

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 3 Populations and Genes

Wednesday 13 May 2026

08:00 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	



J U N 2 6 B L 0 3 0 1

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ANSWER IN THE SPACES PROVIDED**



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

0 1

Photosynthesis involves the light-dependent and the light-independent reactions.

0 1 . 1

Photolysis of water occurs during the light-dependent reaction.

Explain the importance of photolysis.

[2 marks]

0 1 . 2

Name the **two** products of the light-dependent reaction that are needed for the light-independent reaction.

[2 marks]

1 _____

2 _____

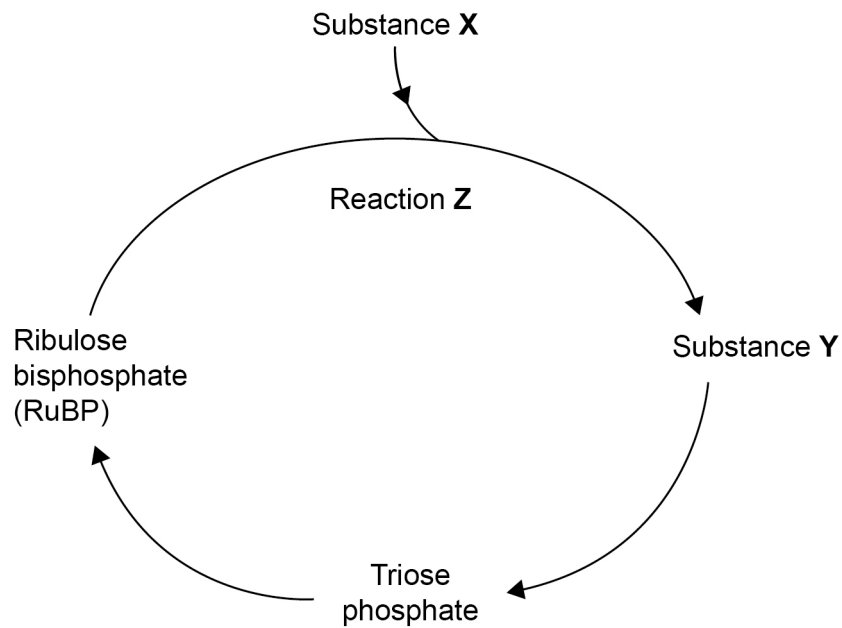
Question 1 continues on the next page

Turn over ►



Figure 1 shows the light-independent reaction of photosynthesis.

Figure 1



0 1 . 3 Where exactly in a cell does the light-independent reaction occur?

[1 mark]

0 1 . 4 Name substance **X** and substance **Y** from **Figure 1**.

[2 marks]

Substance **X** _____

Substance **Y** _____

0 1 . 5 Name the enzyme that catalyses reaction **Z** shown in **Figure 1**.

[1 mark]



0 1 . 6

Triose phosphate is produced in the light-independent reaction.

How does triose phosphate allow the light-independent reaction to continue?

[1 mark]

0 1 . 7

Name **two** organic substances, **not** shown in **Figure 1**, formed from triose phosphate.

[1 mark]

1

2

10

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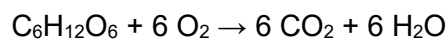


0 2

The respiratory quotient (RQ) can indicate the type of substrate used in respiration.

The RQ for a substrate can be calculated from the balanced symbol equation for the oxidation of the substrate.

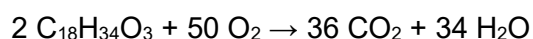
The balanced symbol equation for the oxidation of glucose is:



The RQ for glucose is 1.00

Ricinoleic acid is a fatty acid that can be used as a respiratory substrate in seeds.

The balanced symbol equation for the oxidation of ricinoleic acid is:



0 2 . 1

Calculate the RQ for ricinoleic acid.

Use the balanced symbol equation.

[1 mark]

RQ = _____



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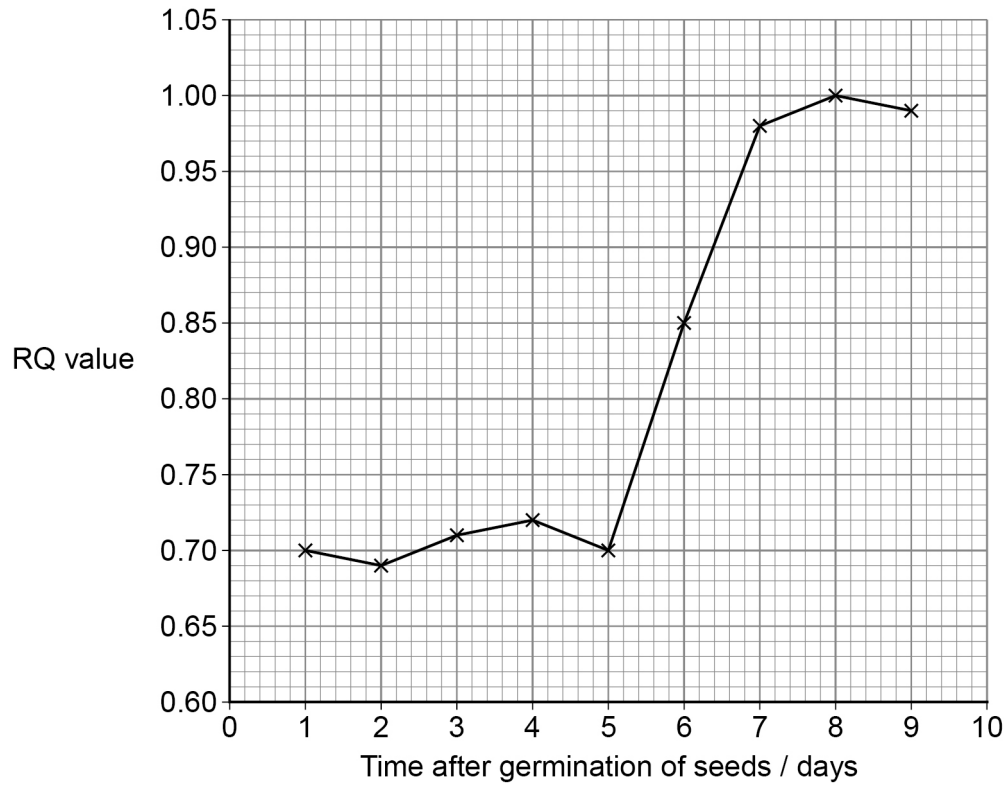
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Germination is when seeds start to grow into plants.

Figure 2 shows the change in RQ values during the germination of seeds.

Figure 2



0 2 . 2

Give **three** conclusions about the respiratory substrates used during the germination of seeds from days 1 to 9.

Use **Figure 2**.

[3 marks]

1 _____

2 _____

3 _____

0 2 . 3

Suggest **one** reason why the RQ can be greater than 1.00

[1 mark]

5

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0 3

The Mauna Loa Observatory in Hawaii is a research centre that measures the carbon dioxide concentration in the atmosphere.

Figure 3 shows changes in the carbon dioxide concentration in the atmosphere from January 2019 to January 2023.

Figure 3

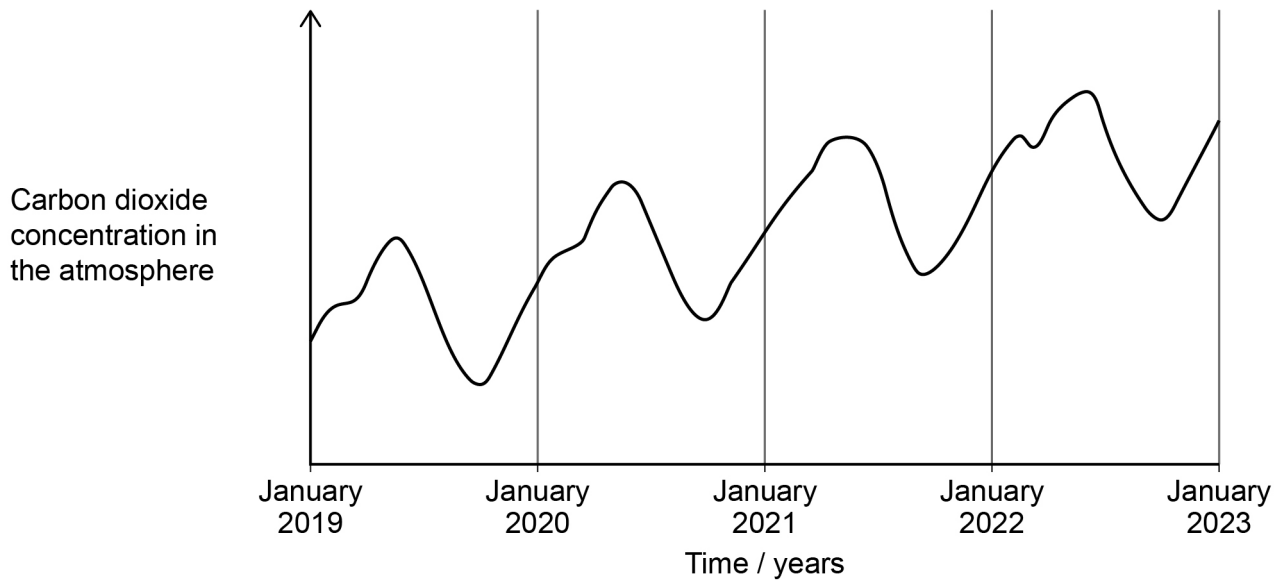
**0 3****1**

Figure 3 shows the carbon dioxide concentration **decreasing** in each year.

Explain why.

[2 marks]



0	3	.	2
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Figure 3 shows an overall increase in the concentration of carbon dioxide in the atmosphere.

Explain how the increase in carbon dioxide concentration can cause changes in global temperature.

[3 marks]

Question 3 continues on the next page.

Turn over ►



0	3	.	3
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[4 marks]

[illegible]

9



0 4

Legumes are plants such as peas and beans.

Nitrogen-fixing bacteria can live in structures called nodules on the roots of legumes.

Figure 4 shows nodules on the roots of a legume.

Figure 4

**0 4 . 1**

What is nitrogen-fixation?

[1 mark]

0 4 . 2

Legumes and nitrogen-fixing bacteria both benefit from their relationship.

Explain the benefit to each organism.

[2 marks]

Benefit to legumes _____

Benefit to nitrogen-fixing bacteria _____

Turn over ►



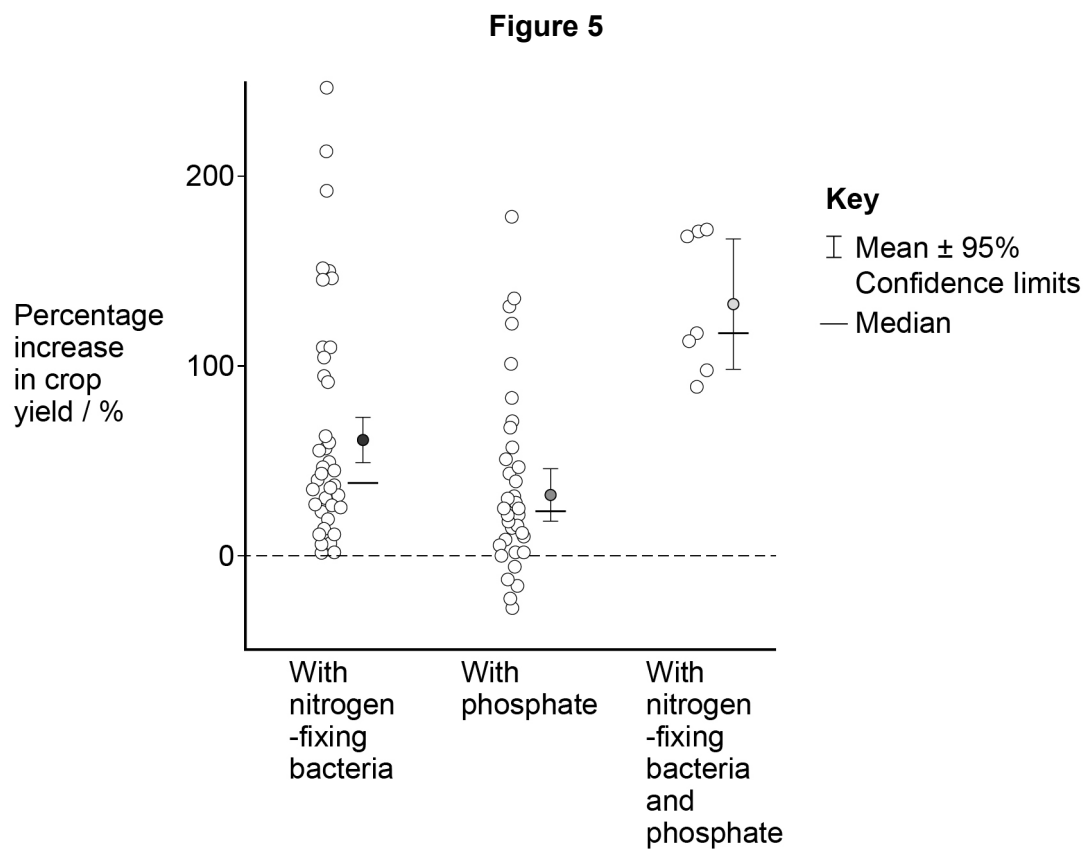
Scientists investigate the effect of adding nitrogen-fixing bacteria and phosphate on the yield of a legume crop called cowpea.

The scientists use four groups of cowpea seeds:

- treated with nitrogen-fixing bacteria
- treated with phosphate
- treated with nitrogen-fixing bacteria and phosphate
- not treated (control).

The scientists calculate the percentage increase in crop yield from the treated seeds compared with the control.

Figure 5 shows the scientists' results.



0 4 . 3

Figure 5 shows the median percentage increase in crop yield.

How is a median calculated?

[1 mark]



0 4 . 4

Explain the difference in the yield of the cowpea crop with nitrogen-fixing bacteria **and** phosphate instead of with **only** nitrogen-fixing bacteria.

Use information from **Figure 5**.

[2 marks]

0 4 . 5

The scientists recommend that farmers should add nitrogen-fixing bacteria and phosphate to their legume crops to increase the yield.

Suggest **three** pieces of information that farmers would need before following the scientists' recommendation.

[3 marks]

1

2

3



0 5

A student investigates the effect of competition on seedling growth.

This is the method the student uses.

1. Wash seeds in disinfectant solution.
2. Put filter paper in a sterile plastic dish and add water.
3. Add two seeds to the dish.
4. Repeat steps 2 and 3 using different numbers of seeds in each dish.
5. Put all of the dishes in a dark cupboard at 20 °C to allow the seeds to grow.
6. Measure the shoot length of each seedling.

0 5**. 1**

In the method, the student controls the temperature and the size of the dish.

Give **two** other variables the student needs to control.

[2 marks]

1 _____

2 _____



0 5 . 2

Explain why the student:

- washes the seeds in disinfectant solution
- keeps the dishes at 20 °C

[4 marks]

Washes seeds in disinfectant _____

Keeps dishes at 20 °C _____

0 5 . 3

Suggest **two** improvements to the student's investigation.**[2 marks]**

1 _____

2 _____

Turn over ►

Table 1 shows the student's results.

Table 1

Number of seeds per dish	Mean length of seedling shoots / mm
2	9.0
4	8.5
5	1.5
8	5.0
10	4.5
16	4.0
20	3.5
25	2.5
32	2.5
34	1.5

0 5 . 4 Suggest **one** reason for the mean seedling length at 5 seeds per dish.

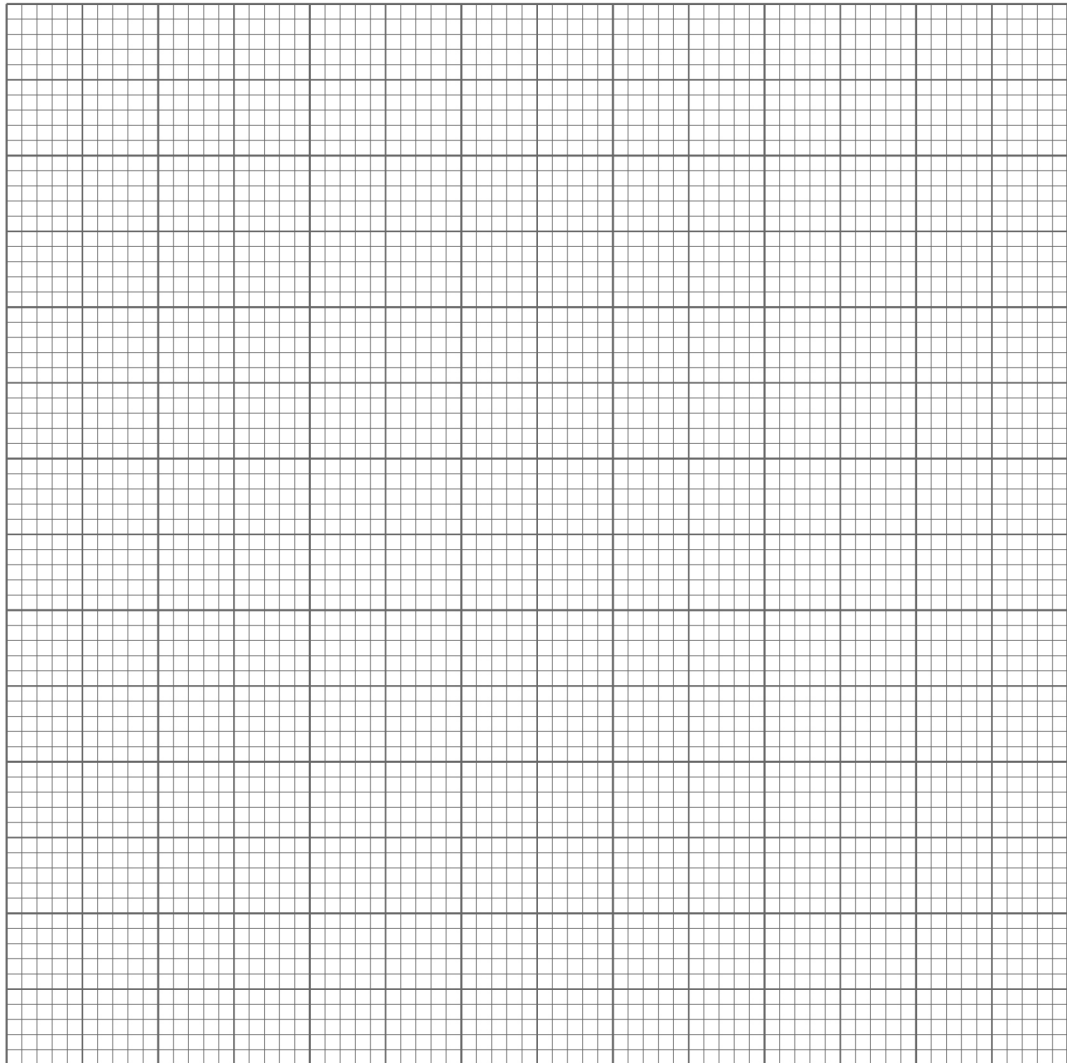
[1 mark]



0 5 . 5 Plot a suitable graph of the student's results.

Use all of the data from **Table 1**.

[4 marks]



0 5 . 6 Describe the student's results.

Use **Table 1** and your graph from Question **05.5**.

[1 mark]

Turn over ►



0	5	.	7
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The student uses a statistical test to analyse the results.

Name the statistical test the student should use.

Give a suitable null hypothesis.

[2 marks]

Statistical test _____

Null hypothesis _____

16



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0 6

The Asian koel is a bird that lays its eggs in the nests of another species of bird. Scientists call this other species a host species.

The host bird species feeds and cares for the Asian koel offspring.

Figure 6 shows an Asian koel.

Figure 6



0 6 . 1

Scientists investigating Asian koels observe that:

- Asian koel eggs have thicker shells than host bird eggs
- Asian koel offspring hatch out of their shells before host offspring.

Suggest **one** advantage to the Asian koel for each of the scientists' observations.

[2 marks]

Eggs have thicker shells _____

Hatch before host offspring _____



The scientists monitor the nests of host birds for 2 years and record:

- the number of host bird eggs and Asian koel eggs in the nests
- the number of offspring that survive.

Table 2 shows the scientists' results.

Table 2

	Mean number of eggs per nest	Mean number of offspring that survive
Host bird	2.9	1.3
Asian koel	1.7	1.2

0 6 . 2 Compare the survival of the host bird offspring with the Asian koel offspring.

Use suitable calculations from the data in **Table 2**.

[2 marks]

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Egg mimicry in birds is when a species has evolved to lay eggs of the same size, shape, colour and pattern as host bird eggs.

Three host birds of the Asian koel are the crow, the myna and the shrike.

Scientists investigate if Asian koels use egg mimicry.

The scientists:

- measure the length and width of the host bird eggs and the Asian koel eggs in the host bird's nests
- calculate the egg shape ratios using the formula $\text{length} \div \text{width}$.

Table 3 shows the scientists' results.

Table 3

Host bird nest	Host bird egg length/mm ($\pm$ standard deviation)	Host bird egg width/mm ($\pm$ standard deviation)	Host bird egg shape ratio	Asian koel egg length/mm ($\pm$ standard deviation)	Asian koel egg width/mm ($\pm$ standard deviation)	Asian koel egg shape ratio
Crow	37.3 ± 2.1	26.5 ± 1.1	1.4	30.0 ± 1.1	23.0 ± 0.6	
Myna	28.4 ± 0.9	21.7 ± 1.0	1.3	30.4 ± 1.2	22.7 ± 1.2	
Shrike	22.9 ± 0.9	19.1 ± 0.5	1.2	31.2 ± 1.2	23.4 ± 0.8	

0 6 . 3 Calculate the egg shape ratios of the Asian koel eggs.

Complete **Table 3**.

Give your answers to an appropriate level of accuracy.

[2 marks]



One conclusion from the scientists' results is that the Asian koel does **not** use egg mimicry.

[5 marks]

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0 7

Summer squash is a type of fruit that can be white, yellow or green in colour.

Figure 7 shows two summer squash fruits.

Figure 7

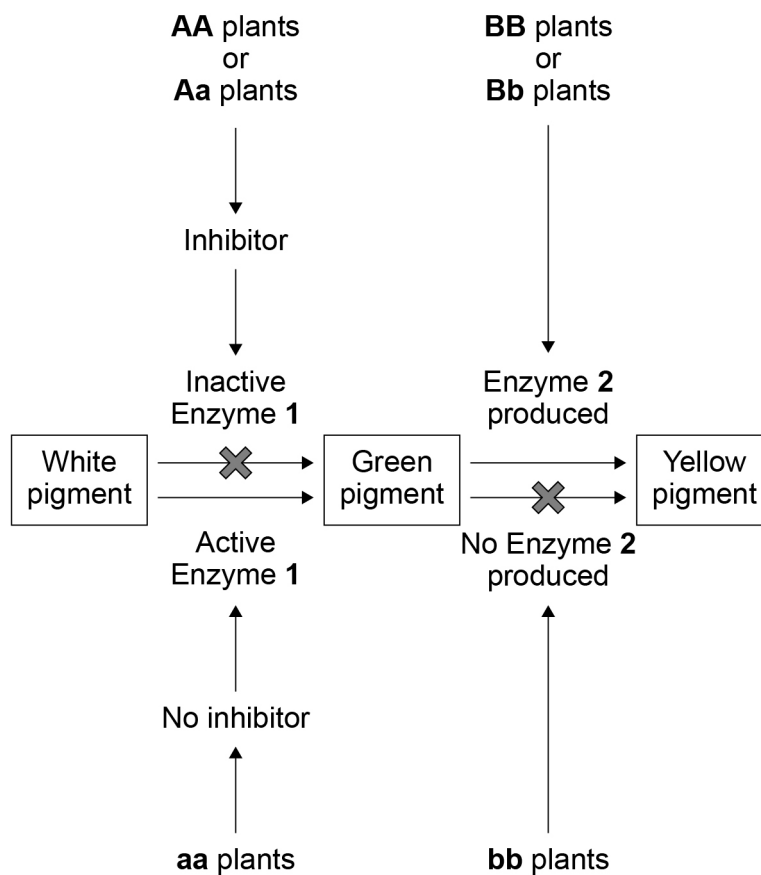


The colour of summer squash is controlled by two genes, gene **A** and gene **B**. Each gene has two alleles.

Figure 8 shows how gene **A** and gene **B** control fruit colour in summer squash.

A = dominant allele for inhibitor production
a = recessive allele for **no** inhibitor production
B = dominant allele for Enzyme 2 production
b = recessive allele for **no** Enzyme 2 production

Figure 8



[6 marks]

- white
- green
- yellow.

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A recessive allele of a different gene causes some summer squash plants to be very small.

Describe how the student would use the Hardy–Weinberg equation to calculate the frequency of summer squash plants that are heterozygous for the gene.

[5 marks]

[illegible]

[4 marks]

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END OF QUESTIONS



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