



## education

Lefapha la Thuto la Bokone Bophirima  
Noordwes Departement van Onderwys  
North West Department of Education  
**NORTH WEST PROVINCE**

# NATIONAL SENIOR CERTIFICATE

**GRADE 12**

**LIFE SCIENCES P2**

**SEPTEMBER 2020**

**MARKS: 150**  
**TIME: 2½ hours**

**This question paper consists of 16 pages.**

## **INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Do ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, flow tables or charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass where necessary.
11. Write neatly and legibly.

**SECTION A****QUESTION 1**

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A to D) next to the question number (1.1.1 to 1.1.10) in the ANSWER BOOK, for e.g 1.1.11 D.

1.1.1 The wing of a bat and the human arm are examples of ...

- A biogeography.
- B homologous structures.
- C different ancestors.
- D hind limbs.

1.1.2 Study the following characteristics:

- i. Long and rectangular palate
- ii. Bare fingertips
- iii. Flat face
- iv. Always walk upright

Which combination of characteristics makes humans different from other primates?

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

1.1.3 In the tomato plant, albinism (the inability to make chlorophyll) is a recessive trait. Two heterozygous tomato plants were crossed and 300 seedlings were produced.

What is the percentage chance that the seedlings will have albinism?

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

- 1.1.4 During an investigation, researchers measured the beak size of a certain species of finch on the Galapagos Islands. The research was carried out from 1975 to 1985. The type of food available before and after drought was a factor in the study of the evolution of the beaks of finches. Average size of the beak changed during the period of study.

Which factor is the dependent variable in the above investigation?

- A The amount of rain
  - B The type of food available
  - C The beak size of the finches
  - D The years
- 1.1.5 A group of students investigated the incidence of polydactyly (having more than five fingers and toes on each hand/foot) in their class. Polydactyly is caused by an autosomal, dominant allele.

None of the members of the class had polydactyly. It can therefore be concluded that all of the class members are/have ...

- A homozygous for dominant allele.
- B heterozygous.
- C two recessive alleles.
- D males with homozygous recessive alleles.

**QUESTIONS 1.1.6 AND 1.1.7 REFER TO THE INFORMATION ABOUT THE DIHYBRID CROSS BELOW.**

In rose plants, two genes in different chromosomes have the following alleles:

Gene for flower colour: Red flower (**R**) and white flower (**r**)  
Gene for height: Tall (**T**) and dwarf (**t**)  
Red and tall are dominant characteristics.

A genetic cross was done between rose plants having the following genotypes:

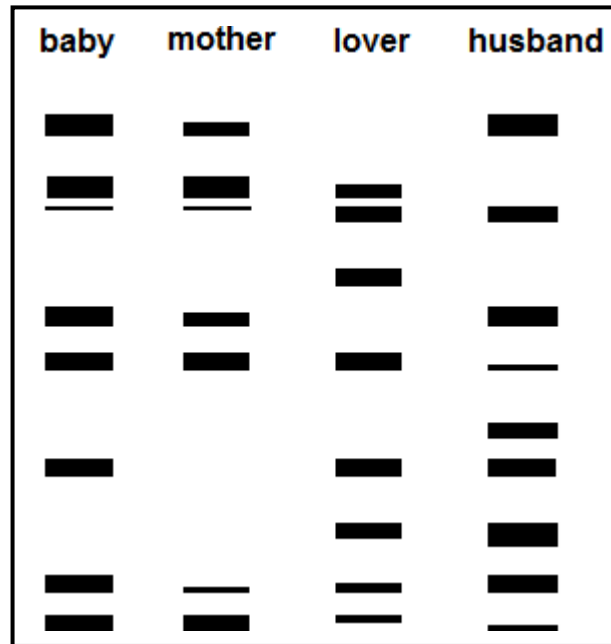
RrTt x RrTt

- 1.1.6 The expected allele combination in the gametes formed will be ...
- A Rr and Tt only
  - B RT, Rt, rT, rt
  - C RR, Rr, TT, tt
  - D RT and rt only

1.1.7 The phenotype of the parents is ...

- A tall plants with red flowers.
- B dwarf plants with red flowers.
- C tall plants with white flowers.
- D dwarf plants with white flowers.

1.1.8 The diagram below shows the DNA profiles of a baby, the baby's mother, the mother's lover and her husband.



Which ONE of the following combinations correctly identifies the biological father and giving a valid reason?

	The biological father	Reason
A	Husband	Approximately 50% of his bands match the baby's DNA profile
B	Husband	All of his bands match the baby's DNA profile
C	Lover	Approximately 50% of his bands match the baby's DNA profile
D	Lover	All of his bands match the baby's DNA profile

- 1.1.9 A ring of DNA (plasmid) is taken from a bacterial cell to produce insulin. The steps which follow are NOT in the correct order-
- i. The gene for insulin is removed from a cell of a human pancreas.
  - ii. The bacteria make clones of themselves and produce insulin.
  - iii. The insulin gene is put into the plasmid and into a new bacterial cell.
  - iv. The bacterial plasmid is cut using enzymes.

The CORRECT order of the steps is ...

- A iii, ii, iv, i
  - B iii, i, iv, ii
  - C iv, i, iii, ii
  - D i, iv, iii, ii
- 1.1.10 Ultraviolet radiation causes mutations, which sometimes leads to antibiotic resistance in bacteria. During an investigation, bacteria were first exposed to ultraviolet radiation and then their resistance to different antibiotics was measured. The results are shown in the table below.

✓ = resistant

X = non-resistant

Treatment of bacteria	Antibiotic resistance		
	Antibiotic P	Antibiotic R	Antibiotic S
Before exposure to ultraviolet radiation	✓	X	X
After exposure to ultraviolet radiation	✓	X	✓

A suitable conclusion for the investigation would be that a mutation in bacteria led to a resistance to antibiotic ...

- A R only.
- B P and R.
- C S only.
- D R and S.

(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 numbers (1.2.1 to 1.2.6) in the ANSWER BOOK.

- 1.2.1 The process by which genetically identical organisms are formed using biotechnology
- 1.2.2 A variable that is manipulated during an investigation
- 1.2.3 The law that describes how alleles are separated from one another during the formation of gametes
- 1.2.4 The type of nucleic acid on which the anti-codon is located during protein synthesis
- 1.2.5 The allele which is expressed physically in an organism when the condition is heterozygous
- 1.2.6 The type of genetic cross between two phenotypically different parents, producing an offspring different from both parents but with an intermediate phenotype (6 x 1) **(6)**

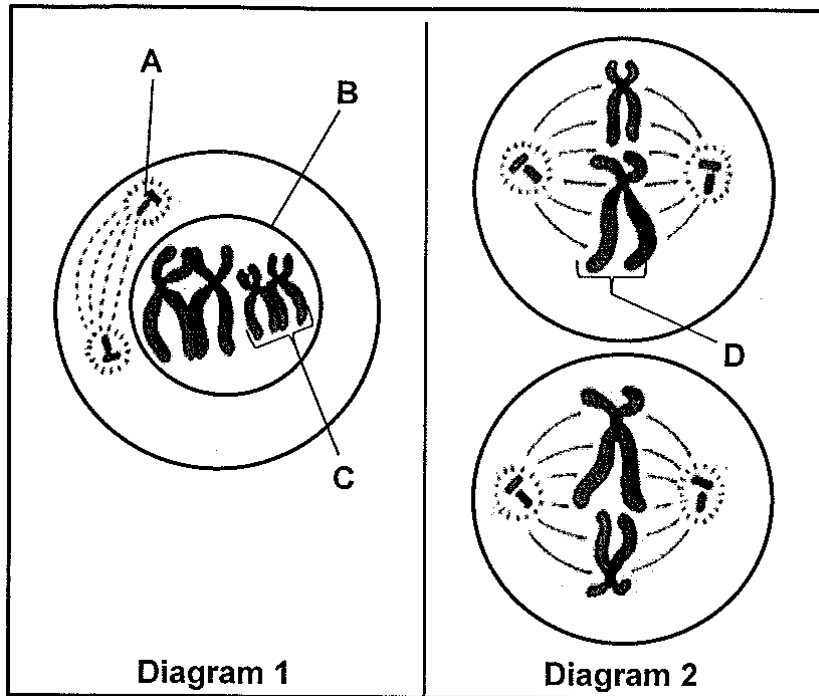
1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B**, or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	The genotype of blood group AB	A: I <sup>A</sup> i B: I <sup>B</sup> i
1.3.2	The type of variation with a range of intermediate phenotypes	A: Continuous variation B: Discontinuous variation
1.3.3	Cytokinesis takes place	A: Telophase I B: Telophase II

(3 x 2)

**(6)**

1.4 The diagram below represents a cell in two different phases of meiosis.

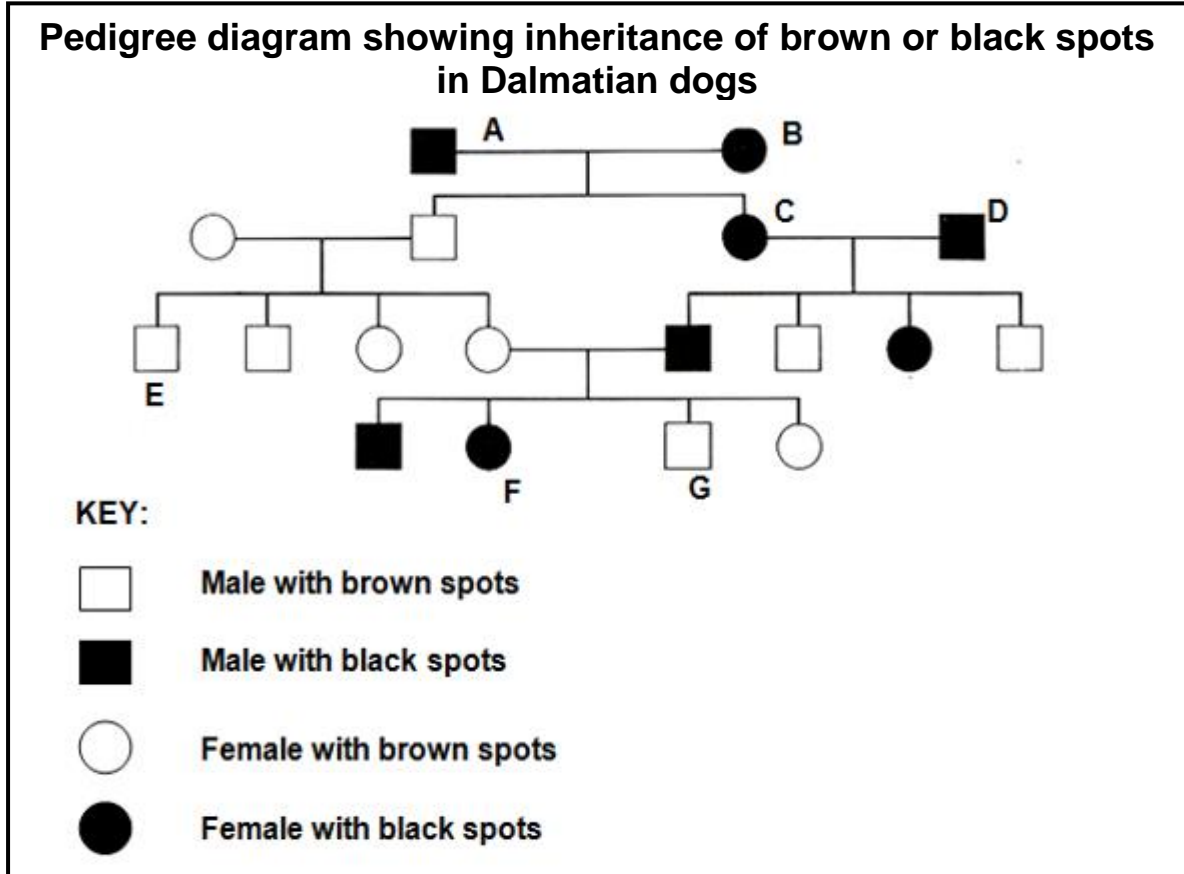


- 1.4.1 Which phase is represented in:
- (a) Diagram 1? (1)
- (b) Diagram 2? (1)
- 1.4.2 Identify part:
- (a) A (1)
- (b) B (1)
- (c) C (1)
- 1.4.3 Give ONE function of part:
- (a) A (1)
- (b) D (1)
- 1.4.4 Are the cells in diagram 2 haploid or diploid? (1)
- 1.4.5 State ONE place in a plant in which meiosis takes place. (1)
- 1.4.6 Give ONE purpose of this type of cell division for organisms. (1)

(1)  
(10)



- 1.5 Study the pedigree diagram below showing the inheritance of black or brown spots in Dalmatian dogs. The colour of the spots is determined by a gene which has two alleles. The allele for black spots (**B**) is dominant over the allele for brown spots (**b**).



- 1.5.1 Name the phenotype of each of the following:
- (a) Dog **B** (1)
  - (b) Dog **G** (1)
- 1.5.2 Give the genotype of:
- (a) Dog **A** (1)
  - (b) Dog **F** (1)
  - (c) Dog **E** (1)
- 1.5.3 If dogs **C** and **D** have another puppy, what is the percentage probability of each of the following?
- (a) The puppy being a female. (1)
  - (b) The puppy having black spots. (2)

**(8)**

**TOTAL SECTION A: 50**

**SECTION B****QUESTION 2**

2.1 In 1953, James Watson a microbiologist and Francis Crick, a physicist, were both working at the Cavendish Laboratory in Cambridge. They used the unpublished photographs and measurements taken by Dr Rosalind Franklin to work out the correct structure of DNA.

In 1962, Watson, Crick and Wilkins were awarded a Nobel Prize for the above discovery.

2.1.1 Why did the scientists Watson, Crick and Wilkins receive a Nobel prize in 1962? (1)

2.1.2 Describe the structure of a DNA molecule. (5)

2.1.3 What is meant by 'coding DNA'? (1)

2.1.4 Explain why DNA is suited as a carrier of the genetic code. (2)  
**(9)**

2.2 Male fruit flies have sex chromosomes **XY** and the females have **XX** chromosomes. In the fruit fly, an allele for eye colour is carried on the X chromosome.

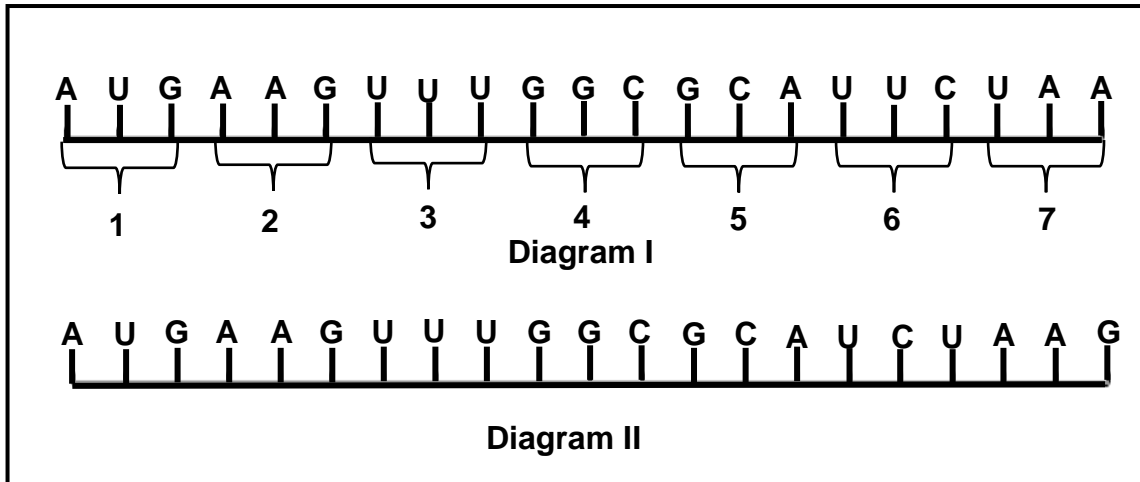
The allele for red eyes (**X<sup>R</sup>**) is dominant to the allele for white eyes (**X<sup>r</sup>**).

2.2.1 A white-eyed male is crossed with a homozygous red-eyed female. Use a genetic diagram, to show the F<sub>1</sub> offspring phenotypic ratio. (6)

2.2.2 Explain why male fruit flies are more likely than female fruit flies to show a phenotype produced by a recessive allele. (2)  
**(8)**

2.3 Diagram I below shows the base sequence on a section of mRNA.

Diagram II shows the section of mRNA after a mutation has occurred.



2.3.1 Describe the role of DNA in protein synthesis. (4)

2.3.2 Give the DNA base sequence for codon 1 in the Diagram 1. (1)

2.3.3 The table below shows anticodons for amino acids.

AMINO ACID	ANTICODON	AMINO ACID	ANTICODON
Leucine	CUU; CUC; CUA; CUG	Isoleucine	AUU; AUC; AUA
Histidine	CAU	Glycine	GGU; GGC; GGA; GGG
Lysine	AAA; AAG	Methionine	AUG
Arginine	AGA; AGG	Serine	UCU; UCC; UCA; UCG
Alanine	GCU; GCC; GCA; GCG	Phenylalanine	UUU; UUC

2.3.3 (a) Give the codon for histidine. (1)

(b) Tabulate TWO differences between the amino acid chains produced by the molecules in Diagram I and II. (5)

(c) Describe the process of translation. (4)

**(15)**

- 2.4 Two investigators carried out an investigation concerning the variation in height of wheat plants in a field, using different procedures.

Investigator **A** carried out the procedure on 30<sup>th</sup> July and the steps are as follow:

- The plants were taken from 20 randomly selected areas
- The plants that were measured were selected at random
- The heights of ten plants were measured in each of the selected area

Investigator **B**'s procedure which was carried out on 6<sup>th</sup> August is as follows:

- The plants were taken from 20 randomly selected areas
- The plants that were measured were selected at random
- The heights of five plants were measured in each of the selected area

The results of both procedures are shown in the table below.

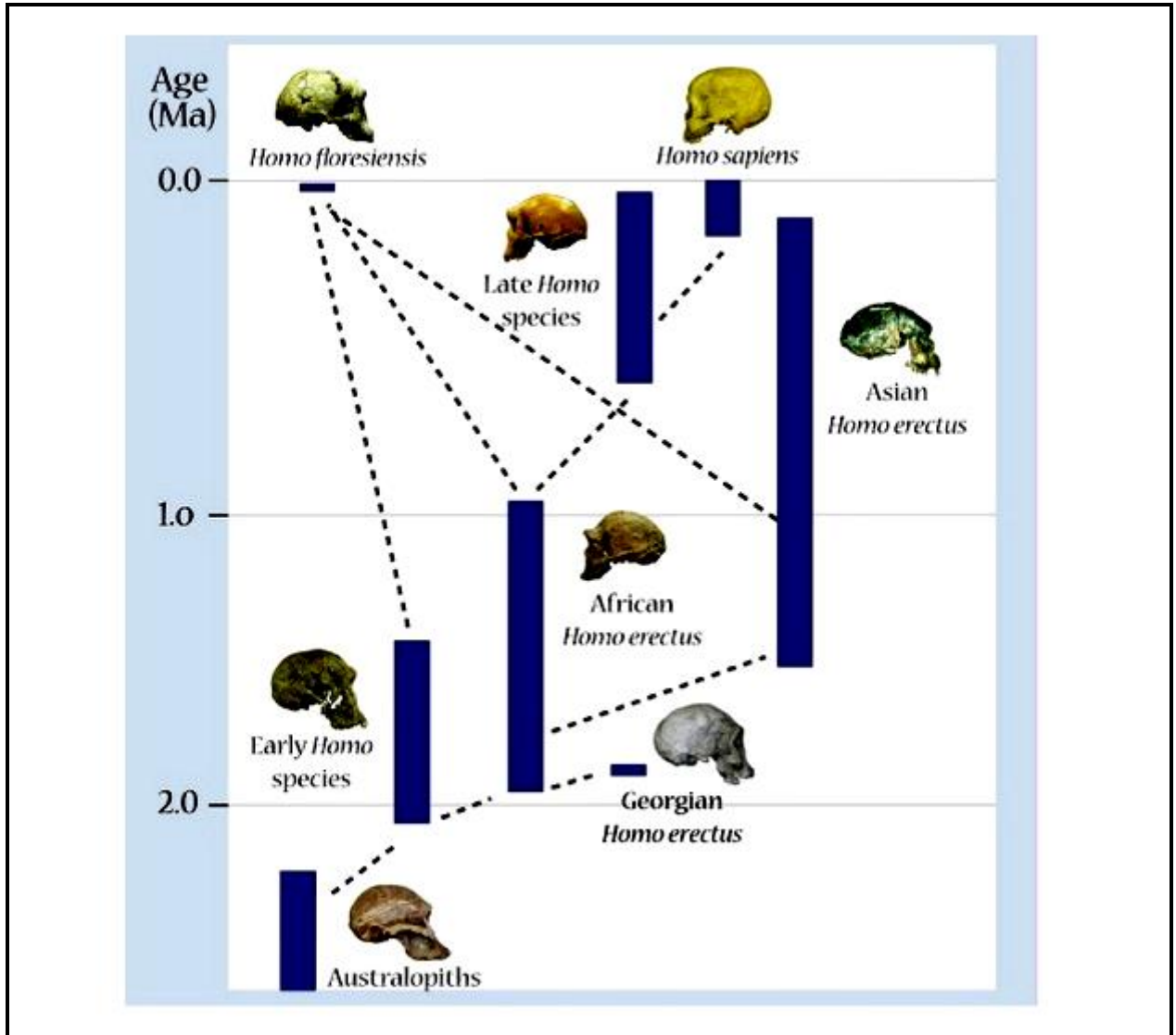
Height interval (cm)	Number of Plants	
	Investigator A	Investigator B
51 - 55	4	3
56 - 60	7	4
61 - 65	11	6
66 - 70	13	7
71 - 75	14	8
76 - 80	20	10
81 - 85	25	12
86 - 90	30	15
91 - 95	34	17
96 - 100	42	18

- 2.4.1 Suggest an aim for the above investigation. (1)
- 2.4.2 Combine BOTH SETS of results and determine the following:  
The percentage of plants that have a height greater than 80 cm. (2)
- 2.4.3 Explain why the plants were selected at random. (1)
- 2.4.4 Investigator **A** concluded that the variation in height of the wheat plants is entirely genetically determined. Explain why this conclusion is probably wrong. (1)
- 2.4.5 Which investigator's results are more reliable? Give a reason for your answer. (2)
- 2.4.6 State ONE way in which the design of the investigation may be improved to ensure that the results obtained are valid. (1)

(8)  
[40]

**QUESTION 3**

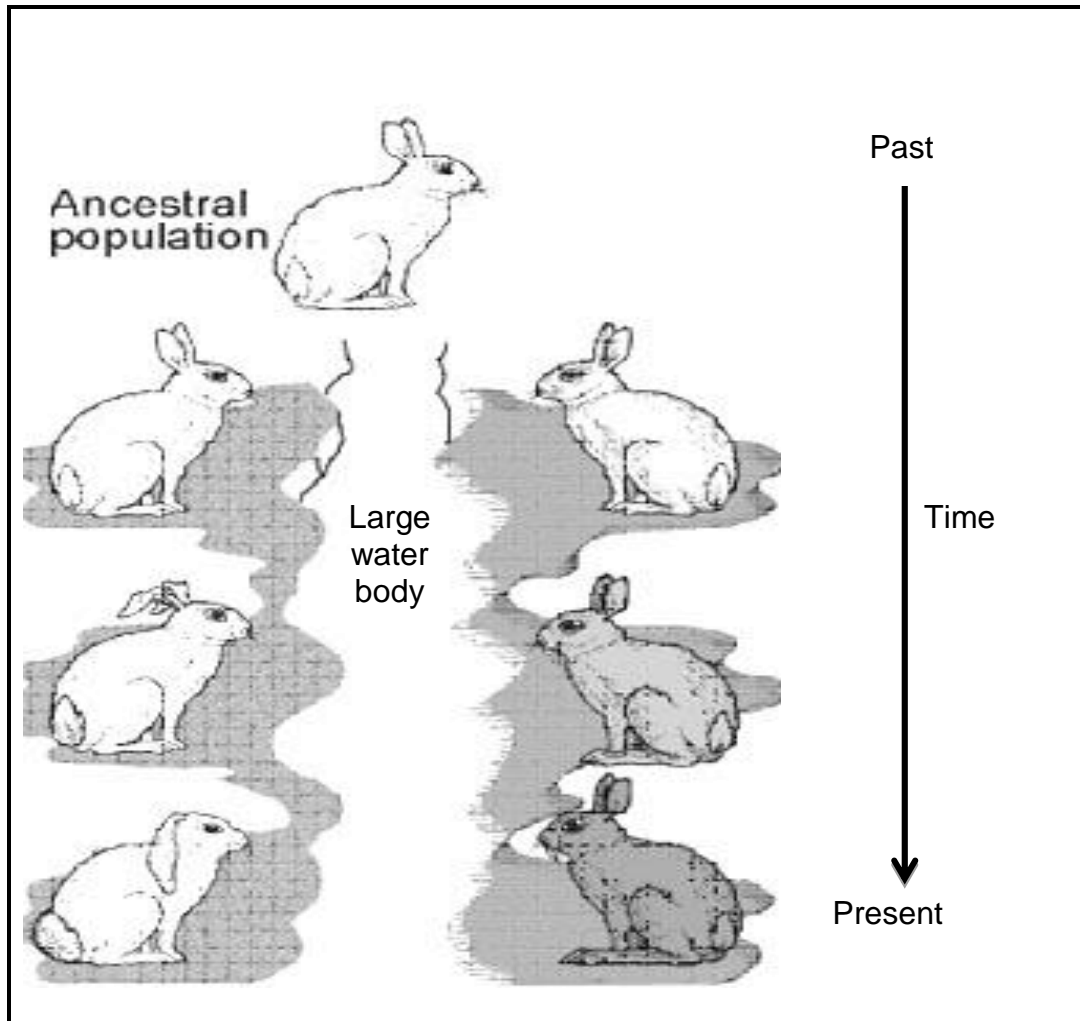
3.1 Study the phylogenetic tree demonstrating possible evolutionary relationships among *Homo* species.



- 3.1.1 Name the family in which both humans and *Australopithecus* belong to. (1)
- 3.1.2 Which species has existed for the longest period of time? (1)
- 3.1.3 Name ONE organism who co-existed with early *Homo* species. (1)
- 3.1.4 How many genera are represented in the above diagram? (1)
- 3.1.5 Identify the oldest ancestor of ALL *Homo* species shown in this phylogenetic tree. (1)

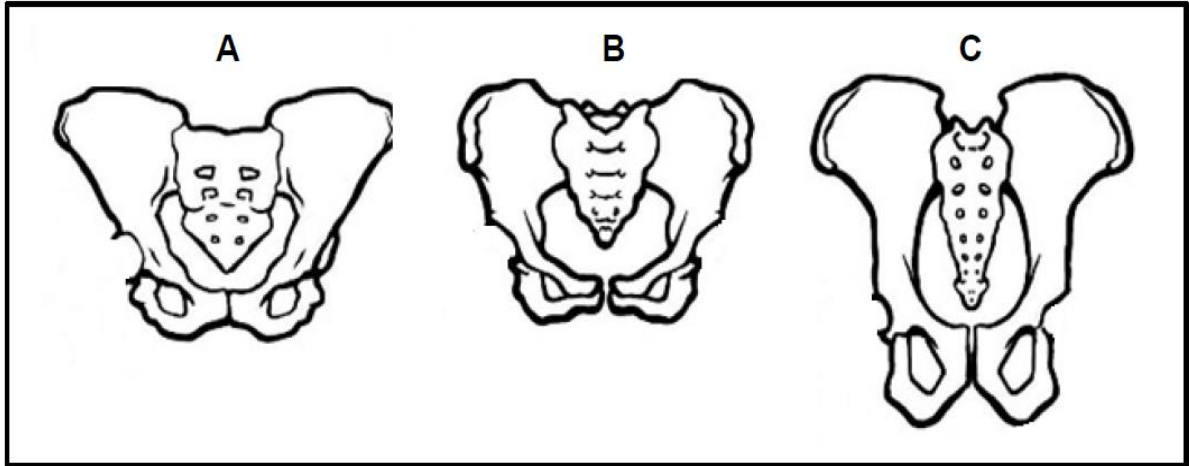
**(5)**

- 3.2 3.2.1 What is meant by the 'Out of Africa hypothesis'? (2)
- 3.2.2 Briefly describe how genetics, fossil and cultural evidence support the "Out of Africa" hypothesis. (6)  
(8)
- 3.3 Flightless birds, such as the ostrich, emu and rhea live on different land masses and belong to separate species.
- 3.3.1 Briefly describe how Lamarck would have explained the evolution of flightless birds. (4)  
(4)
- 3.4 The two hare species *Harius langfootensis* and *Harius albinus* share a common ancestor as shown in the diagram.



- 3.4.1 Provide the speciation scenario with a suitable heading. (1)
- 3.4.2 Describe the process of speciation as shown in the above diagram. (5)  
(6)

- 3.5 In a study to establish the mode of locomotion of some species, scientists compared the pelvic structure of their fossils. They established that two of these species had the ability to walk upright permanently. The diagrams (**A**, **B** and **C**) below show the pelvic structures of three species, drawn to scale.



- 3.5.1 What term is used to describe organisms that are able to walk upright permanently? (1)
- 3.5.2 Which TWO diagrams above represent the pelvis of the organisms in QUESTION 3.5.1. (2)
- 3.5.3 Explain your answer to QUESTION 3.5.2 using evidence visible from the diagrams. (2)
- 3.5.4 State ONE feature of the spine of the organism represented by diagram **C**. (1)
- 3.5.5 Provide ONE difference between the human skull and the gorilla skull. (2)
- (8)**

3.6 Read the following extract and answer the questions that follow.

Elephants use their tusks to dig holes for water, to strip bark from trees for food, for defence and for fighting over females during mating season. In Mozambique's Gorongosa National Park more than 90% of the elephant population was killed between 1977 and 1992 during a civil war as soldiers poached them for ivory. Now in areas where poaching was heavy, 50% of female elephants are born tuskless, while in low poaching areas only 2% of female elephants are born tuskless.

- 3.6.1 Name the process that has occurred resulting in so many tuskless elephants being born. (1)
- 3.6.2 Do you think the allele for tusks will disappear completely from the Gorongosa National Park population?  
Give a reason for your answer. (2)
- 3.6.3 Describe TWO reproductive isolating mechanisms that might cause the population of elephants in the Gorongosa National Park to become a new species. (4)
- 3.6.4 Name an evolutionary theory which explains evolution when species do not change gradually and there are no transitional fossils found. (1)
- 3.6.5 List any ONE observation on which Darwin's theory of evolution was based. (1)
- (9)**  
**[40]**

**TOTAL SECTION B: 80**

## SECTION C

### QUESTION 4

Describe any FIVE mechanisms that contribute to variation amongst individuals of the same species and explain how variation in *Mycobacterium tuberculosis* (TB bacterium) can lead to antibiotic resistant forms.

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

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

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