Province of the
EASTERN CAPE
EDUCATION

**EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE**
Home of Examinations and Assessment, Zone 6, Zwelitsha, 5600
**REPUBLIC OF SOUTH AFRICA, Website:** www.ecdoe.gov.za

# 2020 NSC CHIEF MARKER'S REPORT

| | |
|---|---|
| **SUBJECT:** | **Life Sciences** |
| **PAPER:** | **2** |
| **DURATION OF PAPER:** | **2 ½ hours** |

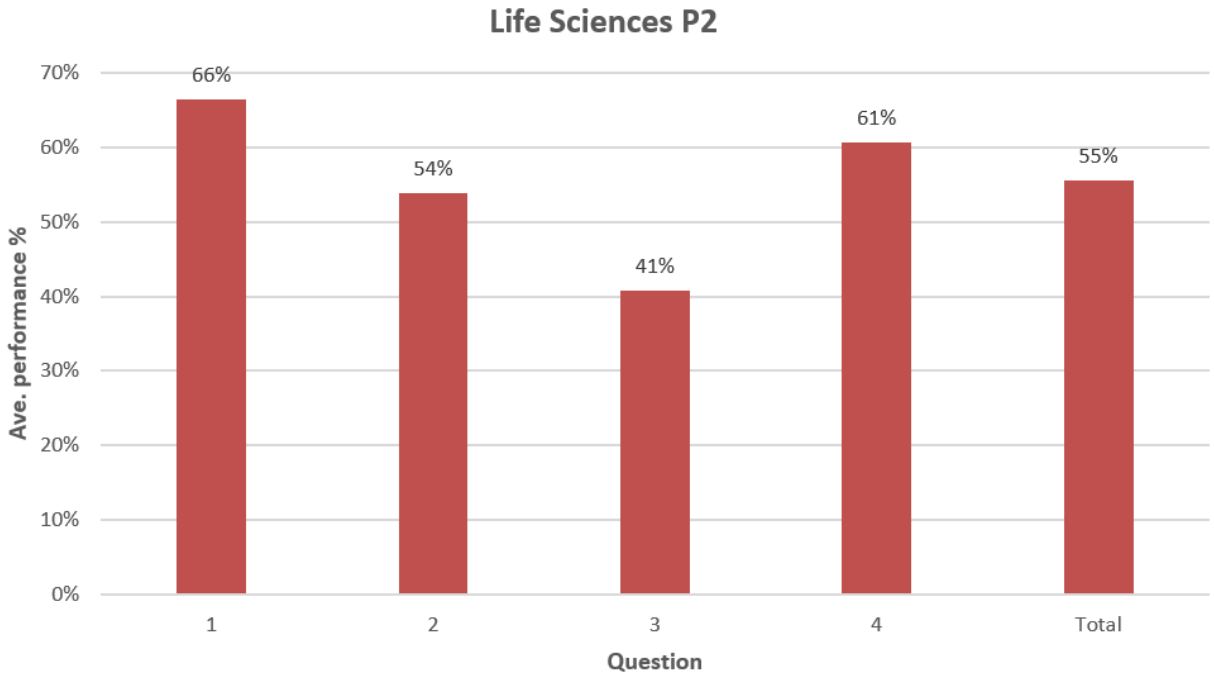
## SECTION 1: (General overview of Learner Performance in the question paper as a whole)

**General performance**

The general performance of 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:

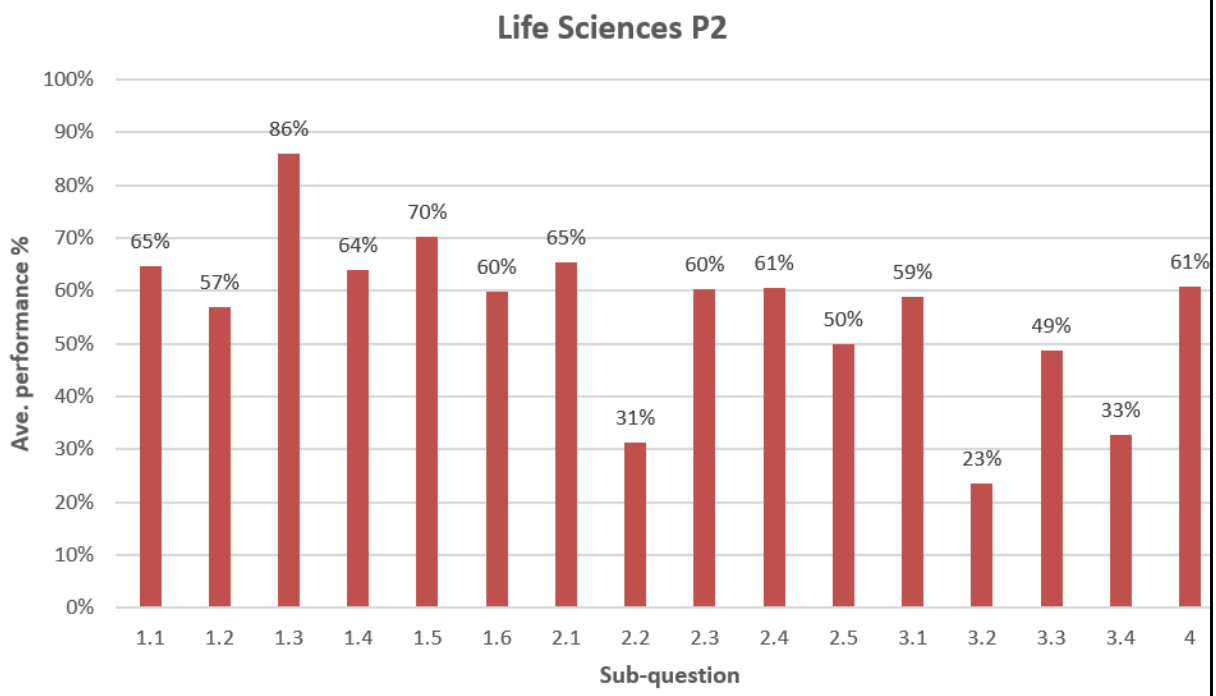
Low Performance (Level 1 -Level 2 i.e. 0-59 marks) - 30 scripts
Mediocre Performance (Level 3- Level 5 i.e. 60-104 marks) - 40 scripts
High performance (Level 6 to Level 7 i.e. 105-150 marks) - 30 scripts

The graph below depicts the average performance of the learners per question:



The sampled candidate's average performance has slightly decreased by 1.3% from last year. The candidates performed well in question 4 based on DNA Code of Life, attaining a 61% average compared to 27% average last year. Question 3 based on Evolution was the worst performed question with 41% average, 12% lower than last year.

The graph below depicts the learner average performance per subquestion.




As can been seen on the graph above, the most poorly answered questions (i.e. below 50%) are
:

- Question 3.2 (23%) – an application question based on the interpretation of a phylogenetic tree on human evolution was the most poorly answered question. This section of work was meant to be covered after the Trial examination. Judging by the poor performance of the learners it is evident many learners did not return to school after the Trial examination or they were not sufficiently taught as there were delays in the re-opening of the schools in the EC province.
- Question 2.2 (31%) – also an application question based on the cloning process.
- Question 3.4 (33%) – involved application of the concepts of biogeography and speciation to a given scenario.
- Question 3.3 (49%) – a scientific investigation question based on a reproductive isolation mechanism. Although the learners performed below 50% in this question, their performance in a scientific investigation question has improved by 8% compared to last year.

**SECTION 2:**

**Comment on candidates' performance in <u>individual questions</u>**

**(It is expected that a comment will be provided for each question on a separate sheet).**

**QUESTION 1**

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

Learners attained an average of 66% in this question, the highest average compared to other questions. The performance is, however, 4% lower than in 2019. There is a marked decrease (18%) in the performance of this year's candidates in question 1.2 on terminology compared to last year.

A breakdown of learner performance in sub-questions is as follows:

| **Average mark from the sample of 100 scripts**: | | |
|---|---|---|
| **SUB-QUESTION** | **TOPIC OR ASPECT TESTED** | **AVERAGE % FROM SAMPLE** |
| 1.1 | MCQ | 65 |
| 1.2 | TERMINOLOGY | 57 |
| 1.3 | AB MATCHING | 86 |
| 1.4 | MEIOSIS (CROSSING OVER) | 64 |
| 1.5 | DIHYBRID CROSS | 70 |
| 1.6 | GENETIC EVIDENCE TO SUPPORT EVOLUTION | 60 |

The overall performance is satisfactory. Most learners were able to attempt the question and obtained a fairly good average (66%). The average learner scored some marks in the question and that lifted their overall score. The above-average learners easily scored 80-100% for the question and very few learners were below average and could not answer the questions.

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

1.1.6 Learners were unable to identify that answers were based on the second filial ($F_2$) generation.

1.1.10 Some learners answered D which refers to a conclusion. It is important to note that in the scenario given only observation was made and then the students made a statement about their observation. No experimentation was done; hence the statement cannot be a conclusion but a hypothesis as the conclusion is stated after the experiment has been done and results obtained.

1.2 Terminology and spelling is a big challenge for many learners. Learners use slang language in writing terminology and this is not acceptable as proper scientific terms are required. For example, learners wrote K-nine/ k9 for canines. It is important that learners learn to spell the terms correctly as sometimes when a word is spelt incorrectly it has another meaning in Life Sciences. For example:

1.2.1 Instead of Homologous, learners wrote homozygous

1.2 3 Cranium was the term required. No marks were awarded for cranial as cranial refers to a space in the cranium. Some learners gave cranial ridge as the answer.

1.2.5 Learners lost marks for writing chromatic (refers to colour) or chromatid instead of chromatin (a network of genetic material found in the nucleus during interphase)

1.2.7 Spelling of prognathous is a problem for some learners. Some wrote prothagonous and lost marks. Some learners were unable to give the biological term, instead, they gave examples of animals/ organisms with protruding jaws e.g. African apes.

1.4.2 Instead of centromere they wrote centriole.

1.6

1.6.1 Some leaners gave molecular biology /biochemistry/DNA evidence as to the answer. All these were not credited, as the example given was relating to Genetic evidence. Comparative biochemistry was accepted but not just biochemistry.

1.6.2. Some learners cannot interpret phylogenetic trees. Most only got 1 mark out of 3 marks in this question.

Some even allocated names of animals and matched them with the numbers given, ignoring the instructions of the question which were to use the table to match the species A, B and C with the numbers 1, 2 and 3 on the phylogenetic tree based on how closely related they are.

**(c) Provide suggestions for improvement in relation to Teaching and Learning.**

- Learners must be encouraged to read all the questions and be able to analyse questions based on diagrams.
- Teachers must emphasise the importance of spelling and pronunciation of different terms by also writing these terms on the board to encourage correct spelling. Many words used in Life Sciences can change to mean something else in Life Sciences if incorrectly spelt e.g. *homozygous* vs *homologous*, *chromatid* or *chromatic* vs *chromatin*, *centriole* or *centrosome* vs *centromere*, *ovum* vs *ovary*.
- Teachers can use crossword puzzles, quizzes to encourage correct spelling.
- Emphasis should be made before the start of a chapter on the terminology related to that chapter and learners should compile lists of terms about the topic.
- Teachers can also put up the commonly confused terms as word cards on the classroom wall.
- Teachers should always use the CAPS document and examination guidelines when preparing their lesson and not only use or follow the textbook as is. Some information in the textbooks may be outdated or incorrect. Pg. 13 of the 2017 examination guidelines lists the evidence of evolution as being: fossil record, biogeography, modification by descent & genetics.

**(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

- The learners show carelessness of not reading the questions for understanding.
- Teachers ignore the examination guidelines. They follow the textbook, not checking what is expected e.g. in 1.6.1 learners gave molecular biology as the answer instead of genetic evidence which is in the examination guidelines.
- All teachers must be in possession of examination guidelines so that they know what content is expected to be taught and assessed for each topic. Copies of examination guidelines should be made available to all learners.
- English remains a learning barrier to many learners that have it as a second language. It is either the learners do not understand the question, or they do not know how to express themselves in English, although they might know the answer.
- Subject Advisors must continue monitoring the implementation of English Across the Curriculum and this must form part of the aspects to be monitored during an onsite visit to the schools.
- ICT integration can also be incorporated into lessons where teachers can design games which test multiple choice questions where learners can go in teams to quickly answer questions and score points. Teachers can visit kahoot.it to create games.

**QUESTION 2**

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

The average for the whole question was 54% which is 3% lower than the performance last year.
The most poorly answered question is 2.2 with an average of 31%.
The range of marks from the sample of 100 scripts was from 2 to 39 out of 40.
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 | DNA Profiling | 65 |
| 2.2 | Genetics and Inheritance - Cloning | 31 |
| 2.3 | Inheritance of Blood groups | 60 |
| 2.4 | Gene Mutations | 61 |
| 2.5 | Pedigree Diagram | 50 |

Q 21.1 & 2.1.2 on DNA profiles were well answered by the learners, however, Q2.1.3 provided challenges. Learners did not explain in terms of the DNA profile or bands and failed to compare the DNA profile bands of the sample found on the crime scene.
Q2.1.4 was answered well by most learners.
Q 2.2 was poorly explained by most learners.
Q 2.3 was attempted by most learners and they did fairly well.
Q2.3.3 the genetic cross was well answered.

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

- Q 2.1.3 Learners do not seem to know the difference between DNA and DNA profile. Learners wrote Jennie's DNA is the same as the DNA of the sample and thus lost 2 marks for not referring to the DNA profile/bands.
- Q 2.2.2 & 2.2.3 learners confused cloning with genetic engineering. Learners seemed to know the steps of cloning but were unable to explain why a particular step in the process was done.
- Q2.3.2 learners struggled with identifying the type of dominance. Most learners did not understand that it is the dominant allele $I^B$ that masks the recessive allele i. Learners talked about blood group B masks blood group O.
- Q2.3.3 Some learners still use the wrong notation for blood group O ( $I^i$ or $I^o$ instead of i)
- Q2.4.1 was poorly answered. Learners were not able to define a gene mutation. Instead, a lot of learners described it as a change in the DNA molecule which leads to the formation of a wrong protein with wrong amino acids.
- Q2.4.2 -2.4.4 was well answered by the majority of learners.
- Q 2.4.3 Some learners knew how to do the calculation but did not have a calculator to complete the calculation. So they could only get 2 out of the 3 marks for the question.
- Q 2.5 Performance was mediocre. Level 6 and 7 learners performed well in this question.

**(c) Provide suggestions for improvement in relation to Teaching and Learning.**

- Q 2.1.3 Teachers must stress the terminology and ensure learners understand the terminology and ensure learners the difference between DNA and DNA profile.
- Learners must be taught that the analysis of a DNA profile is based on the comparison of the black bands/ black bars of the DNA profile.
- Q2.2.2 Teachers should take more care to explain why the different steps are followed in the cloning process. This will ensure that learners understand it and will be able to answer with insight and understanding.
- Q2.2.3 Learners must be taught that a nucleus contains genetical material, not characteristics. Revising questions from previous question papers are valuable in assisting learners to express themselves.
- Q2.3.2 Teachers again have to stress the use of the correct terminology – e.g. when to use the term allele vs blood group. When referring to alleles one is referring to the genotype and blood group is the phenotype (an expression of the genotype) of the individual. (Alleles can be dominant or recessive not blood groups).

- Q2.3.3 Teachers should be aware of the correct notation to use for blood group O i.e. ii and not blindly follow textbooks where it is sometimes incorrect.

- Q2.4.1 Learners defined mutation instead of gene mutation. Learners should be taught the difference between these terms.

Q2.5 Pedigree diagram was answered better in the past. However, the interpretation of the pedigree diagram is still a challenge for some learners because they had difficulty in working out the genotypes of the parents, as well as explaining the son's genotypes and phenotypes.

**(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

- Diagnostic reports should clarify differences in the definition of a mutation, gene mutation and chromosomal mutation as these differ from textbook to textbook.

| **Mutation** | **Gene Mutation** | **Chromosomal Mutation** |
|---|---|---|
| Any sudden change in the genetic structure of a cell | Is a change in the **sequence of nitrogenous bases/** nucleotides in a gene | Is a change in the **number/size** of a chromosome |

- Subject advisors should conduct workshops on Genetics.
- When teachers are teaching pedigree diagram analysis, they must explain using both autosomal and sex-linked characteristics. They must also expose learners to examples of sex-linked disorders caused by dominant alleles in addition to the usual examples of disorders caused by recessive alleles.
- At the end of a chapter, learners should be given practice questions based on that topic. This will assist by exposing them to how the questions are asked and how they should be answered.
- Subject advisors should provide teachers with links to videos on genetics topics prepared by the Life Sciences Curriculum planner for supplemental teaching.

**QUESTION 3**

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

The average for the whole question was 41%, down by 13% when compared to the performance in question 3 last year. Two subquestions i.e. 3.2 and 3.4 contributed to the overall poor performance in this question. It is important to note that question 3.2 with the lowest average in the whole question paper was based on human evolution. This is an indication of inadequate coverage and revision of this topic. The topic was also not covered in the Trial examination due to the limitations of the 2020 Revised ATP's.
The range of marks was from 0 to 39 out of 40 in this question.
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 | Natural selection | 59 |
| 3.2 | Human evolution- Interpretation of Phylogenetic tree | 23 |
| 3.3 | Scientific Investigation on Reproductive Isolation mechanism | 49 |
| 3.4 | Biogeography and Speciation | 33 |

3.1.1 The question was well answered, although a few learners still confuse natural selection with speciation.

3.2 This is the question in which learners performed the most poorly as shown by the average performance of 23% in the table above.
3.2.1 Some learners referred to the family as hominids or hominins instead of *Hominidae*
3.2.2 Most learners had knowledge of cultural evidence but failed to explain how it progressed as humans evolved.
3.2.3 Many learners still cannot interpret a phylogenetic tree
3.2.4 Very few learners were able to identify that *H. ergaster* is a transitional fossil from the phylogenetic tree or support why it is a transitional fossil
3.2.5 Most learners did not know the fossil evidence to support the "Out of Africa" hypothesis. They referred to the oldest fossils of 4mya (instead of stating *Australopithecus* and *Homo habilis*) were only found in Africa. Some said the oldest fossil of *Australopithecus* were only found in Africa which incorrectly implied that the younger fossils were found elsewhere. Some said fossils originated in Africa instead of saying ancestors of humans originated in Africa.

3.3 The scientific investigation question was more understandable, and learners did better than last year. Most learners were able to determine the variables correctly, but some learners still confuse reliability and validity. Many failed to explain the purpose of the control and said it is the baseline instead of it being used for comparison with the other groups. Some said Group C is a controlled variable showing that they do no not understand the difference between a control and controlled variable. Some learners could not link to the aim of the investigation. Other learners struggled to interpret the results from the table/graph and could not identify which group had the highest mating success. Some learners had difficulty giving the correct caption of the graph because the failure to use the headings form the table.

3.4
3.4.1 Was a brilliant application question and tested understanding and insight of learners.
3.4.2 Many leaners struggled with this question and confused biogeography and speciation.

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

3.1 Learners do not understand the difference between natural selection and speciation.

3.2 Some teachers do not expose learners to the levels of classification. As a result, learners confuse families with genera.

3.3 Learners, especially poor performers, do not know that the aim of the investigation must be used to draw the conclusion and the table headings must be used to state the caption of the graph if the instruction stipulates that they must use the results from the table to draw the graph. Learners often lost marks for labelling axes as they left out the average and only wrote number of nests produced

3.4 Some learners still struggle with terminology. They cannot differentiate between common ancestor, same population, different populations and different species.

3.4.1 Better performing students (Level 7) were able to answer this question which required higher cognitive thinking. It was a fair higher-order question. The question was based on past and present distribution of a species which required learners to have a good understanding of the concept of biogeography and to apply it to the given scenario.

3.4.2 The same misconceptions or errors from 2019 question paper were repeated in 2020. This means the misconceptions about species vs population were not addressed by the teachers. Learners lost up to four marks especially when they started with the species being separated by a geographical barrier and no mention of two groups/ populations being formed and everything that follows after the separation occurs in these populations.

Some of the incorrect responses from learners and correct responses are outlined in the table below:
Speciation of the lemurs and pottos.

| **Incorrect response** | **Correct response** |
|---|---|
| The population of pottos/lemurs was separated | The common ancestor / original population of pottos and lemurs was separated |
| The separation was due to continental drifting | The geographical barrier was the ocean |
| Pottos and lemurs were separated into two species | The ancestral population of pottos and lemurs was separated into two populations (not species!) |
| There was no gene flow between the species | There was no gene flow between the two populations |
| The species experienced different environmental conditions | The two populations experienced different environmental conditions |
| The species underwent natural selection independently | Each population underwent natural selection independently |
| The species became different genotypically and phenotypically | The individuals in each population became different genotypically and phenotypically |
| To form new species | To form the pottos and lemurs ( had to specify the new species formed) |

**(c) Provide suggestions for improvement in relation to Teaching and Learning.**

- When teaching speciation, teachers must clearly explain the concept of a common ancestor/ original population of the ancestral species being separated and forming two different populations, then only after the environmental change and natural selection taking place independently in these separate populations eventually 2 different species are formed.
- Refer to pg. 14 of the 2017 Examination guideline as it clearly outlines the process of speciation. This must be used in applying to given examples
- Teachers should consult all past diagnostic reports and chief marker's reports when they prepare their lessons to address misconceptions identified in previous years.

**(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 provided keywords without any elaboration e.g. 'geographical barrier' without identifying the barrier as the ocean. They wrote 'no gene flow' without inditicating between populations or "natural selection occurs independently'
- Learners must be taught to give answers in full sentences especially when describing processes.
- Subject advisors should plan to conduct workshops on evolution for the new teachers and teachers from the underperforming schools.
- Teachers should also read more on the topic of evolution to have a broader understanding of the topic.

**QUESTION 4**

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

The question was attempted by almost all the learners and some did fairly well, others answered the essay perfectly with a few losing the logical sequence mark because of jumping between topics. Other learners struggled with the essay especially with the significance of DNA replication for mitosis, resulting in a number of them losing the comprehensive mark. More learners got the marks for location, structure and replication of DNA and therefore also getting the relevance and logical sequence marks. The average for the question was 61%.

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

The question was straightforward, but some learners confused DNA with RNA, confused replication with transcription and sometimes translation, the significance of replication for mitosis confused with the significance of mitosis and meiosis.

A possible reason for a poor performance in such an easy essay question may be inadequate contact time due to Covid-related circumstances teachers had to operate in. Maybe some teachers did not revise this first term's work enough after returning to school after the lockdown trying to finish the syllabus and possibly focusing more on revising topics they considered difficult or challenging.

**(c) Provide suggestions for improvement in relation to Teaching and Learning.**

- Teachers must refrain from assuming that an essay will be asked on a tougher topic and thus fail to prepare learners for an easy topic such as this.
- Learners need to be trained to write an essay like any other – in full sentences, not bullet form or sentences broken up into meaningless bulleted points.
- When teachers give learners memos of previous question papers to study from, they need to teach the learners not to write like in the memo but write properly in sentences that make sense.
- The topics that are easily confused with each other should be juxtaposed when taught, to contrast them so that the learners can see clearly the differences e.g replication and transcription
- Learners need to be given more questions on such topics to differentiate between them so as to eliminate the confusion.
- Teachers also need to be conscious that their pronunciation of Life sciences terms may affect the performance of their learners.
- It is crucial that teachers use the examination guidelines throughout the syllabus.

**(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

- Teachers need to train learners to identify possible mini essay questions in each topic, then write the required information on each topic separately without mixing it up.

Learners:

- Confused the components of DNA with those of RNA or mentioned components of RNA while discussing DNA
- Confused DNA replication with transcription saying the templates form mRNA
- Some said one strand was used a template
- Confused mitosis with meiosis giving the significance of crossing over in some instances
- Explained the importance of meiosis and reproduction mentioning the development of the zygote
- Mentioned the types of DNA e.g. nuclear, mitochondrial etc. instead of the location
- Discussed DNA profile instead of the significance of replication
- Listed body cells, genes, ovaries, sperm cells or types of DNA for the location of DNA
- Confused nucleotides with nitrogenous bases, deoxyribose with ribose with others just listing the component as a sugar
- Stated that replication results in two identical strands instead of two identical DNA molecules with one original and one new strand

Feedback should always be given to learners through classwork/homework activities to make them understand how they get marked and what will make them lose or earn marks.

basic education

Department:
Basic Education
**REPUBLIC OF SOUTH AFRICA**

# LIFE SCIENCES P2

## SENIOR CERTIFICATE/ NATIONAL SENIOR CERTIFICATE

## GRADE 12

**LIFE SCIENCES P2**

**NOVEMBER 2020(2)**

**MARKS: 150**

**TIME: 2½ hours**

**This question paper consists of 17 pages.**

* L F S C E 2 *



EASTERN CAPE

## 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 correct answer and write only the letter (A to D) next to the question number (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D.

1.1.1 Which ONE of the following may result in Down syndrome in humans?

A A gene mutation on chromosome 21
B Failure of chromosome pair 21 to separate during anaphase I
C Failure of the gonosomes to separate during meiosis II
D A gene mutation occurs on the X chromosome

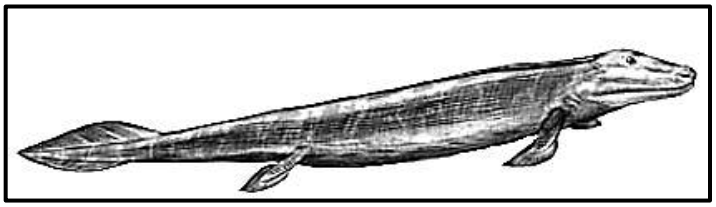
1.1.2 Variation within a species is introduced through …

A random mating and asexual reproduction.
B mitosis and random fertilisation.
C random mating and random fertilisation.
D mitosis and meiosis.

1.1.3 African apes and humans are similar. Both have …

A small jaws and well-developed brow ridges.
B opposable thumbs and bare fingertips.
C gaps between their teeth and eyes in front.
D an upright posture and a cranial ridge.

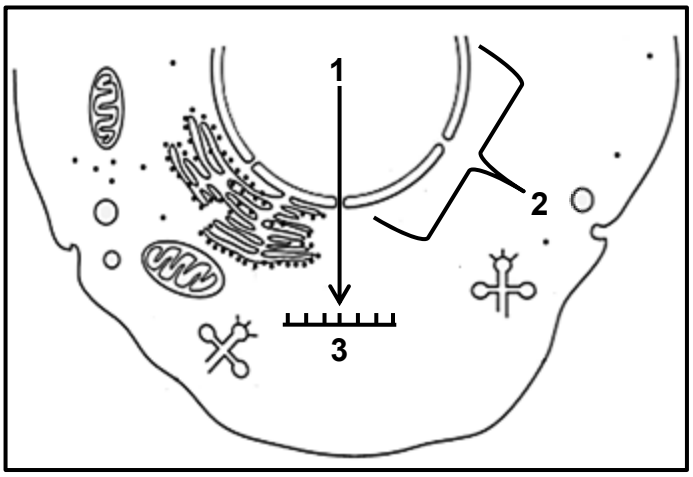
1.1.4 The diagram below shows *Tiktaalik roseae,* a fish that may be the ancestor of the first organisms to live on land.



According to Lamarck, this species of fish may have evolved the ability to 'walk' on land by …

A undergoing natural genetic mutations which caused the fins to develop into legs.
B the process of natural selection.
C passing on the acquired characteristic of fins to their offspring.
D stretching its fins and using them for 'walking'.

1.1.5 The diagram below shows some of the processes, molecules and structures that are involved in protein synthesis in a cell.




Which ONE of the following is the CORRECT labels for **1**, **2** and **3** in the diagram?

| | PROCESS 1 | STRUCTURE 2 | MOLECULE 3 |
|---|---|---|---|
| A | transcription | ribosome | tRNA |
| B | translation | ribosome | mRNA |
| C | transcription | nucleus | mRNA |
| D | translation | nucleus | tRNA |

1.1.6 A homozygous purple flowering plant (**P**) is crossed with a pink flowering plant (**p**) to produce the $F_1$-generation. One of the $F_1$-plants is crossed with the pink flowering parent to produce the $F_2$-generation.

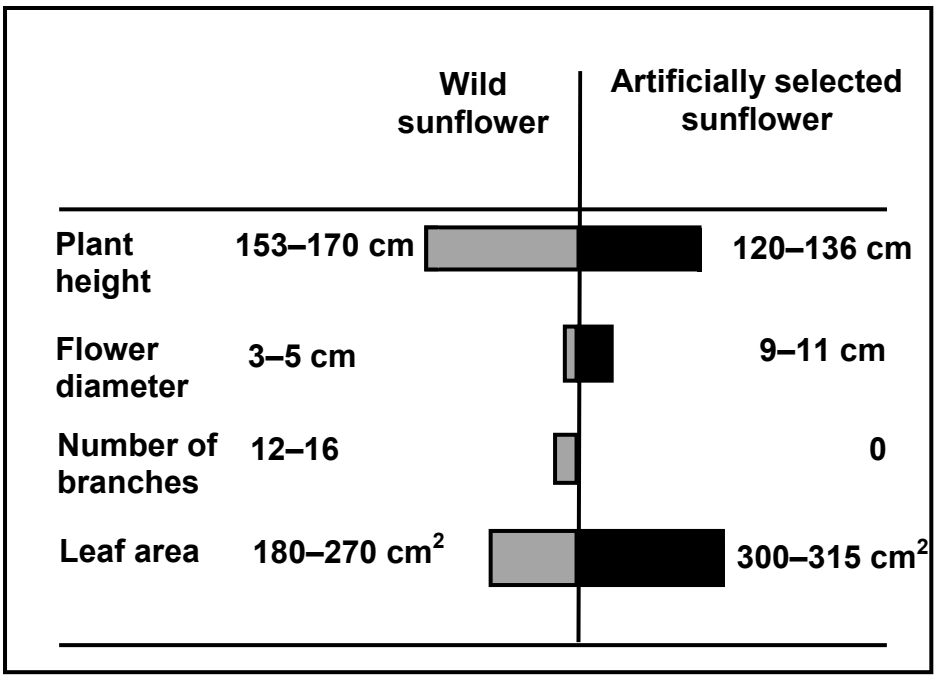
Which ONE of the following is the CORRECT phenotypic ratio of the $F_2$-generation?

A 1 purple **:** 1 pink
B 1 purple **:** 3 pink
C 3 purple **:** 1 pink
D 1 purple **:** 2 pink

1.1.7 Which ONE of the following scientists discovered fossils of *Homo sapiens* and *Ardipithecus sp*?

A Raymond Dart
B Lee Berger
C Louis Leakey
D Tim White

1.1.8 The diagram below compares characteristics of wild sunflowers with sunflowers that have been artificially selected.




Which ONE of the following characteristics was found undesirable by humans?

A Number of branches and leaf area
B Plant height and leaf area
C Plant height and flower diameter
D Plant height and number of branches

1.1.9 Punctuated equilibrium suggests the following:

A Evolution is always a slow and gradual process.
B Natural selection does not explain evolution.
C New species can appear quickly, over a relatively short period of time.
D Artificial selection is the only mechanism that causes evolution.

1.1.10 A group of students observed that the long-term use of antibiotics results in the decreased control of bacterial infections.

From this observation the students stated that:

Antibiotic resistance in bacteria is caused by the long-term use of antibiotics.

This statement is a/an …

A theory.
B aim.
C hypothesis.
D conclusion. (10 x 2) **(20)**

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.7) in the ANSWER BOOK.

1.2.1 Similar structures in different organisms indicating descent with modification

1.2.2 Large, pointed teeth in African apes that are used for tearing food

1.2.3 The part of the skull that houses the brain

1.2.4 The non-sex chromosomes in humans

1.2.5 The network of genetic material found in the nucleus during interphase

1.2.6 The number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell

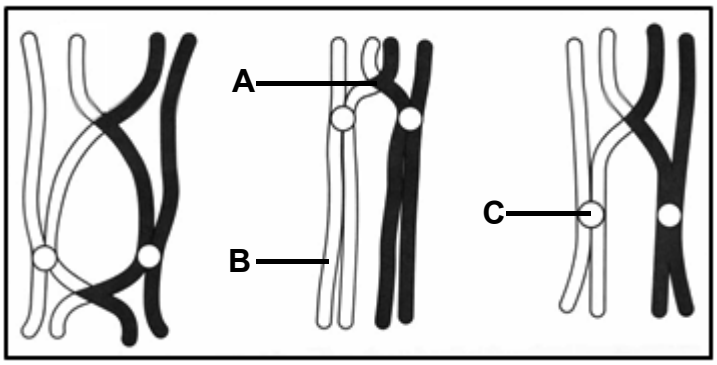
1.2.7 Having a protruding jaw (7 x 1) **(7)**

1.3 Indicate whether each of the statements 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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

| COLUMN I | COLUMN II |
|---|---|
| 1.3.1 Long and narrow pelvis | A: African apes<br>B: Humans |
| 1.3.2 The point of attachment of two overlapping chromatids | A: Locus<br>B: Chiasma |
| 1.3.3 Variation in human height | A: Continuous<br>B: Discontinuous |

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

1.4 The diagram below represents ALL the chromosomes in a cell that is undergoing normal cell division.




1.4.1 Name the:

(a) Type of cell division that is occurring in the cell in the diagram (1)

(b) Phase of cell division during which the chromosomes behave as shown in the diagram (1)

1.4.2 Where in the human female body would the type of cell division named in QUESTION 1.4.1(a) take place? (1)

1.4.3 Give the LETTER and NAME of the structure that attaches to the spindle fibres. (2)

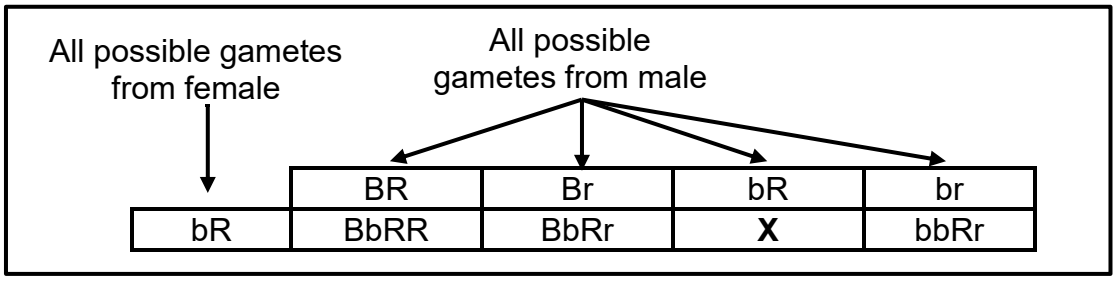
1.4.4 How many chromosomes will be found in each daughter cell at the end of this cell division? (1)
**(6)**

1.5 There is variation in the characteristics of fur colour and fur texture in cats.

The table below shows the alleles that control these two characteristics.

| CHARACTERISTIC | ALLELE | PHENOTYPE |
|---|---|---|
| Fur colour | **B** | Black |
| | **b** | White |
| Fur texture | **R** | Rough |
| | **r** | Smooth |

The Punnett square below shows the inheritance of these alleles in a genetic cross.




1.5.1 Name the:

(a) Dominant phenotype for fur colour (1)

(b) Recessive phenotype for fur texture (1)

1.5.2 Give the:

(a) Genotype of offspring **X** (1)

(b) Phenotype of the female parent (2)

(c) Genotype of the male parent (1)

1.5.3 State the phenotype that ALL the offspring of this genetic cross have in common. (1)
**(7)**

1.6 Scientists compare the number of differences in the amino acid sequence to see how closely related species are. Fewer differences in the amino acid sequence mean the species are more closely related.

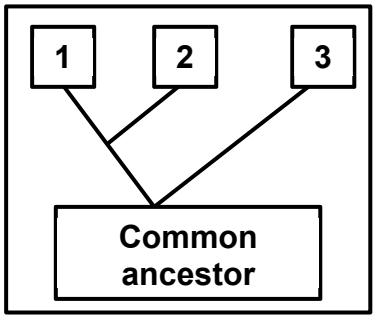
Cytochrome C is a protein that occurs in many species. The amino acid sequence of this protein differs between species.

The table below shows the number of differences in the amino acid sequences of three species, **A**, **B** and **C**.

| | **SPECIES B** | **SPECIES C** |
|---|---|---|
| **SPECIES A** | 11 | 3 |
| **SPECIES B** | | 10 |

1.6.1 What type of evidence for evolution is being used in this table? (1)

1.6.2 Give the LETTER of the species, **A**, **B** and **C**, that should appear at positions **1**, **2** and **3** in the diagram below.




(3)
**(4)**

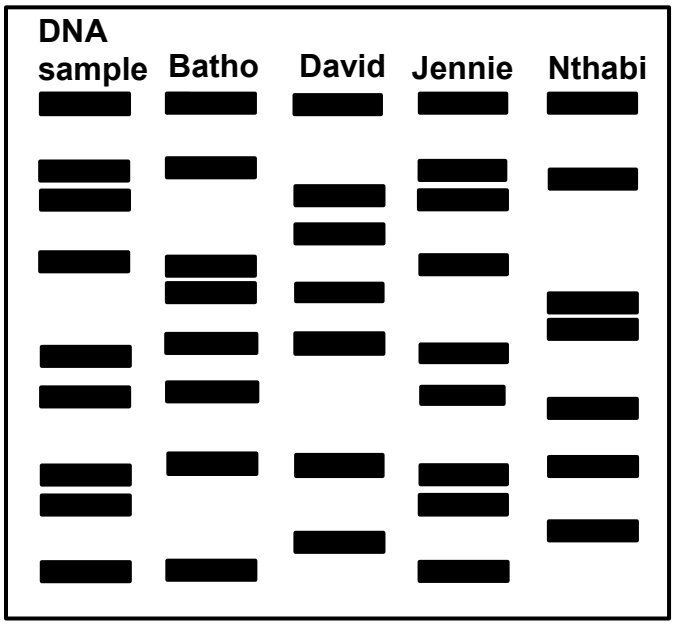
**TOTAL SECTION A: 50**

## SECTION B

## QUESTION 2

2.1 Detectives were investigating a crime scene and found blood on a broken window. They suspected that the blood was that of the criminal. To identify the criminal, they analysed a DNA sample from the blood and compared it to that of four suspects.

The diagram below was produced:




2.1.1 Name the technique that was used to identify the criminal. (1)

2.1.2 Who is the possible criminal? (1)

2.1.3 Explain your answer to QUESTION 2.1.2. (2)

2.1.4 State ONE other use of the technique identified in QUESTION 2.1.1. (1)
**(5)**

2.2 A farmer decided to have his best meat-producing bull cloned.

The following steps were used in the process:

- A muscle cell was taken from the bull and the nucleus was removed.
- An ovum was taken from a cow and the nucleus was removed and discarded.
- The nucleus from the muscle cell was placed in the empty ovum.
- The ovum was given an electric shock to stimulate normal cell division to produce an embryo.
- The embryo was placed in the uterus of a surrogate cow where it developed into the clone.

2.2.1 What is *cloning*? (1)

2.2.2 Explain why the nucleus of a muscle cell was used and not the nucleus of a sperm cell. (2)

2.2.3 Explain why the nucleus of the ovum was removed. (2)

2.2.4 State ONE benefit of cloning. (1)
**(6)**

2.3 A man with blood group **AB** and a woman who is heterozygous for blood group **B** plan to have children.

2.3.1 How many alleles control the inheritance of blood groups? (1)

2.3.2 Describe the type of dominance that occurs in the inheritance of blood group **B** in the woman. (3)

2.3.3 Use a genetic cross to show all the possible genotypes and phenotypes of their children. (6)
**(10)**

2.4 Sickle cell disease is caused by a recessive allele and first appeared in humans as a result of a gene mutation.

The table below shows the number of children born with sickle cell disease in some regions in a particular year.

| REGION | NUMBER OF CHILDREN BORN WITH SICKLE CELL DISEASE |
|---|---|
| Democratic Republic of Congo | 39 746 |
| United States of America | 90 128 |
| Nigeria | 91 011 |
| United Kingdom | 13 221 |
| Tanzania | 11 877 |
| Other | 59 750 |
| **Worldwide total** | **305 733** |

2.4.1 What is a *gene mutation*? (2)

2.4.2 Which region had the highest number of children born with sickle cell disease in that year? (1)

2.4.3 What percentage of the worldwide total of children born with sickle cell disease came from the Democratic Republic of Congo? Show ALL calculations. (3)

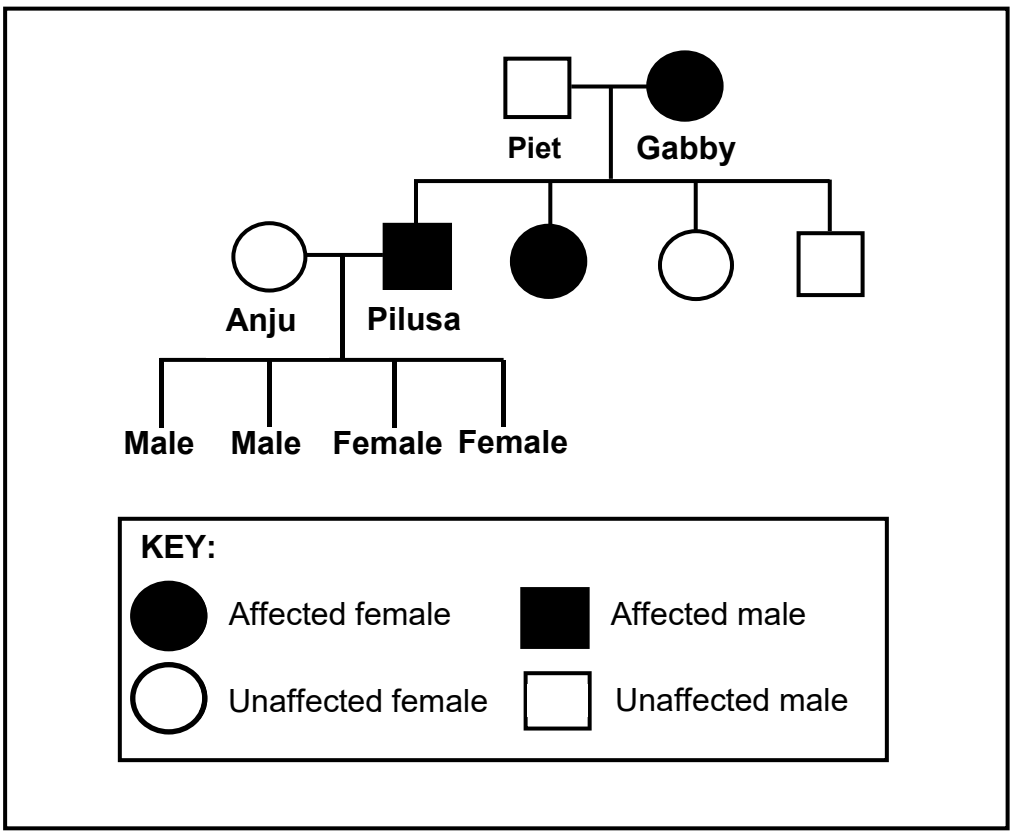
2.4.4 Use the letters **D** and **d** to give the genotype of a person who:

(a) Suffers from sickle cell disease (1)

(b) Carries the allele but does not suffer from the disease (1)
**(8)**

2.5 Goltz syndrome is a sex-linked genetic disorder. It is caused by a dominant allele $\mathbf{X^G}$.

The diagram below shows the inheritance of Goltz syndrome in a family.




2.5.1 Name the type of diagram shown. (1)

2.5.2 How many:

(a) Females are in this family (1)

(b) Males in the $F_1$-generation have Goltz syndrome (1)

2.5.3 Give Gabby's genotype. (2)

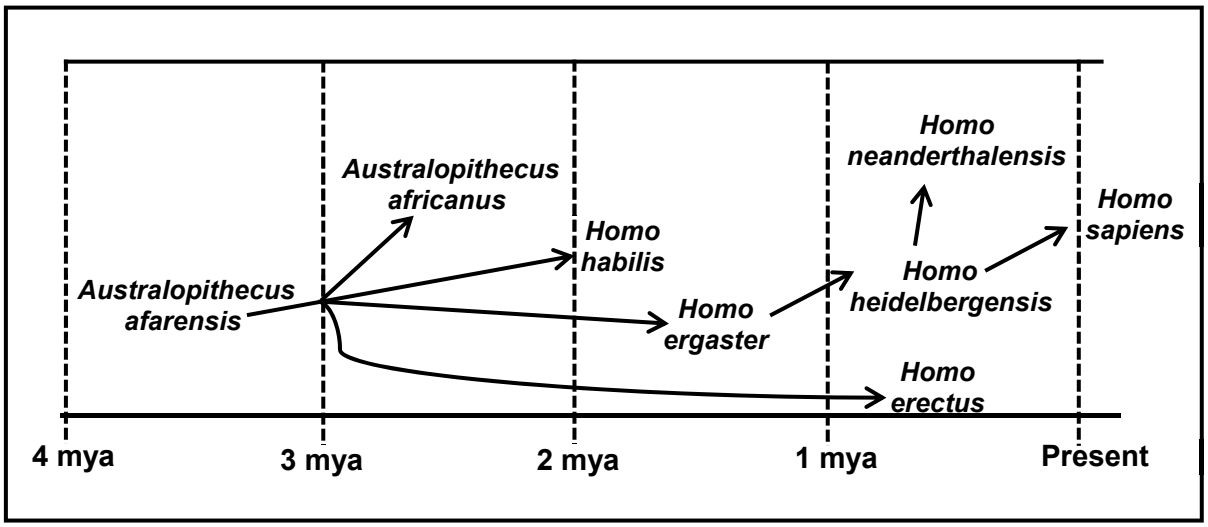
2.5.4 Anju and Pilusa have four children. Give the phenotype of their sons. (2)

2.5.5 Explain your answer to QUESTION 2.5.4. (4)
**(11)**
**[40]**

## QUESTION 3

3.1 Describe the process of natural selection. **(7)**

3.2 Fossil evidence for humans may be interpreted in different ways. One possible model of human evolution is shown below.




3.2.1 Name the family to which all of the represented organisms belong. (1)

3.2.2 Describe how cultural evidence is used to support the theory of human evolution. (2)

3.2.3 How long ago did the most recent common ancestor of *H. erectus* and *H. heidelbergensis* exist on earth? (1)

3.2.4 Explain a possible reason why *H. ergaster* was placed between *A. afarensis* and *H. heidelbergensis* on the model. (2)

3.2.5 Explain how the fossils of organisms that existed from **4** mya to present time are used to support the 'Out of Africa' hypothesis. (3)
**(9)**

3.3 Male long-tailed widowbirds have extremely long tail feathers that they use in mating displays to attract females.

Scientists conducted an investigation to determine the relationship between the length of the male long-tailed widowbird's tail and its mating success.

The procedure was as follows:

- A total of 27 male long-tailed widowbirds was sampled and divided into 3 equal groups.
- The tail feathers of the birds in each group were treated in the following way:
  - Group **1** – Cut short
  - Group **2** – Made longer by adding artificial feathers
  - Group **3** – Left unchanged
- The 3 groups of male long-tailed widowbirds, along with female long-tailed widowbirds, were released into an environment suitable for mating.
- Each time a pair mated successfully they produced a nest and all the nests were counted.
- The average number of nests produced by each group was calculated and used as an indication of mating success.

The results are shown in the table below.

| GROUP | AVERAGE NUMBER OF NESTS PRODUCED |
|---|---|
| 1 | 0,5 |
| 2 | 2,5 |
| 3 | 1 |

3.3.1 Name the:

(a) Reproductive isolating mechanism that occurs in long-tailed widowbirds (1)

(b) Independent variable in this investigation (1)

3.3.2 Explain why 27 long-tailed widowbirds were used in the investigation instead of only 3. (2)

3.3.3 Explain why Group **3** was included in the investigation. (2)

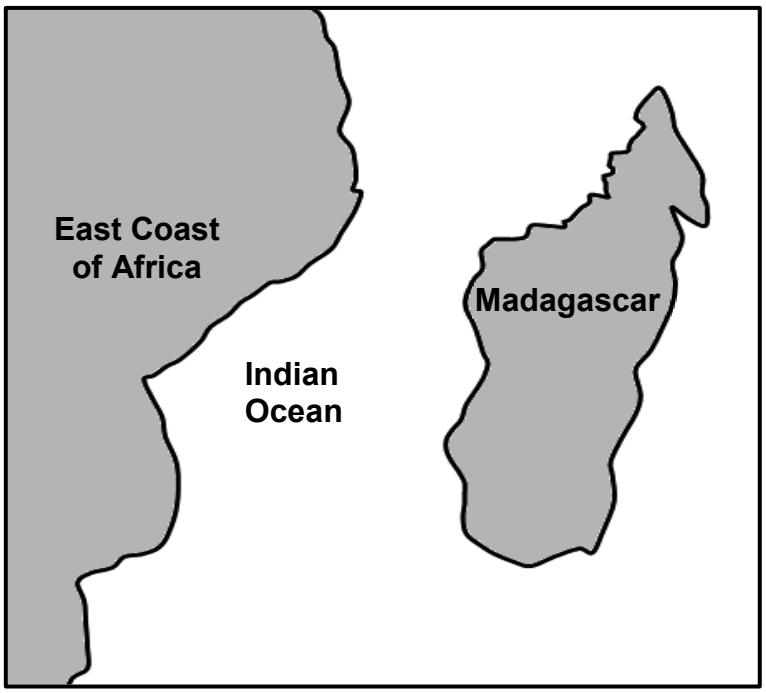
3.3.4 Draw a bar graph to represent the results of this investigation. (6)

3.3.5 State a conclusion for this investigation. (2)
**(14)**

3.4 Pottos and lemurs are small mammals.

Scientists believe that pottos and lemurs share a common ancestor that existed in Africa. Presently pottos only occur in Africa while lemurs are only found in Madagascar.

Madagascar is an island off the East coast of Africa as shown in the diagram below.




3.4.1 Explain how continental drift could have affected the distribution of the common ancestor. (4)

3.4.2 Describe the speciation of the pottos and lemurs to become different species. (6)
**(10)**
**[40]**

**TOTAL SECTION B: 80**

## SECTION C

## QUESTION 4

Describe the location and structure of DNA, the process of DNA replication and the significance of this process for mitosis.

Content: (17)
Synthesis: (3)
**(20)**

a

**NOTE:** NO marks will be awarded for answers in the form of a table, flow charts or diagrams.

**TOTAL SECTION C: 20**
**GRAND TOTAL: 150**

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

# SENIOR CERTIFICATE/ NATIONAL SENIOR CERTIFICATE

## GRADE 12

## LIFE SCIENCES P2

## NOVEMBER 2020(2)

## MARKING GUIDELINES (FINAL – 08/12/2020)

**MARKS: 150**

Approved
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**These marking guidelines consist of 12 pages.**

HAMIDA MOOSA
08/12/2020
INT. MODERATOR



RVAN DER WATT
INT! MODERATOR
08/12/2020

## 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.

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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.

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA, 0001
2020 -12- 08
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATIONS

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## SECTION A

## QUESTION 1



| | | | | |
|---|---|---|---|---|
| 1.1 | 1.1.1 | B✓✓ | | |
| | 1.1.2 | C✓✓ | | |
| | 1.1.3 | B✓✓ | | |
| | 1.1.4 | D✓✓ | | |
| | 1.1.5 | C✓✓ | | |
| | 1.1.6 | A✓✓ | | |
| | 1.1.7 | D✓✓ | | |
| | 1.1.8 | D✓✓ | | |
| | 1.1.9 | C✓✓ | | |
| | 1.1.10 | C✓✓ | (10 x 2) | **(20)** |
| 1.2 | 1.2.1 | Homologous✓structures | | |
| | 1.2.2 | Canines✓ | | |
| | 1.2.3 | Cranium✓ | | |
| | 1.2.4 | Autosomes✓ | | |
| | 1.2.5 | Chromatin✓ | | |
| | 1.2.6 | Karyotype✓ | | |
| | 1.2.7 | Prognathous✓ | (7 x 1) | **(7)** |
| 1.3 | 1.3.1 | A only✓✓ | | |
| | 1.3.2 | B only✓✓ | | |
| | 1.3.3 | A only✓✓ | (3 x 2) | **(6)** |
| 1.4 | 1.4.1 | (a) Meiosis✓/Meiosis I | | (1) |
| | | (b) Prophase I✓ | | (1) |
| | 1.4.2 | Ovary✓ | | (1) |
| | 1.4.3 | C✓- centromere✓ | | (2) |
| | 1.4.4 | 3✓/Three | | (1) |
| | | | | **(6)** |
| 1.5 | 1.5.1 | (a) Black✓fur | | (1) |
| | | (b) Smooth✓texture | | (1) |
| | 1.5.2 | (a) bbRR✓ | | (1) |
| | | (b) White (fur) with rough (texture)✓✓ | | (2) |
| | | (c) BbRr✓ | | (1) |
| | 1.5.3 | Rough✓ texture | | (1) |
| | | | | **(7)** |
| 1.6 | 1.6.1 | Genetic✓ evidence | | (1) |
| | 1.6.2 | 1 - A✓ C<br>2 - C✓ **OR** A<br>3 - B✓ B | | (3) |
| | | | | **(4)** |

**TOTAL SECTION A: 50**

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## SECTION B

## QUESTION 2

| | | | | |
|---|---|---|---|---|
| 2.1 | 2.1.1 | DNA profiling✓ | | (1) |
| | 2.1.2 | Jennie✓ | | (1) |
| | 2.1.3 | - Jennie's DNA profile✓/ bands<br>- matches the DNA profile/ bands of the sample✓from the crime scene | | (2) |
| | 2.1.4 | - Proof of paternity✓<br>- Tracing missing persons✓<br>- Identification of genetic disorders✓<br>- Establishing family relations✓<br>- Matching tissues for organ transplants✓<br>- Identifying dead persons✓/animals<br>**(Mark first ONE only)** | Any | (1)<br>**(5)** |
| 2.2 | 2.2.1 | The production of (genetically) identical organisms✓ | | (1) |
| | 2.2.2 | - A muscle cell contains all the genetic material✓ of the bull/ is diploid whereas<br>- A sperm cell has only half of the genetic material✓/ is haploid | | (2) |
| | 2.2.3 | - To remove the genetic material of the cow✓<br>- so that only the genetic material from the (best meat producing) bull is present✓ | | (2) |
| | 2.2.4 | - To produce organisms with desired traits✓e.g. health; appearance; nutritious; yield; shelf-life; etc<br>- Conservation of threatened species✓<br>- To create tissues/organs for transplant✓<br>**(Mark first ONE only)** | Any | (1)<br>**(6)** |



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2.3 2.3.1 3✓/ Three (1)

2.3.2
- Complete dominance✓
- The allele for blood group B/ $I^B$ is dominant✓ and
- the allele for blood group O/ i is recessive✓ (3)

2.3.3 **$P_1$** Phenotype: Blood group AB x Blood group B✓
Genotype: $I^AI^B$ x $I^Bi$✓

*Meiosis*

**G**/gametes $I^A$ $I^B$ x $I^B$ i✓

*Fertilisation*

**$F_1$** Genotype: $I^AI^B$ $I^Ai$ $I^BI^B$ $I^Bi$✓*

Phenotype: Blood group:
AB; A; B✓*

$P_1$ and $F_1$✓
Meiosis and fertilisation✓

**Compulsory 2***+ Any 4

**OR**



**$P_1$** Phenotype: Blood group AB x Blood group B✓
Genotype: $I^AI^B$ x $I^Bi$✓

*Meiosis*

*Fertilisation*

| Gametes | $I^A$ | $I^B$ |
|---|---|---|
| $I^B$ | $I^AI^B$ | $I^BI^B$ |
| i | $I^Ai$ | $I^Bi$ |

1 mark for correct gametes
1 mark for correct genotypes*

**$F_1$** Phenotype: Blood group:
AB; A; B✓*

$P_1$ and $F_1$✓
Meiosis and fertilisation✓

**Compulsory 2***+ Any 4 (6)
**(10)**



 

| | | | |
|---|---|---|---|
| 2.4 | 2.4.1 | - A change in the sequence ✓of<br>- nitrogenenous bases✓/nucleotides in a gene | (2) |
| | 2.4.2 | Nigeria✓ | (1) |
| | 2.4.3 | $\frac{39\ 746}{305\ 733}$ ✓ x 100✓ = 13✓% | (3) |
| | 2.4.4 | (a) dd✓ | (1) |
| | | (b) Dd✓ | (1) |
| | | | **(8)** |
| 2.5 | 2.5.1 | Pedigree✓ diagram | (1) |
| | 2.5.2 | (a) 6✓ | (1) |
| | | (b) 1✓ | (1) |
| | 2.5.3 | $X^GX^g$✓✓ | (2) |
| | 2.5.4 | Unaffected✓✓/without Goltz syndrome | (2) |
| | 2.5.5 | - Pilusa is affected✓/ $X^GY$<br>- Anju is unaffected✓/ $X^gX^g$<br>- Males inherit the Y chromosome from Pilusa✓<br>- and inherit $X^g$ from Anju✓ | (4) |
| | | | **(11)** |
| | | | **[40]** |



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## QUESTION 3

3.1
- Organisms produce a large number of offspring✓
- There is variation✓ amongst the offspring
- Some have favourable characteristics and some do not✓
- When there is a change in the environmental conditions✓/ there is competition
- organisms with favourable characteristics, survive✓
- whilst organisms with unfavourable characteristics, die✓
- The organisms that survive, reproduce✓
- and pass on the allele for the favourable characteristic to their offspring✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristic✓

Any **(7)**

3.2 3.2.1 *Hominidae*✓ (1)

3.2.2
- Evidence such as tools✓ /weapons/ language/ artefacts
- is used to show advances✓ in human development (2)

3.2.3 3 mya✓ (1)

3.2.4
- *H. ergaster* shows characteristics of both✓*A. afarensis* and *H. heidelbergensis*
- therefore it is a transitional✓ species (2)

3.2.5
- The fossils of *Australopithecus* were ONLY found in Africa✓
- The fossils of *Homo habilis* were ONLY found in Africa✓
- The OLDEST fossils of *Homo erectus* were found in Africa✓
- The OLDEST fossils of *Homo sapiens* were found in Africa✓
- This suggests that (the ancestors of) *Homo sapiens* originated in Africa✓*

***1 Compulsory** + Any 2 (3)
**(9)**

3.3 3.3.1 (a) (Species-specific) courtship behaviour✓ (1)

(b) Length of the (male long-tailed widowbird's) tails✓ (1)

3.3.2
- A larger sample size✓
- increases the reliability✓ of the investigation (2)

3.3.3
- To serve as a control✓
- so that it can be compared✓with the other groups
- and show that the tail length is the only factor that affects the results✓/improves the validity of the investigation

Any (2)

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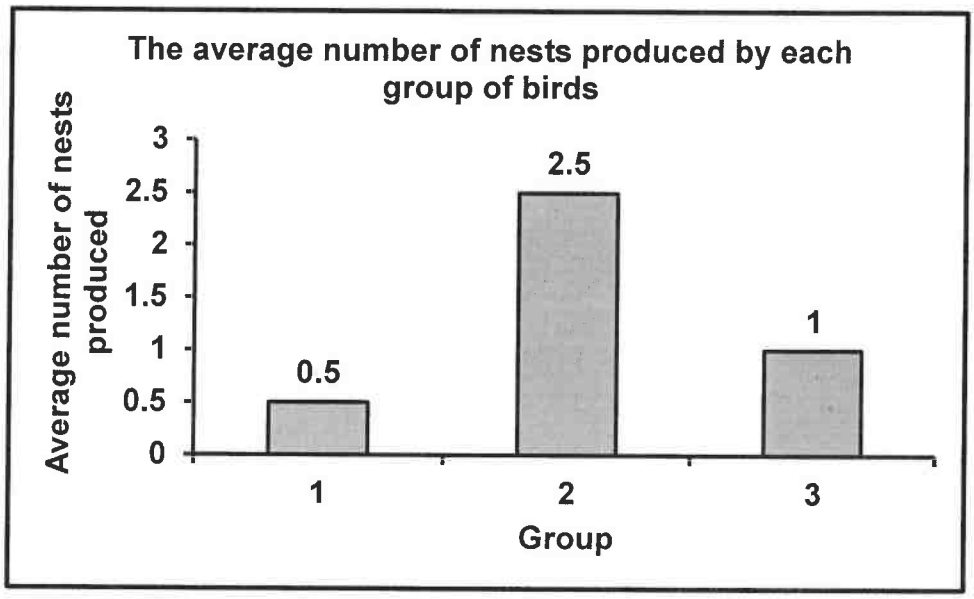
3.3.4




(6)

**Guideline for assessing the graph**

| CRITERIA | ELABORATION | MARK |
|---|---|---|
| Correct type of graph **(T)** | Bar graph drawn | 1 |
| Caption of graph **(C)** | Both variables included | 1 |
| Axes labels **(L)** | X- and Y-axis correctly labelled | 1 |
| Scale for X- and Y-axis**(S)** | - Equal space between bars and width of bars for X-axis and<br>- Correct scale for Y-axis | 1 |
| Plotting of bars **(P)** | 1 to 2 bars plotted correctly<br>All 3 bars plotted correctly | 1<br>2 |



3.3.5 The longer the (male long-tailed widowbird's) tail, the higher the mating success✓✓

**OR**

The shorter the (male long-tailed widowbird's) tail, the lower the mating success✓✓

(2)
**(14)**

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3.4 3.4.1
- There was once one large continent✓ and
- the common ancestor existed throughout this continent✓
- When Madagascar separated✓
- the common ancestor was found in both✓ regions (4)

3.4.2
- The common ancestor became separated into two **groups** by the ocean✓*
- There was no gene flow between the two **groups**✓
- Each **group** experienced different environmental conditions✓
- and underwent natural selection independently✓
- The individuals in each **group** became different✓
- genotypically and phenotypically✓
- to form the pottos and lemurs✓*
- Eventually if the two groups are mixed again, they cannot interbreed✓/produce fertile offspring. ***2 Compulsory** + Any 4 (6)

**(10)**
**[40]**

**TOTAL SECTION B: 80**

## SECTION C

## QUESTION 4

### Location (P)

- The DNA is located in the nucleus✓
- and mitochondria✓ and
- chloroplasts✓

Any (2)

### Structure (S)

- DNA is a double-stranded✓molecule that
- forms a helix✓
- It is made up of nucleotides✓
- Each nucleotide has a deoxyribose sugar✓molecule
- a phosphate group✓ and
- a nitrogenous base✓
- The bases are A, T, C and G✓
- which join to form complementary pairs✓/ (A to T and C to G)
- held by hydrogen bonds✓

Any (7)

### DNA replication (D)

- The DNA (double helix) unwinds✓ and
- unzips✓/hydrogen bonds break
- to form two separate strands✓
- Both DNA strands serve as templates✓
- to build a complementary DNA✓/(A to T and C to G)
- using free (DNA) nucleotides✓ from the nucleoplasm
- This results in two identical (DNA) molecules✓
- Each molecule consists of one original strand and one new strand✓

Any (6)

### Significance of DNA replication for mitosis (M)

- The genetic material/DNA is doubled✓
- so that each cell receives the same amount of DNA✓
- to ensure that all the daughter cells are (genetically) identical✓

Any (2)

Content: (17)
Synthesis: (3)
**(20)**

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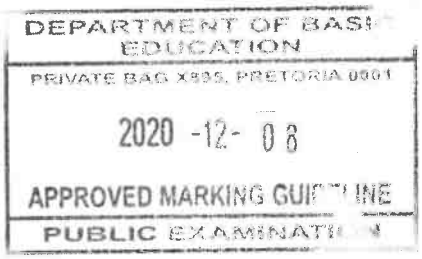
## ASSESSING THE PRESENTATION OF THE ESSAY

| Criterion | Relevance (R) | Logical sequence (L) | Comprehensive (C) |
|---|---|---|---|
| **Generally** | All information provided is relevant to the question | Ideas are arranged in a logical/cause-effect sequence | All aspects required by the essay have been sufficiently addressed |
| **In this essay in Q4** | Only information relevant to:<br><br>- Location and structure of DNA<br>- Process of DNA replication<br>- Significance of DNA replication for mitosis<br><br>There is no irrelevant information | The description for each of:<br><br>- Location and structure of DNA<br>- Process of DNA replication<br>- Significance of DNA replication for mitosis<br><br>Is logical and sequential | At least the following marks should be obtained for:<br><br>- Location of DNA **(P:1/2)**<br>- Structure of DNA **(S:5/7)**<br>- Process of DNA replication **(D:4/6)**<br>- Significance of DNA replication for mitosis **(M:1/2)** |
| **Mark** | 1 | 1 | 1 |

**TOTAL SECTION C: 20**
**GRAND TOTAL: 150**

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