Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8637380180

BIOLOGY **9700/53**

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 **11** printed pages and **1** blank page.

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CAMBRIDGE International Examinations

1 Sodium hydrogencarbonate indicator solution contains sodium hydrogencarbonate.

Some students found out on the internet that this indicator solution changes colour with pH. The students also discovered that this indicator is used to determine the concentration of carbon dioxide in a solution.

The students decided to use this indicator to measure the rate of photosynthesis in algal balls. Algal balls are unicellular algae that are immobilised in alginate.
The students assumed that the rate of carbon dioxide uptake was proportional to the rate of photosynthesis.

Fig. 1.1 shows the apparatus that the students used.

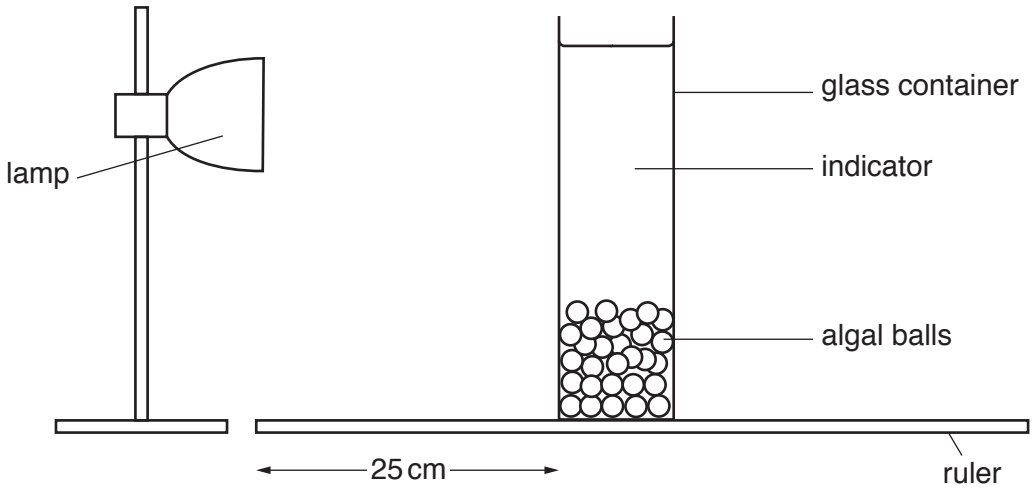


Fig. 1.1

A laboratory technician prepared a series of test-tubes containing hydrogencarbonate indicator solution from pH 7.6 to pH 9.2. The colour of the indicator solution in each test-tube is described in Table 1.1.

Table 1.1

← increasing CO_2 in indicator solution					decreasing CO_2 in indicator solution →			
pH 7.6	pH 7.7	pH 8.0	pH 8.2	pH 8.4	pH 8.6	pH 8.8	pH 9.0	pH 9.2
light yellow	dark yellow	light orange	dark orange	red	light magenta	dark magenta	light purple	dark purple

(a) Suggest what was added to each of the test-tubes to maintain the pH.

..... [1]

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(b) Unicellular algae can be immobilised using a technique that is similar to that used to immobilise enzymes.

Outline the method that the students would have used to immobilise the algae.

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..... [3]

(c) The students used the apparatus shown in Fig. 1.1 and the colours described in Table 1.1 to investigate the effect of light intensity on the rate of photosynthesis.

The students proposed the following hypothesis:

As light intensity increases the rate of photosynthesis increases.

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

independent variable .....

dependent variable .....
[2]

(ii) Describe a method the students could use to collect the data needed to test their hypothesis.

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

You should **not** repeat any details from **(b)** about how to prepare immobilised algal balls.

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..... [5]

(iii) The students were concerned that the lamp may have increased the temperature of the solution in the container. Suggest how they could have attempted to control this variable.

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..... [1]

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(d) The light intensity (I) can be calculated using the formula shown in Fig. 1.2.

$$I = \frac{1}{\text{distance}^2}$$

Fig. 1.2

Use the formula in Fig. 1.2 to calculate the light intensity for the experiment shown in Fig. 1.1.

I = ... [1]

The students decided that using a pH probe would give them more accurate data. They decided to measure the pH change for **one** value of light intensity.

Fig. 1.3 shows their results.

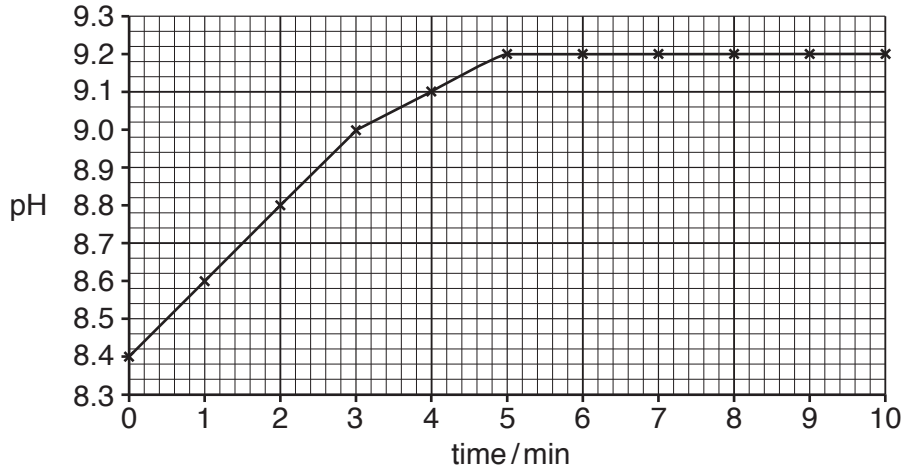


Fig. 1.3

(e) (i) State why the use of a pH probe provides more accurate data.

..... [1]

(ii) The data shown in Fig. 1.3 were for a high light intensity.

On Fig. 1.3, sketch the curve that you would expect for a low light intensity. [1]

(iii) State why carbon dioxide is **not** a limiting factor in this investigation.

.....

..... [1]

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(f) Certain weed killers work by reducing the rate of photosynthesis.

The students modified their method to investigate the effect of three different weed killers on algae at the same light intensity.

The investigation was replicated a number of times and the pH was recorded after 30 minutes. The students calculated the mean pH for each treatment, as shown in Table 1.2.

The students carried out *t*-tests to compare the mean pH for each of the treatments that used weed killers with the treatment that used no weed killer (treatment 1).
The students calculated the value of *t* for each of the tests.

Table 1.2 shows the results from their investigation.

Table 1.2

treatment	**contents**	**mean pH after 30 minutes**	***p* value**
1	algal balls, indicator and distilled water	9.2	
2	algal balls, indicator and weed killer **A**	8.5	< 0.001
3	algal balls, indicator and weed killer **B**	9.0	> 0.05
4	algal balls, indicator and weed killer **C**	8.7	< 0.05

(i) Suggest a null hypothesis for comparing the effect of treatment 2 with treatment 1.

.....

..... [1]

(ii) The *t*-tests were used to compare the means.

State **one** feature of data that allows use of the *t*-test.

.....

..... [1]

(iii) When calculating the effect of weed killer **A** on the rate of photosynthesis, 15 degrees of freedom was chosen. The students carried out 7 replicates of treatment 1.

State how many replicates were carried out for treatment 2.

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..... [1]

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(iv) The students concluded that the weed killers had a significant effect on the rate of photosynthesis.

Explain to what extent the *p* values in Table 1.2 support their conclusion.

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..... [3]

[Total: 22]

2 Lionfish are a type of fish native to the tropical waters of the Indian Ocean and Pacific Ocean.

Lionfish were first reported off the south east coast of the USA in the 1980s. Lionfish are an alien species to this area. Their lack of a natural predator in these waters resulted in their numbers increasing dramatically, allowing them to migrate to new areas. They have now become established across the Caribbean. Their numbers are so high that they are now a threat to many native species.

(a) In one year it was estimated that 5 million prey were consumed by 1000 lionfish.

Express these data as a ratio.

..... **: 1** [1]

(b) Surveys to assess the changes in lionfish abundance have been carried out every year since 2004. Divers have carried out visual transects at nine sites along a 15km stretch of continuous reef off the coast of one island in the Caribbean.

Visual transects involve swimming in a fixed direction across the reef for a set distance and counting the number of lionfish.

(i) State **one** variable which was standardised in these surveys.

.....

..... [1]

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The mean abundance of lionfish on the reef was calculated for each year. These values are shown in Fig. 2.1 using a log scale. The bars show 95% confidence intervals.

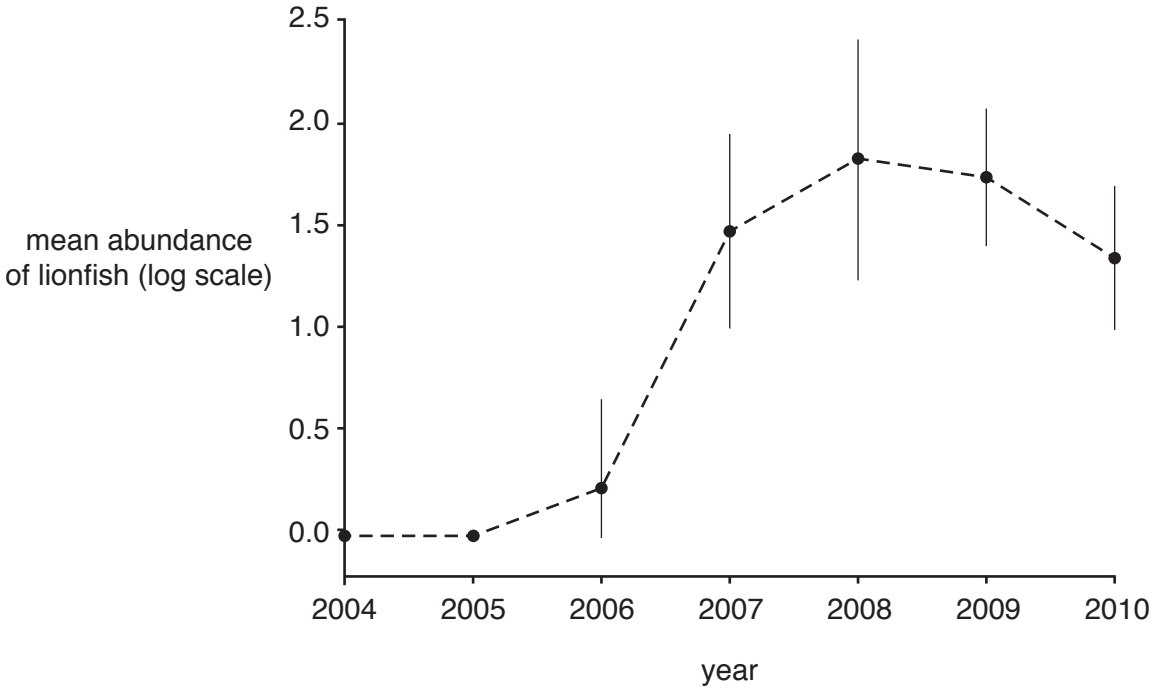


Fig. 2.1

(ii) A group of students read an article stating that local people were being encouraged to catch and eat lionfish in an attempt to reduce their numbers.

The students concluded that local people started catching and eating lionfish in 2008.

Explain to what extent the data in Fig. 2.1 supports their conclusion.

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..... [3]

(c) Some local communities hold annual fishing trips where they are encouraged to catch as many lionfish as possible.

In 2010 and 2011, 16 boats took part in these fishing trips. The mean number of lionfish per boat and the 95% confidence intervals were calculated.

Fig. 2.2 shows the results.

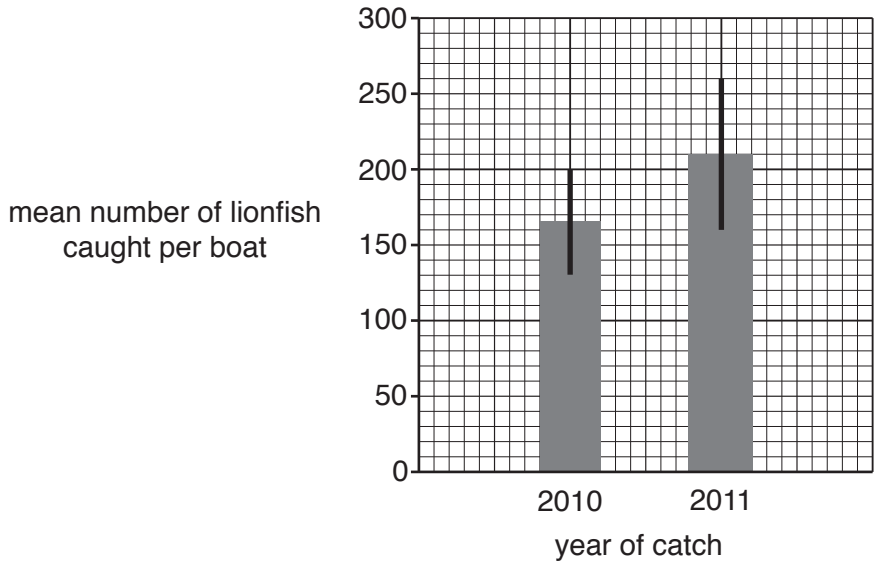


Fig. 2.2

The 95% confidence intervals are calculated from $2 \times S_M$.

Standard deviation can be calculated by rearranging the equation for standard error shown in Fig. 2.3.

$$S_M = \frac{s}{\sqrt{n}}$$

where S_M = standard error

s = standard deviation

n = number of boats

Fig. 2.3

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Use the data in Fig. 2.2 and the equation in Fig. 2.3 to calculate the standard deviation of the mean number of lionfish caught per boat in 2010.

standard deviation for 2010 = ... [3]

[Total: 8]

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