



**Surname** \_\_\_\_\_

**Forename(s)** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** \_\_\_\_\_

**Candidate Signature** \_\_\_\_\_

**I declare this is my own work.**

**A-level**

**BIOLOGY**

**Paper 2**

**7402/2**

**Friday 14 June 2024**

**Morning**

**Time allowed: 2 hours**

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**



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**MATERIALS**

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator.

**INSTRUCTIONS**

- Use black ink or black ball-point pen.
- Answer ALL questions.
- You must answer the questions in the spaces provided. Do not write 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).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**INFORMATION**

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

**DO NOT TURN OVER UNTIL TOLD TO DO SO**

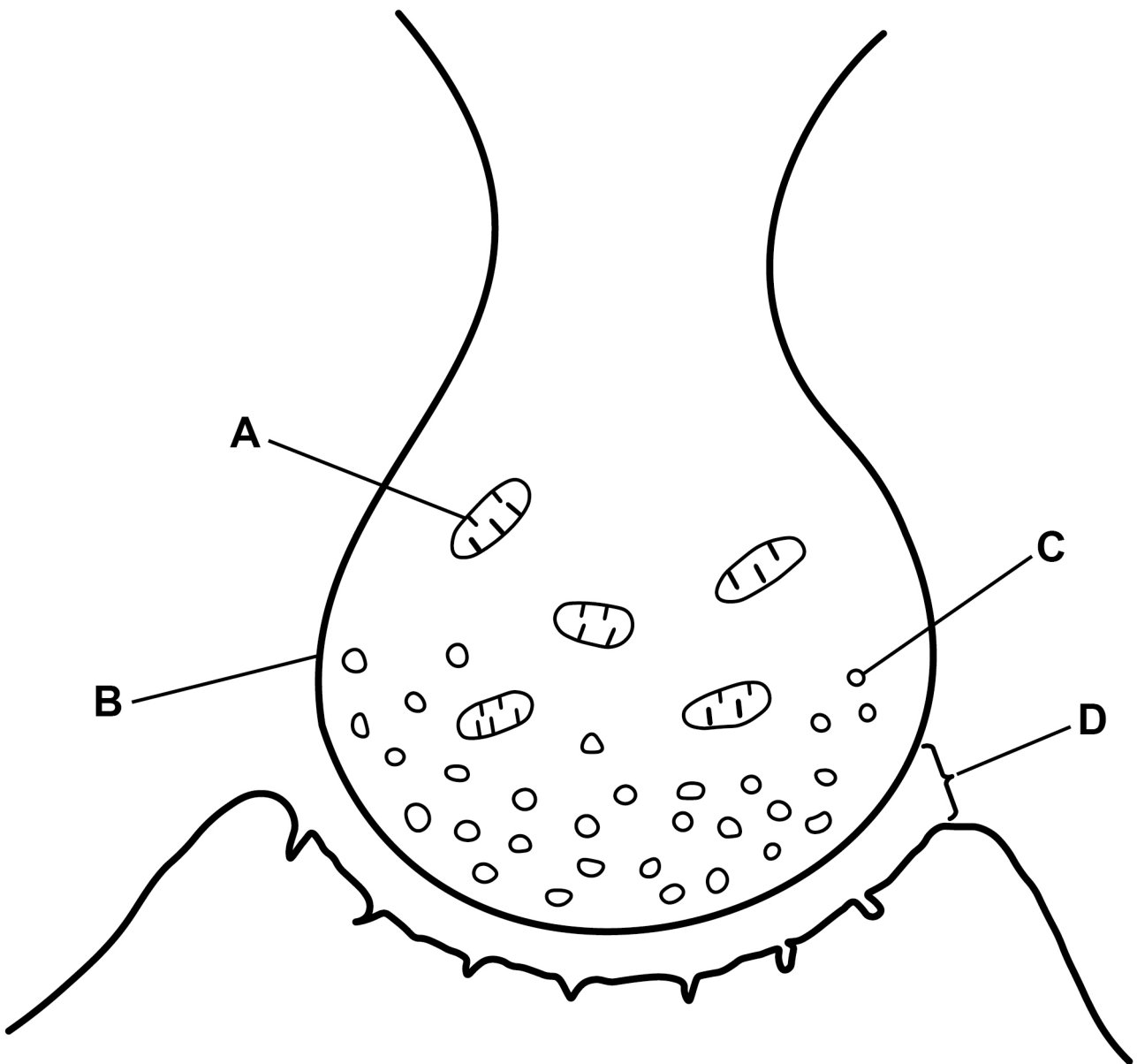


Answer ALL questions in the spaces provided.

0 1

FIGURE 1 shows a drawing of a neuromuscular junction.

FIGURE 1



01.1

Name the parts labelled A to D. [2 marks]

A \_\_\_\_\_

B \_\_\_\_\_

C \_\_\_\_\_

D \_\_\_\_\_

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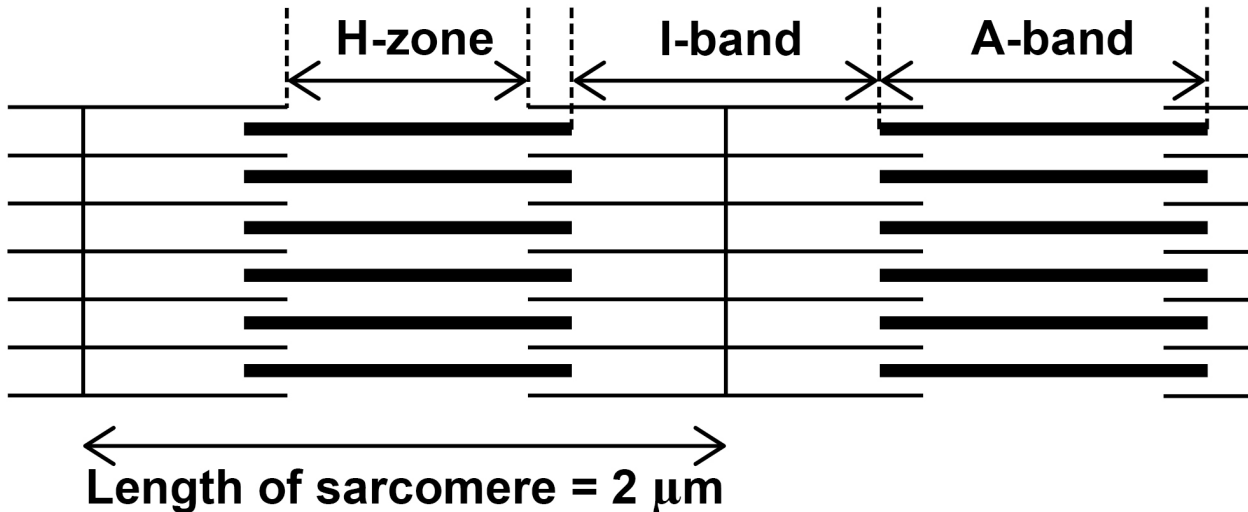
**[Turn over]**



02.1

FIGURE 2 shows part of a relaxed myofibril.

FIGURE 2



The myofibril represented in FIGURE 2 has  
34 sarcomeres.

The length of every sarcomere is  $2 \mu\text{m}$

After contraction of this myofibril, the length of each sarcomere changed by 20%.

Use the information provided to calculate the length of the myofibril after contraction.



**Give your answer in mm and in standard form.**

**Show your working. [2 marks]**

**Answer** \_\_\_\_\_ **mm**

**[Turn over]**



**02.2**

**Which statement correctly describes the changes in length in a sarcomere when a myofibril contracts?  
[1 mark]**

**Tick (✓) ONE box.**

**H-zone decreases, I-band increases,  
A-band decreases**

**H-zone increases, I-band decreases,  
A-band decreases**

**H-zone decreases, I-band decreases,  
A-band no change**

**H-zone increases, I-band increases,  
A-band no change**





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7



**03.1**

**A biologist investigated photosynthesis. They:**

- **measured the percentage of light absorbed by a plant when it was exposed to different wavelengths**
- **measured the rate of photosynthesis at each wavelength of light.**

**FIGURE 3, on page 16, shows the results they obtained.**

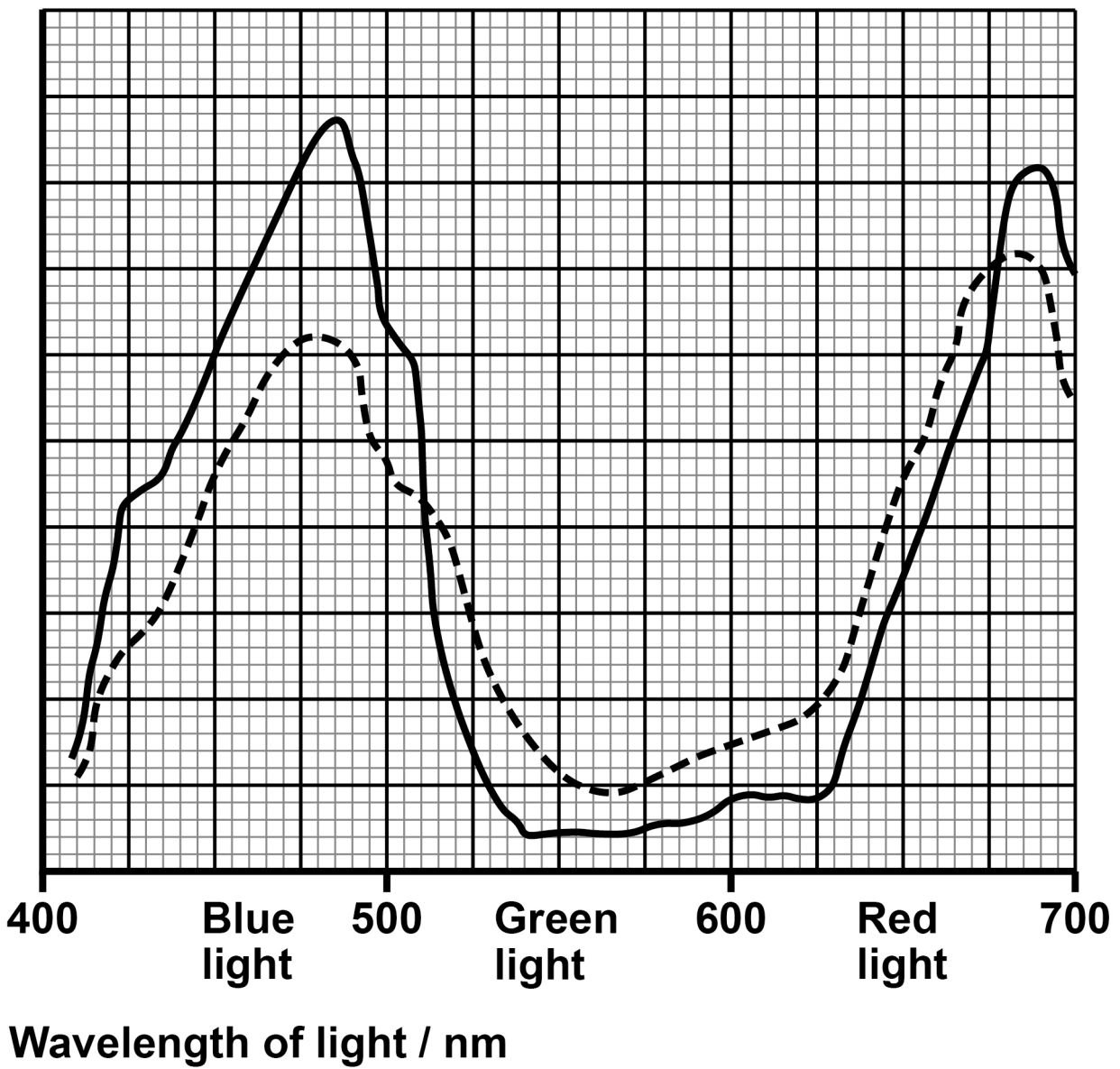
**[Turn over]**



FIGURE 3

↑  
 Percentage of light absorbed  
 ( — )

↑  
 Rate of photosynthesis  
 ( - - - )



Using **FIGURE 3**, what can you conclude about the relationship between:

**the percentage of light absorbed and the rate of**

**photosynthesis** \_\_\_\_\_

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**the colour of light and the rate of photosynthesis**

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**[2 marks]**

**[Turn over]**



**03.2**

**Give THREE environmental factors that should be controlled when measuring the rate of photosynthesis in this investigation.**

**Do NOT include features of the plant in your answer.  
[2 marks]**

**1**

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**2**

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**3**

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**04.2**

In fruit flies, males are XY and females are XX.

A cross between a grey-bodied male fly and a black-bodied female fly produced some black-bodied females. Explain how this shows that the gene for body colour is NOT sex-linked. [1 mark]

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[Turn over]



**04.3**

A population of fruit flies contained 19% grey-bodied flies.

Use the Hardy–Weinberg equation to calculate the percentage of flies heterozygous for gene G.

Show your working. [2 marks]

Answer \_\_\_\_\_ %

**04.4**

In fruit flies, a gene for wing shape has a dominant allele for curly wings, R, and a recessive allele for normal wings, r. The alleles for this gene are on a different pair of chromosomes from the gene for body colour.



Fruit flies that are homozygous dominant for curly wings do not survive beyond the embryo stage.

A curly-winged fly, homozygous for grey body colour was crossed with a curly-winged, black-bodied fly.

Complete the genetic diagram to show all the possible genotypes and the ratio of phenotypes expected to develop into adults from this cross. [3 marks]

Phenotypes of parents

Curly-winged, grey-bodied, × Curly-winged,  
black-bodied

Genotypes of parents \_\_\_\_\_ × \_\_\_\_\_

Genotypes of offspring \_\_\_\_\_

\_\_\_\_\_

Phenotypes of offspring \_\_\_\_\_

\_\_\_\_\_

Ratio of offspring \_\_\_\_\_

[Turn over]









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**[Turn over]**



**05.3**

**TABLE 1** gives some features of fat hen seeds.

**TABLE 1**

<b>FEATURE OF SEED</b>	
<b>Mean mass / mg</b>	<b>0.77</b>
<b>Maximum number produced per fat hen plant during a growing season</b>	<b>20 000</b>
<b>Percentage viable (able to develop) after a growing season</b>	<b>79</b>



During a growing season, it was estimated that a total number of 550 fat hen plants grew on the fields of a farm.

Calculate the maximum mass, in kg, of viable fat hen seeds on this farm after a growing season.

Show your working.

Assume that all the seeds produced during the growing season remain on the farm. [2 marks]

Answer \_\_\_\_\_ kg

[Turn over]

10







06.2

**Atrial fibrillation (AF) is a condition that causes an irregular heart rate. Scientists used a statistical test to investigate the association between different factors and the risk of developing AF.**

**TABLE 2 shows some of the scientists' results, including the probability (P) values obtained using the statistical test.**

**TABLE 2**

<b>FACTOR</b>	<b>Probability (P) value for association between factor and risk of AF</b>
<b>Age</b>	<b>0.004</b>
<b>High blood pressure</b>	<b>0.001</b>
<b>High LDL (Low-density lipoprotein) concentration</b>	<b>0.222</b>
<b>Hyperthyroidism</b>	<b>0.018</b>





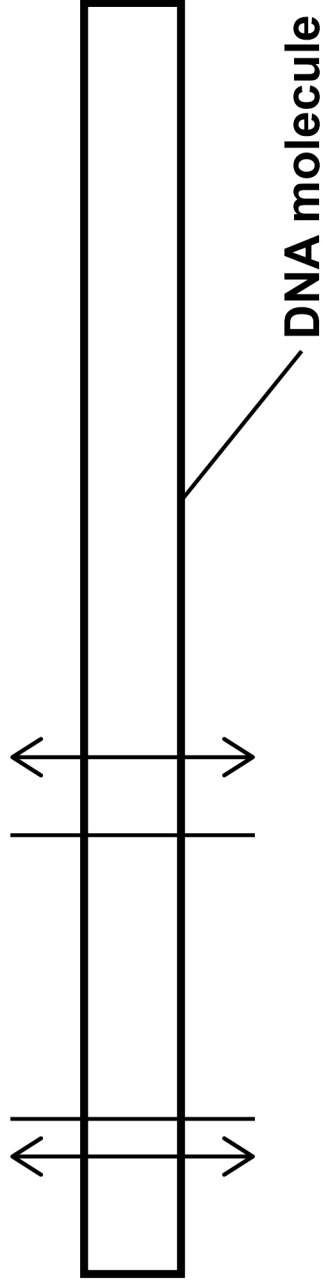


07.1

*Bam*H1 and *Hind*III are both restriction endonucleases.

FIGURE 4 shows the positions where these enzymes cut a linear molecule of DNA.

FIGURE 4



KEY

↑  
|  
↓  
Position DNA molecule  
cut by *Bam*H1

↓  
↑  
↓  
Position DNA molecule  
cut by *Hind*III



In two experiments, multiple copies of the DNA molecule shown in FIGURE 4 were all completely cut into fragments using these restriction enzymes. The DNA fragments produced were then separated by electrophoresis.

**Experiment 1 – DNA cut into fragments using *Bam*H1.**

**Experiment 2 – DNA cut into fragments using *Bam*H1 and *Hind*III.**

**Complete FIGURE 5, on page 37, to show the relative positions of the bands following electrophoresis in experiments 1 and 2. [2 marks]**

**[Turn over]**

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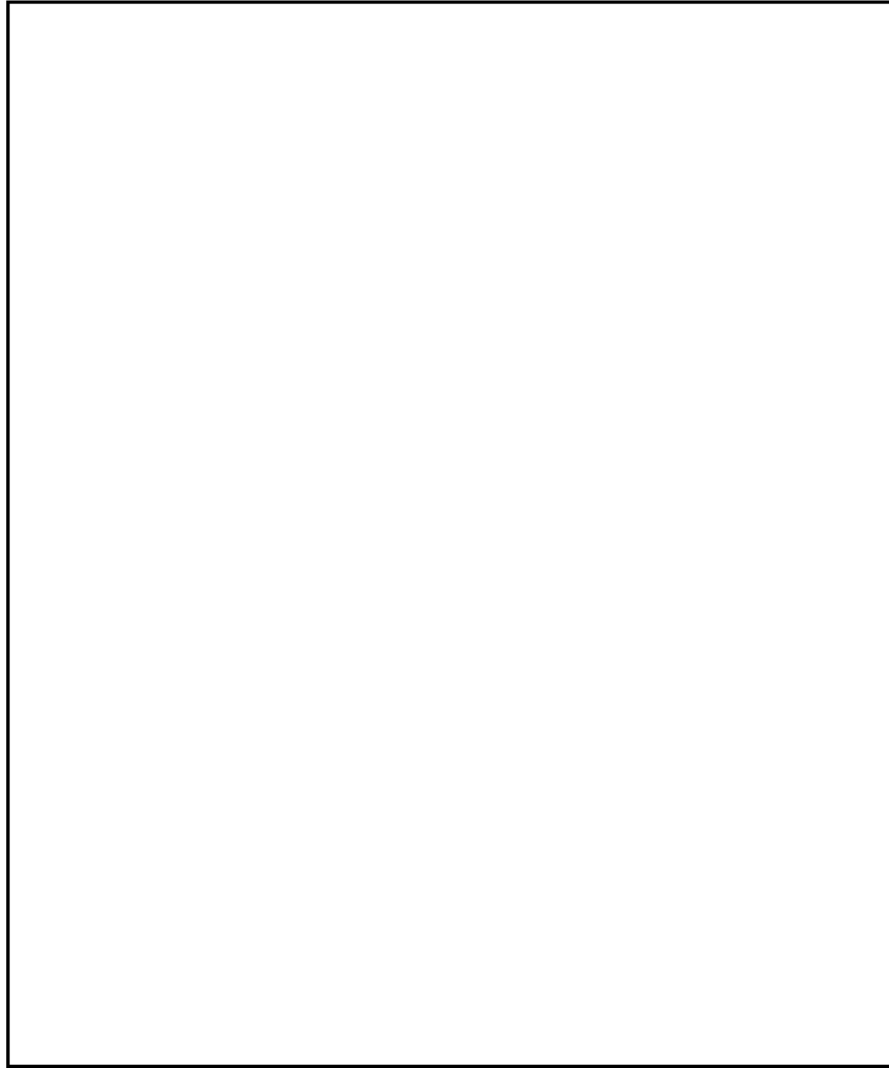




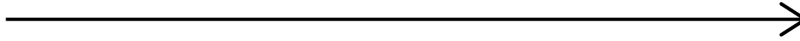
**FIGURE 5**

**Experiment 1**  
*Bam*H1

**Experiment 2**  
*Bam*H1 and *Hind*III



**Direction of  
electrophoresis**



**[Turn over]**

**07.2**

**Suggest how you could determine the size of the different DNA fragments produced in these experiments. [2 marks]**

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**07.3**

**How many DNA fragments would be produced in experiment 2 if the original DNA molecule was a plasmid? [1 mark]**

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**Plant cells are surrounded by a rigid cell wall. Cell wall plasticity refers to the ability of a cell wall to stretch permanently. IAA is a growth factor which can activate enzymes that loosen the cell wall.**

**Scientists investigated the effect of IAA concentration on cell wall plasticity and the growth of stem segments.**

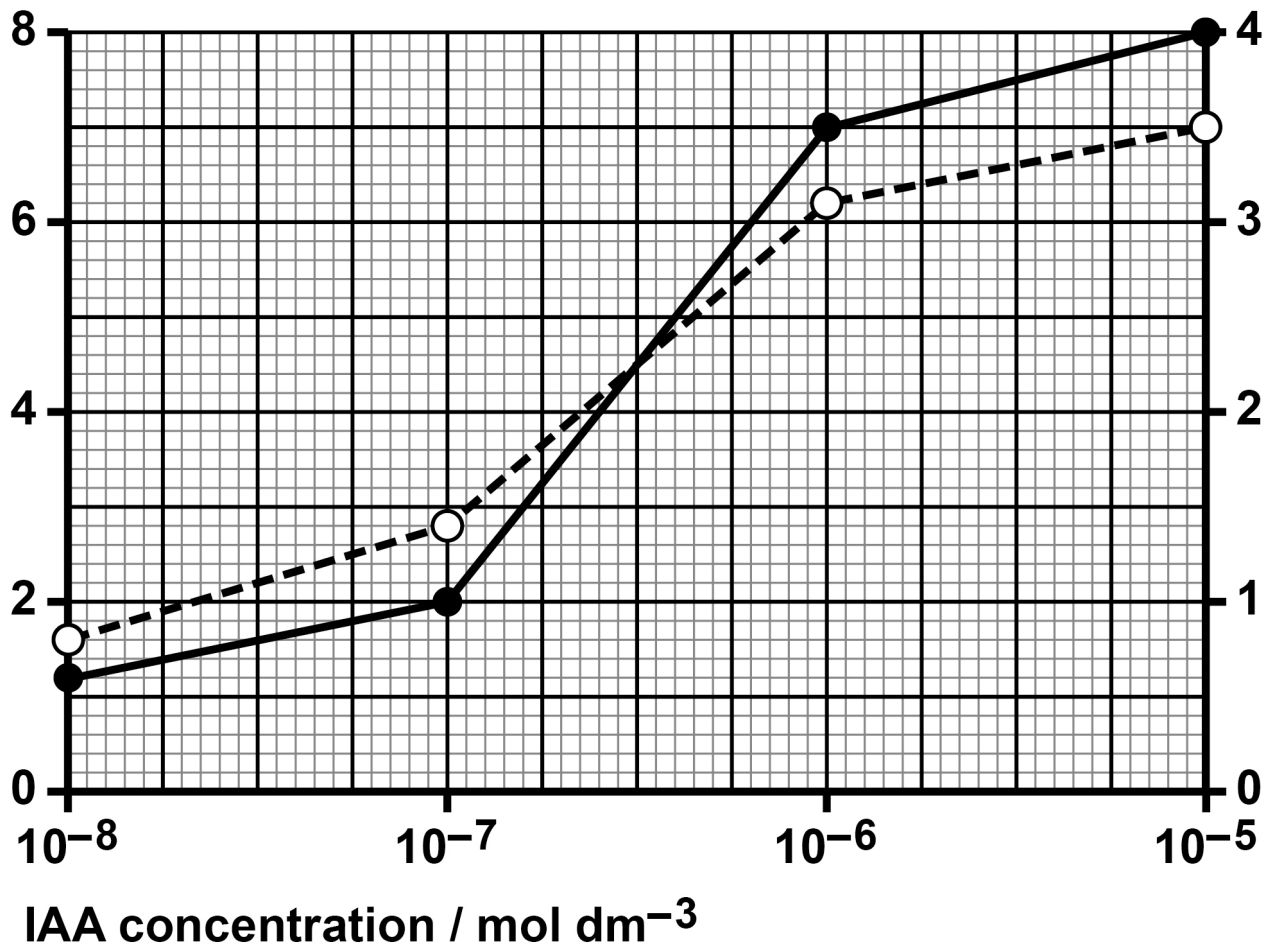
**FIGURE 6, on the opposite page, shows some of the scientists' results.**



FIGURE 6

Cell wall  
plasticity  
/ arbitrary  
units  
(○---○)

Mean  
growth  
of stem  
/ mm  
(●—●)



[Turn over]





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Use FIGURE 6, on page 41, to calculate the percentage increase in mean growth of the stem segments when the IAA concentration was increased from  $10^{-8} \text{ mol dm}^{-3}$  to  $10^{-5} \text{ mol dm}^{-3}$

Give your answer to 2 significant figures.

Show your working. [2 marks]

Answer \_\_\_\_\_ %

[Turn over]



**Gibberellic acid (GA) is another plant growth factor. A student was asked to design and carry out an investigation into the effect of different concentrations of GA on the growth of stem segments.**

**The student was provided with:**

- $10^{-1}$ ,  $10^{-2}$ ,  $10^{-3}$ ,  $10^{-4}$  and  $10^{-5}$  mol dm<sup>-3</sup> concentrations of GA solution
- distilled water
- 6 Petri dishes and access to glassware
- 60 stem segments of different lengths.

**08.3**

**A technician produced the different concentrations of GA solution from a stock  $10^{-1}$  mol dm<sup>-3</sup> concentration of GA.**

**Describe how the technician produced the  $10^{-3}$  mol dm<sup>-3</sup> solution. [1 mark]**

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0	9
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**A person with diabetes is in diabetes remission if their blood glucose concentration is below the diabetes threshold concentration for at least 3 months. This diabetes remission is achieved without taking medication.**

**Scientists investigated whether a weight-loss programme would result in type II diabetes remission.**

**The scientists:**

- **used a computer-generated list to select 380 volunteers from a large number of health centres**
- **selected volunteers aged 25 to 60 years, each with less than 5 years duration of type II diabetes**
- **divided the volunteers in the ratio 1 : 1 between experimental group P and control group Q**
- **placed group P on a weight-loss programme for the 2-year duration of this investigation**
- **recorded loss of mass and percentage of volunteers in each group in type II diabetes remission after 2 years.**



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**Give TWO reasons why a weight-loss programme could be used to treat type II diabetes but NOT type I diabetes. [2 marks]**

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2

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**[Turn over]**



**09.2**

The design of this investigation helps to support the validity of any conclusions obtained.

**Suggest and explain THREE features of this investigation that justify this statement. [3 marks]**

**1**

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**2**

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**3**

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**[Turn over]**



**09.3****TABLE 3 shows some of the scientists' results.****TABLE 3**

	<b>GROUP P</b>	<b>GROUP Q</b>
<b>Percentage achieving diabetes remission</b>	<b>42.1</b>	<b>4.7</b>
<b>Percentage achieving weight loss <math>\geq 15</math> kg</b>	<b>15.8</b>	<b>2.1</b>
<b>Percentage with weight loss <math>\geq 15</math> kg achieving diabetes remission</b>	<b>70.0</b>	<b>75.0</b>
<b>Percentage with weight gain achieving diabetes remission</b>	<b>1.9</b>	<b>1.9</b>



Use the information provided to calculate the difference in number of volunteers between the two groups who achieved diabetes remission.

Show your working. [2 marks]

Answer \_\_\_\_\_

[Turn over]





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[Turn over]

11



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Read the following passage.

The wall gecko is a medium-sized lizard. In an isolated habitat of southern Italy, the wall gecko shows phenotypic diversity. Scientists investigated whether disruptive selection was leading to sympatric speciation in the wall gecko.

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Pale geckos live only on walls and are nocturnal (active at night). Dark geckos live mainly on the dark trunks of olive trees and are diurnal (active during the day). These diurnal geckos can change skin colour when occupying different surfaces during the day.

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Comparison of mitochondrial genes indicated that the diurnal geckos formed a distinct genetic group. This comparison also confirmed that all the geckos in the habitat were of the same species.

15

The scientists used the mark-release-recapture method to estimate the size of the population of geckos in the habitat.



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

10.1

The wall gecko shows phenotypic diversity (lines 1–3).

Suggest TWO factors that have resulted in this phenotypic diversity. [2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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[Turn over]



**10.2**

**The ability of diurnal geckos to change skin colour (lines 9–11) is advantageous.**

**Explain why. [2 marks]**

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**10.5**

**Describe and explain TWO precautions required to ensure that the estimate of the size of the population of geckos was valid (lines 16–18).**

**Do NOT include sample size as one of the required precautions.**

**In your answer, include the formula to estimate the size of the population using the mark-release-recapture method. [3 marks]**

**Precaution 1** \_\_\_\_\_

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**Precaution 2** \_\_\_\_\_

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Formula

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**END OF QUESTIONS**

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<b>15</b>







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For Examiner's Use	
Question	Mark
1	
2	
3	
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10	
<b>TOTAL</b>	

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