OXFORD
INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

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Candidate signature _____
I declare this is my own work.

INTERNATIONAL A-LEVEL
BIOLOGY (9610)

Unit 3 Populations and Genes

Thursday 13 January 2022 07:00 GMT 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	

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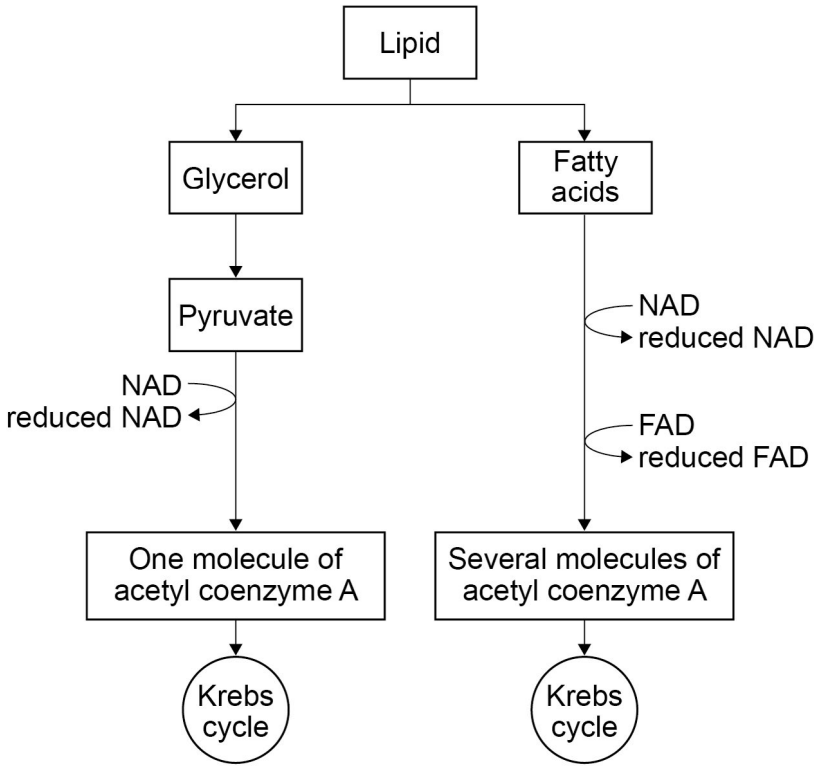
Answer **all** questions in the spaces provided.

0 1 The breakdown products of lipids can be used as respiratory substrates.

Figure 1 shows some of the steps of aerobic respiration using lipids.

Figure 1



0 1 . 1 Aerobic respiration of one glucose molecule can produce up to 38 molecules of ATP whereas one molecule of a fatty acid can produce up to 130 molecules of ATP.

Give **one** reason why more ATP molecules can be produced from a fatty acid than from glucose.

Use information from **Figure 1**.

[1 mark]

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0 1 . 2 Fatty acids cannot be respired anaerobically.

Explain why fatty acids cannot be used in anaerobic respiration.

Use information from **Figure 1**.

[2 marks]

Question 1 continues on the next page

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The Respiratory Quotient (RQ) can be used to identify a respiratory substrate.

Table 1 shows the RQs for amino acids, fatty acids and glucose.

Table 1

Respiratory substrate	**RQ**
Amino acids	0.8–0.9
Fatty acids	0.7
Glucose	1.0

A student investigates respiration using seeds.

The seeds use 17.1 cm^3 of oxygen and produce 13.0 cm^3 of carbon dioxide.

0 1 . 3 The student uses the volumes of gas to calculate the RQ.

Give one quantity that can be used instead of volume to calculate the RQ.

[1 mark]

_____

0 1 . 4 Show that the seeds are using a mixture of respiratory substrates.

Use information from **Table 1**.

[2 marks]

_____

_____

_____

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0 1 . 5 Chronic obstructive pulmonary disease (COPD) is a long-term lung disorder. COPD makes breathing difficult.

People with COPD have high levels of carbon dioxide in their blood.

Suggest why people with COPD may be advised to increase the proportion of lipids in their diet.

Use information from **Table 1**.

[2 marks]

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8

Turn over for the next question

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0 2 Scientists investigate succession after deforestation in the Amazon rainforest. Deforestation means that trees are cut down and removed.

After deforestation, the land becomes either clearcut or pasture.

Clearcut land is abandoned immediately.

Pasture land is planted with grass and the land is grazed by cattle for five to eight years before the land is abandoned.

Succession happens after the land is abandoned.

The scientists investigate if the way land is used before it is abandoned affects succession.

The scientists:

- choose a large study area of deforested, abandoned land
- select several sample sites that were clearcut
- select several sample sites that were pasture
- count the number of plant species in each sample site every year
- collect data from the sample sites for 25 years.

0 2 . 1 Give **one** reason why the scientists' method would give valid results.

[1 mark]

_____

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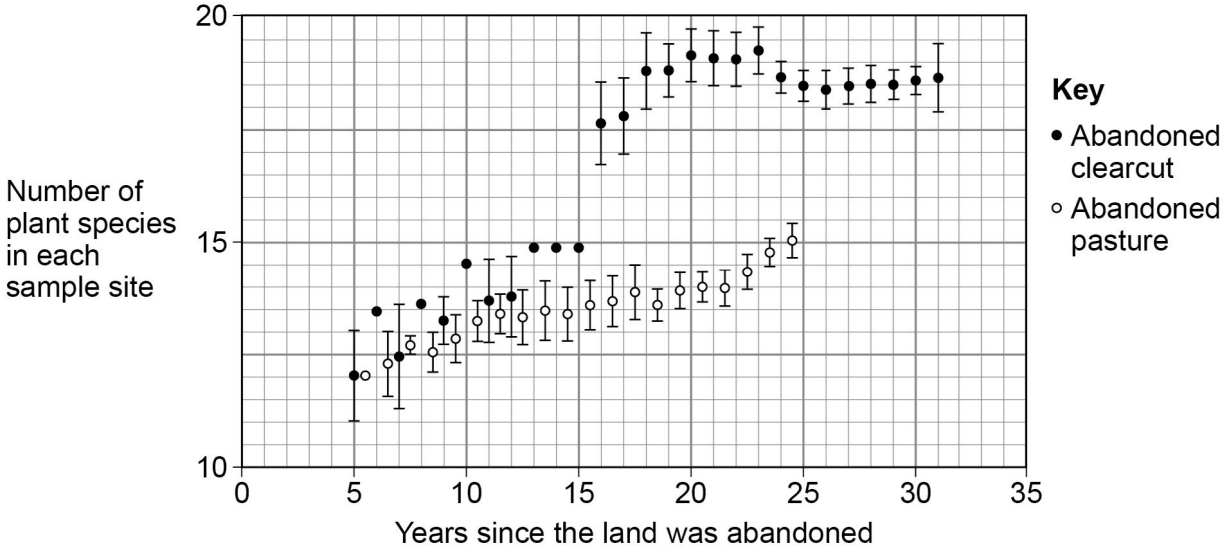
Figure 2 shows the number of plant species in each sample site at different times since the land was abandoned.

The error bars indicate the standard error.

Figure 2



0 2 . 2 Evaluate if the data indicate that there is a significant difference between the number of plant species found in abandoned clearcut and abandoned pasture.

Use information from **Figure 2**.

[3 marks]

Question 2 continues on the next page

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0 2 . 3 Biodiversity in the abandoned clearcut and in the abandoned pasture increases with time.

Explain why.

[3 marks]

0 2 . 4 The scientists measure the amount of nitrogen in the leaves of some plants growing in the study area.

The leaves of plants on abandoned pasture have less nitrogen than the leaves of plants on abandoned clearcut.

The scientists suggest that this could be because the soil in abandoned pasture has less nitrogen available than the soil in abandoned clearcut.

Explain why the soil in abandoned pasture could have less nitrogen available.

[2 marks]

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0 2 . 5 The pioneer species are different in abandoned clearcut and abandoned pasture.

Table 2 shows the main features of the pioneer species.

Table 2

Abandoned clearcut	Abandoned pasture
Dominant pioneer species is *Cecropia* tree	Dominant pioneer species is *Vismia* tree
Cecropia trees attract many types of birds and mammals	*Vismia* trees do not attract many types of birds or mammals
Cecropia tree has a thin crown that lets light pass through	*Vismia* tree has a dense cone-shaped crown that blocks light

Suggest why *Cecropia* is described as a succession **facilitator** whereas *Vismia* is described as a succession **inhibitor**.

Use information from **Table 2**.

[2 marks]

11

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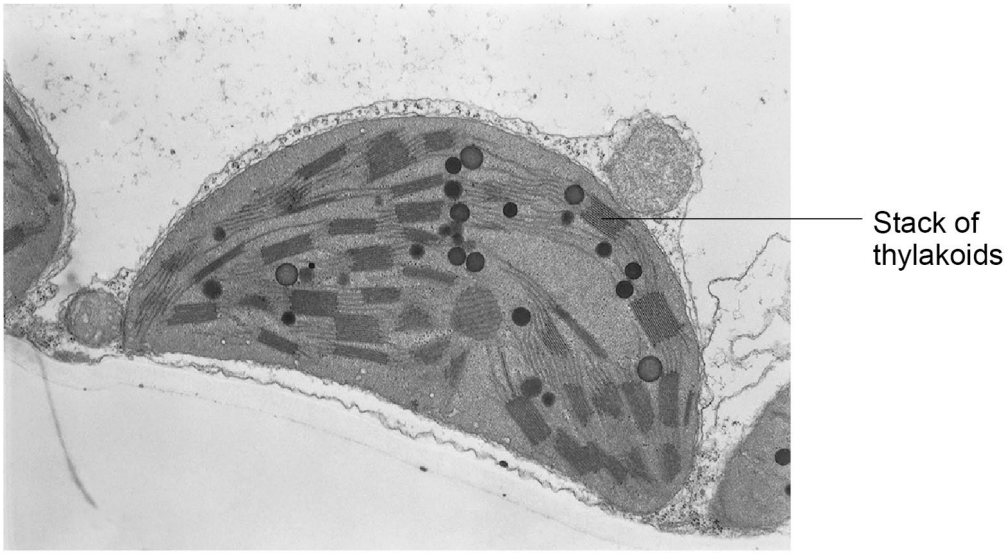
0 3 **Figure 3** shows a chloroplast as seen using an electron microscope.

Figure 3



0 3 . 1 Chloroplasts contain DNA and ribosomes.

Give the roles of both DNA and ribosomes in chloroplasts.

[2 marks]

DNA _____

_____

_____

Ribosomes _____

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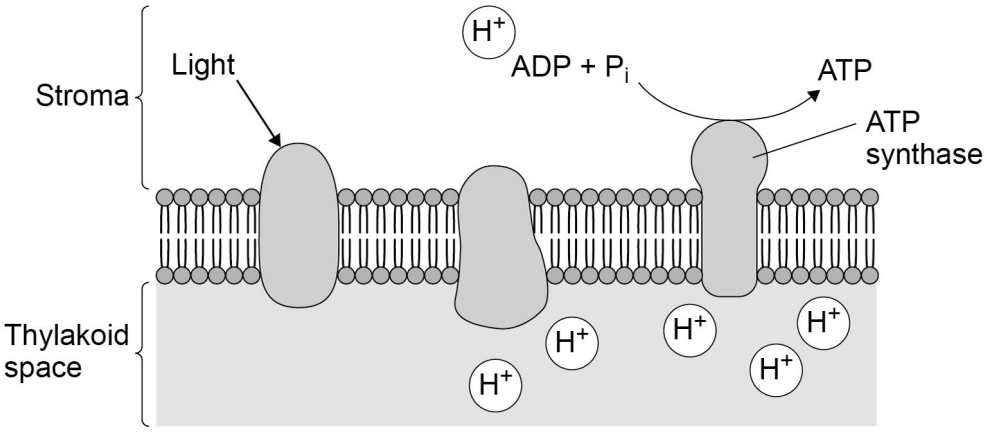
Chloroplasts contain many stacks of discs called thylakoids.

Each thylakoid is surrounded by a membrane.

Figure 4 shows part of a thylakoid membrane.

Figure 4



0 3 . 2 Describe the role of protons in the production of ATP in the chloroplasts.

Use information from **Figure 4**.

[3 marks]

Question 3 continues on the next page

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0 3 . 3 A chloroplast contains 60 stacks of thylakoids.

There are 25 thylakoids in each stack.

The diameter of each thylakoid is 0.45 μm

The membrane area of one thylakoid can be estimated using:

$$\mathbf{A} = \mathbf{2}\,\pi\,\mathbf{r}^2$$

where **A** = area
r = radius
π = 3.14

Calculate the total area of thylakoid membrane in the chloroplast.

[2 marks]

Area of thylakoid membrane _____ μm^2

0 3 . 4 Containing many stacks of thylakoids is an adaptation of chloroplasts for efficient photosynthesis.

Explain how.

[2 marks]

_____

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9

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0 4 Scientists investigate the effect of changes in temperature and rainfall on the yields of four crop plants.

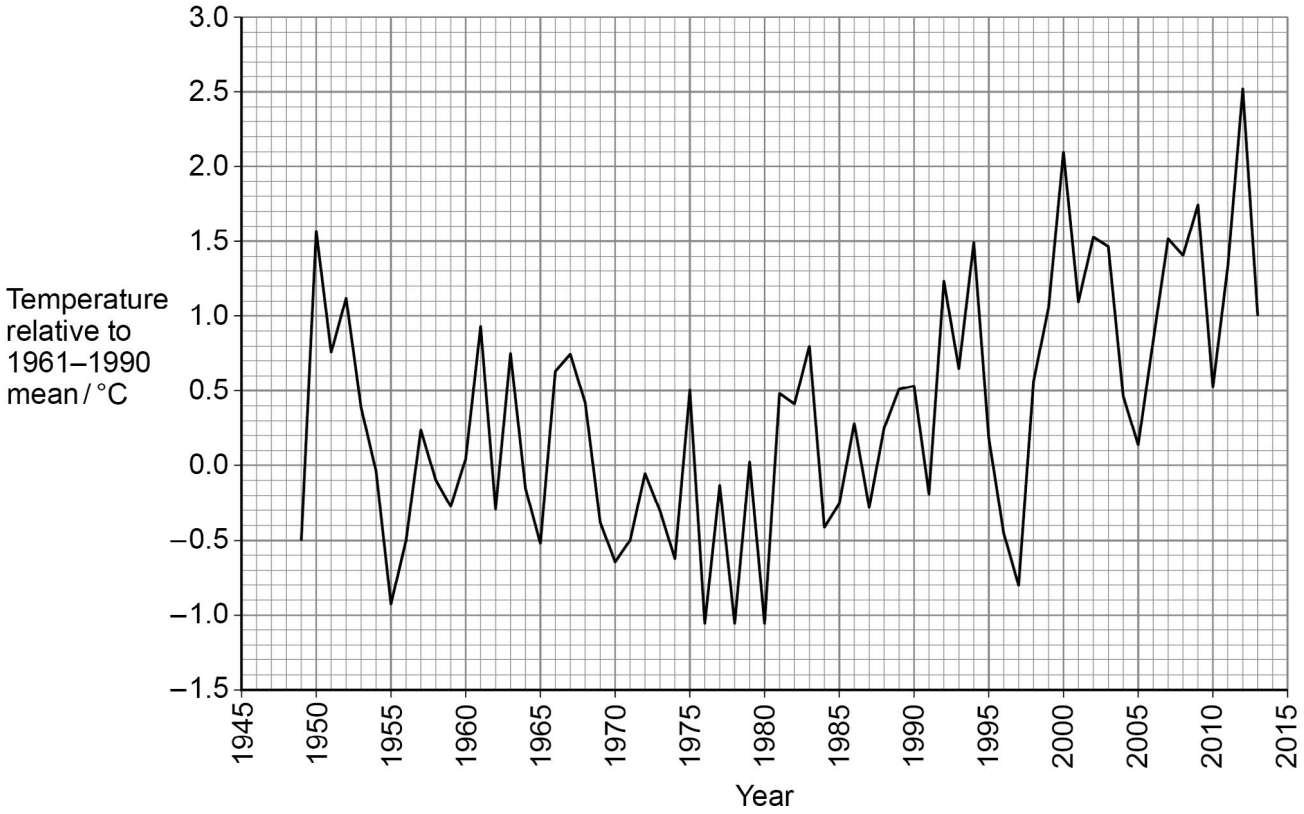
The scientists collect data from 1949 to 2013.

The scientists:

- compare the temperature and rainfall to the mean value for 1961 to 1990
- measure the yield of each crop.

Figure 5 shows the scientists' results for temperature.

Figure 5



0 4 . 1 Calculate the temperature change from 1949 to 2013.

Use data from **Figure 5**.

[1 mark]

Temperature change = _____ °C

Question 4 continues on the next page

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Figure 6 shows the scientists' results for rainfall.

Figure 6

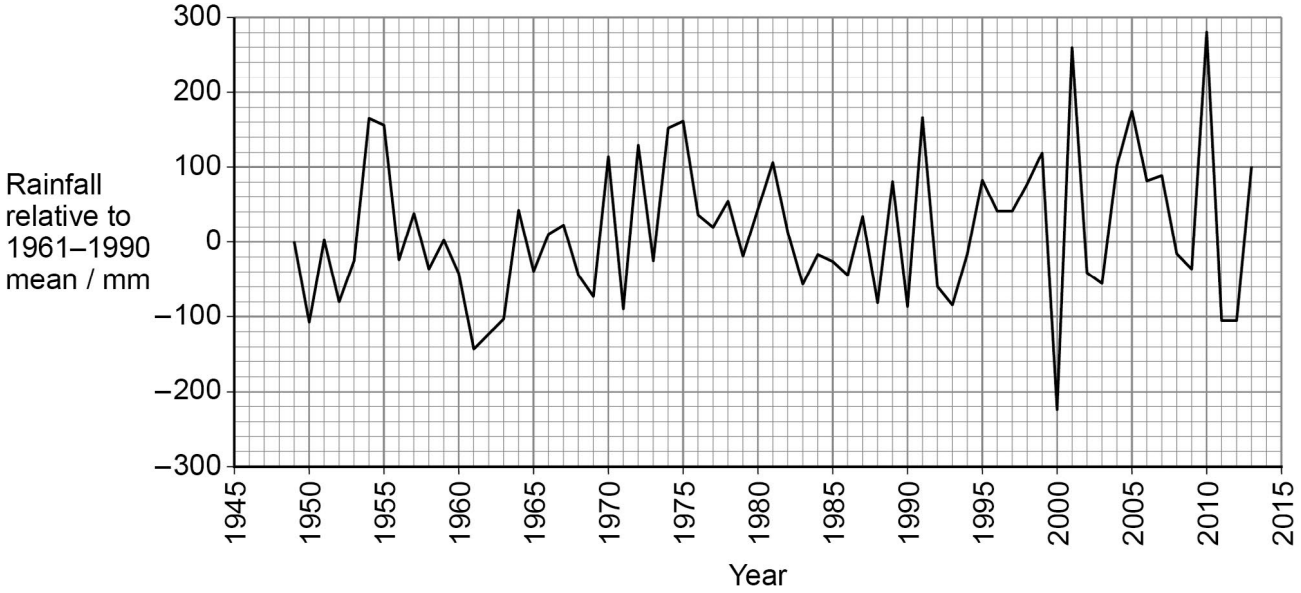
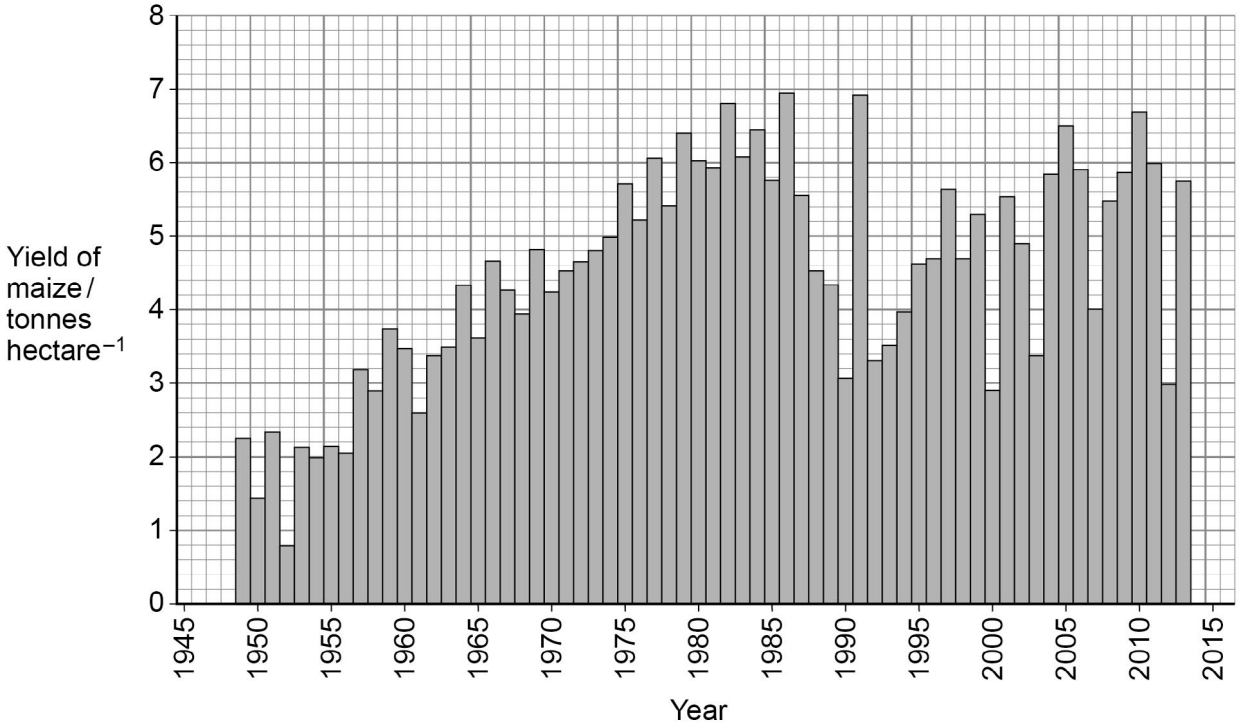


Figure 7 shows the scientists' results for the yield of maize.

Figure 7



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0 4 . 2 One conclusion from the investigation is:

'An increase in rainfall increases the yield of maize.'

Evaluate this conclusion.

Use data from **Figure 6** and **Figure 7**.

[3 marks]

0 4 . 3 The scientists use a statistical test to analyse the effect of temperature and rainfall on maize yield.

Name a statistical test the scientists should use.

Give a reason for your choice.

[2 marks]

Name of test _____

Reason for choice of test _____

Question 4 continues on the next page

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The scientists investigated the effect of changes in temperature and rainfall on the yields of maize, soybean, sugar beet and sunflower.

The scientists calculate the test statistic and find the *p* values.

Table 3 shows the *p* values.

Table 3

	***p* values**	
Crop plant	**Rainfall and crop yield**	**Temperature and crop yield**
Maize	< 0.01	0.01
Soybean	0.69	0.06
Sugar beet	< 0.01	< 0.01
Sunflower	< 0.01	0.01

0 4 . 4 Explain what the scientists can conclude from the *p* values.

[2 marks]

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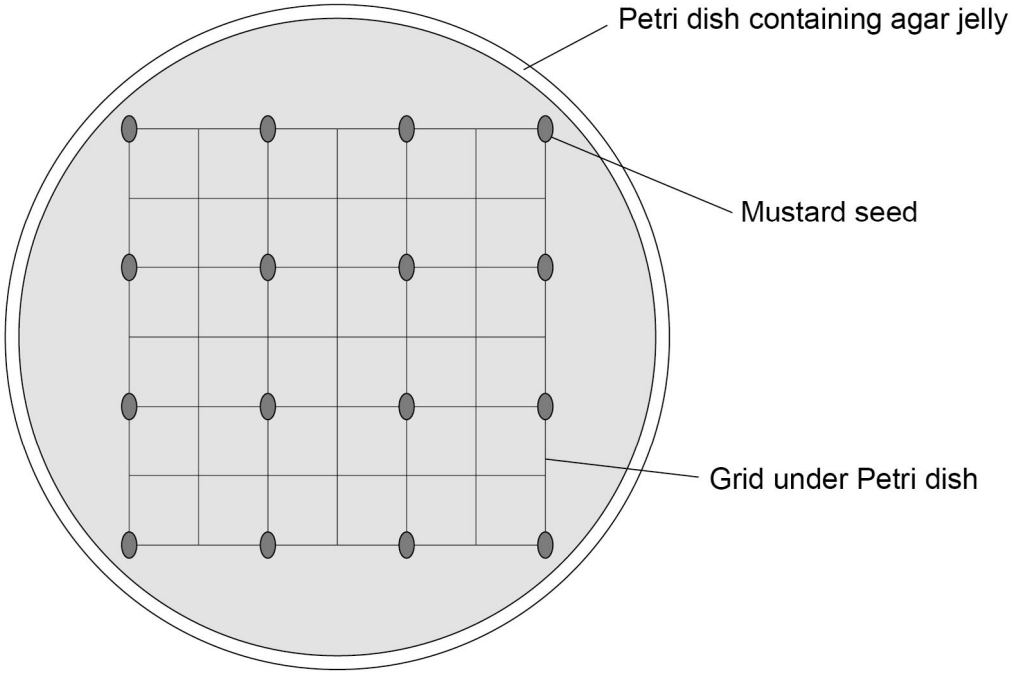
0 5 A student investigates the effect of competition on seed germination.

The student:

1. washes mustard seeds in a dilute bleach solution
2. takes five Petri dishes containing sterile agar jelly
3. puts a 6 cm x 6 cm grid under each Petri dish
4. washes forceps in bleach and uses the forceps to pick up seeds
5. puts different numbers of seeds into each Petri dish spread evenly across the 6 cm x 6 cm grid – an example with 16 seeds is shown in **Figure 8**
6. puts the Petri dishes in a dark cupboard
7. counts the number of seeds that have germinated after 24 hours.

Figure 8



0 5 . 1 Explain why the student washes the seeds and forceps in bleach.

[2 marks]

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0 5 . 2 The student needs to control several variables to collect valid results.

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

[2 marks]

1 _____

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2 _____

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0 5 . 3 Suggest why the student puts the Petri dishes in a dark cupboard.

[1 mark]

_____

_____

_____

0 5 . 4 Explain how putting the Petri dishes in a refrigerator at 4 °C would affect germination.

[2 marks]

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Question 5 continues on the next page

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The student calculates:

- sowing density of the seeds in the 6 cm x 6 cm grid
- percentage germination.

Table 4 shows the student's results.

Table 4

Number of seeds in the Petri dish	Sowing density / number of seeds cm^{-2}	Number of seeds that germinated	Percentage germination
9	0.25	5	56
16	0.44	14	88
25	0.69	21	84
36		26	72
49		30	61

0 5 . 5 Complete **Table 4** by calculating the sowing densities for the Petri dishes with 36 and 49 seeds.

[2 marks]

0 5 . 6 Give the reason why the student calculates germination as a percentage.

[1 mark]

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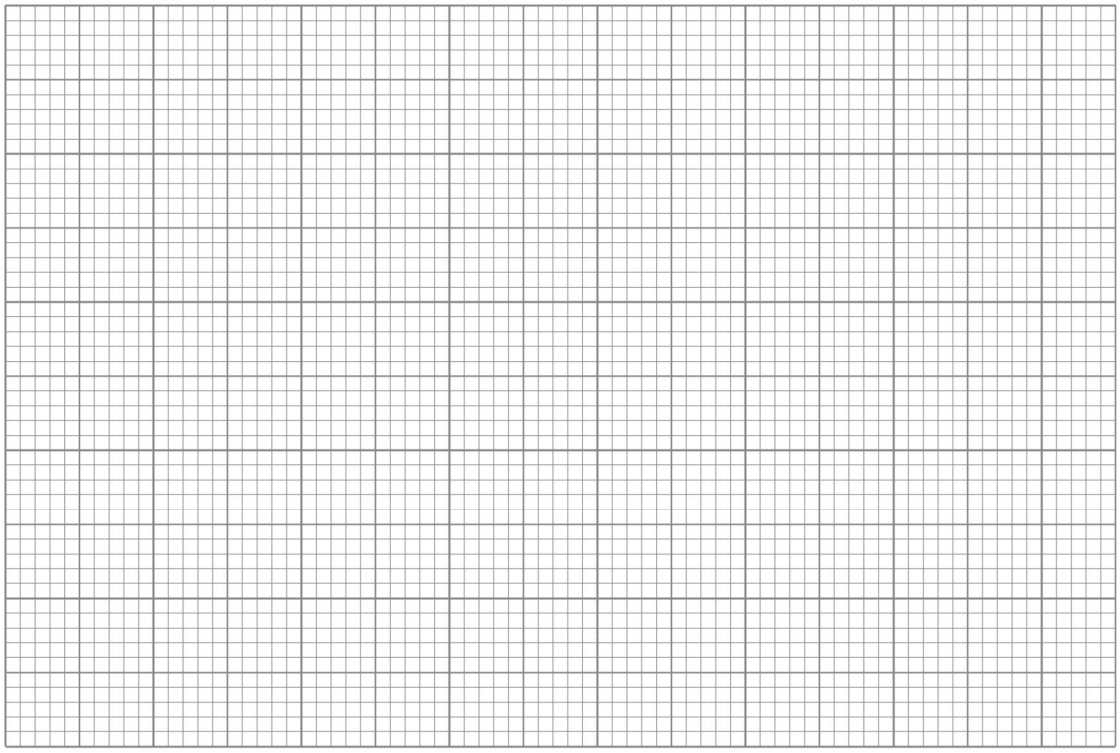
0 5 . 7 Plot a graph of the student's results to show how percentage germination is dependent on sowing density.

[3 marks]



0 5 . 8 The student wants to use the results from this investigation to find the optimum sowing density for all seeds.

The student concludes that 0.44 seeds cm^{-2} is the optimum sowing density.

Evaluate the student's conclusion.

[3 marks]

16

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0 6 Snow geese are large birds found in North America.

Figure 9 shows a snow goose.

Figure 9

The females lay eggs in a nest on the ground and sit on the eggs to keep them warm.
The eggs hatch and the young birds leave the nest a few hours after hatching.
The two parents protect the young birds, but the young birds must find their own food.
Predators may eat the eggs and young birds.

Scientists study a large population of snow geese for 1 year.

The scientists record the:

- number of eggs in each nest (clutch size)
- number of nests with each clutch size
- number of eggs that hatch
- percentage of eggs that hatch.

Table 5 shows the scientists' results.

Table 5

Number of eggs in each nest (clutch size)	Number of nests with each clutch size	Number of eggs that hatch	Percentage of eggs that hatch
2	3	2	33.3
3	21	49	77.8
4	37	110	74.3
5	20	71	71.0
6	10	30	50.0
7	1	6	85.7
8	0	-	-
9	1	5	55.6
10	1	6	60.0

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0 6 . 1 Natural selection affects the number of eggs in a nest.

Name the type of selection shown in **Table 5**.

Give the reason for your choice.

[2 marks]

Type of selection _____

Reason for choice _____

_____

0 6 . 2 One conclusion from the investigation is that 7 is the optimum clutch size for snow geese.

Evaluate this conclusion.

Use information from **Table 5**.

[3 marks]

_____

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0 6 . 3 Suggest **three** reasons why snow geese with clutch sizes above 7 could be at a selective disadvantage.

[3 marks]

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3 _____

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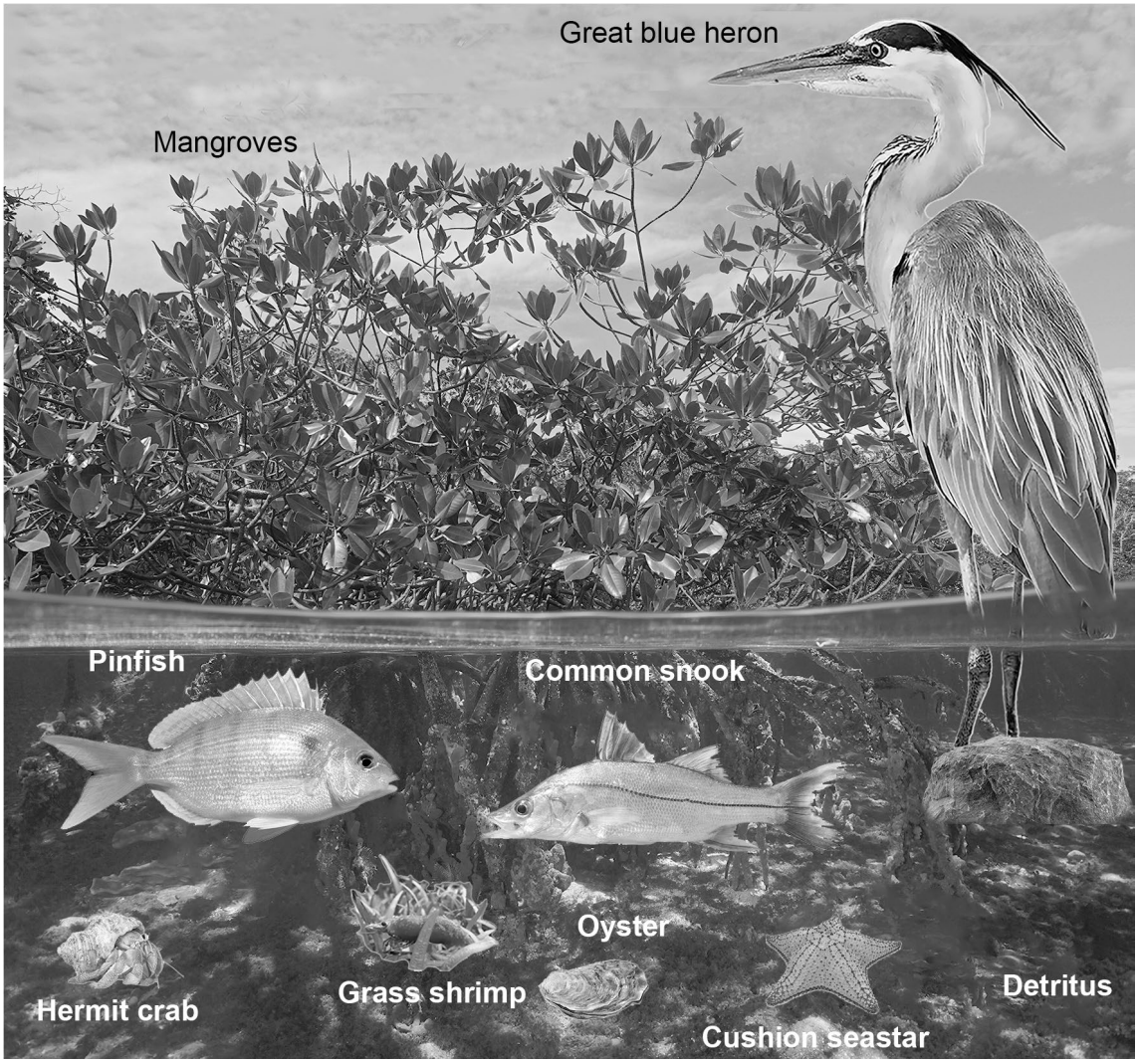
0 7 Mangroves are tropical trees that live in salty water near coasts.

Figure 10 shows part of a mangrove ecosystem.

Figure 10



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0 7 . 1 Describe the structure of an ecosystem.

Give examples from **Figure 10**.

[4 marks]

0 7 . 2 Describe how **biotic** (living) factors can cause variation in a population size.

[5 marks]

Question 7 continues on the next page

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0 7 . 3 Photosynthesis is the main route for energy to enter an ecosystem.

Explain how **abiotic** (non-living) factors affect the rate of photosynthesis.

[6 marks]

15

END OF QUESTIONS

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