Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9001420673

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2019**

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 **8** printed pages.

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Cambridge Assessment International Education

1 (a) *Chlorella* is a photosynthetic, single-celled protoctist that lives in ponds.

A group of students decided to investigate the effect of temperature on respiration in *Chlorella*.

The students were provided with:

- test-tubes
- metal foil
- flat-bottomed tubes with lids
- glass beakers
- hot water supply
- thermometers
- timer
- pH probe and meter
- hydrogencarbonate indicator solution in a closed container
- a pump connected to an oxygen supply
- a pump connected to a carbon dioxide supply
- a suspension of *Chlorella* with a known cell density.

Carbon dioxide is an acidic gas so it causes the pH of the hydrogencarbonate indicator solution to change. The indicator solution changes colour as pH changes.

Fig. 1.1 shows the range of colours seen in hydrogencarbonate indicator exposed to different carbon dioxide concentrations.

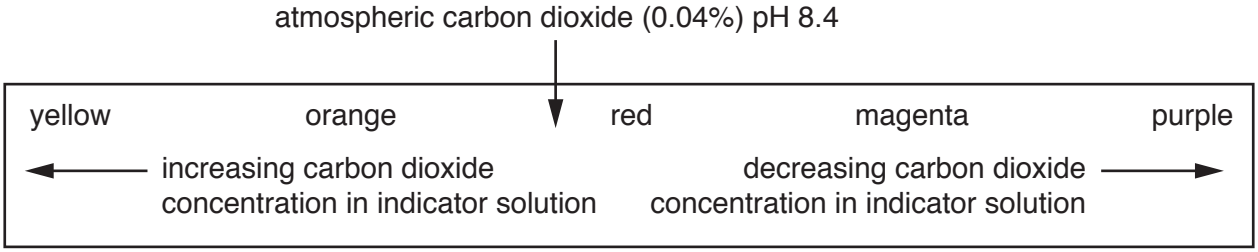


Fig. 1.1

The students made a series of colour standards from yellow to purple by bubbling different volumes of carbon dioxide gas into the indicator solution. The pH was measured with a pH meter for each colour and the solutions were sealed in flat-bottomed tubes labelled with their pH.

The students used the indicator solution to investigate the effect of temperature on carbon dioxide production during respiration in *Chlorella*.

(i) Suggest a hypothesis that the students could test in this investigation.

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..... [1]

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

independent variable .....

.....

dependent variable .....

.....

[2]

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(iii) Describe how the students could use the apparatus provided to investigate the effect of temperature on carbon dioxide production during respiration in *Chlorella*.

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

Details of making the colour standards should **not** be included in your method.

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..... [7]

(b) (i) State how the students could calculate the rate of respiration from their results.

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..... [1]

(ii) Sketch a graph on Fig. 1.2 to show the expected result of the effect of temperature on the rate of respiration of *Chlorella*.

Include suitable axes labels and units on your graph.



Fig. 1.2

[3]

(c) The students carried out a second investigation to determine the effect of cell density on the carbon dioxide production of suspensions of *Chlorella*. All the suspensions were kept at a constant temperature. The students used a probe to measure the production of carbon dioxide in the suspensions of *Chlorella*.

The results are shown in Table 1.1.

Table 1.1

cell density in suspension / arbitrary units	carbon dioxide concentration after 15 min / mg dm^{-3}	rate of carbon dioxide production / mg min^{-1}
10	2.0	0.13
20	2.4	0.16
30	3.0	0.20
40	4.7	
50	7.4	0.49

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(i) Complete Table 1.1 by calculating the rate of carbon dioxide production for the cell density of 40 arbitrary units. [1]

The students used Pearson's linear correlation to test the hypothesis:

As cell density increases the rate of carbon dioxide production increases.

(ii) Suggest a null hypothesis for this test.

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..... [1]

(iii) The Pearson's linear correlation coefficient (r) was calculated as 0.85.

State what the calculated value, $r = 0.85$, indicates about the results.

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..... [2]

(iv) The students concluded that the results showed that their hypothesis is correct.

Explain why this conclusion may not be valid.

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..... [2]

[Total: 20]

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[Turn over

2 A fungal pathogen infects melon plants and causes the leaf cells to lose turgor. The melon plant then becomes permanently wilted.

(a) Suggest a tissue in which the fungal pathogen may be found **and** suggest a reason for your answer.

tissue .....

reason .....

.....

[1]

(b) Breeding experiments between a pure-breeding resistant variety of melon plant, Hemed, and a pure-breeding non-resistant variety, Dulce, were carried out to find out how resistance to the fungal pathogen is inherited.

All the F1 and F2 plants were inoculated with the fungal pathogen.

The numbers of resistant and non-resistant plants were counted 18 days after inoculation with the fungal pathogen.

Fig. 2.1 shows the results of this large-scale breeding programme, involving several thousand melon plants.

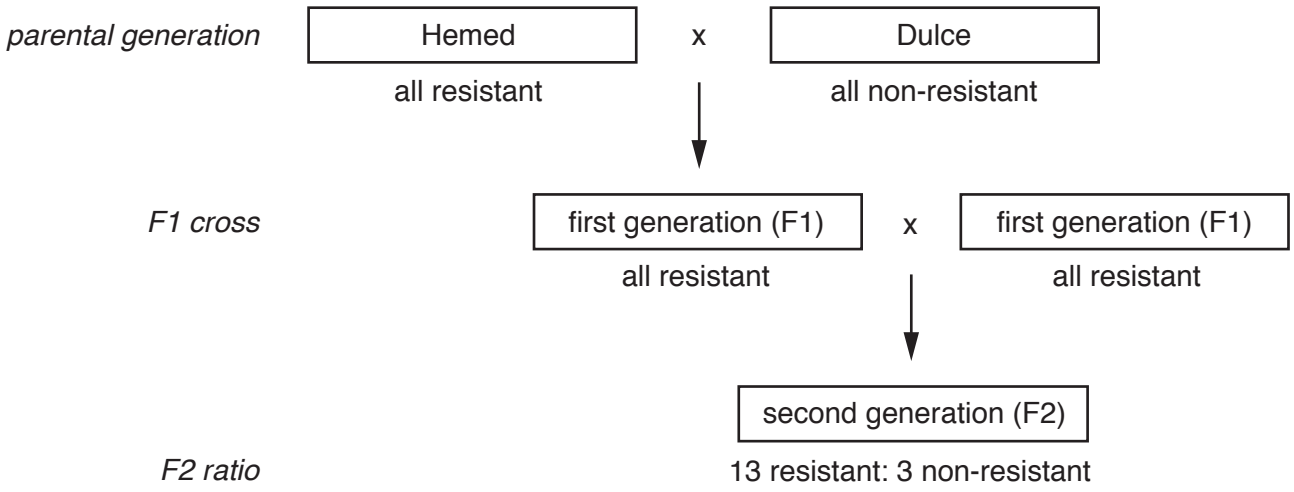


Fig. 2.1

The results in the F2 generation gave a ratio of 13 resistant: 3 non-resistant.

The results in the F2 generation were considered to be anomalous.

Explain why the results for the F2 generation were considered to be anomalous **and** suggest a reason for this ratio.

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..... [2]

(c) Melon plants can be resistant to another fungal pathogen, which has four strains.

Microarrays can be used to study gene expression by detecting mRNA in plant samples.

(i) Outline how microarrays are used to detect mRNA in studies of gene expression in resistant and non-resistant plants.

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..... [3]

Question 2 continues on page 8

Table 2.1 shows the results of a microarray analysis made after the fungal pathogen had infected a resistant variety of melon and a non-resistant variety of melon.

Table 2.1

time after infection with fungal pathogen / hours	number of genes expressed	
	resistant variety	non-resistant variety
24	2461	882
48	821	2237

(ii) Calculate the ratio of the number of genes expressed at 24 hours for the resistant variety of melon and the non-resistant variety of melon.

Give your answer in whole numbers.

ratio ..... [1]

(iii) Calculate the percentage change of the genes expressed between 24 hours and 48 hours in the resistant variety.

percentage change = ... % [1]

(iv) State what the results in Table 2.1 indicate about resistance to the fungal pathogen.

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..... [2]

[Total: 10]

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