2022 NSC CHIEF MARKER'S REPORT

SUBJECT	LIFE SCIENCES		
QUESTION PAPER	1	**2 X**	3
DURATION OF QUESTION PAPER	2½ HOURS		
PROVINCE	EASTERN CAPE		
DATES OF MARKING	07-22 DECEMBER 2022		

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The general performance of the learners was evaluated from a sample of 100 scripts from the 12 districts in the province covering the low, mediocre and high performance. Only one script was sampled per centre to allow sampling over a wide range of centres.

The range of the sampled scripts was distributed as follows:

Low Performance (Level 1 - Level 2 i.e., 0-59 marks) scripts   - 30

Mediocre Performance (Level 3- Level 5 i.e., 60-104 marks) scripts   - 40

High performance (Level 6 to Level 7 i.e., 105-150 marks) scripts   - 30

The graph below depicts the average performance of the learners per question and average performance in the paper as a whole:

Life Sciences P2
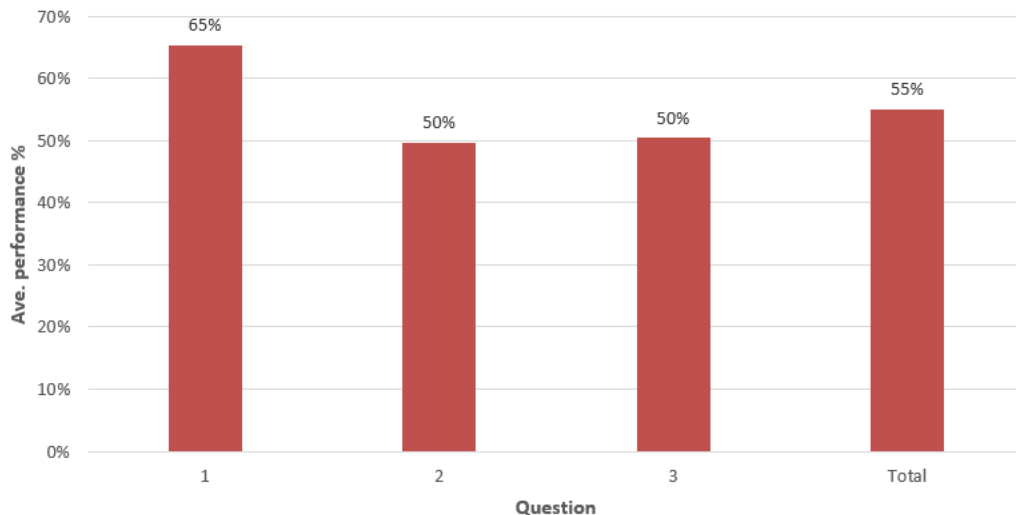
The overall average performance of the sampled learners has improved by 3% compared to 2021. The learners performed best in Question 1, which correlates with the 2021performance. The performance in Question 2 was slightly lower than the performance in 2021. Hover, the learner performance in Question 3 was 11% higher than in 2021. Most questions in this question come from the topic of evolution. This shows that learners are improving in answering questions relating to evolution.

The graph below depicts the learner average performance per sub-question.

Life Sciences P2
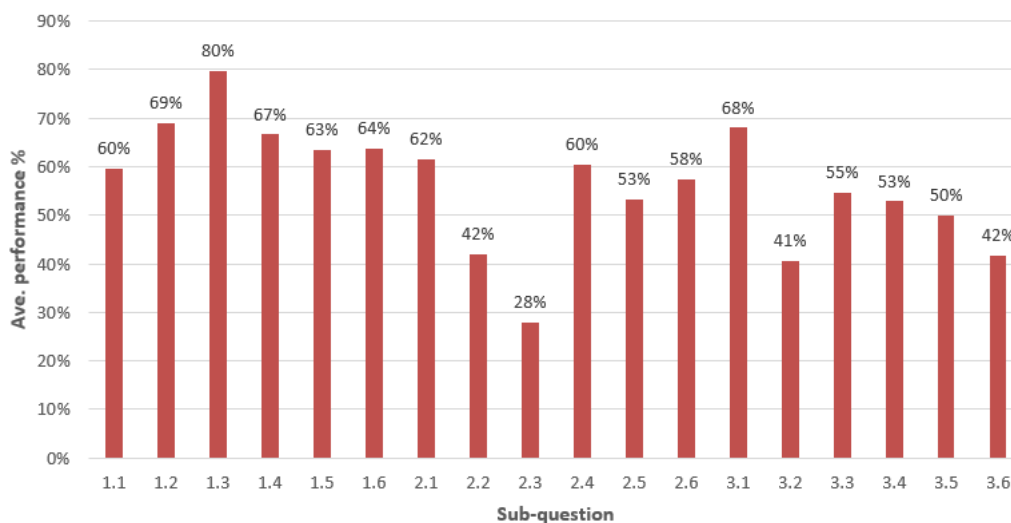
As can been seen from this graph, learners performed well in Question 1 with the best performance in question 1.3 which is based on matching items and statements, followed by Question 3.1 based on an extract on stem cells. The most poorly answered questions (i.e. below 50%) are:

− Question 2.3 (28%) based on Meiosis
− Question 3.2 (41%) based on an extract highlighting the concepts of species vs population and reproductive isolation mechanisms.
− Question 2.2 (42%)based on Mutation during protein synthesis
− Question 3.6 (42%) based on a scientific investigation and evolution in the present times

SECTION 2: Comment on candidates' performance in individual questions

QUESTION 1

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The overall performance was average. Question 1.3 was well answered by most learners. Performance in terminology has improved, although a few learners still confuse centrosome with centromere and homologous with homozygous. Question 1.1 was the worst performed.

The table below shows the breakdown of learner performance in sub questions as follows:

SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
Average mark from the sample of 100 scripts:		
1.1	MCQ	60
1.2	TERMINOLOGY	69
1.3	AB MATCHING	80
1.4	PEDIGREE DIAGRAM	67
1.5	ABNORMAL MEIOSIS & HUMAN KARYOTYPE	63
1.6	DIHYBRID CROSS	64

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Questions 1.1.8 learners could not differentiate between events of meiosis I and mitosis.

Question 1.1.9 was a calculation based on application of complementary base pairing. Learners failed to read the information given in the stem of the question.

Question 1.2.9 was misunderstood by some learners. They stated the site of translation in a cell instead of the organelle in which translation occurs.

Question 1.4.1. A few learners struggled to answer this sub-question based on determining the number of generations shown on a pedigree diagram. Most excluded the parental generation and gave the answer as two generations instead of three generations. Most learners could not provide the genotype of individual A.

Question 1.4.2 (b) Most assumed that the question was based on sex-linked inheritance and gave the genotype X^RY. This indicates that some learners are still having a challenge in the interpretation of pedigree diagrams.

Question 1.5.1 based on part of an abnormal human karyotype was poorly answered. Learners gave their answers as if they were provided with a full human karyotype and therefore assuming that there were 22 autosomes instead of the five shown in the diagram. A few learners could not identify the gender from the karyotype.

Question 1.6 most learners could identify the type of cross as the dihybrid cross. However, many could not work out the genotype for a given phenotype of an organism as well as the genotype of the gametes.

(c) Provide suggestions for improvement in relation to Teaching and Learning
- Training of teachers on the approach on how to teach meiosis, highlighting the events that take place during Meiosis I and II as well the differences between the two divisions.
- Mini workshops on problematic areas in Genetics e.g. interpretation of Pedigree diagrams, dihybrid crosses.
- Learners should be provided with examination guidelines before a particular topic is taught. This will give them clear guidance on the terminology to mastered per sub-topic as well content they should know and learn for exams.
- Teachers must always consult Chief Marker's and Diagnostic reports and apply all the necessary recommendations in their teaching.
- Teachers should extract topic focused questions from previous year's question papers and use these for informal assessment so that learners acquire question interpretation skills and to mitigate against confusing related terminologies.
- Proper feedback should be given by the teacher on any assessment done by the learners.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
- Some learners show gaps in certain topics
- Subject Advisors should develop teachers that are teaching Life Sciences and may not necessarily be qualified for teaching the subject.
- Frequent monitoring of teachers by Subject Advisors and give guidance as soon as possible.
- Teacher Development training workshops on problematic topics.

QUESTION 2

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was generally fairly answered, although there seemed to be challenges in questions that needed explanations and descriptions. Strong learners managed to score over 40 marks but some learners scored less than 10 marks. All learners attempted the question. The average for the whole question was 50% which is 3% lower than the performance in Question 2 in 2021. The range of marks from the 100 sampled scripts was 8 to 49 out of 50 and 51% of the learners obtained 50% and above in this question.

The average performance per sub-question is tabled below:

AVERAGE MARK FROM THE SAMPLE OF 100 SCRIPTS		
SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
2.1	PROTEIN SYNTHESIS	62
2.2	MUTATION DURING PROTEIN SYNTHESIS	42
2.3	APPLICATION OF MEIOSIS	28
2.4	GENETICS: BLOOD GROUPS	60
2.5	DNA PROFILING	53
2.6	GENETIC CROSS: SEX-LINKED INHERITANCE	58

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

2.1.3 A few learners did not present their answer in the form of a table. Most of them wrote the whole process and could not extract the differences in the processes. Some wrote differences between RNA and DNA. For DNA replication, most learners wrote" an identical strand of DNA is formed" instead of two identical DNA molecules are formed. Some learners wrote 'a double stranded molecule is formed which actually refers to one DNA molecule.

2.2.1 Quite a number of learners referred to the type of mutation as a Point mutation. This shows that teachers are not exposing learners to the current examination guidelines which suggest that reference should be made only to two types of mutations i.e. gene mutations and chromosomal mutations. Some learners lost a mark because they referred to genetic mutations, which include both gene mutations and chromosomal mutations.

2.2.2 & 2.2.3 (c) Learners gave general answers, not specific to the question. Instead of describing the exact change and position of the mutation that occurred in the codon/anticodon, they generalized without referring to the specific codons/anticodons. Some learners knew that there was a change in amino acids but did not specify the amino acids that changed.

2.3.2 Most learners wrote that 'a sperm with 15 chromosomes fuses with an ovum with 15 chromosomes to form a diploid zygote with 30 chromosomes. However, they did not indicate that this is to prevent the double effect of fertilization, thus maintaining a constant chromosome number within a species. This is stated on page 9 of the 2021 examination guidelines under the importance of meiosis. Many learners did not refer to the sperm as a gamete/sex cell. Some learners

wrote that the sperm is formed by spermatogenesis. However, that was not credited for, as spermatogenesis includes both mitosis and meiosis and the focus of the question was on the halving of the chromosome number from 30 to 15 through meiosis. A common misconception was that 'a sperm cell undergoes meiosis

2.3.3 Many learners misunderstood the question and identified the phase incorrectly as Telophase I, which is the phase during which the cell splits into two daughter cells after the halving of chromosome number has taken place during Anaphase I. Some learners identified the phase as Anaphase but did not indicate whether it was Anaphase I or Anaphase II.

2.3.4 Most learners, even those who identified the phase correctly in Question 2.3.3, failed to describe the events of Anaphase I. Most learners wrote 'chromosomes are pulled to the opposite poles" without indicating that the homologous pairs first separate or are pulled apart and then move to the opposite poles. This resulted in many learners losing a mark for the second bullet in the answer. Some learners referred to the spindle fibres that constrict which shows that they confuse the terms contract vs constrict; where constrict relates to the narrowing usually of blood vessels and the pupil in the eye.

2.4.3 Many learners could identify the child's blood group as AB as given in the table. However, they did not make reference to the alleles contributed by each parent to produce a child with the genotype for blood group AB (I^AI^B). Many learners seemed unable to differentiate between the phenotype and alleles, as result they wrote about inheritance of blood group A from one parent and blood group B from the other parent. A few learners drew a genetic cross without giving a description

2.5.1 Most learners correctly identified the two biological children.

2.5.2 Most learners could not explain their answer based on comparison of the DNA bands of the children to those of the parents. All the DNA bands of the biological children had to be accounted for when compared with DNA bands of both parents. A common misconception was that the DNA profile of the children is same as the DNA profile of the parents which is incorrect as each individual's DNA profile is unique. However, if individuals are related, they may have DNA bands of the same width at the same position.

2.5.3 Many learners failed to correctly state other uses of DNA profiling other than those mentioned in the question i.e. Paternity testing and identification of relatives. Some wrote to develop cures for genetic disorders instead of identifying genetic disorders. Some wrote to solve crime instead of identify suspects in crime. For organ transplants instead of identification of matching tissues for organ transplant.

2.6.1 Learners could not identify that white teeth is caused by a recessive allele by deducing from the information given in the question stating that brown teeth is caused by a dominant allele. Most explained in terms of the dominant allele causing brown teeth rather than the recessive allele.
Most wrote a whole lot but managed to get only two marks out of four marks for mentioning 2 X for females and one X chromosome for males. Some learners referred to "affected" not the colour of the teeth. Some described the X

chromosome as being recessive and wrote a males has one recessive X-chromosome not allele

2.6.2 When writing the phenotype, some learners left out the gender of the P1 parents even though this was stated in the question. This was required as this question was based on sex-linked inheritance. Learners just wrote brown teeth x white teeth. Some learners could not write the correct genotypes for the parents. For example they wrote X^BY^B x X^bX^b. Most learners did not give the ratio in its simplest form as 1:1. They left it at 2:2 and some wrote it as 50%:50% and they lost the compulsory mark.

(c)   Provide suggestions for improvement in relation to Teaching and Learning
- Teachers must not overlook the revision of the schematic outline of the human life cycle to show the role of meiosis, mitosis and fertilisation as part of the introduction to human reproduction. This will further assist learners to understand the concept of prevention of doubling effect of fertilisation and maintenance of a constant chromosome number from generation to generation.
- For tabulation the differences must correlate
- Teachers must always use examination guidelines, Chief Marker's reports and Diagnostic reports in lesson preparation.
- Learners must be exposed to the meaning of action verbs used in questions. Teachers the explanations of these action verbs in Abridged Section 4 Caps implemented in 2020 in Grade 10 & 11 and in 2021 in Grade 12.

(d)   Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
- Information sharing meeting where markers share with non-markers and Chief Markers reports are mediated for understanding.
- Copies of examination guidelines to be given to learners.

QUESTION 3

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was well attempted by most learners. The question was balanced with lower and higher order questions. Some learners struggled with questions that need interpretation and application.

Performing learners answered all the questions well some attaining 50/50 marks. However, weaker learners struggle to understand the different action verbs e.g. list, name, explain, discuss. The average for the whole question was 50% and this is 11% higher than the average performance in this question in 2021. The range of marks from the sampled learners was from 5 to 49 marks out of 50.

The average performance per sub-question is shown in the table below:

AVERAGE MARK FROM THE SAMPLE OF 100 SCRIPTS		
SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
3.1	EXTRACT ON STEM CELLS	68
3.2	EXTRACT ON THE CONCEPTS SPECIES VS POPULATION AND MECHANISMS OF REPRODUCTIVE ISOLATION	41
3.3	HUMAN EVOLUTION: SIMILARITIES & DIFFERENCES BETWEEN HUMANS & AFRICAN APES	55
3.4	HUMAN EVOLUTION: PHYLOGENETIC TREE	53
3.5	EVOLUTION OF WHALES & LAMARCKISM	50
3.6	EVOLUTION IN PRESENT TIMES	42

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

3.1.1 Learners lacked the skill of extracting information from the text. Instead of naming the sources of stem cells, some rewrote the paragraph as is.

3.1.2 Learners do not know the definition of stem cells as they could not explain why they are used in treating some disorders.

3.2.1 Very few learners obtained 3 marks for the definition of a population. Many learners referred to the same species being in the same habitat and left out that they should be existing at the same time. Some learners wrote about different species in the same habitat which is the definition of a community.

3.2.3 Many learners listed sources of variation as some responses include random mating/fertilisation. It was clear that some learners were not exposed to the examination guidelines as they wrote about such things as habitat isolation, courtship behaviour instead of species-specific courtship behaviour. Some learners confused this with speciation, responding with geographical barrier, biogeography etc.

3.3.1 Many learners wrote such things 'to find evidence for human evolution' to

prove humans evolved from apes" instead of to show that humans and apes share a common ancestor.

3.3.3 Mostly well answered although some referred to jaws/prognathism/shape of palate/ longer/sharper K-9's vs small K9's/K-nines

3.4.1 Learners struggle to spell phylogenetic. Some learners were lost the mark for writing polygenetic tree, phylogenic tree phylogenetic diagram.

3.4.2 Some learners cannot differentiate between genus and species. Some wrote 9 (species); 8 (all but X).

3.4.3 Strong candidates answered well. Weaker learners picked from the diagram and made up their own e.g. *Homo africanus, Homopithecus*

3.4.5 Confused evidence to support theory of evolution versus evidence to support trend in human evolution. Some of the responses written by learners included modification by descent, biogeography, genetic evidence from mitochondrial DNA

3.4.7 Learners are not clear about the fossil evidence which supports the Out of Africa although in the examination guidelines it is stated which fossils were only found in Africa and which oldest fossils are found in Africa implying that the youngest have been found outside of Africa. Many wrote fossils/ organisms originated in Africa instead of modern humans originate in Africa.

3.5.2 Learners failed to extract the relevant characteristics from the table to support their answer in 3.5.1 Many learners omitted flipper-like or large in describing the feet of Ambulocetus.

3.5.3 Learners are unable to define what is a transitional species and therefore could not explain it in the context of the question. Some learners compared different characteristics between the transitional species and the ancestor and between the transitional species and the present-day species. For example, they compare the feet of the transitional species with the ancestral species and compared the tail with the present-day species. Learners were supposed to compare shared/intermediate characteristics between transitional species and the ancestral species as well as the present-day species.

3.5.4 A few learners confused Lamarckism and Darwinism and some wrote about speciation. Most learners gave their explanation in terms of the flippers developing and being the acquired characteristic instead of referring to the absence of legs. Some learners referred to the inheritance of a gene for the absence of legs which is in line with Darwin's theory of evolution through natural selection. Some learners named the two laws of Lamarck without applying them to the question.

3.6.1 There are a few learners who are still confusing the independent and dependent variable in a scientific investigation. In naming the dependent variable, some learners omitted probability and some even referred to percentage chance of HIV developing resistance to antiretroviral drugs. In naming the independent variable they wrote the effect of the number of missed treatments which is referring to the dependent variable rather than the independent variable which was the number of missed treatments. Learners failed to extract the variables from the aim of the investigation.

3.6.3 In stating the conclusion most learners could not show the relationship

between the independent and dependent variable i.e. describe how the change/increase in the number of missed treatments affected the probability of the HI virus developing resistance to antiretroviral medication. Some learners incorrectly described the relationship between the variables as being directly proportional, implying that the increments were equal, which was not the case when analysing the given data.

3.6.4 Some learners completely misunderstood the question and focused on the variation in patients rather than variation of the virus. Some learners were referring to bacteria which shows that they use viruses and bacteria interchangeably and are not clear about the different types of microorganisms which is work done in Grade 11. Some learners gave a general description of natural selection and referred to viruses with the favourable or unfavourable characteristics. A few learners wrote about speciation. Some learners explained how the virus develops resistance to antiretroviral medication without applying the theory of natural selection.

(c)   Provide suggestions for improvement in relation to Teaching and Learning
- Teachers must consult examination guidelines and prepare adequately for lesson preparation.
- Emphasis should be placed on the following:
  – Terminology
  – Definitions
  – Scientific investigations (determining variables)
- Consolidate work after a concept by doing informal assessment with learners.
- Language across the curriculum for learners to understand concepts better.
- Train learners to read questions with understanding, underlining key words/phrases as they read.
- Learners must be taught how to respond to action verbs used in Life Sciences questions e.g. Explain – requires a cause and effect response.
- Learners must be cautioned against using slang language when writing examinations. No marks are awarded for writing K-nines for canines.

(d)   Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
- Learners struggle to differentiate between concepts. It is evident that many learners have only heard certain terms and never seen them (phonetic spelling)
- Focus on terms and definitions
- Do regular informal assessments with a variety of questions
- Guide learners on how to use given information, or how to study a diagram and answer questions based on the diagram.
- Extract questions from past papers to expose learners to exam-type questions pitched at different cognitive levels and levels of difficulty and not only rely on textbook activities.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2022

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 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 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: B:	Artificial selection 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: B:	Incomplete dominance Complete dominance
1.3.3	The separation of alleles during gamete formation	A: B:	Law of Dominance 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.
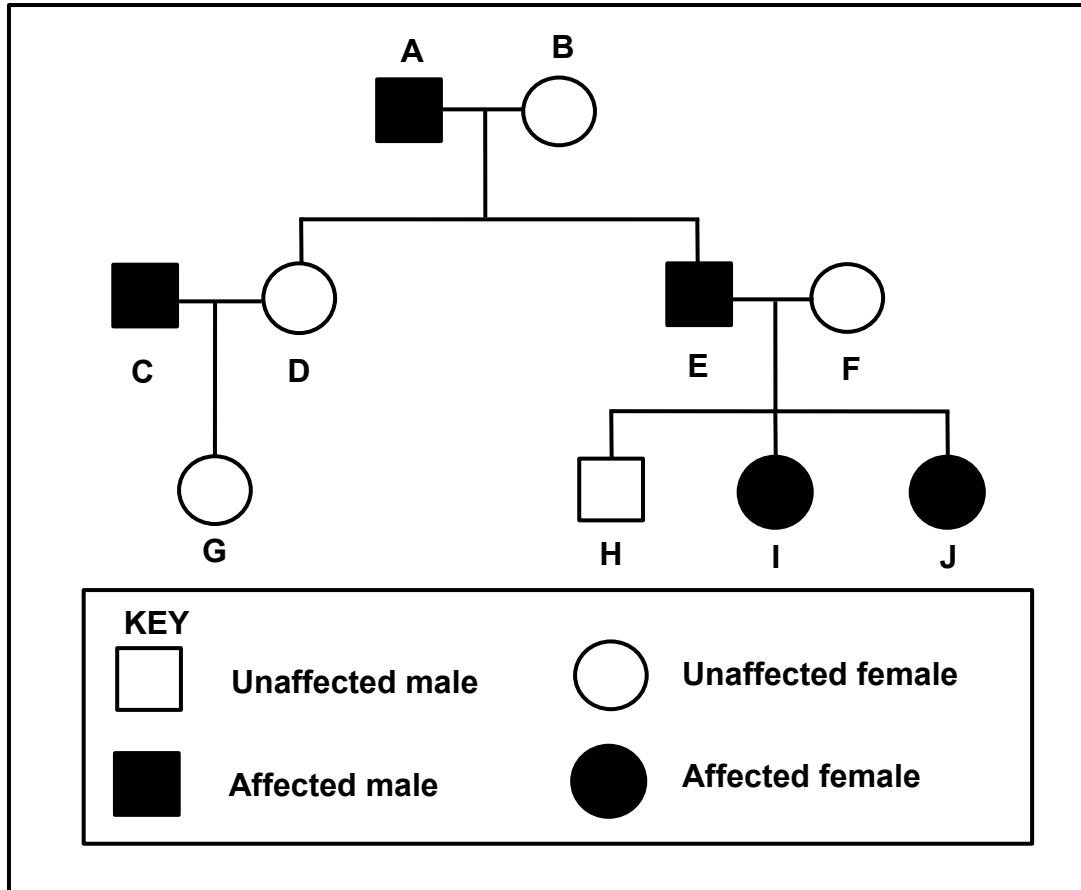
1.4.1　　How many generations are represented in the diagram?　　(1)

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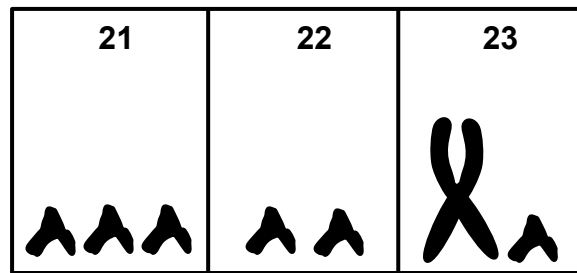
1.5.1   How many autosomes are shown in the diagram?   (1)

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.

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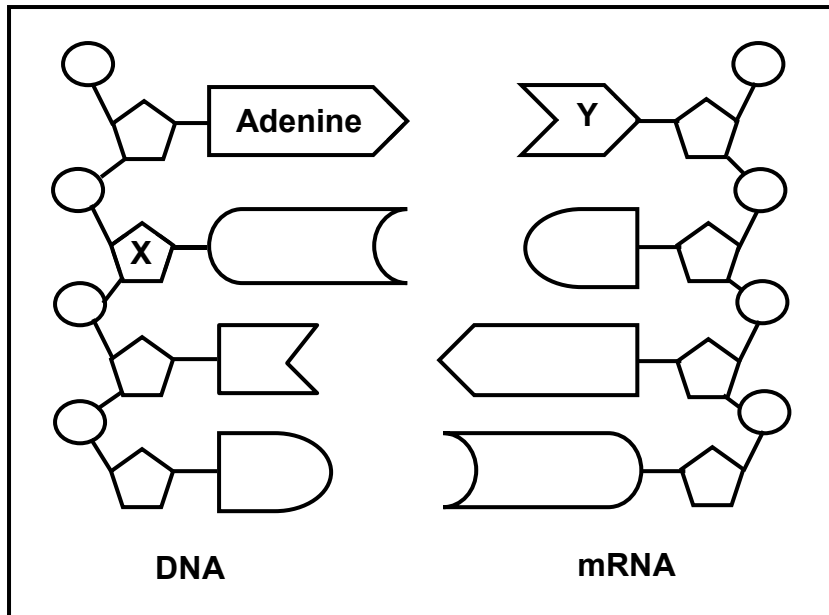
2.1.1   Name the part of the cell where this process occurs.   (1)

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.

The number of chromosomes in the somatic cells of three different species
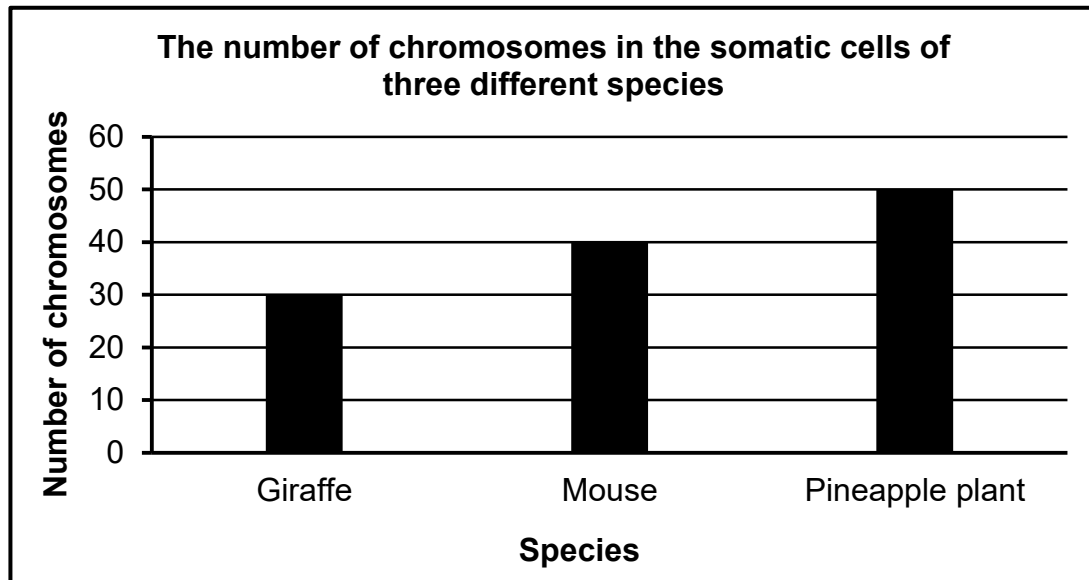
2.3.1   How many chromosomes will be present in:

(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.
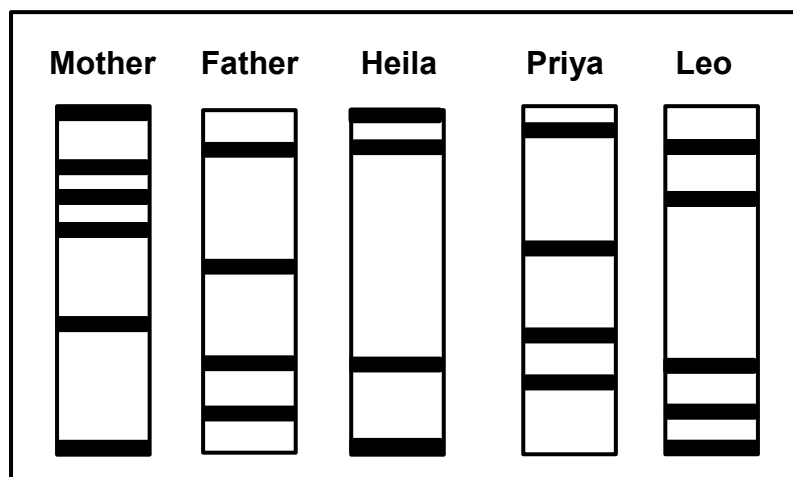
2.5.1   Identify the TWO biological children.   (2)

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 X^B for brown teeth and 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.
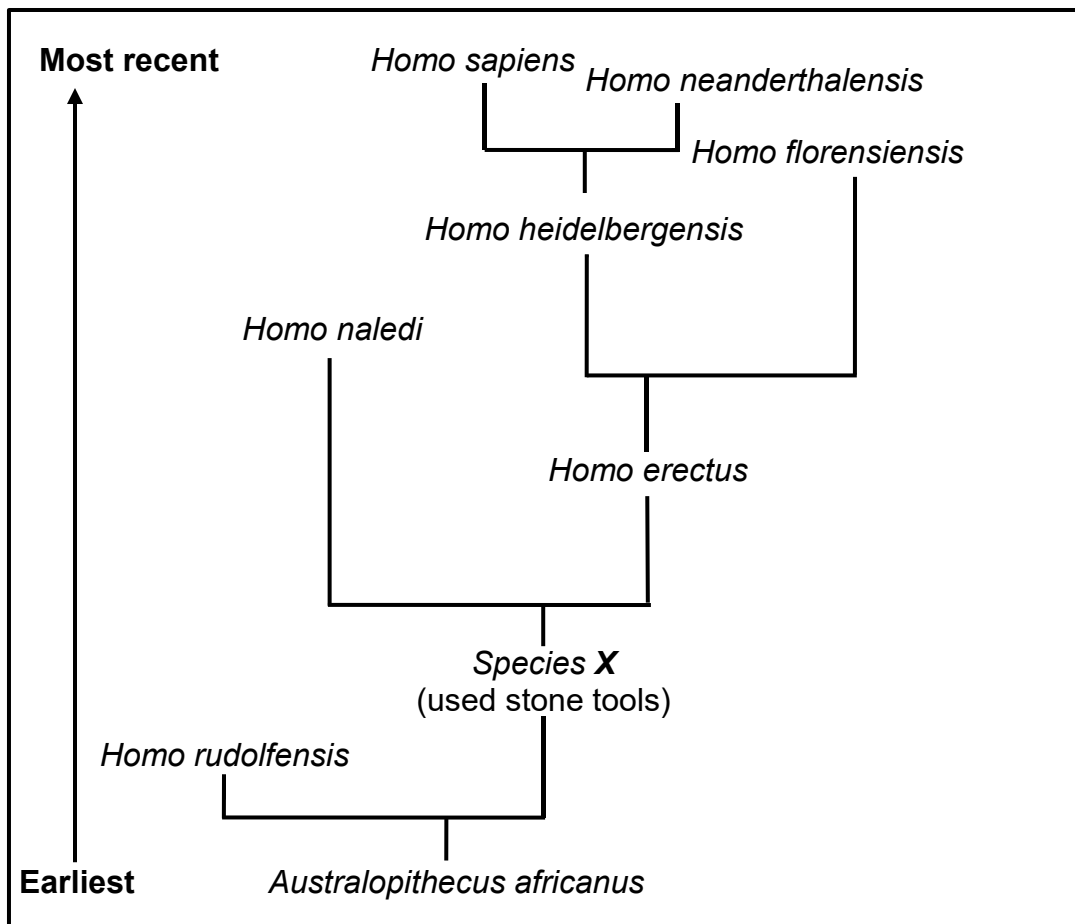
3.4.1   Identify the type of diagram shown.   (1)

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**

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2022

FINAL MARKING GUIDELINES – 02/12/2022

MARKS: 150

DEPARTMENT OF BASIC
EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -12- 0 3
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

HAMIDA MOOSA
INTERNAL MODERATOR
03/12/2022
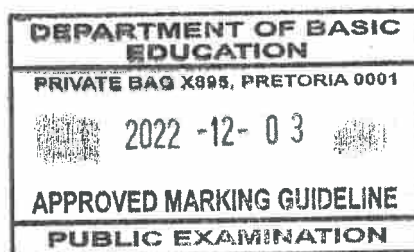
RENETTE VAN DER WATT
INTERNAL MODERATOR
03/12/2022

These marking guidelines consist of 11 pages.

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03/12/2022

DR P. PREETHLALL
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PRINCIPLES RELATED TO MARKING LIFE SCIENCES

1. **If more information than marks allocated is given**
    Stop marking when maximum marks is reached and put a wavy line and 'max' in the right-hand margin.

2. **If, for example, three reasons are required and five are given**
    Mark the first three irrespective of whether all or some are correct/incorrect.

3. **If whole process is given when only a part of it is required**
    Read all and credit the relevant part.

4. **If comparisons are asked for, but descriptions are given**
    Accept if the differences/similarities are clear.

5. **If tabulation is required, but paragraphs are given**
    Candidates will lose marks for not tabulating.

6. **If diagrams are given with annotations when descriptions are required**
    Candidates will lose marks.

7. **If flow charts are given instead of descriptions**
    Candidates will lose marks.

8. **If sequence is muddled and links do not make sense**
    Where sequence and links are correct, credit. Where sequence and links are incorrect, do not credit. If sequence and links become correct again, resume credit.

9. **Non-recognised abbreviations**
    Accept if first defined in answer. If not defined, do not credit the unrecognised abbreviation, but credit the rest of the answer if correct.

10. **Wrong numbering**
    If answer fits into the correct sequence of questions, but the wrong number is given, it is acceptable.

11. **If language used changes the intended meaning**
    Do not accept.

12. **Spelling errors**
    If recognisable, accept the answer, provided it does not mean something else in Life Sciences or if it is out of context.

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

14. **If only the letter is asked for, but only the name is given (and vice versa)**
    Do not credit.

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

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

17. **Caption**
    All illustrations (diagrams, graphs, tables, etc.) must have a caption.

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. The provincial internal moderator must be consulted, who in turn will consult with the national internal moderator (and the Umalusi moderators where necessary).

20. **Official marking guidelines**
    Only marking guidelines bearing the signatures of the national internal moderator and the Umalusi moderators and distributed by the National Department of Basic Education via the provinces must be used.

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APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION
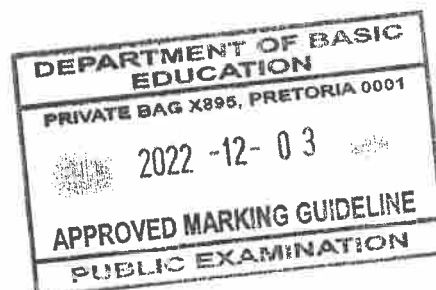
SECTION A

QUESTION 1

1.1 1.1.1   B✓✓
     1.1.2   B✓✓
     1.1.3   A✓✓
     1.1.4   C✓✓
     1.1.5   C✓✓
     1.1.6   A✓✓
     1.1.7   B✓✓
     1.1.8   D✓✓
     1.1.9   B✓✓   (9 x 2)   **(18)**

1.2 1.2.1   (Biological) evolution✓
     1.2.2   Hydrogen✓bonds
     1.2.3   Centromere✓
     1.2.4   Cytokinesis✓
     1.2.5   Crossing over✓
     1.2.6   Centrosomes✓/Centrioles
     1.2.7   Homologous✓structures
     1.2.8   Interphase✓
     1.2.9   Ribosome✓   (9 x 1)   **(9)**

1.3 1.3.1   B only✓✓
     1.3.2   A only✓✓
     1.3.3   B only✓✓   (3 x 2)   **(6)**

1.4 1.4.1   3✓/Three   (1)

     1.4.2   (a) H✓   (1)

             (b) Rr✓   (1)

             (c) C✓ and F✓   (2)
                                                              (5)

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1.5   1.5.1   5✓/Five   (1)

        1.5.2   Gonosomes✓/Sex chromosomes   (1)

        1.5.3   (a)   Down syndrome✓/Trisomy 21   (1)

                  (b)   Non-disjunction✓   (1)

        1.5.4   Male✓   (1)
                                                                        (5)

1.6   1.6.1   Dihybrid✓cross   (1)

        1.6.2   (a)   Brown✓ fur and long ears✓   (2)

                  (b)   bbee✓✓   (2)

                  (c)   Be✓ be✓   (2)
                                                                        (7)

TOTAL SECTION A: 50

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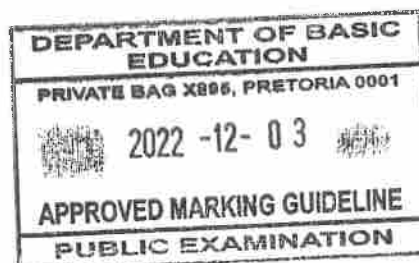
SECTION B

QUESTION 2

2.1   2.1.1   Nucleus✓/nucleoplasm   (1)

       2.1.2   (a)   Deoxyribose✓   (1)

                (b)   Uracil✓/U   (1)

       2.1.3

Transcription	DNA replication
Only one strand acts as a template✓	Both strands act as templates✓
(Free) RNA nucleotides✓ are complementary	(Free) DNA nucleotides✓ are complementary
Adenine complements uracil✓/(A complements U)	Adenine pairs with thymine✓/ (A pairs with T)
A mRNA molecule is formed✓	Two identical DNA molecules are formed✓
Only a short section of DNA✓ is used	The whole DNA molecule✓ is used
DNA unwinds and unzips partially✓	DNA unwinds and unzips completely✓

(Mark first TWO only)   1 mark for table + (Any 2 x 2)   (5)
                                                                                   (8)

2.2   2.2.1   Gene✓ mutation   (1)

       2.2.2   - There is a change in the sequence (of nitrogenous bases) from
                   CCG to CUG✓   (1)

       2.2.3   (a)   5✓/Five   (1)

                (b)   UAU✓   (1)

                (c)   - The codon CCG changed to CUG✓/ 4th codon has
                          changed
                       - The anticodon/tRNA sequence changed✓
                       - The amino acid proline✓
                       - was replaced by leucine✓
                       - This resulted in a different protein✓/no protein being
                          formed   Any   (4)
                                                                                                   (8)

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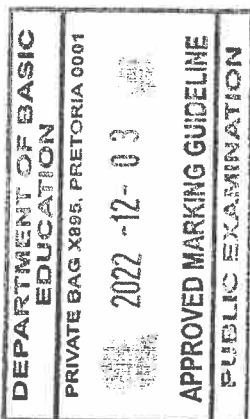UMALUSI
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2.3 2.3.1 (a) 20✓   (1)

            (b) 50✓   (1)

     2.3.2 - A sperm cell is a gamete✓
            - formed by meiosis✓
            - and must be haploid✓
            - to overcome the doubling effect of fertilisation✓   (4)

     2.3.3 - Anaphase I✓   (1)

     2.3.4 - Spindle fibres shorten✓/contract
            - Chromosome pairs separate✓and
            - move to the opposite poles✓   (3)
                                                                                                   (10)

2.4 2.4.1 954 000✓   (1)

     2.4.2 1 800 000✓ – (954 000 + 180 000 + 54 000)✓
            = 612 000✓people

                                            OR

            1 800 000✓ - 1 188 000✓
            = 612 000✓people

                                            OR

            $\frac{34}{100}$ ✓ x 1 800 000✓ = 612 000✓people   (3)

     2.4.3 - The allele for blood group A/ I^A is inherited from one parent✓
               and
            - the allele for blood group B/ I^B is inherited from the other
               parent✓ therefore
            - the child has blood group AB✓/genotype I^AI^B (3)
                                                                                                   (7)

2.5 2.5.1 Heila✓ and Leo✓   (2)
            (Mark first TWO only)

     2.5.2 - All of the (DNA) bands from Heila and Leo✓
            - match with the (DNA) bands of the mother and the father✓
                                            OR
            - None of the (DNA) bands from Priya✓
            - match with the (DNA) bands of the mother and the father✓   (2)

     2.5.3 - Tracing missing persons✓
            - Identification of genetic disorders✓
            - Identification of suspects in a crime✓
            - Matching tissues for organ transplants✓
            - Identifying dead persons✓   Any   (3)
            (Mark first THREE only)   **(7)**
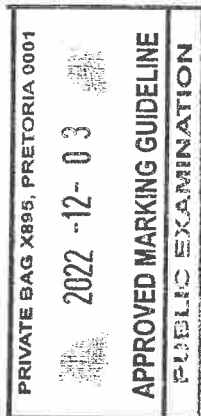
2.6   2.6.1
- Males have only one X chromosome✓/The Y-chromosome does not have this allele and
- have to inherit only one recessive allele✓ to have white teeth
- whereas females have two X chromosomes✓ and have to
- inherit two recessive alleles to have white teeth✓   (4)

2.6.2   **P₁**   Phenotype   Male with brown teeth   X   Female with white teeth✓

Genotype X^BY x X^bX^b✓

Meiosis

G/gametes X^B,   Y   x X^b, X^b✓

Fertilisation

F₁   Genotype X^BX^b, X^BX^b, X^bY, X^bY✓

Phenotype   1 female with brown teeth: 1 male with white teeth✓*

P₁ and F₁✓

Meiosis and fertilisation✓

*1 compulsory mark + Any 5

OR

P₁   Phenotype   Male with brown teeth   x   Female with white teeth✓

Genotype X^BY x X^bX^b✓

Meiosis

Fertilisation

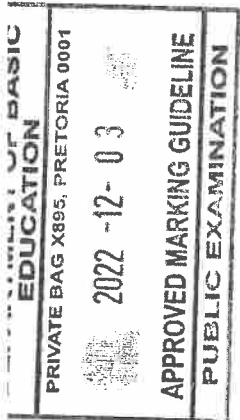| Gametes	X^B	Y
X^b	X^BX^b	X^bY
X^b	X^BX^b	X^bY

1 mark for correct gametes
1 mark for correct genotypes

F₁   Phenotype   1 female with brown teeth: 1 male with white teeth✓*

P₁ and F₁✓
Meiosis and fertilisation✓
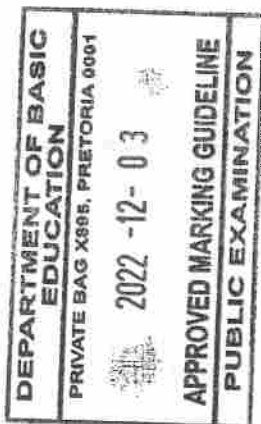
*1 compulsory mark + Any 5   (6)
(10)
[50]

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QUESTION 3

3.1   3.1.1
- Embryos✓
- Umbilical cord✓
- Bone marrow✓   (3)

(Mark first THREE only)

      3.1.2
- Stem cells are undifferentiated✓
- and have the potential to develop into any type of cell✓
- to replace affected/defective cells✓ causing a disorder   Any   (2)

      3.1.3
- Heart disease✓
- Spinal injuries✓   Any   (1)

(Mark first ONE only)   **(6)**

3.2   3.2.1
- A group of organisms of the same species✓
- occupying the same habitat✓
- at the same time✓   (3)

      3.2.2
They produce infertile offspring✓   (1)
(Mark first ONE only)

      3.2.3
- Breeding at different times of the year✓
- Species-specific courtship behaviour✓
- Adaptation to different pollinators✓
- Prevention of fertilisation✓   Any   (3)

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

3.3   3.3.1
- To show a possible common ancestor✓
- To identify trends in evolution✓   Any   (1)

      3.3.2
- Both have opposable thumbs✓
- to allow for a power grip✓/precision grip/ any example thereof   (2)

      3.3.3
- Humans have small teeth✓/canines whereas African apes have large teeth✓/canines
- There are no gaps✓/diastema between the teeth in humans whereas African apes have gaps✓ /diastema between the teeth

(Mark first ONE only   (Any 1 x 2)   (2)
      (5)

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3.4   3.4.1   Phylogenetic tree✓/cladogram   (1)

        3.4.2   2✓/Two   (1)

        3.4.3   (a) *Homo habilis*✓   (1)

                (b) *(Homo) naledi*✓   (1)

        3.4.4   *(Homo) sapiens*✓   (1)

        3.4.5   -   Fossil✓evidence
                -   Cultural✓ evidence
                -   Genetic✓ evidence   Any   (2)
                (Mark first TWO only)

        3.4.6   -   A large cranial capacity✓ in *Homo sapiens*
                -   indicates a larger brain✓
                -   leading to greater intelligence✓
                                            OR
                -   A small cranial capacity✓in *Australopithecus africanus*
                -   indicates a smaller brain✓
                -   leading to lower intelligence✓   (3)

        3.4.7   -   Fossils *of Australopithecus spp.* were found in Africa only✓ and
                -   fossils of species *X*/*Homo habilis* were found in Africa only✓
                -   The oldest fossils of *Homo erectus* were found in Africa✓ /the
                    younger fossils were found elsewhere
                -   indicating that modern humans originated in Africa and migrated
                    out of Africa✓   (4)
                                                                                          (14)

3.5   3.5.1   *Ambulocetus*✓   (1)

        3.5.2   It had flipper-like large feet and a tail✓✓   (2)
                (Mark first ONE only)

        3.5.3   -   They share characteristics✓/have intermediate characteristics
                -   of the ancestor/*Pakicetus* <u>and</u> the present-day species✓/
                    Balaena
                                            OR

                -   They have legs like *Pakicetus*✓ and
                -   flippers of the present day *Balaena*✓   (2)
                -
        3.5.4   -   Ancestral species of whales all had legs✓/lived on land
                -   As more time was spent in the water✓in search of food
                -   the legs were used less✓ and disappeared
                -   the acquired characteristic was passed on to the next
                    generation✓   Any   (3)
                                                                                          (8)
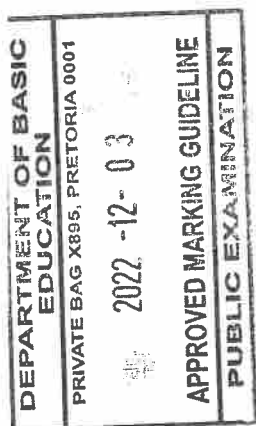
3.6   3.6.1   (a)   Probability of developing resistance✓to antiretroviral drugs   (1)

                 (b)   Number of missed treatments✓   (1)

    3.6.2   Treatment must not be missed✓   (1)

    3.6.3   The probability of HIV developing resistance to antiretroviral drugs increases with the increase in the number of missed treatments✓✓

OR

The more the days of missed treatment, the greater the probability of the virus developing resistance to antiretroviral drugs✓✓   (2)

    3.6.4
- There is variation in the resistance✓ of the HI virus to antiretroviral drugs
- Some viruses are resistant✓ to the drugs and
- others are not resistant✓
- Those that are not resistant do not survive✓
- When treatments are missed✓,
- the resistant viruses survive and reproduce✓
- passing the resistance to their offspring✓   Any   (5)

    (10)
    [50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

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