education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

PREPARATORY EXAMINATION

SEPTEMBER 2020

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the 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. Do 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 may use a non-programmable calculator, protractor and a compass.
11. Write neatly and legibly.

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SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A 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 Which ONE of the following represents molecules that make up a single nucleotide?

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

1.1.2 Which of the following refers to the specific position of a gene on a chromosome?

A Allele
B Locus
C Genome
D Karyotype

1.1.3 In plants, tall is a dominant characteristic over short.

If two heterozygous tall plants are crossed, what is the chance of them having an offspring that is short?

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

1.1.4 The table below shows the differences between DNA and RNA.

	DNA	RNA
(i)	It is double-stranded	It is single-stranded
(ii)	It has uracil	It has thymine
(iii)	It has deoxyribose sugar	It has ribose sugar

Which ONE of the following represents differences between the DNA and RNA?

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

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1.1.5 Which ONE of the following is most likely the chromosome compliment of a normal person?

A 46 and XX
B 46 and XY
C 45 and XX
D 44 and XY

1.1.6 When a homozygous red bull is crossed with a white cow, the offspring are all roan (red and white fur together. This type of inheritance is known as ...

A co-dominance.
B incomplete dominance.
C Complete dominance.
D multiple alleles.

1.1.7 Steps in the process of cloning an organism are provided below.

(i) The embryo is implanted into the uterus of organism A
(ii) An ovum is removed from organism A
(iii) The nucleus of a donor cell from organism B is inserted into the ovum
(iv) The cell is stimulated to divide

Which ONE of the following represents the correct order of steps?

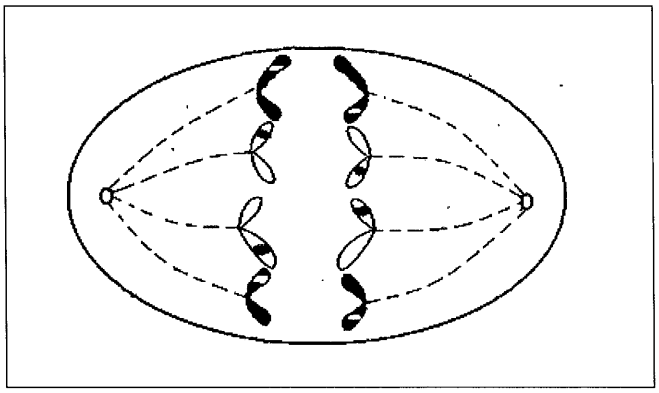
A (i), (ii), (iii), (iv)
B (i), (iii), (ii), (iv)
C (ii), (iv), (i), (iii)
D (ii), (iii), (iv), (i)

1.1.8 Which ONE of the following is only expressed in the homozygous state.

A Gene
B Dominant allele
C Recessive allele
D Genome

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1.1.9 Which phase and type of cell division are illustrated in the following diagram?



A Anaphase II of meiosis
B Metaphase II of meiosis
C Anaphase I of meiosis
D Anaphase of mitosis

(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 1.2.10) in the ANSWER BOOK.

1.2.1 Tangled network of chromosomes located within the nucleus

1.2.2 The strand of DNA used to form another strand of DNA

1.2.3 The bonds formed between DNA nitrogenous bases

1.2.4 The splitting of the cytoplasm during cell division

1.2.5 Chromosome condition of a cell having two sets of chromosomes

1.2.6 The chromosomes that control all body characteristics except sex characteristics

1.2.7 A segment of a chromosome that codes for a particular protein

1.2.8 More than two different alleles for the same gene

1.2.9 The use of biological process to manufacture products intended to improve the quality of human life

1.2.10 The external appearance of an organism

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

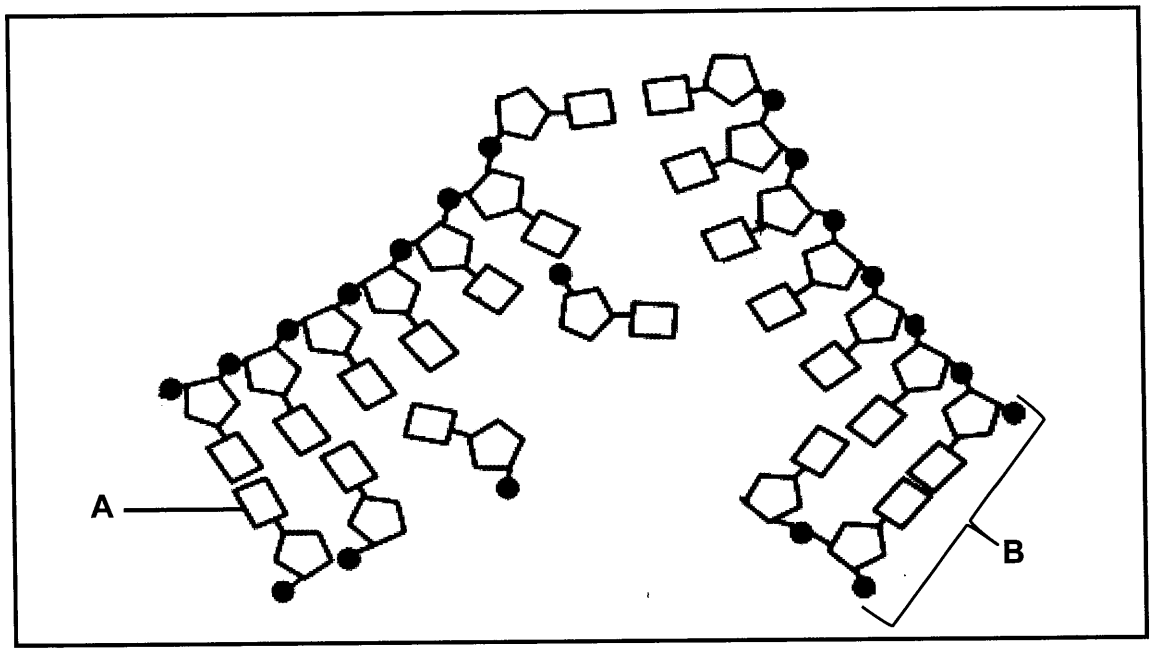
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1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B or NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B,** or **none** next to the question number (1.3.1 to 1.3.3)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

	COLUMN I	**COLUMN II**
1.3.1	Discovered the structure of DNA	A: Crick B: Watson
1.3.2	An alternative form of a gene found at the same locus	A: Genome B: Allele
1.3.3	Example of discontinuous variation	A: Blood groups B: Height

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

1.4 The diagram below represents DNA replication.



1.4.1 Name the phase in which the process shown in the diagram above occurs. (1)

1.4.2 Identify:

(a) Part **A** (1)

(b) Molecule **B** (1)

1.4.3 What is the natural shape of the molecule mentioned in QUESTION 1.4.2 (b)? (1)

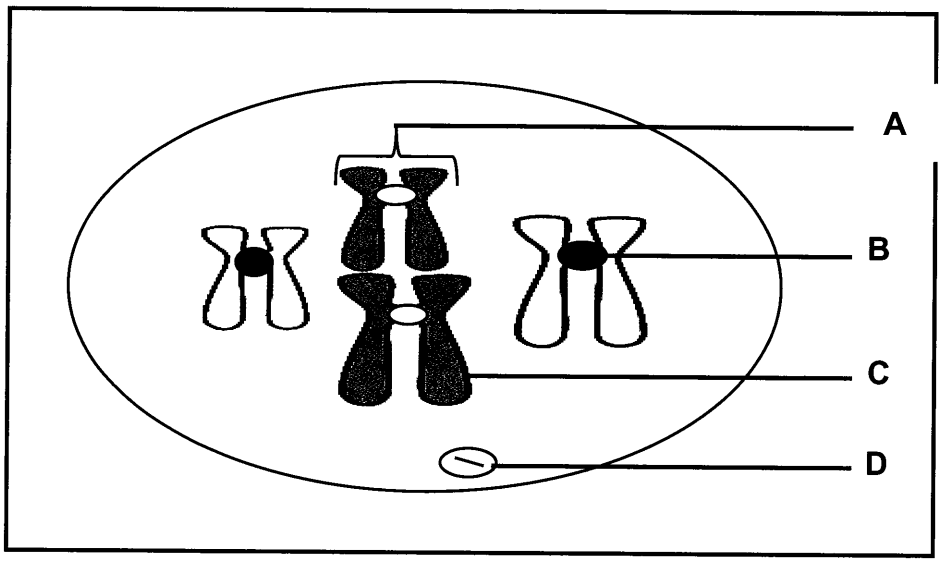
1.4.4 Name the protein that controls the process shown in the diagram above. (1)

1.4.5 State the importance of the process shown in the diagram above. (1)

1.4.6 Name TWO locations of DNA molecule in a human cell. (2)
(8)

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1.5 The diagram below represents a cell before meiosis I.



1.5.1 Identify part:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

1.5.2 Give the number of:

(a) Chromosomes that will be present at the end of meiosis I in each cell. (1)

(b) Chromatids that will be present at the beginning of metaphase II in each cell. (1)

1.5.3 Part **D** in the diagram above is the centrosome.

State the role of part **D** during meiosis. (1)

1.5.4 Name the process in meiosis during which genetic material is exchanged. (1)

1.5.5 State the organ in females where meiosis occurs. (1)
(8)

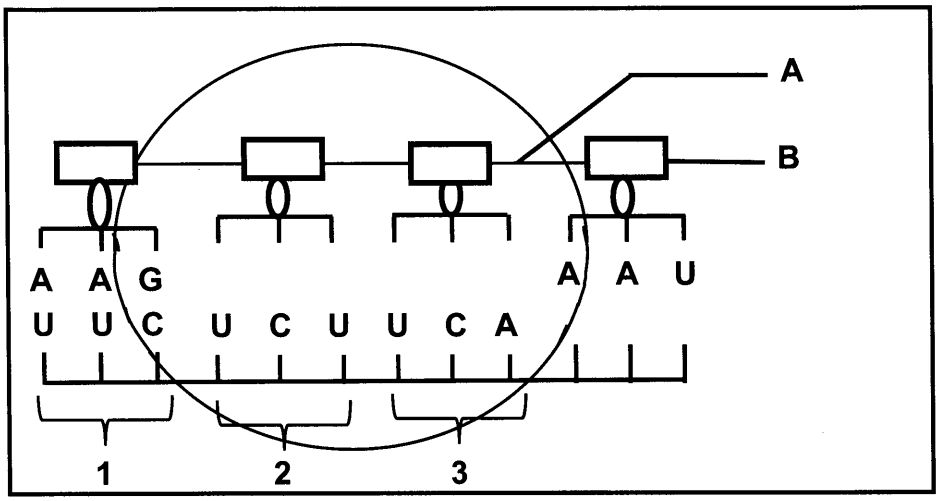
TOTAL SECTION A: 50

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SECTION B

QUESTION 2

2.1 The **diagram** below shows a stage in protein synthesis.



The **table** below shows the tRNA molecules that code for different amino acids.

ACU, ACC, ACA, ACG – Threonine	AAU, AAC – Asparagine AAA, AAG – Lysine	AGU, AGC – Serine AGA, AGG – Arginine

2.1.1 Identify:

(a) Bond **A** (1)

(b) Molecule **B** (1)

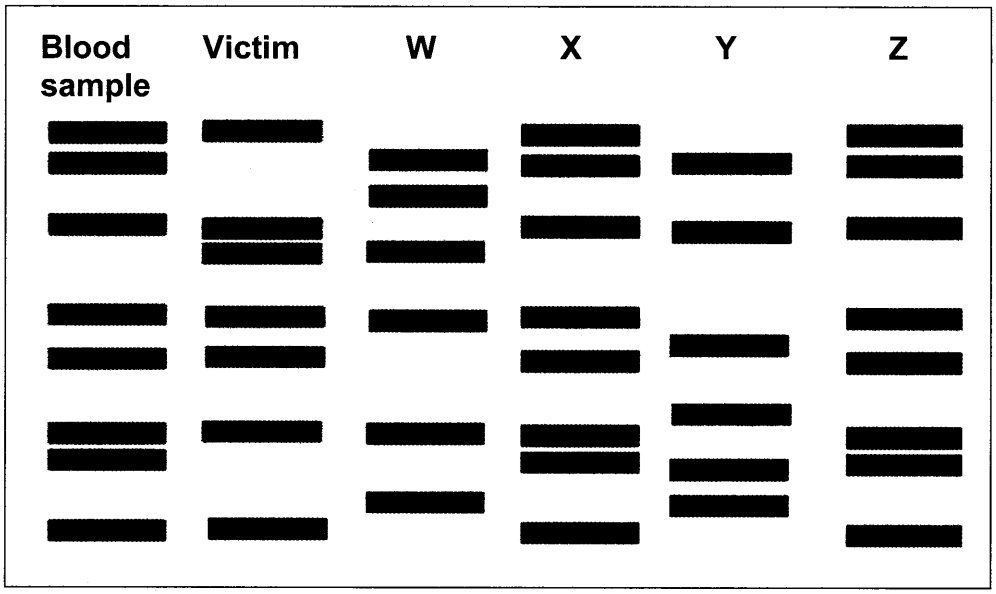
2.1.2 Write down the mRNA codon that codes for asparagine in the diagram. (1)

2.1.3 In codon **3**, guanine was replaced by cytosine as a result of a mutation.

Explain how this mutation will affect the protein that will be formed. (3)
(6)

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

2.3 Study the diagram below which shows the DNA profile of blood sample found in the crime scene, victim and suspect **W**, **X** ,**Y** and **Z**.



2.3.1 Explain what could be the conclusion about the DNA profile of suspects **X** and **Z**. (3)

2.3.2 Give ONE reason why DNA profiling is preferred in solving crimes. (1)

2.3.3 Name THREE benefits of DNA profiling other than for solving crimes. (3)
(7)

2.4 Haemophilia is an inherited sex-linked disorder caused by a recessive allele **h** on X chromosome. A man with haemophilia cannot pass it on to his son.

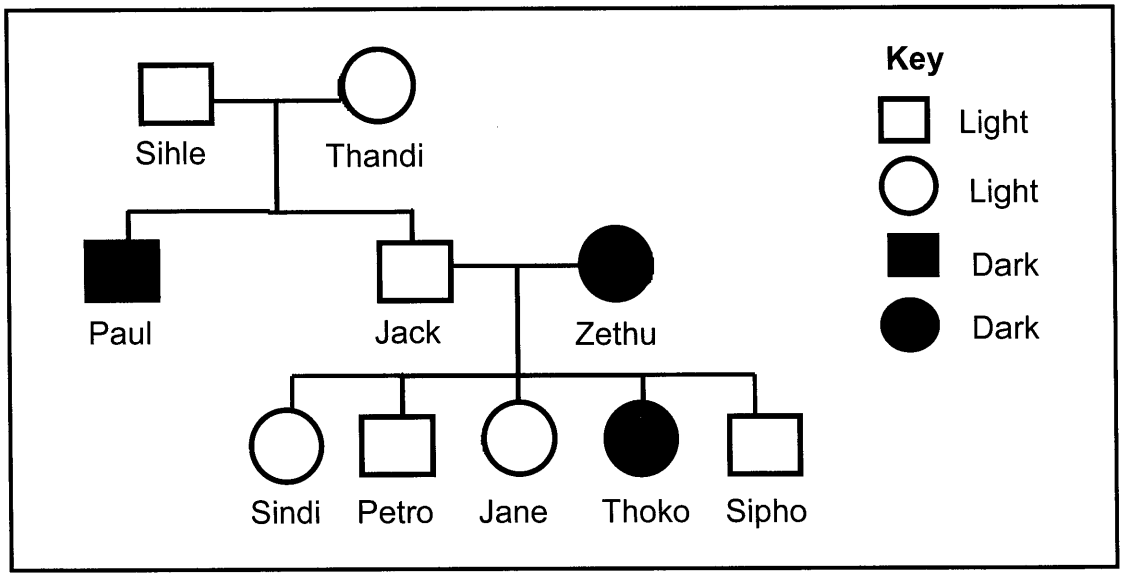
2.4.1 Explain why a man with haemophilia cannot pass it on to his son. (3)

2.4.2 A normal female and normal male are married.

Do a genetic cross to show how they would have a son that is haemophiliac. (6)
(9)

2.5 The light skin colour is controlled by a dominant allele **D**. Jack is homozygous for the skin colour.

The diagram below shows the inheritance of the skin colour in a family.



2.5.1 Define *homozygous*. (2)

2.5.2 Give the possible genotype of:

(a) Paul (1)

(b) Sindi (1)

2.5.3 Thandi is expecting her third child before the end of the year.

What is the percentage chance of her giving birth to an offspring with a dark skin colour? (2)

2.5.4 Explain why the offspring will always be light if he/she inherits two different alleles for the skin colour. (2)

2.5.5 Identify the child that is adopted by Jack and Zethu. (1)

2.5.6 Give a reason for your answer in QUESTION 2.5.5. (3)
(12)
[40]

QUESTION 3

3.1 Read the passage below.

GENETICALLY MODIFIED CROPS

Genetically modified (GM) crops were planted on 175 million hectares in 2013. In 2014, about 181.5 million hectares of genetically modified crops were planted in 28 countries. The GM crops planted were either herbicide tolerant, insect resistant or drought tolerant.

The table below shows the percentage of vegetable yield in different GM crops.

GENITICALLY MODIFIED CROPS	VEGETABLE YIELD (%)
Maize	30
Canola	5
Cotton	14
Soybean	50
Other	1

3.1.1 Which TWO GM crops in the table are the least successful amongst the 28 countries? (2)

3.1.2 Give ONE evidence from the passage suggesting that GM crops may withstand climate change due to genetic modification. (1)

3.1.3 Calculate the difference increase of the GM crops 2013 to 2014. (2)

3.1.4 Explain TWO objections to genetically modified crops. (4)

3.1.5 Draw a bar graph to show the THREE highest percentage of vegetable yield of genetically modified crops. (6)
(15)

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3.2 In humans, blood groups are coded by more than two alleles.

Richard has blood type AB and his daughter Nomzamo has the genotype I^Bi. Richard's wife Nosipho has blood type A.

3.2.1 How many alleles code for the blood groups? (1)

3.2.2 State the:

(a) Phenotype of Nomzamo (1)

(b) Genotype of Nosipho (1)

(c) Possible genotypes of other Richard's offspring (3)
(6)

3.3 In prickly pear fruit, the allele for long leaves (**R**) is dominant over the allele for short leaves and the allele for thick cuticle (**T**) is dominant over the allele for thin cuticle (**t**).

Plant **1** with heterozygous long leaves and thin cuticle was crossed with plant **2** with the genotype **RrTt**.

3.3.1 Name the type of crossing between plant **1** and **2**. (1)

3.3.2 Write down all the possible gametes of plant **1**. (2)

3.3.3 State Mendel's law that ensures the presence of one allele for a characteristic in the gamete. (1)

3.3.4 Write down the phenotype of plant **2**. (1)

3.3.5 What is the expected phenotypic ratio of the offspring in a cross between plant **1** and **2**? (2)
(7)

3.4 Tabulate TWO differences between artificial selection and natural selection. **(5)**

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3.5 Read the extract below.

Certain vegetable crops are eaten by insects, reducing the yield of vegetables. In order to control insects, farmers are forced to buy expensive insecticides. A certain insecticide was developed in an attempt to control insects. The insects with a higher resistance of insecticides survive and reproduce.

An investigation was carried out to determine the resistance of insects to insecticides.

The investigation was carried as follows:

- Vegetable crops were grown in ten separate plots of 100 m^2 greenhouse structures.
- Insects were introduced in all greenhouse structures.
- A solution of insecticides was sprayed once a month in all greenhouse structures.
- Insecticides were used for three seasons after the insects have developed resistance.
- The insect population was estimated before the use of insecticides.

3.5.1 Identify the dependent variable in the investigation. (1)

3.5.2 Explain what would be the expected results after the application of insecticides in greenhouse structures (2)

3.5.3 Give ONE reason why the vegetable crops were grown in greenhouse structures. (1)

3.5.4 Explain why the insect population was estimated before the use of insecticides in controlling insects. (2)

3.5.5 Give a reason for the use of insecticides for three seasons after insects have developed resistance. (1)
(7)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe the formation of a new species due to geographical barrier. Also describe how Darwin and Lamarck should have explained the evolution of thorns in honey locust tree.

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

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GRADE 12

LIFE SCIENCES-P2

PRELIMINARY EXAMINATION

SEPTEMBER 2020

MARKING GUIDELINE

MARKS: 150

This marking guideline consists of 11 pages.

F.M. MEMELA

A. Singh

PRINCIPLES RELATED TO MARKING LIFE SCIENCES 2020

1. **If more information than marks allocated is given**
   Stop marking when maximum marks are 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 part of it is required**
   Read all and credit relevant part.

4. **If comparisons are asked for and descriptions are given**
   Accept if 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 is incorrect, do not credit. If sequence and links becomes correct again, resume credit.

9. **Non-recognised abbreviations**
   Accept if first defined in answer. If not defined, do not credit the unrecognized abbreviation but credit the rest of 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 recognizable accept provided it does not mean something else in Life Sciences or if it is out of context.

13. **If common names given in terminology**
    Accept provided it was accepted at the National memo discussion meeting.

14. **If only letter is asked for and only name is given (and vice versa)**
    No credit

15. **If units are not given in measurements**
    Candidates will lose marks. Memorandum will allocate marks for units separately

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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

18. **Code-switching of official languages (terms and concepts)**
A single word or two that appears in any official language other than the learners' assessment language used to the greatest extent in his/her answers should be credited, if it is correct. A marker that is proficient in the relevant official language should be consulted. This is applicable to all official languages.

SECTION A

QUESTION 1

1.1	1.1.1	C✓✓		
	1.1.2	B✓✓		
	1.1.3	A✓✓		
	1.1.4	C✓✓		
	1.1.5	D✓✓		
	1.1.6	A✓✓		
	1.1.7	D✓✓		
	1.1.8	C✓✓		
	1.1.9	A✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Chromatin✓network		
	1.2.2	Template✓		
	1.2.3	Hydrogen✓ bonds		
	1.2.4	Cytokinesis✓		
	1.2.5	Diploid✓		
	1.2.6	Autosomes✓		
	1.2.7	Gene✓		
	1.2.8	Multiple alleles✓		
	1.2.9	Biotechnology✓		
	1.2.10	Phenotype✓		
			(10 x 1)	**(10)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	B only✓✓		
	1.3.3	A only✓✓		
			(3 x 2)	**(6)**
1.4	1.4.1	Interphase✓		(1)
	1.4.2	(a) Nitrogenous base✓		(1)
		(b) DNA✓ molecule		(1)
	1.4.3	Double helix✓		(1)
	1.4.4	Enzyme✓		(1)
	1.4.5	- Make identical copies of DNA✓ - Doubles the amount of DNA/genetic material	(any 1)	(1)
	1.4.6	- Nucleus✓ - Mitochondrion✓		(2)
		(Mark the first TWO only)		**(8)**

1.5	1.5.1	(a) Chromosome✓	(1)
		(b) Centromere✓	(1)
		(c) Chromatid✓	(1)
	1.5.2	(a) 2✓	(1)
		(b) 4✓	(1)
	1.5.3	Forms spindle fibres✓	(1)
	1.5.4	Crossing over✓	(1)
	1.5.5	Ovary✓/ovule	(1)
			(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) Peptide✓bond (1)
(b) Amino acid✓/Asparagine (1)

2.1.2 UUA✓ (1)

2.1.3 -Threonine✓
- will be replaced by serine✓
- forming a different protein✓

OR

- UGA codes for threonine✓
- UCA codes for serine✓
- forming a different protein✓ (3)
(6)

2.2
- 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)**

2.3 2.3.1 - The DNA profiles are identical✓
- since the bars of the two DNA profiles match✓ (2)

***(question has been allocated 2 marks)**

2.3.2 - DNA of each individual is unique✓
- It leads to greater convictions✓ (Any) (1)

(Mark the first ONE only)

2.3.3 - Paternity testing✓
- Identify relatives✓/individuals
- Find inherited disorders✓
- Develop cures for inherited disorders✓ Any (3)

(Mark the first THREE only) **(7)**

2.4 2.4.1 - Man has one X and Y chromosome✓
- and will only pass the Y chromosome to the son✓
- the Y chromosome does not have an allele for haemophilia ✓ (3)

2.4.2 **P_1** Phenotype Normal female x Normal male✓
Genotype $X^H X^h$ x $X^H Y$✓

Meiosis
Gametes X^H, X^h x X^H, Y✓

Fertilisation

F_1 Genotype $X^H X^H$, $X^H Y$, $X^H X^h$, $X^h Y$✓

Phenotype 2 normal daughters, 1 normal son and 1 haemophiliac son✓

P_1 and F_1✓
Meiosis and fertilisation✓

OR

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

Meiosis

Fertilisation

F_1

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

1 mark for correct gametes
1 mark for correct genotypes

Phenotype 2 normal daughters, 1 normal son and 1 haemophiliac son✓

P_1 and F_1✓
Meiosis and fertilisation✓ (6)
(9)

2.5 2.5.1 Individual with two identical alleles for a particular characteristic✓✓ (2)

2.5.2 (a) dd✓ (1)
(b) Dd✓ (1)

2.5.3 25%✓✓ (2)

2.5.4 - Light skin colour is controlled by a dominant allele✓
- so a light skin colour allele shows up in a phenotype✓
- since it masks the recessive allele✓for dark skin colour Any (2)

2.5.5 Thoko✓ (1)

2.5.6 - Thoko is dark skinned✓
- requiring two recessive alleles✓
- but she can only receive one recessive allele from Zethu✓/ cannot receive any recessive allele from Jack (3)
(12)
[39]*

QUESTION 3

3.1 3.1.1 - Canola✓
- Other✓ (2)
(Mark the first TWO only)

3.1.2 Drought tolerant✓ (1)
(Mark the first ONE only)

3.1.3 181.5 m – 175m✓

= 6.5 m✓ (2)

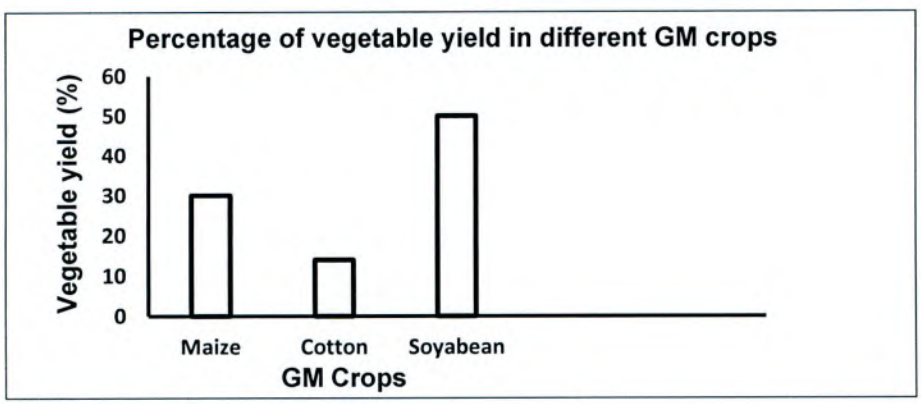
3.1.4 - There may be side-effects to eating GM crops✓
- which may be negative to human health✓ /may cause allergies

- Decreases biodiversity✓
- since habitats of indigenous species are removed to provide space for GM crops✓

- Undesired effect of the new gene on organisms✓
- which may be unpredictable and uncontrolled✓

- Genetically modified seeds are expensive✓
- increasing the cost of production for the farmer✓/food prices
(Mark the first TWO only) Any (2 x 2) (4)

3.1.5



Criteria for assessing the graph

Bar graph drawn (**T**)	1
Title of the graph shows the relationship between the two variables (**V**)	1
Correct label for X-axis and Y-axis (**L**)	1
Correct scale for X-axis(equal width and spacing of bars) and for Y-axis (**S**)	1
Drawing of bars (**B**)	1 (1 to 2 required bars correct) 2 (only the 3 required bars drawn and correct)

(6)
(15)

3.2 3.2.1 3✓ (1)

3.2.2 (a) blood type B✓ (1)
(b) I^Ai✓ (1)

(c) - I^AI^A✓
- I^Ai✓
- I^AI^B✓ (3)
(6)

3.3 3.3.1 Dihybrid cross✓ (1)

3.3.2 - Rt✓
- rt✓ (2)

3.3.3 Law of segregation✓ (1)

3.3.4 Long leaves and thick cuticle✓ (1)

3.3.5 3 long and thick:3 long and thin:1 short and thick:1 short and thin✓✓ (2)
(7)

T✓

3.4

Artificial selection	Natural selection
Human selects✓	Nature selects✓
Selection is in response to satisfying human needs✓	Selection is in response to suitability to the environment✓
Occurs within a selected species✓	Involve one or more species✓

(Mark the first TWO only) (2 x 2 + 1 mark for table) **(5)**
[33]*

TOTAL SECTION B: 72

SECTION C

QUESTION 4

Speciation (S)

- If a population of a single species becomes separated by a geographical barrier 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 (6)

Natural selection (Darwinism) (D)

- There is a variation in honey locust trees✓
- Some have thorns, others have no thorns✓
- Honey locust trees without thorns were eaten✓/died
- Honey locust trees with thorns were not eaten✓/survived
- and reproduced✓/passing on their alleles for presence of thorns to the next generation
- Honey locust trees with thorns increased✓ (6)

Lamarckism (L)

- The honey locust trees had small thorns✓/invisible
- They used thorns to defend themselves from herbivores✓
- Their thorns grew large✓
- and defended them from being eaten by herbivores✓
- and they passed on this characteristic to the next generation✓
- resulting in a greater proportion of honey locust trees with thorns✓ Any (5)

Content: 17
Synthesis: 3
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance	Logic sequence	Comprehensive
All information provided is relevant to the question	Ideas arranged in a logical cause-effect sequence	Answered all aspects required by the essay in sufficient detail
All the information provided is relevant to the: - Speciation - Natural selection/Darwinism - Larmackism No irrelevant information given	All the information regarding the: - Speciation - Natural selection/Darwinism - Larmackism Is arranged in a logical manner	At least the following points should be included: - Speciation 4/6 - Natural selection/ Darwinism 4/6 - Larmackism 3/5
1 mark	**1 mark**	**1 mark**

TOTAL SECTION C: 20
GRAND TOTAL: 150

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Mark adjustment as follows:

1-8	No change
9-26	Add 1
27-44	Add 2
45-62	Add 3
63-79	Add 4
80-97	Add 5
98-115	Add 6
116-133	Add 7
134-142	Add 8

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