Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

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|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | |

*3060741898*

**BIOLOGY** **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2018**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **9** printed pages and **3** blank pages.

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CAMBRIDGE International Examinations

**[Turn over**

**1** **(a)** Some students were asked to use leaf discs to investigate photosynthesis in leaves of different types.

The students decided to compare the rate of photosynthesis in four different types of leaf in a room kept at a temperature of 20 °C.

The leaves were taken from:

- ivy, which has a thick waxy cuticle on the upper surface
- geranium, which has a thin cuticle on the upper surface
- spiderwort, which has purple and green stripes and a thin cuticle
- sorghum, which has a thick waxy cuticle on the upper surface.

The students prepared leaf discs of the same diameter from all four types of leaf and placed them onto damp paper in Petri dishes. Each Petri dish was covered by a lid.

When first placed in a solution, the leaf discs sink. As photosynthesis occurs oxygen is released and the discs rise to the surface. The time taken for the discs to reach the surface allows the rate of photosynthesis to be determined.

Fig. 1.1 shows leaf discs rising to the surface after being placed in a solution of sodium hydrogencarbonate.

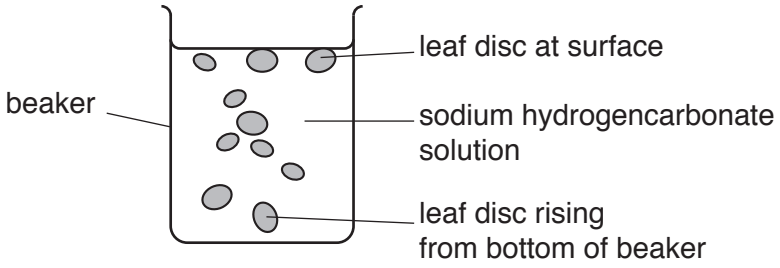



**Fig. 1.1**

**(i)** State the independent variable **and** the dependent variable in this investigation.

*independent variable* .....

.....

*dependent variable* .....

..... [2]

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**(ii)** Use the information provided to describe a method by which the students could compare the rate of photosynthesis in discs cut from the four types of leaf.

Your method should be set out in a logical order and be detailed enough to let another person follow it.

Details of the preparation of the leaf discs are **not** required.

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**(b)** The students' results are shown in Table 1.1.

**Table 1.1**

| type of leaf | ivy | geranium | spiderwort | sorghum |
|---|---|---|---|---|
| mean time for leaf discs to reach the surface / s | 130 | 75 | 95 | 100 |

**(i)** Describe how the students could calculate the rate of photosynthesis from their results.

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..... [1]

**(ii)** The students made three conclusions.

conclusion 1
Leaves with a thick cuticle absorb less light and photosynthesise more slowly than leaves with a thin cuticle.

conclusion 2
Leaves of spiderwort have a slower rate of photosynthesis because they have less chlorophyll than other plants.

conclusion 3
Sorghum is a C4 plant and so its leaves photosynthesise faster than those of ivy which is a C3 plant.

Each of these conclusions is supported by the evidence, but may **not** be valid.

Explain why each conclusion may **not** be valid, using the information in **(a)** about the leaves and the method used to determine the rate of photosynthesis.

conclusion 1 .....

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conclusion 2 .....

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conclusion 3 .....

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[3]

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**(c)** A colorimeter passes a beam of light through a coloured filter into a solution and measures the light absorbance of that solution.

A standard solution is used to set the colorimeter scale to zero (0) before taking any measurements.

Chlorophyll absorbs red light, so the chlorophyll concentration of a leaf extract can be measured using a colorimeter.

**(i)** Outline how the students could use a colorimeter to obtain further evidence to support the conclusion that leaf discs of spiderwort have a lower chlorophyll content than the leaf discs from the other types of leaf investigated.

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..... [3]

**(ii)** Suggest a standard solution that could be used in the colorimeter to ensure that light absorbance is due **only** to the chlorophyll in a leaf extract.

..... [1]

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**(d)** Table 1.2 shows the students' results from the colorimeter measurements made on 10 samples of each of the four types of leaf.

**Table 1.2**

| type of leaf | ivy | geranium | spiderwort | sorghum |
|---|---|---|---|---|
| mean absorbance ± *s* | 0.28 ± 0.08 | 0.32 ± 0.1 | 0.43 ± 0.18 | 0.39 ± 0.21 |

The students decided to use the *t*-test to test the hypothesis that:

The difference in the chlorophyll concentration between spiderwort and each of the other plants is significant.

The formula for the *t*-test is shown in Fig. 1.2.

$$t = \frac{\left|\bar{x}_1 - \bar{x}_2\right|}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}} \qquad \nu = n_1 + n_2 - 2$$

$\nu$ = degrees of freedom
$s$ = standard deviation
$n$ = sample size (number of observations)
$\bar{x}$ = mean

**Fig. 1.2**

Comment on the use of the *t*-test by:

stating how many values of *t* the students should calculate **and** explaining your answer

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explaining how the students would find out if the results of their *t*-tests were significant.

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[4]

[Total: 21]

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**2** The red squirrel is a tree-living mammal native to woodlands in the United Kingdom. The population and distribution of the red squirrel have been decreasing since the introduction of a North American species of grey squirrel. The grey squirrel occupies an ecological niche that overlaps with that of the red squirrel, but the grey squirrel is a better competitor.

One cause of the decline in red squirrels is the clearance of woodland for development. New areas of woodland have been planted, but the species of tree planted have changed over time.

Table 2.1 shows the changes in species composition of woodland in England and Scotland from 1980 to 1990 and the suitability of each species as habitats for red and grey squirrels.

**Table 2.1**

| **tree species** | | **suitability of tree species as a habitat for squirrels** | **percentage change in species composition** | |
|---|---|---|---|---|
| | | | **England** | **Scotland** |
| narrow-leaved trees | Sitka spruce | poor for both species | +14 | +61 |
| | Scots pine | poor for both species | −5 | +8 |
| | Norway spruce | good for both species | −21 | −28 |
| | Douglas fir | good for both species | +3 | +1 |
| | European larch | good for red squirrels | −34 | −39 |
| | Japanese larch | good for red squirrels | −3 | +21 |
| broad-leaved trees | | good for grey squirrels | +36 | +68 |

**(a) (i)** Use the information in Table 2.1 to summarise the effects on habitat for these species of squirrel as a result of the changes in the tree species composition in woodland.

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**(ii)** Suggest why the populations of red squirrels in England and Scotland have decreased.

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..... [2]

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**[Turn over**

**(b)** Squirrel parapoxvirus (SPPV) infects both red squirrels and grey squirrels.
Grey squirrels develop immunity to SPPV, but red squirrels are killed by this virus.

One method used to conserve red squirrels on an island involved culling all the grey squirrels.

During the cull, research was carried out to find the percentage of grey squirrels that were immune to SPPV. When the cull started the island had an estimated population of 40 red squirrels and 3000 to 4000 grey squirrels.

The research involved several steps.

- Traps were placed at a density of 1 per 0.01 $km^2$ in broad-leaved woodland and 2 per 0.01 $km^2$ in narrow-leaved woodland.
- Humane steel traps, all of the same size, were used. Non-target animals caught were released, any grey squirrel was killed.
- Blood samples were taken from grey squirrels trapped between January and August at randomly selected habitats.
- A standard test for antibodies to SPPV was used to screen the blood samples.
- A control sample of grey squirrels from the mainland was tested in 2010.
- The percentage testing positive for antibodies to SPPV was calculated for each sample.

Table 2.2 shows the results of this research.

**Table 2.2**

| year | number of grey squirrels tested | percentage positive for SPPV antibodies |
|---|---|---|
| 1999 | 23 | 52 |
| 2002 | 20 | 75 |
| 2003 | 99 | 40 |
| 2007 | 54 | 13 |
| 2010 | 28 | 4 |
| 2010 (control) | 70 | 67 |

**(i)** State two variables that were controlled during the research.

1 .....

2 .....
[2]

**(ii)** The researchers concluded that culling could help to reduce the spread of SPPV.

State how the evidence in Table 2.2 supports this conclusion.

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..... [1]

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Culling of grey squirrels on the island successfully removed all of them by 2013. Subsequently the population of red squirrels has increased.

Culling of grey squirrels has also occurred on the mainland in areas occupied by both species. Within a few months of the end of a cull, the grey squirrel population returns to pre-cull level and the red squirrel population is unchanged.

**(iii)** Suggest why the cull on the mainland is less effective at removing grey squirrels than the cull on the island.

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..... [1]

[Total: 9]

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