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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

GRADE 12

LIFE SCIENCES P2

SEPTEMBER 2022

PREPARATORY EXAMINATION

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MARKS:150
TIME: 2½ HOURS

This question paper consists of 17 pages.

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in your ANSWER BOOK.
3. Begin the answers to each question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. ALL drawings should be done in pencil and labelled in blue or black ink.
7. Only draw diagrams or flow charts when asked to do so.
8. The diagrams in this question paper are NOT all drawn to scale.
9. Do NOT use graph paper.
10. Non-programmable calculators, protractors and compasses may be used.
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 correct answer and write only the letter (A–D) next to the question number (1.1.1 to 1.1.10) in your ANSWER BOOK, for example
1.1.11 D.

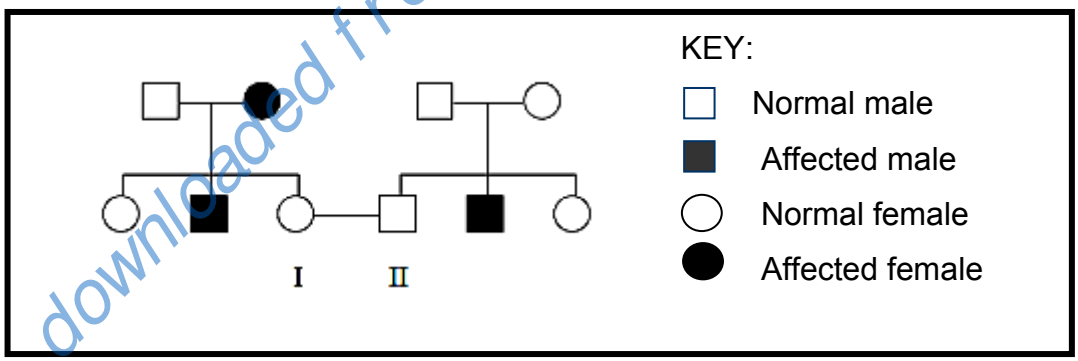
1.1.1 The sequence of nitrogenous bases UCA CGA ACC GCU AAC could represent ...

A a gene that codes for one protein.
B a DNA strand that codes for one mRNA molecule.
C a chain of five amino acids.
D an mRNA strand that codes for five amino acids.

1.1.2 A male who is homozygous for blood group A and a female with blood group B have children. Which ONE of the following genotypes is possible in the offspring?

A I^AI^A
B I^Ai
C ii
D I^Bi

1.1.3 Colour blindness is a sex-linked trait and is caused by a recessive allele on the X chromosome. The pedigree diagram below shows the inheritance of colour blindness in a family.



Persons I and II have a child. What is the chance that the child will be colour-blind?

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

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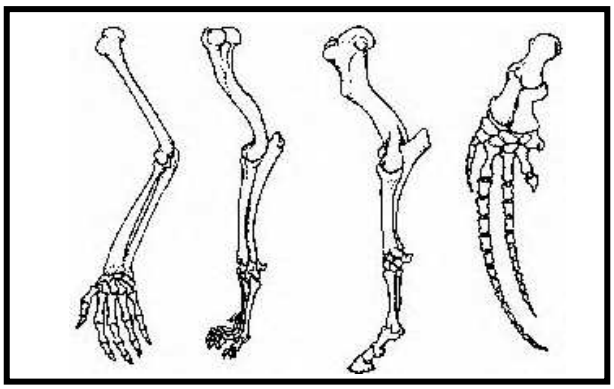
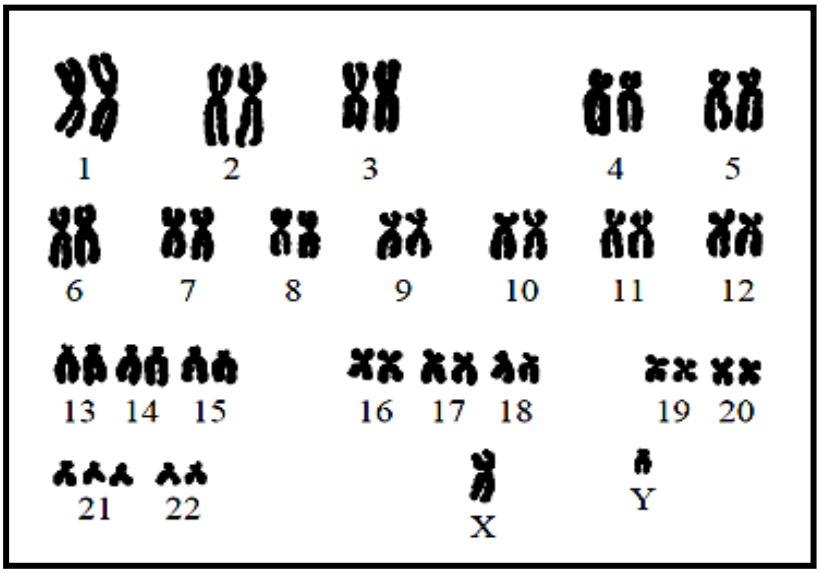
1.1.4 The diagrams below show the forelimbs of some vertebrates



The type of evidence for evolution represented is...

A fossil evidence
B biogeography.
C modification by descent
D genetic evidence

1.1.5 The diagram below shows a karyotype of a human. Which statement about this karyotype is correct?



A Non-disjunction has occurred, and the individual is male.
B Non-disjunction has not occurred, and the individual is female.
C Non-disjunction has not occurred, and the individual is male.
D Non-disjunction has occurred, and the individual is female.

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1.1.6 Changes to the genetic material of organisms can ONLY be inherited by the next generation if they ...

A occur in somatic cells.
B increase the survival chances of the species.
C occur in reproductive cells.
D increase the survival chances of an individual.

1.1.7 Below is a list of fossils discovered in South Africa:

1. Taung child
2. Little Foot
3. Karabo
4. Mrs Ples

Which of the fossils above are classified in the genus *Australopithecus*?

A 1, 2 and 3
B 1, 2, 3 and 4
C 2, 3 and 4
D 1, 3 and 4

1.1.8 DNA from the cells of an animal was analysed in a laboratory. The results are shown in the table below.

Nitrogenous Base Composition			
X	**Guanine**	**Y**	**Z**
23,4%	26,3%	26,7%	23,6%

Which of the following is a possible correct identification of the bases **X**, **Y** and **Z**?

	X	Y	Z
A	cytosine	adenine	thymine
B	thymine	adenine	cytosine
C	adenine	cytosine	thymine
D	cytosine	thymine	adenine

1.1.9 When red shorthorn cattle are crossed with white shorthorn cattle, the offspring have both red and white fur. This cross is an example of…..

A Inheritance with multiple alleles
B Incomplete dominance
C Dihybrid cross
D Co-dominance

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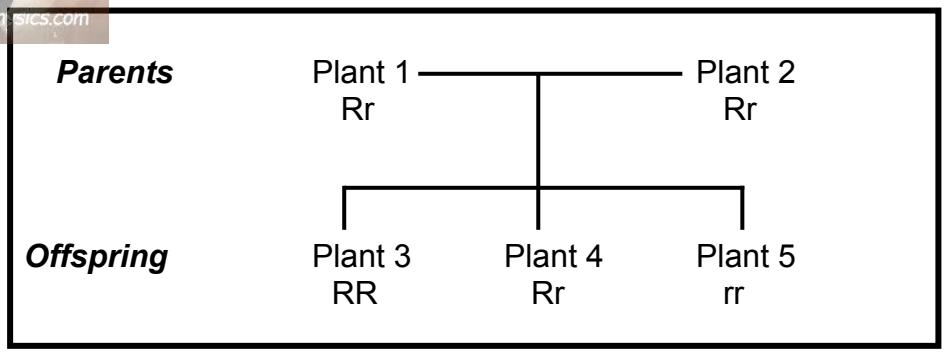
1.1.10 The diagram below shows the genotypes of two parent plants and three of their offspring for a characteristic that is controlled by a dominant allele.



Which of the plants have the same phenotype?

A 1, 2 and 4
B 1, 2, 3 and 4
C 3 and 5
D 3, 4 and 5

(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 your ANSWER BOOK.

1.2.1 A factor/variable that is changed or manipulated during an investigation

1.2.2 The law that describes how alleles are separated from one another during the formation of gametes

1.2.3 A genotype consisting of different alleles for a specific trait

1.2.4 The complete disappearance of a species from earth

1.2.5 The splitting of the cytoplasm during cell division

1.2.6 An opening on hominid skulls through which the spinal cord passes

1.2.7 The region of a chromosome where two chromatids are attached to each other

(7)

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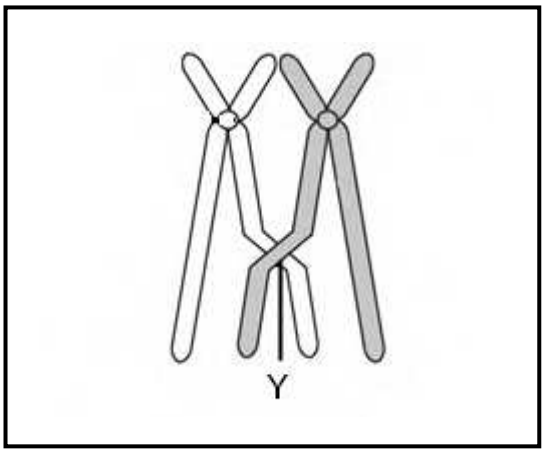
1.3 Indicate whether each of the statements in **COLUMN 1** applies to **A ONLY, B ONLY, BOTH A AND B** or **NONE** of the items in **COLUMN 2**. Write **A only, B only, both A and B, or none** next to the question number (1.3.1 to 1.3.8) in the ANSWER BOOK.

COLUMN 1		COLUMN 2	
1.3.1	Genetic disorder linked to a sex chromosome	A B	Haemophilia Sickle-cell anaemia
1.3.2	The evidence used to support the "Out of Africa" hypothesis by tracing the maternal lineage	A B	Mitochondrial DNA Y-chromosome
1.3.3	Examples of reproductive isolation mechanisms	A B	Breeding at different times of the year Adaptation to different pollinators

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

1.4 The diagram below shows a process that occurs during meiosis.



1.4.1 Name:

(a) the process occurring in the diagram above. (1)

(b) the phase in meiosis during which this process occurs. (1)

1.4.2 Identify the part marked **Y**. (1)

1.4.3 Describe the process mentioned in QUESTION 1.4.1 (a). (3)
(6)

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1.5 In cattle, black coat colour (B) is dominant to brown coat colour (b), and long horns (H) are dominant over short horns (h).

Study the following Punnett square of the cross between a cow and a bull before answering the questions that follow.

FEMALE → MALE ↓	**BH**	**Bh**	**bH**	**bh**
Bh	**X**			
Bh		**Y**		
Bh				
Bh				

1.5.1 State why the example above represents a dihybrid cross. (2)

1.5.2 Give the genotype of the female parent (1)

1.5.3 Give the:
(a) genotype of offspring X (2)
(b) phenotype of offspring Y (2)

1.5.4 What percentage of the offspring will be black with long horns? Show your working out. (3)

1.5.5 Which principle of Mendel applies to dihybrid crosses only? (1)

(11)
[50]

TOTAL SECTION A: 50

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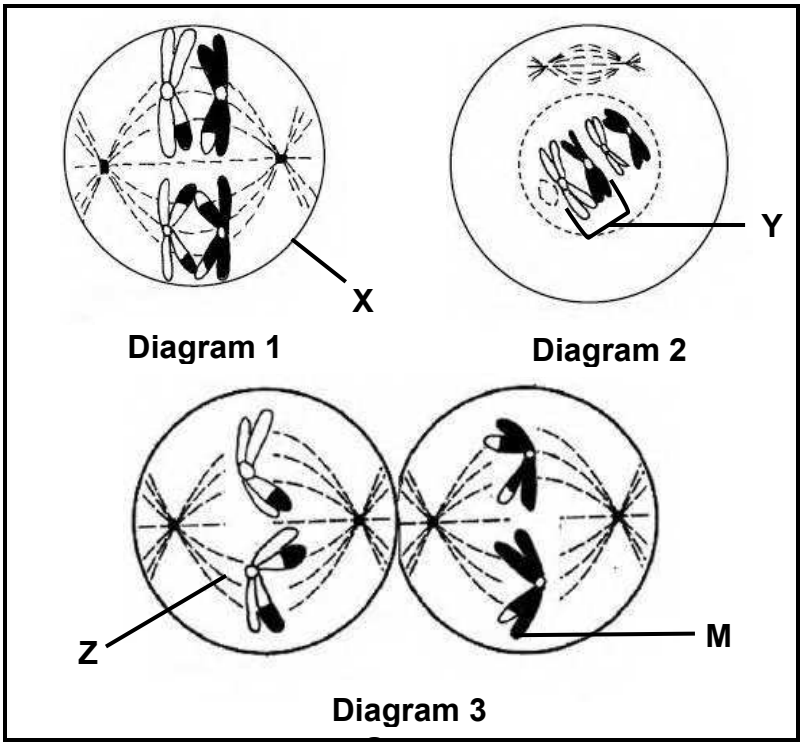
SECTION B

QUESTION 2

2.1 The diagram below shows different phases of meiosis in an organism.



2.1.1 Identify structure:

(a) **X** (1)

(b) **Z**. (1)

2.1.2 Give TWO observable reasons why chromosomes pair **Y** is regarded as being ***homologous*.** (2)

2.1.3 Identify the phases shown in diagrams **1**, **2** and **3**. (3)

2.1.4 List TWO events in meiosis that contribute to genetic variation. (2)
(9)

2.2 A blue-eyed woman marries a man who is heterozygous for brown eyes. Brown eyes (B) are dominant over blue eyes (b).

Use a genetic cross to show the possible genotypes and phenotypes of their children. (6)

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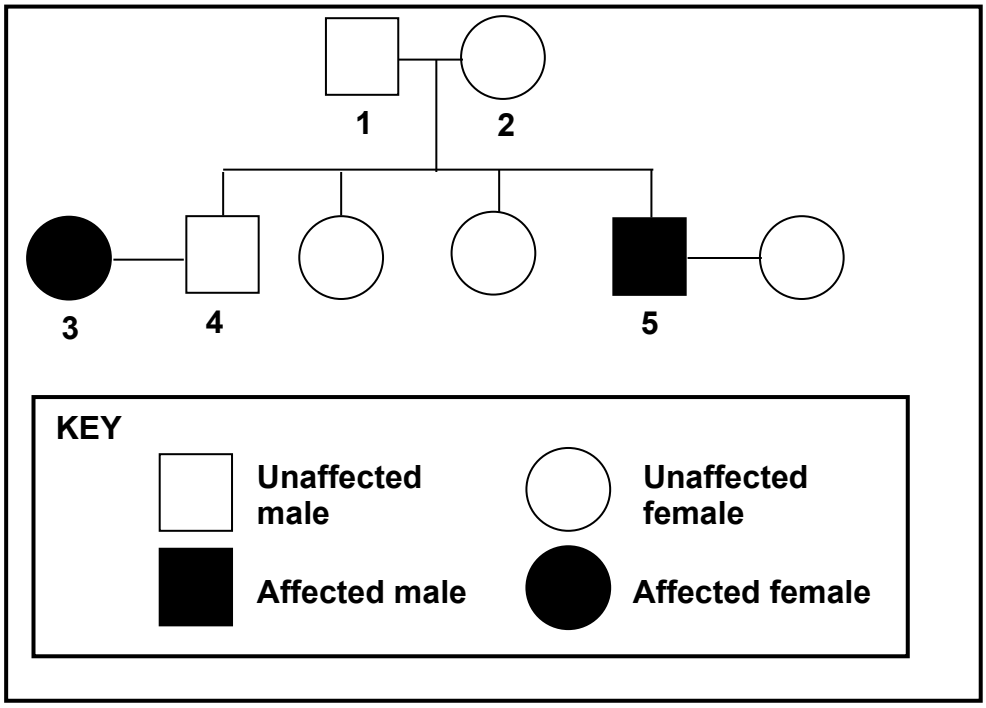
2.3 The pedigree diagram below shows the inheritance of a genetic disease caused by a single gene.



2.3.1 Use individuals 2 and 5 to explain why this disease is a caused by a recessive allele on the X-chromosome. (5)

2.3.2 Use the letters X^n for the recessive allele and X^N for the dominant allele to give the genotypes of individual:

(a) 3 (1)

(b) 4 (1)

2.3.3 What percentage of the daughters produced by individuals **3** and **4** would be affected? (1)
(8)

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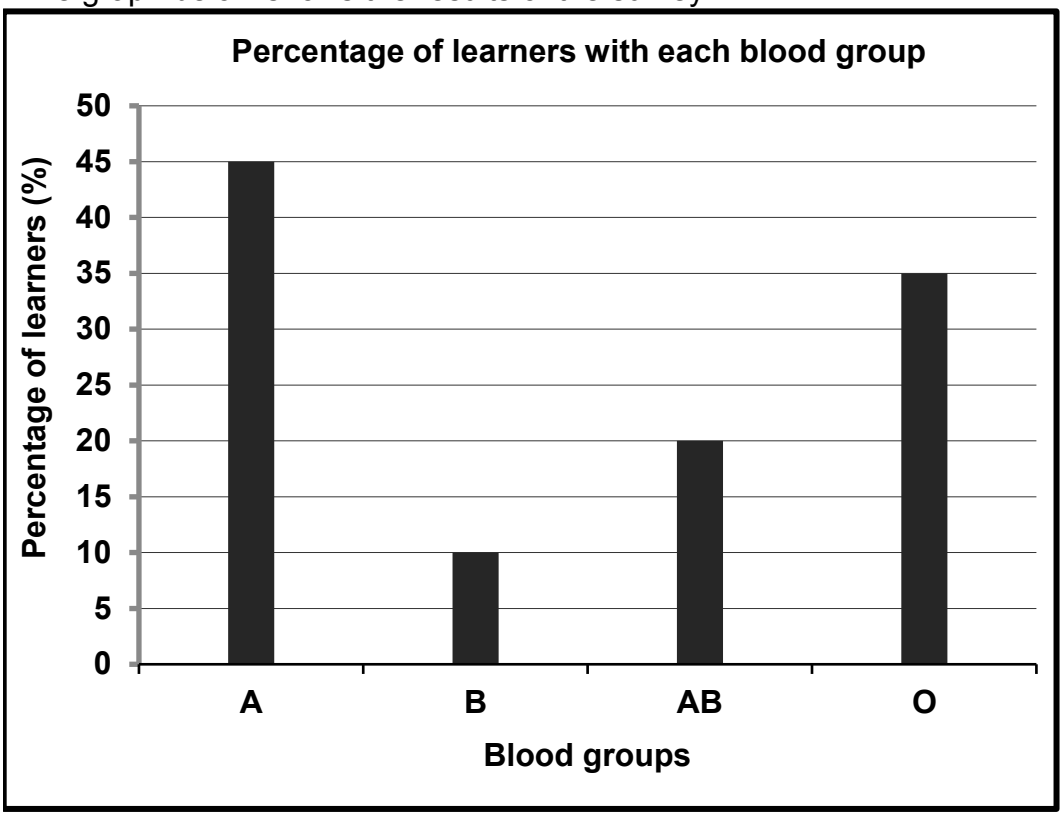
2.4 A group of grade 12 learners conducted a survey to establish the number of learners with each blood group.
The graph below shows the results of the survey.



2.4.1 State TWO planning steps that should be considered before carrying out this investigation (2)

2.4.2 Which blood group has the lowest percentage of learners? (1)

2.4.3 Give ONE reason why the data from this investigation was represented using the above type of graph. (2)

2.4.4 What conclusion can be drawn from the results presented in the graph? (2)

2.4.5 The frequency of each blood group worldwide is shown in the table below

Blood type	Worldwide Frequency (%)
O	45
A	40
B	11
AB	4

The learners expected their results to correspond with the results in the table, but they do not.
Explain why the results of the learners' investigation are not reliable.
(2)
(9)

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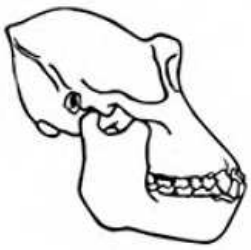
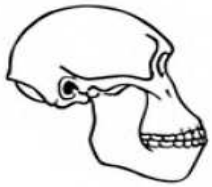
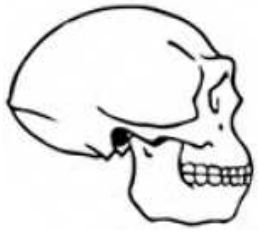
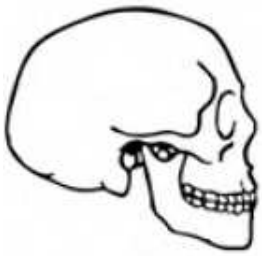
2.5 The table below shows the skulls of fossils of different genera.

GENERA	SKULL	BRAIN VOLUME	PERIOD OF EXISTENCE (MILLION YEARS AGO)
African ape		530 cm³	8 mya
Australopithecus		430cm³	4–2,7 mya
Homo erectus		850cm³	2–0,4 mya
Homo sapiens		1450cm³	0,2 mya–present

2.5.1 How many million years ago did *Homo erectus* first appear? (1)

2.5.2 Calculate the difference in brain volume between *Australopithecus* and *Homo sapiens*. Show ALL calculations. (2)

2.5.3 State TWO advantages of a larger brain volume. (2)

2.5.4 Tabulate THREE visible differences between the skulls of Homo sapiens and the African ape. (7)

2.5.5 Describe TWO structural features of the body that correspond with the evolution to bipedalism. (4)
(16)

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2.6 Genetically modified organisms (GMOs) bring new hope for medical cures, promise to increase yields in agriculture and have the potential to help solve the world's pollution and resource crisis.
There are also many objections to GMOs, some stating that they are expensive to produce and are a threat to biodiversity.

2.6.1 Give ONE reason why:

(a) the initial cost of production of GMOs is high (1)

(b) GMOs are considered a threat to biodiversity (1)

(2)

TOTAL QUESTION 2: [50]

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QUESTION 3

3.1 Read the extract.

> Scientists have studied the appearance, genetics and behaviours of wolves and domesticated dogs to better understand what caused them to diverge thousands of years ago. Wolves began to evolve through a process in which people selectively bred individuals with desired traits and behaviours, such as reduced aggression and willingness to submit to human social structure. Scientists have discovered that some wolves had the genes to produce amylase and digest starch and benefited from the human food they were scavenging. Domesticated dogs produce much more amylase compared to wolves and this allows dogs to benefit from a high-starch diet of humans in a way that wolves never could.

3.1.1 Using the example given in the passage, describe how a population of wolves may have evolved to form the first population of dogs. (6)

3.1.2 Although all dogs are descendants of the wolf, the use of artificial selection has allowed humans to drastically alter the appearance of dogs. For centuries, dogs have been bred for various desired characteristics, leading to the creation of a wide range of dogs, from the tiny Chihuahua to the massive Great Dane.

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(a) Explain why all breeds of domestic dogs belong to the same species. (3)

(b) Describe how artificial selection has led to the different breeds of domestic dogs. (3)

(12)

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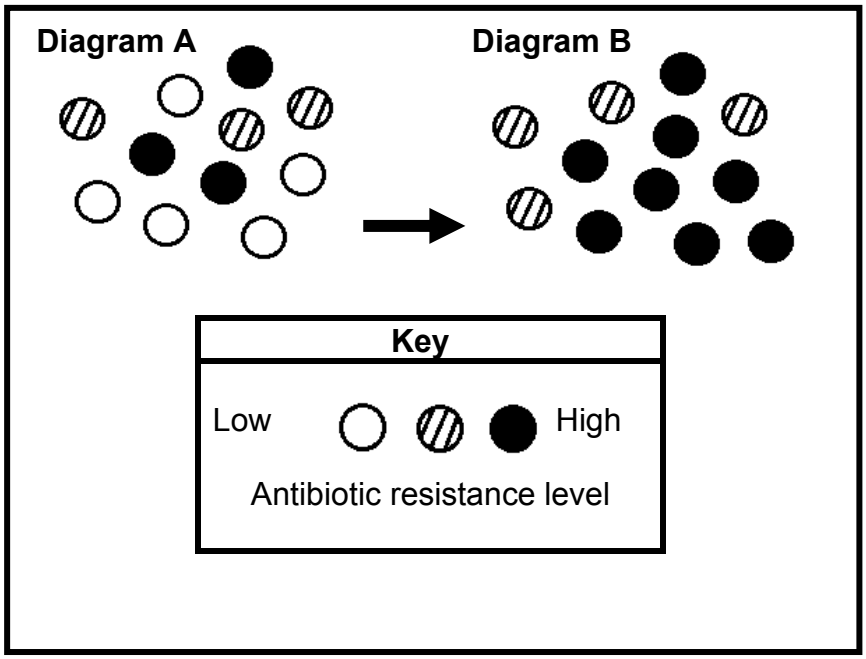
3.2 The diagram below represents the changes in a population of bacteria as a result of exposure to an antibiotic over time.



3.2.1 Explain, in terms of natural selection, the change in the proportion of antibiotic resistant bacteria in the population in diagram **B** (6)

3.2.2 Explain why antibiotic resistance can become a severe health problem in hospitals (3)

(9)

3.3 Read the following extract.

Since 1972, biologists Peter and Rosemary Grant have studied finch populations in the Galapagos Islands. They studied one finch population on an island called Daphne Major.
The table below shows the data they collected over a period of 7 years.

Year	1974	1975	1976	1977	1978	1979	1980
Rainfall (mm)	-	-	130	20	130	70	50
Number of finches	1 100	1 300	1 100	200	350	300	250
Small seeds (mg/m^2)	-	800	600	90	300	70	50

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3.3.1 Use the information in the table to draw a line graph to show the number of finches from 1974 until 1980. (6)

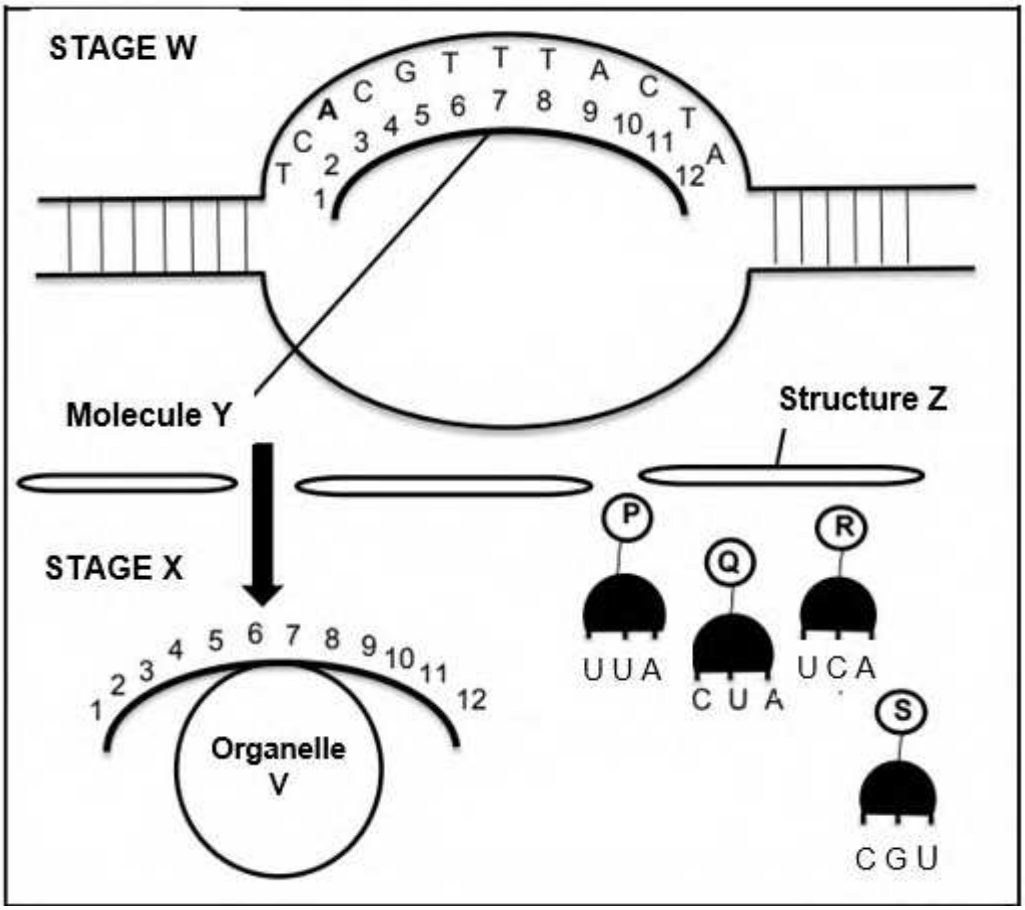
3.3.2 In which year were the largest drop in rainfall, number of seeds and number of finches recorded? (1)

3.3.3 Explain how the three events mentioned in QUESTION 3.3.2 are related to each other. (4)

3.3.4 When the number of finches decreased, there were still plenty of large seeds on the island. What does this tell you about the seed-eating habits of the finches that died? (1)

(12)

3.4 The diagram below shows some processes that occur during protein synthesis.



3.4.1 Identify:

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

(b) Organelle **V** (1)

(c) Structure **Z** (1)

3.4.2 Give the sequence of nitrogenous bases for the first codon on Molecule **Y** (1, 2, 3). (1)

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3.4.3 Give the correct order in which molecules **P**, **Q**, **R** and **S** would attach to molecule **Y**. (From left to right) (2)

3.4.4 Where in a cell does stage **X** occur? (1)

3.4.5 If the third nitrogenous base (**A**) of the DNA strand was replaced by **G**, describe how this would affect the protein that will form. (4)

3.4.6 Describe the process of transcription (6)
(17)

TOTAL QUESTION 3: 50
GRAND TOTAL: 150

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ERRATUM: LFSC PREP PAPER 2 MARKING GUIDELINE 2022

ENGLISH

1.2.7 Centromere ✓

1.2.8 Delete

1.4 1.4.1 (a) Crossing over✓ (1)
(b) Prophase✓ (1)

1.4.2 Y - Chiasma✓ (1)

1.4.3
- Homologous chromosomes✓/bivalents pair up
- Each chromosome has 2 chromatids✓
- Chromatids overlap/cross over✓
- Genetic material is exchanged✓between non-sister chromatids✓
- After the process of crossing-over chromosomes have genes from the homologous partner✓

Max (3)

(6)

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PROVINCIAL GOVERNMENT
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DEPARTMENT OF
EDUCATION

NATIONAL
SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2
SEPTEMBER 2022
MARKING GUIDELINES

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MARKS: 150

This memorandum consists of 11 pages

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PRINCIPLES RELATED TO MARKING LIFE SCIENCES 2022

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 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 are incorrect, do not credit. If sequence and links becomes correct again, resume credit.

9. **Non-recognized abbreviations**
   Accept if first defined in answer. If not defined, do not credit the unrecognised 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.

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15. **If units are not given in measurements**
Memorandum will allocate marks for units separately, except where it is already given in the question.

16. Be sensitive to the **sense of an answer, which may be stated in a different way**.

17. **Caption**
Credit will be given for captions to all illustrations (diagrams, graphs, tables, etc.) except where it is already given in the question.

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.

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SECTION A
QUESTION 1

1.1	1.1.1	D✓✓		
	1.1.2	B✓✓		
	1.1.3	B✓✓		
	1.1.4	C✓✓		
	1.1.5	A✓✓		
	1.1.6	C✓✓		
	1.1.7	B✓✓		
	1.1.8	C✓✓		
	1.1.9	D✓✓		
	1.1.10	B✓✓	(10 x 2)	**(20)**
1.2	1.2.1	Independent✓variable		
	1.2.2	(Law of) segregation✓		
	1.2.3	Heterozygous✓		
	1.2.4	Extinction✓		
	1.2.5	Cytokinesis✓		
	1.2.6	Foramen magnum✓		
	1.2.7	Centromere✓		**(7)**
1.3	1.3.1	A only✓✓		
	1.3.2	A only✓		
	1.3.3	Both A and B✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Crossing over✓		(1)
		(b) Prophase✓		(1)
	1.4.2	Y - Chiasma✓		(1)
	1.4.3	- Homologous chromosomes✓/bivalents pair up - Each chromosome has 2 chromatids✓ - Chromatids overlap/cross over✓ - Genetic material is exchanged✓between non-sister chromatids✓ - After the process of crossing-over chromosomes have genes from the homologous partner✓	**Max**	(3) **(6)**

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1.5 1.5.1 This is a Dihybrid cross:
It is a cross between two individuals
with **two observed traits**✓/ coat colour and horn length
that are controlled by **two distinct genes**.✓ (2)

1.5.2 BbHh ✓ (1)

1.5.3 (a) BBHh ✓✓ (2)
(b) BBhh = black coat colour;✓ short horns ✓ (2)

1.5.4 BBHh = 4
BbHh = 4
} 8 x Black coat; Long horns

Bbhh = 4
BBhh = 4
} 8 x Black coat; Short horns

} ✓

$\frac{8}{16} \times 100$ } ✓= 50 ✓% (3)

1.5.5 (Principle of) Independent Assortment (1)
(11)

TOTAL SECTION A: 50

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SECTION B

QUESTION 2

2.1

2.1.1 (a) Cell membrane ✓
(b) Spindle fibres✓ (2)

2.1.2 The chromosomes are of the:
- Same size✓
- Same shape✓
- Same length✓

Any (2)
(Mark first TWO only)

2.1.3 **1** - Metaphase 1✓
2 - Prophase 1✓
3 - Metaphase 2✓ (3)

2.1.4 - Crossing over ✓ (2)
- Random arrangement of chromosomes✓

(Mark first TWO only) **(9)**

2.2 **P**$_1$/parent phenotype blue eyes x brown eyes✓
genotype bb x Bb ✓

Meiosis
G/gametes b, b x B, b✓

Fertilisation
F$_1$/offspring genotype Bb, bb, Bb & bb ✓

phenotypes 2 blue eyes and 2 brown eyes✓
genotypes Bb, bb, Bb, bb✓
Parents and offspring✓/P$_1$ and F$_1$
Meiosis and fertilisation✓ **Any** (6)

OR

P$_1$/parent phenotype blue eyes x brown eyes✓
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✓

F$_1$/offspring: phenotype 2 blue eyes and 2 brown eyes✓
Parents and offspring✓/P$_1$ and F$_1$
Meiosis and fertilisation✓ **Any** (6)

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2.3

2.3.1
- Individual 5 is an affected male✓ and
- He must have one Y chromosome✓ and
- the recessive allele on the X chromosome✓
- which he would have inherited from his mother (individual 2) ✓
- But she does not have the disorder✓, which means it is caused by a recessive allele (5)

2.3.2 (a) 3: X^nX^n✓

(b) 4: X^NY ✓ (2)

2.3.3 0% ✓ (1)
(8)

2.4

2.4.1 Planning:
- Get permission from all stakeholders/ the learners and their parents ✓
- Decide on the sample size/ composition/ participants ✓
- Decide on the method to use to determine the blood groups/ ensure that the learners know their blood groups ✓
- Determine the apparatus and equipment needed to test for the different blood groups ✓
- Design a record sheet ✓
- Set a date/ time for the investigation ✓
- Arrange venue ✓

(Mark first TWO only) Any (2)

2.4.2 B✓ (1)

2.4.3 Represent separate/discrete/different✓ entities/blood groups /units✓

OR

Discontinuous✓ variable✓ / No ✓ intermediate groups✓ (2)

2.4.4 45 % ✓ /Majority of the sample group have blood group A✓

OR

10 % ✓ /Minority of the sample group have blood group B✓

OR

20 %✓ of the sample group have blood group AB✓

OR

35 %✓ of the sample group have blood group O✓ (2)

2.4.5 The sample group was very small✓/ only one group of learners from an entire school and is therefore not representative of the world population ✓ (2)
(9)

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2.5

2.5.1 2 mya✓ (1)

2.5.2 1450 cm^3 – 430✓ cm^3 ╱ (1450 – 430) ✓ cm^3
= 1020✓ cm^3
(2)

2.5.3 Have better co-ordination of movement✓
Process large amount of information✓
Processing information faster✓
Development of spoken and written languages to communicate✓
(Mark first TWO only) (2)

2.5.4 Table✓ (1)

Homo sapiens	**African ape/Gorilla**
Large cranium✓	Small cranium✓
Smaller jaw✓	Bigger jaw✓
Non-prognathous✓	Prognathous✓
Smaller teeth/canines✓	Bigger teeth/canines✓
Brow ridge reduced✓/ absent	Brow ridge large✓/ pronounced
Well-developed chin✓	Less developed chin✓

(Mark first THREE only) (6)
(7)

2.5.5

- The foramen magnum✓ moved from a backwards position to a more forward position in the modern human✓
- The curvature of the spine✓changed from C-shaped to S-shaped✓
- The pelvis✓ changed from long and narrow to wider and shorter. ✓

(Mark first TWO only) (4)
(16)

2.6 2.6.1 (a) new equipment✓ is expensive
labour intensive✓
many clinical trials✓must be done/long time to produce a safe product
(Mark first ONE only) Any (1)

(b) may easily pollinate non-GM crops✓/may mate with non-GM animals✓
they might out-compete the naturally occurring organisms✓
(Mark first ONE only) Any (1)
(2)

TOTAL QUESTION 2: [50]

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QUESTION 3

3.1

3.1.1
- there is variation ✓in the wolves
- in terms of their behaviour✓/ reduced aggression
- and genetics ✓/ ability to produce amylase/ digest starch
- A population of less aggressive/more tame wolves✓ were separated✓from the original wild population
- They became scavengers✓ around human settlements because they could digest the starch in human food ✓
- and were more suited for survival ✓amongst a human population
- The genes for producing more amylase were passed on to their offspring✓
- The next generation had a higher proportion of individuals with the favourable characteristic ✓

Max 6 (6)

3.1.2 (a) They can interbreed✓with different domestic dog breeds✓ to produce fertile✓ offspring (3)

(b) Humans chose desired characteristics✓ and bred dogs✓ with those phenotypes and genotypes to create dogs that suit their needs ✓/ e.g. hunters, companions, helpers. (3)
(12)

3.2

3.2.1
- Due to a mutation✓
- some bacteria are resistant to the antibiotic✓ and
- others are not✓
- There is a large degree of variation in the bacteria population✓
- When the antibiotic was first used,
- the non-resistant bacteria died ✓
- The resistant bacteria survived✓
- to reproduce✓ thereby
- increasing the population of antibiotic-resistant bacteria✓

Any Max 6 (6)

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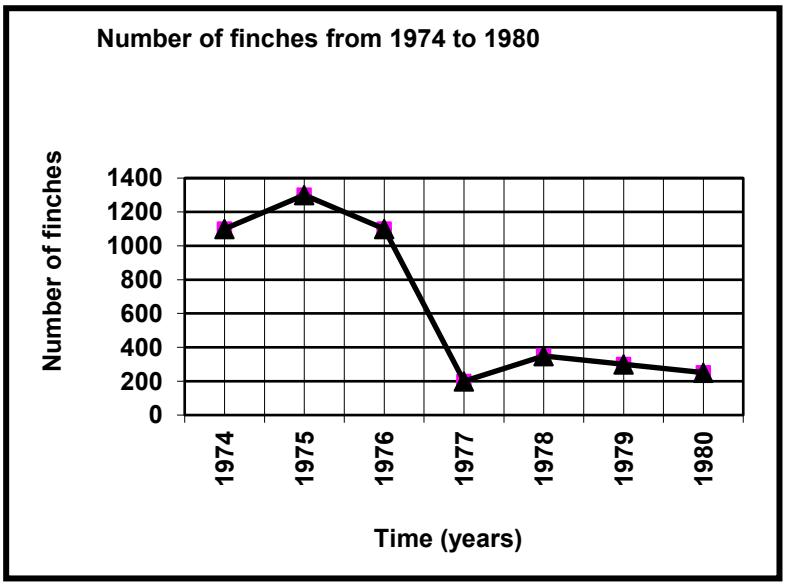
3.2.2
- Overuse/ frequent use of antibiotics✓
- may lead to the development of antibiotic resistant strains of bacteria ✓/Infections caused by these bacteria are no longer affected by the antibiotic treatment
- Antibiotic resistance leads to higher medical costs, prolonged hospital stays, and increased mortality. ✓

(3)
(9)

3.3

3.3.1



Rubric for awarding marks for the graph

Correct type of graph	1
Title of graph	1
Correct label for X and Y-axes	1
Correct scale and units for X and Y-axes	1
Plotting points	1: 1 - 4 correctly plotted 2: All 7 correctly plotted

NOTE:
If the wrong type of graph is drawn: marks will be forfeited for "correct type of graph" as well as for the "joining of points".

(6)

3.3.2 1977✓

(1)

3.3.3 A drop in rainfall✓/ drought
causes a drop in seed production✓/plant growth
causing less food✓ to support fewer finches✓

(4)

3.3.4 the beaks of these finches were too small✓/ not strong enough to be able to eat the large seeds

(1)
(12)

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3.4

3.4.1 (a) Molecule Y: mRNA✓
(b) Organelle V: ribosome✓
(c) Structure Z: nuclear membrane✓ (3)

3.4.2 First codon on molecule Y: AGU✓ (1)

3.4.3 R; S; P; Q (must be in correct order) ✓✓ (2)

3.4.4 Cytoplasm ✓ (1)

3.4.5 If nitrogenous base A is replaced by G, the codon will change to AGC ✓
This will code for another anticodon✓/ UCA instead of AGU
And may result in coding for another amino acid✓
which may change the protein that is formed✓ (4)

3.4.6 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)
(17)

TOTAL QUESTION 3: 50

GRAND TOTAL: 150

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