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basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P1

VERSION 1 (NEW CONTENT) FOR FULL-TIME CANDIDATES

NOVEMBER 2012

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 your 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. ALL drawings should be done in pencil and labelled 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 all drawn to scale.
9. Do NOT use graph paper.
10. You may use a non-programmable calculator, protractor and 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 your ANSWER BOOK, for example 1.1.11 D.

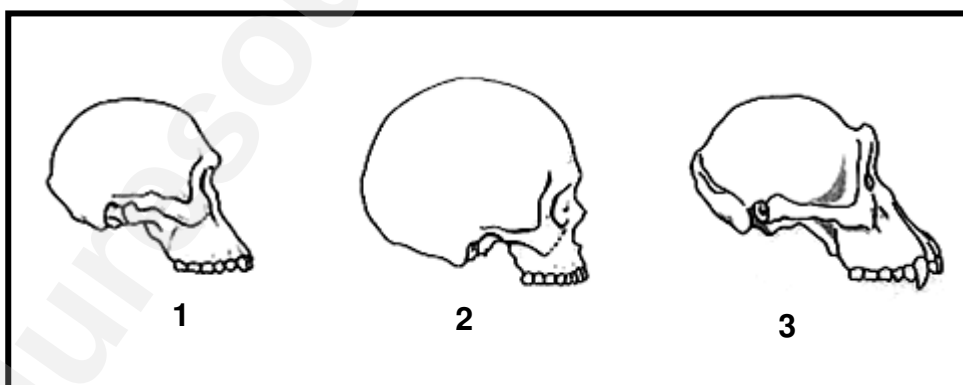
1.1.1 The present-day distribution of organisms is referred to as ...

- A mutations.
- B biodiversity.
- C biochemistry.
- D biogeography.

1.1.2 Changes to genetic material in organisms can ONLY be inherited by the next generation if they ...

- A occur in somatic cells.
- B increase the survival chances of the species.
- C occur in reproductive cells.
- D increase the survival chances of an individual.

1.1.3 Study the diagrams of hominid skulls below.



The correct sequence of evolution, from oldest to youngest, of the hominid species shown is ...

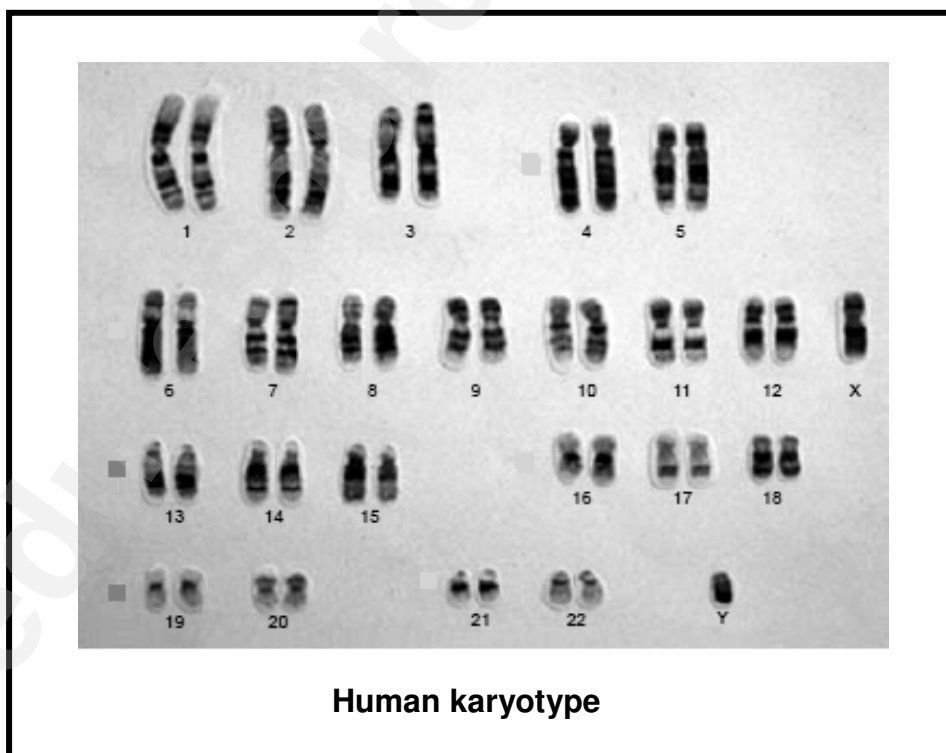
- A 2, 3, 1.
- B 3, 1, 2.
- C 1, 3, 2.
- D 2, 1, 3.

- 1.1.4 DNA sequences are now routinely used to determine how closely related different species are to each other. The table below shows DNA sequences from the amylase gene of four different organisms.

	Amylase DNA sequence									
Organism 1	C	A	G	G	T	C	A	G	T	T
Organism 2	C	C	G	G	T	C	A	G	G	T
Organism 3	C	A	G	G	A	C	A	T	T	T
Organism 4	C	C	G	G	T	C	A	C	G	T

Based on this information alone, which TWO organisms are most closely related?

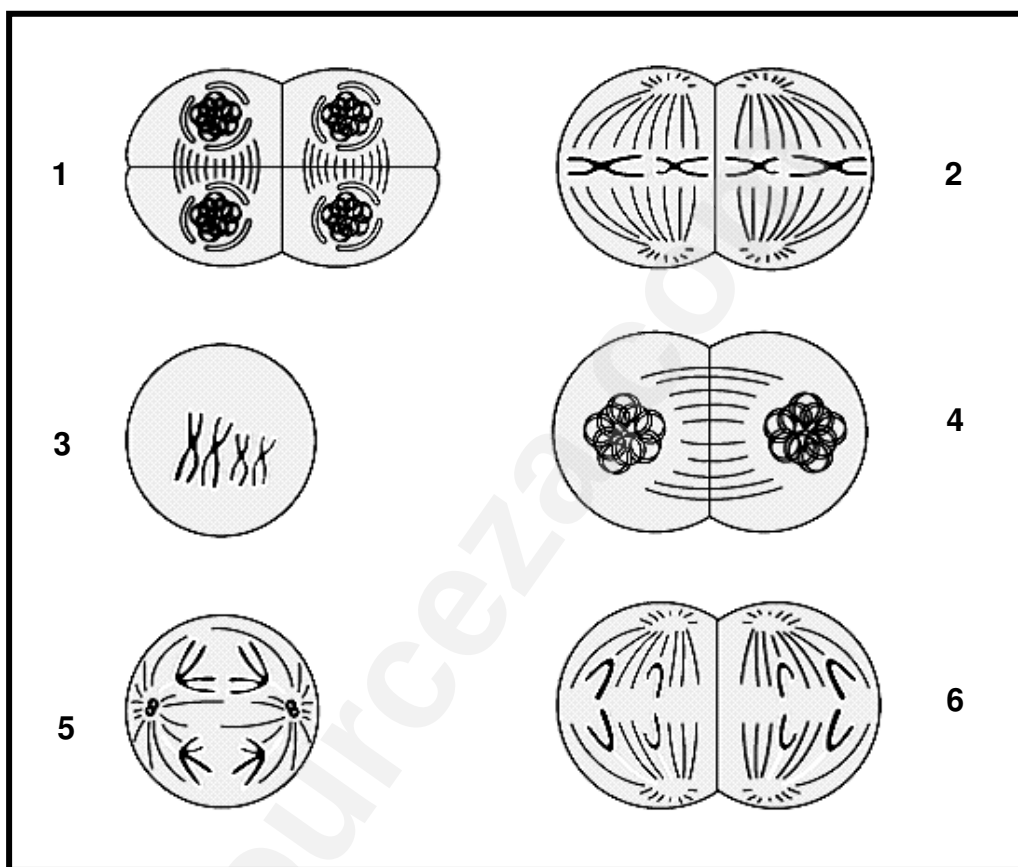
- A Organism 1 and Organism 2
B Organism 2 and Organism 3
C Organism 2 and Organism 4
D Organism 3 and Organism 4
- 1.1.5 The photograph below represents a human karyotype prepared from a sample of foetus cells collected during amniocentesis.



It is reasonable to conclude that ...

- A the foetus is a female.
B the child will develop Down syndrome.
C the foetus is a male.
D there are 46 autosomes.

- 1.1.6 The diagrams below represent six different phases of meiosis taking place in a cell with four chromosomes.



The correct sequence of the different phases in which the above-mentioned division takes place is ...

- A 1, 2, 3, 4, 5, 6.
 B 6, 2, 5, 4, 1, 3.
 C 3, 5, 4, 2, 6, 1.
 D 3, 4, 5, 6, 1, 2.
- 1.1.7 Two types of birds belong to the same species if they ...
- A look similar.
 B are separated by a geographical barrier.
 C successfully interbreed.
 D live in the same habitat.

1.1.8 Which of the following is CORRECT regarding scientific investigations?

- A Increasing the sample size decreases the validity.
- B Allowing many variables increases the reliability.
- C Controlling the variables decreases the validity.
- D Repeating the investigation increases the reliability.

1.1.9 Two parents have children with the following blood groups:

CHILD	BLOOD GROUP
1	A
2	O
3	AB
4	B

If the father has blood group A, what blood group must the mother have?

- A Blood group A
- B Blood group B
- C Blood group O
- D Blood group AB

1.1.10 In a monohybrid cross the two parental genotypes are AA and aa. The genotype of all the F_1 plants is Aa. If the F_1 plants are crossed, what percentage of the F_2 generation will have the dominant phenotype?

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

(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 1.2.8) in your ANSWER BOOK.

- 1.2.1 The formation of new species in the absence of a physical barrier
- 1.2.2 Failure of one or more chromosomes to separate during meiosis
- 1.2.3 Organisms having two identical alleles at a given locus
- 1.2.4 The condition in which an organism has more than two complete sets of chromosomes in a cell
- 1.2.5 Similar structures that descend from a common ancestor
- 1.2.6 Monomers/Building blocks of a nucleic acid
- 1.2.7 The division of the cytoplasm during cell division in plant and animal cells
- 1.2.8 The process of making new DNA from existing DNA

(8)

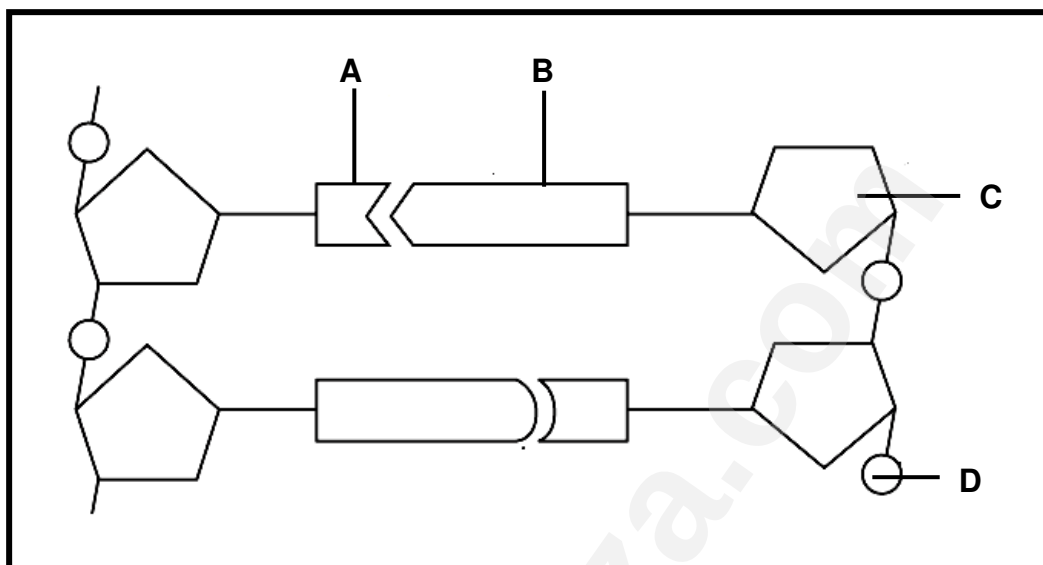
1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.8) in your ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Examples of reproductive isolation mechanisms	A: Adaptation to different pollinators B: Breeding at different times
1.3.2 Fossils found in the Great Rift Valley	A: Nutcracker man B: Taung child
1.3.3 Supports the 'Out of Africa' hypothesis	A: Y-chromosome mutations B: Migration of <i>Homo erectus</i>
1.3.4 Characteristics that may be used by scientists to build a phylogenetic tree	A: Similarity of DNA sequencing B: Fossil evidence
1.3.5 Foramen magnum is towards the back of the skull	A: Human B: Chimpanzee
1.3.6 Characterises blood grouping	A: Multiple alleles B: Co-dominance
1.3.7 An organism's complete set of DNA	A: Genotype B: Genome
1.3.8 A sudden change in the sequence of nitrogen bases in DNA	A: Translation B: Transcription

(8 x 2)

(16)

1.4 The diagram below shows a short section of a DNA molecule.



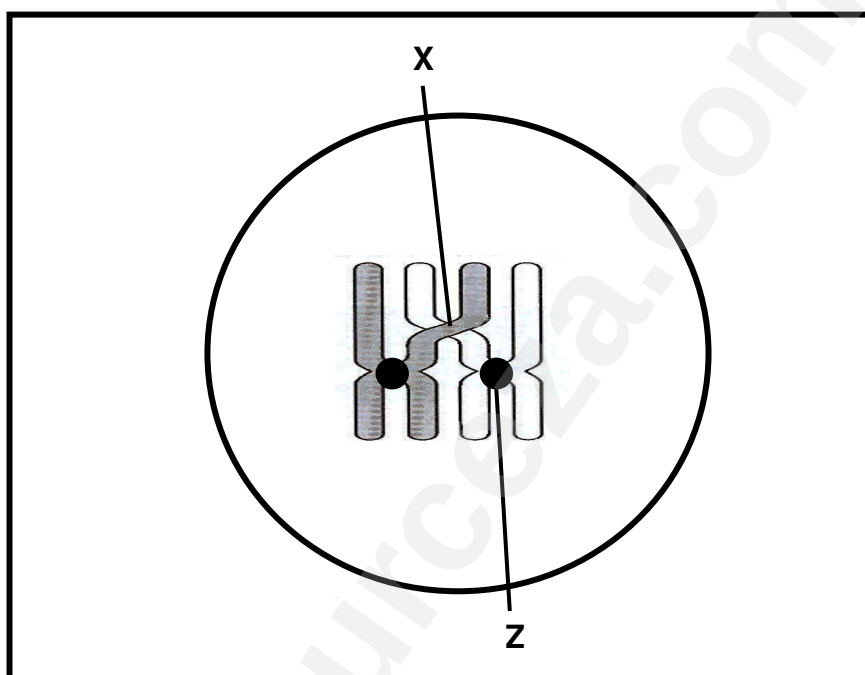
- 1.4.1 Identify part **C** and part **D** respectively. (2)
- 1.4.2 Name the type of bond that joins **A** and **B**. (1)
- 1.4.3 Give ONE visible reason for identifying the above molecule as DNA. (1)
- 1.4.4 Name TWO structures in a non-dividing human cell where DNA is found. (2)
- (6)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

- 2.1 The diagram below shows crossing over in a pair of homologous chromosomes.



- 2.1.1 Identify the point **X** and part **Z** respectively. (2)
- 2.1.2 Give ONE observable reason why the chromosomes above are regarded as homologous. (1)
- 2.1.3 Give ONE reason why crossing over is important. (1)
- 2.1.4 Name ONE other process occurring during meiosis that has the same importance as crossing over. (1)
- 2.1.5 If a mouse egg cell contains 20 chromosomes, how many chromosomes will there be in its skin cell? (1)
- (6)**

- 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.

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:

- (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 from triplet number 4 to triplet number 6 for the DNA template above. (3)

- 2.2.3 Using the table below, determine the amino acid sequence coded by triplet number 4 to triplet number 6.

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

- 2.2.4 If the T in the 6th triplet of bases changed to A in the DNA template above:

- (a) Write down the new amino acid (using the table above) that this 6th triplet now codes for (1)
- (b) State the type of gene mutation that has occurred (1)

- 2.2.5 The change of T to A, referred to in QUESTION 2.2.4, is the mutation that causes sickle cell anaemia. It is characterised by the red blood corpuscles changing shape from biconcave to sickle-shaped with a much smaller surface area than normal red blood corpuscles.

Explain how this may possibly affect the person suffering from sickle cell anaemia.

(3)
(14)

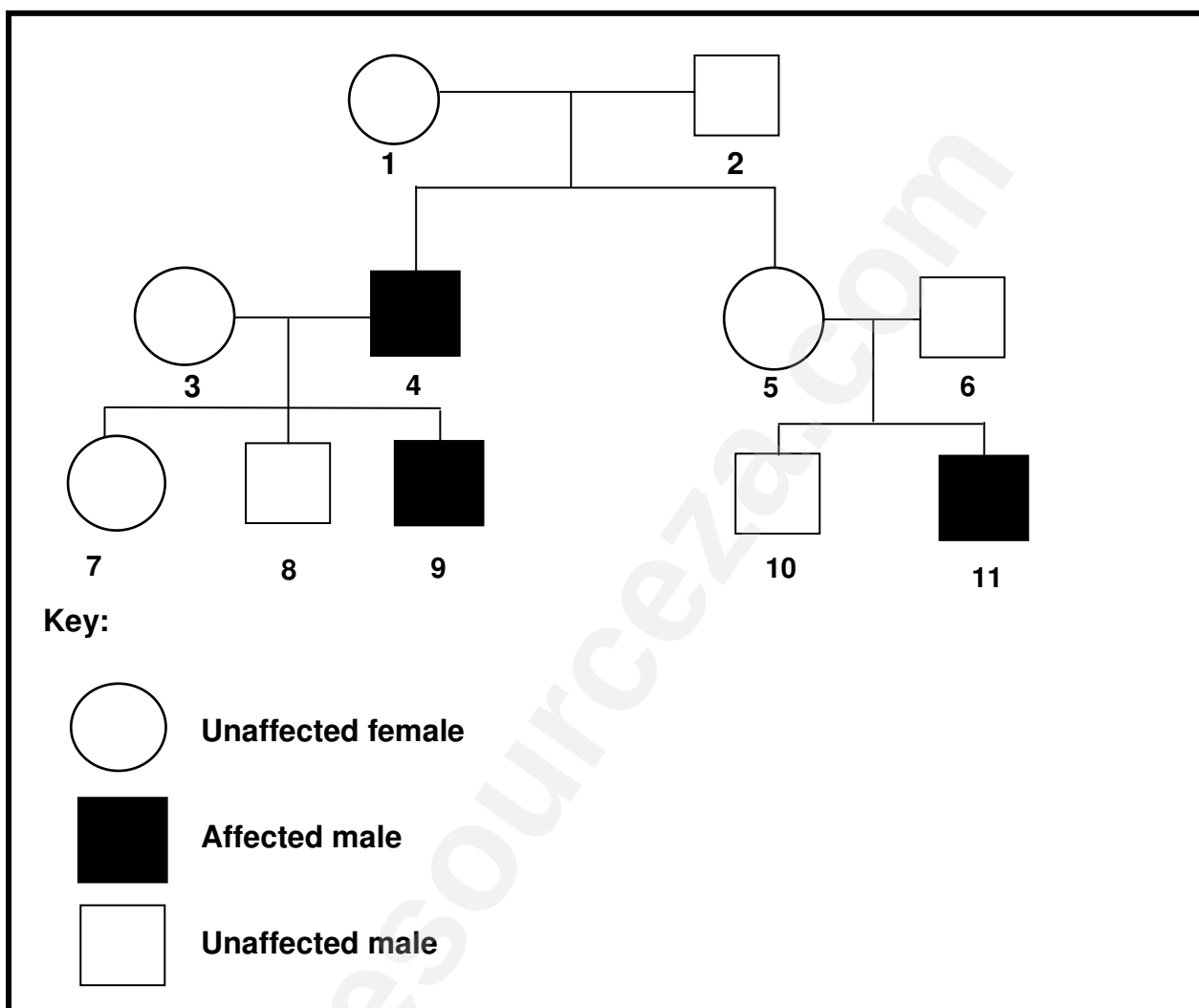
- 2.3 A geneticist wanted to find out which corn colour is dominant in a species of maize. The species has two phenotypes for colour, yellow and white. She performed four genetic crosses and recorded the colour of the offspring as shown in the table below.

Genetic crosses	Parent phenotypes	Offspring phenotypes
1	yellow x yellow	all yellow
2	white x white	51 white and 17 yellow
3	white x yellow	32 white and 34 yellow
4	white x white	all white

- 2.3.1 According to the results, which colour is dominant? (1)
- 2.3.2 Which ONE of the genetic crosses (1, 2, 3 or 4) from the table allows the conclusion suggested in QUESTION 2.3.1? (1)
- 2.3.3 Give a reason for your answer to QUESTION 2.3.2. (2)
- 2.3.4 Use the symbols **G** and **g** to represent genetic cross 2. Also indicate the proportions of the F₁ phenotypes. (6)
- (10)**
[30]

QUESTION 3

3.1 The pedigree diagram below traces the inheritance of haemophilia in a family.



- 3.1.1 How many family members not affected by haemophilia are carriers? (1)
- 3.1.2 Explain why this disorder affects mostly males in this family. (3)
- 3.1.3 Use the possible alleles X^H , X^h and Y to determine the genotype of the following:
- (a) Individual 1 (2)
 - (b) Individual 4 (2)
- 3.1.4 What are the chances of individual 10 and his wife, who is a carrier (not shown in the pedigree), having a son who is affected? (2)
- 3.1.5 Give TWO reasons why individual 9 and his partner should undergo genetic counselling before starting a family. (2)
- (12)**

- 3.2 During their work to establish the structure of DNA, Watson and Crick were interested in the proportion of nucleotides in the DNA of skin cells from a particular organism. They considered the results from three different samples done in the same laboratory, as shown in the table below.

Nucleotides in DNA	Percentage of each nucleotide		
	Sample 1	Sample 2	Sample 3
A	29	31	30
T	31	29	30
C	21	20	19
G	19	21	20

- 3.2.1 Why did Watson and Crick consider results from three samples? (1)
- 3.2.2 What is the ratio of adenine to thymine in the overall experiment? (1)
- 3.2.3 Give a reason for your answer to QUESTION 3.2.2. (1)
- 3.2.4 Draw a pie chart illustrating the percentages of the different nucleotides in sample 1. Show ALL working. (8)
(11)

- 3.3 Genetically modified organisms (GMO) bring new hope for medical cures, promise to increase yields in agriculture and have the potential to help solve the world's pollution and resource crisis.

There are also many objections to GMO, some stating that they are expensive and a threat to our biodiversity.

- 3.3.1 Give TWO reasons why:
- (a) The initial cost of production of GMO is high (2)
- (b) GMO are considered a threat to biodiversity (2)
- 3.3.2 Apart from those in the text, state THREE objections that some people have against the production of GMO. (3)
(7)
[30]

TOTAL SECTION B: 60

SECTION C

QUESTION 4

- 4.1 Study the information about the discovery of a new species of australopithecine in South Africa.

DISCOVERY OF A NEW SPECIES IN SOUTH AFRICA

Professor Lee Berger a paleoanthropologist at the University of the Witwatersrand, with the help of his 9-year-old son, found two fossils in South Africa on 15 August 2008.

Berger and about 60 of his colleagues from all over the world, studied the fossilized bone fragments before they announced their findings to the public on 8 April 2010. Their findings were published in a scientific journal.

They presented it as a new species called *Australopithecus sediba*, dated to approximately 1,78 to 1,95 million years ago. It consists of many primitive features characteristic of other australopithecine species and more advanced features typical of later *Homo* species.

The almost 2-million-year-old partial skeletons are thought to possibly be that of the transitional species between *Australopithecus africanus* (such as the famous Mrs Ples) and either *Homo habilis* or *Homo erectus*, the early ancestors of humans.

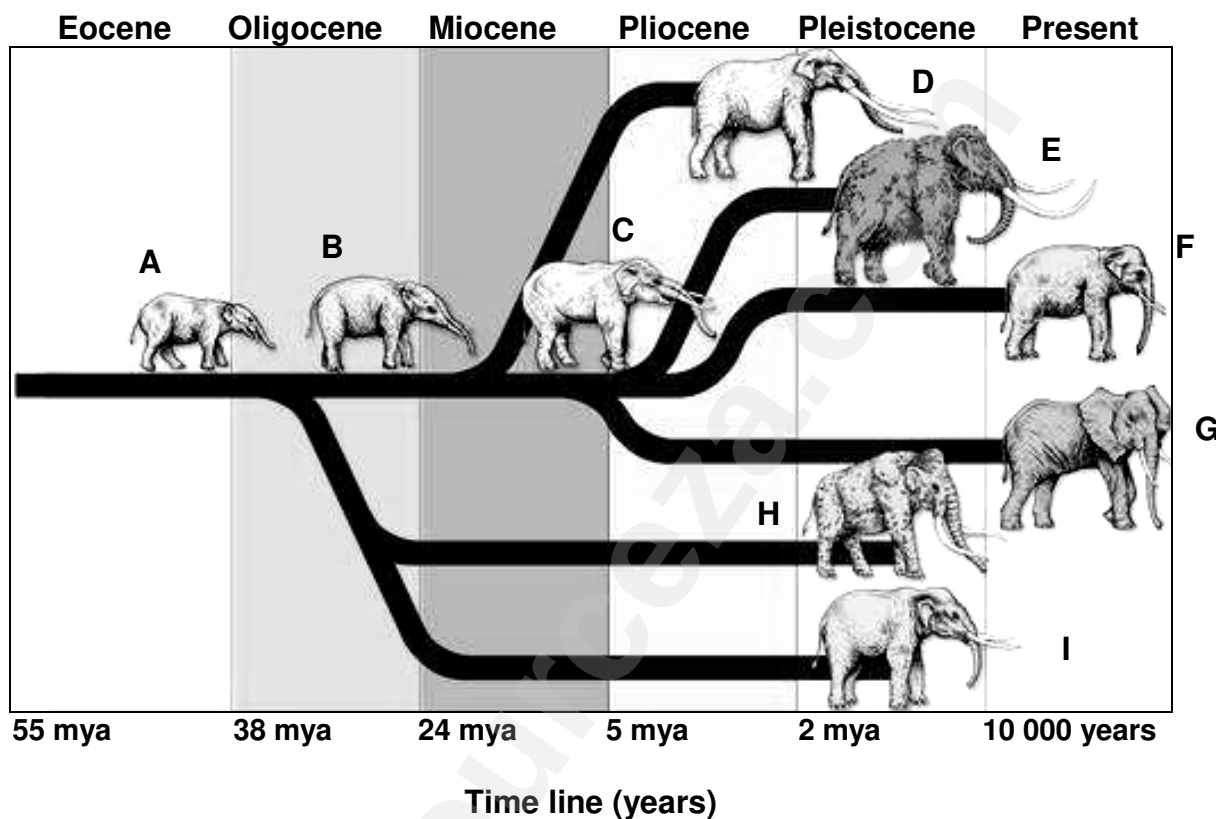
Berger said that the brain, hand and foot have characteristics of both modern and early pre-human forms. It represents a model that could have led to the human genus *Homo*.

It was noted that the brain of *A. sediba* is small, like that of a chimpanzee, but with a re-organisation more human-like, particularly with an expansion behind and above the eyes.

[Adapted from <http://www.sciencemag.org>]

- 4.1.1 Explain why scientists took a long time to present their findings to the public. (2)
- 4.1.2 Explain why it was important to publish their findings in a scientific journal. (2)
- 4.1.3 Define the term *transitional form*. (2)
- 4.1.4 Use ONE characteristic from the passage to explain your answer to QUESTION 4.1.3. (2)
- 4.1.5 State SIX similarities not mentioned in the passage above, between *Homo sapiens* and other primates such as *Australopithecus sediba*. (6)
- (14)

4.2 Study the phylogenetic tree of nine elephant species over six geologic time periods from 55 million years ago (mya) to the present and answer the questions below.



A phylogenetic tree of nine elephant species

Key:

- | | |
|----------------------------------|---------------------------------|
| A: <i>Palaeomastodon</i> species | B: <i>Gomphotherium</i> species |
| C: <i>Primelaphus</i> species | D: <i>Anancus</i> species |
| E: <i>Mammuthus</i> species | F: <i>Elephas</i> species |
| G: <i>Loxodonta</i> species | H: <i>Mammut</i> species |
| I: <i>Stegodon</i> species | |

- | | | |
|-------|--|-----|
| 4.2.1 | According to the phylogenetic tree above, which is the ancestral species of ALL the named species? | (1) |
| 4.2.2 | Name the TWO species of elephants that exist today. | (2) |
| 4.2.3 | Name the immediate ancestor of the two species mentioned in QUESTION 4.2.2. | (1) |
| 4.2.4 | In which period did: | |
| | (a) The <i>Anancus</i> species first appear | (1) |
| | (b) The <i>Stegodon</i> species become extinct | (1) |
| | | (6) |

- 4.3 One of the observations Darwin made during his study of pigeons was about artificial selection. In 1859 Darwin and Wallace jointly proposed that new species could develop by a process of natural selection.

Using examples, describe natural and artificial selection and also highlight the differences between these two processes.

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

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

TOTAL SECTION C: 40
GRAND TOTAL: 150