basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION

LIFE SCIENCES P2

2015

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 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. ALL drawings must be done in pencil and labelled 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 1.1.8) in the ANSWER BOOK, for example 1.1.9 D.

1.1.1 Humans have 46 chromosomes in each somatic cell. Each gamete produced will have …

A 22 autosomes and 1 gonosome.
B 21 autosomes and 2 gonosomes.
C 23 autosomes.
D 23 gonosomes.

1.1.2 The table below shows the results of the F_1 generation after an investigation into the inheritance of eye colour in fruit flies was carried out.

EYE COLOUR	NUMBER OF FLIES
Red	182
White	61

The genotypes of the parents were …

A RR x Rr.
B Rr x rr.
C Rr x Rr.
D RR x rr.

1.1.3 Which ONE of the following is TRUE about genes?

Genes are …

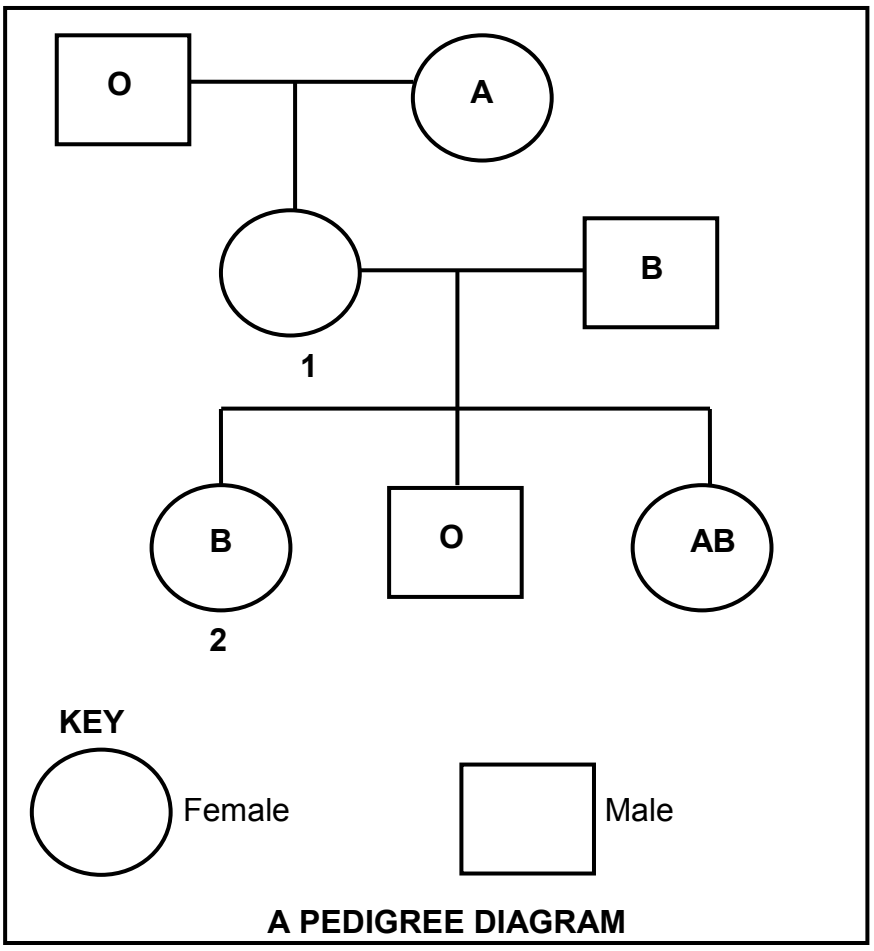
A codes for a particular characteristic.
B made up of amino acids.
C made up of RNA.
D found in a ribosome.

1.1.4 Which ONE of the following is used to produce genetically identical individuals?

A Stem cell research
B Genetic modification
C Cloning
D DNA profiling

QUESTIONS 1.1.5 and 1.1.6 are based on the pedigree diagram below.

The pedigree diagram shows the inheritance of blood groups in a family. The blood groups of the individuals are represented by the letters.



A PEDIGREE DIAGRAM

1.1.5 Which ONE of the following represents the genotype and phenotype of individual number **1** above?

A ii and blood group O
B I^Ai and blood group A
C I^Ai and blood group O
D I^Bi and blood group B

1.1.6 If individual **2** has a child with blood group AB, then her partner could only have blood group …

A AB.
B A.
C O.
D B.

1.1.7 Which ONE of the following is CORRECT with regard to the structure of DNA and RNA?

A RNA is double-stranded and DNA is single-stranded.
B RNA contains uracil and DNA contains thymine.
C RNA is a very long molecule while DNA is a short molecule.
D RNA forms a double helix while DNA does not.

1.1.8 Which ONE of the following represents molecules that make up a single nucleotide?

A Phosphate, sugar and a nitrogenous base
B Sugar, protein and phosphate
C Nitrogenous base, phospholipid and sugar
D Adenine, sugar and a nitrogenous base (8 x 2) **(16)**

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 1.2.9) in the ANSWER BOOK.

1.2.1 The type of inheritance involving two alleles of a gene that are not dominant over one other

1.2.2 Characteristics controlled by genes which are located on the sex chromosomes

1.2.3 Chromosomes that are similar in structure and code for the same characteristics

1.2.4 The monomers/building blocks of proteins

1.2.5 The type of inheritance involving alleles that equally determine the phenotype of heterozygous offspring

1.2.6 Undifferentiated cells which are able to develop into any other types of cells

1.2.7 Intermediate fossils showing features of both more primitive and more advanced organisms

1.2.8 An allele that is expressed phenotypically only in the homozygous condition

1.2.9 A genetic cross involving one characteristic only **(9)**

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 1.3.4) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Discovered the fossil of *Australopithecus sediba*	A: Raymond Dart B: Ron Clark
1.3.2 Example of continuous variation	A: Height B: Blood groups
1.3.3 Pronounced brow ridges	A: African apes B: *Homo sapiens*
1.3.4 Discovered the structure of DNA	A: Watson B: Crick

(4 x 2) **(8)**

1.4 In tomato plants the allele for red fruit **(R)** is dominant over the allele for yellow fruit **(r)**. The allele for tallness **(T)** is dominant over the allele for shortness **(t)**.

Plant **A**, which is heterozygous for red fruit and homozygous tall, was crossed with Plant **B**, which has yellow fruit and is short.

1.4.1 Write down the genotype of:

(a) Plant **A** (1)

(b) Plant **B** (1)

1.4.2 Write down ALL the possible genotypes of the gametes of plant **A**. (2)

1.4.3 Name the phenotype of an offspring having the genotype:

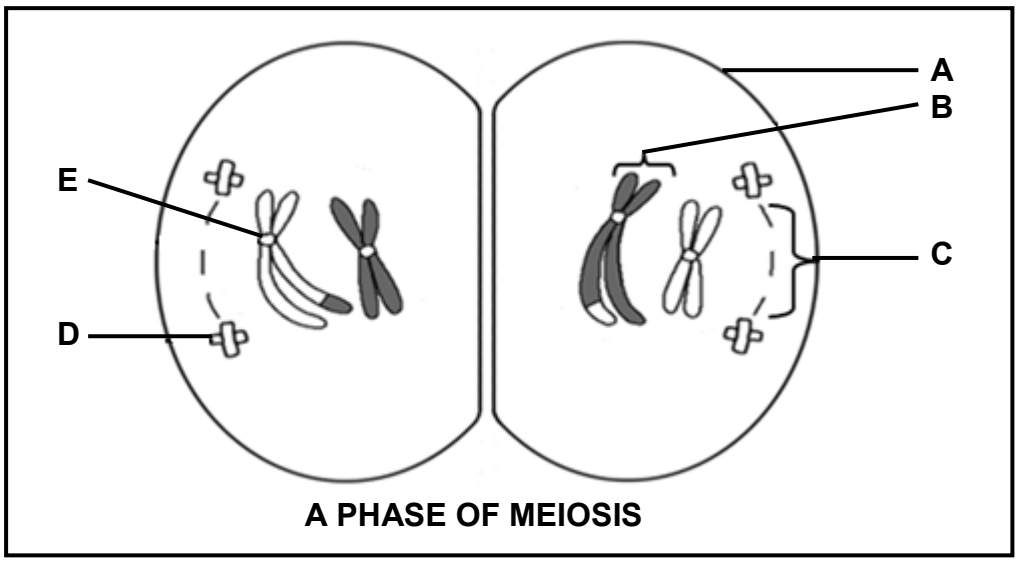
(a) Rrtt (1)

(b) RrTt (1)

1.4.4 Plant **B** was then crossed with another plant (Plant **C**) and all the offspring had red fruit and were tall.

Use this information to write down the genotype of Plant **C**. (2)
(8)

1.5 The diagram below shows cells of an organism in one of the phases of meiosis.



A PHASE OF MEIOSIS

1.5.1 Which phase of meiosis is represented in the diagram? (1)

1.5.2 Give the LETTER and NAME of the part that:

(a) Is responsible for the formation of the spindle fibres (2)

(b) Carries the genetic information (2)

(c) Holds the chromatids together (2)

1.5.3 State the number of chromosomes that would be present in each of the cells of this organism:

(a) At the beginning of meiosis (1)

(b) In a gamete of this organism (1)
(9)

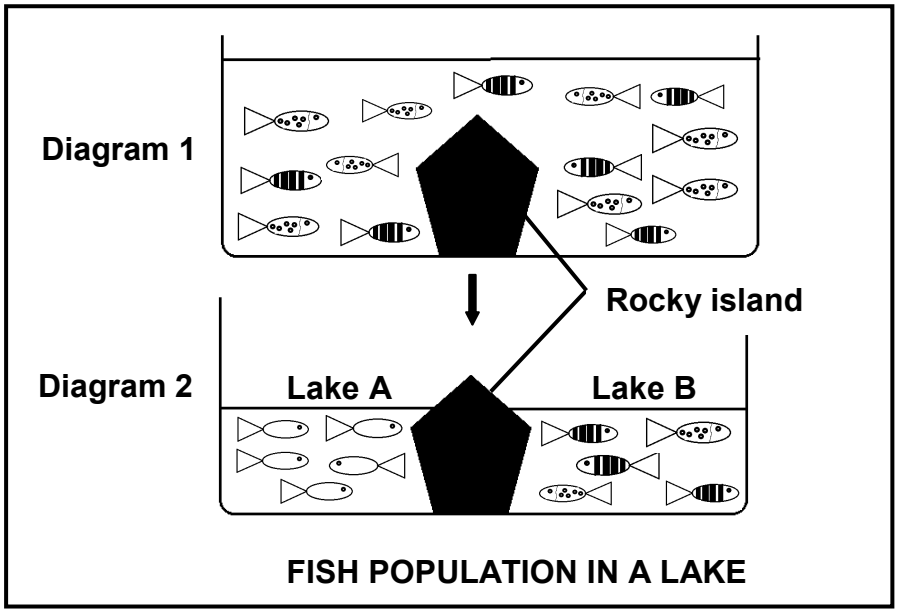
TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Diagram **1** shows variation in a species of fish living in a lake. There was a rocky island that extended across the whole length of the lake, but it was under water due to the high water level. The fish were therefore able to move freely throughout the lake.

Diagram **2** shows the same lake many years later. A drought had caused the level of the water in the lake to drop so that the rocky island in the centre separated the lake into two smaller lakes, **A** and **B**, for a long period of time.



FISH POPULATION IN A LAKE

2.1.1 Define *population*. (2)

2.1.2 State FOUR possible causes of the variation in the fish population in Diagram **1**. (4)

2.1.3 Eventually, as shown in Diagram **2**, lake **A** and lake **B** contained two different species of fish.

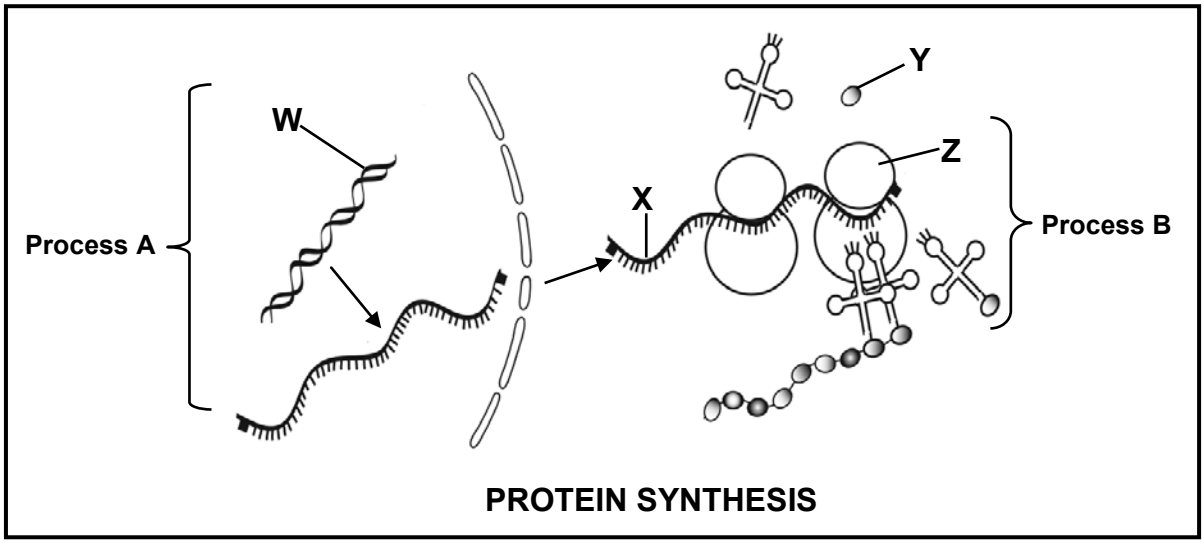
(a) Name the process that resulted in the fish population becoming two different species. (1)

(b) Explain how the new species was formed. (6)
(13)

2.2 A grey (**G**) male rabbit was mated with an albino (**g**) female rabbit. The entire F_1 generation was grey.

Use a genetic cross to show the phenotypic ratio of their offspring if one of the males of the F_1 generation was mated with an albino female. **(7)**

2.3 The diagram below shows the process of protein synthesis.



PROTEIN SYNTHESIS

2.3.1 Identify the following molecules:

(a) **W** (1)

(b) **Y** (1)

2.3.2 Name the part of protein synthesis indicated by process **A**. (1)

2.3.3 Describe how a mutation on molecule **W** will affect the structure of the protein formed by process **B**. (4)

2.3.4 The following sequence represents a part of the nitrogenous base sequence on molecule **X**.

AGA	AUG	GGA
triplet 1	triplet 2	triplet 3

(a) Write down the base sequence of the anticodon of triplet **1** shown above. (1)

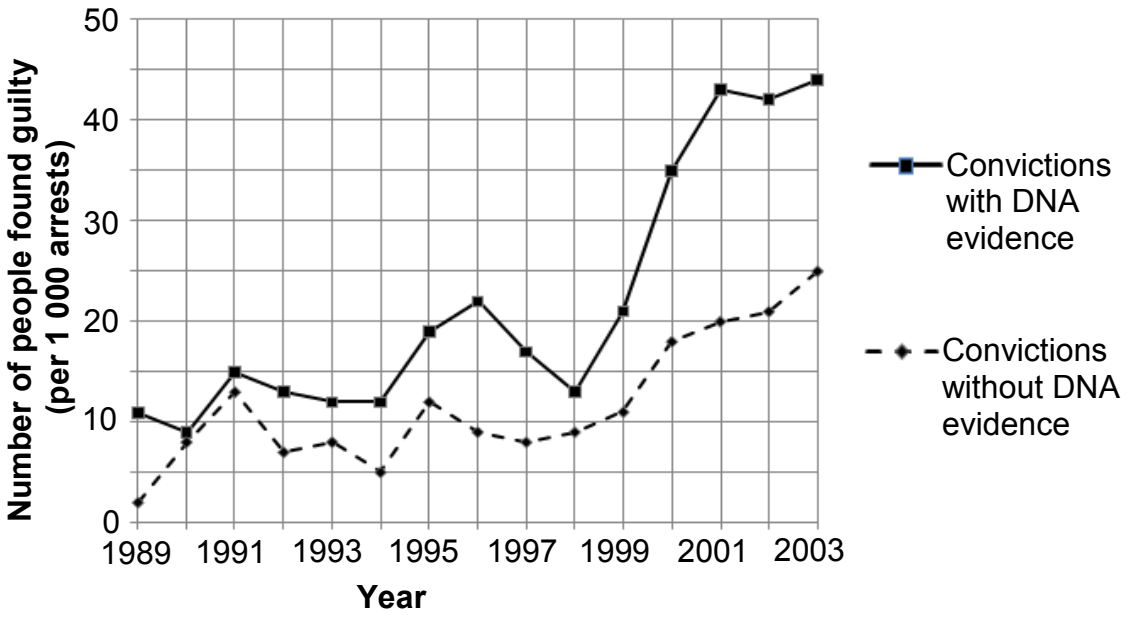
(b) The table below shows the amino acids that correspond with different DNA codes.

AMINO ACID	DNA CODE
Arginine	TCT
Glycine	CCT
Methionine	TAC

Write down the correct sequence of amino acids for triplets **1** to **3**. (3)
(11)

2.4 The graph below represents the results of an investigation which compares the conviction (number of people found guilty) of criminals with the use of DNA evidence and without the use of DNA evidence from 1989 to 2003.

COMPARISON OF THE CONVICTIONS WITH THE USE OF DNA EVIDENCE AND WITHOUT THE USE OF DNA EVIDENCE, FROM 1989 TO 2003



[Adapted from http://www.mindfully.org]

2.4.1 Formulate a hypothesis for this investigation. (2)

2.4.2 State the dependent variable in this investigation. (1)

2.4.3 How many more successful convictions per 1 000 arrests were made in 2003 with the use of DNA evidence? Show ALL calculations. (2)

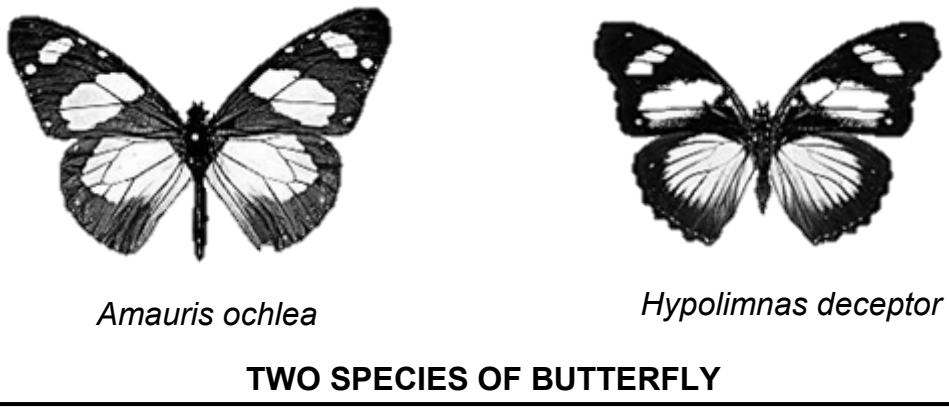
2.4.4 A DNA database is a collection of the DNA profiles of all the citizens of a country.

Explain how you would use the information in the graph to convince the government to create a DNA database. (4)
(9)
[40]

QUESTION 3

3.1 The photographs of two butterflies are provided below. Both butterflies live in the same habitat and are preyed on by predators. Although these butterflies are very similar in appearance they are two separate biological species.

Amauris ochlea has an unpleasant taste while *Hypolimnas deceptor* does not have an unpleasant taste.



TWO SPECIES OF BUTTERFLY

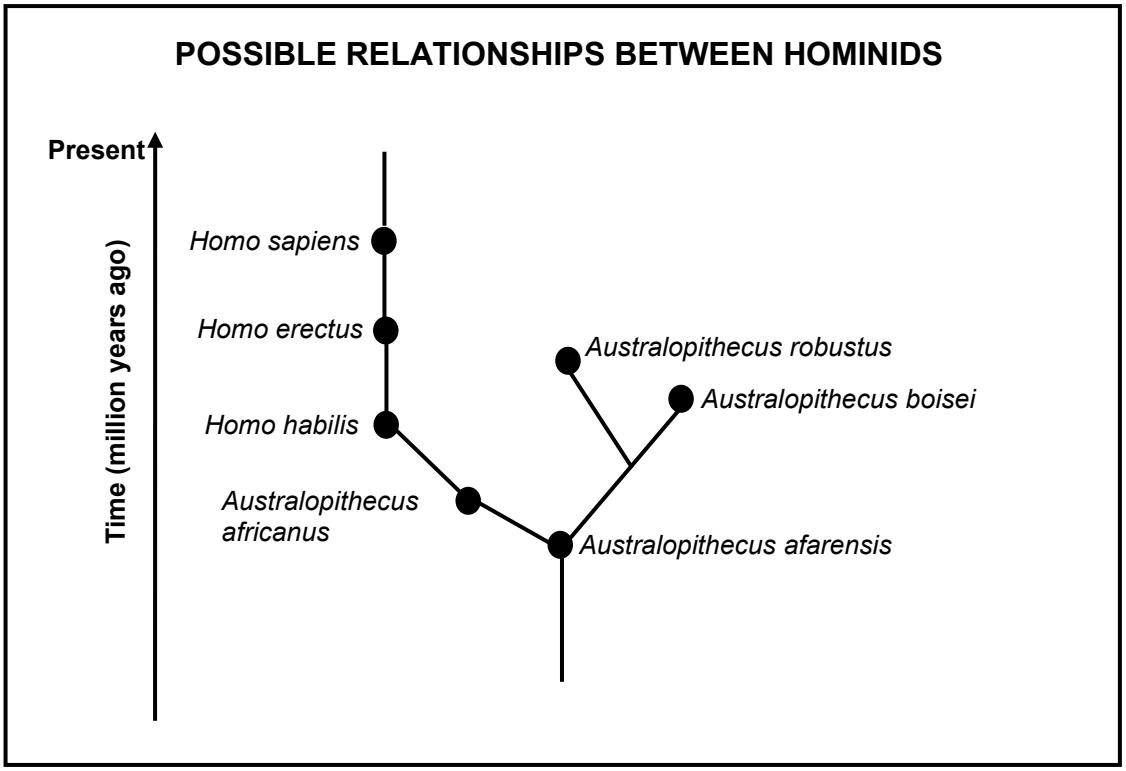
[From http://www.biodiversityexplorer.org.]

3.1.1 Explain why most predators are less likely to feed on *Hypolimnas deceptor*. (3)

3.1.2 Use Darwin's theory of evolution through natural selection to explain the evolution of the *Hypolimnas deceptor* butterfly. (6)

3.1.3 State ONE way in which natural selection differs from artificial selection. (2)
(11)

3.2 The diagram below shows possible relationships between members of the family *Hominidae.*



[Adapted from http://www.ideacentre.org]

3.2.1 What is the name given to the type of diagram above? (1)

3.2.2 How many of each of the following are represented in the diagram?

(a) Genera (1)

(b) Species (1)

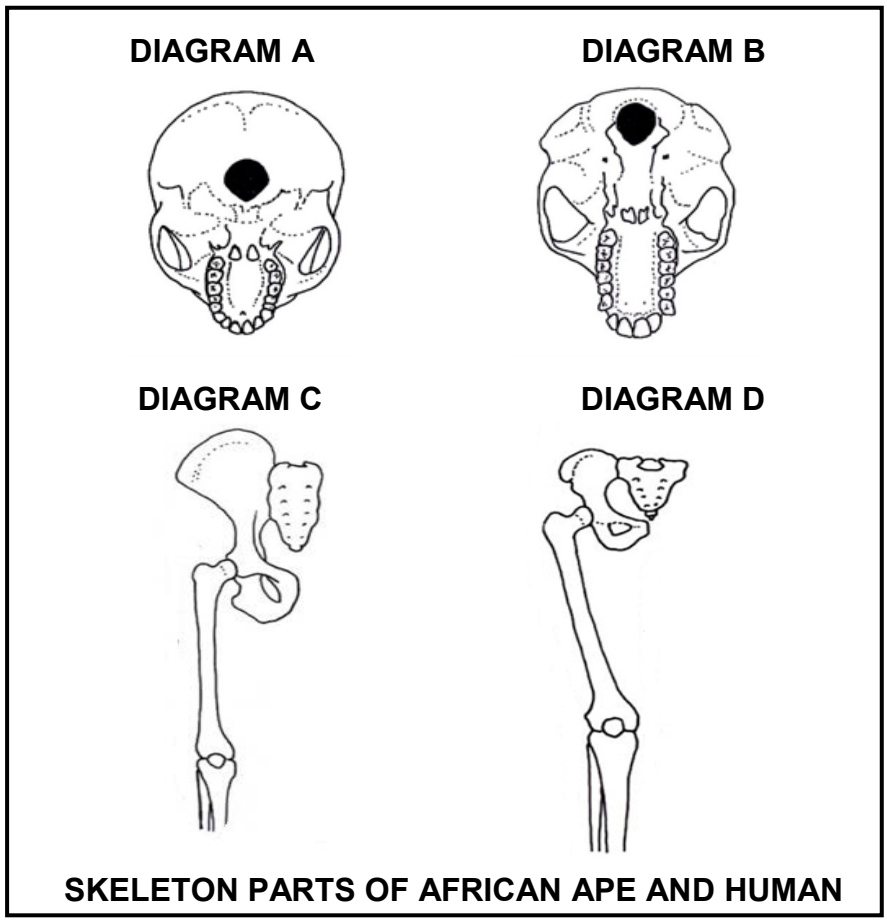
3.2.3 Explain why *A. robustus* and *A. boisei* are more closely related than *A. boisei* and *A. afarensis*. (2)

3.2.4 Which of the hominids in the diagram above is considered to have been the first to use tools? (1)

3.2.5 Name TWO *Australopithecus* fossils found in South Africa. (2)

3.2.6 Explain how the location and the age of *Homo* fossils are used as evidence for the 'Out of Africa' hypothesis. (3)
(11)

3.3 The diagrams below represent parts of the skeletons of an African ape and a human. Diagrams **A** and **B** are drawn to scale.



SKELETON PARTS OF AFRICAN APE AND HUMAN

3.3.1 Write down the LETTERS only of the diagrams (**A**–**D**) that represent bipedal organisms. (2)

3.3.2 Explain how the shape of the pelvis contributes to bipedalism. (2)

3.3.3 Explain the significance of the position of the foramen magnum in the skulls in diagram **A** and in diagram **B**. (4)

3.3.4 Tabulate THREE visible differences between the jaws/teeth of the skulls labelled **A** and **B** that indicate trends in human evolution. (7)

3.3.5 State THREE physical characteristics of the forelimb/upper limb that humans share with African apes. (3)
(18)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe TWO types of mutations and how they lead to altered characteristics in FOUR genetic disorders you have studied.

Content: (17)
Synthesis: (3)

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

TOTAL SECTION C: 20
GRAND TOTAL: 150