SPECIMEN MATERIAL

A-level
BIOLOGY
(7402/3)
Paper 3

Specimen 2014 Session Time allowed: 2 hours

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions in Section **A**.
- Answer **one** question from Section **B**.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 78.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature _____

Section A

Answer **all** questions in this section.

1 Ecologists investigated the size of an insect population on a small island. They used a mark-release-recapture method. To mark the insects they used a fluorescent powder. This powder glows bright red when exposed to ultraviolet (UV) light.

0 1 . 1 The ecologists captured insects from a number of sites on the island. Suggest how they decided where to take their samples.

[2 marks]

0 1 . 2 Give **two** assumptions made when using the mark-release-recapture method.

[2 marks]

1

2

0 1 . 3 Suggest the advantage of using the fluorescent powder in this experiment.

[2 marks]

The ecologists did **not** release any of the insects they captured 1–5 days after release of the marked insects.

Table 1 shows the ecologists' results.

Table 1

Days after release	Number of marked insects remaining in population	Number of insects captured	Number of captured insects that were marked
1	1508	524	78
2	1430	421	30
3	1400	418	18
4	1382	284	2
5	1380	232	9

0 1 . 4 Calculate the number of insects on this island 1 day after release of the marked insects.

Show your working.

[2 marks]

Answer = _____

0 1 . 5 The ecologists expected to obtain the same result from their calculations of the number of insects on this island on each day during the period 1–5 days after release. In fact, their estimated number increased after day 1.

During the same period, the number of insects they caught decreased.

The method used by the ecologists might have caused these changes.

Use the information provided to suggest **one** way in which the method used by the ecologists might have caused the increase in their estimates of the size of the insect population.

[2 marks]

_____

_____

_____

_____

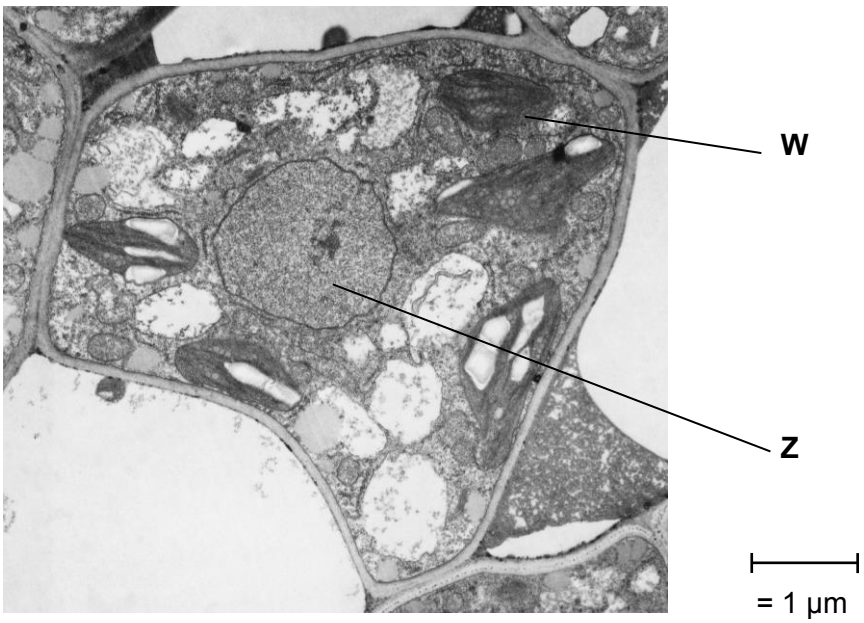
0 2 . 1 Describe how you could make a temporary mount of a piece of plant tissue to observe the position of starch grains in the cells when using an optical (light) microscope.

[4 marks]

[Extra space]

Figure 1 shows a microscopic image of a plant cell.

Figure 1



0 2 . 2 Give the name and function of the structures labelled **W** and **Z**.

[2 marks]

Name of **W** _____

Function of **W** _____

Name of **Z** _____

Function of **Z** _____

0 2 . 3 A transmission electron microscope was used to produce the image in **Figure 1**. Explain why.

[2 marks]

_____

_____

_____

_____

_____

0 2 . 4 Calculate the magnification of the image shown in **Figure 1**.

[1 mark]

Answer = _____

3 A student investigated the effect of chewing on the digestion of starch in cooked wheat.

He devised a laboratory model of starch digestion in the human gut. This is the method he used.

1. Volunteers chewed cooked wheat for a set time. The wheat had been cooked in boiling water.
2. This chewed wheat was mixed with water, hydrochloric acid and a protein-digesting enzyme and left at 37 °C for 30 minutes.
3. A buffer was then added to bring the pH to 6.0 and pancreatic amylase was added. This mixture was then left at 37 °C for 120 minutes.
4. Samples of the mixture were removed at 0, 10, 20, 40, 60 and 120 minutes, and the concentration of reducing sugar in each sample was measured.
5. Control experiments were carried out using cooked wheat that had been chopped up in a blender, not chewed.

0 3 . 1 What reducing sugar, or sugars, would you expect to be produced during chewing? Give a reason for your answer.

[2 marks]

0 3 . 2 In this model of digestion in the human gut, what other enzyme is required for the complete digestion of starch?

[1 mark]

0 3 . 3 What was the purpose of step 2, in which samples were mixed with water, hydrochloric acid and pepsin?

[1 mark]

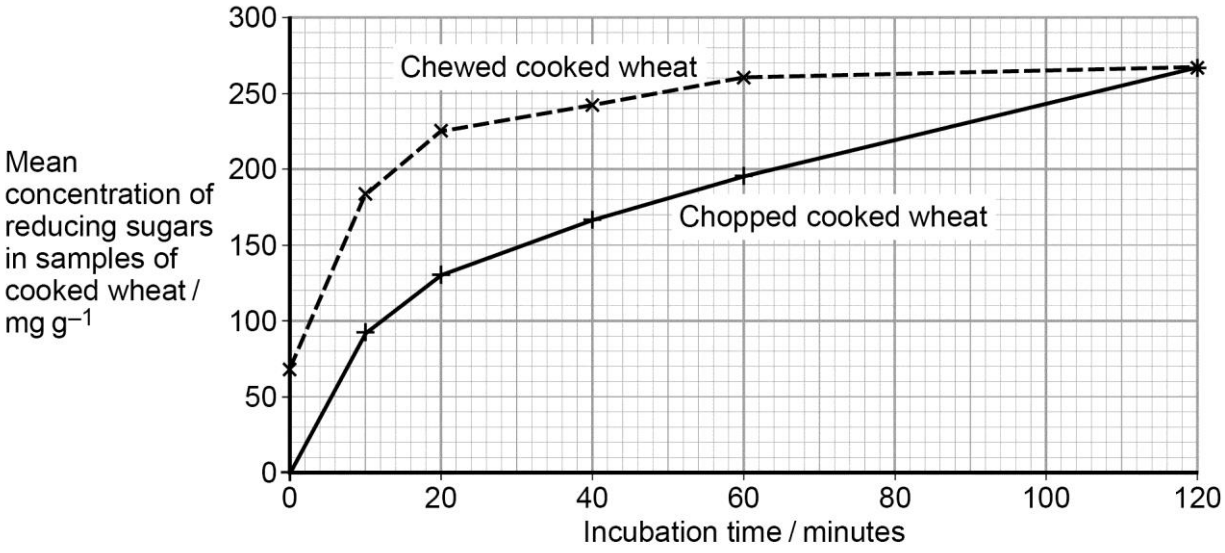
0 3 . 4 In the control experiments, cooked wheat was chopped up to copy the effect of chewing.

Suggest a more appropriate control experiment. Explain your suggestion.

[2 marks]

0 3 . 5 **Figure 2** shows the student's results.

Figure 2



Explain what these results suggest about the effect of chewing on the digestion of starch in wheat.

[3 marks]

4 Metastatic melanoma (MM) is a type of skin cancer. It is caused by a faulty receptor protein in cell-surface membranes. There have been no very effective treatments for this cancer.

Dacarbazine is a drug that has been used to treat MM because it appears to increase survival time for some people with MM.

Doctors investigated the use of a new drug, called ipilimumab, to treat MM. They compared the median survival time (ST) for two groups of patients treated for MM:

- a control group of patients who had been treated with dacarbazine
- a group of patients who had been treated with dacarbazine and ipilimumab.

The ST is how long a patient lives after diagnosis.

The doctors also recorded the percentage of patients showing a significant reduction in tumours with each treatment.

The total number of patients in the investigation was 502.

Table 2 shows the doctors' results.

Table 2

Treatment	**Median survival time (ST) / months**	**Percentage of patients showing significant reduction in tumours**
Dacarbazine	9.1	10.3
Dacarbazine and ipilimumab	11.2	15.2

0 4 . 1 The doctors compared median survival times for patients in each group.

How would you find the median survival time for a group of patients?

[2 marks]

0 4 . 2 In many trials of new drugs, a control group of patients is given a placebo that does not contain any drug.

The control group in this investigation had been treated with dacarbazine.
Suggest why they had not been given a placebo.

[1 mark]

0 4 . 3 A journalist who read this investigation concluded that ipilimumab improved the treatment of MM.

Do the data in **Table 2** support this conclusion? Give reasons for your answer.

[4 marks]

[Extra space]

Question 4 continues on the next page

0 4 . 4 MM is caused by a faulty receptor protein in cell-surface membranes.
Cells in MM tumours can be destroyed by the immune system.

Suggest why they can be destroyed by the immune system.

[3 marks]

[Extra space]

5 Scientists investigated the effect of a mycorrhizal fungus on the growth of pea plants with a nitrate fertiliser or an ammonium fertiliser. The fertilisers were identical, except for nitrate or ammonium.

The scientists took pea seeds and sterilised their surfaces. They planted the seeds in soil that had been heated to 85 °C for 2 days before use. The soil was sand that contained no mineral ions useful to the plants.

0 5 . 1 Explain why the scientists sterilised the surfaces of the seeds and grew them in soil that had been heated to 85 °C for 2 days.

[2 marks]

0 5 . 2 Explain why it was important that the soil contained no mineral ions useful to the plants.

[1 mark]

The pea plants were divided into four groups, **A**, **B**, **C** and **D**.

- **Group A** – heat-treated mycorrhizal fungus added, nitrate fertiliser
- **Group B** – mycorrhizal fungus added, nitrate fertiliser
- **Group C** – heat-treated mycorrhizal fungus added, ammonium fertiliser
- **Group D** – mycorrhizal fungus added, ammonium fertiliser

The heat-treated fungus had been heated to 120 °C for 1 hour.

0 5 . 3 Explain how groups **A** and **C** act as controls.

[2 marks]

Question 5 continues on the next page

After 6 weeks, the scientists removed the plants from the soil and cut the roots from the shoots. They dried the plant material in an oven at 90 °C for 3 days. They then determined the mean dry masses of the roots and shoots of each group of pea plants.

0 5 . 4 Suggest what the scientists should have done during the drying process to be sure that all of the water had been removed from the plant samples.

[2 marks]

The scientists' results are shown in **Table 3**.

Table 3

Treatment	**Mean dry mass / g per plant (± standard deviation)**	
	Root	**Shoot**
A – heat-treated fungus and nitrate fertiliser	0.40 (±0.05)	1.01 (±0.12)
B – fungus and nitrate fertiliser	1.61 (±0.28)	9.81 (±0.33)
C – heat-treated fungus and ammonium fertiliser	0.34 (±0.03)	0.96 (±0.26)
D – fungus and ammonium fertiliser	0.96 (±0.18)	4.01 (±0.47)

0 5 . 5 What conclusions can be drawn from the data in **Table 3** about the following?

[4 marks]

The effects of the fungus on growth of the pea plants.

The effects of nitrate fertiliser and ammonium fertiliser on growth of the pea plants.

Question 5 continues on the next page

The scientists determined the dry mass of the roots and shoots separately. The reason for this was they were interested in the ratio of shoot to root growth of pea plants. It is the shoot of the pea plant that is harvested for commercial purposes.

0 5 . 6 Explain why determination of dry mass was an appropriate method to use in this investigation.

[2 marks]

0 5 . 7 Which treatment gave the best result in commercial terms? Justify your answer.

[2 marks]

Section B
Answer **one** question.

6 Write an essay on **one** of the topics below.

EITHER

0 6 . 1 The importance of movement in living organisms**.**

[25 marks]

OR

0 6 . 2 The importance of receptors in living organisms.

[25 marks]

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Acknowledgement of copyright holders and publishers

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright holders have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements in future papers if notified.

Figure 1: Marilyn Schaller/Science Photo Library

Copyright © 2014 AQA and its licensors. All rights reserved.