



## 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.

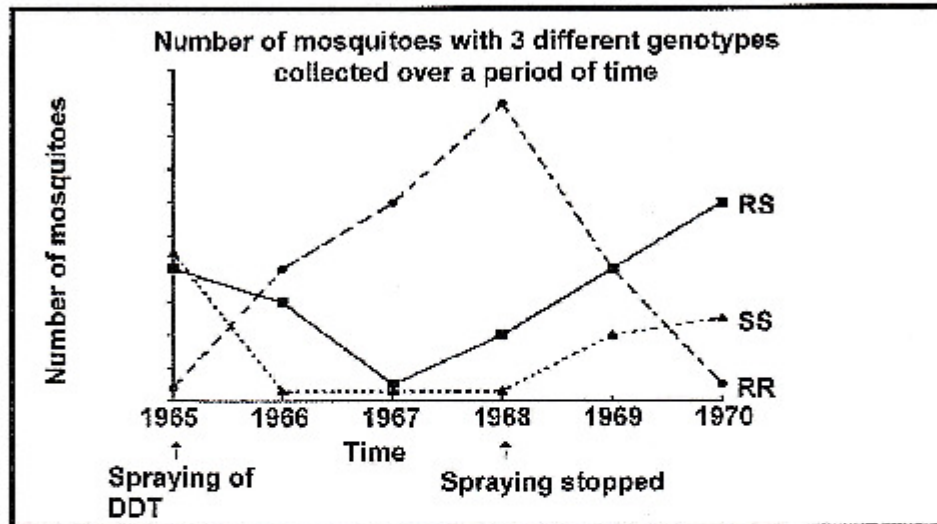
- i Cultural evidence from use of tools
- ii Fossil evidence
- iii Differences in anatomical features
- iv Genetic evidence

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 (**Ea**) was crossed with a black female rhino that was heterozygous for normal lips (**Pp**) and homozygous recessive for long ears (**ee**).

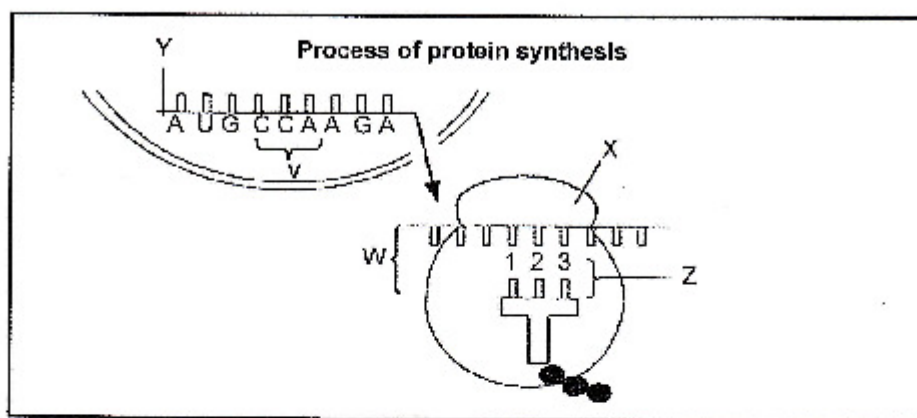
- 1.4.1 List the possible gametes that could be produced by the male parent. (2)
- 1.4.2 State the phenotype of an offspring having the genotype:
- (a) **PpEe** (1)
- (b) **ppee** (1)
- 1.4.3 Write down the possible genotype of the black rhinos that would have to be interbred to produce offspring with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

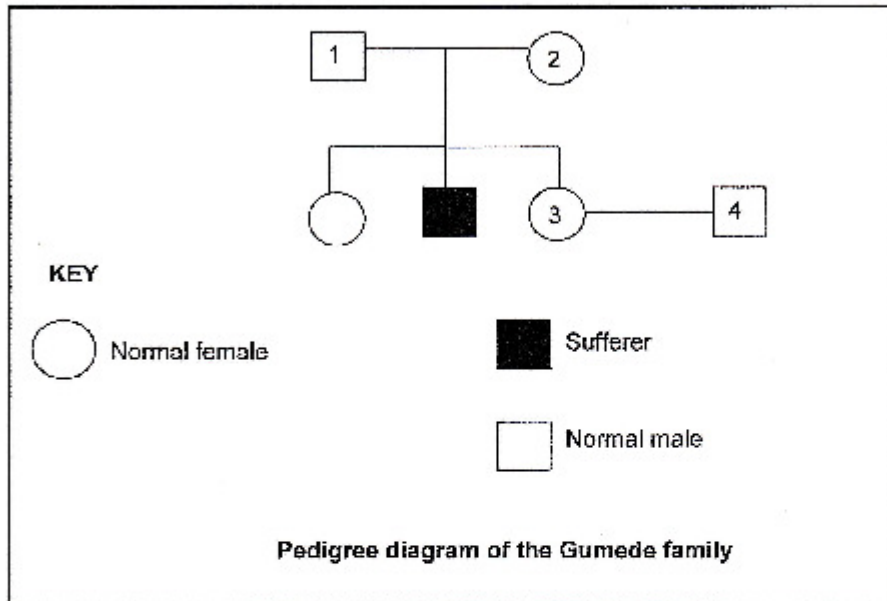
**AUG - CCA - AGA**

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.



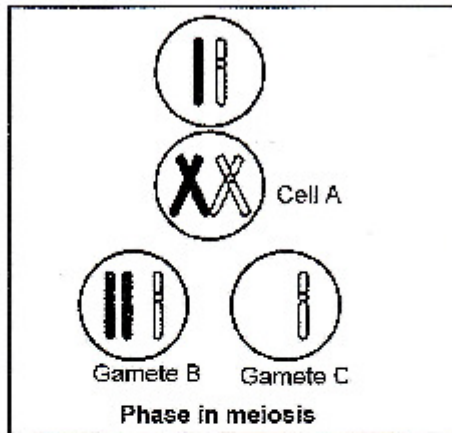
- 2.2.1 State the genotype of individual 2. (2)
- 2.2.2 Represent a genetic cross to determine the possible genotypes and phenotypes of the offspring that may be formed by individuals 3 and 4. Individual 3 is a carrier of DMD. (6)
- 2.2.3 Based on the results of the genetic cross, state THREE benefits 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.

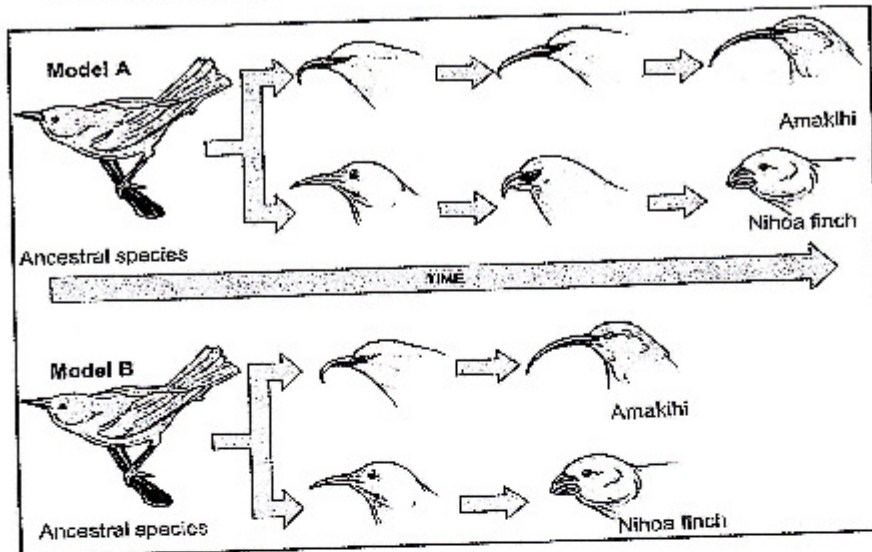
The table below represents the number of stem cells used in the treatment of some of the disorders of the human body.

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

[Adapted from: [ownipproject.wikispaces.com](http://ownipproject.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](http://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, 10<sup>th</sup> Edition*, McGraw-Hill, 2011]

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

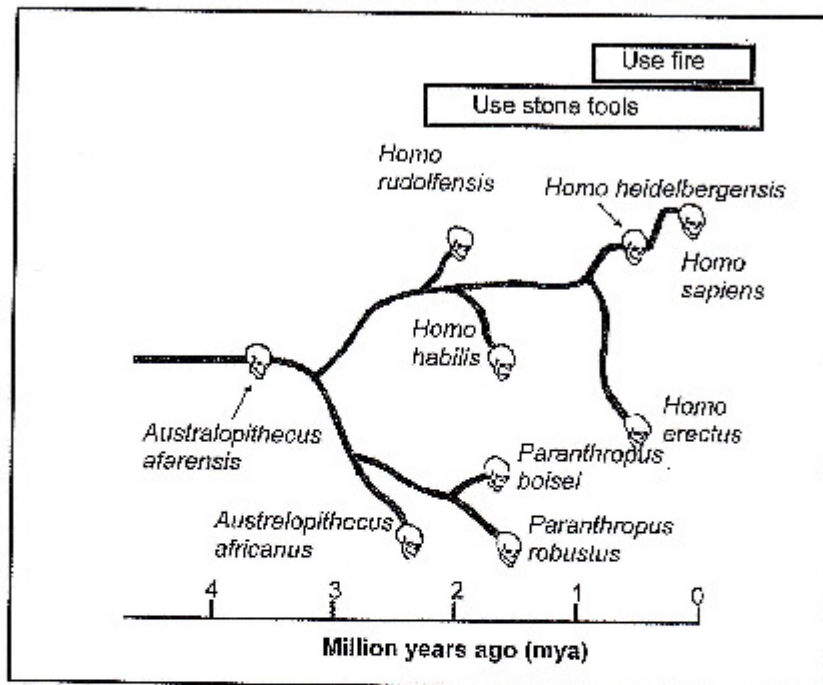
3.3.2 Explain if the Highveld gerbil and the Cape gerbil are the same species. (2)  
(3)

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**