KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12



LIFE SCIENCES P2

PREPARATORY EXAMINATION

SEPTEMBER 2024

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MARKS: 150

TIME: 2½ hours

N.B. This question paper consists of 16 pages.

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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 may use a non-programmable calculator, protractor and a compass.
11. Write neatly and legibly.

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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 to D) next to the question number (1.1.1 to 1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1.1 Which ONE of the following occurs in mitosis but NOT in meiosis?

A Crossing over takes place
B Two cells are formed at the end of the division
C Homologous chromosomes arrange at the equator
D Centrioles form at the poles of the cell

1.1.2 The scientists who discovered that DNA is double helix.

A Crick and Watson
B Franklin and Wilkins
C Watson and Wilkins
D Wilkins and Crick

1.1.3 Which ONE of the following is an acceptable explanation based on Lamarck's theory of evolution?

A An increasing number of insects that are resistant to insecticides because they are able to survive and reproduce
B Giraffes have long necks and some have short necks
C Humans evolved from apes
D The parents who had their little fingers removed will give birth to children without the little fingers

1.1.4 Which ONE of the following is an acceptable explanation based on Mendel's law of segregation?

A Various 'factors' controlling the different characteristics separate out independently during gamete formation
B Two 'factors' separate so that each gamete contains different 'factors'
C Heterozygous individual for a particular characteristic will have the dominant trait as the phenotype
D Two 'factors' separate so that each gamete contains only one of these 'factors'

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1.1.5 DNA was extracted from the cells of a cat and was analysed for its nitrogenous base composition. It was found that 26% of the bases are guanine.

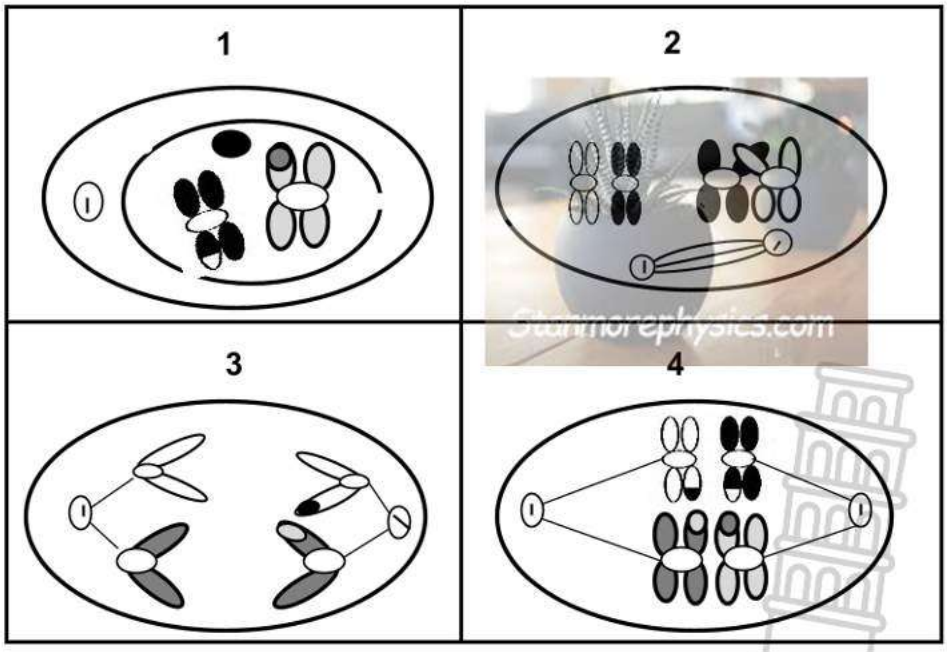
What percentage of the bases are *thymine*?

A 26
B 52
C 24
D 48

1.1.6 A female that has received two identical alleles for haemophilia from each parent is described as being …

A dominant
B homozygous
C homologous
D heterozygous

1.1.7 The diagrams below represent the four phases of meiosis in no sequence.



Which ONE of the following is the correct sequence in which the phases of meiosis occur?

A **2, 3, 4, 1**
B **4, 1, 2, 3**
C **2, 4, 1, 3**
D **2, 4, 3, 1**

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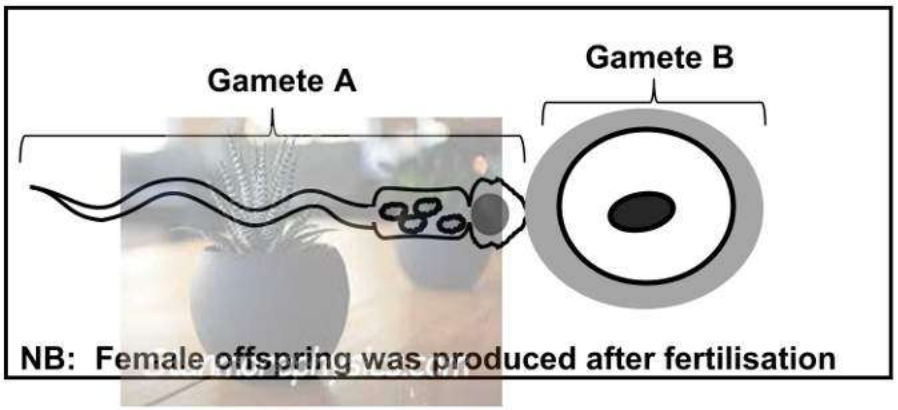
1.1.8 A mother has blood type O and father blood type AB. They have two biological children and two adopted. The genotypes of all children are represented in the table below.

CHILDREN	GENOTYPE
Peter	I^Ai
Paul	ii
Penny	I^Bi
Patricia	I^AI^B

Children adopted are …

A Peter and Paul
B Paul and Penny
C Penny and Patricia
D Patricia and Paul

1.1.9 The diagram below shows the process fertilisation in humans.



Which ONE of the following correctly represents the chromosomes in gamete **A** and **B** respectively?

	GAMETE A	GAMETE B
A	23 autosomes and Y gonosome	21 autosomes and X gonosome
B	22 autosomes and Y gonosome	22 autosomes and X gonosome
C	22 autosomes and X gonosome	22 autosomes and X gonosome
D	22 autosomes and X gonosome	23 autosomes and X gonosome

(9 x 2) **(18)**

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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 1.2.9) in the ANSWER BOOK.

1.2.1 A disorder due to the presence of an extra chromosome on the chromosome pair 21 in somatic cells of humans

1.2.2 Similar structures that are inherited from a common ancestor and modified for different function

1.2.3 A segment of a chromosome that codes for a particular characteristic

1.2.4 The stage in protein synthesis during which mRNA is coded from DNA

1.2.5 Undifferentiated cells that have the potential to form any body tissue

1.2.6 The study of the distribution of living organisms found in different regions

1.2.7 The type of nucleic acid that carries a specific amino acid

1.2.8 The chromosome condition describing the presence of a single set of chromosomes in a cell

1.2.9 An allele that is expressed phenotypically only in the homozygous condition

(9 x 1) **(9)**

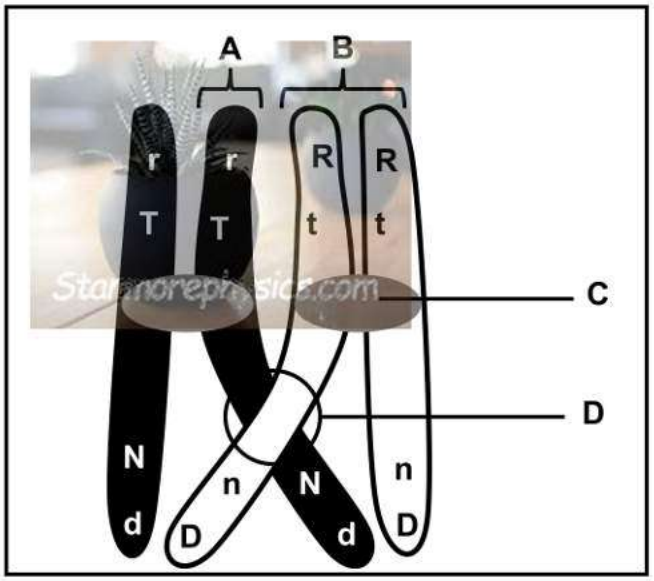
1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B or NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B,** or **none** next to the question number (1.3.1 to 1.3.2) in the ANSWER BOOK.

	COLUMN I	**COLUMN II**
1.3.1	The random arrangement of chromosomes at the equator singly	A: Metaphase I B: Metaphase II
1.3.2	The natural shape of the DNA molecule	A: Double helix B: Single helix
1.3.3	The site of meiosis in plants	A: Stigma B: Anther

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

1.4 The diagram below shows a process during meiosis.

The letters represent the alleles of genes in the chromosomes.



1.4.1 Name the:

(a) Process shown in the diagram (1)

(b) Phase of meiosis represented above (1)

1.4.2 Identify:

(a) Point **D** (1)

(b) Part **B** (1)

1.4.3 Write down the LETTER and NAME of the part that join together two chromatids. (2)

1.4.4 Write down the genotype of the resulting chromatid **A** after the process named in QUESTION 1.4.1 (a). (1)

1.4.5 State how many:

(a) Characteristics are represented in the diagram above. (1)

(b) Different genes are represented by the alleles in the diagram above. (1)

(9)

1.5 Fossils are used as the evidence for human evolution.

The table below shows the period of existence of some hominids.

HOMINID	PERIOD OF EXISTENCE
Australopithecus aferensis	4 – 3 mya
Australopithecus africanus	3.2 – 2 mya
Homo habilis	2.2 – 1.4 mya
Homo erectus	2 – 0.4 mya
Homo neanderthalensis	0.4 – 0.05 mya
Homo sapiens	0.2 – 0 mya

1.5.1 With reference to the table above, name TWO:

(a) Genera (2)

(b) Species that existed for the longest period of time. (2)

1.5.2 State how long did *Homo habilis* live on earth. (1)

1.5.3 Name:

(a) TWO fossils of *Australopithecus africanus* that were discovered in Sterkfontein. (2)

(b) The family to which *Homo sapiens* belong. (1)

(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Pepsin (protein digesting enzyme) is a protein secreted in the stomach as an inactive pepsinogen.

The TABLE **1** below shows the sequence of bases on the mRNA coding for some of the amino acids in a pepsin protein.

1	2	3	4	5	6	7
UUC	AAG	CUG	UGG	GAU	AUC	UGG

2.1.1 Give the number of:

(a) Different anticodons needed to form this part of a pepsin protein. (1)

(b) Phosphates on the mRNA base triplets in the table above. (1)

2.1.2 Name the organelle where pepsin is synthesised in a human cell. (1)

2.1.3 The TABLE **2** below shows the amino acids and DNA base triplets.

AMINO ACID	DNA BASE TRIPLET
Isoleucine	TAG
Tryptophan	ACC
Serine	AGT
Phenylalanine	AAG
Leucine	GAC
Tyrosine	ATG

With reference to the TABLE **1** in QUESTION 2.1 and TABLE **2** above:

(a) Give the correct sequence of the tRNA base triplet that brings tyrosine for the synthesis of pepsin. (1)

(b) Give the amino acid coded for by the mRNA base triplet number **3**. (1)

(c) A mutation caused the mRNA base triplet number **6** to change from UUC to AUC.

Explain the effect of this mutation on the protein formed. (4)

(d) Describe the type of mutation referred to in QUESTION 2.1.3 (c). (2)

(11)

2.2 Read the information below.

DNA profiling is a forensic technique in criminal investigations. It is a tool for determining the identity of a specific DNA sample to solve legal disputes and notably help to determine paternity.

Faulty preparation procedures during DNA profiling may cause problems. Other errors that may occur during DNA profiling include contamination of samples, intentional planting of DNA samples, and mistakes during interpretation of results. All this may lead to discrepancies in legal proof in court cases.

2.2.1 From the information above, state ONE:

(a) Use of DNA profiling other than determining paternity. (1)

(b) Effect of faulty preparations during DNA profiling. (1)

2.2.2 Explain how the DNA profiling is used in paternity testing. (6)

(8)

2.3 In cattle, long horns (**L**) and a twisted horns (**T**) are dominant over short horns and straight horns.

The diagram below shows part of a genetic cross between a bull and cow. A cow is heterozygous for the length of horns.

P1	Bull	X	Cow (Long and straight horn)
	↓		↓
Genotype	LlTt	X	**A**
Phenotype offspring	6 long and twisted horns		6 long and straight horns
	2 short and twisted horns		2 short and straight horns

2.3.1 Name the type of dominance displayed by the horn length and shape. (1)

2.3.2 Give:

(a) The phenotype of a bull. (1)

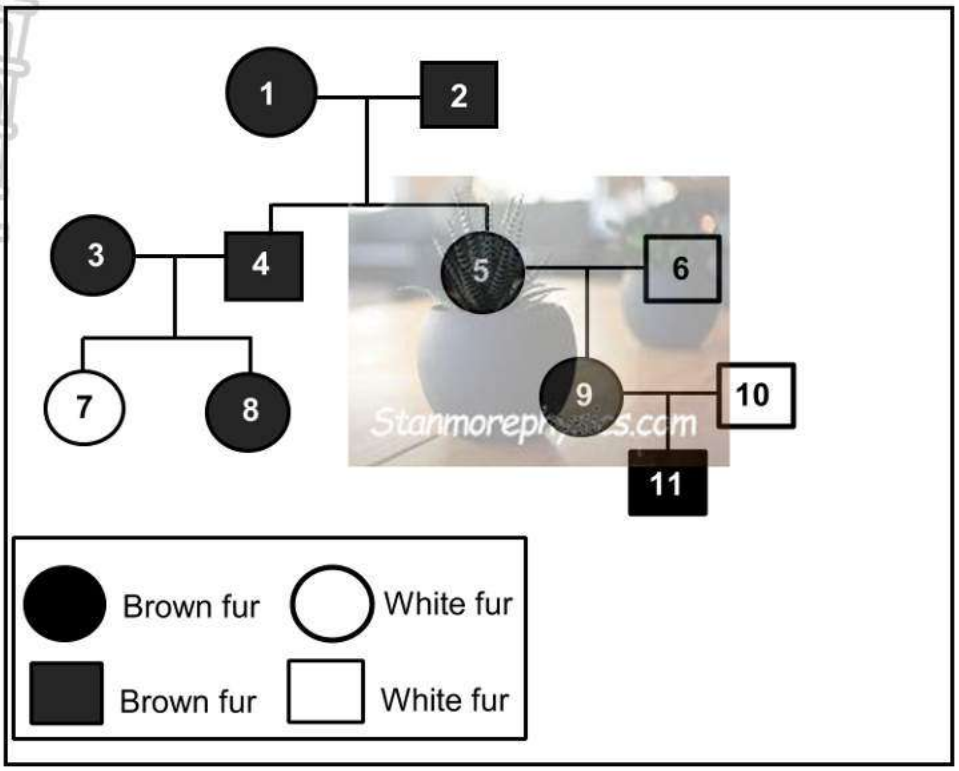
(b) ALL the possible genotypes in the **gametes** of a bull. (3)

(c) The genotype at **A** above. (1)

(d) The phenotypic ratio for short and straight horns to long and twisted horns offspring. (1)

(7)

2.4 The diagram below shows the inheritance of fur colour in rabbits.



2.4.1 Name the phenotype that is controlled by the recessive allele. (1)

2.4.2 Explain your answer in QUESTION 2.4.1. (4)

2.4.3 Identify the parents that support the conclusion that both rabbits with brown and white fur coat belong to the same species. (1)

2.4.4 Give a reason for your answer in QUESTION 2.4.3. (2)

2.4.5 State how many generations in the diagram have heterozygous rabbits? (1)

2.4.6 Rabbit **11** was crossed with a white fur coat colour rabbit.

Using the letters **B** and **b**, do a genetic cross to show the phenotypic ratio of their offspring. (7)

(16)

2.5 Read the passage below.

> Farmers can kill weeds by spraying glyphosate which targets EPSPS (enzyme) which is essential for plant life. Weeds are consistently developing resistance to herbicides.
>
> Soybean was genetically modified using glyphosate-resistant gene from the cell of a resistant weed. Genetically modified organism (GMO) such as soybean has an impact on food security and resistance to diseases.
>
> The environmental impact of genetically modified soybeans includes the increased herbicide usage which pollutes air. The consumption of GMO foods can cause allergic reactions and increased antibiotic resistance.

2.5.1 Define the term *genetically modified organism*. (2)

2.5.2 From the passage, give TWO:

(a) Negative effects of GMO in human health (2)

(b) Benefits of GMO in agriculture (2)

2.5.3 Explain why the gene of a weed cell was used in modifying soybean. (2)

(8)

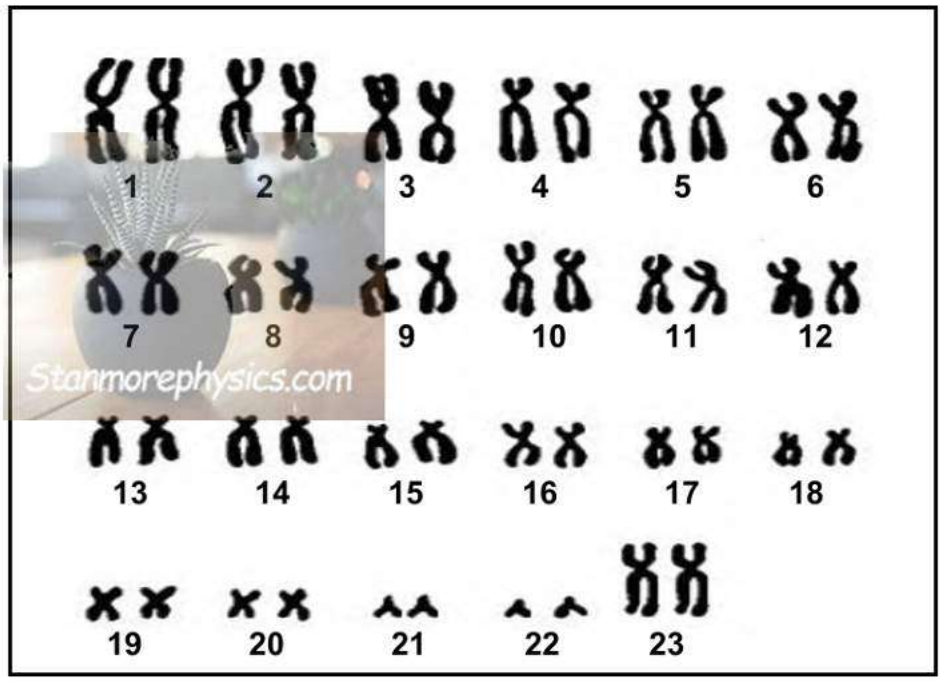
[50]

QUESTION 3

3.1 Read the information below.

Colour blindness (**b**) occurs when there is a problem with the pigments in certain nerve cells of the photoreceptors in the retina. Parents pass down the red-green colour vision deficiency to the offspring.

The diagram below represents the human somatic cell.



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3.1.1 Identify the diagram above. (1)

3.1.2 Name the type of photoreceptors referred to in the information above. (1)

3.1.3 Give the:

(a) Collective name for the type of chromosomes in pair numbered 23 (1)

(b) Genotype of the male who is colour blind. (1)

3.1.4 State THREE characteristics of the autosomal homologous chromosome pairs. (3)

3.1.5 Give ONE reason why this diagram represents the human somatic cell. (1)

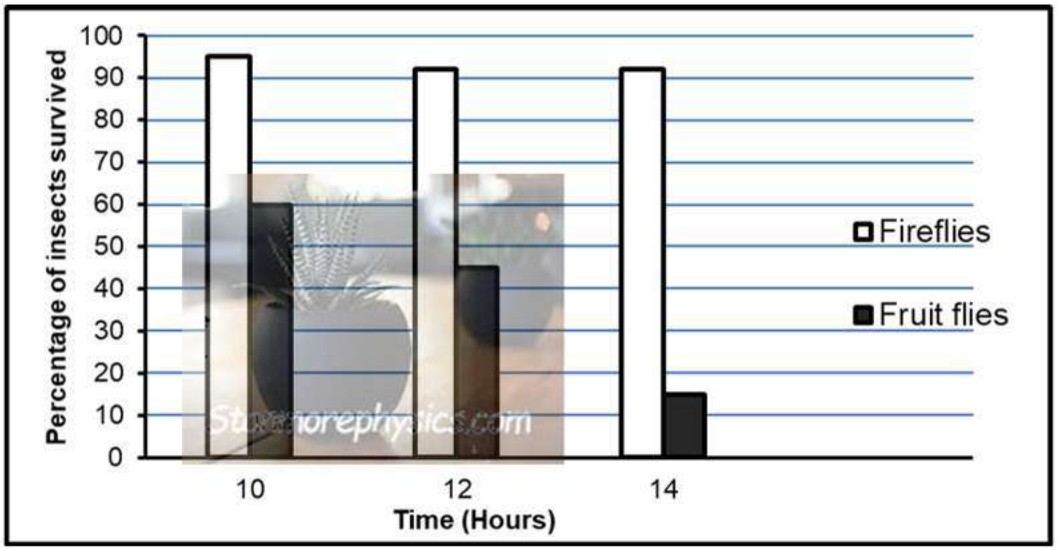
(8)

3.2 There are insects called Fireflies, their blood contain a toxic chemical called *lucibufagin*. They produce a glowing light to warn predators that they are toxic.

A scientist conducted an investigation to determine the relationship between the toxic chemical and survival of the insects against predation.

- Fireflies and non-toxic fruit flies were collected (200 each).
- Both insects were released into the greenhouse structure in a controlled environment.
- The lizards of the same species that are feeding on insects were released into the greenhouse structure for one day.
- The number of survived insects was counted and recorded 3 times a day.

The percentage of insects survived are shown in the graph below.



3.2.1 State the aim of the investigation. (2)

3.2.2 Identify the dependent variable of the investigation. (1)

3.2.3 State THREE planning steps to consider when conducting this investigation. (3)

3.2.4 State ONE way in which the scientist ensured the:

(a) Validity of the results (1)

(b) Reliability of the results (1)

3.2.5 Calculate the number of fruit flies that have survived from predation in 10 hours. Show ALL workings. (3)

(11)

3.3 Describe the process of speciation through geographic isolation. **(6)**

3.4 Different insecticides were used to control weeds in fields. The insecticides kill insects. Random mutations within the insects over time, has caused the insects to be resistant to insecticides. Colorado potato beetle has a remarkable ability to develop resistance to a wide range of insecticides.

Colorado potato beetle has shown a continuous resistance to different insecticides since 1960.

The table below shows the number of different insecticides that were resisted by the Colorado potato beetle over years.

Year	Number of insecticides that were resisted
1960	2
1970	10
1980	28
1990	38
2000	40
2010	40

3.4.1 State ONE way in which the resistance of Colorado potato beetle was determined in the investigation over years. (1)

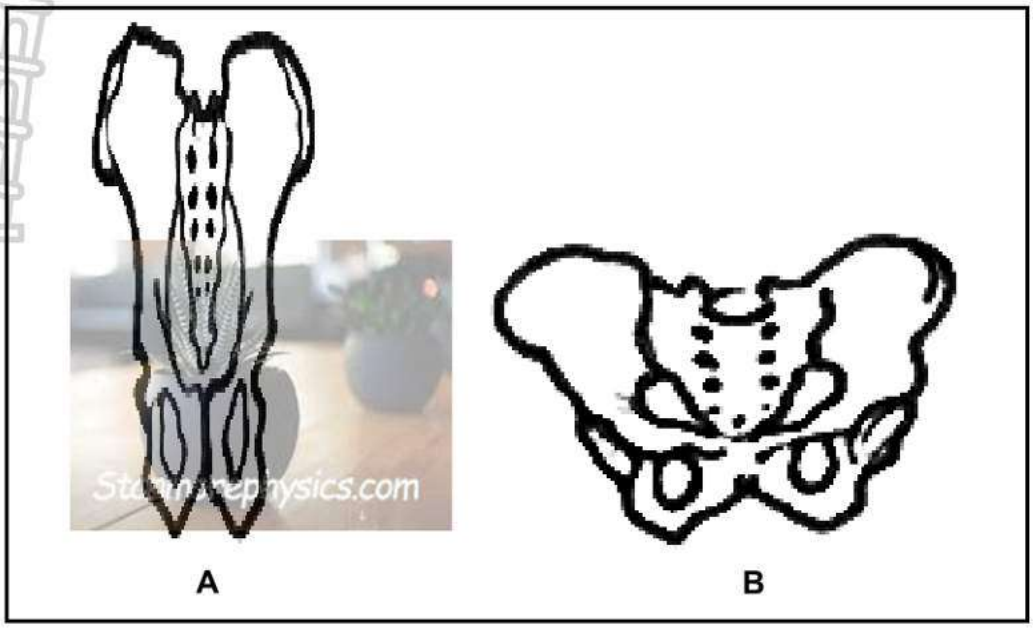
3.4.2 Describe the change in insecticide resistance over time. (3)

3.4.3 Explain the economic impact caused by the Colorado potato beetle resistance to insecticides. (3)

3.4.4 Use Darwin's theory of natural selection to explain the evolution of insecticide-resistant Colorado potato beetle. (6)

[13]

3.5 The diagrams below show the pelvises of the African ape and modern human. The diagrams are not drawn to scale.



3.5.1 Identify a diagram of the pelvis above that belongs to an African ape? (1)

3.5.2 Tabulate TWO visible differences between pelvis in diagrams **A** and **B**. (5)

3.5.3 Explain the significance of the position of the foramen magnum that is associated with the pelvis in diagram **B**. (2)

3.5.4 The 'Out of Africa' hypothesis is one explanation of the evolution of modern humans.

Describe how genetic evidence is used to support the 'Out of Africa' hypothesis. (4)

(12)

[50]

TOTAL SECTION B: 100

GRAND TOTAL: 150

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