



Basic Education

KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

LIFE SCIENCES P2

PREPARATORY EXAMINATION

SEPTEMBER 2015

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MARKS: 150

TIME: 2½ hours

This question paper consists of 17 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. Make ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, flow charts or tables 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 given as possible answers to the following questions. Choose the 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, for example 1.1.11 D.

1.1.1 The monomers that join together to form nucleic acids are ...

- A glucose molecules.
- B fatty acids.
- C amino acids.
- D nucleotides.

1.1.2 Study the following features of the DNA molecule.

- i The order of the bases on the molecular chain
- ii The arrangement of the sugar-phosphate groups
- iii The pairing of the complementary bases
- iv The weak hydrogen bonds between the bases

Which ONE of the following combinations of features are always the same in the DNA molecule?

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

1.1.3 During DNA replication ...

- A amino acids are brought to the ribosome.
- B the weak peptide bonds break.
- C the DNA molecule moves to the cytoplasm.
- D the hydrogen bonds break to separate the double helix.

1.1.4 Four different blood groups are possible in the children if the parents blood groups are ...

- A AB and O.
- B A and B.
- C B and AB.
- D O and B.

- 1.1.5 The table below shows the proportions of the four bases in the DNA of four different organisms.

ORGANISM	ADENINE (%)	GUANINE (%)	CYTOSINE (%)	THYMINE (%)
Onion	31,8	18,4	18,2	31,3
Wild carrot	26,7	23,2	23,3	26,8
Catfish	28,4	19,5	19,4	32,8
Bacterium	36,9	14,0	12,8	36,3

Which ONE of the following facts does the above evidence support?

- A All the bases in an organism are in equal proportion to each other
 - B The sequence of bases in a DNA molecule are constant
 - C The ratio of adenine to guanine is the same as that of adenine to thymine
 - D The ratio of adenine to thymine is the same as that of guanine to cytosine
- 1.1.6 When the first child of two parents with no visible genetic disorder was born, doctors found that the child had a serious genetic disorder. Doctors told the parents that a recessive allele had caused the disorder.

If they have a second child, this child would ...

- A be certain to have the disorder.
 - B have a 1 in 2 chance of having the disorder.
 - C have a 1 in 4 chance of having the disorder.
 - D have no chance of having the disorder.
- 1.1.7 In multiple alleles ...
- A more than one gene controls a trait or characteristic.
 - B there are more than two different alleles for the same gene.
 - C the different alleles for the different characteristics are on one chromosome.
 - D there are only two alleles for a particular gene.

1.1.8 Which ONE of the following statements describes the significance of meiosis in the evolution of new species?

- A Meiosis produces eggs and sperm that are identical
- B The gametes produced by meiosis ensure the continuation of any species by asexual reproduction
- C Equal numbers of eggs and sperm are produced by meiosis
- D Meiosis leads to genetic variation in the gametes

1.1.9 Study the list below relating to evidence for human evolution.

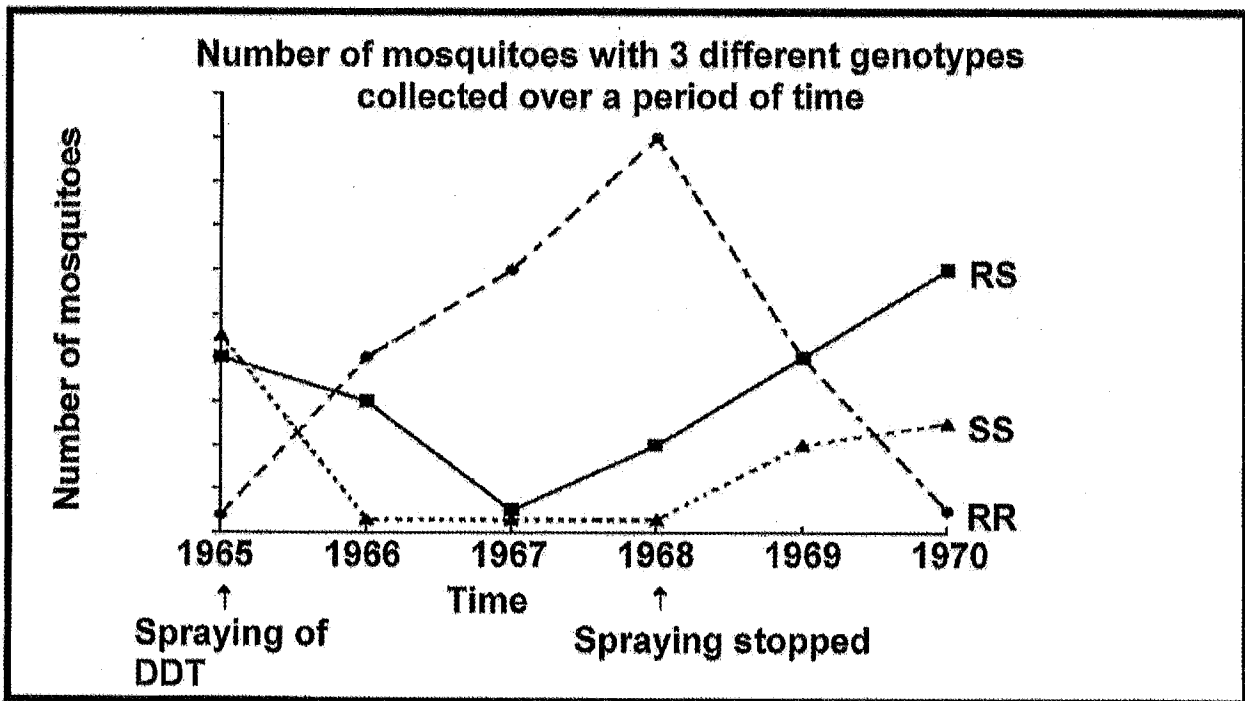
- i Cultural evidence from use of tools
- ii Fossil evidence
- iii Differences in anatomical features
- iv Genetic evidence

Which ONE of the following combinations represents evidence to support the idea of a common ancestor for living hominids, including humans?

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

- 1.1.10 There is a gene locus which has two alleles, **R** and **S** in mosquitoes. The mosquito will be resistant to the insecticide DDT if the alleles are **RR** and the mosquito will be sensitive to the insecticide if it is **RS** or **SS**.

The graph below shows the number of mosquitoes of the 3 genotypes present in a population of mosquitoes. The data was collected from 1965 (when DDT was first used) to 1970 (two years after the spraying of DDT stopped).



From this data it is reasonable to conclude that ...

- A most mosquitoes in 1970 had the **SS** allele.
- B resistant mosquitoes were least common in 1970.
- C the population size of mosquitoes with the **RS** allele increased only once the spraying was stopped.
- D the highest number of insecticide sensitive mosquitoes were present in 1968.

(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 1.2.10) in the ANSWER BOOK.

- 1.2.1 The sugar found in RNA
- 1.2.2 The two parts of a chromosome joined by a centromere
- 1.2.3 Structure that forms the spindle in animal cells during cell division
- 1.2.4 The division of the nucleus during cell division
- 1.2.5 Structures with a similar building plan inherited from a common ancestor
- 1.2.6 The breeding of organisms by humans to produce the desired traits in the offspring
- 1.2.7 Bonds that hold amino acids together in a protein molecule
- 1.2.8 The fossil skull of the child discovered by Professor Raymond Dart in 1924
- 1.2.9 A tentative explanation of a phenomenon, that can be tested
- 1.2.10 The 'barcode' pattern of the sequence of base pairs of the DNA of a person

(10)

- 1.3 Indicate whether each of the statements 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 number (1.3.1 to 1.3.7) in the ANSWER BOOK.

COLUMN I		COLUMN II	
1.3.1	Nitrogenous base found in DNA and RNA	A:	Cytosine
		B:	Uracil
1.3.2	Site of DNA replication	A:	Ribosome
		B:	Cytoplasm
1.3.3	Inheritance of height in humans	A:	Continuous variation
		B:	Discontinuous variation
1.3.4	Disease resulting from an autosomal mutation	A:	Haemophilia
		B:	Colour-blindness
1.3.5	Inheritance of characteristics independent of each other	A:	Law of Segregation
		B:	Law of Independent Assortment
1.3.6	The full complement of genes present in an organism	A:	Gene pool
		B:	Genome
1.3.7	Acquired traits are passed down from parent to offspring	A:	Darwin
		B:	Lamarck

(7 x 2)

(14)

- 1.4 In black rhinos, two particular traits allow them to be better adapted to their environment. The first trait is a long lip that allows for more efficient eating over a normal lip. The second trait is long ears that allow them to hear a potential predator earlier than normal sized ears.

Both these desired traits are homozygous recessive.

A black male rhino, homozygous dominant for the normal lip (**PP**) and heterozygous for the normal ears (**Ee**) was crossed with a black female rhino that was heterozygous for normal lips (**Pp**) and homozygous recessive for long ears (**ee**).

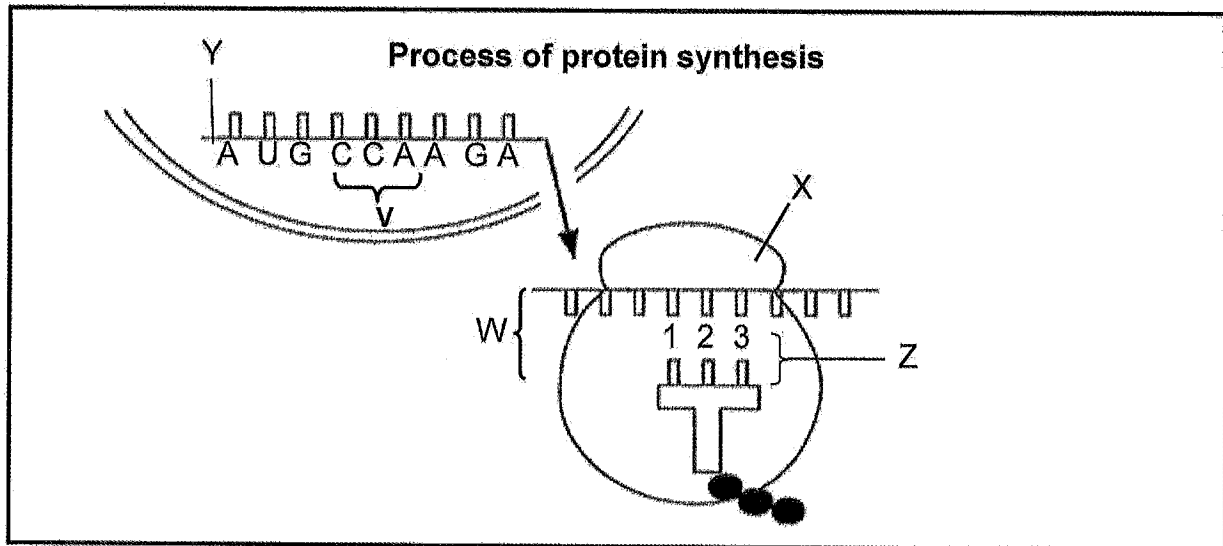
- 1.4.1 List the possible gametes that could be produced by the male parent. (2)
- 1.4.2 State the phenotype of an offspring having the genotype:
- (a) PpEe (1)
- (b) ppee (1)
- 1.4.3 Write down the possible genotype of the black rhinos that would have to be interbred to produce offspring with a phenotypic ratio of 9:3:3:1. (2)

(6)

TOTAL SECTION A: 50

SECTION B**QUESTION 2**

2.1 The diagram below shows a stage in the synthesis of a protein.



- 2.1.1 Name the stage of protein synthesis shown at **W** in the diagram above. (1)
- 2.1.2 Identify organelle **X**. (1)
- 2.1.3 Provide the term to identify the triplet of bases at **Z**. (1)
- 2.1.4 Describe the role of tRNA in the stage of protein synthesis named in QUESTION 2.1.1. (4)
- 2.1.5 Refer to the sequence of nitrogenous bases as shown in the above diagram and answer the questions that follow.

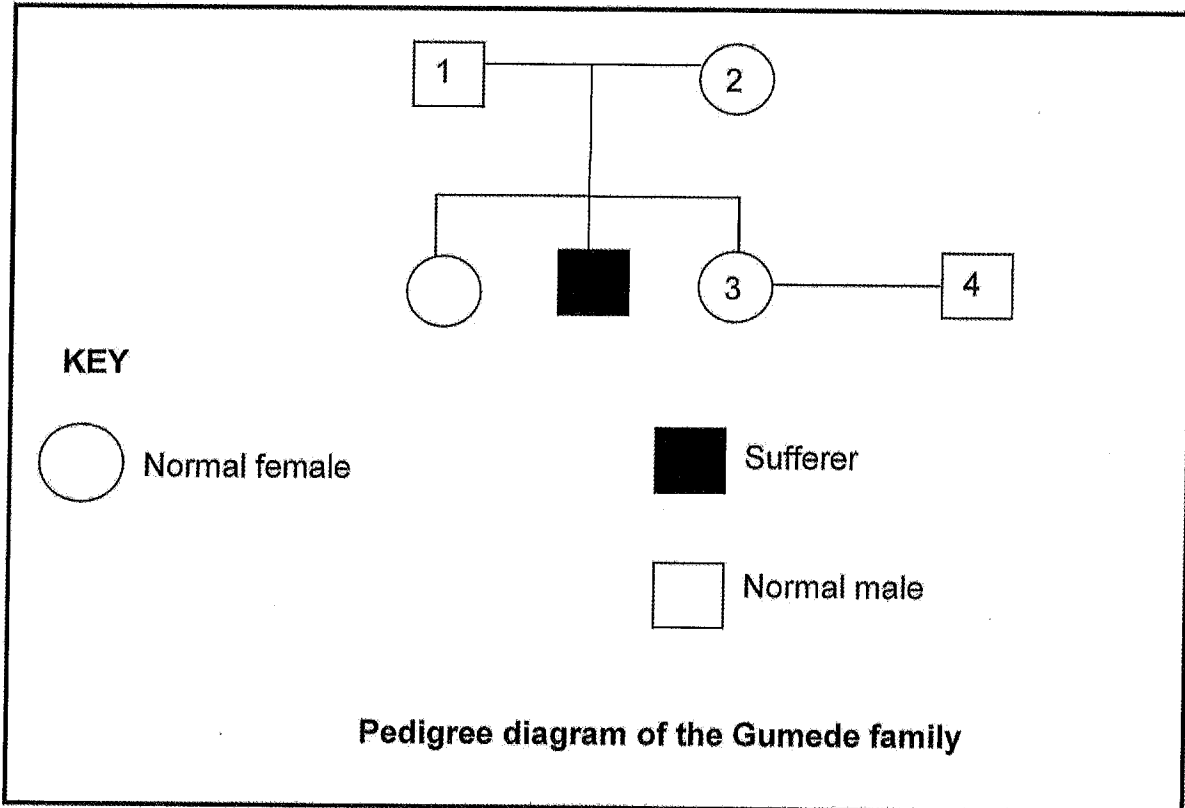
AUG - CCA - AGA

Write down the corresponding base sequence:

- (a) Of the DNA molecule that complements strand **Y** (2)
- (b) On molecule **Z** (2)
- 2.1.6 Explain how the composition of the protein molecule would change if the base sequence at **V** was CCU instead of CCA. (3)
- (14)**

2.2 Duchenne Muscular Dystrophy (DMD) is a fatal neuromuscular, sex-linked disorder that is carried by a recessive allele on the X chromosome, represented as X^d . DMD causes weakness to the muscles, including the muscles of the heart.

Study the pedigree diagram showing the inheritance of DMD over two generations in the Gumede family and answer the questions that follow.



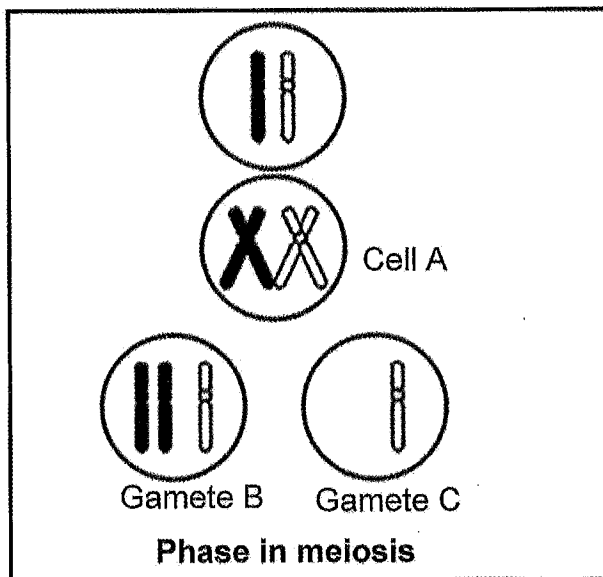
- 2.2.1 State the genotype of individual 2. (2)
 - 2.2.2 Represent a genetic cross to determine the possible genotypes and phenotypes of the offspring that may be formed by individuals 3 and 4. Individual 3 is a carrier of DMD. (6)
 - 2.2.3 Based on the results of the genetic cross, state THREE benefits of genetic counselling for the couple. (3)
 - 2.2.4 Explain why mainly men suffer from this disease. (3)
- (14)**

2.3 The "Out of Africa" hypothesis states that all modern humans originated in Africa.

2.3.1 Name the first species to move out of Africa. (1)

2.3.2 Explain TWO types of evidence in support of the "Out of Africa" hypothesis. (4)
(5)

2.4 The following diagram shows an error that may occur during meiosis.



2.4.1 Name TWO organs in the human body where meiosis takes place. (2)

2.4.2 Account for the difference in the number of chromosomes in gametes B and C. (5)

(7)
[40]

QUESTION 3

- 3.1 Stem cells were cultured under ideal laboratory conditions to replace damaged cells associated with a number of disorders in the human body.

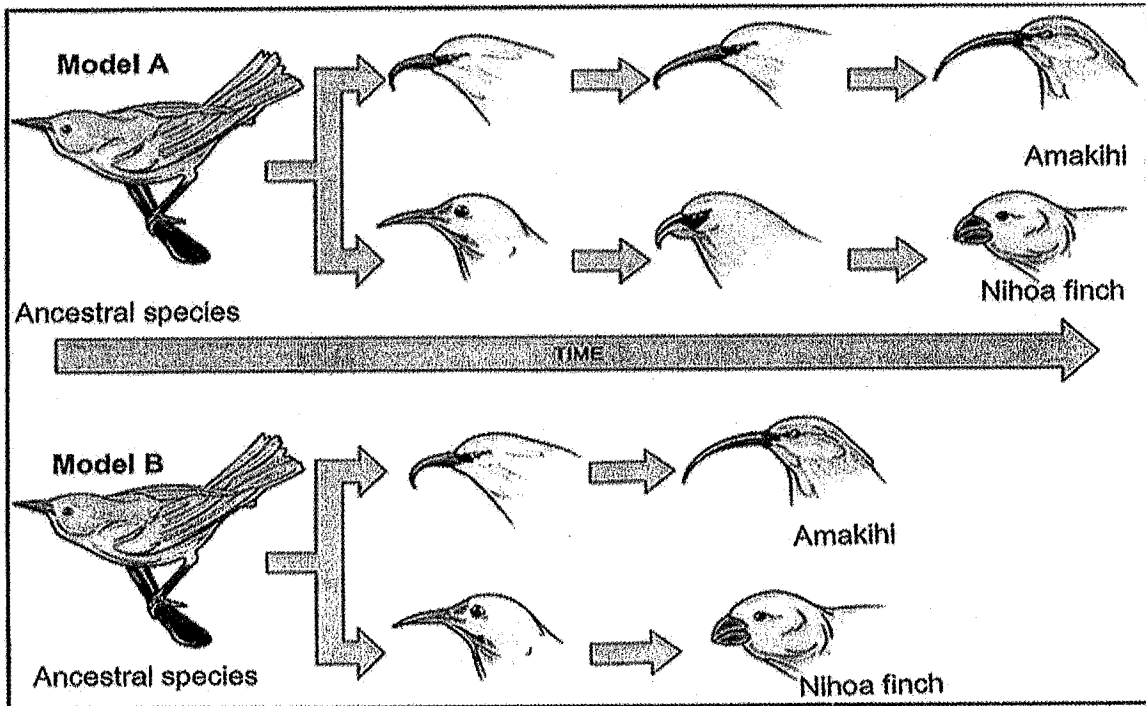
The table below represents the number of stem cells used in the treatment of some of the disorders of the human body.

DISORDERS	NUMBER OF STEM CELLS USED (MILLIONS)
Cancer	425
Alzheimer's disease	200
Heart disease	150
Diabetes	75

[Adapted from: townshipproject.wikispaces.com]

- 3.1.1 State TWO sources of stem cells. (2)
- 3.1.2 Draw a bar graph to represent the information provided in the above table. (6)
- 3.1.3 Name ONE use of stem cells other than in treating the above disorders. (1)
- (9)

3.2 The diagram below represents two possible models that show the changes of the beaks in finch species based on their feeding habits over a period of time.



[Adapted from: www.boundless.com]

- 3.2.1 Which model, **A** or **B** represents punctuated equilibrium? (1)
 - 3.2.2 Explain your answer in QUESTION 3.2.1 above. (2)
 - 3.2.3 Explain how Darwin would have explained the changes in the beak size over time. (6)
- (9)

3.3 Read the following case study.

The Highveld gerbil, a rat-like creature and the Cape gerbil, also a rat-like creature, live in Southern Africa. Both species have a diploid number of 44 chromosomes.

A researcher put 16 pairs (one male and one female) together with one of each pair being a Highveld gerbil and the other, a Cape gerbil. Over the next 12 months, 18 babies were born.

Nine babies died before they reached adult size due to a genetic mutation. The nine gerbils that survived were left to mate again. No offspring were produced.

[Adapted from: *Biology, 10th Edition*, McGraw-Hill, 2011]

3.3.1 How many chromosomes will be present in the gamete of the gerbil? (1)

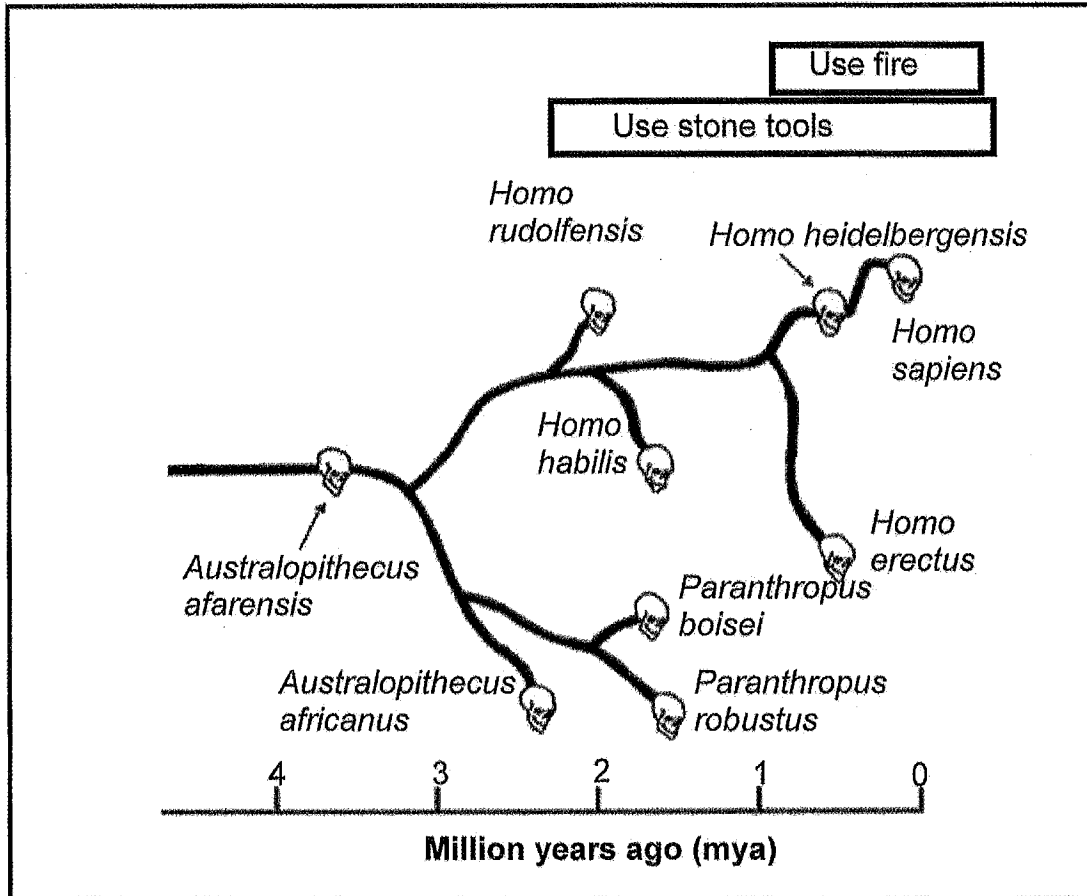
3.3.2 Explain if the Highveld gerbil and the Cape gerbil are the same species. (2)
(3)

3.4 Flightless birds are found on different continents. They all share a common ancestor.

Explain how they became different species. (8)

3.5 Study the phylogenetic tree below which shows a possible representation of human evolution.

The solid lines represent the origin and extinction of the species. The skulls are not representative of the species and are not drawn to scale.



- 3.5.1 Name the ancestral species in the evolutionary process, as shown in the phylogenetic tree. (1)
 - 3.5.2 How many million years ago did *Paranthropus boisei* first appear? (1)
 - 3.5.3 According to the phylogenetic tree, which species was the first to use simple stone tools? (1)
 - 3.5.4 Name **THREE** species represented that used simple stone tools and fire. (3)
 - 3.5.5 Tabulate **TWO** structural differences in the skulls of African apes and Humans that represent trends in human evolution. (5)
- (11)
[40]

TOTAL SECTION B: 80

SECTION C**QUESTION 4**

Describe the structural features that made bipedalism possible and explain how bipedalism and a larger brain capacity led to the success of *Homo sapiens*.

Content: (17)
Synthesis: (3)

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

TOTAL SECTION C: 20
GRAND TOTAL: 150





Basic Education
KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

LIFE SCIENCES P2
PREPARATORY EXAMINATION - SEPTEMBER 2015
MEMORANDUM

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MARKS: 150

This memorandum consists of 12 pages.

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Please turn over

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 is incorrect, do not credit. If sequence and links becomes correct again, resume credit.
9. **Non-recognized abbreviations**
Accept, if first defined in the 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 recognizable 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.

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14. If only the letter is asked for but only the name is given (and vice versa)

- 1.1 1.1.1 D✓✓
- 1.1.2 C✓✓
- 1.1.3 D✓✓
- 1.1.4 B✓✓
- 1.1.5 D✓✓
- 1.1.6 C✓✓
- 1.1.7 B✓✓
- 1.1.8 D✓✓
- 1.1.9 D✓✓
- 1.1.10 B✓✓

Do n
I f
u n
i t
s a

15.

(10 x 2) (20)

re not given in measurements

Candidates will lose marks. Memorandum will allocate marks for units separately.

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

17. Caption

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

18. Code-switching of official languages (terms and concepts)

A single word or two that appears in any official language other than the learners' assessment language used to the greatest extent in his/her answers should be credited if it is correct. A marker that is proficient in the relevant official language should be consulted. This is applicable to all official languages.

SECTION A

QUESTION 1

- 1.2 1.2.1 Ribose✓
- 1.2.2 Chromatids✓
- 1.2.3 Centriole✓ / Centrosome
- 1.2.4 Karyokinesis✓
- 1.2.5 Homologous✓
- 1.2.6 Artificial selection✓ / selective breeding
- 1.2.7 Peptide✓
- 1.2.8 Taung child✓
- 1.2.9 Hypothesis✓
- 1.2.10 DNA fingerprint✓ / DNA profile

- 1.3 1.3.1 A only✓✓
- 1.3.2 None✓✓
- 1.3.3 A only✓✓
- 1.3.4 None✓✓

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- 1.3.5 B only✓✓
- 1.3.6 B only✓✓
- 1.3.7 B only✓✓

(7 x 2) (14)

- 1.4 1.4.1 PE✓ and Pe✓ (2)
- 1.4.2 a) Normal lip with normal ears✓ (1)
- b) Long lips with long ears✓ (1)
- 1.4.3 PpEe✓✓ (2)

TOTAL SECTION A: 50

QUESTION 2

- 2.1 2.1.1 Translation✓ (1)
- 2.1.2 Ribosome✓ (1)
- 2.1.3 Anticodon✓ (1)

2.1.4 -
- tRNA carries a specific amino acid✓
- the anticodon✓ on the tRNA
- the codon✓ on the mRNA
- tRNA brings the required amino acid to the ribosome✓
- acids become attached by peptide✓ bonds
- the required protein✓ (Any 4)
- to form

- 2.1.5 (a) TAC - GGT - TCT✓✓ (Correct sequence) (2)
- (b) GGU✓✓ (2)

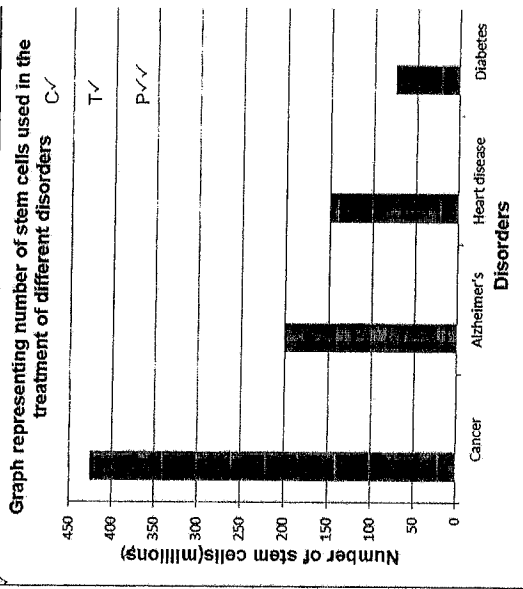
2.1.6 -
- The
- codon will change✓ / base sequence will change
- A
- different amino acid will be brought to the ribosome✓
- A
- different protein will form✓ / the required protein will not form✓

- 2.2 2.2.1 X⁰X⁰✓✓ (2)

2.2.2 P Phenotype Normal female x Normal male✓

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3.1.2



Mark allocation of the graph

Criterion	Elaboration	Mark
Type of graph(T) Caption(C)	Bar graph drawn Includes both variables: Disorders and number of stem cells	1
Scale	Scale on X and Y axes correct	1
Labelling	Correct label for X axis: Disorders and correct label and units for Y axis: Stem cells (millions)	1
Drawing of bars	All 4 bars plotted correctly- 2 marks 1-3 bars plotted correctly-1 mark	2

3.1.3

Skin regeneration✓
Organ regeneration✓

Muscle cells grown in culture to form meat✓
(Mark first ONE only)

(Any 1)

(1)

(9)

3.2 3.2.1 B✓

3.2.2 New species were formed✓
in a shorter period of time✓

3.2.3

variation in the species✓
food types were available ✓

There was

Different

Those

birds with beaks not suited✓ to food types

died✓
Some

birds with beaks suited✓ to the food types

survived✓
Birds with

to pass

a favourable beak shape/size reproduced✓

favourable characteristics to their offspring✓
increasing the proportion✓ of birds with beaks suited to a particular
food source
(Any 6)

(9)

3.3 3.3.1 22✓

3.3.2

gerbil and Cape gerbil were not✓ of the same
species

Highveld

since their

offspring were sterile✓ / could not produce further
offspring

(2)

(3)

3.4

geographical✓ barrier

The

the original population

separated✓

populations

into many✓

There was

no gene flow✓ between the different populations of flightless birds

Since each

population was exposed to different environmental conditions✓

natural

selection took place independently in each population✓

which

changed the flightless birds genotypically and phenotypically✓

such

that

even when the flightless birds were allowed to mix✓

they were

unable to interbreed with each other✓ thus forming new species.

(Any 8)

(1)

(1)

(1)

(3)

3.5 3.5.1

3.5.2

3.5.3

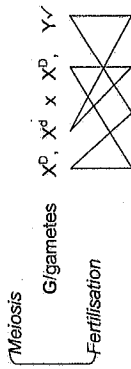
3.5.4 *Australopithecus afarensis*✓

2✓ mya

3.5.5 *Homo rudolfensis*✓

Homo heidelbergensis✓; *Homo erectus*✓; *Homo sapiens*✓

Genotype $X^D X^d$ x $X^D Y$



F Genotype: $X^D X^D, X^D Y, X^d X^D, X^d Y$
 Phenotype: 2 normal females : 1 normal male : 1 male DMD sufferer

P and F : 1 mark
 Meiosis + Fertilisation : 1 mark

OR

P Phenotype: Normal female x Normal male
 Genotype: $X^D X^d$ x $X^D Y$

Gametes	X^D	X^d
X^D	$X^D X^D$	$X^D X^d$
Y	$X^D Y$	$X^d Y$
	1 mark for correct gametes	1 mark for correct genotypes

F Phenotype: 2 normal females : 1 normal male : 1 male DMD sufferer

P and F : 1 mark
 Meiosis + Fertilisation : 1 mark (Max 6) (6)

2.2.3 - They will know the chances of their child suffering from DMD
 - They have other options like adopting
 - Not having children
 - Having amniocentesis done
 - Coping strategies will be explained to the parents
 (Mark first THREE only) Any (3) (3)

2.2.4 - Men only have one X chromosome
 - and if it carries the recessive allele
 - they will be DMD sufferers
 (3)

2.3 2.3.1 *Homo erectus* (1)

2.3.2 - The oldest known fossils of *H. ergaster* and *H. sapiens* have been found in Africa (14)

- Transitional fossils that show intermediate stages between *H. ergaster* and *H. sapiens* are found only in Africa

- Largest number of hominin fossils found in Great Rift Valley and Cradle of Humankind (Any 2 x 2) (4)

2.4.1 Ovary
 Testes (5)

2.4.2 - was non-disjunction
 - Anaphase I/II
 - one pair of chromosomes/chromatids did not separate
 - in gamete B having one extra chromosome
 - gamete C having one less chromosome (2)

There during where resulting and

(7) [40]

QUESTION 3

3.1 3.1.1 Embryo / blastocyst
 Foetus
 Umbilical cord
 Amniotic fluid
 Placenta
 Organs in adults that have already developed
 (Mark first TWO only) (Any 2) (2)

African apes	Humans
Small cranium/brain capacity✓	Large cranium/brain capacity✓
Large canines✓teeth	Small canines✓teeth
Protruding jaw✓ prognathous	Less protruding jaw✓
Cranial ridge present✓	No cranial ridge✓
Larger brow-ridge✓	Small brow-ridge✓
Jaw U-shaped✓	Jaw C-shaped✓

(Table 1 + Any 2 x 2)

(5)
(11)

[40]
80

TOTAL SECTION B:

SECTION C

QUESTION 4

Structural features contributing to bipedalism

- The more forward position✓ of the foramen magnum✓
- allowed for the vertical entry of the spinal cord✓ suited to an upright posture
- The S-shaped✓ vertebral column✓ provides better balance✓ for an upright posture
- The wide✓ pelvis✓ allows for better support✓ of the entire body weight of an upright organism (Any 6)

Significance of bipedalism

- Upright posture allowed a wider view✓ of their surroundings
- allowing them to search for food✓ as well as avoid predators✓
- Their hands were free✓ to use tools/ prepare food / carry young / hunt or fight✓
- it exposed a smaller surface area ✓to the sun reducing the risk of overheating✓
- Enabled more efficient locomotion✓
- allowing species to migrate✓ to new areas
- to secure new sources of food✓
- Upright posture also exposed their gender ✓ which allowed them to attract the opposite sex✓
- leading to reproduction✓ to continue the species

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(Any 7)

Significance of large brain size

- The larger brain capacity gave rise to a more complex✓ brain
- which allowed for a well developed hand-eye co-ordination✓ leading the species to make and use tools✓
- Also allowed for the capacity for language✓/communication leading to social organisation✓
- Larger brain also allowed for the use of fire✓
- which allowing for cooking and keeping warm✓

(Any 4)

Content: (17)

Synthesis: (3)

(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion Generally	Relevance (R)	Logical sequence (L)	Comprehensive (C)
	All information provided is relevant to the topic	Ideas are arranged in a logical sequence for each process	All aspects required by the essay have been sufficiently addressed
In this essay	Only information relevant to the following is provided: - Features related to bipedalism - Significance of bipedalism - Significance of the large brain size There is no irrelevant information	Information arranged in a logical way for each of the following: - Features related to bipedalism - Significance of bipedalism - Significance of the large brain size	The following minimum points are included for each of the following: - Features related to bipedalism (4/6) - Significance of bipedalism (5/7) - Significance of the large brain size (2/4)
Mark	1 R	1 L	1 C

TOTAL SECTION C: 20
GRAND TOTAL: 150

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