basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LFSC.2

LIFE SCIENCES P2

NOVEMBER 2014

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 pages.

MORNING SESSION

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

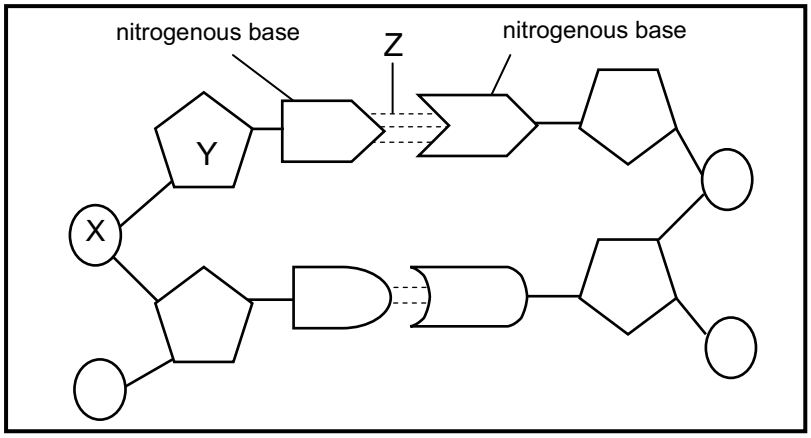
1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
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 diagram below shows part of a DNA molecule.



The correct labels for parts **X**, **Y** and **Z** respectively are ..

A deoxyribose sugar, phosphate and hydrogen bond.
B phosphate, deoxyribose sugar and hydrogen bond.
C ribose sugar, nitrogenous base and peptide bond.
D phosphate, ribose sugar and hydrogen bond.

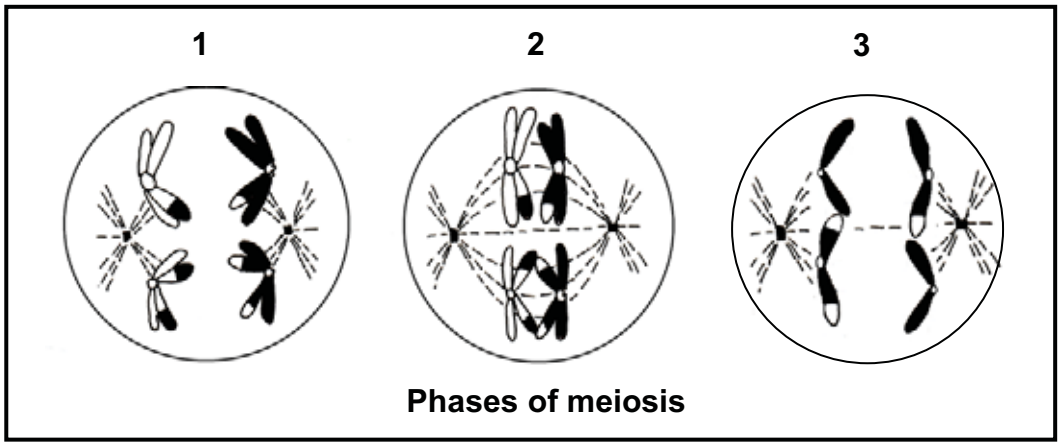
1.1.2 If 10% of the bases in a molecule of DNA are adenine, what is the ratio of adenine to guanine in the same molecule?

A 1 : 1
B 4 : 1
C 1 : 3
D 1 : 4

1.1.3 Lamarck's 'laws' of use and disuse and inheritance of acquired characteristics were ...

A rejected, because only characteristics that benefit offspring can be inherited.
B not rejected, because evidence shows that acquired characteristics can be inherited.
C rejected, because only characteristics that are coded for in the DNA can be inherited.
D not rejected, because Darwin's theory supports Lamarck's ideas.

1.1.4 The diagrams below represent different phases of meiosis.



Phases of meiosis

The correct order of the phases is ...

A 1, 2 and 3.
B 2, 3 and 1.
C 3, 1 and 2.
D 2, 1 and 3.

1.1.5 Two red-eyed fruit flies were mated and they produced 150 flies with red eyes and 48 flies with white eyes. From this information we can reasonably conclude that the ...

A white-eyed condition is recessive and both parents are heterozygous.
B red-eyed condition is dominant and both parents are homozygous for red eyes.
C white-eyed condition is recessive and both parents are homozygous for red eyes.
D red-eyed condition is recessive and both parents are heterozygous.

1.1.6 Which ONE of the following monohybrid crosses will result in a phenotypic ratio of 1 : 1? A cross where ...

A both parents are heterozygous.
B both parents are homozygous for the dominant characteristic.
C one parent is heterozygous and the other parent is homozygous recessive.
D one parent is heterozygous and the other parent is homozygous dominant.

1.1.7 Study the list below.

1. Fossils
2. Homologous structures
3. Biogeography
4. Genetics

Which ONE of the combinations of the above can be used as evidence for evolution?

A 1, 2 and 3 only
B 1, 2, 3 and 4
C 2, 3 and 4 only
D 1, 3 and 4 only

1.1.8 One reason why some people are opposed to genetic modification is that ...

A the use of herbicides is reduced.
B crop yields are improved.
C the taste and quality of food is improved.
D the potential impact on human health is unknown.

1.1.9 Homologous chromosomes are described as ...

A being similar in structure and coding for the same characteristics.
B a product of the division of chromosomes.
C identical daughter chromatids formed through DNA replication.
D two chromosomes that code for different characteristics.

1.1.10 Four different phenotypes are possible in the F_1-generation if the parents' blood groups are ...

A B and B.
B A and B.
C O and AB.
D AB and AB. (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 An allele that does not influence the phenotype when found in the heterozygous condition

1.2.2 A section of a DNA molecule that codes for a specific characteristic

1.2.3 The production of a genetically identical copy of an organism using biotechnology

1.2.4 The manipulation of the genetic material of an organism to get desired changes

1.2.5 The deliberate breeding of organisms for desirable characteristics selected by humans

1.2.6 The explanation that species experience long periods without physical change, followed by short periods of rapid physical change

1.2.7 The phase of meiosis during which homologous chromosomes separate and start moving towards opposite poles

1.2.8 The defect in cell division that leads to Down syndrome

1.2.9 The structure that is made up of two chromatids joined by a centromere

1.2.10 An explanation for something that has been observed in nature and which can be supported by facts, laws and tested hypotheses **(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 1.3.6) in the ANSWER BOOK.

	COLUMN I		COLUMN II
1.3.1	Discovered the shape of the DNA molecule	A: B:	Francis Crick James Watson
1.3.2	Each gamete receives only one allele for each characteristic	A: B:	Mendel's principle of segregation Darwin's theory of natural selection
1.3.3	An advantage of genetic modification	A: B:	Increases shelf life of food Increases resistance to disease
1.3.4	An example of a reproductive isolating mechanism	A: B:	Species-specific courtship behaviour Infertile offspring
1.3.5	Type of variation represented by skin colour in humans	A: B:	Continuous variation Discontinuous variation
1.3.6	A group of similar organisms that can interbreed to produce fertile offspring	A: B:	Species Genus

(6 x 2) **(12)**

1.4 About 70% of people get a bitter taste when a substance called PTC is placed on their tongue. They are referred to as 'tasters'. All other people are unable to taste PTC and are referred to as 'taste-blind'. The 'taster' allele is dominant and the 'taste-blind' allele is recessive.

Also in humans, normal skin pigmentation is dominant to the albino condition (no pigmentation).

The letters in the key below must be used to represent the alleles for the different characteristics above.

Key:
T – taster **t** – taste-blind **N** – normal skin pigmentation **n** – no skin pigmentation (albino)

A man who is heterozygous for both tasting PTC and skin pigmentation marries a woman who is taste-blind for PTC and is an albino.

1.4.1 State why the example above represents a dihybrid cross. (1)

1.4.2 Write down:

(a) The genotype of the woman (1)

(b) ALL the possible gametes of the man (2)

1.4.3 The man and woman have a child whose genotype is **ttNn**. What is the child's phenotype? (2)

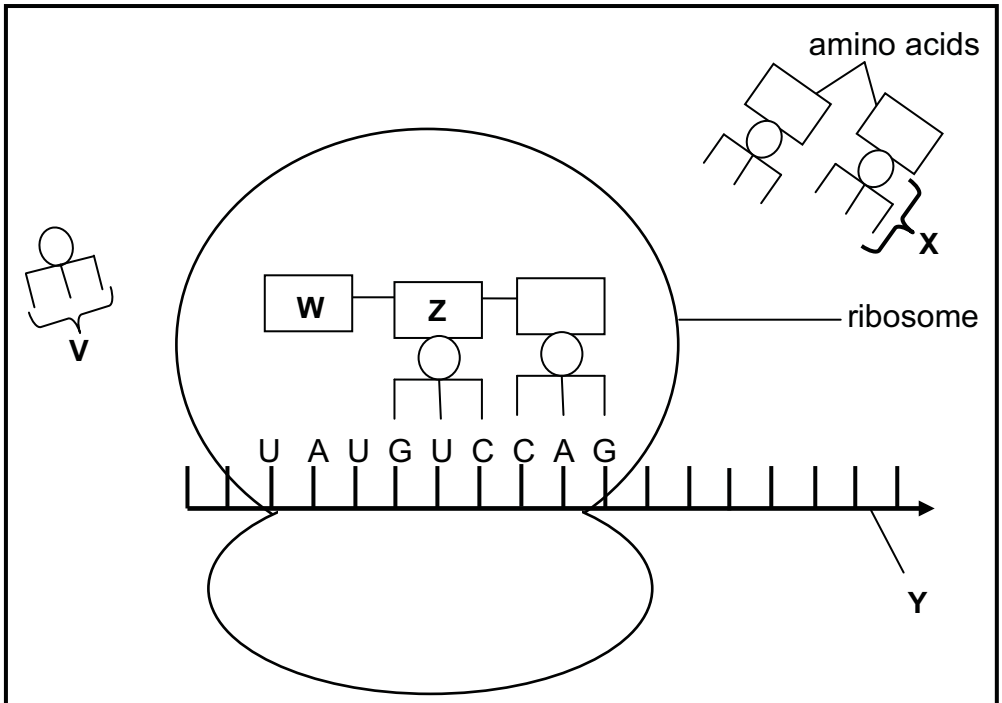
1.4.4 A man and a woman are only able to produce children with the genotype **TtNn**. The woman's genotype is **ttnn**. State the only possible genotype of the man. (2)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Study the diagram below which shows a part of the process of protein synthesis.



Protein synthesis at the ribosome

2.1.1 Identify the stage of protein synthesis that is shown in the diagram above. (1)

2.1.2 Identify molecules **X** and **Y**. (2)

2.1.3 State the term for the group of three nitrogenous bases indicated by **V**. (1)

2.1.4 Give the nitrogenous bases on the DNA strand that codes for the bases UAU on molecule **Y**. (1)

2.1.5 Use the table below to identify amino acid **W**.

tRNA	Amino acid
GUC	glutamine
UAA	isoleucine
AUA	tyrosine
CCC	glycine
GGG	proline
CAG	valine

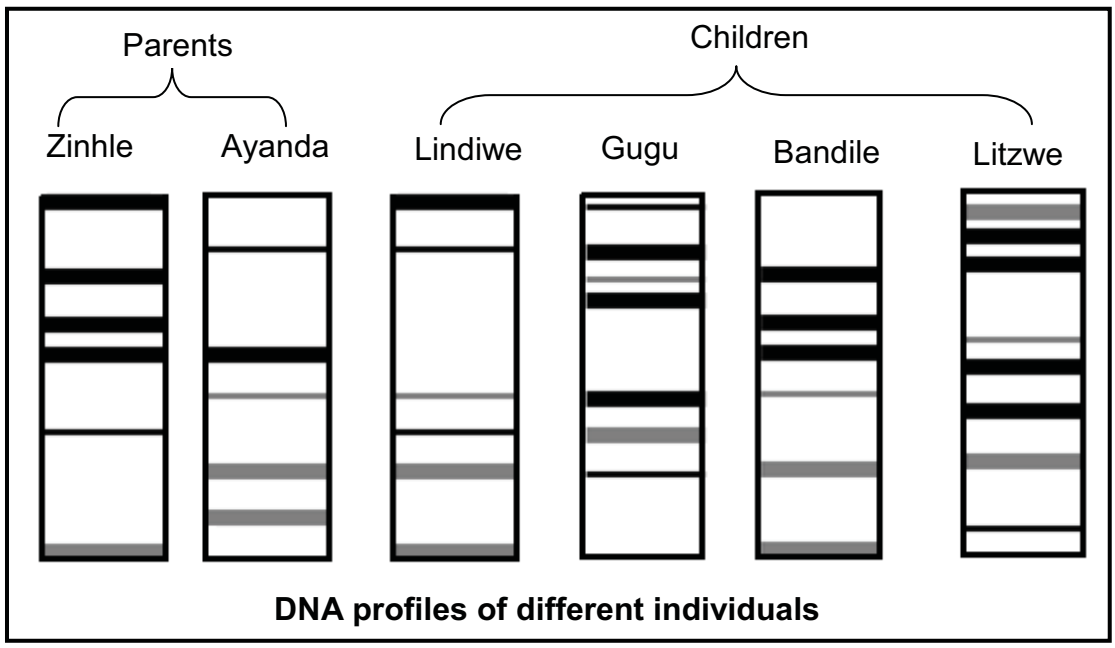
(2)

2.1.6 Name and describe the process that occurs in the nucleus to produce molecule **Y**. (5)

(12)

2.2 The diagram below shows the DNA profiles of six members of a family. The greater the similarity in the position of the bands in the DNA profiles of different individuals, the more closely they are related.

The parents, Zinhle and Ayanda, have four children. Two of the children are their biological offspring while the other two children are adopted.



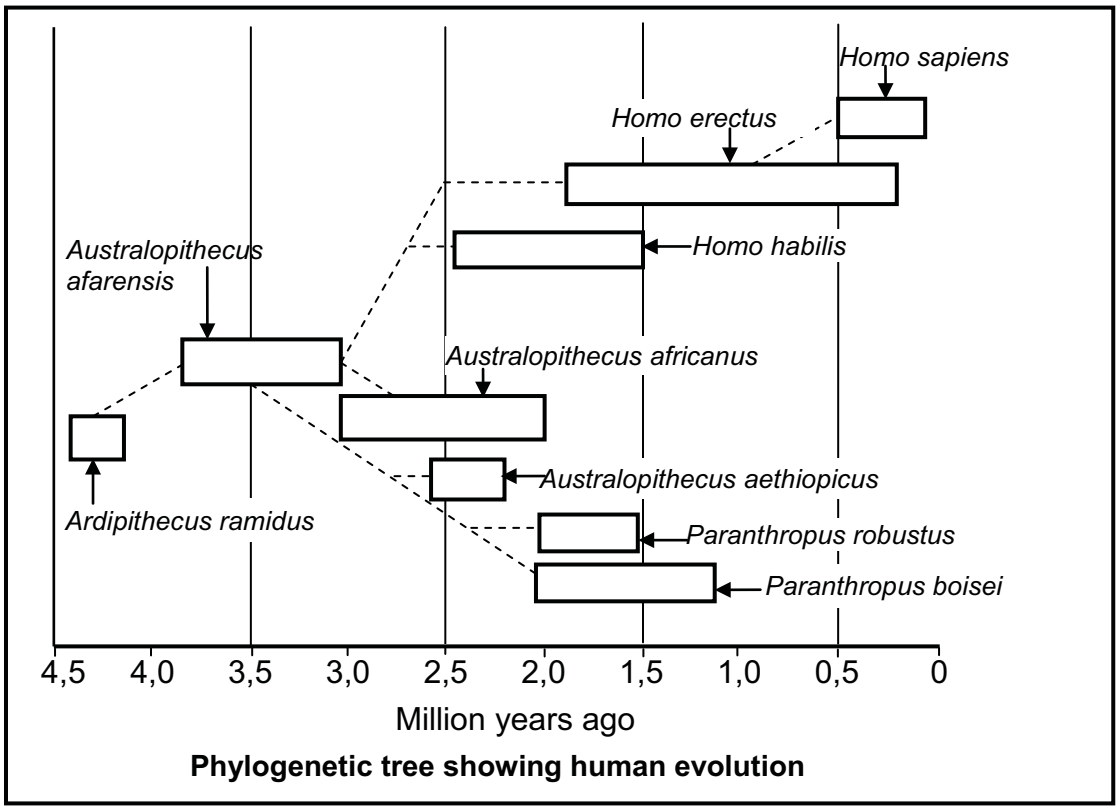
DNA profiles of different individuals

2.2.1 Which TWO children are the biological offspring of Zinhle and Ayanda? (2)

2.2.2 Give an explanation for your answer to QUESTION 2.2.1 using evidence from the DNA profiles. (2)

2.2.3 Apart from paternity testing, state TWO ways in which DNA profiling is of use to humans. (2)
(6)

2.3 Study the phylogenetic tree below showing a possible representation of human evolution and answer the questions which follow.



Phylogenetic tree showing human evolution

[Adapted from *Biology: Understanding Life*, Sandra Alters, 1995]

2.3.1 According to the phylogenetic tree, which organism, *Paranthropus boisei* or *Homo habilis*, appeared first on Earth? (1)

2.3.2 Name TWO species whose existence on Earth overlapped with that of *Homo erectus.* (2)

2.3.3 Which organism was the direct ancestor of *Homo habilis*? (1)

2.3.4 List FIVE characteristics that are shared by all the organisms in the above phylogenetic tree. (5)

2.3.5 How long did *Australopithecus africanus* exist on Earth? (1)
(10)

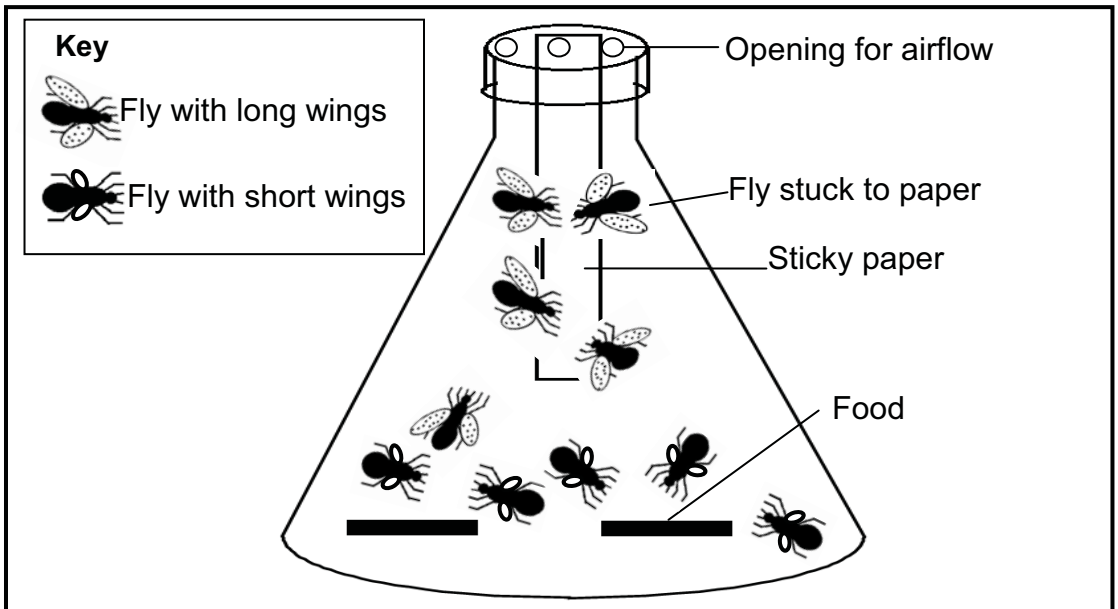
2.4 There is variation in the wing length of fruit flies (*Drosophila melanogaster*). Some have long wings and can fly while others have short wings and cannot fly.

An investigation was conducted to determine which flies would survive under certain conditions.

The following steps were carried out:

1. Five flies with short wings and five flies with long wings were placed in a flask.
2. Food was placed at the bottom of the flask.
3. The lid of the flask allowed airflow.
4. Sticky paper was suspended from the top of the flask. Flies that got stuck to the paper died.
5. The apparatus was left for 24 hours.

The results of the investigation are shown in the diagram below.



Fruit flies in a flask with food

[Adapted from *Biology: Investigate Life on Earth* – Vernon L Avila, 1995]

2.4.1 Formulate a hypothesis for the investigation. (3)

2.4.2 Explain why it is necessary to have openings for airflow. (3)

2.4.3 State TWO ways in which the reliability of the investigation could be improved. (2)

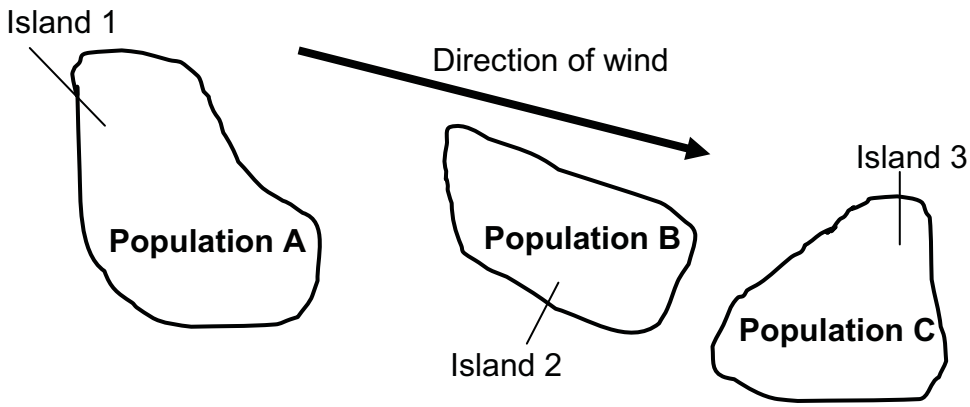
2.4.4 Other than the opening for airflow, explain TWO other precautions that should be taken in this investigation. (4)
(12)
[40]

QUESTION 3

3.1 Three populations of butterflies, **A**, **B** and **C** live separately on three oceanic islands. The butterflies on Island 2 and Island 3 originated from Island 1.

The islands experience strong prevailing winds from the north-west throughout the year.

Populations **A** and **B** can interbreed and produce fertile offspring. Population **B** can mate with Population **C**, but the offspring are infertile. Mating does not occur between Populations **A** and **C** at all.



Three populations of butterflies living on different islands

[Adapted from *Advanced Biology*, M Kent, 2000]

3.1.1 How many species are represented by the three populations? (1)

3.1.2 Explain your answer to QUESTION 3.1.1. (2)

3.1.3 Use the information provided to explain how speciation might have taken place in the above example. (5)
(8)

3.2 Study the passage on evolution below and answer the questions that follow.

The 'Out of Africa' hypothesis suggests that primitive humans migrated from Africa to all other continents of the world about 1,8 million years ago. Scientists that studied some fossilised bones of early humans that lived in Europe concluded that humans were unable to digest cow's milk before 7 000 years ago.

A mutation occurred that resulted in some individuals of the human population living in Europe being able to digest cow's milk. This ability was beneficial as it provided additional nutrients all year round. Milk is a source of vitamin D and calcium.

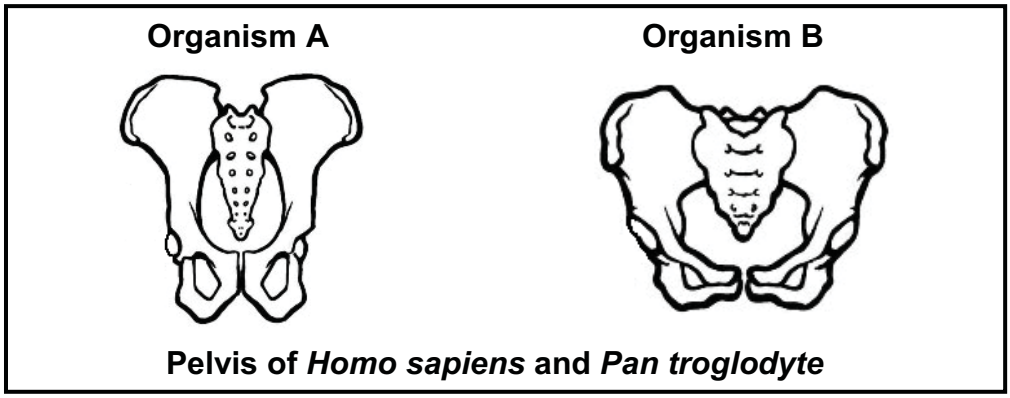
[Adapted from *Impact of Selection and Demography on the Diffusion of Lactose Persistence.* PLoS ONE 4(7) D O'Rouke, 2009]

3.2.1 State ONE advantage of being able to digest cows' milk to early humans that lived in Europe. (1)

3.2.2 Explain why the primitive humans that migrated out of Africa were unable to digest cows' milk. (2)

3.2.3 Apart from fossils, name ONE other type of evidence that can be used to support the 'Out of Africa' hypothesis. (1)
(4)

3.3 Study the diagrams below showing the pelvis of *Homo sapiens* and *Pan troglodyte* (chimpanzee). The diagrams are not drawn to scale.



Pelvis of *Homo sapiens* and *Pan troglodyte*

3.3.1 Which organism, **A** or **B**, is bipedal? (1)

3.3.2 Give ONE observable reason for your answer to QUESTION 3.3.1. (2)

3.3.3 Explain TWO advantages of bipedalism. (4)
(7)

3.4 The table below shows the cranial capacities of different species of primates.

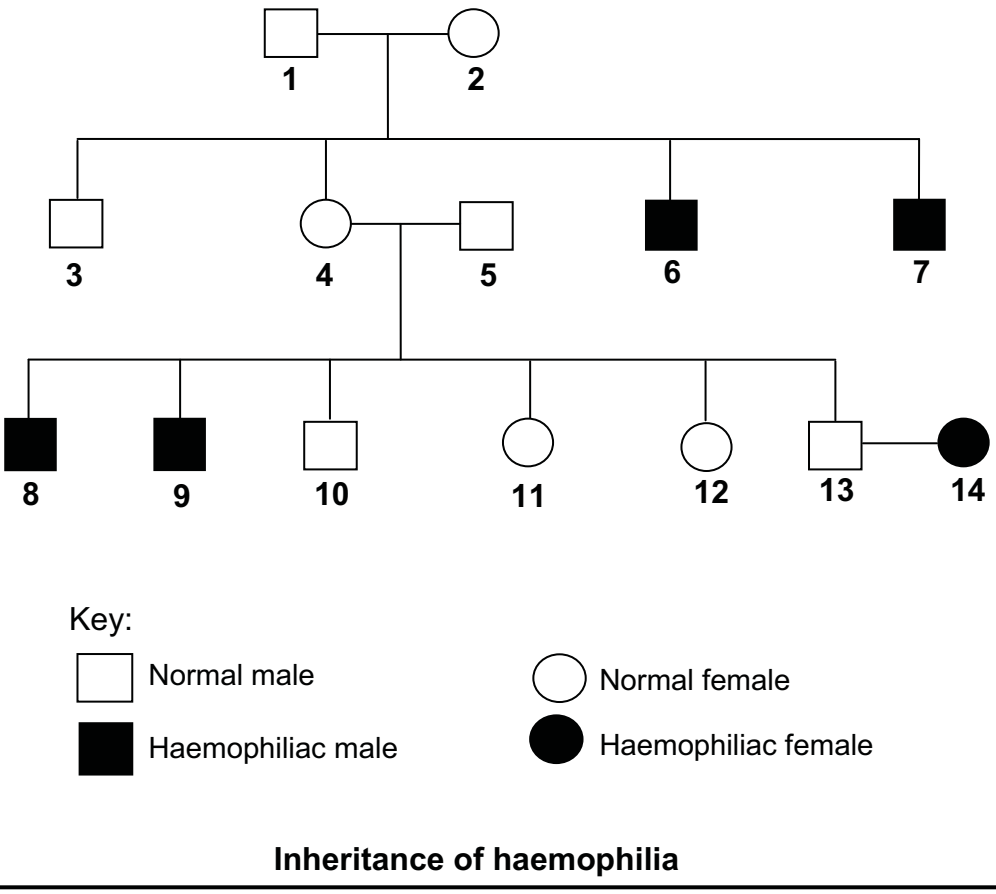
Species	Cranial capacity (cm^3)
Chimpanzee	400
Gorilla	550
Australopithecus sp.	500
Homo habilis	650
Homo erectus	1 000
Homo sapiens	1 500

[Adapted from *Advanced Biology*, M Kent, 2000]

3.4.1 State TWO advantages of the large cranial capacity of *Homo sapiens.* (2)

3.4.2 Draw a bar graph to represent the data in the table. (6)
(8)

3.5 The pedigree diagram below shows the inheritance of haemophilia in a family. The allele causing haemophilia is represented by X^h and the normal allele is represented by X^H.



Inheritance of haemophilia

3.5.1 Determine the:

(a) Phenotype of individual **4** (1)

(b) Genotype of individual **2** (2)

3.5.2 Explain why females have a smaller chance of suffering from haemophilia. (3)

3.5.3 Represent a genetic cross to show the percentage chance of individuals **13** and **14** having a haemophiliac son. (7)
(13)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe how meiosis and different types of mutations contribute to genetic variation and the role of this variation in natural selection.

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