

Hillcrest High School

Grade 12

Life Science

Trials Paper 1

September 2013

Time: 2 ½ hours

Examiner: Mrs Harmse

150 Marks



Instructions

1. Write your Life Science teachers name on all booklets.
 2. Answer ALL the questions.
 3. Number the answers exactly as the questions are numbered.
 4. Write neatly and legibly
 5. Do all drawings in pencil and label them in ink.
 6. Only draw diagrams and flow charts when requested to do so.
 7. The diagrams in the question paper may not necessarily be drawn to scale.
 8. Non-programmable calculators, protractors and compasses may be used.
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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 (1.1.1–1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1.1 In humans, the allele for brown eyes is dominant over the allele for blue eyes. The probability of two parents, heterozygous for brown eyes, having children with blue eyes is ...

- A 75%.
- B 50%.
- C 25%.
- D 0%.

1.1.2 The nitrogenous base which replaces thymine in a RNA molecule is ...

- A guanine.
- B uracil.
- C adenine.
- D cytosine.

1.1.3 Human blood type is determined by three different alleles known as I^A , I^B and i . The I^A and I^B alleles are codominant and the i allele is recessive.

The possible human phenotypes for blood groups are type A, type B, type AB and type O.

Blood type A and B individuals can be either homozygous ($I^A I^A$ or $I^B I^B$ respectively) or heterozygous ($I^A i$ or $I^B i$ respectively).

A woman with type A blood and a man with type B blood could have offspring with the following blood types:

- A A and B only
- B B and AB only
- C O only
- D A, B, AB or O

- 1.1.4 During an investigation the DNA of an animal cell was analysed in a laboratory and the results are shown in the table below.

BASE COMPOSITION			
X	Adenine	Y	Z
30,0%	20,0%	30,0%	20,0%

Which of the following is a CORRECT identification of the bases called X, Y and Z?

- | | X | Y | Z |
|---|----------|----------|----------|
| A | Cytosine | Guanine | Thymine |
| B | Adenine | Thymine | Cytosine |
| C | Thymine | Cytosine | Adenine |
| D | Guanine | Adenine | Thymine |

- 1.1.5 Assume that plant A has an unknown genotype but shows the dominant trait. This means that plant A could be either homozygous or heterozygous for that trait. To determine which of these two genotypes apply, plant A can be crossed with another plant showing the recessive trait.

Which of the following predictions can be made by studying the offspring from such a cross of complete dominance?

- A If all the offspring show the dominant phenotype, then plant A is heterozygous.
- B If all the offspring show the recessive phenotype, then plant A is homozygous.
- C If 50% of the offspring show the dominant phenotype and 50% of the offspring show the recessive phenotype, then plant A is homozygous.
- D If all the offspring show an intermediate characteristic, then plant A is heterozygous.

- 1.1.6 If all 18 nucleotides of a DNA strand code for amino acids, how many amino acids will be present in the polypeptide that is formed?

- A 9
- B 18
- C 7
- D 6

QUESTIONS 1.1.7 and 1.1.8 refer to the information below.

Some characteristics are controlled by more than one gene. Human skin colour is controlled by at least three genes (three different pairs of alleles). There is incomplete dominance between the allele for dark pigmentation and the allele for light pigmentation. A heterozygous individual will therefore have an intermediate colour. Assume that the alleles A, B and C control dark pigmentation and the alleles a, b and c control light pigmentation. A person with the genotype **AABBCC** would have a very dark skin colour and someone with the genotype **aabbcc** would have a very light skin colour.

1.1.7 The phenomenon whereby a characteristic is controlled by more than one pair of alleles is called ...

- A incomplete dominance.
- B complete dominance.
- C polygenic inheritance.
- D dihybrid cross.

1.1.8 Which ONE of the following is a possible heterozygous combination of the three genes for skin colour?

- A AABBCC
- B AaBbCc
- C aabbcc
- D ABC

1.1.9 Study the following statements:

- 1 The same characteristic has more than two different alleles for the same gene.
- 2 The different alleles for the same characteristic are on the same locus.
- 3 The alleles for the same characteristic are on different loci.
- 4 More than one gene controls a characteristic.

The following combination of statements refer to multiple alleles:

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

(9 x 2) (18)

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1–1.2.6) in the ANSWER BOOK.

1.2.1 The pair of chromosomes in a diploid individual that have the same shape and size, and control the same set of characteristics

1.2.2 The type of genetic cross where an intermediate phenotype is expressed in F_1 , while parental phenotypes reappear in F_2

1.2.3 The law that accounts for gametes having only one allele for a characteristic due to a separation of the pair of alleles during meiosis

1.2.4 A ring of DNA found in bacteria that is used in the production of insulin

1.2.5 A study of the transmission of characteristics from parents to offspring

1.2.6 Chromosome condition of a cell resulting from meiosis, having only one set of chromosomes (6 x 1) **(6)**

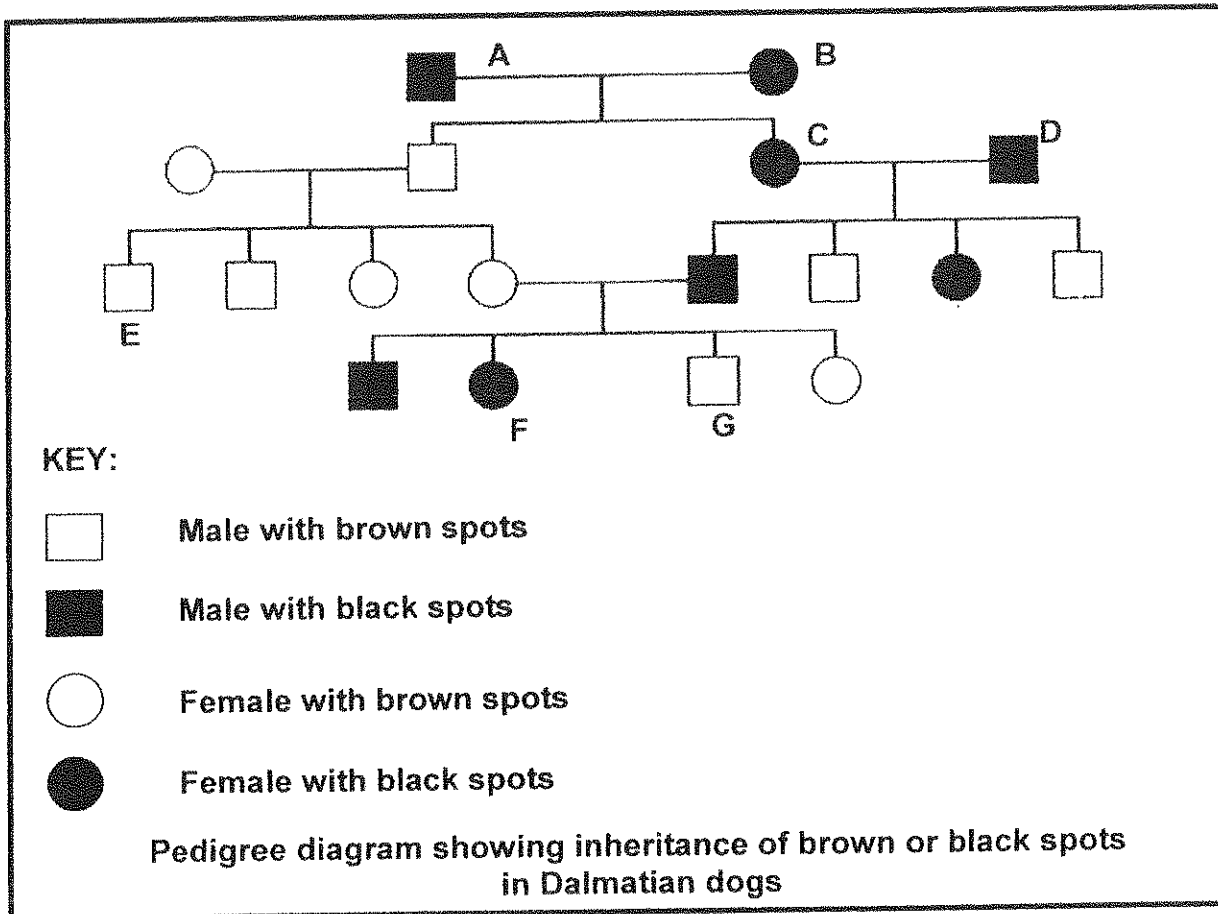
- 1.3 Indicate whether each of the statements in COLUMN I applies to **A only**, **B only**, **both A and B** or **none** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1–1.3.8) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Provides genetic evidence for the 'out of Africa' hypothesis	A: Mitochondrial DNA B: DNA from X chromosomes
1.3.2 Organism(s) which is/are bipedal	A: <i>Homo habilis</i> B: <i>Australopithecus africanus</i>
1.3.3 Proposed natural selection as an explanation of evolution	A: Wallace B: Lamarck
1.3.4 Genetic disorder(s) which lead(s) to absence of blood-clotting factors	A: Down's syndrome B: Haemophilia
1.3.5 Natural shape of a DNA molecule	A: Double helix B: Single-coiled strand
1.3.6 Evidence for evolution	A: Biogeography B: Fossil records
1.3.7 Fossil(s) found in South Africa	A: <i>Australopithecus sediba</i> ('karabo') B: 'Nutcracker Man'
1.3.8 Transfer of a gene for drought-resistance from one species to another	A: Cloning B: Genetic engineering

(8 x 2)

(16)

- 1.4 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).



- 1.4.1 Name the colour and gender of each of the following:
- (a) B (2)
 - (b) G (2)
- 1.4.2 Name the genotype of:
- (a) A (1)
 - (b) F (1)
 - (c) E (1)

1.4.3 If C and D have another puppy, what is the percentage probability of each of the following:

- (a) The puppy being female (1)
 - (b) The puppy having black spots (2)
- (10)**

TOTAL SECTION A: 50

SECTION B

QUESTION 2

- 2.1 Study the genotypes and phenotypes below that show how the alleles for colour-blindness are inherited. X and Y represent sex chromosomes. A carrier does not suffer from colour-blindness but can pass the allele for colour-blindness to their children.

NAME OF PERSON	GENOTYPE	PHENOTYPE
Lindi	$X^B X^B$	Normal female
Beauty	$X^B X^b$	Carrier female
Sarah	$X^b X^b$	Colour-blind female
Paul	$X^B Y$	Normal male
Thabani	$X^b Y$	Colour-blind male

- 2.1.1 State why colour-blindness is referred to as a sex-linked disorder? (2)
- 2.1.2 Is colour-blindness caused by a dominant or a recessive allele? (1)
- 2.1.3 Explain your answer to QUESTION 2.1.2 above. (2)
- 2.1.4 Explain why Thabani is colour-blind. (2)
- 2.1.5 Sarah and Paul marry and have two children, a son and a daughter.

Represent this genetic cross by using the information in the table above to determine the genotypes and phenotypes of the son and the daughter.

(6)
(13)

2.2 People with the phenotype known as 'hitch-hiker's thumb' are able to curve their thumb backwards without assistance, so that it forms an arc shape. The allele for 'hitch-hiker's thumb' is dominant over the allele for the normal thumb.

After making their own observations, Grade 12 learners formulated the following question around which they were then required to develop an investigation:

Is the 'hitch-hiker's thumb' more common than the normal thumb in a population?

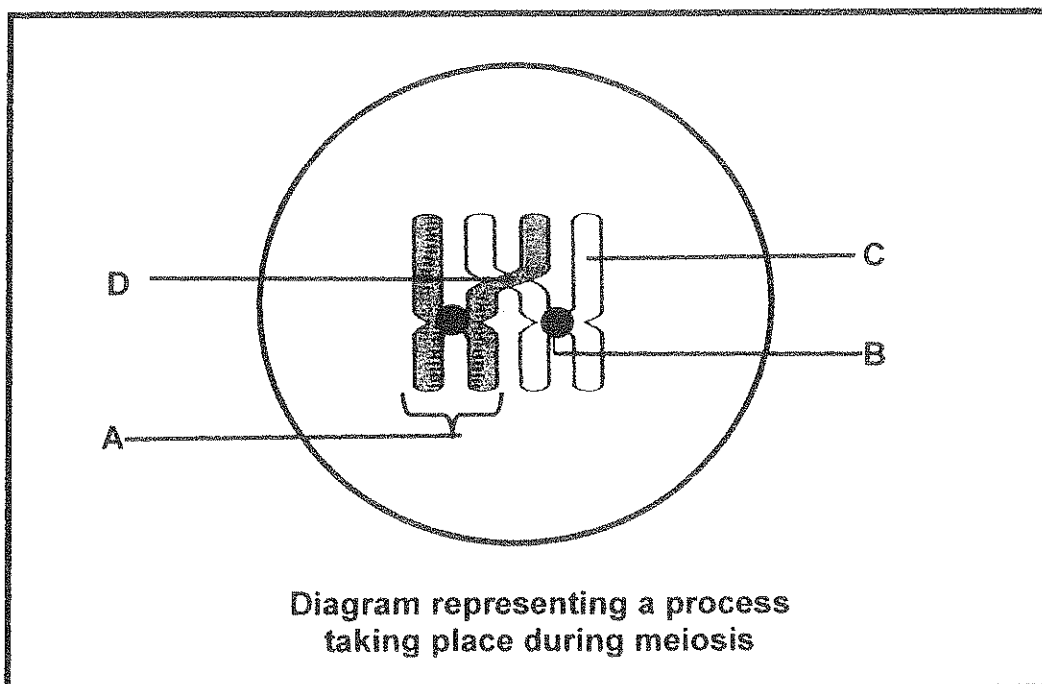
2.2.1 Formulate a hypothesis for this investigation. (3)

2.2.2 State FOUR planning steps for the investigation. (4)

2.2.3 Name the scientist who formulated the concept of dominance after experimenting with pea plants. (1)

2.2.4 State TWO ways of ensuring that the findings of the investigation are reliable. (2)
(10)

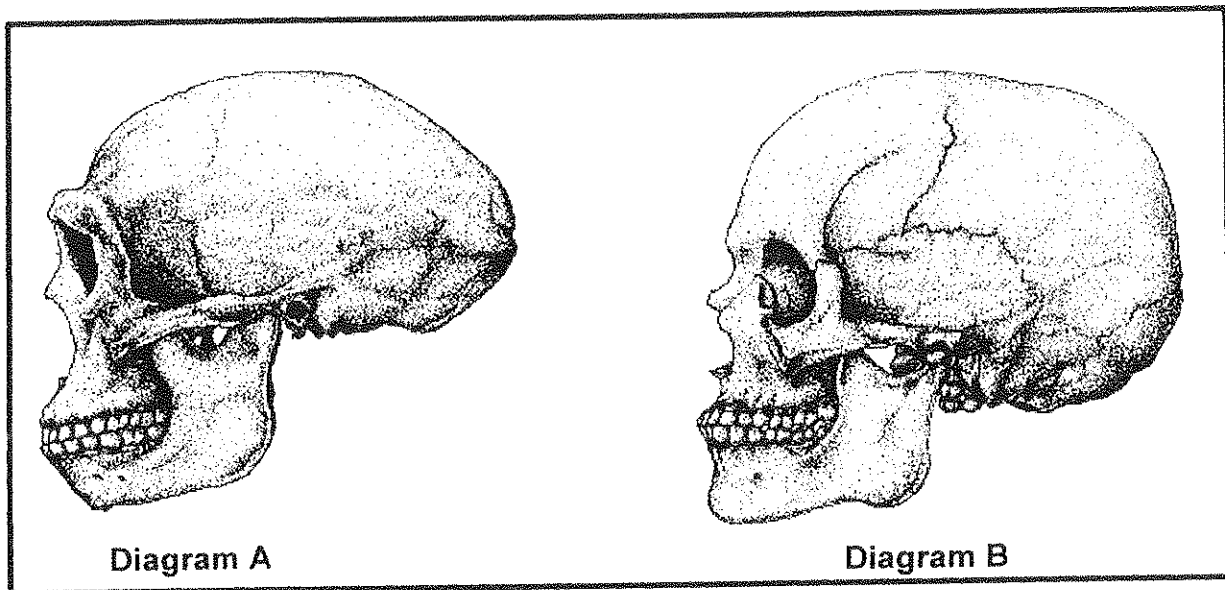
2.3 Study the diagram of a phase in meiosis below and answer the questions that follow.



- 2.3.1 Give labels for parts B, C and D. (3)
- 2.3.2 Name the process in meiosis that is illustrated in the diagram above. (1)
- 2.3.3 State ONE importance of the process named in QUESTION 2.3.2. (1)
- 2.3.4 Draw a diagram of the structure labelled A to show its appearance immediately after the process named in QUESTION 2.3.2. (2)
- (7)
- [30]

QUESTION 3

- 3.1 Diagrams A and B below illustrate the skulls of *Homo sapiens* and *Homo erectus*. The diagrams are drawn to scale.



- 3.1.1 Which of the diagrams (A or B) represents the following: (1)
- (a) *Homo sapiens* (1)
- (b) *Homo erectus* (1)
- 3.1.2 Tabulate TWO visible differences between the skulls in diagrams A and B that represent changes in the structure that characterises human evolution. (5)
- 3.1.3 Describe the significance of *Homo erectus* to the 'out of Africa' hypothesis. (3)
- 3.1.4 List FOUR similarities between *Homo sapiens* and other primates. (4)
- (14)

- 3.2 Read the passage below about the evolution of wheat and answer the questions that follow.

Thousands of years ago, wheat was one of many wild grasses, producing few, small seeds. The wild wheat which has a diploid number of 14 crossed in a 'genetic accident' with a natural goat grass, which also had a diploid number of 14 chromosomes. A new fertile hybrid species called Emmer, which had 28 chromosomes, was produced.

Emmer had many more seeds which were also larger than the wild wheat and the seeds were attached to the husk in such a way that it could easily be dispersed by wind.

There was a second 'genetic accident' in which Emmer crossed with another species of goat grass which had a diploid number of 14, to produce a hybrid with 42 chromosomes.

This hybrid is the present-day bread wheat with seeds that are larger in size and number than any of the species from which it was formed. This wheat can only be propagated by humans, since the seeds are attached to the husk in such a way that it cannot easily be dispersed by wind.

[Adapted from *The Ascent of Man* – J Bronowski]

- 3.2.1 How many chromosomes are normally found in the gametes of the wild wheat plant? (1)
- 3.2.2 How many chromosomes are normally found in the offspring grown from the seed of the wild wheat plant? (1)
- 3.2.3 Name and explain the mechanism that accounts for Emmer having a chromosome number that was twice that of each of the two species from which it was formed. (5)
- 3.2.4 The term 'diploid' refers to the presence of two sets of chromosomes in a cell, whereby each chromosome is present with its homologous partner.
- (a) Name the general term used to describe the presence of many sets of chromosomes in cells of the present-day bread wheat. (1)
- (b) Using the information in the passage above, name TWO advantages of the concept named in QUESTION 3.2.4 (a). (2)
- 3.2.5 Explain why bread wheat cannot grow in the wild and must therefore be cultivated by humans. (2)
- 3.2.6 What type of speciation occurred in the production of the hybrid wheat? (1)

- 3.2.7 Name the other type of speciation that you have studied. (1)
- 3.2.8 State ONE difference between the two types of speciation. (2)
- (16)
- [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*.

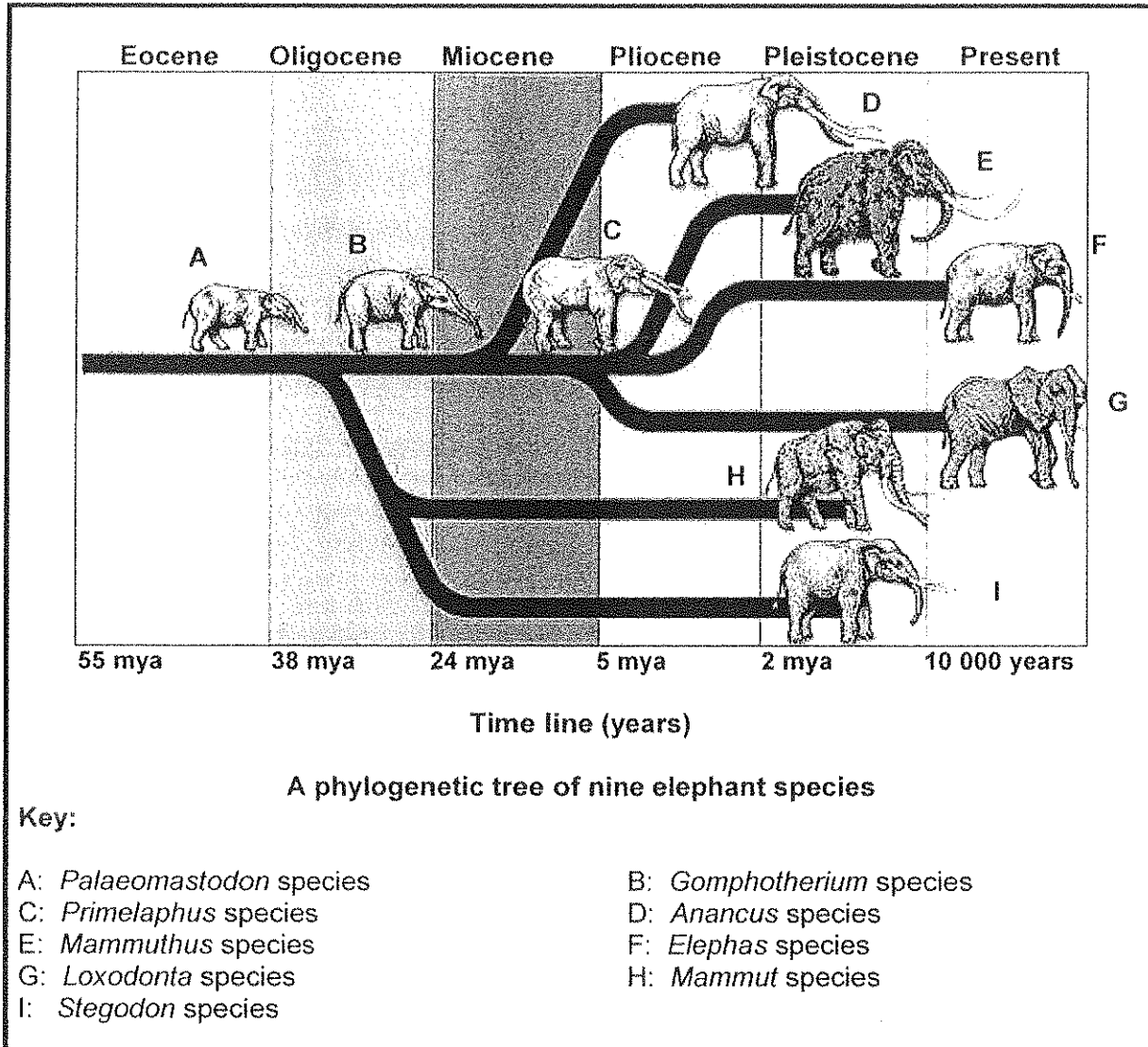
It was noted that the brain of *A. sediba* is small, like that of a chimpanzee, but with a re-organisation more human-like, particularly with an expansion behind and above the eyes.

[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.



- 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 *Anancus* species first appear (1)
 - (b) The *Stegodon* 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

