

PREPARATORY EXAMINATION

2023

10832

LIFE SCIENCES

(PAPER 2)

TIME: 2½ hours

MARKS: 150

19 pages

LIFE SCIENCES: Paper 2



10832E

X05



INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions in the ANSWER BOOK.
2. Start the answers to EACH question at the top of a NEW page.
3. Number the answers according to the numbering system used in this question paper.
4. Present your answers according to the instructions of each question.
5. Do ALL drawings in pencil and label them in blue or black ink.
6. Draw diagrams, flow charts or tables only when asked to do so.
7. The diagrams in this question paper are NOT necessarily drawn to scale.
8. Do NOT use graph paper.
9. You must use a non-programmable calculator, protractor and a compass where necessary.
10. Write neatly and legibly.

SECTION A

QUESTION 1

- 1.1 Four options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 E.

1.1.1 The position of a gene on a chromosome is called the ...

- A allele.
- B codon.
- C locus.
- D triplet.

1.1.2 The diagram below represents a process occurring in the cell. The process represents ...



- A transcription.
- B mutation.
- C DNA replication.
- D translation.

1.1.3 Jason and Robert are identical twins.

Which of the following uses of DNA profiles is NOT possible when considering identical twins?

- A Identification of Jason and Robert's father
- B Determining if a woman is Jason and Robert's aunt
- C Distinguishing between Jason and Robert when determining who committed a crime
- D Determining if Jason or Robert could donate a kidney

QUESTIONS 1.1.4 AND 1.1.5 ARE BASED ON THE INFORMATION BELOW.

Part of a gene that produces a protein has the base triplet **TTC** which codes for a specific amino acid. A mutation occurs, and the base triplet becomes **TTT**.

The table below gives the mRNA codons with their corresponding amino acids.

mRNA codon	Amino acid
AAA	lysine
UUC	phenylalanine
AAG	lysine
UUG	leucine
UGG	tryptophan
UAA	stop
AAC	asparagine
UUU	phenylalanine

- 1.1.4 The anticodon that will ensure the correct amino acid is placed in the normal protein is ...
- A TTC.
 - B UUG.
 - C AAG.
 - D UUC.
- 1.1.5 Which amino acid will be found in the protein as a result of the mutation?
- A The amino acid sequence is unaffected
 - B Asparagine
 - C Phenylalanine
 - D Tryptophan
- 1.1.6 Which of the following describes an event that occurs in meiosis but NOT in mitosis?
- A The chromatin network becomes chromosomes.
 - B The nuclear membrane disappears.
 - C The cytoplasm separates to form daughter cells.
 - D The halving of the amount of DNA

- 1.1.7 Lindiwe suffers from a disorder called hyperhidrosis. Hyperhidrosis is an inherited disorder that results in a person sweating too much.

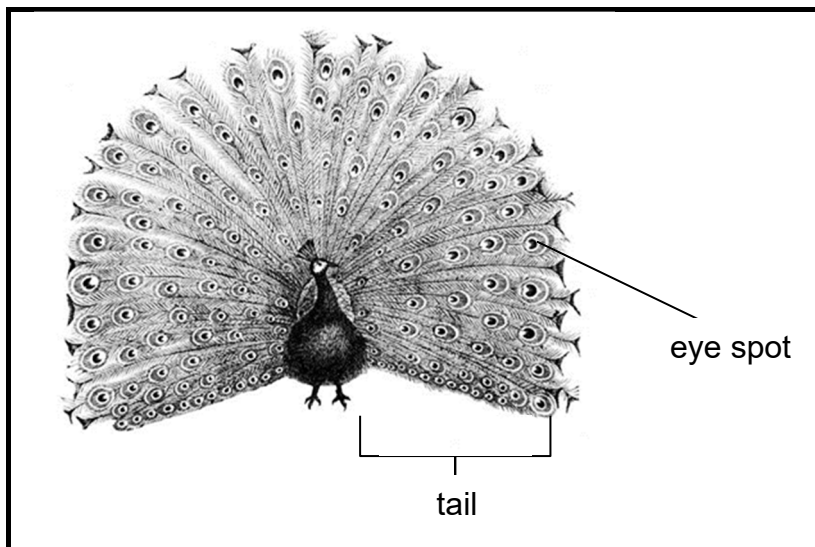
Scientists have discovered that a dominant allele causes the disorder. Lindiwe is homozygous dominant for hyperhidrosis.

A doctor successfully treats Lindiwe's hyperhidrosis by injecting her with a drug to reduce sweating.

Which of the following statements about Lindiwe's treatment with the drug is correct?

Treatment with the drug will ...

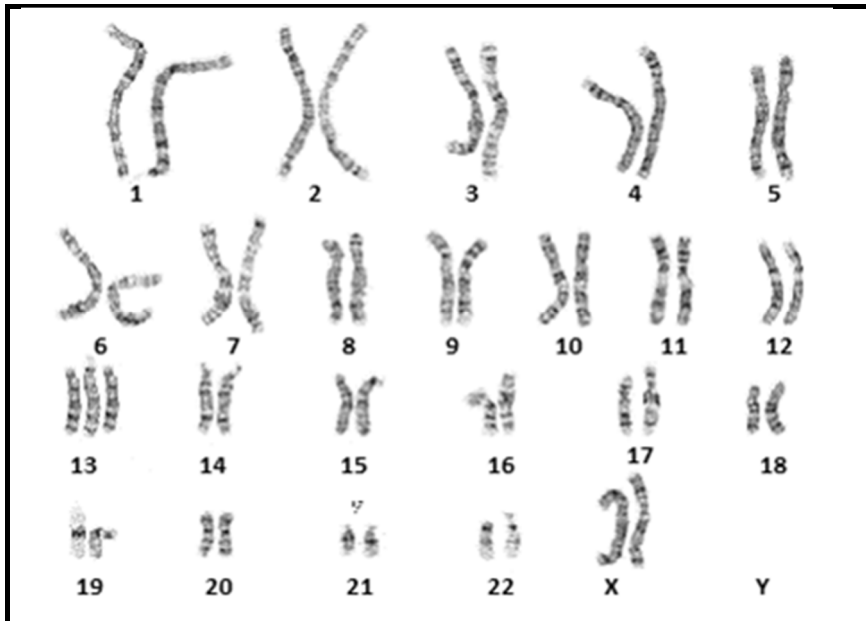
- A ensure that Lindiwe's offspring do not inherit hyperhidrosis.
 - B only affect Lindiwe's phenotype.
 - C only affect Lindiwe's genotype.
 - D affect neither Lindiwe's genotype nor phenotype.
- 1.1.8 A scientist writes a hypothesis that female peahens will choose to mate with a male peacock that has a longer tail and more eye spots over a male with a shorter tail and fewer eye spots.



Which factor will be the dependent variable?

- A Number of eye spots
- B Number of mating attempts
- C Tail length
- D Number of female peahens

1.1.9 The diagram below shows the karyotype of a human.



Read the following statements about the karyotype.

- (i) There are 44 chromosomes.
- (ii) There are 45 autosomes.
- (iii) The 2 gonosomes are different.
- (iv) The 2 gonosomes are identical.
- (v) The karyotype is from a gamete.
- (vi) The human has Down Syndrome.

Which of the following statement combinations about the karyotype above is CORRECT?

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

1.1.10 Which example is NOT a source of variation?

- A Mutations
- B Crossing over in prophase II
- C Random arrangement of chromosomes
- D Random fertilisation of gametes

(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 numbers (1.2.1 to 1.2.8) in the ANSWER BOOK.

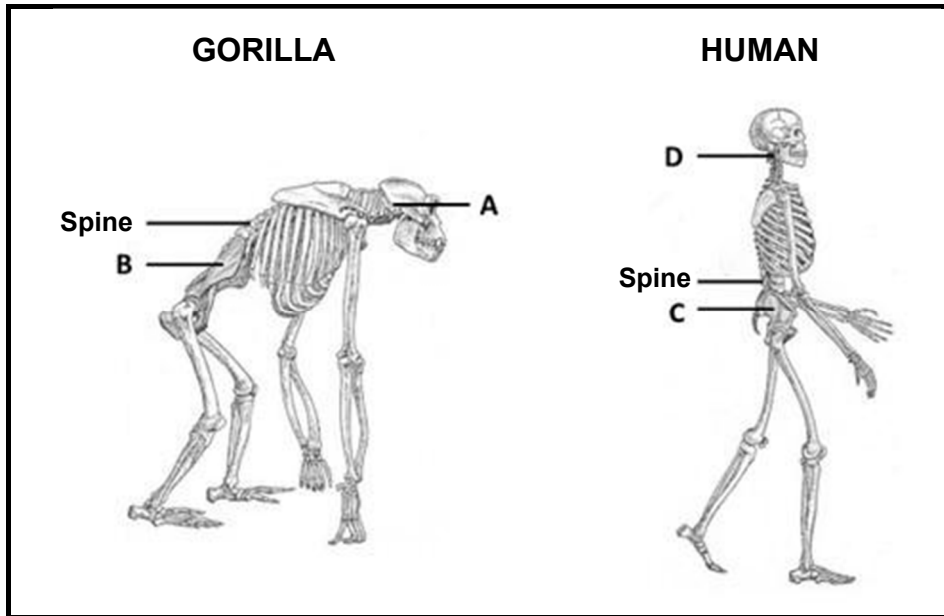
- 1.2.1 A type of nucleus that contains one set of chromosomes
- 1.2.2 Undifferentiated cells that can become specialised tissues
- 1.2.3 A characteristic where a large, protruding jaw causes a slanting face
- 1.2.4 An organism that contains genes inserted from an organism of a different species
- 1.2.5 A type of inheritance that results in an intermediate phenotype in the heterozygous genotype
- 1.2.6 An African ape that shares the most recent common ancestor with humans
- 1.2.7 An inherited disorder that results in the absence of pigments in some photoreceptors of the eye
- 1.2.8 All the genes in all the chromosomes of a species (8 x 1) (8)

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 numbers (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Decreases genetic variation	A: Cloning B: Meiosis
1.3.2 Site of meiosis in plants	A: Stigma B: Ovule
1.3.3 Type of variation in blood types	A: Continuous B: Discontinuous

(3 x 2) (6)

1.4 The diagram below shows the skeleton of a gorilla compared to a modern human.



1.4.1 Give the LETTER and NAME of the part that:

- (a) Is in a forward position, so the head and body are on a vertical plane (2)
- (b) Functions to support the internal organs of the body (2)

1.4.2 State the shape of the spine of the:

- (a) Gorilla (1)
- (b) Human (1)

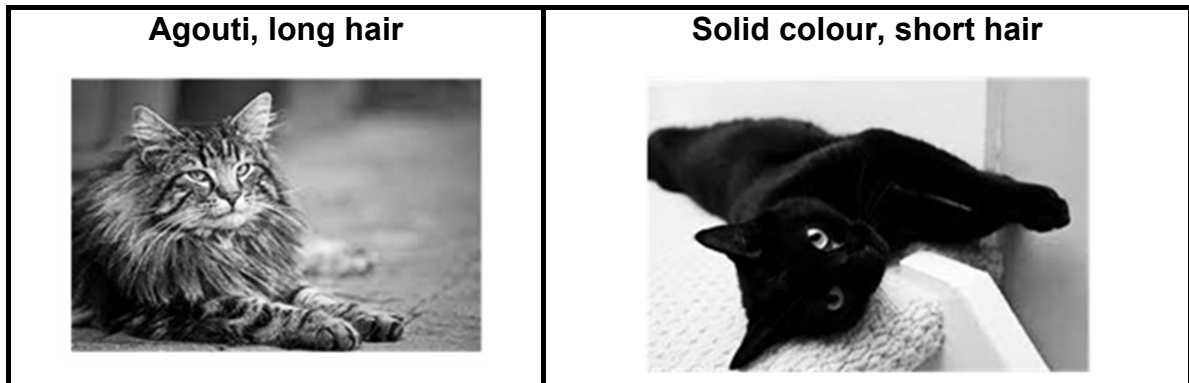
1.4.3 Name the mode of locomotion that the spine shape mentioned in QUESTION 1.4.2 facilitates for the:

- (a) Gorilla (1)
 - (b) Human (1)
- (8)**

1.5 Cats inherit many genes that affect the appearance of their coat.

One gene controls whether the coat is striped or a solid colour. The agouti allele (**A**) for striped hair is dominant over the allele for hair that is a solid colour (**a**).

A second gene affects the length of coat. Cats can either have long hair or short hair. Long hair (**L**) is dominant over short hair (**l**).



A male who is heterozygous for both agouti and long hair mates with a short-haired, solid-colour-haired female.

1.5.1 State the type of genetic cross represented above. (1)

1.5.2 Give the:

(a) Genotype of the female cat (2)

(b) Possible gametes produced by the male cat (2)

1.5.3 Name the type of inheritance shown by both coat appearance traits mentioned above. (1)

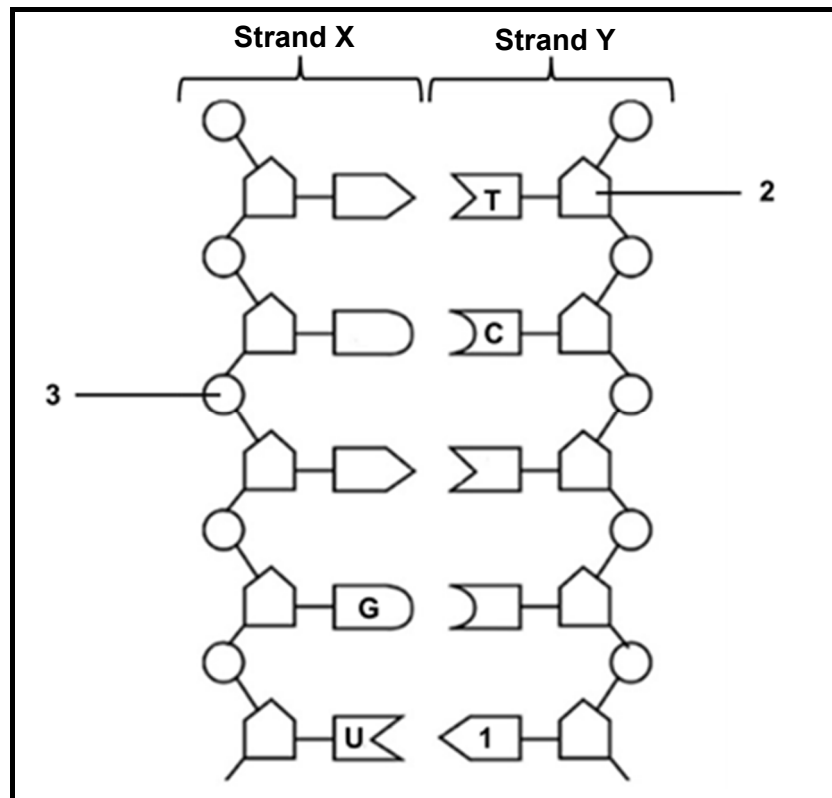
1.5.4 What percentage of the offspring will inherit the same phenotype as their mother? (2)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below shows a strand of DNA and a strand of mRNA that is involved in transcription.



2.1.1 Provide labels for the parts labelled:

- | | | |
|-----|---|-----|
| (a) | 1 | (1) |
| (b) | 2 | (1) |
| (c) | 3 | (1) |

2.1.2 Identify the strand that represents the mRNA molecule. (1)

2.1.3 Give ONE visible reason for your answer in QUESTION 2.1.2. (1)

2.1.4 Describe the process of transcription. (5)

2.1.5 Explain ONE reason why transcription is important. (2)

(12)

- 2.2 Mr Megabucks, the wealthiest man in the world, recently died. According to his will, Mr Megabucks' children will inherit his fortune.

Since his death, three women have claimed to have had a child with Mr Megabucks.

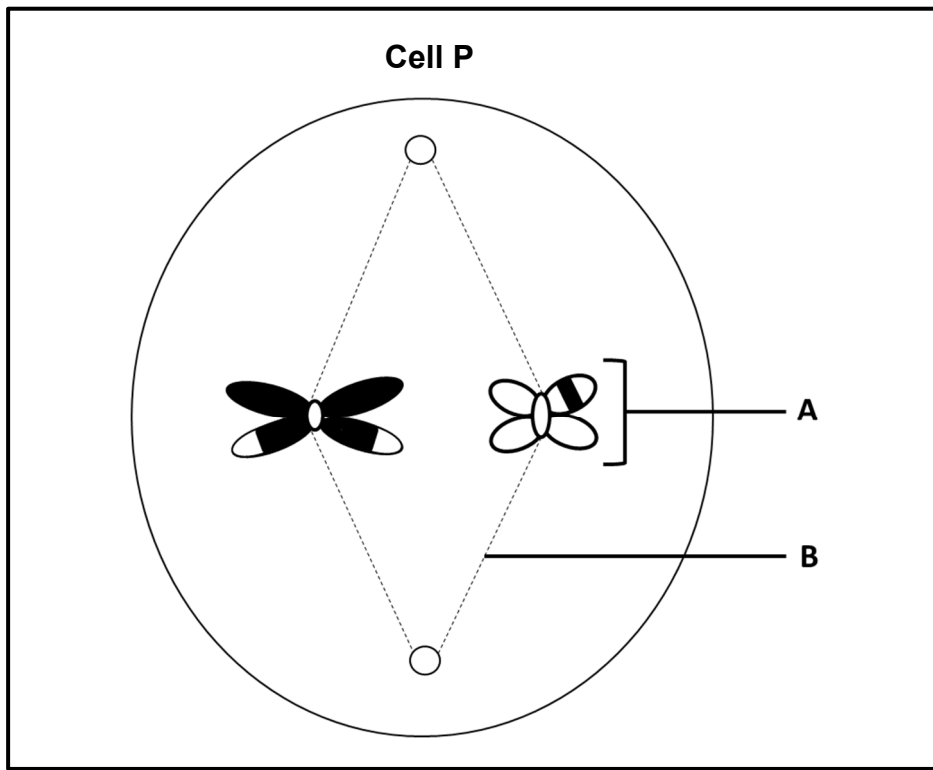
Before Mr Megabucks died, his lawyers insisted that he have a DNA profile done. The lawyers for the estate have also insisted on a DNA profile for each woman and her child.

The diagram below shows the DNA profile comparison of Mr Megabucks with each woman and all the children.

Mr Megabucks	Woman X	X's child	Woman Y	Y's child	Woman Z	Z's child

- 2.2.1 Give ONE scientific reason why the lawyers insisted on a DNA profile from each woman and their children to determine paternity. (2)
- 2.2.2 (a) Which child will inherit from Mr Megabucks? (1)
 (b) Explain your answer in QUESTION 2.2.2 (a) using evidence from the DNA profiles in the diagram above. (3)
- 2.2.3 Name ONE sample source that could have been used to get the DNA profiles. (1)
 (7)

2.3 The diagram below represents Cell P in a phase of meiosis.



2.3.1 Name the phase of meiosis represented in the diagram above. (1)

2.3.2 Give the number of chromosomes that were present in:

- (a) The parent cell of **Cell P** (1)
- (b) One daughter cell at the end of meiosis in **Cell P** (1)

2.3.3 (a) Give the name of structure **A**. (1)
(b) Give ONE function of structure **B**. (1)

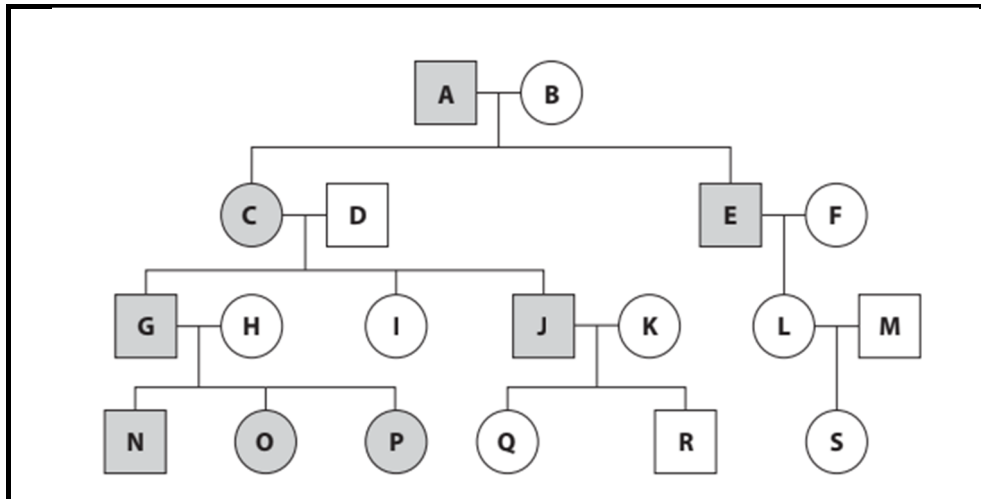
2.3.4 Describe the process of crossing over that resulted in the appearance of structure **A**. (4)

2.3.5 Draw a diagram of the phase that occurs after the phase in the diagram above. (5)
(14)

- 2.4 Familial hypercholesterolemia (FH) is an inherited condition caused by a dominant allele. People with the condition have high levels of cholesterol in their blood. This increases the risk of dying from blocked arteries.

The diagram below shows the FH inheritance pattern in several generations of a family with familial hypercholesterolemia.

Dominant allele = **T** Recessive allele = **t**



KEY:



Male without FH



Female without FH



Male with FH



Female with FH

- 2.4.1 How many generations are shown in the pedigree diagram above? (1)
- 2.4.2 Determine the number of males, in the diagram above, who are homozygous recessive for hypercholesterolemia (FH). (1)
- 2.4.3 Couple **G** and **H** are planning to have a fourth child. Use a genetic cross to show the percentage probability of having a child without hypercholesterolemia. (6)

(8)

- 2.5 Lactose is a sugar found in cow's milk. It is digested by an enzyme called lactase.

Some people cannot produce lactase and have a condition called lactose intolerance. The condition is caused by a recessive allele (**d**). This means that people with the homozygous recessive genotype are lactose intolerant.

People from different countries were tested to determine if they were lactose intolerant. The table below shows the number of people tested in each country and the lactose intolerance percentage.

Country	Number of people tested	Percentage who were lactose intolerant
A	160	4
B	315	12
C	236	54
D	134	92
E	20	100

- 2.5.1 The population size of Country B is 190 million.

Calculate the number of people in this country likely to be lactose intolerant. Show all your workings.

(3)

- 2.5.2 Which country shows the least reliable result?

(1)

- 2.5.3 Give a reason for your answer to QUESTION 2.5.2.

(1)

- 2.5.4 Provide TWO ways in which the validity of the results can be improved.

(2)

- 2.5.5 Describe TWO planning steps that would have been taken for this investigation.

(2)

(9)

[50]

QUESTION 3

- 3.1 Flies lay their eggs in the urine and faeces that stick to the wool of sheep. The eggs hatch and the larvae damage the sheep's skin, leading to infection.

To reduce this problem, farmers in New Zealand have been developing sheep with no wool growth on their legs, backside (bottom) or the underside of their abdomen.

Farmers have crossed different breeds of sheep to produce offspring with the desired characteristics. The characteristics of other breeds of sheep are shown in the table below.

Breed of sheep	Characteristic
Cheviot	Bare heads and legs
East Friesian	Bare backsides
Wiltshire	Bare abdomens

- 3.1.1 Using evidence from the table above, describe how farmers could use selective breeding to develop sheep with bare legs and bare backsides. (5)
- 3.1.2 Tabulate TWO differences between *selective breeding* and *natural selection*. (5)
- 3.1.3 Explain ONE disadvantage of selective breeding of the sheep in QUESTION 3.1.1. (2)
- (12)

- 3.2 The diagram below shows a modern swordfish.

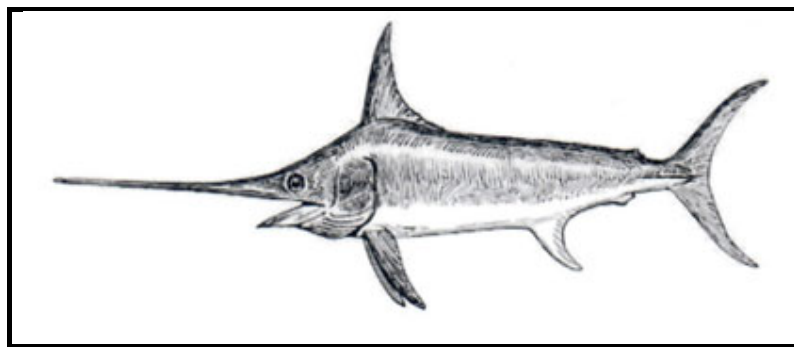


Diagram 1

Ancestors of swordfish had short swords. Modern swordfish have long swords.

Swordfish use their swords to injure prey. The injured prey is easier to catch and eat.

The diagram below shows one theory of how the length of the sword of swordfish evolved.

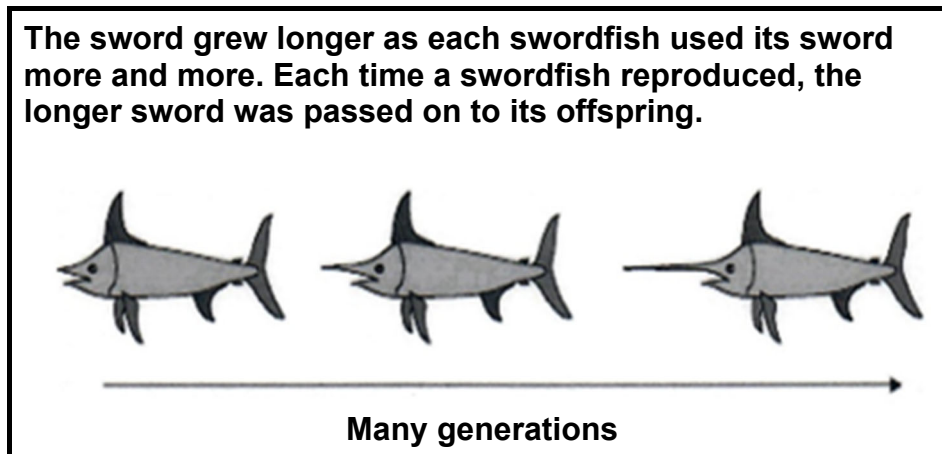


Diagram 2

- 3.2.1 (a) Which scientist suggested the theory shown in **Diagram 2**? (1)
(b) Explain ONE reason why the theory put forward by the scientist in QUESTION 3.2.1 (a) is not accepted. (2)

- 3.2.2 Describe how natural selection could result in modern swordfish having a longer sword than their ancestors. (6)
(9)

3.3 The table below shows the average cranial capacity in hominin fossils.

Hominin	Number of fossil examples	Average capacity of the cranium (ml)
<i>Australopithecus</i>	6	440
<i>Paranthropus</i>	4	519
<i>Homo habilis</i>	4	640
<i>Homo erectus</i> (Javanese)	6	930
<i>Homo erectus</i> (Chinese)	7	1 029
<i>Homo sapiens</i>	7	1 350

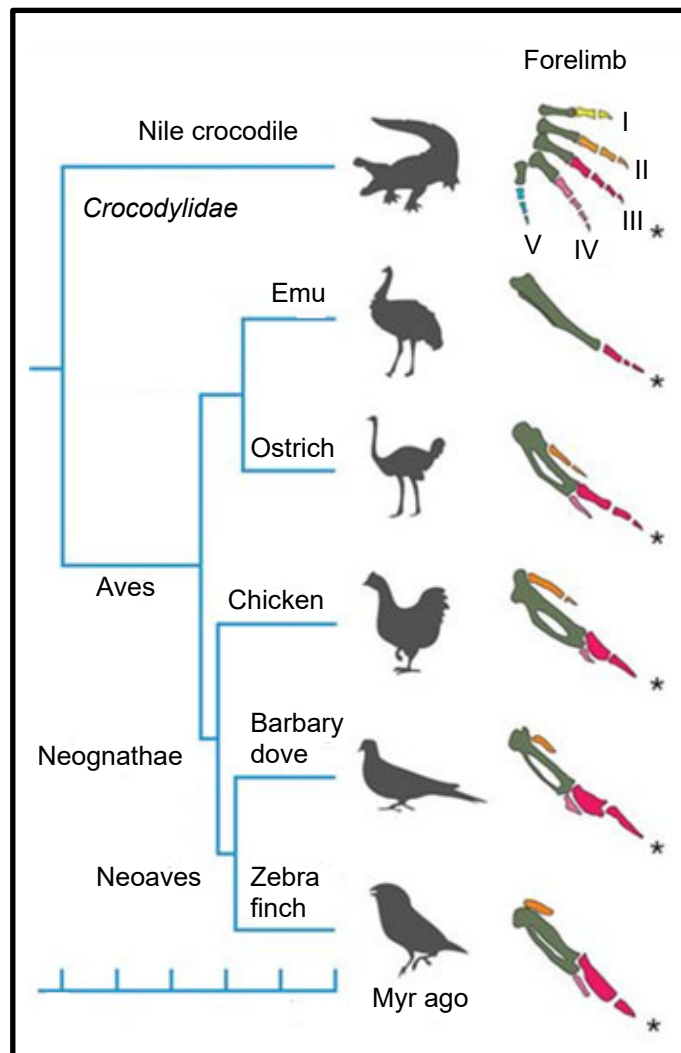
- 3.3.1 Select ONE *Australopithecus* fossil example that you have learnt about, and give the:

- (a) Scientific name (1)
(b) Common name given to the fossil example (1)
(c) Name of the scientist that discovered the fossil (1)

- 3.3.2 State TWO advantages of the larger cranial capacity. (2)

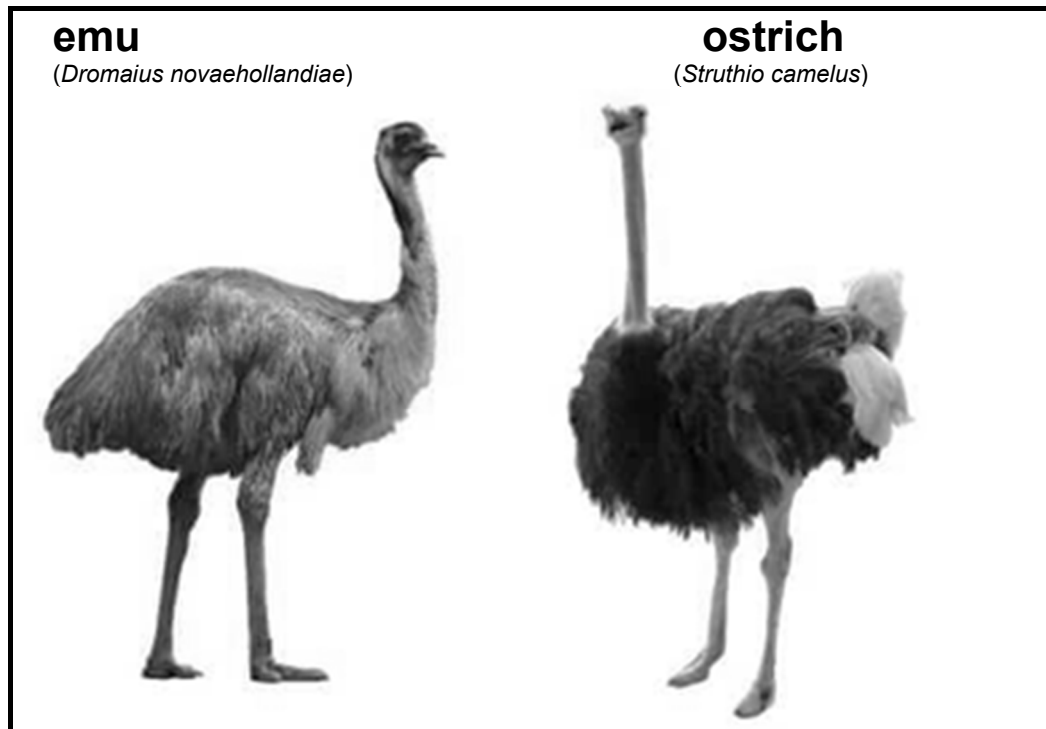
- 3.3.3 Draw a bar graph to compare the average cranial capacity of the *Homo* species shown in the table above. (6)
- 3.3.4 Explain how genetic evidence supports the hypothesis that the ancestors of Chinese *Homo erectus* fossils originated in Africa. (3)
- (14)

- 3.4 Study the phylogenetic tree showing the evolutionary relationship between birds (*Aves*) and reptiles (*Crocodylidae*) and answer the following questions.



- 3.4.1 When did the *Aves* (birds) branch from *Crocodylidae* (reptiles)? (2)
- 3.4.2 Give the term that describes the common structures shown by a * symbol in the forelimb that was inherited from a common ancestor. (1)

- 3.4.3 Emus and ostriches are both large, flightless birds. Emus are only found on the Australian continent and ostriches are in Africa.



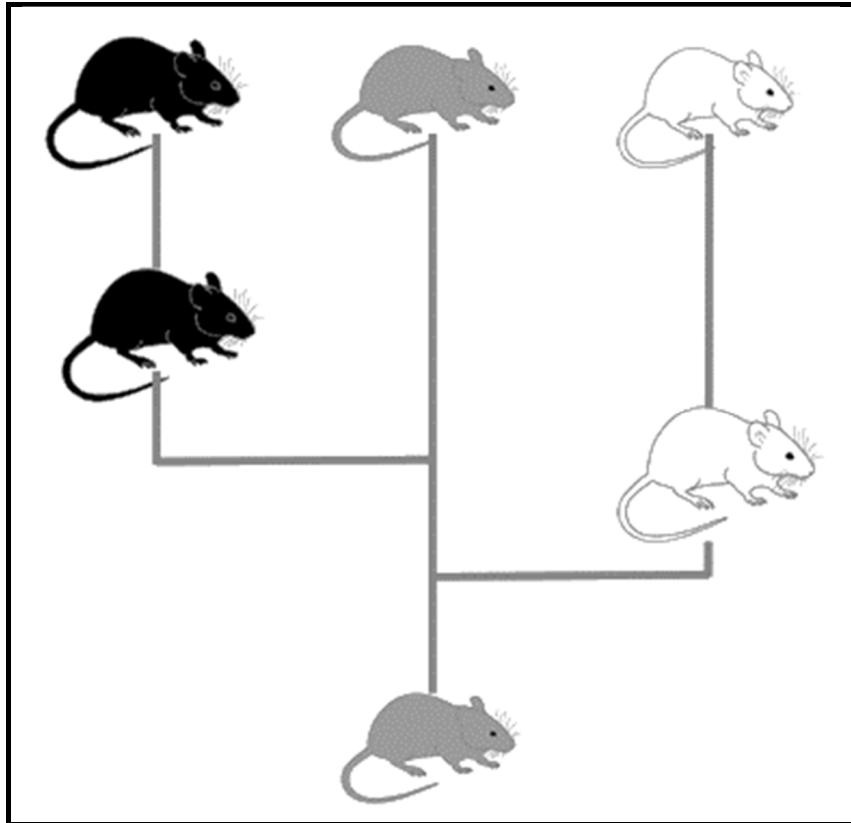
The original hypothesis about the evolution of emus and ostriches was that they share a common flightless ancestor. The sea separated the ancestral population due to continental drift into Australia and Africa.

More evidence has resulted in a new hypothesis that the ancestral population of emus and ostriches was a high-flying smaller ancestral bird that could fly long distances and emigrated from Central Asia to continents in the Southern hemisphere. New genetic analyses show that mutations in DNA caused modern birds to lose the ability to fly eventually.

Describe how the high-flying smaller ancestral bird evolved into different species of larger flightless birds, ostriches and emus, on the other continents.

(7)
(10)

3.5 The diagram represents a concept in evolution.



3.5.1 Identify the concept of evolution illustrated by the example in the diagram above.

(1)

3.5.2 Give the definition of the concept *evolution* as shown in the diagram above.

(4)

(5)

[50]

TOTAL SECTION B: 100

TOTAL: 150

END