



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**SEPTEMBER 2014**

**LIFE SCIENCES P2**

**MARKS:** 150

**TIME:** 2½ hours



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This question paper consists of 15 pages.

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**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

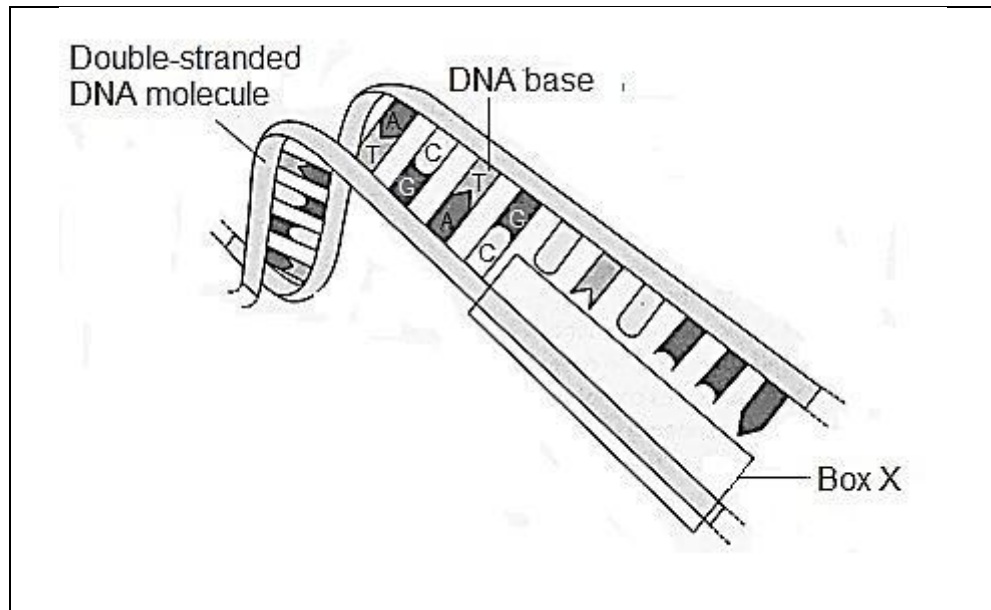
1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start EACH question on a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. If answers are NOT presented according to the instructions of each question, candidates will lose marks.
6. ALL drawings should be done in pencil and labelled in blue or black ink.
7. Draw diagrams and flow charts ONLY when requested to do so.
8. The diagrams in this question paper may NOT necessarily be drawn to scale.
9. The use of graph paper is NOT permitted.
10. Non-programmable calculators, protractors and compasses may be used.
11. Write neatly and legibly.

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

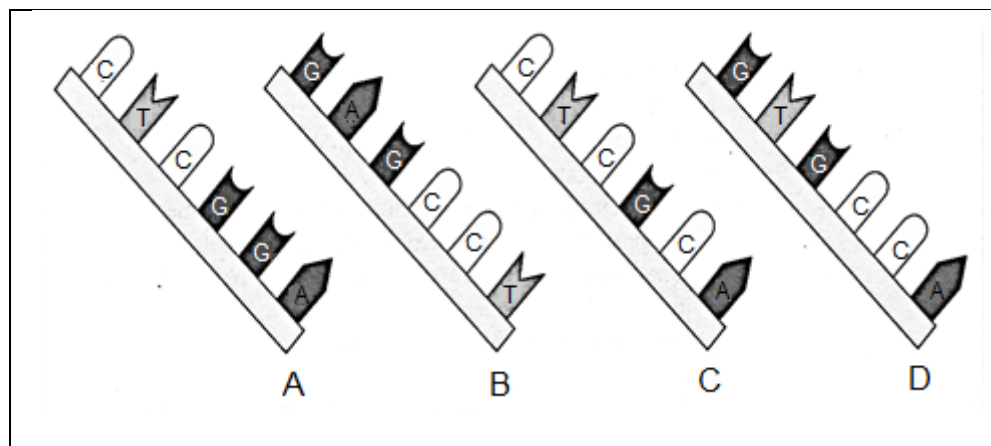
- 1.1 Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (1.1.1–1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

- 1.1.1 The only difference between the DNA of one member of a species and that of another member of the same species is the ...
- A order in which the nitrogenous bases occur.
  - B type of bonds present between the nitrogenous bases.
  - C type of nitrogenous bases present.
  - D number of strands.
- 1.1.2 Translation of a mRNA molecule with 48 nucleotides produces a polypeptide of ...
- A 3 amino acids.
  - B 12 amino acids.
  - C 16 amino acids.
  - D 48 amino acids.
- 1.1.3 A genetic counsellor told a pregnant woman that her baby had equal chances of having blood type A or blood type AB. This means that the genotypes of the woman and her husband must have been ...
- A  $I^A I^A$  and  $I^B i$ .
  - B  $I^A I^B$  and  $I^B i$ .
  - C  $I^A i$  and  $I^B I^B$ .
  - D  $I^A I^B$  and  $I^A i$ .
- 1.1.4 The following form part of Darwin's observations on which his theory of natural selection was based:
- (i) Large number of offspring are produced
  - (ii) Acquired characteristics are inherited
  - (iii) Offspring show a great deal of variation
  - (iv) A structure becomes better developed when it is used more regularly
  - (v) Of the large number of offspring that are produced, only a few survive
- A (i) and (ii)
  - B (i), (iii) and (v)
  - C (i), (ii) and (iii)
  - D (ii) and (iv)

- 1.1.5 The diagram below represents a small part of a DNA molecule where the four types of nitrogenous base molecules are represented by A (Adenine), T (Thymine), G (Guanine) and C (Cytosine).



Which of the following (A, B, C or D) supplies the information missing from box X in the diagram below?



- 1.1.6 Charles Darwin proposed ...
- A a mechanism for evolution.
  - B the law of inheritance of acquired characteristics.
  - C the law of use and disuse.
  - D the law of segregation.
- 1.1.7 During which ONE of the following stages does replication of DNA occur?
- A Interphase
  - B Prophase 1
  - C Telophase 1
  - D Telophase 2

1.1.8 A DNA nucleotide consists of a ...

- A ribose sugar, four nitrogenous bases and a phosphate group.
- B phosphate group and a nitrogenous base.
- C deoxyribose sugar and four nitrogenous bases.
- D deoxyribose sugar, a nitrogenous base and a phosphate group.

1.1.9 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 Groups
Simanele	A
Thusini	B
Philani	AB
Ncube	O

Which child is adopted?

- A Simanele
- B Philani
- C Thusini
- D Ncube

1.1.10 Which of the following is regarded as a source of variation for evolution?

- (i) Mutation
- (ii) Modification by descent
- (iii) Meiosis
- (iv) Random fertilisation

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

(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 (1.2.1–1.2.10) in the ANSWER BOOK.

1.2.1 The shape of the twisted strands of DNA

1.2.2 The phase of protein synthesis during which information is copied from DNA to mRNA

1.2.3 The bonds between two nitrogenous bases

1.2.4 The process of making new DNA from existing DNA

1.2.5 A type of nucleic acid on which is located the anti-codon for protein synthesis

- 1.2.6 Chromosome condition of a cell which has only a single set of chromosomes
- 1.2.7 Alternate forms of a gene situated on corresponding positions of homologous chromosomes and influencing the same characteristic
- 1.2.8 Theory which proposes that evolution does not always occur at a steady rate, but in a sudden burst after long periods of no change
- 1.2.9 Formation of a new species when a physical barrier has divided a population
- 1.2.10 The use of technology to change the genetic structure of an organism

(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 in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	The "father of genetics"	A: Charles Darwin B: Rosalind Franklin
1.3.2	Chromosomes that determine the sex of an organism	A: Gonosomes B: Autosomes
1.3.3	Example(s) of reproductive isolation mechanisms	A: Breeding at different times of the year B: Infertile offspring
1.3.4	The allele that produces its characteristic phenotype only when in a homozygous state	A: Recessive B: Dominant
1.3.5	A sudden change in the sequence of nitrogenous bases in DNA	A: Cloning B: Mutation
1.3.6	Fossil evidence found in Ethiopia	A: <i>Ardipithecus spp</i> B: <i>Australopithecus boisei</i>
1.3.7	Involves the principle of segregation	A: Monohybrid B: Dihybrid
1.3.8	The scientist(s) who first proposed the structure of the DNA molecule	A: James Watson B: Francis Crick
1.3.9	Organisms have an inherent/internal drive to change	A: Darwin B: Lamarck
1.3.10	Nitrogenous base found in both RNA and DNA	A: Adenine B: Uracil

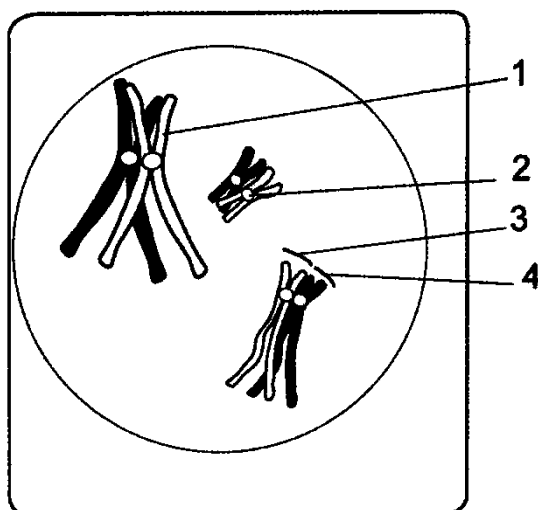
(10 x 2) (20)

**TOTAL SECTION A: 50**

## SECTION B

## QUESTION 2

- 2.1 The diagram below represents an animal cell during meiosis. Study the diagram and answer the questions that follow.



- 2.1.1 How many homologous pairs of chromosomes are present in the nucleus above? (1)
- 2.1.2 Identify the phase that is taking place. (1)
- 2.1.3 Name the process that is taking place in the diagram above that involves numbers **3** and **4**. (1)
- 2.2 The first 7 triplets of nitrogenous bases that form part of the gene coding for one chain of the haemoglobin protein that makes up red blood corpuscles in humans is shown below. Study the table and answer the questions that follow.

DNA Template	CAC	GTG	GAC	TGA	GGA	CTC	CTC
Base Triplet number	1	2	3	4	5	6	7

- 2.2.1 How many of the following are coded for in the DNA template sequence above? (1)
- (a) Nitrogenous bases (1)
  - (b) Different types of t-RNA molecules that are required to form the polypeptide from this piece of DNA (1)
  - (c) Amino acids (1)
- 2.2.2 Write down the mRNA sequence for the triplets numbered **4**, **5** and **6** in the above table. (3)

- 2.2.3 Using the table below, determine the amino acid sequence coded by triplet numbers 4, 5 and 6.

Anticodons on tRNA coding for the amino acid	Amino acid coded for
CUC	Glutamate
GUC	Histidine
GGA	Proline
GAC	Leucine
UGA	Threonine
CAC	Valine

(3)

- 2.2.4 If the T in the 6<sup>th</sup> triplet of bases changed to A in the DNA template above, write down the new amino acid (using the table above) that this 6<sup>th</sup> triplet now codes for.

(1)

- 2.3 The table below shows how the risk of having a child with Down syndrome changes with the age of the mother. Study the table and answer the questions that follow.

Age of mother	Risk of having a child with Down syndrome
20	1 in 1 500
25	1 in 1 300
30	1 in 900
35	1 in 350
40	1 in 100

- 2.3.1 State the relationship between the age of the mother and the risk of having a child with Down syndrome.

(2)

- 2.3.2 How many times greater is the risk of having a child with Down syndrome when the mother is 40, compared to when she is 30 years old?

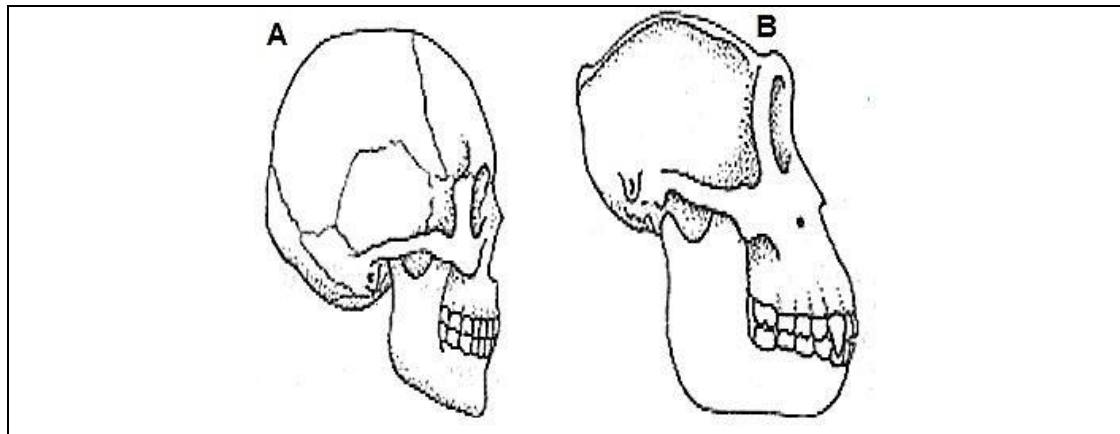
(2)

- 2.3.3 Why is Down syndrome also known as Trisomy-21?

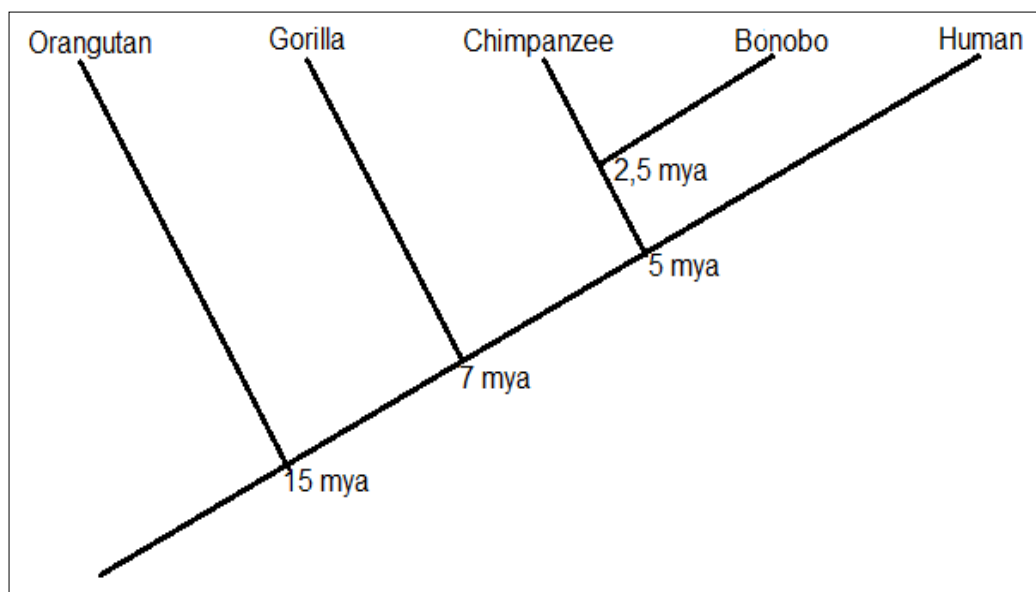
(2)



- 2.4 The diagrams below represent the skulls of two organisms; a modern human and a gorilla. Study the diagrams, which are drawn to scale and answer the questions that follow.



- 2.4.1 Which diagram (**A** or **B**), represents the skull of a gorilla? (1)
- 2.4.2 Which organism (**A** or **B**), is bipedal for most of its adult life? (1)
- 2.4.3 Explain THREE possible advantages of bipedalism for an organism. (6)
- 2.4.4 Name the scientist who developed the theory of evolution through natural selection. (1)
- 2.4.5 Explain how the scientist mentioned in QUESTION 2.4.4, would have explained the development of long necks in giraffes. (7)
- 2.5 The diagram below shows a phylogenetic tree constructed after scientists analysed the mitochondrial DNA of humans and of the modern apes. Study the diagram and answer the questions that follow.

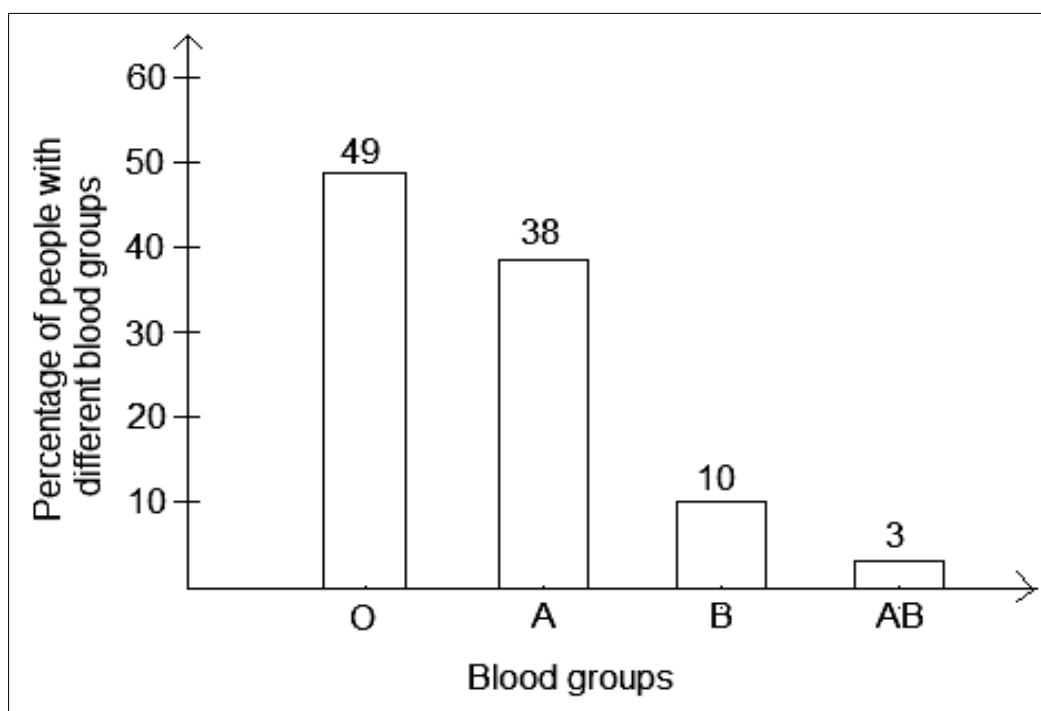


- 2.5.1 Which species is most closely related to chimpanzees? (1)

- 2.5.2 How long ago did the common ancestor of gorillas, chimpanzees and humans arise? (1)
- 2.5.3 Which species is most distantly related to humans? (1)
- 2.5.4 Explain why the following statement is NOT true: "Humans evolved from chimpanzees". (2)

**[40]****QUESTION 3**

- 3.1 In mice, the allele for red fur colour (R) is dominant over the allele for grey fur colour (r). It also happens that all embryos, which are homozygous for the dominant factor, will always die before birth. If a colony of heterozygous mice were inbred to produce 300 young living mice, how many of these offspring would be likely to have red fur and how many will have grey fur? Use a genetic diagram to show how you arrived at your answer. (7)
- 3.2 Blood groups in humans are controlled by multiple alleles. As a result, there are four possible blood groups: A, AB, B and O. Study the graph below which shows the percentage of people that have different blood group and then answer the questions that follow.



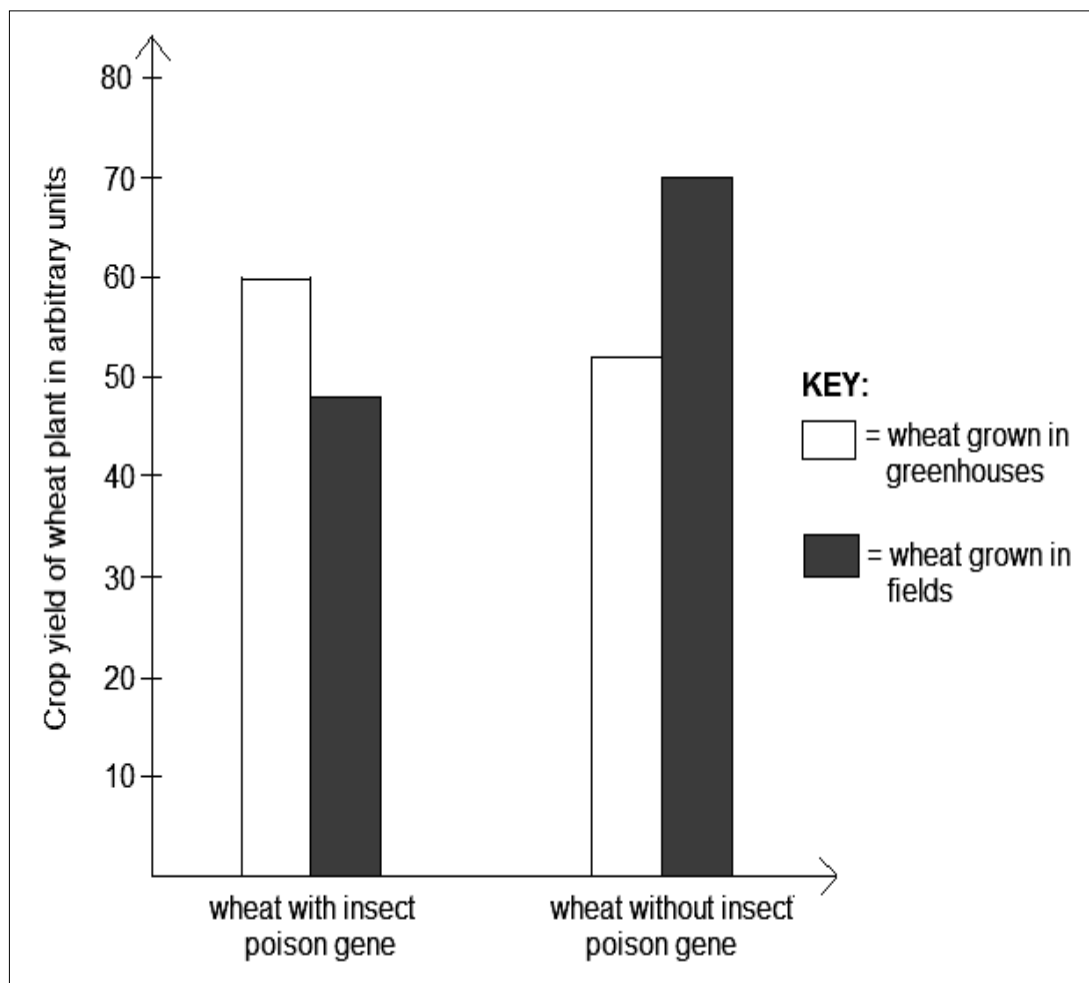
- 3.2.1 Explain what is meant by *multiple alleles*. (2)
- 3.2.2 Which blood group is the least common in the human population? (1)
- 3.2.3 Recent population statistics show that KwaZulu-Natal has a human population of approximately 9,2 million. Calculate the number of people who will have blood group O in KwaZulu-Natal. (2)

- 3.3 A microorganism contains a gene, which causes the production of an insect poison. Scientists transferred the gene for production of the insect poison into wheat plants. This makes genetically modified (GM) wheat.

The scientists:

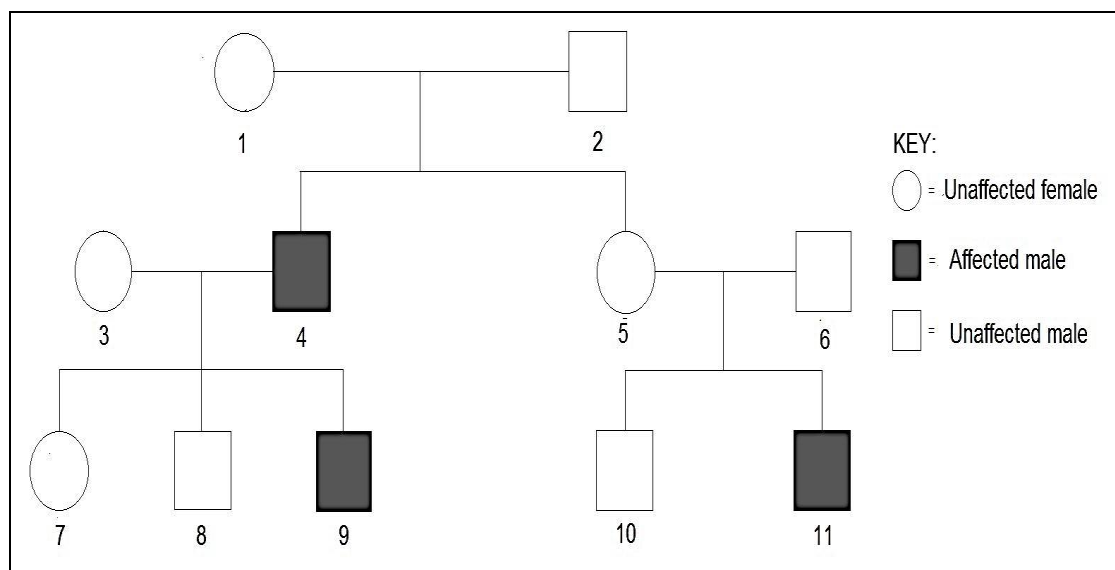
- \* grew wheat plants with the insect poison gene in fields and in greenhouses
- \* grew wheat plants without the insect poison gene in fields and in greenhouses
- \* measured the crop yield of all the wheat plants

The bar graph shows the results.



- 3.3.1 What was the yield of the wheat with the insect poison gene grown in the greenhouses? (1)
- 3.3.2 What was the difference in yield between the wheat with the insect poison gene and the wheat without the insect poison gene grown in the greenhouse? Show your working. (2)
- 3.3.3 What advice would you give to a farmer about which type of wheat to grow in fields? (1)
- 3.3.4 Give a reason for your answer in QUESTION 3.3.3. (1)

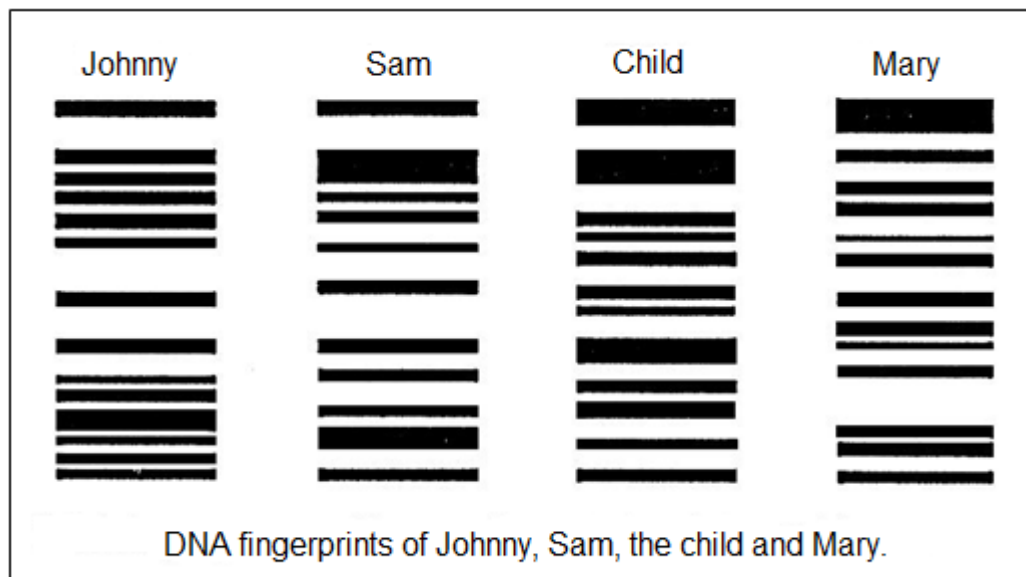
- 3.4 The pedigree diagram below traces the inheritance of *haemophilia* in a family. Study the diagram and answer the questions that follow.



- 3.4.1 How many family members not affected by *haemophilia* are carriers? (2)
- 3.4.2 Use the possible alleles  $X^H$ ;  $X^h$  and Y to determine the genotype for each of the following:
- (a) Individual 1 (1)
- (b) Individual 4 (1)
- 3.4.3 Explain why this disorder affects mostly males. (2)
- 3.4.4 Individual 10 and his wife, who is a carrier (not shown in the diagram), have a son. What are the chances of this son developing *haemophilia*? (1)
- 3.4.5 Suggest TWO reasons why individual 9 and his partner should undergo genetic counselling before starting a family. (2)




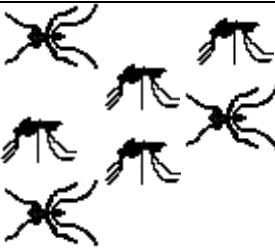


3.5 Read the passage below and answer the questions that follow.

Mary had a child while she was going out with Sam. When she told Sam, he said that the child was not his. He accused Mary of having an affair with his friend, Johnny. Mary said this was not true, but Sam did not believe her. Mary had a DNA test done after the baby was born to compare the baby's DNA with the DNA of Sam, Johnny and herself. The DNA fingerprints show the test results.



- 3.5.1 Explain how you can tell that Mary is the baby's mother. (2)
- 3.5.2 From the DNA fingerprints, explain who you think the baby's father is. (2)
- 3.5.3 (a) Name another way how paternity can be proved. (1)
- (b) State why this is not hundred percent reliable. (1)

- 3.6 Study the following diagram showing the effect of DDT on a population of mosquitoes and answer the questions that follow.

	Before pesticide application	After pesticide application	Key
First generation		 Survivors of first pesticide application	Resistant mosquito 
Second generation		 Survivors of second pesticide application	Susceptible mosquitoes (affected by DDT) 

- 3.6.1 Describe the proportion of phenotypes of the first generation of mosquitoes:
- (a) Before pesticide application (1)
- (b) After pesticide application (1)
- 3.6.2 Explain the result of the first pesticide application. (2)
- 3.6.3 Why are there many mosquitoes that are more resistant in the second generation before pesticide application? (2)
- 3.6.4 Explain why there are no susceptible mosquitoes in the second generation after the pesticide was applied. (2)

[40]

TOTAL SECTION B: 80

**SECTION C****QUESTION 4**

- 4.1 It is thought that modern humans evolved gradually from ape-like beings over millions of years through speciation.

Explain how the differences in the skulls and other parts of the skeleton of primitive ape-like beings and modern humans support the idea that the general trend in human evolution has been towards bipedalism and a change in diet from raw food to cooked food.

Synthesis (17)  
(3)

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

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

