



eduresourceza.com



ST DAVID'S
MARIST INANDA

Grade 12

Life Sciences Preliminary Examination- Paper 1

27th August 2024

Examiners: R Minnie, S Rogans, S Ramsurwaj

Time: **3 hours**

Moderator: C Marangoni

Marks: **200**

MARKING GUIDELINES

****PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY****

1. This question paper consists of 48 pages and an additional 2 page colour insert.
2. Please check that your question paper is complete.
3. This question paper consists of four questions.
4. Read the questions carefully.
5. **Answer ALL the questions on the question paper** and hand it in at the end of the examination.
6. There are two additional lined pages after question 4. Please make use of this allocated space for any extra information or corrections. Please indicate at the question and number this clearly.
7. Use the total marks that can be awarded for each question as an indication of the detail required.
8. It is in your own interest to write legibly and to present your work neatly.
9. Calculators may be used.
9. All rules for examinations apply.

Q1	Q2	Q3	Q4	TOTAL
80	40	40	40	200

ACADEMIC HONOUR CODE:

On my honour as a St David's Marist Gentleman, I accept my role in ensuring the integrity of this assessment. I have neither given, nor received any help on this paper, nor am I aware of any breach of the Academic Honour Code.

SIGNED: _____

DATE: _____

QUESTION 1

1.1. Matching columns

Select the term in Column B that best matches the description in Column A. Write the letter of the term in the corresponding space provided between the brackets. Each letter may be used only once.

Column A		Column B	
[G]	1.1.1 DNA that has been combined from different biological species.	A	Plasmid
[D]	1.1.2 A condition in which more than two sets of genes are present in a cell.	B	Gene therapy
[K]	1.1.3 A form of macroevolution with a constant rate of variation over long periods of time.	C	Adaptive radiation
[H]	1.1.4 The change in gene frequencies that occur over time.	D	Polyploidy
[A]	1.1.5 Circular DNA used as a vector in genetic engineering	E	Polysomy
[I]	1.1.6 Structure which once performed a function in an ancestor of an organism.	F	Analogous
[J]	1.1.7 Similar structures in organisms acquired from a common ancestor.	G	Recombinant DNA
[B]	1.1.8 A technique that modifies a person's genes to treat or cure disease.	H	Microevolution
[L]	1.1.9 Evolution that occurs when organisms that aren't closely related evolve similar features.	I	Vestigial organ
[C]	1.1.10 The evolutionary process by which many species originate from one species in an area.	J	Homologous
		K	Gradualism
		L	Convergent
		M	Divergent
		N	Mutant DNA

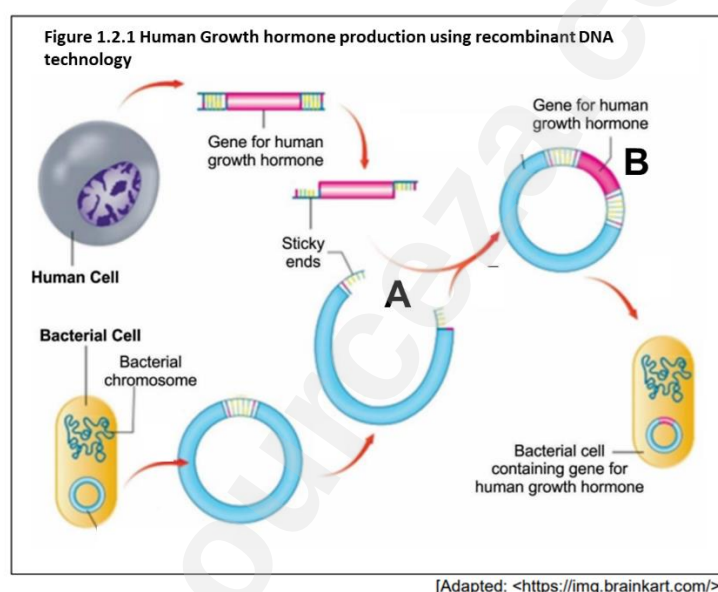
[10]

1.2. Multiple choice

Eight multiple-choice questions are given below. Choose the most correct option for each question and write the letter of your choice in the space provided in the table below.

1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7	1.2.8
C✓	B✓	C✓	D✓	D✓	B✓	B✓	D✓

1.2.1. Which row is correct regarding the enzymes labelled A and B in Figure 1.2.1?



	Enzyme A	Enzyme B
A.	Restriction enzyme	Polymerase
B.	Ligase	Restriction enzyme
C.	Restriction enzyme	Ligase
D.	Ligase	Helicase

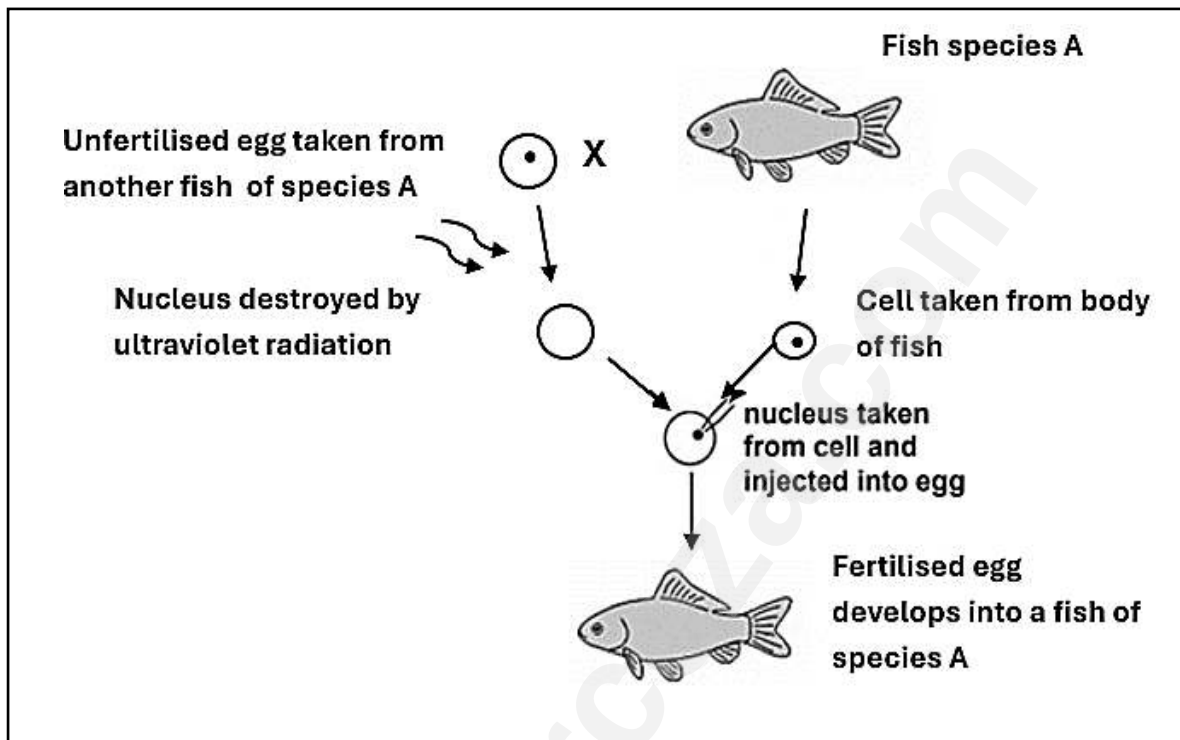
(1)

1.2.2. In a group of plants, the genes responsible for large fruit size became more common over many generations. This occurred because humans chose to only allow plants with large fruits to reproduce. What process could be responsible for the genetic change described above?

- A. Natural selection
- B. Artificial selection
- C. Genetic drift
- D. Artificial & Natural selection

(1)

Questions 1.2.3 and 1.2.4 refer to the diagram below, showing how genetically identical fish can be made from unfertilised fish eggs.



1.2.3. If the diploid number ($2n$) for the fish is 36, what is the chromosome number of the cell at X?

- A. 9
- B. 36
- C. 18
- D. 72

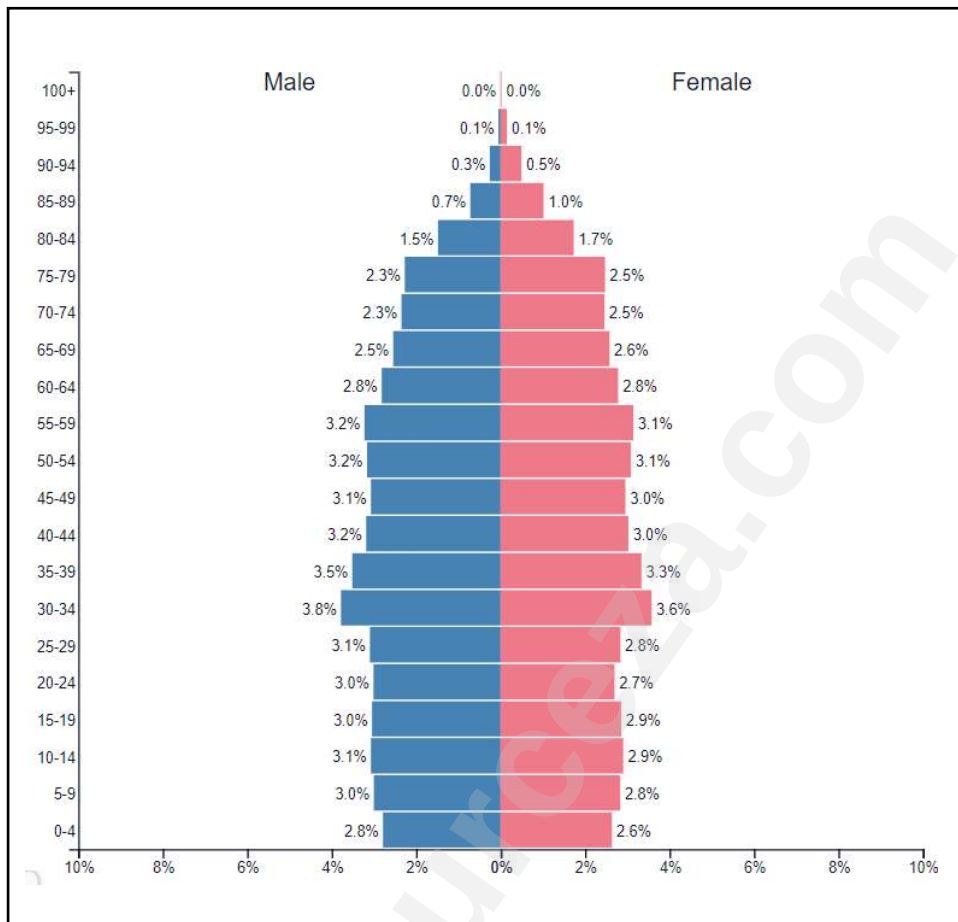
(1)

1.2.4. The technological process in the diagram is known as:

- A. Therapeutic cloning
- B. Asexual reproduction
- C. Embryological cloning
- D. Somatic cell nuclear transfer

(1)

Questions 1.2.5. and 1.2.6. are based on the population pyramid below:



1.2.5. Based on the population pyramid above, what percentage of male and female individuals are between the ages of 50 and 54?

- A. 3,1 %
- B. 3,2%
- C. 6,1 %
- D. 6,3 %

(1)

1.2.6. Which of the following is a correct interpretation of the population shown in the pyramid above?

- A. A rapidly growing population; characteristic of a LEDC.
- B. A declining population; characteristic of a former LEDC.
- C. A stable population; characteristic of a MEDC.
- D. A declining population; characteristic of a MEDC.

(1)

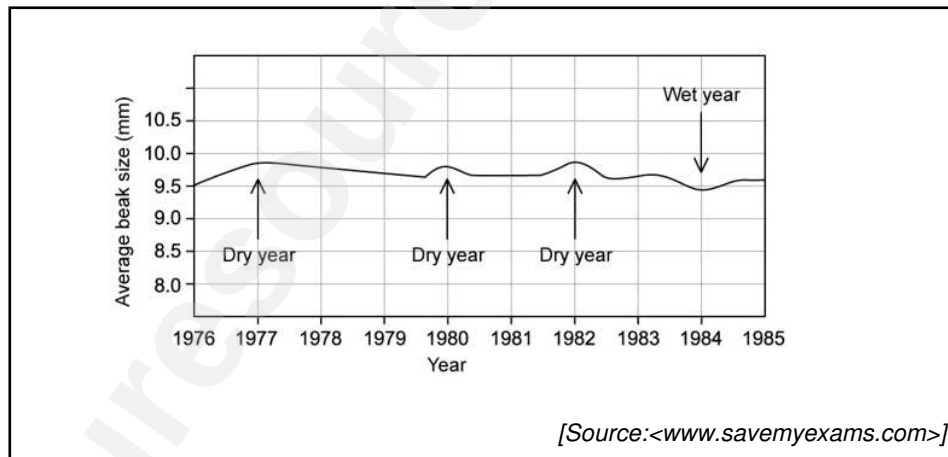
1.2.7. Which of the following are consequences of artificial selection?

- (i) Increase in recessive disorders
- (ii) Variation in the population increases
- (iii) Allele frequency changes
- (iv) Homozygosity increases

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

(1)

1.2.8. Research was carried out on beak size in the island living finch species, *Geospiza fortis*. *Geospiza fortis* feeds on seeds, which are plentiful, small, and soft in the years when the weather is normal, but the seeds become larger and tougher in drought years. Some of the research results are shown in the graph below.



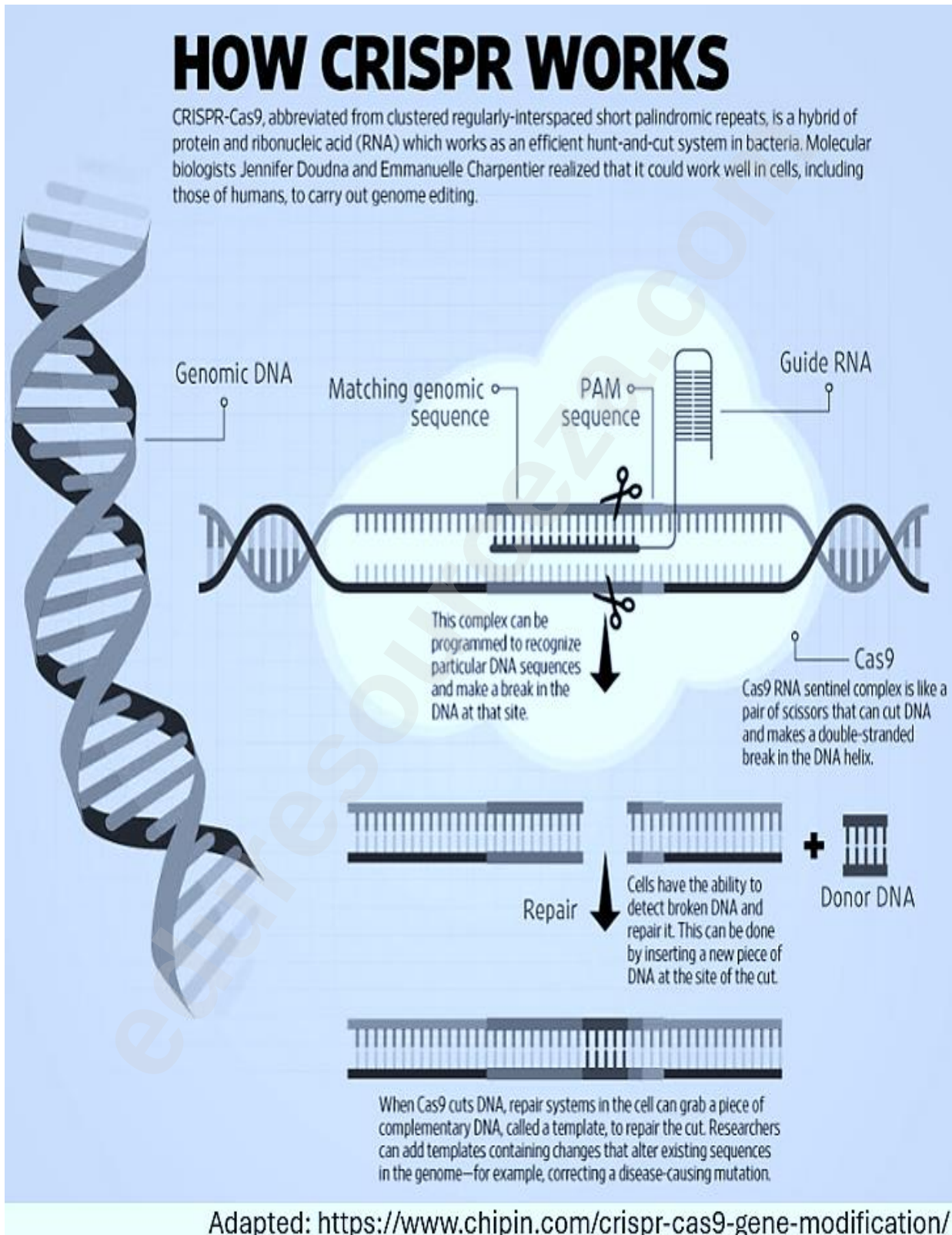
Which of the following statements explains the results in the graph?

- A. Finches adapt to drought years by developing larger beaks, passing on the characteristic to their offspring, and leading to an increase in average beak size.
- B. Average finch beak size increases during years of drought and decrease during wet years.
- C. Average beak size increased from 9.5 mm in 1976 to 9.9 mm in 1977, before slowly decreasing to 9.7 mm by 1979.
- D. Finches with larger beaks have an advantage when competing for food in drought years and are therefore more likely to survive and pass on their alleles, leading to an increase in average beak size.

(1)

[8]

- 1.3. The following infographic relates to gene editing using CRISPR. Use the information below to answer that follow.



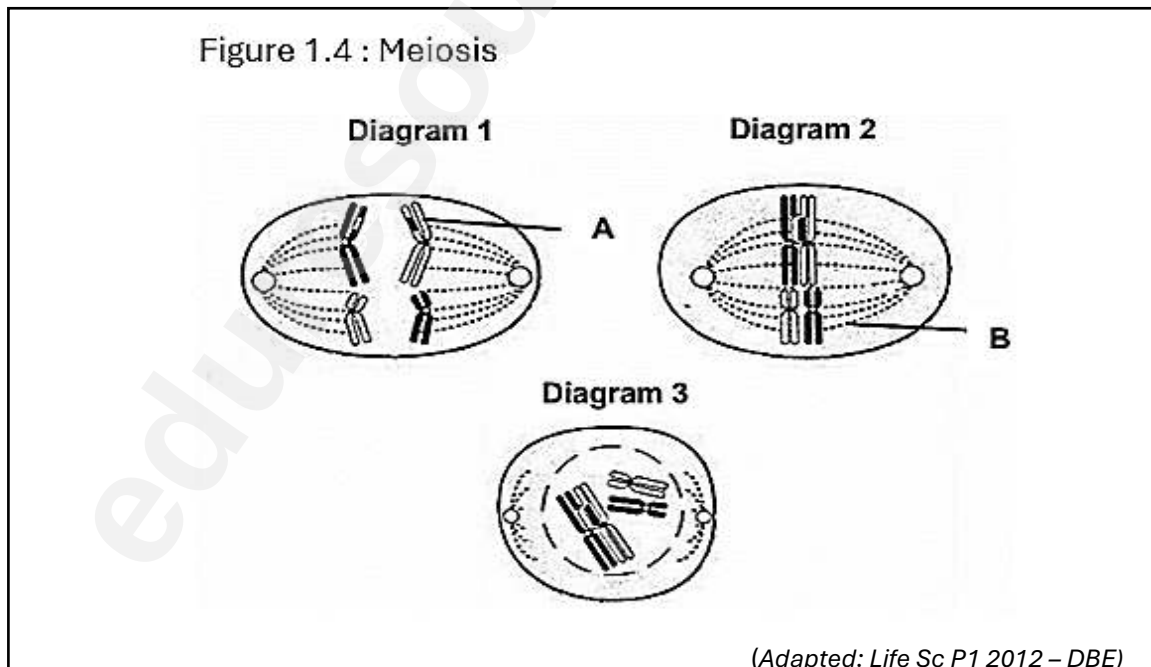
The four statements in the table below, refer to the infographic on page 7
For each statement decide whether:

- A.** the statement is **supported** by the information in the infographic.
B. the statement is **contradicted** by the information in the infographic.
C. the statement is **neither supported nor contradicted** by the information in the infographic.

	Statement	A, B or C
1.3.1.	CRISPR is a system used by bacteria.	A✓
1.3.2.	Sometimes, CRISPR fails to repair DNA strands leading to large pieces of chromosome being lost.	C✓
1.3.3.	CRISPR is used to edit genes to make them beneficial.	A✓
1.3.4.	Cells are unable to detect broken DNA and thus cannot repair it.	B✓

(4)

1.4. Study the diagrams below which illustrate some phases of meiosis and answer the questions that follow.



1.4.1. **A: Chromatid/sister chromatid/chromosome✓**

B: Spindles/spindle fibres✓

(2)

1.4.2. **3, 2, 1 ✓**

(1)

1.4.3.

Only see One cell and not Two daughter cells

Centromeres do not split

Crossing over is taking place in diagram 3 ✓

Homologous chromosomes moving to poles in diagram 1✓

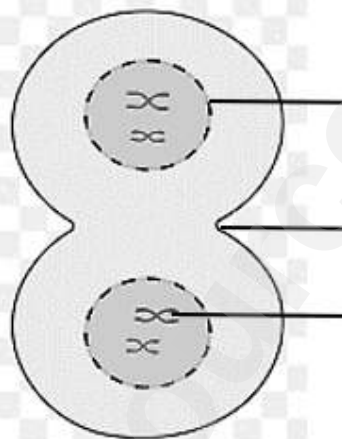
Bivalents (homologous pair of chromosomes) lie in the equator in diagram 2✓ (any two)

(2)

1.4.4.

**correct
diagram ✓**

CD – shows
cleavage furrow
and 2
chromosomes
in each nucleus



NP – nucleus present at each pole

CC – constriction of cell membrane starts to take place

HC – each nucleus must have 1 tall and 1 shorter chromosome (distinguishable) within a nucleus

Diagram showing a cell undergoing telophase 1 of meiosis ✓ H

***Accept similar diagrams of telophase and other suitable annotations**

(5)

1.5. White fur (**N**) in mice is determined by a dominant gene. A mutation in some mice caused a recessive gene for black fur (**n**).

1.5.1. **Parent 1- Nn✓**

Parent 2 nn ✓ (2)

1.5.2. **6 White : 1 Black / 85,7% : 14,29 %**

Accepted (3 white male : 3 white female: 1 black female) ✓✓ (2)

1.5.3. **For 1 offspring to have a black coat it must have received a black fur allele from each parent (MUST HAVE)**

3 white:1 black offspring produced; in order to obtain a phenotypic ratio of 3 offspring displaying the dominant characteristic and 1 displaying the recessive characteristic, both parents, which includes mouse 4, must be heterozygous for the white fur colour. If 4 was homozygous white then all offspring would be white.

Mouse 4 inherited the allele for black fur from Parent 2 (has black fur) (3)

1.5.4. **Gamma rays/X-rays/ UV radiation/Carcinogens/exposure to named chemicals - benzene/herbicides/pesticides/pollutants** (1)
(pollution alone was not given)

1.5.5.

P1:	Phenotype:	White fur mouse	X	White fur mouse
	Genotype:	Nn	X	Nn
	Gametes:	N, n		N, n
F1:				
		N	NN	Nn
		n	Nn	nn
	Genotype ratio:	1 NN : 2Nn : 1nn		
	Phenotype ratio:	3 White: 1 Black		
	Therefore 25% or 1 in 4 chance of producing black fur mouse	(6)		

If parents wrong:

ca for PS

ca for ratio

ca for answer

- 1.5.6. Both males and females are displaying the different fur colours not just males or just females.
If x-linked, 1 and 2 would not be able to produce males with white fur (1)

1.6. Use the given information below and your own knowledge to answer the questions that follow.

Southern Ground Hornbill (SGH) (*Bucorvus leadbeateri*) is the largest of the hornbill family; a fully-grown bird stands more than 1 m tall and can weigh up to 6 kg. The most striking feature of the bird is the thick, slightly curved hornbill, designed for effective foraging, and capturing prey. Although its diet sometimes includes fruits and seeds, the SGH is more likely to eat insects, toads, lizards, snakes, and tortoises. The “horn” on top of the bill looks like an extra piece of beak attached (it is a chamber that amplifies the sounds the hornbill makes).

The SGH lives in savannahs where there is grass in which they can find food and tall trees for nesting. They live in ‘families’ or groups of 3 to 12 individuals. Co-operative breeding occurs, where there is a dominant mating pair (oldest or biggest and strongest birds). Mostly the male birds then assist the breeding pair in defending the territory, hunting for food, feeding and rearing chicks. SGH groups are very vocal; the group calls in chorus and can be heard at distances of up to 3 km. The calls allow each group to maintain its territories, which can be as large as 100 km².

(Adapted from : <https://africafreak.com/southern-ground-hornbill> and <https://www.nationalgeographic.com/animals/birds/facts/southern-ground-hornbill/>]



- 1.6.1. How does the social organisation of the southern ground hornbill help improve the survival of the species? (2)

- **Division of labour:**
- **Male helpers can share finding food for breeding pair/chicks**
- **More members in the group:**
- **Reduced workload/reduced energy expenditure for hunting**

- Help defend the nest/protect the chick
- Some will notice danger/threats can alert other members
- Have an alpha breeding pair so offspring more genetically fit
(1 well-explained fact or any 2) (2)

1.6.2. How does the social organisation in the Southern Ground Hornbill compare to that of the African wild dog? (2)

Both have a dominant/alpha mating pair (for life) ✓
Whole pack of wild dog share in the hunt (searching for food) as does the flock of SGH ✓
Whole pack assists with care of the young and ill as does the flock of SGH ✓
(Any 2) (2)

1.6.3. In times of drought, the Southern Ground Hornbill successfully captures small invertebrates with its large curved beak. The table below contains a list of statements describing possible steps involved in the evolution of the Southern Ground Hornbill large curved beak.

(a) Indicate which of the four statements below correspond to Darwin's or to Lamarck's explanation of the evolution of the large curved beak. (4)

Make use of the following code:

- Write **D** for Darwin's explanation
- Write **L** for Lamarck's explanation

STATEMENT	L OR D
1. SGH acquire adaptations to their large curved beak over a lifetime.	L✓
2. The more the SGH used its beak to capture invertebrates, the larger and more curved it became.	L✓
3. SGH's who could catch and digest small invertebrates survived, reached adulthood and reproduced.	D✓
4. In times of drought, SGH individuals who had large and more curved beaks, were able to catch small invertebrates, whilst those with shorter beaks weren't as successful.	D✓

- 1.7 Read the information below and answer the questions that follow.

The Cape vulture, native to southern Africa, is critically endangered due to several factors, including habitat loss due to urbanisation and agriculture, poisoning, and collisions with power lines.

The smaller population size means there is less genetic diversity within the species. With fewer individuals that can mate, there is an increased risk of inbreeding, which can lead to genetic disorders and reduced fitness.

(Adapted from: <https://africageographic.com/stories/vultures/>)

- 1.7.1 Explain why the low genetic variation in the Cape vulture population is due to a bottleneck effect **and not** the founder effect. (2)

It is an example of a bottleneck effect as the Cape vulture population was drastically reduced in size due to human activity. ✓
Founder effect is when a small group of individuals from a larger population migrate and establish a new population in a different location. ✓

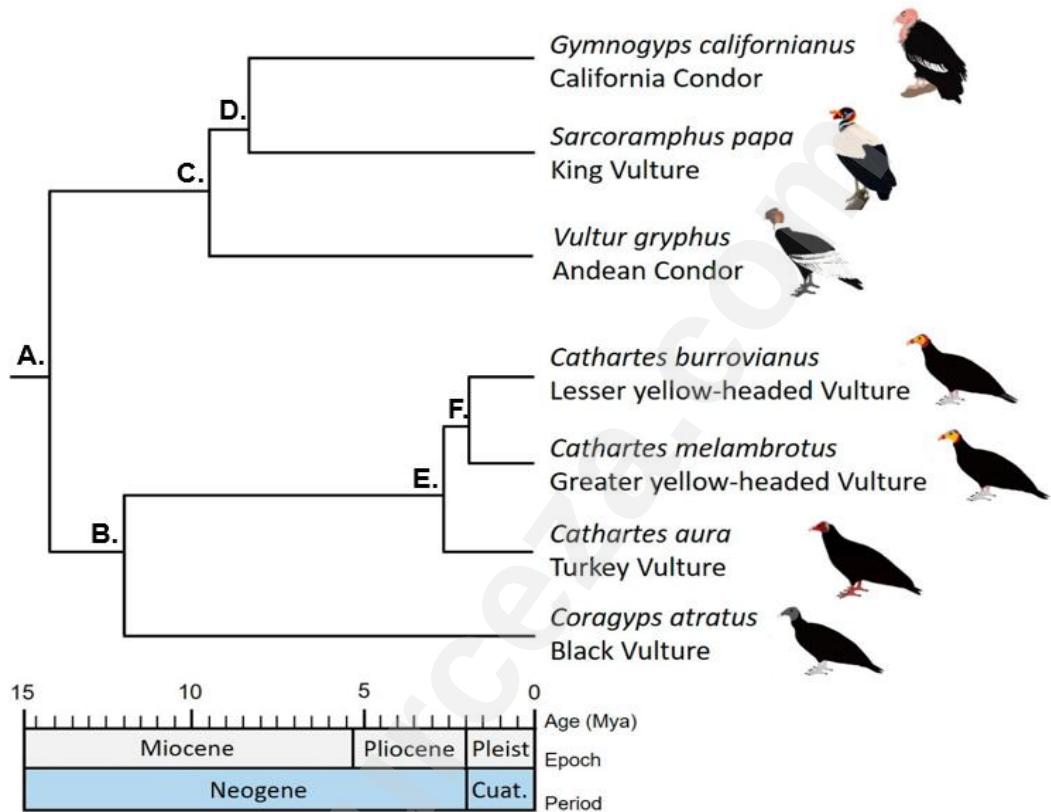
- 1.7.2 Name ONE potential consequence of the lack of genetic diversity in the Cape vulture population. (1)

The lack of genetic diversity makes Cape vultures less adaptable to environmental changes and diseases/ become extinct if there is a change in their environment. ✓

- 1.7.3 List TWO potential conservation strategies that could be used for the Cape vultures. (2)

- **Protected Areas: Establishing and maintaining protected areas to secure habitats. ✓**
- **Awareness Campaigns: Educating farmers and the public about the dangers of poisoning and the importance of vultures in the ecosystem. ✓**
- **Artificial Nesting Sites: Providing safe nesting sites to increase breeding success. ✓**
- **Breeding programs to introduce genetic variation into different Cape vulture populations. ✓**

1.8. Study the cladogram below, that depicts phylogenetic relationships between different scavengers. Answer the questions that follow:



(Adapted from: https://www.mdpi.com/animals/animals-13-03175/article_deploy/html/images/animals-13-03175-g001.png)

1.8.1. Which species, the King Vulture or the Andean Condor, is more closely related to the California Condor? Give a reason for your answer. (2)

King Vulture ✓

Share a more recent common ancestor ✓

1.8.2. Approximately how long ago did the Lesser yellow-headed Vulture and the Greater yellow-headed vulture diverge ? (1)

2 mya (million years ago) ✓

1.8.3. Which scavenger species is the oldest amongst all the scavengers? (1)

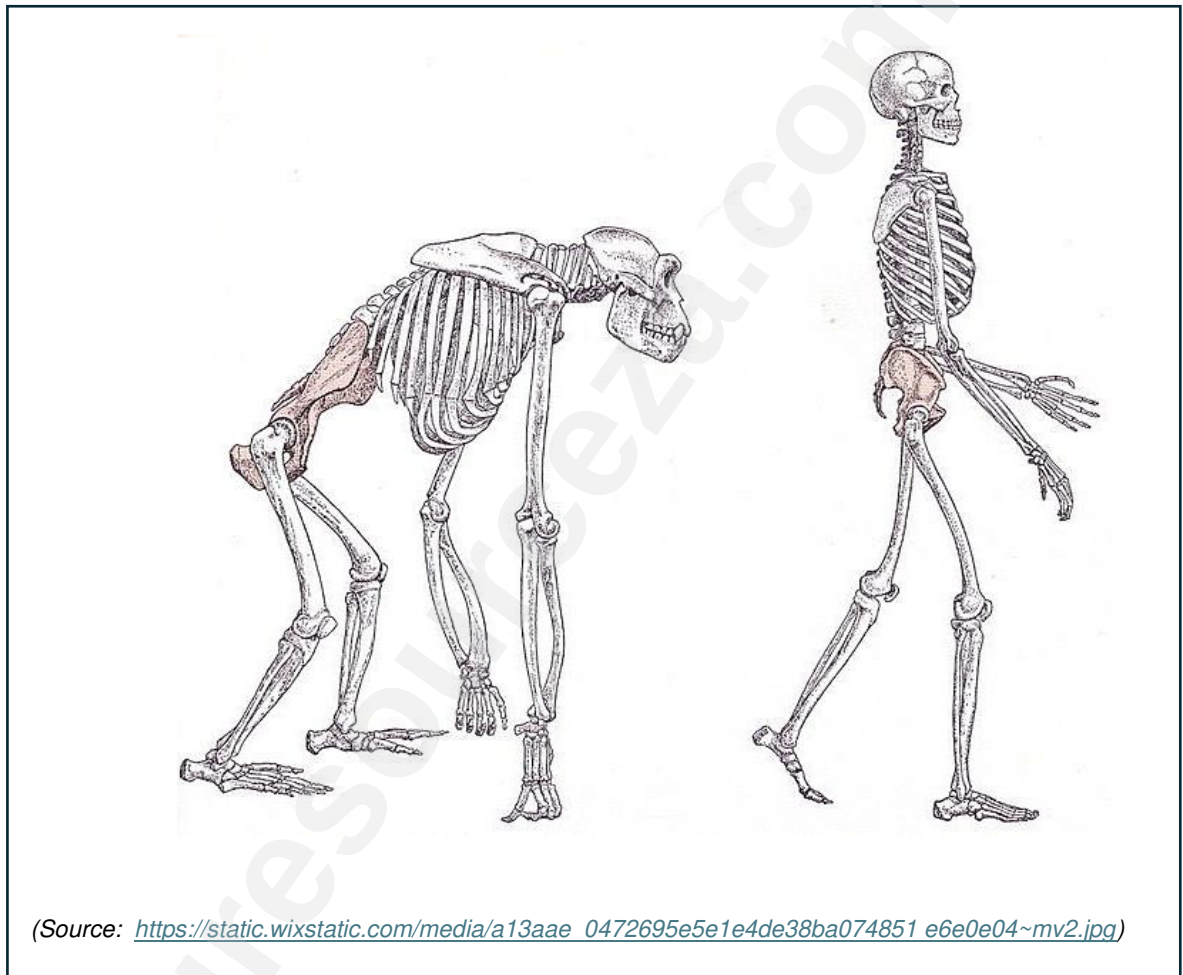
Black Vulture ✓

1.8.4. Name the genus of the King vulture.

(1)

Sarcoramphus ✓ (must be underlined and start with a capital letter)

1.9. The image below shows the skeletal structure of a primate and a modern human.



- 1.9.1. Identify **TWO major skeletal changes visible in the image** (pg. 16) that facilitated the evolution of bipedalism in hominids. Explain how each change contributes to bipedal locomotion. (4)

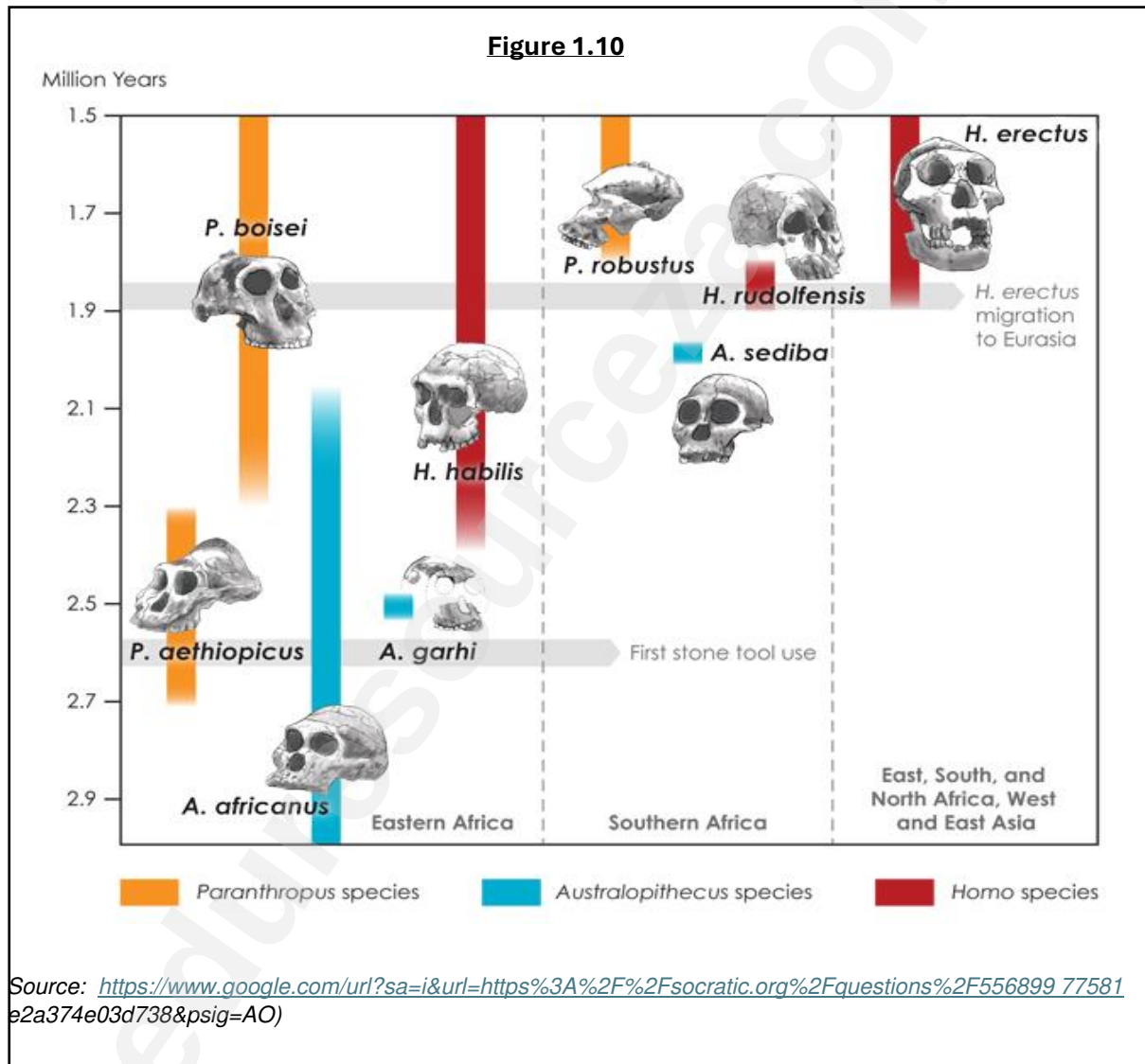
	Major skeletal <u>change</u>	How skeletal change facilitated the evolution of bipedalism in hominids.
1.	<u>Human pelvis is shorter and broader compared to the early hominid.</u> ✓	<u>Helps support the internal organs during upright walking and provides a more stable base for bipedal locomotion.</u> ✓
2.	<u>The modern human spine exhibits an S-shaped curve, while the early hominid spine is more straight</u>	<u>The curvature in the human spine allows for better weight distribution and balance when walking upright.</u>
3	Arched foot ✓	<u>Arch of the foot acts as a natural shock absorber, helping to distribute the forces exerted on the foot during walking and running</u> □ supporting their ability to travel long distances and adapt to various environments.
4	Parallel big toe ✓	Gives push off power during walking and running
5	Position of skull ✓	Quad = in front , Biped = above → allows for forward vision in an upright position.

(Did not accept size of heel bone , angle of femur → not visible in picture
Long legs & shorter and did not facilitate the evolution of bipedalism)

- 1.9.2. Discuss the evolutionary significance of bipedalism in hominids. Name and explain TWO advantages that bipedalism offer in terms of survival and adaptation? (4)

- **Bipedalism allowed hominids to free their hands for tool use✓, increase their field of vision by standing taller✓, and improve energy efficiency during long-distance travel. ✓**
- **These advantages likely contributed to their ability to survive and adapt to diverse environments✓**

1.10. Study the timeline below (Figure 1.10). Use this timeline to answer the following questions. (See colour insert)



1.10.1. During what time period did the first stone tool use occur? (1)

2.6 and 2.3 million years ago✓

1.10.2. How many *Australopithecus* species are depicted ? (1)

3✓

1.10.3. Which genus appears to have the longest continuous existence, and approximately how long did it persist? (2)

- The genus *Paranthropus* appears to have the longest continuous existence. ✓
 - It spans from about 2.5 million years ago (*P. aethiopicus*) to about 1.5 million years ago (*P. boisei*) giving it an approximate duration of 1 million years✓
- (2)

1.10.4. Compare the timelines of *Australopithecus* and early *Homo* species. What overlap exists, and what might this suggest about human evolution?(3)

- The timelines show overlap between late *Australopithecus* (*A. sediba*, around 2 million years ago) and early *Homo* (*H. habilis*, from about 2.3 to 1.5 million years ago). ✓
 - This overlap suggests that human evolution was not a linear progression,✓ but rather a complex branching process with multiple hominin species coexisting at the same time.✓
- (3)

[80]

eduresourceza.com

QUESTION 2

2.1

2.1.1 In the nucleus/nucleoplasm✓ (1)

2.1.2 Autosomes✓ (1)

2.1.3 47 chromosomes present instead of 46✓//Aneuploidy of chromosome 23.✓
Extra X sex chromosome (gonosome)✓/ 2 X sex chromosome instead of 1 X sex chromosome.✓ (2)

2.1.4 Somatic cell ✓
Homologous chromosomes present (diploid number of chromosomes present)✓/gametes have 23 single chromosomes (haploid number of chromosomes).✓ (2)

2.1.5 Klinefelter syndrome occurs by chance✓ during a random event during meiosis when chromosomes do not separate properly (non-disjunction of gonosomes) in meiosis✓ therefore not an inherited condition. Klinefelter syndrome individuals are sterile/infertile therefore can't pass the syndrome onto next generation/offspring✓. (max 2) (2)

2.1.6 Invasive/dangerous procedure to get foetal cells✓/ expensive procedure✓/ can cause miscarriage✓/ if no family history of abnormalities not needed✓/mutations not common✓/ rare/low risk in young women.✓ (2)

2.1.7 Expert in genetics / inheritance✓. Trained medical/ person/Specialist Doctor in treating genetic conditions✓/ understanding of psychology✓/ social work expertise. ✓ (any 2) (2)

2.2

2.2.1 A random change✓ in the nucleotide sequence of the DNA. ✓ (2)

2.2.2 Circle the letter of your choice below.

- A The position or place of a gene on a chromosome.
B Two or more versions of a DNA sequence for a gene. ✓
 C Multiple genes that influence the expression of a characteristic.

(1)

2.2.3 Polydactyly ✓ (1)

2.2.4 The allele that cause Goltz syndrome is a dominant allele located on the X chromosome. ✓ Females have two X chromosomes and males one and thus females have twice the chance of possessing the Goltz syndrome allele. ✓ (2)

2.2.5 Many individuals afflicted with the disease die at birth so it goes unreported. ✓ (1)

2.2.6

(a)

<u>MUTATED DNA SEQUENCE</u>	T	T	G	A	A✓	T	T	A	G✓
--	----------	----------	----------	----------	-----------	----------	----------	----------	-----------

(2)

(b) Deletion✓ (1)

(c)

mRNA SEQUENCE	A	A	C✓	U	U	A✓	A	U	C✓
--------------------------	----------	----------	-----------	----------	----------	-----------	----------	----------	-----------

(3)

(d) Asn ✓; (Leu; Ile) ✓ (2)

2.3

2.3.1 1. DNA✓

2. mRNA✓

3. tRNA✓ (3)

2.3.2

(a) codon: 7✓ (1)

(b) anticodon: 8✓ (1)

2.3.3 It allows mRNA to leave the nucleus✓ and move to the ribosomes located in the cytoplasm✓

(2)

2.3.4 Transcription✓ (1)

2.3.5 RNA polymerase✓ (1)

2.3.6

mRNA moves to the ribosomes in the cytoplasm and ribosomes (made of rRNA) reads the codons on mRNA. (RC)



tRNA moves with the matching anticodon moves to the codon on mRNA. (AMC)



tRNA leaves behind the amino acid attached to it at the ribosomes (or mRNA). The amino acids are joined together by peptide bonds to form a protein. (APP)

(Heading must be detailed and state translation taking place)

Flow diagram showing the process of translation during protein synthesis

(4)

[40]

QUESTION 3

3.1.

3.1.1. Interspecific competition ✓ (1)

3.1.2. Feed on different lengths of grass ✓ Wildebeest on short grass, zebra medium length and Buffalo on tall fibrous grass ✓ (2)

3.1.3. resource partitioning / competitive co-existence ✓ (1)

3.1.4. natality (birthrate)✓ and mortality (deathrate)✓ (2)
No immigration or emigration as Kruger Park is a closed population.

3.2.

3.2.1. $P = \frac{M \times C}{R}$

✓

$$= \frac{226 \times 93}{7} \quad \checkmark$$

$$= 3002.5 = 3003 \text{ zebra} \quad \checkmark \quad (3)$$

3.2.2.

- Only 1 week between first and second capture – not too long that natality & mortality will have an effect .
- Ear tags are small and did not inhibit the movement of the zebra (2)

3.3.

3.3.1. Predator prey relationship ✓ (1)

3.3.2. Accept 138 – 140 thousand ✓ (1)

3.3.3. As the lion (predator) eats more zebra (prey), the zebra / prey population size decreases.✓ As predation decreases, the zebra/ prey population size increases which allows more resources for lion/predator that increases✓

OR

lion population increase with the size of the impala ✓ and limit growth of the zebra population as population size increases. ✓ (2)

3.3.4. Increase in number of zebra / prey (mice) ✓ which could result in spread of disease and/ or depletion of resources for the zebra ✓ / or more competition ✓ (Any 2) (2)

3.4.

3.4.1. A group of individuals belonging to the same species ✓ that live in the same/defined area / habitat at the same time ✓ and can breed freely / interbreed with each other. ✓ (3)

3.4.2.

(a) Average number per quadrat = $\frac{\text{Total number}}{\text{No of quadrats}}$
 $= \frac{10}{5}$ ✓
 $= 2$ Red grass plants per quadrat ✓ (2)

(b) Total Pop (N) = $\frac{\text{Numbers in samples} \times \text{size of whole habitat}}{\text{Size of quadrat}}$
 $= \frac{2 \times 400}{4}$ ✓
 $= 200$ Red grass plants ✓ (2)
Or $\frac{10 \times 400}{20} = 50$

(c) decreases chance or removes sampling bias ✓ (1)

3.5.

3.5.1. It is the pattern of changes in the type of species/plant growth/ animal types✓ in a community/new area/undisturbed area /over time following a disturbance.✓

(1)

3.5.2. Secondary succession✓

(1)

3.5.3. grazing✓

(1)

3.5.4. Line 1 ✓ High amount of species diversity then large decrease in number of species which would indicate a disturbance, then species slowly increase again ✓

(2)

3.5.5. climax species ✓

(1)

3.5.6.

- Pioneer plants are hardy/can withstand extreme variations in temperature
- Can tolerate low moisture levels
- Establish themselves rapidly/fast growing
- Produce many spores or seeds
- Spores can disperse over long distances
- Spores/seeds germinate quickly
- Do not have to grow in the shade
- Can tolerate low nutrient levels/very little to no soil/only on rock
- Small/low growing to withstand wind, etc.
- No agent required for pollination/wind pollinated (Any 2 ✓✓)

(2)

3.6.

3.6.1.

	Procedure	Answer
(a)	the process that rapidly produced millions of copies of the specific segment of DNA from each of the grass species.	Polymerase chain reaction / PCR✓
(b)	the technique used to separate the DNA segments of each tree species according to size.	Gel Electrophoresis ✓
(c)	The enzyme used to make the DNA segments	Restriction enzymes ✓

(3)

3.6.2. non-coding DNA/ STR's ✓ – unique to each individual / Greatest variation due to non codes ✓

(2)

3.6.3. Elephant grass ✓ Red grass & Elephant grass have more bands in common (10 in total) ✓ Finger grass only has 4 bands in common, Spear grass has 6 bands in common with red grass. ✓ Elephant grass is therefore more closely related to Red grass. (2)

[40]

QUESTION 4

4.1.

4.1.1. Sympatric speciation ✓
Not geographically isolated ✓ (2)

4.1.2. Mechanism of Sympatric Speciation

1. Initial Variation: Within the ancestral Erica population, there was genetic variation ✓ that led to differences in habitat preference, flowering time, and pollinator attraction.
2. Ecological Specialisation: Individuals that thrived in different microhabitats experienced different selection pressures ✓, leading to ecological specialisation.
3. Reproductive Isolation: With reduced gene flow ✓, the populations accumulated genetic differences over time, leading to the emergence of two distinct species. (3)

4.1.3. (a)

- Different flowering seasons / pollen produced at different times ✓
 - Erica coccinea Flowers in late winter to early spring (July to September).
 - Erica plukenetii Flowers in early summer (October to December). ✓
- Adaptations to different pollinators ✓
 - Erica coccinea Primarily pollinated by sunbirds
 - Bright colours of flowers and long, tubular flowers that produce nectar attracts and suite for sunbird
 - Erica plukenetii Pollinated by a mix of bees and other insects. Red, pink or white flowers that produce scents that attract specific pollinators ✓

(2 Facts + description) (4)

(b) Pre-zygotic isolation ✓
Prevent gametes fertilizing and producing the zygote ✓ (2)

4.1.4. (a)

A niche provides the resources and conditions needed ✓ for the species to survive allowing the species to maintain a viable population. ✓
An ecological niche is defined as the specific set of environmental conditions ✓ required by an organism or the functions it performs in nature ✓.

In ecology, a niche is the match of a species to a specific environmental condition ✓. It describes how an organism or population responds ✓ to the distribution of resources and competitors ✓ and how it in turn alters those same factors. In ecology, the term “niche” describes the role ✓ an organism plays in a community (Any 2) (2)

(b)

- Access to resources is varied – sun and type of soils ✓
- Access to pollinators is varied ✓
- Reduces competition between species ✓

(Any 2)

(2)

4.1.5.

- Mutations ✓ – random changes in nucleotide sequence of DNA ✓
- DNA recombination ✓ during prophase 1 during meiosis ✓
- Independent assortment and random segregation ✓ of chromosomes during meiosis ✓
- Randomness of gametes ✓ fusing during fertilisation ✓ (2)

4.2.

4.2.1.

- Multiregional hypothesis - Homo sapiens evolved independently/simultaneously in separate regions ✓ from Homo erectus/ Homo neanderthalensis.
- Out of Africa hypothesis – Homo sapiens originated in Africa and then dispersed/spread to other parts of the world. ✓ (2)

4.2.2

(a) 100 000 years ago ✓ (1)

(b) 1 -2 million years ago ✓ (1)

4.2.3

- Environmental and climatic changes. ✓
- Availability of resources, such as food and water. – competition for resources✓ (Any one) (1)

4.2.4

- Larger brain✓ enabled to plan ahead/communication✓
- Use of fire✓ source of warmth in inhospitable areas/defence against prey/social organisation✓
- Bipedalism✓ enabled to cover large distances/hands free for making tools✓

(List two characteristics and explain how each enabled them to survive.
Accept any reasonable answers) (4)

4.2.5 (a)

- Maternal Inheritance: mtDNA is inherited exclusively from the mother✓, allowing researchers to trace maternal lineage directly✓
- Lack of Recombination: Unlike nuclear DNA, mtDNA does not undergo recombination✓, so it remains relatively unchanged through generations✓, except for occasional mutations.

(Any One) (1)

(b)

- Fossil evidence✓ - oldest fossils of Homo sapiens found in Africa✓
- Archaeological evidence✓ – oldest evidence of symbolic thought found in Africa / e.g. Art (Blombos Cave). ✓
- San✓ – oldest extant population of Homo sapiens found in Africa✓
- Y chromosome Adam✓ - all men alive today can trace their ancestry back to a single male who lived in Africa. ✓ (2)

4.3.

4.3.1 Trait determined by multiple genes✓ (1)

4.3.2.

- Trait and variation – variation of dark and light skin✓
 - Selective pressure/change in environment – amount of UV radiation ✓
 - Favourable traits - Africa: darker skin in Africa is favourable as it provides a natural barrier from UV radiation protecting from DNA damage and skin cancers. ✓
 - Moving out from Africa towards Europe: Light skin favourable in areas like Europe with less UV more efficient at producing vitamin D which is essential for bone health and immune function. ✓
 - Reproduction and pass on favourable trait in the different areas to offspring✓
- (5)

4.4.

- No Neanderthal DNA in Homo sapiens of Africa descent✓
 - There was interbreeding/gene flow between the Homo sapiens and Neanderthals in Europe and Asia but not Africa. ✓
 - Neanderthals carried versions of the human leukocyte antigen (HLA) ✓ genes that are abundant in modern humans in parts of Europe and Asia✓ but absent in Africans✓.
- (4)

[40]

GRAND TOTAL: 200 MARKS

Remember to clearly indicate at the question, that you used the additional page.

eduresourceza.com

