NATIONAL SENIOR CERTIFICATE EXAMINATION
SUPPLEMENTARY EXAMINATION – MARCH 2019

LIFE SCIENCES: PAPER I

Time: 3 hours 200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 10 pages and a yellow Answer Booklet of 13 (i–xiii) pages. 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. Question 1 must be answered in the yellow Answer Booklet provided. Questions 2, 3 and 4 must be answered in your Answer Book.

4. Start **each question** on a **new** page.

5. Read the questions carefully.

6. Number the answers exactly as the questions are numbered.

7. Use the total marks that can be awarded for each of Questions 1, 2, 3 and 4 as an indication of the detail required.

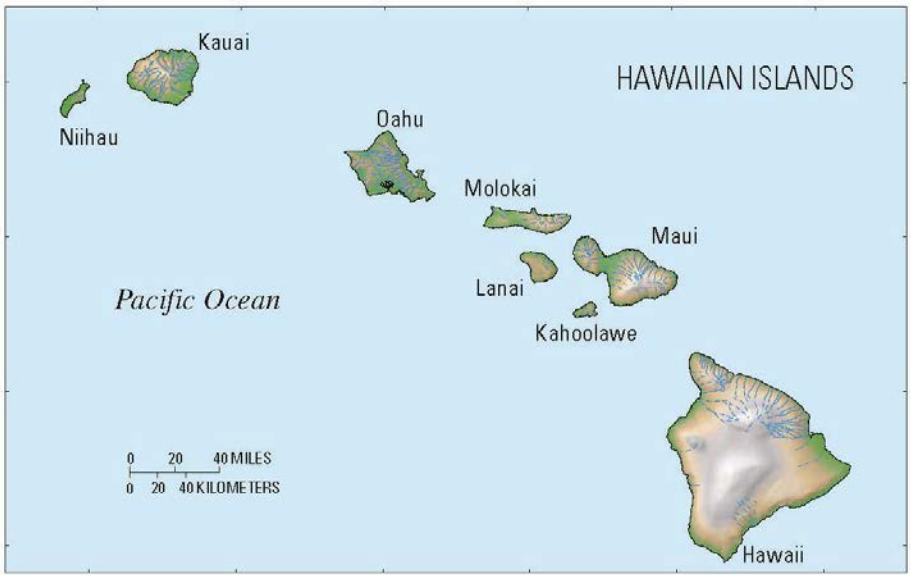
8. It is in your own interest to write legibly and to present your work neatly.

QUESTION 2

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

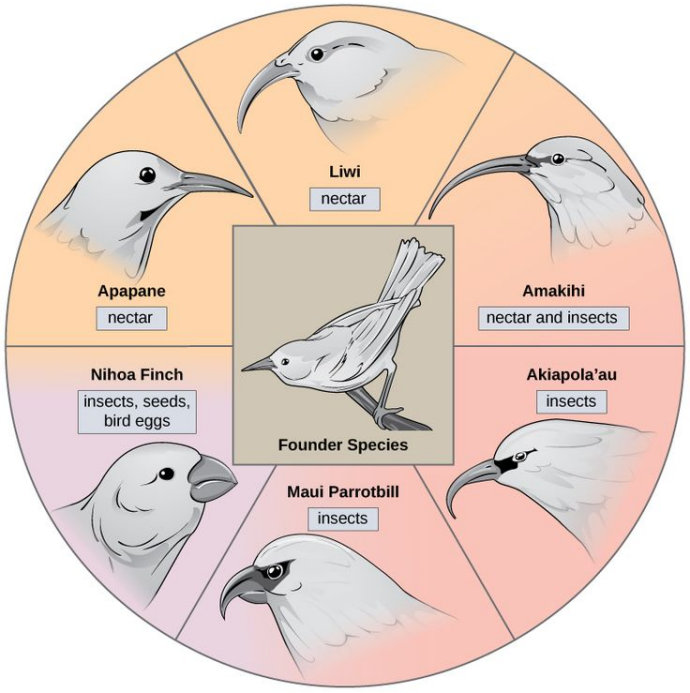
The islands of the Hawaiian archipelago (a group of islands) formed from volcanoes millions of years ago. Initially a newly formed island would have had no land organisms. Today the islands support a wide diversity of plants and animals. One example is the 23 species of a bird known as Hawaiian honeycreepers. Scientists believe that the founder species were a group of rosefinches carried to the islands by a storm about 6–7 million years ago. The diverse range of Hawaiian honeycreeper species is due to the wide ranges of rainfall, temperatures and vegetation experienced on the islands.

Map showing the Hawaiian Islands



[Source: <https://swimnova.com>]

Diagram showing the founder species of rosefinch and some of the species of honeycreepers found on the islands today



[Source: <https://i.pinimg.com>]

2.1.1 Define the term "species". (3)

2.1.2 What is the most distinctive difference noted amongst the different species of honeycreepers? (1)

2.1.3 Suggest how the founder species evolved into the wide range of honeycreeper species found on the islands today. (5)

2.1.4 Seeds of land plants, such as the sea bean, would have survived in seawater before arriving at the islands. Describe the method of a simple experiment that could be done to determine the amount of time the seeds from a plant such as the sea bean can survive in seawater and still be able to germinate. (5)

2.1.5 The islands of Hawaii were formed from volcanoes. What type of ecological succession would be evident on these islands? Give a reason for your answer. (2)

2.1.6 Tabulate TWO differences between a pioneer community and a climax community. (4)

2.2 Read the text below. Use the information in the text and your own knowledge to answer the questions that follow.

Four different species of *Anolis* lizards live on the West Indian island of Jamaica. Although these species all live together in the same trees and shrubs and eat similar foods, there are differences among them. The height and the thickness of the branches they live on and the time they spend in the sun or shade differs from species to species.

Also, species found near one another, tend to differ considerably in size. As a result, they are likely to consume different foods.

[Adapted: <https://ecology3e.sinauer.com>]

2.2.1 What type of competition is evident amongst the different lizard species? (1)

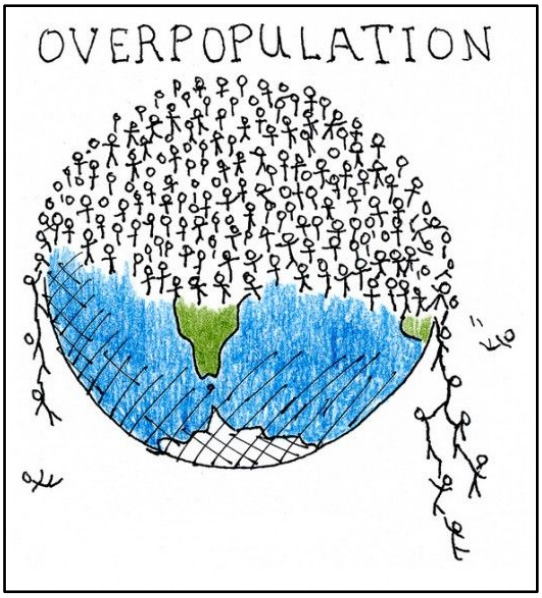
2.2.2 Describe strategies employed by the different species of lizards to reduce competition. (4)

2.2.3 A scientist wanted to determine the population size of one species of lizard. He set traps to catch the lizards. On the first day he caught 27 lizards. He marked them with non-toxic paint and released them into the environment. Three days later he reset the traps and caught 14 lizards. 5 of these lizards had been marked with paint.

(a) Use the mark-recapture method to calculate the estimated size of the lizard population. Show all working. (4)

(b) State THREE precautions that scientists should take to ensure that the estimated population size of lizards was as accurate as possible. (3)

2.3 Study the image below and answer the questions that follow:



[Source: <https://planetearth5.com>]

2.3.1 Provide a definition for "carrying capacity". (2)

2.3.2 What does the image suggest about the earth's carrying capacity? (2)

2.3.3 Humans have increased the carrying capacity of earth. Explain TWO ways they have been able to do this. (4)

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QUESTION 3

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

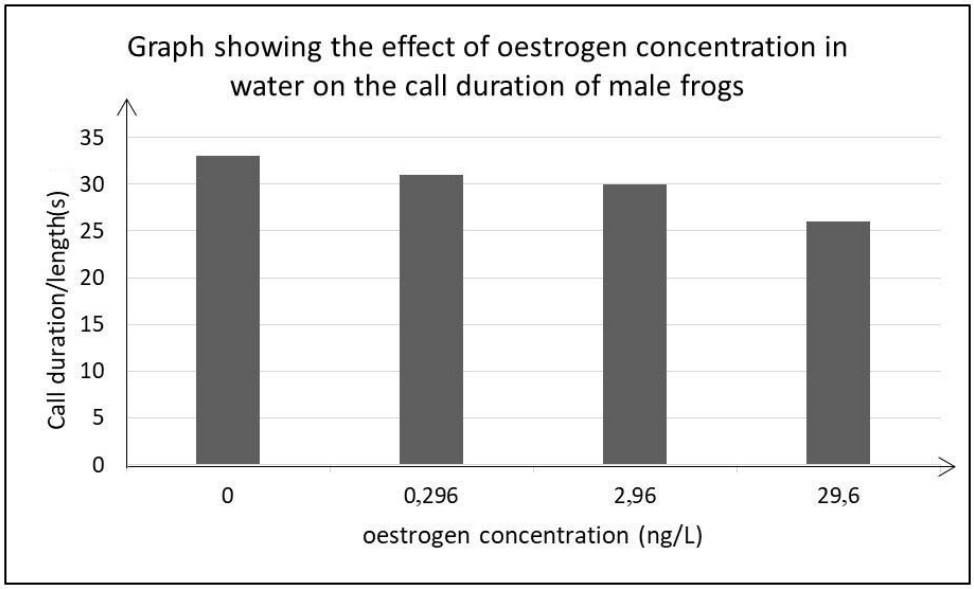
There are high levels of oestrogen in both drinking water and in natural water supplies. When women take oral contraceptives, only a small portion of the oestrogen hormone is used and the rest is excreted from the body. Water treatment facilities only remove a small portion of the hormones from sewage (waste water from homes and factories). Other sources of oestrogen polluting water supplies comes from certain types of plastics, crop fertilisers and livestock that are given synthetic and natural oestrogen to increase milk production.

Scientists are concerned that the high level of oestrogen can disrupt the reproductive behaviour of aquatic organisms.

A study was done to investigate the effect of oestrogen on the mating behaviour of adult male frogs belonging to the species, *Xenopus laevis.* The males of this species attract females by producing clicking sounds.

Five year old male frogs were kept in groups of 25 males inside 60 litre tanks. Frogs were exposed for 96 hours to different concentrations of oestrogen. The nocturnal calling (clicking sounds) of the frogs was then recorded over 4 nights.

The results are shown in the graph below:



[Adapted: <https://symptopro.org & http://journals.plos.org>]

3.1.1 From the text, state FOUR sources of oestrogen found in water. (4)

3.1.2 Where in the human body is oestrogen naturally secreted? (1)

3.1.3 Explain the function of oestrogen in oral contraceptives. (2)

3.1.4 During which period of time were the clicking sounds of the male frogs recorded? (1)

3.1.5 What is the purpose of the clicking sounds produced by the male frogs? (2)

3.1.6 (a) What conclusion can be drawn from the results of the experiment? (2)

(b) Suggest how the link between length of call and oestrogen concentration could affect frog reproductive behaviour. (2)

3.1.7 Suggest how the difference in call duration on attracting the female frogs could be measured. (3)

3.1.8 Discuss TWO practical ways to reduce the amount of oestrogen in water. (4)

3.1.9 The reproductive system of a male frog has testes and a sperm duct.

(a) State TWO functions of the testes. (2)

(b) State ONE function of the sperm duct. (1)

3.2 Different dog breeds have been bred by humans by artificial selection, e.g. the Icelandic Sheepdog which is a very rare dog breed.

- In 1955, the Icelandic Sheepdog breed was founded with a very small number of dogs, 36 in total.
- The Icelandic Sheepdog population grew very slowly. In 1990, the numbers reached about 500 dogs.
- After 1990, the population grew rapidly and numbered 2 500 by 2010.
- A small, closed population like this suffers from inbreeding.

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

[Source:<https://dogwellnet.com>]

3.2.1 Draw a sketch graph to represent the population numbers of Icelandic Sheepdogs from 1955 to 2010. (5)

3.2.2 Discuss what is meant by a "small, closed" population in this context. (2)

3.2.3 Why can inbreeding be seen as a threat to the Icelandic Sheepdog breed? (3)

3.2.4 Discuss THREE ways in which artificial selection differs from natural selection. (6)

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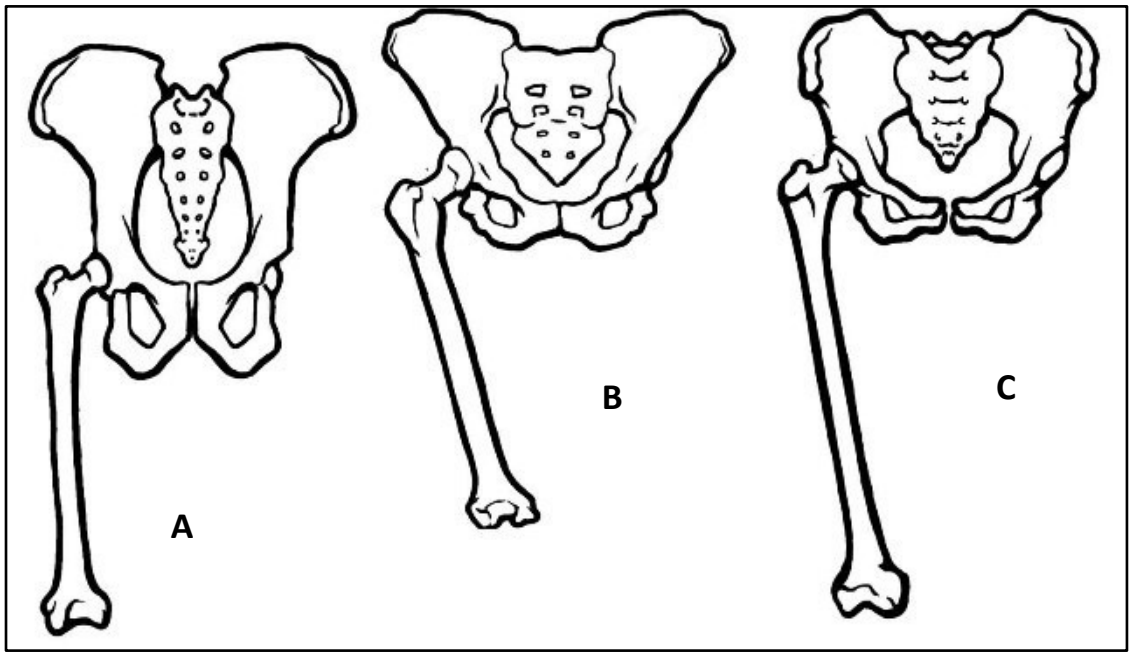
QUESTION 4

4.1 The diagrams below show the pelvis and upper leg bones of a chimpanzee, early human and modern human.

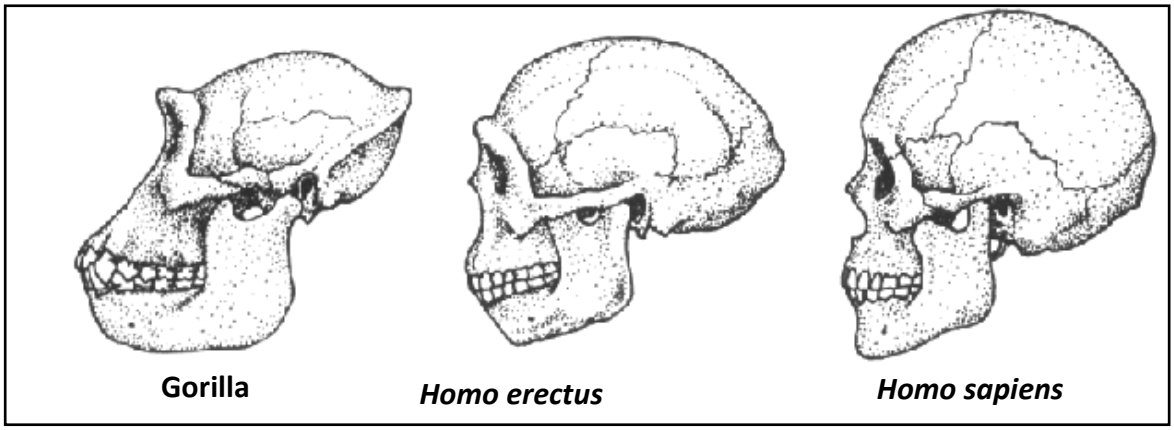


[Source: <http://humanorigins.si.edu>]

4.1.1 Identify the diagram(s) that show the skeleton(s) of a bipedal organism. (1)

4.1.2 List TWO visible features in the diagram(s) which indicate bipedalism. (2)

4.2 The diagrams below show the side view of skulls from a gorilla, *Homo erectus* and *Homo sapiens.*



[Source: <http://www.talkorigins.org>]

4.2.1 Identify THREE physical features which show evolutionary changes in these skulls. Give a reason to explain each of these visible differences. (6)

4.2.2 *Australopithecus africanus* also shows similar physical features to the skulls shown in the diagram. Between which two species would *Australopithecus africanus* be placed? Give a reason for your answer. (2)

4.3 Read the text below and answer the questions that follow:

Lee Berger made an extraordinary discovery in a South African cave system in the Cradle of Humankind. Thousands of bones belonging to a species of early human were found. Berger identified the bones as belonging to a brand new species of human – *Homo naledi.* Berger has suggested that the remains had been deliberately buried.

However, some anthropologists say the specimens found by Berger look like a human ancestor from the genus *Australopithecus*. Other anthropologists say that the fossils belong to *Homo erectus* and that Berger made some basic errors in his analysis. Other research challenges Berger's claim that the cave was a burial site.

There is a lot of discussion and debate concerning *Homo naledi* because Berger published his work more quickly than normal in an open-access journal. This allowed researchers, journalists, teachers, policy makers and the general public free access to his work. He also made digital scans of his specimens available for download or 3D printing.

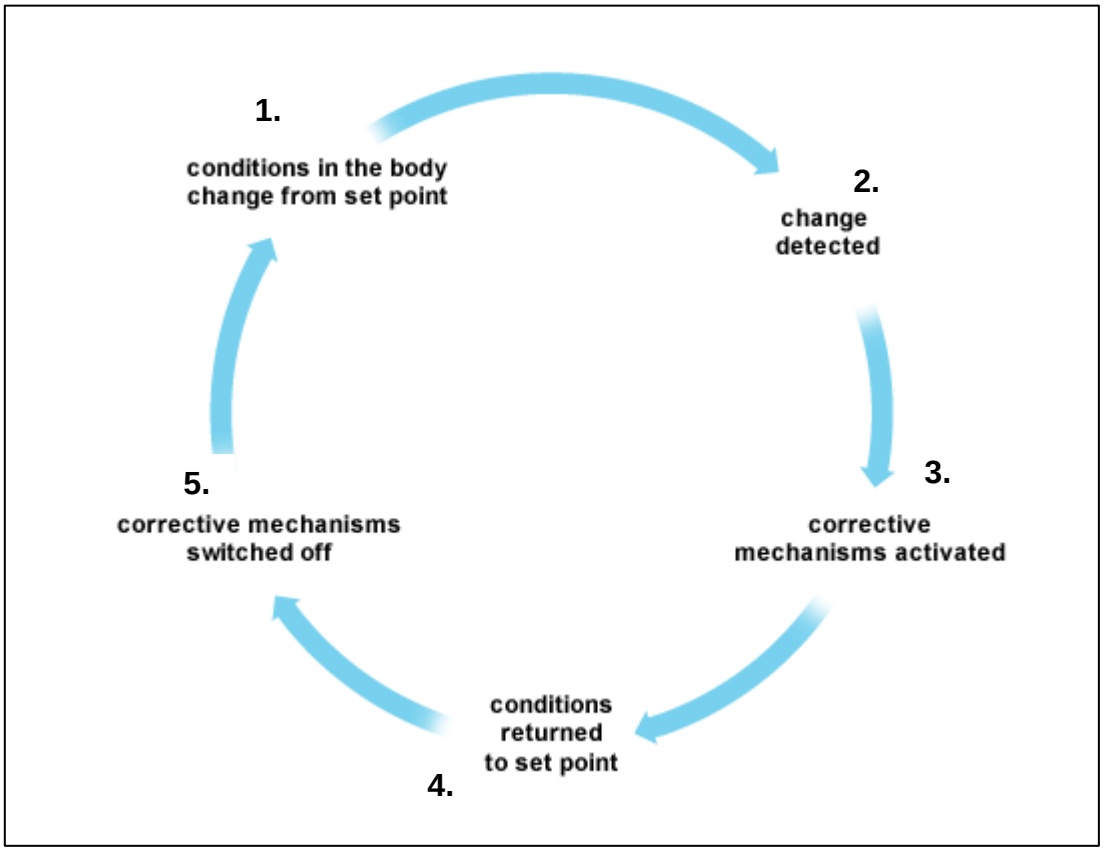
[Adapted: <https://www.npr.org & https://gizmodo.com>]

4.3.1 Name TWO other fossils that have been discovered in the Cradle of Humankind. (2)

4.3.2 State TWO ways in which other anthropologists were critical of Berger's work. (2)

4.3.3 Berger has made his work freely available. Discuss TWO ways this action can promote the importance of studying and understanding human evolution. (4)

4.4 The diagram below shows the stages in the negative feedback in maintaining homeostasis in the body.



[Source:< http://www.bbc.co.uk>]

4.4.1 Explain the meaning of the term "homeostasis". (2)

4.4.2 Thyroxin levels are controlled through a negative feedback mechanism. If thyroxin levels in the blood drop **below** set point, what will happen at each of the following steps:

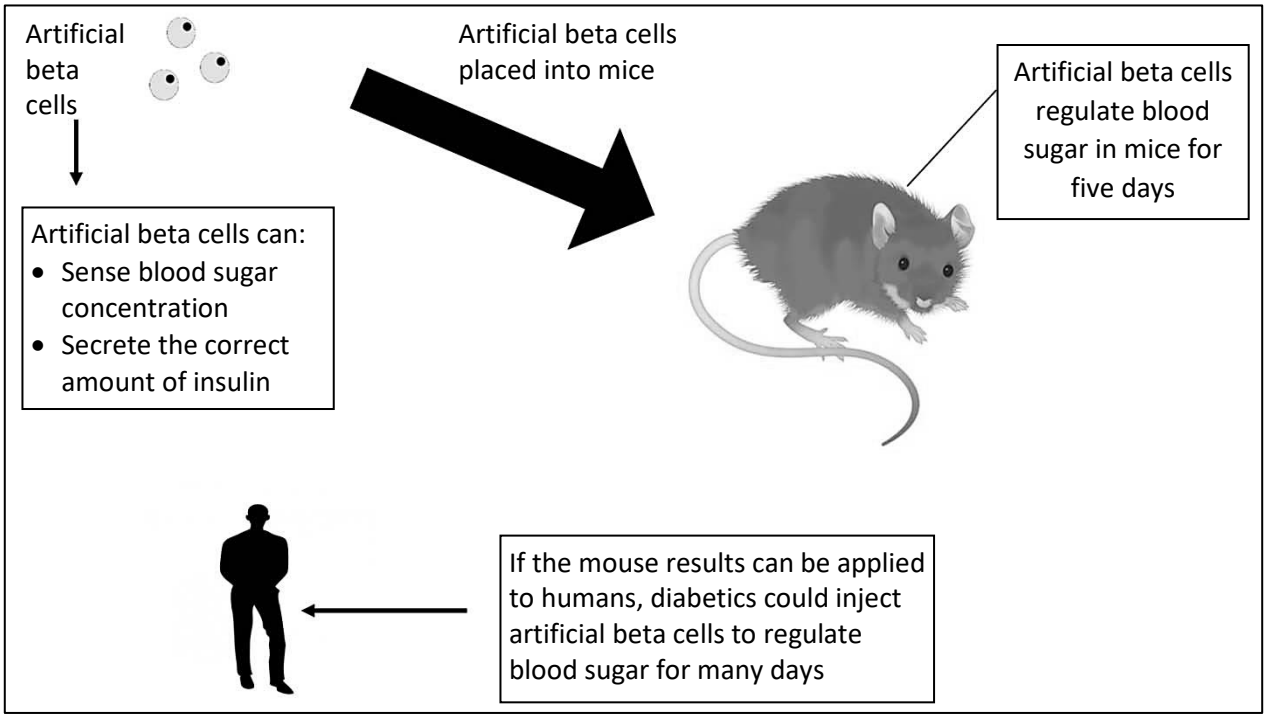
(a) Step 3? (5)

(b) Step 4? (1)

(c) Step 5? (1)

4.5 Artificial beta cells could one day offer a more effective, patient-friendly diabetes treatment.

The steps involved in this process are shown in the image below.



[Adapted: <https://www.sciencenews.org & https://www.environmentalscience.bayer.co.za & https://pixabay.com>]

4.5.1 Where are the insulin-making beta cells located in the body? (1)

4.5.2 What occurs in the blood that results in the beta cells secreting insulin? (2)

4.5.3 State THREE symptoms that could indicate an individual has diabetes. (3)

4.5.4 Explain how diabetic patients could benefit from using these artificial cells. (4)

4.5.5 Suggest why the scientists tested the artificial cells on mice before making them available to humans. (2)

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TOTAL: 200 marks