DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS
LEFAPHA LA THUTO
ISEBE LEZEMFUNDO

PROVINSIALE VOORBEREIDENDE EKSAMEN/ PROVINCIAL PREPARATORY EXAMINATION

GRAAD/GRADE 12

LEWENSWETENSKAPPE/LIFE SCIENCES

VRAESTEL/PAPER 2

SEPTEMBER 2024

PUNTE/MARKS: 150

TYD/TIME: 2½ uur/hours

Hierdie vraestel bestaan uit 14 bladsye./
This question paper consists of 14 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 answer to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions 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 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 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 nitrogenous bases of a DNA molecule are held together by a … bond.

A weak hydrogen
B weak peptide
C strong hydrogen
D strong peptide

1.1.2 The phase during meiosis I when the spindle fibres start to form

A Prophase I
B Metaphase I
C Anaphase I
D Telophase I

1.1.3 The complementary DNA strand of template GATCAA is …

A CUAGUU.
B CTAGTT.
C AGCTGG.
D AGCUGG.

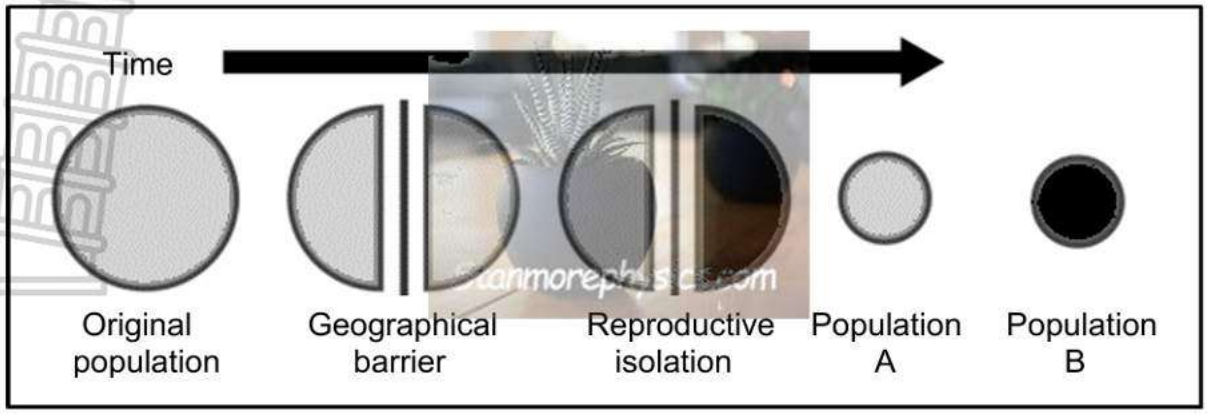
1.1.4 A benefit of cloning is that it …

A will reduce the variation within a population.
B produces genetically identical individuals with desirable characteristics.
C will enable offspring to survive under any unfavourable conditions.
D is the only scientific technique which is accepted by all religions.

1.1.5 The genotype for 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.

1.1.6 The diagram below shows a process in evolution.



This diagram illustrates …

A natural selection.
B variation.
C punctuated equilibrium.
D speciation.

1.1.7 The following are possible causes of Down syndrome:

(i) An example of trisomy
(ii) Chromosomal mutation
(iii) Two chromosomes at position 21 in the karyotype
(iv) Error takes place during Prophase I

Which ONE of the following applies to Down syndrome?

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

1.1.8 In humans, colour-blindness is a sex-linked disorder. A mother who is a carrier for colour-blindness has two children: a colour-blind boy and a girl without colour-blindness. This means that …

A the father is colour-blind.
B the father is colour-blind and carried the disorder over to his son.
C all her sons will be colour-blind.
D the allele for colour-blindness is recessive and is carried on the X-chromosome.

1.1.9 The probability that two heterozygous parents will produce a homozygous dominant offspring, is ...

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

(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 inability of homologous chromosome pairs to separate during meiosis

1.2.2 An inherited disorder in which blood fails to clot properly

1.2.3 The position of a gene on a chromosome

1.2.4 The organ where meiosis takes place in human females

1.2.5 The type of DNA present in plant cells only

1.2.6 A cell condition in which the nucleus contains only a single set of chromosomes

1.2.7 The organelle in a cell where proteins are formed

1.2.8 Cell division that results in two identical daughter cells

1.2.9 The type of dominance which results in an intermediate phenotype in the heterozygous condition (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	The breeding of organisms over many generations to achieve a desirable phenotype	A: Cloning B: Artificial selection
1.3.2	Influences the inheritance of blood groups	A: Codominance B: Multiple alleles
1.3.3	The physical and functional expression of a gene	A: Genotype B: Phenotype

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

1.4 The table below shows the mRNA codons and their corresponding amino acids.

TABLE 1

CODONS OF mRNA	AMINO ACIDS
GGU, GGC	Glycine
GCU, GCC, GCA, GCG	Alanine
CGU, CGA, CGC, CGG	Arginine
AAU, AAC	Asparagine
UGG	Tryptophan
UAU, UAC	Tyrosine

DIAGRAM 1 (DNA molecule)

GCG — ATA — ACC

1.4.1 Identify the tRNA sequence (from left to right) for **Diagram 1**. (3)

1.4.2 Select the correct sequence of amino acids from **Table 1** required by the DNA in **Diagram 1**. (3)
(6)

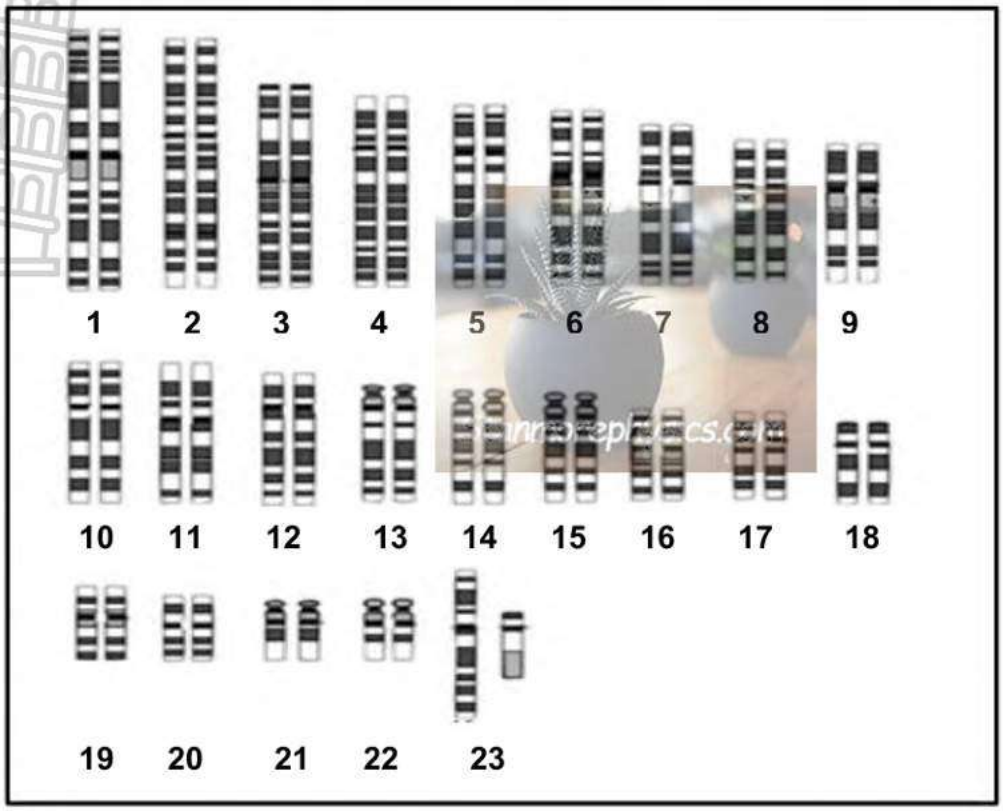
1.5 In mice, the ability to run in a straight line is dominant. A mouse with this trait is called a running mouse (**R**). The recessive trait causes the mice to only run in circles. A mouse with this trait is called a waltzing mouse (**r**). Dark fur (**D**) is dominant over light fur (**d**).

A light-furred heterozygous running mouse is crossed with a waltzing mouse which is heterozygous for fur colour.

1.5.1 Identify the genotypes of both parents. (4)

1.5.2 Give ALL the possible gametes that the **running mouse** (used in the crossing) can produce. (2)
(6)

1.6 The diagram below represents a human karyotype.



1.6.1 Give the number of diploid chromosomes in this cell. (1)

1.6.2 What is the collective term for chromosomes numbered 1 to 22? (1)

1.6.3 Identify the gender of this person. (1)

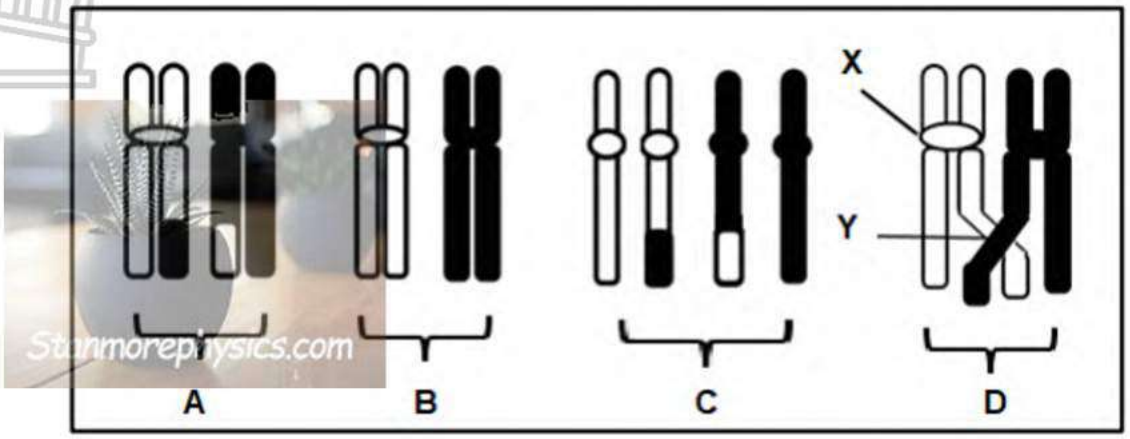
1.6.4 Give ONE visible reason for the answer to QUESTION 1.6.3. (2)
(5)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagrams below illustrate the appearance of chromosomes in a cell during meiosis. Each LETTER (**A** to **D**) represents a particular phase of meiosis.



2.1.1 Label the part:

(a) **X** (1)

(b) **Y** (1)

2.1.2 (a) Does this diagram represent a human cell? (1)

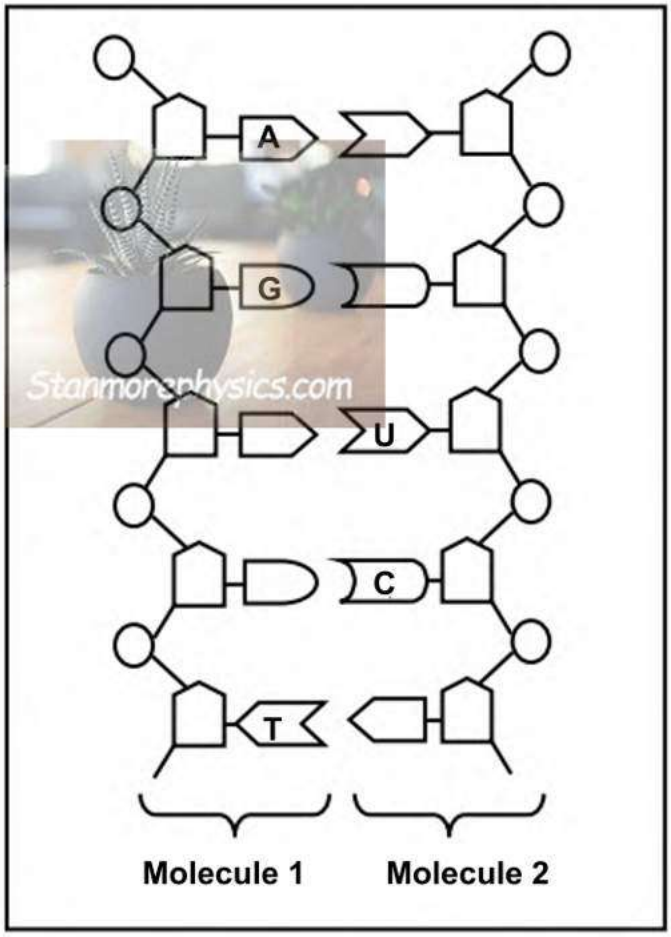
(b) Explain your answer to QUESTION 2.1.2(a). (2)

2.1.3 Using only the LETTERS (**A** to **D**), arrange the phases in the correct sequence. (2)

2.1.4 Explain how meiosis contributes to genetic variation. (4)

2.1.5 Draw a diagram that will represent this cell during Anaphase II. (4)
(15)

2.2 The diagram below shows two different nucleic acid molecules during protein synthesis.



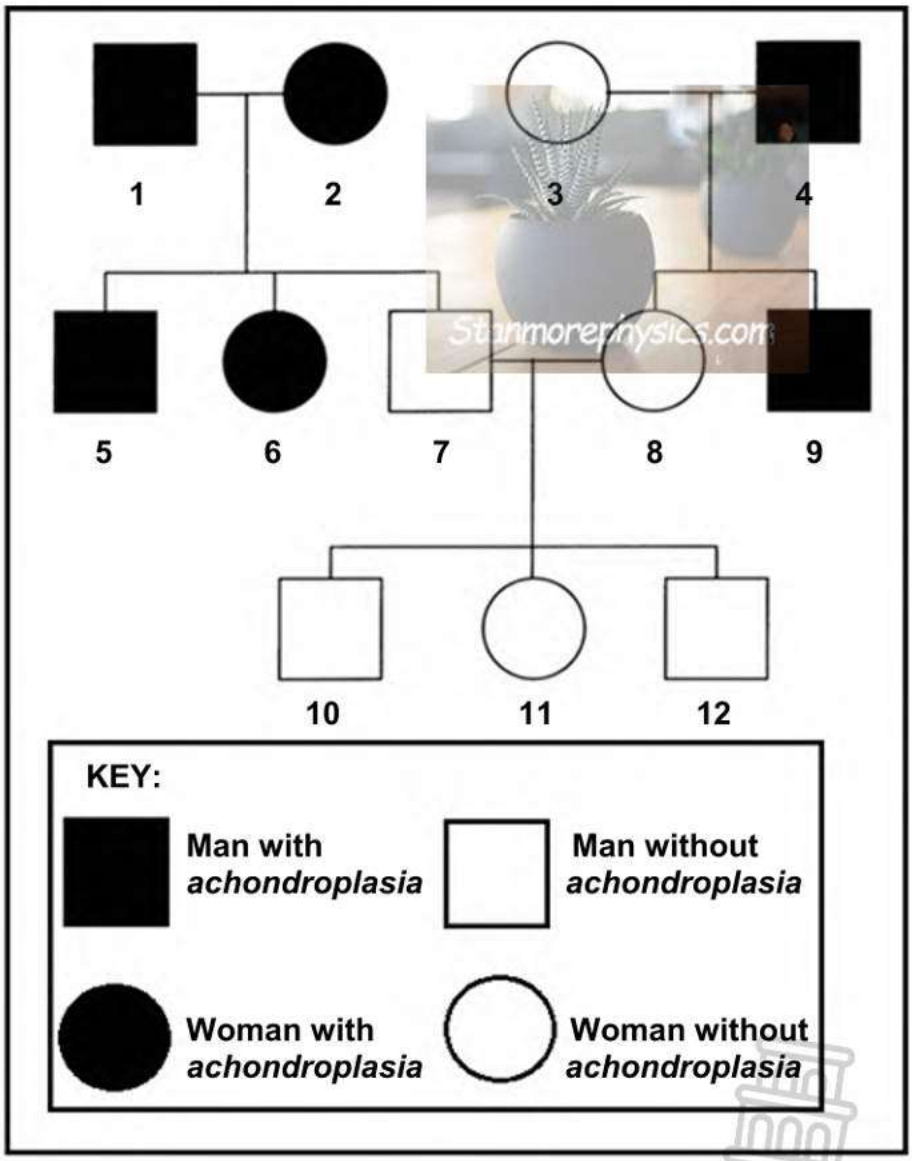
2.2.1 Identify molecules **1** and **2**. (2)

2.2.2 Tabulate THREE differences between molecule **1** and **2**. (7)

2.2.3 Name and describe this stage of protein synthesis. (6)
(15)

2.3 *Achondroplasia* is the most common type of short-limbed dwarfism. Over 80% of *achondroplasia* is a result of a gene mutation. *Achondroplasia* is normally inherited as an autosomal dominant gene.

The following diagram illustrates the inheritance of *achondroplasia* in a family.



2.3.1 Describe what is meant by a *gene mutation*. (2)

2.3.2 Name this type of diagram. (1)

2.3.3 How many individuals in the diagram have *achondroplasia*? (1)

USE THE LETTERS A AND a TO ANSWER QUESTIONS 2.3.4 AND 2.3.5.

2.3.4 Identify the genotypes of individuals **3** and **4**. (2)

2.3.5 Use a genetic cross to show how individuals **1** and **2** were able to have child as individual **7** (a son without *achondroplasia*). (6)

2.3.6 According to statistics, there should be approximately 2 416 achondroplastic dwarfs in South Africa. Calculate how many cases of *achondroplasia* are **inherited** normally. Show all calculations. (3)
(15)

2.4 Read the information below, which describes FOUR examples of biotechnology.

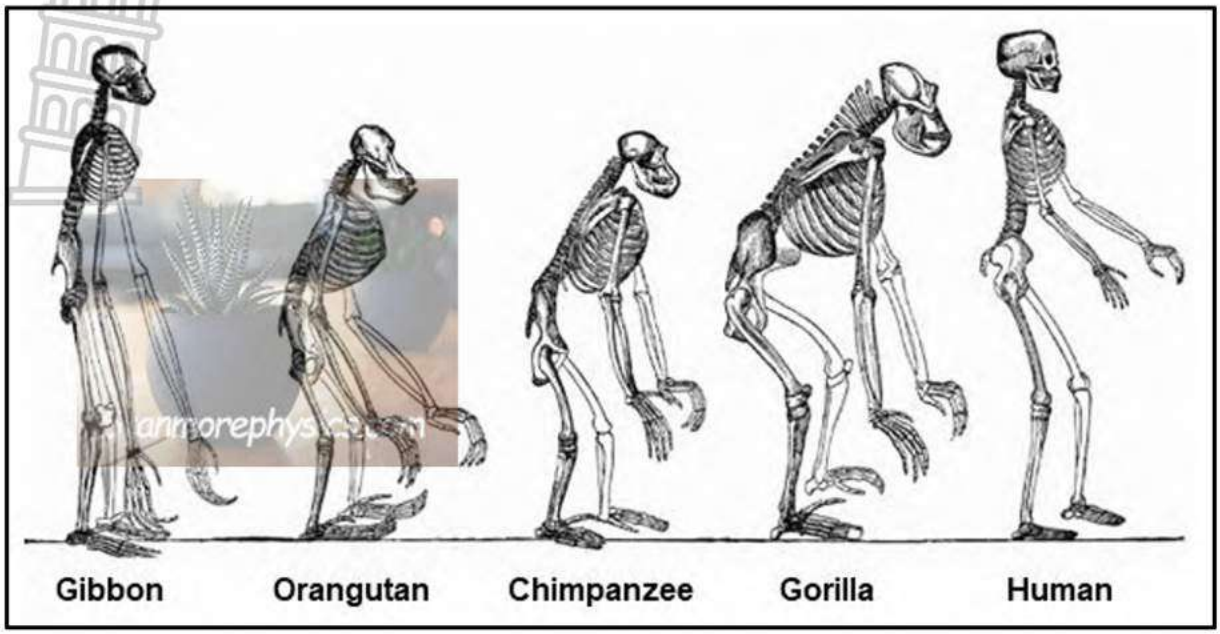
- Scientists have deleted the section of DNA that leaves pigs vulnerable to porcine reproductive and respiratory syndrome (PRRS).
- Male mosquitoes have been produced that carry a gene that, when they mate with females, their offspring cannot reach adulthood.
- Cows have been changed to produce milk that has a similar composition to that of human milk.
- Chickens have received an extra gene that interrupts the transmission of avian flu.

2.4.1 Identify the type of biotechnology that is described in the text above. (1)

2.4.2 Describe TWO ways in which biotechnology can satisfy human needs, according to the text. (4)
(5)
[50]

QUESTION 3

3.1 The diagram below shows the development of bipedalism.



3.1.1 List FOUR advantages of bipedalism. (4)

3.1.2 List FOUR ways in which the human skeleton is suitable for bipedalism. (4)

3.1.3 Give the scientific name of the bipedal organism shown in the diagram. (1)
(9)

3.2 The table below shows the evolution of cranial capacity in different 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

3.2.1 Name TWO fossils of *Australopithecus africanus* which were found in South Africa. (2)

3.2.2 Name TWO other lines of evidence for human evolution. (2)

3.2.3 Give ONE example of each line of evidence mentioned in QUESTION 3.2.2. (2)

3.2.4 Explain the significance of the evolution of cranial capacity. (2)

3.2.5 Use the information in the table and draw a bar graph to show the average cranial capacity of the different species. (6)
(14)

3.3 Read the information below.

> Blond hair appeared in Europe around 11 000 years ago. Due to food shortages, many men died during their very long and dangerous hunting trips, resulting in more women than men surviving. Gene mutations gave rise to blond hair which became popular during reproduction.

Describe the evolution of blond hair through natural selection. **(8)**

3.4 The giraffe (*Giraffa camelopardalis*) is presently the animal with the longest neck.

3.4.1 Explain how the giraffe got its long neck, according to Lamarck's theory of evolution. (6)

3.4.2 Explain why Lamarck's theory is rejected. (2)
(8)

3.5 An investigation was conducted by a scientist to determine if two plant populations belonged to the same species. The scientist collected seeds from both Population **A** and Population **B**.

The procedure was as follows:

- He planted 20 seeds from Population **A** and 20 seeds from Population **B** in two separate plots close to each other.
- The stamens (male fertilising organs) of all the flowers of Population **A** were removed.
- Only pollen from the flowers of Population **B** was used to pollinate the flowers of Population **A**.
- The scientist harvested the seeds of the plants in Population **A**.
- He planted these seeds under ideal conditions in a laboratory.

Result: NONE of the seeds germinated.

3.5.1 Give the definitions for

(a) species (2)
(b) population (2)

3.5.2 Explain why the stamens from the flowers of Population **A** were removed. (2)

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

3.5.4 Suggest ONE way in which the scientist could have increased the reliability of the results. (1)

3.5.5 What conclusion can be drawn at the end of the investigation? (1)

3.5.6 Give a reason for your answer to QUESTION 3.5.5. (1)
(11)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

DEPARTMENT OF EDUCATION

DEPARTEMENT VAN ONDERWYS

LEFAPHA LA THUTO

ISEBE LEZEMFUNDO

PROVINCIAL PREPARATORY EXAMINATION

GRADE 12

LIFE SCIENCES

PAPER 2

SEPTEMBER 2024

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 13 pages.

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 part of it is required**
   Read all and credit 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 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 provincial memo discussion meeting.

14. **If only letter is asked for, but only 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, drawings, graphs, tables, etc.) must have a caption.

18. **Code-switching of official languages (terms and concepts)**
A single word or two that appear(s) in any official language other than the learner's 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.

19. **Changes to the marking guidelines**
No changes must be made to the marking guidelines without consent of the examiner and internal moderator.

SECTION A

QUESTION 1

1.1	1.1.1	A✓✓		
	1.1.2	A✓✓		
	1.1.3	B✓✓		
	1.1.4	B✓✓		
	1.1.5	D✓✓		
	1.1.6	D✓✓		
	1.1.7	B✓✓		
	1.1.8	D✓✓		
	1.1.9	C✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Non-disjunction✓		
	1.2.2	Haemophilia✓		
	1.2.3	Locus✓		
	1.2.4	Ovary✓		
	1.2.5	Chloroplast✓ DNA		
	1.2.6	Haploid✓		
	1.2.7	Ribosome✓		
	1.2.8	Mitosis✓		
	1.2.9	Incomplete✓ dominance	(9 x 1)	**(9)**
1.3	1.3.1	B only✓✓		
	1.3.2	Both A and B ✓✓		
	1.3.3	B only✓✓	(3 x 2)	**(6)**
1.4	1.4.1	GCG✓ AUA✓ ACC✓		(3)
	1.4.2	Arginine✓ Tyrosine✓ Tryptophan✓		(3) **(6)**
1.5	1.5.1	Rrdd✓✓/ddRr and rrDd✓✓/Ddrr		(4)
	1.5.2	Rd✓/dR rd✓/dr **(Mark first TWO only)**		(2) **(6)**

1.6	1.6.1	46✓/23 pairs	(1)
	1.6.2	Autosomes✓	(1)
	1.6.3	Male✓	(1)
	1.6.4	- The gonosomes✓/chromosome pair 23/sex chromosomes - are not identical✓/XY	(2) **(5)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) **X** - centromere✓/chromatid (1)

(b) **Y** - chiasma(ta)✓ (1)

2.1.2 (a) No✓ (1)

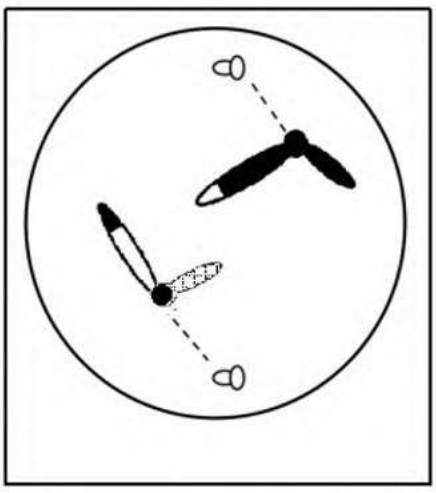
(b) - The cells have only 2 chromosomes✓/1 pair of chromosomes
- Human cells have 46 chromosomes✓/23 pairs of chromosomes (2)

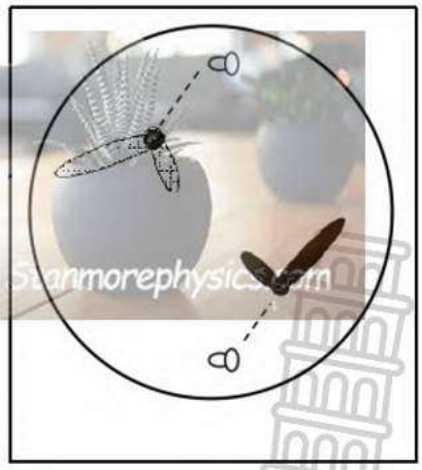
2.1.3 B, D, A, C✓✓ (2)
(Two or nothing)

2.1.4
- Crossing over✓
- takes place during Prophase I✓
- The **random** arrangement of chromosomes at the **equator**✓ (4)
- during Metaphase✓(I or II)

2.1.5

TWO EXAMPLES of a cell – any possible combination of chromatids is possible





Guideline for assessing the diagram: *mark independently*

Cell is drawn, centrioles **and** spindle fibres are present	**(D)**	1
2 chromatids	**(N)**	1
Chromatids moving towards poles	**(P)**	1
Correct shading chromatids (any combination of the shaded chromatids as above)	**(S)**	1

(4)
(15)

2.2 2.2.1 Molecule **1** - DNA✓
Molecule **2** - RNA✓/mRNA (2)

2.2.2

T✓

DNA	RNA
Contains deoxyribose✓sugar	Contains ribose✓ sugar
Double✓ helix	Single✓ stranded
Contains the nitrogenous base thymine✓/T	Contains the nitrogenous base uracil ✓/U
Found in the nucleus only✓	Found in the nucleus, ribosomes and cytoplasm of cells✓

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

2.2.3 Transcription✓*
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.✓
(1* compulsory mark + any other 5) (6)
(15)

2.3 2.3.1 - A change in the sequence✓ of
- nitrogenous bases✓/nucleotides in a gene/DNA (2)

2.3.2 Pedigree✓diagram (1)

2.3.3 6✓ (1)

2.3.4 **-Individual 3:** aa✓
-Individual 4 Aa✓ (2)

2.3.5 **IF ANOTHER LETTER IS USED, CANDIDATES WILL LOSE MARKS FOR P_1 AND F_1 GENOTYPES**

P_1 phenotype achondroplasia X achondroplasia✓
genotype Aa X Aa✓

Meiosis

Gametes/G **A a** **A a** ✓

Fertilisation x

F_1
genotype **AA** **Aa** **Aa** **aa** ✓

phenotype 3/75% achondroplasia
1/25% **not achondroplasia**✓*

P_1 and F_1✓
Meiosis and fertilisation✓

1 **Compulsory mark** + Any 5

OR

P_1 phenotype achondroplasia X achondroplasia✓
genotype Aa X Aa✓

Meiosis
fertilisation

Gametes	A	a
A	AA	Aa
a	Aa	aa

1 mark for correct gametes
1 mark for correct genotypes

F_1 phenotype 3/75% achondroplasia
1/25% **not achondroplasia**✓*

P_1 and F_1✓
meiosis and fertilisation✓

1 Compulsory mark + Any 5 (6)

2.3.6 $\frac{20}{100}$✓ × 2 416✓ = 483✓/483,2
Accept range 10 – 20 AND adjust answer accordingly (3)
(15)

2.4 2.4.1 Genetic modification✓/engineering (1)

2.4.2 Pigs have been modified not to get a disease✓
therefore, more food will be available✓/increased food security/less money wasted on medication

Mosquitoes have been modified produce an offspring that will not reach adulthood✓
therefore, less diseases✓/less money wasted on medication

Cows have been modified to produce milk similar to human milk✓
therefore, healthier for humans✓/easier to digest

Chickens have been modified not to get a disease/Asian flu✓
therefore, more food will be available✓/increased food security/less money wasted on medication
(Mark first TWO only) Any (2 x 2) (4)
(5)
[50]

QUESTION 3

3.1 3.1.1
- Hands are free to pick or carry food✓/to use tools and handle weapons/any example.
- Standing upright gives a better, wider view ✓ of surroundings, a timelier warning of approaching predators or of potential prey.
- Movement becomes easier ✓and more energy efficient.
- A more vertical posture reduces the body's exposure to sunlight✓ when in an open area (60% less than for quadrupeds).
- It also raises a large percentage of the body away from the hot ground, where it is exposed to cooling breezes.✓
- In courtship behaviour, the male sex organ is readily displayed.✓ Any 4 (4)

3.1.2
- Foramen magnum is in a **more** forward position✓
- Spine is S-shaped✓
- Pelvis is short✓
- and wide✓/bowl-shaped (4)

3.1.3 *Homo sapiens*✓/*H. sapiens* (1)
(9)

3.2 3.2.1
- Taung child✓
- Mrs Ples✓
- Little foot✓

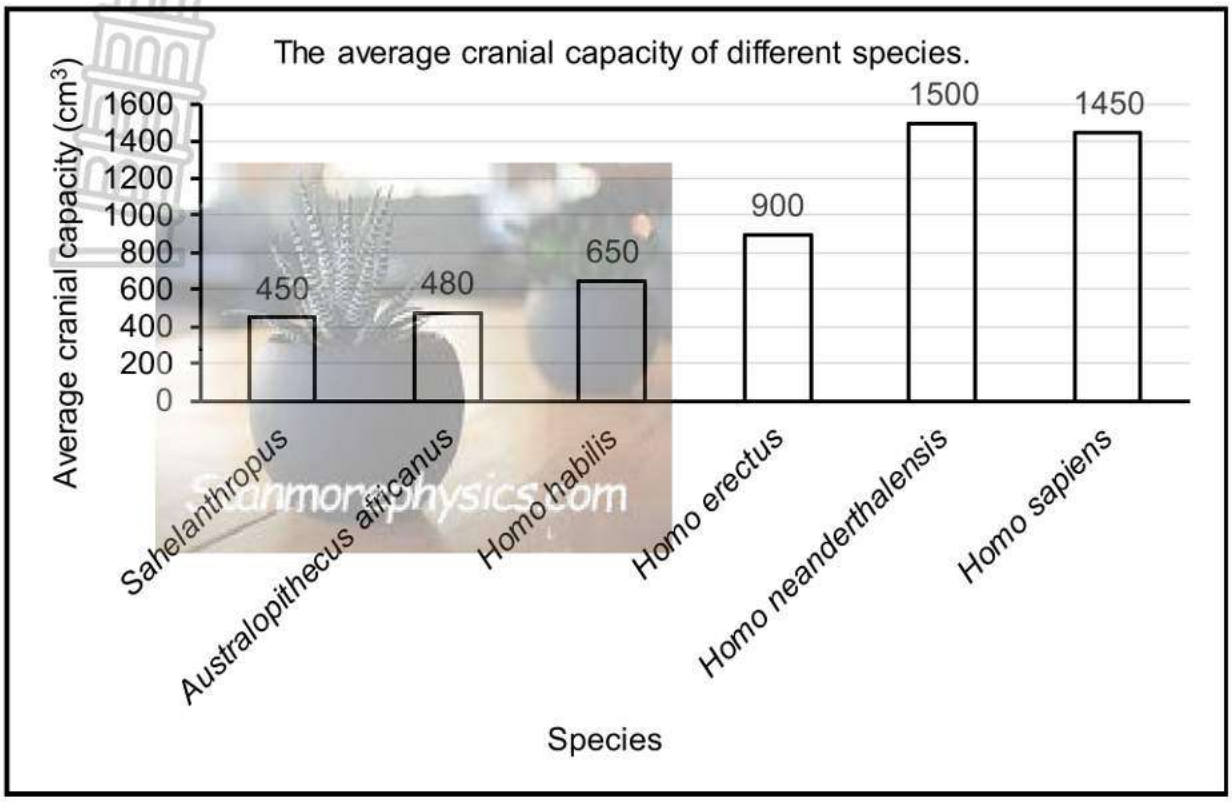
(Mark first TWO only) Any 2 (2)

3.2.2
- Genetic ✓evidence/ genetics
- Cultural ✓evidence (2)

3.2.3
- *Genetic evidence:*
- The **analysis of mitochondrial DNA**✓/(mtDNA)
-
- *Cultural evidence:*
- is the **development /use** of tools.✓/the use of fire/the use of art (2)

3.2.4 It increased in size✓/enlarged which means more intelligence✓ (2)

3.2.5



Guideline for assessing the graph:

Type: bar graph	**(T)**	1
Caption for graph (contains both variables)	**(C)**	1
Scale for Y-axis and width of the bars AND spaces for X-axis	**(S)**	1
Label for X-axis and label and unit for Y-axis	**(L)**	1
Drawing of the bars	**(B)**	1: 1-5 bars drawn correctly 2: All bars drawn correctly

NOTE:
If the wrong type of graph is drawn: - Marks will be lost for type **(T)**
If axes are transposed: - Marks will be lost for labelling **(L)**

(6)
(14)

3.3
- There is a great deal of **variation in hair colour**✓ in humans/among the offspring.
- Blond hair was caused by a mutation✓
- Some people had blond hair, and some did not✓
- There were more women than men✓ (Due to food shortages, many men died during hunting trips)
- This led to **competition**✓ for a mate
- People with blond hair (Blondes) were chosen✓
- above people with other colour hair✓/example of hair colour
- Reproduction took place✓
- and the **allele/gene for the blond hair** was passed to their offspring✓
- The next generation will therefore have a **higher proportion** of individuals with blond hair✓

Any 8 **(8)**

3.4 3.4.1
- All giraffes had short necks✓ originally
- Giraffes frequently stretched✓/used their necks to reach for leaves of tall trees✓
- necks become longer✓
- The long necks acquired✓ in this way could be passed on to the next generation✓/ were inherited

(6)

3.4.2 **Acquired characteristics**✓ are not inherited✓/do not cause any change to the DNA of an organism's gametes (sperms or ova)

OR

Organisms did not evolve because they want to evolve✓✓/ Lamarck's theory is deterministic (2)

(8)

3.5 3.5.1 (a) *A species* is a group of organisms with similar characteristics✓ that can interbreed to produce fertile offspring.✓ (2)

(b) *A population* is a group of organisms of the same species✓ living in the same habitat at the same time.✓ (2)

3.5.2
- Stamens contain pollen✓ grains in the anthers
- Removing stamens prevents self-fertilisation of Population **A**.✓
- It ensures pollination from Population **B**. ✓

Any 2 (2)

3.5.3	- (Same) amount of water✓ used on both populations - (Same) distance between the planted seeds✓ - (Same) type of soils used✓ - (Same) environmental conditions✓/amount of light/ temperature for both populations - (Same) size of pots✓/containers	Any 2	(2)
3.5.4	- Increase the sample size (more seeds) for each of the populations✓ - Repeat the investigation✓ **(Mark first ONE only)**	Any 1	(1)
3.5.5	Population **A** and **B** are not the same species✓/are two different species.		(1)
3.5.6	None of the seeds germinated.✓/Inability to produce fertile seeds.		(1)
			(11)
			[50]

TOTAL SECTION B:	**100**
GRAND TOTAL:	**150**