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# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**SENIOR CERTIFICATE/  
NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**LIFE SCIENCES P2**

**NOVEMBER 2020(2)**

**MARKS: 150**

**TIME: 2½ hours**

**This question paper consists of 17 pages.**

## **INSTRUCTIONS AND INFORMATION**

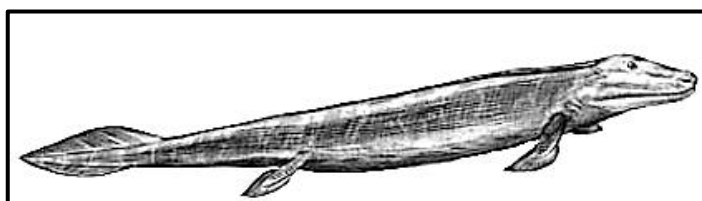
Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers 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. Do ALL drawings in pencil and label them 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 a 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 the ANSWER BOOK, e.g. 1.1.11 D.

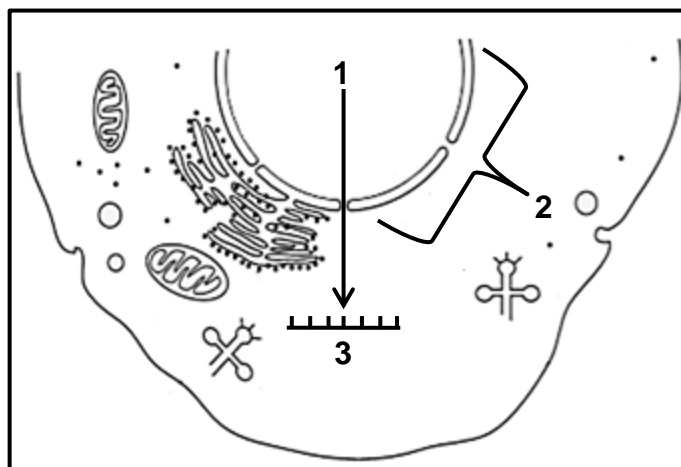
- 1.1.1 Which ONE of the following may result in Down syndrome in humans?
- A A gene mutation on chromosome 21
  - B Failure of chromosome pair 21 to separate during anaphase I
  - C Failure of the gonosomes to separate during meiosis II
  - D A gene mutation occurs on the X chromosome
- 1.1.2 Variation within a species is introduced through ...
- A random mating and asexual reproduction.
  - B mitosis and random fertilisation.
  - C random mating and random fertilisation.
  - D mitosis and meiosis.
- 1.1.3 African apes and humans are similar. Both have ...
- A small jaws and well-developed brow ridges.
  - B opposable thumbs and bare fingertips.
  - C gaps between their teeth and eyes in front.
  - D an upright posture and a cranial ridge.
- 1.1.4 The diagram below shows *Tiktaalik roseae*, a fish that may be the ancestor of the first organisms to live on land.



According to Lamarck, this species of fish may have evolved the ability to 'walk' on land by ...

- A undergoing natural genetic mutations which caused the fins to develop into legs.
- B the process of natural selection.
- C passing on the acquired characteristic of fins to their offspring.
- D stretching its fins and using them for 'walking'.

- 1.1.5 The diagram below shows some of the processes, molecules and structures that are involved in protein synthesis in a cell.



Which ONE of the following is the CORRECT labels for 1, 2 and 3 in the diagram?

	PROCESS 1	STRUCTURE 2	MOLECULE 3
A	transcription	ribosome	tRNA
B	translation	ribosome	mRNA
C	transcription	nucleus	mRNA
D	translation	nucleus	tRNA

- 1.1.6 A homozygous purple flowering plant (**P**) is crossed with a pink flowering plant (**p**) to produce the  $F_1$ -generation. One of the  $F_1$ -plants is crossed with the pink flowering parent to produce the  $F_2$ -generation.

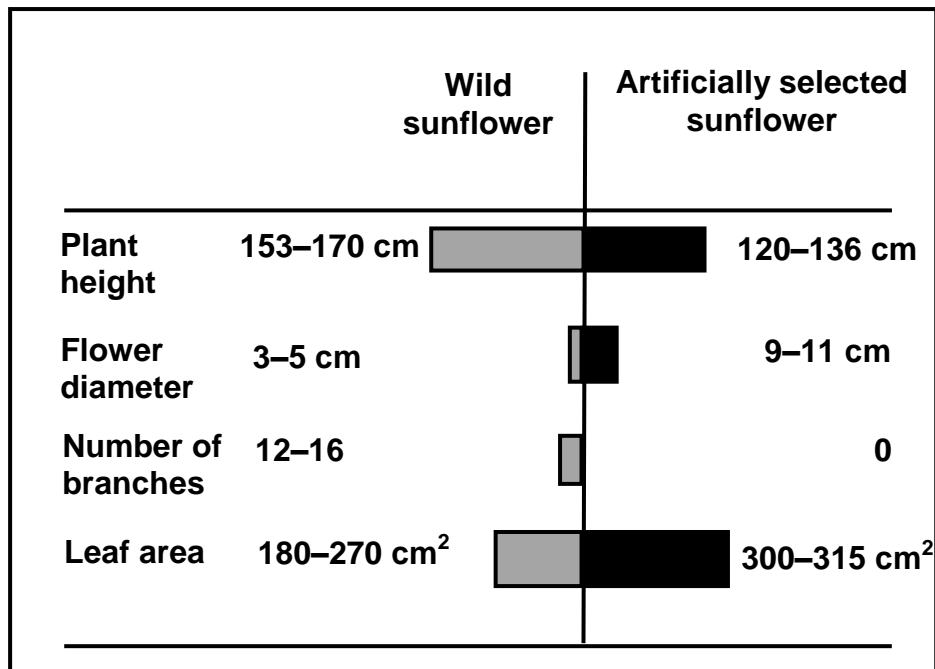
Which ONE of the following is the CORRECT phenotypic ratio of the  $F_2$ -generation?

- A 1 purple : 1 pink
- B 1 purple : 3 pink
- C 3 purple : 1 pink
- D 1 purple : 2 pink

- 1.1.7 Which ONE of the following scientists discovered fossils of *Homo sapiens* and *Ardipithecus sp*?

- A Raymond Dart
- B Lee Berger
- C Louis Leakey
- D Tim White

- 1.1.8 The diagram below compares characteristics of wild sunflowers with sunflowers that have been artificially selected.



Which ONE of the following characteristics was found undesirable by humans?

- A Number of branches and leaf area
  - B Plant height and leaf area
  - C Plant height and flower diameter
  - D Plant height and number of branches
- 1.1.9 Punctuated equilibrium suggests the following:
- A Evolution is always a slow and gradual process.
  - B Natural selection does not explain evolution.
  - C New species can appear quickly, over a relatively short period of time.
  - D Artificial selection is the only mechanism that causes evolution.
- 1.1.10 A group of students observed that the long-term use of antibiotics results in the decreased control of bacterial infections.

From this observation the students stated that:

Antibiotic resistance in bacteria is caused by the long-term use of antibiotics.

This statement is a/an ...

- A theory.
- B aim.
- C hypothesis.
- D conclusion.

(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 1.2.7) in the ANSWER BOOK.

1.2.1 Similar structures in different organisms indicating descent with modification

1.2.2 Large, pointed teeth in African apes that are used for tearing food

1.2.3 The part of the skull that houses the brain

1.2.4 The non-sex chromosomes in humans

1.2.5 The network of genetic material found in the nucleus during interphase

1.2.6 The number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell

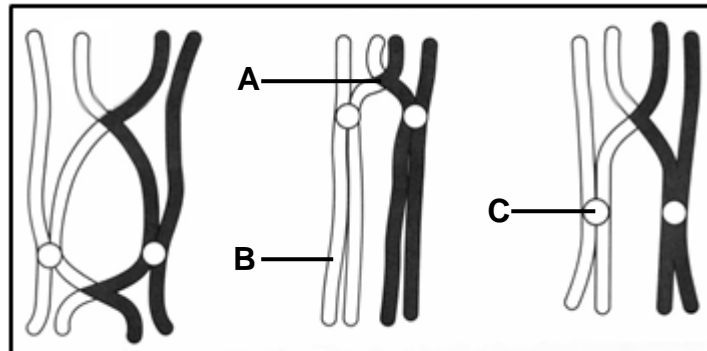
1.2.7 Having a protruding jaw (7 x 1) **(7)**

1.3 Indicate whether each of the statements in COLUMN I apply 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 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Long and narrow pelvis	A: African apes B: Humans
1.3.2 The point of attachment of two overlapping chromatids	A: Locus B: Chiasma
1.3.3 Variation in human height	A: Continuous B: Discontinuous

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

- 1.4 The diagram below represents ALL the chromosomes in a cell that is undergoing normal cell division.



- 1.4.1 Name the:
- Type of cell division that is occurring in the cell in the diagram (1)
  - Phase of cell division during which the chromosomes behave as shown in the diagram (1)
- 1.4.2 Where in the human female body would the type of cell division named in QUESTION 1.4.1(a) take place? (1)
- 1.4.3 Give the LETTER and NAME of the structure that attaches to the spindle fibres. (2)
- 1.4.4 How many chromosomes will be found in each daughter cell at the end of this cell division? (1)
- (6)**



1.5 There is variation in the characteristics of fur colour and fur texture in cats.

The table below shows the alleles that control these two characteristics.

CHARACTERISTIC	ALLELE	PHENOTYPE
Fur colour	<b>B</b>	Black
	<b>b</b>	White
Fur texture	<b>R</b>	Rough
	<b>r</b>	Smooth

The Punnett square below shows the inheritance of these alleles in a genetic cross.

All possible gametes from female		All possible gametes from male			
↓		BR	Br	bR	br
	bR	BbRR	BbRr	<b>X</b>	bbRr

1.5.1 Name the:

- (a) Dominant phenotype for fur colour (1)
- (b) Recessive phenotype for fur texture (1)

1.5.2 Give the:

- (a) Genotype of offspring **X** (1)
- (b) Phenotype of the female parent (2)
- (c) Genotype of the male parent (1)

1.5.3 State the phenotype that ALL the offspring of this genetic cross have in common. (1)

**(7)**

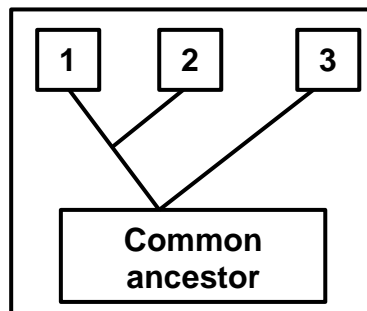
- 1.6 Scientists compare the number of differences in the amino acid sequence to see how closely related species are. Fewer differences in the amino acid sequence mean the species are more closely related.

Cytochrome C is a protein that occurs in many species. The amino acid sequence of this protein differs between species.

The table below shows the number of differences in the amino acid sequences of three species, **A**, **B** and **C**.

	SPECIES B	SPECIES C
SPECIES A	11	3
SPECIES B		10

- 1.6.1 What type of evidence for evolution is being used in this table? (1)
- 1.6.2 Give the LETTER of the species, **A**, **B** and **C**, that should appear at positions **1**, **2** and **3** in the diagram below.



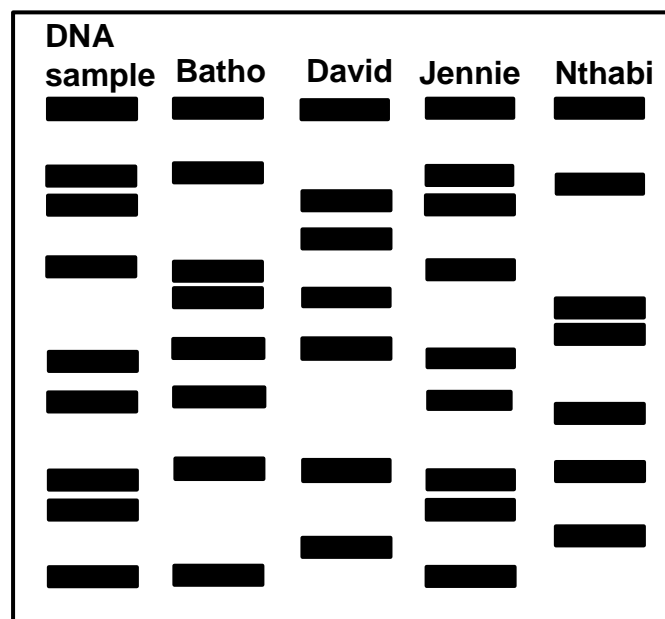
(3)  
(4)

**TOTAL SECTION A: 50**

**SECTION B****QUESTION 2**

- 2.1 Detectives were investigating a crime scene and found blood on a broken window. They suspected that the blood was that of the criminal. To identify the criminal, they analysed a DNA sample from the blood and compared it to that of four suspects.

The diagram below was produced:



- 2.1.1 Name the technique that was used to identify the criminal. (1)
- 2.1.2 Who is the possible criminal? (1)
- 2.1.3 Explain your answer to QUESTION 2.1.2. (2)
- 2.1.4 State ONE other use of the technique identified in QUESTION 2.1.1. (1)
- (5)**

2.2 A farmer decided to have his best meat-producing bull cloned.

The following steps were used in the process:

- A muscle cell was taken from the bull and the nucleus was removed.
- An ovum was taken from a cow and the nucleus was removed and discarded.
- The nucleus from the muscle cell was placed in the empty ovum.
- The ovum was given an electric shock to stimulate normal cell division to produce an embryo.
- The embryo was placed in the uterus of a surrogate cow where it developed into the clone.

2.2.1 What is *cloning*? (1)

2.2.2 Explain why the nucleus of a muscle cell was used and not the nucleus of a sperm cell. (2)

2.2.3 Explain why the nucleus of the ovum was removed. (2)

2.2.4 State ONE benefit of cloning. (1)  
(6)

2.3 A man with blood group **AB** and a woman who is heterozygous for blood group **B** plan to have children.

2.3.1 How many alleles control the inheritance of blood groups? (1)

2.3.2 Describe the type of dominance that occurs in the inheritance of blood group **B** in the woman. (3)

2.3.3 Use a genetic cross to show all the possible genotypes and phenotypes of their children. (6)  
(10)

- 2.4 Sickle cell disease is caused by a recessive allele and first appeared in humans as a result of a gene mutation.

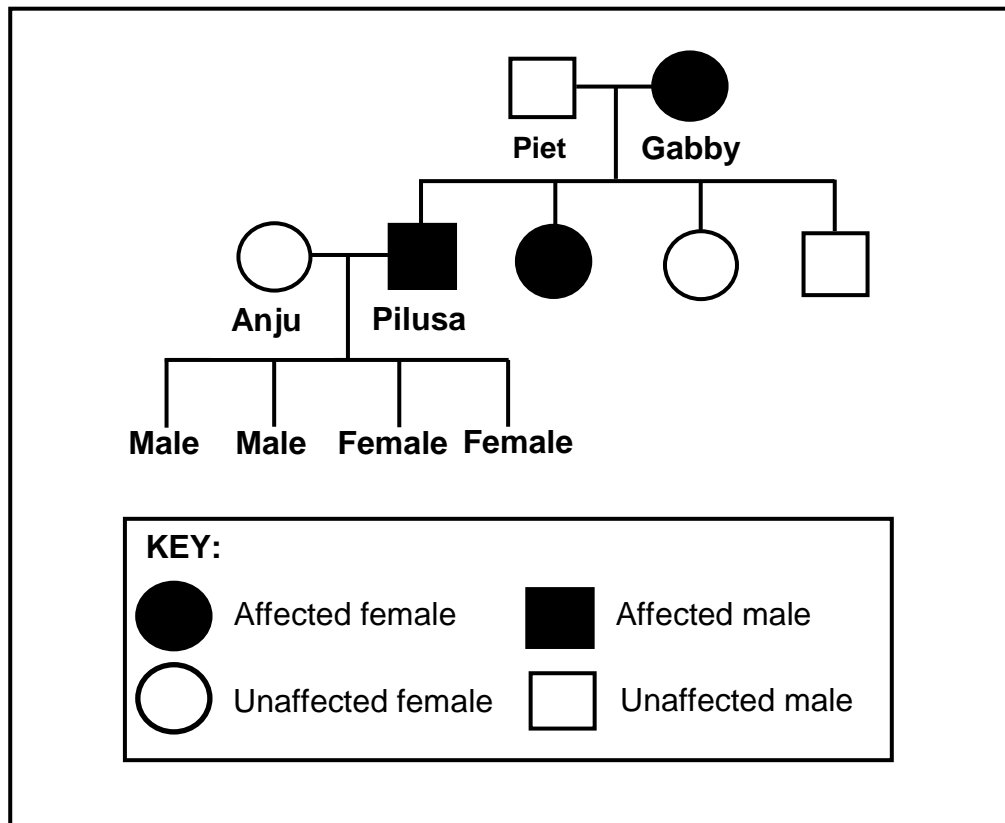
The table below shows the number of children born with sickle cell disease in some regions in a particular year.

REGION	NUMBER OF CHILDREN BORN WITH SICKLE CELL DISEASE
Democratic Republic of Congo	39 746
United States of America	90 128
Nigeria	91 011
United Kingdom	13 221
Tanzania	11 877
Other	59 750
<b>Worldwide total</b>	<b>305 733</b>

- 2.4.1 What is a *gene mutation*? (2)
- 2.4.2 Which region had the highest number of children born with sickle cell disease in that year? (1)
- 2.4.3 What percentage of the worldwide total of children born with sickle cell disease came from the Democratic Republic of Congo? Show ALL calculations. (3)
- 2.4.4 Use the letters **D** and **d** to give the genotype of a person who:
- (a) Suffers from sickle cell disease (1)
- (b) Carries the allele but does not suffer from the disease (1)
- (8)**

- 2.5 Goltz syndrome is a sex-linked genetic disorder. It is caused by a dominant allele  $X^G$ .

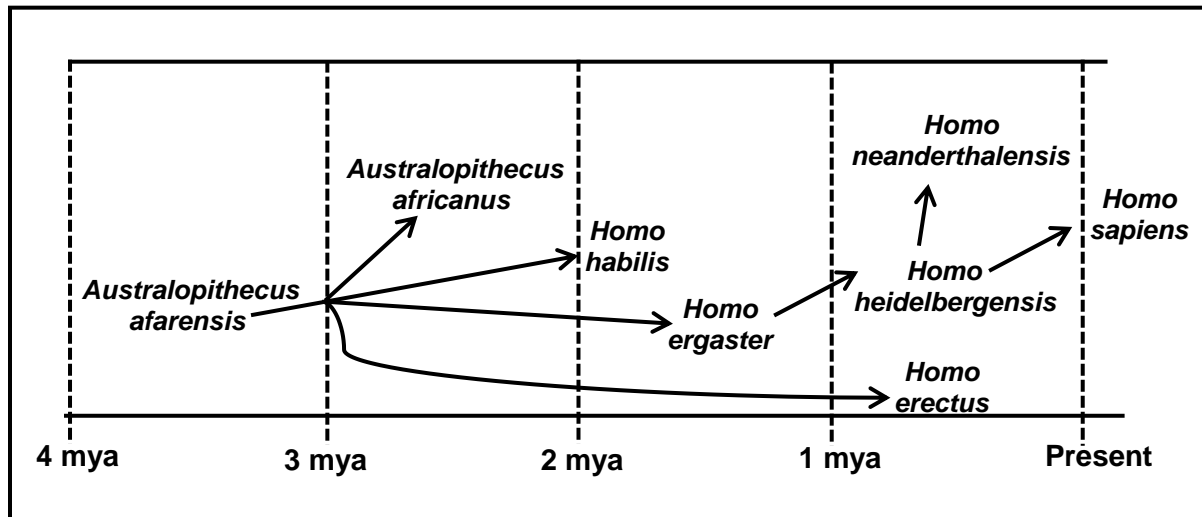
The diagram below shows the inheritance of Goltz syndrome in a family.



- 2.5.1 Name the type of diagram shown. (1)
- 2.5.2 How many:
- Females are in this family (1)
  - Males in the  $F_1$ -generation have Goltz syndrome (1)
- 2.5.3 Give Gabby's genotype. (2)
- 2.5.4 Anju and Pilusa have four children. Give the phenotype of their sons. (2)
- 2.5.5 Explain your answer to QUESTION 2.5.4. (4)
- (11)**  
**[40]**

**QUESTION 3**

- 3.1 Describe the process of natural selection. (7)
- 3.2 Fossil evidence for humans may be interpreted in different ways. One possible model of human evolution is shown below.



- 3.2.1 Name the family to which all of the represented organisms belong. (1)
- 3.2.2 Describe how cultural evidence is used to support the theory of human evolution. (2)
- 3.2.3 How long ago did the most recent common ancestor of *H. erectus* and *H. heidelbergensis* exist on earth? (1)
- 3.2.4 Explain a possible reason why *H. ergaster* was placed between *A. afarensis* and *H. heidelbergensis* on the model. (2)
- 3.2.5 Explain how the fossils of organisms that existed from 4 mya to present time are used to support the 'Out of Africa' hypothesis. (3)
- (9)**

**3.3 Male long-tailed widowbirds have extremely long tail feathers that they use in mating displays to attract females.**

Scientists conducted an investigation to determine the relationship between the length of the male long-tailed widowbird's tail and its mating success.

The procedure was as follows:

- A total of 27 male long-tailed widowbirds was sampled and divided into 3 equal groups.
- The tail feathers of the birds in each group were treated in the following way:
  - Group 1 – Cut short
  - Group 2 – Made longer by adding artificial feathers
  - Group 3 – Left unchanged
- The 3 groups of male long-tailed widowbirds, along with female long-tailed widowbirds, were released into an environment suitable for mating.
- Each time a pair mated successfully they produced a nest and all the nests were counted.
- The average number of nests produced by each group was calculated and used as an indication of mating success.

The results are shown in the table below.

GROUP	AVERAGE NUMBER OF NESTS PRODUCED
1	0,5
2	2,5
3	1

**3.3.1 Name the:**

- (a) Reproductive isolating mechanism that occurs in long-tailed widowbirds (1)
- (b) Independent variable in this investigation (1)

**3.3.2 Explain why 27 long-tailed widowbirds were used in the investigation instead of only 3. (2)**

**3.3.3 Explain why Group 3 was included in the investigation. (2)**

**3.3.4 Draw a bar graph to represent the results of this investigation. (6)**

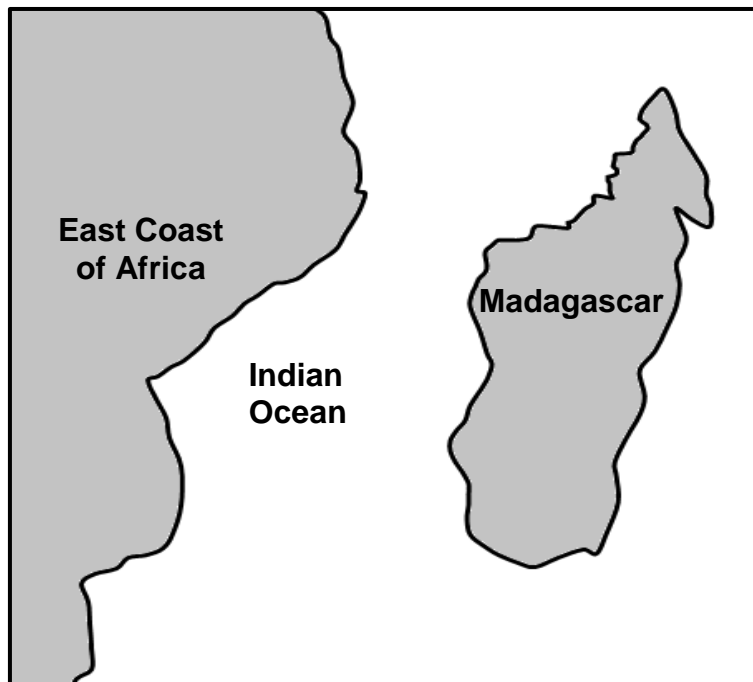
**3.3.5 State a conclusion for this investigation. (2)**  
**(14)**



3.4 Pottos and lemurs are small mammals.

Scientists believe that pottos and lemurs share a common ancestor that existed in Africa. Presently pottos only occur in Africa while lemurs are only found in Madagascar.

Madagascar is an island off the East coast of Africa as shown in the diagram below.



3.4.1 Explain how continental drift could have affected the distribution of the common ancestor. (4)

3.4.2 Describe the speciation of the pottos and lemurs to become different species. (6)

(10)  
[40]

**TOTAL SECTION B: 80**

**SECTION C****QUESTION 4**

Describe the location and structure of DNA, the process of DNA replication and the significance of this process for mitosis.

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

c

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

**TOTAL SECTION C: 20**  
**GRAND TOTAL: 150**