GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2021

10832

LIFE SCIENCES

PAPER 2

TIME: 2½ hours

MARKS: 150

17 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. Make 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 correct answer and write only the letter (A–D) next to the question number (1.1.1 – 1.1.10) in the ANSWER BOOK, for example 1.1.11 D.

1.1.1 The molecules that are involved in transcription are …

A mitochondrial DNA and mRNA.
B nuclear DNA and tRNA.
C nuclear DNA and mRNA.
D mitochondrial DNA and nuclear DNA.

1.1.2 During meiosis …

A two daughter cells are formed.
B all the daughter cells are identical to each other.
C the chromosome number is doubled.
D two divisions of the nucleus occur.

1.1.3 In an investigation it is found that 10% of the nitrogenous bases in a molecule of DNA is cytosine.

What is the ratio of cytosine to adenine in the same molecule?

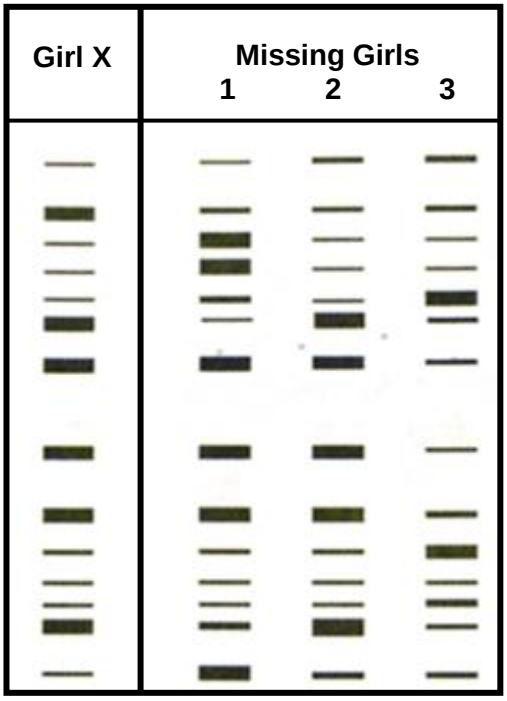
A 1 : 1
B 1 : 2
C 1 : 3
D 1 : 4

1.1.4 A certain disorder in humans is caused by an X-linked dominant allele. What is the expected result in the offspring of a normal female and a male who has the disorder?

A 50% of the sons are affected and 50% of the daughters are normal.
B All daughters are normal and all sons are affected.
C All daughters are affected and all sons are normal.
D All the sons and daughters are affected.

1.1.5 Three two-year old girls went missing in a particular area. Forensic experts had managed to obtain samples of their DNA and used these to produce DNA profiles. Six years later, a girl was found and is suspected to be one of the missing girls. She was named Girl **X**.
Her DNA profile was produced and compared to those of the three missing girls.

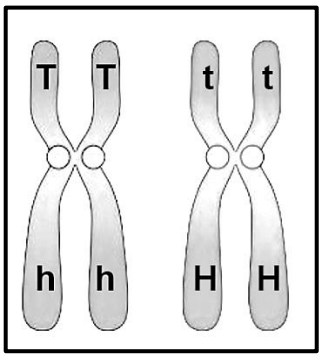
All the DNA profiles are shown below.



According to these DNA profiles, Girl **X** is …

A the missing girl 1.
B the missing girl 2.
C the missing girl 3.
D not any of the missing girls.

1.1.6 A pair of homologous chromosomes carry the gene combination **Th** and **tH** respectively before meiosis, as shown in the diagram below
The resulting gamete has the genotype **TH**.



Which of the following processes is most likely to have caused this combination?

A Independent assortment
B Crossing over
C Segregation of alleles
D Chromosome mutation

1.1.7 The amino acid sequence of haemoglobin molecules are routinely used to determine how closely related different species are to each other.
The following table shows the amino acid sequence of a small portion of haemoglobin of various species.

Species	Amino acid sequence in the same part of the haemoglobin molecules
Human	Lys-Glu-His-Iso
Horse	Arg-Lys-His-Lys
Gorilla	Lys-Glu-His-Lys
Chimpanzee	Lys-Glu-His-Iso
Zebra	Arg-Lys-His-Arg

Assuming that the amino acid sequence is the same for the rest of the molecule, which two species are the most closely related?

A Human and Gorilla
B Gorilla and Chimpanzee
C Horse and Zebra
D Human and Chimpanzee

1.1.8 Which of the following occurs in prophase 1, but not in prophase 2 of meiosis?

A Chromosomes are visible
B Homologous chromosomes pair up
C The nuclear membrane breaks down
D Spindle fibres develop

1.1.9 The type of protein formed is determined by the ...

A sequence of amino acids.
B type of sugar in the nucleic acid.
C number of phosphate molecules.
D pairing of nitrogen bases in the DNA molecule.

1.1.10 During the process of cloning a genetically superior sheep …

A the nucleus of the ovum fuses with the nucleus of the somatic cell.
B a sperm cell is taken to fuse with the ovum to form the embryo.
C the nucleus from the donor sheep is placed in an empty ovum.
D the embryo develops by meiosis.

(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 – 1.2.6) in the ANSWER BOOK.

1.2.1 The division of the cytoplasm during the process of meiosis

1.2.2 The stage of protein synthesis that occurs in the cytoplasm

1.2.3 Cells formed in males as a result of meiosis

1.2.4 Monomers of nucleic acids

1.2.5 The visible representation of a complete set of chromosomes in a cell

1.2.6 The use of living systems and organisms to develop or make products that help improve our lives

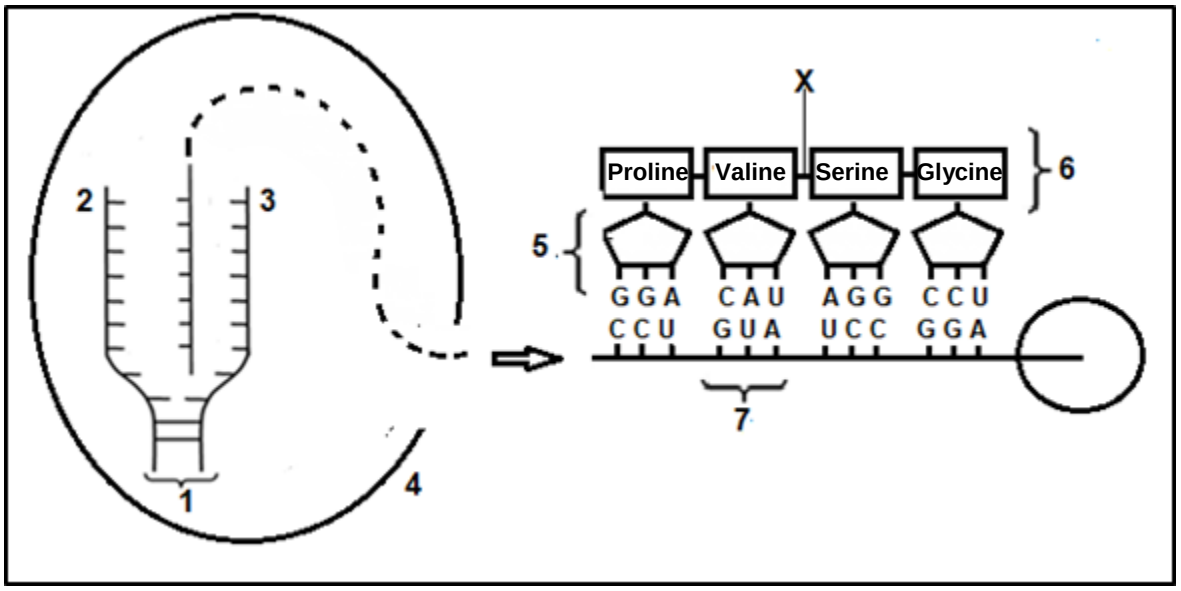
(6 x 1) **(6)**

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 number (1.3.1 – 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II	
1.3.1	Responsible for discovering the shape of the DNA molecule	A B	Crick Franklin
1.3.2	The importance of meiosis	A B	Production of zygotes Doubling of chromosome number
1.3.3	Fossils found in South Africa	A B	Mrs Ples Lucy

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

1.4 The diagram below represents two stages of protein synthesis.



1.4.1 Provide labels for:

(a) The bond at **X** (1)

(b) Organelle **4** (1)

(c) Molecule **1** (1)

(d) Molecule **5** (1)

1.4.2 Does strand **2** or strand **3** serve as the template for the process that is taking place? (1)

1.4.3 Write down the DNA base triplet that corresponds to the codon numbered **7.** (1)

1.4.4 The table below shows two differences between a DNA molecule and an RNA molecule.

	DNA	**RNA**
Type of sugar	(a)	(b)
Number of strands	(c)	(d)

Write down the letters (a – d) in your ANSWER BOOK and list the differences. (4)

(10)

1.5 In sheep, the allele for black wool (**B**) is dominant over the allele for white wool (**b**) and the allele for horns (**H**) is dominant over the allele for being hornless (**h**).

A black-wooled sheep with horns is crossed with a white-wooled, hornless sheep.

The Punnett diagram below shows the possible gametes produced by each parent.

SHEEP 1 → / **SHEEP 2** ↓	**BH**	**Bh**	**bH**	**bh**
bh		**X**		
bh			**Y**	
bh				
bh				

1.5.1 State why the example above represents a dihybrid cross? (2)

1.5.2 Give the genotype of the black-wooled sheep with horns that was used in this cross. (1)

1.5.3 Give the:

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

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

1.5.4 Give the proportion of offspring that could:

(a) Have horns (1)

(b) Be black-wooled and hornless (1)

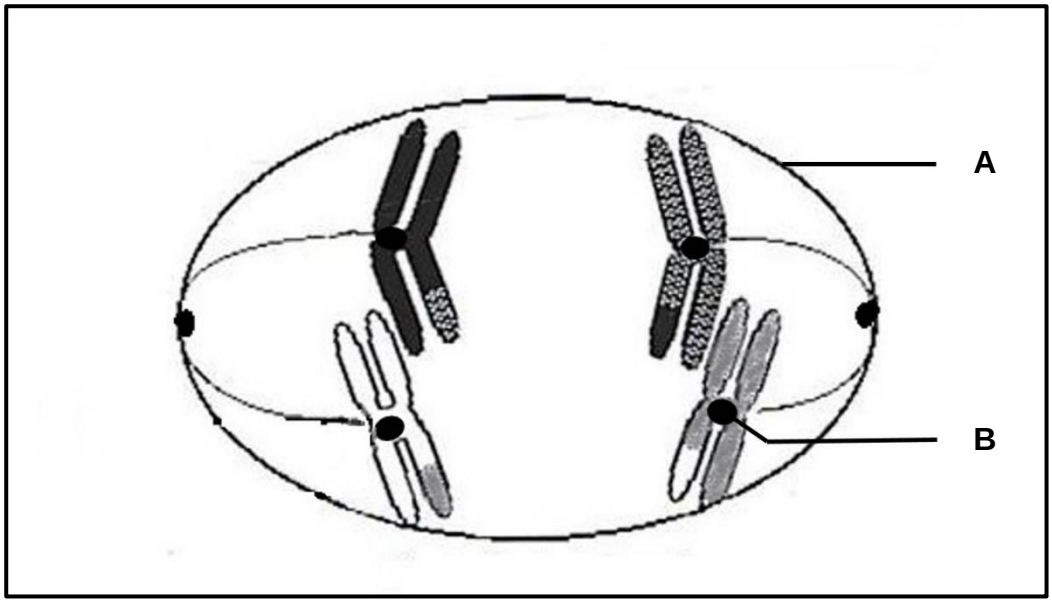
1.5.5 What percentage of offspring is expected to be recessive for both characteristics? (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents a phase of meiosis.



2.1.1 Identify the phase represented in the diagram. (1)

2.1.2 Give TWO visible reasons for your answer to QUESTION 2.1.1. (2)

2.1.3 Identify the part labelled:

(a) **A** (1)

(b) **B** (1)

2.1.4 State the number of chromosomes that would be present in each daughter cell at the end of meiosis 2 of this cell. (1)

2.1.5 Draw a labelled diagram of the phase before the one mentioned in QUESTION 2.1.1. (5)

2.1.6 Give TWO sources of genetic variation other than meiosis. (2)
(12)

2.2 Describe how a sperm cell formed through non-disjunction of chromosome pair 21 leads to Down syndrome. **(3)**

2.3 Grade 12 learners were studying the inheritance of characteristics in fruit flies. They observed two characteristics of the fruit flies, namely eye colour and wing type. The learners wanted to investigate the number of fruit flies that had the dominant and recessive phenotype for each characteristic in a population of 3 000 flies.

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

Characteristic	Phenotype	
	Dominant	**Recessive**
Eye colour	Red eyes (R)	White eyes (r)
Wing type	Normal wings (N)	Vestigial wings (n)

To conduct their investigation they:

- Randomly collected 200 fruit flies from the population
- Recorded the number of fruit flies that had each phenotype

Their results are shown in the table below:

Characteristic	Phenotype	Number of fruit flies
Eye colour	Red	125
	White	75
Wing type	Normal	47
	Vestigial	153

2.3.1 State the type of inheritance that is represented for both characteristics. (1)

2.3.2 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

2.3.3 Describe THREE planning steps for this investigation. (3)

2.3.4 Give TWO ways in which the Grade 12 learners could increase the reliability of the investigation. (2)

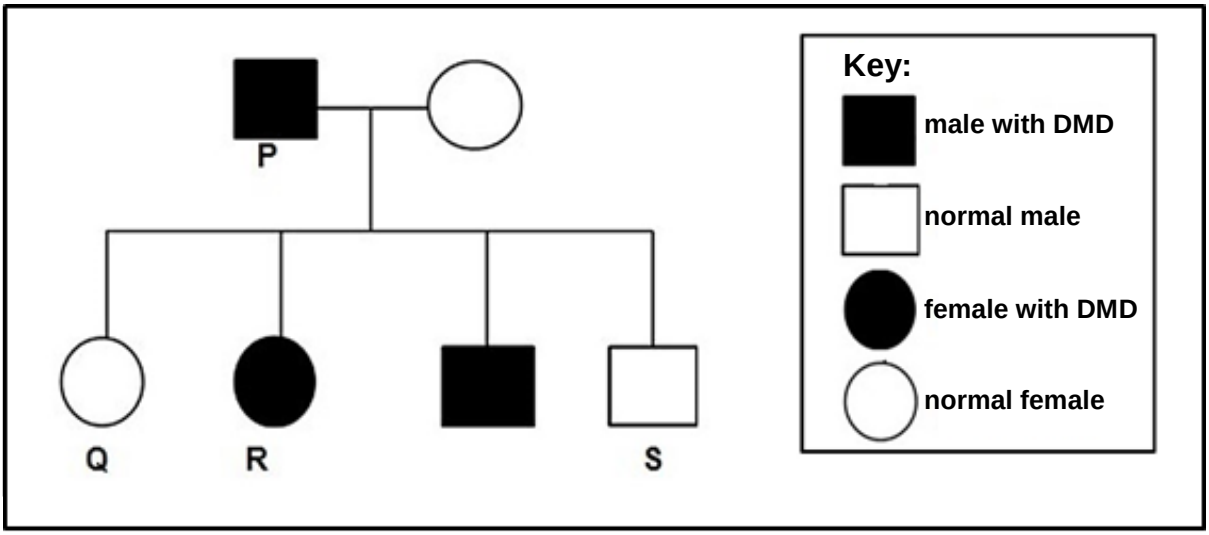
2.3.5 State a conclusion based on the results. (2)

2.3.6 Draw a bar graph to represent the results of the investigation. (6)

(16)

2.4 Duchenne muscular dystrophy (DMD) is a neuromuscular disorder and is caused by a recessive allele X^d on the X-chromosome. The allele for normal neuromuscular functioning is X^D.

The inheritance of DMD in a family is shown in the diagram below.



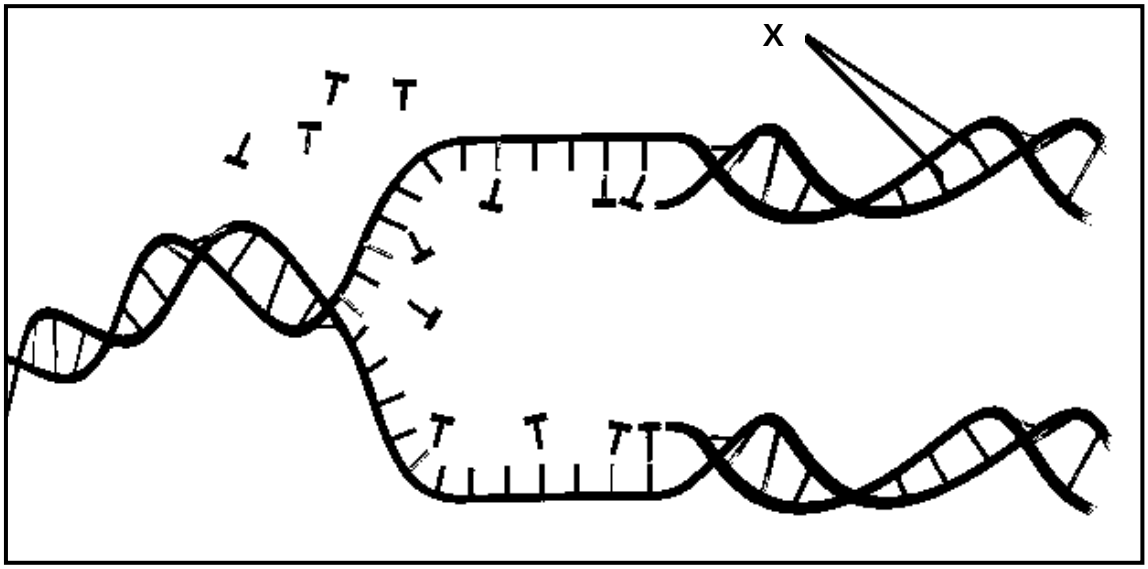
2.4.1 How many generations are shown in this family? (1)

2.4.2 Give the phenotype for individual **P**. (2)

2.4.3 Give the genotype for individual **Q**. (1)

2.4.4 Individual **S** marries a woman who is normal for neuromuscular functioning but carries the recessive allele. Use a genetic cross to show the percentage of offspring that will have DMD. (6)
(10)

2.5 The diagram below shows a process occurring in the nucleus of a cell.



2.5.1 Identify the process shown in the diagram. (1)

2.5.2 Name the bonds that are labelled **X**. (1)

2.5.3 Name the phase in the cell cycle when this process takes place. (1)

2.5.4 State TWO reasons why the process mentioned in QUESTION 2.5.1 is important. (2)
(5)

2.6 Blood type in humans is controlled by multiple alleles.

2.6.1 List the THREE alleles for blood type. (1)

2.6.2 State the number of alleles inherited by each individual. (1)

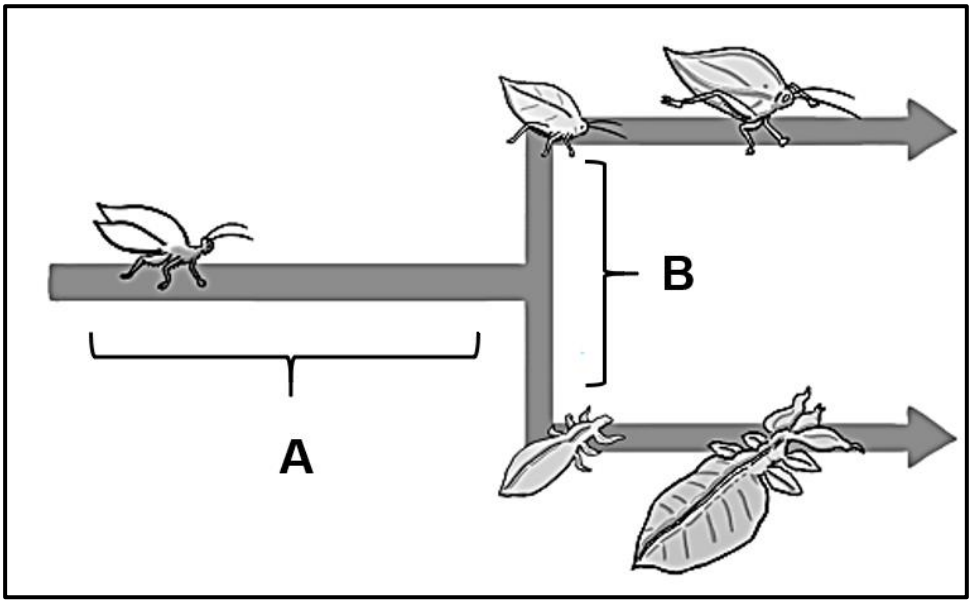
2.6.3 Briefly state why using blood groups are not completely reliable in establishing paternity. (2)
(4)

[50]

QUESTION 3

3.1 Tabulate THREE differences between artificial selection and natural selection. **(7)**

3.2 The phylogenetic tree below shows evolution by punctuated equilibrium in a species of insect.



Use the letters **A** and **B** to explain the theory of punctuated equilibrium. **(4)**

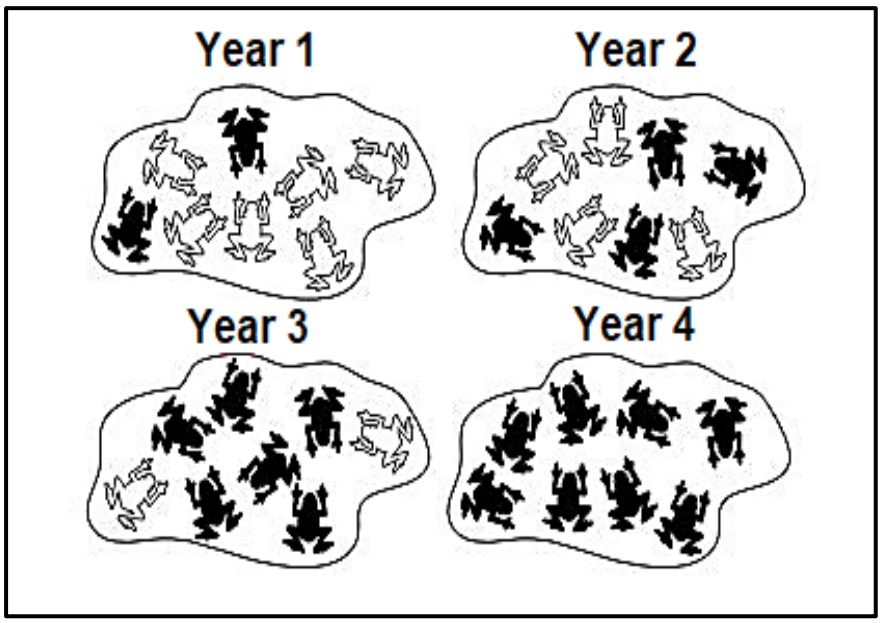
3.3 An ancestral squirrel population living in an area was separated when an earthquake caused a deep valley to form. The two populations were separated from each other and no longer lived in the same area. Over thousands of years, the divided squirrel populations became two different species.

3.3.1 Define the term *population*. (2)

3.3.2 Describe the speciation of the squirrels. (6)

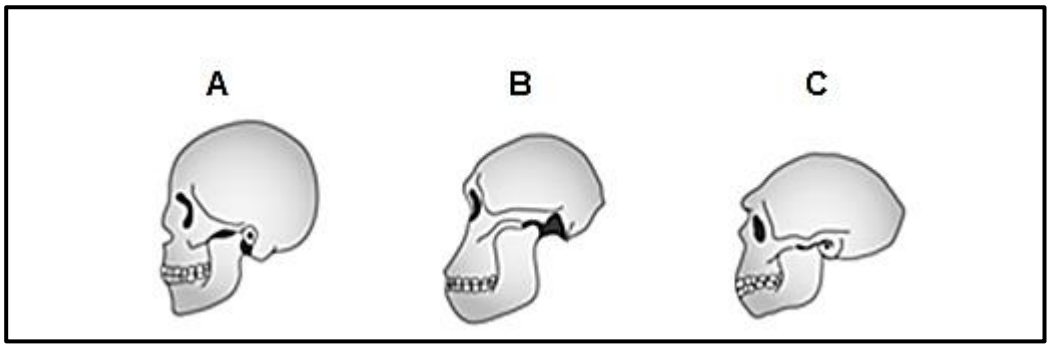
3.3.3 Name TWO reproductive isolating mechanisms that help to keep species separate. (2)
(10)

3.4 A population of frogs live in a pond. The frogs may be darker or lighter in colour. A population of herons (long-legged water birds), who feed on the frogs, live in the same habitat. Over a period of time, the water in the pond became darker in colour. This caused the frog population to change over a period of 4 years as shown in the diagram below.



Use Darwin's theory of evolution to explain how the frog population changed over the period of 4 years. **(6)**

3.5 The diagram below shows three skulls.

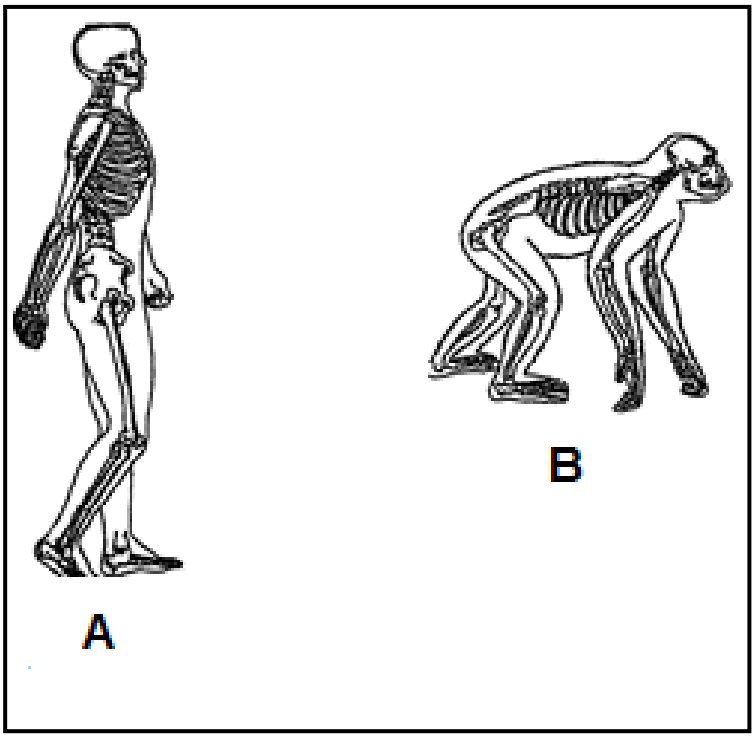


3.5.1 Arrange the skulls **A**, **B** and **C** from oldest to youngest (most recent). (2)

3.5.2 Describe the significance of the difference in cranium size between skulls **A** and **C**. (3)

3.5.3 Describe TWO visible differences in the structure of the jaw of skulls **A** and **B**. (4)
(9)

3.6 The picture below shows the parts of the skeletal structures of two hominids.

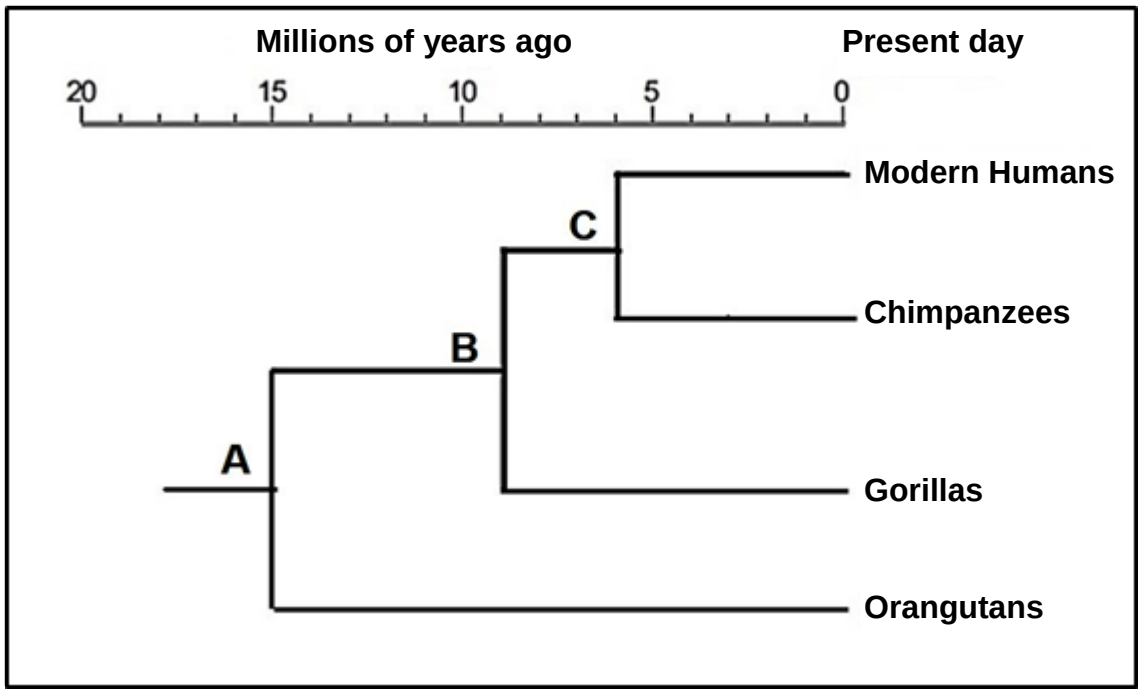


3.6.1 Name the term used to describe the type of locomotion of species **B**. (1)

3.6.2 Explain how the position of the foramen magnum, the shape of the spine and the structure of the pelvis are suited for the type of locomotion in species **A**. (6)

3.6.3 Name TWO species that display the type of locomotion shown by species **A**. (2)
(9)

3.7 The phylogenetic tree below shows the evolutionary relationships between some species.



3.7.1 Give the LETTER of the most recent common ancestor of all the species in the diagram. (1)

3.7.2 When did chimpanzees and modern humans diverge (separate) from the common ancestor **C**? (1)

3.7.3 State THREE characteristics of the upper limb that humans share with other primates. (3)
(5)
[50]

TOTAL SECTION B: 100

TOTAL: 150

END