Please paste the barcoded label here	TOTAL MARKS

INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2024

BIOLOGY: PAPER I

EXAMINATION NUMBER

Time: 3 hours 200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 33 pages. Please check that your question paper is complete.

2. Read the questions carefully and make sure that you answer all parts of all the questions.

3. **Questions must be answered on the question paper in the spaces provided. Write your examination number in the blocks above.**

4. Use the total marks that can be awarded for each question and the space provided as an indication of the detail required.

5. It is in your own interest to write legibly and to present your work neatly.

6. One blank page (page 33) is included at the end of the question paper. If you run out of space for an answer, use this page. Should you use this extra space, number the answers exactly as the questions are numbered.

FOR MARKERS' USE ONLY

Question	1	2	3	4	**Total**
Marks	80	40	40	40	**200**
Marked					
Moderated					

QUESTION 1

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

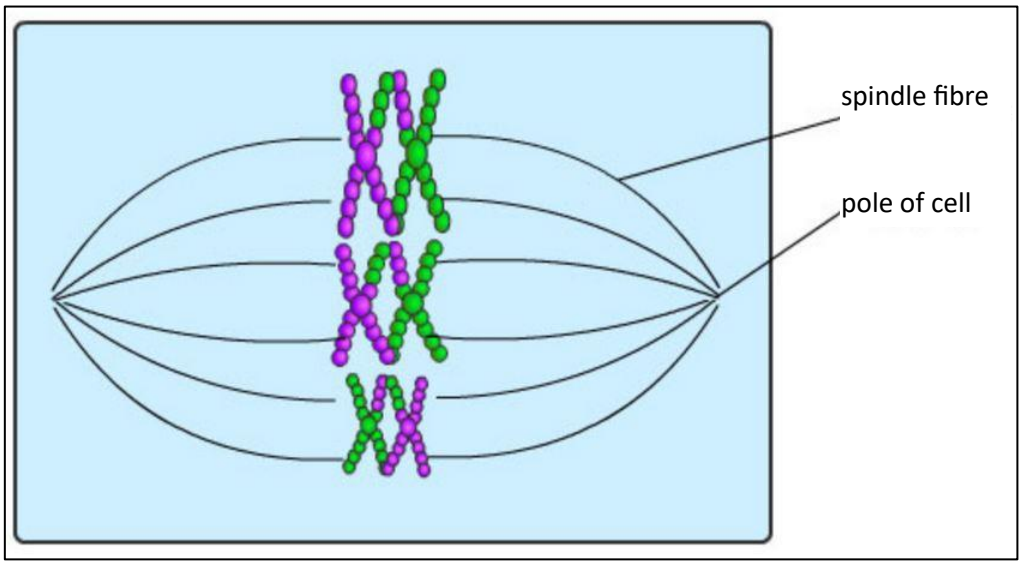
	COLUMN A		COLUMN B
[ ]	A new gene editing tool that edits specific regions of a DNA molecule.	A	Restriction enzyme
[ ]	An artificially made DNA strand that has been created from genes taken from different species.	B	Hybrid vigour
[ ]	An enzyme used to join two small pieces of DNA.	C	Plasmid
[ ]	The technology used to create genetically identical copies of cells.	D	Recombinant DNA
[ ]	When an organism displays improved features as a result of cross-breeding.	E	Ligase enzyme
[ ]	The condition where a cell has more than two sets of chromosomes.	F	Cas 9 enzyme
[ ]	An organism whose DNA has been altered using genetic engineering.	G	Cloning
[ ]	The enzyme used to cut sections of DNA.	H	Polygenic
[ ]	A phenotypic characteristic that is determined by more than two genes.	I	CRISPR
[ ]	Small circular DNA used as a vector in genetic engineering.	J	PCR
		K	Polyploidy
		L	Genetically modified organism

(10)

1.2 Seven multiple-choice questions are given below. Choose the most correct option for each question and write the letter of your choice in the grid below.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7
Answer							

1.2.1 Which option below correctly identifies the phase of meiosis shown in the diagram?



[Source: <https://www.physicsforums.com/threads/is-the-number-of-spindles-attached-to-bivalents>]

A Prophase 1
B Metaphase 1
C Anaphase 1
D Metaphase 2 (1)

1.2.2 What event takes place during crossing over?

A DNA replication creates two identical chromatids.
B The homologous chromosomes line up along the equator.
C The chromatids of homologous chromosomes separate and move towards opposite poles.
D Genetic material is exchanged between chromatids of homologous chromosomes. (1)

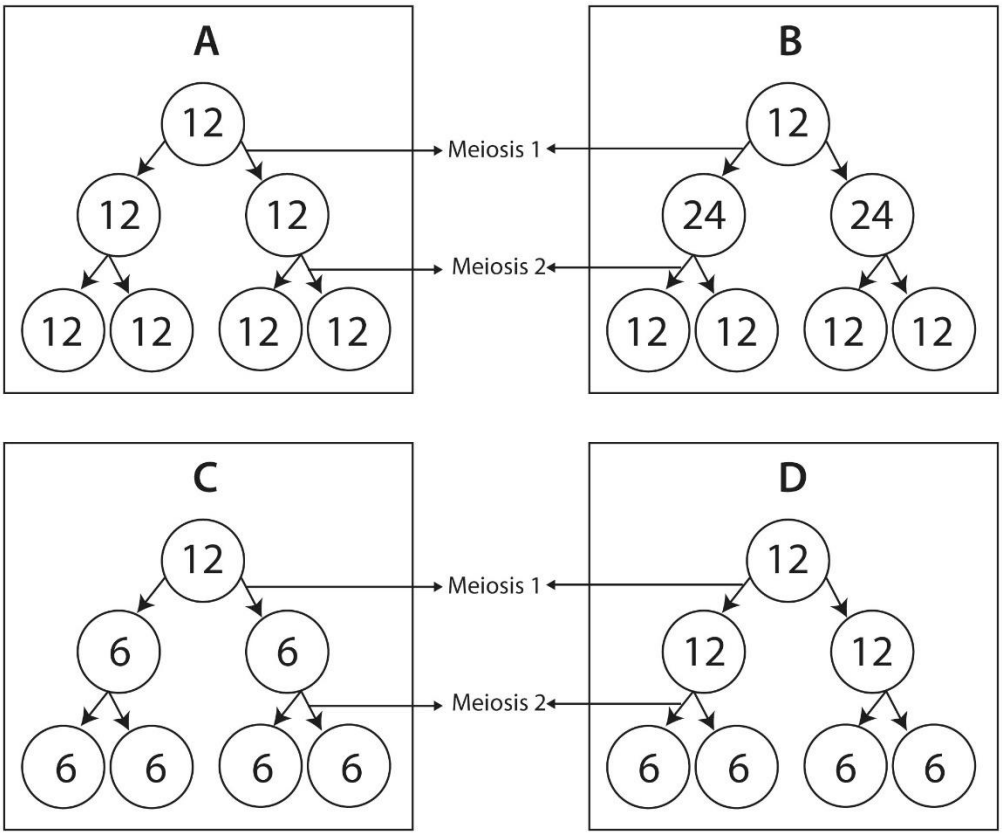
1.2.3 Which option below is a correct representation of the chromosome number in a human sperm cell?

A 46 autosomes + XY
B 22 autosomes + XX
C 22 autosomes + Y
D 2 gonosomes only (1)

1.2.4 The structure in a cell that contracts to pull chromosomes apart during meiosis.

A Spindle fibre
B Chromatids
C Chiasma
D Centromere (1)

1.2.5 The somatic cell of a mosquito contains 12 chromosomes. Which of the following diagrams correctly represents meiosis in a mosquito?



(2)

1.2.6 Many trisomy disorders exist in humans. Trisomy is when an individual has an extra chromosome in each cell. An example of a trisomy disorder is Edwards' syndrome. The image below was obtained from a person suffering from Edwards' syndrome.

From the image above, what type of trisomy is Edwards' syndrome?

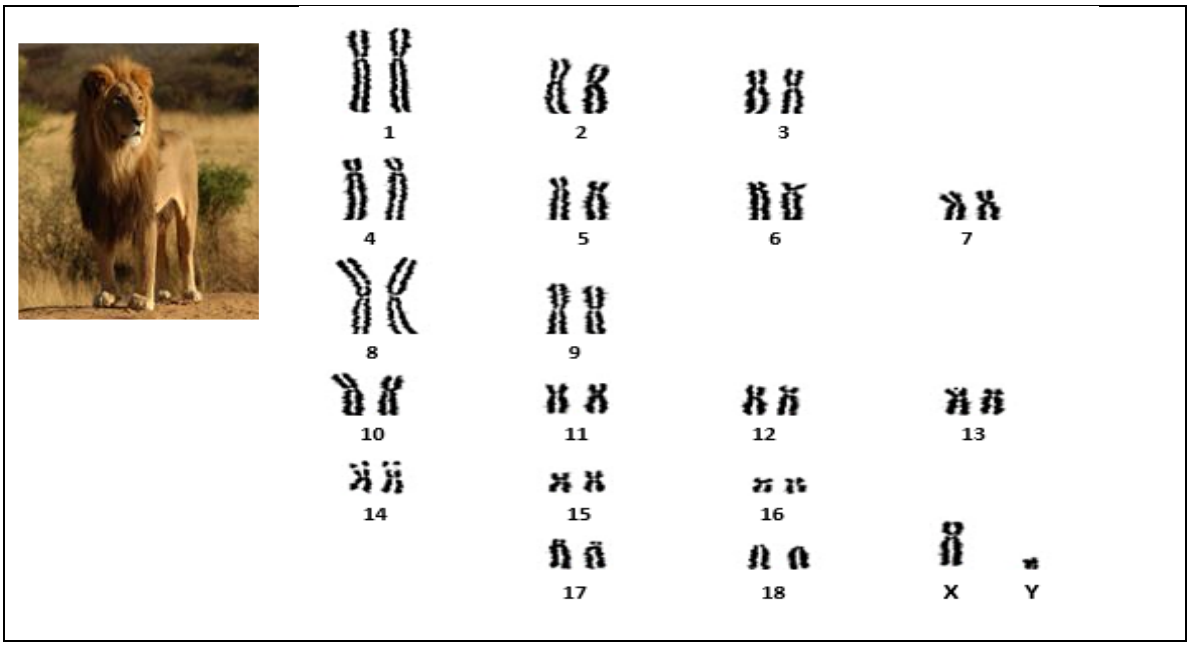
A Trisomy 23
B Trisomy 1
C Trisomy 21
D Trisomy 18 (2)

1.2.7 Below is a list of statements, i to v, referring to meiosis. Which are TRUE regarding the **importance** of meiosis?

(i) Gametes are produced.
(ii) The number of chromosomes is doubled.
(iii) It results in genetic variation.
(iv) Identical haploid cells are produced.
(v) It ensures that organisms produced by sexual reproduction have the correct number of chromosomes in their cells.

A (ii), (iii) and (iv) are correct.
B (i), (iii) and (iv) are correct.
C (i), (ii) and (v) are correct.
D (i), (iii) and (v) are correct. (2)

1.3 Study the diagram below showing the chromosomes from a somatic cell of a lion. The DNA of a diploid lion cell weighs 14 pg (picograms).



[Source: <https://www.ivis.org/library/comparative-placentation/african-lion-panthera-leo>]

The table below contains a statement in the first column and three options (0,1 and 2) in the second column. Decide whether:

1: Only option 1 relates to the statement.
2: Only option 2 relates to the statement.
0: Neither option 1 nor option 2 relate to the statement.

Select the correct option from the key provided above. Write only the correct number 0, 1 or 2 in the column on the right.

	Statement	**Options**	**0, 1 or 2**
1.3.1	The name for this type of diagram.	1. DNA profile 2. Karyotype	
1.3.2	The gender of the lion.	1. Male 2. Female	
1.3.3	The diploid number of chromosomes in the somatic cells of the lion.	1. 18 2. 19	
1.3.4	The amount of picograms of DNA in a gamete produced by a lion.	1. 28 2. 7	
1.3.5	The number of chromosomes in the cell during Prophase I.	1. 19 2. 76	
1.3.6	The type of cell that could have provided the DNA shown on the diagram.	1. Cheek cell 2. Sperm cell	

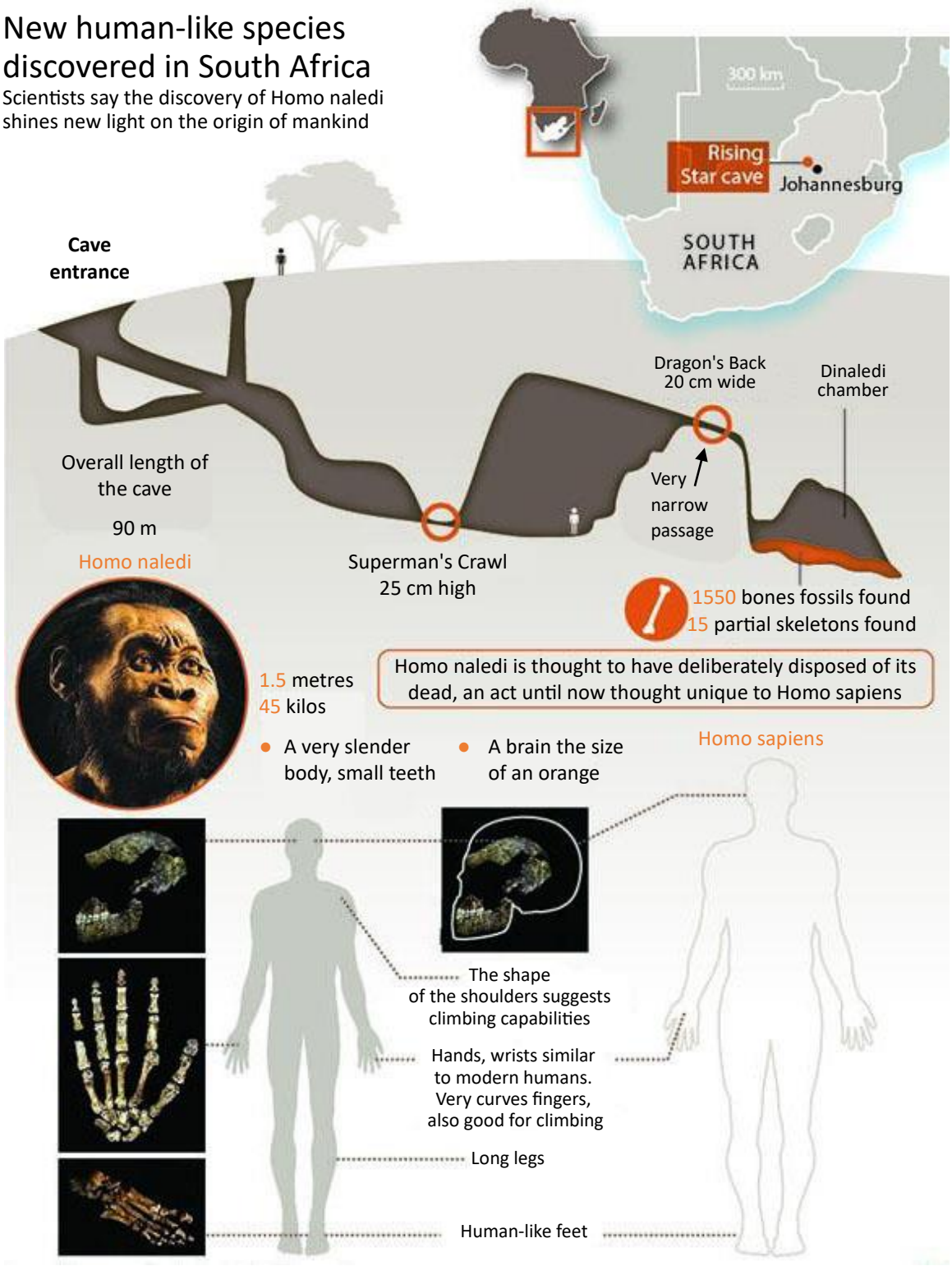
(6)

1.4 *Homo naledi* is an extinct hominid species that lived in Africa between 236 000 and 335 000 years ago. It had a cranial capacity of about 465 cm^3. Some scientists believe that *Homo naledi* is the closest ancestor to modern humans.

Homo naledi displayed the following modern human features:

- Foot structure well-adapted for standing and walking on two feet.
- Wrist bones and thumb show features that indicate powerful grasping and the ability to use stone tools.

Figure 1.4 The discovery of *Homo naledi*



[Source: <https://www.dailymail.co.uk/sciencetech/article-5727365/Mystery-hominid-species-pint-sized-brain-existed-alongside-humans.html>]

1.4.1 Name the chamber in the cave system where *Homo naledi* fossils were discovered.

_____

(1)

1.4.2 Even though *Homo naledi* only had a brain the size of an orange (246 cm^3), it is regarded as intelligent. Provide ONE piece of evidence from the source that led scientists to believe that *Homo naledi* was an intelligent species like *Homo sapiens*.

_____

_____

(1)

1.4.3 (a) From your knowledge and the information in the image, list and explain TWO pieces of fossil evidence that allowed scientists to classify *Homo naledi* as belonging to the *Homo* genus.

_____

_____

_____

_____

(4)

(b) Some scientists believe that *Homo naledi* should be classified into the *Australopithecus* genus. Using the evidence provided, discuss TWO reasons why some scientists disagreed with the classification of *Homo naledi* as belonging to the *Homo* genus.

_____

_____

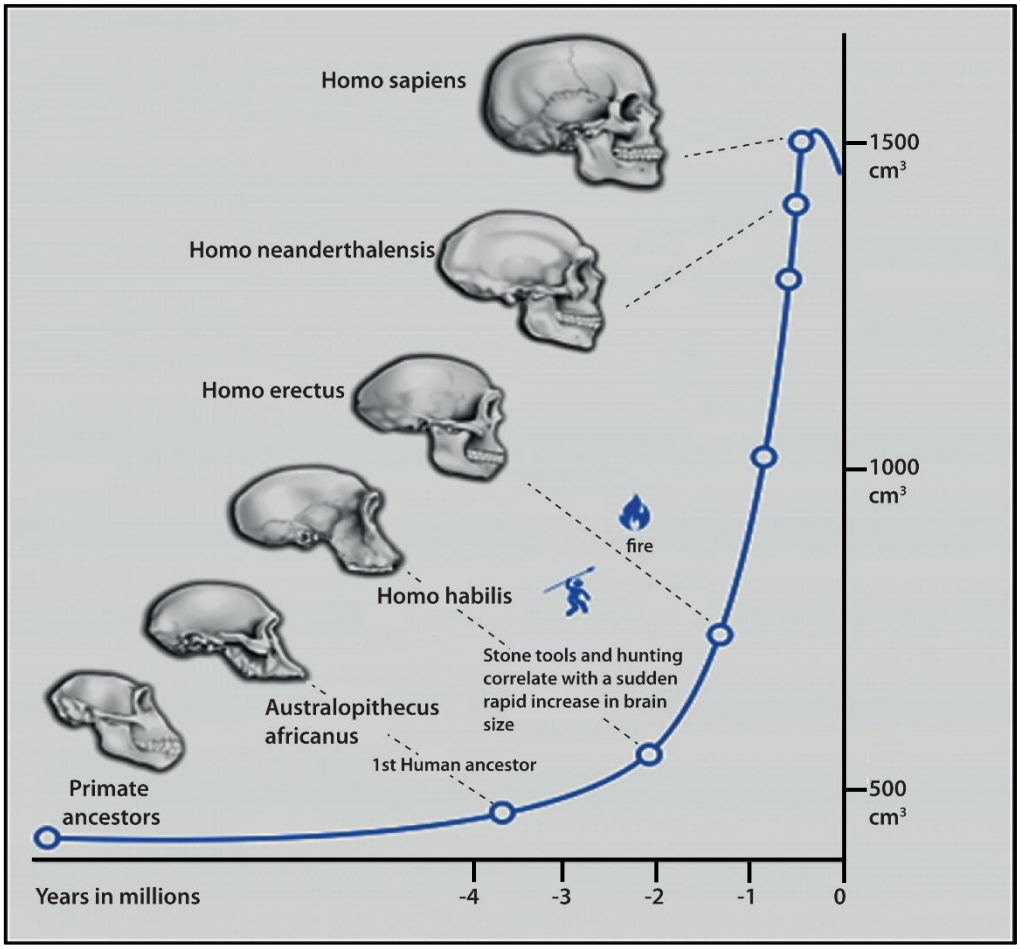
_____

_____

(4)

1.5 Refer to the diagram below which shows the increase in brain size in the evolution of modern humans.

Figure 1.5 Human evolution and the increase in brain size



[Source: <https://www.researchgate.net/figure/Human-evolution-based-on-skull-endocasts-of-fossil-archaic-primates-and-early-hominids_fig4_317784454>]

1.5.1 *Homo naledi* lived in Africa between 236 000 and 335 000 years ago and had a cranial capacity of about 465 cm^3. Based on this information, indicate the following on the curve of the graph above:

(a) Use an X to indicate where *Homo naledi* would be placed on the graph, according to the dating of its fossils. (1)

(b) Use a Z to indicate where *Homo naledi* would be placed on the graph according to its cranial capacity. (1)

1.5.2 According to the graph, which hominid discovered fire?

_____

(1)

1.5.3 Answer the following questions using evidence provided on the graph.

(a) Estimate the size of the cranial capacity of *Homo habilis*.

_____

(1)

(b) Estimate how long ago *Homo habilis* lived.

_____

(1)

1.5.4 Suggest why *Homo erectus* would have been more successful at hunting compared to *Homo habilis*.

_____

_____

_____

_____

_____

(2)

1.5.5 Name ONE example of an *Australopithecus africanus* fossil.

_____

(1)

1.5.6 (a) *Homo erectus* was completely bipedal. Explain how one could determine this by examining a fossilised skull.

_____

(2)

(b) Discuss ONE advantage of bipedalism.

_____

_____

(2)

1.6 Read the information provided below to answer the following questions.

Recently developed new sorghum varieties can now meet the nutritional needs of children in sub-Saharan Africa. Scientists have modified varieties of sorghum by integrating multiple traits into the genome of a single sorghum plant. Sorghum provides many dietary benefits, as it is high in protein, fibre, and vitamin B; however, it lacks sufficient vitamin A and key minerals such as iron and zinc.

To overcome these shortages, scientists used a biotechnological technique commonly used in plant breeding to make the sorghum variety more suitable. The new varieties are enhanced with vitamin A. The BCMO1 gene was integrated into the genome of the sorghum plant. This gene assists in the production of vitamin A. Sorghum grains produced by the newly modified sorghum plant can produce 32 times more vitamin A than regular sorghum varieties. Children under five years in sub-Saharan Africa with a vitamin A deficiency face a higher risk of blindness and an increased number of deaths from infections.

Figure 1.6 Genetically modified sorghum plant

[Source: <https://www.downtoearth.org.in/news/africa/these-new-sorghum-varieties-might-help-sub-saharan-africa-meet-nutritional-needs-91013>]

1.6.1 Explain the meaning of the term *biotechnology*.

_____

_____

(2)

1.6.2 Provide the correct phrase from the text that means the same as:

(a) genetically modified plant

_____

(1)

(b) transgenic organisms

_____

(1)

1.6.3 Describe, in point form, the process of genetic modification used by scientists to create new varieties of sorghum with added vitamin A.

(6)

1.6.4 Provide ONE advantage and ONE disadvantage of the **original** sorghum plant.

Advantage

(1)

Disadvantage

(1)

1.6.5 (a) Explain how the new sorghum variety will be beneficial to the people of sub-Saharan Africa.

(4)

(b) Even though the new sorghum variety is beneficial, discuss TWO reasons why many people may be against feeding this variety to their children.

_____

_____

(2)

1.7 Read the information below regarding the bat population in Zambia and answer the questions that follow.

Bat season in Kasanka National Park in Zambia is a spectacular sight which attracts many tourists. They come to observe the African fruit bats emerging from their roosting sites in large numbers every evening. The bats migrate to Kasanka every year in October from the Congo rainforest, their numbers drastically increase in November and by January, they return to the Congo rainforest.

The common question asked is how many bats are present in one bat season. There are too many bats, and they fly too quickly, making it impossible to physically count them. To solve this problem, scientists filmed the bats leaving their roost and then developed artificial intelligence (a computer program) to count the bats in the video. This method is inexpensive, fast and repeatable, and helps to count large numbers of moving animals.

Figure 1.7.1 Roosting sites of the bats in Kasanka National Park

Figure 1.7.2 Wind turbines being used in farms near the Park

Bats disperse seeds over long distances every night by excreting seeds in their droppings. Larger colonies disperse more seeds. Unfortunately, the bat population is drastically decreasing due to an increase in wind farms where more wind turbines are being erected. Bats have evolved to roost in trees and are therefore attracted to tall trees. Air currents that surround the wind turbines mimic air currents that surround tall trees, where the bats like to roost. Bats confuse wind turbines for tall trees and approach wind turbines to roost and are killed by the dangerous blades of the turbine.

[Source: <https://www.downtoearth.org.in/news/africa/world-s-biggest-bat-colony-gathers-in-zamb ia-every-year-we-used-artificial-intelligence-to-count-them-91982>
<https://www.iflscience.com/bats-mistaken-wind-turbines-trees-25837>]

1.7.1 (a) Name the direct method that scientists would use to 'physically count' the numbers of organisms such as bats.

_____

(1)

(b) Explain why it is not possible to use the method you mentioned in Question 1.7.1 (a) for counting bats.

_____

_____

(2)

1.7.2 (a) List ONE reason why it may be advantageous to use artificial intelligence technology to count the bats.

(1)

(b) Suggest why the artificial intelligence method of counting organisms may not be a viable option in all African countries.

(1)

1.7.3 (a) What population parameter would be responsible for the bat population to increase hugely in November?

(1)

(b) Explain how the increase in the number of wind turbines is causing the bat population to decrease.

(4)

1.7.4 Discuss ONE way in which the decrease in bat numbers every year will impact on both the ecosystem of the park and the economy of the country.

Ecosystem

(2)

Economy

(2)

[80]

QUESTION 2

2.1 Read the information provided to answer the questions that follow.

The emergence of drug-resistant malaria in east African countries like Rwanda, Uganda and Eritrea is hindering the fight against malaria. The treatment of malaria is a challenge as the parasite, *Plasmodium falciparum*, which is responsible for the most dangerous form of malaria has started to develop resistance to artemisinin, the main chemical ingredient used in antimalarial drugs.

The treatment of the parasite relies on the administration of artemisinin-based medications in combination with another antimalarial drug. This is referred to as artemisinin-based combination therapy (ACT) which has been highly effective at treating mild cases. ACT reduces the number of parasites in the blood of a patient during the first three days of treatment.

In a recent study conducted between 2016 and 2019, researchers looked at the success rates of antimalarial drugs. The results of the study were published in *the New England Journal of Medicine.* The researchers focused on the success rate of three-day courses of ACT in Eritrea and found that the effectiveness of the drug therapy declined during the study period. In 2016, the drugs failed to clear parasites in 0,4% of patients, and in 2019, the drugs failed to clear parasites in 4,2% of patients.

The main reason for resistance developing was due to sudden random changes in the *Plasmodium falciparum* parasite gene *kelch13* which had remained unchanged for more than 50 million years. There was a substantial rise in the percentage of parasites carrying the altered *kelch13* gene; 8,6% in 2016 compared to 21% in 2019.

[Source: <https://www.downtoearth.org.in/news/africa/emerging-drug-resistance-in-eastern-africa-hinders-fight-against-malaria-92244>; <https://www.nejm.org/doi/full/10.1056/NEJMoa2210956>]

2.1.1 Provide the correct biological term for the following phrase: 'random changes in the *Plasmodium falciparum* parasite gene'.

_____

(1)

2.1.2 Calculate the change in percentage of the parasites carrying the altered gene from 2016 to 2019.

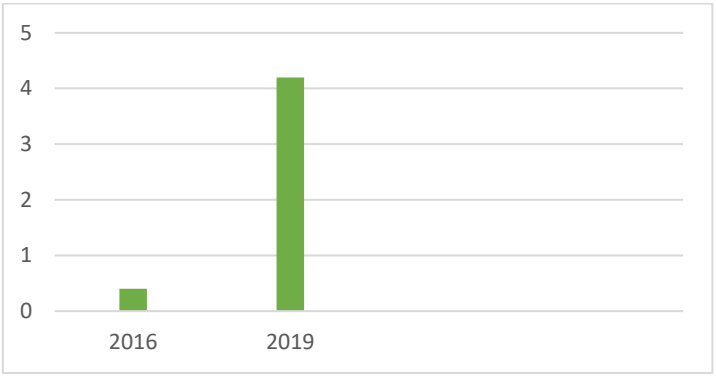
_____

_____

(1)

2.1.3 The graph below shows the percentage of patients for whom ACT was unsuccessful in treating malaria from 2016 to 2019.

Complete the graph by filling in the labels **AND** units on the x and y axis. (4)



2.1.4 (a) Explain how artemisinin-resistant strains of *Plasmodium falciparum* have evolved by natural selection.

(6)

(b) Name the scientist who proposed the theory of natural selection.

(1)

2.1.5 Using evidence from the text, explain why the pattern of evolution for drug resistant *Plasmodium falciparum* is considered an example of punctuated equilibrium.

(2)

2.1.6 Explain why the evolution of *Plasmodium falciparum* is described as natural selection and not artificial selection.

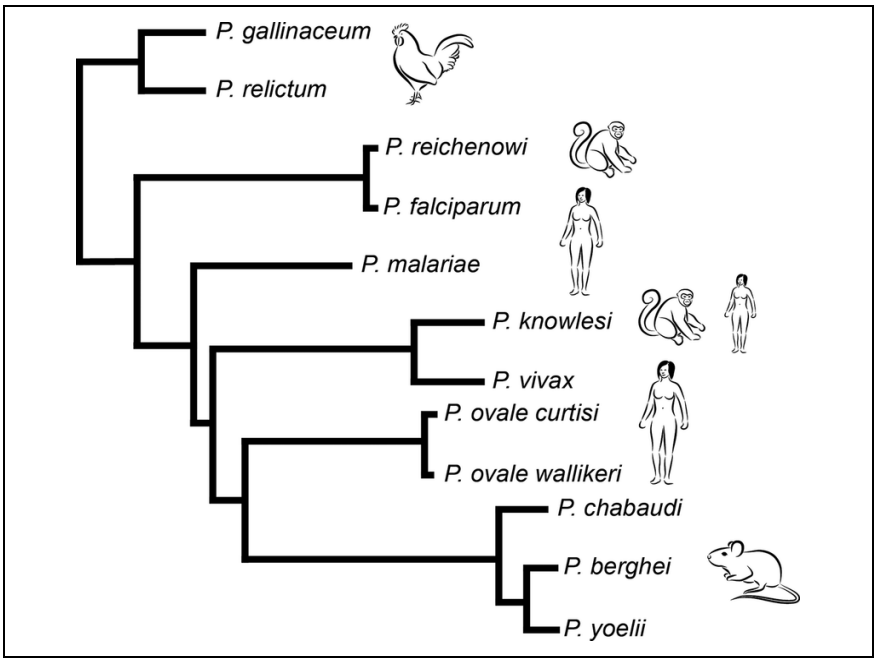
(2)

2.1.7 Explain why the study on the effectiveness of ACT can be considered scientifically reliable.

(2)

2.1.8 Different species of plasmodia parasites infect different types of living organisms as indicated by the images next to the species. Use the phylogenetic tree below to answer the questions that follow.

Figure 2.1 Phylogenetic representation of different *Plasmodia* species and the types of organisms they infect



[Source: <https://www.researchgate.net/figure/Phylogenetic-representation-of-Plasmodium-lineages-Schematic-of-phylogenetic-tree-based_fig1_333930874>]

(a) Place an X on the diagram to indicate the most recent common ancestor of *Plasmodium knowlesi* and *Plasmodium vivax*.

(1)

(b) State whether the following statements are correct regarding the information provided in Figure 2.1. If correct, place a tick ✓ in the answer column.

STATEMENT	ANSWER COLUMN
P. berghei affects rodents only.	
P. gallinaceum and *P. relictum* are closely related to each other.	
P. falciparum causes malaria in monkeys.	
P. berghei is more closely related to *P. chabaudi* than to *P. yoelii.*	

(4)

2.2 Read the information provided on the Masai giraffe and then answer the questions that follow.

The Masai giraffe is the largest subspecies of the nine subspecies (smaller groups of the same species) of the giraffe family. The population of Masai giraffes, native to Tanzania and southern Kenya, has decreased drastically in the past thirty years. A recent study indicates that the Masai giraffes are endangered. The Great Rift Valley has separated the population into two groups. The two groups are separated by steep cliffs and as giraffes are bad climbers, they remain isolated. Although isolated, they are still the same species. The Great Rift Valley prevents interbreeding and the exchange of genetic material between the two groups.

Researchers looked at the genomes of 100 Masai giraffes to determine if populations on either side of the Rift Valley have crossed over to breed with each other in the recent past. They found that Masai giraffes on the east side of the Rift Valley had no genes in common with Masai giraffes on the west side, suggesting that migration has not occurred across the Rift Valley to breed in the past 250 000–300 000 years.

Figure 2.2.1 The Masai Giraffe in Kenya

Figure 2.2.2 The Great Rift Valley in Kenya

[Source: <https://www.downtoearth.org.in/news/africa/east-africa-s-masai-giraffes-more-endangered-than-previously-thought-here-s-why-90031>]

2.2.1 (a) Provide the phrase from the text that gives the meaning for the term 'gene flow'.

_____

_____

(1)

(b) Explain the meaning of the term *genome*.

_____

_____

(2)

2.2.2 To study the evolution of giraffes, researchers looked at the genomes of 100 Masai giraffes.
Besides studying similarities in DNA, name and describe ONE other line of evidence that can be used to study the evolution of giraffes.

(2)

2.2.3 (a) The type of speciation that occurs in the two giraffe populations is considered to be allopatric speciation.
Provide evidence from the source that supports this statement.

(1)

(b) Describe how allopatric speciation would result in two new species of giraffe evolving.

(6)

2.2.4 Explain the negative implications for the survival of the giraffe population if they continue to remain isolated in their small groups.

(4)
[40]

QUESTION 3

3.1 Read the information provided below to answer the questions that follow.

An extremely rare black leopard was spotted in Kenya in 2018. This rare female cat has melanism. Melanism is a condition in which the body produces an excess of pigment that is physically expressed in skin, hair or fur.

Melanism in leopards is caused by a recessive mutation that affects the gene that regulates melanin production. This causes an overproduction of melanin which turns the coat black. Melanistic cubs can be born to two normal spotted parents. The MC1R gene that codes for melanin can be found on chromosome 16. The melanin polypeptide chain contains 317 amino acids.

Black leopards are nocturnal animals that hunt at night. They are found in tropical forests where there is an abundance of shade.

Figure 3.1: Melanistic leopard compared to a normal coloured leopard

[Source: <https://www.nationalgeographic.com/animals/article/rare-black-panther-spotted-in-africa-century>]

Figure 3.2: Segment of the MC1R gene – normal segment compared to mutated segment

Normal segment

-TAA – CGC – TCT – AAT – CCG – GGG -

1 2 3 4 5 6

Mutated segment

-TAA – CCT – CTA – ATC – CGG - GG -

1 2 3 4 5 6

Figure 3.3: mRNA codon chart

First Base in Codon	Second Base in Codon: U	Second Base in Codon: C	Second Base in Codon: A	Second Base in Codon: G	Third Base in Codon
U	UUU, UUC: Phe; UUA, UUG: Leu	UCU, UCC, UCA, UCG: Ser	UAU, UAC: Tyr; UAA Stop; UAG Stop	UGU, UGC: Cys; UGA Stop; UGG Trp	U C A G
C	CUU, CUC, CUA, CUG: Leu	CCU, CCC, CCA, CCG: Pro	CAU, CAC: His; CAA, CAG: Gln	CGU, CGC, CGA, CGG: Arg	U C A G
A	AUU, AUC, AUA: Ile; AUG: Met or Start	ACU, ACC, ACA, ACG: Thr	AAU, AAC: Asn; AAA, AAG: Lys	AGU, AGC: Ser; AGA, AGG: Arg	U C A G
G	GUU, GUC, GUA, GUG: Val	GCU, GCC, GCA, GCG: Ala	GAU, GAC: Asp; GAA, GAG: Glu	GGU, GGC, GGA, GGG: Gly	U C A G

3.1.1 Provide the correct biological terms for the following statements:

(a) A trait, like skin colour, that is physically expressed in an organism.

(1)

(b) The position of a gene on a chromosome.

(1)

(c) The monomer of a protein.

(1)

3.1.2 (a) Provide the meaning of the term 'a gene'.

(2)

(b) How many nucleotides make up the MC1R gene? Show all working.

(2)

3.1.3 Refer to the text and provide evidence that explains why the pattern of inheritance for melanism is described as 'autosomal recessive'.

(2)

3.1.4 Describe ONE difference between the structure of mRNA and tRNA.

(2)

3.1.5 Refer to Figure 3.2 to answer the following questions.

(a) Write out the **first three codons** only of the complementary mRNA base sequence for the normal segment of the MC1R gene.

(3)

(b) Identify the type of mutation that occurred in the second codon to produce the black leopard.

(1)

(c) Refer to Figures 3.2 and 3.3, describe the difference in amino acid sequence formed in the mutated segment versus the normal segment of the MC1R gene and explain how this results in the production of melanistic leopards.

(4)

3.1.6 Explain how a gene such as the MC1R gene is translated at the ribosome.

(5)

3.1.7 Discuss how the black coat colour can be advantageous to the leopard.

(4)

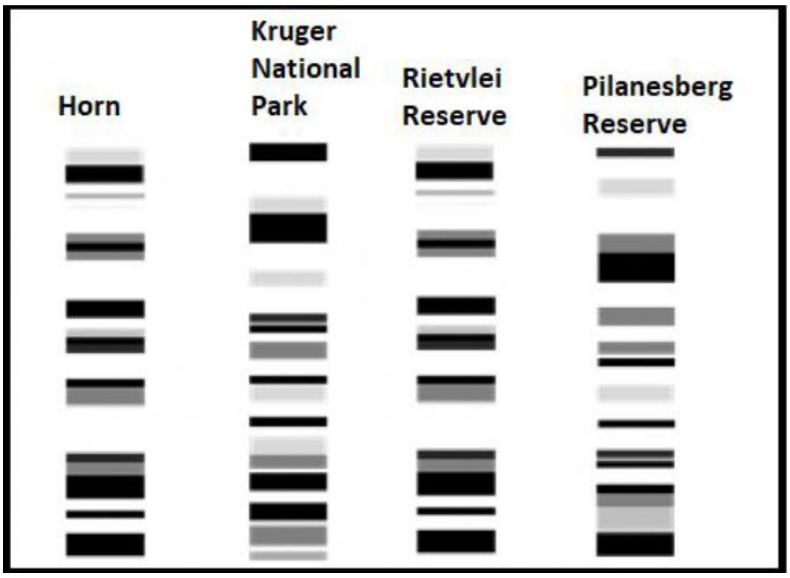
3.1.8 Using a genetic diagram/punnet square, show the inheritance of melanism in a melanistic (black) leopard from two normal heterozygous parents. Include parent genotypes and phenotypes, gametes formed and all phenotypic and genotypic ratios of the cross.

Use the following letters in your cross:
M = normal coat colour
m = melanistic coat colour.

(5)

3.2 Three rhinos from different reserves in South Africa were poached and killed for their horns. A month later, a horn was confiscated after an attempted smuggling at OR Tambo International Airport. A very small amount of DNA was extracted from the horn and compared to the DNA of the three deceased rhinos from the three different reserves.

The image below shows the results of the DNA comparison:



3.2.1 From which South African reserve was the rhino poached? Give a reason for your answer.

_____

(2)

3.2.2 Do you agree with the idea of creating a DNA database for rhinos? Provide a well-explained reason to justify your answer.

_____

_____

(2)

3.2.3 Identify the process below that would have created the image shown above. Circle the correct option.

A DNA replication
B Protein synthesis
C Gel Electrophoresis (1)

3.2.4 (a) Name the process that scientists would use in the lab to make more copies of the small amount of DNA extracted from the rhino horn.

_____

(1)

(b) Name the enzyme that would be used to make copies of the rhino DNA.

_____

(1)

[40]

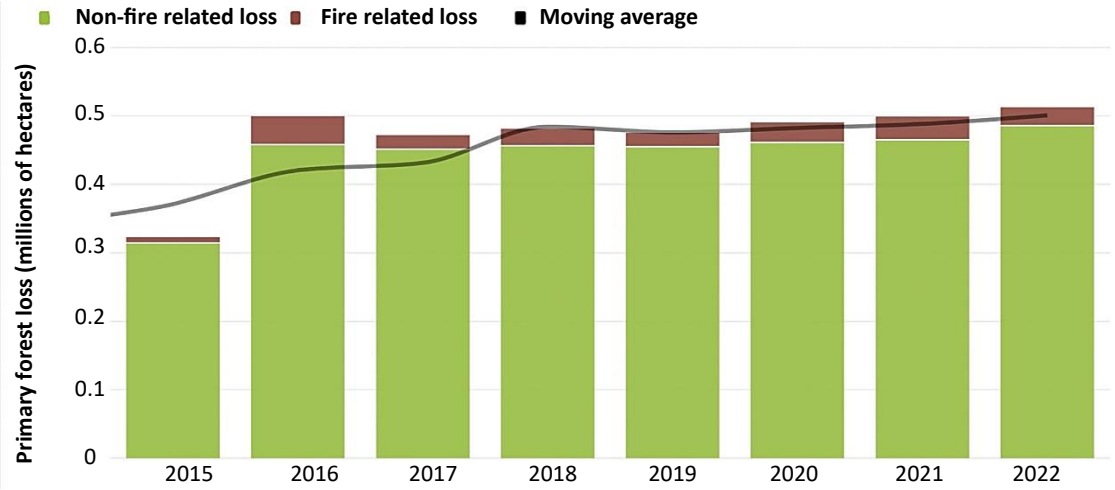
QUESTION 4

4.1 Study the information provided below to answer the questions that follow.

The world's second largest rainforest is found in Africa. Sixty percent of the rainforest lies in the Democratic Republic of Congo (DRC). The DRC has a rapidly growing population with increasing food and energy needs. The Congo rainforest, which is spread over six African countries, is shrinking in size. The majority of the primary forest is being lost due to clearing of the forest to create agricultural land for growing crops. Other major causes of forest loss in the DRC are uncontrolled forest fires, charcoal production for local and regional markets, cattle farming, and illegal logging (cutting and transporting of trees to be used for timber). Charcoal is the dominant form of energy in the region, which is generated by cutting and burning timber. In the DRC, poverty is widespread and access to electricity is limited.

Even though the DRC government committed to uphold the conservation of protected areas, they recently auctioned off permits allowing for oil and gas exploration in untouched parts of the forest and have now indicated that a ban on logging will be lifted.

Democratic Republic of the Congo primary forest loss, 2015–2022



[Source: <https://www.downtoearth.org.in/news/africa/congo-world-s-2nd-largest-rainforest-continues-to-vanish-with-half-a-million-hectares-lost-in-2022-says-report-90284> <https://research.wri.org/gfr/latest-analysis-deforestation-trends>]

4.1.1 Differentiate between the terms 'population' and 'species'.

(4)

4.1.2 What type of succession will occur in the forest after an uncontrolled forest fire? Explain your answer.

(2)

4.1.3 Discuss TWO reasons why the increase in population size is causing the loss of the forest.

(4)

4.1.4 Do you think the government of the DRC is committed to conserving the forest? Give reasons for your opinion.

(4)

4.1.5 Study the graph and the information provided in the source to answer the following questions.

(a) Identify ONE factor that resulted in non-fire related loss of the forest.

(1)

(b) What was the total forest loss in 2016?

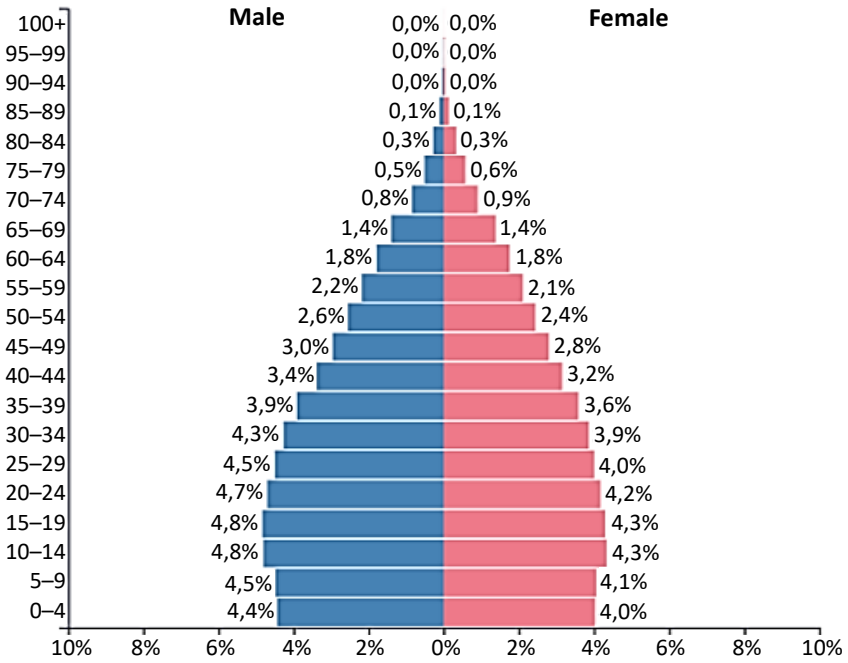
(1)

(c) Identify TWO years that showed the same total area of forest loss.

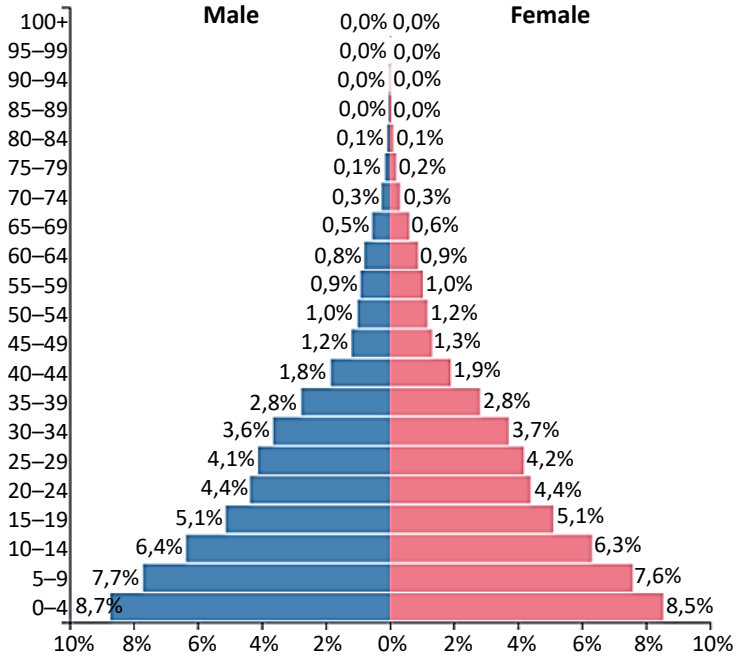
(1)

4.1.6 Which graph below, A or B, represents the population of the DRC? Use evidence from the text on page 27 and the pyramid to give reasons for your answer.

A



B



(3)

4.2 Read the information given below and then answer the questions that follow.

The Agulhas long-billed lark is a South African endemic species restricted to the Agulhas plains, within the Western Cape province. It builds nests on the ground mainly in the Renosterveld fynbos, a type of vegetation filled with grass and wild spring flowers. The Renosterveld fynbos is critically endangered due to agricultural expansion. There are only random patches of vegetation left. The area in which this lark occurs has been almost fully changed into agricultural land and these birds are now classified as near threatened.

Figure 4.2 – The Renosterveld Fynbos

[Source: <https://www.capetownbotanist.com/what-is-renosterveld/>]

In the nests monitored during a study, it was found that only 14% of the lark chicks survived until they were ready to fly for the first time. The rest were eaten by predators such as caracals and snakes. Bird species that nest and breed on the ground often lose a high proportion of their nests to predators, but lark nests are usually very well-hidden. Many predators on the Agulhas Plain rely on their eyesight to locate nests, so this camouflage generally pays off. As soon as the chicks are mobile, but before they can fly, they leave the nest area to hide under small bushes nearby, which makes them even harder to spot. The adult larks aggressively defend their nests by mobbing in large flocks i.e., squawking or flying at predators to chase them away.

Figure 4.2.1 Agulhas long-billed lark, well camouflaged in the endangered Renosterveld.

Figure 4.2.2 A well-hidden Agulhas long-billed lark nest on the fynbos ground in the endangered Renosterveld.

[Source: <https://theconversation.com/south-africas-agulhas-long-billed-lark-adapting-and-surviving-despite-farming-taking-over-their-nesting-grounds-219269>

<https://www.downtoearth.org.in/blog/africa/south-africa-s-agulhas-long-billed-lark-adapting-and-surviving-despite-farming-taking-over-their-nesting-grounds-94049>]

4.2.1 State the type of competition that occurs between caracals and snakes when feeding on the eggs or chicks of the Agulhas long-billed lark.

(1)

4.2.2 List TWO density dependent factors that are limiting the size of the lark population.

(2)

4.2.3 The mark-recapture method can be used to estimate the size of the lark population.

(a) Explain how scientists would carry out the mark-recapture method on the lark population to collect data.

(4)

(b) List TWO precautions that need to be taken when using the mark-recapture technique to provide accurate results.

(2)

4.2.4 Explain TWO ways in which the decreasing Renosterveld fynbos vegetation will affect the survival of the Agulhas long-billed lark.

(4)

4.2.5 Describe the type of social organisation strategy used by the larks to protect their nests.

(2)

4.2.6 Draw a graph showing the predator-prey relationship between the caracal and the larks. Provide a key for your graph and label the x and y axis.

(5)
[40]

Total: 200 marks

ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION, THAT YOU USED THE ADDITIONAL SPACE, TO ENSURE THAT ALL ANSWERS ARE MARKED.