OXFORD
INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 4 Control

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	
TOTAL	

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

0 1 When an action potential reaches the end of a neurone, a sequence of events occurs at a synapse.

Figure 1 shows the sequence of events at a synapse.

Figure 1

Figure 1 not reproduced here due to third-party copyright restrictions

0 1 . 1 Describe the role of mitochondria in synaptic transmission.

[2 marks]

Do not write outside the box

0 1 . 2 Describe the sequence of events in the **postsynaptic** neurone after large numbers of acetylcholine molecules have fused with the cholinergic receptors.

[4 marks]

0 1 . 3 Describe the importance of acetylcholinesterase at the synapse.

Use information from **Figure 1** and your own knowledge.

[2 marks]

Question 1 continues on the next page

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0 1 . 4 Chemicals called organophosphates inhibit acetylcholinesterase.

Suggest how these organophosphates work as insecticides to kill insects.

[3 marks]

11

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0 2 Skeletal muscle contains two types of fibres: fast and slow.

0 2 . 1 State **two** differences between fast and slow muscle fibres.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 2 The proportion of fast and slow fibres can be determined by using a stain for the enzyme ATPase.

Explain why both types of fibre contain ATPase.

[2 marks]

_____

_____

_____

_____

_____

_____

Question 2 continues on the next page

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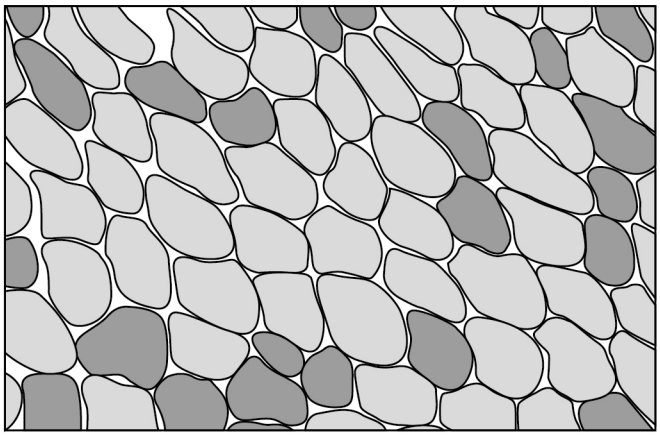
Figure 2 shows a section of muscle tissue.

Fibres containing a lot of ATPase stain more darkly.

Figure 2



0 2 . 3 Calculate the percentage of dark-staining fibres in the muscle tissue shown in **Figure 2**.

- Count all fibres that are completely within **Figure 2**.
- Count fibres that are touching the right side and the upper side.
- Do not count fibres that are touching the left side and the lower side.

[2 marks]

Percentage = _____ %

Do not write outside the box

Question 2 continues on the next page

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ANSWER IN THE SPACES PROVIDED

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Investigations show that exercise and training can change**:**

- the number of mitochondria in a fibre
- the diameter of fibres
- the proportion of fast and slow fibres.

The number of muscle fibres in a muscle remains constant.

Figure 3 shows the percentage of fast and slow fibres measured in different types of athlete.

Figure 3

Figure 3 not reproduced here due to third-party copyright restrictions

0 2 . 4 Which type of athlete shown in **Figure 3** would have muscle fibres with the highest number of mitochondria?

Explain your reasons for choosing this type of athlete.

[2 marks]

Do not write outside the box

0 2 . 5 Suggest why the leg muscles of cyclists and speed skaters are usually much larger than the leg muscles of non-athletes.

[2 marks]

10

Turn over for the next question

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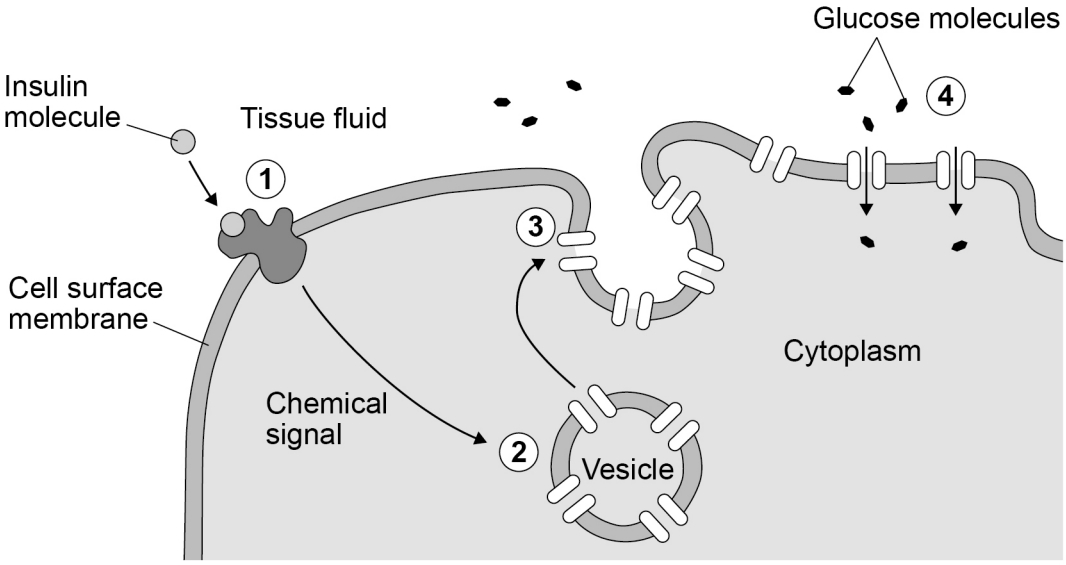
0 3 Insulin is involved in the control of blood glucose.

Figure 4 shows how insulin affects a muscle cell.

Figure 4



0 3 . 1 Describe the role of insulin in reducing blood glucose concentration.

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

[5 marks]

Do not write outside the box

0 3 . 2 Type 2 diabetes is increasingly common in the populations of economically developing countries.

Suggest **three** reasons for this increase.

[3 marks]

1

2

3

Question 3 continues on the next page

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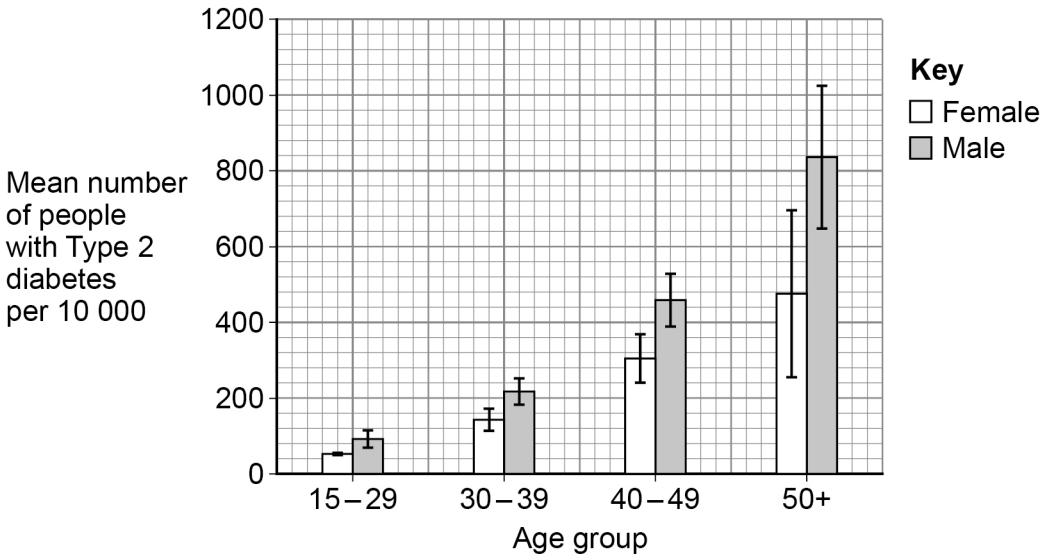
Figure 5 shows the mean number of people with Type 2 diabetes from different regions of Thailand.

The bars show standard errors.

Figure 5



0 3 . 3 Describe the patterns of Type 2 diabetes in Thailand shown in **Figure 5**.

Do **not** refer to standard errors in your answer.

[2 marks]

Do not write outside the box

0 3 . 4 What do the standard error bars indicate about the differences between the incidence of Type 2 diabetes in males and females in Thailand?

[2 marks]

12

Turn over for the next question

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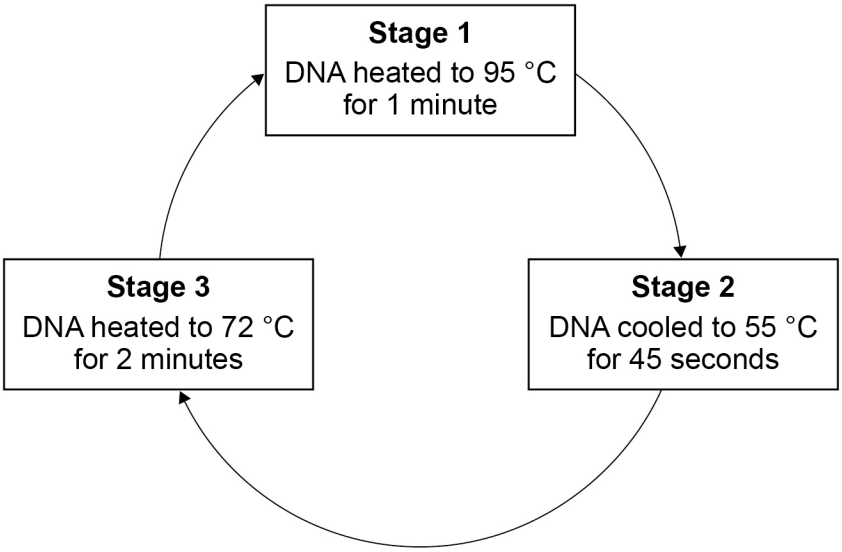
0 4 The polymerase chain reaction (PCR) can be used to amplify DNA fragments.

Figure 6 shows a simplified version of the steps in the PCR.

Figure 6



0 4 . 1 Describe the function of each stage shown in **Figure 6**.

[6 marks]

Stage 1 _____

_____

_____

_____

Stage 2 _____

_____

_____

_____

Stage 3 _____

_____

_____

_____

Do not write outside the box

0 4 . 2 One molecule of DNA is added to a PCR machine.

Calculate the number of molecules of DNA after 12 cycles.

Give your answer in standard form to 3 significant figures.

[2 marks]

Number of copies = _____

Influenza is a disease caused by a virus. The virus has many different strains. A new strain of influenza A virus called H1N1 emerged in 2009.

PCR can be used to identify the strain of influenza by copying target sequences from the genetic material of the virus. The first stage of this technique involves adding reverse transcriptase to the virus.

0 4 . 3 Suggest why reverse transcriptase is added to the viral genetic material.

[2 marks]

_____

_____

_____

_____

_____

_____

Gene probes are short sections of single-stranded DNA that can identify the copied target sequences. The probes can have fluorescent markers attached which emit light.

0 4 . 4 Suggest why the probes bind to the new copies of the DNA.

[1 mark]

_____

_____

_____

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0 4 . 5 Suggest how the fluorescent probes can be used to give scientists an estimate of the amount of DNA produced.

[1 mark]

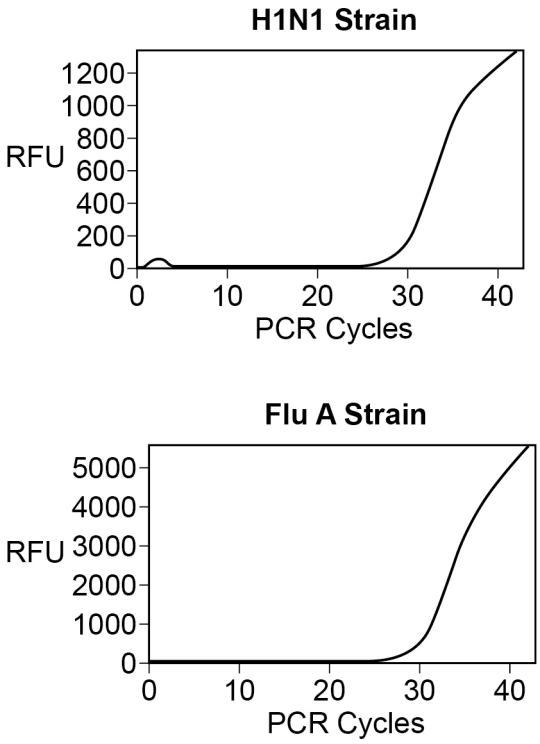
_____

_____

_____

Figure 7 shows the results of PCR cycles on two strains of influenza virus.

Figure 7



Key

RFU = Relative Fluorescence Units

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0 4 . 6 The same fluorescent probe is added to the genetic material from each of the two strains of influenza virus.

Suggest why the viral strains give different results as shown in **Figure 7**.

[2 marks]

0 4 . 7 Explain why it is important for scientists to identify new strains of influenza quickly.

[2 marks]

16

Turn over for the next question

Do not write outside the box

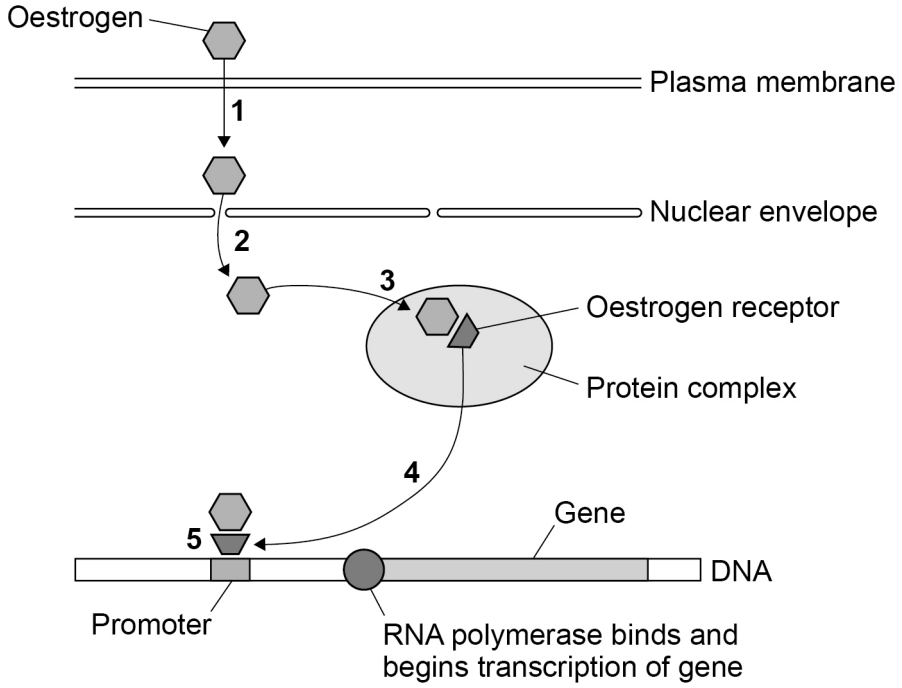
0 5 Various mechanisms control gene expression.

0 5 . 1 Give the meaning of the term **epigenetic control**.

[2 marks]

Figure 8 shows how oestrogen stimulates the transcription of a target gene.

Figure 8



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High levels of oestrogen can cause oestrogen-dependent breast tumours.

A drug called tamoxifen is used to treat oestrogen-dependent breast tumours. Tamoxifen is converted to endoxifen in the liver.

Figure 9 shows the structure of oestrogen and endoxifen.

Figure 9

Oestrogen **Endoxifen**

0 5 . 2 Use information from **Figure 8** and **Figure 9** to suggest how endoxifen inhibits the growth of tumour cells.

[3 marks]

Question 5 continues on the next page

Do not write outside the box

Scientists have discovered enzymes called RNA-dependent RNA polymerases (RDRs). These RDRs catalyse the production of double-stranded RNA using molecules of mRNA in the cytoplasm.

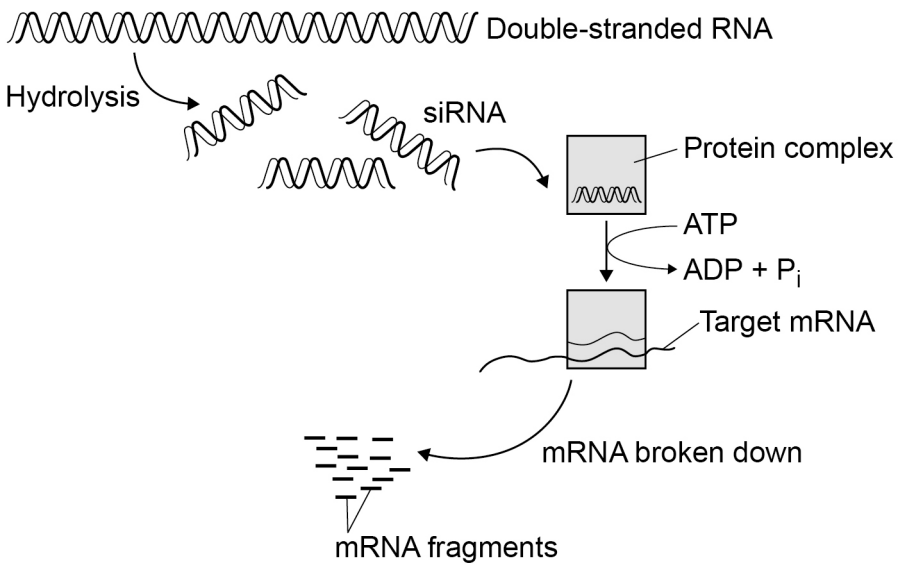
0 5 . 3 Suggest how the RDRs catalyse the production of double-stranded RNA from mRNA molecules.

[2 marks]

The double-stranded RNA molecules are then hydrolysed into small fragments called small interfering RNA (siRNA).

Figure 10 shows how the siRNA controls gene expression.

Figure 10



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0 5 . 4 Over-expression of a gene causes the production of many molecules of mRNA in the cytoplasm.

Describe how the production of siRNA reduces the expression of a particular gene. Use information from **Figure 10**.

[4 marks]

11

Turn over for the next question

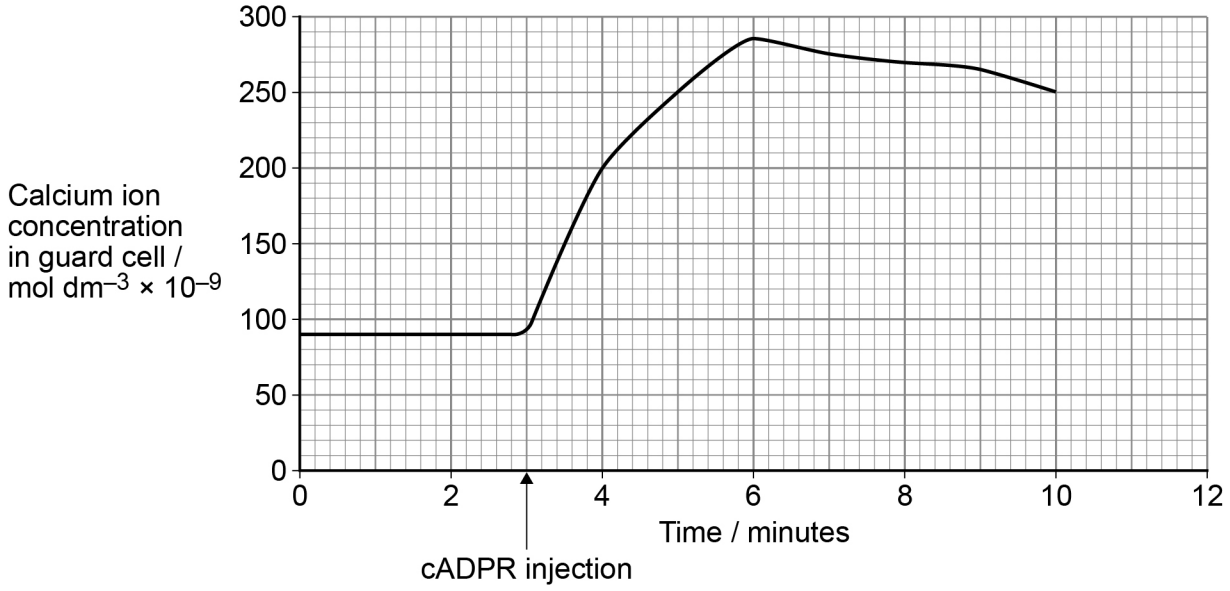
Do not write outside the box

0 6 Plants release a compound called cyclic adenosine 5′-diphosphoribose (cADPR) in conditions of reduced water availability.

Scientists injected cADPR into guard cells. Increased calcium ion concentration in guard cells affects the turgor of the cells.

Figure 11 shows the effect of injecting cADPR on the calcium ion concentration of guard cells.

Figure 11



0 6 . 1 Calculate the percentage increase in calcium ion concentration from 3 to 6 minutes.

Give your answer to 3 significant figures.

[2 marks]

Percentage increase = _____ %

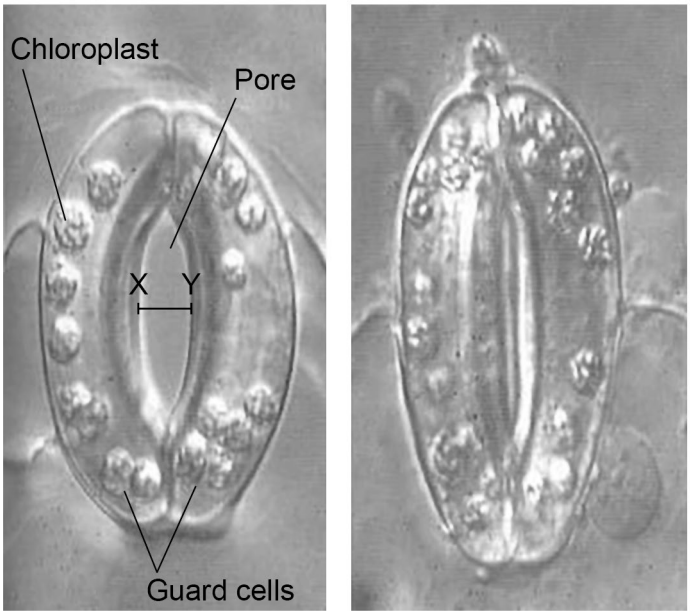
Do not write outside the box

Figure 12 shows two stomata.

Photograph **A** shows the guard cells before injecting with cADPR.

Photograph **B** shows the guard cells after injecting with cADPR.

Figure 12



Photograph **A** Photograph **B**

0 6 . 2 The magnification of **Figure 12** is ×850.

Calculate the width of the pore (stomatal aperture) marked X–Y in photograph **A**.

Give your answer to the nearest micrometre.

[2 marks]

Stomatal aperture = _____ µm

Question 6 continues on the next page

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0 6 . 3 **Photograph B** in **Figure 12** (on page 23) shows the effect of injecting the guard cells with cADPR.

Scientists have shown that cADPR stimulates the active transport of potassium ions out of guard cells.

Explain the effect of cADPR shown in **Figure 11** and **Figure 12** (on pages 22 and 23).

[4 marks]

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Question 6 continues on the next page

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ANSWER IN THE SPACES PROVIDED

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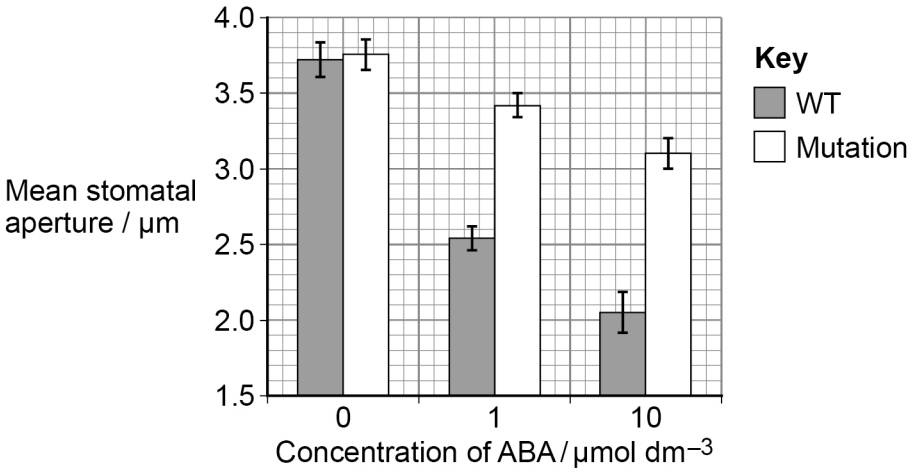
Abscisic acid (ABA) is a plant hormone involved in the response of plants to reduced water availability.

Scientists investigated the effect of different concentrations of ABA on stomatal aperture.

Figure 13 shows the effect of a mutation found in some species of plants compared with normal wild type plants (WT). The bars show standard errors.

Figure 13



0 6 . 4 Describe the effect of the mutation on the control of stomatal aperture by abscisic acid (ABA). Use information from **Figure 13**.

[3 marks]

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0 6 . 5 Describe how the scientists could have obtained the data shown in **Figure 13**.

[4 marks]

15

END OF QUESTIONS

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