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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 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** ink.
7. Draw diagrams, tables or flow charts only when requested to do so.
8. The diagrams in the question paper are **NOT** necessarily drawn to scale.
9. A non-programmable calculator, protractor and compass may be used, where necessary.
10. Write neatly and legibly, in **BLUE** ink only.



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 numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

1.1.1 The 'Law' of Use and Disuse was used by ... to explain evolution.

- A Darwin
- B Lamarck
- C Eldredge
- D Gould

1.1.2 If an organism contains four maternal and four paternal chromosomes, what are the chances of a sperm cell receiving all four paternal chromosomes?

- A 1 out of 16
- B 1 out of 4
- C 1 out of 8
- D 1 out of 2

1.1.3 A blue-eyed female and a brown-eyed male have two daughters with blue eyes. The genotypes of the parents must be:

- A Bb x Bb
- B bb x bb
- C bb x Bb
- D BB x bb

1.1.4 Two organisms that are heterozygous for two traits are crossed. Determine the chance of producing an offspring that exhibits only the recessive alleles.

- A $\frac{1}{16}$
- B $\frac{4}{16}$
- C $\frac{8}{16}$
- D $\frac{16}{16}$



1.1.5 The product of meiosis is:

- A Four daughter cells that are identical to the parent cell.
- B Two daughter cells, each with a diploid chromosome number.
- C Two daughter cells, each with a haploid chromosome number.
- D Four daughter cells, each with a haploid chromosome number.

1.1.6 Closely related monkey flowers differ greatly in their colours and shapes. They cannot cross-pollinate due to ...

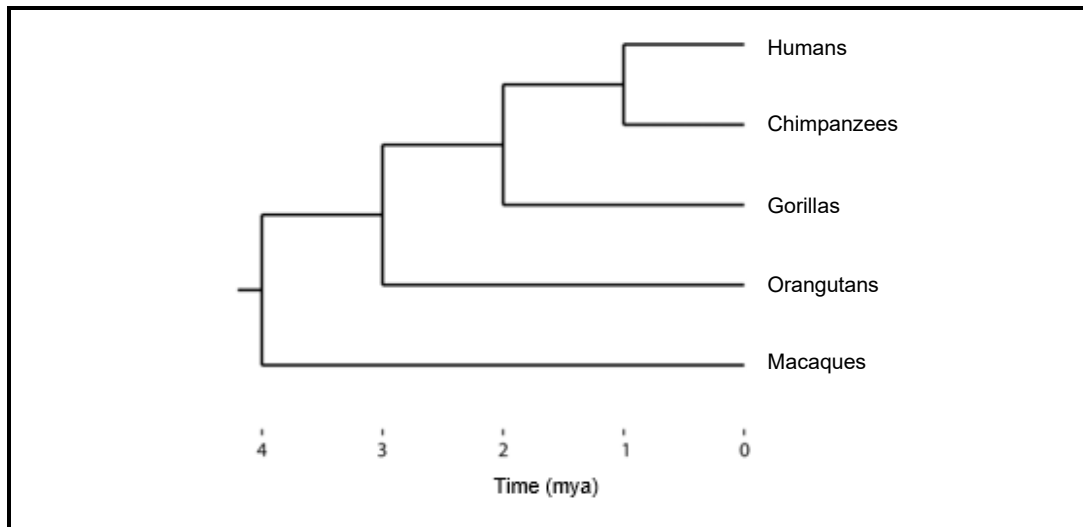
- A geographical isolation.
- B temporal isolation.
- C reproductive isolation.
- D habitat isolation.

1.1.7 The nucleus of a human muscle fibre contains x units of DNA. How many units of DNA will be in the nucleus of the following?

	Kidney	Lung	Ovum
A	$0.5x$	$0.5x$	$0.5x$
B	x	x	$0.5x$
C	$0.5x$	x	x
D	x	$0.5x$	x



1.1.8 Consider the phylogenetic tree below:



- i) Macaques are the common ancestor of orangutans.
- ii) Humans and chimpanzees are the most closely related.
- iii) Gorillas are an older species than chimpanzees.
- iv) Humans and orangutans share a common ancestor.

Which one of the following combinations of statements is TRUE?

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

1.1.9 The offspring of a brown mouse that is crossed with a white mouse are all brown. What conclusion can be drawn?

- A Mouse colour illustrates incomplete dominance.
- B The gene for brown is dominant over the gene for white.
- C The gene for white is dominant over the gene for brown.
- D The brown parent must be heterozygous.

1.1.10 The oldest fossil found in South Africa is that of ...

- A *Australopithecus sediba*.
- B *Homo naledi*.
- C *Australopithecus africanus*.
- D *Homo erectus*.

(10x2) (20)



1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question numbers (1.2.1 to 1.2.9) in the ANSWER BOOK.

- 1.2.1 Mendel's Law that describes that an organism possesses two factors for each characteristic that separate during meiosis so that each gamete contains only one of these factors.
- 1.2.2 Theory explaining the speed at which evolution takes place.
- 1.2.3 Phase in meiosis during which crossing over takes place.
- 1.2.4 Position of a gene on a chromosome.
- 1.2.5 A scientific factor that can be ensured by using random samples in the investigation.
- 1.2.6 The manipulation of biological processes to satisfy human needs.
- 1.2.7 Type of sugar in ribonucleic acid.
- 1.2.8 A change in the process of meiosis in which chromosomes or chromatids fail to separate.
- 1.2.9 Type of dominance where one allele is dominant to the effect that the recessive allele is masked by the dominant allele in the heterozygous condition.

(9x1) (9)

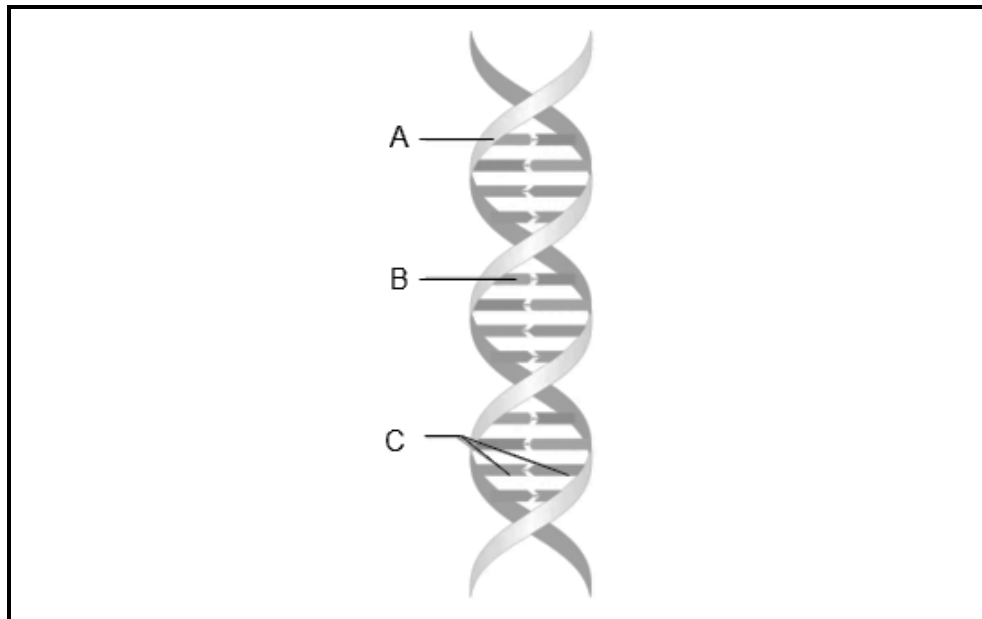
1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B**, or **NONE** of the items in COLUMN II. Write only **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** next to the question numbers (1.3.1 to 1.3.4) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Phases of meiosis	A. Prophase B. Cytokinesis
1.3.2 Possible genotype of a person with blood group A	A. $I^A i$ B. $I^A I^A$
1.3.3 Increases variation within a species	A. Random mating B. Mutations
1.3.4 Used in an experiment as the baseline reference	A. Controlled variable B. Control

(4x2) (8)



- 1.4 The diagram below illustrates a microscopic molecule present in the nucleus of all cells.



- 1.4.1 Identify the molecule illustrated above. (1)
- 1.4.2 Provide a reason for your answer. (1)
- 1.4.3 Provide a label for structure **B**. (1)
- 1.4.4 Structure **A** consists of two components. Name the components. (2)
- 1.4.5 What importance regarding the structure of the molecule illustrated is highlighted by **C**? (2)
- 1.4.6 Provide ONE function of this molecule in the human body. (1)
- (8)**



- 1.5 The table below shows selected information regarding hominin fossils found in South Africa.

Organism	Common name of the fossil	Fossil Site	Discovering Scientist
K	Mrs. Ples	Sterkfontein Caves	Robert Broom
<i>Australopithecus sediba</i>	L	Malapa Cave, Cradle of Humankind	M
<i>Homo naledi</i>	Star	Rising Star Cave, Cradle of Humankind	N

1.5.1 Identify the scientist responsible for the discovery at:

- a) **M** (1)
- b) **N** (1)

1.5.2 Provide the name of species to which Mrs. Ples belongs at **K**. (1)

1.5.3 Provide the common name for the fossil found in the Malapa Cave at **L**. (1)

1.5.4 Give ONE reason why the discovery of fossils is important. (1)

(5)

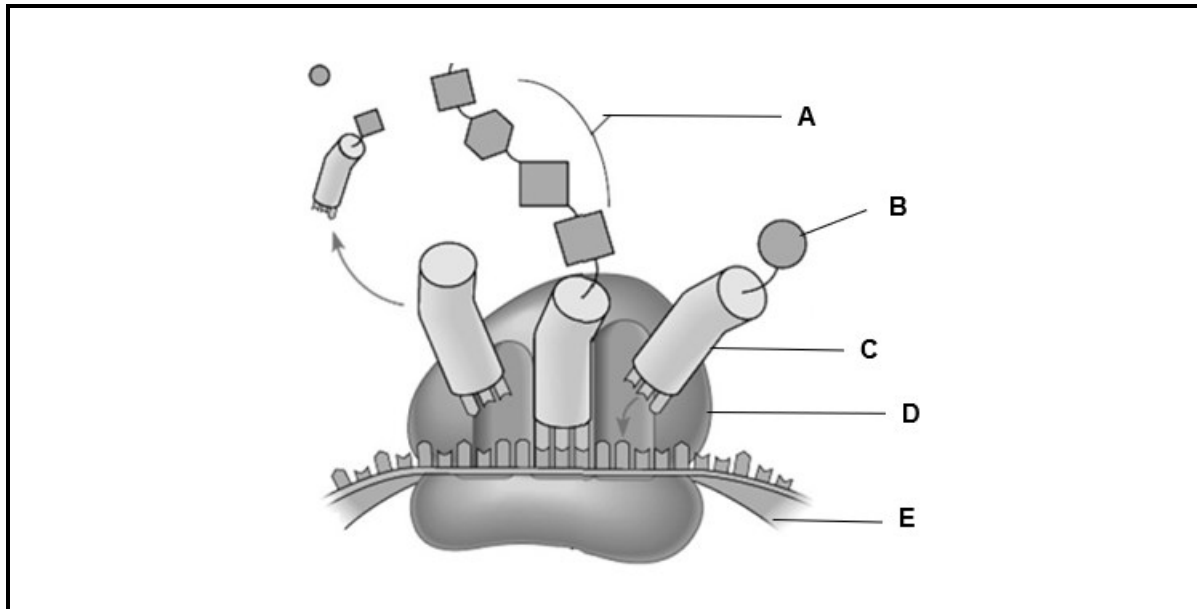
TOTAL SECTION A: [50]



SECTION B

QUESTION 2

2.1 The diagram below illustrates a phase of an important process for growth taking place in the human body.



2.1.1 Provide labels for the following:

- a) Part **A** (1)
- b) Organelle **D** (1)

2.1.2 Distinguish between the **location** and **function** of structures **C** and **E**. (4)

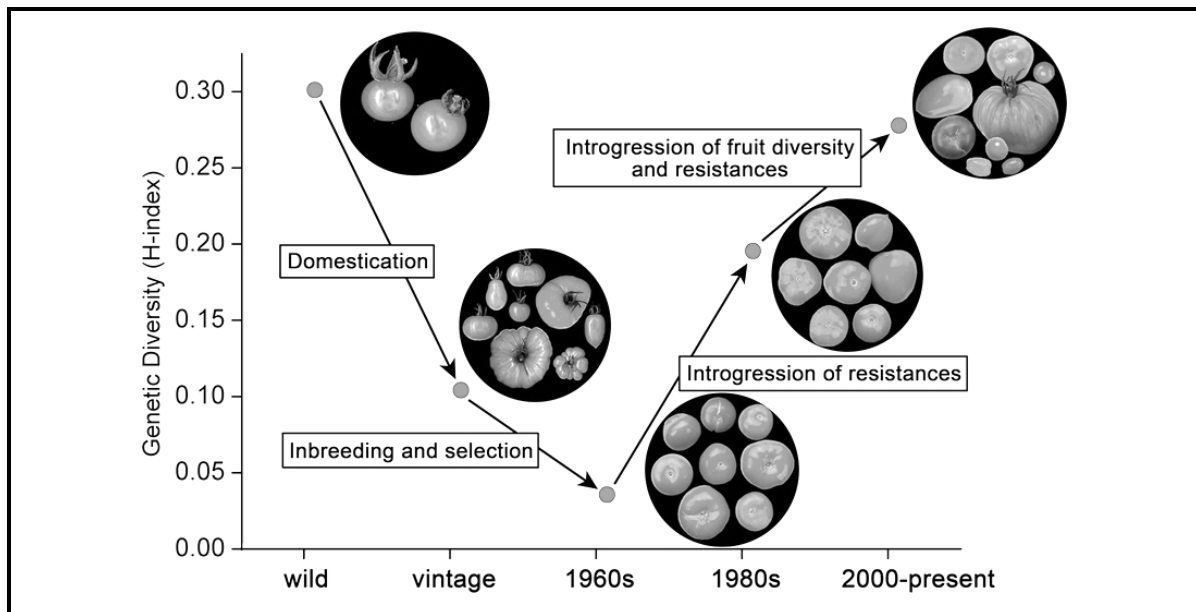
2.1.3 Structure **E** breaks away prematurely from structure **D**. Briefly discuss the consequence thereof. (3)

2.1.4 Identify and briefly describe the steps of the phase prior to the phase illustrated in the diagram above. (5)

(14)



2.2 The graph below illustrates the evolution of genetic diversity in tomatoes. Tomatoes have been altered quite a lot to become the tomatoes we know and use today.



- 2.2.1 Tomatoes are genetically modified organisms. Define the term *genetically modified organism*. (2)
- 2.2.2 Give TWO reasons why tomatoes have been altered from the wild index to the present-day tomato. (2)
- 2.2.3 Briefly discuss how inbreeding and selection led to a decrease in genetic diversity. (2)
- (6)**



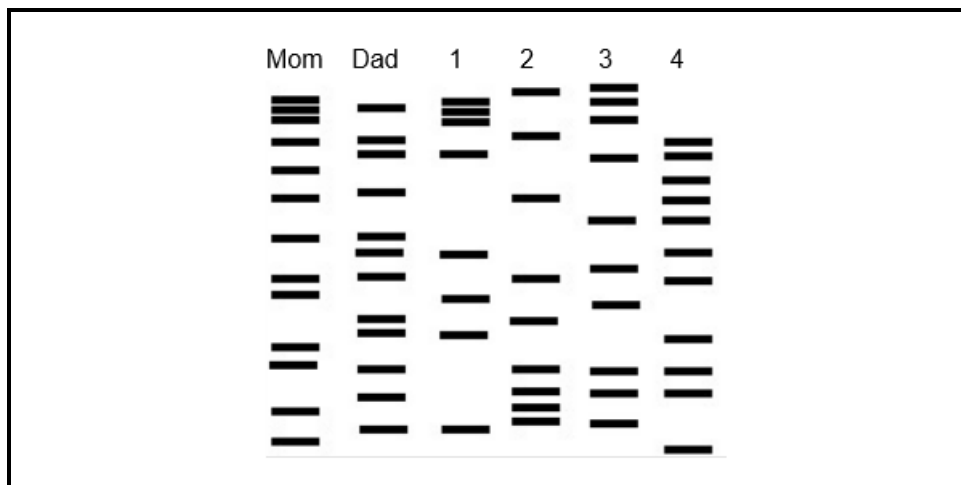
2.3 Read the extract below to answer the questions that follow:

X-linked recessive hypohidrotic ectodermal dysplasia (XHED) is a congenital disorder found in Holstein cows, characterised by abnormal development of tissues originating from the ectoderm such as teeth, sweat glands and hair. Although it is not life-threatening, it should be taken into consideration when crossbreeding this breed as it can cause physical or functional anomalies such as hairlessness, excessive sweating and reduced teeth.

- 2.3.1 Explain what is meant by the term *X-linked recessive*. (2)
- 2.3.2 Use the information in the extract and your knowledge to explain ONE reason why a farmer would not want this disorder to be present in his cattle. (2)
- 2.3.3 Use the letters **H** and **h** in a genetic cross to determine the sex and percentage of affected offspring of a female carrier and a normal bull. (7)
- 2.3.4 Suggest TWO ways in which farmers can prevent the disorder in their livestock. (2)

(13)

2.4 Four siblings found out that only one of them is the biological child of their parents. See the DNA profiles of the family below.

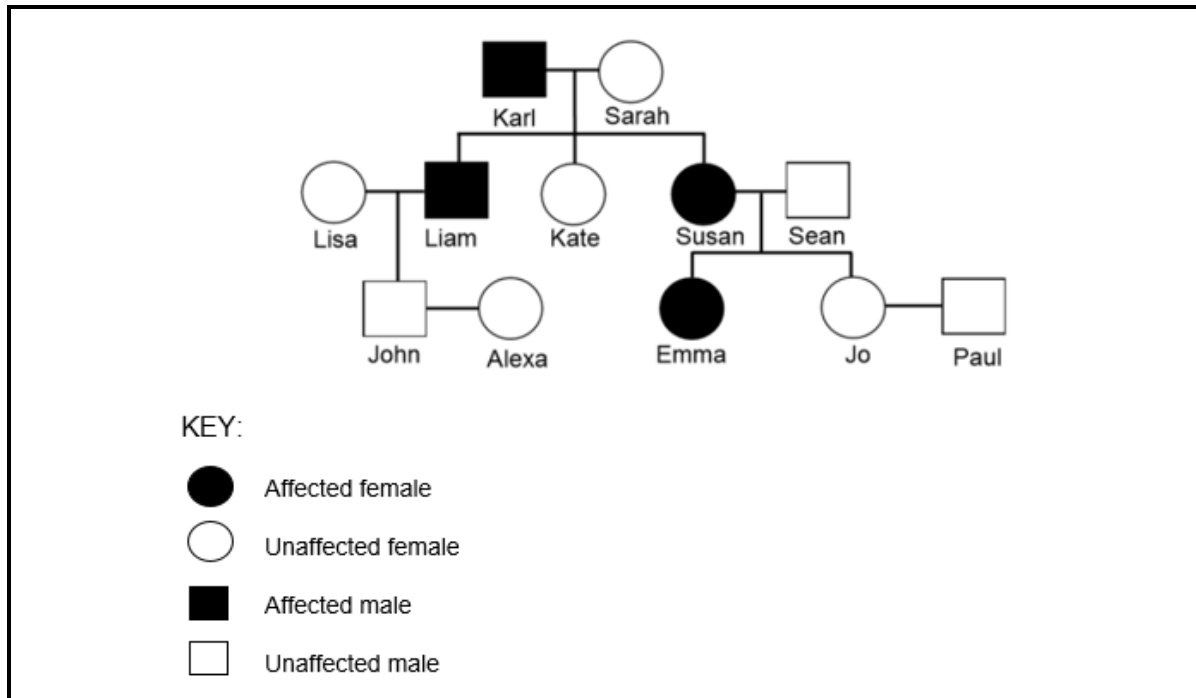


- 2.4.1 Determine which child is the biological child of the parents. (1)
- 2.4.2 Define the term *DNA profile*. (2)
- 2.4.3 Suggest TWO reasons why people would be against DNA profiling. (2)

(5)



- 2.5 The diagram below is a pedigree diagram of the Smith family who suffers from Steatocystoma multiplex – a disorder characterised by numerous subcutaneous (under the skin) cysts. It is caused by the allele (**G**).



- 2.5.1 How many generations are visible on the diagram above? (1)
- 2.5.2 Determine if the disorder is:
- a) Dominant or recessive (1)
 - b) Autosomal or gonosomal (1)
- 2.5.3 Determine:
- a) Jo's phenotype (1)
 - b) Emma's genotype (1)
- 2.5.4 Determine the percentage affected males in the second generation.
Show ALL calculations. (3)
- 2.5.5 Determine the genotype of the father if Kate has a 50% chance of conceiving a child with the disorder. (1)
- 2.5.6 Explain your answer in QUESTION 2.5.5. (3)

(12)**TOTAL QUESTION 2: [50]**



QUESTION 3

3.1 Read the extract below to answer the questions that follow.

Formation of the Grand Canyon and consequences thereof.

Around 6 million years ago, waters rushing off the Rockies formed the mighty Colorado River. As the plateau rose, the river cut into it, carving the canyon over time. Smaller rivers eventually cut the side canyons, mesas (flat-topped elevations/ridges), and buttes (isolated flat-topped hills with steep sides) that are so characteristic of the canyon today.

The Grand Canyon covers 4 926 km² and its width is up to 26 km at its widest point. These remarkable distances and the sheer depth of the canyon hindered some species from being able to cross it. An example of a species affected was the Abert's Squirrel.

Approximately 10 000 years ago the Kaibab Squirrel (*Sciurus kaibabensis*) was separated from a common ancestor of the Abert's squirrel due to the depth of the Grand Canyon. This separation caused the Kaibab squirrel to begin to evolve on its own. While the two are still closely related, the Kaibab squirrel developed noticeable differences, such as a dark belly and forelimbs. Their tails are white and the backs of their heads are a chestnut brown.



Abert's Squirrel



Kaibab Squirrel

3.1.1 Use your knowledge of speciation to explain why and how the Abert's squirrel and Kaibab squirrel developed into different species around the Grand Canyon. (7)

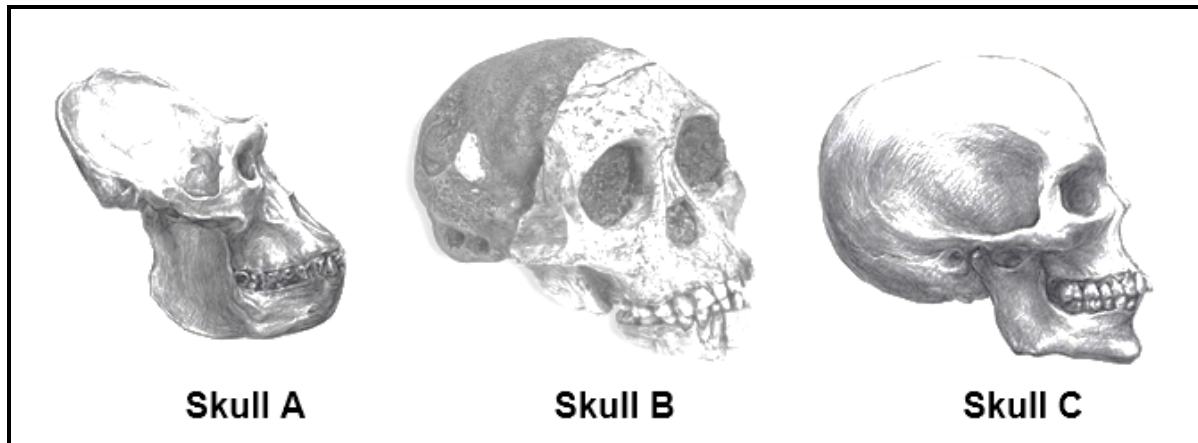
3.1.2 In 1972 scientists feared that a plague could wipe out the entire species because the squirrel populations were localised on the Kaibab Plateau. For five years they released additional squirrels to mix the gene pool and make a self-sustaining population.

- a) Identify the type of breeding referred to in the text. (1)
- b) Briefly discuss how adding squirrels could ensure a self-sustaining population. (3)

(11)



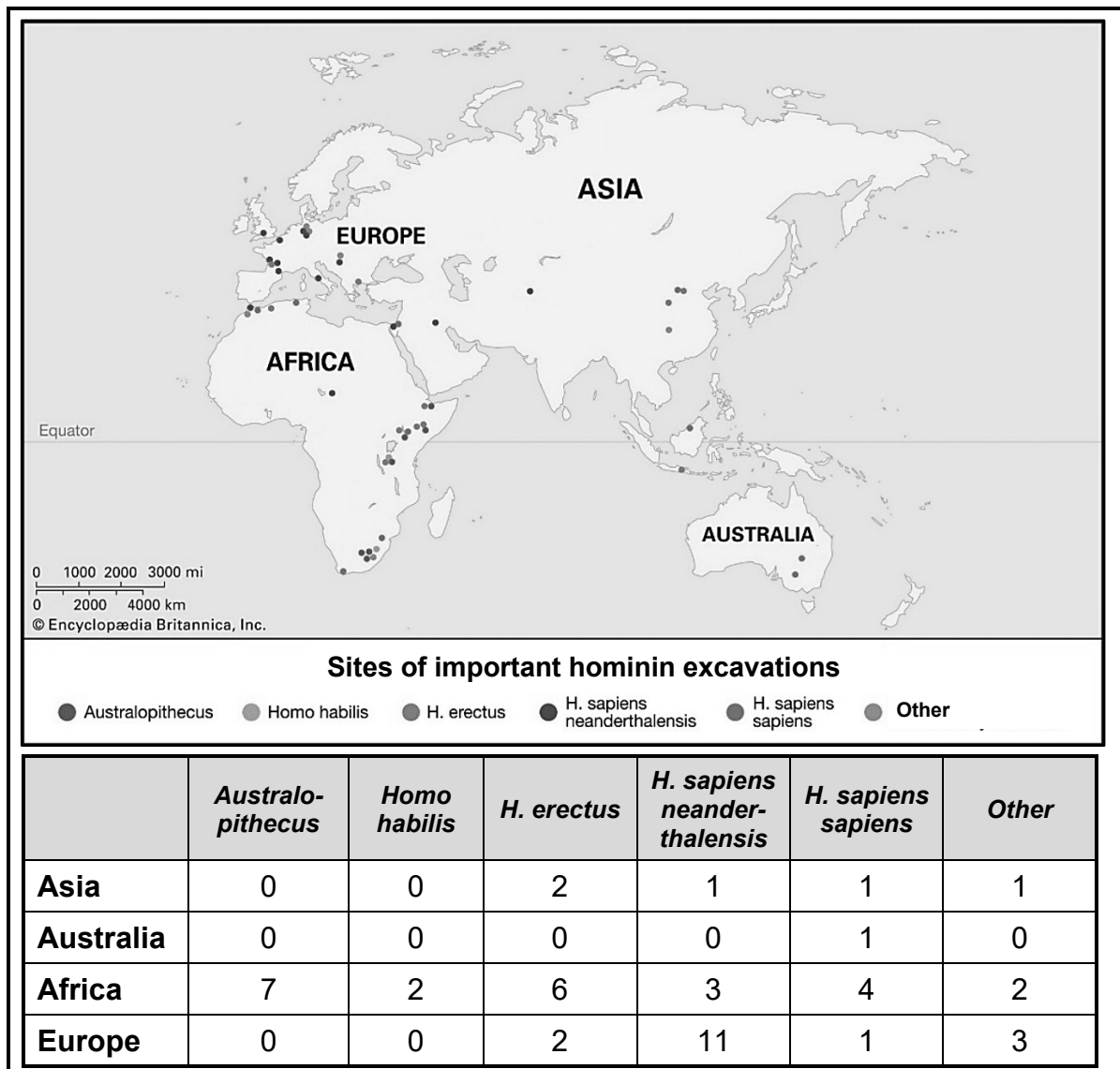
- 3.2 The diagram below represents the skulls of the modern human, gorilla and Taung child.



- 3.2.1 Write down which species each skull mentioned above belongs to. (3)
- 3.2.2 Tabulate TWO visible differences between skulls **A** and **C**. (5)
- 3.2.3 Give THREE characteristics concerning the upper limbs that humans share with other primates. (3)
- 3.2.4 Explain how the cranial volume between skull **A** and **B** relates to the intelligence of these species. (4)
- (15)



- 3.3 The diagram and table below indicate the sites of important hominin excavations on four continents.

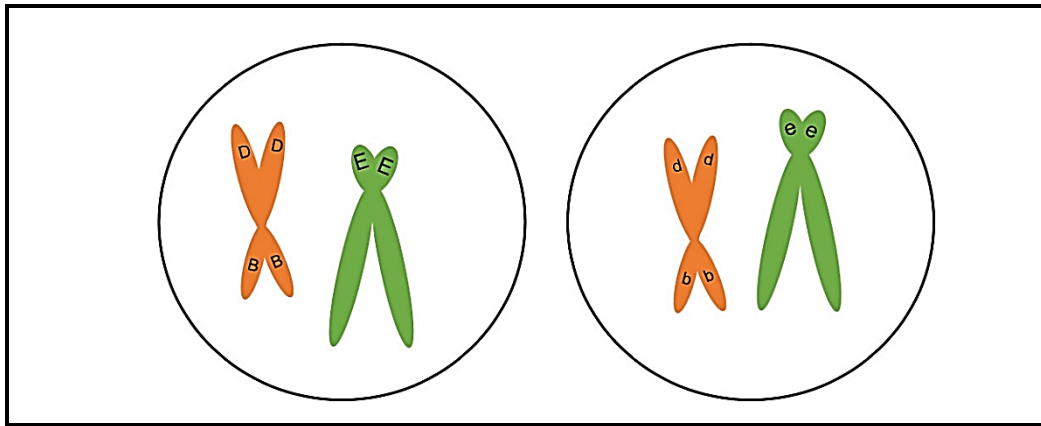


- 3.3.1 Indicate the number of fossil sites of *Homo erectus* for the four continents on a HISTOGRAM. (6)
- 3.3.2 Draw a conclusion based on the number of fossil sites on the different continents. (2)
- 3.3.3 Discuss the connection of the number of fossil sites on the different continents in context of the Out-of-Africa hypothesis. (3)

(11)



3.4 The diagram below shows a phase in the process of meiosis.



- 3.4.1 Define *meiosis*. (2)
- 3.4.2 Identify the phase of meiosis shown above. (1)
- 3.4.3 Provide ONE visible reason for your answer in QUESTION 3.4.2. (1)
- 3.4.4 Explain what is represented by the letters on the different chromosomes. (2)
- 3.4.5 Tabulate TWO differences between mitosis and meiosis. (2)
- 3.4.6 Draw a labelled diagram of the cell in the phase before the phase illustrated above. (5)
- (13)**

TOTAL QUESTION 3: [50]

TOTAL SECTION B: [100]

GRAND TOTAL: [150]