education

Department of Education
FREE STATE PROVINCE

GRADE 12

LIFE SCIENCES P2

JUNE 2026

TOTAL: 150

TIME: $2^{1}/_{2}$ 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 1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

1.1.1 The nitrogenous base that is not present in DNA.

A Uracil
B Thymine
C Adenine
D Cytosine

1.1.2 In an investigation, it was found that 10% of a DNA molecule consisted of adenine. What would the ratio of adenine to guanine in the complete DNA molecule be?

A 4:1
B 2:1
C 1:4
D 1:1

1.1.3 The phase in meiosis during which the homologous chromosomes separate.

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

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1.1.4 Haemophilia is a sex-linked recessive disorder in humans. A father and his son both have haemophilia, but the mother is without haemophilia. Her genotype will be …

A X^hX^h
B X^HX^h
C X^HX^H
D X^hY

1.1.5 The difference between a nucleic acid and a nucleotide is that …

A nucleotides are building blocks of nucleic acids.
B nucleic acids are building blocks of nucleotides
C nucleic acids are in the nucleus and nucleotides are in the cytoplasm.
D nucleotides are larger than nucleic acids.

1.1.6 The organelle that is only present in animal cells during Prophase 1.

A Centrosome
B Nucleus
C Centromere
D Cytoplasm

1.1.7 In males, meiosis results in …

A four identical diploid gametes
B two non-identical diploid gametes
C four identical, haploid gametes
D four non-identical haploid gametes

1.1.8 The following is a list of steps taken during the synthesis of insulin using recombinant DNA techniques.

(i) The plasmid is inserted back into the bacteria.
(ii) The bacterial plasmid is cut using enzymes.
(iii) The human insulin gene is combined with the bacterial plasmid.
(iv) The human insulin gene is located and removed.

Which combination shows the correct sequence of events?

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

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1.1.9 A white flower (WW) is crossed with a red flower (RR) to produce pink flowers (WR).

This is an example of…

A complete dominance.
B multiple alleles.
C incomplete dominance.
D co-dominance.

1.1.10 A couple has three children, two girls and a boy. The mother is pregnant with their fourth child. The percentage chance of this baby being a boy is…

A 0%
B 25%
C 50%
D 75%

(10x2) **(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 1.2.8) in the ANSWER BOOK.

1.2.1 The process where DNA profile bands are used to identify missing persons.

1.2.2 Non-sex chromosomes in humans.

1.2.3 The factor that is manipulated by the investigator in a scientifical investigation

1.2.4 The structure that is made up of two chromatids, joined by a centromere.

1.2.5 A condition where a person cannot differentiate between red and green colour.

1.2.6 The "father of genetics" who compiled the law of dominance.

1.2.7 The allele that is always expressed in the phenotype in a heterozygous condition.

1.2.8 The outward physical appearance of an individual

(8x1) **(8)**

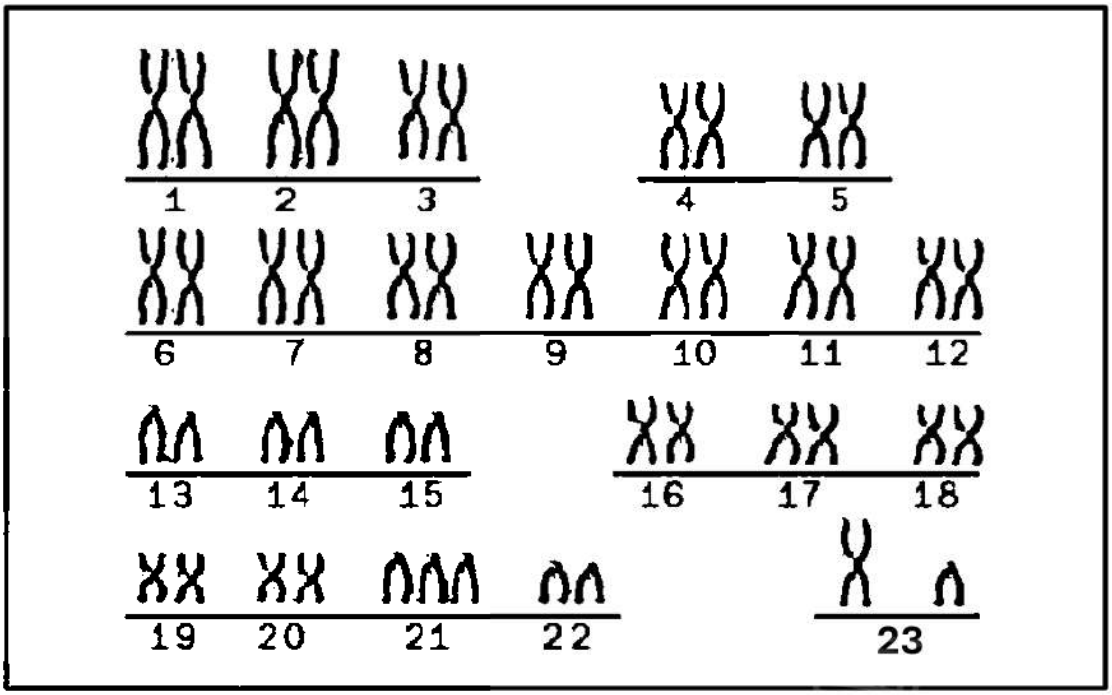
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1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3)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

COLUMN I		COLUMN II
1.3.1	Location of DNA in animal cells.	A: Chloroplast B: Cytoplasm
1.3.2	The division of cytoplasm after nuclear division.	A: Cytokinesis B: Karyokinesis
1.3.3	The importance of meiosis.	A: Production of gametes B: Halving the chromosome number

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

1.4 The diagram below shows the karyotype of an individual with Down syndrome.



1.4.1 Is this the karyotype of a **sex cell** or a **somatic cell**? (1)

1.4.2 What is the gender of the person above? (1)

1.4.3 Provide ONE observable reason for you answer in QUESTION 1.4.2. (2)

1.4.4 How many autosomes are present in this karyotype. (1)

1.4.5 Identify the type of mutation that results in a person having Down syndrome. (1)
(6)

1.5 In pugs, a dog breed, black fur colour (**B**) is dominant over light brown fur colour (**b**) and long moustache (**L**) is dominant over a short moustache (**l**).

Light brown fur colour and a long moustache are more desirable to humans.

A breeder of pugs has a black male pug with a long moustache and a light brown female with a short moustache.

1.5.1 Provide the:

a) Genotype of a pug with light brown colour and a short moustache. (2)

b) Allele for the dominant fur colour. (1)

c) Gametes for the female pug of the breeder. (2)

1.5.2 State:

a) The number of genes that control fur colour. (1)

b) All possible genotypes of the desired pug. (2)

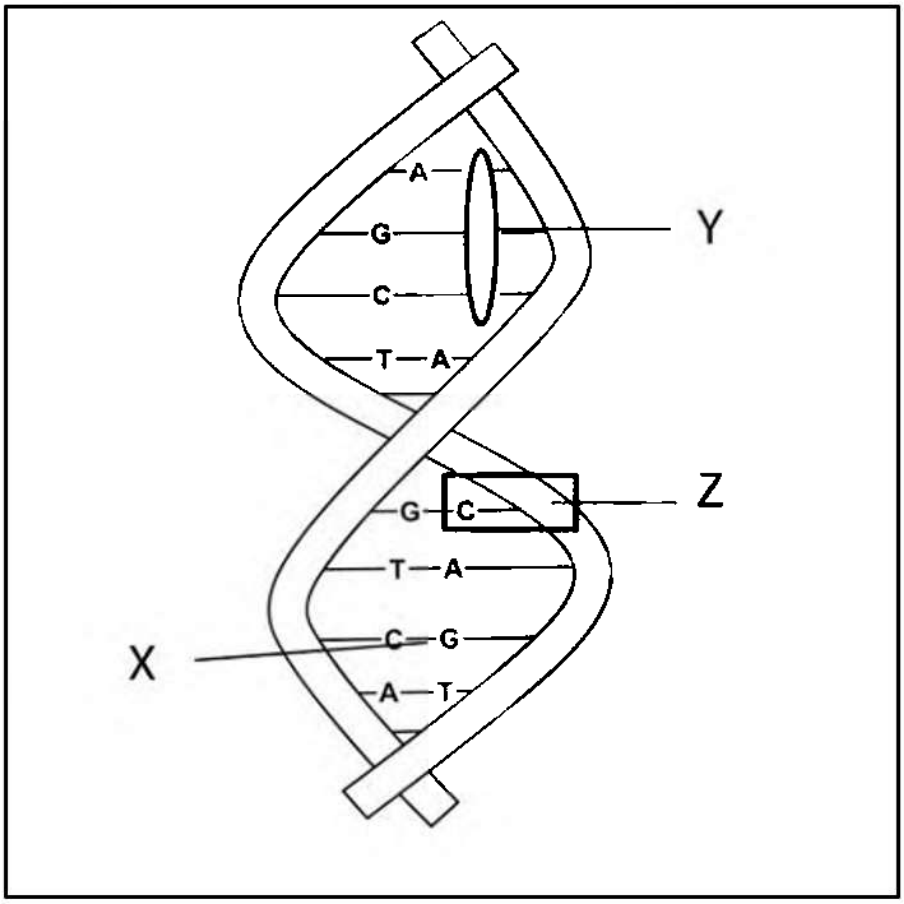
c) The phenotype of a pug that is heterozygous for both characteristics. (2) **(10)**

TOTAL SECTION A: [50]

SECTION B

QUESTION 2

2.1 The diagram below shows a deoxyribonucleic acid molecule.



2.1.1 Identify:

(a) Natural shape of the molecule above. (1)

(b) Complimentary base pairs at **Y** (from top to bottom) (2)

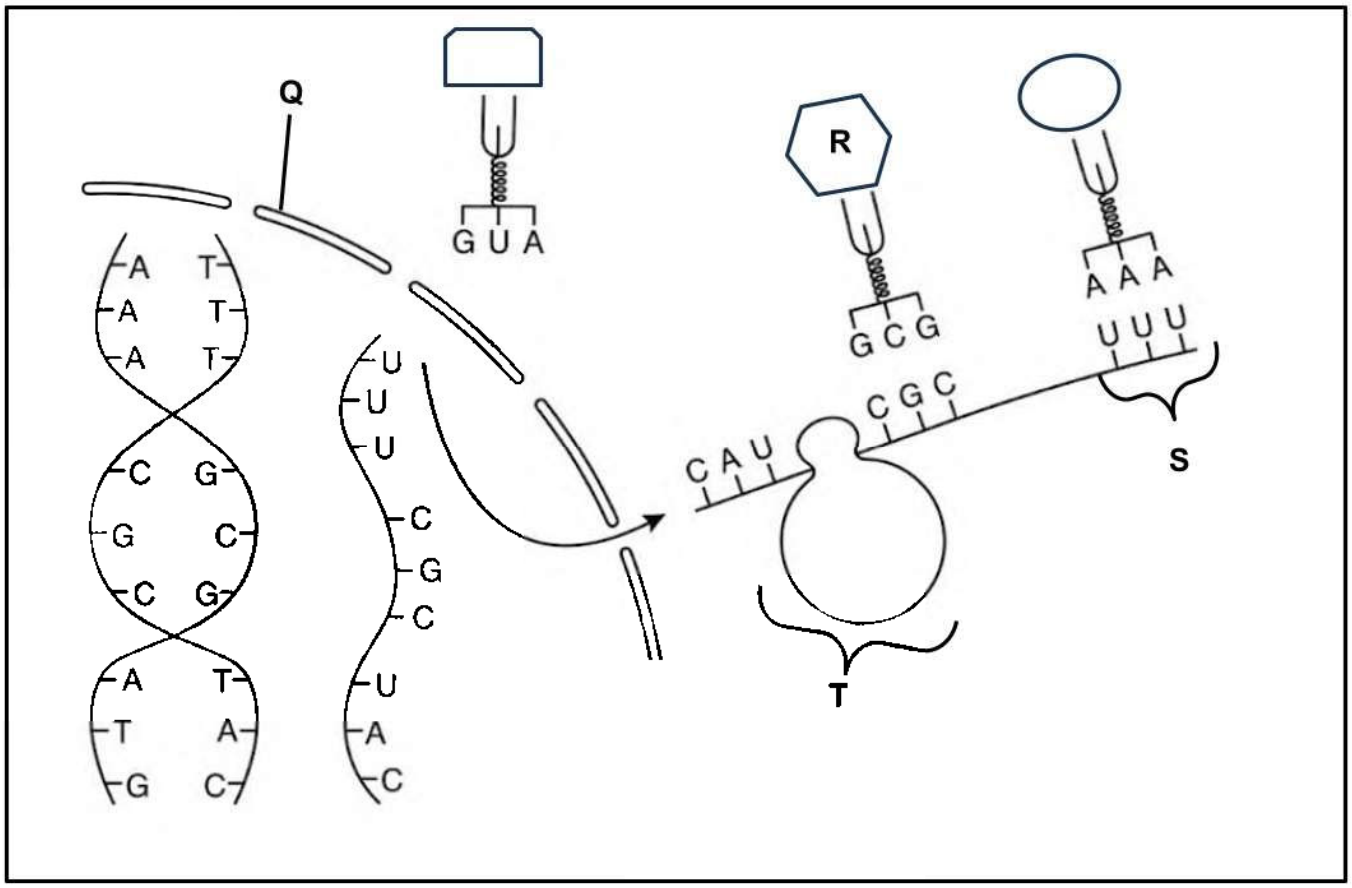
(c) Bond **X** (1)

2.1.2 Draw a labelled diagram of monomer **Z**. (5)

2.1.3 Name the TWO scientists who took an X-ray photograph of the molecule above. (2)

2.1.4 Describe the process where the molecule above makes an identical copy of itself. (6)
(17)

2.2 The diagram below shows the process of protein synthesis.



2.2.1 Identify:

(a) Structure **Q** (1)

(b) The stage of protein synthesis at organelle **T** (1)

(c) Base triplet **S** (1)
(3)

2.3 The table below shows the nitrogenous base triplet of mRNA and the amino acids each codes for.

mRNA base triplet	Amino acid
UUU	Lysine
GCG	Alanine
UAC	Methionine
AAA	Phenylalanine
CGC	Arginine
AUG	Tyrosine
UGC	Threonine

2.3.1 Use the table above and identify amino acid labelled **R** (2)

2.3.2 Give the anticodon for **Tyrosine**. (2)

The table below represents nitrogenous base sequences of a portion of the DNA in two protein molecules.

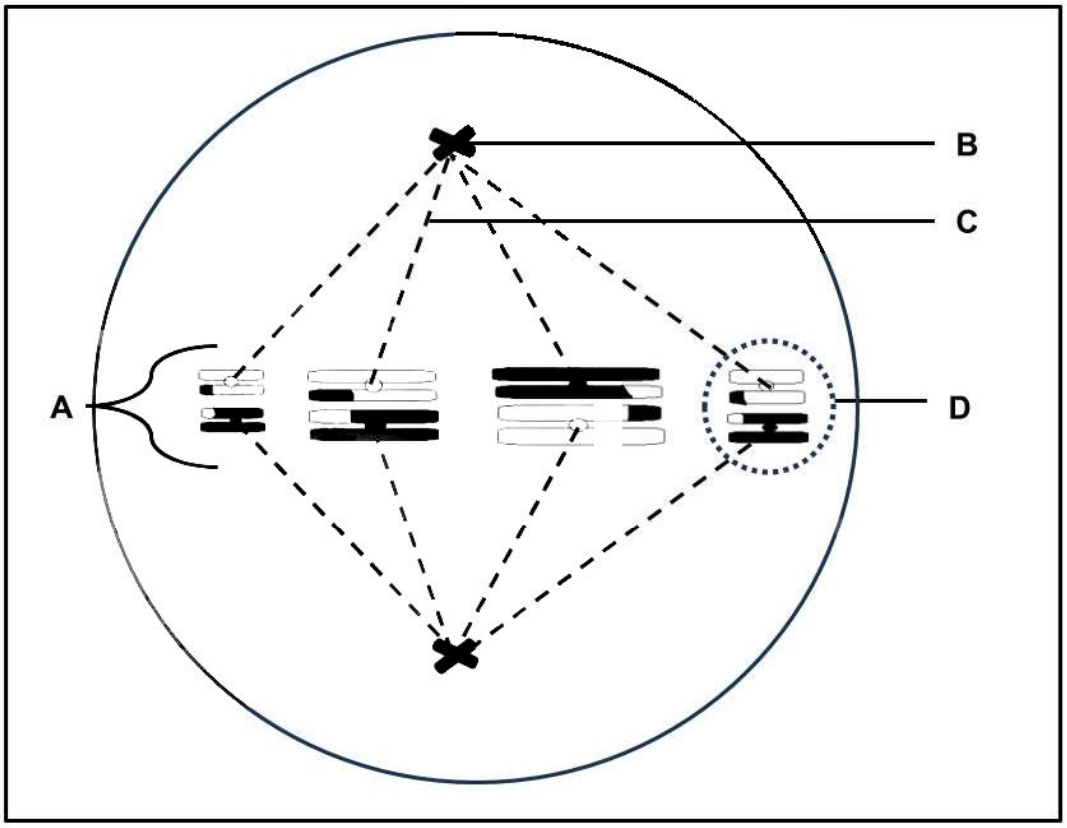
A gene mutation occurred in **protein 2.**

	DNA BASE SEQUENCE		
Protein 1	AAA	GCC	ATG
Protein 2	AAA	GCG	ATG

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

2.3.4 Describe how the mutation will affect the structure of protein **2.** (6)
(12)

2.4 The diagram below illustrates a phase of meiosis where homologous chromosome fails to separate at **D.**



2.4.1 Give the LETTER and NAME of the structure that pulls chromosomes to opposite poles. (2)

2.4.2 How many centromeres are visible in this phase of meiosis? (1)

2.4.3 Give THREE characteristics of structure **A.** (3)

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2.4.4 Explain how this phase of meiosis contributes to genetic variation. (3)

2.4.5 Describe the results at the end of meiosis if the chromosomes at **D** fail to separate. (3)

2.4.6 Identify the process illustrated by **D.** (1)

2.4.7 Tabulate TWO differences in the behavior of chromosomes between prophase in meiosis **I** and **II.** (5)

(18)

TOTAL QUESTION 2: [50]

QUESTION 3

3.1 Read the extract below.

> Arctic apples were developed by Okanagan Specialty Fruits using genetic engineering to reduce the activity of the PPO enzyme (polyphenol oxidase) that causes browning when apples are cut or bruised.
>
> Scientists used gene silencing to block the genes responsible for producing the enzyme. PPO is not harmful and is a normal part of the fruit, but in Arctic apples the amount of PPO is reduced so the apples brown much more slowly.
>
> Because there is much less PPO the apple stays its normal colour longer, sliced apples look fresher and food waste can be reduced because people are less likely to throw away browned fruit.

3.1.1 Give the function of polyphenol oxidase enzymes (PPO). (1)

3.1.2 Name THREE advantages of this genetic engineering process. (3)

3.1.3 Describe how the genetic engineering process used to produce Arctic apples differs from the biotechnology process used to produce insulin. (4)
(8)

3.2 Grade 12 learners were studying the inheritance of characteristics of grasshoppers. They observed two characteristics, namely, hind leg length and body colour.

The learners wanted to determine the number and frequency of grasshoppers showing dominant and recessive phenotypes for hind leg length and body colour.

The phenotypes and alleles coding for them are shown in the table below.

Characteristic	Phenotype	
	Dominant	**Recessive**
Hind leg length	Long hind leg (**H**)	Short hind leg (**h**)
Body colour	Green (**B**)	Yellow (**b**)

The procedure was as follows:

- Collect and observe a sample of 200 grasshoppers from the same area.
- Identify two characteristics for each grasshopper.
- Record each grasshopper characteristic in a table.
- Count the number showing dominant and recessive phenotypes for each trait.

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- Calculate totals for each category.

The results are shown in the table below:

Characteristic	Phenotypes	Number of Grasshoppers
Hind leg length	Long hind legs	172
	Short hind legs	28
Body colour	Green	153
	Yellow	47

3.2.1 Name the type of cross where two characteristics are crossed. (1)

3.2.2 Calculate the percentage frequency of the dominant phenotype for hind leg length in the given sample of grasshoppers. Show all your calculations. (3)

3.2.3 Identify:

(a) The independent variable (1)

(b) The phenotype that is more common (2)

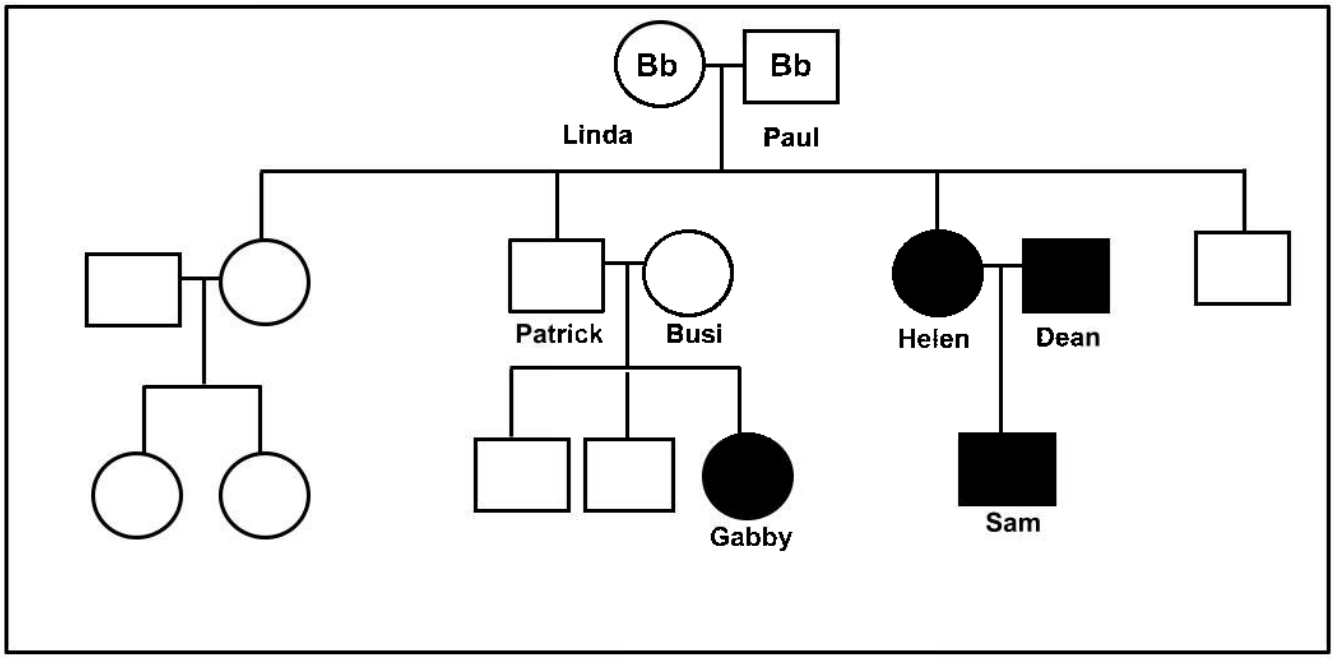
3.2.4 Give TWO ways how the learners could increase the reliability of their investigation. (2)

3.2.5 Name THREE planning steps that should be considered when conducting this investigation. (3)

3.2.6 Draw a bar graph to represent the number of grasshoppers showing different phenotypes for the observed characteristics. (6)
(18)

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3.3 The pedigree diagram below shows the inheritance of eye colour in a family. The letter **B** is used for the dominant eye colour (brown) and **b** is used for the recessive eye colour (blue).



3.3.1 How many of EACH of the following are represented in this diagram?

(a) Males (1)

(b) Children of Linda and Paul (1)

(c) Generations (1)

3.3.2 Give the:

(a) Phenotype of Paul (2)

(b) Genotype of Dean (2)

3.3.3. Both Gabby's parents have brown eyes, yet she has blue eyes.

Explain how she inherited her blue eyes. (2)

3.3.4 Sam marries a woman who is heterozygous for brown eyes. Use a genetic cross to show the percentage chance of them having a child with blue eyes. (6)
(15)

3.4 In humans, blood groups are controlled by multiple alleles.

3.4.1 Define *multiple alleles*. (2)

3.4.2 Name the TWO alleles that are codominant in the inheritance of blood groups. (2)

3.4.3 A female with genotype $\mathbf{I^Ai}$ has children with her husband Jerry. They have a son with blood group **AB** and a daughter with blood group **O.**

Give:

(a) The female's blood group (1)

(b) The daughters genotype (1)

3.4.4. If Jerry is blood group **B,** Explain, what can we conclude about the blood groups of their future children? (3)
(9)

TOTAL QUESTION 3: [50]
TOTAL SECTION B: [100]
GRAND TOTAL: [150]

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