



Education and Sport Development

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NORTH WEST PROVINCE

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

LIFE SCIENCES P2

SEPTEMBER 2019

MARKS: 150

TIME: 2½ hours

This question paper consists of 19 pages.

INSTRUCTIONS AND INFORMATION

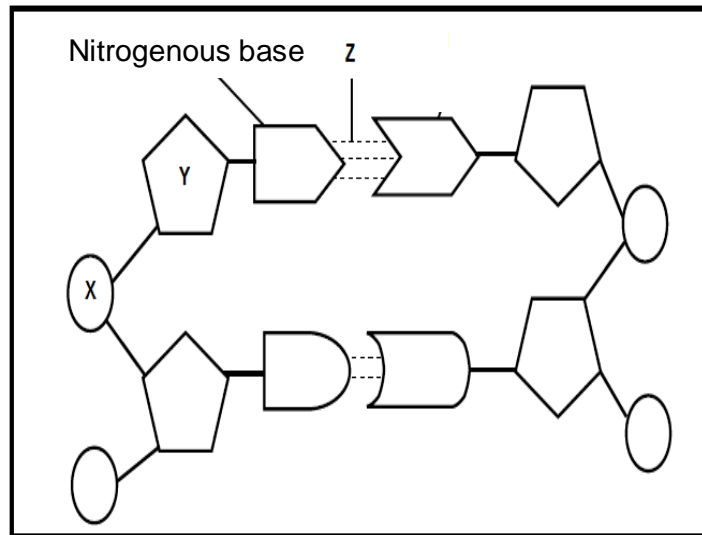
Read the following instructions carefully before answering the questions.

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. 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 to D) next to the question number (1.1.1 to 1.1.10) in the ANSWER BOOK, for e.g. 1.1.11 D.

1.1.1 The diagram below represents part of a DNA molecule.



The correct labels for parts **X**, **Y** and **Z** respectively are

- A deoxyribose sugar, phosphate and hydrogen bond.
- B phosphate, deoxyribose sugar and hydrogen bond.
- C ribose sugar, nitrogenous base and peptide bond.
- D phosphate, ribose sugar and hydrogen bond.

1.1.2 The following is a list of characteristics of a nucleic acid:

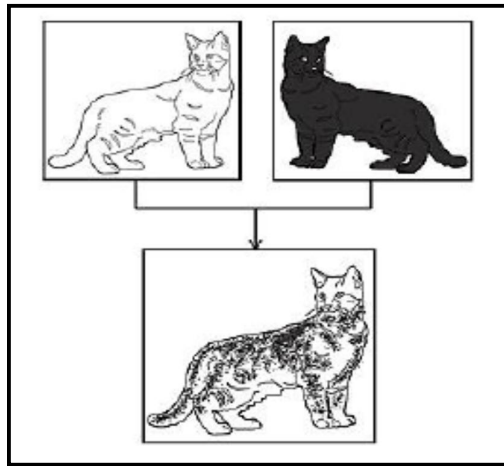
- (i) Single stranded
- (ii) Has hydrogen bonds
- (iii) Contains uracil
- (iv) Found in cytoplasm and nucleus

Which **ONE** of the following combinations represents the characteristic of mRNA?

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

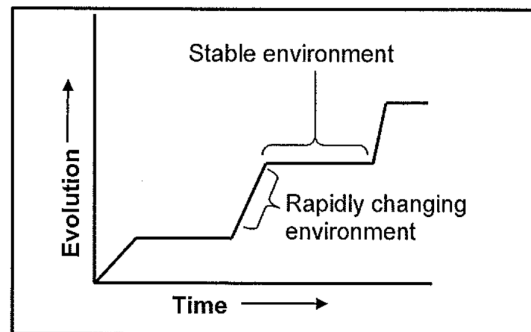
- 1.1.3 A pregnant woman was told by a genetic counsellor that her baby had equal chances of having blood type **A** or blood type **AB**. This means that the genotype of the woman and her husband must have been ...
- A $I^A I^A$ and $I^B i$
 - B $I^A I^B$ and $I^B i$
 - C $I^A i$ and $I^B I^B$
 - D $I^A I^B$ and $I^A i$
- 1.1.4 In which ONE of the following cells will a mutation in the DNA be passed from one generation to the next?
- A Brain
 - B Sperm
 - C Liver
 - D Muscle
- 1.1.5 A DNA molecule consists of 400 nucleotides of which 20% contain the base Adenine. How many of the nucleotides in this DNA will contain Guanine?
- A 80
 - B 100
 - C 120
 - D 160
- 1.1.6 Shrubs of the family Proteaceae (for example waratahs and proteas) can be found in Australia, South America, Indo-China and parts of Africa.
- What is this type of evidence for evolution called?
- A Biogeography
 - B The 'Out of Africa' hypothesis
 - C Fossil evidence
 - D Cultural evidence
- 1.1.7 The following refers to reproduction in different organisms:
- (i) Fertile offspring
 - (ii) Breed at the same time of the year
 - (iii) Species-specific courtship behaviour displayed in animals
 - (iv) Plants adapted to specific pollinators
- Which of the above are reproductive isolating mechanisms?
- A (i), (ii), (iii) and (iv)
 - B (i) and (ii) only
 - C (iii) and (iv) only
 - D (ii) and (iv) only

- 1.1.8 The diagram shows a cross between a white cat and a black cat which produced a white cat with black patches.



Which ONE of the following types of dominance is illustrated in the diagram?

- A Incomplete dominance
 - B Co-dominance
 - C Complete dominance
 - D Partial dominance
- 1.1.9 The graph below shows the pace at which evolution occurred in a species of butterfly.



Which type of evolution is represented in the graph?

- A Speciation
- B Inheritance of acquired characteristics
- C Punctuated equilibrium
- D Gradualism

- 1.1.10 The sample of a DNA profile shown below was used to determine if man **X** was the father of all four children. The sample shown are for the mother **M**, four children (1 to 4) and man **X**.

M	1	2	3	4	X
●		●	●		
			●	●	●
	●	●			
	●	●			
●	●			●	
					●

Which of the children have a different father?

- A 1 and 2
- B 2 and 3
- C 3 and 4
- D 1 and 4

(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 number (1.2.1 to 1.2.6) in the ANSWER BOOK.

- 1.2.1 Two or more alternative forms of a gene at the same locus
- 1.2.2 A portion of DNA that codes for a particular protein
- 1.2.3 A region on the chromosome to which spindle fibres attach
- 1.2.4 A phase during meiosis when the chromosome number is halved as the homologous chromosomes separate
- 1.2.5 A cell with one set of chromosomes
- 1.2.6 A sex-linked disorder where different colours cannot be distinguished

(6 x 1) (6)

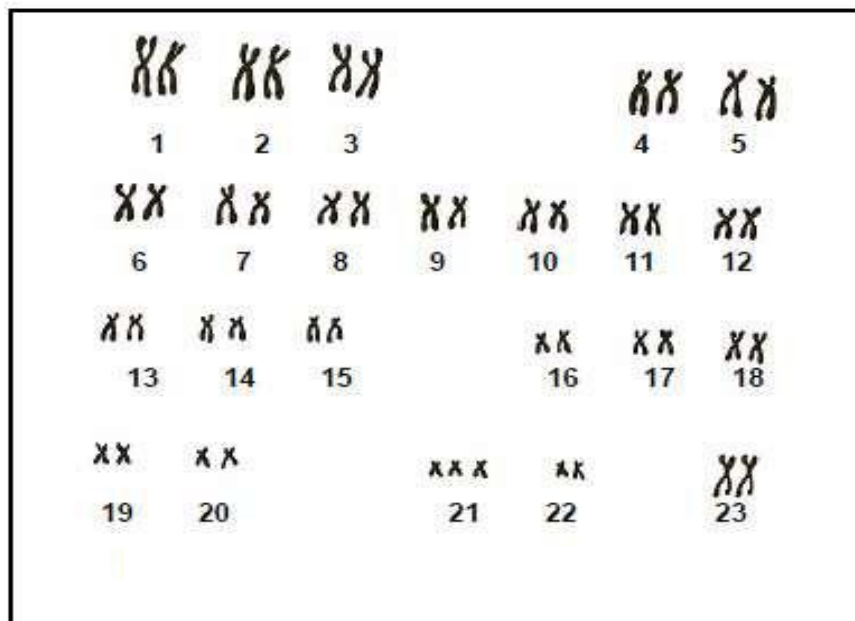
- 1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B**, or **none** next to the question numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Mendel's law that shows different characteristics are inherited independently of each other	A: Law of independent assortment B: Law of segregation of genes
1.3.2 The full complement of genes present in an organism	A: Gene pool B: Genome
1.3.3 The observable characteristics of an organism	A: Phenotype B: Genotype

(3 x 2)

(6)

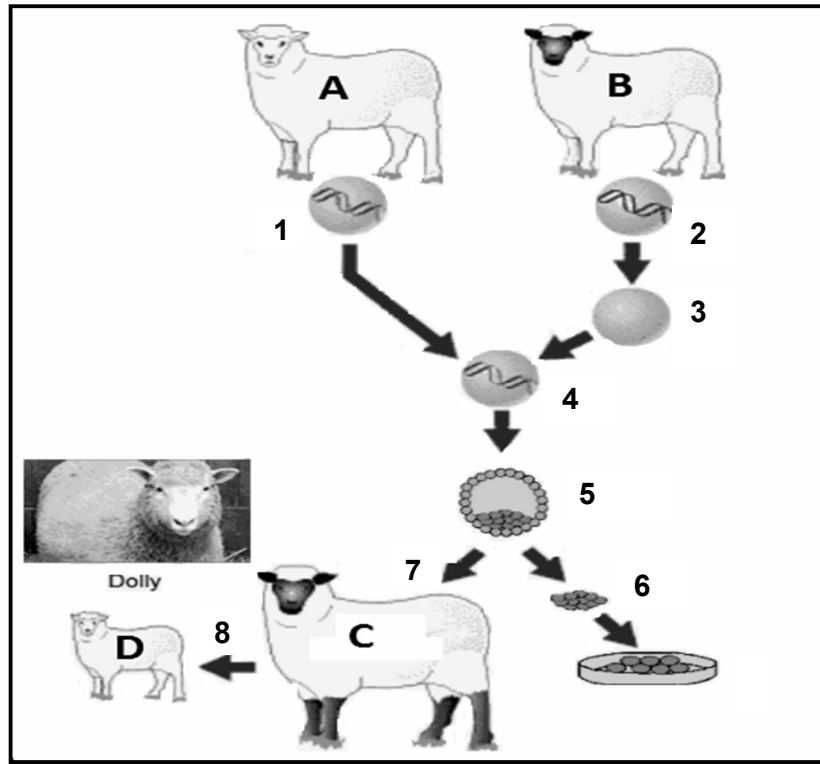
- 1.4 Study the karyotype of a human with a genetic disorder.



- 1.4.1 How many chromosomes does this individual have? (1)
- 1.4.2 Identify the genetic disorder shown in the above diagram. (1)
- 1.4.3 State the term for chromosome pairs 1 to 22. (1)
- 1.4.4 What is the gender of the individual shown in the above karyotype? (1)
- 1.4.5 Give ONE observable reason for your answer to QUESTION 1.4.4. (1)
- 1.4.6 Name the process in meiosis which results in an abnormal number of chromosomes. (1)

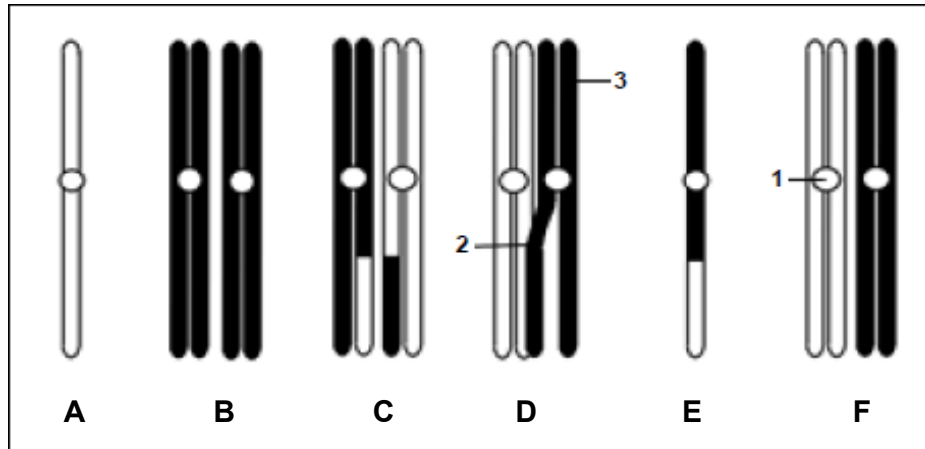
(6)

1.5 The diagram below shows a genetic engineering process.



- 1.5.1 Name the process shown in the diagram. (1)
- 1.5.2 Give the LETTER only that represents the:
- (a) Genetic donor (1)
 - (b) Surrogate (1)
- 1.5.3 Give:
- (a) The NUMBER of the step that represents fusion of the donor ovum with the donor DNA (1)
 - (b) TWO numbers that represent stem cells (2)
- 1.5.4 Name TWO locations of stem cells in humans, not shown in the diagram above. (2)
- (8)**

- 1.6 The diagram below represents the chromosomes at different stages of meiosis.
The shaded chromosomes are maternal in origin and the unshaded chromosomes are paternal in origin.



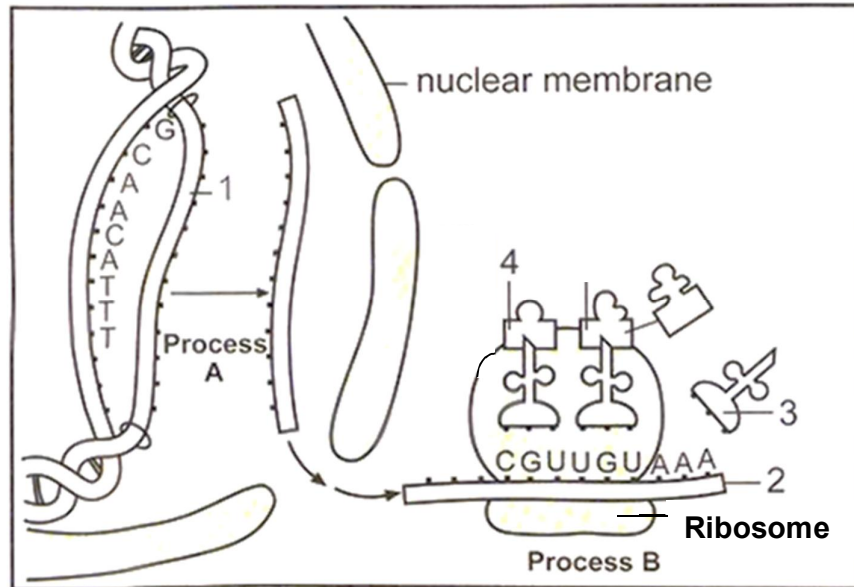
1.6.1 Write the LETTER only that represents the following:

- (a) The pairing of homologous chromosomes (1)
- (b) Crossing over (1)
- (c) Chromosomes in anaphase II (1)
- (d) Chromosomes in metaphase I (1)
- (4)**

TOTAL SECTION A: 50

SECTION B**QUESTION 2**

2.1 The diagram below represents an important biological process.



2.1.1 Identify nucleic acids:

(a) **1** (1)

(b) **2** (1)

2.1.2 Use the letters of the genetic code to write down the order of the first THREE complementary bases on strand **1**, starting from the top. (2)

2.1.3 Write down the anticodons present on the molecule numbered **4**. (2)

2.1.4 Describe the process of *translation in protein synthesis*. (5)
(11)

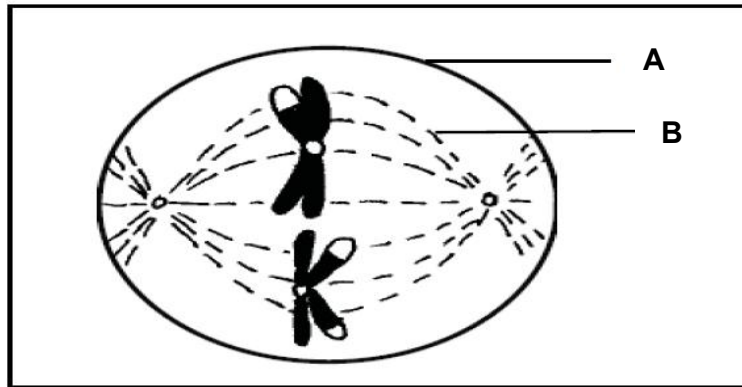
- 2.2 Haemoglobin (protein in blood) is made up of two types of polypeptide chains. In people with sickle cell anaemia, one polypeptide chain has one amino acid which is different from the normal sequence. This is due to a mutation which produces the base sequence **CAT** instead of **CTT** in the **DNA** molecule of haemoglobin.

The table below shows the mRNA codons for some amino acids.

mRNA base codons	Amino acids
CAU	Histidine
CAA	Glutamine acid
GUA	Valine
GAA	Glutamic acid
CUU	Leucine
GAU	Aspartic acid

- 2.2.1 State what is meant by a *mutation*. (1)
- 2.2.2 What type of mutation is responsible for sickle cell anaemia? (1)
- 2.2.3 Explain your answer to QUESTION 2.2.2. (2)
- 2.2.4 Use the information provided as well as the table to determine the:
- (a) Amino acid present in a normal haemoglobin (1)
- (b) Amino acid present in sickle cell haemoglobin (1)
- 2.2.5 Explain the consequences if the bond between two complementary chains of DNA is not able to break during replication. (2)
- (8)**

2.3 Study the diagram that shows a phase of meiosis.



- 2.3.1 Label structure **A**. (1)
- 2.3.2 Give ONE function of the structure labelled **B**. (1)
- 2.3.3 Which phase of meiosis is represented in the diagram? (1)
- 2.3.4 Explain your answer to QUESTION 2.3.3. (2)
- 2.3.5 Name ONE process that ensures that the gametes produced by meiosis are genetically different from each other. (1)
- (6)**

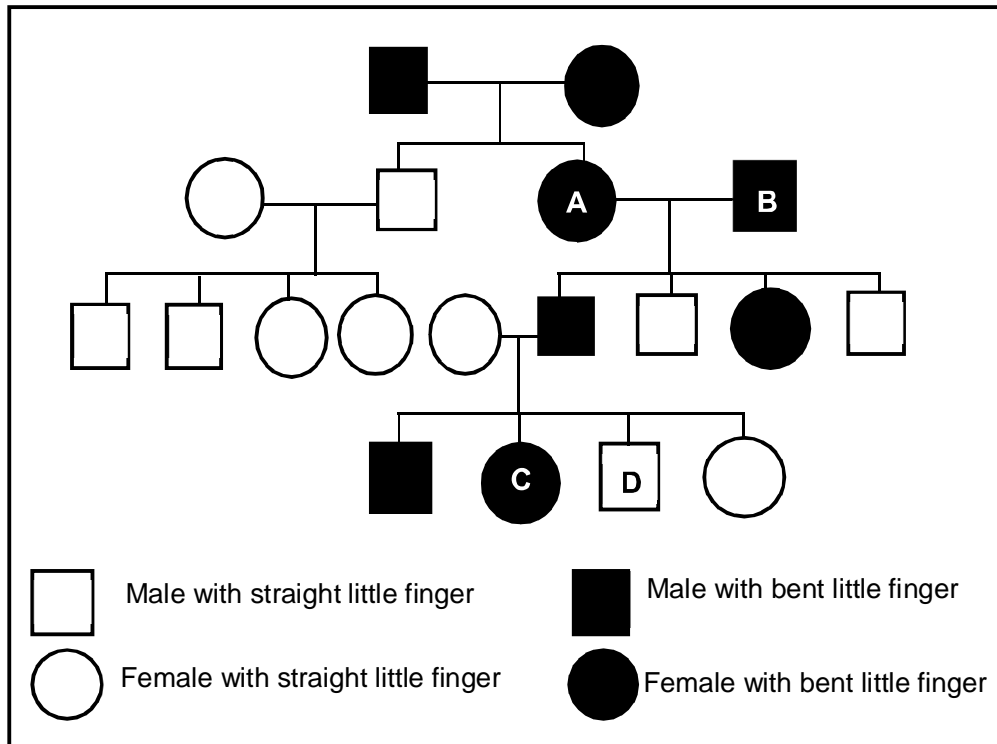
2.4 In watermelons, the allele for bitter fruit (**B**) is dominant over the allele for sweet fruit (**b**). The allele for yellow spots (**N**) is dominant over the allele for no spots (**n**).

Plant **A**, which is heterozygous for bitter fruit and for yellow spots, was crossed with plant **B**, which has sweet fruit and no spots.

- 2.4.1 Write down the genotype of:
- (a) Plant **A** (1)
- (b) Plant **B** (1)
- 2.4.2 Write down ALL the possible genotypes of the gametes of plant **A**. (2)
- 2.4.3 State the phenotype of an offspring having the genotype:
- (a) Bbnn (1)
- (b) bbNN (1)
- (6)**

- 2.5 A dominant allele (**B**) causes the last joint of the little finger to bend inwards towards the fourth finger and is called 'bent little finger'. The recessive allele (**b**) causes the little finger to be straight.

The pedigree diagram below shows the inheritance of a bent little finger in a family.



- 2.5.1 Explain why individuals **A** and **B** are heterozygous for this trait. (3)

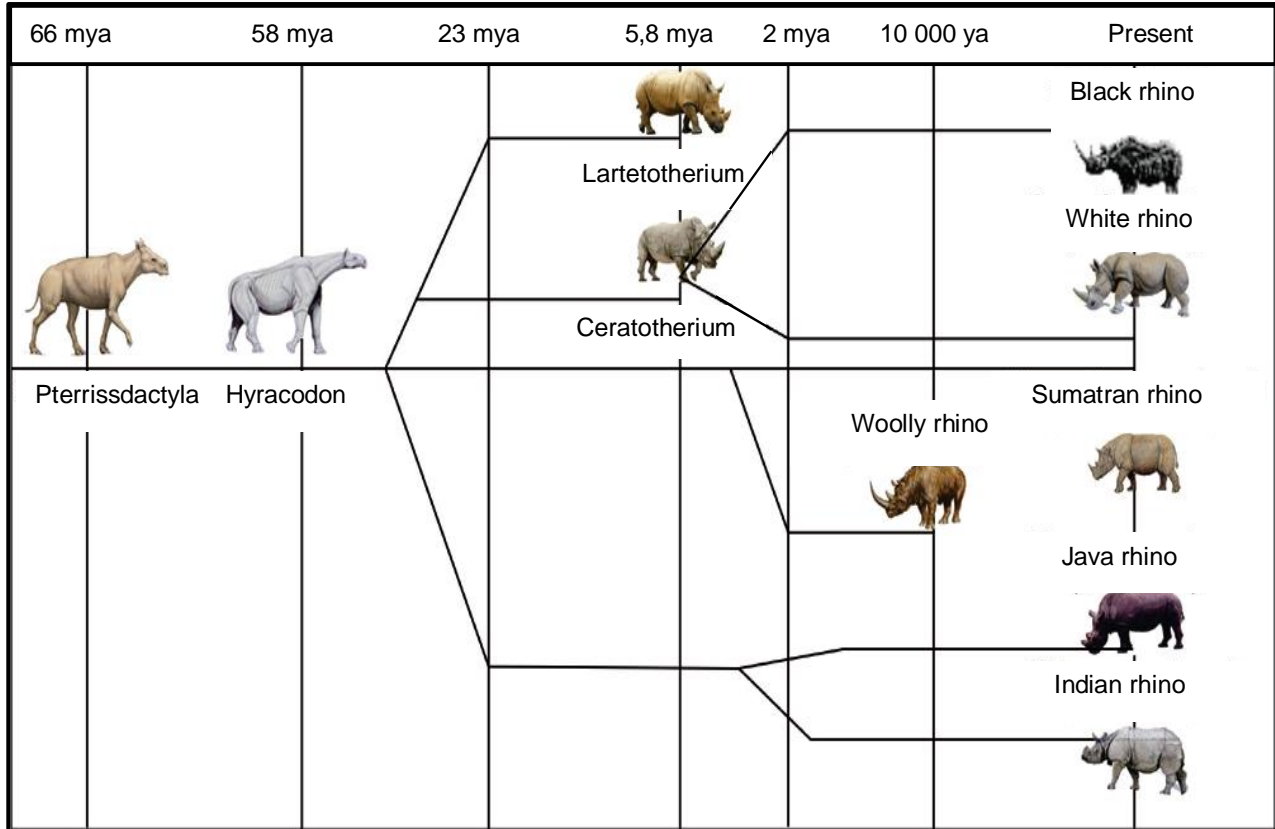
- 2.5.2 Individual **C** had four children with a male who has straight little fingers.

Use a genetic cross to show the possible genotypes and phenotypes of the offspring.

(6)
(9)
[40]

QUESTION 3

3.1 Study the phylogenetic tree showing the possible evolution of the modern rhinoceros.



3.1.1 Name the most recent common ancestor of the black and white rhinos. (1)

3.1.2 Explain how Jean-Baptiste de Lamarck would have described the evolution of the modern rhino's horn. (4)

(5)

- 3.2 A programme to produce a new variety of rice began in 1997 in Vietnam. The programme was based on a disease and pest resistant variety (IR59655) from the international seed bank in the Philippines.

The new hybrid variety VND404 was ready for trial planting on 6000 hectares in 2002.

The difference between IR59655 and the new variety VND404 are shown in the table below.

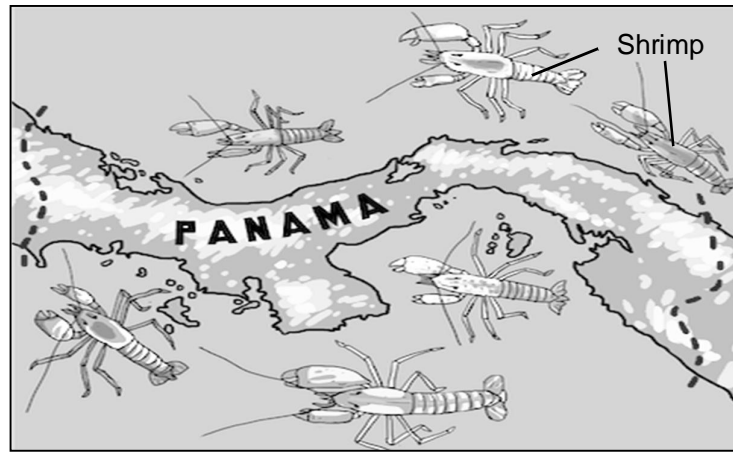
Parent variety IR9655	New variety VND404
Shorter plants	Taller plants
Longer life cycle	Shorter life cycle
Small yield	Greater yield
Not able to grow in soil rich in aluminium	Able to grow in soil rich in aluminium
Less able to compete well with weeds	More able to compete well with weeds

- 3.2.1 State the name of this type of biotechnology to produce a new variety of rice. (1)
- 3.2.2 Give THREE advantages of the new variety of rice that was produced within 5 years through the process named in QUESTION 3.2.1. (3)
- 3.2.3 Give TWO possible disadvantages of growing the new VND404 variety. (2)
- (6)**

- 3.3 Up until 3 million years ago North and South America were separated by the ocean. As dry land rose between the continents a land bridge (now Panama) was formed joining the two Americas and separating the Caribbean sea from the Pacific ocean.

Shrimps (sea organisms) that once freely interbred were separated by the barrier. When they were put together in a laboratory, they attacked each other instead of mating.

They had become separate species as the theory would predict.



- 3.3.1 Describe how speciation could have taken place to form two different types of shrimp species. (6)
- 3.3.2 Which process will provide a possible explanation as to how this land feature formed? (1)
(7)

- 3.4 Rock rabbits of a certain species on an island are usually brown in colour. A mutation in one gene for body colour results in white or black rock rabbits. Black rock rabbits camouflage well against the dark rock and warm up faster on cold days which will give them energy to avoid predators.

Scientists investigated the relationship between the colour of rock rabbits in a population and their survival rate on an island.

While conducting the investigation they:

- Selected a group of rock rabbits of a certain species in a habitat.
- Recorded the percentage of each colour (brown, white and black) in the selected group.
- Repeated the investigation over a period of 30 generations of offspring.

The results of the investigation are shown in the table below:

COLOUR OF ROCK RABBITS	PERCENTAGE (%) OF EACH COLOUR IN THE POPULATION			
	Initial population	10 th generation	20 th generation	30 th generation
BROWN	200	100	60	30
WHITE	8	0	0	0
BLACK	8	15	20	70

- 3.4.1 State the:
- (a) Independent variable (1)
- (b) Dependent variable (1)
- 3.4.2 Explain the effect of the mutation on the survival of the white rock rabbits. (2)
- 3.4.3 Briefly describe why the scientists had to conduct the above investigation over 30 generations. (2)
- 3.4.4 State ONE way in which the scientists could have improved the validity of the investigation. (1)
- 3.4.5 Use the theory of natural selection to explain the higher percentage of black rock rabbits in the population of the 30th generation. (6)
- (13)**

- 3.5 Scientists use fossils as evidence for human evolution. The brain volume of some extinct primates has been estimated from their fossils and has been compared to the brain volumes of living primates.

The results are shown in the table below.

Primate	Period of existence (million years ago)	Average brain volume (cm ³)
<i>Ardipithecus ramidus</i>	5,8 to 4,4	400
<i>Australopithecus afarensis</i>	4 to 2,7	450
<i>Australopithecus africanus</i>	3 to 2	450
<i>Homo habilis</i>	2,2 to 1,6	750
<i>Homo erectus</i>	2 to 0,4	1 000
<i>Homo sapiens</i>	0,2 to present	1 400
Modern apes	0,2 to present	500

- 3.5.1 Name the primate that has a brain volume of 750 cm³. (1)
- 3.5.2 Apart from fossil evidence, give TWO other types of evidence for human evolution. (2)
- 3.5.3 Which primate became extinct first? (1)
- 3.5.4 Calculate the difference in brain volume between the two living primates. Show ALL calculations. (2)
- 3.5.5 Give evidence in the table that suggests that *Australopithecus afarensis* and *Australopithecus africanus* may have existed at the same time. (1)
- 3.5.6 The brain of an organism is not preserved as a fossil.
How do scientists determine the brain volume of extinct primates? (2)

(9)
[40]

TOTAL SECTION B: 80

SECTION C**QUESTION 4**

The general trend in human evolution has been towards bipedalism and a change in diet from raw food to cooked food.

Describe how the differences in the skull and other parts of the skeleton of primitive ape-like beings and modern humans support this idea.

Content: (17)
Synthesis: (3)
(20)

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

TOTAL SECTION C: 20
GRAND TOTAL: 150