1.7 The nitrogenous base sequence below represents a small portion of a nucleic acid molecule:

A G C U C G U U

From this data it is reasonable to conclude that …

A this portion of nucleic acid will code for a chain of eight amino acids.
B the sequence given will be complementary to the sequence C T C G T G C T on tRNA.
C the nucleic acid shown contains the sugar ribose.
D the nucleic acid shown is DNA.

1.1.8 Study the phylogenetic tree below.



Which ONE of the following is a reasonable conclusion based on the phylogenetic tree?

A **1** and **2** belong to the same species
B **3** is more closely related to **4** than to **5**
C **1** and **5** do not have a common ancestor
D The DNA of **1** will be more similar to **4** than to **2**

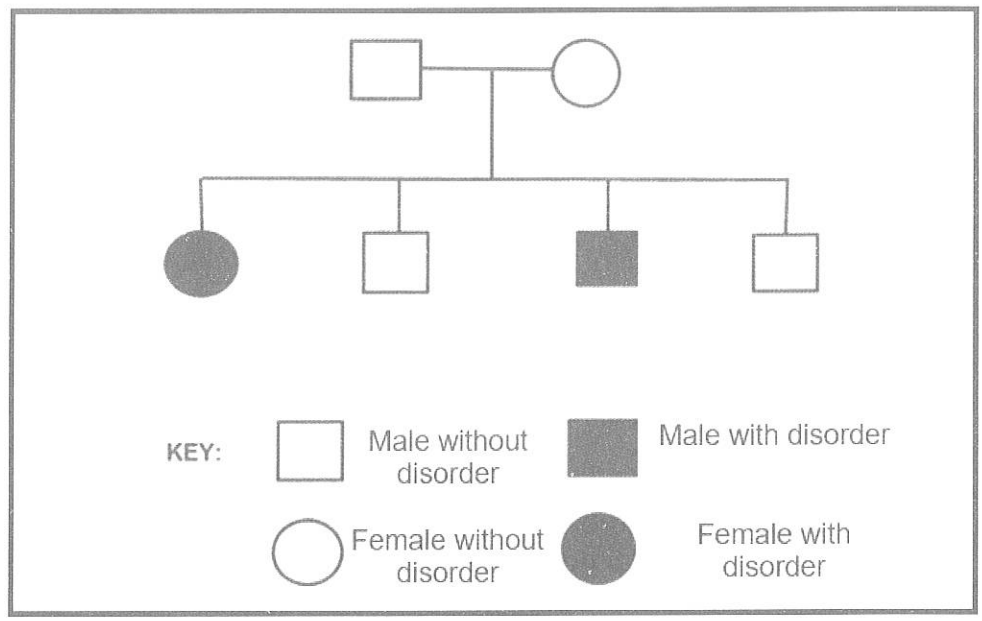
1.1.9 Below is a list of steps involved in DNA replication.

(i) The two strands separate
(ii) Free nucleotides from the nucleoplasm come to pair with their complementary bases on the template strands
(iii) Weak hydrogen bonds break
(iv) Two identical molecules are formed

Which ONE of the combinations below is the correct sequence of these events?

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

1.1.10 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.**



The genotypes of the father and the mother respectively are …

A NN and nn.
B Nn and Nn.
C nn and nn.
D Nn and nn.

(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 An allele that influences the phenotype whether in a homozygous or heterozygous combination

1.2.2 The type of dominance where a black cow and a white bull produces a grey calf

1.2.3 A genetic cross involving two different characteristics

1.2.4 Three consecutive nitrogenous bases of a tRNA molecule

1.2.5 The condition of having protruding jaws

1.2.6 The type of chromosomes which determine the sex of a child

1.2.7 An explanation for something that has been observed in nature and which can be supported by facts, laws and tested hypotheses

1.2.8 The physical and/or functional expression of a gene

1.2.9 The type of variation that produces distinct phenotypes without a range of intermediate phenotypes

1.2.10 Individuals of the same species living together at the same time and capable of interbreeding

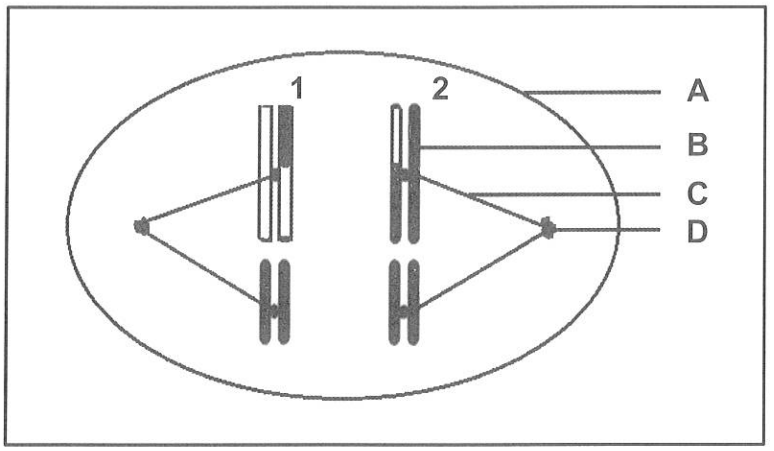
(10 x 1) **(10)**

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 1.3.5) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Genotype of blood group A	A: I^AI^A B: I^AI^B
1.3.2	Cytokinesis takes place	A: Telophase I B: Telophase II
1.3.3	Inheritance of colour blindness	A: Non-disjunction B: Sex-linked inheritance
1.3.4	Example of a fossil of *A. africanus*	A: Little foot B: Mrs Ples
1.3.5	Used in paternity testing	A: Blood grouping B: DNA profiling

(5 x 2) **(10)**

1.4 The diagram below shows a phase in meiosis.



1.4.1 Identify the phase of meiosis represented in the diagram. (1)

1.4.2 Provide ONE visible reason for your answer to Question 1.4.1. (1)

1.4.3 Provide labels for **A, B, C** and **D**. (4)

1.4.4 Name the mechanism that led to the difference in appearance of chromosomes **1** and **2**. (1)

1.4.5 State the significance of the mechanism named in Question 1.4.4. (1)

1.4.6 State TWO places in a plant where meiosis will take place. (2)

(10)

TOTAL SECTION A: 50

SECTION B

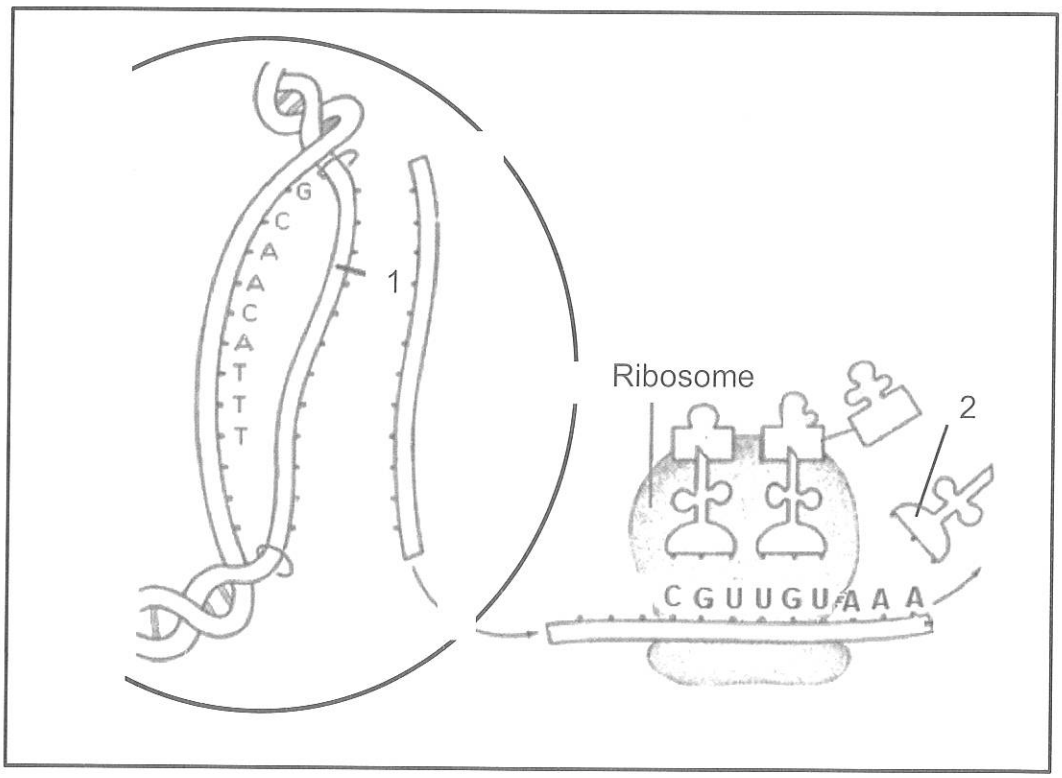
QUESTION 2

2.1 DNA undergoes replication before meiosis.

2.1.1 Describe DNA replication. (6)

2.1.2 State TWO ways in which DNA replication is important. (2)
(8)

2.2 The diagram below represents stages of protein synthesis.



2.2.1 Identify molecule **2**. (1)

2.2.2 If strand **1** was a template strand for protein synthesis, write down the corresponding anti-codons from top to bottom. (3)

2.2.3 Name and describe the stage of protein synthesis that occurs at the ribosome. (6)
(10)

2.3 A group of Grade 12 learners in a school were asked to conduct a survey to determine whether right handedness or left handedness is more common amongst learners in the FET phase.

Handedness is the dominance of one hand over the other.

As part of planning, the learners did the following:

- Asked permission from the principal
- Collected recording material
- Decided on the recording method

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

	Handedness			
	Right handedness		Left handedness	
Gender	BOYS	GIRLS	BOYS	GIRLS
Number of learners	120	160	80	40

2.3.1 State any other TWO planning steps for this investigation. (2)

2.3.2 State a conclusion for this investigation. (2)

2.3.3 Draw a bar graph to represent the information in the table. (6)
(10)

2.4 In rabbits, long ears is controlled by a dominant allele (**E**) and short ears is controlled by a recessive allele (**e**).

Short fur is controlled by a dominant allele (**T**) and long fur is controlled by a recessive allele (**t**).

A breeder crossed rabbit **A** with short ears and heterozygous for short fur with rabbit **B** which was heterozygous for both long ears and short fur.

The phenotypic ratio was:

3 long ears and short fur
1 long ears and long fur
3 short ears and short fur
1 short ears and long fur

2.4.1 Write down the genotype of rabbit **B.** (2)

2.4.2 Write down all the possible genotypes of the gametes produced by rabbit **A**. (2)

2.4.3 If 25 offspring were produced, how many rabbits are likely to have short ears with short fur amongst the offspring? Show ALL working. (2)
(6)

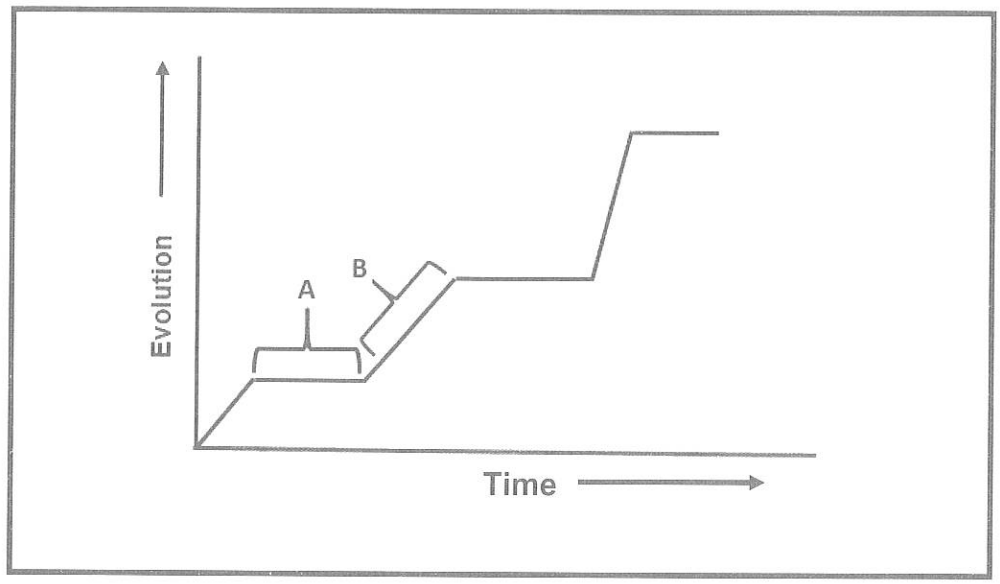
2.5 A female who is not colour blind but who has one allele for colour blindness marries a male who is not colour blind.

Use a genetic cross to show all possible genotypes and phenotypes of their children. Use the alleles **N** for normal and **n** for colour-blindness. **(6)**

[40]

QUESTION 3

3.1 The graph below shows the speed at which evolution occurs in a species of butterfly.



3.1.1 Explain the trend in evolution represented by:

(a) Phase **A** (2)

(b) Phase **B** (2)

3.1.2 In view of the trend represented by **A** and **B**, what type of evolution is represented by the graph? (1)

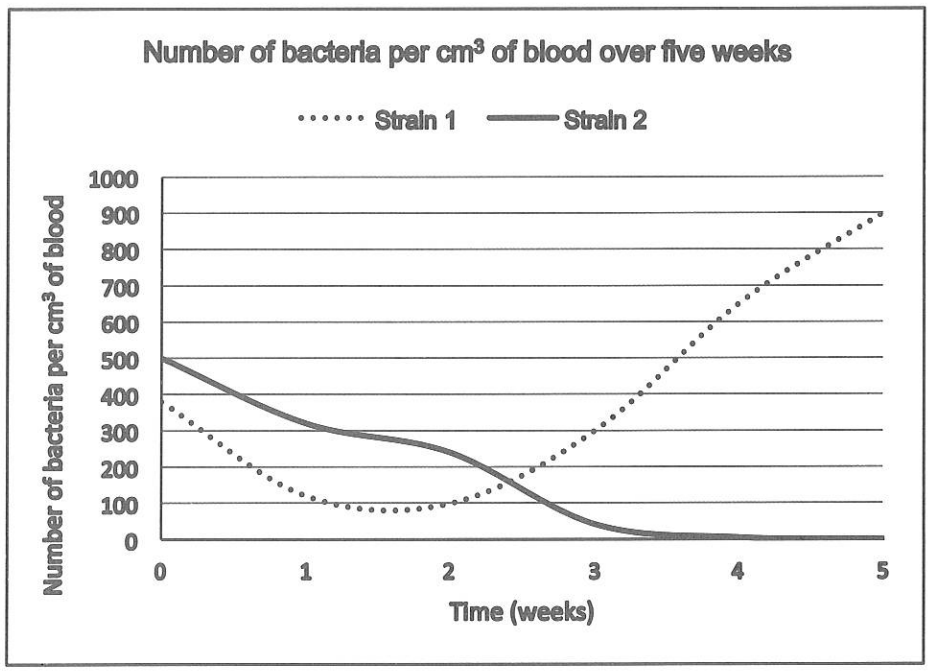
3.1.3 Explain why the chances of speciation are great during phase **B.** (2)

(7)

3.2 A species of bacterium had two strains, Strain **1** and Strain **2**. A patient, infected by this bacterium, was treated with an antibiotic that was taken daily for 5 weeks.

To determine the effectiveness of the antibiotic, the investigator monitored the patient by measuring the number of each bacterial strain present in the blood samples on a weekly basis.

The graph below represents the results obtained.



3.2.1 What was the:

(a) Highest number of strain **2** bacteria recorded for the patient (1)

(b) Number of strain **1** bacteria at the end of 3 weeks (1)

3.2.2 Explain the trend for strain **1** in the first week. (2)

3.2.3 Use your knowledge of natural selection to explain the trends shown by both strains after the first **2** weeks? (6)

3.2.4 State THREE factors that the investigator could have kept constant in this investigation. (3)
(13)

3.3 Genetic modification is sometimes used to develop crop plants that are herbicide resistant.

3.3.1 Describe the steps involved in genetic modification. (4)

3.3.2 Explain ONE advantage for a farmer to have herbicide-resistant crops. (2)

3.3.3 State TWO advantages of genetic modification in crop production other than for the development of herbicide-resistant crops. (2)
(8)

3.4 The trend in human evolution has been towards bipedalism.

3.4.1 List THREE structural features of *Homo sapiens* that are characteristic of bipedalism. (3)

3.4.2 List THREE similarities between the forelimb of the human and the African ape. (3)

3.4.3 Explain why a well-developed brow-ridge in the skull is generally associated with an organism that feeds on hard, raw food. (2)
(8)

3.5 Describe TWO lines of evidence used to support the "Out of Africa" hypothesis. **(4)**
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe how Lamarck would have explained the evolution of flightless birds. Also describe how a population of flightless birds may undergo speciation through geographic isolation and the way in which any THREE reproductive isolating mechanisms may keep the new species separate.

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

Education

KwaZulu-Natal Department of Education

LIFE SCIENCES P2

PREPARATORY EXAMINATION

FINAL MEMORANDUM - SEPTEMBER 2018

NATIONAL
SENIOR CERTIFICATE

GRADE 12

MARKS: 150

This memorandum consists of 10 pages.

 Please turn over

PRINCIPLES RELATED TO MARKING LIFE SCIENCES

1. **If more information than marks allocated is given**
   Stop marking when maximum marks is reached and put a wavy line and 'max' in the right-hand margin.
2. **If, for example, three reasons are required and five are given**
   Mark the first three irrespective of whether all or some are correct/incorrect.
3. **If whole process is given when only a part of it is required**
   Read all and credit the relevant part.
4. **If comparisons are asked for, but descriptions are given**
   Accept if the differences/similarities are clear.
5. **If tabulation is required, but paragraphs are given**
   Candidates will lose marks for not tabulating.
6. **If diagrams are given with annotations when descriptions are required**
   Candidates will lose marks.
7. **If flow charts are given instead of descriptions**
   Candidates will lose marks.
8. **If sequence is muddled and links do not make sense**
   Where sequence and links are correct, credit. Where sequence and links are incorrect, do not credit. If sequence and links become correct again, resume credit.
9. **Non-recognised abbreviations**
   Accept if first defined in answer. If not defined, do not credit the unrecognised abbreviation, but credit the rest of the answer if correct.
10. **Wrong numbering**
    If answer fits into the correct sequence of questions, but the wrong number is given, it is acceptable.
11. **If language used changes the intended meaning**
    Do not accept.
12. **Spelling errors**
    If recognisable, accept the answer, provided it does not mean something else in Life Sciences or if it is out of context.
13. **If common names are given in terminology**
    Accept, provided it was accepted at the national memo discussion meeting.
14. **If only the letter is asked for, but only the name is given (and vice versa)**
    Do not credit.
15. **If units are not given in measurements**
    Candidates will lose marks. Memorandum will allocate marks for units separately.
16. **Be sensitive to the sense of an answer, which may be stated in a different way.**
17. **Caption**
    All illustrations (diagrams, graphs, tables, etc.) must have a caption.

SECTION A

QUESTION 1

1.1	1.1.1	A ✓✓		
	1.1.2	B ✓✓		
	1.1.3	A ✓✓		
	1.1.4	B ✓✓		
	1.1.5	C ✓✓		
	1.1.6	C ✓✓		
	1.1.7	C ✓✓		
	1.1.8	B ✓✓		
	1.1.9	D ✓✓		
	1.1.10	B ✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Dominant✓		
	1.2.2	Incomplete✓dominance		
	1.2.3	Dihybrid✓cross		
	1.2.4	Anti-codon✓		
	1.2.5	Prognathism✓/prognathous		
	1.2.6	Gonosomes✓		
	1.2.7	Theory✓		
	1.2.8	Phenotype✓		
	1.2.9	Discontinuous✓variation		
	1.2.10	Population✓		**(10)**
1.3	1.3.1	A only✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	B only✓✓		
	1.3.4	Both A and B✓✓ / B only		
	1.3.5	Both A and B✓✓	5 x 2	**(10)**
1.4	1.4.1	Anaphase I✓		(1)
	1.4.2	Chromosomes are moving apart✓/to the opposite poles. **(Mark the FIRST ONE only)**		(1)
	1.4.3	A – Cell membrane✓ B – Chromatid✓ C – Spindle fibre✓/thread D – Centriole✓		(4)
	1.4.4	Crossing over✓		(1)
	1.4.5	Brings about genetic variation✓		(1)
	1.4.6	- Anther✓ - Ovary✓/ ovule **(Mark the FIRST TWO only)**		(2) **(10)**

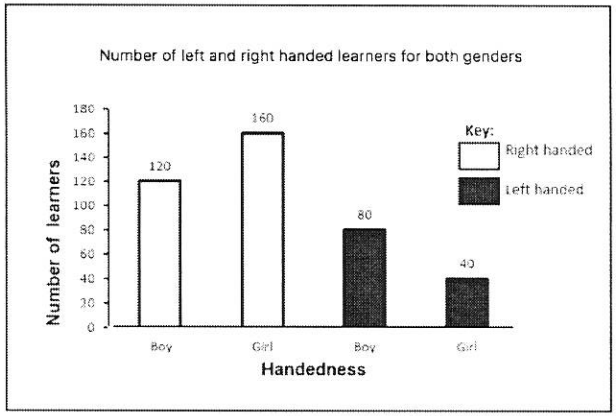
TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1	2.1.1	- The DNA molecule unwinds✓ - Weak 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✓/ A-T and C-G - Two identical DNA molecules are formed✓ - This process is controlled by enzymes✓	Any	(6)
	2.1.2	- To ensure that daughter cells have identical DNA✓ - To ensure that DNA is shared equally amongst daughter cells✓ **(Mark the first TWO only)**		(2) **(8)**
2.2	2.2.1	tRNA✓		(1)
	2.2.2	CGU✓ - UGU✓ - AAA✓		(3)
	2.2.3	Translation✓* - According to the codons on the mRNA✓ - tRNA with its complementary anti-codons✓ - brings the required amino acid✓ - to the ribosome✓ - Amino acids are joined together by peptide bonds✓ - to form a specific protein✓	1 compulsory* + any 5 other	(6) **(10)**
2.3	2.3.1	- Ask for permission from participants✓ - Decide on the sample size✓ - Decide on the method to collect the information✓ - Decide on the venue to be used✓ - Decide on the date and time to conduct the investigation✓ **(Mark the first TWO only)**		(2)
	2.3.2	There are more right handed than left handed learners✓✓		(2)

2.3.3

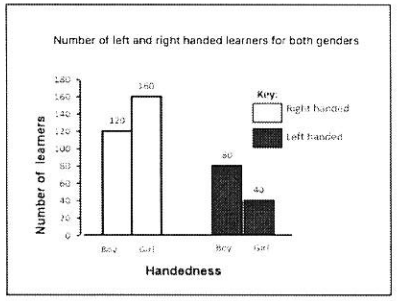


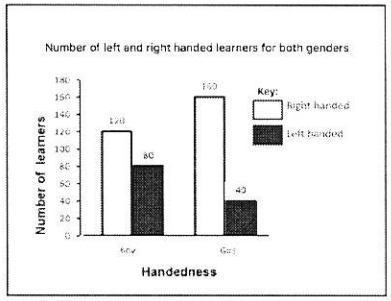
Mark allocation for the graph

Criteria	Mark allocation
Correct type of graph (bars not in contact)	1
Title/Caption of the graph	1
Correct scale for X-axis and Y-axis	1
Correct label for X-axis and Y-axis	1
Drawing of the graph	0: No bars plotted correctly 1: 1 to 3 bars plotted correctly 2: All 4 bars plotted correctly

(6)
(10)

The following graphs may also be accepted.





2.4 2.4.1 EeTt ✓✓ (2)

2.4.2 eT✓and et ✓ (2)

2.4.3 $\frac{3}{8}$ ×25✓= 9 ✓rabbits (2)
(6)

2.5 P_1 Phenotype: Normal female × Normal male ✓
Genotype: X^NX^n × X^NY ✓
Meiosis
G/Gametes: X^N, X^n × X^N, Y ✓
Fertilisation

F_1 Genotype: X^NX^N X^NY X^NX^n X^nY ✓
Phenotype: normal female; normal male; normal female; colour-blind male ✓

P_1 and F_1✓
Meiosis and fertilisation✓

Any 6

OR

P_1 Phenotype: Normal female × Normal male ✓
Genotype: X^NX^n × X^NY ✓
Meiosis

Fertilisation

F_1 Phenotype

Gametes	X^N	X^n
X^N	X^NX^N	X^NX^n
Y	X^NY	X^nY

✓(correct gametes)
✓ (correct genotype)

2 normal females, 1 normal male and 1 colour-blind male✓

P_1 and F_1✓
Meiosis and fertilisation✓

Any 6 **(6)**
[40]

QUESTION 3

3.1 3.1.1 (a)
- Organisms do not change for a long period of time✓/no evolution
- due to stable environment✓ (2)

(b)
- Organisms change rapidly in a short period of time✓/increased evolution
- due to changing conditions in the environment✓ (2)

3.1.2 Punctuated equilibrium✓ (1)

3.1.3
- Rapid changes occur✓/new populations vary greatly from the original population
- As a result the new population cannot reproduce with the original population✓ (2)
(7)

3.2 3.2.1 (a) 500✓ per cm^3 of blood (1)

(b) 300✓ per cm^3 of blood (1)

3.2.2
- The number of bacteria decreased✓
- since they were killed/destroyed by antibiotics✓ (2)

3.2.3
- The bacterial population showed a great deal of variation✓
- Strain 2 was not resistant✓ to the antibiotic
- and were therefore eliminated✓
- Strain 1 was resistant✓ to the antibiotic
- and therefore survived✓
- and reproduced✓
- to pass the alleles for resistance to their offspring✓
- thus increasing the number of strain1 bacteria✓ in subsequent generations

Any 6 (6)

3.2.4
- Same instrument must be used✓
- Samples must be taken at the same time of the day✓
- Same person must take the measurements✓
- Same amount of blood sampled✓
- Same method of taking antibiotics✓

(Mark the first THREE only)

Any 3 (3)
(13)

3.3 3.3.1
- Desired gene/ herbicide resistant gene is identified✓
- It is extracted✓ from a donor organism
- It is then inserted into another organism✓/crop plant
- which then displays the desired characteristics✓/ herbicide resistance (4)

3.3.2
- When herbicides are applied to kill weeds✓
- the crop plant will not be affected✓ (2)

(Mark the first ONE only)

3.3.3
- Produce crops that are resistant to adverse conditions✓/drought/ disease/pests
- Increase crop yield ✓
- Change the time for the ripening of fruits✓
- Increase shelf life of plant products✓ (2)

(Mark the first TWO only)

(8)

3.4 3.4.1
- A more forward foramen magnum✓
- A broad and short pelvis✓
- An S-shaped spine✓ (3)

(Mark the first THREE only)

3.4.2
- Freely rotating arms✓
- Long upper arm✓
- Rotation at the elbow✓
- Opposable thumbs✓
- Five fingers✓
- Bare finger-tips✓/nails instead of claws (3)

(Mark the first THREE only)

3.4.3
- The brow ridge strengthens the skull✓
- to prevent damage from the action of the large jaws✓/muscles

Any 2 (2)
(8)

3.5
- The analysis of mutations on the mitochondrial DNA✓
- shows that all modern humans evolved from a female ancestor that lived in Africa✓

AND

- Fossils of *Ardipithecus*✓*/Australopithecus/Homo habilis*
- have been found in Africa only✓

OR

- The oldest fossils of *Homo erectus*✓*/Homo sapiens*
- were found in Africa✓ Any (1 × 2)

(Mark the first TWO only) **(4)**
[40]

SECTION C

QUESTION 4

Lamarckism (L)

- The ancestral birds could fly✓
- Due to abundance of resources in their immediate environment✓
- they did not fly often✓/used their wings less
- causing a decrease in wing size✓/ resulting in them losing their ability to fly
- which was inherited by the offspring✓
- who were born unable to fly✓

Any 5

Speciation (S)

- The original population became separated✓ by a geographical barrier
- There was no gene flow between the sub-populations✓
- Each population was exposed to different environmental conditions✓
- They underwent natural selection independently✓ in each population
- and the individuals of each population became different from each other✓
- genotypically and phenotypically✓
- even if the sub-populations were to mix again✓
- they would not be able to interbreed✓/reproduce with each other
- meaning they have become different species✓

Any 6

Reproductive isolating mechanisms (R)

- Breeding at different times of the year✓/when two species breed during different seasons
- then when one species is reproductively active the other is not✓

- Species-specific courtship behaviour✓/as a result of a slight difference in the courtship behaviour
- One species will not be able to attract a mating partner from the other species✓

- Prevention of fertilisation✓/gametes of the different species fail to fuse
- as a result of a difference in chromosome number✓/incompatibility of reproductive organs

- Infertile offspring may be produced✓ when two species reproduce
- that are not capable of producing the next generation✓

Any (3 × 2)
Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance	Logical sequence	Comprehensive
All information provided is relevant to the topic	Ideas arranged in a logical/ cause-effect sequence	Answered all aspects required by the essay in sufficient detail
Only information relevant to - Lamarckism - speciation and - reproductive isolating mechanisms is given No irrelevant information included.	The explanation of - Lamarckism, - speciation and - reproductive isolating mechanism is given in a logical and sequential manner	At least the following marks must be obtained: - Lamarckism = 3/5 - Speciation = 4/6 - Reproductive isolating mechanisms = 4/6
1 mark	1 mark	1 mark

TOTAL SECTION C: 20
GRAND TOTAL: 150