OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

INTERNATIONAL A-LEVEL

BIOLOGY (9610)

Unit 4 Control

Wednesday 19 June 2019 07:00 GMT 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	
3	
4	
5	
6	
7	
TOTAL	

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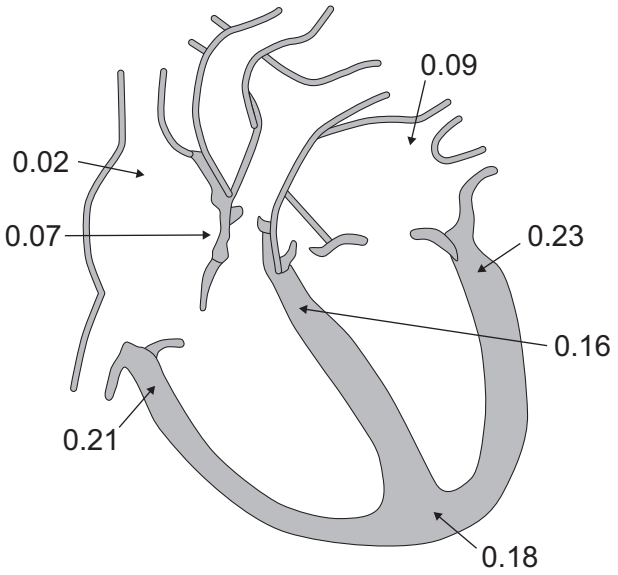
Answer **all** questions in the spaces provided.

0 1 Heart rate in humans can be controlled by myogenic stimulation.
The sinoatrial node (SAN) is the heart's 'pacemaker'. The SAN sends electrical impulses through the walls of the heart.

Figure 1 shows a section through the human heart. The numbers show the time taken in seconds for an electrical impulse to travel from the SAN to seven different parts of the heart.

Figure 1



Key

0.02 = impulse takes 0.02 seconds to travel from SAN to here

0.23 = impulse takes 0.23 seconds to travel from SAN to here

Electrical impulses in the heart wall can only pass from the atria to the ventricles through the atrioventricular node (AVN).

0 1 . 1 Use data from **Figure 1** to show that the AVN causes a slight delay in the transmission of the electrical impulse from the atria to the ventricles.

[2 marks]

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0 1 . 2 Explain how the delay in transmission of the impulse at the AVN helps the heart to function efficiently.

[2 marks]

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0 1 . 3 Use data from **Figure 1** to show that the ventricles contract from the base of the heart upwards.

[1 mark]

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0 1 . 4 Suggest why it is an advantage for the ventricles to contract from the base of the heart upwards.

[1 mark]

_____

_____

0 1 . 5 During exercise, chemoreceptors detect a change in the composition of the blood.

The chemoreceptors cause an increase in the heart rate.

Which substance increases in concentration in the blood during exercise and stimulates an increase in heart rate?

[1 mark]

Tick (✓) **one** box.

ATP ☐

Carbon dioxide ☐

Glucose ☐

Oxygen ☐

7

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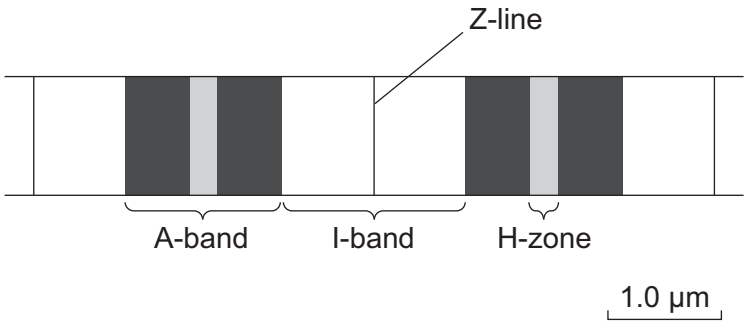
0 2 A skeletal muscle fibre contains many units called myofibrils.

Figure 2 shows part of a relaxed myofibril.

Figure 2



0 2 . 1 Explain how the distribution of the muscle proteins **actin** and **myosin** causes the banding pattern shown in **Figure 2**.

[4 marks]

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0 2 . 2 Calculate the length of **one** sarcomere shown in **Figure 2**.

Give your answer in micrometres (µm).

[2 marks]

Length of one sarcomere = _____ µm

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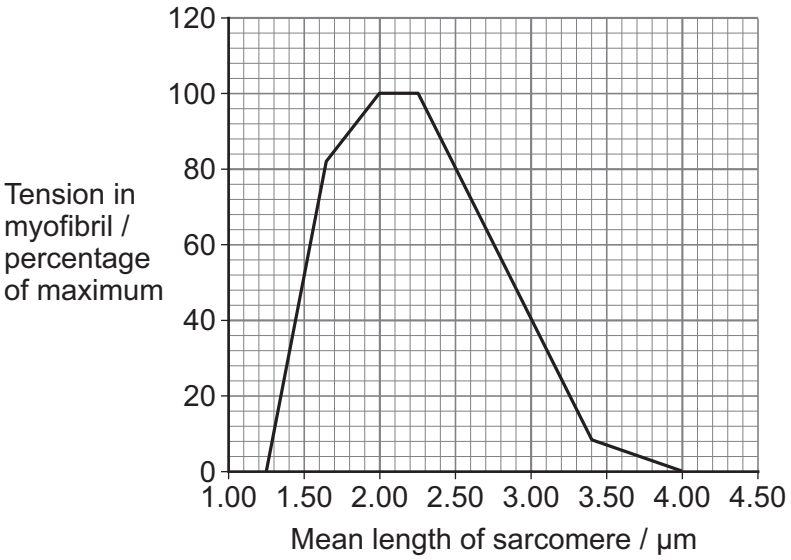
Figure 3 shows the relationship between the mean length of a sarcomere and the amount of tension developed in the myofibril.

Figure 3



0 2 . 3 The myofibril in **Figure 2** contracts by 20%.

Calculate the tension developed in the myofibril.

Use your answer from question **02.2** and information from **Figure 3**.

[2 marks]

Tension = _____ % of maximum

Question 2 continues on the next page

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0 2 . 4 Describe the role of calcium ions in the contraction of a myofibril.

[4 marks]

12

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Turn over for the next question

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0 3 Regulation of the temperature of the human body is an example of a homeostatic process.

0 3 . 1 State the meaning of the term, 'homeostatic process'.

[2 marks]

Human core body temperature normally varies between 36.8 and 37.9 °C.

When a person is exposed to cold and wet environmental conditions for several hours, the core body temperature may drop by 4 or 5 °C and the person suffers from hypothermia. Severe hypothermia may cause cardiac arrest.

A person with hypothermia needs to be warmed up slowly.

One suggested method is:

- remove the person's wet clothing and replace with dry clothing
- wrap the person in a blanket
- give the person a warm drink to swallow slowly
- allow the person to breathe warm, moist air from a ventilator machine.

0 3 . 2 Suggest how removing wet clothing and replacing with dry clothing helps to warm the body of a person with hypothermia.

[3 marks]

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0 3 . 3 **Table 1** compares the effects of:

- wrapping a person in a blanket
- allowing a person to breathe warm, moist air from a ventilator machine.

Table 1

Time / min	Change in core body temperature / °C	
	Person A: Blanket	**Person B: Breathing warm, moist air**
0	0.0	0.0
5	−0.3	+0.3
10	−0.2	+0.6
15	+0.6	+0.8
20	+1.6	+1.0
25	+2.0	+1.1
30	+2.2	+1.2
35	+2.1	+1.3
40	+2.0	+1.3
45	+1.9	+1.4
50	+1.9	+1.4

Doctors think that breathing warm, moist air is a better treatment for hypothermia than wrapping the person in a blanket.

Evaluate this opinion.

[4 marks]

9

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0 4 A nerve impulse is generated by the movement of ions across the axon membrane of a neurone.

Figure 4 shows changes in the permeability of part of an axon membrane to two types of ion, **A** and **B**. The changes in permeability cause an action potential in the neurone.

Figure 5 shows changes in the membrane potential during the action potential.

Figure 4

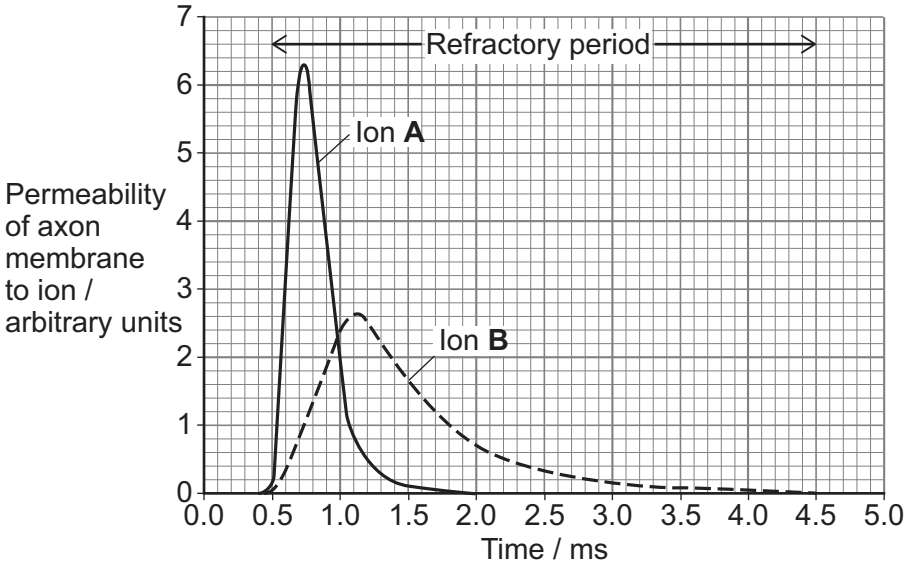
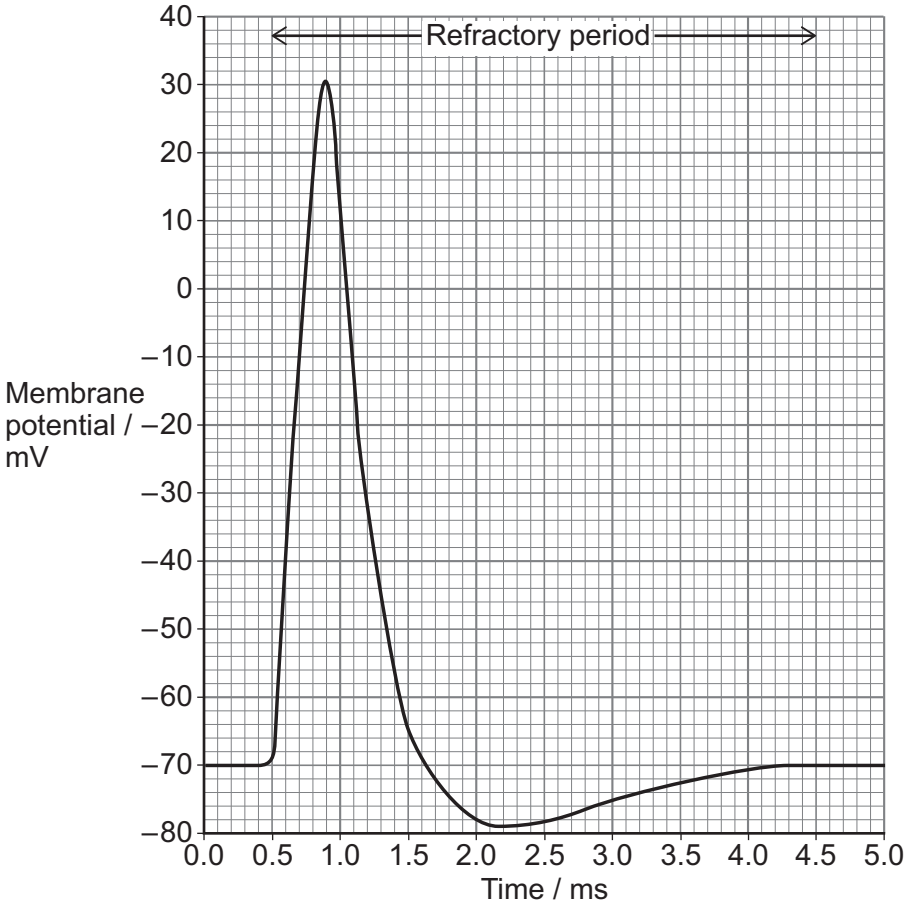


Figure 5



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0 4 . 1 Name ion **A** and ion **B** in **Figure 4**.

[1 mark]

A _____

B _____

0 4 . 2 Explain what causes the changes in membrane potential of the neurone between 0.5 milliseconds and 1.5 milliseconds.

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

[6 marks]

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0 4 . 3 Explain why the maximum frequency of action potentials along this neurone is 250 per second.

Use data from **Figure 5**.

[2 marks]

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0 4 . 4 One of the proteins in the axon membrane is an ATP-ase enzyme.

Scientists added a chemical inhibitor of the ATP-ase to a nerve.

After some time the nerve lost the ability to conduct action potentials.

Explain why the inhibitor prevented the production of action potentials.

[4 marks]

13

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0 5 Crop plants can be genetically modified to make them resistant to the herbicide glyphosate.

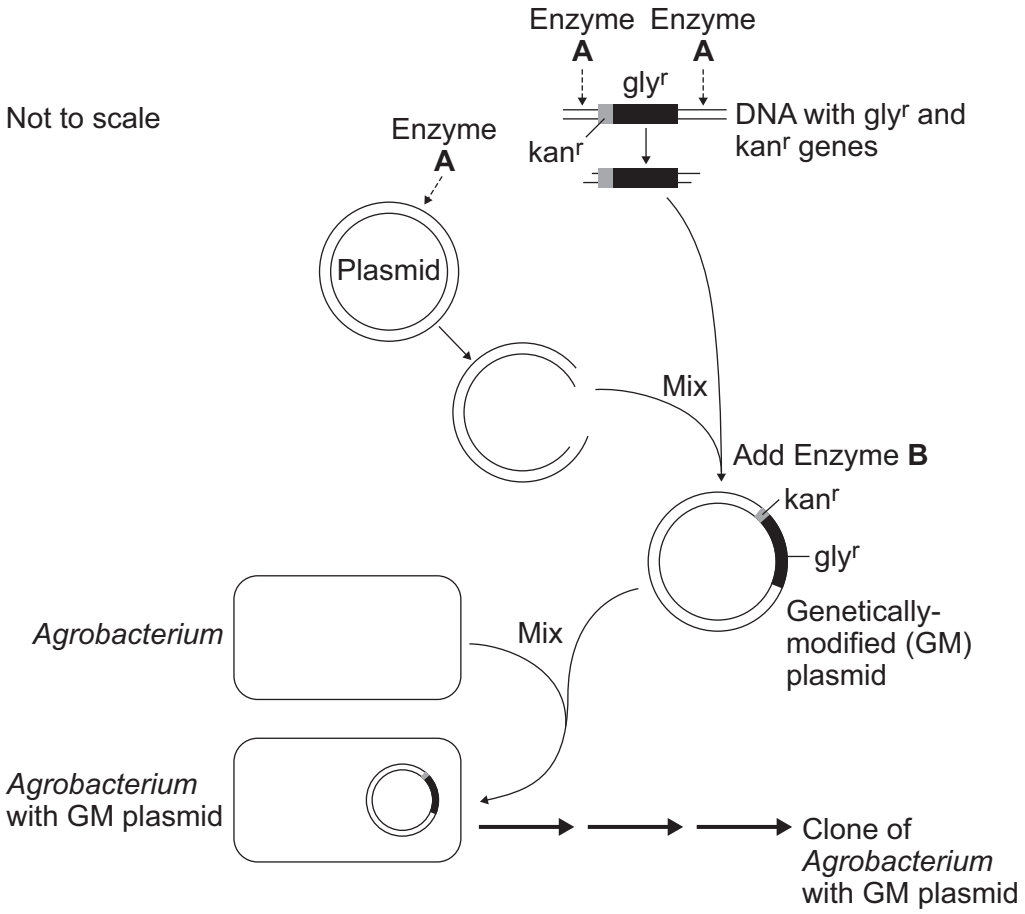
0 5 . 1 Explain the advantage of producing crops resistant to the herbicide glyphosate.

[3 marks]

Scientists used a bacterium called *Agrobacterium* to put the glyphosate-resistance gene (gly^r) into maize plants and soya plants.

Figure 6 shows how the scientists put a plasmid into *Agrobacterium*.
The plasmid contained the gly^r gene and a gene for resistance to a substance called kanamycin (kan^r).

Figure 6



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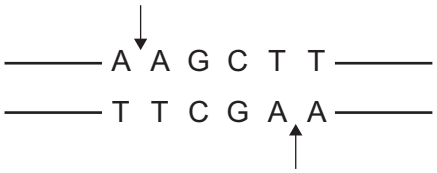
Enzyme **A** in **Figure 6** is a restriction endonuclease enzyme.

Enzyme **A** cuts DNA at the specific base sequence shown in **Figure 7**.

Figure 7



↓ and ↑ = positions where DNA is cut

0 5 . 2 Explain why enzyme **A** only cuts DNA at the specific positions shown in **Figure 7**.

[1 mark]

_____

_____

0 5 . 3 **Figure 6** shows that enzyme **A** is used for cutting:

- plasmid DNA
- DNA with the gly^r and kan^r genes.

Explain why scientists use the **same** enzyme to cut both pieces of DNA.

[2 marks]

_____

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0 5 . 4 Enzyme **B** in **Figure 6** joins the two pieces of DNA.

Give the name of enzyme **B**.

[1 mark]

_____

Question 5 continues on the next page

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0 5 . 5 **Figure 6** on page 14 shows the GM plasmid entering an *Agrobacterium* cell to form GM *Agrobacterium*.

The GM *Agrobacterium* divides repeatedly to form a clone of GM *Agrobacterium* cells.

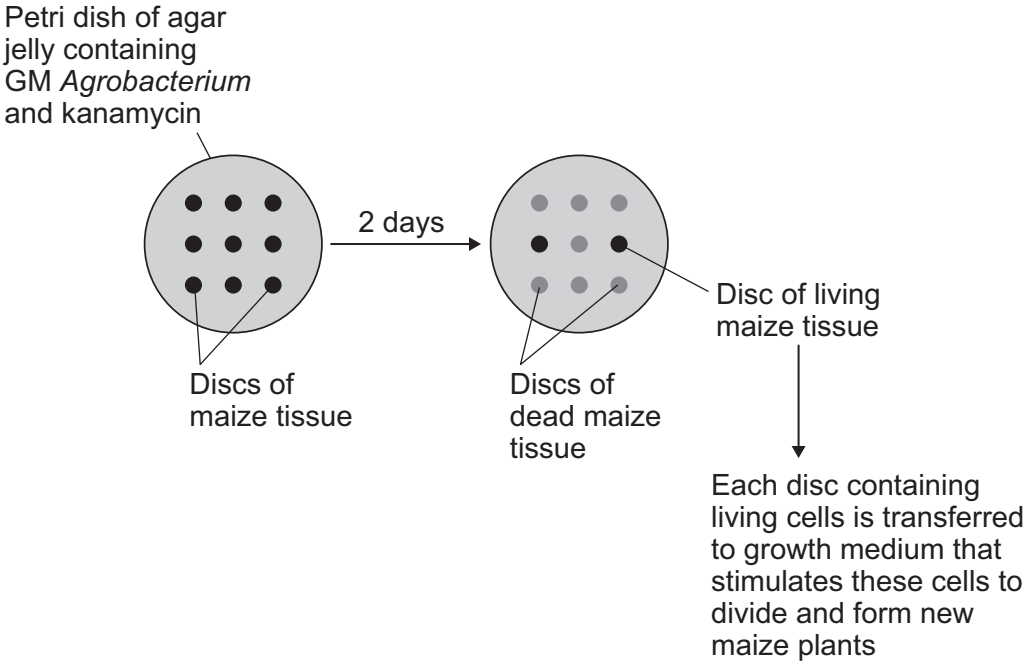
Name the type of cell division that produces the clone of GM *Agrobacterium* cells.

[1 mark]

_____

0 5 . 6 **Figure 8** shows how scientists can use the GM *Agrobacterium* to produce GM maize plants resistant to glyphosate.

Figure 8



Kanamycin will kill plant cells.

Explain why all of the cells of the maize plants produced as shown in **Figure 8** contain the gly^r gene.

[2 marks]

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Question 5 continues on the next page

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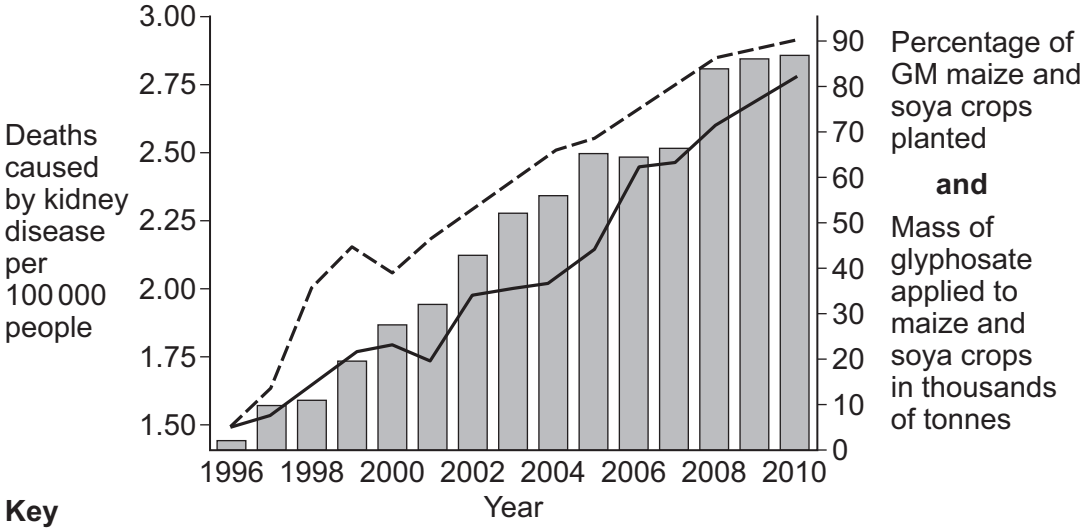
Some people have concerns about the use of GM herbicide-resistant crop plants.

Figure 9 shows data about the use of glyphosate and glyphosate-resistant maize and soya crops in the USA and human deaths caused by kidney disease.

Figure 9



Key

Number of deaths caused by kidney disease

Percentage of GM maize and soya crops planted

Mass of glyphosate applied to maize and soya crops

Do not write outside the box

A newspaper printed the data in **Figure 9** under the headline:

'Scientists show that herbicide-resistant GM crops cause kidney disease.'

0 5 . 7 Give evidence from **Figure 9** to support the newspaper's headline.

[1 mark]

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0 5 . 8 Suggest **three** reasons why the headline may **not** be valid.

[3 marks]

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14

Turn over for the next question

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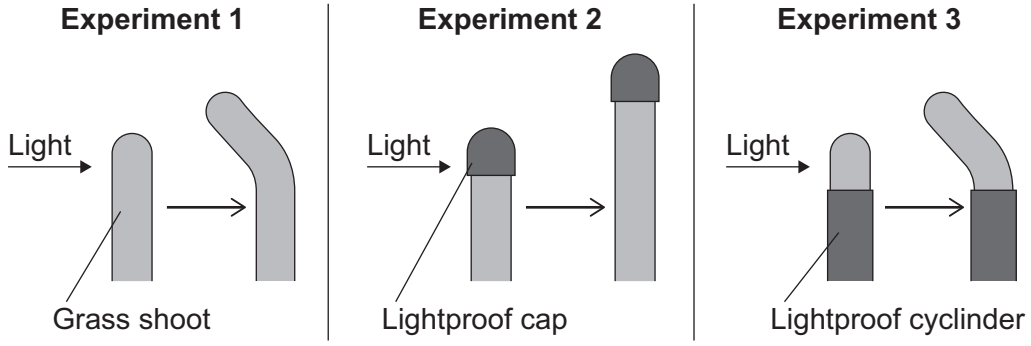
0 6 Charles Darwin investigated tropisms using grass shoots.

Figure 10 shows the results of three of Darwin's experiments.

Figure 10



0 6 . 1 Give **three** conclusions from the results of Darwin's investigation.

[3 marks]

1 _____

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2 _____

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3 _____

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0 6 . 2 Suggest a suitable control for Darwin's investigation.

[1 mark]

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Do not write outside the box

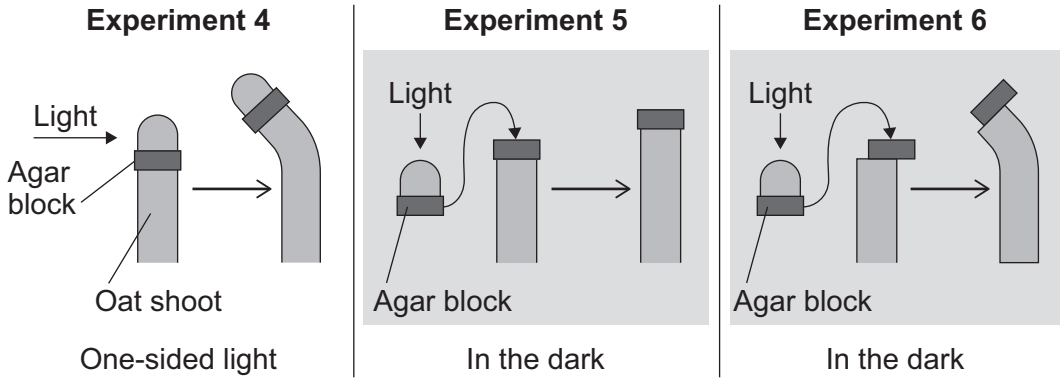
A different scientist investigated tropisms using oat shoots.

The scientist:

- cut the tips off some growing shoots
- placed each tip on a small block of agar jelly
- placed each agar block on top of a cut shoot in one of three different ways, as shown in **Figure 11**.

Figure 11 also shows the results of each experiment.

Figure 11



0 6 . 3 This scientist concluded:

'A chemical substance diffuses from the shoot tip into the agar.
This substance stimulates growth further down the shoot.'

Evaluate this conclusion.

You should refer to experiments **4**, **5** and **6** in your answer.

[3 marks]

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A student thinks that the chemical substance is an auxin called indoleacetic acid (IAA). The student investigates the role of IAA in growth using pieces from the shoot of a single daffodil plant.

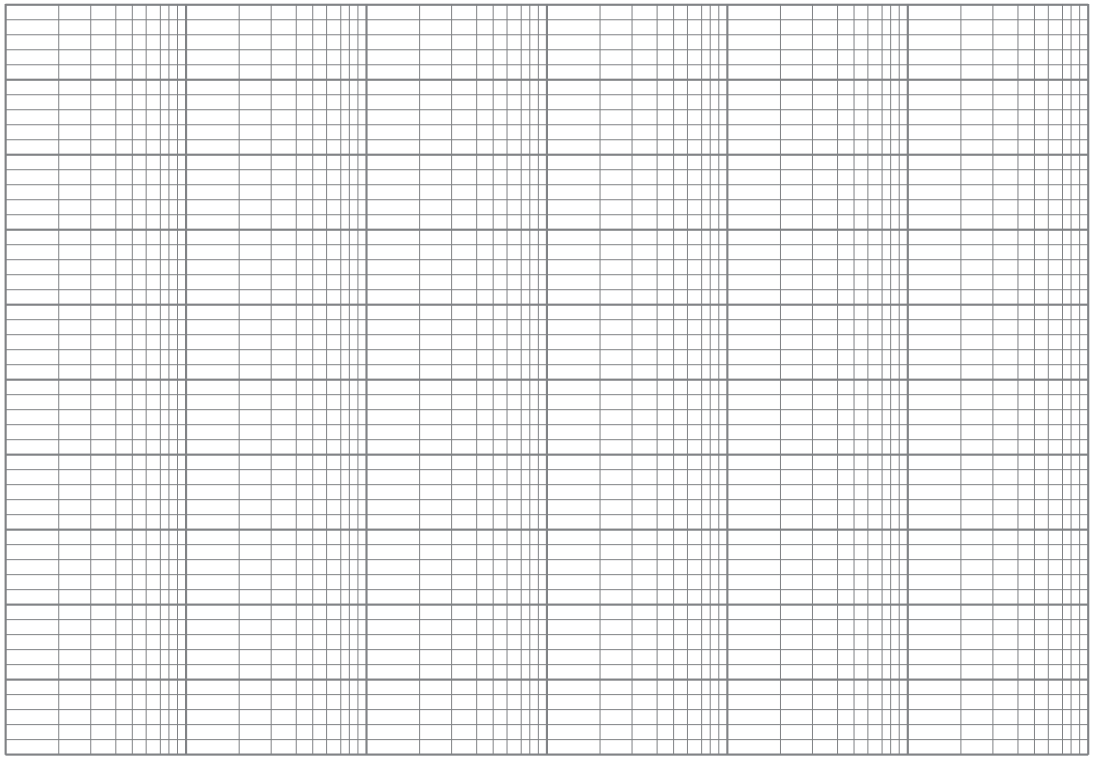
Table 2 shows the results of the student's investigation.

Table 2

IAA concentration / ppm	Percentage stimulation of shoot growth
10^{-4}	0
10^{-3}	5
10^{-2}	20
10^{-1}	60
10^{0}	130
10^{1}	160
10^{2}	−20

0 6 . 4 Plot the results from **Table 2** on the graph paper. Join the points with a suitable line.

[3 marks]



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0 6 . 5 What conclusions can you make about the effect of IAA on shoot growth?

Use the student's results.

Include data from the graph in your answer.

[2 marks]

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0 6 . 6 Explain why using only one plant of one species in the investigation may invalidate your conclusions in question **06.5**.

[3 marks]

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15

Turn over for the next question

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0 7 Scientists have found a correlation between prostate cancer and exposure to cadmium ions.

The scientists investigated the effect of cadmium ions on cells from a human prostate gland.

The scientists placed some prostate gland cells in a medium containing 10 μmoles dm^{-3} cadmium ions for 10 weeks and some cells in a control medium.

At intervals, the scientists measured:

- how much DNA was methylated
- how much mRNA for the enzyme methyl transferase was produced
- how much p16 tumour-suppressor protein was produced.

The scientists also compared the amount of DNA methylation in cells from several different types of cancer with the amount of DNA methylation in normal, non-cancerous cells.

Figures 12, **13**, **14** and **15** show the scientists' results.

Figure 12

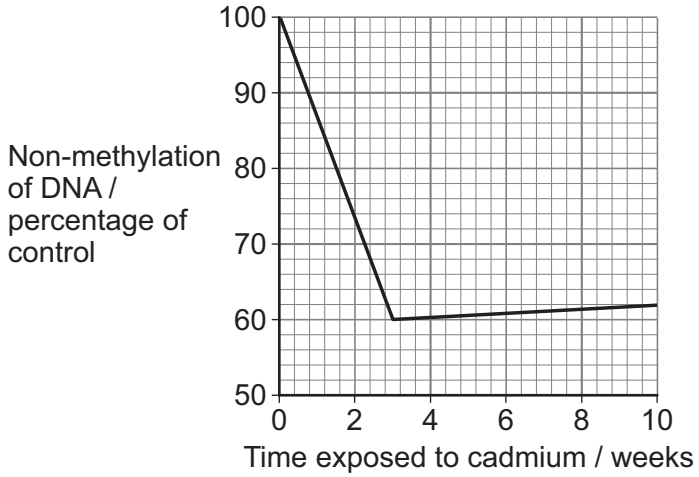


Figure 13

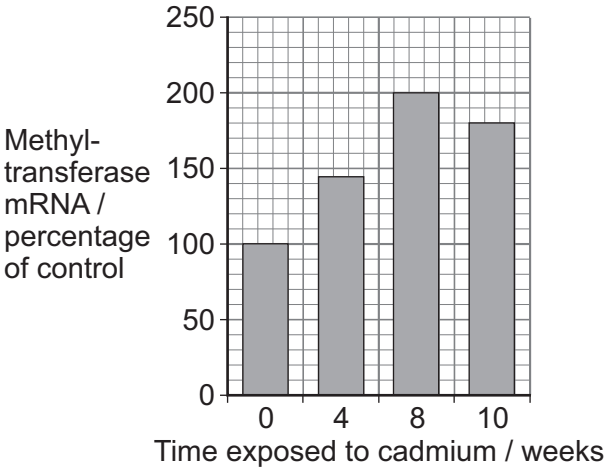


Figure 14

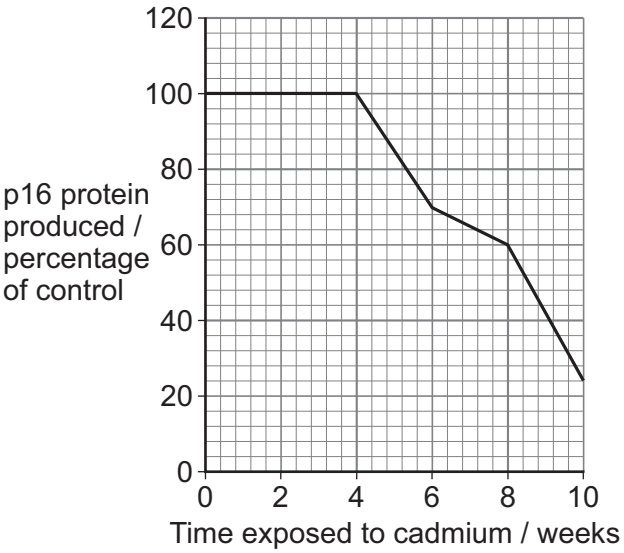
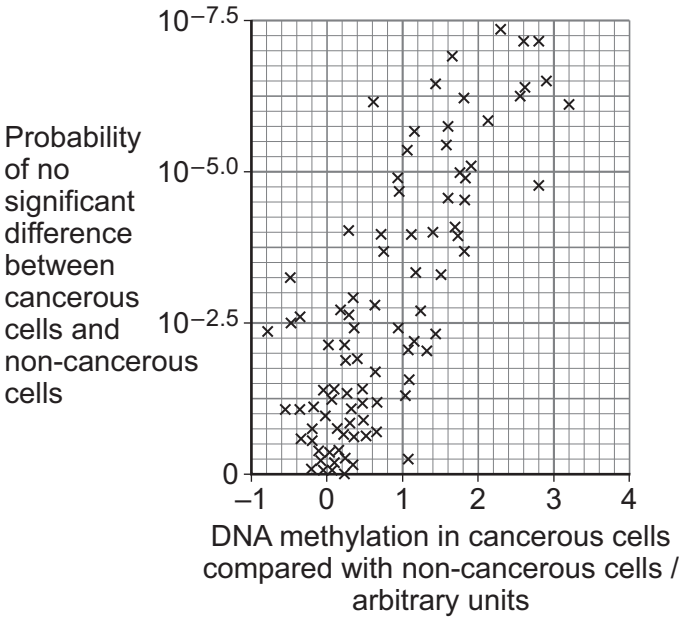


Figure 15



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0 7 . 1 The scientists concluded that increased methylation of the promoter region of tumour suppressor genes is an important factor in stimulating the growth of tumours.

Use information from **Figures 12**, **13**, **14** and **15** to give evidence for this conclusion.

[5 marks]

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5

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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