

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL A-LEVEL BIOLOGY (9610)

Unit 4 Control

Wednesday 3 June 2026

08:00 UK Time

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	



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BL04

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[4 marks]

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Doctors use a glucose tolerance test (GTT) to assess how well a patient's body controls blood glucose concentration.

A patient must not eat any food for 12 hours before the start of the GTT.

During a GTT the doctor:

- measures the concentration of glucose in the patient's blood at the start
- gives the patient a drink that contains 50 g of glucose
- tells the patient to sit for 2 hours and not to eat
- measures the concentration of glucose in the patient's blood again at the end.

0 1 . 2

Explain why a patient must **not** eat any food for 12 hours before the start of a GTT.

[2 marks]

Question 1 continues on the next page

Turn over ►



Table 1 shows the results for three patients who have taken a GTT.

Table 1

Patient	Blood glucose concentration / mmol dm ⁻³	
	Start	After 2 hours
A	5.17	5.00
B	13.67	14.39
C	5.83	5.98

0 1 . 3 Explain what the doctor may conclude from the result of the GTT for patient **B**.
[2 marks]

0 1 . 4 Suggest **one** disadvantage of a GTT to assess how well a patient can control their blood glucose concentration.
[1 mark]



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ANSWER IN THE SPACES PROVIDED**

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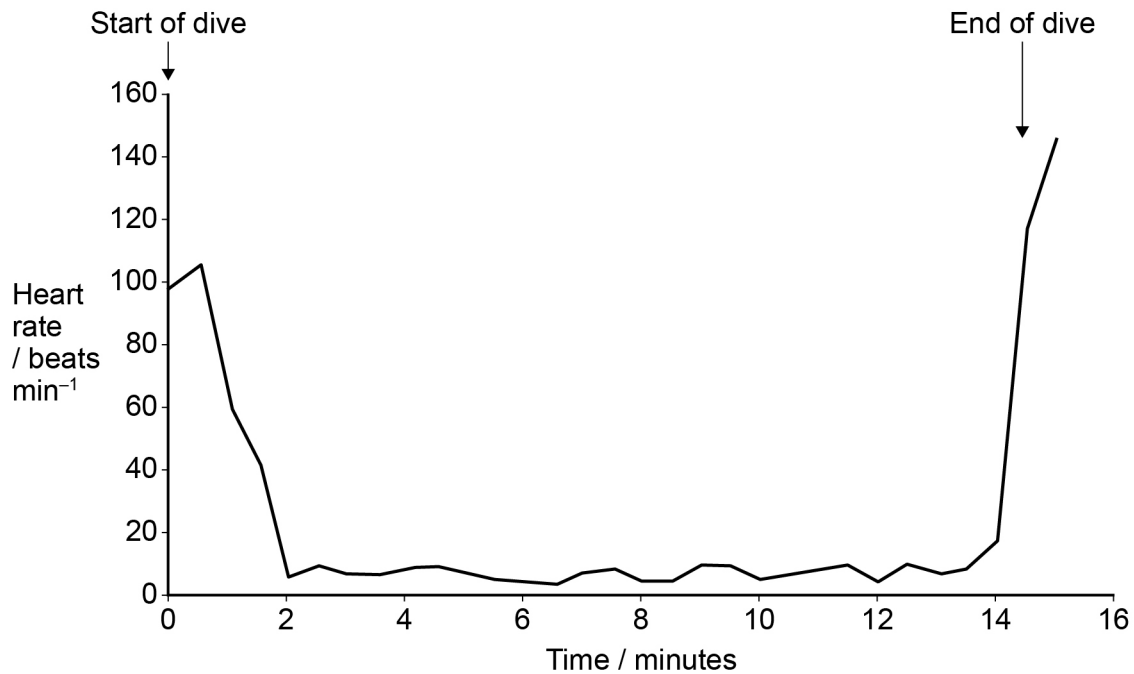
0 5

0 2

Seals are mammals that live in the sea and swim underwater (dive) to find food.

Figure 1 shows the changes in the heart rate of a seal when it dives, is underwater and when it returns to the surface.

Figure 1



0 2 . 1

Describe how the heart rate of the seal changes from the start of the dive to the end of the dive.

[2 marks]

0	2	.	2
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Explain the advantage of the change in the seal's heart rate during the dive.

[2 marks]

0	2	.	3
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During the dive, the carbon dioxide concentration in the seal's blood increases.

Explain how this increase in carbon dioxide concentration affects the seal's heart rate as it returns to the surface at the end of the dive.

[3 marks]

—
7



0 3

A Pacinian corpuscle is a type of receptor that responds to pressure.

0 3 . 1

Describe how applying pressure to a Pacinian corpuscle can produce a generator potential.

[3 marks]

Scientists investigate the response of a Pacinian corpuscle when they apply pressure.

The scientists use:

- pressure probes (**D** and **E**) to apply pressure to the Pacinian corpuscle in three different combinations:
 - **D** once only
 - **D** twice in rapid succession
 - **D** and **E** at the same time
- microelectrodes (**M**₁ and **M**₂) to measure changes in the maximum membrane potential of the Pacinian corpuscle and the sensory neurone when pressure is applied.



Figure 2 shows the Pacinian corpuscle, the sensory neurone and the position of the pressure probes and microelectrodes.

Figure 2

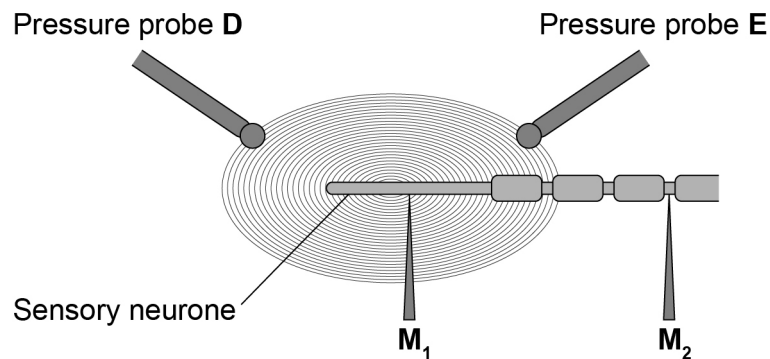


Table 2 shows the scientists' results.

Table 2

Pressure applied from probe	Maximum membrane potential at M_1 / mV	Maximum membrane potential at M_2 / mV
No pressure	-75	-75
D once only	-55	-75
D + D in rapid succession	+35	+40
D + E at the same time	+40	+40

0 3 . 2 Explain the results shown in **Table 2**.

[3 marks]

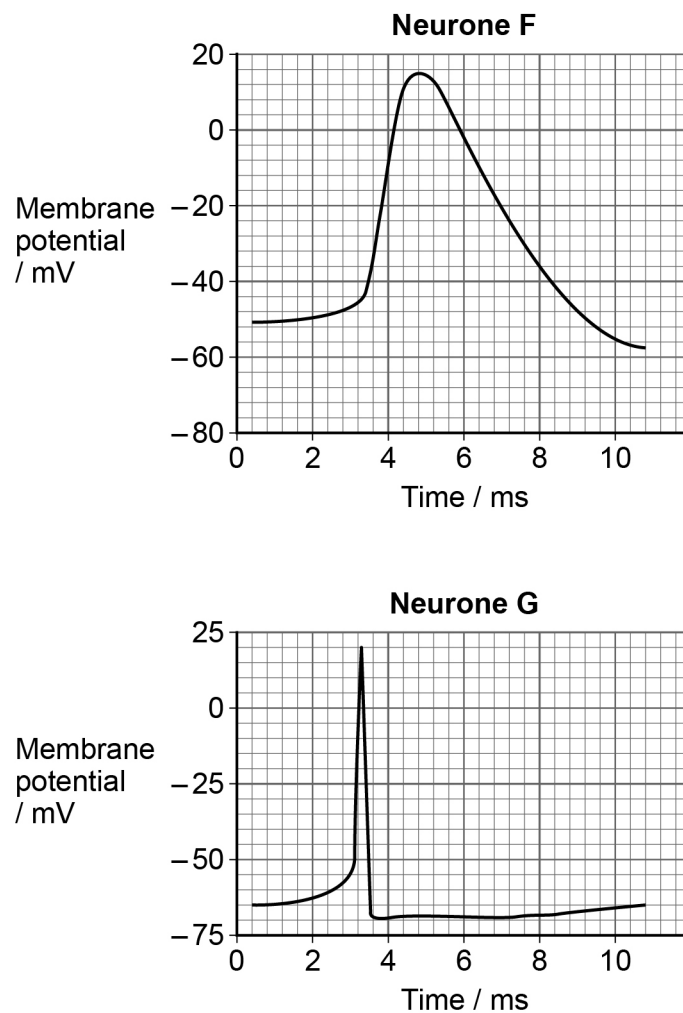
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Other scientists investigate action potentials from two different types of neurone, **F** and **G**.

Figure 3 shows the scientists' results.

Figure 3



0 3 . 3

Give **three** ways that the action potential in neurone **F** is different from the action potential in neurone **G**.

[3 marks]

1 _____

2 _____

3 _____

0 3 . 4

Suggest **two** reasons why the action potential in neurone **F** is different from the action potential in neurone **G**.

[2 marks]

1 _____

2 _____



[1 mark]

[4 marks]

[illegible]

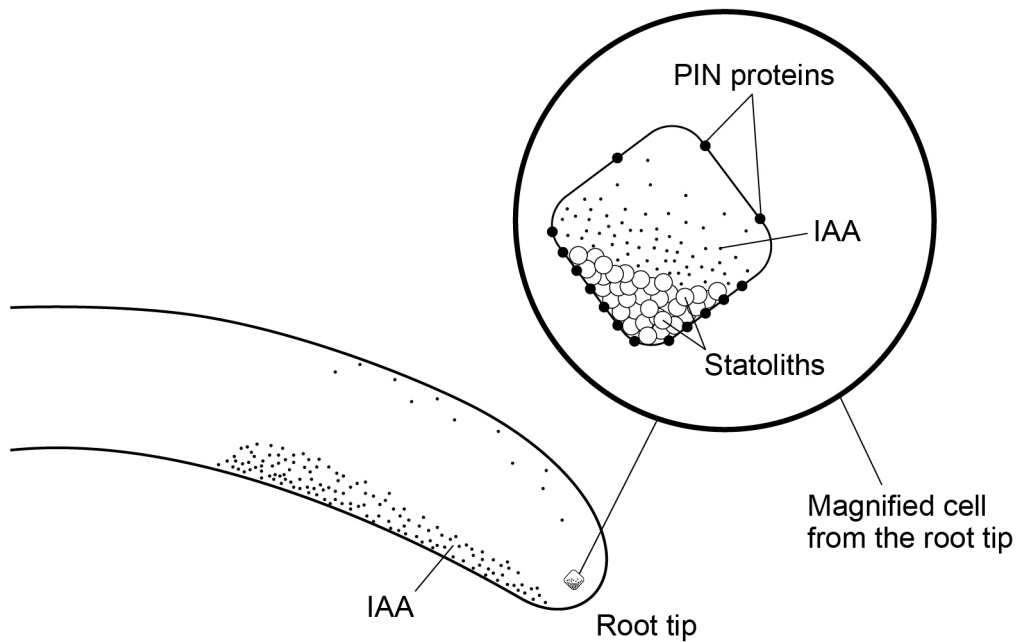
Cells in the root tip contain starch-filled organelles called statoliths.

The statoliths settle to the lowest part of the cells due to gravity.

The statoliths increase the number of indoleacetic acid (IAA) transporter proteins (PIN proteins) in the cell membrane. The PIN proteins allow the movement of the IAA **out** of the cells.

Figure 4 shows this process.

Figure 4



0 4 . 3 Explain how the movement of statoliths causes a horizontal root to grow downwards.

Use **Figure 4** and your own knowledge.

[3 marks]

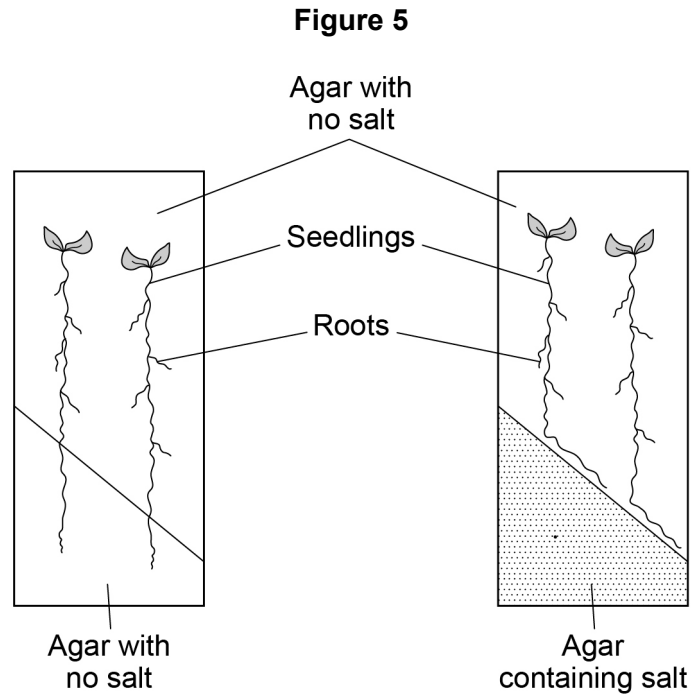
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Plant roots also respond to water and salt.

The presence of salt causes the breakdown of statoliths in the root tip cells.

Figure 5 shows how plant root growth is affected by salt concentration.



Agar is a thick clear substance.

0 4 . 4

Suggest a mechanism that would allow a plant root to grow away from a high salt concentration as shown in **Figure 5**.

Use information from **Figure 4** and **Figure 5**.

[3 marks]

0	4	.	5
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Suggest why it is important for a plant root to grow away from an area of high salt concentration.

[2 marks]

13

Turn over for the next question

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0	5
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Recombinant DNA technology involves the transfer of fragments of DNA from one organism to another. This produces a genetically modified organism (GMO).

0	5	.	1
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Name **one** type of protein made by GMOs.

[1 mark]



There are several ways to produce fragments of DNA.

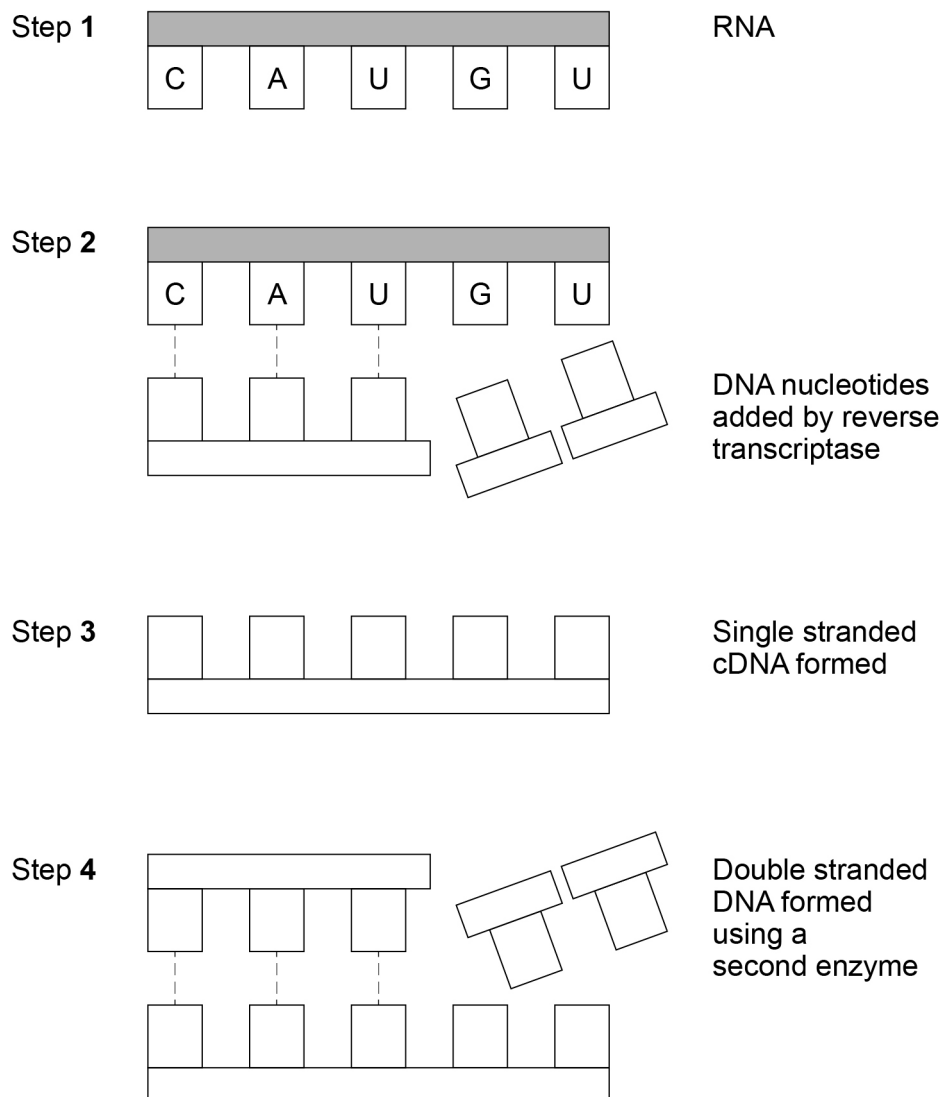
One method is to use an enzyme called reverse transcriptase.

Reverse transcriptase catalyses the production of DNA from RNA.

The DNA produced is called complementary DNA (cDNA).

Figure 6 shows this process.

Figure 6



0 5 . 2

Complete **Figure 6** by adding letters to show the correct nucleotides in step 3 and step 4.

[2 marks]

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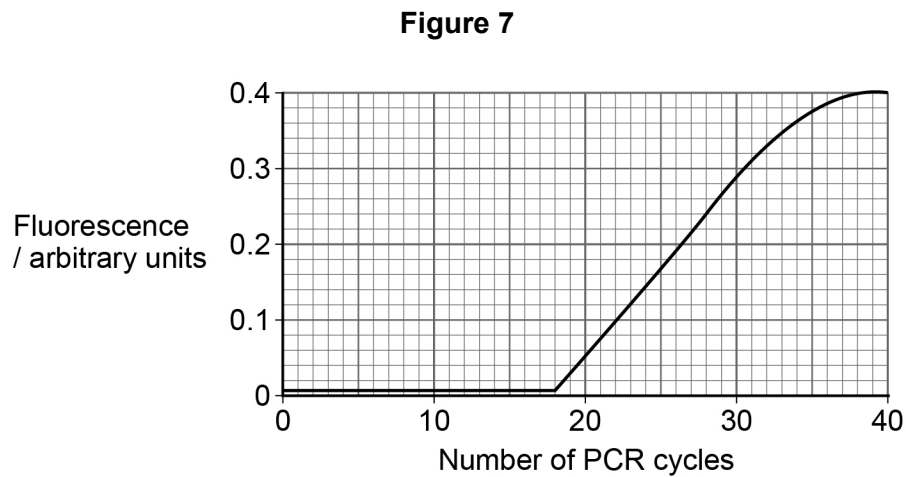
The polymerase chain reaction (PCR) is a method of amplifying fragments of DNA.

In standard PCR, the copied DNA fragments are detected at the end of the reaction.

A new form of PCR called quantitative PCR (qPCR) measures the amount of DNA as the reaction progresses.

The new DNA fragments are detected using a fluorescent marker.

Figure 7 shows an amplification graph for a qPCR reaction.



0 5 . 3 Describe the results shown in **Figure 7**.

[2 marks]

0	5	.	4
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Calculate the number of DNA fragments when the fluorescence value is 0.24

Assume the DNA sample contained 12 DNA fragments at the start.

Give your answer in standard form.

[3 marks]

Number of DNA fragments = _____

0	5	.	5
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Suggest why the fluorescence does not increase above 0.4 arbitrary units in **Figure 7**.

[1 mark]

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9

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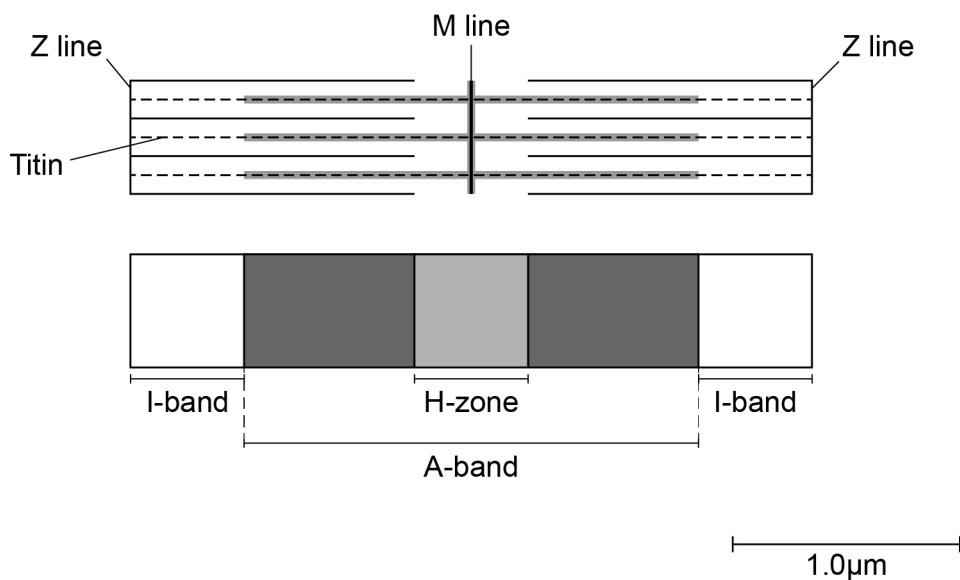
0 6

Muscle fibres contain units called sarcomeres that contain different proteins.

Titin is a protein found in sarcomeres and connects the Z line to the M line.

Figure 8 shows a sarcomere from a relaxed muscle fibre.

Figure 8



0 6

1

A section of muscle fibre is 22.5 mm long when relaxed.

Use **Figure 8** to calculate the number of sarcomeres in this section of muscle fibre.

[2 marks]

Number of sarcomeres = _____

0 6

2

Describe **one** feature in **Figure 8** that shows the sarcomere is relaxed.

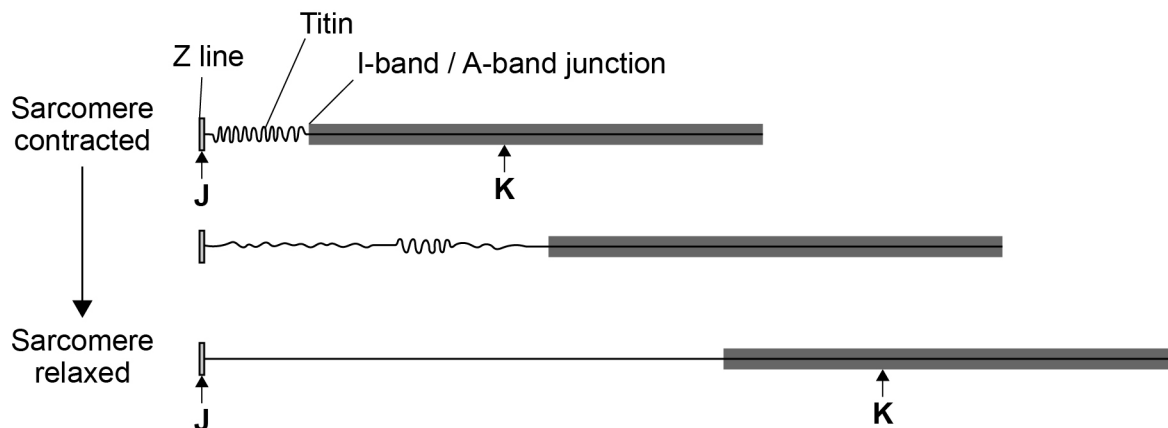
[1 mark]



Titin shortens when a sarcomere contracts.

Figure 9 shows part of a sarcomere and the changes in a titin molecule as the sarcomere relaxes.

Figure 9



0 6 . 3 Use **Figure 9** to calculate the percentage increase in the length of titin from when the sarcomere is contracted to when the sarcomere is relaxed.

Use the points **J** and **K** marked on the titin.

[1 mark]

Percentage increase in the length of titin = _____ %

0 6 . 4 Suggest the role of titin in the functioning of a sarcomere.

[1 mark]

Turn over ►



Scientists investigate the effects of a mutation in a gene called CT1 on muscle contraction in mice.

The scientists use mice **with** the CT1 mutation and mice **without** the CT1 mutation.

The scientists measure:

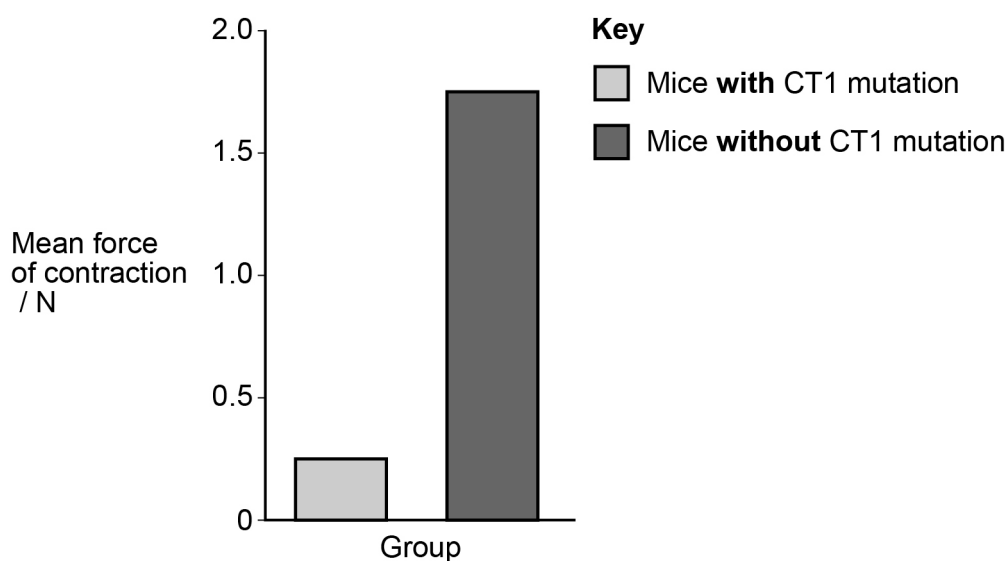
- the mean concentration of creatine that the mice produce in a skeletal muscle
- the mean force of contraction the mice produce when they grip with their front feet.

Table 3 and **Figure 10** show the scientists' results.

Table 3

Group	Mean concentration of creatine $\pm$ SE / nmol mg ⁻¹ protein
Mice with CT1 mutation	16.1 $\pm$ 5.3
Mice without CT1 mutation	131.9 $\pm$ 6.7

Figure 10



0 6 . 5

The scientists use a statistical test to compare the two groups of mice.

The statistical test gives a result of $P < 0.001$

Name the statistical test the scientists use.

Explain the result of the statistical test.

[3 marks]

Name of statistical test _____

Explanation of statistical test result _____

0 6 . 6

Explain the results for the mice **with** the CT1 mutation.

Use information from **Table 3** and **Figure 10**.

[3 marks]



0 7

The ability to measure and regulate fruit ripening is important to fruit growers.

Ethene is a plant growth regulator that controls fruit ripening.

During ripening, an increase in ethene causes increased breakdown of starch by enzymes.

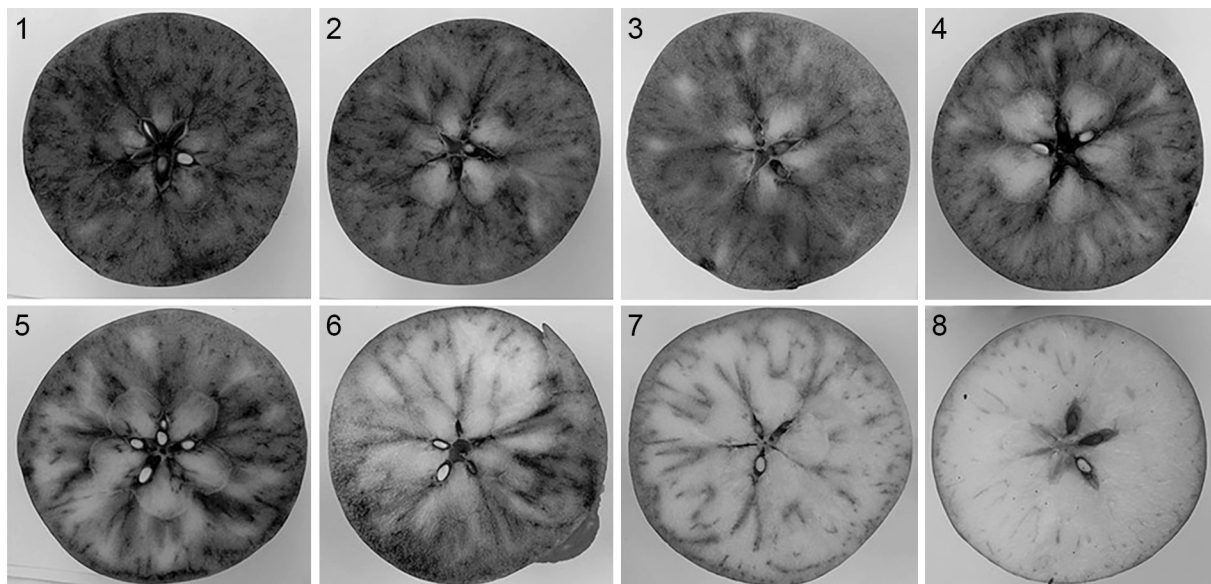
Fruit growers use a starch index to measure ripening in apples.

Cut apples are sprayed with iodine solution and a number is given to the pattern of staining obtained.

A starch index ranges from 1 to 8, with 1 indicating no starch breakdown and 8 indicating complete starch breakdown.

Figure 11 shows a starch index for cut apples.

Figure 11



0 7

1

Name the enzyme involved in starch breakdown and a product of this breakdown.

[2 marks]

Enzyme _____

Product _____



For some varieties of apples, the starch index that corresponds to a particular stage of ripeness has been determined.

Apples can be harvested for short-term or long-term storage.

Table 4 shows the starch index for some apple varieties at the optimum harvest time for short-term and long-term storage.

Table 4

Apple variety	Starch index at the optimum harvest time	
	Short-term storage	Long-term storage
Cortland	3.0–4.0	1.5–2.5
Empire	5.0–6.0	3.5–4.5
Gala	5.0–6.0	3.0–4.5
Honeycrisp	6.0–7.0	4.5–5.5
Jonagold	5.0–7.0	3.0–4.5
Macoun	5.0–6.0	3.0–4.5
McIntosh	5.5–6.0	4.0–5.0

- 07.2** Describe the general pattern between starch index and length of storage shown in **Table 4**.

[1 mark]

- 07.3** Suggest a reason for the pattern you described in Question **07.2**.

[1 mark]

Turn over ►



Climacteric fruits, such as apples and bananas, ripen after harvest.

This means they can be picked when they are unripe, stored and transported.

They can then be ripened by exposure to ethene.

0 7 . 4

Suggest why it is useful to control ripening in this way.

[2 marks]

The ripening process involves changes in the colour, softness and taste of the fruit. These changes are all controlled by enzymes.

Ethene causes:

- an increase in the synthesis of the enzymes that cause ripening
- an increase in the rate of respiration.

0 7 . 5

Suggest why ethene causes an increase in the rate of respiration.

[2 marks]



It is expensive to use ethene to ripen fruits.

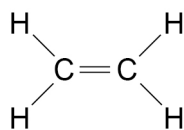
Some countries use calcium carbide instead.

When calcium carbide comes into contact with water it produces acetylene gas (ethyne).

Acetylene has similar effects to ethene.

Figure 12 shows the structure of ethene and acetylene.

Figure 12



Ethene



Acetylene

0 7 . 6

Suggest how acetylene can produce similar effects to ethene.

[3 marks]

Turn over ►



Scientists have investigated the effect of different concentrations of calcium carbide on isolated mammalian cells.

Figure 13 shows the effects of different concentrations of calcium carbide on cell viability (the percentage of living cells).

The error bars show $\pm$ standard error.

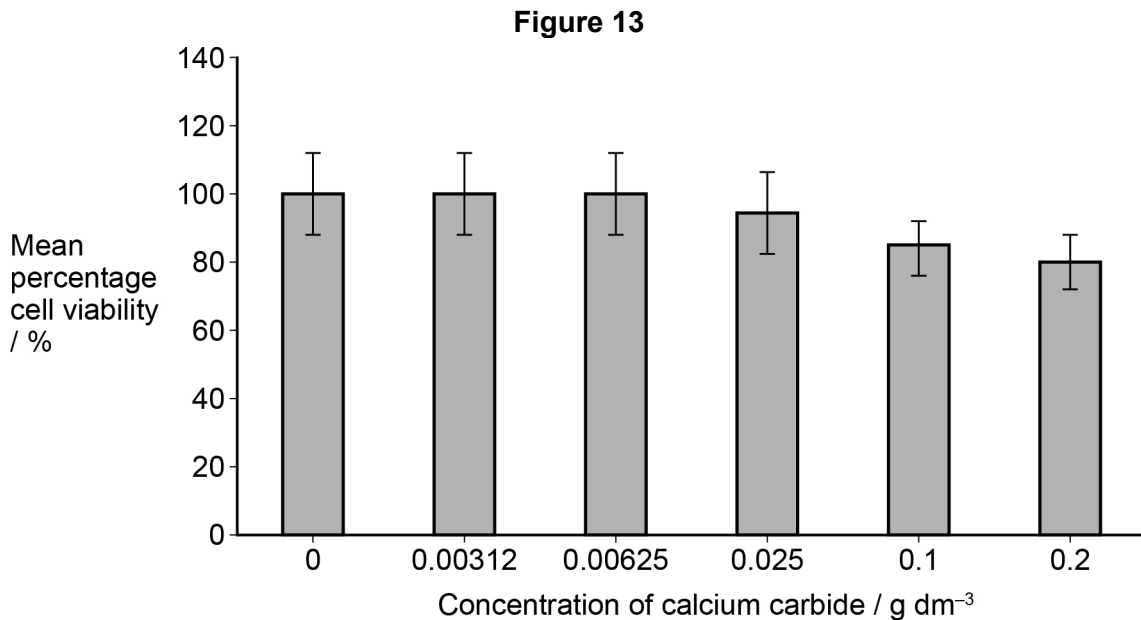
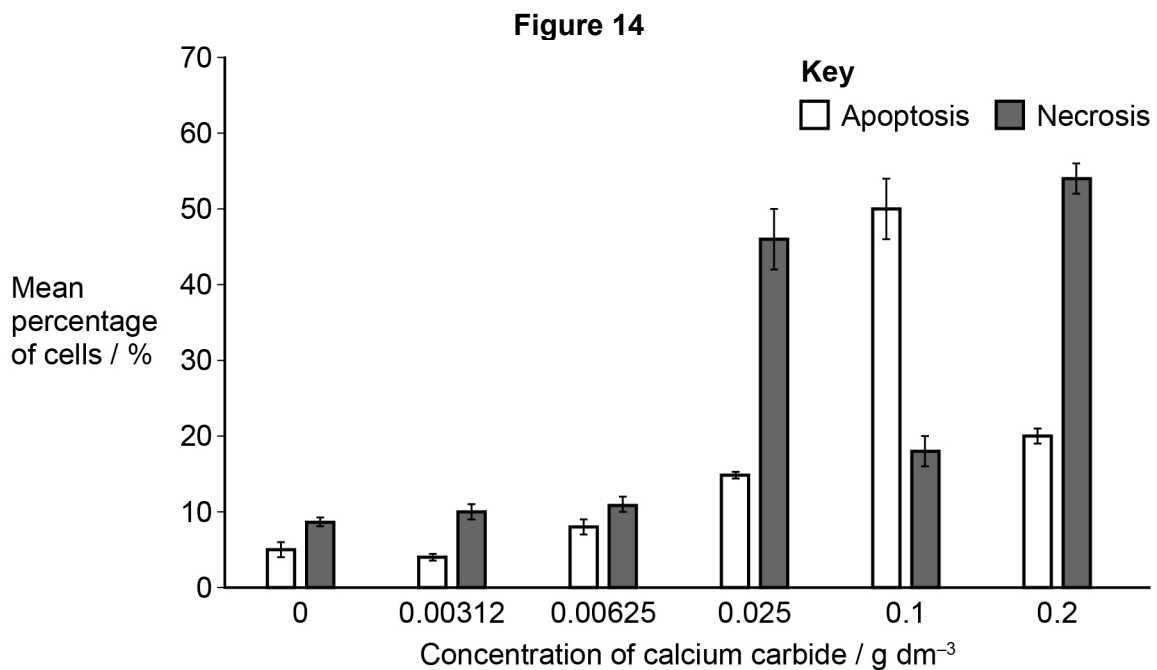


Figure 14 shows the effects of different concentrations of calcium carbide on the amount of apoptosis and necrosis.

Apoptosis and necrosis are processes that lead to cell death.

The error bars show $\pm$ standard error.



[4 marks]

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15

END OF QUESTIONS



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