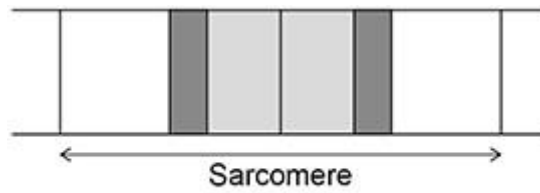


Q1.

The diagram below shows the banding pattern of a single sarcomere.



(a) Explain the banding pattern shown in the diagram above.

(3)

Q2.

Scientists investigated the effect of a decrease in pH on muscle contraction. The scientists did the investigation with four different preparations of isolated muscle tissue: **A**, **B**, **C** and **D**.

A - mouse muscle fibres at typical pH of mouse muscle tissue (control 1).

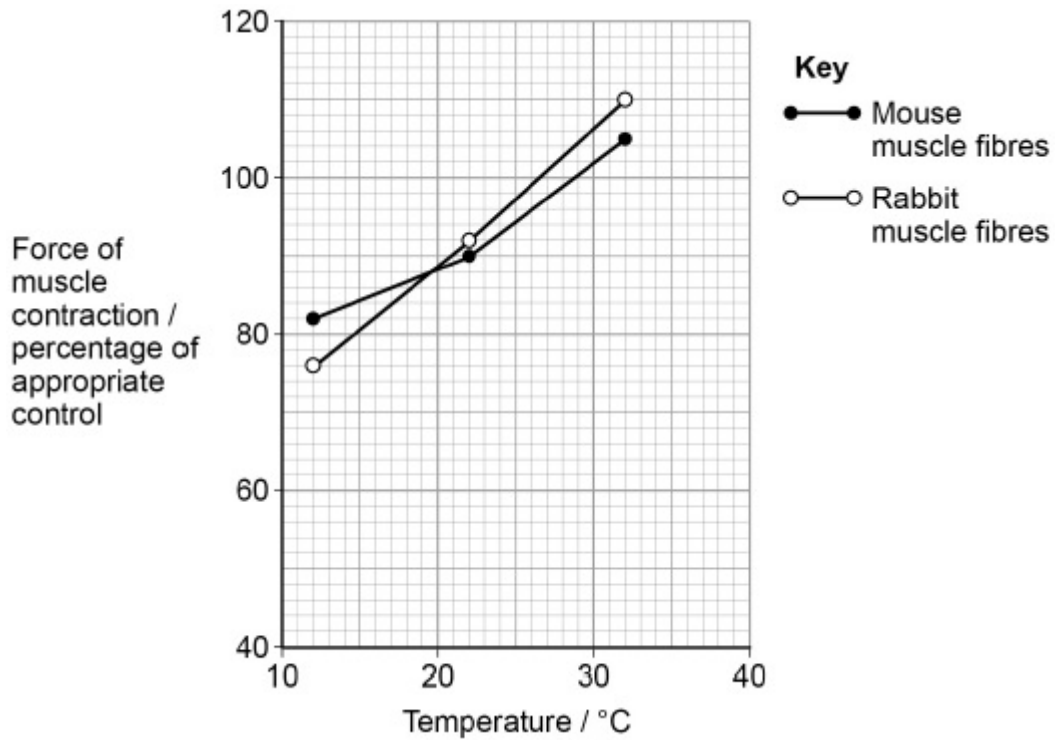
B - mouse muscle fibres at 0.5 pH units below typical pH.

C - rabbit muscle fibres at typical pH of rabbit muscle tissue (control 2).

D - rabbit muscle fibres at 0.5 pH units below typical pH.

They measured the force of muscle contraction of the muscle fibres at 12 °C, 22 °C and 32 °C

The graph shows the results the scientists obtained for **B** and **D** compared with the appropriate control.



- (a) A student looked at the results and concluded that a decrease in pH does cause a decrease in the force of muscle contraction.

Use the graph above to evaluate this conclusion.

(4)

- (b) Another group of scientists suggested that a decrease in the force of muscle contraction is caused by an increase in the concentration of inorganic phosphate, Pi, in muscle tissues.

Their hypothesis is that an increase in the concentration of Pi prevents the release of calcium ions within muscle tissues.

Explain how a decrease in the concentration of calcium ions within muscle tissues could cause a decrease in the force of muscle contraction.

(3)

- (c) In muscles, pyruvate is converted to lactate during prolonged exercise.

Explain why converting pyruvate to lactate allows the continued production of ATP by anaerobic respiration.

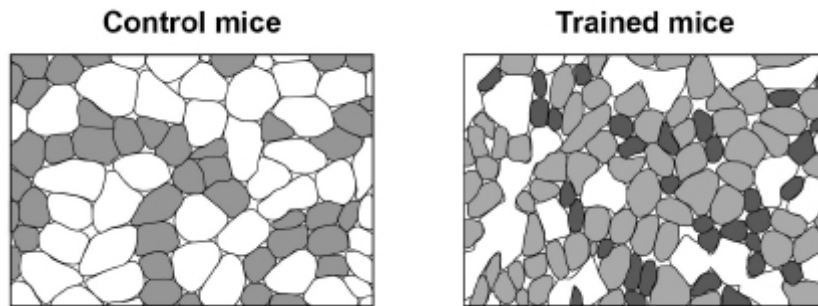
(2)

(Total 9 marks)

Q3.

Scientists investigated the effect of regular exercise on skeletal muscle fibres in mice. The scientists compared the muscle fibres of mice after six weeks of regular exercise (trained mice) with those of mice that had not exercised (control mice). The scientists stained the muscle fibres from both sets of mice to show succinic acid dehydrogenase activity. The darker the stain the greater the succinic acid dehydrogenase activity.

The diagram below shows a typical set of results they obtained.



- (a) Succinic acid dehydrogenase is an enzyme used in the Krebs cycle.

Suggest **one** reason for the difference in the staining between the muscle fibres of the control mice and the trained mice.

(1)

- (b) The scientists then compared the length of time that the control mice and the trained mice could carry out prolonged exercise. The trained mice were able to exercise for a longer time period than control mice.

Explain why.

(3)

- (c) The scientists determined the mean diameter of muscle fibres in trained mice using an optical microscope to examine sections of muscle tissue. The circular area (πr^2) of one field of view was 1.25 mm^2 . The diameter of this area was equal to the diameter of 15 muscle fibres.

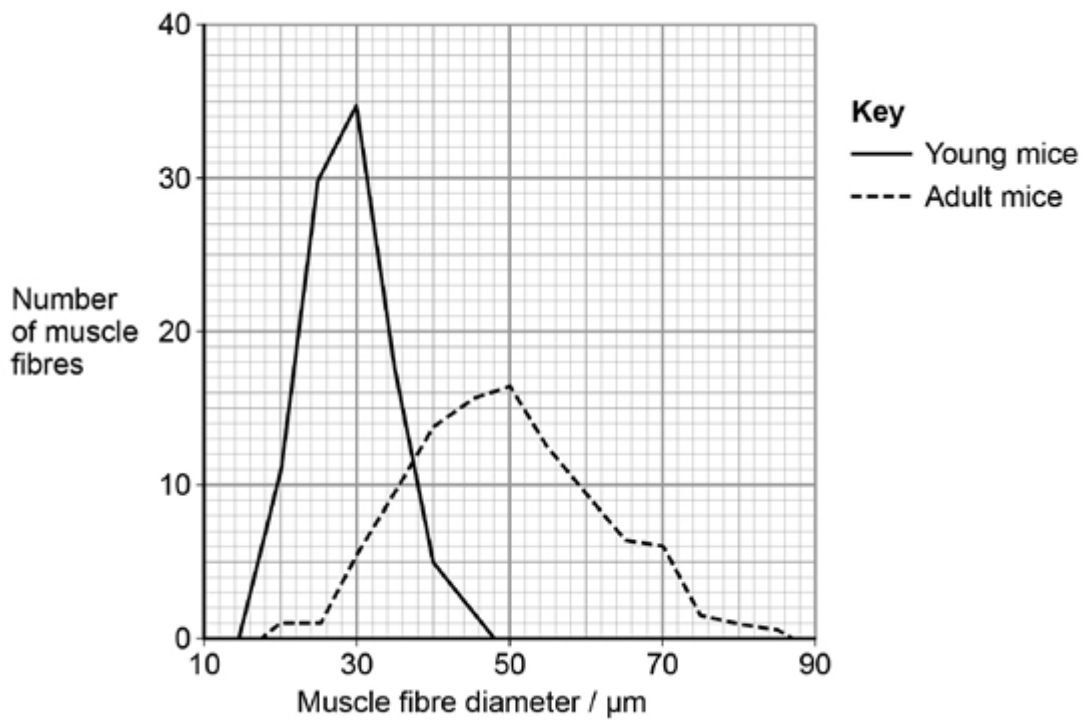
Using this information, calculate the mean diameter in μm (micrometres) of muscle fibres in this section of tissue.

Answer _____ μm

(2)

- (d) The scientists also compared the diameter of samples of muscle fibres taken from young mice and adult mice.

Some of their results are shown in the graph.



Describe **two** differences between these samples of muscle fibres.

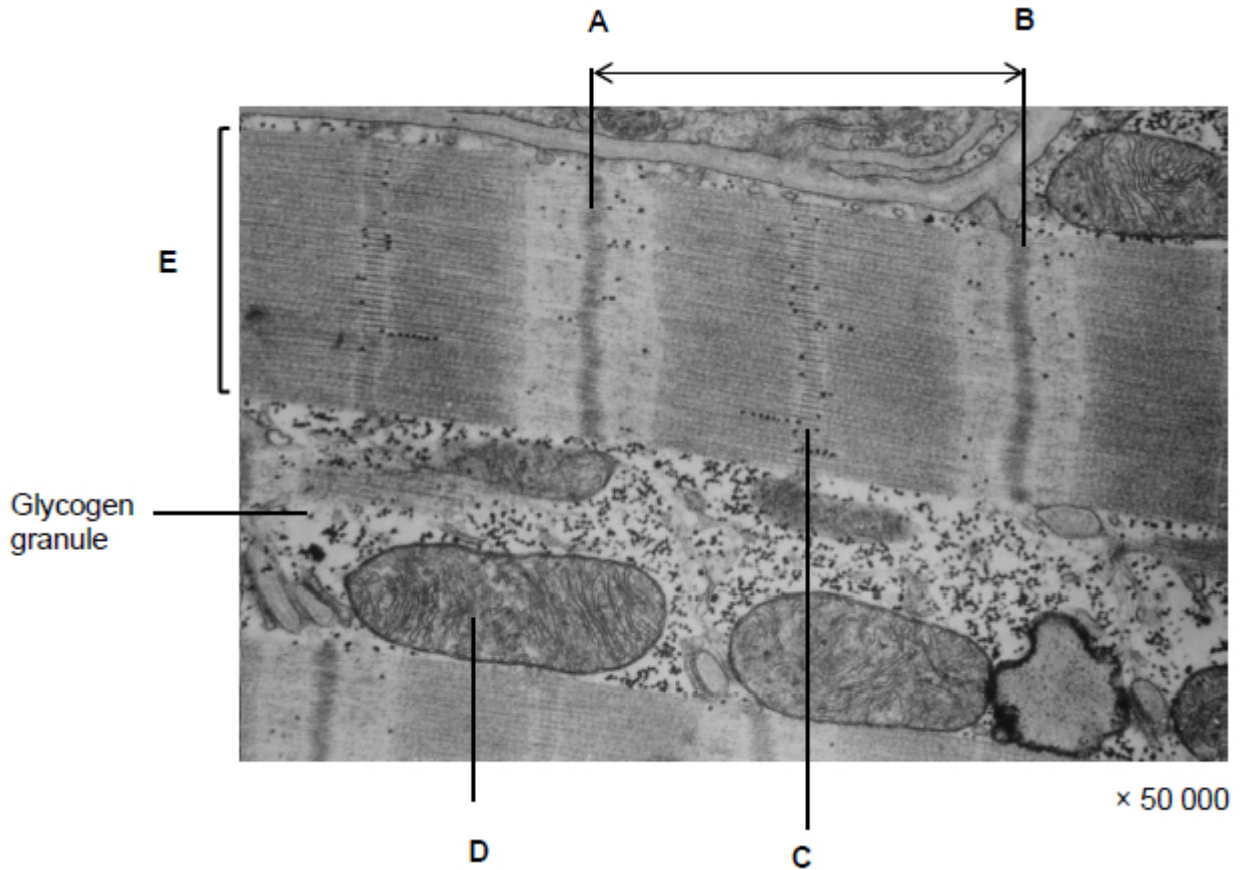
1. _____

2. _____

(2)
(Total 8 marks)

Q4.

The image below shows a transmission electron micrograph of a longitudinal section of skeletal muscle.



(a) Name structures **C**, **D** and **E**.

C _____

D _____

E _____

(3)

(b) Give the name of the structure shown between points **A** and **B**.

(1)

- (c) Calculate the actual distance between points **A** and **B**. Give your answer in micrometres (μm).

Answer = _____ μm

(1)

- (d) The image shows glycogen granules present in skeletal muscle.

Explain their role in skeletal muscle.

(2)

- (e) During vigorous exercise, the pH of skeletal muscle tissue falls. This fall in pH leads to a reduction in the ability of calcium ions to stimulate muscle contraction.

Suggest how.

(3)

(Total 10 marks)

Q5.

- (a) Describe the roles of calcium ions and ATP in the contraction of a myofibril.

(5)

- (b) ATP is an energy source used in many cell processes. Give **two** ways in which ATP is a suitable energy source for cells to use.

1. _____

2. _____

(2)

(Total 7 marks)

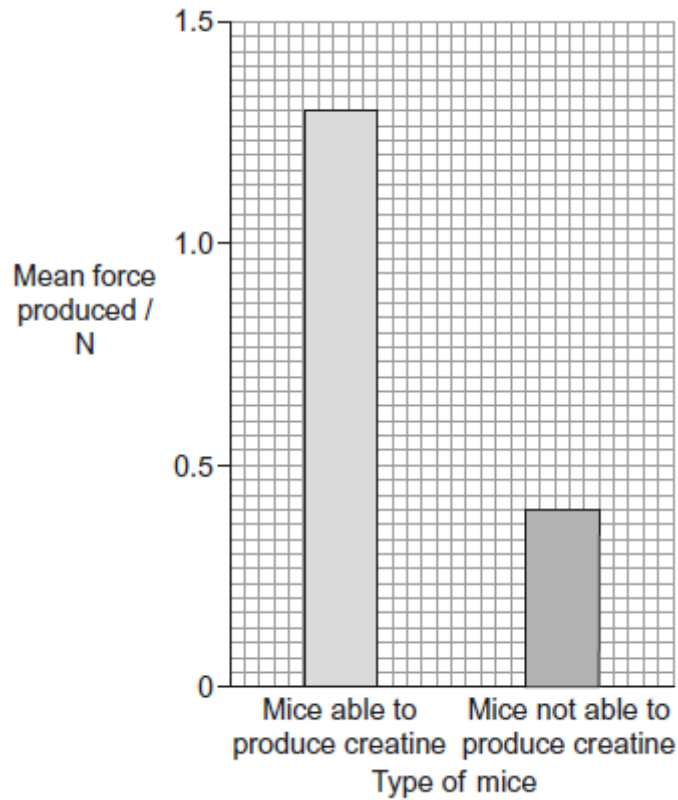
Q6.

- (a) What is the role of ATP in myofibril contraction?

(2)

- (b) Scientists investigated the effect of not being able to produce creatine on the force produced by muscle. They used mice with a mutation that made them not able to produce creatine. The force produced when these mice gripped with their paws was compared with the force produced by normal mice that were able to produce creatine.

The graph shows the scientists' results.



- (i) What was the percentage fall in the mean force produced by mice not able to produce creatine, compared with the normal mice? Show your working.

Answer _____ %

(2)

(ii) Suggest an explanation for these results.

(2)

(c) The mice that were not able to produce creatine were homozygous for a recessive allele of a gene. Mice that are heterozygous for this allele are able to produce forces similar to those of normal mice that are homozygous for the dominant allele of the same gene.

Explain why the heterozygous mice can produce forces similar to those of normal mice.

(2)

(Total 8 marks)