

education

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NATIONAL SENIOR CERTIFICATE

GRADE 12

**LIFE SCIENCES P2
SEPTEMBER 2014**

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 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 answer 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 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 may 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, for example 1.1.11 D.

1.1.1 Which of the following is true about mitochondrial DNA (mtDNA)?

- A It is passed on from father to child
- B It can be used to determine female ancestors
- C It can be used to determine male ancestors of female individuals
- D It does not undergo mutations

1.1.2 What causes the genetic disorder where some males have the sex chromosomes XXY?

- A A sex linked recessive allele
- B Non-disjunction of chromosomes during meiosis
- C Two sperm cells fertilizing one ovum
- D Crossing over during meiosis

1.1.3 The study of fossils is called ...

- A archeology.
- B biotechnology.
- C paleontology.
- D fossilisation.

1.1.4 Which of the following is an example of evidence from molecular biology and genetics?

- A Similar sequence of genes
- B Identical DNA structure
- C Homologous structures
- D Similar respiratory pathways

1.1.5 There were 13 species of finches on the Galapagos Islands million years ago, each with its unique gene pool, beak shape, food type, size and behavior. Which factor caused the first step of evolution of the species above?

- A Geographical isolation from the mainland
- B The unique gene pool
- C The inability to interbreed to produce fertile offspring
- D Natural selection

1.1.6 DNA was extracted from cells of *E coli* and was analysed to determine its nitrogenous base composition. It was found that 12% of the bases are adenine. What percentage of the bases is cytosine?

- A 24
- B 38
- C 76
- D 88

1.1.7 A nitrogenous base found only in RNA is ...

- A adenine.
- B uracil.
- C guanine.
- D thymine.

1.1.8 A mother has blood group AB and a father has blood group B. They have three children and an adopted child. The blood groups of the children are represented in the table below.

Children	Blood group
Zanele	A
Nelson	B
Archy	AB
Crossby	O

Which child is adopted?

- A Zanele
- B Nelson
- C Archy
- D Crossby

1.1.9 A woman who is homozygous for curly hair marries a man who is homozygous for straight hair. What is the probability of them producing a child with wavy hair?

- A 25%
- B 50%
- C 100%
- D 75%

1.1.10 If all 24 nucleotides of a DNA strand code for amino acids, how many amino acids will be present in the polypeptide?

- A 6
- B 8
- C 12
- D 24

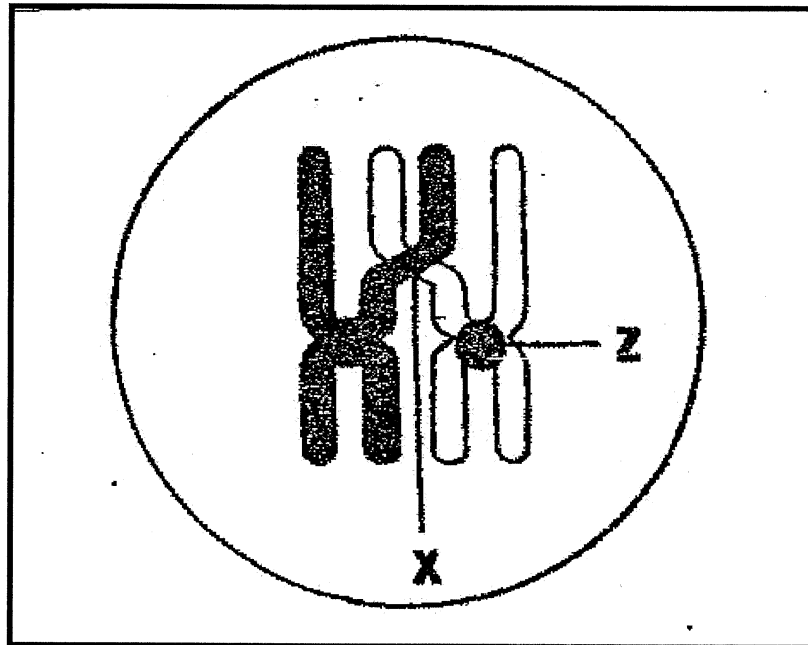
(10 × 2) (20)

- 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 Group of mammals with large brains, colour vision, nails instead of claws and eyes looking forward
- 1.2.2 The process during which mRNA is decoded in the cytoplasm during protein synthesis
- 1.2.3 A cell condition in which the nucleus contains a single set of chromosomes
- 1.2.4 A sub-theory of evolution which states that most species remain outwardly unchanged for long periods of time and then suddenly evolve into new species
- 1.2.5 One strand of a double stranded mature chromosome
- 1.2.6 A biotechnological production of a genetically identical offspring
- 1.2.7 The stage in meiosis during which chromosomes are arranged along the equator in homologous pairs, attached to spindle threads (7)
- 1.3 Indicate whether each of the statements in COLUMN 1 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 1.3.8) in your ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Discovered the double helical structure of DNA	A: Francis Crick B: James Watson
1.3.2	A sudden unexpected change in the genetic structure of a cell	A: Mutagen B: Mutation
1.3.3	Contributes to variation in the offspring	A: Meiosis B: Random arrangement of chromosomes
1.3.4	Offspring of parents that are from different species	A: Hybrid B: Mutation
1.3.5	Characteristics that are used to build a phylogenetic tree	A: Similarity of DNA sequence B: Biogeography
1.3.6	Examples of reproductive isolation mechanisms	A: Breeding at different times of the year B: Infertile offspring
1.3.7	Influences the inheritance of blood groups	A: Incomplete dominance B: Multiple alleles
1.3.8	Found in RNA	A: Nitrogen bases B: Ribose sugar

(8 × 2) (16)

1.4 Study the diagram below and answer the questions that follow.



1.4.1 Provide labels for:

(a) X (1)

(b) Z (1)

1.4.2 Which phase of meiosis is represented by the diagram? (2)

1.4.3 Name the process in meiosis that is illustrated in the diagram above. (1)

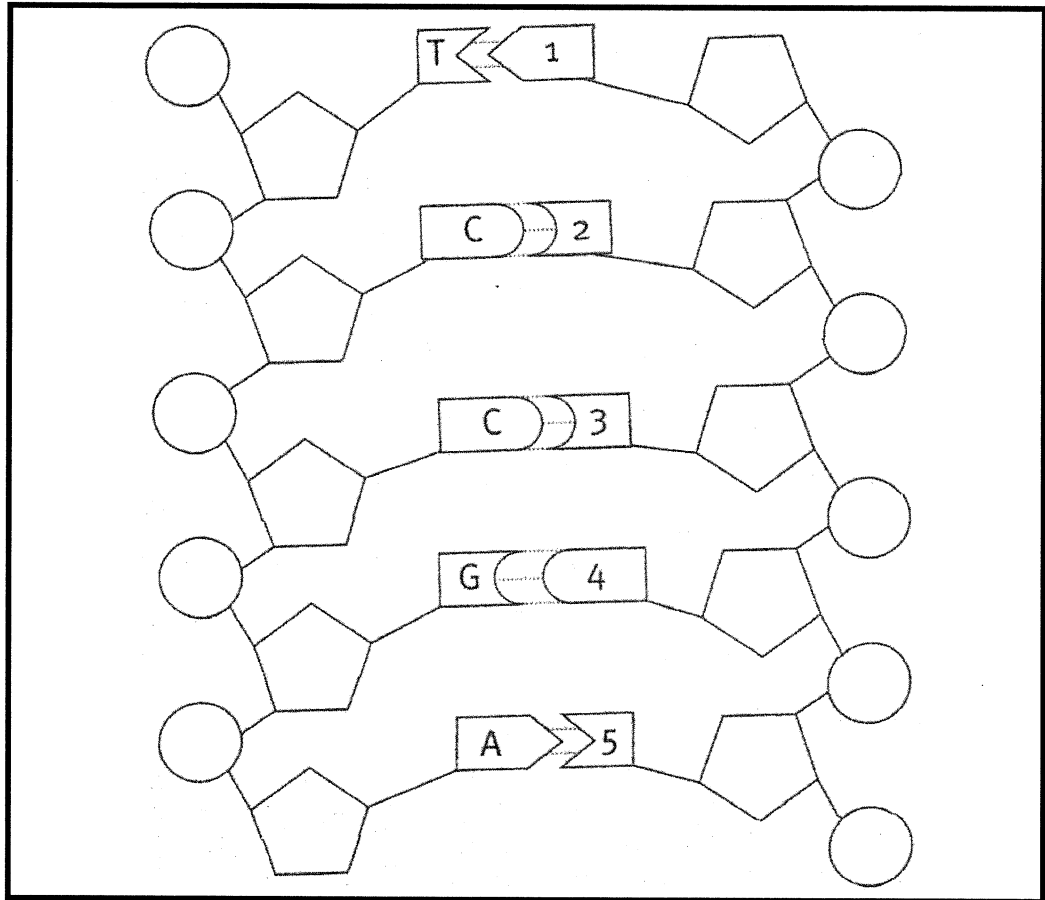
1.4.4 State TWO biological functions of the process mentioned in QUESTION 1.4.3. (2)

(7)

TOTAL SECTION A: 50

SECTION B**QUESTION 2**

- 2.1 The diagram below shows a schematic representation of a nucleic acid. Study the diagram and answer the questions that follow.



- 2.1.1 Which nucleic acid is illustrated by the above diagram? (1)
- 2.1.2 Give ONE reason from the diagram to support your answer in QUESTION 2.1.1. (1)
- 2.1.3 Name the type of bond holding the two strands together. (1)
- 2.1.4 What can this molecule be used for? (2)
- (5)**

- 2.2 A group of eighteen year old learners conducted a survey on the frequency of genetic disorders in a rural area (with a sample size of 500). The results are shown in the table below.

Genetic disorder	Frequency in population (%)
Haemophilia	2
Down syndrome	3
Sickle cell anaemia	15
Absence of any disorder	80

- 2.2.1 Explain why age needed not to be controlled in this investigation. (2)
- 2.2.2 State TWO ways in which the learners could ensure reliable results. (2)
- 2.2.3 State any TWO planning steps that the learner had to consider before conducting the investigation. (2)
- (6)**
- 2.3 Study the genotypes and phenotypes below that show how the alleles for colour-blindness are inherited. X and Y represent sex chromosomes. Carriers do not suffer from colour-blindness, but can pass the allele for colour-blindness onto their children.

Name of person	Genotype	Phenotype
Sarah	$X^B X^B$	Female with normal sight
Beauty	$X^B X^b$	Carrier female
Leonie	$X^b X^b$	Colour-blind female
Paul	$X^B Y$	Male with normal sight
Sam	$X^b Y$	Colour-blind male

- 2.3.1 Is colour-blindness caused by a dominant or recessive allele? (1)
- 2.3.2 Explain why Sam is colour-blind even though he carries only one allele for colour-blindness. (2)
- 2.3.3 Use a genetic diagram to determine the possible genotypes and phenotypes of children produced by a female with normal sight crossed with a colour-blind male. (6)
- (9)**

- 2.4 The arrangement below shows the sequence of DNA bases coding for nine amino acids in an enzyme:

CTT ACC CAC CAC ACC AAC CAC ACC AAC

The numbers of each type of amino acid coded for by this sequence of DNA bases are shown in the table. Study the diagram below and answer the questions that follow.

Amino acids	Number of amino acids present
His	3
Thr	3
Asn	2
Leu	1

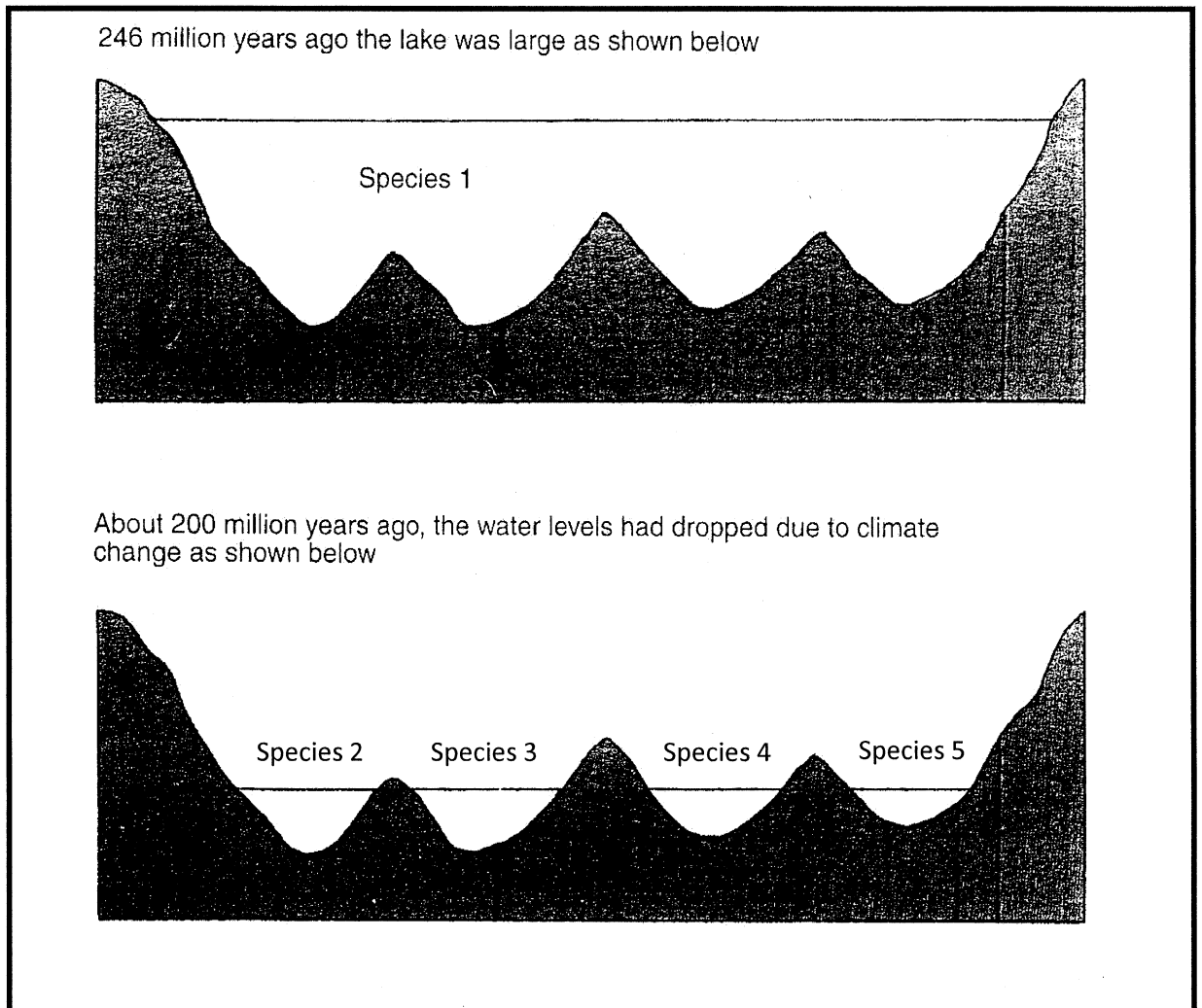
An amino acid in this enzyme is **His** which is coded for by **CAC** in DNA.

Use the DNA base sequence and the table above to determine the remaining amino acids in this part of the enzyme. (3)

- 2.5 Give **THREE** reasons why mitosis is an important process in organisms. (3)

2.6 Lake Malawi is estimated to be about two million years old. No major river systems flow into Lake Malawi and there is only a single outlet at the Southern tip of the lake, the Shire River. The water level, therefore, is entirely controlled by climate, making the lake subject to frequent and severe fluctuations.

The following diagrams describe a hypothetical lake such as Lake Malawi. The first diagram also shows a hypothetical fish species (Species 1). In the second diagram, this species seems to have disappeared and four new species exist. Study the diagrams and answer the questions that follow.



2.6.1 What type of speciation is represented in the diagrams above? (1)

2.6.2 Describe how the new species formed from the original Species 1. (5)

(6)

2.7 In a dihybrid cross, a plant homozygous for tallness and coloured flowers was crossed with a pure breeding short plant which had white flowers. The alleles for tall plants (T) and coloured flowers (D) are dominant.

2.7.1 Use the letters T, t, D and d to show a genetic cross between a tall plant with coloured flowers and a short plant with white flowers. (6)

2.7.2 If the F₁-generation is self-pollinated, four different kinds of plants were produced in the F₂-generation as shown below.

		♂ gametes			
		TD	Td	tD	td
♀ gametes	TD	TTDD	TTDd	TtDD	TtDd
	Td	TTDd	TTdd	TtDd	Ttdd
	tD	TtDD	TtDd	ttDD	ttDd
	td	TtDd	Ttdd	ttDd	ttdd

Use the punnet diagram above to determine the phenotypic ratio of the F₂-generation.

(2)
(8)
[40]

QUESTION 3

3.1 Study the data below which shows reported malaria cases and malaria-attributed deaths in the Mpumalanga Province between 2001 and 2005.

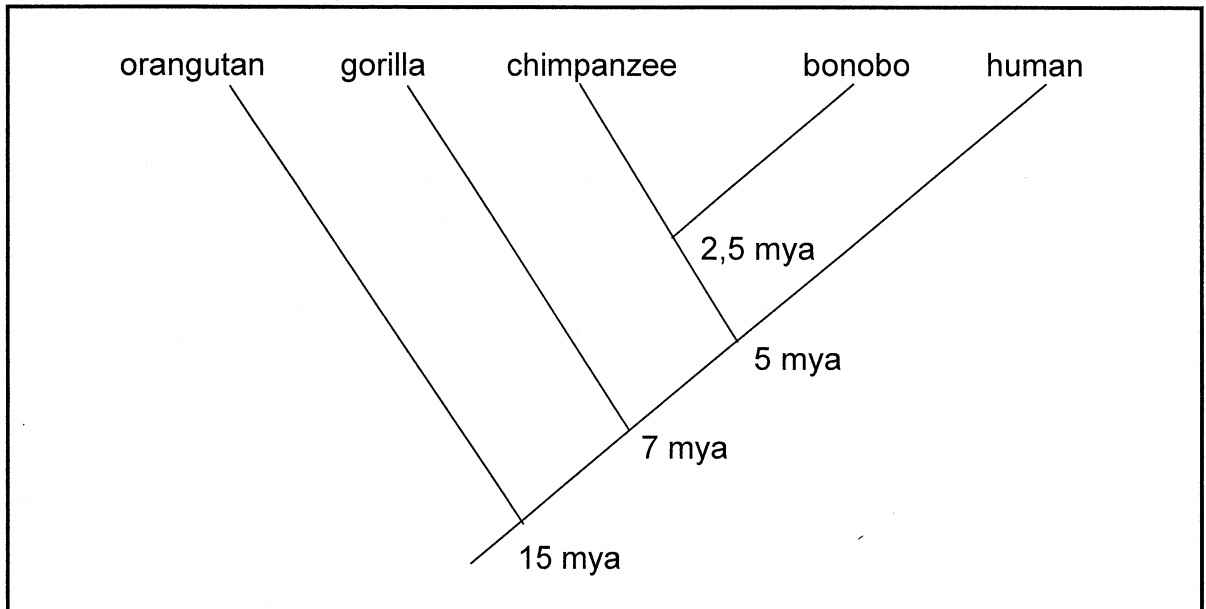
Answer the questions that follow.

Year	2001	2002	2003	2004	2005
Malaria incidence rate	385	126	145	96	139
Deaths from malaria	34	14	30	18	25

3.1.1 Draw a bar graph to show the trend in deaths from malaria during the time period 2001 to 2003 on the table. (7)

3.1.2 Calculate the percentage of people that died from malaria in 2004. (3)
(10)

- 3.2 By analysing the DNA of humans and living apes, scientists have produced the phylogenetic tree below. Study the evolutionary relationship below and then answer the questions that follow.



- 3.2.1 When did gorillas first arise? (1)
- 3.2.2 When did the human line branch off from the chimpanzee? (1)
- 3.2.3 Which TWO organisms are most closely related? (2)
(4)
- 3.3 According to the "Out of Africa" hypothesis, humans originated in Africa and migrated to other parts of the world.
- Describe mitochondrial DNA (mtDNA) as one line of evidence to support the above statement. (3)

3.4 The following are some examples of evolutionary trends in different stages of human evolution. In these trends the following characteristics were identified:

- Opposable thumb
- Small brain
- Prognathous face
- Bipedal
- Smaller canines
- Projecting nose
- Small body size

[Adapted from: *Ape Human*, National Geographic, Aug 2011]

3.4.1 List FOUR characteristics from the list above that are similar to that of *Australopithecus africanus*. (4)

3.4.2 State TWO advantages of having an opposable thumb. (2)

3.4.3 Explain why Professor Berger called Karabo a transitional fossil. (2)
(8)

3.5 Tabulate THREE differences between natural selection and artificial selection. (7)

3.6 Give ONE similarity between natural selection and artificial selection. (2)

3.7 Read the following article on the Bonsmara cattle breed and answer the questions that follow.

While working as a research officer at the Department of Agriculture's Mara Research Station near Musina in Limpopo, Prof Jan Cornelis Bonsma made several breakthroughs in the field of adaptation physiology and experimental breeding, which eventually led to the creation of the well-known Bonsmara cattle breed.

The Bonsmara is a breed of cattle that is known for its high quality beef. The Bonsmara was created after many matings consisting of 5/8 Afrikaner (Sanga-type), 3/16 Hereford and 3/16 Shorthorn animals (both Taurine-type).

[Adapted from: www.up.co.ac/2011]

3.7.1 Through which process was the Bonsmara cattle breed developed? (1)

3.7.2 Explain your answer in QUESTION 3.7.1 by referring to the previous article. (3)

3.7.3 Did the process mentioned in QUESTION 3.7.1 involve inbreeding or outbreeding? (1)

- 3.7.4 What characteristic was selected to create the Bonsmara cattle breed? (1)
(6)
[40]

SECTION C**QUESTION 4**

The theory of evolution states that:

“Everything we see today arose from that which existed in the past; however it may look different because things change with time.”

Name and describe the principle(s) that Lamarck and Darwin used to explain how evolution took place. In your explanation, give reasons why Lamarck’s theory was not accepted.

Content: (17)
Synthesis: (3)
[20]

TOTAL SECTION C: 20
GRAND TOTAL: 150

