education

Department of Education
FREE STATE PROVINCE

GRADE 12

LIFE SCIENCES P2

June 2025

TOTAL: 150

TIME: 2 ½ HOURS

This question paper consists of 15 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. Make 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.

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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 number (1.1.1 to 1.1.8) in the ANSWER BOOK, for example 1.1.11 D.

1.1.1 Random arrangement of homologous chromosomes in pairs at the equator of a cell takes place during …

A Prophase 1.
B Metaphase 1.
C Anaphase 2.
D Metaphase2.

1.1.2 The statements below describe the steps in the process of cloning an animal.

(i) The embryo is implanted into the uterus of an adult female for development.
(ii) The nucleus from a somatic cell of the donor is extracted.
(iii) The nucleus from the somatic cell is inserted into the ovum.
(iv) The nucleus from the ovum of another individual is removed.
(v) The ovum with the new nucleus is given an electric shock to stimulate cell division and the formation of the embryo.

The correct sequence of steps for this process is…

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

1.1.3 Which scientists were credited with first describing the DNA molecule?

A Rosalind Franklin and Maurice Wilkins
B Maurice Wilkins and Francis Crick
C James Watson and Rosalind Franklin
D James Watson and Francis Crick

1.1.4 In ants, females are diploid, and males are haploid. Females and males both produce haploid gametes.
This means that …

A females produce gametes by mitosis.
B males produce gametes by meiosis.
C males produce gametes by mitosis.
D females have half the number of chromosomes that males have.

1.1.5 The table below shows the percentages of nitrogen bases in DNA samples from various organisms.

Source of DNA	Adenine	Cytosine	Guanine	Thymine
Human liver	30	20	20	**Z**
Chicken liver	**W**	40	40	10
Dog liver	24	26	26	24
Mouse bone marrow	23	**X**	27	23
Sunflower leaf	11	39	**Y**	11

Which ROW of the table below correctly reflects the missing data values?

	W	X	Y	Z
A	10	23	38	30
B	10	26	39	31
C	10	27	39	30
D	10	25	38	29

1.1.6 When two heterozygous plants for a characteristic are crossed, the expected genotype ratio is:

A 3:1
B 1:2:1
C 2:1:2
D 1:2

1.1.7 The DNA of different species only differs in the …

A components of the nucleotides.
B sequence of the nucleotides.
C type of bond between the nitrogen bases.
D type of sugar that it contains.

1.1.8 How do codons and anticodons contribute to the process of protein synthesis?

A Codons determine the sequence of amino acids in proteins, while anticodons recognize the codons and bring the correct amino acids to the ribosome.
B Anticodons determine the sequence of amino acids in proteins, while codons recognize the anticodons and bring the correct amino acids to the ribosome.
C Codons and anticodons are only involved in transcription.
D Codons determine the sequence of amino acids in proteins, while anticodons recognize the codons and bring random amino acids to the ribosome.

(8 x2) **(16)**

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 The phase in the cell cycle when DNA replication takes place

1.2.2 An inherited condition where the blood's ability to clot is impaired due to a missing clotting factor

1.2.3 The process where a unique striped pattern is obtained from a person's DNA or sample of bodily fluid

1.2.4 The structure in an animal cell that forms spindle fibers

1.2.5 The type of bond between two nitrogenous bases in a DNA molecule

1.2.6 An organism that has identical alleles for a characteristic

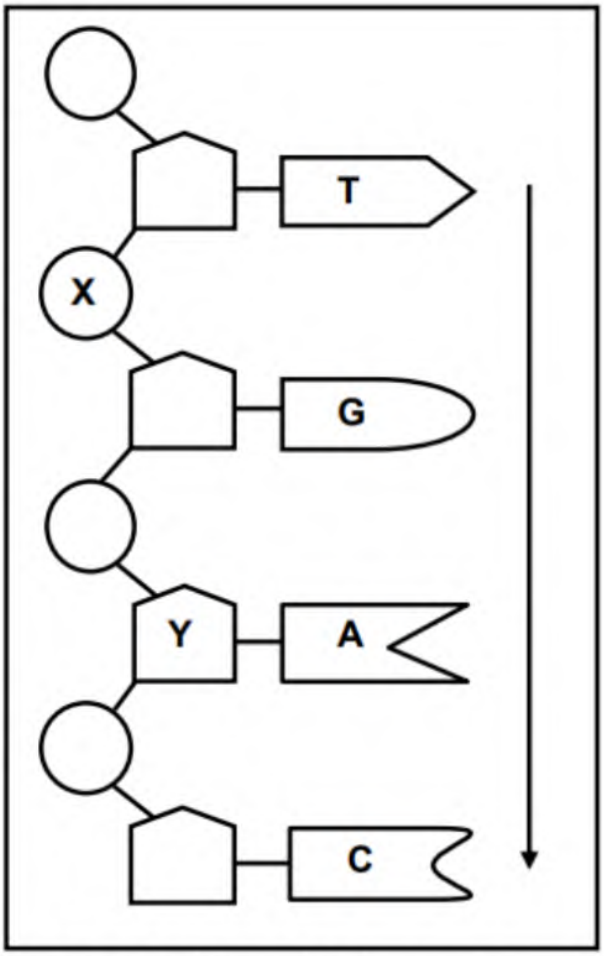
1.2.7 The sugar present in RNA (7x1) **(7)**

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 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	The origin of mitochondrial DNA in a person	A: Maternal grandmother B: Maternal grandfather
1.3.2	Percentage chance of a child being female	A: 25% B: 75%
1.3.3	When two different alleles in a heterozygous individual result in a phenotype that is different from both homozygous parents.	A: Complete dominance B: Incomplete dominance

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

1.4 The diagram below represents nucleotides in a single strand of a DNA molecule.



1.4.1 Give the LETTER of the part that represents:

(a) A sugar molecule (1)

(b) A phosphate molecule (1)

1.4.2 What is the natural shape of this molecule? (1)

1.4.3 If this strand was to be replicated, write the sequence of nitrogenous bases on the complimentary strand from top to bottom. (2)

1.4.4 State TWO location of DNA, other than the nucleus. (2)

1.4.5 Which nitrogenous base in the diagram would not be present in RNA? (1)

1.4.6 How many *different* nucleotides can be found in a DNA molecule? (1)
(9)

1.5 In mice, the characteristics of hair colour and hair length are controlled by the following alleles:

Hair colour:	**B** black **b** brown	Hair length:	**H** short **h** long

A mouse with black, long hair was crossed with a mouse with brown, long hair. All the F1 offspring had black, long hair.

1.5.1 Name this type of genetic cross? (1)

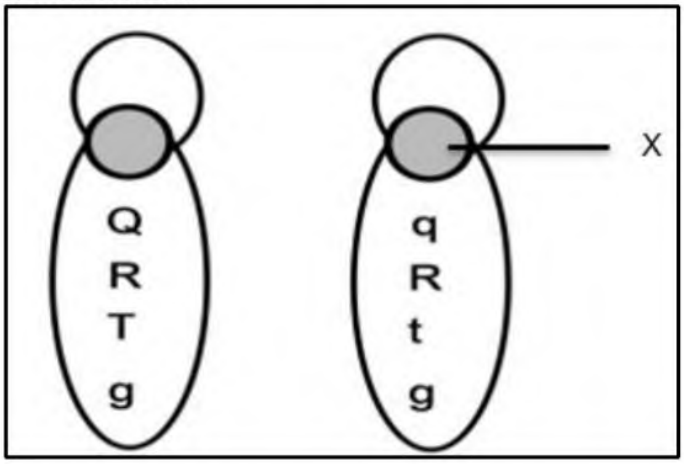
1.5.2 Give the:

(a) Genotype of the parent mouse with black, long hair. (2)

(b) Genotype of all the possible gametes of the parent mouse with brown, long hair. (1)

(c) Phenotype of a mouse with the genotype **bbHh.** (2)
(6)

1.6 The diagram below represents a pair of homologous chromosomes with alleles on specific loci as indicated.



1.6.1 How many genes are represented? (1)

1.6.2 Give the number of characteristics for which this individual is heterozygous. (1)

1.6.3 State TWO features of the chromosomes represented that indicate that they are homologous. (2)

1.6.4 Identify structure **X**. (1)

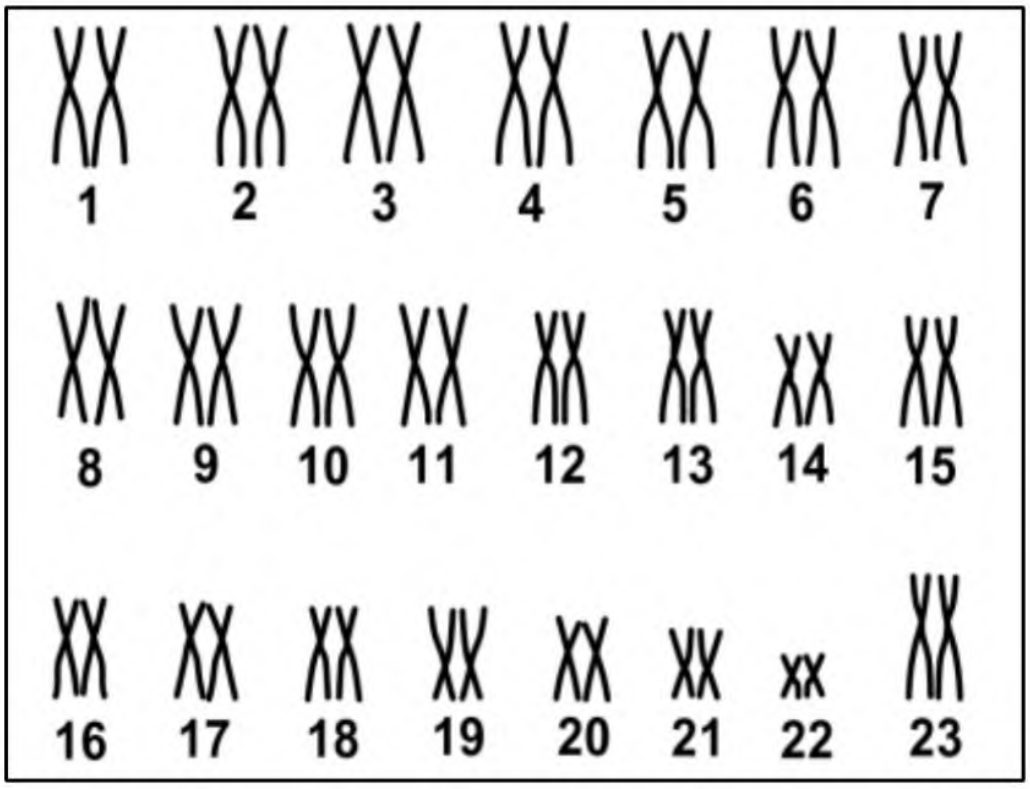
1.6.5 Which type of cell (**diploid cell** or **haploid cell**) contains homologous chromosomes? (1)
(6)

TOTAL SECTION A: (50)

SECTION B

QUESTION 2

2.1 The diagram below represents the karyotype of a human somatic cell.



2.1.1 Describe what a *karyotype* is? (2)

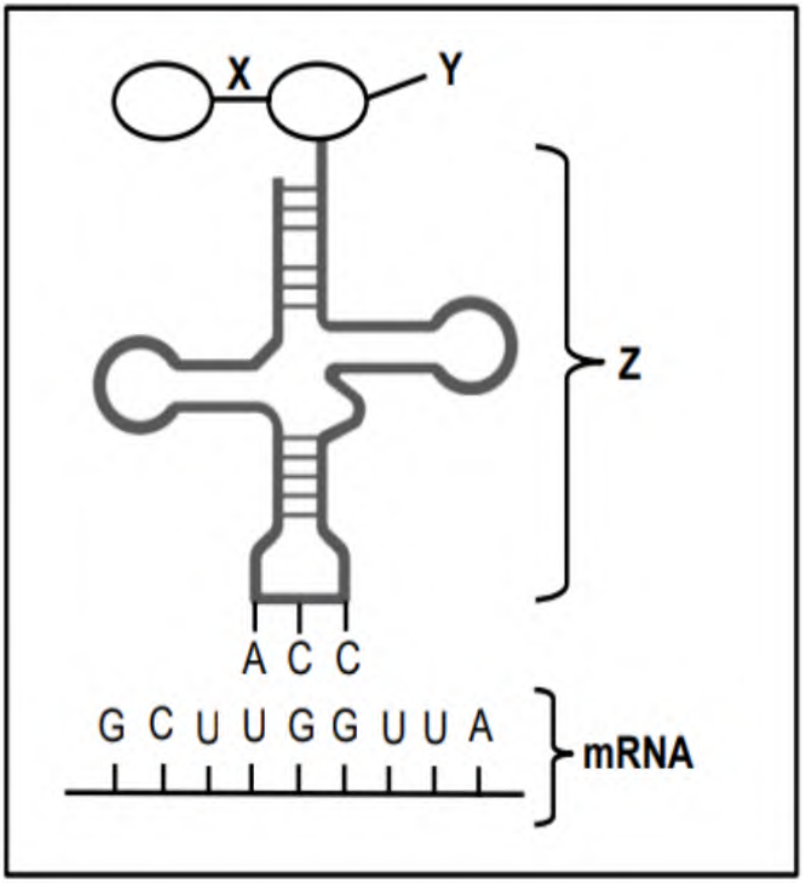
2.1.2 State the collective name for chromosome pair **1** to **22**. (1)

2.1.3 State the phenotype of chromosome pair **23**? (2)

2.1.4 Describe how the karyotype of a person with Down syndrome would differ from the one represented in the diagram. (2)
(7)

2.2 State Mendel's principle of segregation. **(3)**

2.3 The diagram below represents part of a process that occurs during protein synthesis.



2.3.1 Name the process shown in the diagram. (1)

2.3.2 Name the organelle where this proses take place? (1)

2.3.3 Identify:

(a) Bond **X** (1)

(b) Molecule **Z** (1)

2.3.4 How many codons make up the portion of the mRNA molecule? (1)

2.3.5 The table below shows amino acids coded for by different mRNA codons.

mRNA CODON	AMINO ACID
GCU	Alanine
UUA	Leucine
UGG	Tryptophan
UAC	Tyrosine
UUG	Leucine

Use the information in the diagram and in the table to identify:

(a) The amino acid at **Y** (1)

(b) The DNA base triplet that coded for **Y** (2)

(c) How many codons code for Leucine, according to the table? (1)

2.3.6 A mutation caused a DNA base triplet to change from **AAT** to **AAC**. Describe the effect of this mutation on the protein formed. (5)
(14)

2.4 Describe the process of transcription in protein synthesis. **(6)**

2.5 Cheetahs are big cats found in the dry grasslands and woodlands of Southern Africa. Cheetahs normally have spotted fur markings. However, the King Cheetah is a rare variety with striped fur markings. The rarity of the King cheetah is due to a genetic mutation that affects the production of Melanin, resulting in a unique and distinctive coat pattern. The letters **N** and **n** represent the alleles for the different fur markings.

The table shows the results of genetic crosses between two different breeding pairs of cheetahs.

Cross	**Phenotype for fur pattern**	
	Parents	**Offspring**
Breeding pair 1	spotted fur x spotted fur	3 with spotted fur 1 with striped fur
Breeding pair 2	spotted fur x striped fur	2 with spotted fur 2 with striped fur

2.5.1 Which phenotype is recessive? (1)

2.5.2 Explain your answer for QUESTION 2.5.1 using the results in the table (3)

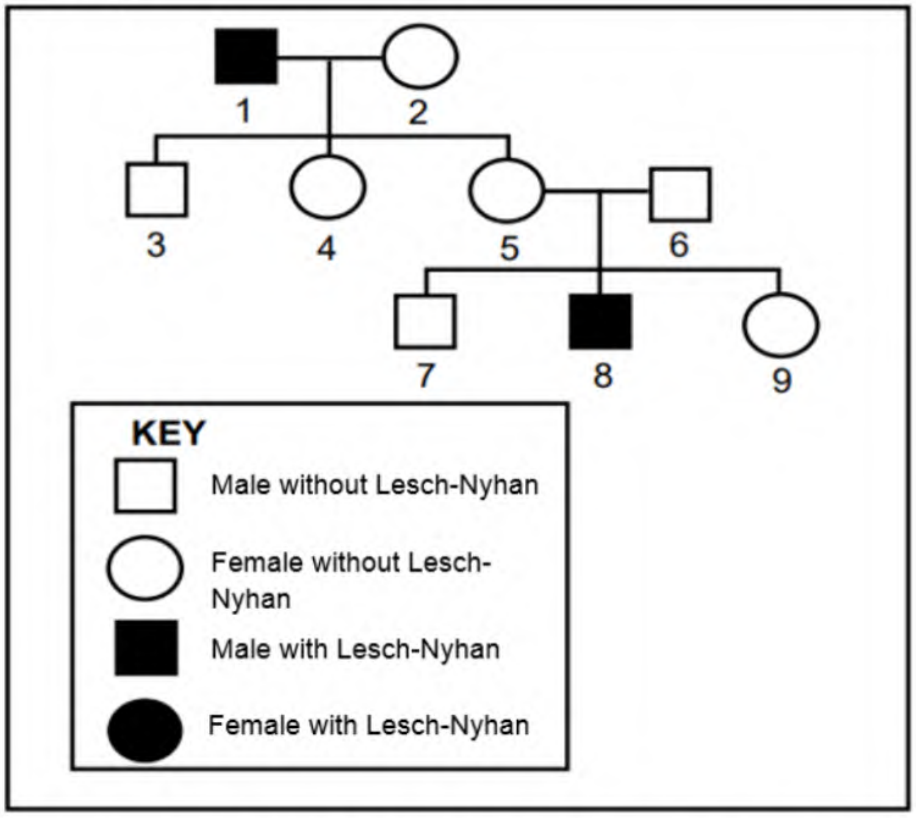
2.5.3 Define the term *gene mutation*. (2)

2.5.4 Name the law of Mendel demonstrated by the phenotype of the offspring? (1)

2.5.5 Use the letters **N** and **n**, do a genetic cross to show the phenotype ratio of the offspring produced when two heterozygous spotted fur cheetahs are crossed. (6)
(13)

2.6 Lesch-Nyhan syndrome is inherited as a sex-linked recessive ($\mathbf{X^r}$) genetic disorder that, with rare female exceptions, most often affects males. The symptoms of Lesch-Nyhan syndrome include decreased kidney function, acute gouty arthritis and self-mutilating behaviours such as lip and finger biting and/or head banging.

The pedigree diagram below shows the inheritance of Lesch-Nyhan syndrome in a family.



2.6.1 How many males in this family suffer from Lesch-Nyhan syndrome? (1)

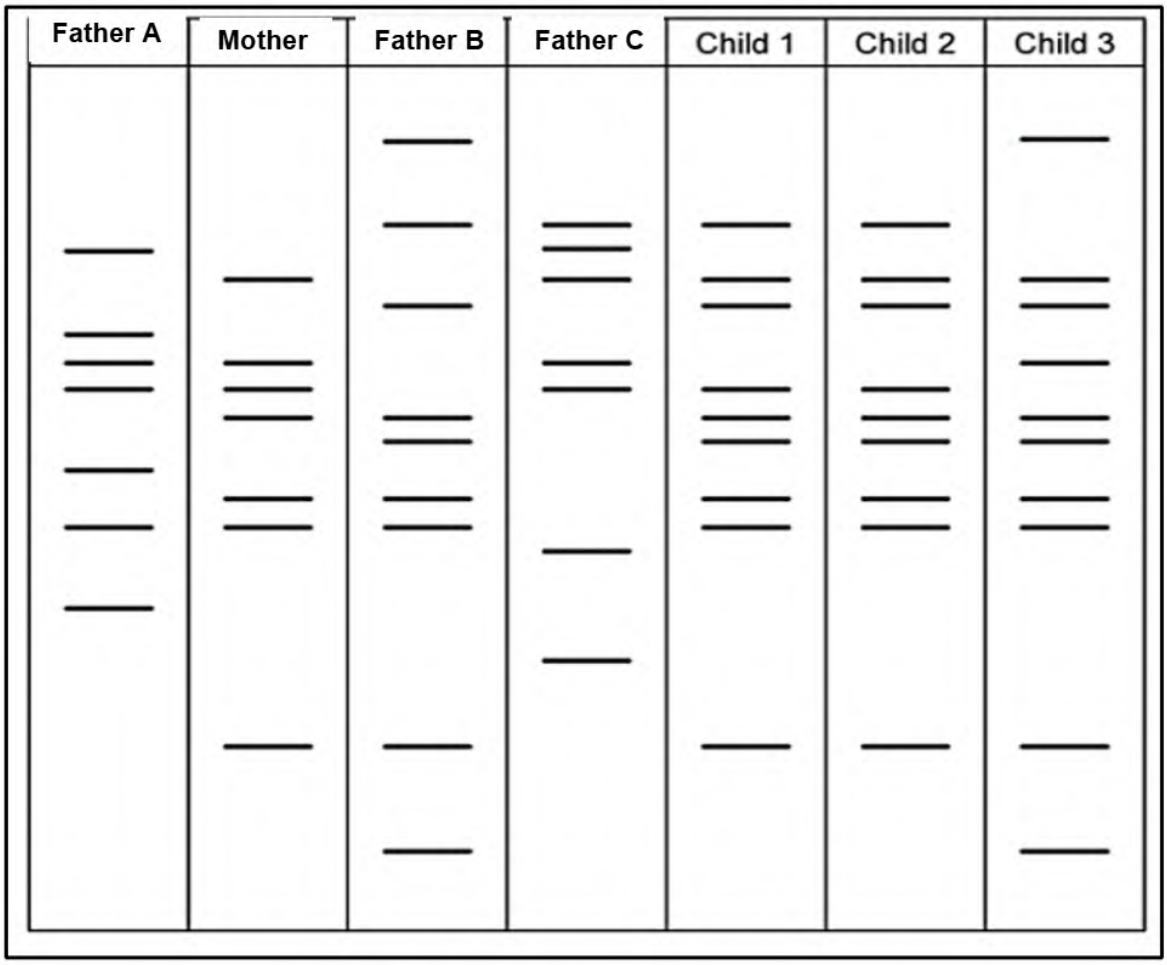
2.6.2 State ALL the possible genotypes of individual 5. (2)

2.6.3 Explain why males are more likely to suffer from Lesch-Nyhan syndrome than females. (4)
(7)

TOTAL QUESTION 2: [50]

QUESTION 3

3.1 The diagram below represents the results of a paternity investigation. It was determined that the three children were siblings (brothers or sisters) and share the same biological mother. Letters **A**, **B** and **C** represent the DNA profile of possible fathers.



3.1.1 Identify the children's father? (1)

3.1.2 Give a reason for your answer to QUESTION 3.1.1. (2)

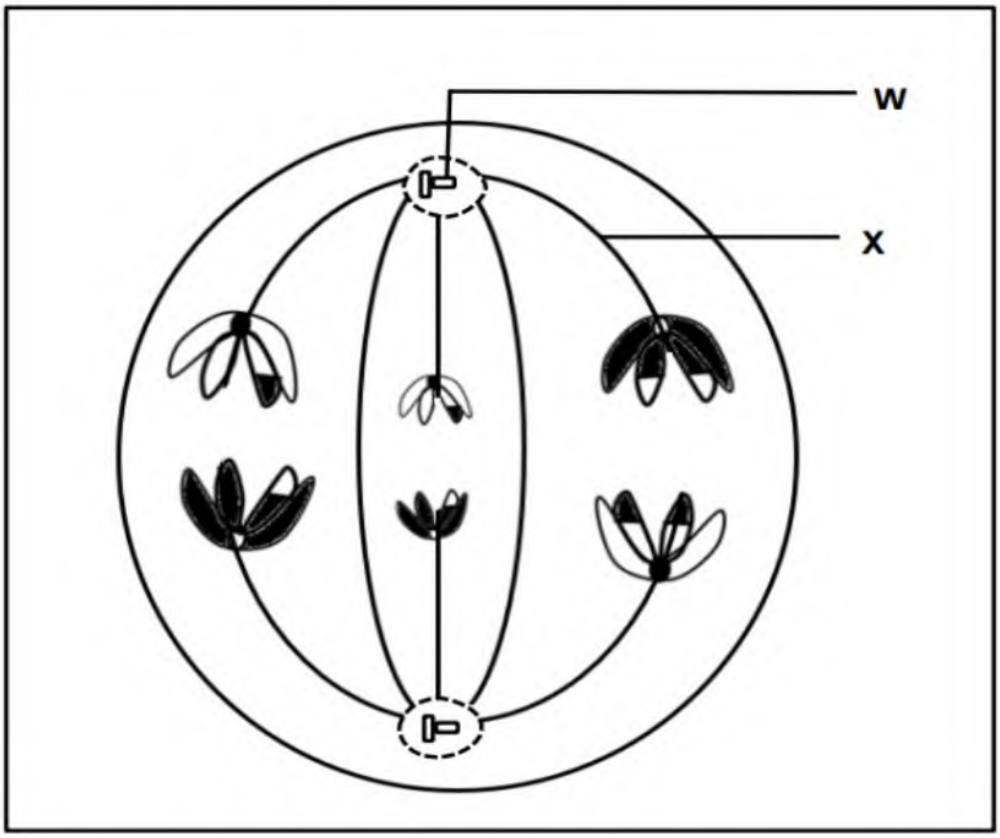
3.1.3 Which of the children are identical twins? (2)

3.1.4 Explain why blood tests are not as accurate in determining paternity as DNA profiling. (3)

3.1.5 State TWO other uses of DNA profiling. (2)

3.1.6 Describe ONE precaution when working with DNA samples in the laboratory to ensure accurate results. (2)
(12)

3.2 The diagram below represents a phase during meiosis.



3.2.1 Identify the phase of meiosis shown. (1)

3.2.2 Give ONE reason for your answer in QUESTION 3.2.1 (1)

3.2.3 Identify the structures:

(a) **W** (1)

(b) **X** (1)

3.2.4 State the number of chromosomes that each gamete will contain at the end of meiosis. (1)
(5)

3.3 Tabulate THREE differences between mitosis and meiosis. **(7)**

3.4 A scientist wanted to investigate the effect of temperature on the frequency of meiotic recombination in barley plants.

He expects that an increase in temperature will lead to an increase in meiotic recombination in barley plants.

The procedure was as follows:
- Prepared three growth chambers with temperatures of 15^{o}C, 20^{o}C and 25^{o}C
- Planted the same variety of 10 barley seeds in each chamber and the plants were given the same amount of water and same amount of sunlight.
- Collected the samples after 6 weeks from each chamber.
- Stained and examined the samples, by using a precise method under a microscope to count the number of chiasmata per cell.
- Record and analyze the data.

3.4.1 Give a scientific question for this investigation. (2)

3.4.2 Identify the:

(a) Independent variable (1)

(b) Dependant variable (1)

3.4.3 State THREE ways in which the validity of this investigation was ensured. (3)

3.4.4 What happens at the chiasmata in meiosis? (1)

3.4.5 What is the biological importance of meiosis in the life cycle of a plant such as barley? (2)
(10)

3.5 Researchers may obtain human stem cells from embryos or adult sources. Adult stem cells can help to replace and repair damaged cells after an injury or infection but have limited differentiative potential and embryonic stem cells have the ability to differentiate into any cell type.
Some diseases and disorders that can be treated with stem cells include Leukaemia and Parkinson's disease.

3.5.1 Define the term *stem cells*? (2)

3.5.2 What type of cell division do stem cells undergo to produce tissues? (1)

3.5.3 From the passage, give TWO reasons for the use of stem cells. (2)

3.5.4 Give ONE source where adult stem cells can be collected from. (1)
(6)

3.6 Humans have four blood groups **A**, **B**, **AB** and **O**. Blood groups are determined by the alleles inherited from parents.

3.6.1 Explain how the four blood groups in humans can result from a single gene. (6)

3.6.2 Explain how it is possible for a mother with blood group **A** and a father with blood group **B** to have a child with blood group **O.** (4) **(10)**

TOTAL QUESTION 3: [50]

TOTAL SECTION B: 100

GRAND TOTAL: 150