AQA

SPECIMEN MATERIAL v1.0

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

A-level BIOLOGY

Paper 2

Specimen materials (set 2)

Time allowed: 2 hours

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 the 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.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

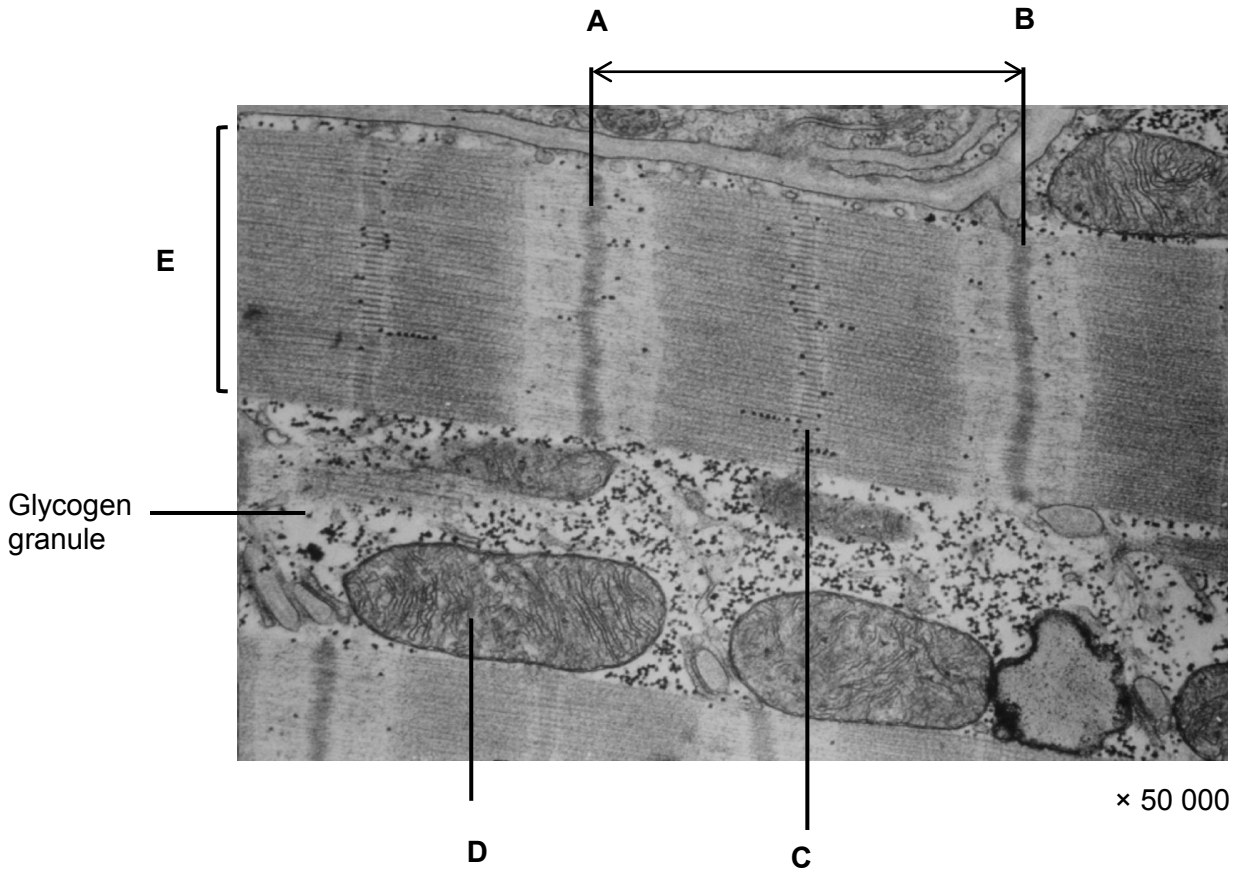
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 91.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

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

0 1 **Figure 1** shows a transmission electron micrograph of a longitudinal section of skeletal muscle.

Figure 1



0 1 . 1 Name structures **C**, **D** and **E**.

[3 marks]

C _____

D _____

E _____

0 1 . 2 Give the name of the structure shown between points **A** and **B**.

[1 mark]

_____

0 1 . 3 Calculate the actual distance between points **A** and **B**. Give your answer in micrometres (μm).

[1 mark]

Answer = _____ μm

0 1 . 4 **Figure 1** shows glycogen granules present in skeletal muscle.

Explain their role in skeletal muscle.

[2 marks]

0 1 . 5 During vigorous exercise, the pH of skeletal muscle tissue falls. This fall in pH leads to a reduction in the ability of calcium ions to stimulate muscle contraction.

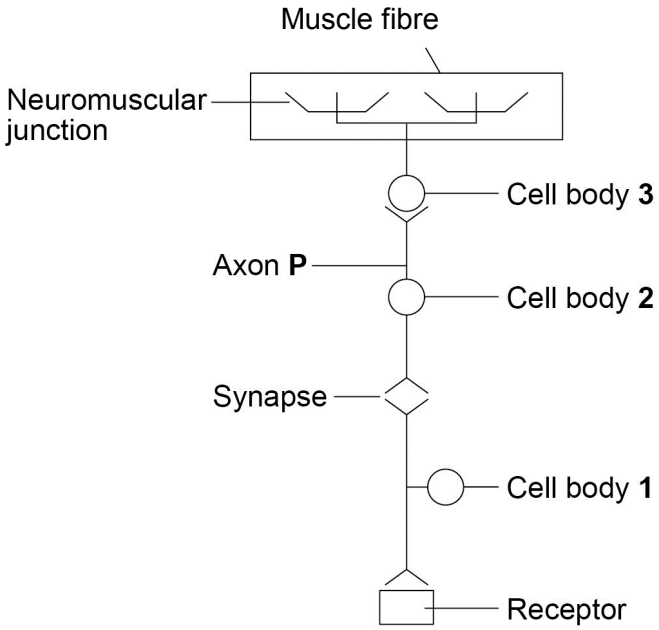
Suggest how.

[3 marks]

10

0 2 **Figure 2** shows a nerve pathway in an animal.

Figure 2



0 2 . 1 The nerve pathway shown in **Figure 2** may be regarded as a simple reflex arc.

Use **Figure 2** to explain why.

[1 mark]

0 2 . 2 Suggest **two** advantages of simple reflexes.

[2 marks]

1

2

0 2 . 3 In the nerve pathway in **Figure 2**, synapses ensure that nerve impulses only travel towards the muscle fibre.

Explain how.

[2 marks]

0 2 . 4 Axon **P** was found to conduct impulses much faster than other axons in the nerve pathway shown in **Figure 2**.

Describe and explain **one** feature of axon **P** that might cause this difference.

[2 marks]

7

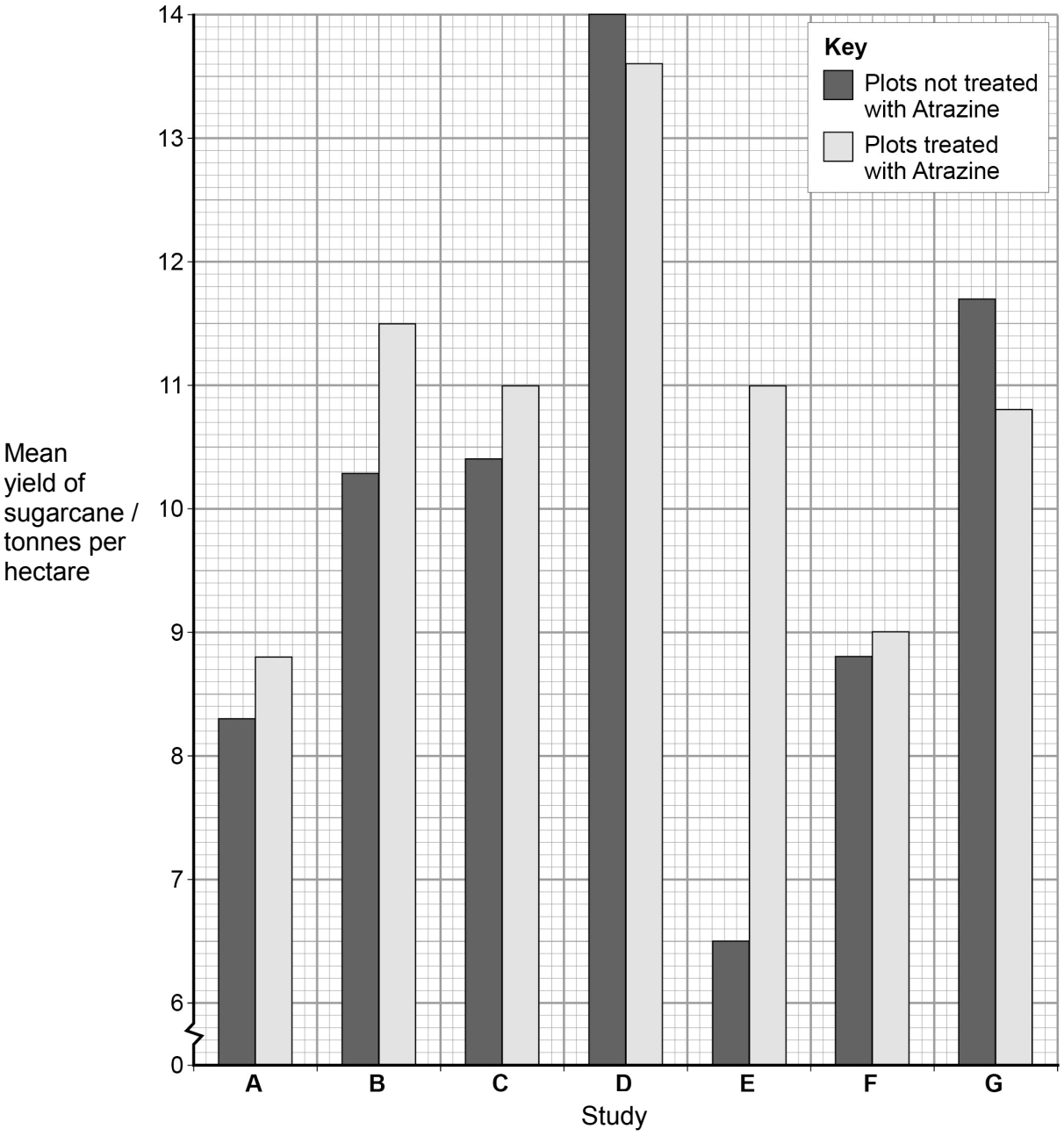
Turn over for the next question

0 3 Herbicides can be used to reduce the growth of weeds.

Scientists completed seven studies to determine how the use of the herbicide Atrazine affected the yield of sugarcane. In each study, some plots were treated with Atrazine and some plots were not treated with Atrazine.

Figure 3 shows the scientists' results. (1 hectare = 10 000 m^2)

Figure 3



0 3 . 1 Calculate the percentage decrease in yield caused by the use of Atrazine in study **G**.

[1 mark]

Answer = _____ %

0 3 . 2 A teacher studying these data with her students told her class that no definite conclusions could be drawn when comparing the mean values in **Figure 3**.

Suggest why the teacher said this.

[2 marks]

0 3 . 3 Atrazine binds to proteins in the electron transfer chain in chloroplasts of weeds, reducing the transfer of electrons down the chain.

Explain how this reduces the rate of photosynthesis in weeds.

[4 marks]

0 3 . 4 When treated with Atrazine, weeds have been shown to give off small amounts of heat.

Suggest an explanation for this observation.

[1 mark]

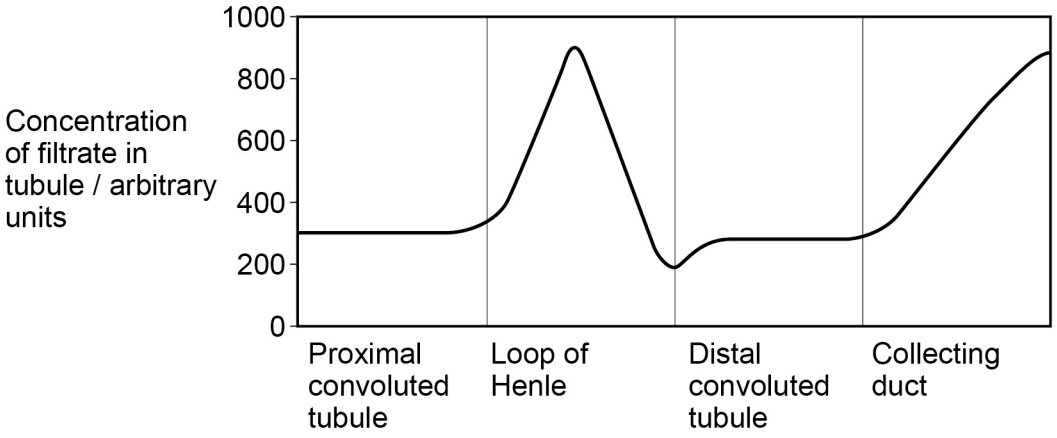
8

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 4 . 1 **Figure 4** shows the concentration of the filtrate in different parts of one kidney tubule.

Figure 4



0 4 . 1 More than 99% of biological molecules are reabsorbed from the filtrate in the proximal convoluted tubule.

Despite this, the concentration of fluid in this tubule remains constant.

Explain why.

[1 mark]

0 4 . 2 Explain the shape of the curve in the loop of Henle in **Figure 4**.

[3 marks]

0 4 . 3 What is the evidence in **Figure 4** that this person was secreting antidiuretic hormone (ADH)?

Explain your answer.

[2 marks]

6

Turn over for the next question

0 5 . 1 Define what is meant by epigenetics.

[2 marks]

0 5 . 2 In eukaryotes, transcription of target genes can be stimulated or inhibited when specific transcriptional factors move from the cytoplasm into the nucleus.

Oestrogen, methyl groups and acetyl groups are control factors that can play a role in initiating transcription.

Complete **Table 1** to show features of these control factors.

Put a tick (✓) in the box if the control factor shows the feature.

[2 marks]

Table 1

	Feature	
Control factor	**Binds with DNA**	**Binds with protein**
Oestrogen		
Methyl groups		
Acetyl groups		

0 5 . 3 Explain how increased methylation could lead to cancer.

[3 marks]

0 5 . 4 Give **one** way in which benign tumours differ from malignant tumours.

[1 mark]

8

Turn over for the next question

0 6 Ecologists studied a stream community before and after a flood. The flood reduced animal populations in the stream by 98%.

Table 2 shows how the populations of six animal species found in the stream changed following the flooding.

Table 2

Animal species	Number of days after flooding						
	1	5	13	22	35	49	63
	Mean number of organisms / thousands m^{-3}						
Baetis quilleri	0.03	0.85	2.6	9.3	6.4	0.9	0.3
Leptohyphes packeri	0.0	0.0	0.25	2.5	17.3	18.0	29.5
Helicopsyche mexicana	0.0	0.02	0.2	0.1	0.07	0.03	0.01
Cryptolabis paradoxa	0.0	13.3	21.3	55.8	62.9	168.7	182.6
Pentaneurini guttipennis	0.1	0.5	0.6	1.8	1.0	0.6	0.25
Micropsectra klinki	0.0	0.0	0.0	0.0	0.0	0.2	5.6

0 6 . 1 Explain how the data in **Table 2** provides evidence of succession.

[5 marks]

0 6 . 2 The populations of *Cryptolabis paradoxa* and *Leptohyphes packeri* both increased between days 13 and 63.

Calculate how many times the population growth per day of *Cryptolabis paradoxa* is greater than that of *Leptohyphes packeri* between these days.

[2 marks]

Answer = _____

0 6 . 3 The stream eventually recovered to reach a climax community.

Give **two** features of a climax community.

[2 marks]

1 _____

_____

2 _____

_____

___
9

Turn over for the next question

0 7 People suffering from pituitary dwarfism do not make enough human growth hormone (HGH). They can be treated using injections of HGH.

A geneticist wants to transform the bacterium, *Escherichia coli,* to make HGH by adding the gene coding for HGH.

The geneticist could obtain the *HGH* gene using any one of three methods.

1. Use restriction enzymes to cut out a fragment of DNA containing the *HGH* gene from a human genome.
2. Convert mRNA for HGH into cDNA using reverse transcriptase.
3. Create the *HGH* gene using a 'gene machine'.

0 7 . 1 The geneticist decided **not** to use restriction enzymes to cut out a fragment of DNA containing the *HGH* gene from a human genome. She made this decision because only methods 2 and 3 would produce DNA that *E. coli* could use to make HGH.

Explain why only methods 2 and 3 would produce DNA that *E. coli* could use to make HGH.

[2 marks]

0 7 . 2 The geneticist concluded it would be faster to create the *HGH* gene using a gene machine than by using reverse transcriptase to convert mRNA for HGH into cDNA.

Suggest why the geneticist reached this conclusion.

[1 mark]

0 7 . 3 After obtaining copies of the *HGH* gene, the geneticist will attempt to insert them into plasmid vectors.

Describe how the geneticist would attempt to insert copies of the *HGH* gene into these plasmids.

[3 marks]

[Extra space]

Question 7 continues on the next page

0 7 . 4 The geneticist plans to use the plasmids containing the *HGH* gene to try to transform cells of *E. coli*. She knows that some *E. coli* might not take up the plasmid.

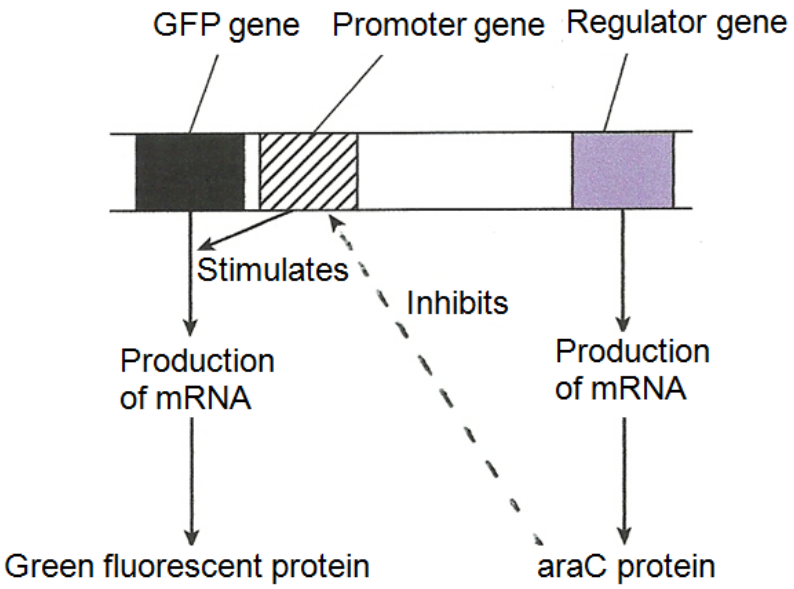
To enable her to identify which bacteria have taken up the plasmid with the *HGH* gene, the plasmids she intends to use contain a gene that codes for a green fluorescent protein (GFP). Bacteria that contain this plasmid glow green under UV light.

Suggest **one** advantage of using this gene for GFP to identify bacteria that have taken up plasmids.

[1 mark]

Figure 5 shows part of the plasmid containing the gene that codes for GFP. It also shows the roles of two genes that control the GFP gene.

Figure 5



0 7 . 5 Arabinose is a sugar that can bind to the araC protein.

Use information in **Figure 5** to suggest why the geneticist must include arabinose in the agar on which she hopes to grow *E. coli* containing the transgenic plasmids.

[2 marks]

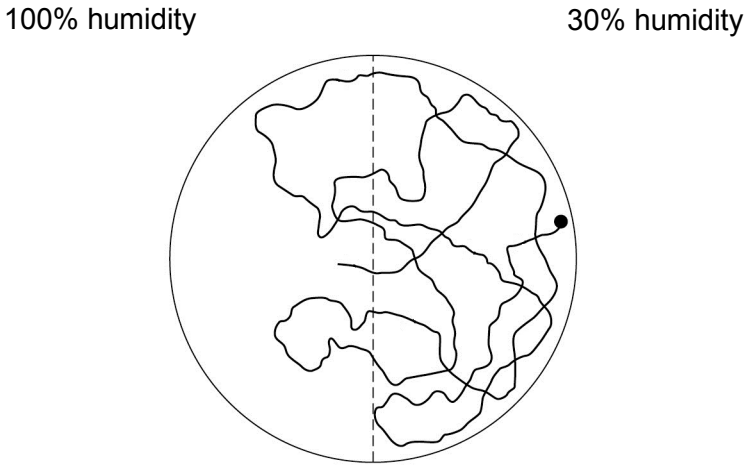
9

Turn over for the next question

0 8 Scientists investigated the effect of humidity on the movement of the insect, *Tenebrio molitor*.
The insects were placed in choice chambers with one side kept at 100% humidity and the other side kept at 30% humidity.
The insects were used one at a time and the path the insect followed recorded on paper.

Figure 6 shows a typical result. The solid dot shows the final recorded position of the insect.

Figure 6



0 8 . 1 What type of behaviour was shown by the insect in **Figure 6**?

Give evidence from **Figure 6** to support your answer.

[2 marks]

0 8 . 2 The scientists found that the insects moved for 94% of the time in the more humid side, but in the drier side they moved only 20% of the time. The scientists concluded that reduced movement in the drier side was an adaptation that reduced water loss.

Use your knowledge of gas exchange in insects to explain how this behaviour would reduce water loss in the insects.

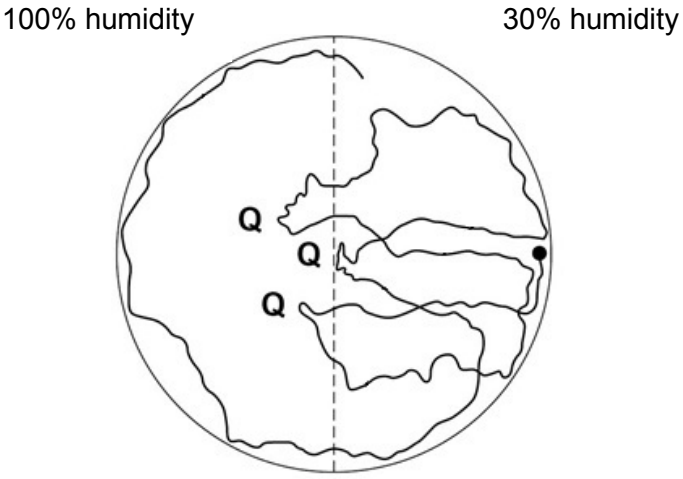
[2 marks]

0 8 . 3 *Tenebrio molitor* has two antennae on its head. These are sense organs.

The scientists found that one insect stopped when it reached the boundary between the two sides of the choice chamber and seemed to perform various movements with its antennae. The insect then moved to the drier side.

This behaviour can be seen in **Figure 7**. The points marked with a **Q** indicate where the insect showed this behaviour.

Figure 7



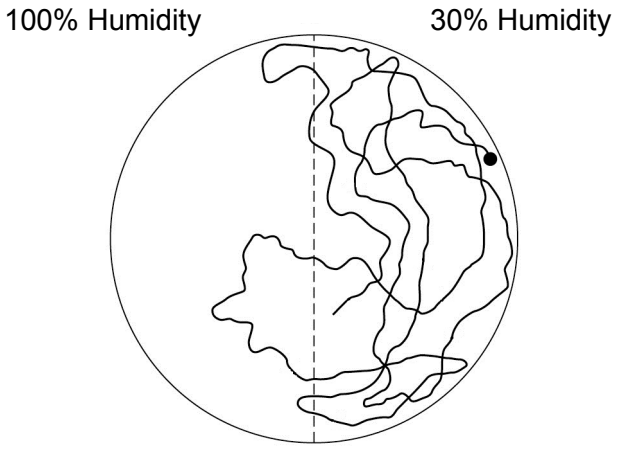
What type of behaviour did the scientists conclude that the insect in **Figure 7** was showing?

[1 mark]

0 8 . 4 After observing the behaviour of the insect in **Figure 7**, the scientists hypothesised that if an insect had one of its antennae removed it would have a tendency to turn to one side and move in circles. The scientists tested this hypothesis by cutting one antenna off another insect and observing its movement.

The result of this experiment can be seen in **Figure 8**.

Figure 8

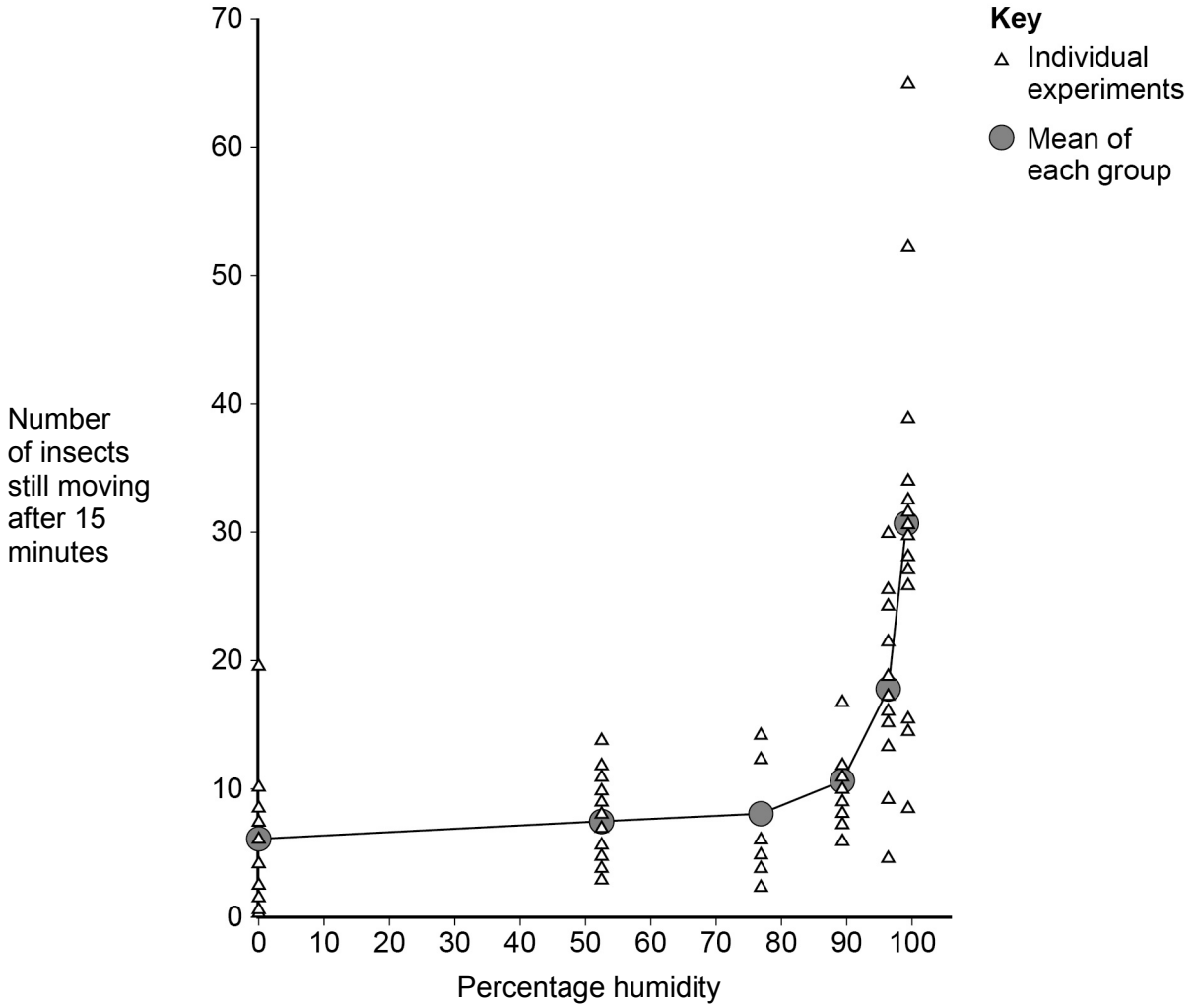


Does the movement observed in **Figure 8** support the scientists' hypothesis?
Give the reason for your answer.

[2 marks]

0 8 . 5 The scientists then investigated the effect of a range of humidities on the activity of the insects. **Figure 9** shows their results. The triangles represent the number of insects still moving after 15 minutes.

Figure 9



A student studying **Figure 9** concluded that as humidity increases, so does movement of the insects.

Evaluate the student's conclusion.

[2 marks]

9

0 9 A student investigated the monohybrid inheritance of eye shape in fruit flies. Two fruit flies with bar (narrow) eyes were crossed. Of the offspring, 1538 had bar eyes and 462 had round (normal) eyes.

0 9 . 1 Using suitable symbols, give the genotypes of the parents.

Explain your answer.

[2 marks]

Genotypes _____

Explanation _____

_____

_____

_____

0 9 . 2 The ratio of bar-eyed flies and round-eyed flies in the student's results were not the same as the ratio she had expected.

What ratio of bar-eyed to round-eyed flies was the student expecting?

[1 mark]

_____

0 9 . 3 Suggest **two** reasons why observed ratios are often **not** the same as expected ratios.

[2 marks]

_____

_____

_____

_____

_____

0 9 . 4 The student wished to test her results with the ones she had expected.

Which statistical test should she use?

[1 mark]

_____

0 9 . 5 This fruit fly has another characteristic controlled by a pair of codominant alleles, W^N and W^V.

What is meant by **codominant** alleles?

[1 mark]

_____

_____

_____

0 9 . 6 There were 850 fruit flies in one population. In this population, 510 fruit flies had the genotype W^NW^N, 255 had the genotype W^NW^V and 85 had the genotype W^VW^V.

Calculate the **actual** frequency of the allele W^V. **Do not** use the Hardy-Weinberg equation in your calculation.

[1 mark]

Answer = _____

0 9 . 7 In another population of 950 fruit flies, the frequency of the W^V allele was 0.2.

Use the Hardy-Weinberg equation to calculate the number of insects that would be **expected** to have the genotype W^NW^V.

[2 marks]

Answer = _____

10

Turn over for the next question

1 0 . 1 Read the following passage.

Plants require phosphate ions that they get from soil. These ions are often in poor supply and this results in poor growth of the plants. Most plants have mycorrhizae that help the plants to obtain nitrates. Mycorrhizal networks can connect the roots of plants growing next to each other. The use of fertilisers containing phosphate and nitrates in farming inhibits the growth of mycorrhizae. As a result, intensively farmed crop plants do not have mycorrhizae.

Plants can defend themselves by producing defensive enzymes that destroy pathogens such as bacteria. Some plants express the genes for defensive enzymes in response to signal proteins secreted by other plants that are being attacked by a pathogen. These signal proteins can be released into the air.

Scientists have discovered that tomato plants increase production of defensive enzymes if plants next to them become infected with a pathogen. These tomato plants were connected by a mycorrhizal network that can carry signal proteins between them. The largest increase in defensive enzyme secretion that the scientists found in a tomato plant in response to the signal protein was by 122.6 per cent.

Use the information in the passage and your own knowledge to answer the following questions.

1 0 . 1 Suggest and explain **two** reasons why a poor supply of phosphate ions results in poor growth of plants (lines 1–2).

[2 marks]

1 _____

_____

2 _____

_____

1 0 . 2 Suggest how defensive enzymes produced by plants destroy bacteria (lines 8–9).

[2 marks]

_____

_____

_____

_____

_____

1 0 . 3 The signal proteins secreted into the air by a plant being attacked by a pathogen act as stimuli leading to the expression of genes for defensive enzymes in other plants (lines 9–11).

Suggest how they lead to the expression of these genes.

[3 marks]

1 0 . 4 Suggest and explain **the** advantage to tomato plants of transmitting signal proteins through mycorrhizal networks, rather than releasing them into the air (line 11 and lines 13–15).

[2 marks]

1 0 . 5 The largest increase in defensive enzyme secretion that the scientists found in a tomato plant in response to the signal protein was by 122.6 percent (lines 16–17).

The rate of secretion of the defensive enzymes before the signal protein was produced was 450 μmol dm^{-3} g^{-1} $hour^{-1}$.

Calculate the rate of secretion **per second** after the response to the signal protein.

[2 marks]

Answer = _____ μmol dm^{-3} g^{-1} $second^{-1}$

1 0 . 6 A student who read this passage concluded that farmers should **not** use fertilisers to increase yields when growing tomato plants.

Evaluate his conclusion.

[4 marks]

15

END OF QUESTIONS

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