1   The scientific article you have studied is adapted from several sources.

Use the information from the article and your own knowledge to answer the following questions.

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in cellulose and starch.

Give **two** structural differences between cellulose and starch.

(2)

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(b) Naked mole rats show evidence of poikilothermy (paragraph 5) whilst other mammals, such as humans, maintain a nearly constant body temperature.

(i)   Describe the role of the human nervous system in returning a slightly raised body temperature to its normal level.

(4)

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(ii) Explain how shivering generates heat to return a slightly reduced body temperature to its normal level.

(2)

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(c) Suggest how Buffenstein and Horsby introduced cancer-causing genes into cells from naked mole rats (paragraph 13).

(3)

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*(d) If we had to breathe the 'rank air' found in the tunnels of naked mole rats, it would leave us 'gasping for air' (paragraph 33).

Describe how the mechanism involved in the control of breathing rate in humans would respond to this 'rank air'.

(5)

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(e) Suggest how a study of the naked mole rat could help in the design of prosthetic limbs (paragraph 47).

(2)

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(f) Using the information in paragraph 48, name **one** hormone and state its target organ.

(1)

Hormone ....

Target organ ....

(g) Suggest **two** reasons why the structure of the sperm may make it non-motile (paragraph 48).

(2)

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(h) The 'coefficient of band sharing' (paragraph 49) is a measure of the number of bands that different DNA samples have in common. The higher the coefficient the more bands the samples share. The maximum coefficient is 1.00.

Suggest why the coefficient of band sharing ranges from 0.93 to 0.99 within a colony of naked mole rats.

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(i) Suggest the importance of dispersers in naked mole rat colonies (paragraphs 50, 51 & 52).

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(j) Describe and explain **two** ways in which naked mole rats are adapted to their environment.

(4)

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(Total for Question 1 = 30 marks)

2 Cardiovascular disease (CVD) is responsible for many deaths. One cause of CVD is atherosclerosis.

The photograph below shows a section through an artery with a plaque (atheroma) from a patient with CVD.
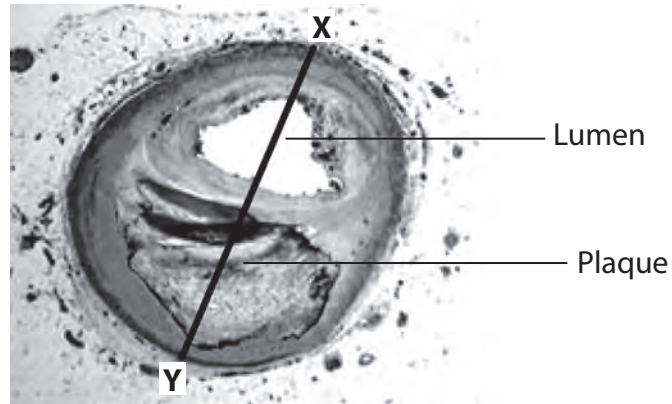
(a) Calculate the increase in the thickness of the artery wall where the plaque is located. Take your measurements along the line labelled **X** and **Y**.
Show your working.

(3)

Answer ....

(b) The plaque often increases in size and can block the artery. If the artery supplying blood to the heart becomes blocked, blood no longer flows to the heart muscle cells. Shortly after the loss of blood flow, heart muscle cells stop contracting and start to die.

In the heart muscle cells, energy (ATP) is made available from respiration.

The graph below shows how the energy (ATP) available to heart muscle cells changes with time, after the loss of blood flow.
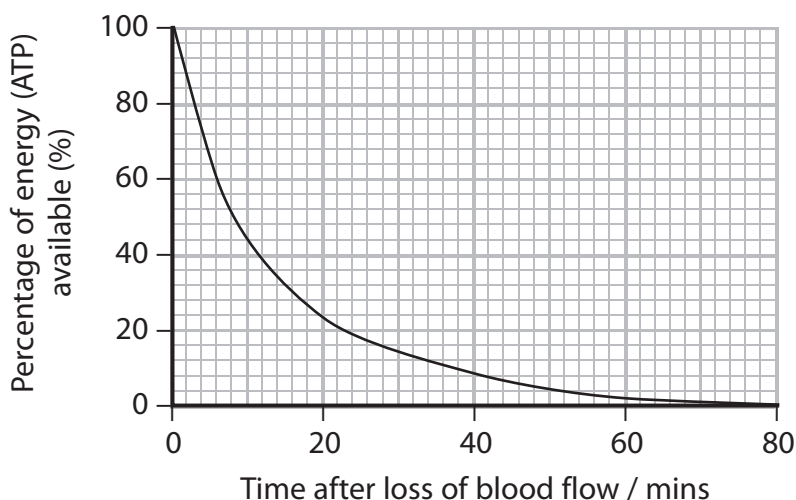
(i) Using the information in the graph, describe how the energy (ATP) available to the heart muscle cells changes with time after the loss of blood flow.

(2)

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(ii) Suggest why there are changes to the available energy (ATP) in the heart muscle cells following the loss of blood flow.

(2)

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(iii) About 8 minutes after the loss of blood flow, the heart muscle cells no longer contract. After about 20 minutes, the heart muscle cells begin to die.

Using the information in the graph and your own knowledge, suggest explanations for the timings of these two events.

(3)

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(iv) If blood flow is restored within 30 minutes, most heart muscle cells will eventually recover. Suggest an explanation for this recovery.

(2)

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(Total for Question 2 = 12 marks)