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ST ALBAN'S COLLEGE
LIFE SCIENCES PRELIMINARY EXAMINATION 2020

PAPER 1

EXAMINER: K. Dewar

TIME: 3 hours

MODERATORS: J. Nel (External); J. Brits (Internal) **MARKS:** 200

NAME: _____

INSTRUCTIONS:

- THIS PAPER IS MADE UP OF AN ANSWER BOOKLET CONTAINING QUESTION 1 (15 PAGES) AS WELL AS THIS BOOKLET WHICH IS A QUESTION PAPER CONTAINING QUESTIONS 2-4 (14 PAGES)
- ANSWER QUESTION 1 ON THE ANSWER BOOKLET USING THE SPACES PROVIDED
- ANSWER QUESTIONS 2-4 USING FOLIO PAPER
- PLEASE NUMBER THE QUESTIONS EXACTLY AS THEY APPEAR ON THE QUESTION PAPER
- PLEASE WRITE YOUR ANSWERS IN BLUE OR BLACK INK ONLY
- ROUND OFF ALL CALCULATIONS TO 2 DECIMAL PLACES

FOR MARKER'S USE ONLY:

QUESTION	TOTAL MARKS	ACHIEVED MARKS
1	80	
2	40	
3	40	
4	40	
TOTAL	200	

QUESTION 2

- 2.1. Cri-du-chat Syndrome is a Genetic disorder also known as 5p minus syndrome. This syndrome is caused by a large Deletion mutation on Chromosome number 5. The term Cri-du-chat is French for “Cry of the Cat”. Individuals with this syndrome have an underdeveloped Larynx which causes a cat-like high pitched cry in babies. Infants with this disorder have a small and round head, together with heart defects. As individuals age, they experience trouble walking and talking as well as severe mental retardation.

The image below shows the chromosome arrangement of a person with Cri-du-chat Syndrome:

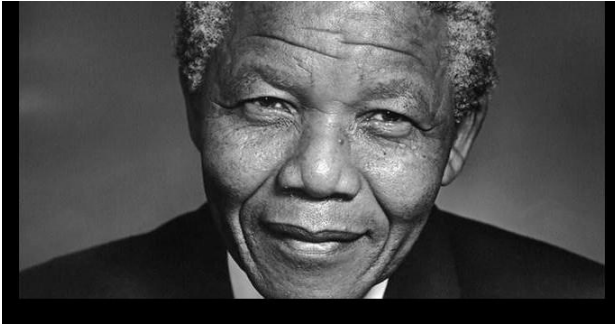


- 2.1.1. What is the term given to the image above? (1)
- 2.1.2. Is the individual from the above image a male or female? Explain why. (2)
- 2.1.3. Briefly explain how and why the appearance of Chromosome 5 above indicates that the individual has Cri-du-chat. (2)
- 2.1.4. Describe how a Deletion mutation may change a genotype. (2)
- 2.1.5. Use the Cri-du-chat example above to explain the difference between Genotypes and Phenotypes. (3)
- 2.1.6. If parents have a child with Cri-du-chat, would you recommend they consult a Genetic Counsellor before they have a second child? Substantiate your answer. (3)

[13]

2.2. Read the extract below and answer the questions that follow:

Mitochondrial DNA reveals the origins of our great leader



In 2004, Nelson Mandela's Mitochondrial DNA was analysed for his origins, with some surprising results. While he was Xhosa, his mitochondrial DNA shows that he can trace his maternal lineage back to the San Bushmen, the earliest inhabitants of Africa with the oldest

form of mitochondrial DNA. There is evidence that he also descended from a group of Africans from the Great Lakes region of East Africa.

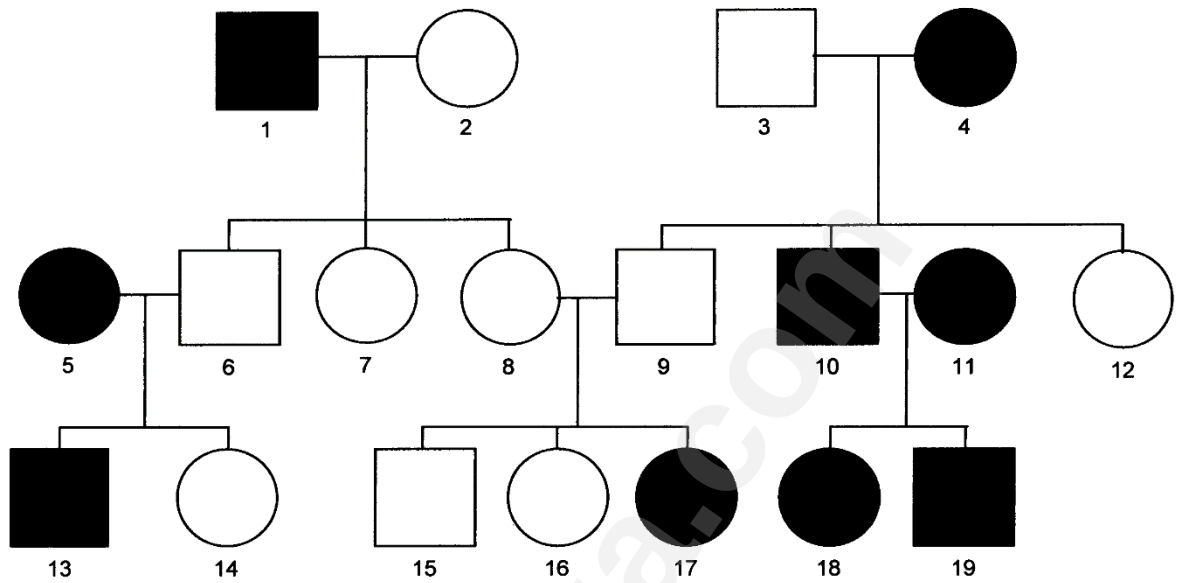
Adapted from www.brandsouthafrica.co.za

- 2.2.1. Explain why Mitochondrial DNA is particularly useful in determining the origins of people. (2)
- 2.2.2. Compare the composition of an individual's Mitochondrial DNA and Nuclear DNA. (2)
- 2.2.3. Do you think that it was fair to publish the results of Mandela's DNA testing? Substantiate your answer. (3)
- [7]**

2.3. There are two forms of front hairlines- a Widow's Peak and a Straight Hairline. The image below shows the difference between the two types of hairline.



The chart on the following page shows the inheritance of different types of hairlines in a family. The shaded individuals have a straight hairline whilst the non-shaded individuals have a Widow's Peak.



Adapted from www.khanacademy.org

- 2.3.1. Based on the information in the pedigree chart above, state which hairline is dominant and which is recessive. (2)
- 2.3.2. The allele for the type of hairline is not gender-linked. Point out the evidence from the pedigree chart that substantiates this. (2)
- 2.3.3. Using appropriate letters, state the genotypes of the following individuals:
 - a. Individual 1
 - b. Individual 6
 - c. Individual 11
 (3)
- 2.3.4. Individual 13 marries a woman who is **homozygous recessive**. Do a genetic cross to determine the genotype and phenotype ratios of the offspring. Include a punnett square in your answer. (6)
- 2.3.5. Individual 14 marries a man with a Widow's Peak. They have three children: 2 sons with Widow's Peaks and a daughter with a straight hairline. Draw a pedigree chart to represent this information. (3)

[16]

- 2.4. In Parrots, there are a number of different colour varieties for feathers. Red feathers (F^R) are dominant over all other colours. Orange feathers (F^O) are recessive to red feathers but dominant over all other colours. White feathers (f) are recessive to all other feather colours whilst grey feather (F^G) are dominant over white feathers and recessive to the other colours.

2.4.1. List the possible genotypes of a grey parrot. (2)

2.4.2. An orange parrot and a white parrot mate. Which phenotype(s) is/are impossible in the offspring? (2)

[4]

QUESTION 2 TOTAL [40]

QUESTION 3

- 3.1. Killer Whales (*Orcinus orca*) can be surprisingly picky eaters. In the North Pacific Ocean, there are two populations of *Orcinus orca*. One group feeds mainly on fish and the other group feeds mainly on sea mammals. Scientists have also noted significant differences in the behaviours of these two groups. The whales prefer to mostly mate with whales of their same eating group; however, breeding between the two eating groups is still possible.

Many scientists have proposed that the two groups are undergoing speciation, however, it may be too soon to tell. Evidence shows that the two groups of whales have developed considerable genetic differences over the last ten thousand years.

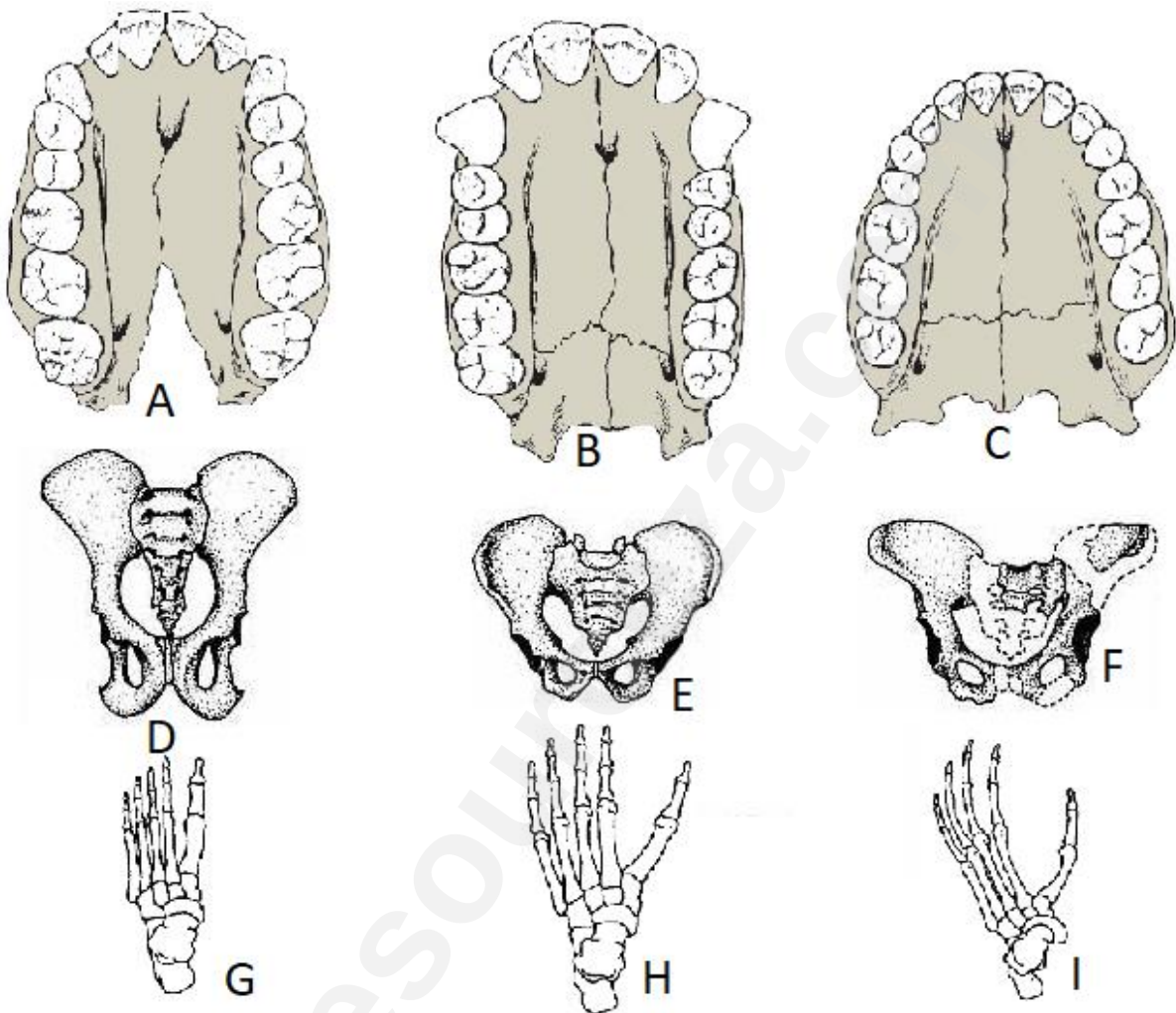
Adapted from www.sciencemag.org



- 3.1.1. What type of speciation may be occurring in the Killer Whales of the North Pacific Ocean? Define this type of speciation. (3)
- 3.1.2. Use a piece of information from the text above that indicates that the two different eating groups may still be the same species. (2)
- 3.1.3. What is the genus name of the killer whale? (1)
- 3.1.4. Using the context of the Killer Whales above, explain what the term “Adaptive Radiation” means. (2)
- 3.1.5. Name ONE example of organism that you have studied that has undergone the same type of speciation as the killer whales in the text above. (1)

[9]

- 3.2. The image below shows various skeletal remains of three different Hominid groups- *Homo habilis*, *Homo sapiens* and *Australopithecus sediba*. The parts are placed in a random order and do not necessarily correlate across vertical rows.



- 3.2.1. Define the term "Hominid". (3)
- 3.2.2. Which of the feet bones are most likely to be from a bipedal hominid? Explain your choice. (2)
- 3.2.3. Which combination of parts are from a *Homo sapiens* fossil? Write only the LETTERS. (3)
- 3.2.4. Which jaw is most likely belongs to *Australopithecus sediba*? Explain your choice. (2)
- 3.2.5. Which pelvis most likely belongs to *Homo habilis*? Explain your choice. (2)

“Bipedalism is probably the single most important development in the story of human evolution. This has led to Humans being superior in many aspects”

- 3.2.6. Discuss your opinion on the above statement, using at least THREE facts that you have learned about human evolution.

(4)

[16]

3.3. Read the text below and answer the questions that follow:

Homo naledi's fossilised remains were first discovered in 2013, in a cave in the Cradle of Humankind by two recreational cavers.

The fossils had shoulders and torso like an ape as well as a tiny brain. However, there were many human-like features too. The fossils were found in a chamber with the remains of many other organisms of the same species. This discovery suggests that this newly discovered species placed all the deceased members in one place in some sort of ritual. The *Homo naledi* fossils have been analysed and are proposed to be between the ages of 236 000 and 335 000 years old.

“This is astonishingly young for a species that displays primitive characteristics found in fossils that are about 2 million years old”, says Professor Stringer, a prominent Palaeontologist.

Figure 1: The cave system where *H. naledi* were discovered

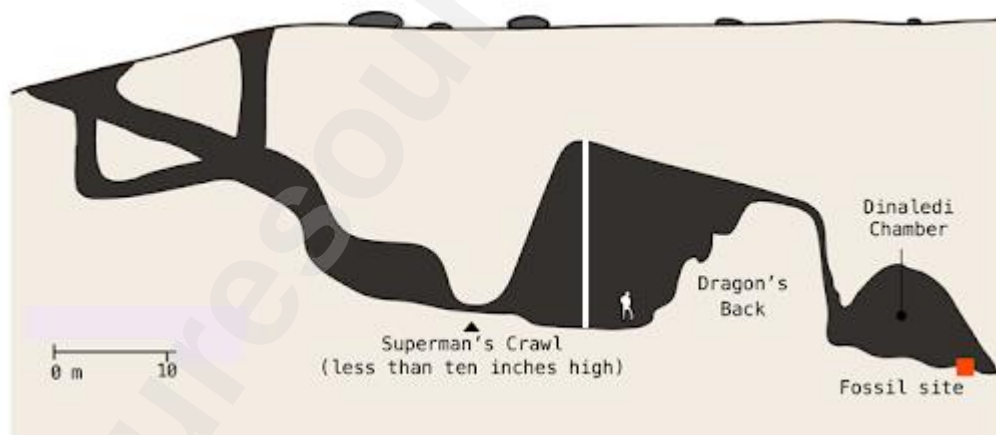
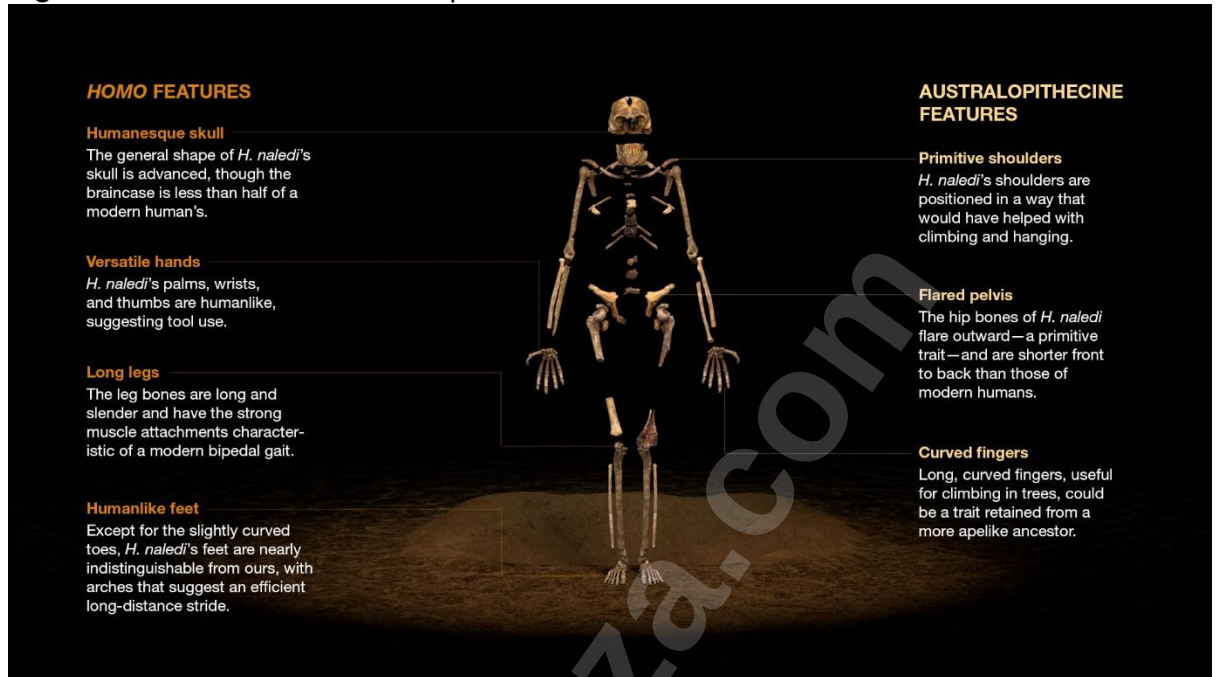


Figure 2: The mix of modern and primitive characteristics found in *Homo naledi*



Adapted from www.nationalgeographic.com

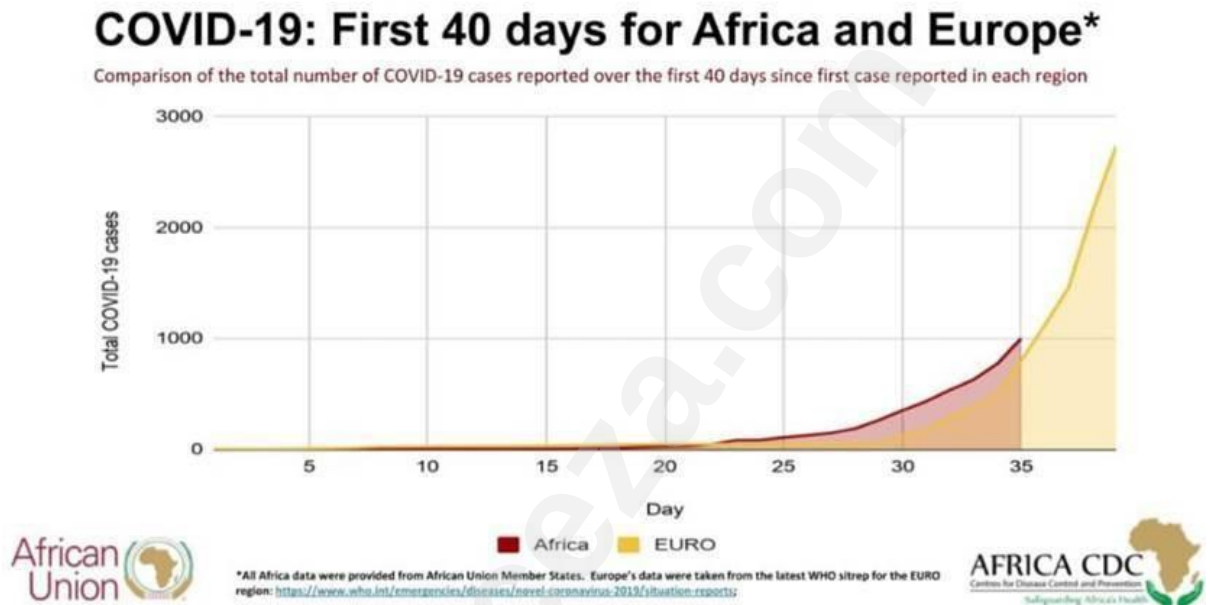
- 3.3.1. Name ONE hominid species that you have studied that is older than *Homo naledi*. (1)
- 3.3.2. Which fact from the text above suggests that *Homo naledi* had some sort of culture? (1)
- 3.3.3. Construct a table in which you show THREE modern and THREE primitive features that *Homo naledi* has. (4)
- 3.3.4. The age of *Homo naledi* was highly contested by numerous scientists at the start, and was the cause of rigorous debate. Why is it important that scientists debate scientific information before it is published? (3)
- 3.3.5. Calculate the **actual height** of the cave in Figure 1, indicated by the vertical white line. Show your calculations. (4)
- 3.3.6. Explain why ape-like features are seen as most primitive. (2)

[15]

QUESTION 3 TOTAL [40]

QUESTION 4

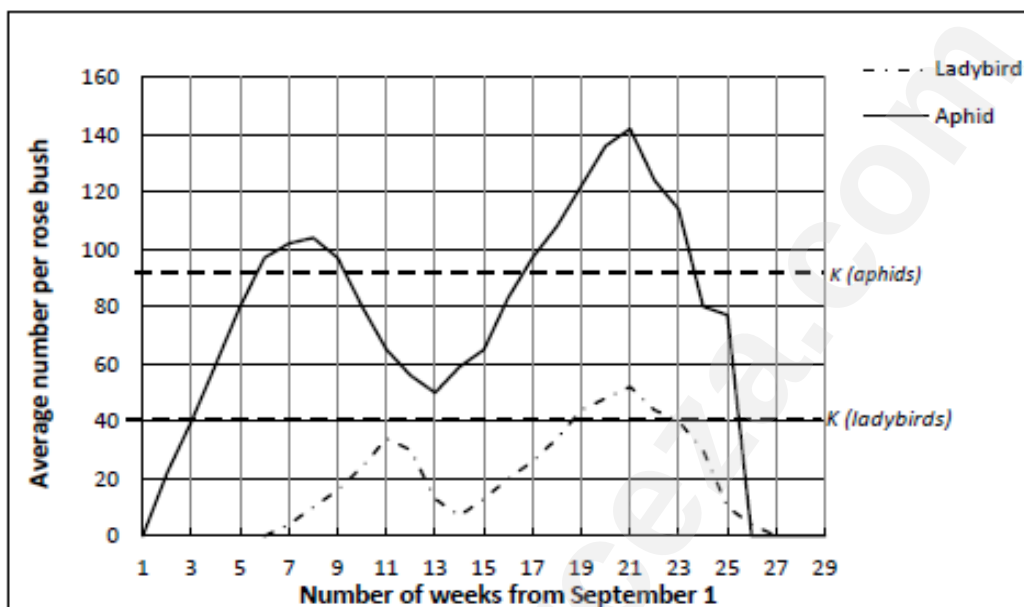
- 4.1. The following graph is found in the World Economic Forum Website. It shows the comparison between infection rates in both Africa and Europe for the first 40 days of the Covid-19 Pandemic.



- 4.1.1. Do you think that the information from the graph above is reliable and accurate? Provide a reason for your answer. (2)
- 4.1.2. What does "CDC" stand for? (1)
- 4.1.3. Compare the differences between infection rate between days 20 and 35. (2)
- 4.1.4. Account for the differences found in 4.1.3. (2)
- 4.1.5. Is Covid-19 a density dependent or density independent factor in the human population? Explain your choice. (2)
- 4.1.6. Other than the implications on the health of the world population, list TWO other negative effects of the Covid-19 pandemic. (2)

[11]

- 4.2. A gardener with a large rose garden containing 100 rose bushes decided to find out how well the ladybirds were able to control the numbers of aphids on his plants. He examined his rose bushes once a week during a whole growing season from September to March. The results of his investigation are shown on the graph alongside. Answer the questions about the gardener's investigation that follow.

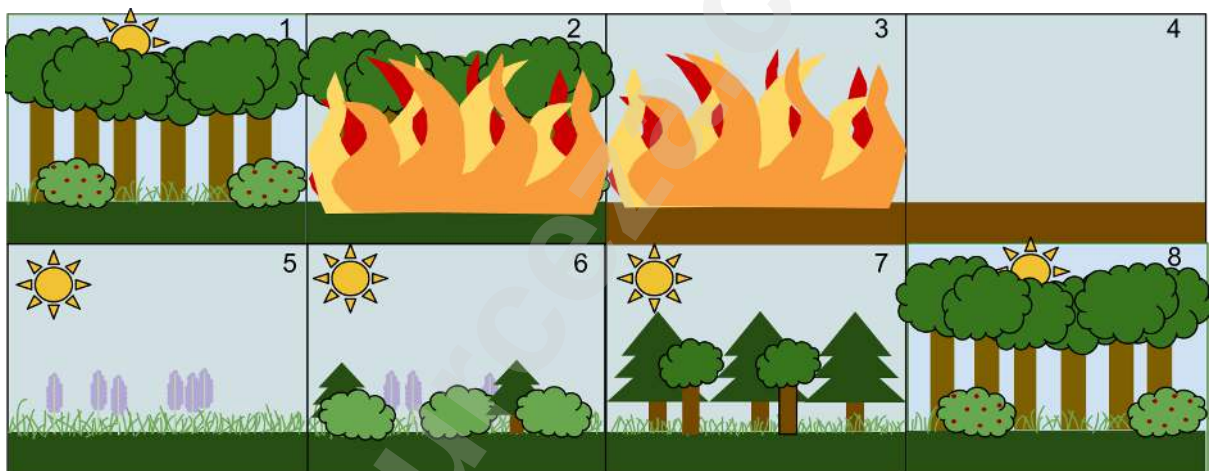


- 4.2.1. Provide one piece of evidence from the graph that suggests that ladybirds prey on aphids. (1)
- 4.2.2. Suggest a possible reason for the decline in aphid numbers in the middle of the growing season (after week 7). (1)
- 4.2.3. Why do the ladybird numbers never exceed the aphid numbers? (2)
- 4.2.4. Why do the ladybird AND aphid numbers both drop after week 22? (2)
- 4.2.5. State the following variables in the gardener's investigation: (2)
- Independent Variable
 - Dependent Variable
- 4.2.6. A mark-recapture test was done on the ladybird population. 30 aphids were caught and marked with a dot of paint. They were then released. A few days later, 50 aphids were caught and 12 of those aphids had marks on them. (3)
- Calculate the estimated population size of the aphids. Show your working out. (3)
 - Explain TWO precautions that should be taken when carrying out the mark recapture method. (2)

4.2.7. Explain why the quadrat method of counting would not be suitable for aphids. (1)

[14]

4.3. The Knysna/Plettenberg Bay Fires of June 2017 was the worst wildfire disaster in South African History. In these fires, hundreds of homes were destroyed and seven people lost their lives. The series of images below represent the changes that the areas affected by the fire have and will continue to go through.



Before the fires broke out, the land in the Knysna and Plettenberg Bay areas was rich in alien trees. These trees grew to be very large, densely populated and high in mass. Although there were many factors which contributed to the fires, the large amount of fuel provided by the alien trees was a large one.

As soon as a few weeks after the fires ravaged through 20 hectares of land, residents of the area started to notice green shoots of plants sprouting. Unfortunately, most of these shoots belonged to alien plant species such as the Black Wattle.

It is vital that farmers, reserve managers and landowners in the area keep the numbers of alien plant species in the area under control in order to prevent future fires of the devastating magnitude such as the fires of 2017.

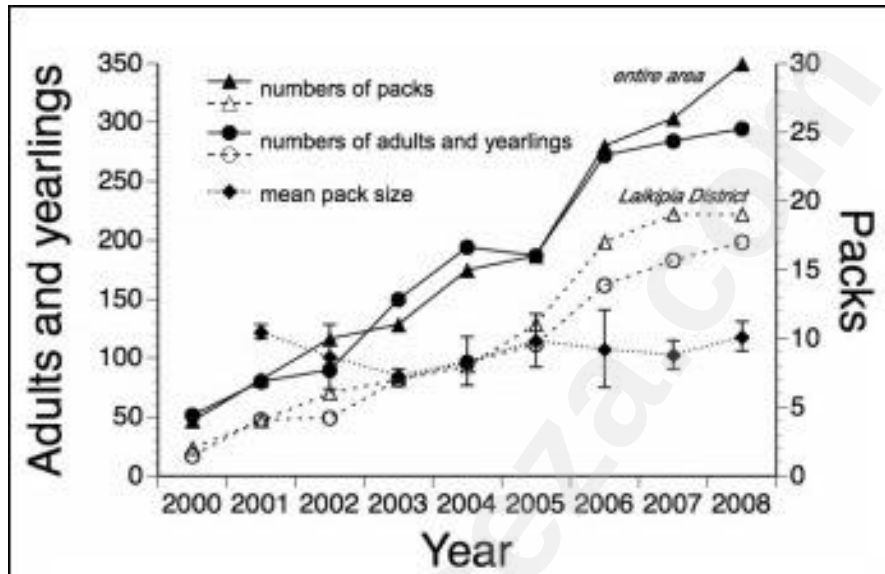
Adapted from www.scli.org.za

- 4.3.1. Is fire a density dependent or density independent factor controlling population size? Explain your answer. (2)
- 4.3.2. What environmental phenomenon is occurring in the images 4-8 above (after the fire)? (2)
- 4.3.3. Provide the terms for the types of communities present in:
- a. Image 5
 - b. Image 8 (2)
- 4.3.4. According to environmentalists, with human intervention, the forests which burned down may be able to be totally re-established to the same state as before the fire in approximately 60 years. By your estimation, which year will this occur by? (2)
- 4.3.5. Why are alien trees such a threat to the Knysna area? Give TWO reasons (one from the text and one from your own knowledge). (2)

[10]

- 4.4. The graph below shows the changes in Wild Dog numbers over a period of 8 years. This data compared the numbers of Wild Dogs in the Laikipia District and a wider area (both in Kenya).

A Wild Dog Yearling is a young dog that is between the ages of 10 months and 18 months. A pup is younger than 10 months old.



- 4.4.1. Discuss **two** characteristics that Wild Dog packs demonstrate in their pack behaviour that assists their survival. (2)
- 4.4.2. Discuss how the total number of Wild Dog packs have changed over the 8 years of the study. (2)
- 4.4.3. Why were the number of yearlings counted and not the number of pups? (1)

[5]

QUESTION 4 TOTAL [40]