



**LIFE SCIENCES: PAPER I**

Time: 3 hours

200 marks

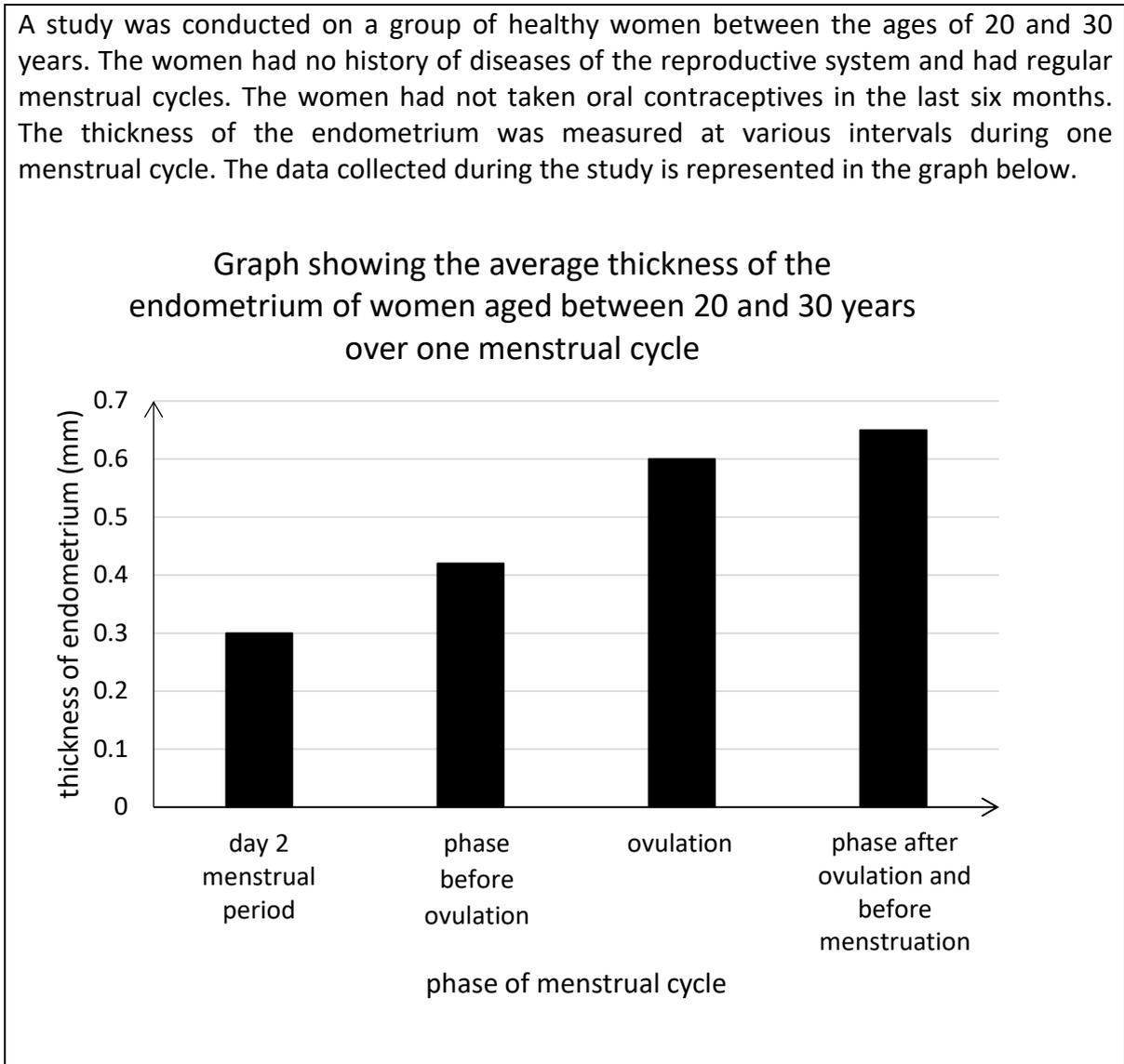
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**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

1. This question paper consists of 14 pages and a yellow Answer Booklet of 15 pages (i–xv). Please check that your question paper is complete. Detach the yellow Answer Booklet from the middle of the question paper. Remember to write your examination number in the blocks provided.
  2. This question paper consists of four questions.
  3. Read the questions carefully.
  4. Question 1 appears in the Answer Booklet and must be answered in this Booklet.
  5. Questions 2, 3 and 4 must be answered in your Answer Book.
  6. Start **each question** on a **new** page.
  7. Number the answers exactly as the questions are numbered.
  8. Use the total marks that can be awarded for each question as an indication of the detail required.
  9. It is in your own interest to write legibly and to present your work neatly.
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**QUESTION 2**

2.1 Read the article below. Use the information in the source and your own knowledge to answer the questions that follow:



- 2.1.1 Where in the body is the endometrium located? (1)
- 2.1.2 What is the purpose of the endometrium? (1)
- 2.1.3 What happens to the endometrium during menstruation? (2)
- 2.1.4 Describe the trend shown by the graph. (2)
- 2.1.5 Name TWO hormones released from the ovary during the menstrual cycle that stimulate the thickening of the endometrium. (2)
- 2.1.6 The thickness of the endometrium was measured on **day two** of the menstrual period. Suggest why a specific day was not indicated when measuring the endometrium thickness at ovulation. (2)

- 2.1.7 Suggest why the researchers used women in the study who had not used oral contraceptives in the six months before the study. (1)
- 2.1.8 List TWO ethical guidelines that should be followed when conducting this type of research. (2)
- 2.1.9 Why is it important that ethical guidelines should be followed in this study? (2)
- 2.1.10 If one of the women in the study fell pregnant, predict what would happen to the endometrium thickness. (1)

2.2 Read the following extract and answer the questions that follow:

Scientists are developing a hormonal birth-control pill for men that would be taken on a daily basis. Hormonal contraception works for men much as it does for women — by changing levels of certain hormones so that the body stops making its own.

In men, synthetic testosterone suppresses the pituitary gland's release of LH and FSH. This reduction in LH and FSH stops the testes from making natural testosterone as well as sperm cells. Once men stop taking the birth control pill, the body goes back to producing reproductive hormones and sperm production returns.

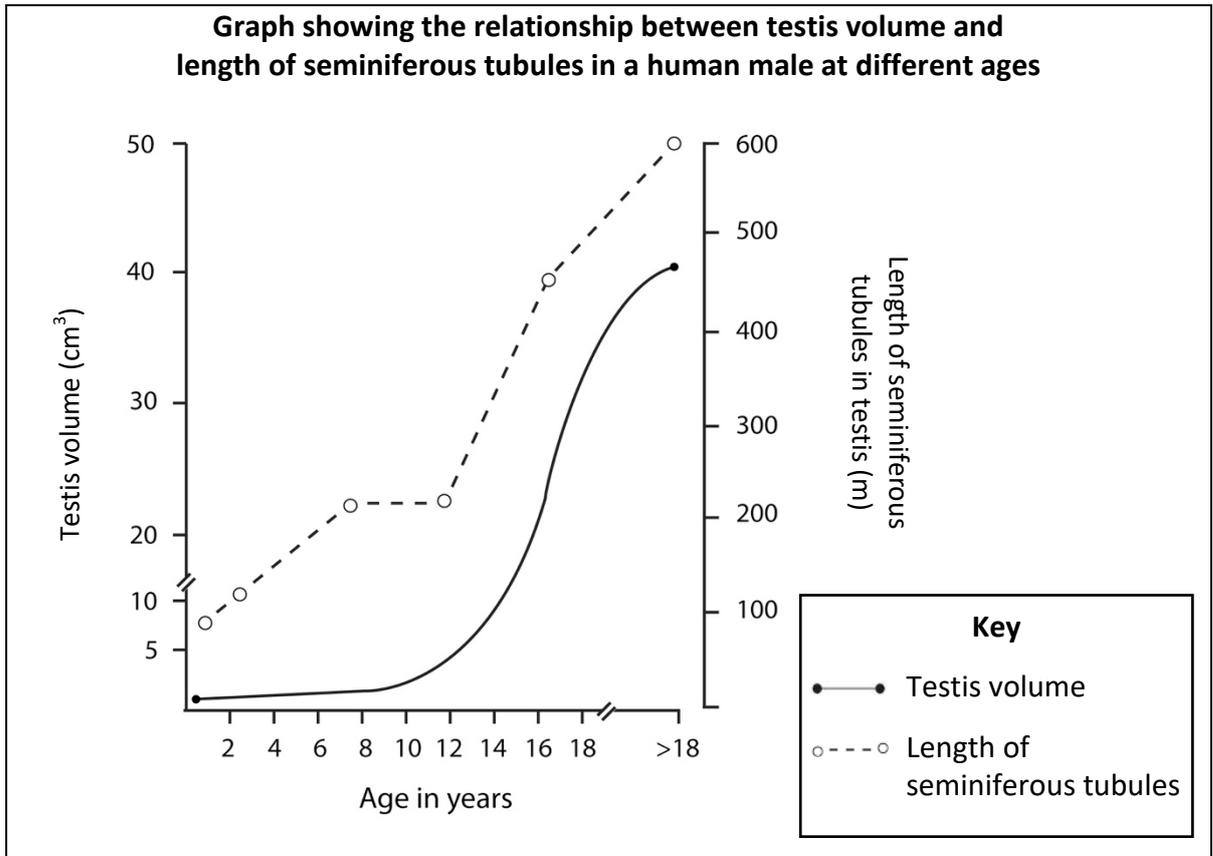
[Adapted: <<https://www.sciencenews.org>>]

- 2.2.1 Name the hormone that the male contraceptive pill would contain. (1)
- 2.2.2 Suggest TWO reasons why a birth-control pill for men is a good idea. (2)
- 2.2.3 The male birth-control pill is currently being developed by scientists. Suggest TWO considerations that would need to be taken into account before this pill is made available for use by the public. (2)
- 2.2.4 Use a flow diagram to explain the negative feedback mechanism involved in sperm production in a male not taking the birth-control pill. Start in the following manner:  

Testosterone levels low

 (6)
- 2.2.5 Name and briefly discuss ONE other form of contraception that can currently be used by men. (3)

2.3 Study the graph below that shows the relationship between testis volume and the length of seminiferous tubules in a human male.



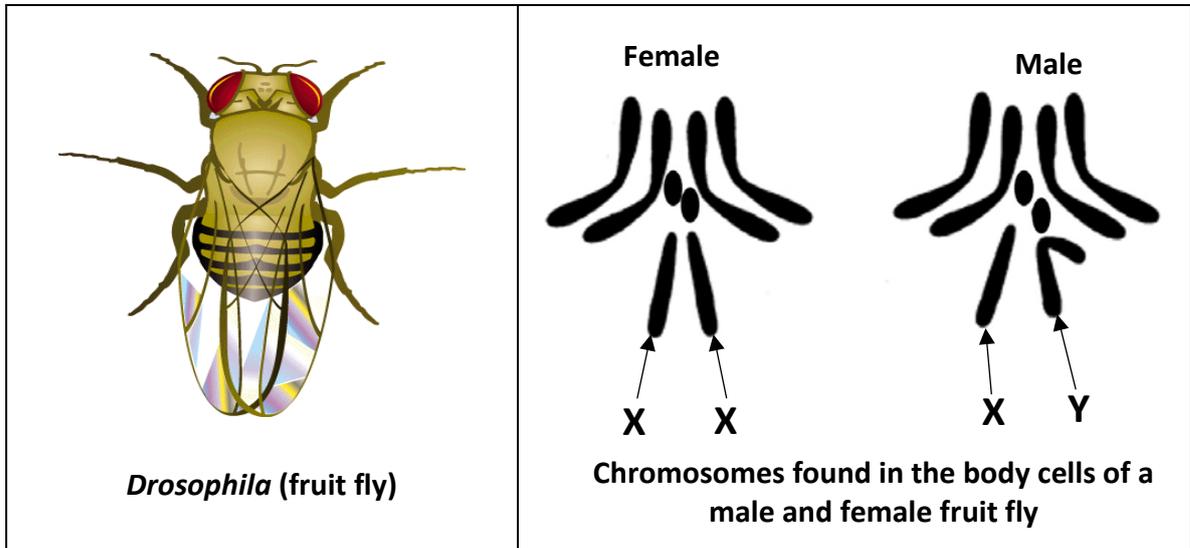
[Adapted: <<https://oncohemakey.com>>]

- 2.3.1 What is the function of the seminiferous tubules? (1)
- 2.3.2 What can be concluded from the data shown in the graph? (3)
- 2.3.3 From the graph, determine the length of seminiferous tubules at the age of 16. (2)
- 2.3.4 Does the graph suggest that puberty starts at age 13? Provide an explanation for your answer. (2)
- 2.3.5 Briefly describe TWO other physical changes not shown in the graph that occur in males during puberty. (2)

**[40]**

**QUESTION 3**

3.1 The images below show a diagram of *Drosophila* (fruit fly) and the chromosomes of a male and female fruit fly.



[Source: <https://www.unc.edu>]

[Adapted: <https://www.nature.com>]

3.1.1 From the information provided, state the diploid number of chromosomes found in a somatic cell of the fruit fly. (1)

3.1.2 How is sex determination in fruit flies similar to that in humans? (1)

3.1.3 Draw ONE gamete to show the correct number and shape of chromosomes that could be produced as a result of meiosis in the **female fruit fly**. Refer to the diagram above to assist you. (5)

3.2 In fruit flies, the eye-colour genes are sex-linked. Red eye colour is dominant to white eye colour.

Use a genetic cross/Punnett square to show the cross between a white-eyed female and a red-eyed male. Express the probability of the expected phenotypes of the offspring as a ratio.

Use the following key in your answer:

Red eyes –  $X^R$

White eyes –  $X^r$  (6)

3.3 Read the article below and use this information and your own knowledge to answer the questions that follow:

X-rays had been used in medicine and for experimental purposes in physics since their discovery in 1895. But their value to genetics research only became apparent when Hermann Muller, an American geneticist, used X-rays to produce point mutations in the fruit fly *Drosophila*.

Muller conducted experiments that showed that exposure to X-rays, a form of high-energy radiation, can cause genetic mutations and changes to an organism's genome, particularly in the gametes (ova and sperm cells). In his experiments, Muller exposed fruit flies (*Drosophila*) to X-rays, mated the flies, and observed the number of mutations in the offspring. He compared these results to a control group of flies who were not exposed to X-rays.

The results are shown in the table below:

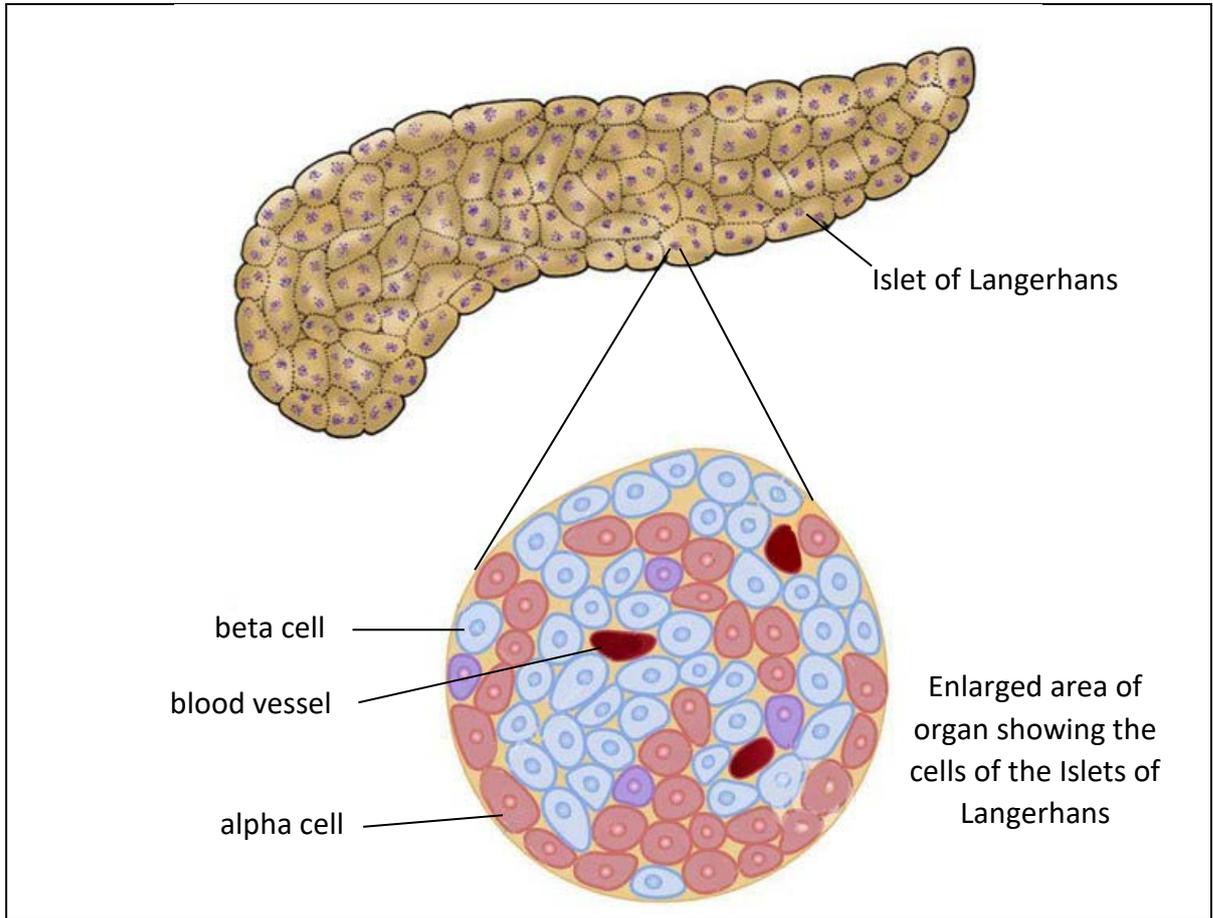
**Table showing the number of lethal mutations in fruit flies subjected to X-rays and fruit flies not subjected to X-rays**

Subjected to X-rays or not	Number of groups of flies	Number of lethal mutations
Experiment group subjected to X-rays	758	88
Control group not subjected to X-rays	947	1

[Adapted: <<http://www.genomenetwork.org>> and <<https://embryo.asu.edu>>]

- 3.3.1 Provide a definition for the following terms:
  - (a) genome (1)
  - (b) point mutation (1)
- 3.3.2 Identify the mutagen referred to in the text. (1)
- 3.3.3 Explain how mutations can be passed from parents to offspring. (3)
- 3.3.4 Identify the independent variable of Muller's investigation. (1)
- 3.3.5 What do the results of Muller's experiments in fruit flies suggest about the safety of humans being subjected to X-rays? Explain fully. (4)

3.4 The diagram below shows the organ where the Islets of Langerhans are located. The diagram also shows an enlarged area of the organ to show the cells of the Islets of Langerhans.



[Adapted: <<https://za.pinterest.com>> and <<https://usc-dori.org>>]

3.4.1 Identify the organ where these cells are located. (1)

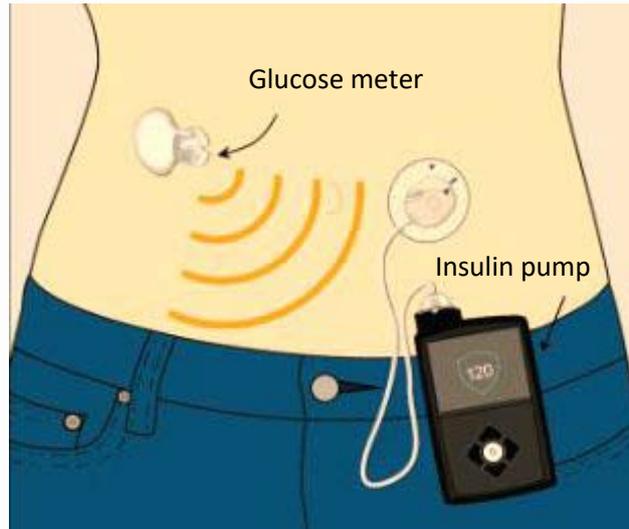
3.4.2 Name TWO hormones secreted by the Islets of Langerhans. (2)

3.4.3 What is the purpose of the blood vessels seen in the diagram? (2)

3.4.4 Read the article below and answer the questions that follow:

A device, the size of a cell phone, monitors and treats patients with type 1 insulin-dependent diabetes. The system includes a glucose meter, an insulin pump strapped to the body and a tiny catheter (thin tube) for delivering insulin into the blood stream.

The glucose meter measures a patient's glucose levels every five minutes. The insulin pump releases insulin into the blood stream when needed. This helps patients maintain glucose levels within the normal range.



[Adapted: < <https://edition.cnn.com>>]

- (a) Explain clearly how this device assists the patient to maintain normal blood glucose levels. (5)
- (b) Suggest why this type of device would be appropriate for diabetic teenagers. (4)

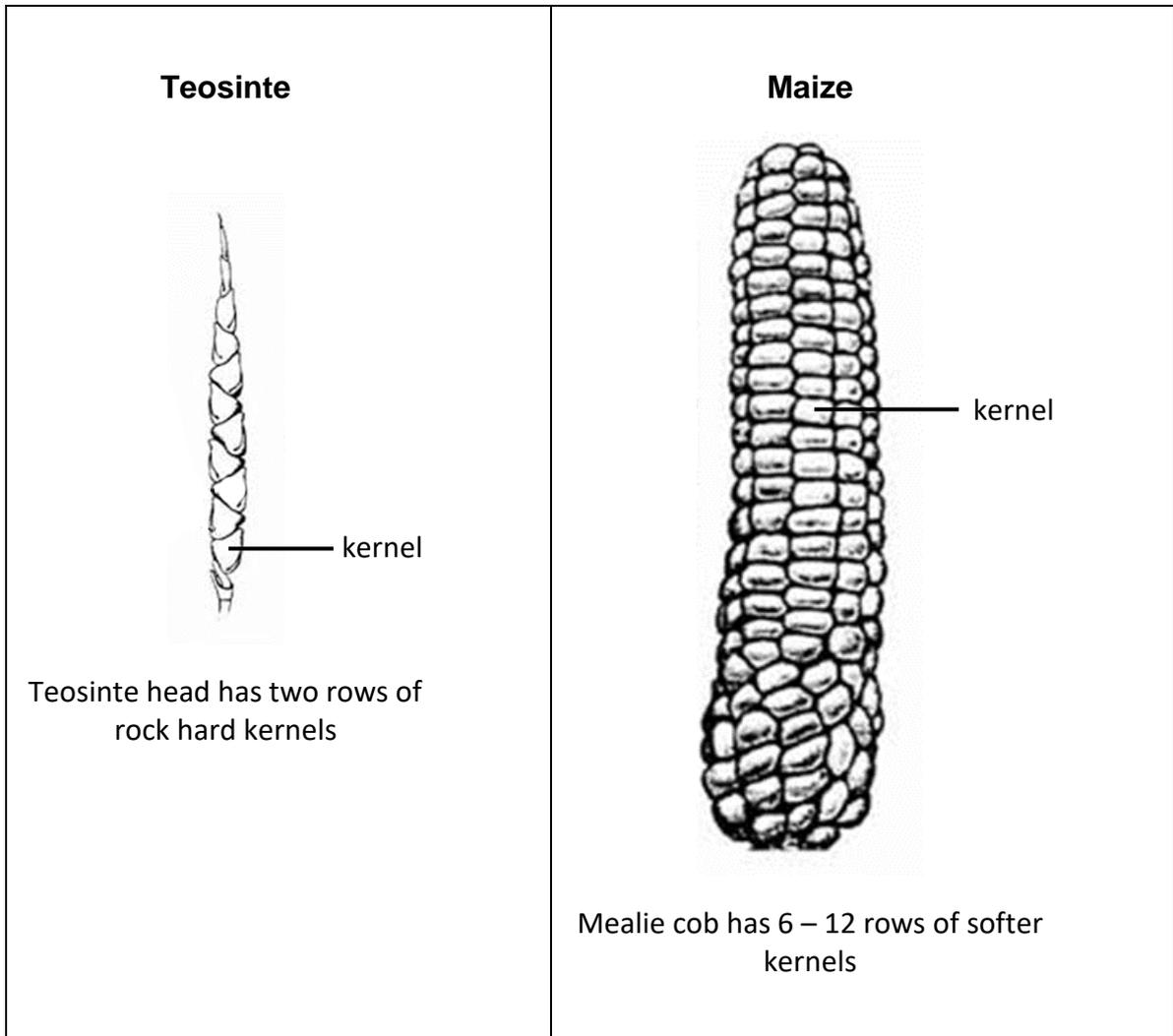
3.4.5 The majority of diabetic patients in South Africa have type 2 diabetes (insulin resistant diabetes).

List TWO life style changes that South Africans can implement to prevent type 2 diabetes. (2)

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**QUESTION 4**

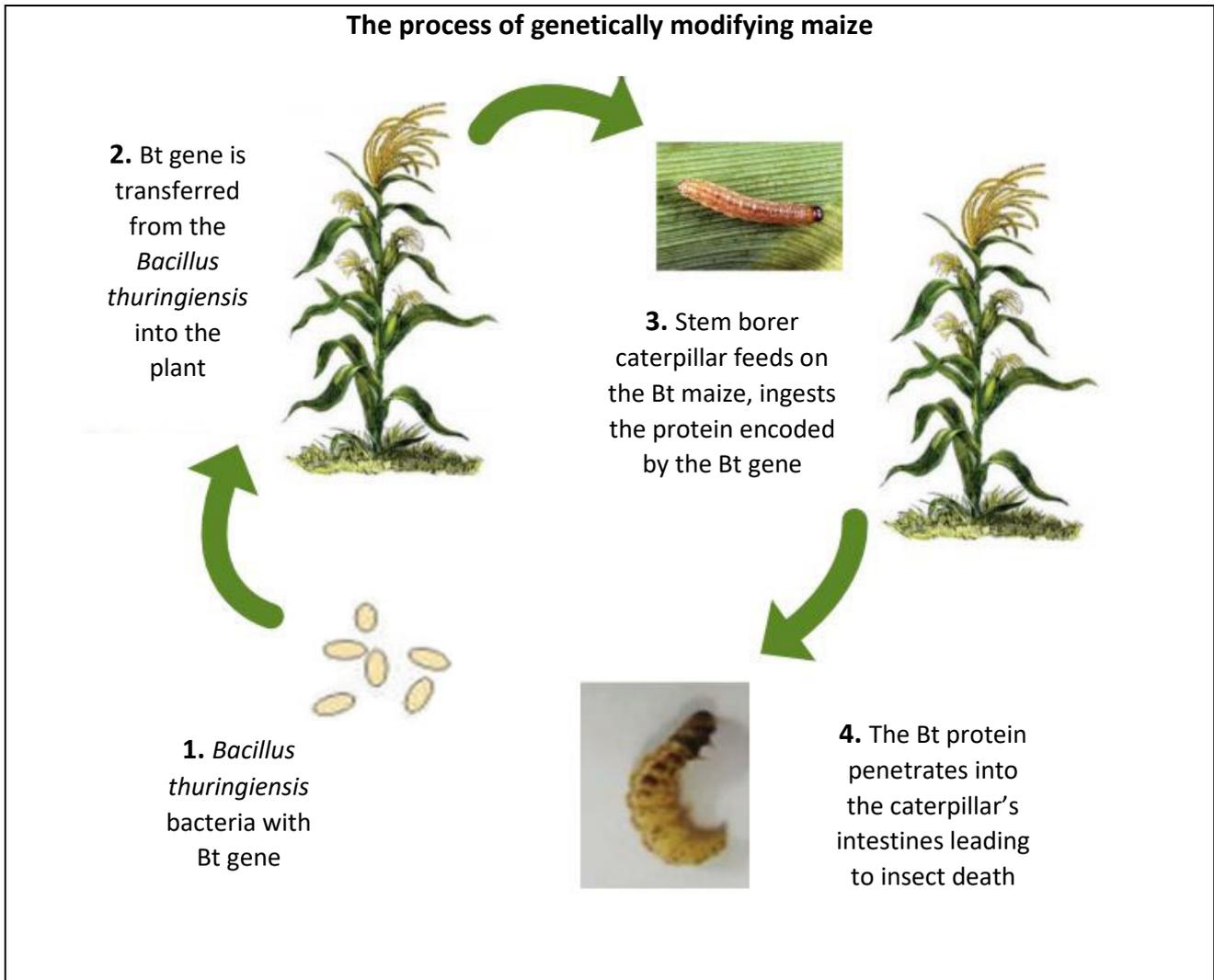
4.1 Study the diagram below that shows the changes that have occurred as teosinte has been selectively bred by humans over hundreds of years to produce the maize that we grow in South Africa today. Use the information provided and your own knowledge to answer the questions that follow:



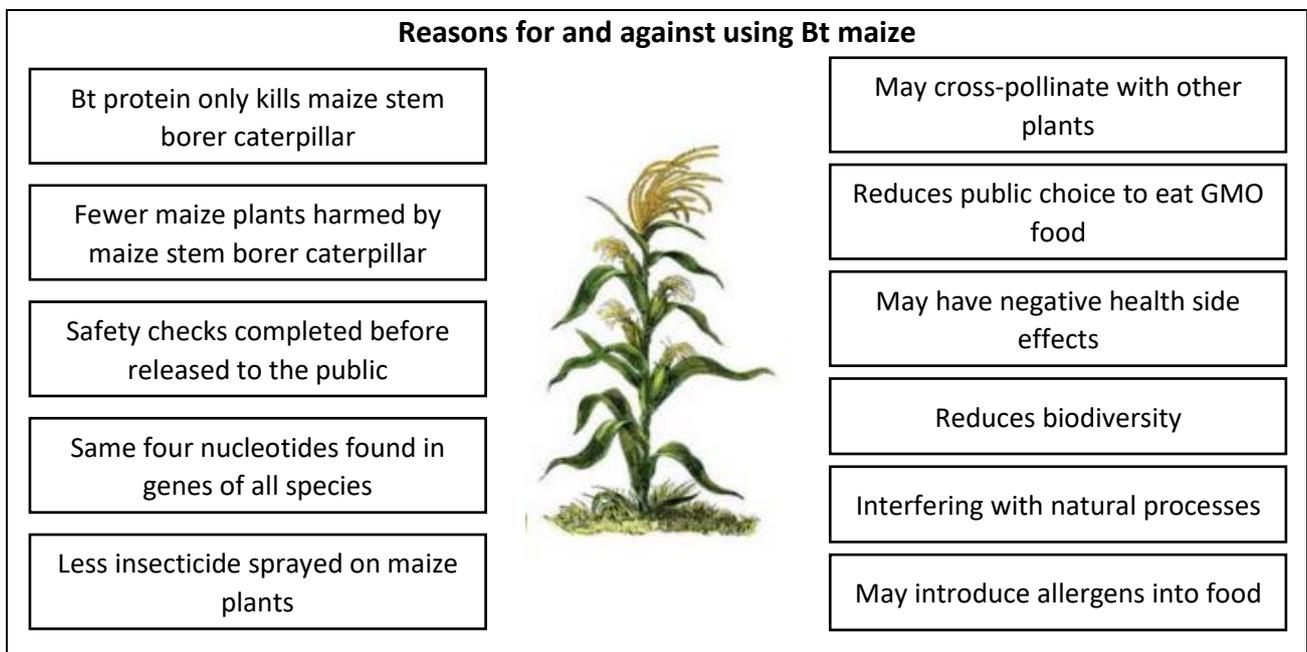
[Adapted: <<https://teosinte.wisc.edu>>]

- 4.1.1 State TWO characteristics that have been selected by humans during the selective breeding process to produce maize. (2)
- 4.1.2 Explain how the process of selective breeding was carried out to produce the changes seen in this crop. (4)

4.2 Seventy to eighty percent of maize grown in South Africa is genetically modified. The genetically modified crop is known as Bt maize. Bt maize is protected against the African maize stem borer, a caterpillar that eats the stem, leaves and maize cobs of the plant.



[Adapted: <<https://wema.aatf-africa.org>>]



- 4.2.1 Bt maize can be referred to as a "transgenic organism". Explain the meaning of this term. (2)
- 4.2.2 Do you think the South African public's concerns about the growth and consumption (eating) of Bt maize is justified? Explain your answer by discussing THREE reasons. (6)
- 4.3 Read the following article on wild dogs. Use this information and your own knowledge and answer the questions that follow:

**Wild dogs vote to initiate a hunt by sneezing**

For the wild dogs of Botswana's Selinda Reserve, a sneeze may represent a form of democratic communication. Wild dogs are carnivores that hunt in packs. A new study suggests that the decision to initiate (start) a hunt may come from a voting system in which a sneeze equals a "yes". The voting occurs during a prehunt "rally" in which the dogs gather together, but the process isn't perfectly democratic. When high-ranking members of the pack start the rally, as few as three sneezes are needed to get the hunt going. Low-ranking members may need as many as 10 sneezes before the hunt is on.



[Adapted: <<http://www.sciencemag.org>>]

- 4.3.1 Provide TWO pieces of evidence from the article that indicate that social organisation exists amongst wild dogs. (2)
- 4.3.2 State TWO other features of social organisation in wild dogs not referred to in the article. Briefly explain how each feature provides an advantage to the pack. (4)

- 4.4 Read the following information on sable antelope. Use this information and your own knowledge and answer the questions that follow:

Sable antelope are grazers (feeding on grasses). They live in herds of up to 25 members. Young sable antelope are vulnerable to predation by lions, hyenas, leopards and crocodiles. Sable antelope prefer to feed during the day because of a high risk of predation at night. Sable antelope also have better access to water during the day.

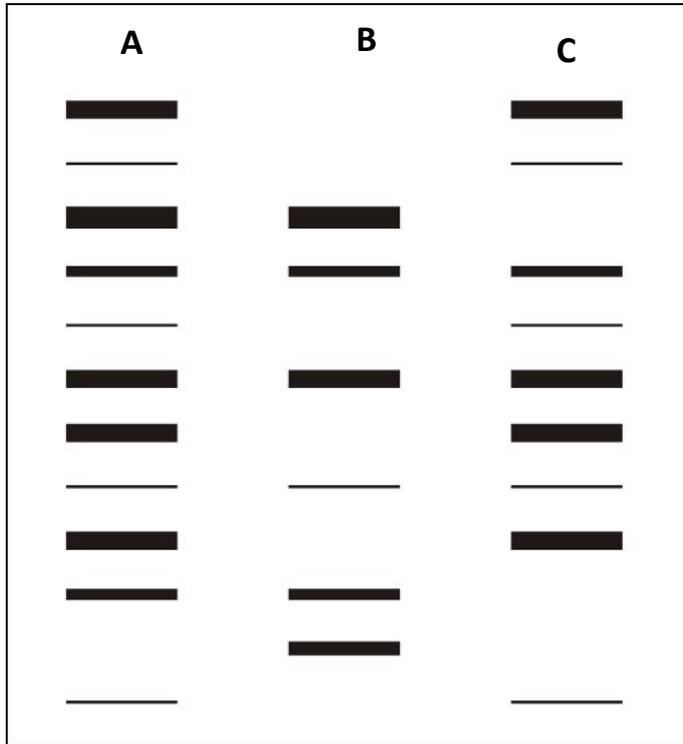


[Source: <<http://www.krugerpark.co.za>>]

[Adapted: <<http://animaldiversity.org>>]

- 4.4.1 Suggest TWO strategies that can be used by sable antelope to provide them with protection against predators. (2)
- 4.4.2 What type of competition is evident amongst the predators of the sable antelope? (1)
- 4.4.3 Sable antelope population numbers vary from year to year. List THREE density-dependent factors that would limit their population size. (3)
- 4.4.4 Research has shown that human activity such as hiking, hunting and agriculture has forced animals such as the sable antelope to avoid humans by becoming more nocturnal (active at night).
- (a) Explain the impact of the change to a more nocturnal routine on the size of a sable antelope population. (2)
- (b) Provide TWO suggestions that could be put in place by officials managing natural areas to limit human disturbances of sable antelope. (2)

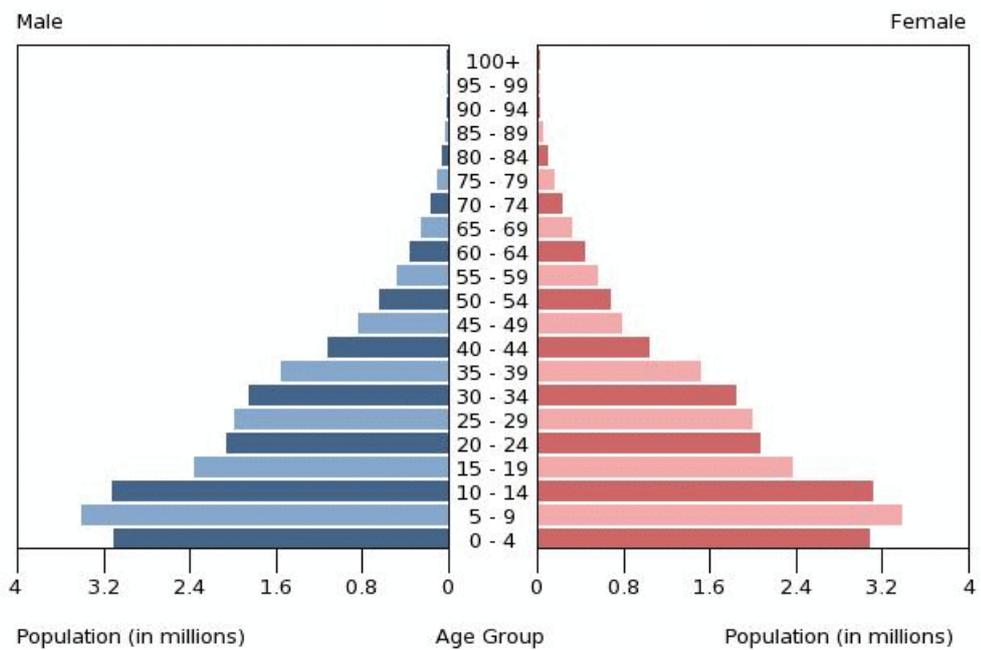
4.4.5 DNA samples were taken from three different population groups of the sable antelope. The DNA profiles of the three populations are shown below.



Which population (B or C) is most closely related to population A? Provide a reason for your answer.

(2)

4.5 The graph below depicts the population of a country in 2016.

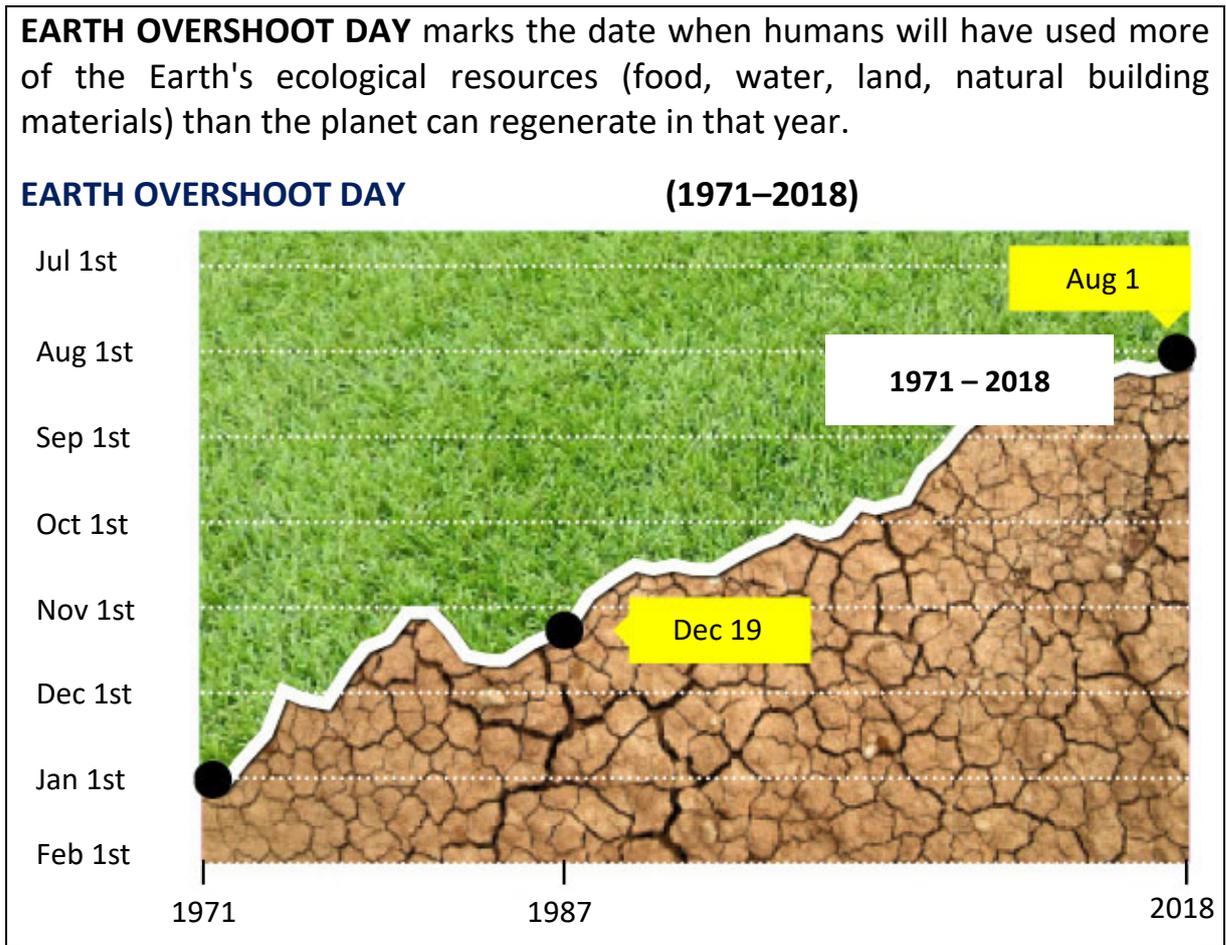


[Source: <<https://www.indexmundi.com>>]

Identify whether the graph represents the population from a more-developed country or a less-developed country. Provide TWO reasons to explain your choice.

(3)

4.6 Study the image below and answer the questions that follow.



[Source: <<https://timesofindia.indiatimes.com>>]

- 4.6.1 Explain what you understand by the term **ecological resource**. (1)
  - 4.6.2 Suggest a reason why humans used more ecological resources in 2018 than in 1971. (2)
  - 4.6.3 What does the graph suggest about the future of humanity on earth? (2)
- [40]**

**Total: 200 marks**