

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

Thursday 8 January 2026

07:00 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	
3	
4	
5	
6	
7	
TOTAL	



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

0 1

Insulin and glucagon are hormones involved in glucose homeostasis.

Homeostasis involves negative feedback.

0 1 . 1

Describe the purpose of negative feedback.

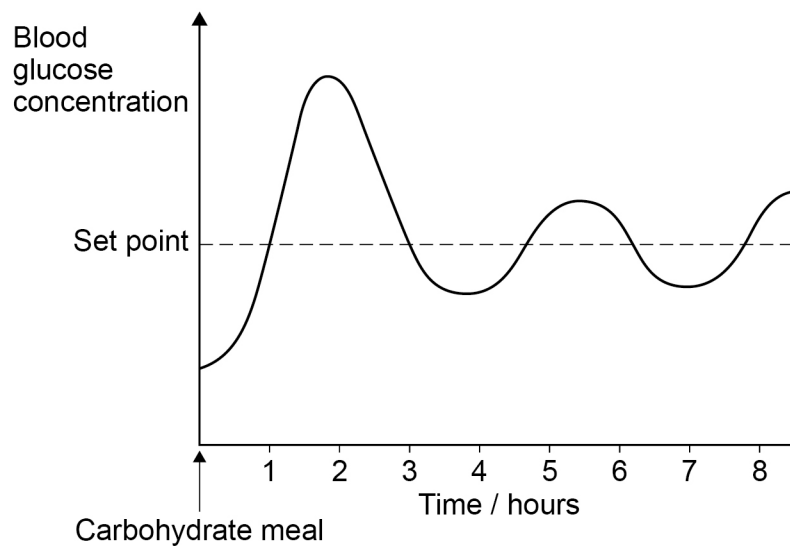
[1 mark]

Scientists monitor blood glucose concentration over time for two people. Each person does **not** eat any food for 24 hours. This is called a fast.

At the end of the 24-hour fast, person **1** eats a meal containing only carbohydrates.

Figure 1 shows the pattern of the blood glucose concentration for person **1**, after the carbohydrate meal.

Figure 1



0 1 . 2

Label the graph in **Figure 1** with the letter **X** to show when the effect of insulin is observed.

[1 mark]

0 1 . 3 At the end of the 24-hour fast, person **2** eats a meal containing only protein.

Explain what happens to the blood glucose concentration of person **2**:

- during the 24-hour fast
- after the protein meal.

[4 marks]

During the fast _____

After the **protein** meal _____

6

Turn over for the next question

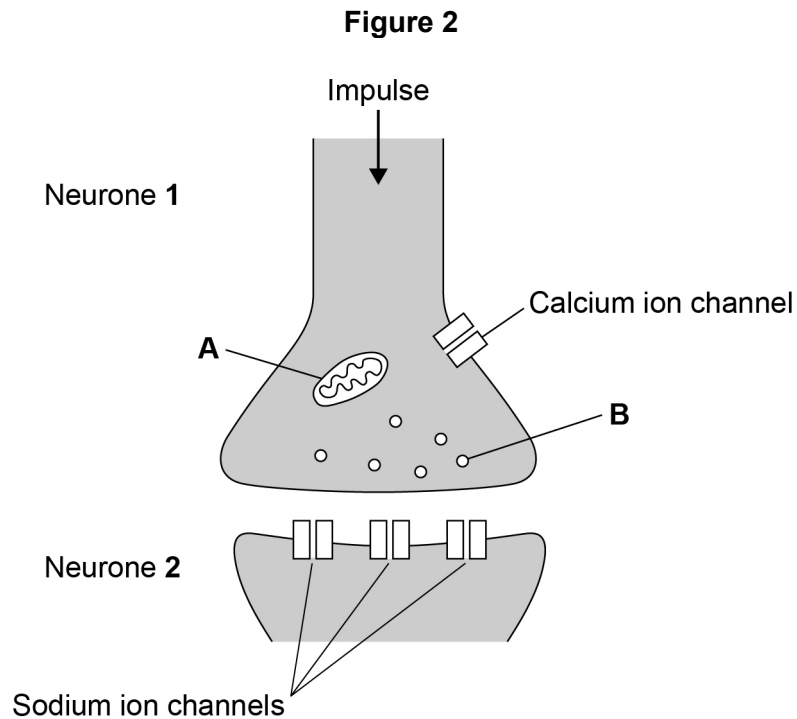
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0 2

Ions are important in the transmission of nerve impulses at a synapse.

Figure 2 shows a synapse between two neurones.



0 2

1

Name the structures **A** and **B**.

[1 mark]

A _____

B _____

Transmission of the impulse from neurone **1** to neurone **2** requires calcium ions.

0 2

2

Describe how calcium ions entering neurone **1** cause sodium ion channels to open in neurone **2**.

[2 marks]



- 0 2 . 3** Transmission across a synapse can be described as being **unidirectional** and may show **summation**.

Describe what causes these features.

[2 marks]

Unidirectional _____

Summation _____

Gamma-aminobutyric acid (GABA) is a chemical that prevents the transmission of an impulse at a synapse.

GABA binds to receptors on neurone **2** causing chloride ion channels to open. This allows chloride ions to enter. Chloride ions have a negative charge.

- 0 2 . 4** Explain how GABA can prevent the transmission of an impulse at a synapse.

[2 marks]

Question 2 continues on the next page

Turn over ►



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There is evidence that higher levels of GABA could reduce stress.

Drinking tea is also thought to reduce stress.

Students in Australia compare the effects of drinking regular tea (**T**) with tea high in GABA (**GABA-T**).

- **T** contains 1.25 mg dm^{-3} GABA.
- **GABA-T** contains 10.05 mg dm^{-3} GABA.

Both teas are prepared in the same way.

The students:

- divide themselves into 2 groups (11 per group)
- rate how stressed they are feeling on a scale of 0–10
(0 = no stress, 10 = extreme stress)
- each drink 0.2 dm^3 of one type of tea in 10 minutes
- rate how stressed they are feeling again.

0 2 . 5

Suggest **one** way to improve the students' method.

[1 mark]

Question 2 continues on the next page

Turn over ►



Table 1 shows the students' results.

A scale of 0–10 is used to assess the level of stress
(0 = no stress, 10 = extreme stress).

Table 1

T			GABA-T		
Student	Stress score before	Stress score after	Student	Stress score before	Stress score after
1	3	1	12	2	1
2	3	2	13	2	2
3	3	3	14	3	1
4	4	2	15	3	3
5	4	3	16	4	4
6	5	3	17	5	3
7	5	4	18	6	4
8	5	3	19	6	8
9	5	4	20	7	3
10	8	3	21	7	7
11	8	4	22	9	7
Mean	4.8	2.9	Mean	4.9	3.9
Median	5	3	Median	5	3



0 2 . 6

The students use **some** of the data to develop their conclusions.

Student **1** concludes that drinking **T** reduces stress more than drinking **GABA-T**.

Student **2** concludes that drinking either **T** or **GABA-T** causes the same reduction in stress.

Suggest how the two students could reach different conclusions.

Use data from **Table 1**.

[3 marks]

11

Turn over for the next question

Turn over ►



0 3

The retina of the eye contains light-sensitive cells.

0 3 . 1

Describe how the light-sensitive cells detect light.

[2 marks]

0 3 . 2

The eye is a hollow sphere with an internal diameter of 22 mm

The retina covers 72% of the inside of the eye.

Calculate the surface area of the retina.

Use the formula: *Surface area* = $4\pi r^2$

Use $\pi = 3.14$

[2 marks]

Surface area of retina = _____ mm²



Question 3 continues on the next page

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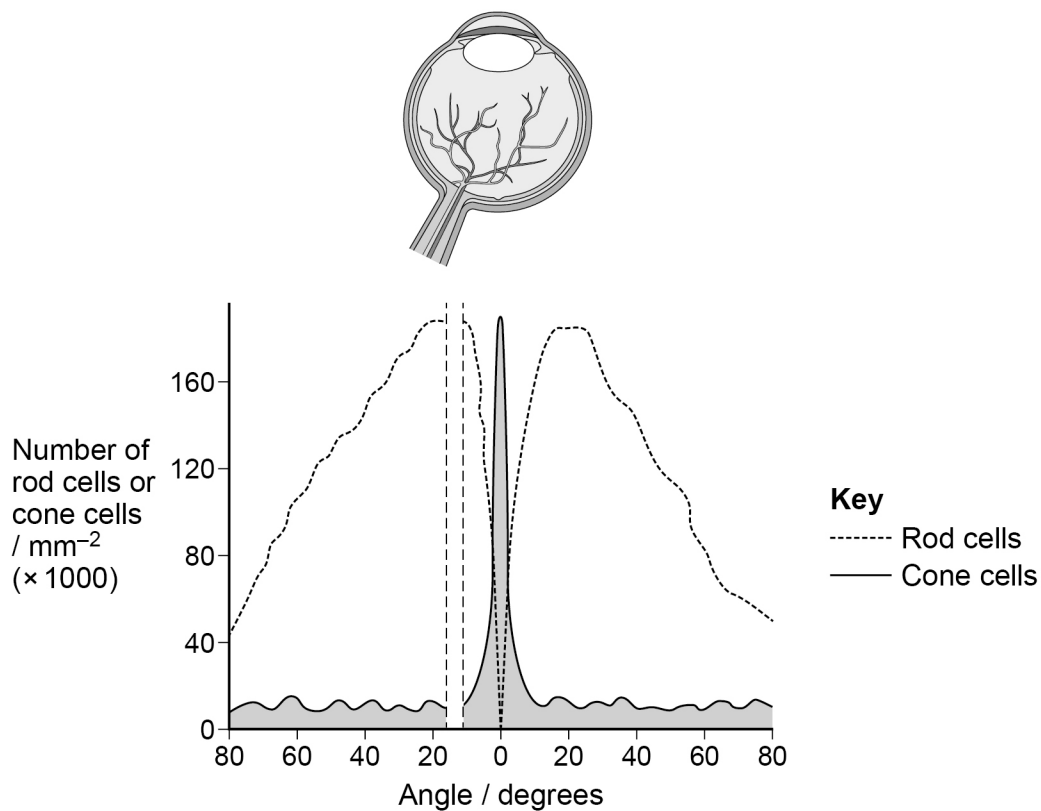
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The retina contains two types of light-sensitive cells, rod cells and cone cells.

Figure 3 shows a section through an eye and shows the distribution of rod cells and cone cells in the retina.

Figure 3



The **fovea** is a small region of the retina containing only cone cells. When a person is looking directly at an object, the light is focused on the fovea.

0 3 . 3 Draw an **X** on the section of the eye in **Figure 3** to show the position of the fovea.

[1 mark]



A region called the macula surrounds the fovea. The macula contains **both** rod cells and cone cells.

Age-related macular degeneration (AMD) is a common cause of severe, permanent sight loss.

People with normal vision and people with AMD can see images in colour when looking directly at the object. However, people with AMD do **not** see the whole object.

Figure 4 shows what people with normal vision see compared with what people with AMD see.

Figure 4



Normal vision



Vision with AMD

0 3 . 4

People with AMD can see the whole object if they turn their head slightly to the side. However, the image is not as detailed.

Explain why.

Use information from **Figure 3** and **Figure 4**.

[2 marks]

Question 3 continues on the next page

Turn over ►



One cause of AMD is the growth of extra blood vessels under the retina.

Scientists investigate if a drug called pegaptanib (PEG) can prevent the formation of extra blood vessels. PEG is given as an injection into the eye.

The scientists compare the effect of PEG with an injection of the same volume of a salt solution (SAL) that does **not** contain PEG.

This is the method the scientists use.

1. Divide the people with AMD into two groups at random:

- group 1 is given PEG (n=295)
- group 2 is given SAL (n=295).

2. Measure the visual acuity of each person.

3. Give the injection into the left eye of each person.

4. Repeat steps 2–3 every 6 weeks until each person has 9 injections of PEG or 9 injections of SAL.

The scientists **and** the person with AMD do **not** know who is in each group.

0 3 . 5

Give **one** reason why this method is likely to produce valid results.

[1 mark]



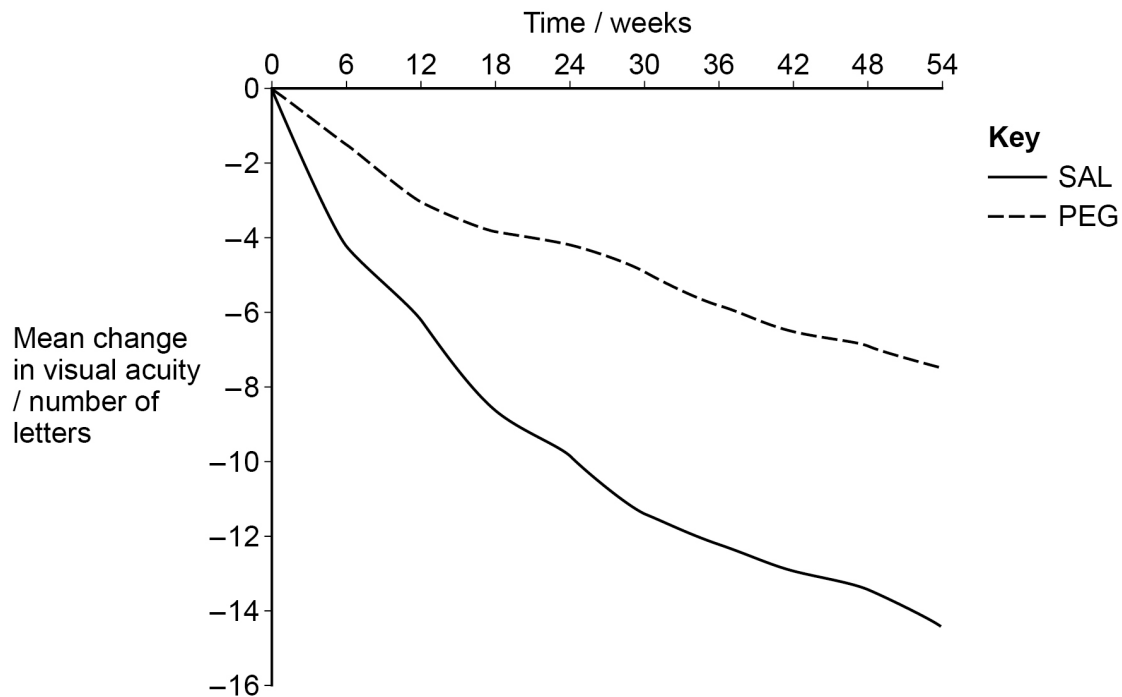
The scientists measure visual acuity using a chart. The chart shows mixed letters that get smaller and smaller.

A person with higher visual acuity can read more letters correctly.

Figure 5 shows how visual acuity changes over time.

A negative number indicates that visual acuity is getting worse.

Figure 5



0 3 . 6 Give **one** advantage and **one** disadvantage of using PEG.

Use information from **Figure 5** and from page 14.

[2 marks]

Advantage _____

Disadvantage _____

Turn over for the next question



0 4

Ethene is a plant growth substance (PGS) that stimulates the process of fruit ripening.

0 4 . 1

Give **two other** plant growth substances and a process that is regulated by each.

[2 marks]

Plant growth substance _____

Process regulated _____

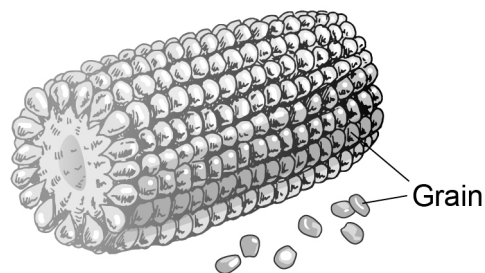
Plant growth substance _____

Process regulated _____

Maize is an important food crop.

Figure 6 shows maize grains.

Figure 6



Students compare two varieties of maize, **D** and **E**, to find the one with the larger grains. They use two different methods.

Student 1:

- collects 10 grains from each variety
- measures the length of each grain
- calculates a mean grain length for each variety.

Student 2:

- collects 100 grains from each variety
- measures the combined mass of 100 grains from each variety
- calculates a mean grain mass for each variety.



0	4	.	2
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Both students discover that variety **E** has larger grains.

A teacher states that the method used by student **2** is more accurate than the method used by student **1**.

Suggest why.

[2 marks]

Question 4 continues on the next page

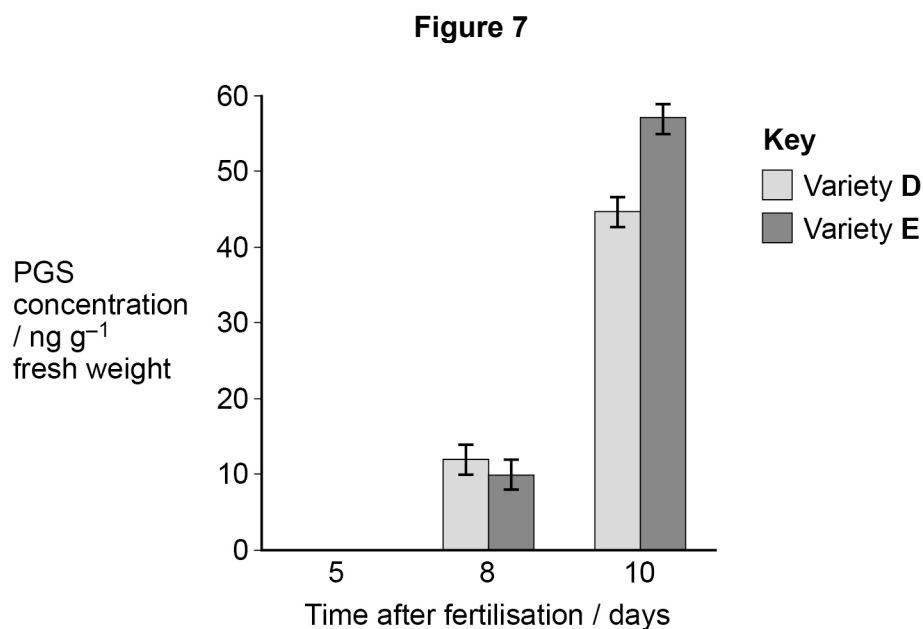
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The maize grains start to develop after fertilisation of the female gamete. The growth of the grains could be controlled by a plant growth substance (PGS).

Scientists measure the concentration of PGS in the maize grains on days 5, 8 and 10 after fertilisation.

Figure 7 shows the scientists' results. Values are mean $\pm$ standard error.



0 4 . 3 Describe the data in **Figure 7**.

Refer to days **5**, **8** and **10** in your answer.

[3 marks]

Day **5** _____

Day **8** _____

Day **10** _____



Question 4 continues on the next page

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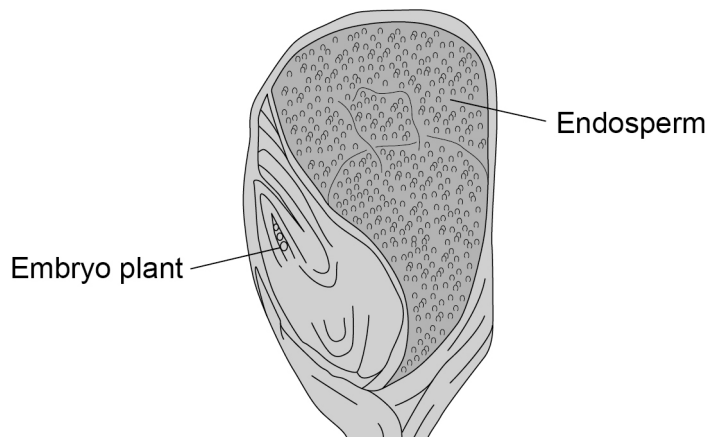
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Each maize grain includes an embryo plant and endosperm. The endosperm cells contain starch. Starch provides an energy source for the growth of the embryo plant.

Figure 8 shows the inside of a maize grain.

Figure 8



The scientists find that:

- embryo plants are the **same** size in both varieties of maize
- endosperm cells **vary** in size between the varieties
- **large** endosperm cells contain **more** starch than **small** endosperm cells
- different processes occur in endosperm cells in the days after fertilisation.

Table 2 shows the results.

Table 2

Day after fertilisation	Process occurring in endosperm cells
5	Mitosis
8	Mitosis
10	Synthesis of starch

The scientists consider two different hypotheses to explain why variety **E** has larger grains than variety **D**.

Hypothesis 1: PGS causes variety **E** to have **more** endosperm cells than variety **D**.

Hypothesis 2: PGS causes variety **E** to have **larger** endosperm cells than variety **D**.



0 4 . 4

Identify the correct hypothesis.

Show how all the data support this hypothesis.

Use information from **Figure 7** and **Table 2**.**[2 marks]**

Hypothesis chosen _____

How data support this hypothesis _____

0 4 . 5

The difference in the sizes of the grains could be due to genetic factors. MicroRNA can be used to change gene expression.

Explain how microRNA can be used to **decrease** the expression of a gene.**[2 marks]**

Question 4 continues on the next page**Turn over ►**

The scientists investigate if a gene called YA13 is responsible for producing maize grains of different sizes.

The scientists:

- measure the expression of YA13 in variety **D** and in variety **E**
- add microRNA to both varieties of maize plants
- measure the expression of YA13 in variety **D** and in variety **E**.

Table 3 shows the scientists' results.

Table 3

	Before microRNA treatment		After microRNA treatment	
	D	E	D	E
Expression of gene YA13 / arbitrary units	180.0	50.0	0.4	50.0
Mass of 100 maize grains / g	21.9	23.5	26.0	23.5

0 4 . 6 The scientists conclude that the gene YA13 affects grain size in variety **D**.

How do the data in **Table 3** support this conclusion?

[1 mark]



0 4 . 7

The grains from variety **E** have the **same** mass before and after microRNA treatment.

Suggest **two** possible explanations for this.

[2 marks]

Explanation 1 _____

Explanation 2 _____

0 4 . 8

The data suggest that it is possible to change grain size in some varieties of maize using this microRNA.

Suggest **one** advantage and **one** disadvantage of using this microRNA.

[2 marks]

Advantage _____

Disadvantage _____

16

Turn over for the next question

Turn over ►



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0 5

Taxes and kineses are two different types of simple response that some animals make to environmental stimuli.

0 5**. 1**

State **one** way that a taxis is different from a kinesis.

[1 mark]

0 5**. 2**

The purpose of both taxes and kineses is similar.

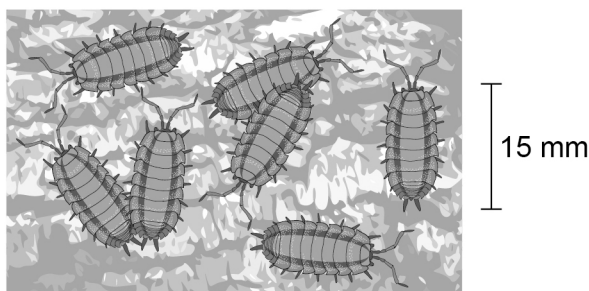
What is the purpose of these responses?

[1 mark]

Woodlice are found in wet places such as under fallen leaves.

Figure 9 shows some woodlice.

Figure 9

**Turn over ►**

Students investigate if wetter conditions affect the woodlice.

The students use equipment called a choice chamber.

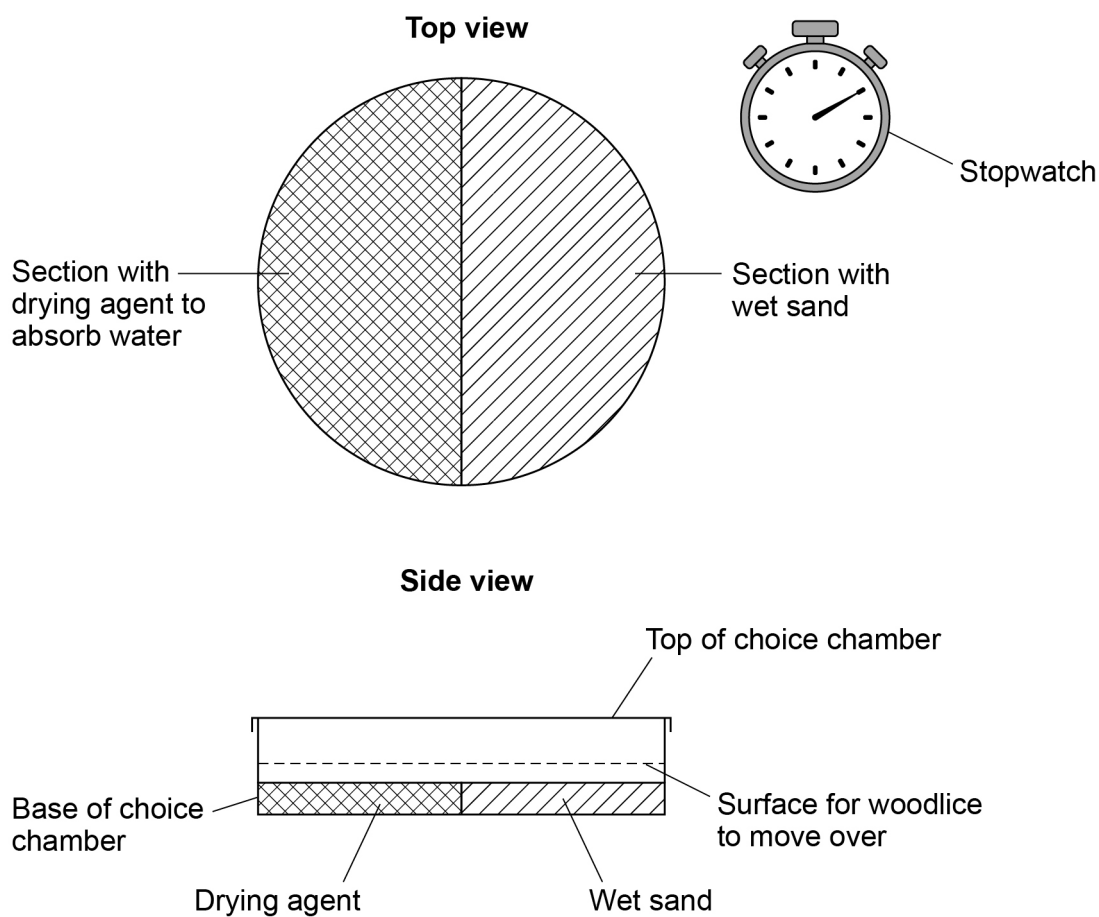
Figure 10 shows a choice chamber. The top of the choice chamber can be lifted to put things inside.

Half of the choice chamber is dry and the other half is wet. The students can see the woodlice through the top of the choice chamber.

The students have:

- 30 woodlice
- the equipment shown in **Figure 10**.

Figure 10



0 5 . 3

Describe how the students use **all** of the equipment to test if the woodlice prefer wetter conditions.

[3 marks]

0 5 . 4

The students use a χ^2 test to analyse their results.

State the students' null hypothesis.

[1 mark]

6

Turn over for the next question

Turn over ►

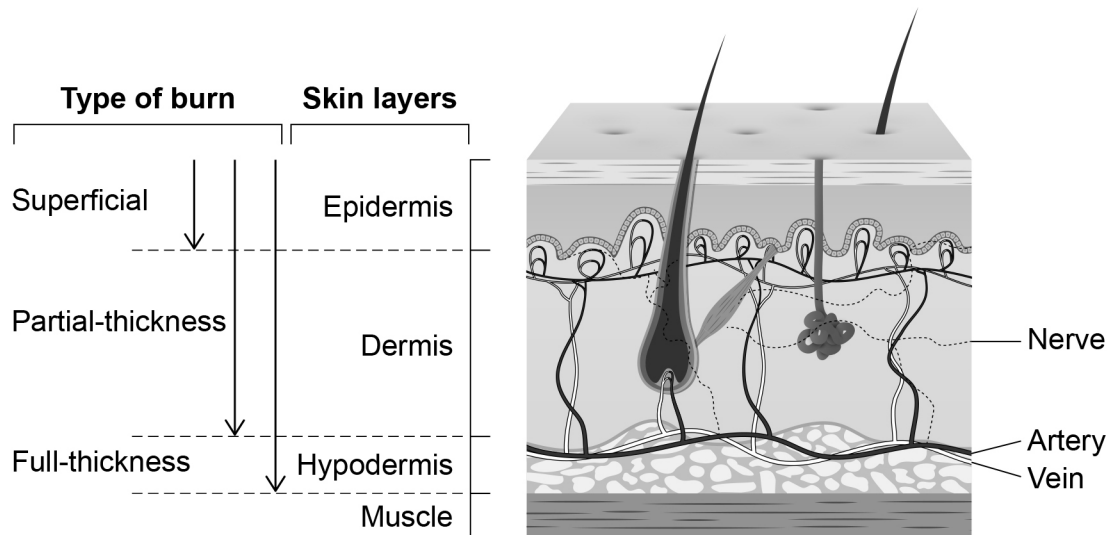


0 6

The skin is made of layers of different tissues containing different cell types. A burn can damage some or all of these layers.

Figure 11 shows the different types of burn and the skin layers damaged by them.

Figure 11



0 6 . 1

A full-thickness burn may be **less** painful than a superficial burn.

Suggest why.

Use information from **Figure 11**.

[2 marks]



Large, full-thickness burns cause:

- severe fluid loss
- dehydration and organ failure.

Doctors assess how much of the total body surface area (TBSA) is covered by the burn.

If the burn covers >20% TBSA, doctors give the patient a solution containing ions directly into a vein within 24 hours.

The volume of solution needed is calculated using the formula:

$$\text{Volume (cm}^3\text{)} = 4 \times \% \text{ TBSA burned} \times \text{body mass (kg)}$$

Half of the calculated volume must be given in the first 8 hours.

0 6 . 2

A person weighing 67.5 kg receives a full-thickness burn. The burn is estimated to cover 30% TBSA.

Calculate the rate of solution delivery needed in the first 8 hours.

[3 marks]

Rate of solution delivery = _____ cm³ min⁻¹

Further treatment for the burn could involve a skin graft. This is when healthy skin is removed from another part of the patient's body and used to cover the burn.

Skin grafts can be painful. The skin is damaged at the removal site as well as at the burn site. This leaves marks called scars at both sites. Thicker scars can be more obvious.

Question 6 continues on the next page

Turn over ►



0	6	.	3
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Stem cells could be used as an alternative to skin grafts.

Explain why stem cells could be used to treat burns.

[2 marks]

Stem cell treatment involves covering the burn site with a support material filled with stem cells.

During a skin graft, the burnt skin is removed. Scientists discover that the burnt skin still contains living stem cells.

The scientists investigate the use of these stem cells to repair burns.

First, the scientists prepare the human cells.

The scientists:

- collect burnt skin removed from human patients during skin graft treatment
- separate the stem cells from the burnt skin (SCBS)
- mix the SCBS with a supporting material (SM).

Next, the scientists prepare and treat some mice.

The scientists:

- cut small wounds (6 mm diameter) into the skin of several mice
- put the SCBS and SM onto wounds in the skin of some mice
- put **only** the SM onto wounds in the skin of control mice
- measure the diameter of the wounds and the thickness of the scar tissue formed after 12 days.



Question 6 continues on the next page

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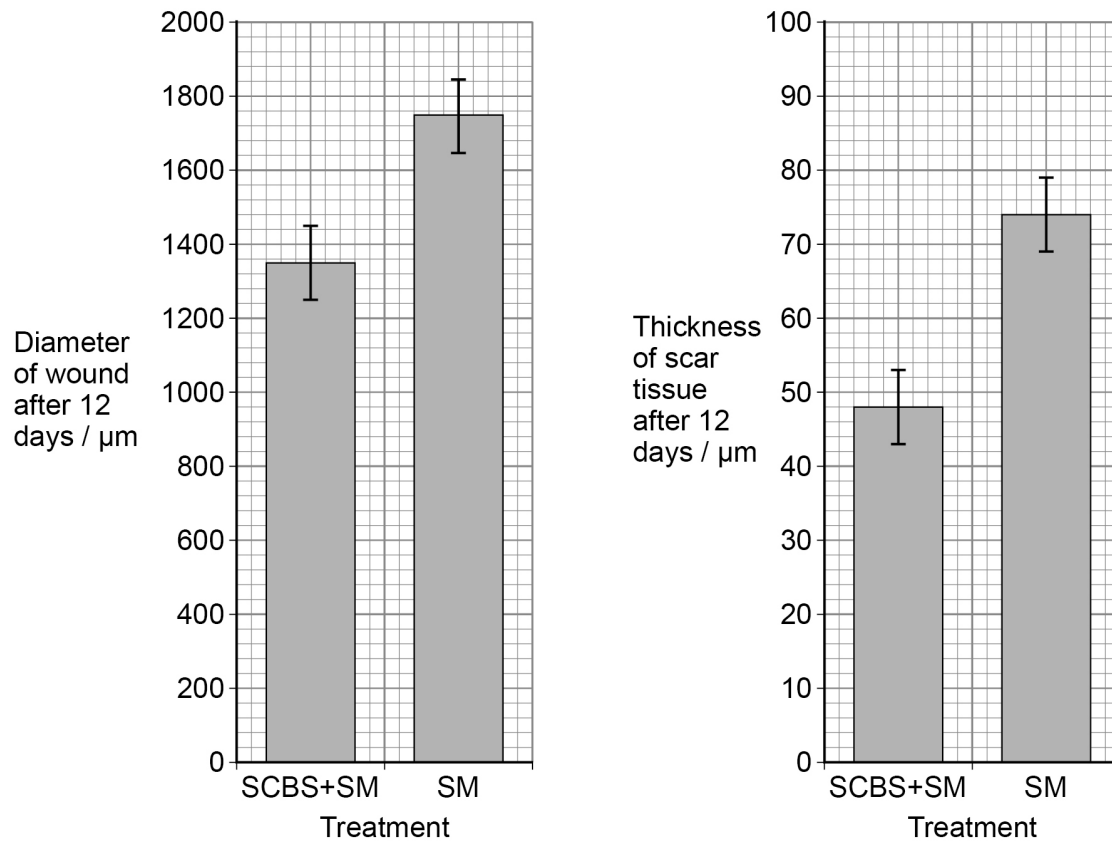
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Figure 12 shows the scientists' results. The error bars show $\pm$ standard error.

Figure 12



0 6 . 4

The scientists conclude that SCBS could be suitable for the treatment of burns.

Give **two** reasons why.

Use data from **Figure 12**.

[2 marks]

Reason 1 _____

Reason 2 _____

0 6 . 5

Scientists need to do more research before SCBS can become a new treatment for burns.

Suggest **one** other investigation that scientists need to do.

Give the reason why this investigation is needed.

[2 marks]

Investigation _____

Reason _____

11

Turn over for the next question

Turn over ►



0 7

The performance of skeletal muscles could be affected by exercise and diet.

Investigation 1: Effect of exercise

Scientists investigate if swimming training can change the percentage of different types of muscle fibre in a leg muscle.

The scientists:

- select 15 healthy people
- ask the people to swim for 60 minutes, 3 times a week, for 10 weeks
- take a sample from a muscle in each person's leg at the start and at the end of the investigation
- cut thin sections of the muscle sample, stain and view the sections using an optical microscope
- calculate the mean percentages of slow muscle fibres and fast muscle fibres in each sample.

Table 4 shows the percentage of each type of muscle fibre in the samples. The values are mean $\pm$ standard error.

Table 4

Type of muscle fibre	Before training / %	After training / %
Slow	40 $\pm$ 3	51 $\pm$ 6
Fast	60 $\pm$ 3	49 $\pm$ 4

Different types of athlete use their muscles in different ways.

Power athletes, for example 100 m runners, use intense muscle contractions for a short time.

Endurance athletes, for example long-distance runners, use less-intense muscle contractions for a long time.



0	7	.	1
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The scientists conclude that swimming training is more useful to **endurance** athletes than to power athletes.

Explain why.

Use information from **Table 4** and your knowledge of the properties of slow and fast muscle fibres.

[4 marks]

Question 7 continues on the next page

Turn over ►



Investigation 2: Effect of adding creatine to the diet

Increasing the stores of phosphocreatine in the muscles could improve performance. Some athletes try to do this by adding creatine to their diets.

Creatine + Phosphate $\rightleftharpoons$ Phosphocreatine

0 7 . 2

Explain why additional creatine might improve the performance of muscles in **power** athletes.

[3 marks]

A scientist investigates the effects of creatine on muscle performance. The scientist asks 10 healthy male and 10 healthy female biology students to take part in the investigation. The whole investigation lasts for 31 days.

Stage 1 (days 1–11):

- each student takes one tablet that does **not** contain creatine, five times a day
- muscle performance is tested on day 5, 7, 9 and 11.

Rest (days 12–19): No tablets are taken; no testing is done.

Stage 2 (days 20–31):

- each student takes one creatine tablet five times a day
- muscle performance is tested on day 25, 27, 29 and 31.



0 7 . 3

All the tablets used in both Stage 1 and Stage 2 look identical. This means the students do **not** know when the tablets contain creatine.

Suggest why it is important that the students do **not** know which tablets contain creatine.

[1 mark]

The students' muscle performance is tested using an exercise bicycle.

Table 5 shows the four different types of exercise used.

Table 5

Exercise	Description of exercise type
J	Continuous cycling
K	Repeating periods of 30 s cycling then 60 s rest
L	Repeating periods of 20 s cycling then 40 s rest
M	Repeating periods of 10 s cycling then 20 s rest

Question 7 continues on the next page

Turn over ►



On each testing day, each student:

- warms up for 5 minutes
- does only one type of exercise (**J**, **K**, **L** or **M**)
- cycles at the same set speed until stopped by the scientist.

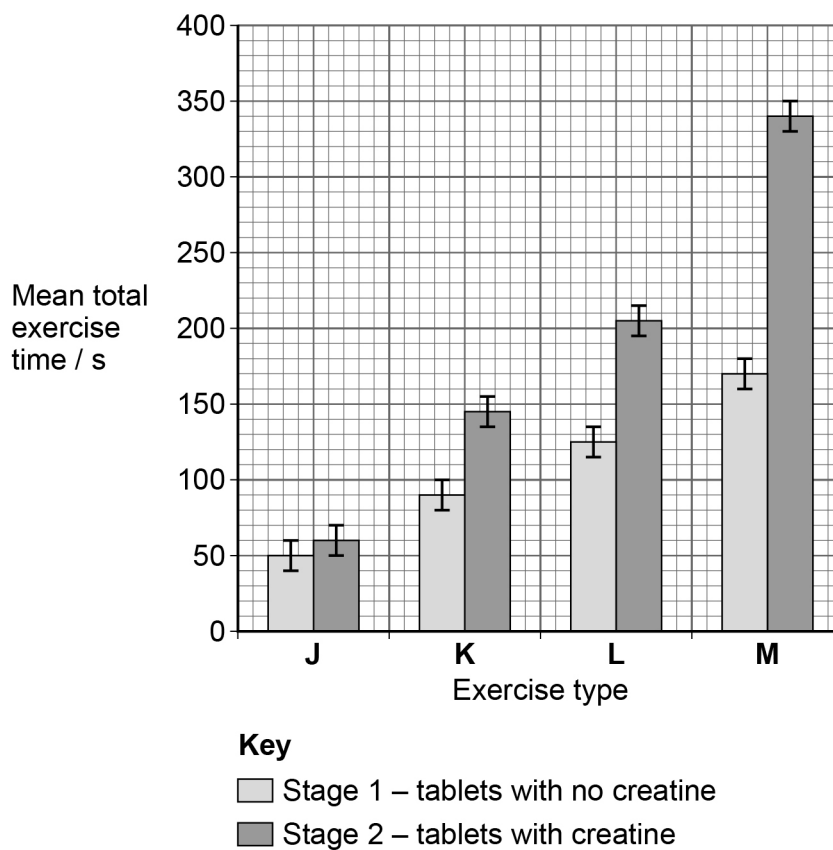
All students do a different exercise on each day until they have completed **all** four types of exercise.

The scientist:

- measures the total time the student cycles for each type of exercise (not including the rest breaks)
- stops the test when the student is too tired to continue at the set speed
- calculates the total time spent cycling.

Figure 13 shows the scientist's results. The error bars show $\pm$ standard error.

Figure 13



0	7	.	4
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State **two** conclusions the scientist could make from this investigation.

Use data from **Figure 13** to support each conclusion.

[4 marks]

Conclusion 1 _____

Data to support conclusion 1 _____

Conclusion 2 _____

Data to support conclusion 2 _____

Question 7 continues on the next page

Turn over ►



Creatine occurs naturally in the human body, but creatine tablets are produced in a laboratory. Previous research has shown that creatine does **not** improve muscle performance for endurance athletes.

Scientists investigate if a natural product could help **endurance** athletes. This product is made from a type of food called a mushroom.

Investigation 3: Effect of adding the mushroom product to the diet

The scientists:

- put 30 mice into 3 groups at random
- give all the mice standard laboratory food
- add a different concentration of the mushroom product to the food of each group for 7 days
- test the endurance of the mice on day 7

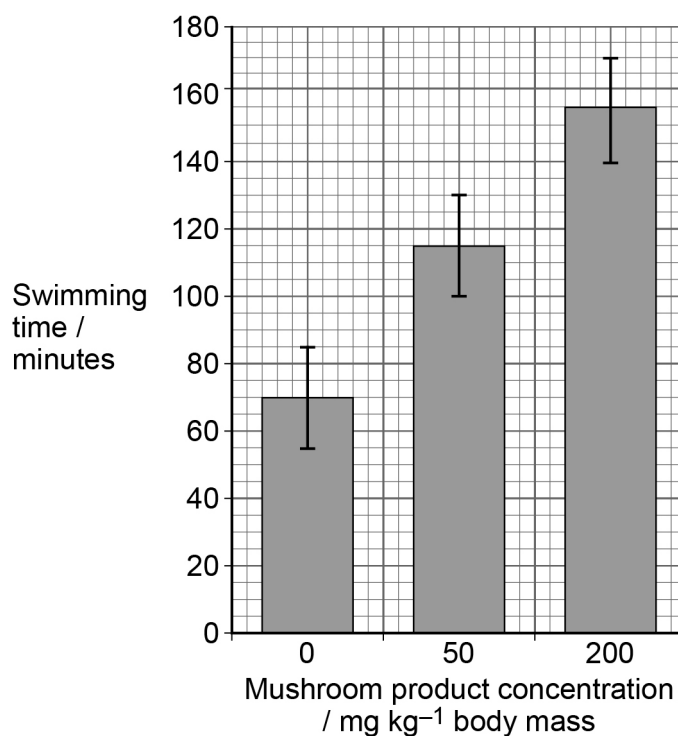
This is how the scientists test the endurance of the mice.

The scientists:

- put each mouse in a small tank of water at 25 °C
- time how long each mouse keeps swimming
- remove the mouse from the water when it is too tired to swim.

Figure 14 shows the scientists' results. The error bars show $\pm$ standard error.

Figure 14



0	7	.	5
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A journalist reads the research and writes the headline:

‘Mushrooms improve muscle performance more than creatine.’

Evaluate this headline.

Use information from **Investigation 2** and **Investigation 3**.

[3 marks]

15

END OF QUESTIONS



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