Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2025**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

1 Pepsin is an enzyme that is present in gastric juice. Gastric juice is secreted into the stomach of humans and many other animals.

Pepsin catalyses the hydrolysis of proteins into peptides, as shown in Fig. 1.1.

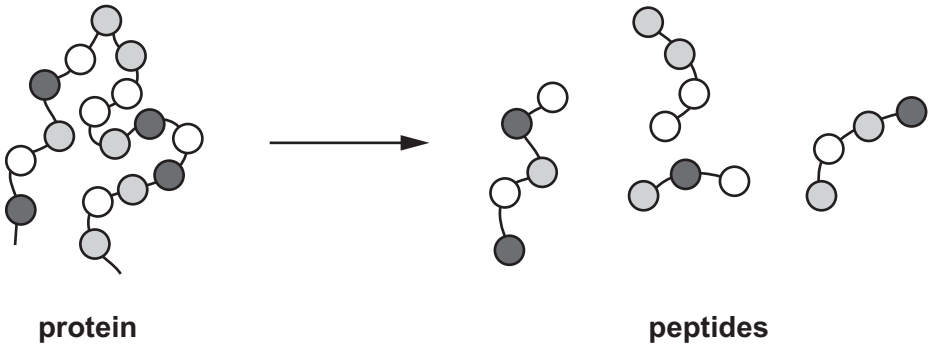

Fig. 1.1

Egg albumen (egg white) contains a high proportion of protein.

10% albumen solution is a cloudy-white colour. This becomes colourless when pepsin is added to the 10% albumen solution.

A student used a colorimeter to follow the progress of the hydrolysis of protein by pepsin.

(a) (i) The student used a blue filter in the colorimeter.

Outline **one other** step the student should carry out to prepare the colorimeter so that correct measurements of absorbance can be obtained.

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(ii) After preparing the colorimeter, the student:

- made a pH 2.0 albumen solution by mixing 10 cm^3 of 10% albumen solution with 10 cm^3 of pH 2.0 buffer solution
- added 3.0 cm^3 of the pH 2.0 albumen solution to a colorimeter tube
- added a small volume of pepsin solution to the colorimeter tube
- immediately placed the colorimeter tube in the colorimeter
- recorded the absorbance of the mixture every 20 seconds for 5 minutes
- calculated the rate of change in absorbance as a measure of the rate of protein hydrolysis.

The results are shown in Fig. 1.2.

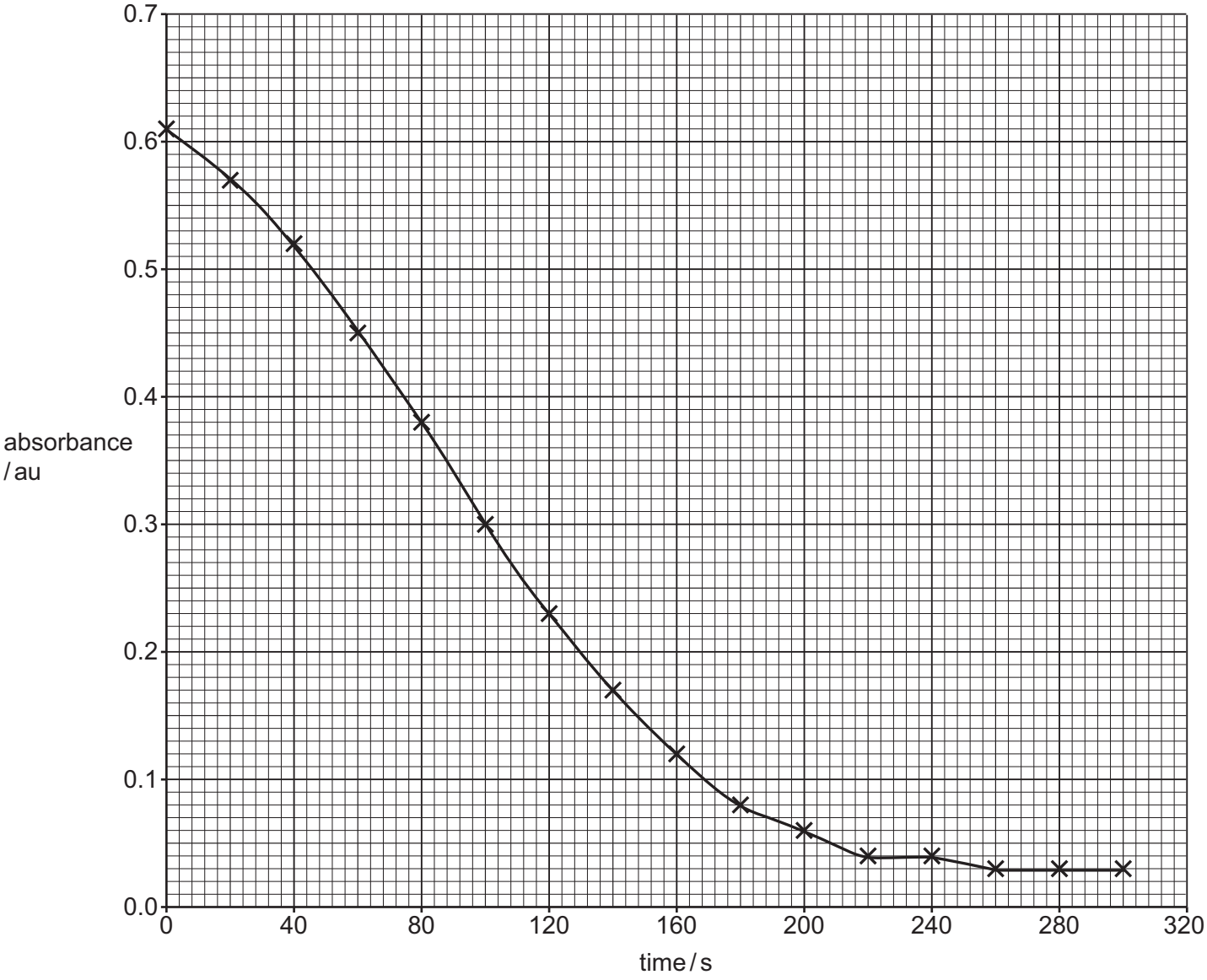

Fig. 1.2

Use Fig. 1.2 to calculate the rate of change in absorbance at pH 2.0 between 40 s and 120 s.

Show your working **and** include appropriate units.

rate of change in absorbance at pH 2.0 = ... [3]

(b) The student decided to investigate the effect of pH on the rate of protein hydrolysis by pepsin.

From the internet the student found out that pepsin is **inactive** at **pH 6.5 and above**.

(i) The student was provided with a colorimeter and standard laboratory apparatus.

Describe a method that the student could use to investigate the effect of pH on the rate of protein hydrolysis by pepsin **and** to determine the optimum pH of pepsin.

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

Details of how to prepare and use the colorimeter should **not** be included.

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(ii) Complete the sketch graph in Fig. 1.3 to predict the effect of pH on the rate of protein hydrolysis by pepsin.

Include a label for the *y*-axis in your answer.

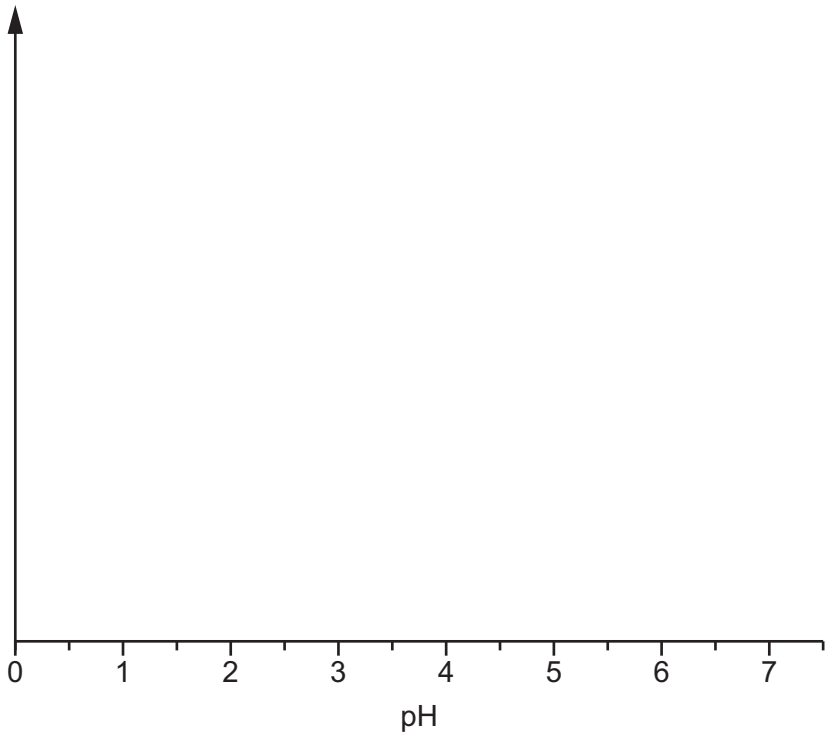

Fig. 1.3

[2]

(c) (i) Laryngopharyngeal reflux (LPR) is a disease that occurs when gastric juice from the stomach moves up the oesophagus and into the larynx, as shown in Fig. 1.4.

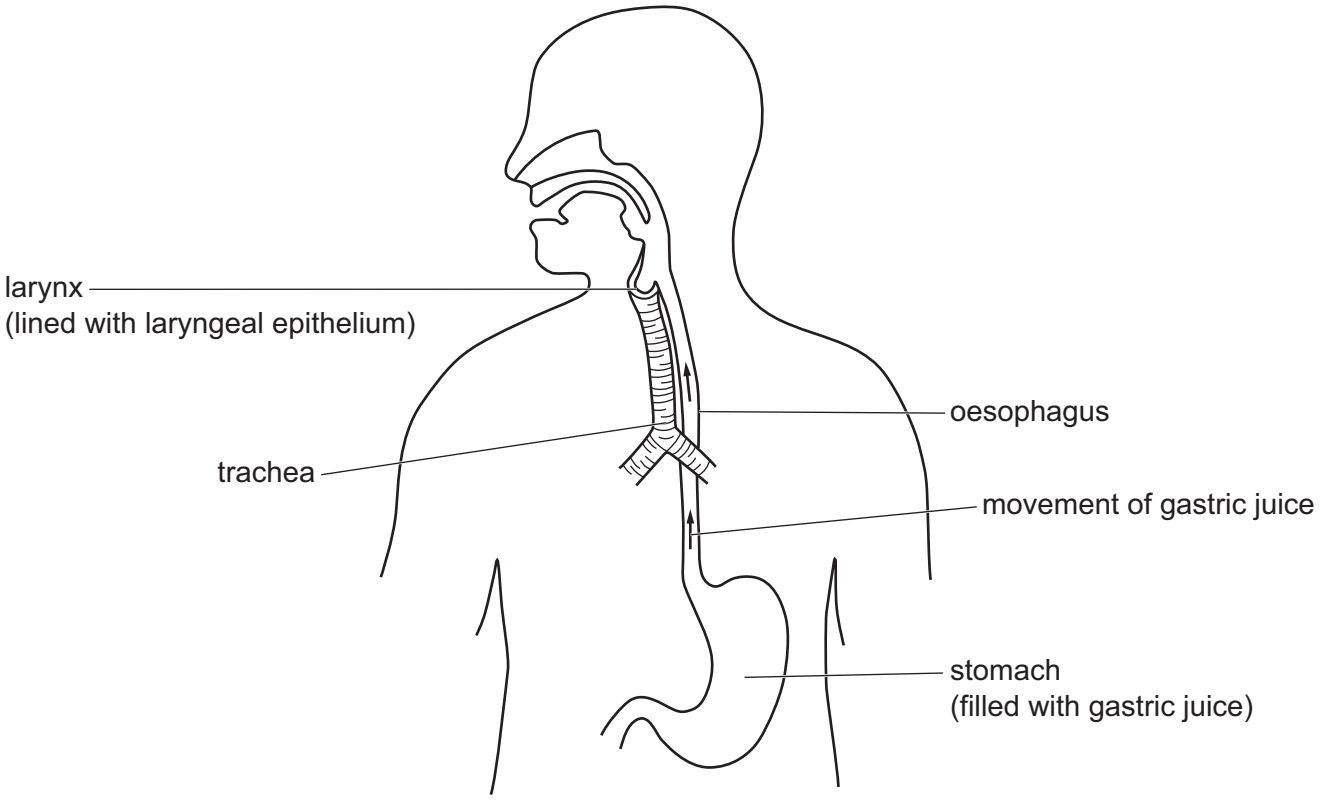

Fig. 1.4

Gastric juice can damage the laryngeal epithelium. Gastric juice contains hydrochloric acid and pepsin.

Some scientists identified a reduction in the quantity of two proteins, CA3 and Sep70, present in the laryngeal epithelium of people with LPR.

The scientists obtained 6 sections of mammalian laryngeal epithelium to investigate how different test conditions affect the quantity of CA3 and Sep70 in the laryngeal epithelium.

Each section of laryngeal epithelium was exposed to different test conditions for 20 minutes, as shown in Table 1.1.

Pepsin is inactive in the presence of the inhibitor, pepstatin.

Table 1.1

treatment used	test condition					
	1	2	3	4	5	6
pepsin	yes	yes	yes	yes	no	no
pepstatin (inhibitor)	no	no	yes	yes	yes	yes
pH buffer	7.4	4.0	7.4	4.0	7.4	4.0

Proteins were then extracted from the sections of laryngeal epithelium. The proteins were separated using electrophoresis. CA3 and Sep70 were identified using fluorescent antibodies.

Fig. 1.5 shows the results of the protein electrophoresis.

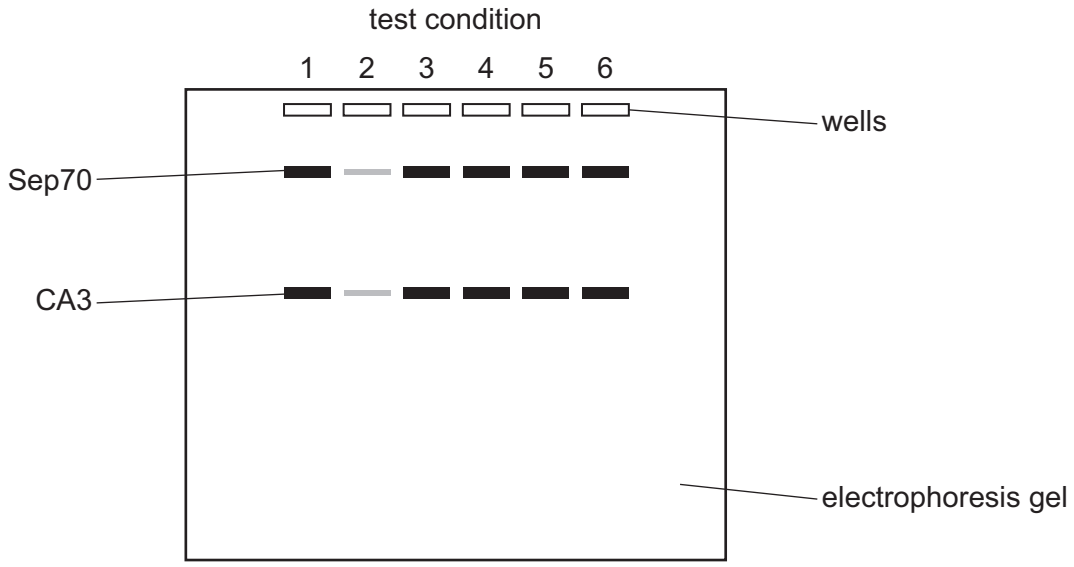

Fig. 1.5

Use Table 1.1 and Fig. 1.5 to state the conclusions that can be made from the results of the protein electrophoresis.

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(ii) The results of this investigation were published in a scientific paper.

A student who read the scientific paper concluded that pepsin causes damage to the laryngeal epithelium in people with LPR.

Suggest why the results of this investigation might **not** support this conclusion.

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[Total: 17]

2 Golden orb weaver spiders, *Nephila pilipes*, are found in East Asia, South-east Asia and Australia. They are active in the day and at night. Golden orb weaver spiders build webs in trees and shrubs to catch different species of insects for food.

All female golden orb weaver spiders are black with yellow spots on their legs and body. Biologists think that this adaptation evolved due to natural selection. Spiders with yellow spots may be able to attract more insects to their webs.

Fig. 2.1 shows a female golden orb weaver spider sitting on a web.

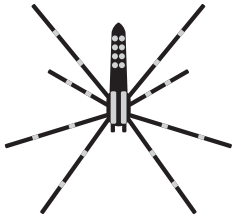
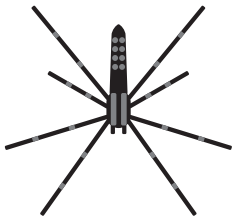
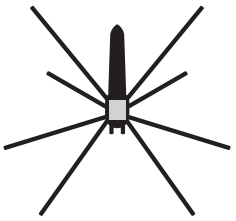
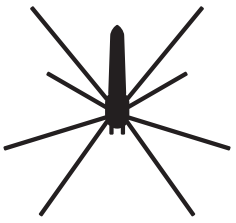
Fig. 2.1

Some biologists visited a forest in East Asia in July 2008. The biologists found five webs that were approximately the same size. Each web belonged to a female golden orb weaver spider.

The biologists decided to investigate how the colour and pattern of spots on the spiders affect the number of insects attracted per hour to each web (insect attraction rate).

The biologists made two-dimensional (2D) models of spiders, as shown in Table 2.1.

Table 2.1

model	description	diagram
A	• black body with yellow spots • black legs with yellow spots • same colour and pattern of spots as golden orb weaver spiders	
B	• black body with blue spots • black legs with blue spots • same pattern of spots as golden orb weaver spiders	
C	• black body with large yellow spot • black legs • total area of yellow colour is the same as model **A**	
D	• yellow body • yellow legs	
E	• black body • black legs	

At the first web, the biologists:

- removed the living golden orb weaver spider from the web
- placed model **A** in the centre of the web
- placed a video camera 1 m from the web
- filmed the web and model for 6 hours
- recorded an insect attraction event whenever an insect flew towards the model, touched the model, or touched the web
- calculated the insect attraction rate of model **A**.

The procedure was repeated by placing models **B**, **C**, **D** and **E** on the four other webs.

The whole investigation was repeated 25 times, and a mean insect attraction rate for each model was calculated.

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

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(ii) The pattern of spots on models **A** and **B** was the same as the pattern of spots on female golden orb weaver spiders.

Identify **two other** variables that the biologists should standardise when making the models for this investigation.

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(iii) Suggest a suitable control for this investigation.

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(b) Fig. 2.2 shows the mean insect attraction rates for the five models. The error bars show ± one standard error (SE).

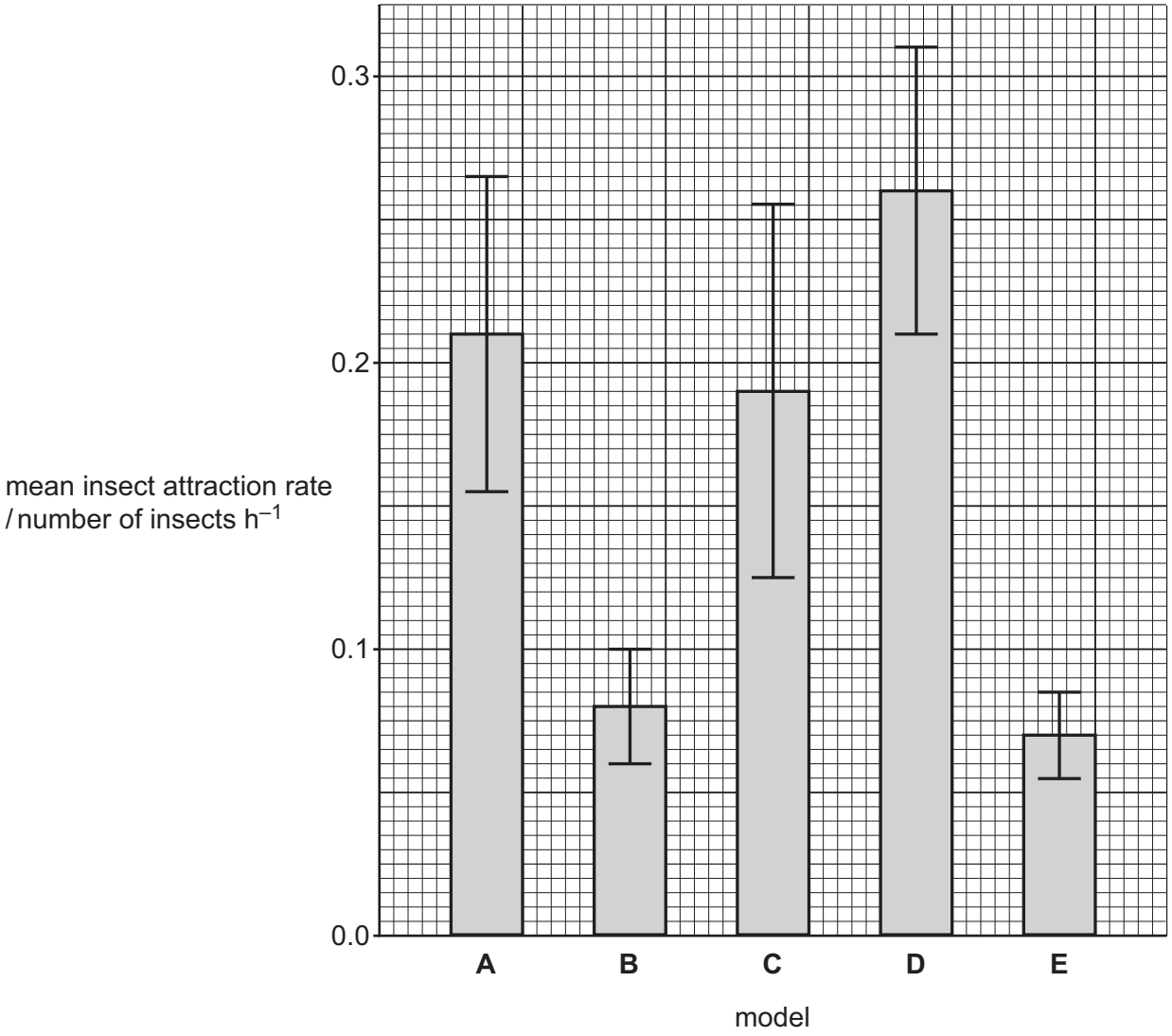

Fig. 2.2

(i) Use the information shown in Table 2.1 and Fig. 2.2 to discuss the conclusions that can be made about the effect of colour **and** pattern of spots on the models on insect attraction rates.

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(ii) The biologists decided to analyse the data in Fig. 2.2 using *t*-tests.

State a null hypothesis the biologists could make before carrying out the *t*-tests.

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(iii) State **two** reasons why the *t*-test is suitable for analysing the data shown in Fig. 2.2.

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(c) A student thought that the investigation did not provide enough information about how the colour and pattern of spots on female golden orb weaver spiders help to attract insects to their webs.

Suggest how this investigation could be improved to increase confidence in the results.

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[Total: 13]

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