basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2022

MARKS: 150

TIME: 2½ hours

Stanmorephysics

This question paper consists of 15 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 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 must use a non-programmable calculator, protractor and a compass, where necessary.
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–D) next to the question numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, e.g. 1.1.10 D.

1.1.1 The scientist who discovered the fossil 'Karabo' (*A. sediba)*:

A Robert Brown
B Lee Berger
C Raymond Dart
D Ronald Clarke

1.1.2 Which ONE of the following is a source of variation that occurs during normal meiosis?

A Random mating
B Random arrangement of chromosomes
C Chromosomal mutations
D Cloning

1.1.3 How many sex chromosomes does a normal human female inherit from her mother?

A 1
B 2
C 23
D 46

1.1.4 During which phase of meiosis does the nuclear membrane disappear?

A Metaphase
B Telophase
C Prophase
D Anaphase

1.1.5 Which ONE of the following is an example of discontinuous variation in humans?

A Height
B Heart rate
C Gender
D Weight

1.1.6 For a particular characteristic, the offspring inherits …

A one allele from the mother and one allele from the father.
B both alleles from the father.
C both alleles from the mother.
D the alleles from either the mother or the father randomly.

1.1.7 Which ONE of the following is CORRECT for speciation through geographic isolation?

A The populations undergo phenotypic changes only.
B Each population undergoes natural selection independently.
C The conditions on each side of the geographic barrier are the same.
D The new species formed are genotypically the same as the original species.

1.1.8 Below is a list of events that occur during cell division.

(i) Homologous chromosomes line up at the equator of the cell.
(ii) Chromatids are pulled to opposite poles of the cell.
(iii) Chromosome pairs arrange themselves randomly at the equator of the cell.
(iv) Individual chromosomes line up at the equator of the cell.

Which ONE of the following combinations occur in both meiosis and mitosis?

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

1.1.9 A short piece of DNA, containing 19 nucleotides in each strand, was analysed. The number of some of the different nitrogenous bases in each strand is shown below.

	Number of nitrogenous bases			
	A	**T**	**G**	**C**
Strand 1	8	-	-	-
Strand 2	-	8	3	4

How many nucleotides containing thymine (**T**) were present in strand **1**?

A 8
B 4
C 6
D 2

(9 x 2) **(18)**

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question numbers (1.2.1 to 1.2.9) in the ANSWER BOOK.

1.2.1 The process of change in the characteristics of biological species over time

1.2.2 The type of bonds between nitrogenous bases in a DNA molecule

1.2.3 The structure that joins two chromatids of a chromosome

1.2.4 The division of the cytoplasm of a cell during cell division

1.2.5 The process during meiosis where there is an exchange of genetic material between chromatids

1.2.6 The structures in animal cells that give rise to spindle fibres during cell division

1.2.7 Similar structures that are inherited from a common ancestor and are modified for different functions

1.2.8 The phase in the cell cycle during which DNA replication takes place

1.2.9 The organelle where translation occurs during protein synthesis

(9 x 1) **(9)**

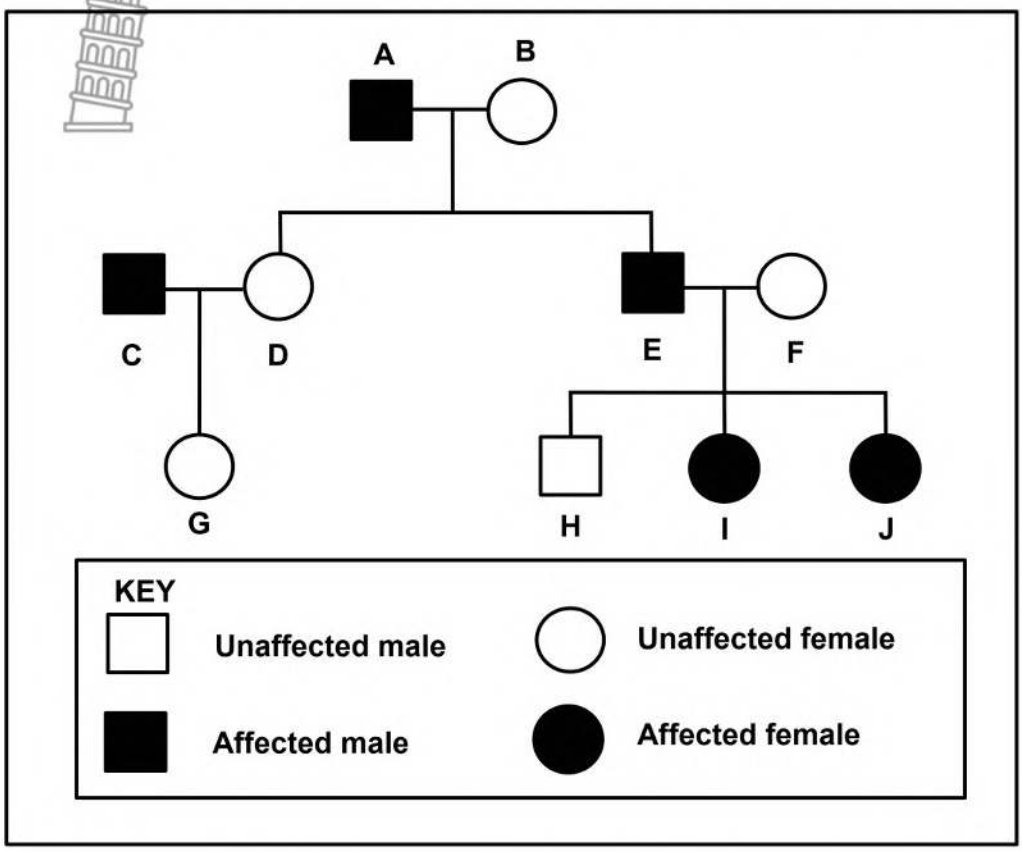
1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Type of evolution characterised by long periods of little or no change alternating with short periods of rapid change	A: Artificial selection B: Punctuated equilibrium
1.3.2	A plant with white flowers that is crossed with a plant with red flowers and produces offspring with pink flowers	A: Incomplete dominance B: Complete dominance
1.3.3	The separation of alleles during gamete formation	A: Law of Dominance B: Principle of Segregation

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

1.4 Moyamoya is a disorder caused by a dominant allele (**R**). This disorder damages the arteries supplying blood to the brain.

The pedigree diagram below shows the inheritance of Moyamoya in a family.



1.4.1 How many generations are represented in the diagram? (1)

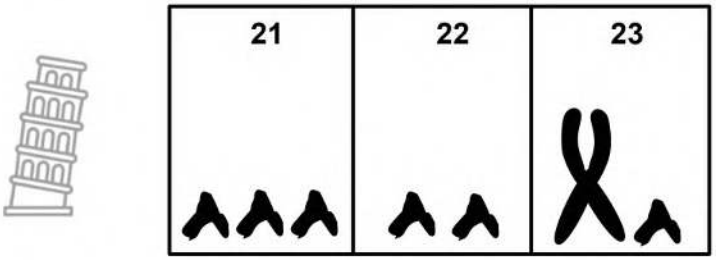
1.4.2 Give the:

(a) LETTER(S) of unaffected males (1)

(b) Genotype of individual **A** (1)

(c) LETTER(S) of individuals not biologically related to **A** and **B** (2)
(5)

1.5 The diagram below represents part of an abnormal human karyotype.



1.5.1 How many autosomes are shown in the diagram? (1)

1.5.2 Name the type of chromosomes represented by pair **23**. (1)

1.5.3 Name the:

(a) Disorder represented in the diagram (1)

(b) Process during anaphase of meiosis that resulted in the abnormal number of chromosomes in this karyotype (1)

1.5.4 State the gender of the person represented in this karyotype. (1)
(5)

1.6 In rabbits, brown fur (**B**) is dominant to white fur (**b**) and long ears (**E**) is dominant to short ears (**e**).

A rabbit, that is heterozygous for both characteristics, is crossed with a white rabbit with short ears.

1.6.1 Name the type of cross represented. (1)

1.6.2 Give the:

(a) Phenotype of a rabbit that is dominant for both characteristics (2)

(b) Genotype of the white rabbit with short ears (2)

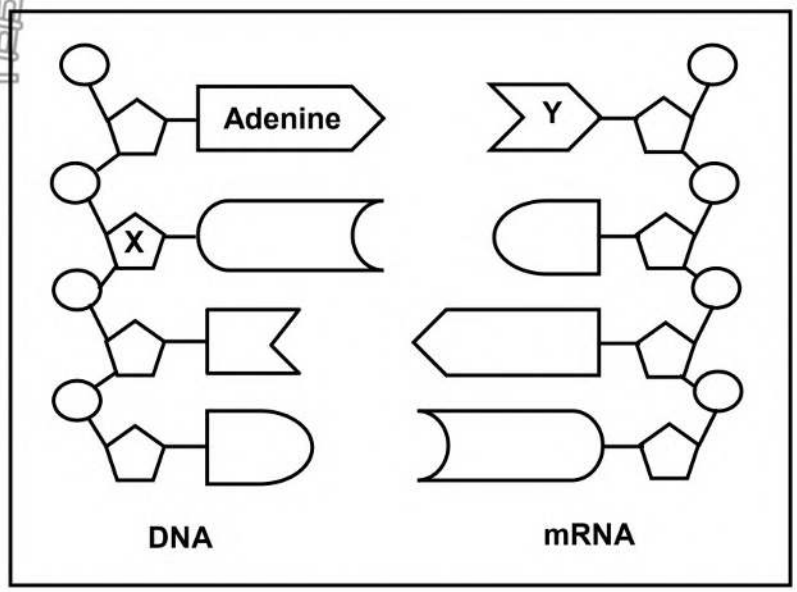
(c) Genotype of the gametes of a heterozygous brown rabbit with short ears (2)
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents transcription during protein synthesis.



2.1.1 Name the part of the cell where this process occurs. (1)

2.1.2 Identify:

(a) Sugar **X** (1)

(b) Nitrogenous base **Y** (1)

2.1.3 Tabulate TWO differences between *transcription* and *DNA replication*. (5)
(8)

2.2 A mutation has occurred on a section of an mRNA molecule as shown below.

Original sequence	AUG GAA AUA CCG CCA GGA
Mutated sequence	AUG GAA AUA CUG CCA GGA

2.2.1 Name the type of mutation that has occurred. (1)

2.2.2 Give a reason for your answer to QUESTION 2.2.1. (1)

2.2.3 The table below shows some mRNA codons and the amino acids that they code for.

mRNA codon	Amino acid
AUA	Isoleucine
AUG	Methionine
CCA	Proline
CCG	Proline
CUG	Leucine
GAA	Glutamic acid
GGA	Glycine

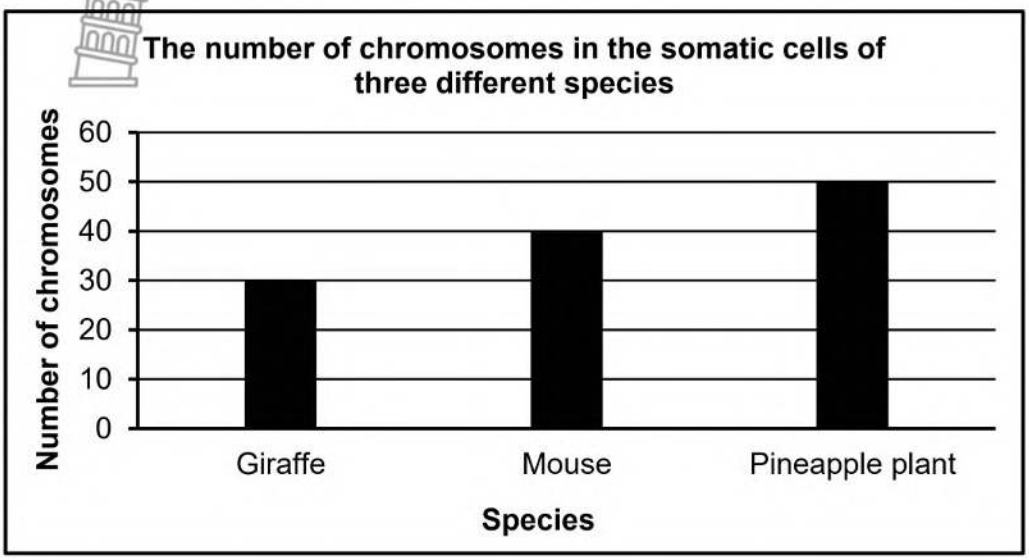
(a) State the number of different amino acids coded for by the original sequence of the mRNA molecule given above. (1)

(b) Give the anticodon on the tRNA molecule that carries the amino acid isoleucine. (1)

(c) Use information in the table to describe the effect of the mutation on the protein formed. (4)
(8)

2.3 The number of chromosomes in the somatic cells of organisms differs from species to species.

The graph below shows the number of chromosomes in each somatic cell of THREE different species.



2.3.1 How many chromosomes will be present in:

(a) Mouse cells during Telophase II of meiosis (1)

(b) A leaf cell of a pineapple plant (1)

2.3.2 Explain why the sperm cell of a giraffe has 15 chromosomes. (4)

2.3.3 Name the phase of meiosis where the halving of the chromosome number begins. (1)

2.3.4 Describe the events in the phase named in QUESTION 2.3.3. (3)
(10)

2.4 The table below shows information about blood groups in a certain population.

BLOOD GROUP	NUMBER OF PEOPLE	PERCENTAGE OF THE POPULATION
O	954 000	53
A	**X**	34
B	180 000	10
AB	54 000	3

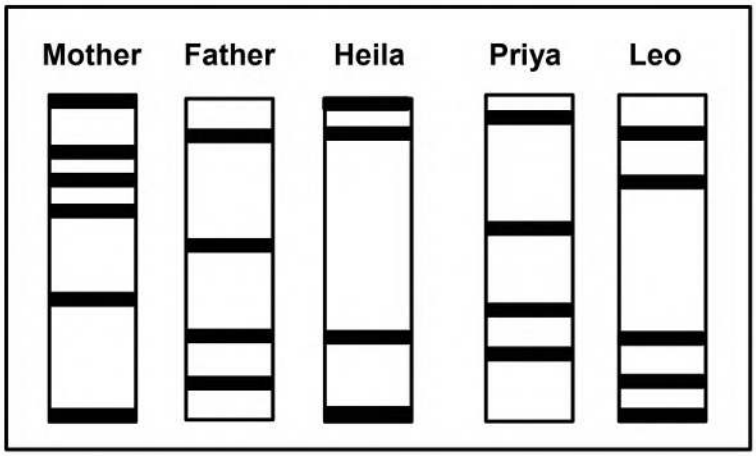
2.4.1 How many people have the genotype ii? (1)

2.4.2 The population size is 1 800 000.

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

2.4.3 Describe how a child inherits the blood group represented by 3 per cent of this population. (3)
(7)

2.5 The diagram below represents the DNA profiles of three children and their parents. Only two of the children are their biological children and one is adopted.



2.5.1 Identify the TWO biological children. (2)

2.5.2 Explain your answer to QUESTION 2.5.1. (2)

2.5.3 State THREE other uses of DNA profiling. (3)
(7)

2.6 Brown enamel of the teeth is a sex-linked trait. A dominant allele on the **X** chromosome causes brown teeth in humans.

2.6.1 Explain why more males than females have white teeth. (4)

2.6.2 A man with brown teeth married a woman with white teeth.

Use a genetic cross to show the possible phenotypic ratios of their children. Use $\mathbf{X^B}$ for brown teeth and $\mathbf{X^b}$ for white teeth. (6)
(10)
[50]

QUESTION 3

3.1 Read the extract below.

> When a child is born, the umbilical cord is cut and stem cells can be obtained from it. Many people think that the stem cells for treating human conditions should be obtained from umbilical cords, rather than from human embryos.
>
> Recently, stem cells have also been obtained from bone marrow. These stem cells are used to treat conditions such as heart disease and spinal injuries.

3.1.1 Name THREE sources of stem cells mentioned in the extract. (3)

3.1.2 Explain why the characteristics of stem cells make them useful for treating some disorders. (2)

3.1.3 Name ONE condition in the extract that can be treated with stem cells. (1)
(6)

3.2 Read the extract below.

> Samango and vervet are two species of monkeys that occupy the same habitat. Researchers have recently discovered that a population of samango monkeys were able to interbreed with vervet monkeys to produce offspring. These offspring were infertile.

3.2.1 Define the term *population.* (3)

3.2.2 Give ONE reason why samango and vervet monkeys are considered to be two different species. (1)

3.2.3 List THREE mechanisms of reproductive isolation that are NOT mentioned above. (3)
(7)

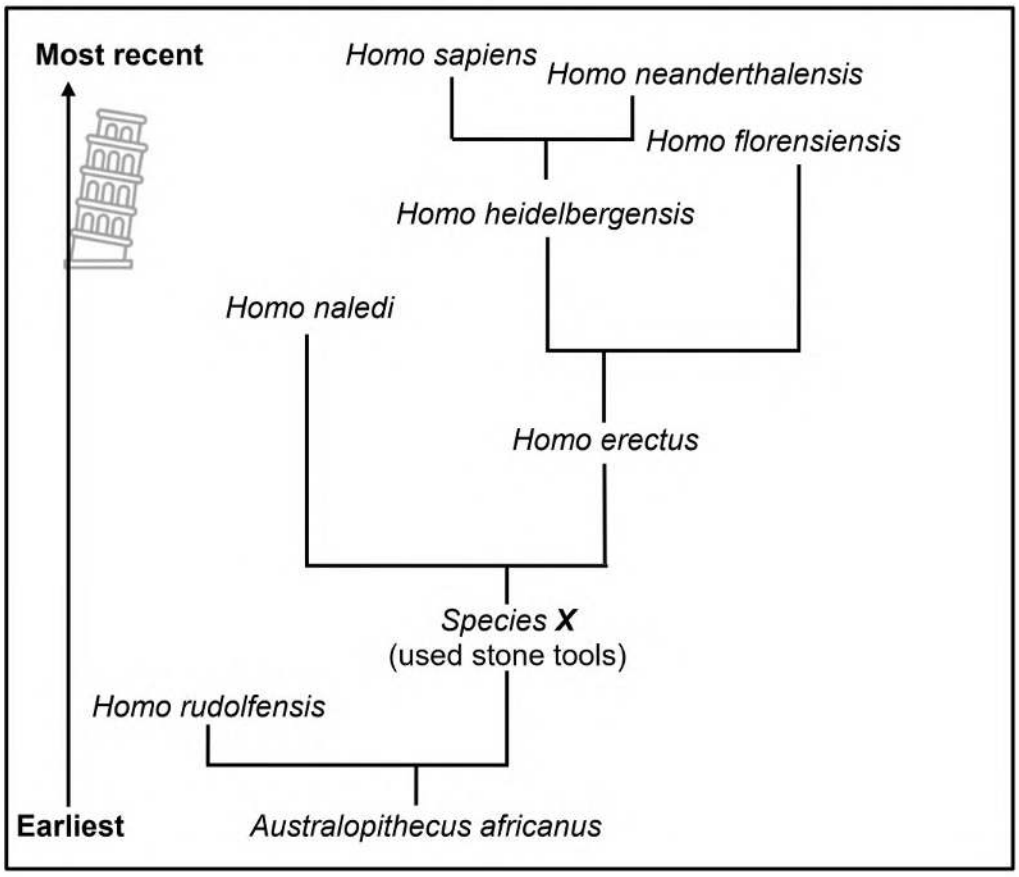
3.3 Scientists find evidence for human evolution by comparing humans to other hominids. The upper limbs of humans and African apes show similar characteristics, whereas there are differences between the dentition (teeth) of the two.

3.3.1 Why do scientists look for similarities between humans and African apes? (1)

3.3.2 Explain the importance of the positioning of the thumbs for humans and African apes. (2)

3.3.3 State ONE difference between the teeth of humans and African apes. (2)
(5)

3.4 The diagram below represents one model of the evolution of some hominids.



3.4.1 Identify the type of diagram shown. (1)

3.4.2 How many genera are represented by the diagram? (1)

3.4.3 Name the species:

(a) Represented by **X** on the diagram (1)

(b) That shares a common ancestor with *Homo erectus* (1)

3.4.4 Which species of the genus *Homo* is the only one in existence today? (1)

3.4.5 Name TWO forms of evidence that would have been used to support the information in the diagram. (2)

3.4.6 The average cranial capacity of *Homo sapiens* is 1 500 cm^3 compared to 520 cm^3 in *Australopithecus africanus*.

Explain the significance of the difference in cranial capacity. (3)

3.4.7 Explain how the fossils of *Australopithecus africanus*, *Species* ***X*** and *Homo erectus* are used to support the 'Out of Africa' hypothesis. (4)
(14)

3.5 Modern-day whales are aquatic mammals, spending their entire lives in the ocean. They are thought to have evolved from four-legged ancestors, as represented below.

SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
Pakicetus 	50 mya	Quadrupedal carnivore
Ambulocetus 	48 mya	Flipper-like large feet and tail for swimming
Dorudon 	40 mya	Large flippers in front and very small hind limbs
***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

3.5.1 Which ancestor of whales most likely lived both in water and on land? (1)

3.5.2 Give ONE reason for your answer to QUESTION 3.5.1. (2)

3.5.3 Explain why *Ambulocetus* and *Dorudon* may be considered as transitional species in the evolution of whales. (2)

3.5.4 Explain, according to Lamarck, why modern-day whales do not have legs. (3)
(8)

3.6 Patients infected with the HI virus (HIV) are treated with antiretroviral drugs. When they miss their treatment, it can increase the chances (probability) of the virus developing resistance to the drug.

Scientists conducted an investigation to determine the effect of the number of missed treatments on the probability of the HI virus developing resistance to antiretroviral drugs.

The results are shown in the table below.

Number of missed treatments (in days)	Probability of the HI virus developing resistance to antiretroviral drugs (%)
2	0
7	20
14	35
21	40
37	60

3.6.1 State the following for this investigation:

(a) The dependent variable (1)

(b) The independent variable (1)

3.6.2 Based on the results, state ONE precaution for patients receiving antiretroviral treatment. (1)

3.6.3 State a conclusion for this investigation. (2)

3.6.4 Describe the evolution of resistance to antiretroviral medication in the HI virus. (5)
(10)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

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