Hillcrest High School

Grade 12 **Life Sciences Paper Two** **September 2018**

R.Harmse **Time: 2.5 hours**

Marks: 150

INSTRUCTIONS

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Rule a line after EACH question.
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. Make ALL drawing 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-D) next to the question number (1.1.1-1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

1.1.1 Which of the following distinguishes prophase 1 of meiosis from prophase of mitosis
- A. Homologous chromosomes pair up
- B. Spindle forms
- C. Nuclear membrane breaks down
- D. Chromosomes become visible

1.1.2 DNA was analysed and found to contain 14% T (thymine). What percentage of the molecule is cytosine?
- A. 14%
- B. 28%
- C. 36%
- D. 72%

1.1.3 The theory of evolution by natural selection was first described by...
- A. Gregor Mendel
- B. Watson and Crick
- C. Jean Baptiste de Lamarck
- D. Charles Darwin

1.1.4 During which phase of meiosis do homologous chromosome pairs separate?
- A. Metaphase I
- B. Anaphase I
- C. Anaphase II
- D. Telophase II

1.1.5 A codon is a sequence of three nucleotides on a molecule of ...
- A. rRNA
- B. mRNA
- C. tRNA
- D. DNA

1.1.6 Scientists visiting a group of four islands P, Q, R and S found similar spiders on each island. They carried out investigations to see if the spiders from different islands belonged to the same species.

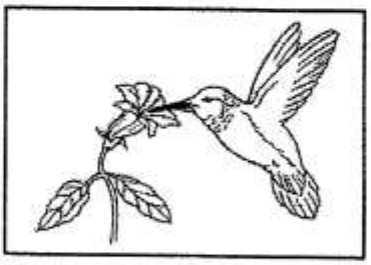
The results are in the table below(✓ indicates successful interbreeding. **X** indicates unsuccessful interbreeding)

	Spiders from			
	P	**Q**	**R**	**S**
P	✓	✓	X	X
Q	✓	✓	X	X
R	X	X	✓	X
S	X	X	X	✓

Which two populations belong to the same species?

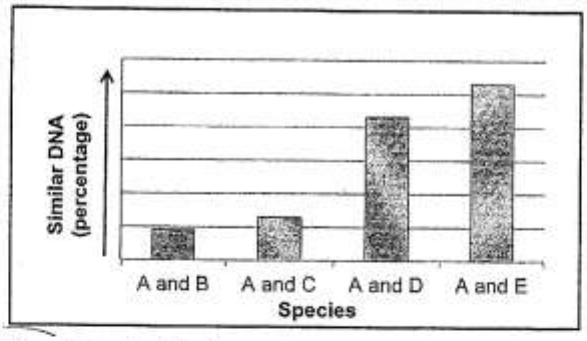
A. **Q** and **R**
B. **R** and **S**
C. **Q** and **S**
D. **P** and **Q**

1.1.7 A hummingbird uses its long beak to feed on the nectar in flowers. The reasons that Lamarck would have provided for the long beak of the hummingbird is that...



A. All hummingbirds have the same beak length.
B. There is a natural variation in beak length and some birds are therefore better suited to feed on nectar.
C. The more the hummingbird used its beak, the longer it grew.
D. Hummingbirds with shorter beaks were more fit for survival.

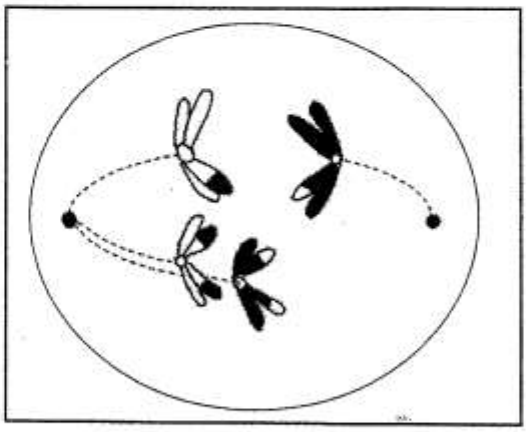
1.1.8 Which statement is a valid conclusion that can be drawn from the graph below



Species **A** is most closely related to...

A. Species **B**
B. Species **C**
C. Species **D**
D. Species **E**

1.1.9 The diagram below shows a cell undergoing meiosis



The diagram above shows...

A. Non-disjunction in metaphase II
B. A chromosomal aberration that results in haemophilia.
C. A chromosomal aberration involving chromosome pair number 23, leading to Down syndrome.
D. Non-disjunction in anaphase I.

1.1.10 In the most stable freshwater environments populations of *Daphnia* are almost entirely female and reproduce asexually. However, males are observed in low-oxygen environments or when food is scarce.

Based on these observations, a researcher suggests at the start of an experiment that:

Male *Daphnia* only develop in response to unfavourable environmental conditions.

This is an example of a/an...

A. Conclusion.
B. Hypothesis.
C. Theory.
D. Aim.

(2x10=20)

1.2 Give the correct BIOLOGICAL TERM for each of the following descriptions. Write only the term next to the question number from (1.2.1 – 1.2.10) in the ANSWER BOOK.

1.2.1 The division of the cytoplasm after a cell nucleus has divided.
1.2.2 The preserved remains of ancient organisms
1.2.3 The death of the last individual of a species
1.2.4 Position of a gene on a chromosome
1.2.5 The name of the process when homologous chromosome pairs fail to separate during meiosis
1.2.6 Chromosomes that carry the same set of genes
1.2.7 A phase in the cell cycle that occurs before cell division
1.2.8 A diagrammatic representation showing possible evolutionary relationships among different species
1.2.9 The present-day distribution of organisms

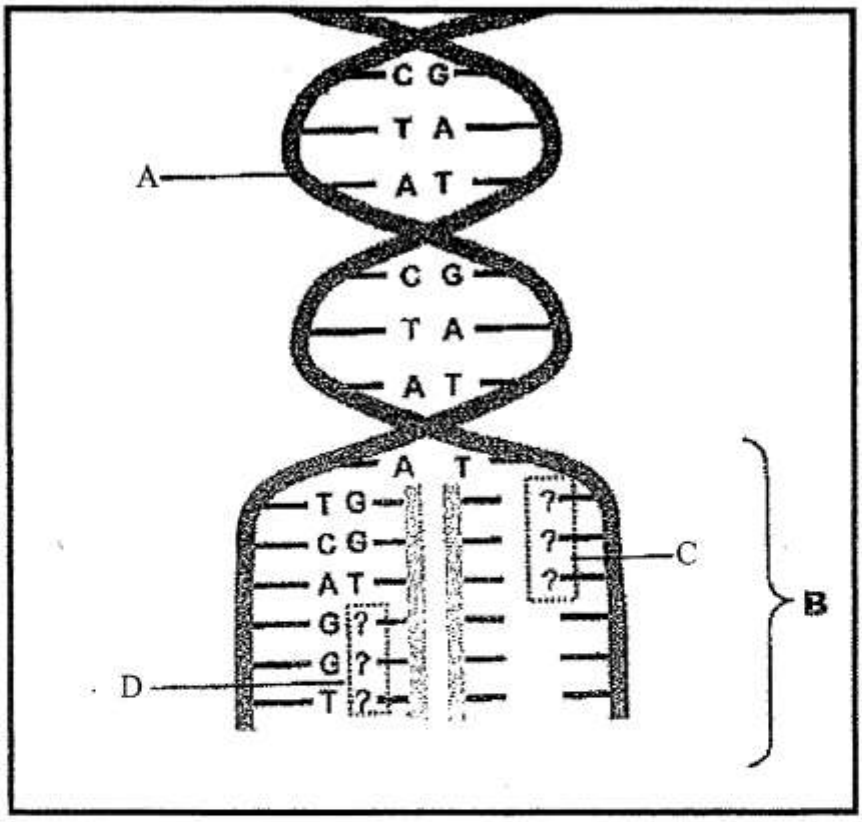
(9x1=9)

1.3 Indicate whether each of the descriptions 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 – 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Evidence of evolution	A. Biogeography B. Modification by descent
1.3.2 An allele that is not shown/expressed in the phenotype when found in the heterozygous condition	A. Dominant B. Recessive
1.3.3 Law of inheritance of acquired characteristics	A. Darwin B. Lamarck

(3x2=6)

1.4 Study the diagram provided below that represents parts of molecules. Use the information to answer the questions that follow.



1.4.1 Identify the molecule labelled A. (1)

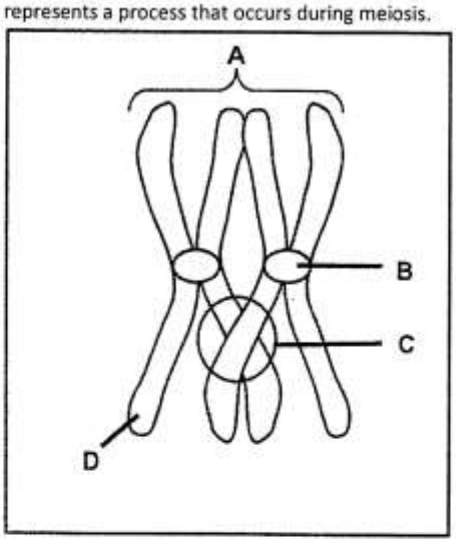
1.4.2 a) Identify the process occurring at B. (1)

b) Describe the process named in question 1.4.2 (a) (5)

c) Give ONE reason why this process is important in cells. (1)

[8]

1.5 The diagram below represents a process that occurs during meiosis.



1.5.1 Provide labels for:

a) **A** (1)
b) **B** (1)
c) **D** (1)

1.5.2 Give the function of the structure labelled **B.** (1)

1.5.3 Name:

a) The process occurring at **C** (1)
b) The phase in meiosis during which the process at **C** occurs (1)

1.5.4 State ONE reason why process **C** is significant. (1)

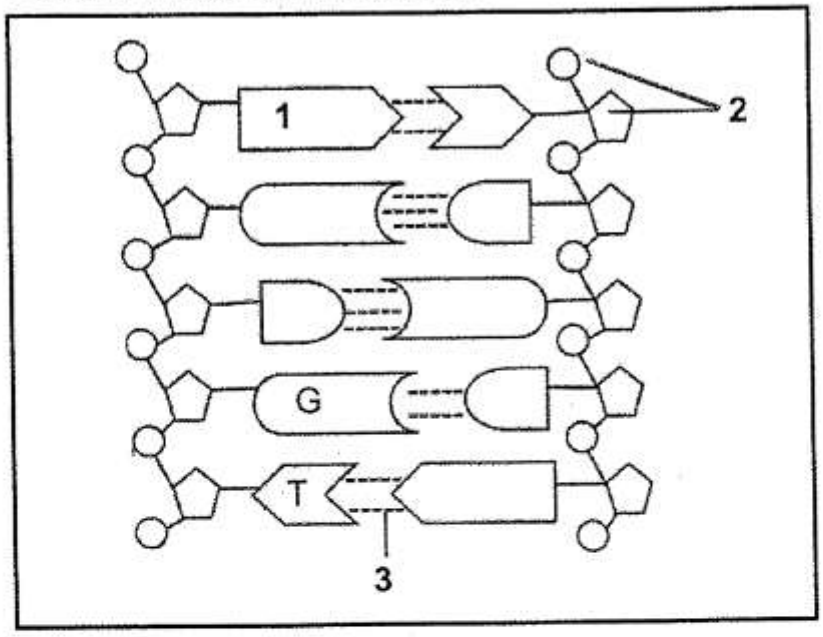
[7]

TOTAL SECTION A: 50 MARKS

SECTION B

Question 2

2.1 The diagrams below shows part of a DNA molecule.

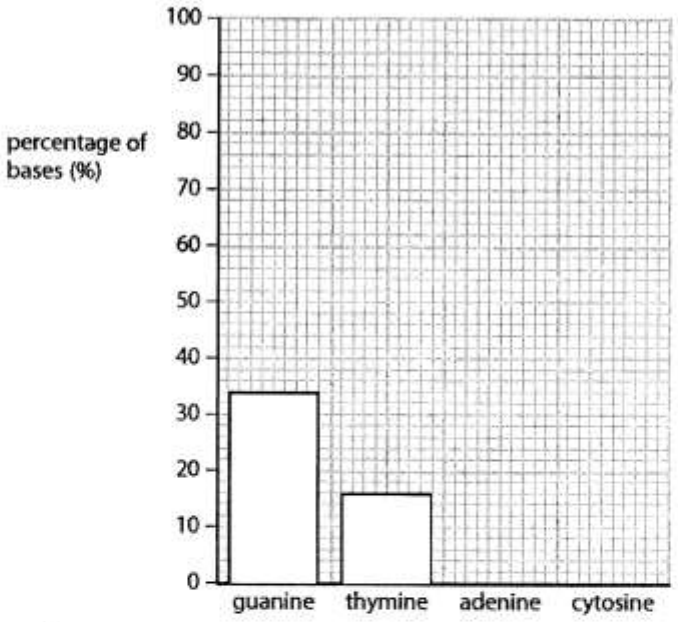


2.1.1 Provide labels for **1, 2 and 3** (3)

2.1.2 Give the collective name for **1 and 2** (1)

2.1.3 Give **TWO** differences with regards to nitrogenous bases found in RNA molecules and those found in DNA molecules. (2)

2.1.4 The bar chart shows the percentage of guanine and thymine in a sample of DNA. Redraw the bar chart to show the percentage of adenine and cytosine in the sample. (2)



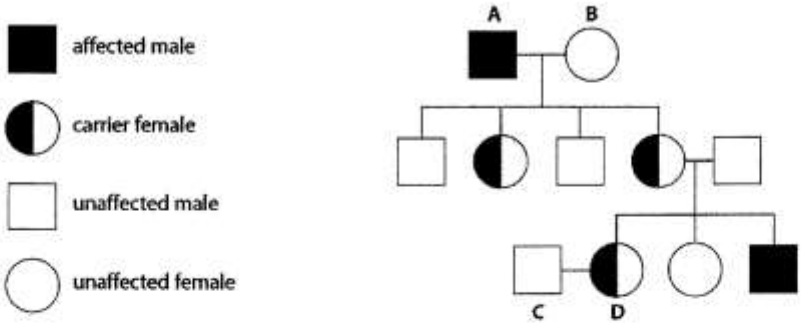
2.1.5 The diagram shows part of one DNA strand. Complete the empty boxes to show the mRNA strand coded for by this DNA strand. (2)

DNA strand	G	G	C	T	A	G	T	T	G
mRNA strand									

2.1.6 State the maximum number of amino acids that are coded for by this DNA strand. (1)

[11]

2.2 Haemophilia is a recessive sex-linked disorder. This family pedigree shows the inheritance of haemophilia.



2.2.1 State the sex chromosomes of person **B**. (2)

2.2.2 Give the genotype for **A and B.** (2)

2.2.3 Explain why the male offspring from A and B do not have haemophilia. (2)

2.2.4 Use a Punnett square, calculate the probability that individuals **C** and **D** could have a child with haemophilia. (3)

(9)

2.3 The European Corn Borer (ECB) worm is a pest which reduces crop yield of corn farms. The soil bacterium *Bacillus thuringiensis* (Bt) contains a gene which causes the production of a poison which kills the ECB worm. In an effort to control the ECB worm, scientists incorporated the Bt poison gene into a corn plant resulting in corn plants that produce the same poison.

They wanted to investigate if using the Bt corn would increase crop yield.

The scientists conducted the investigation as follow:

- They planted Bt corn in one field and non Bt corn in another field (the environmental conditions for the two fields were exactly the same)
- The European Corn Borer was introduced to the fields
- The plants were grown and harvested after a period of five months
- The average yield of plants was recorded
- The experiment was repeated four times and an average was calculated

The results are shown in the table below

TABLE SHOWING THE AVERAGE YIELD OF DIFFERENT VARIETIES OF CORN PLANTS

	Average crop yield (bushels per acre)
Corn variety	**With ECB**
non Bt	146
Bt corn	158

10

2.3.1 Name the process by which Bt gene is inserted into the corn to make it Bt corn. (1)

2.3.2 State the hypothesis of this investigation. (2)

2.3.3 State the:

a) Independent variable (1)
b) Dependant variable (1)

2.3.4 Describe ONE way in which the reliability was ensured in this investigation. (1)

2.3.5 State the conclusion for this investigation. (2)

2.3.6 Explain ONE benefit to a farmer of using Bt corn. (2)

2.3.7 On the same set of axes, draw a bar graph to show the average crop yield of the two varieties of corn plants. (4)

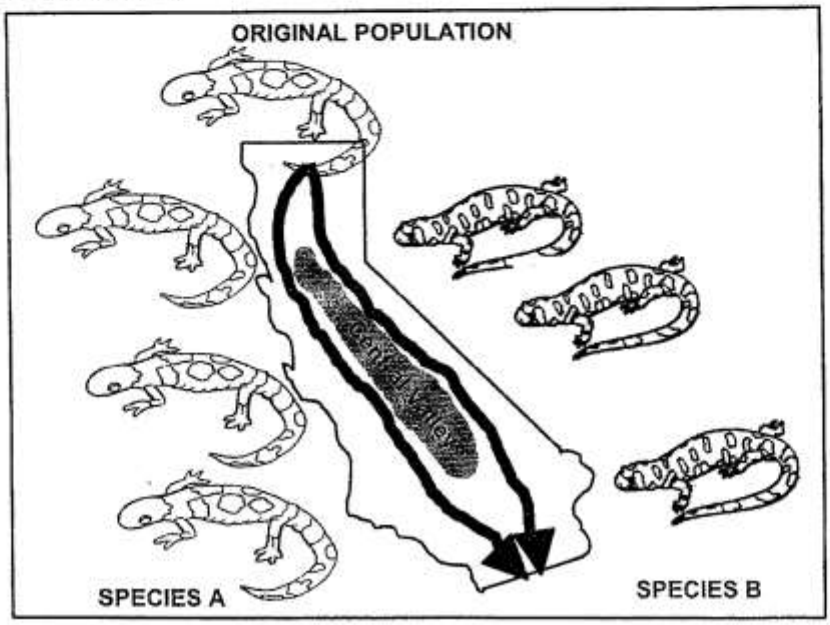
[14]

2.4 Zodwa is blood group O and has a daughter Thandeka who is blood group B. There are two possible fathers. Sipho is blood group B and Jabu is blood group AB. Zodwa says that she is sure that Sipho is the father but he says he is not.

Use your knowledge of the different blood group alleles to draw a full genetic diagram to prove if Sipho is the father of Thandeka or not. **(6)**

Question 3

3.1 The diagram below shows an evolutionary process taking place in a population of salamanders in California. The process took place gradually, millions of years ago. Study the diagram and answer the questions that follow.



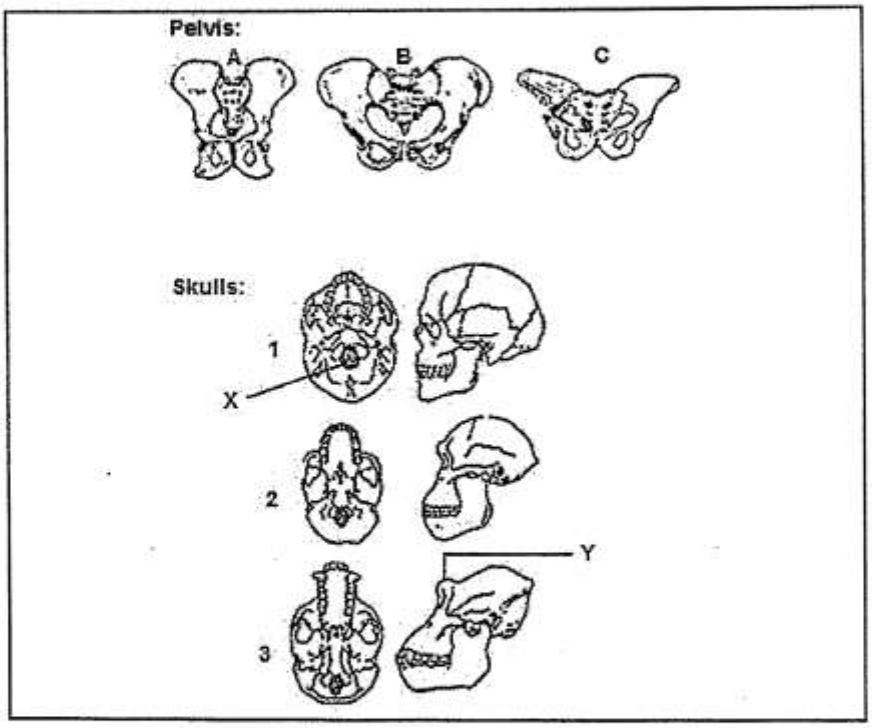
3.1.1 What evolutionary process is illustrated in the diagram above? (1)

3.1.2 Use the diagram to explain how the Species **B** evolved from the original population. (6)

3.1.3 Explain why this is not an example of punctuated equilibrium. (3)

(10)

3.2 The following diagrams show the pelvis and skulls of three organisms, *Australopithecus,* a gorilla and modern human in no particular order.



3.2.1 Give the LETTER of the pelvis and the NUMBER of the skull of the organism which is bipedal most of its adult life. (2)

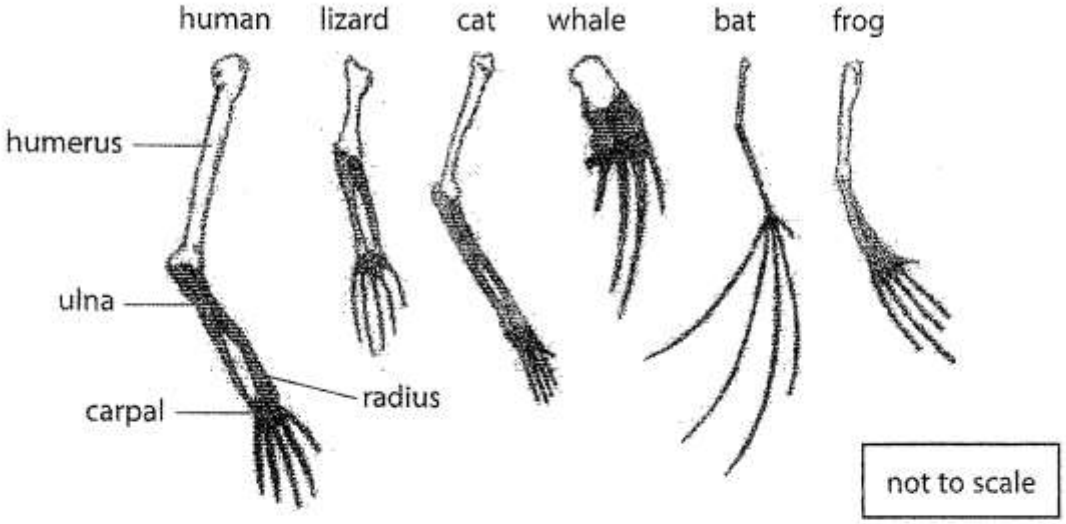
3.2.2 Give the LETTER of the pelvis and the NUMBER of the skull which belongs to a modern human. (2)

3.2.3 Feature X enables a physical phenomenon which has many advantages to modern humans. Name this phenomenon. (1)

3.2.4 Tabulate TWO anatomical differences between skulls 1 and 3 with respect to labels X and Y (5)

[10]

3.3 The diagrams show the limbs of six organisms.



3.3.1 Many scientists believe that these six organisms evolved from one common ancestor.

Describe the evidence shown in the diagrams that supports this belief. (3)

3.3.2 Give the term for features that appear to be similar, have similar functions but have evolved in different ways. (2)

[5]

3.4 Read the extract below.

The recent Ebola outbreak has international medical organisations on high alert. The Ebola virus is deadly because it causes uncontrolled bleeding. The virus is only spread through direct contact with body fluids. There is, however, concern as to whether the Ebola virus could mutate, thereby enabling it to be transmitted through the air. If this happens, the virus would spread more easily.

This virus contains RNA only and when RNA is copied, many more mistakes are made than when DNA is copied. The Ebola virus, therefore, displays high mutation rates that generate lots of genetic variation.

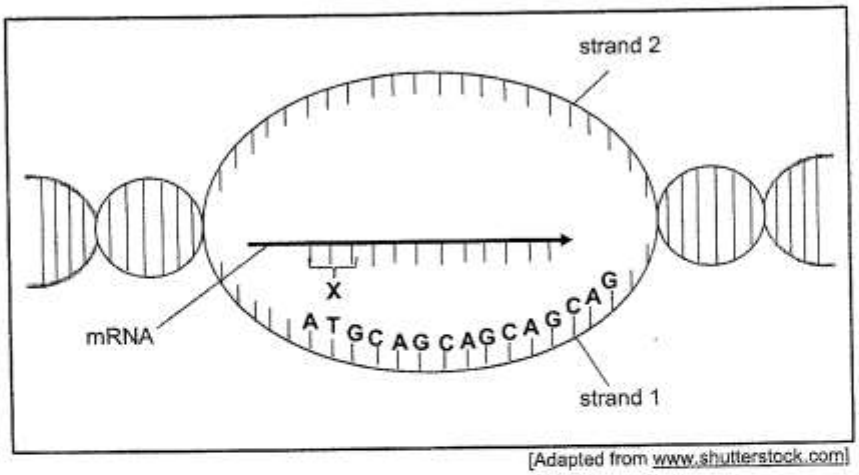
[Adapted from https://www.evolution.berkeley.edu]

3.4.1 State why viruses that contain only RNA show more genetic variation than viruses containing DNA. (2)

3.4.2 Name three types of mutations that can occur when nucleic acids are copied. (3)

[5]

3.5 The diagram below shows the process whereby an mRNA molecule is formed from the DNA molecule.



[Adapted from www.shutterstock.com]

3.5.1 Name the process taking place in the organelle. (1)

3.5.2 Name the organelle where this process takes place. (1)

3.5.3 Explain how the mRNA will exit this organelle. (1)

3.5.4 What is the function of the mRNA once it leaves this organelle? (2)

3.5.5 Which organelle is the target of the mRNA? (1)

3.5.6 Name the part X. (1)

3.5.7 What happens to strand 1 and 2 once this process is completed? (1)

3.5.8 Name the anti-codon that will join up to the mRNA codon to form an amino acid. (2)

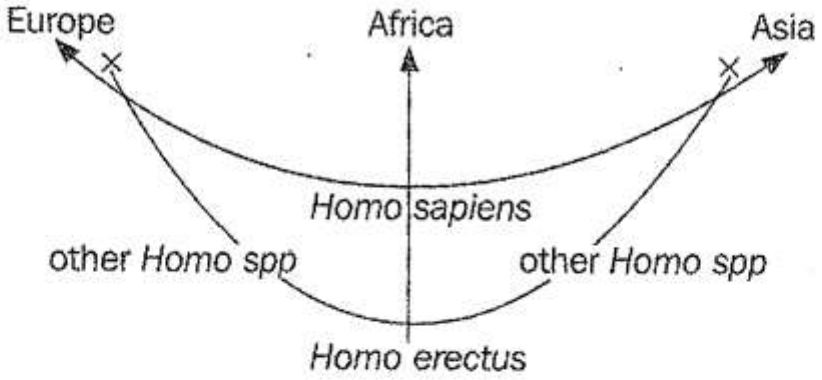
[10]

TOTAL SECTION B: 80 MARKS

SECTION C

QUESTION 4

The diagram shows one idea of human migration and evolution called the 'Out of Africa hypotheses."



Use the diagram to write an essay in which you describe the 'Out of Africa Hypothesis' of human evolution and describe the evidence that supports it. Describe in your essay the origin of *Homo erectus* and why the Homo genus is considered to be separate from the earlier hominins in Africa

Content: (17)

Synthesis: (3)

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

TOTAL SECTION C: 20 MARKS

GRAND TOTAL: 150