GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2025

10832

LIFE SCIENCES

(PAPER 2)

LIFE SCIENCES: Paper 2

10832E

TIME: 2½ hours

MARKS: 150

19 pages

X05

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, flow charts or tables 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 answer and write only the letter (A – D) next to the question numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D.

1.1.1 A change in the characteristics of species over time is known as …

A a biological species.
B a population.
C a natural selection.
D biological evolution.

1.1.2 Which of the following options is the correct combination of sources of variation?

A Crossing over, random arrangement of chromosomes, mutations and mitosis.
B Crossing over, random arrangement of chromosomes, continuous variation and random fertilisation.
C Random mating, random fertilisation, mutations and meiosis.
D Meiosis, mutations, discontinuous variation and continuous variation.

1.1.3 Evolution involving long periods of time during which species undergo little or no change, followed by short periods of time where species undergo rapid change through natural selection, is called …

A Lamarckism.
B punctuated equilibrium.
C artificial selection.
D gradualism.

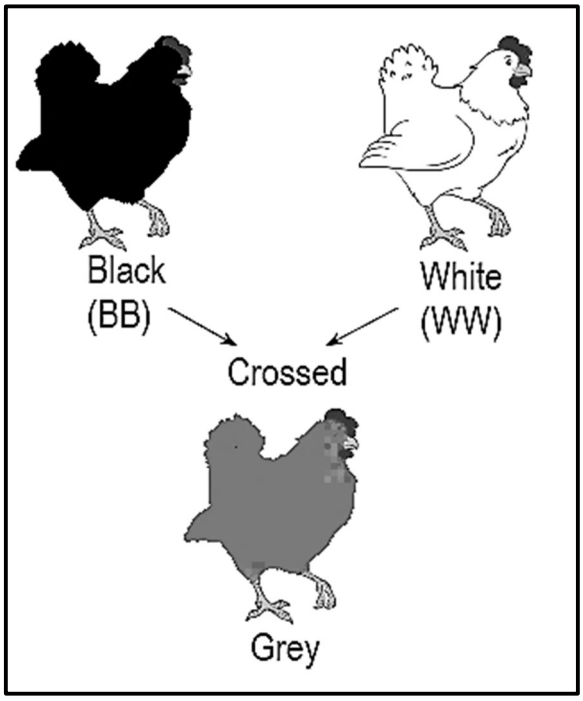
1.1.4 Which of the following fossils does not belong to the *Australophithecus africanus*?

A Mrs Ples
B Lucy
C Little Foot
D Taung Child

1.1.5 Which of the following is only found in an RNA nucleotide?

A Adenine nitrogenous base
B Uracil nitrogenous base
C Deoxyribose sugar
D Phosphate

QUESTIONS 1.1.6 AND 1.1.7 ARE BASED ON THE DIAGRAM BELOW.



[Source: *Nagwa.com*]

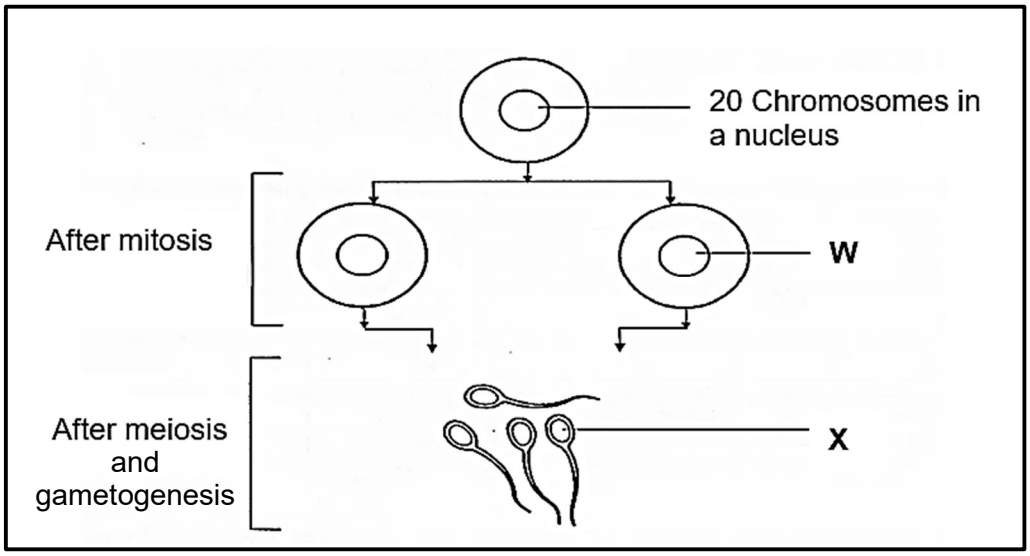
1.1.6 What type of dominance results in an intermediate phenotype as shown in the diagram above?

A Co-dominance
B Complete dominance
C Incomplete dominance
D Law of dominance

1.1.7 The genotype of the grey chicken is:

A Bb
B BW
C WW
D Bw

1.1.8 The diagram below shows the formation of the sperm cells of a fruit fly.

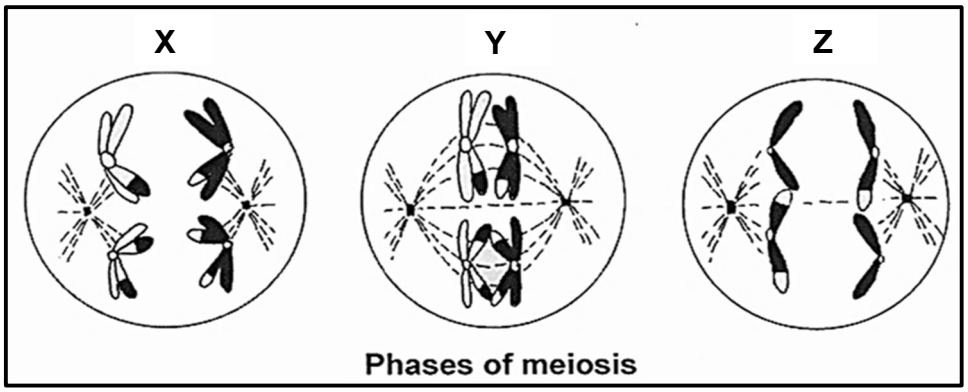


[Source: GP 2014 Prep P2]

How many chromosomes are present in the nucleus of cells **W** and **X**, respectively?

	W	X
A	10	20
B	10	10
C	20	20
D	20	10

1.1.9 The diagrams below represent different phases of meiosis.



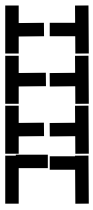
[Adapted from DBE Mind the Gap]

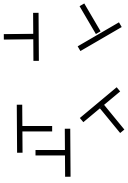
Which of the following represents the correct sequence of phases?

A X, Y and Z
B Y, Z and X
C Z, X and Y
D Y, X and Z

1.1.10 The diagram below shows a DNA molecule on the left and a pool of new nucleotides on the right.

Original DNA molecule

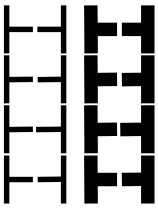
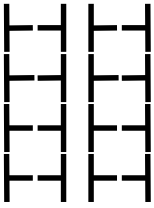
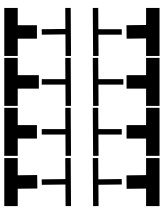
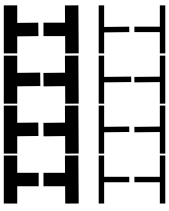




New nucleotides

If replication of the original DNA molecule takes place using the new nucleotides, what would the product of replication look like?

Write down the letter representing the correct product.

A	B	C	D
			

[Source: *Coursehero.com*]

(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 numbers (1.2.1 to 1.2.7) in the ANSWER BOOK.

1.2.1 A diagram used to show the evolutionary relationships between species

1.2.2 The ability of a chimpanzee to walk on all four limbs

1.2.3 The part of the skull that houses the brain

1.2.4 The structure in an animal cell that gives rise to spindle fibres during cell division

1.2.5 A sex-linked genetic disorder whereby blood does not clot

1.2.6 The genetic state of having two identical alleles for a particular characteristic

1.2.7 An organelle containing DNA, found in plant cells and not in animal cells

(7 x 1) **(7)**

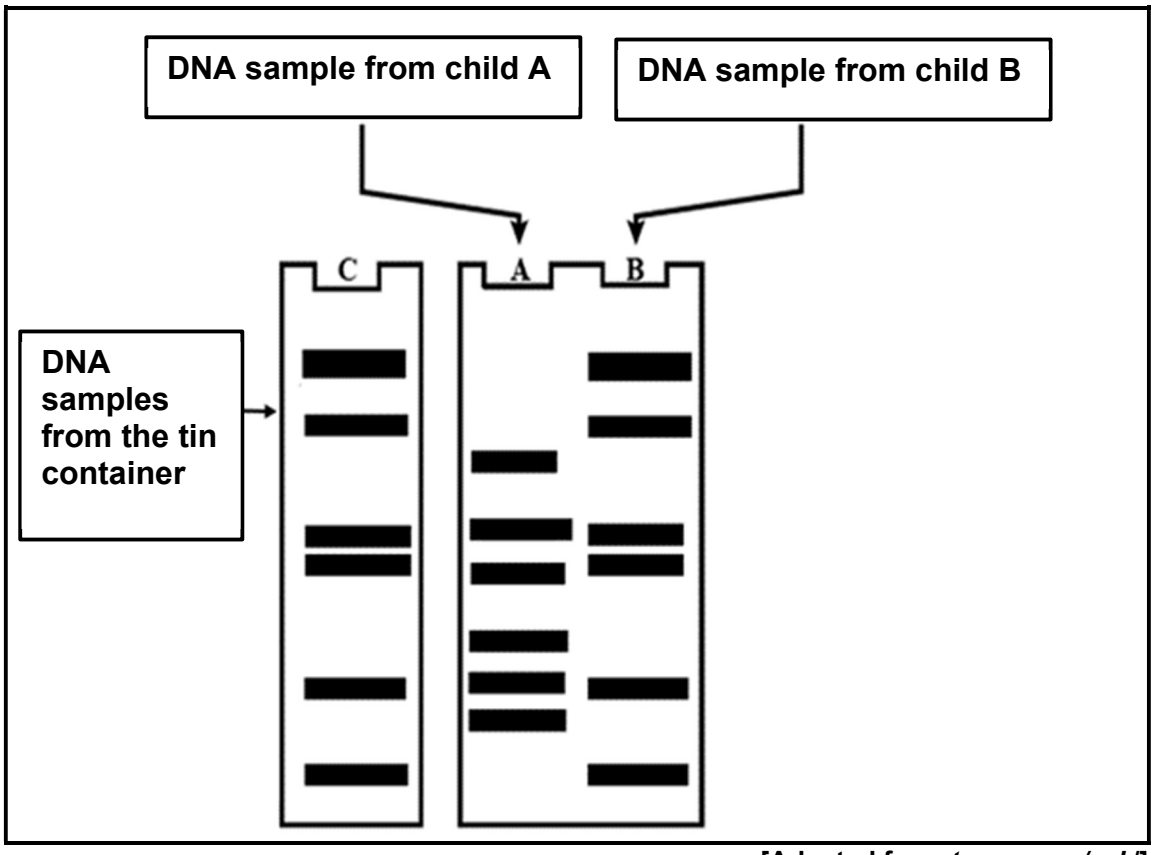
1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY, B ONLY, BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only, B only, both A and B or none** next to the question numbers (1.3.1 to1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Law of use and disuse	A: Eldredge and Gould B: Lamarck
1.3.2	Chromosome complement of a woman with Down syndrome	A: 44 + XX B: 44 + XXX
1.3.3	Father of genetics	A: Mendel B: Watson

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

1.4 Mrs Forbes had baked a graduation cake for her sister and then left it in a tin container in the cupboard. When she returned from work, all that remained in the tin container were crumbs from the cake and traces of blood droplets, where the thief had grazed his/her finger on the sharp part of the container.

Below are the DNA samples of her two children, along with the DNA sample from the blood found on the tin container.



[Adapted from *toppr.com/ask/*]

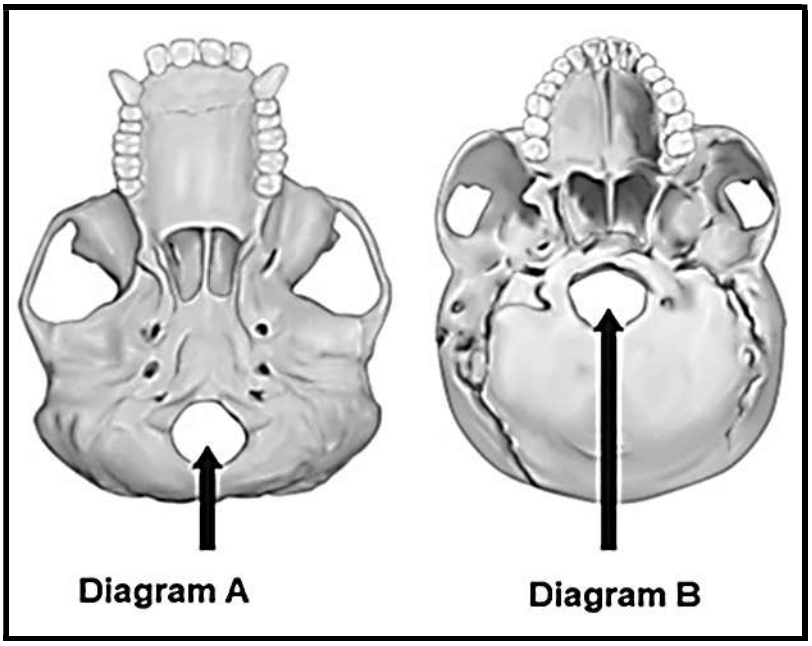
1.4.1 Name the technique used to compare the DNA bars to identify the suspect. (1)

1.4.2 Give the letter of the child who most likely ate the cake. (1)

1.4.3 From the list below, write down the LETTERS of the TWO correct uses of the technique named in QUESTION 1.4.1.

A Cloning
B Identifying genetic disorders
C To establish family relations
D Genetic engineering (2)
(4)

1.5 Diagrams **A** and **B** show the skulls of two hominids.



[Source: *https://ars.els-cdn.com/content/image*]

1.5.1 Which diagram (**A** or **B**) shows …

(a) a larger cranium? (1)

(b) a skull of a chimpanzee? (1)

1.5.2 Name the opening to which the arrows are pointing. (1)

1.5.3 State the shape of the jaw in diagram **A**. (1)

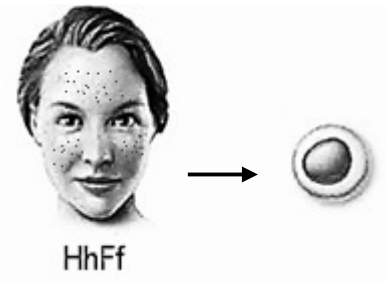
1.5.4 Give the letter of the diagram (**A** or **B**) representing a bipedal hominid. (1)

1.5.5 Which skull in the diagram (**A** or **B**) is better adapted to eating raw, uncooked food? (1)

1.5.6 Give the scientific name of the modern human. (1)
(7)

1.6 In humans, one gene controls hairline and another controls freckles. The hairline can be curved, forming a point down the forehead (called a widow's peak) (**H**) or straight (**h**). Freckles, which are tiny brown spots on the face, can be present (**F**) or absent (**f**). The diagram below shows a cross between a male and female who are both heterozygous for both genes.





	HF	**Hf**	**hF**	**Hf**
HF	HHFF	HHFf	HhFF	**X**
Hf	HHFf	HHff	HhFf	Hhff
hF	HhFF	HhFf	hhFF	hhFf
hf	HhFf	Hhff	hhFf	**Y**

[Adapted from *Shiken.ai*]

1.6.1 Name the type of genetic cross represented above. (1)

1.6.2 State the dominant characteristic of the hair line. (1)

1.6.3 Name the process in reproduction indicated by the:

(a) Arrows (1)

(b) Punnett square (1)

1.6.4 Give the:

(a) Genotype of offspring **X** (1)

(b) Phenotype of offspring **Y** (1)

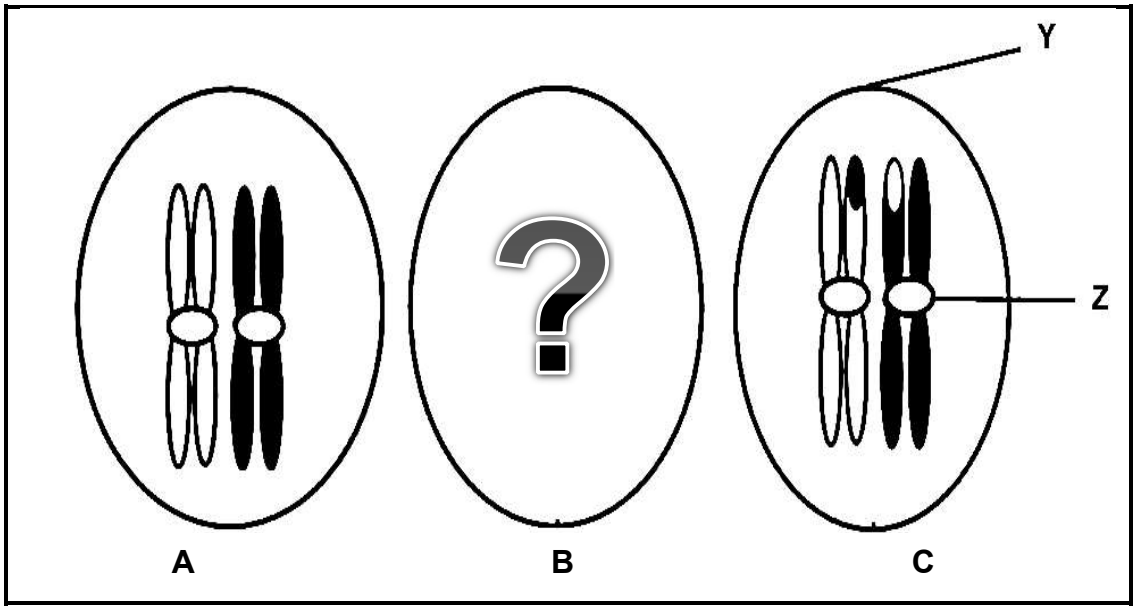
(6)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagrams below represent a chromosome pair in a male human cell. The cells (**A**, **B** and **C**) show different events in a phase of meiosis.



[Adapted from DBE National Textbook]

2.1.1 Provide labels for the following structures:

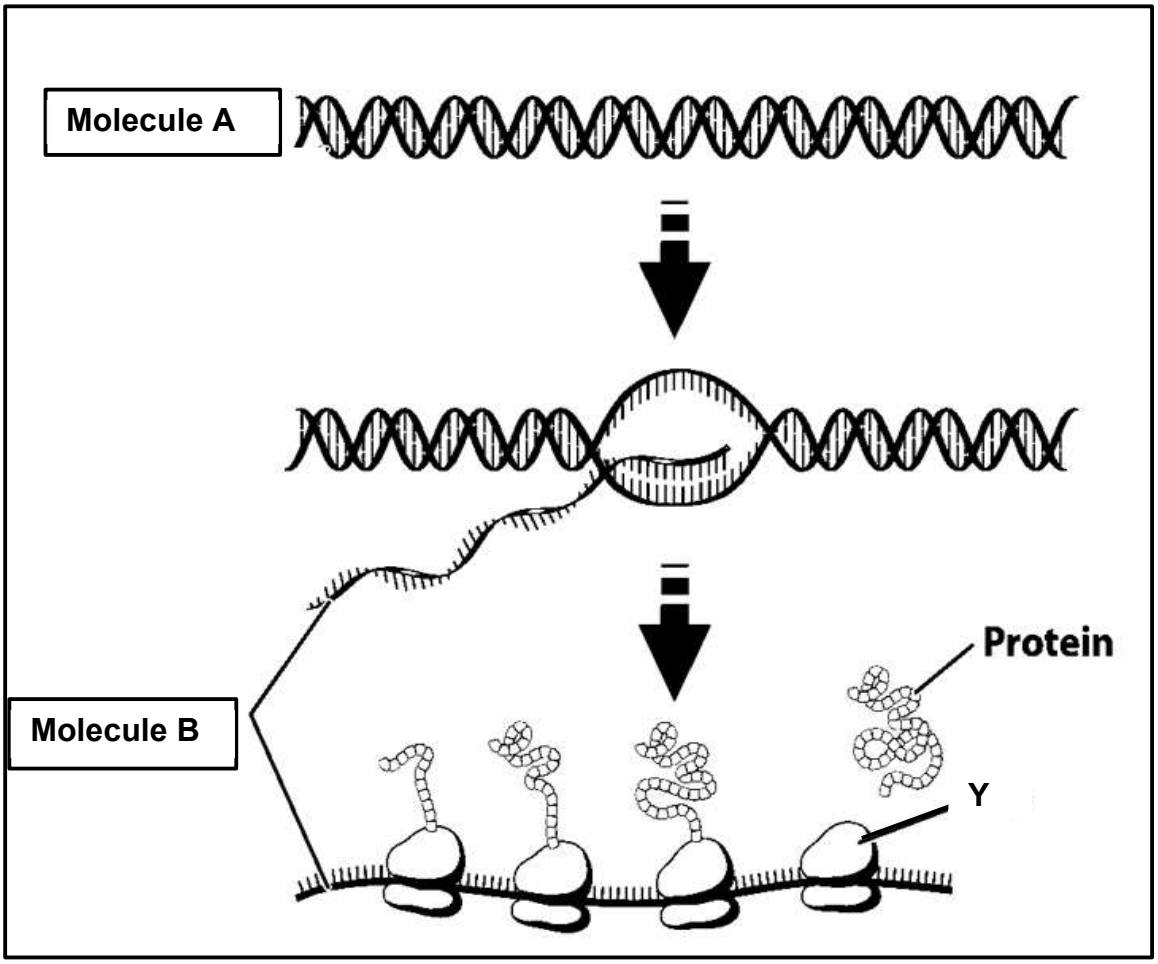
(a) **Y** (1)
(b) **Z** (1)

2.1.2 Name and describe the process that caused the chromosomes in cell **C** to look different from the original chromosomes in cell **A**. (4)

2.1.3 Explain the impact of the process named in QUESTION 2.1.2 for the survival of a species. (3)

2.1.4 Draw a labelled diagram showing how the chromosomes would appear in cell **B** during the process named in QUESTION 2.1.2.
(Do NOT include labels for **Y** and **Z**.) (5)
(14)

2.2 The diagram below represents processes that occur during protein synthesis.



[Source: *https://biotech.gsu.edu/2107/lecture24.html*]

2.2.1 Identify:

(a) Molecule **A** (1)
(b) Molecule **B** (1)

2.2.2 Describe THREE structural features of molecule **A**. (3)

2.2.3 State the function of organelle **Y**. (1)

2.2.4 Name and describe the stage of protein synthesis that takes place at organelle **Y**. (5)
(11)

2.3 The information below shows the sequences of a protein's first six amino acids found in the saliva of Angela and Brian. A mutation caused a change in Brian's sequence of amino acids. The amino acids are sequenced from left to right.

	Sequence of amino acids					
Angela	Glycine	Valine	Histidine	Proline	Isoleucine	Tyrosine
Brian	Glycine	Valine	Histidine	Valine	Isoleucine	Tyrosine

2.3.1 Describe how a mutation caused the change to Brian's amino acid sequence. (4)

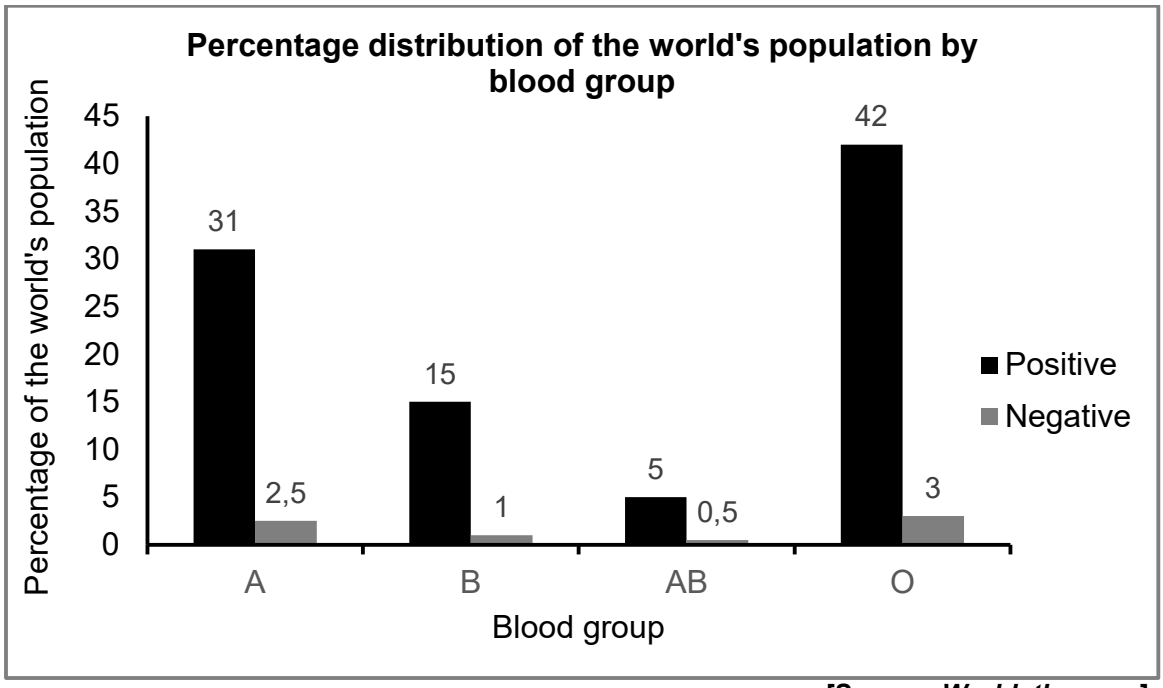
2.3.2 How many mRNA nucleotides would be involved in forming the portion of the protein shown for Angela in the table above? (1)

2.3.3 A section of mRNA has the following base sequence and is read from left to right:

CUG ACG

Write down the DNA base triplet sequence (from left to right) for the mRNA sequence above. (2)
(7)

2.4 The graph below shows the percentage distribution of the world's population according to blood groups A, B, AB and O, and whether they have the positive or negative forms.



[Source: *Worldatlas.com*]

2.4.1 According to the data, what is the total percentage of the world's population with blood group O? (1)

2.4.2 Tabulate TWO differences between the type of dominance shown by the inheritance of blood group A compared to blood group AB. (5)

2.4.3 Use a genetic cross to show how parents with the two least common blood groups in the world could have a child with blood group A. (6)
(12)

2.5 The CCR5 gene in humans is located on chromosome number 3. This gene is responsible for producing a protein on white blood cells. The HI virus normally uses this protein to attach to and infect white blood cells.

A mutation in the CCR5 gene appears to offer some protection against the HI virus by changing the shape of the protein on the white blood cells.

Scientists have discovered that long-term reduction of the HI virus in patients is possible through stem cell transplants from individuals with this mutation. Bone marrow is a rich source of adult stem cells. These stem cells can develop into new white blood cells.

[Adapted from *link.springer.com*]

2.5.1 Name the type of chromosome on which the CCR5 gene is found. (1)

2.5.2 Define a *stem cell*. (2)

2.5.3 Using the information provided, explain how stem cells from a person with the mutation could reduce the HI virus in patients. (3)

(6)

[50]

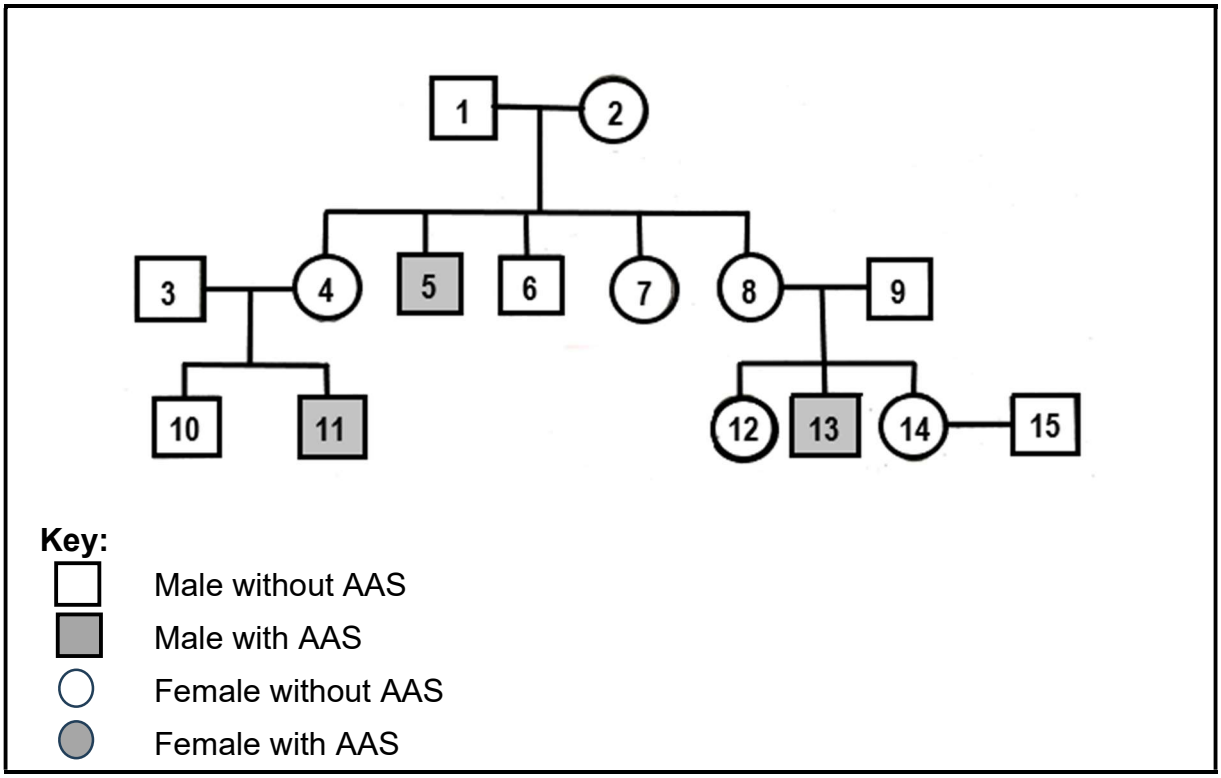
QUESTION 3

3.1 Aarskog-Scott syndrome (AAS) is a rare genetic disorder caused by a recessive allele ($\mathbf{X^a}$) located on the X chromosome. The dominant allele ($\mathbf{X^A}$) results in normal physical features.

People with AAS often have the following physical features:

- Widely spaced eyes
- A small nose
- A long area between the nose and mouth
- A widow's peak hairline
- A shawl scrotum (in which the scrotum surrounds the penis instead of hanging below)
- Undescended testes (Less often)

The pedigree diagram below shows the inheritance of AAS in a family.



[Source: *Medlineplus.gov*]

3.1.1 Using the information provided, state TWO characteristics of AAS that are unique to males. (2)

3.1.2 Define a *recessive allele*. (2)

3.1.3 How many offspring do individuals **8** and **9** have? (1)

3.1.4 State the:

(a) Phenotype of individual **11** (1)

(b) Genotype of individual **4** (1)

3.1.5 Explain why females are less likely to inherit AAS. (3)
(10)

3.2

Cloning is a type of biotechnology used by people who want to keep their beloved dog in their lives. It allows them to produce a genetically identical dog to their previous one; however, it is a very expensive process and reduces genetic variation. During this process, the nucleus from the skin cell of the dog being cloned is removed and placed into the ovum of another female dog (from which the nucleus has been removed). Once the embryo of the cloned dog has formed, it gets implanted into the uterus of a surrogate female dog, where it will develop further until the cloned dog is born.

[Source: *Shutterstock.com*]

3.2.1 Based on the information above, state TWO disadvantages of cloning. (2)

3.2.2 Explain why the nucleus of the ovum was replaced with the nucleus of a skin cell. (4)
(6)

3.3

Frogs produce different sounds to attract females of the same species to the breeding site. The calls signal the start of a breeding season. *H. ornate* breeds in summer, and the males make strong chorus sounds. However, *P. adspersus* breeds in spring, and the males make deep, low-pitched whoops.

3.3.1 List THREE requirements that organisms must satisfy before they can be called a species. (3)

3.3.2 Use the text above to identify and describe TWO reproductive isolation mechanisms between these frog species. (4)

3.3.3 Frogs become reproductively isolated because they are different species. This may have happened due to geographic isolation.

Describe speciation through geographic isolation. (6)
(13)

3.4 Tuberculosis (TB) is a bacterial infection caused by the bacterium *Mycobacterium tuberculosis*. TB can be life-threatening. Resistant strains of *Mycobacterium tuberculosis* have evolved because some patients do not complete their antibiotic treatment. Isoniazid is one of the antibiotics used as a first-line treatment for TB and to prevent TB from becoming active.

A survey conducted by the National Institute of Communicable Diseases from 2013 – 2014 compared the percentage of patients in whom TB has developed resistance to Isoniazid antibiotics with that of a 2001 – 2002 survey.

The 2013 – 2014 survey was conducted as follows:

- 349 patients with TB receiving treatment with Isoniazid were selected. They were from different South African hospitals or clinics in all nine provinces.
- All the patients were over 18 years of age.
- All the patients' medical records were reviewed.

The table below shows the percentage of patients in which TB has developed resistant to Isoniazid antibiotic in each of the 9 provinces for both surveys.

Province	**The percentage of patients in whom TB has developed resistance to Isoniazid antibiotic over the years**	
	2001 – 2002	**2013 – 2014**
Eastern Cape	3,5	5,0
Free State	3,7	5,6
Gauteng	1,3	4,7
KwaZulu-Natal	3,4	4,3
Limpopo	2,9	4,2
Mpumalanga	2,7	6,3
North West	1,4	5,0
Northern Cape	4,2	7,0
Western Cape	2,4	6,1

[Source: *https://www.nicd.ac.za/assets/files/K-12750%20NICD%20National%20Survey%20Report_Dev_V11-LR.pdf*]

3.4.1 Name the theory that Charles Darwin proposed to explain how *Mycobacterium tuberculosis* evolved to become antibiotic-resistant. (1)

3.4.2 Identify the dependent variable. (1)

3.4.3 Which province had the highest percentage of TB patients with resistance to Isoniazid in the 2013 – 2014 survey? (1)

3.4.4 State ONE way in which the reliability of this survey was ensured. (1)

3.4.5 Give TWO factors that were kept constant during this investigation. (2)

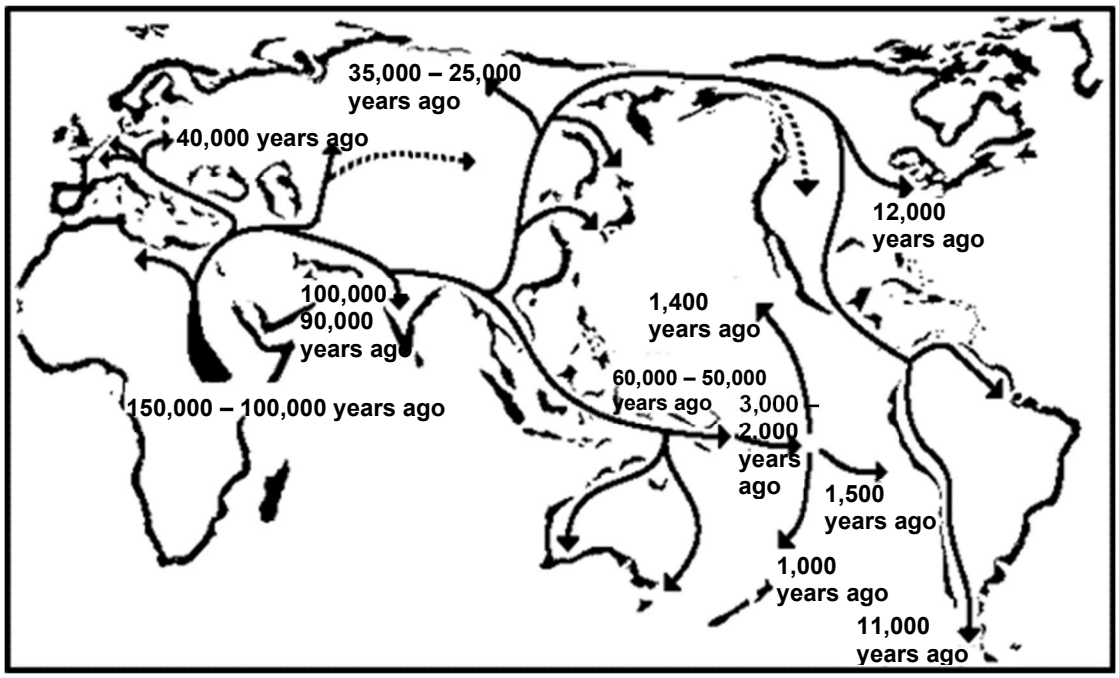
3.4.6 Calculate the average percentage of patients who had drug resistance to Isoniazid in South Africa during the 2013 – 2014 survey.

Show ALL calculations. Round-off your answer to two decimal places. (3)

3.4.7 Use the information in the table to formulate a conclusion for this survey. (2)

3.4.8 Draw a bar graph representing the 2013 – 2014 survey results for the Eastern Cape, Free State, North West and Northern Cape only. (6)
(17)

3.5 The map below represents a hypothesis used in evolution to describe the origin of modern humans based on the ages of fossils discovered worldwide.



[Source: *https://factsanddetails.com/archives/003/201810/5bd26afc8eef2.png*]

3.5.1 Identify the hypothesis represented by the map above. (1)

3.5.2 Describe how genetic evidence can support the hypothesis identified in QUESTION 3.5.1. (2)

3.5.3 Name ONE type of evidence used to support the hypothesis identified in QUESTION 3.5.1 other than genetic evidence. (1)
(4)
[50]

TOTAL SECTION B: 100

TOTAL: 150

END