



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

[Turn over]



On the front of this book, write your surname and other names, your centre number, your candidate number and add your signature.

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, on the opposite page, shows a drawing of a neuromuscular junction.

0 1 . 1

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

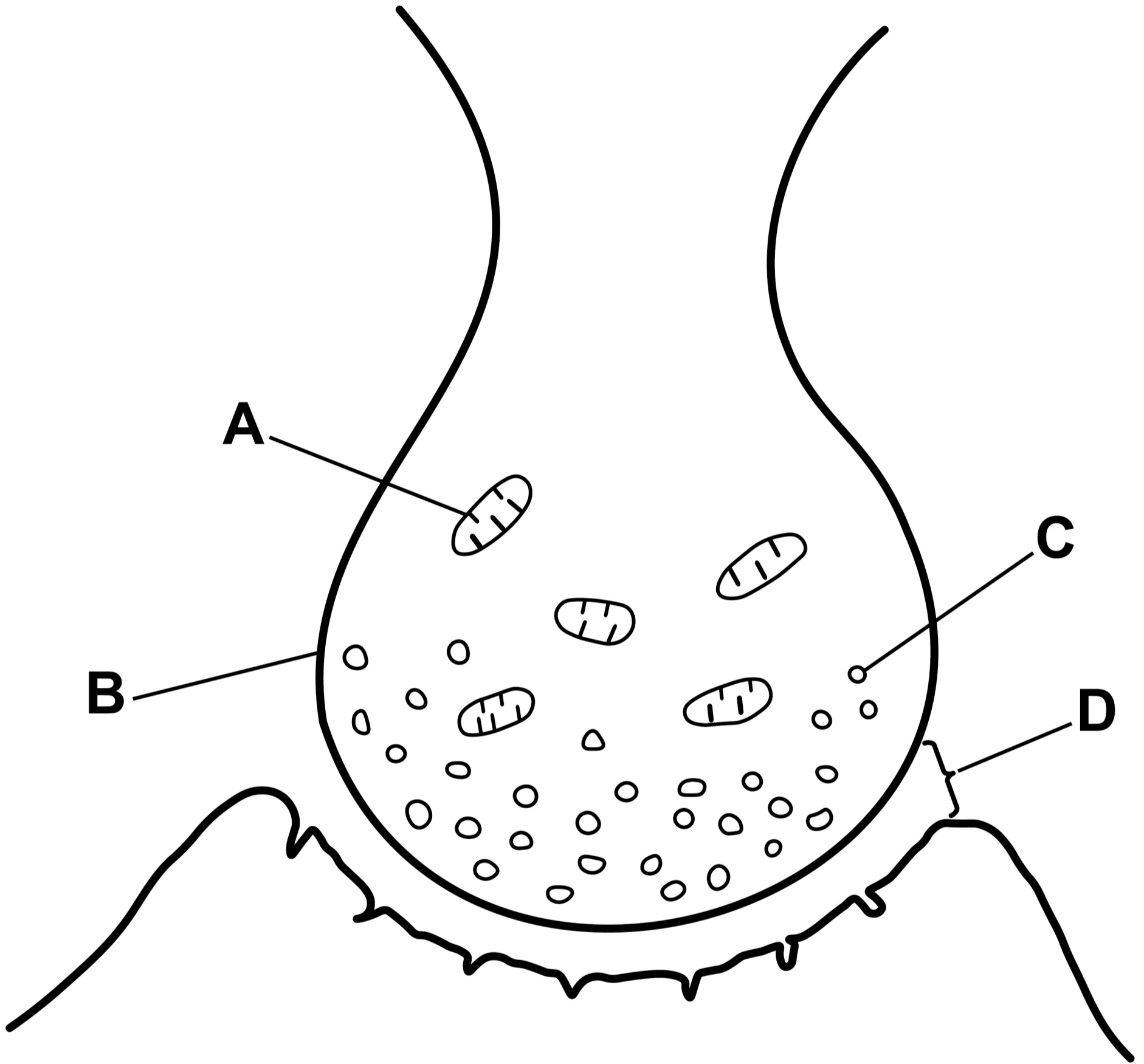
A _____

B _____

C _____

D _____

FIGURE 1



[Turn over]



01.2

Following the release of acetylcholine into a neuromuscular junction, a muscle contraction occurs.

Describe the sequence of events, following the release of acetylcholine, that leads to stimulation of this contraction.

Do NOT include in your answer the events following the release of calcium ions in the myofibril. [4 marks]

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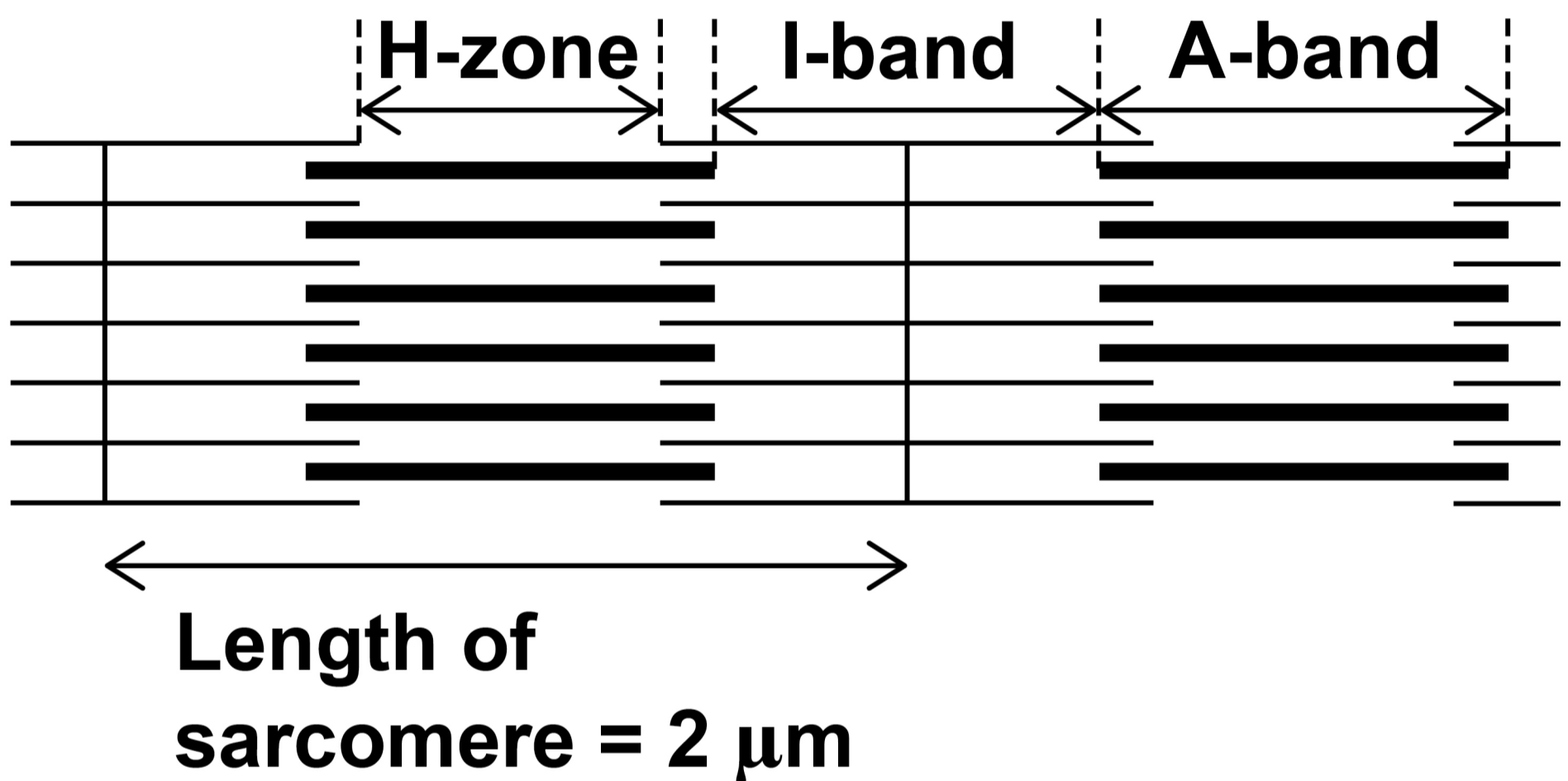
[Turn over]



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 μm

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]

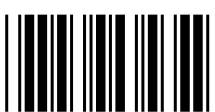
Tick (✓) ONE box.

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



0 2 . 3

Fast muscle fibres have a higher concentration of glycogen than slow muscle fibres.

Explain how the difference in glycogen concentration is related to the different properties of these muscle fibres.

[4 marks]

[Turn over]



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.

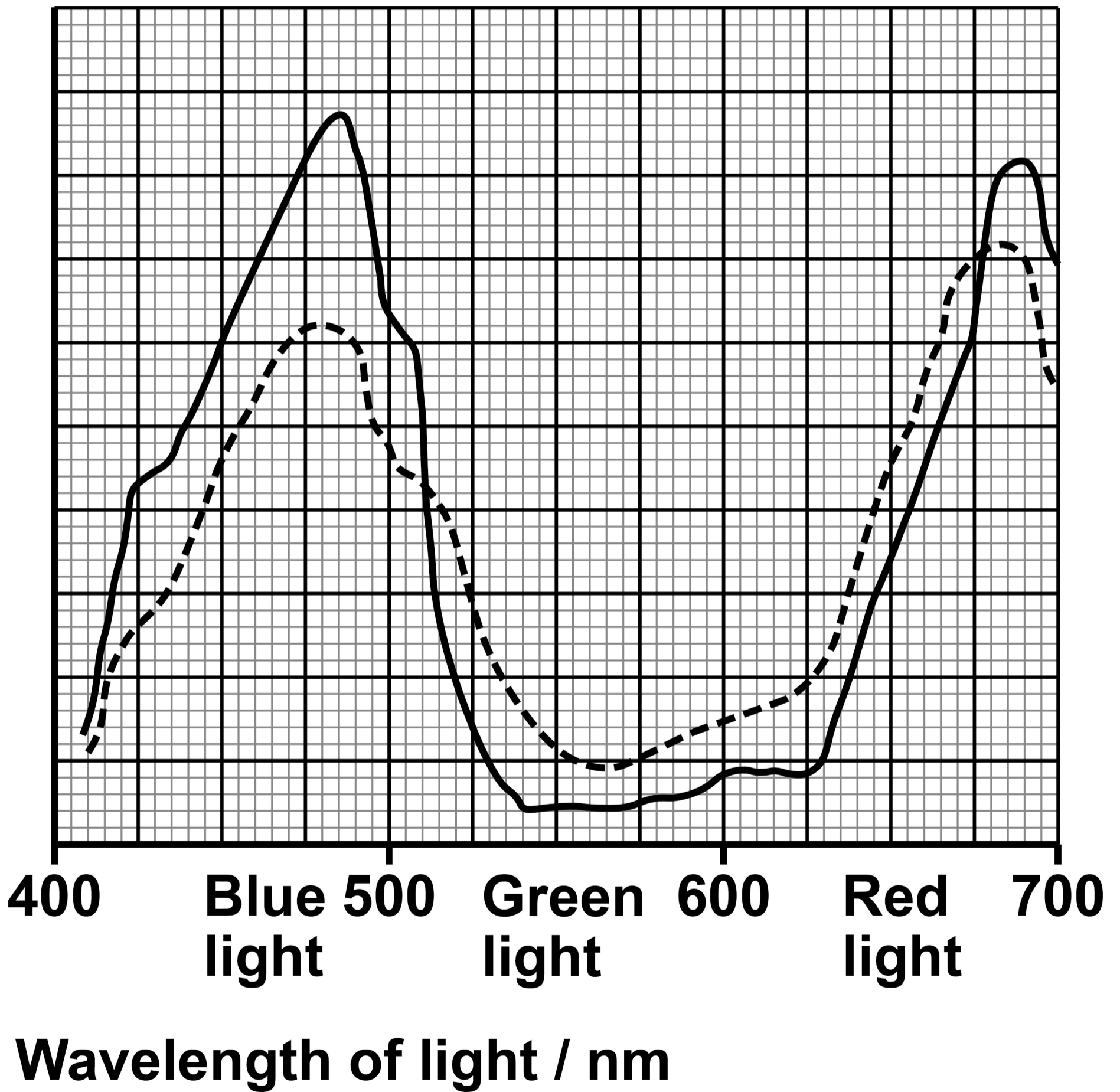
[Turn over]



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 _____

the colour of light and the rate of photosynthesis _____

[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 _____

2 _____

3 _____



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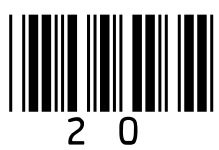
[Turn over]



03.3

Describe how the products of the light-dependent reaction are used in the light-independent reaction to produce triose phosphate.

**Do NOT include the role of ribulose biphosphate (RuBP) in your answer.
[3 marks]**



[Turn over]

<hr/>
7



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]

[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 _____ **%**



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[Turn over]



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, on the opposite page, 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]



05.2

In potato plant fields, fat hen plants can grow up to a height of 2 m and absorb large quantities of nutrients from the soil.

Fat hen has a negative effect on the growth of potato plants.

Use the information provided to explain why.

In your answer, name the type of competition occurring between fat hen plants and potato plants. [3 marks]

05.3

TABLE 1 gives some features of fat hen seeds.

TABLE 1

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

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, on page 38, shows some of the scientists' results, including the probability (P) values obtained using the statistical test.



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[Turn over]



TABLE 2

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





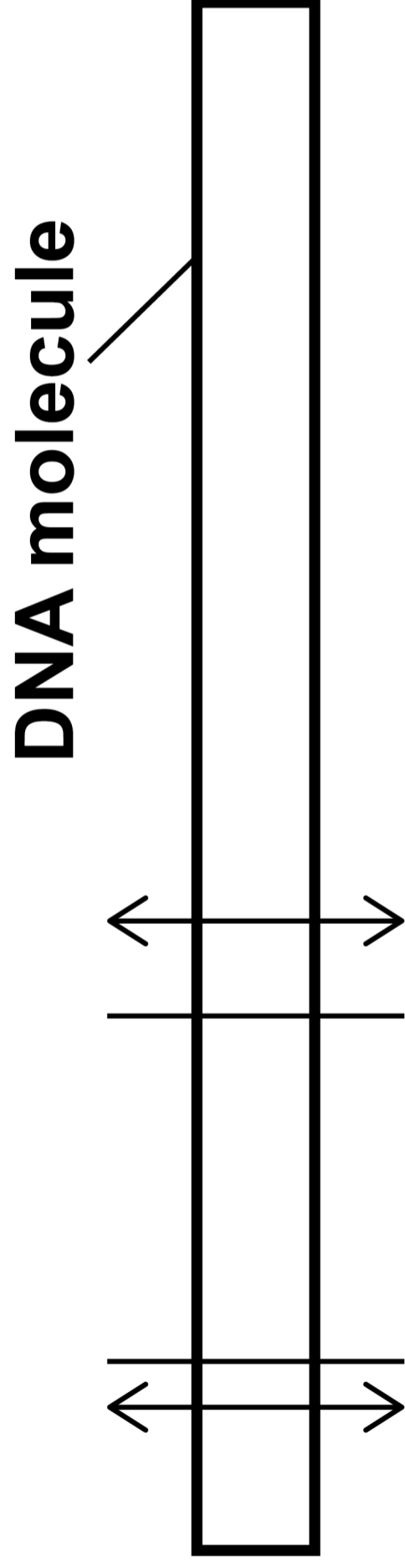
07.1

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

FIGURE 4, on the opposite page, 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

[Turn over]



In two experiments, multiple copies of the DNA molecule shown in FIGURE 4, on page 41, 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 the opposite page, to show the relative positions of the bands following electrophoresis in experiments 1 and 2. [2 marks]



4 3

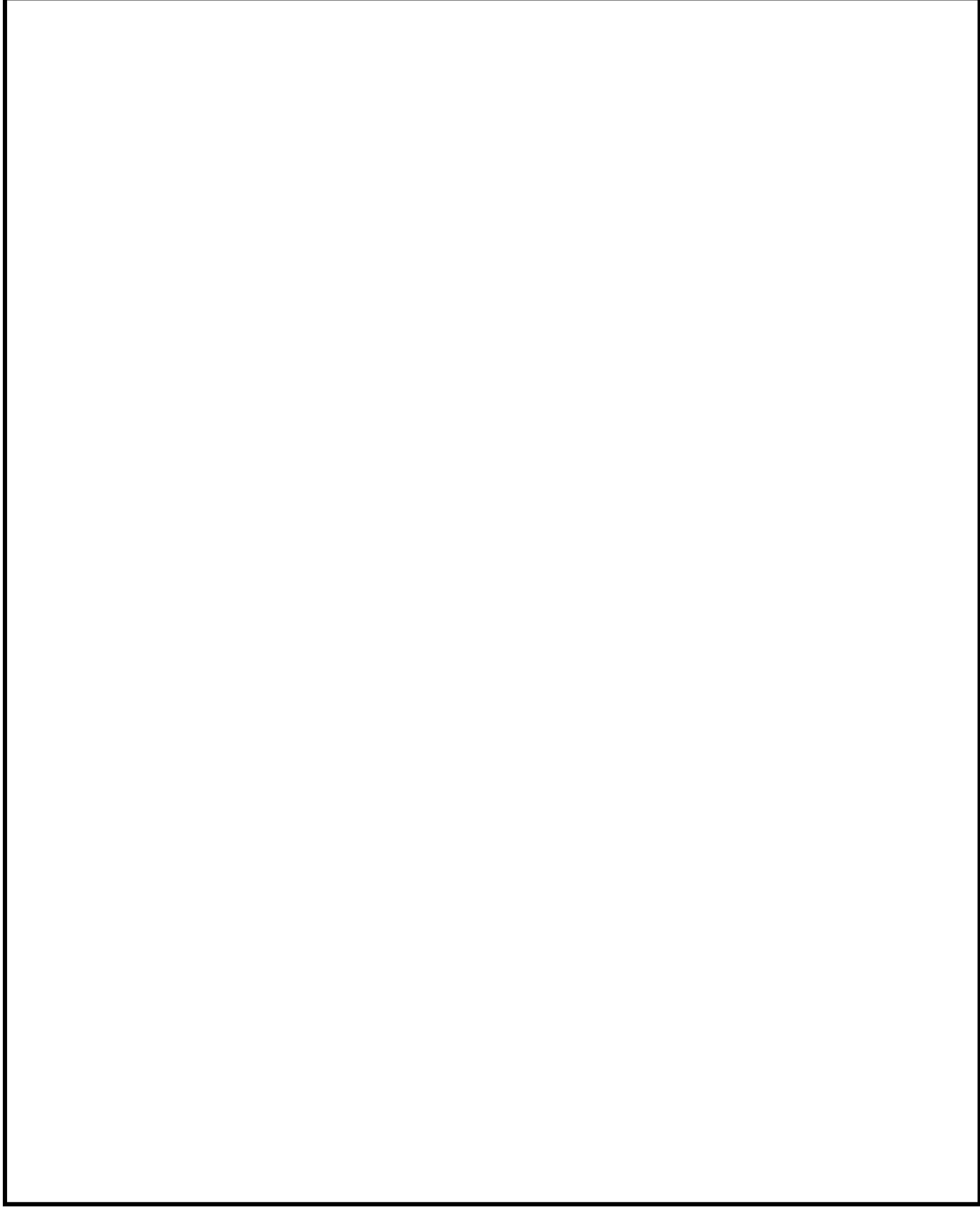
FIGURE 5

Experiment 1

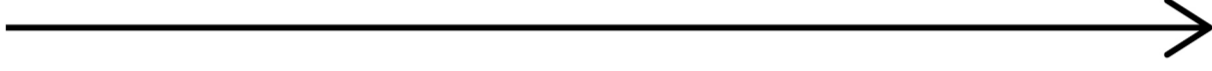
*Bam*H1

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]

0	7	.	3
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How many DNA fragments would be produced in experiment 2 if the original DNA molecule was a plasmid? [1 mark]

[Turn over]



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[Turn over]



0	8
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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.



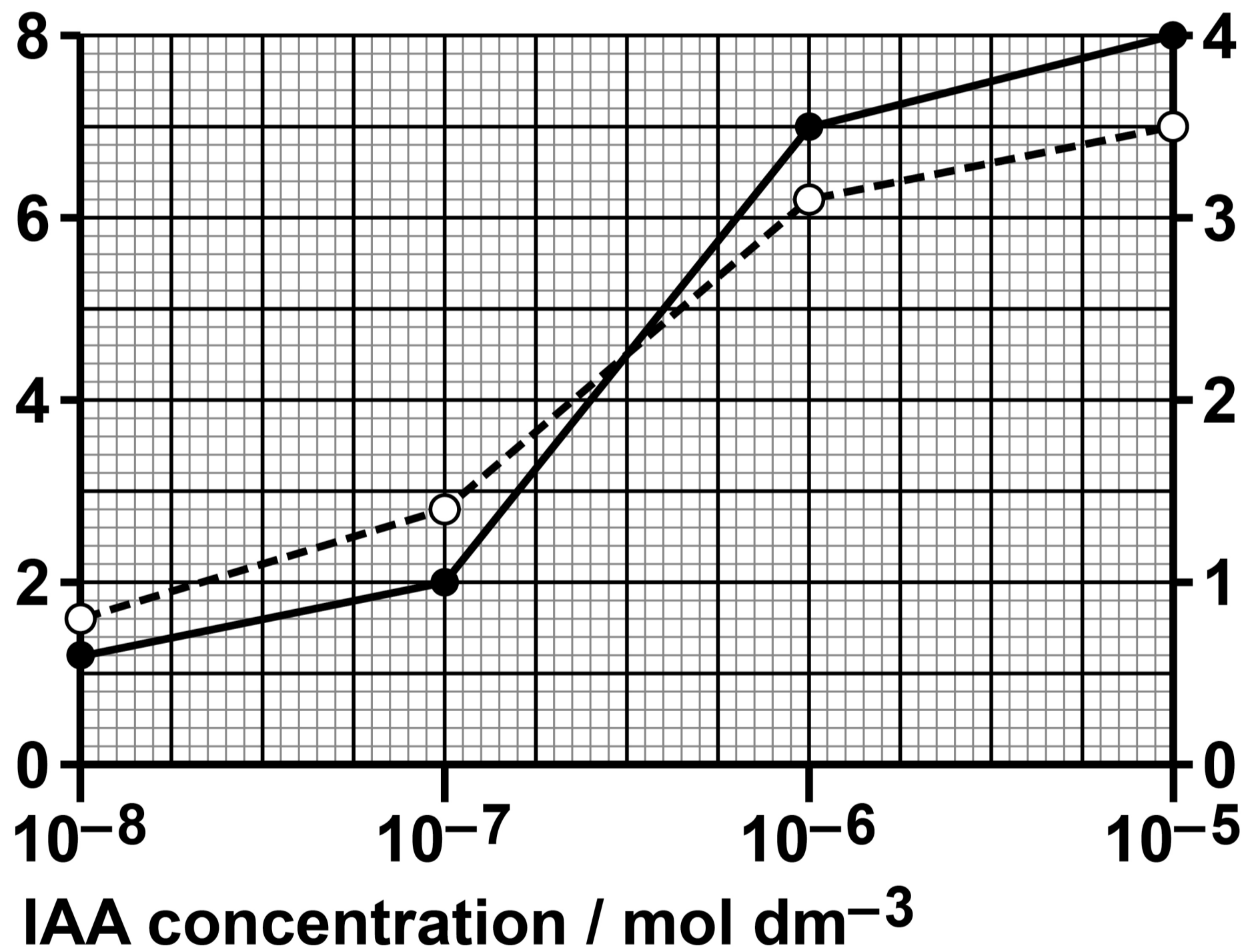
FIGURE 6

Cell wall
plasticity
/ arbitrary
units

(○---○)

Mean
growth
of stem
/ mm

(●—●)



[Turn over]



0	8	.	2
---	---	---	---

Use FIGURE 6, on page 49, 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⁻³ concentrations of GA solution**
- **distilled water**
- **6 Petri dishes and access to glassware**
- **60 stem segments of different lengths.**



0	8	.	3
---	---	---	---

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

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

[Turn over]



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[Turn over]



0	9
---	---

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.**

[Turn over]



09.1

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

[2 marks]

1 _____

2 _____

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 _____

2 _____

3 _____

[Turn over]



09.3

TABLE 3 shows some of the scientists' results.

TABLE 3

	GROUP P	GROUP Q
Percentage achieving diabetes remission	42.1	4.7
Percentage achieving weight loss ≥ 15 kg	15.8	2.1
Percentage with weight loss ≥ 15 kg achieving diabetes remission	70.0	75.0
Percentage with weight gain achieving diabetes remission	1.9	1.9



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]



[Turn over]

11



1	0
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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.

5

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.

10

15

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.** 20

**The scientists used the
mark-release-recapture method to
estimate the size of the population of
geckos in the habitat.** 25

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

[Turn over]

10.1

The wall gecko shows phenotypic diversity (on page 66, lines 1–4).

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

1 _____

2 _____

10.4

Explain how comparison of mitochondrial genes could indicate that the nocturnal geckos formed a distinct genetic group (on pages 66–67, lines 16–18).

In your answer, explain how new techniques enable the comparison of genes to be completed rapidly.

[3 marks]



[Turn over]



10.5

Describe and explain TWO precautions required to ensure that the estimate of the size of the population of geckos was valid (on page 67, lines 22–25).

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 _____

Precaution 2 _____



Formula _____

END OF QUESTIONS

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15



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For Examiner's Use	
Question	Mark
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TOTAL	

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