education

Department of Education
FREE STATE PROVINCE

# PREPARATORY EXAMINATION

## GRADE 12

# LIFE SCIENCES P2

## SEPTEMBER 2023

## MARKS: 150

## TIME: 2½ HOURS

**This question paper consists of 16 pages.**

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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 for each question.
6. ALL drawings should be done in pencil and labelled in blue or black ink.
7. Draw diagrams, tables or flow charts 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 compass where necessary.
11. Write neatly and legibly.

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## 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 numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, for example, 1.1.10 D.

1.1.1 During which phase of meiosis do spindle fibres start to form?

A Prophase I
B Metaphase I
C Anaphase I
D Telophase I

1.1.2 The following list includes some features that are studied in evolution.

(i) Bipedalism
(ii) Dentition
(iii) Brow ridges
(iv) Stereoscopic vision

Which of these key features separate the human line of evolution from that of the African Apes?

A (i) only
B (i) and (iv) only
C (ii) and (iv) only
D (i), (ii) and (iii) only

1.1.3 A small section of mRNA has the following sequence of bases that codes for different amino acids:

C C C C G U U A A

Which ONE of the following is the representation of the anticodons and number of amino acids coded for by this section?

| | ANTICODONS | | | NUMBER OF AMINO ACIDS |
|---|---|---|---|---|
| A | GGG | GCA | AUU | 9 |
| B | GGG | GCA | AUU | 3 |
| C | GGG | GCA | ATT | 9 |
| D | GGG | GCA | ATT | 3 |

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1.1.4 In a family with four children, each child has a different blood group.

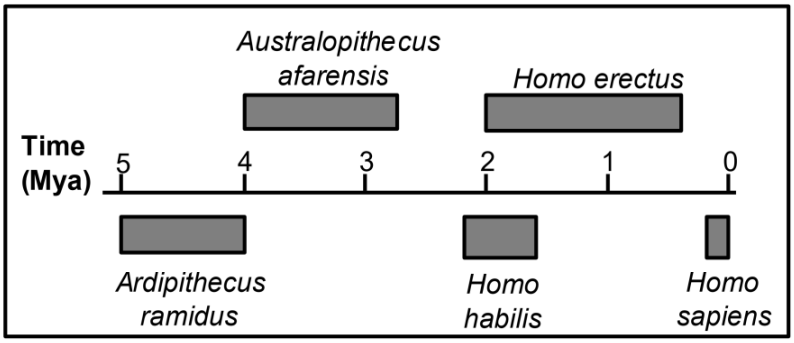
The genotypes of the parents must be …

A $I^A$ i and $I^B$ i
B $I^A$ $I^B$ and ii
C $I^B$ i and $I^A$ $I^B$
D $I^B$ i and ii

1.1.5 Which ONE of the following monohybrid crosses where complete dominance applies, will result in a phenotypic ratio of 3:1?

A Both parents are heterozygous
B One parent is heterozygous, and the other is homozygous recessive
C Both parents are homozygous for the dominant characteristic
D One parent is heterozygous, and the other is homozygous dominant

QUESTIONS 1.1.6 AND 1.1.7 ARE BASED ON THE TIMELINE BELOW SHOWING THE POSSIBLE EVOLUTION OF SOME HOMINIDS:




1.1.6 Which species inhabited the Earth for the longest time, and how many years ago did this species appear?

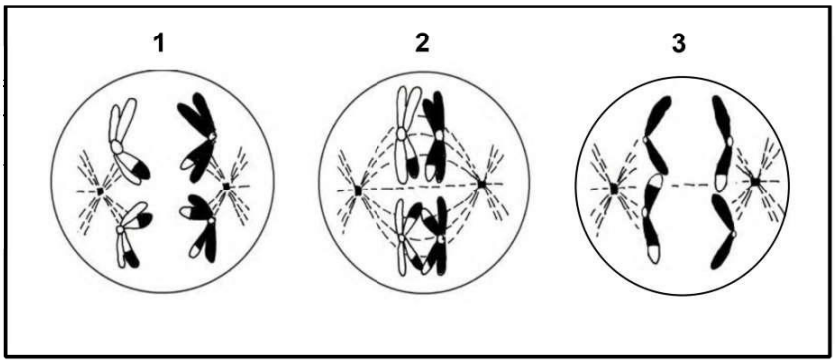
A *Australopithecus afarensis*; 4 mya
B *Homo erectus*; 2 mya
C *Homo habilis*; 2.2 mya
D *Ardipithecus ramidus;* 5mya

1.1.7 How many genera are represented on the timeline above?

A 5
B 3
C 1
D 2

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1.1.8 The diagram below represents different phases of meiosis.




Identify the correct phase in diagram **2**

A Anaphase II
B Metaphase II
C Prophase I
D Metaphase I

1.1.9 If a DNA molecule contains 20 000 nitrogenous bases, of which 20% are cytosine, how many adenine molecules will be present?

A 1 000
B 2 000
C 6 000
D 8 000

(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 numbers (1.2.1 to 1.2.9) in the ANSWER BOOK.

1.2.1 The mode of locomotion where an animal uses four limbs

1.2.2 The bond formed between amino acids

1.2.3 The part of the skull that houses the brain

1.2.4 A change in the sequence of nitrogenous bases

1.2.5 A disorder due to the presence of an extra chromosome on the 21$^{st}$ pair of chromosomes in somatic cells of humans

1.2.6 Genetic evidence that is used to support the 'Out of Africa' hypothesis

1.2.7 The process by which genetically identical organisms are formed using biotechnology

1.2.8 Type of dominance in which both alleles are expressed in the phenotype

1.2.9 Similar structures that are inherited from a common ancestor and modified for different functions

(9 x 1) **(9)**

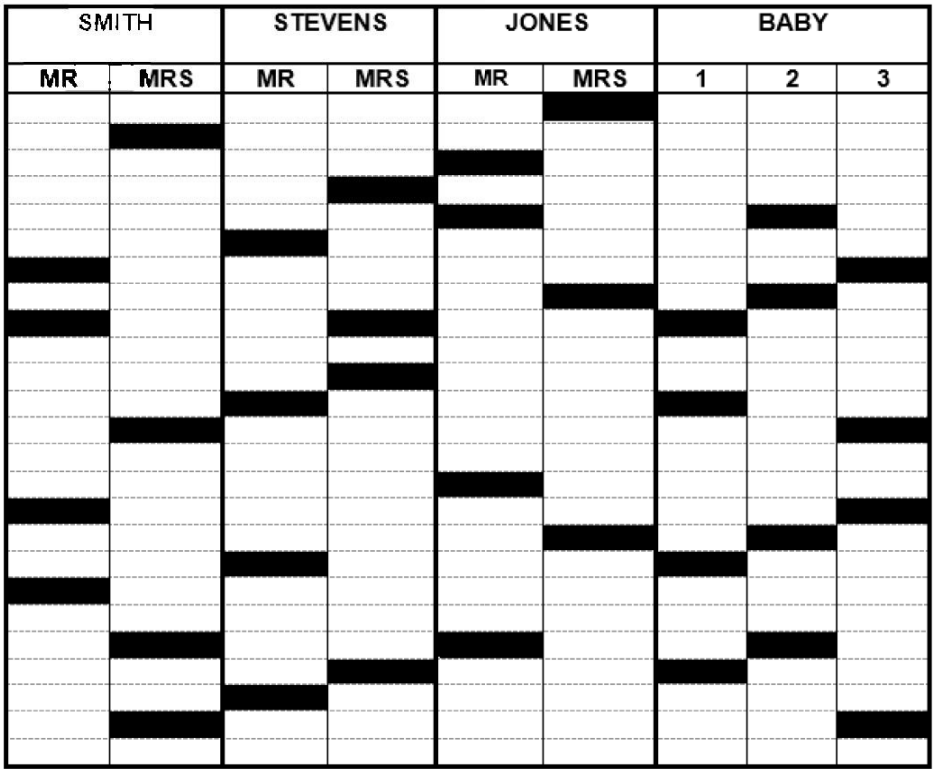
1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

| | **COLUMN I** | **COLUMN II** |
|---|---|---|
| 1.3.1 | The genotype of a person with haemophilia | A: $X^hY$<br>B: $X^hX^h$ |
| 1.3.2 | Variation in human height | A: Continuous variation<br>B: Discontinuous variation |
| 1.3.3 | Involved in the discovery of DNA molecule | A: Eldredge<br>B: Gould |

(3 x 2) **(6)**

1.4 Three ladies each gave birth to a baby boy in a hospital. The babies were accidentally swopped.

The diagram below shows a technique used in paternity testing and the results of each parent and their baby boys.



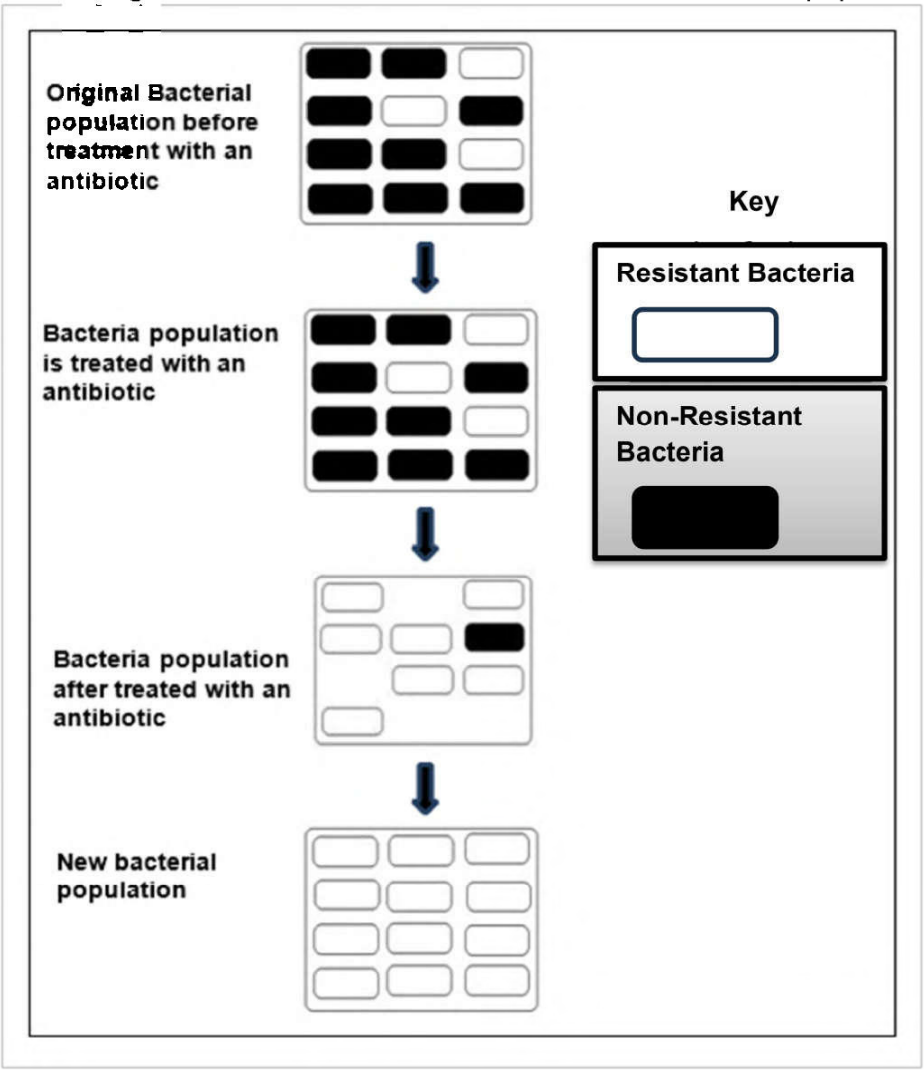

1.4.1 Identify the technique shown above. (1)

1.4.2 Which baby (**1, 2** or **3**) belongs to the Smiths? (2)

1.4.3 State TWO other uses for the technique named in QUESTION 1.4.1. (2)
**(5)**

1.5 An investigation was carried out to determine the effect of an antibiotic on bacterial resistance.

The diagram shows the effect of an antibiotic on a bacterial population.




1.5.1 Give the:

(a) Dependent variable (1)

(b) Independent variable (1)

1.5.2 Name the type of evolution that occurs in this bacterial population. (1)

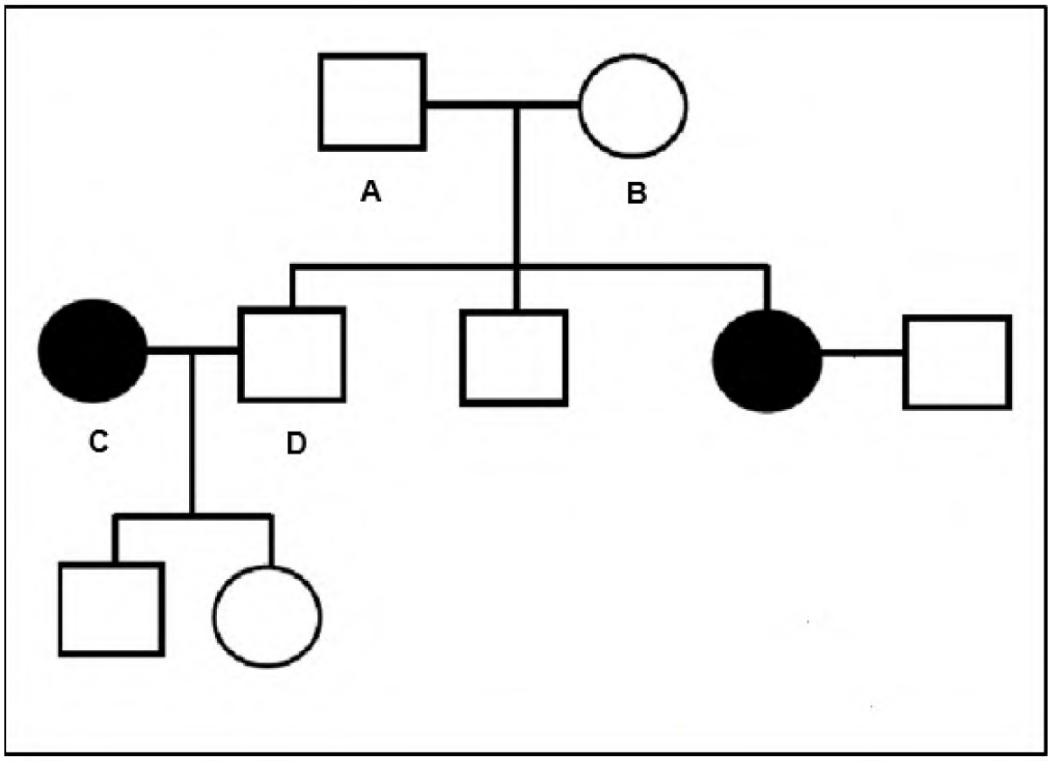
1.5.3 What is the change in the environment that brings about the change in the bacteria population? (1)

1.5.4 Which variation can be found in greater proportion in the final population? (1)

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1.5.5 What percentage of the bacteria in the original population was resistant to antibiotics? (1)
**(6)**

1.6 A genetic disorder is caused by a recessive allele **(a)**.
An individual with the disorder is described as affected, and an individual without it is described as unaffected. The affected individual is indicated by a black circle or square.
The pedigree diagram below shows the inheritance of this disorder in a family.




1.6.1 How many of each of the following are present in the diagram?

(a) Males (1)

(b) Generations (1)

(c) Children of individuals **A** and **B** (1)

1.6.2 Give the:

a) Possible genotype of individual **D** (2)

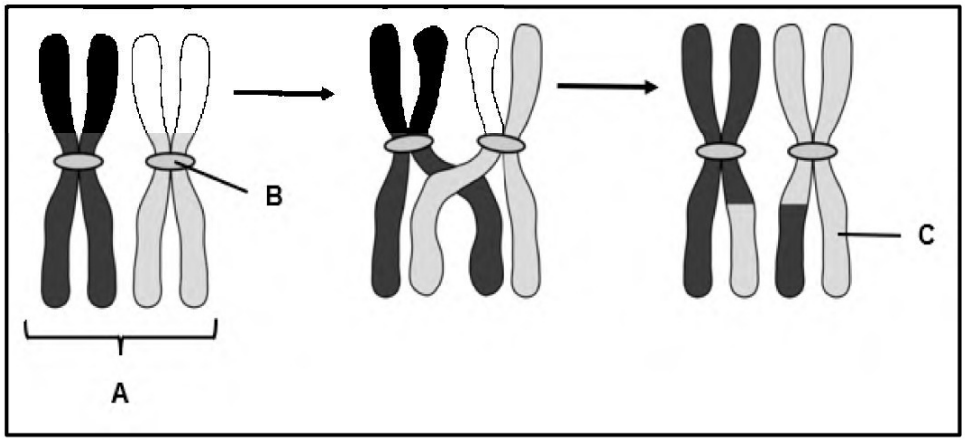
b) Phenotype of individual **C** (1)
**(6)**

**TOTAL SECTION A: 50**

## SECTION B

## QUESTION 2

2.1 The diagram below represents chromosomes in a cell that is undergoing meiosis.




2.1.1 Identify:

(a) Chromosome pair **A** (1)

(b) Structure **B** (1)

(c) Part **C** (1)

2.1.2 Which process is illustrated in the diagram? (1)

2.1.3 During which phase of meiosis does the process named in QUESTION 2.1.2 take place? (1)

2.1.4 What is the importance of the process named in QUESTION 2.1.2? (1)

2.1.5 Describe ONE other process in meiosis which will ensure the same outcome as the one stated in QUESTION 2.1.4. (3)
**(9)**

2.2 Tabulate THREE differences between meiosis I and meiosis II. (7)

2.3 Lamarckism refers to the theory of evolution suggested by Jean Baptiste de Lamarck.

Answer the following questions on Lamarck's theory.

2.3.1 State the TWO principles (laws) that Lamarck used to explain evolution. (2)

2.3.2 Explain ONE reason why most scientists reject this theory. (2)
**(4)**

2.4 Human blood types are determined by multiple alleles. Each person has only two alleles in their DNA that code for their blood type.

Explain how an analysis of blood groups can be used to determine paternity. (5)
**(5)**

2.5 Scientists wanted to determine which type of inheritance accounted for most of the selected genetic disorders in dogs.

To do this they sequenced the genomes of many dogs of the same breed that suffered from the genetic disorders.

The table below represents the type of inheritance for genetic disorders in dogs.

| TYPE OF INHERITANCE | PERCENTAGE OF GENETIC DISORDERS (%) |
|---|---|
| Autosomal recessive | 71 |
| Autosomal dominant | 11 |
| Sex-linked | 10 |
| Other | 8 |

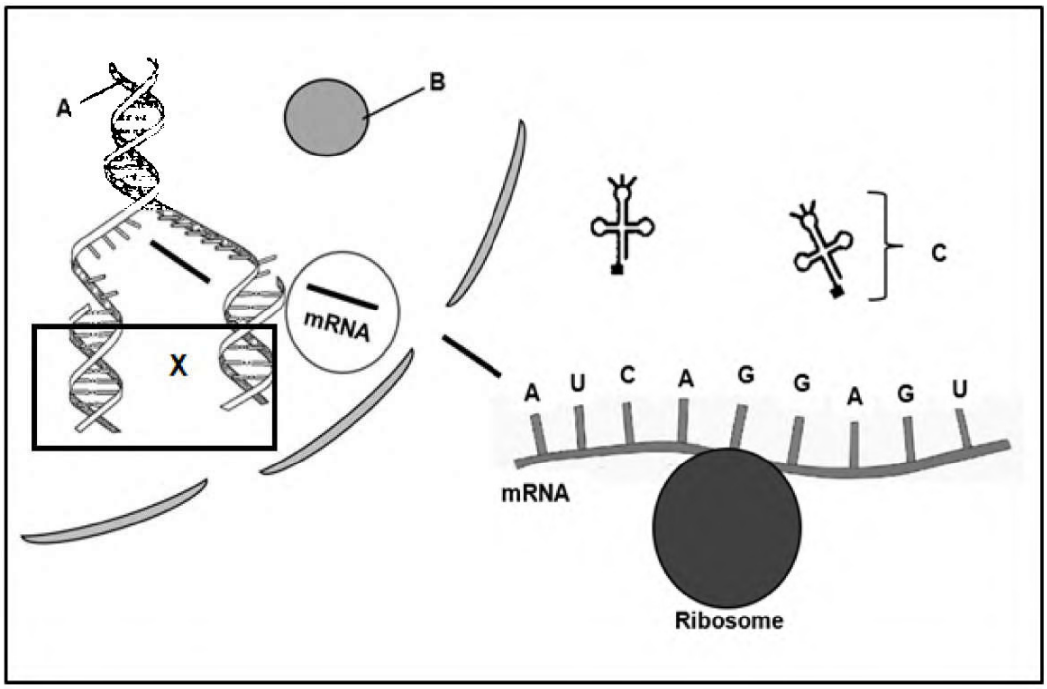
2.5.1 Define the term *genome.* (2)

2.5.2 State ONE factor that was kept constant in this investigation. (1)

2.5.3 Draw a pie graph to represent the information provided in the table. (6)
**(9)**

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2.6 The diagram below shows parts of two different processes that take place in the nucleus and a process taking place at the ribosome.




2.6.1 Identify:

(a) Molecule **A** (1)

(b) Organelle **B** (1)

(c) Molecule **C** (1)

(d) The number of codons shown in the diagram on the mRNA (1)

2.6.2 Give the anticodon for the second codon from left to right. (2)

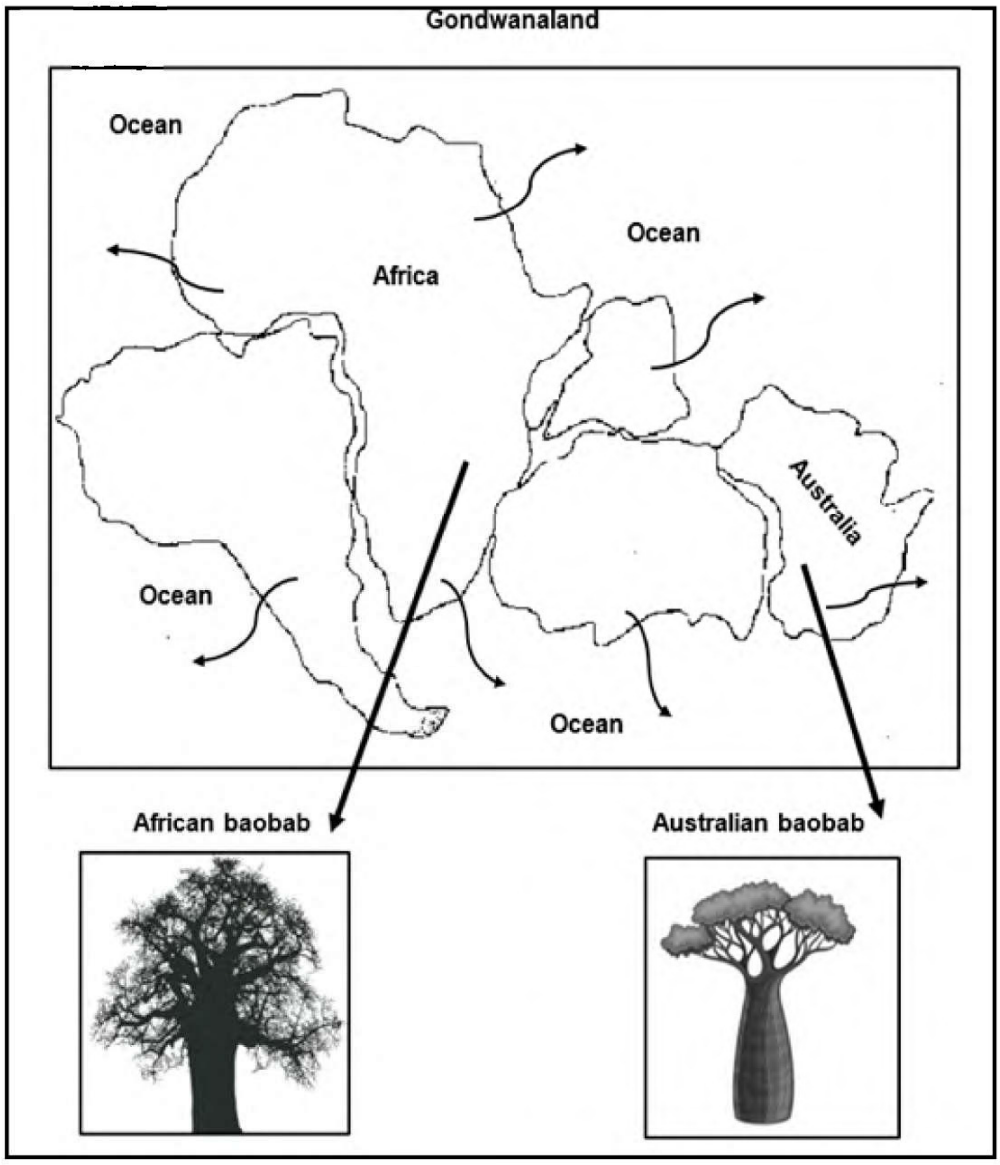
2.6.3 Name AND describe the process that is taking place at **X.** (6)

2.6.4 Describe the role of mRNA in protein synthesis. (4)
**(16)**

**[50]**

## QUESTION 3

3.1 The baobab tree belongs to the genus *Adansonia*. Different species are found in Africa and Australia. Originally these two continents formed part of Gondwanaland, as shown in the diagram below.




Explain how the different species of baobab could have evolved on the different continents. **(6)**

3.2 Read the extract below on a group of birds.

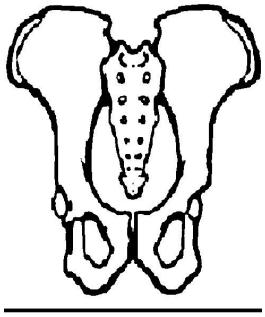
Warblers/songbirds belong to a large group of birds grouped together in the same bird family. In Siberia, Russia, two distinct species of greenish warblers coexist, one in the west and one in the east. A large region of desert, where they cannot survive, separates the two groups of warblers. Their distributions only narrowly overlap in central Siberia, where they do not interbreed. The two species differ, in the songs that males sing to attract females. Also, females of each species do not recognize the song of the other species but respond strongly to the song of the males from their own species.

3.2.1 Name AND describe the reproductive isolation mechanism described in the extract. (3)

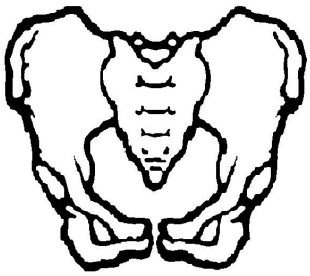
3.2.2 Mention TWO other reproductive isolation mechanisms that keep species separated. (2)
**(5)**

3.3 The diagrams below show the pelvic structure of two species not drawn to scale.

A



B

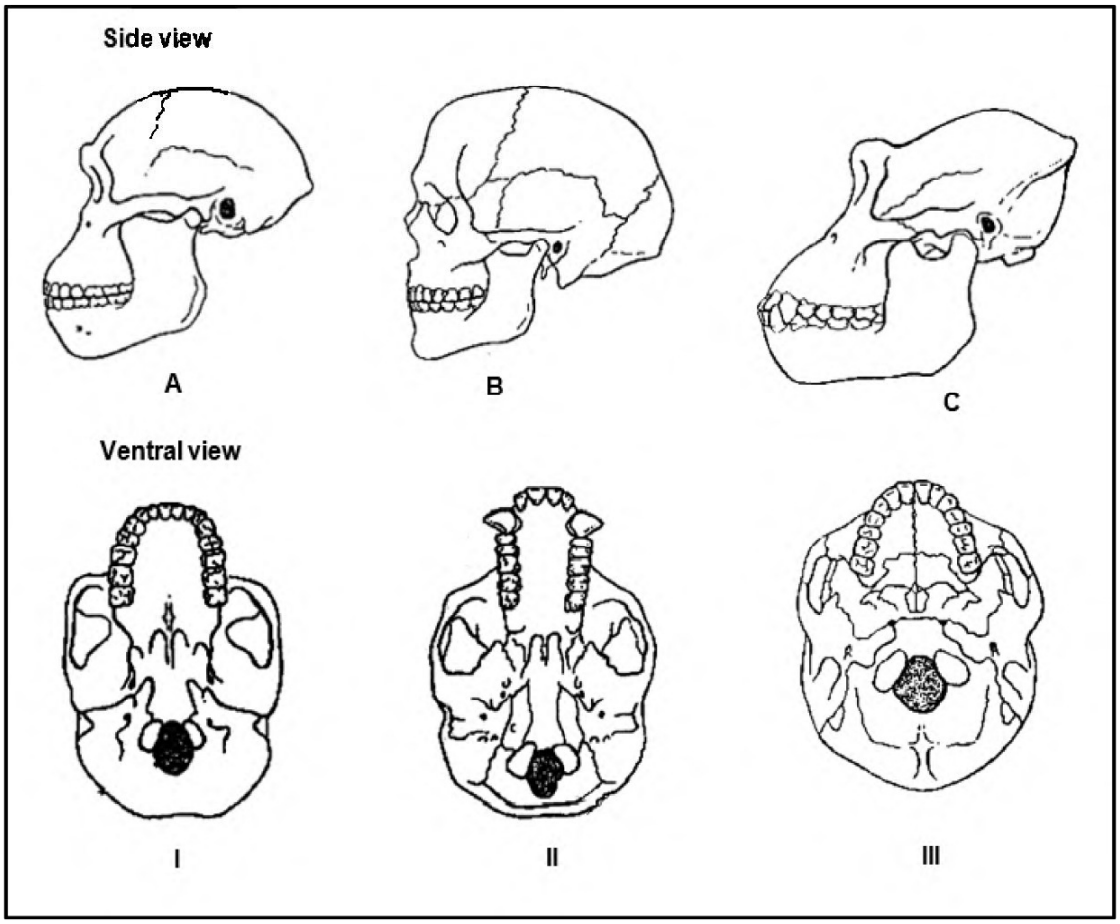


3.3.1 Which diagram represents the pelvis of a hominid? (1)

3.3.2 Explain ONE reason why Diagram **B** is better suited for a bipedal mode of locomotion. (2)

3.3.3 Explain TWO advantages of bipedalism. (4)
**(7)**

3.4 The diagrams below represent the side and ventral views of the skulls of three primates: A gorilla, *Australopithecus africanus* and *Homo sapiens*. The diagrams showing the side views are not necessarily in the same order as the diagrams showing the ventral views.




3.4.1 Name the family that all these primates belong to. (1)

3.4.2 Which diagram (**I, II** or **III**) represents the ventral view of skull **B**? (1)

3.4.3 Give TWO visible reasons for your answer to QUESTION 3.4.2. (2)

3.4.4 Describe THREE visible differences between the jaws in diagrams **II** and **III,** which show trends in human evolution. (6)

3.4.5 Based on the differences in dentition, what conclusion can be made about the difference in the diet of the organisms in diagrams **II** and **III**? (2)
**(12)**

3.5 In guinea pigs, black fur (**B)**, is due to a dominant gene and white fur (**b)** is due to a recessive gene. Short fur (**H)** is due to a dominant gene and long fur (**h)** is due to a recessive gene.

A breeder made the following cross: **BbHh x bbhh**

3.5.1 State the phenotypes of the parents that the breeder crossed. (2)

3.5.2 Give the genotypes of ALL the possible gametes of the parents. (2)

3.5.3 Give :

a) All the possible phenotypes of the offspring (2)

b) The dominant allele for fur colour (1)

3.5.4 Explain Mendel's law of independent assortment. (3)
**(10)**

3.6 Study the extract below on the characteristics of fruit flies.

| |
|---|
| Female fruit flies are approximately 2,5 mm long. Males are smaller and possess a distinct black patch on their bodies. Females lay up to 400 eggs, which develop into adults in 7 to 14 days. Fruit flies can survive and breed in small flasks containing a simple nutrient medium consisting mainly of sugar. The gonosomes of fruit flies are similar to that of humans (XX and XY). |

3.6.1 Explain TWO reasons why the fruit fly is a useful organism for studying genetic crosses. (4)

3.6.2 In fruit flies, the gene for eye colour is sex-linked and is carried on the X chromosome.

The allele for red eyes **R** is dominant to the allele for white eyes **r**.
A male with white eyes is crossed with a homozygous female with red eyes.

Use a genetic cross to show the phenotypic ratio of the $F_1$ offspring. (6)
**(10)**

**[50]**

**TOTAL SECTION B: 100**
**GRAND TOTAL: 150**

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