Cambridge Pre-U

Cambridge International Examinations
Cambridge Pre-U Certificate

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

6749355819

BIOLOGY (PRINCIPAL) **9790/04**

Paper 4 Practical **May/June 2018**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

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.

For Examiner's Use	
Section A	
Section B	
Total	

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **16** printed pages and **4** blank pages.

CAMBRIDGE International Examinations

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Section A

Answer **all** the questions.

You are advised to spend no more than **90 minutes** on Question 1.

1 You are advised to read the whole of this question before starting the practical work, as you will need to make decisions about how to obtain high quality results using the apparatus and materials provided.

Browning in fruits, such as bananas, is the result of oxidation of colourless substances to a coloured substance. Fruits possess many polyphenol oxidase enzymes that catalyse the sequence of reactions involved. In banana, one of these enzymes is dopa oxidase.

The sequence of reactions is as follows:

$$\text{L-dopa} \xrightarrow{\text{dopa oxidase}} \text{dopaquinone} \xrightarrow{\text{spontaneous reaction}} \text{dopachrome}$$

L-dopa and dopaquinone are colourless. Dopachrome is a coloured substance.

You are supplied with six solutions of L-dopa as follows:

- 5 mmol dm^{-3} (labelled 5)
- 10 mmol dm^{-3} (labelled 10)
- 20 mmol dm^{-3} (labelled 20)
- 30 mmol dm^{-3} (labelled 30)
- 40 mmol dm^{-3} (labelled 40)
- 50 mmol dm^{-3} (labelled 50)

You are also provided with an enzyme extract made from bananas that contains dopa oxidase.

You will investigate some of the properties of dopa oxidase.

Part 1

In **Part 1** you will investigate the effect of pH on dopa oxidase.

1 Label six test-tubes **1** to **6**.

Use the apparatus and materials provided to set up these six test-tubes as shown in Table 1.1.

Table 1.1

test-tube	50 mmol dm^{-3} L-dopa solution / cm^3	distilled water / cm^3	boiled enzyme / cm^3	buffer solution (pH3) / cm^3	buffer solution (pH5) / cm^3	buffer solution (pH7) / cm^3
1	2			1		
2	2				1	
3	2					1
4	2	1				1
5	2		1			1
6		2				1

2 Add 1 cm^3 of the enzyme extract to test-tubes **1**, **2**, **3** and **6**.
Do **not** mix the contents of the tubes in any way, for example by shaking.

3 Leave the test-tubes for **two minutes**. While you are waiting, begin to prepare the reaction mixtures for **Part 2**.

4 Use Table 1.2 to record the appearance of the contents of the test-tubes after two minutes.

(a) Record the appearance of the contents of the test-tubes in Table 1.2.

Table 1.2

test-tube	appearance of contents
1	
2	
3	
4	
5	
6	

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(b) Explain the conclusions that can be made from the results that you recorded in Table 1.2.

You may refer to the test-tubes by their numbers (**1** to **6**).

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(c) Evaluate the procedure that you have followed in **Part 1** by:

- stating a limitation, **other than** only carrying out each test once
- suggesting a suitable improvement
- explaining how this improves the information gained about dopa oxidase.

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Part 2

In **Part 2** you will investigate:

- the effect of a change in concentration of L-dopa on the **rate of the reaction** catalysed by dopa oxidase
- the effect of substance **X** on the **rate of the reaction** catalysed by dopa oxidase.

5 Label a test-tube **C**. The contents of this test-tube will be used as a colour comparator.

Prepare test-tube **C** in exactly the same way as test-tube **3** in Table 1.1.
Do **not** add any enzyme extract at this stage.

6 Label six test-tubes **P1** to **P6** and label another six test-tubes **X1** to **X6**.

7 Add 1 cm^3 of **pH7** buffer solution to all twelve test-tubes (**P1** to **P6** and **X1** to **X6**).

8 Add 1 cm^3 of distilled water to test-tubes **P1** to **P6** and to test-tube **C**.

9 Add 1 cm^3 of the solution of substance **X** to test-tubes **X1** to **X6**.

10 Add 2 cm^3 of the 5 $mmol\,dm^{-3}$ solution of L-dopa to test-tube **P1** and add 2 cm^3 of the 5 $mmol\,dm^{-3}$ solution of L-dopa to test-tube **X1**.

11 Add 2 cm^3 of the 10 $mmol\,dm^{-3}$ solution of L-dopa to test-tube **P2** and add 2 cm^3 of the 10 $mmol\,dm^{-3}$ solution of L-dopa to test-tube **X2**.

12 Repeat step **11** with the remaining test-tubes, **P3** to **P6** and **X3** to **X6**, so that they have increasing concentrations of L-dopa (20-50 $mmol\,dm^{-3}$).

13 Add 1 cm^3 of the enzyme extract to test-tube **C**. Do **not** shake or stir the test-tube. Leave the test-tube for **two minutes**.

14 Add 1 cm^3 of the enzyme extract to each of the test-tubes **P1** to **P6**. Observe the lower half of each test-tube and record the time taken to reach the colour shown by the colour comparator (test-tube **C**). If this end point has not been reached after 20 minutes, simply record 'end point not reached'.

Record your results in the space provided for **(d)** on page 6.

15 Add 1 cm^3 of the enzyme extract to each of the test-tubes **X1** to **X6**. Observe the lower half of each test-tube and record the time taken to reach the colour shown by the colour comparator (test-tube **C**). If this end point has not been reached after 20 minutes, simply record 'end point not reached'.

Record your results in the space provided for **(d)** on page 6.

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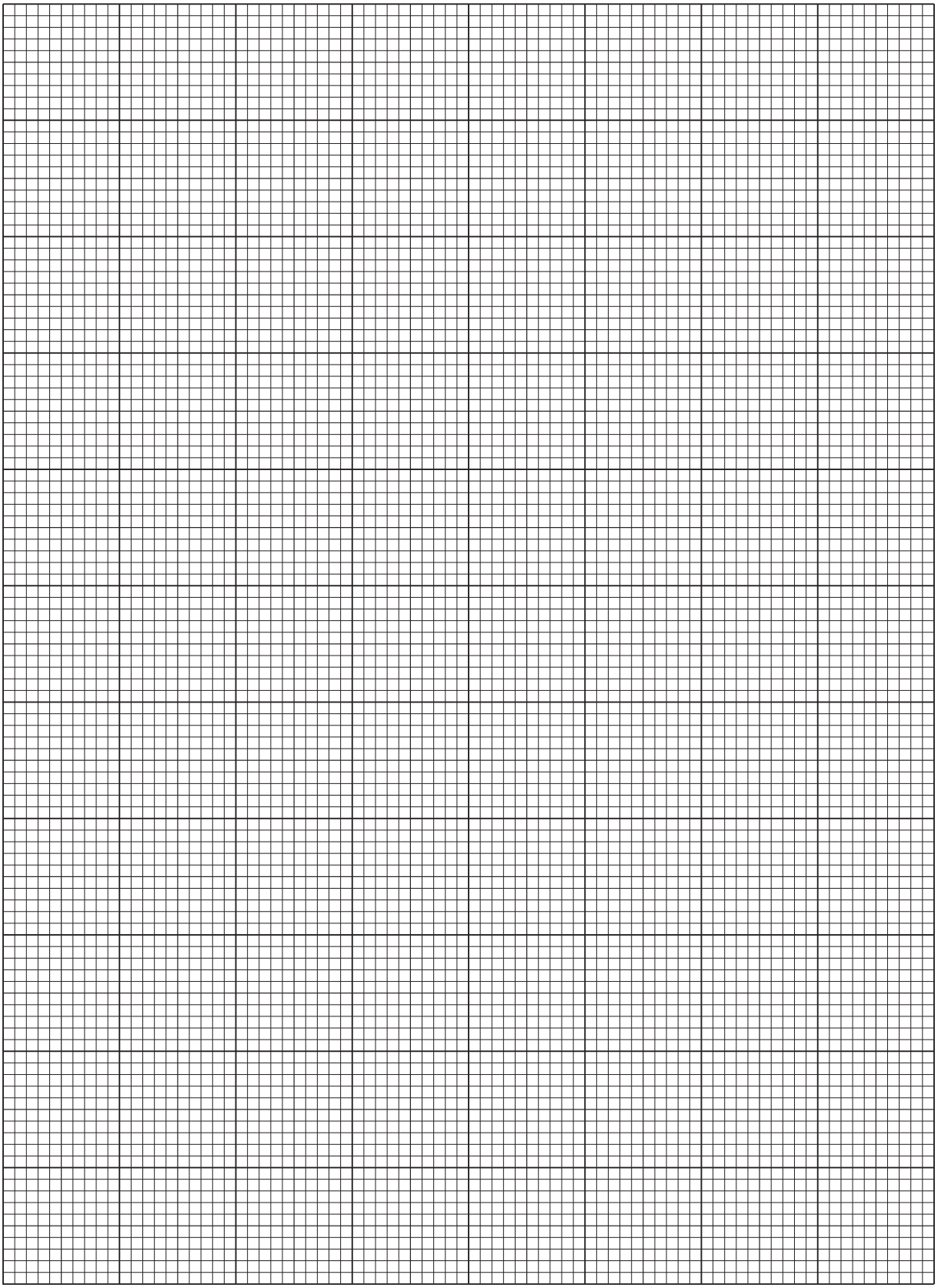
(d) Calculate the rate of reaction for each of the reaction mixtures.

Calculate the rate as $1000/t$ where t = the time taken to reach the colour of the colour comparator (test-tube **C**).

Record all your results and calculations for **Part 2** in a suitable form in the space below.

[8]

(e) Plot a graph to show the **rate of the reaction** catalysed by dopa oxidase with and without substance **X** on the grid provided.



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(f) Describe and explain the effect of increasing the concentration of L-dopa on the activity of dopa oxidase.

Support your answer with evidence from your results.

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(g) It is suggested that substance **X** is a competitive inhibitor of dopa oxidase.

Discuss the evidence from your results to support this conclusion.

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(h) Describe the precautions that you took in **Part 2** to ensure that you collected high-quality results.

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(i) Discuss the limitations of the investigation in **Part 2** and the ways in which the procedure could be changed to improve the quality of the results.

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Section B

Answer **all** the questions.

You are advised to spend no more than **60 minutes** on Section B.

2 You should read through the whole of this question carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

You are provided with flowers of the Peruvian lily, *Alstroemeria*.

The sepals of the flower are very similar in appearance to the petals. A protective cap-like structure or cover encloses some of the anthers when the flower first opens.

Use the dissection instruments, hand lens and the low power of your microscope to investigate the structure of these flowers.

(a) Produce labelled and annotated drawings to show how the flower of *Alstroemeria* is adapted for insect pollination.

Use the space below and the following page for your drawings and annotations.

Indicate the scales of your drawings.

[10]

(b) Outline additional ways in which you could gather information about pollination in *Alstroemeria*.

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(c) Slide **C1** is a cross-section of part of an anther of the lily, *Lilium* sp.

Study **C1** using a hand lens and the low power and high power of your microscope.

Make a labelled, low power plan diagram of a representative region of the anther to show where pollen grains develop.

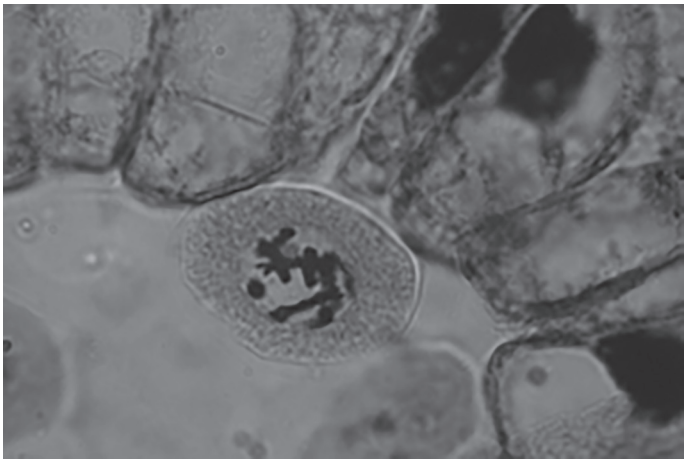
Indicate the scale of your drawing.

[7]

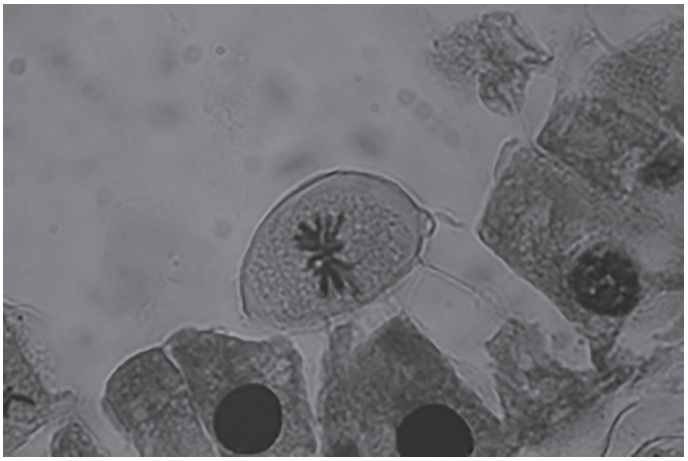
(d) Fig. 2.1 shows three stages in the development of pollen grains.

(i) Label and annotate the three photomicrographs in Fig. 2.1 to show the different stages in reductional division during meiosis.

A



B



C

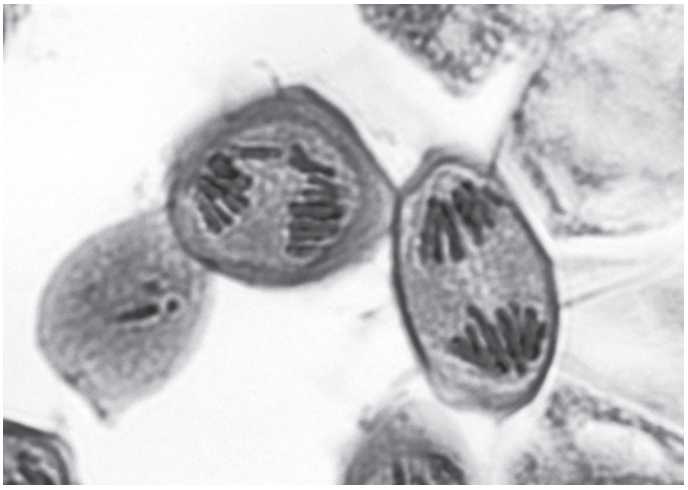


Fig. 2.1

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(ii) Explain how the stages indicated in Fig. 2.1 lead to genetic variation.

You may use the space below for any labelled drawings or diagrams to help your answer.

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