Cambridge International Examinations
Cambridge Pre-U Certificate

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0123456789

BIOLOGY (PRINCIPAL) **9790/02**

Paper 2 Data Analysis and Planning **For Examination from 2016**

SPECIMEN PAPER

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 and 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.

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

This document consists of **15** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

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Answer **all** the questions.

Section A – Data analysis

1 Fig. 1.1 shows an American eel, *Anguilla rostrata*, which lives for part of its life in the rivers and mountain streams of the Eastern USA. Adult fish migrate to the Atlantic Ocean when they are ready to breed. After breeding the adults die.

Young eels migrate from the sea back to the rivers and streams and may live for five years or more before reaching the stage when they are ready to breed.

This species of fish has become rare in mountain streams over recent years.

Fig. 1.1

As part of a long-running study to find out more about the biology and behaviour of *A. rostrata*, mark-release-recapture was used to estimate the population size in one mountain stream in Virginia. Very young eels were not marked.

Table 1.1 shows the results of the mark-release-recapture.

Table 1.1

year	total number of fish caught	number of fish marked	total number of fish captured one year later	number of marked fish recaptured one year later	population estimate
2000	334	279	352	98	1002
2001	352	226	290	57	1150
2002	290	149	180	25	1073
2003	180	76	232	11	1603
2004	232	116	184	21	.....

(a) (i) Complete Table 1.1 by calculating the population estimate for the year 2004.

[1]

(ii) Comment on the accuracy of the population estimates for eels recorded in Table 1.1, including limitations of the mark-release-recapture method for estimating population size.

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[6]

The annual growth of the eels was also measured. Fig. 1.2 shows a box-whisker plot of the results for growth in length and growth in mass of eels in one stream that were marked with tags and then recaptured from 2000 to 2005.

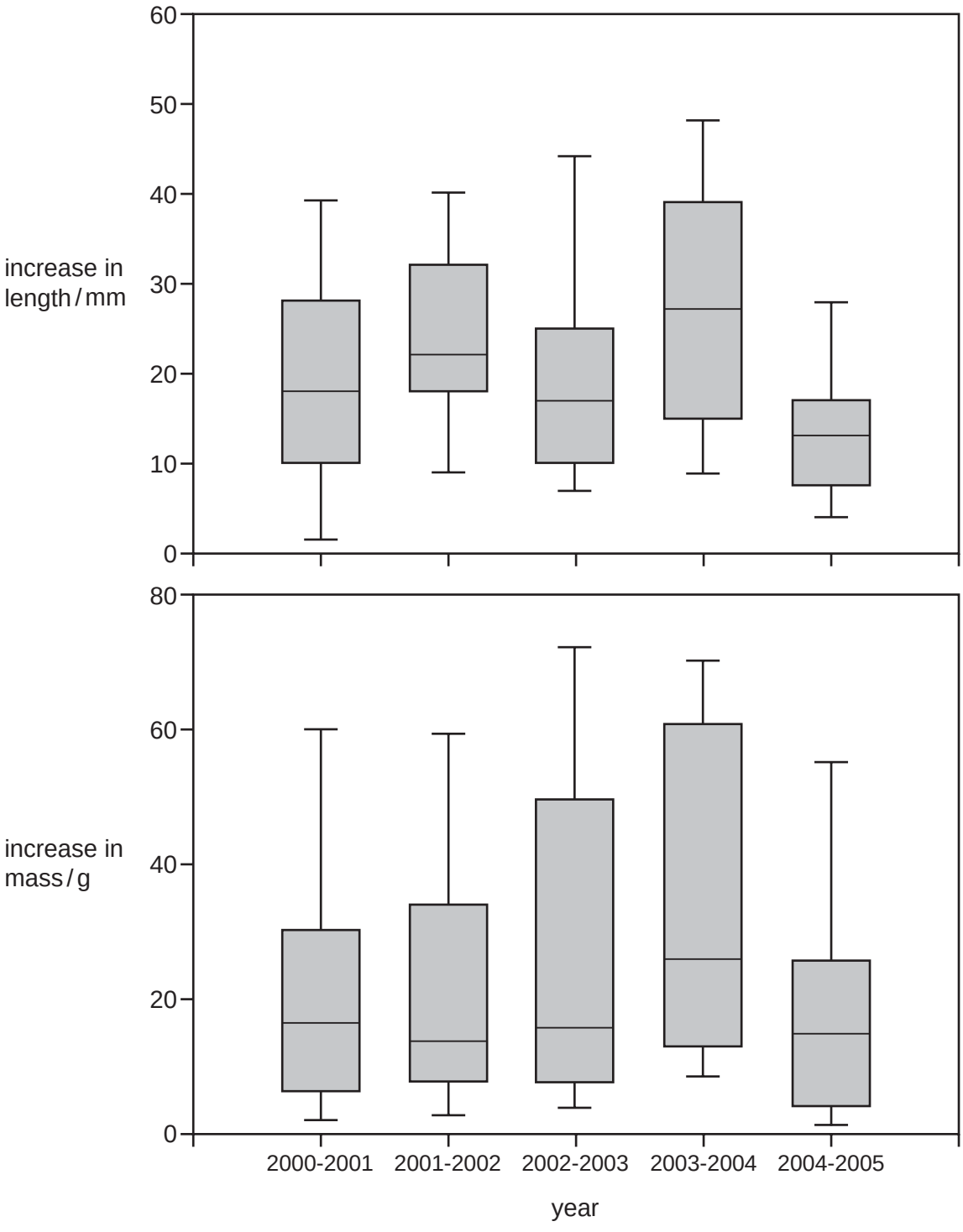

Fig. 1.2

The horizontal line in each box represents the median. The top and bottom of each box show 25th and 75th percentiles. The 'whiskers' show the 10th and 90th percentiles.

(b) (i) Describe the results shown in Fig. 1.2.

[3]

(ii) Suggest advantages of using box-whisker plots to show these data rather than bar charts or histograms.

[3]

(c) *A. rostrata* is not officially recognised as an endangered species, but its numbers are in decline.

Discuss the limitations of the results of this study in terms of providing sufficient information to inform the conservation of *A. rostrata* in Virginia.

[4]

[Total: 17]

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2 In an investigation into pollen release from Timothy grass, *Phleum pratense*, the number of pollen grains released into the atmosphere was sampled at hourly intervals, on three consecutive days. Traps sited just above the level of the leaves were used to do this.

The wind speed and the relative humidity were recorded at the times of sampling.

The results of the investigation are shown in Fig. 2.1.

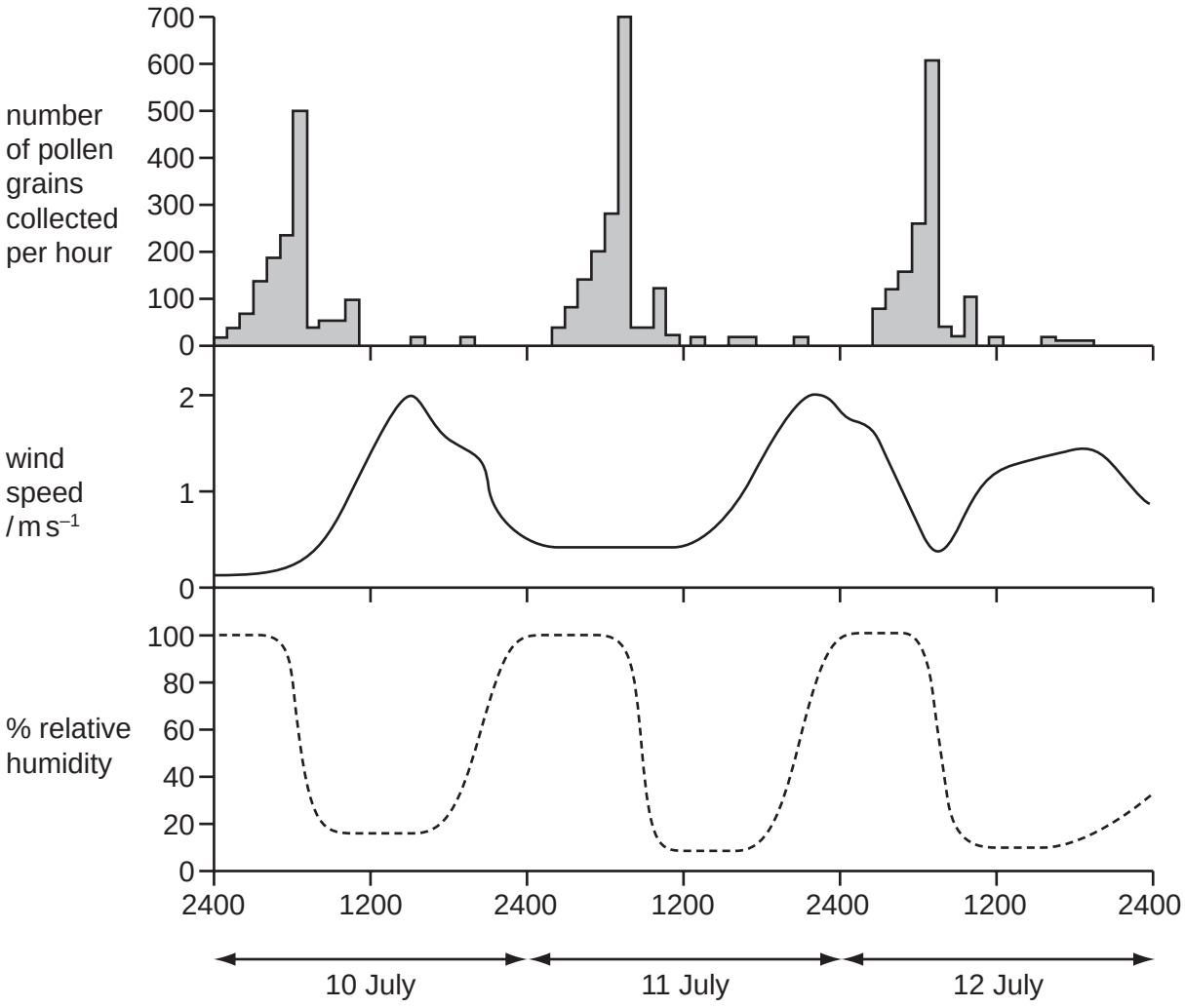


Fig. 2.1

(a) Describe the results shown in Fig. 2.1.

[6]

(b) One researcher concluded that high humidity and low wind speed were important factors for the release of pollen from Timothy grass.

Discuss why this conclusion may not be valid.

[4]

[Total: 10]

3 The technique of polyacrylamide gel electrophoresis (PAGE) is used to separate and identify proteins. One method of PAGE involves treating proteins with an ionic detergent to dissociate proteins into their constituent polypeptide subunits. Sodium dodecyl sulfate (SDS) is often used for this. Proteins treated with SDS have a uniform net charge on each polypeptide so that during electrophoresis they are separated only on the basis of their relative molecular mass.

After treatment with SDS, proteins are placed in wells cut into a polyacrylamide gel. A dye is added to each sample to show the progress of the samples across the gel. A current is applied to the gel and when the dye reaches a point towards the end of the gel, the current is switched off.

The relative mobility of each polypeptide is calculated as follows:

$$\frac{\text{distance travelled by polypeptide band}}{\text{distance travelled by dye front}}$$

Six proteins, **A**, **B**, **C**, **D**, **E** and **F**, were analysed with SDS-PAGE and the results are shown in Fig. 3.1.

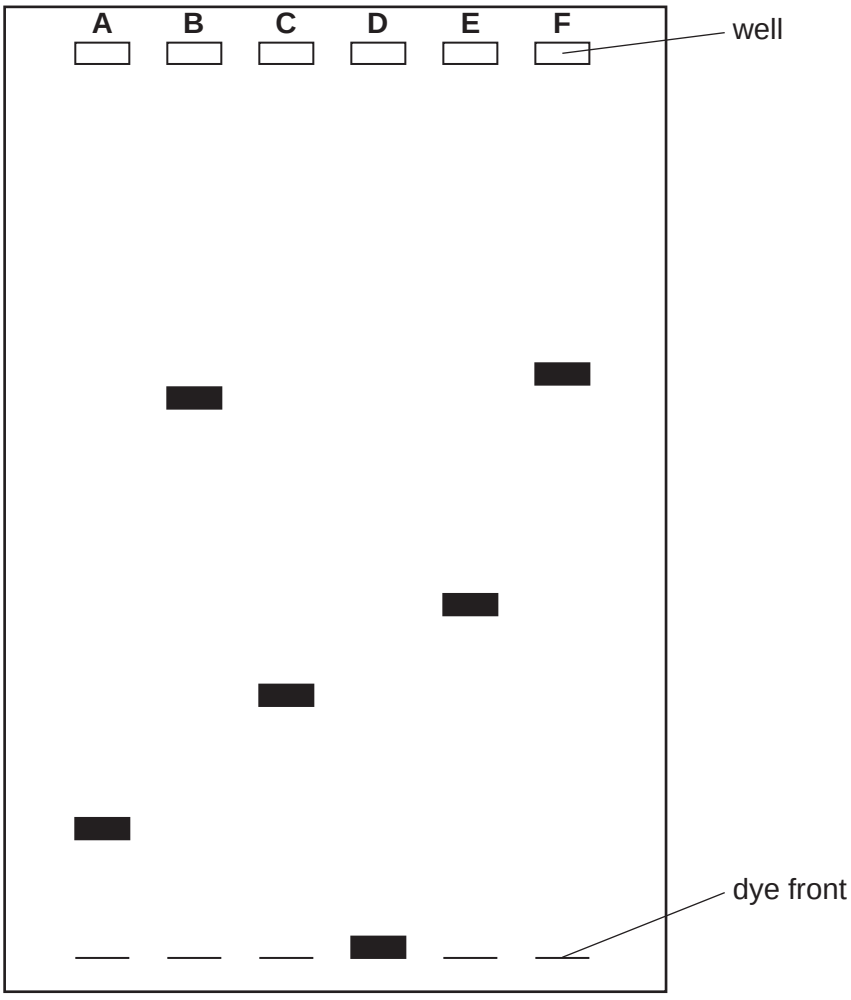


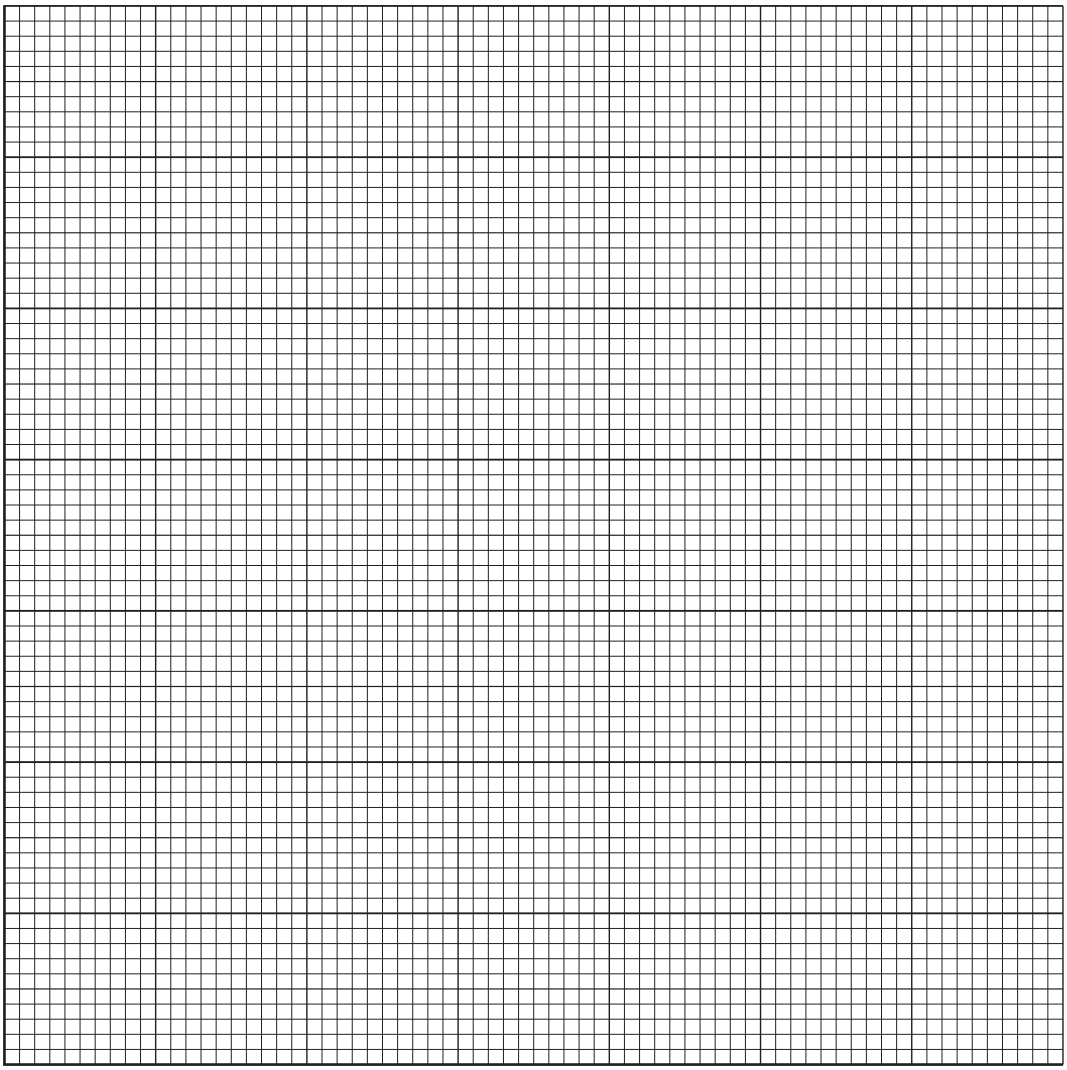
Fig. 3.1

(a) (i) Calculate the relative mobility of proteins **A**, **B**, **C**, **E** and **F** and add your calculated values to the appropriate spaces in Table 3.1, opposite. [2]

Table 3.1

protein	relative molecular mass	relative mobility
A	29 000	.....
B	68 000	.....
C	unknown	.....
D	17 200	1.00
E	43 000	.....
F	77 000	.....

(ii) Plot, on the grid below, a graph of the relative molecular mass of proteins **A**, **B**, **D**, **E** and **F** against their relative mobility. [4]



(b) Use your graph to find the relative molecular mass of protein **C**.

Explain how you arrived at your answer.

relative molecular mass of protein **C**: .....

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..... [2]

[Total: 8]

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Section B – Planning

4 Yeast cells have transport proteins in their cell membranes for the uptake of nutrients from the surroundings. There are separate transport proteins for glucose and for maltose. When exposed to both glucose and maltose the transport protein for maltose is downregulated and is not produced.

Plan an investigation to find out whether or not the yeast transport proteins for glucose and maltose function at the same rate.

Glucose and maltose are both reducing sugars.

You are provided with the following materials. Choose your materials from this list. You may **not** use any additional materials.

- 10% yeast suspension
- 10 g dm^{-3} glucose solution
- 10 g dm^{-3} maltose solution
- Benedict's solution
- dilute hydrochloric acid
- dilute sodium hydroxide solution and sodium hydrogencarbonate solution for neutralising
- beakers and flasks of different sizes
- stopwatch or electronic timer
- colorimeter and tubes
- centrifuge and centrifuge tubes
- thermometer
- thermostatically-controlled water baths
- pipettes and pipette fillers
- burettes and burette stands
- filter funnels and filter paper
- syringes
- glass rods for stirring
- test-tubes and boiling tubes
- test-tube and boiling tube racks

Your plan should

- include a clear statement of the hypothesis or prediction
- identify the key variables
- give full details and explanations of the procedures that you would adopt to ensure that the results are as precise and repeatable as possible
- show how you would present and analyse your results
- include a brief risk assessment
- be written in clear, scientific language.

[25]

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