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 5 Synoptic paper

Tuesday 25 June 2019 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a pencil
- 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.
- All working must be shown.
- 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).
- 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.
- In Question 6, 2 marks will be awarded for the quality of your written communication.
  You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

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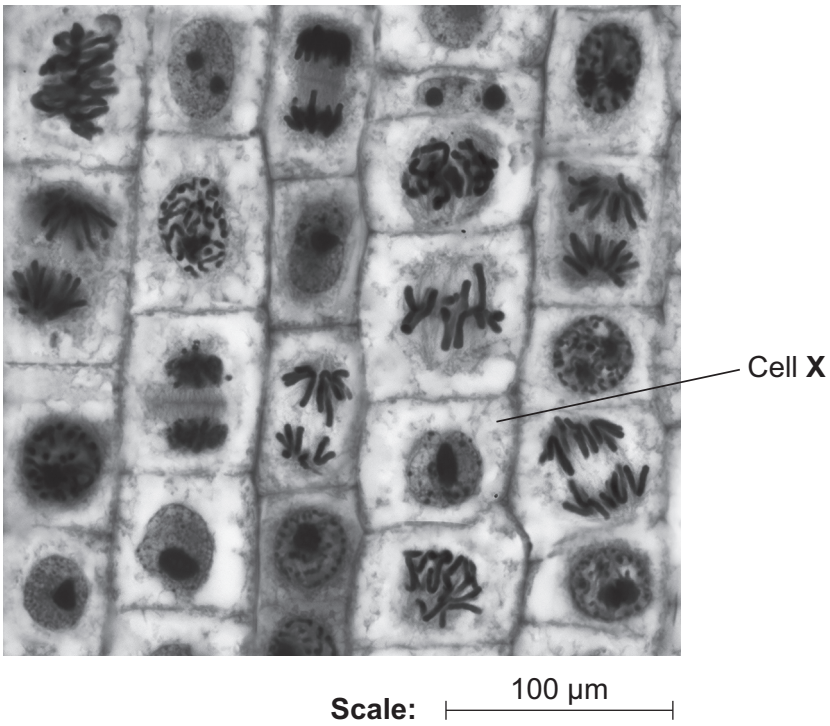
Answer **all** questions in the spaces provided.

0 1 Students investigate mitosis in the roots of onion plants.

This is the method the students use:
- cut sections of the root tips
- stain the sections
- place the sections on microscope slides.

Figure 1 shows some of the cells on one student's microscope slide.

Figure 1



0 1 . 1 Draw a diagram of **one** cell in metaphase from **Figure 1**.

[3 marks]

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0 1 . 2 Calculate the width of cell **X**.
Give your answer in micrometres (μm).

[1 mark]

Width of cell **X** = _____ μm

Question 1 continues on the next page

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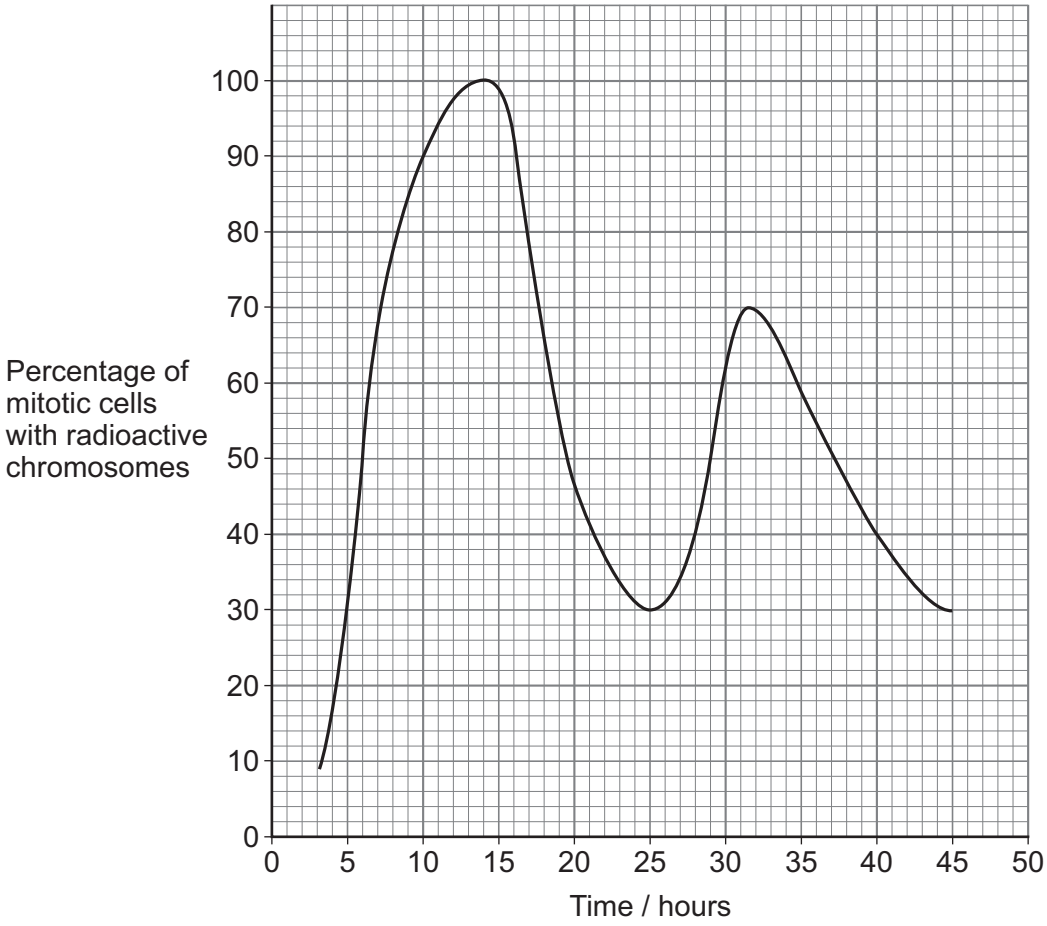
Scientists measure the time taken to complete the cell cycle in onion root tips.

This is the method the scientists use:

1. place onion bulbs on top of conical flasks containing tap water with the roots in the water
2. add a measured amount of radioactively-labelled thymine to the water
3. after 1 hour, remove the liquid from each flask
4. rinse the roots with water
5. repeat step 1
6. at intervals, make root tip squash preparations of some of the roots
7. measure the percentage of cells in mitosis that have radioactive chromosomes.

Figure 2 shows the scientists' results. Two cell cycles occurred during the investigation.

Figure 2



0 1 . 3 Explain why the scientists add radioactive thymine at step 2, and **not** radioactive adenine, cytosine or guanine.

[2 marks]

_____

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0 1 . 4 The scientists measure the time interval between two points on the graph.

They use the point when 50% of the cells in mitosis first become radioactive during the first cell cycle and the point when 50% of the cells in mitosis first become radioactive during the second cell cycle.

The scientists use this time interval as the value for the time taken for one cell cycle.

Calculate the time taken for one cell cycle.

Use information from **Figure 2**.

[1 mark]

Time taken for one cell cycle = _____ hours

Students in one class count all the cells they observe in the different phases of the cell cycle.

Table 1 shows the students' results.

Table 1

Phase	Number of cells
Interphase	461
Prophase	12
Metaphase	2
Anaphase	2
Telophase	3

0 1 . 5 The number of cells in each phase is proportional to the time taken for each phase.

Calculate the time the cells are in anaphase.

Use information from **Table 1** and your answer to Question **01.4**.

Give your answer in minutes, correct to the nearest whole number.

[2 marks]

Time in anaphase = _____ minutes

Question 1 continues on the next page

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0 1 . 6 Suggest **two** reasons why your answer to Question **01.5** may not be accurate.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 1 . 7 Calculation of the mitotic index using information from **Figure 1** gives a value of 0.48

Calculation of the mitotic index using data from **Table 1** gives a value of 0.04

Suggest why the two values for the mitotic index are very different.

[1 mark]

_____

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12

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Turn over for the next question

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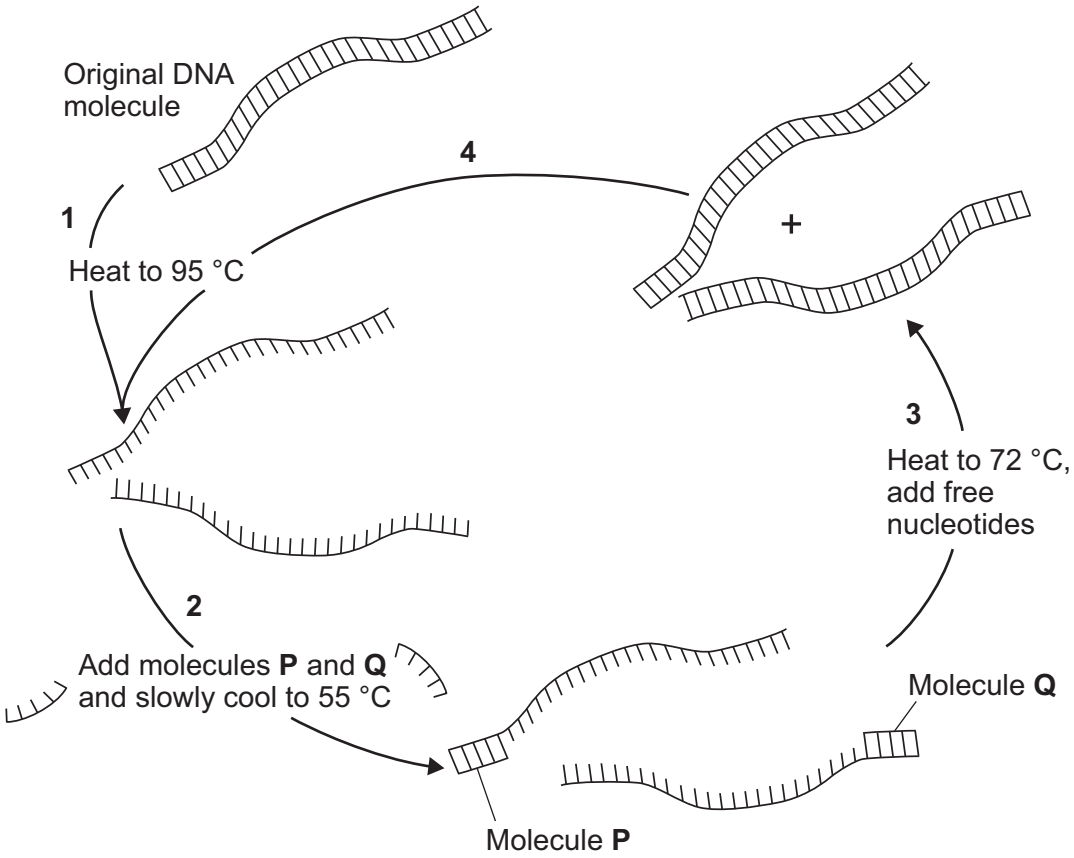
0 2 Scientists use the polymerase chain reaction (PCR) to make many copies of a DNA molecule.

Figure 3 shows one cycle of PCR.

Figure 3



0 2 . 1 Explain why the DNA is heated to 95 °C at step **1**.

[2 marks]

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0 2 . 2 Molecule **P** and Molecule **Q** are 'primers'.

These primers bind to single-stranded DNA at step **2**.

Give the reason why two **different** primers are needed.

[1 mark]

_____

_____

_____

0 2 . 3 At what step in the PCR cycle does DNA-polymerase catalyse a reaction?

Tick (✓) **one** box.

[1 mark]

1 ☐ **2** ☐ **3** ☐ **4** ☐

0 2 . 4 Police scientists find small samples of a criminal's DNA at the scene of a crime.

The scientists can use PCR to make many copies of the DNA.

Calculate how many molecules of the DNA there will be after 15 cycles of PCR, starting with one molecule of DNA.

Give your answer:
- in standard form
- to 3 significant figures.

[2 marks]

Number of DNA molecules after 15 cycles of PCR = _____

6

Turn over for the next question

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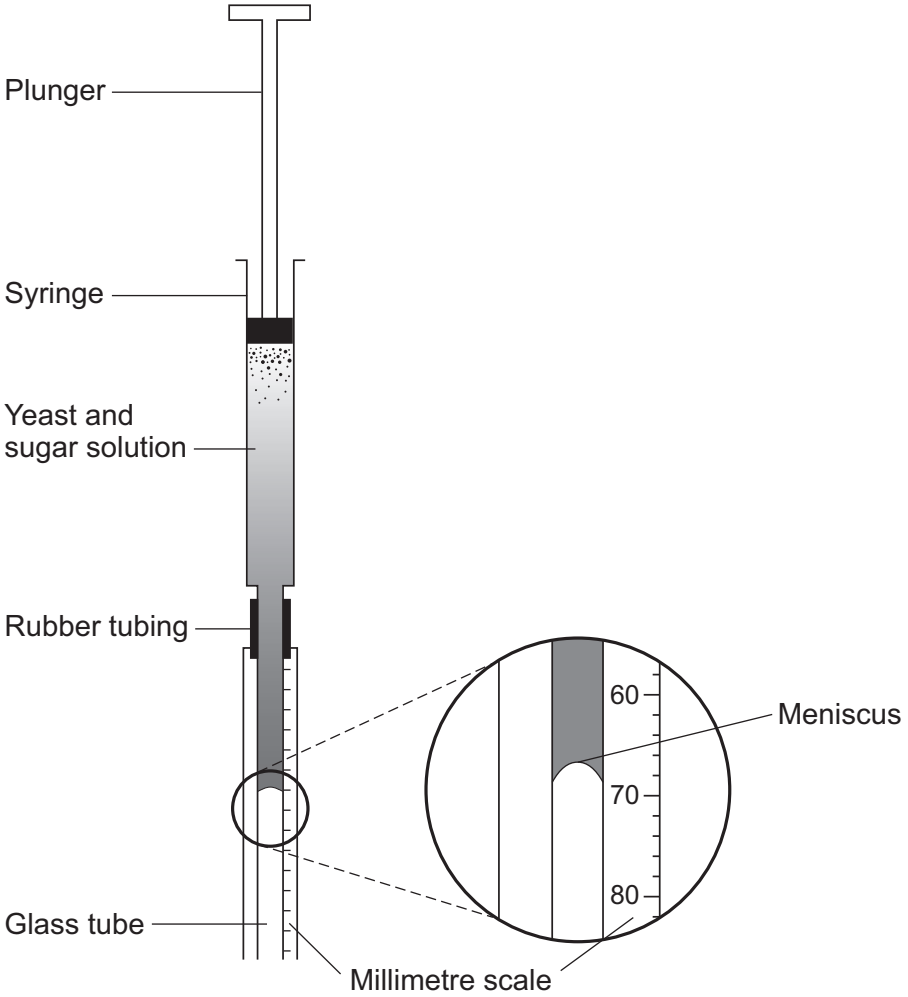
0 3 Students investigate anaerobic respiration in yeast using three different sugars:

- fructose
- glucose
- lactose.

Figure 4 shows the apparatus the students use.

Figure 4



Yeast produces carbon dioxide during respiration.
The carbon dioxide pushes the yeast and sugar solution down the glass tube.

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0 3 . 1 Describe how you would use the apparatus shown in **Figure 4** to compare the effect of using each of the three sugars, fructose, glucose and lactose, on the rate of respiration in yeast.

Include details of how you would control any other variables that might affect the results.

[6 marks]

Question 3 continues on the next page

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Table 2 shows the students' results.

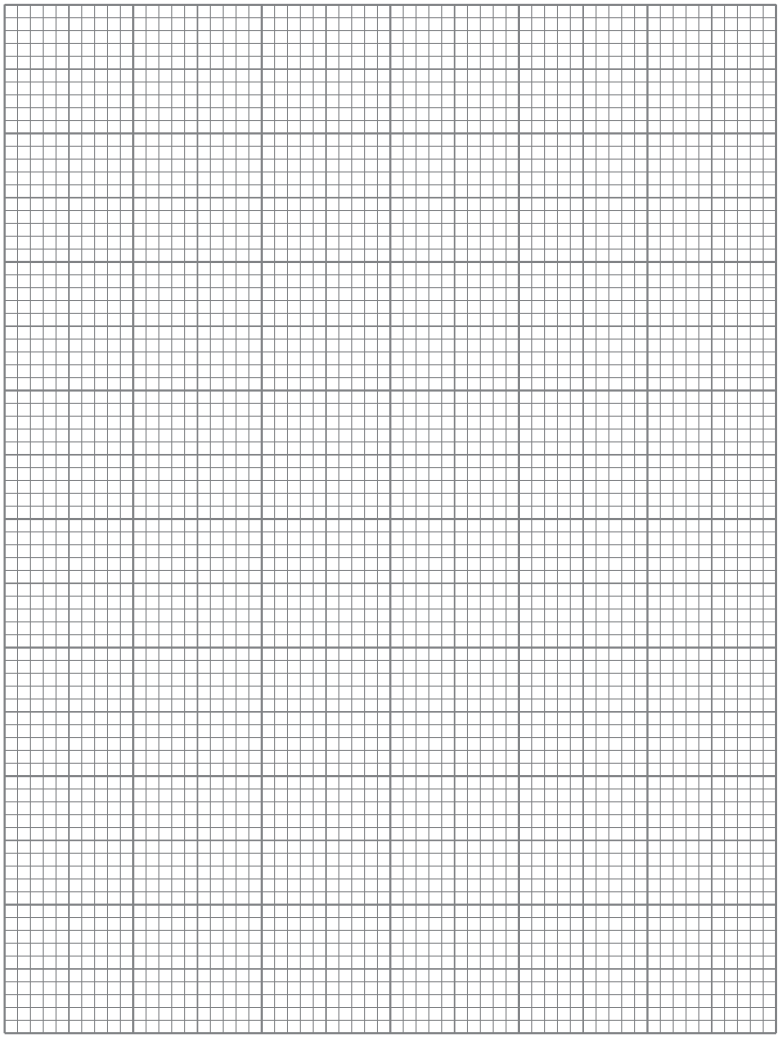
Table 2

Time / min	Position of meniscus on scale / mm		
	Fructose	Glucose	Lactose
0	0	0	0
10	0	0	0
20	19	19	0
30	46	30	1
40	60	36	4
50	71	55	4

0 3 . 2 Draw a graph of the results shown in **Table 2**.

Draw a line of best fit for each sugar.

[4 marks]



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One student thinks that the result for glucose at 40 minutes is an anomaly.

0 3 . 3 Give evidence that the result for glucose at 40 minutes is an anomaly.

[1 mark]

_____

_____

_____

_____

0 3 . 4 Suggest **one** possible cause for this anomalous result.

[1 mark]

_____

_____

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0 3 . 5 What should the students do to check that the result for glucose at 40 minutes really is an anomaly?

[1 mark]

_____

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13

Turn over for the next question

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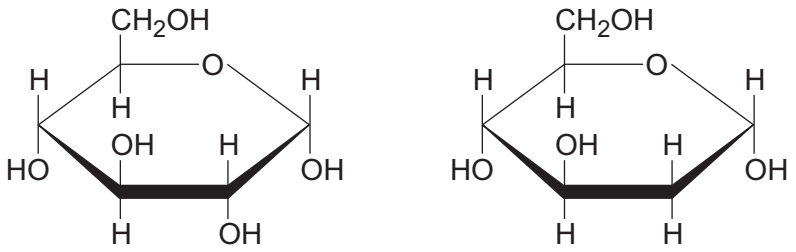
0 4 Type 2 diabetes is the most common form of diabetes.
Type 2 diabetes can be treated with drugs.

Scientists investigate the effect of the drug Troglitazone (TGZ) on the uptake of a substance called 2-deoxyglucose by muscle cells.

Figure 5 shows the structure of glucose and of 2-deoxyglucose.

Figure 5



Glucose 2-deoxyglucose

0 4 . 1 2-deoxyglucose can:
- enter muscle cells through glucose transporter proteins
- act as a competitive inhibitor of an enzyme in glucose metabolism.

Use information from **Figure 5** to explain why.

[2 marks]

In their investigation, the scientists use 2-deoxyglucose labelled with the radioactive isotope, ^{3}H.

The scientists measure the uptake of the 2-deoxyglucose by:

- a group of muscle cells treated with TGZ
- a control group of muscle cells.

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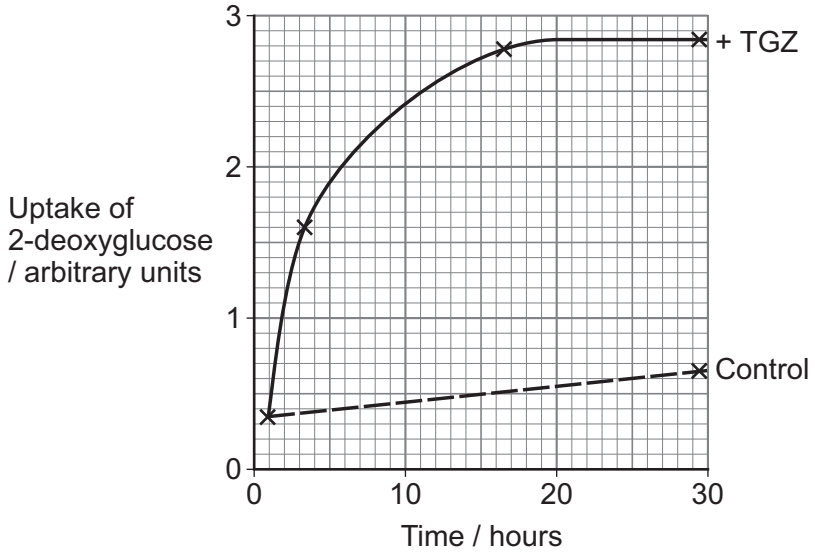
Figure 6 shows the scientists' results.

Figure 6



Each point plotted in **Figure 6** is the mean of 12 repeats.

0 4 . 2 Why do the scientists use 2-deoxyglucose labelled with the isotope ^{3}H?

[1 mark]

_____

_____

0 4 . 3 Suggest how the scientists should treat the control muscle cells.

[1 mark]

_____

_____

0 4 . 4 Describe the effect of TGZ on the uptake of 2-deoxyglucose by muscle cells.

Use data from **Figure 6** in your answer.

[2 marks]

_____

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0 4 . 5 In this investigation, the scientists use a substance similar to glucose that cannot be metabolised.

Explain why.

[2 marks]

_____

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0 4 . 6 TGZ was used for treating Type 2 diabetes for only 3 years.

TGZ was then withdrawn from use.

Suggest **one** reason why.

[1 mark]

_____

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_____

9

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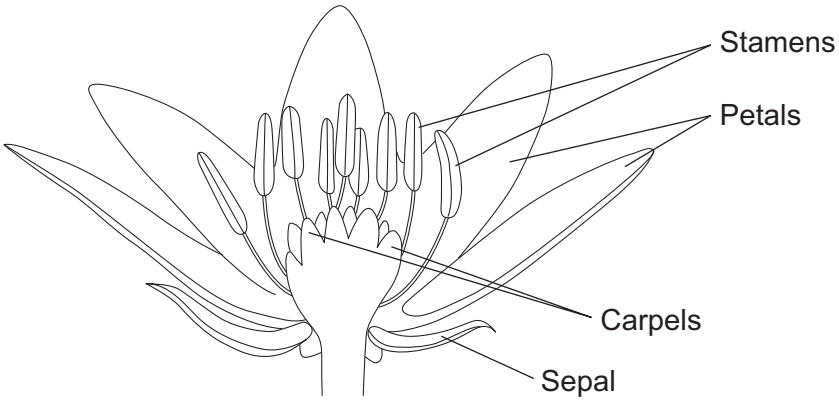
0 5 The celandine is a plant found growing wild in many countries in the northern hemisphere.

Figure 7 shows a section through a celandine flower.

Figure 7

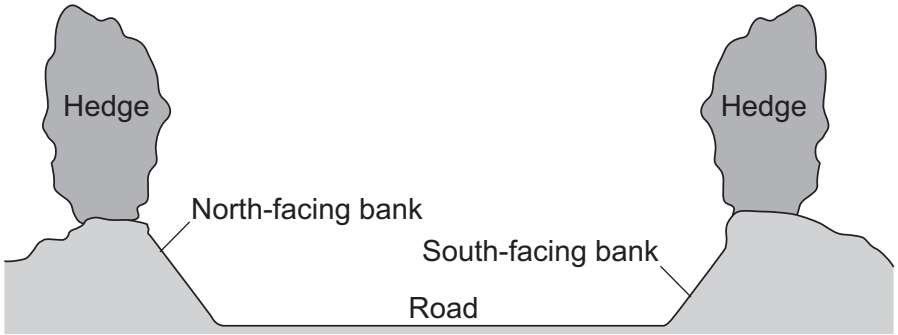


The numbers of petals, stamens and carpels in the flowers are very variable.

Students compare the celandine flowers found on north-facing and south-facing road banks by a road in the UK.

Figure 8 shows a section through the road.

Figure 8



The students want to investigate whether the environment affects the numbers of petals and stamens in the flowers.

0 5 . 1 Suggest **three** abiotic environmental factors that might cause the plants to grow differently on the two road banks.

[3 marks]

1 _____

2 _____

3 _____

Turn over ▶

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The students collect 30 celandine flowers from the north-facing bank and 30 celandine flowers from the south-facing bank.

0 5 . 2 Why do the students collect a large number of flowers from each road bank?

[2 marks]

0 5 . 3 Describe how the students should choose which flowers to collect.

[2 marks]

Table 3 shows the students' results.

Table 3

Feature	**Mean ± standard deviation**	
	North-facing	**South-facing**
Number of petals	8.27 ± 0.74	9.57 ± 1.91
Number of stamens	25.83 ± 6.88	39.37 ± 7.94

Figure 9 shows more detail for the results for the number of stamens in the celandine flowers growing on each road bank.

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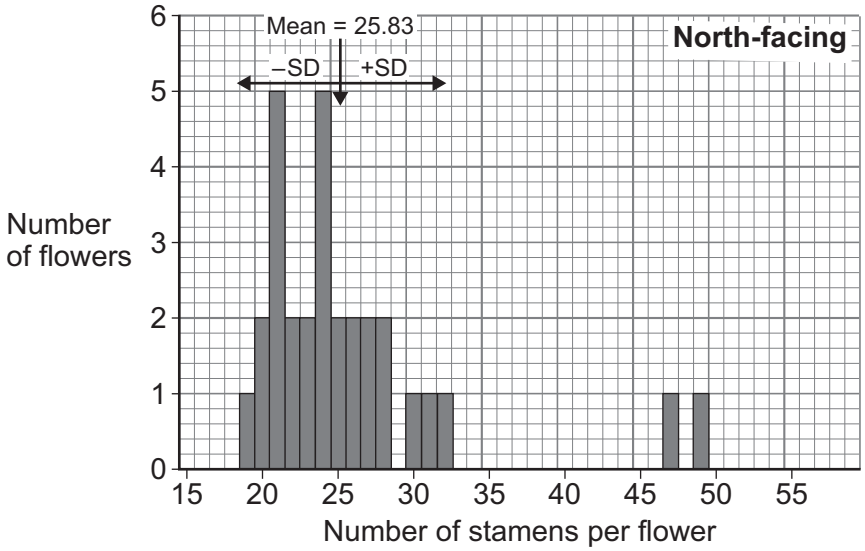
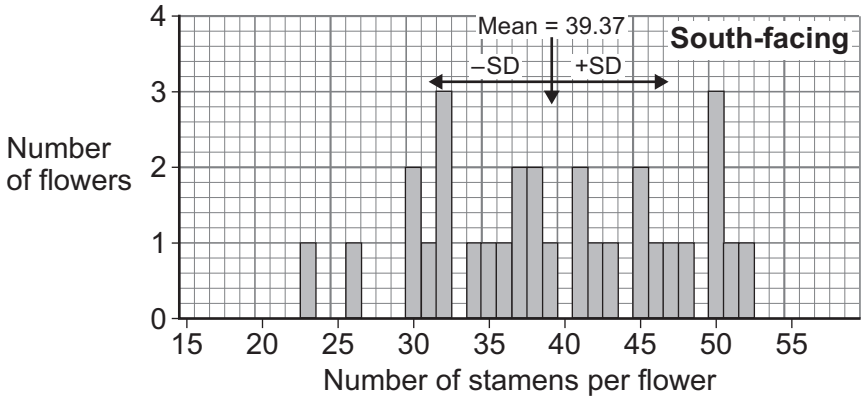
Figure 9





0 5 . 4 What is the range for the number of stamens per flower for each road bank?

[1 mark]

North-facing road bank: From _____ to _____

South-facing road bank: From _____ to _____

0 5 . 5 **Table 3** gives the mean and standard deviation for the number of stamens per flower for each road bank.

Explain why the means and standard deviations are more useful than the ranges for detecting any differences between the two samples of celandine flowers.

[3 marks]

_____

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0 5 . 6 The students use a statistical test to compare the mean number of petals for the two populations of celandines.

Suggest a suitable statistical test.

[1 mark]

0 5 . 7 The statistical test gives a probability value, $P = 1.3 \times 10^{-3}$

Explain what this means.

Use the terms

- **significance**
- **probability**
- **chance**

in your answer.

[3 marks]

15

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You are reminded that 2 marks will be awarded
for the quality of your written communication in Question 6.

0 6 All plants need water to survive.

0 6 . 1 Describe how plants use water.

[6 marks]

Question 6 continues on the next page

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0 6 . 2 Describe how water enters, moves through and is lost from a flowering plant.

[6 marks]

Do not write outside the box

0 6 . 3 Describe how some plants are adapted to live in very dry conditions.

[6 marks]

Quality of written communication [2 marks]

20

END OF QUESTIONS

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