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PRELIMINARY EXAMINATION
5 SEPTEMBER 2024

LIFE SCIENCES: PAPER 1

NAME

Time: 3 hours

200 marks

INSTRUCTIONS:

1. This paper consists of 34 pages. Please check that your question paper is complete.
2. This paper consists of four questions.
3. Answer ALL the questions in the spaces provided on this question paper.
4. Write your name in the space provided above.
5. Read the questions carefully and use the total marks that can be awarded for each of the questions as an indication of the detail required.
6. It is in your own interest to write legibly and to present your work neatly.

Examiner: Mrs M. Gostmann

Moderator: Dr. S. Hoffmann

QUESTION 1

1.1 Match the biological terms in column B to the definitions in column A. Write only the letter of the correct answer in the brackets provided.

<u>COLUMN A:</u>	<u>COLUMN B:</u>
[] Chromosome that determines sex.	A. Homo habilis
[] DNA that is only passed from mother to offspring through the ovum.	B. Australopithecus
[] Organism that has had its DNA altered or modified by genetic engineering	C. Punctuated equilibrium
[] Promotes heterozygosity	D. Gradualism
[] A form of macroevolution with a constant rate of variations over long periods of time.	E. Gene flow
[] “Handy man”	F. Homologous
[] Structure which once performed a function in an ancestor of an organism.	G. Vestigial organ
[] A phenotypic characteristic that is determined by more than two genes.	H. Outbreeding
[] New communities start forming in an ecosystem after a disturbance has previously destroyed the environment.	I. Extinction
[] Technology used to create genetically identical copies of cells.	J. Mitochondrial DNA
	K. Gonosomes
	L. Cloning
	M. Polygenic
	N. GMO
	O. Replication
	P. Chiasma
	Q. Bivalent
	R. Primary succession
	S. Secondary succession

[10]

1.2 Various possibilities are suggested as answers to each of the following multiple-choice questions. Choose the most correct answer and write down only the letter of your choice 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	1.2.9	1.2.10

[10]

1.2.1 Which of the following best describes the carrying capacity of a habitat?

- A. An indication of the fertility of a population.
- B. A two-directional movement (migration) of organisms in a habitat.
- C. The maximum, stable population size a specific area can support over a long period of time.
- D. The interaction between individuals of the same species in a habitat.

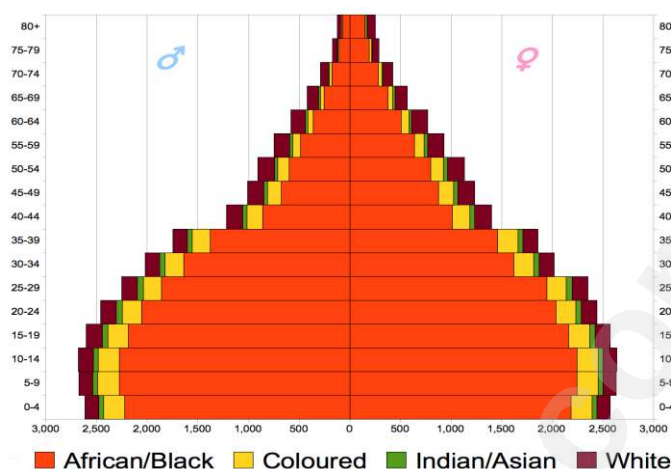
1.2.2 When using the mark-recapture technique it is assumed that, when a sample of animals from a population is marked and allowed to spread out among the unmarked ones, the _____ will be the same as the proportion of marked to unmarked individuals in the whole population.

- A. number of marked
- B. number of unmarked
- C. proportion of unmarked individuals in the total population
- D. proportion of marked to unmarked individuals in the next sample

1.2.3 Which of the following does NOT fit? The accuracy of the mark-recapture method is only valid when the . . .

- A. Marks remain clear for the whole duration of the experiment.
- B. Chances of the animal being captured change during the experiment.
- C. Marked individuals mix completely with the rest before the next sample is taken.
- D. Population is closed and there are no births or deaths during the experiment.

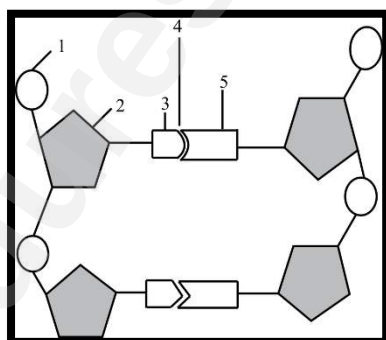
The population pyramid below represents data which was collected in South Africa in 2019.



1.2.4 Which of the following conclusions relates best to the information represented by the population pyramid above?

- A. The high population size of people between the ages of 20 – 40 indicates that South Africa can be referred to as a developed country.
- B. The high birth rate is an indication that most South Africans have sufficient access to healthcare facilities.
- C. South African females generally have a higher survival rate than males.
- D. Based on this data the unemployment rate in South Africa should start decreasing in the near future.

Questions 1.2.5 and 1.2.6 refers to the diagram showing a short section of DNA:



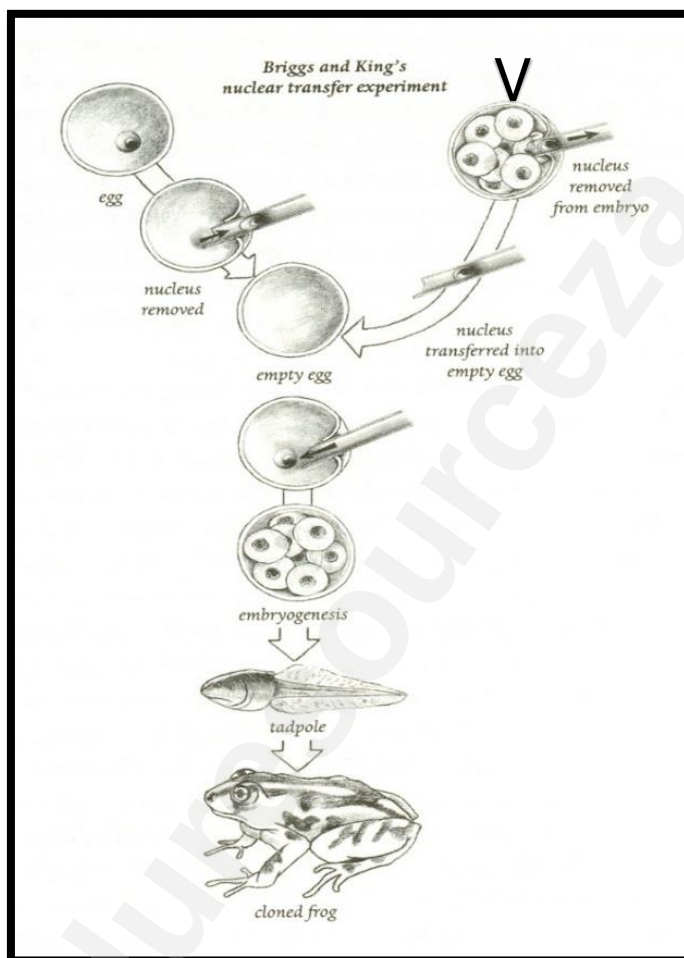
1.2.5 What are the correct labels for parts 1, 2 and 4?

	Part 1	Part 2	Part 4
A	Deoxyribose sugar	Phosphate	Hydrogen bond
B	Ribose sugar	Phosphate	Sulphate bond
C	Phosphate	Deoxyribose sugar	Hydrogen bond
D	Histone	Ribose sugar	Helicase enzyme

1.2.6 Parts 1, 2 and 3 are collectively referred to as a / an:

- A. Nucleotide
- B. Nucleic acid
- C. Amino acid
- D. Codon

Questions 1.2.7 and 1.2.8 refer to the diagram below showing how genetically identical frogs can be made from unfertilised eggs.



(<http://www.wordpress.com>)

1.2.7 If the diploid number ($2n$) for the frog is 26, what is the chromosome number of the cell at V?

- A. 26
- B. 52
- C. 13
- D. 2

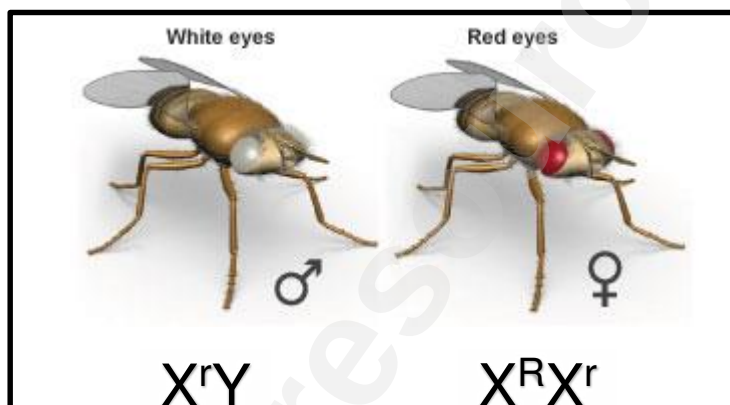
1.2.8 The technological process in the diagram is known as:

- A. therapeutic cloning
- B. asexual reproduction
- C. evolution
- D. somatic cell nuclear transfer / SCNT

1.2.9 Which option best represents the chromosome number and the characteristic associated with polyploidy in fruit?

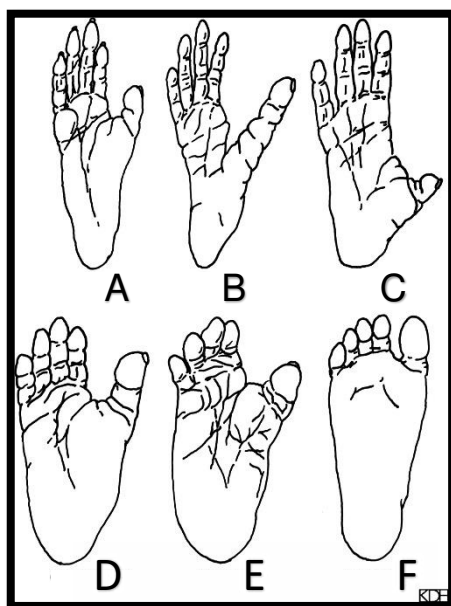
Option	Sets of chromosomes in cells:	Characteristic of fruit:
A	Haploid	Larger fruit, less flavour
B	More than diploid	Smaller fruit, decreased yield
C	More than diploid	Larger fruit, increased yield
D	Diploid	Smaller fruit, increased nutritional value

1.2.10 White eye colour in *Drosophila* fruit flies is caused by a sex-linked allele. The dominant allele is for red-eyed flies. What is the most likely phenotype from the cross shown below:



- A. 50 % white-eyed and 50 % red-eyed flies
- B. 100 % red-eyed flies
- C. 75 % red-eyed flies and 25 % white-eyed flies
- D. 100 % white eyed flies

1.3 The diagrams below show the under-surface of feet of various modern primates.



1.3.1 Explain how the diagrams above could be used as evidence of divergent evolution.

(2)

1.3.2 Which of the diagrams (A – F) would belong to modern man?

(1)

1.3.3 Give TWO visible features, evident in the diagrams, which indicate that modern man's mode of locomotion differs from that of tree-dwelling primates.

(2)

1.3.4 Explain THREE possible benefits of modern man's mode of locomotion.

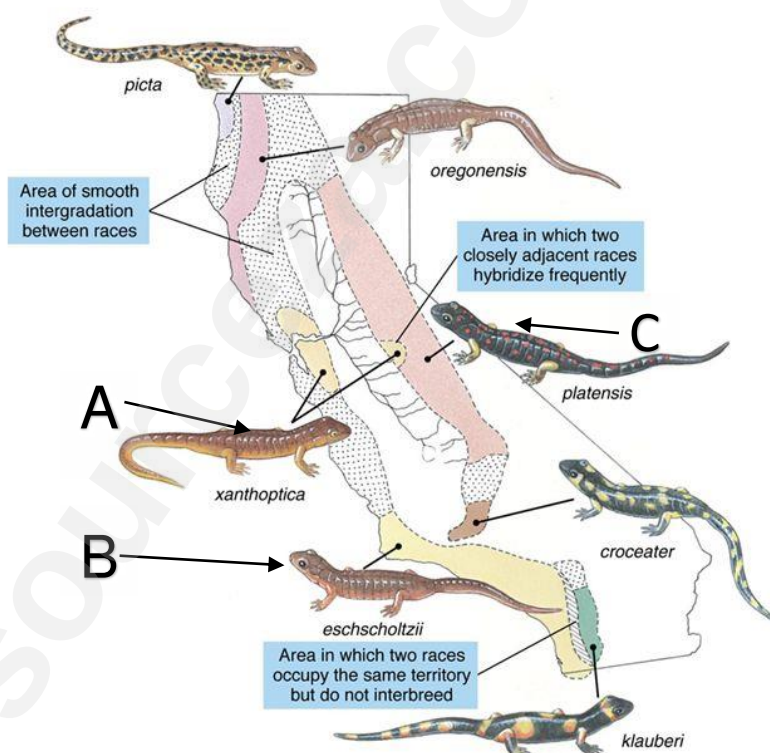
(6)
[11]

1.4

Ring species—salamanders

The ensatina salamander (*Ensatina eschscholtzii*) occurs from Canada to Southern California with interbreeding between adjacent populations through this range.

The Central Valley—a dry, hot lowland area—is divided into a coastal arm and inland arm. However, where these two arms of the species meet again in Southern California, interbreeding does not occur.



[http://slideplayer.com]

1.4.1 Briefly describe the difference in the type of speciation which would take place between the species of salamander labelled **A and B**, and the species of salamander labelled **B and C**.

A and B: _____

(2)

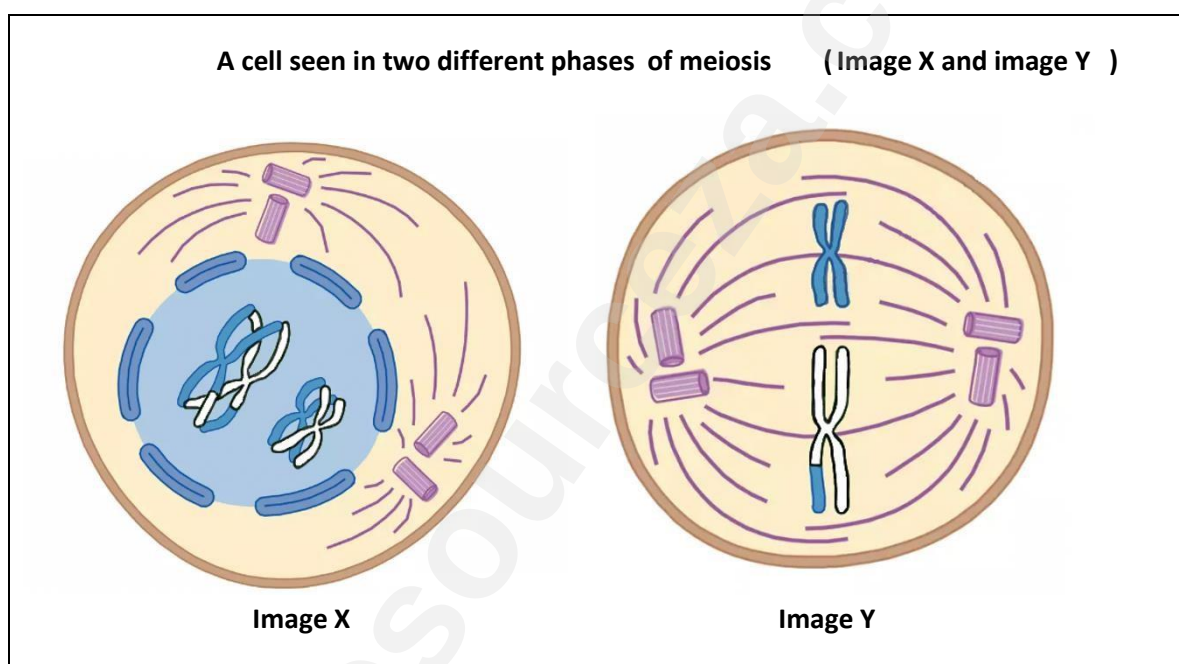
B and C: _____

(2)

- 1.4.2 Explain the difference in colouration between the salamander species found on the **coastal arm** (example *Xanthoptica* which are usually light brown) and the salamander species found on the **inland arm** (example *Platensis* which are black and red, or *Croceater* which are black and yellow)

(3)
[7]

- 1.5 The figure below shows a cell at two different phases in meiosis.



[Adapted: <www.slideshare.net/nirmalajosephine1/biology-form-4-chapter-5-cell-dvision-part-2-meiosis>]

- 1.5.1 Draw a circle around the option in the brackets provided in the table below to correctly identify the phases shown in the figure above.

	Phase in Meiosis Division
Image X	(Prophase I/Telophase I)
Image Y	(Metaphase I/Metaphase II)

(2)

1.5.2 Explain why it is important in animals that meiosis halves the chromosome number in cells produced by gonads.

(2)

1.5.3 Refer to Image Y on page 9. Draw any ONE cell that will be produced at the end of meiosis in Telophase II.

Your diagram must include the following:

- The correct number of chromosomes
- The correct relative sizes of chromosomes



(4)
[8]

1.6

FUR FROM A FLUFFY WHITE CAT USED IN MURDER TRIAL



On 7 October 1994, a car was found abandoned on Highway 169, near Tyne Valley in rural Prince Edward Island, with missing licence plates and apparent blood spatter on the windshield and throughout the vehicle's interior. The car belonged to Shirley Anne Duguay, a 32-year-old mother of five, from Canada. Upon investigation, the Royal Canadian Mounted Police (RCMP) were told by Duguay's family that she had not been seen since October 3.

On 6 May 1995, Duguay's battered and partially decomposed body was discovered in a shallow grave in a wooded area. Her hands were tied behind her back and she had been strangled. Near the body, RCMP found a plastic bag containing a leather jacket covered in Duguay's blood and two strands of white feline hairs.



Investigators recalled that during a previous interview with her estranged common-law spouse, **Douglas Leo Beamish**, that he had a white cat named **Snowball**. The detectives obtained a sample of the cat's blood, intending to do DNA testing, but they found that no one in the world had done this before.

After contacting the Laboratory of Genomic Diversity, a laboratory specializing in the study of genetic diseases rather than in forensics, detectives and scientists were able to develop a method to test the feline DNA. The test included a fail-safe method of randomly testing 20 other cats from the isolated Prince Edward Island, in order to establish the degree of genetic diversity among cats in the area.

The tests revealed that the hairs did come from Snowball, and Beamish was subsequently convicted for the murder of his wife. The Duguay case marked the world's first use of non-human DNA in a criminal trial. While the forensic science of testing cat and dog hairs had been firmly established and studied, it was an unknown science up until that point.

[Source: Adapted from: https://en.wikipedia.org/wiki/Murder_of_Shirley_Duguay]

1.6.1 Explain (in 4-5 steps) how genetic testing would be done on the cat hairs that were collected from the jacket.

1.6.2 Name TWO OTHER types of body tissue / cells that could also be used by geneticists and investigators for genetic testing in crime investigations.

(2)

1.6.3 Describe TWO other ways (other than forensic investigations) how this type of genetic testing can be useful.

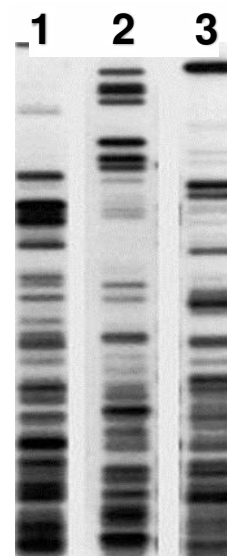
(4)

1.6.4 The genetic profiles below show results from the genetic testing:

A. Genetic profile of fur taken from jacket



B. Genetic profiles of ‘Snowball’ and two other cats in the neighbourhood



- a) Which of the cats' profiles, 1, 2 or 3, in B, belongs to 'Snowball'? Give a reason for your choice.

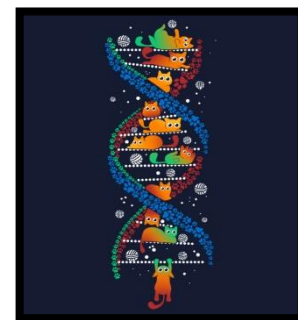
(2)

- b) Why do you think the crime investigators also included samples from the cats in Douglas Beamish's neighbourhood?

(2)

1.6.5 A new 'cat' database in America is analysing mitochondrial DNA (mtDNA). It has already become an extensive database which could be widely used by criminal investigators.

mtDNA is useful in forensics due to it having a high mutation rate, making comparisons easier, as well as the genes in mtDNA existing in large amounts.



- a) Explain briefly what (mitochondrial) mtDNA is.

(2)

- b) Explain how the properties of mtDNA makes it useful in forensics.

(2)

- c) Do you think South Africa should establish a DNA database for cats for forensic or other use? Give TWO reasons for your opinion.

(2)

[24]

1.7 Evolution of group living in lions

Lions are spectacularly sociable: they hunt together, raise their cubs in nursery groups and defend joint territories.

The traditional explanation for lion sociality has been cooperative hunting. However, lions only hunt cooperatively when they need to. If their best chance for a meal is a large dangerous prey like a Cape buffalo, lions certainly do pull together. But if the prey is relatively easy for a singleton to capture, the rest of the pride is more likely to cheer on their hunting companion rather than join the hunt.



Also, individual lions don't always feed better in larger groups. Food availability is highly seasonal, and during the "lean season" solitary females (who can catch warthogs by themselves) feed just as well as individuals in groups of five females (which are large enough to subdue buffalo); but groups of two to four females suffer lower food intakes.

Lions, generally, tend to be shades of yellow, brown, and orange-brown. This is the case for both female and male lions.

*A lion's colouring is not **only** indicative of its genetic background, but also its direct surroundings.*

Many factors can play into what determines a lion's colouring, such as the regional environment that a lion lives in, as well as the weather which also plays a role in a lion's fur. Lions that live in hotter places will tend to have lighter coats, while lions living in cooler regions will have darker coats.

However, lion's fur will undergo changes depending on their age. For instance, cubs have a mottled coat and spots. The spots, or rosette patterns on their legs and abdomen regions, which help to camouflage the cubs from predators. As the cub grows out of adolescence, these spots fade away and the adult lion bears a more consistent colouring.



Besides the colouring of the fur on a lion's body, male lions also have varying colours amongst their iconic manes.

As lions grow and age, their manes will get darker. A dark mane is often indicative of good health and high testosterone levels.

[Source: Adapted from <https://cbs.umn.edu/lion-research-center/lion-research/group-living> and <https://lionrecoveryfund.org/what-determines-lion-fur-coloring>]

1.7.1 Each of the questions in the table below consist of two items. For each question decide which item(s) best describes lions and lion cubs, **according to the given information**.

Write down your answer making use of the following code:

A – **only item 1** is correct.

B – **only item 2** is correct.

C – **both** items 1 and 2 are correct.

D – **neither** item 1 nor 2 is correct.

Question:	Items:	ANSWER:
A	1. Population density is mostly affected by interspecific competition. 2. Population density is mostly affected by intraspecific competition	
B	1. Social organisation in a pride is based on division of labour 2. Social organisation in a pride is based on strength by numbers	
C	1. Rosettes on cubs are a genotypic characteristic 2. Rosettes on cubs are a phenotypic characteristic.	

(3)

1.7.2 Give ONE advantage of:

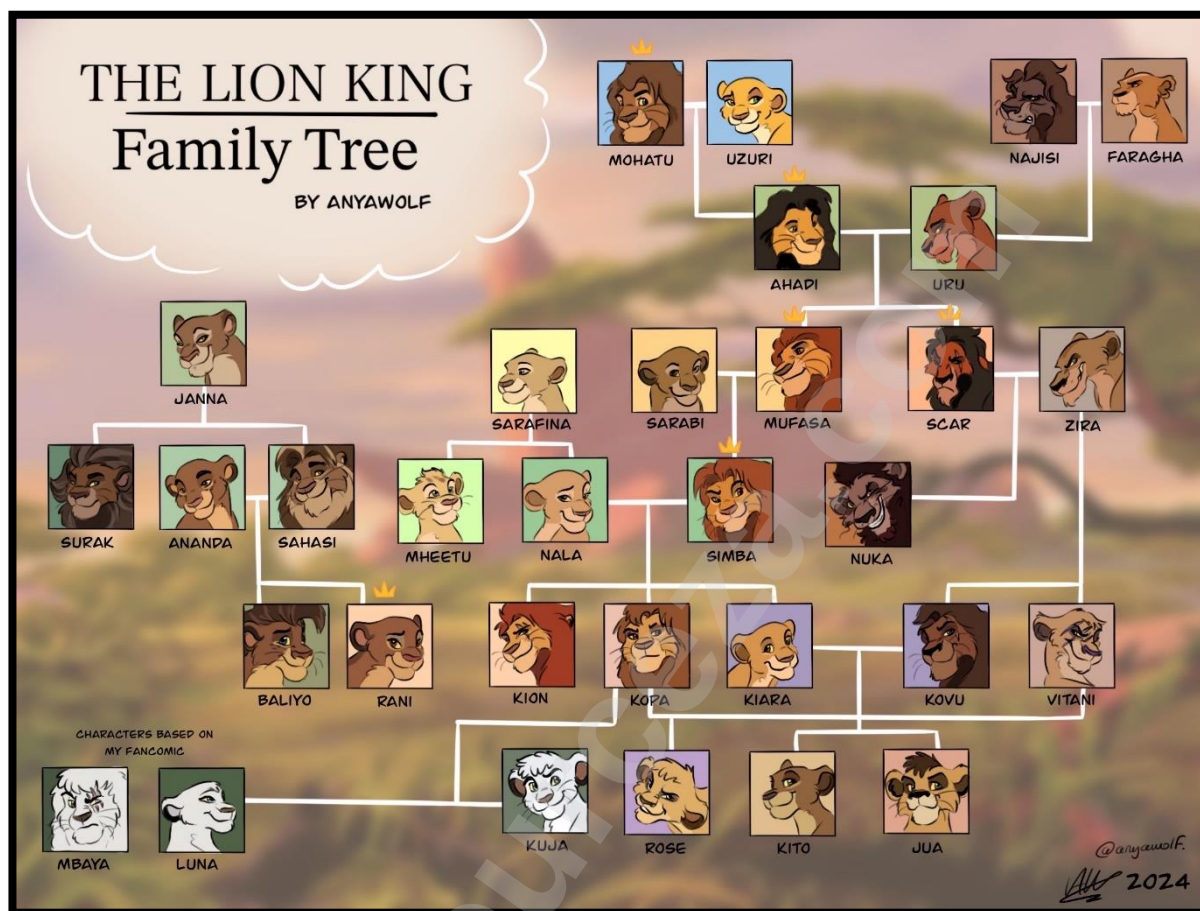
a) Lionesses hunting as a pack:

(2)

b) Rosette-shaped spots found on cubs as well as the abdomens of female lions:

(2)

- 1.7.3 According to the Lion King Family tree below, the inheritance of brown manes in male lions are dominant over black manes. (The gene for mane colour is NOT sex-linked)



- a) Give a possible advantage that male lions with a black mane might have over lions with a brown mane.

_____ (1)

- b) Make use of the letter **B/b**, and write down the genotypes of Scar and Mufasa.

Scar: _____

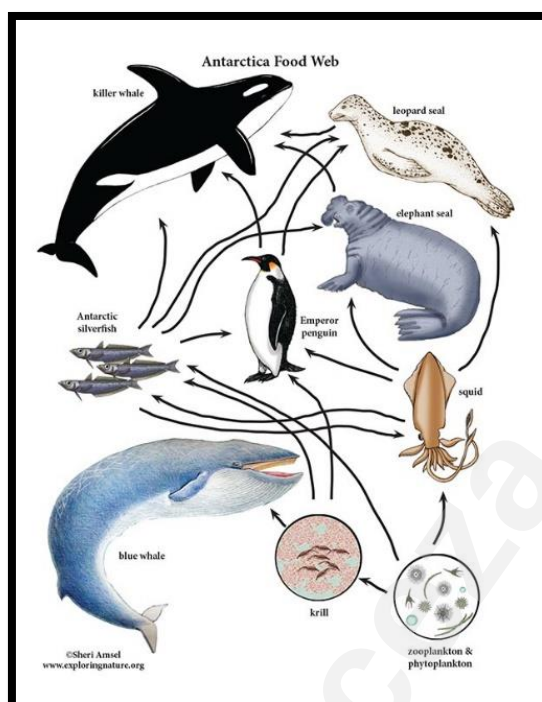
Mufasa: _____

(2)
[10]

80 marks

QUESTION 2

2.1 Study the food web below and read through the information on leopard seals before answering the following questions.



The **leopard seal** (*Hydrurga leptonyx*), also referred to as the **sea leopard**, is the second largest species of seal in the Antarctic (after the southern elephant seal).

Its only natural predator is the orca.

The leopard seal has a distinctively long and muscular body shape when compared to other seals. The overall length of adults is 2.4–3.5 m and their weight is in the range 200 to 600 kilograms.



It is perhaps best known for its massive jaws, consisting of sharp teeth and molars lock together in a way that allows them to sieve krill from the water.

The coat is counter-shaded with a silver to dark grey blend and a distinctive spotted "leopard" coloration pattern dorsally and a paler, white to light grey colour ventrally.

Leopard seals are perhaps most well known for their predation on Antarctic penguins. They wait at the ice edge for penguins to enter the water to feed and then aggressively chase them for a quick meal. Young penguins, especially those entering the water for the first time, are particularly vulnerable to predation by leopard seals.



Though penguins do make up a large part of their diet during some seasons, the Leopard Seal's diet is more heterogeneous than one might expect. They are known to eat fish, squid, krill, and juveniles of other seal species, in addition to penguins.

Leopard seals do not play well with others! They are exceptionally solitary animals and, generally, they hunt alone and are never seen with more than one or two other seals. Exceptions to this include the annual breeding period

Like most Antarctic species, the remote nature of the leopard seal's home range keeps human interactions to a minimum. Though they are known for their aggressive behavior, they only very rarely aim that aggression towards humans. There are currently no strong human threats to this seal, and scientists generally consider it to be a species of least concern.

[Source: Adapted from: https://en.wikipedia.org/wiki/Leopard_seal; & <https://oceanwide-expeditions.com/blog/danger-beneath-the-water-10-facts-about-leopard-seals>]

2.1.1 Write down the biological definition for the term *predator*.

(2)

2.1.2 Which animal in the food web could be referred to as an apex predator? Give a reason for your answer.

(2)

2.1.3 Identify and explain TWO structural adaptations of leopard seals which makes them effective predators in their specific environment.

(4)

- 2.1.4 Which type of competition would most likely exist between leopard seals and elephant seals? Explain your answer.

(3)
[11]

- 2.2 The photographs below show a group of emperor penguins as often spotted in Antarctica



[<https://kids.nationalgeographic.com/animals/birds/facts/emperor-penguin>]

While at sea, a group of penguins is known as a "raft." On land, however, penguins form into vast colonies. These colonies consist of thousands of members, with 5,000 being a conservative estimate and 10,000 being among the larger colonies. These colonies are referred to as "rookeries", "waddles" or "penquineries".

[<https://homework.study.com/explanation/what-is-a-group-of-emperor-penguins-called>]

- 2.2.1 Explain briefly how the social organisation of Emperor penguins effectively protects them from being attacked by predators, such as leopard seals.

(3)

- 2.2.2 Briefly describe another example, which you have studied, of organisms using a similar social strategy for protection from predators.

(3)

2.2.3 Explain briefly why each of the following methods used for estimating population size, might not be effective in estimating the size of an Emperor penguin population as shown in the photograph above:

a) Mark-and-recapture method

(2)

b) Quadrat method

(2)

2.2.4 Suggest a possible, alternative method which might be used to effectively calculate the size of the Emperor penguin population

(2)
[12]

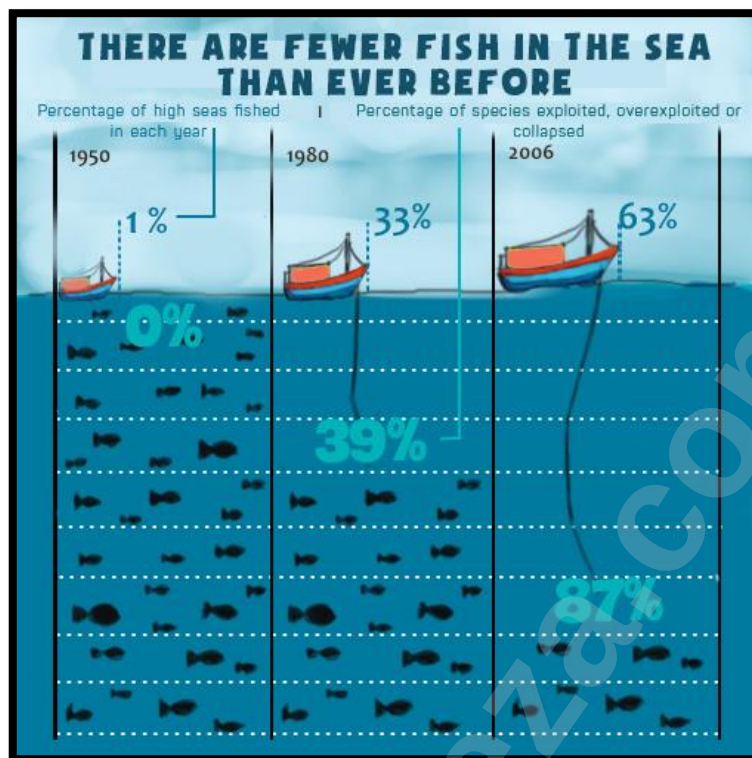
2.3

The disappearance of life in the oceans is a major problem, and current trends could put an end to oceans as a source of food for the world human population.

Nearly 80% of the world's fisheries are already fully exploited, over-exploited, depleted, or in a state of collapse. Worldwide, 90% of the stocks of large predatory fish, such as sharks, tuna, marlin, and swordfish, are already gone!

If overfishing does not stop and we fail to implement sustainable fishing practices, the world could run out of seafood as we know it by 2048, leading to severe ecological imbalances, a collapse of global fish stocks, and profound socioeconomic impacts on coastal communities and industries that depend on a healthy marine life.

[Source: Adapted from <https://www.theworldcounts.com/challenges/planet-earth/oceans/overfishing-statistics>]



[<https://www.ecobusiness.com/news/can-the-wto-curb-dangerous-overfishing/>]

2.3.1 Explain briefly what is meant by *environmental resistance*..

(2)

2.3.2 Do you think that over fishing could be referred to as a form of environmental resistance? Explain your answer.

(2)

2.3.3 Refer to the food web given in question 2.1. Explain how overfishing, and the harvesting of arctic fish species (like Antarctic silverfish) will affect:

a) The population density of the leopard seals:

(2)

b) The population density of the blue whales:

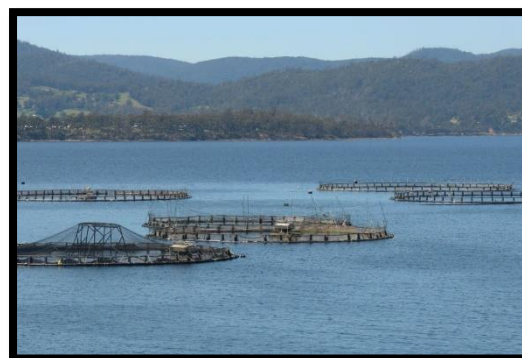
(2)

2.3.4 Why could overfishing be referred to as a density independent factor of environmental resistance?

(3)

The photograph below shows marine farming in Japan.

Since Japan is an archipelago (a chain of islands scattered in the ocean), food habits are strongly linked to ocean resources and consumption of a wide range of seafood is part of the general population's regular basic diet. Fish farming in Japan covers multiple freshwater and saltwater species due to diverse local demand for traditional Japanese cuisine.



[<https://issuu.com/aquacultureasiapacific/doc>]

2.3.5 What effect could marine farming possibly have on the population density of other fish species surrounding Japan? Explain your answer.

(4)

2.3.6 Do you think this type of farming should be encouraged in ocean areas surrounding South Africa? Give a reason for your answer.

(2)
[17]

40 marks

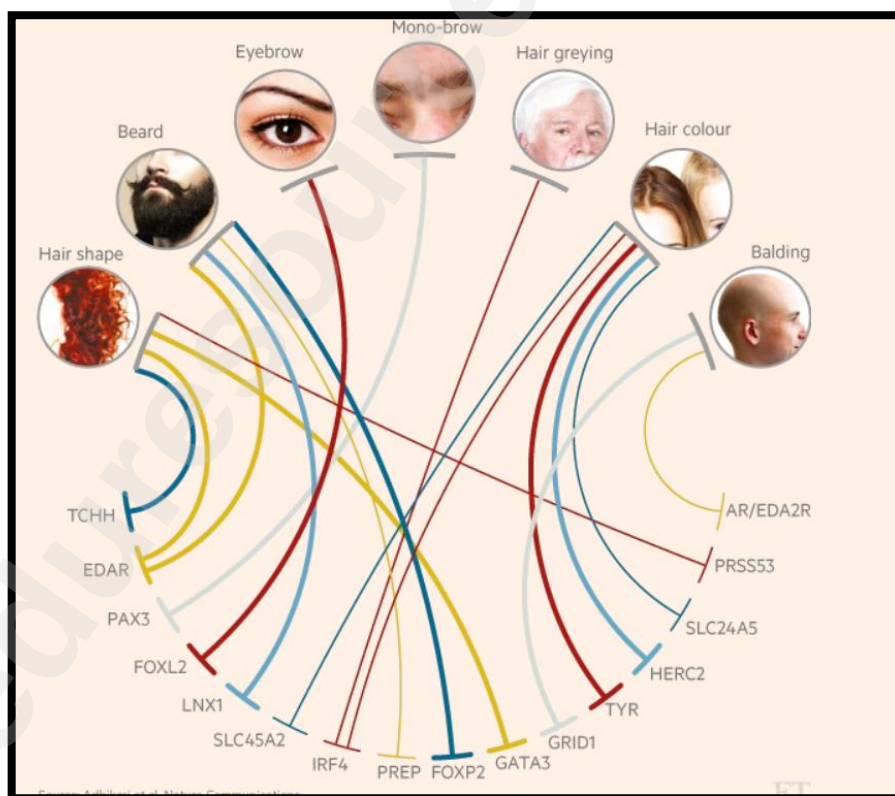
QUESTION 3

- 3.1 A major study has identified the genes that influence the trait of human hair. Scientists searched thoroughly through the genomes of more than 6 000 people to find versions of genes linked to straight hair, curly hair, grey hair, no hair, thick and thin beards, and even mono-brows.

The findings provide insight into human hair types. They also pave the way for the development of drugs that slow or prevent certain changes, such as greying, before hairs even appear on the scalp. One gene identified in the study, known as *IRF4*, is the first gene to be linked to grey

The cosmetic and hair care industry is reliant on people using their products. People spend a lot of money changing their hair colour by buying products like bleach and hair dyes.

Kaustubh Adhikari, a geneticist who conducted the study at University College London, says that the identification of the *IRF4* gene shows that there is a genetic component to hair greying. This raises the concern of the development of drugs and/or products by cosmetic companies. Technology, such as *CRISPR*, could be used to produce cosmetic products that will act on the hair internally so that the hair that grows out is the natural colour rather than grey.



[<https://www.ft.com/content/b03ad8ca-df9b-11e5-b072-006d8d362ba3>]

3.1.1 Provide the term that best describes the following phrase from the text:

‘versions of genes’: _____ (1)

3.1.2 Explain clearly the differences between the terms *gene* and *genome*.

(4)

3.1.3 Explain how evidence from the figure shows that the trait of human hair is *polygenic*.

(2)

3.1.4 Explain ONE fact from the study that suggests the information is scientifically reliable.

(1)

3.1.5 The TCHH gene controls the production of a protein called **trichohyalin**, which is expressed at high levels in the hair follicles of curly-haired individuals.

A mutation at position 790 in the DNA sequence in the TCHH gene causes straight hair (see the table below)

Hair type:	DNA sequence	Amino acid
Curly hair	GAC	Leucine
Straight	TAC	Methionine

a) Name and describe the specific type of mutation that causes straight hair.

(2)

b) Fill in the table below stating the codon and the anticodon for the DNA sequence TAC.

DNA sequence	Codon	Anti-codon
TAC		

(2)

c) Describe the process of protein synthesis for a protein such as trichohyalin that is assembled from an mRNA strand.

(6)

- 3.1.6 Suggest ONE reason why scientists may be concerned about this research leading to the development of drugs or products that act internally on hair.

(2)
[20]

- 3.2 *The TCHH gene controls the curliness of hair. This gene is located on chromosome 1.*

Curly hair (H) is dominant to straight hair (h).

Consider the following scenario:

A man with naturally curly hair has a child with a woman who has naturally straight hair. Their first child has naturally straight hair.

- 3.2.1 Explain why curly and straight hair are considered autosomal traits.

(2)

- 3.2.2 Complete the parental genotypes and gamete genotypes, and show by means of a Punnett diagram in the space below, the probability of a child having straight hair.

Parent genotypes:

Man: _____ Woman: _____

Gametes:

Man: _____ Woman: _____

Punnett diagram:

Probability of straight hair: _____

(6)
[8]

- 3.3 *Crown gall disease in plants is caused by a soil bacterium. The infected plant develops a tumour (referred to as a gall) in its stem. The gall is caused by a short portion in a DNA strand in the bacterium, called a plasmid. Galls can grow large and kill the host plant. The modified plasmid can be isolated; its tumour-producing gene removed and a 'good' gene introduced in its place. This 'good' gene is introduced into the plant genome by the plasmid. The plant tissue can be stimulated to grow into whole plants which are called transgenic plants. These contain the 'good' gene which prevents crown gall disease.*



[Adapted from John Addis, Erica Larkcom and Ruth Miller]

- 3.3.1 What is a 'transgenic plant' as described in this passage?

(2)

- 3.3.2 Make a flow diagram (series of words or short sentences separated by arrows) to show the process by which a transgenic plant is formed. The first step is given to you below:

Gene causing Crown gall disease removed from soil bacterium



(5)

- 3.3.3 Use the information provided in the extract above to write a motivation for funding of a transgenic plant project in fruit orchards in the Cape to prevent the growth of crown gall disease. Limit your answer to one paragraph.

(5)
[12]

40 marks

QUESTION 4

- 4.1 *In April 2012, Professor Lee Berger, a paleoanthropologist, unveiled fossils of a new species of early human ancestor, named **Australopithecus sediba**. The fossilised skeletons of a young female and a boy were discovered in late 2008.*

They were estimated to have lived about 1,78 to 1,95 million years ago.

*This exciting find is believed to be a **transitional species** between the more primitive ape-men, or **australopithecines**, and human's direct ancestors the Hominid species.*



[<http://www.wikipedia>]

- 4.1.1 Where in South Africa was this fossil discovered?

(1)

- 4.1.2 Suggest TWO possible reasons for the gap in time between the date of discovery and the date on which its discovery was made public.

(2)

- 4.1.3 The fossil in the photograph was adapted and built up by Prof. Berger.
Give any TWO features on this fossil which could be used as evidence that *Australopithecus sediba* and humans might have shared a common ancestor, AND TWO features which could show that they might be closer related to apes.

(4)

- 4.1.4 *Homo naledi* was found at the same site as *Australopithecus sediba*, but, unlike *A. sediba*, large amounts of fossilised bones were found, buried together, at one site. Explain how this discovery can be used as proof that these specific hominids showed more brain development than other primate species.

(3)

- 4.1.5 Explain TWO ways how EACH of the following enhanced the chances of survival for specific hominid species:

a) The discovery of fire:

(4)

b) The development of language:

(4)

4.1.6 Professor Berger described *Australopithecus sediba* as '**becoming a terrestrial biped, but has a reserve safety parachute with its ape-like arms**'. What do you think he means by this description?

(2)

4.1.7 Some scientists agree with Professor Berger's hypothesis that *Australopithecus sediba* is a transitional species.

a) What is meant by the term *transitional species*?

(2)

b) What would scientists still need to do before they could state with certainty that this idea has become scientific theory?

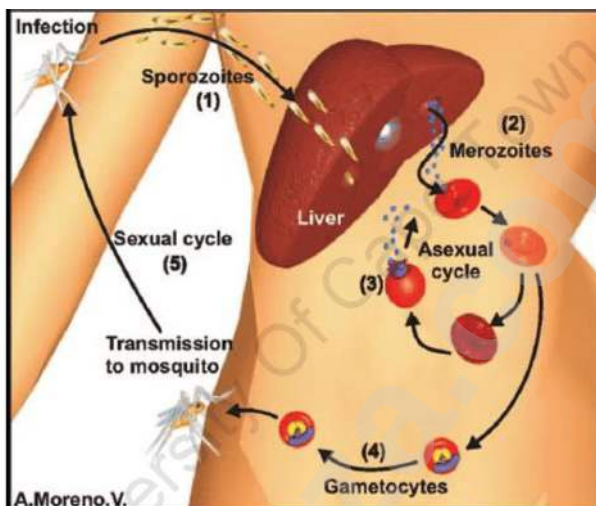
(2)

4.1.8 State one social or economic benefit to South Africa of the discovery of this fossil.

(2)
[26]

4.2 Study the following text and graphs about drug resistance in *Plasmodium*:

Malaria continues to be a disease which causes an enormous number of deaths in Africa. Human malaria is caused by a parasite belonging to the genus *Plasmodium*. The life cycle of *Plasmodium* involves sexual and asexual reproductive stages.

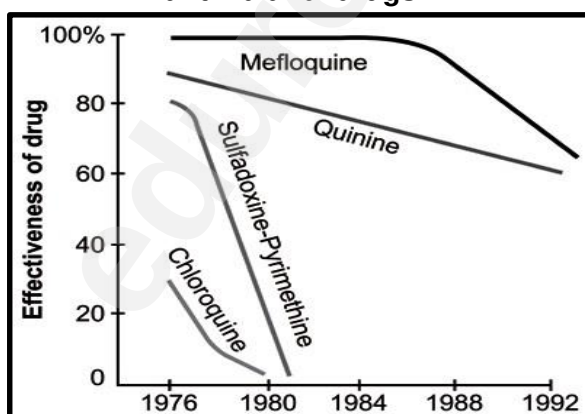


The discovery of Chloroquine (CQ) in the 1930s revolutionised malaria treatments. CQ was the most widely-used drug from the early 1950s until the 1980s. During that time, the *Plasmodium* parasite developed resistance to CQ. While some parasites remained sensitive to CQ, it seemed that the resistant types had developed an ability to excrete the CQ from their systems at a very rapid rate, preventing the drug from affecting them.

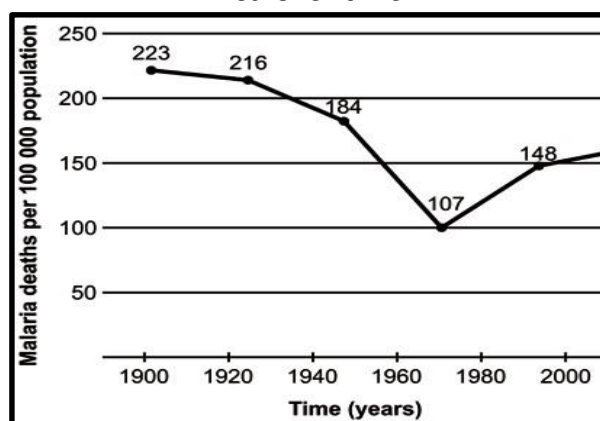
Scientists thus had to develop new drugs to treat malaria, as CQ is not always effective.

[Adapted from: <<http://www.nature.com/scitable/knowledge>>]

GRAPH A: Declining response to antimalarial drugs



GRAPH B: Malaria mortality rate in to Africa over time



[Adapted from: *The Southeast Journal of Tropical Medicine and Public Health, Mekong Malaria, Volume 3, 1999*]

4.2.1 According to Graph B, how many malaria deaths were there in 1970?

_____ (1)

4.2.2 Provide TWO pieces of evidence from the graphs indicating that by 1980 the drug Chloroquine was no longer effective in treating malaria.

_____ (4)

4.2.3 According to Darwin's theory of Evolution by Natural Selection, explain how *Plasmodium* developed resistance to Chloroquine.

_____ (5)

4.2.4 The article explains that *Plasmodium* undergoes both asexual and sexual reproduction.

a) Explain the difference between these two terms.

_____ (2)

(b) Which of the two types of reproduction mentioned in (a) above would most likely contribute to the evolution of drug-resistant *Plasmodium*? Explain your answer.

_____ (2)

40 marks

TOTAL : 200