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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

LIFE SCIENCES: PAPER I

EXAMINATION NUMBER

Time: 3 hours 200 marks

ANSWER BOOKLET

There are (xvi) pages in this Answer Booklet. Please write your examination number in the blocks above.

QUESTION 1

1.1 Select the term in Column B that best matches a description in Column A. Write the letter of the term in the corresponding space provided between the brackets. Each letter may only be used once.

	COLUMN A		COLUMN B
[ ]	DNA that has been combined from different biological species	A	Mitochondrial DNA
[ ]	Circular DNA used as a vector in genetic engineering	B	Gonosomes
[ ]	Position of a gene on a chromosome	C	Ligase
[ ]	A phenotypic characteristic that is determined by more than two genes	D	Cloning
[ ]	Chromosomes that determine sex	E	Locus
[ ]	DNA that is only passed from mother to offspring through the ovum	F	Restriction
[ ]	Enzyme used to join small fragments of DNA	G	Autosomes
[ ]	Twenty two pairs of chromosomes in humans that are not sex chromosomes	H	Plasmid
[ ]	An organism that has had its DNA altered or modified through genetic engineering	I	Polygenic
[ ]	Technology used to create genetically identical copies of cells	J	Recombinant DNA
		K	GMO – genetically modified organism

(10)

1.2 Ten multiple-choice questions are given below. Choose the most correct option for each question and write the letter of your choice in the space provided in the table below.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7	1.2.8	1.2.9	1.2.10
Answer										

1.2.1 The theory of the inheritance of acquired characteristics was developed by:

A Alfred Wallace
B Jean-Baptiste Lamarck
C Erasmus Darwin
D Charles Darwin (1)

1.2.2 Bacteria that cause the disease "tuberculosis" have become increasingly resistant to the antibiotics used to treat the disease because:

A the rate of evolution in bacterial populations is fast.
B the rate of evolution in human populations is fast.
C the bacteria that cause tuberculosis are genetically very similar to humans.
D tuberculosis is a new disease affecting humans. (1)

1.2.3 In evolutionary terms, the San are described as an extant population because:

A they have become extinct.
B they are hunter-gatherers.
C they are one of the oldest living human populations.
D they live in Southern Africa. (1)

1.2.4 Which one of the following statements best describes the Out of Africa hypothesis?

A *Homo erectus* migrated out of Africa and evolved into *Homo sapiens* in different regions.
B Modern humans evolved in Africa from early humans and then migrated to other regions.
C Modern humans evolved in Europe from early humans and then dispersed to other regions including Africa.
D *Homo sapiens* bred with *Homo neaderthalensis* in Europe.

(1)

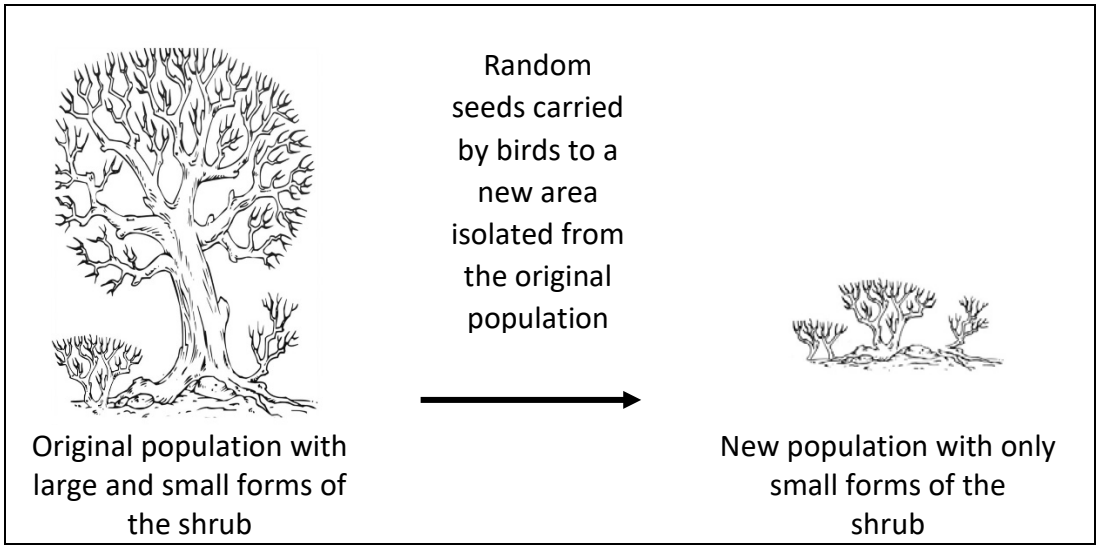
1.2.5 Which one of the following hominids was an early tool maker known as "handy man"?

A *Homo habilis*
B *Homo erectus*
C *Australopithecus africanus*
D *Homo naledi* (1)

1.2.6 The development of early human societies may be attributed to which of the following?

A The use of stone tools
B Controlling and using fire
C The development of language
D All of the above (1)

1.2.7 Study the diagram below showing an evolutionary mechanism in a species of shrub.

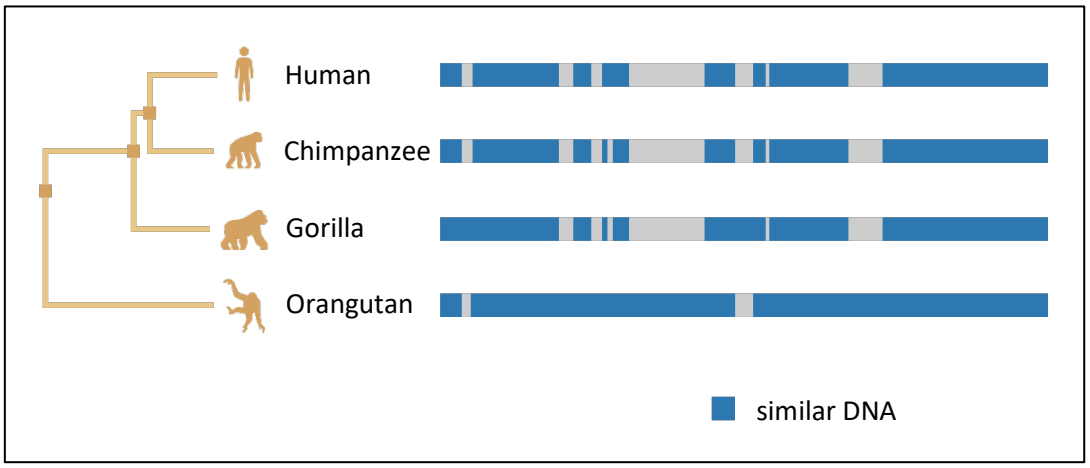


[Adapted: <https://science.sciencemag.org>]

Which of the following is the most likely explanation for the new population having only small forms of the shrub?

A Convergent evolution
B A high rate of mutation
C The founder effect
D Artificial selection (1)

1.2.8 The diagram below shows a comparison of the DNA of four primates and their evolutionary relatedness.



[Adapted: <https://www.yourgenome.org>]

Which of the following statements describes the most correct evolutionary relationship?

A Chimpanzees have a closer evolutionary relationship to gorillas than to humans.
B The similarity in the DNA of the human and chimpanzee indicates their evolutionary relatedness.
C Humans are not closely related to the other primates.
D The DNA of the orangutan is most similar to that of human DNA.

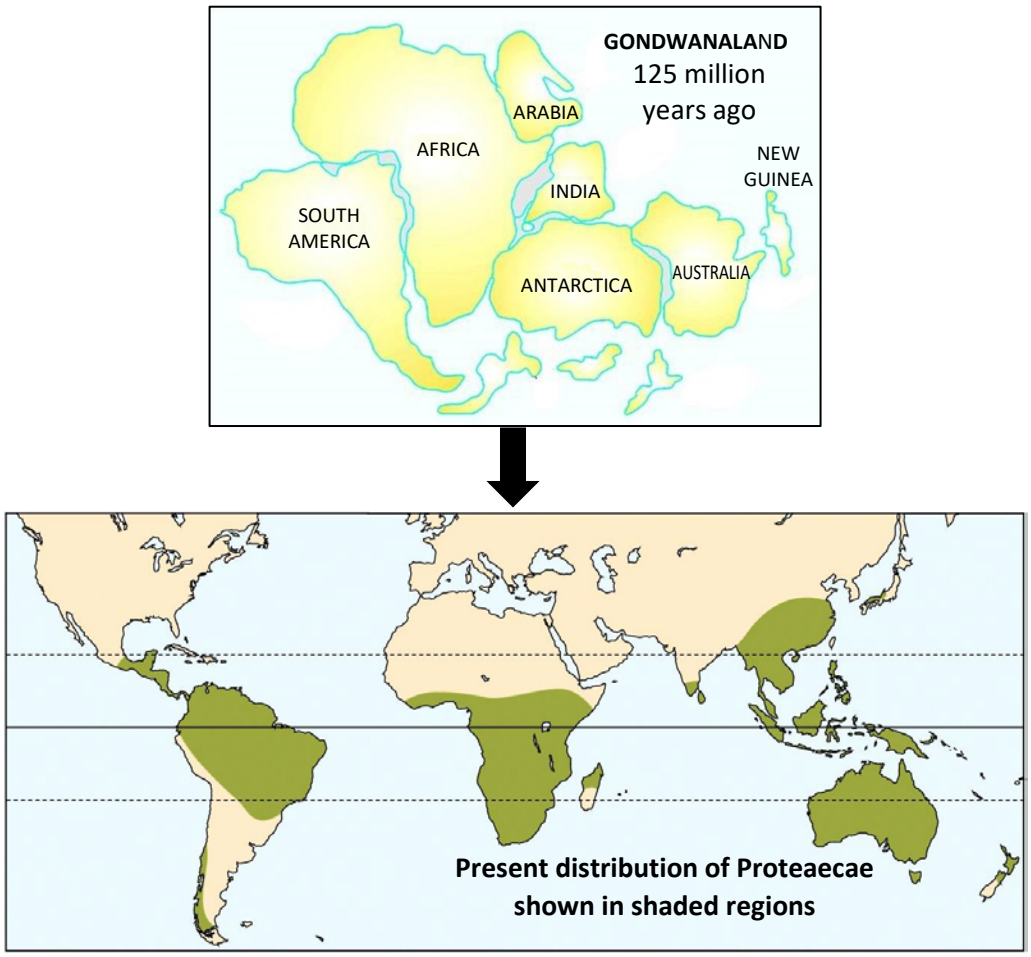
(2)

1.2.9 Which of the following combination of characteristics, (i) to (iv) are true of a small population lacking genetic diversity?

(i) High risk of extinction
(ii) Low levels of homozygosity
(iii) Loss of hybrid vigour
(iv) Increased risk of inbreeding

A (i), (ii), (iii), (iv)
B (i), (ii)
C (i), (iii), (iv)
D (ii), (iii) (2)

1.2.10 The diagram below depicts the biogeographical distribution of Proteaecae.



[Adapted: <http://www.proteaflora.com> ; <http://www.prism.gatech.edu>]

Example of the Proteaecae group

[Source: <http://pza.sanbi.org/>]

Which of the following is the best explanation for the present distribution of Proteaecae shown in the map?

A Proteaecae evolved separately on different continents.
B The seeds of the Proteaecae group were distributed by ocean currents.
C The Proteaecae originated in Australia which now has the greatest diversity of Proteaecae plants.
D The Proteaecae group were spread by the separation of the continental landmasses.

(2)

1.3 Study the following table which consists of two items (numbered 1 and 2) in the first column and a term in the second column. **Decide which item(s) relate to the term.**

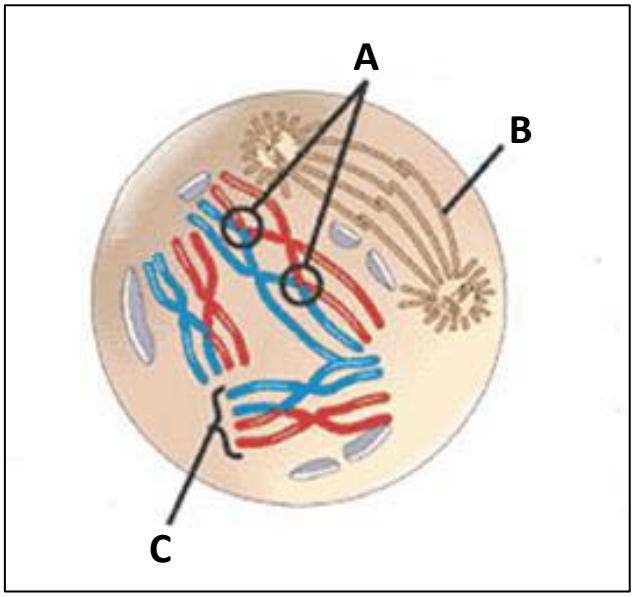
Write down your choice in the space provided in the "answer" column, making use of the following codes:

A only item 1 relates to the term
B only item 2 relates to the term
C both item 1 and 2 relate to the term
D neither item 1 or 2 relates to the term

Item	Term	Answer
1. Ovary 2. Anther	Meiosis	
1. Connects two chromatids 2. Found only in animal cells	Centromere	
1. DNA replication 2. Cytokinesis occurs	Interphase	
1. Extra X chromosome 2. Polyploid individual	Down syndrome	
1. DNA profile 2. Indicates chromosome mutations	Karyotype	

(5)

1.4 The diagram below shows a phase of meiosis.



[Adapted: <http://biologismktham.blogspot.com>]

1.4.1 Provide labels for A–C.

A _____

B _____

C _____

(3)

1.4.2 Which phase of meiosis is depicted in the diagram?

_____

(1)

1.4.3 What important process is depicted in the diagram at A?

_____

(1)

1.4.4 What is the biological importance of the process referred to in Question 1.4.3?

_____

_____

(1)

1.4.5 In the space below, draw a diagram of a cell representing the next phase of meiosis occurring after the phase indicated in the diagram on page (vi). Chromosomes must be clearly visible. Indicate the name of the phase in the heading. No labels are required.

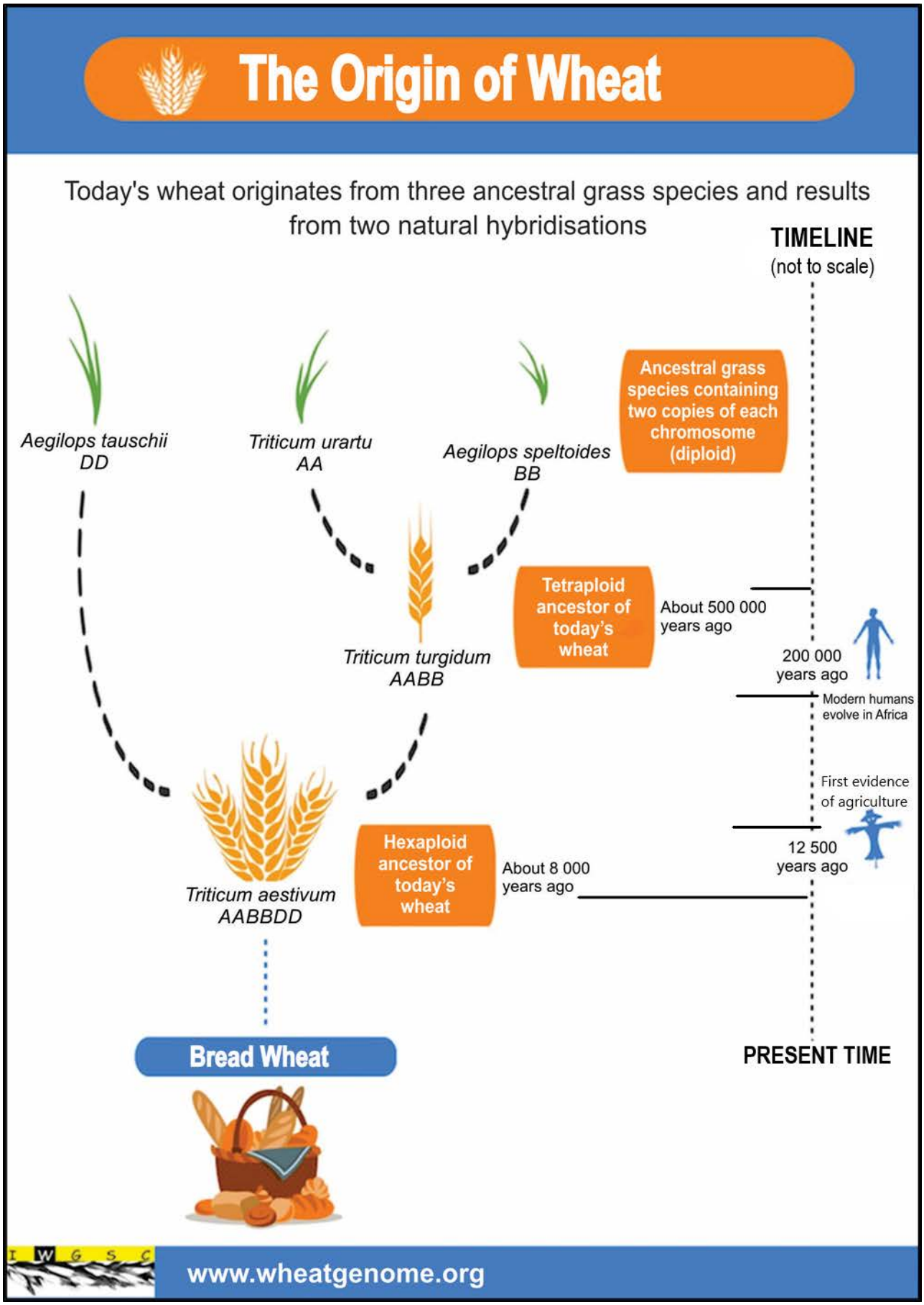
(4)

1.4.6 How many chromosomes would be present in each of the gametes at the end of the whole process of meiosis?

_____

(1)

1.5 The following infographic relates to the origin of wheat. Use the information below to answer the questions on the following page.



The five statements in the table below refer to the infographic on the previous page. For each statement decide whether:

A the statement is supported by the information in the infographic.
B the statement is contradicted by the information in the infographic.
C the statement is neither supported nor contradicted by the information in the infographic.

	Statement	**A, B or C**
1.5.1	*Triticum turgidum* is a hybrid of two grass species.	
1.5.2	The hexaploid ancestor of bread wheat originated before humans were involved in agriculture.	
1.5.3	The modern bread wheat genome is composed of 42 chromosomes.	
1.5.4	A hexaploid has double the chromosome number of a diploid.	
1.5.5	The ancestral grass species, *Aegilops tauschii* has two copies of each chromosome, i.e. diploid.	

(5)

1.6 Read the article below. Use the information in the text and your own knowledge to answer the questions that follow:

Using DNA from elephant dung to prevent poaching

Poaching of elephants is now occurring at rates that threaten African elephant populations with extinction. Scientists have collected 2 000 dung (faeces/droppings) samples from 81 different elephant populations across Africa. Fresh elephant dung contains body cells from the elephant. The DNA from the cells is extracted and amplified (many copies of DNA was made).

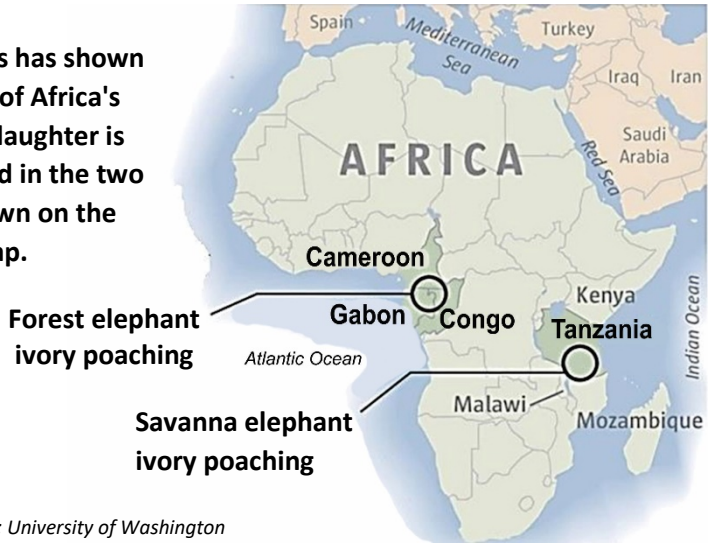
A DNA database has been generated using all the DNA samples collected from the dung. Using a sample of elephant dung, scientists can identify where it had been collected. Every elephant population carries different mutations primarily found in the non-coding DNA. The clear genetic differences between elephants from different regions, allows scientists to identify an individual elephant's home territory.

When poached ivory is found by law enforcement, a DNA profile can be obtained and used to compare to the elephant DNA database.

Using this method, scientists have identified two poaching hot spots in Africa.

Two hot spots account for most of Africa's elephant poaching

DNA analysis has shown that most of Africa's elephant slaughter is concentrated in the two areas shown on the map.



Source: University of Washington

[Source: <https://www.seattletimes.com>]

[Adapted: <https://www.iflscience.com> ; <https://www.smithsonianmag.com>]

1.6.1 From which organelle in the cell is DNA extracted?

_____

(1)

1.6.2 Suggest why using elephant dung is an easy and convenient method to collect DNA from elephants.

(1)

1.6.3 What process is used to amplify the DNA?

(1)

1.6.4 Why would elephants from the same region show similarities in DNA?

(1)

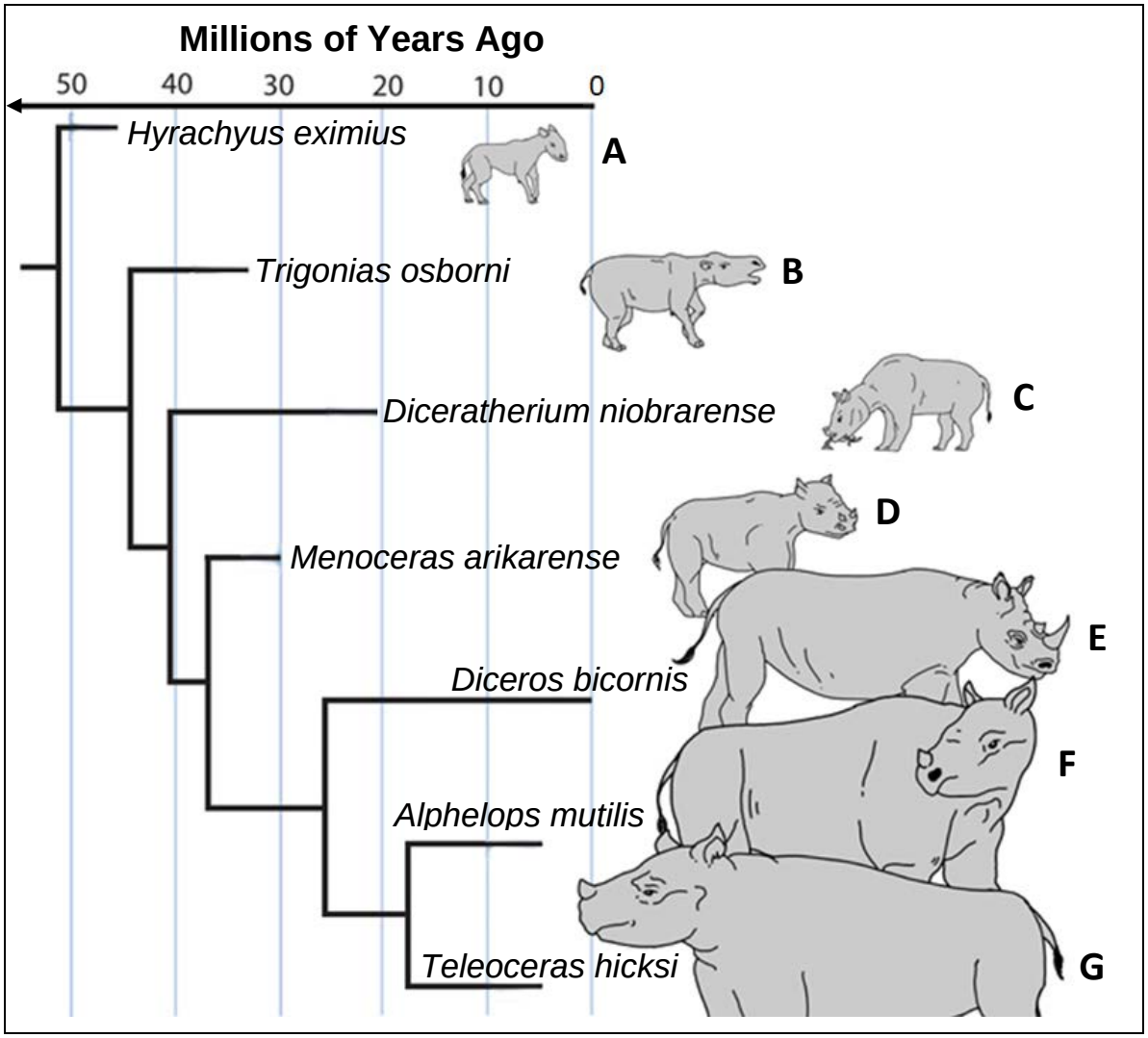
1.6.5 Explain your understanding of the term *non-coding DNA*.

(2)

1.6.6 Discuss TWO reasons why a DNA database of elephant populations in Africa would be useful.

(4)

1.7 Study the phylogenetic tree of the rhinoceros group shown below.



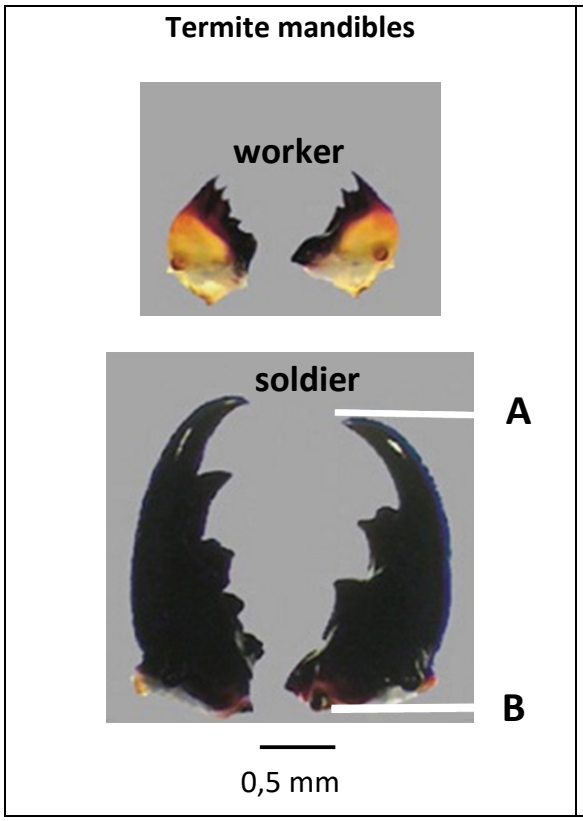
[Adapted: <https://journals.plos.org>]

State whether the following statements regarding the phylogenetic tree depicted above are TRUE or FALSE.

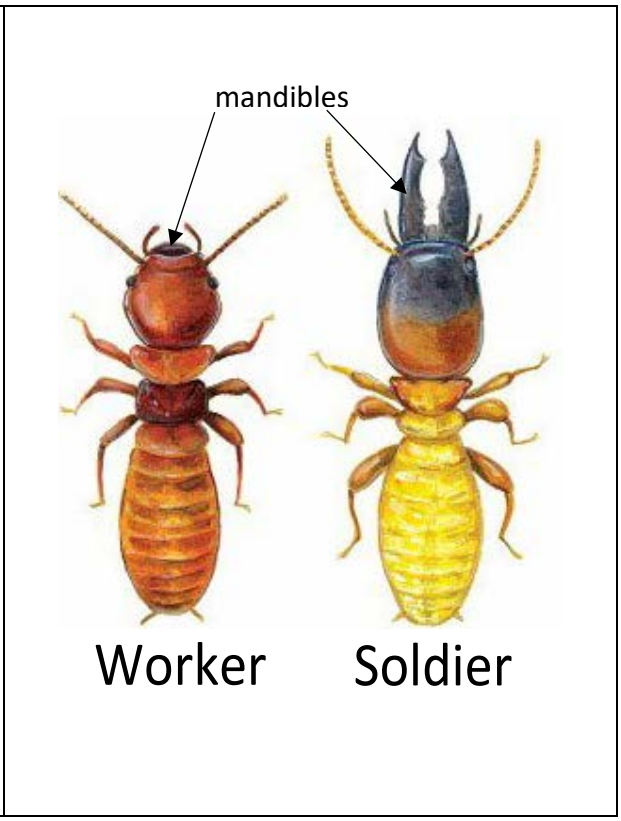
	Statement	**True or False**
1.7.1	Divergent evolution is shown in the diagram.	
1.7.2	All species have a horn.	
1.7.3	B became extinct before A.	
1.7.4	E is not extinct.	
1.7.5	F and G share a more recent common ancestor than E and F.	
1.7.6	D was present and living on earth for more than 10 million years.	

(6)

1.8 The images below compare the sizes of the mandibles (jaws) of two castes of termites.



[Adapted: <https://www.u-tokyo.ac.jp>]



[Adapted: <https://amcoranger.com>]

1.8.1 Use the scale line to calculate the actual length of the soldier mandible from A to B. Show all working.

(4)

1.8.2 Suggest why the mandibles of the soldier and the worker are different sizes.

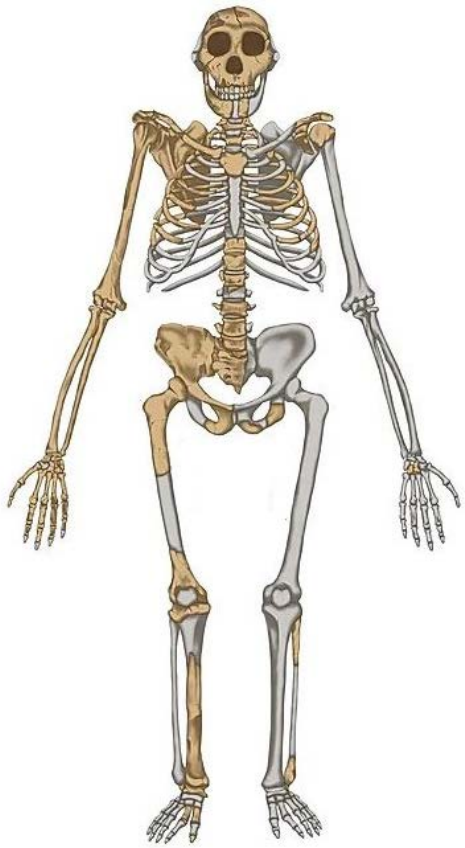
(2)

1.8.3 Name ONE other caste of termite (not depicted in the diagram) and state the role it plays in the colony.

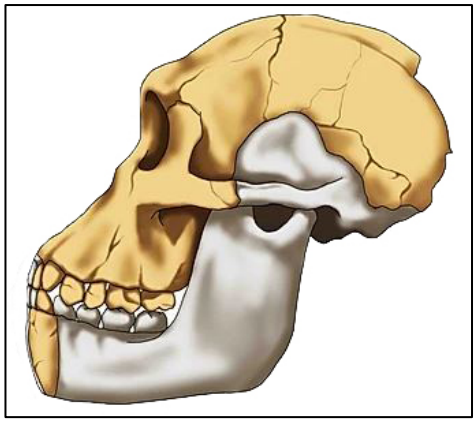
(2)

1.9 Study the skeleton and side view of the skull of *Australopithecus sediba.*

Skeleton of *Australopithecus sediba*



Side view of skull



[Adapted: <https://www.misakiouchida.com>]

1.9.1 List FOUR ape-like features of *Australopithecus sediba* depicted in the diagrams.

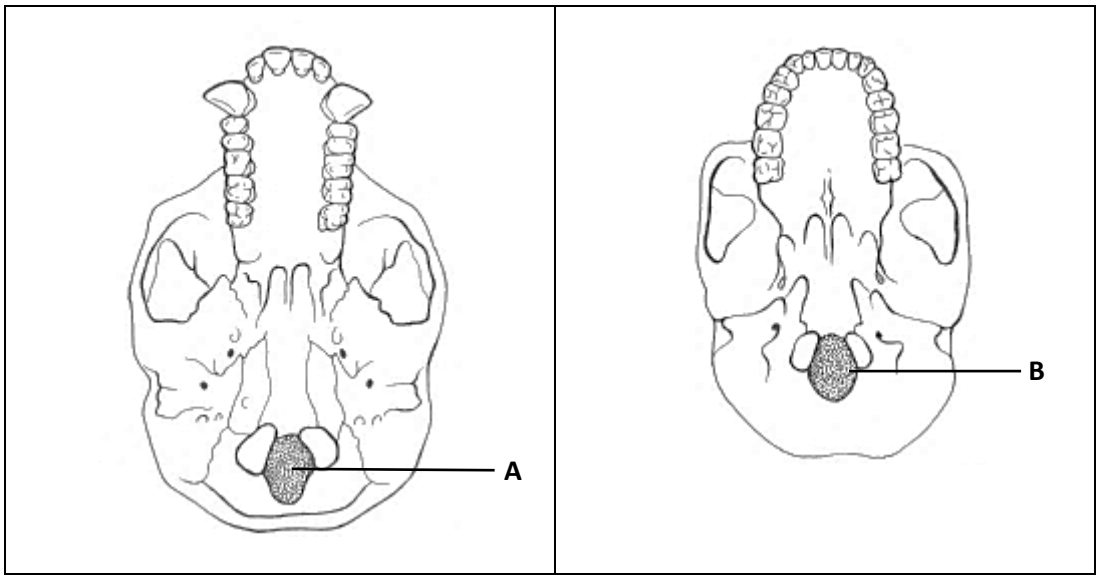
(4)

1.9.2 Where in South Africa have the fossils of this hominid been found?

_____

(1)

1.9.3 Study the images below showing the position of the foramen magnum in two primate skulls.



[Adapted: <http://www.talkorigins.org>]

(a) From the images shown above, select one (A or B) that best depicts the position of the foramen magnum in the skull of *Australopithecus sediba*.

_____

(1)

(b) What does the position of the foramen magnum suggest about the locomotion of *Australopithecus sediba*?

_____

_____

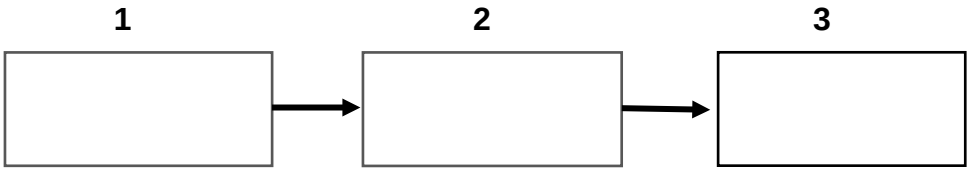
_____

(1)

1.10 Read the information given below on plants that grow in the grassland biome.

Plant A	• Live for a few years • Fast growing • Grows in low and high nutrient soils • Roots not widespread
Plant B	• Live for many years • Slow growing • Grows in high nutrient soils • Has deep and widespread roots
Plant C	• Germinates quickly • Fast growing • Grows in low nutrient soils • Also grows in disturbed areas

1.10.1 Decide where each plant fits in the process of ecological succession. Write the letter of the plant in the correct stage of succession in the textboxes below.



(3)

1.10.2 Provide the correct term for the name of stages in Question 1.10.1 indicated by:

(a) 1 _____

(1)

(b) 3 _____

(1)

[80]