Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Biology

Advanced Subsidiary
Unit 3: Practical Biology and Research Skills

Monday 23 January 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
WBI03/01

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Pearson

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Answer ALL questions.

1 Pineapple is a very good source of vitamin C.

Published estimates show that fresh pineapple, of a variety called Queen Victoria, contains 24.8 mg of vitamin C per 100 g of fruit. However, pineapple decays very quickly and is often processed to extend its shelf life.

Processing procedures, and the length of time the processed fruit is stored, are known to affect vitamin C content.

One way to process fruit is to make it into jam.

A study was carried out into the effects of making and storing jam on the vitamin C content of pineapple.

Batches of pineapple, of the Queen Victoria variety, were made into jam by mixing them with sugar and heating. The jam was stored in 25 jars, each containing 100 g. The jars were stored at a temperature of 20 °C, as would be normal in a supermarket.

The mean vitamin C content of samples from each of five jars of jam was determined at the start of the study and then every two weeks for eight weeks.

The vitamin C content of each sample was determined by titration with a 0.1% DCPIP solution.

(a) (i) State the independent variable in this investigation.

(1)

.....

(ii) Name **one** variable that could have been controlled when making the jam. Describe how this variable could have been controlled.

(2)

Variable .....

How the variable is controlled .....

.....

.....

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(iii) Describe how the samples of jam should be prepared for titration.

(3)

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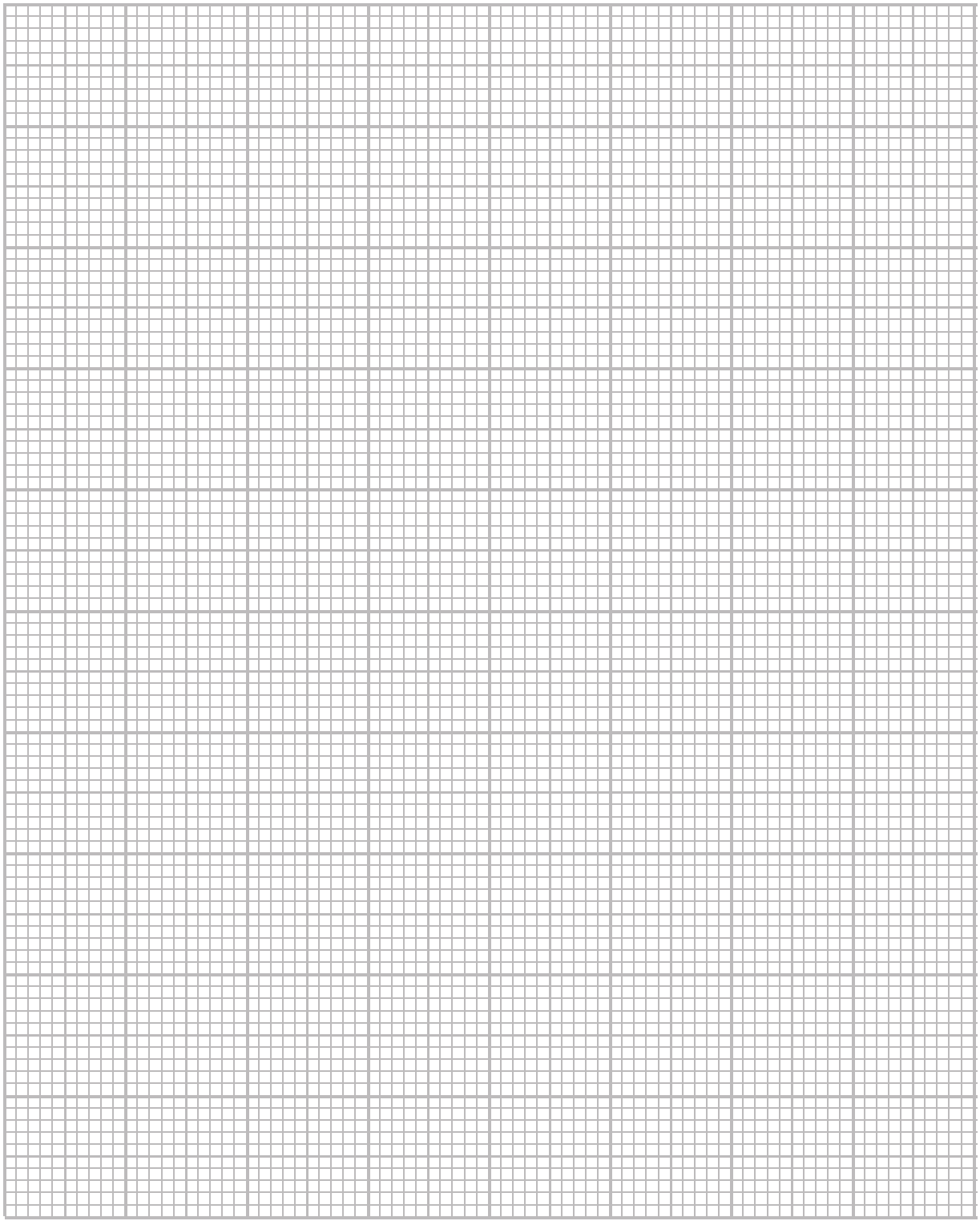
(b) The results of this study are shown in the table below.

Storage time / weeks	Mean vitamin C content / mg per 100 g
0	14.3
2	11.7
4	10.7
6	9.8
8	7.7

(i) Plot a line graph to show the effect of storage time on the mean vitamin C content of the jam. Draw a line of best fit through the points.

(4)



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(ii) Use the information in the table to calculate the mean rate of decrease of vitamin C per day during storage.

Show your working.

(3)

Answer ..... mg per 100 g per day

(iii) The fresh pineapple contained 24.8 mg of vitamin C per 100 g.

Use the information in the table to calculate the percentage decrease of vitamin C when jam is made.

Show your working.

(3)

Answer ..... %

(c) The scientists who carried out this study also looked at the effect on the vitamin C content when the fruit was used to make fresh juice and a frozen dessert.

The vitamin C content decreased by 35.8% when fresh juice was made and by 12.5% when the frozen dessert was made.

One recommended daily intake for adults is 40 mg of vitamin C.

Using all the information given, discuss the use of pineapple juice, jam and frozen dessert as sources of vitamin C.

(4)

(Total for Question 1 = 20 marks)

2 Read the following account from a student's draft report on gnats as pests of orchids.

1. Gnats are small insects. Some species of gnats cause damage to orchid plants. This results in significant financial losses. Each plant is worth about 1.15 US dollars and the gnats can affect up to 20% of plants. A way to try and reduce the gnat population in glasshouses used to grow orchids is needed.

2. In the larval stage, the gnats burrow into the roots of the plants. This provides an entry point for pathogens, resulting in the roots rotting. This can kill the plant if there is sufficient damage. Also, adult flying gnats transmit diseases between plants. Disease-causing fungi, such as *Pythium* and *Rhizoctonia*, can be spread by the gnats.

3. The gnats produce about 150 eggs each, of which about 50% hatch. Eggs hatch into larvae after 2 to 7 days. The larvae feed on decaying organic matter, soil fungi, algae, fine roots and the lower stems of plants for 5 to 14 days. At this point, they become pupae from which the adults emerge after 4 to 6 days. The length of the life cycle depends on the temperature.

4. Orchids require conditions in the glasshouses that mimic the environment in the trees where they grow naturally. Temperatures of 27 to 28 °C in the day and 26 °C at night are maintained in orchid glasshouses. The orchids also require high humidity. Gnats require a similar environment, of high humidity and temperature.

5. A possible solution to the gnat problem is to use the insecticide Met 52 granular. This insecticide is based on the spores of a fungus. The spores are an insect pathogen and affect gnat larvae. The spores germinate on the surface of the larvae, penetrate them and grow inside the larvae. The spores can remain in the soil for years without germinating.

6. Met 52 was not specifically designed for gnats but to reduce vine weevil populations. This insect also completes its life cycle in the soil. In an experiment, a control group of plants had 15 vine weevil eggs in the soil, whereas in the Met 52 treated group there was only one. When a different insecticide, chloryprifos, was used five eggs were found in the soil.

7. Met 52 is a broad spectrum insecticide and may infect any other organisms that come into contact with the soil in which the orchids are growing. It has been found to infect the larvae of some predatory beetles. Therefore, Met 52 may have a negative effect on the population of non-harmful insects, especially those that complete part of their life cycle in the soil. Furthermore, Met 52 needs to be kept away from surface water because there is a risk that it could pollute water sources. It may be necessary to take extra precautions to prevent run-off into water sources from the orchids after treatment with Met 52. This could have financial implications.

8. The insecticide costs 43 US dollars for a kilogram and 1 kg treats 2 m^3 of soil. At the orchid grower visited, there are 6000 m^2 of glasshouses growing approximately 200 000 orchids per year. Each orchid requires 1000 cm^3 of soil. Treating this number of plants could mean that this treatment may not be cost effective. This is because the cost of the treatment may be greater than the cost of the damage.

9. Met 52 causes less harm to the environment than chemical insecticides. There have been no reports of insect pests building up resistance to Met 52. Therefore Met 52 can be used for long-term control. After an initial investment in Met 52, the gnats will be controlled for many years.

10. Met 52 can cause allergic reactions in some people. This may be a risk for the orchid growers. There has been no recorded issue with toxicity to plants. When Met 52 was tested on laboratory animals, no signs of significant toxicity or disease were observed. People using Met 52 should wear waterproof gloves, eye goggles, a long-sleeved shirt, long pants, shoes, socks and a face mask.

11. One possible alternative to the use of Met 52 for the control of gnats is the use of predatory mites. The mites are sprinkled over the surface of the soil, using 100 mites per m^2 before an infestation develops or 300 mites per m^2 for an existing infestation. Unlike Met 52, they are known to target gnats. However, they only occupy the top centimetre of the soil, unlike Met 52 which is spread throughout the soil.

12. Nematodes can also be used. They are added by spraying them on to the soil. They penetrate the larvae and pupae of gnats and release bacteria into their blood. This causes poisoning and kills the host in about 48 hours. However, a large number of these nematodes are needed and the treatments are expensive. For the growers visited, treatment with nematodes would cost 9000 US dollars every two weeks and the application is time consuming.

(a) The problem identified in this report is that of gnats affecting orchids grown in glasshouses.

Explain why this a problem.

(3)

(b) In suggesting visuals that could be used, the student's teacher thought a diagram of the gnat life cycle would be useful.

Draw and label a diagram showing the details of the life cycle of a gnat as described in paragraph 3.

(3)

(c) One economic implication of the information in the report is the cost of treating orchids with Met 52 compared with the cost of gnat damage.

Use the information in paragraphs 1, 7, 8 and 10 to explain whether treatment with Met 52 is likely to be cost effective.

Space for working

(4)

(d) (i) Describe **one** possible environmental implication of the use of Met 52.

(2)

(ii) State **one** possible risk to humans associated with the use of Met 52.

Describe how this risk could be minimised.

(2)

Risk .....

How the risk could be minimised .....

(e) Paragraph 6 states that "*Met 52 was not specifically designed for gnats*".

The student found a study of the effects of Met 52 on the gnats. Met 52 is based on the fungus *Metarhyzium*.

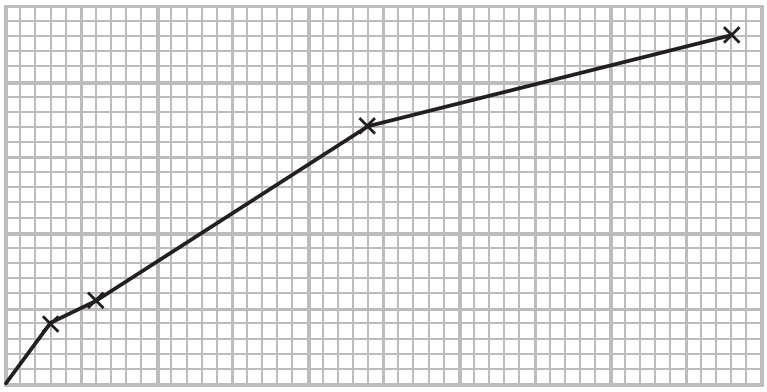
The number of colonies of the fungus *Metarhyzium* growing on gnats was counted.

The results are shown in the table.

Time from first exposure to Met 52 / hours	Mean number of *Metarhyzium* colonies per gnat
0	0
3	8
6	11
24	34
48	46

(i) Use the information in the table to complete the graph below.

(2)



(ii) Explain how these data support the conclusion that Met 52 is useful for the control of gnats on orchids.

(2)

(f) Identify **one** alternative solution for the control of gnats and compare it with the use of Met 52.

(2)

(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

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