OXFORD AQA
INTERNATIONAL QUALIFICATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

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I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological Systems and Disease

Thursday 16 May 2024 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 Pathogens must enter the body of an organism to cause disease.

0 1 . 1 Give **two** organ systems that could allow pathogens to enter the body of a mammal.

[2 marks]

1 _____

_____

2 _____

_____

When a pathogen enters a mammal's body, phagocytosis can occur.

Phagocytes are attracted to the pathogen by chemicals secreted by the pathogen.

0 1 . 2 In the following passage, the numbered spaces can be filled with biological terms.

Antigens on the cell surface membrane of the pathogen bind with ____(1)____ on the surface of the phagocyte.
The pathogen is ____(2)____ by the phagocyte and is enclosed in a vesicle called a phagosome.
Structures called ____(3)____ then fuse with the phagosome, releasing ____(4)____ into the phagosome to digest the pathogen.
The products of digestion are absorbed into the cytoplasm of the phagocyte.

Write the correct biological term next to each number below that matches the space in the passage.

[4 marks]

1 _____

2 _____

3 _____

4 _____

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0 1 . 3 Phagocytes are one type of cell in the immune system.

Name **three** other types of cell in the immune system.

Give **one** function for each.

[3 marks]

Name of cell type _____

Function _____

_____

Name of cell type _____

Function _____

_____

Name of cell type _____

Function _____

_____

Question 1 continues on the next page

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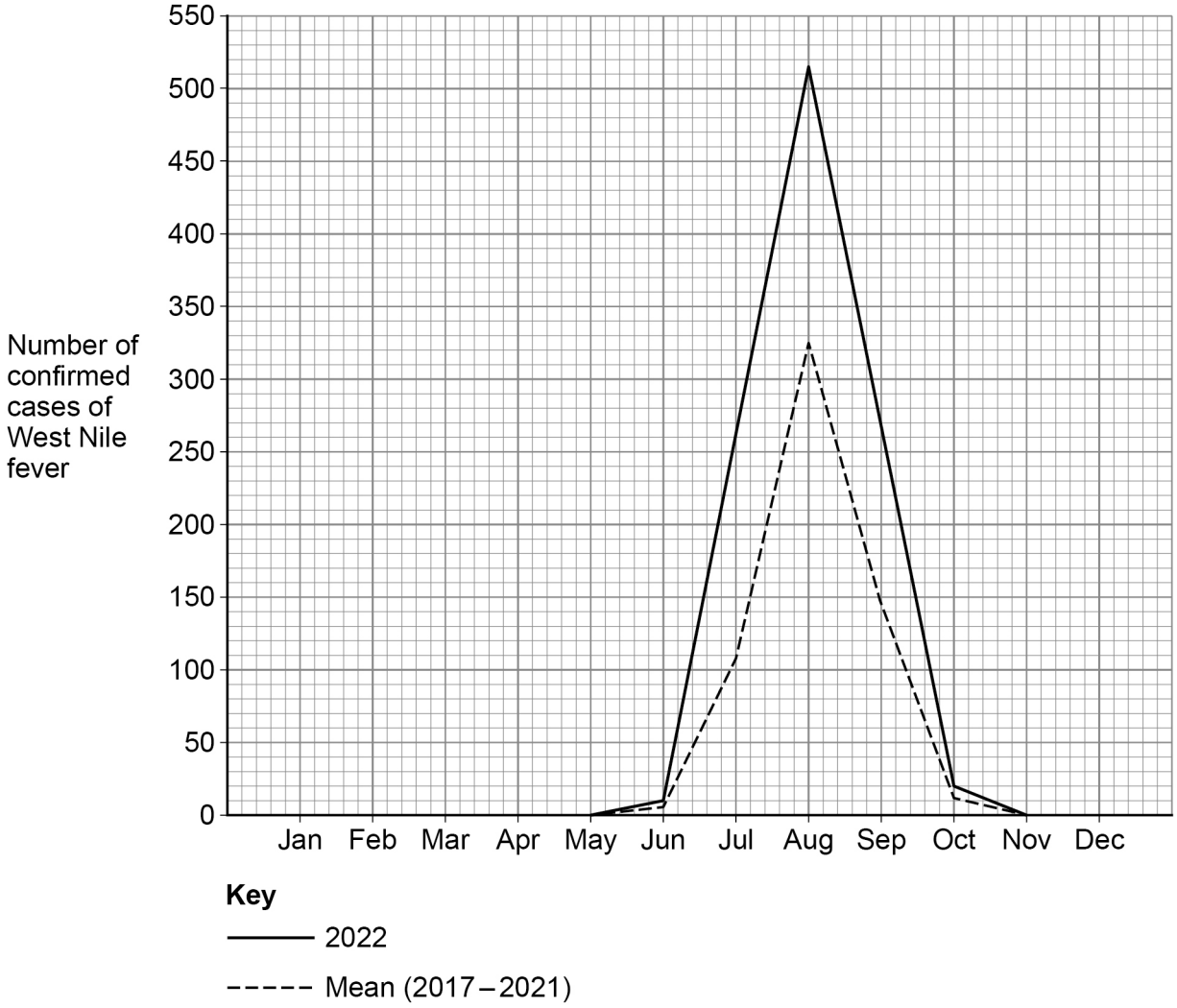
West Nile fever is a viral disease spread between people by mosquitos. Infected people usually have no symptoms or only develop a mild fever.

Figure 1 shows the number of confirmed cases of West Nile fever in Europe each month during 2022 compared with the mean number of infections between 2017 and 2021.

Figure 1



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0 1 . 4 The estimated population of Europe is 4.47×10^8 people.

Give the peak number of cases of West Nile fever per million people in 2022.

Use **Figure 1**.

[2 marks]

Number of cases = _____ per million people

Approximately 1% of cases of West Nile fever develop meningitis.

Meningitis is inflammation of the membranes around the brain and spinal cord and can be fatal.

Drug companies could develop a vaccine to prevent West Nile fever.

0 1 . 5 However, the drug companies have **not** developed a vaccine to prevent West Nile fever.

Suggest **one** reason why.

[1 mark]

_____

_____

_____

12

Turn over for the next question

Do not write outside the box

0 2 Aphids are insects that feed on the sap of plants.

0 2 . 1 Describe how aphids feed on a plant.

[3 marks]

0 2 . 2 Name **one** organic molecule in the sap that aphids feed on.

[1 mark]

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ANSWER IN THE SPACES PROVIDED

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Aphids are common pests of tomato plants. Some varieties of tomato are resistant to aphids.

Tomato plants are covered in hairs called trichomes. These trichomes might help the plant to resist aphids by preventing the aphids landing on the plant.

Figure 2 shows trichomes on a tomato plant.

Figure 2

The wild type (WT) of tomatoes has trichomes and is resistant to aphids.

The commercial type (CT) of tomatoes also has trichomes but is **not** resistant to aphids.

Scientists investigate why some varieties of tomato with trichomes are resistant to aphids, while other varieties of tomato with trichomes are not resistant to aphids.

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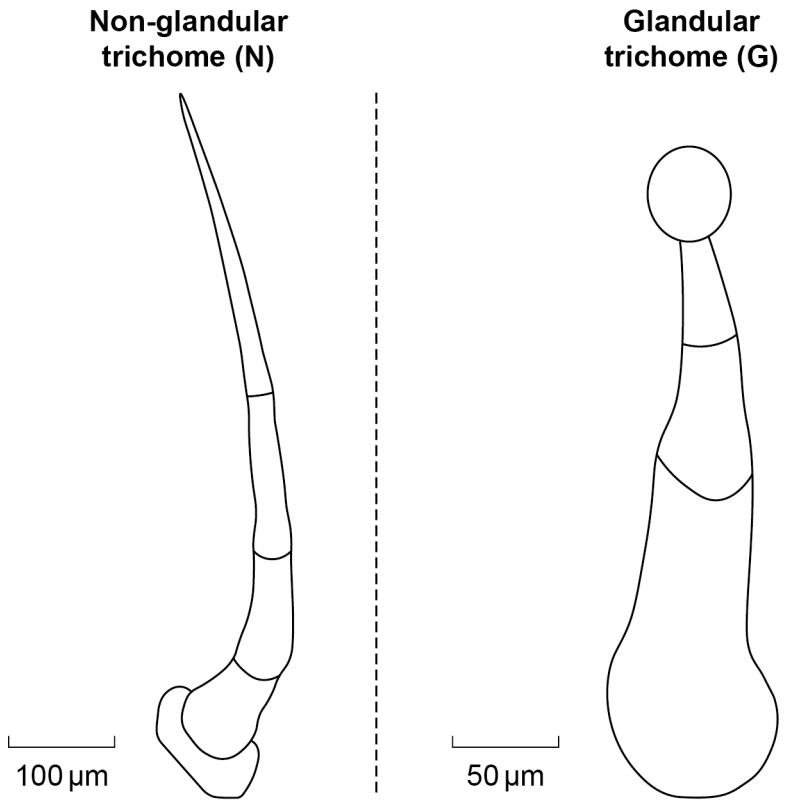
Using a microscope, the scientists find that there are 2 different types of trichome on the leaves. A trichome can be non-glandular (**N**) or glandular (**G**) as shown in **Figure 3**.

Figure 3



0 2 . 3 Compare the lengths of the different types of trichome.

Use data from **Figure 3**.

[2 marks]

Question 2 continues on the next page

Do not write outside the box

Scientists investigate if the different types of trichome affect the number of aphids present on different varieties of tomato.

The scientists use:

- wild tomato (WT)
- commercial tomato variety (CT)
- offspring of six crosses between WT and CT (XT1–XT6)

The scientists:

- count the number of **N** trichomes per mm^2 leaf area
- count the number of **G** trichomes per mm^2 leaf area
- count the number of aphids on 10 leaves of 10 different plants from each variety.

Table 1 shows the results.

Table 1

	Mean number of trichomes per mm^2 leaf area			
Variety	Non-glandular (**N**)	Glandular (**G**)	Total (T)	Mean number of aphids per leaf
WT	2.1	20.3	22.4	1.3
CT	53.9	0.0	53.9	6.2
XT1	69.0	0.0	69.0	6.2
XT2	59.7	0.0	59.7	4.8
XT3	31.0	21.0	52.1	1.5
XT4	2.6	43.0	45.6	1.2
XT5	44.3	0.0	44.3	4.9
XT6	33.3	9.3	42.6	1.3

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0 2 . 4 One scientist states that:

'Trichomes **do** help the tomato plants resist aphids.'

Give **one** piece of evidence for this statement and **one** piece of evidence against this statement.

Use information from **Table 1**.

[2 marks]

Evidence for the statement _____

_____

_____

Evidence against the statement _____

_____

_____

Question 2 continues on the next page

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The scientists use Spearman rank correlation tests to determine if there is a relationship between the number of aphids and the number of trichomes.

The scientists' results are shown in **Table 2**.

Table 2

	Comparison of the number of aphids with:		
	Total number of trichomes	Number of non-glandular (**N**) trichomes	Number of glandular (**G**) trichomes
R value	0.158	0.369	−0.762
p	0.50	0.08	0.04

0 2 . 5 Explain what the scientists can conclude from the statistical tests.

[2 marks]

10

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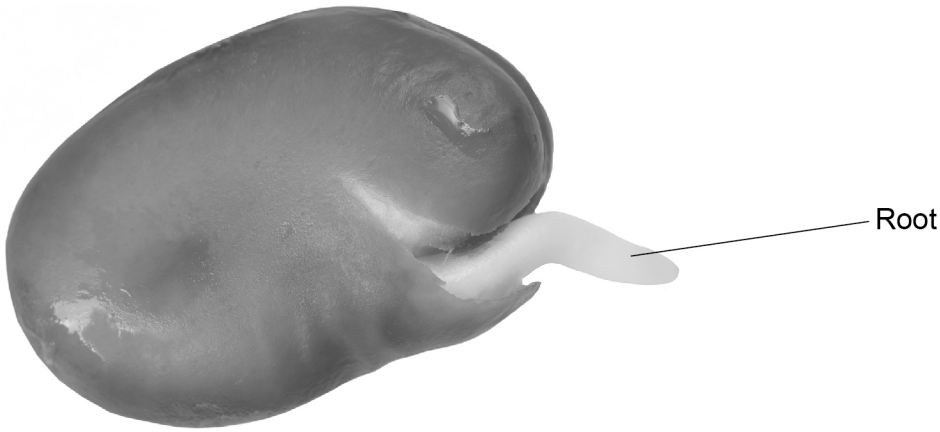
0 3 Some students investigate the effect of low temperature on mitosis in bean seeds.

The students:

- wait for the bean seeds to germinate and grow roots (**Figure 4**).
- incubate the germinated bean seeds at 4 °C for different time intervals between 30 minutes and 6 hours
- use 10 bean seeds at each time interval
- collect the root tips from each bean seed.

Figure 4 shows a germinated bean seed.

Figure 4



0 3 . 1 The students collect just the root tips and not the whole root.

Give the reason why.

[1 mark]

0 3 . 2 The students prepare a root tip squash and stain it using toluidine blue.

Give the reason why this stain is suitable.

[1 mark]

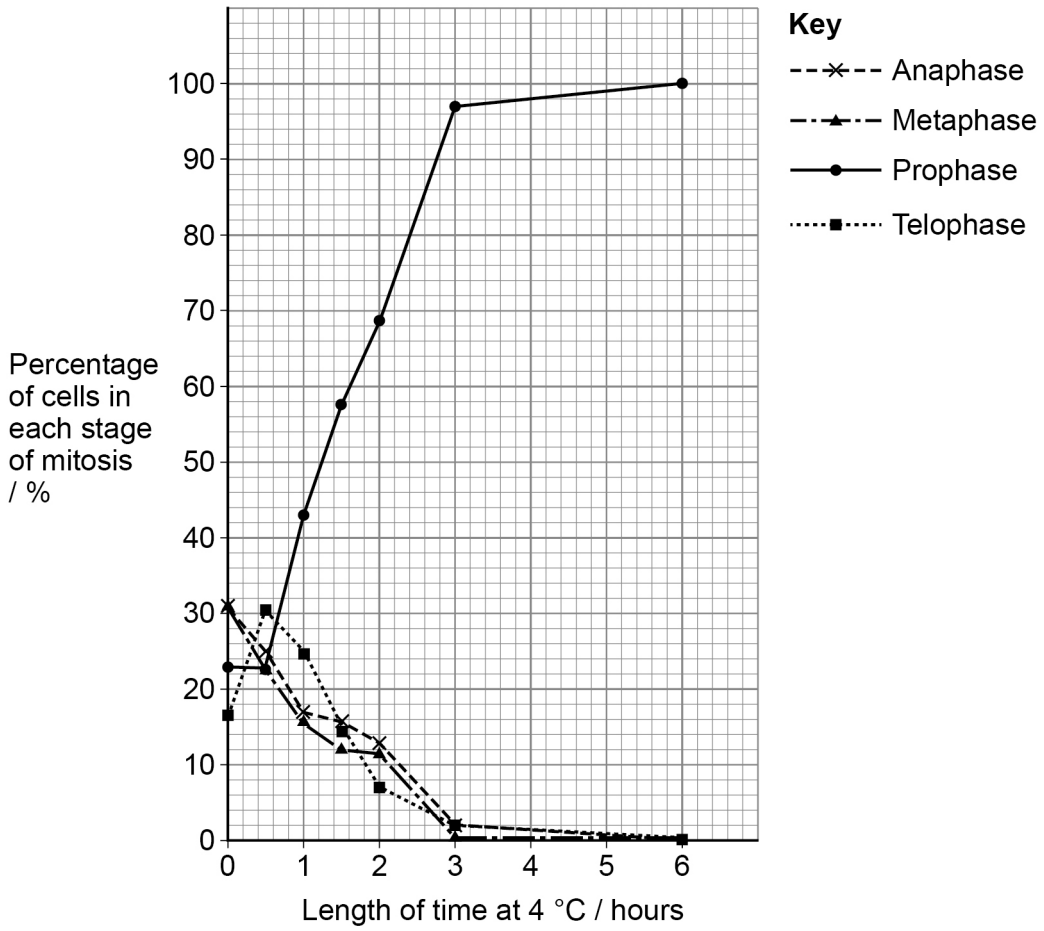
Do not write outside the box

The students want to show how incubation for different time intervals at 4 °C affects the percentage of cells in each stage of mitosis.

The students collect data from a large number of cells in mitosis to plot the graph in **Figure 5**.

Figure 5 shows the percentage of cells in each stage of mitosis following incubation at 4 °C

Figure 5



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0 3 . 3 Describe what data the students collect **and** how they calculate the values to plot for metaphase in **Figure 5**.

[2 marks]

During the incubation at 4 °C the students expect the percentage of cells in each stage of mitosis to stay about the same.

If the percentage of cells in a stage changes, this could mean that normal mitosis has stopped.

Based on **Figure 5**, the students conclude that incubation at 4 °C affects **one** stage of mitosis, causing mitosis to stop.

0 3 . 4 Identify the stage when mitosis stops.

Give a reason for your choice.

[2 marks]

Stage of mitosis

Reason

0 3 . 5 Suggest what happens to stop mitosis at the stage you identified in Question **03.4**.

[1 mark]

Question 3 continues on the next page

Do not write outside the box

The students use new germinated bean seeds to investigate if the effect of the incubation at 4 °C is permanent.

The students:

- incubate the germinated bean seeds at 4 °C for 3 hours
- transfer the germinated bean seeds to incubate at 23 °C for different time intervals of between 30 min to 6 hours.

0 3 . 6 Based on the data from **Figure 5**, the students incubate the bean seeds at 4 °C for 3 hours.

Suggest **two** reasons why they select **3 hours** for the incubation.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 3 . 7 For this second investigation, the students decide to combine the data for anaphase, metaphase and telophase.

Evaluate this decision.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

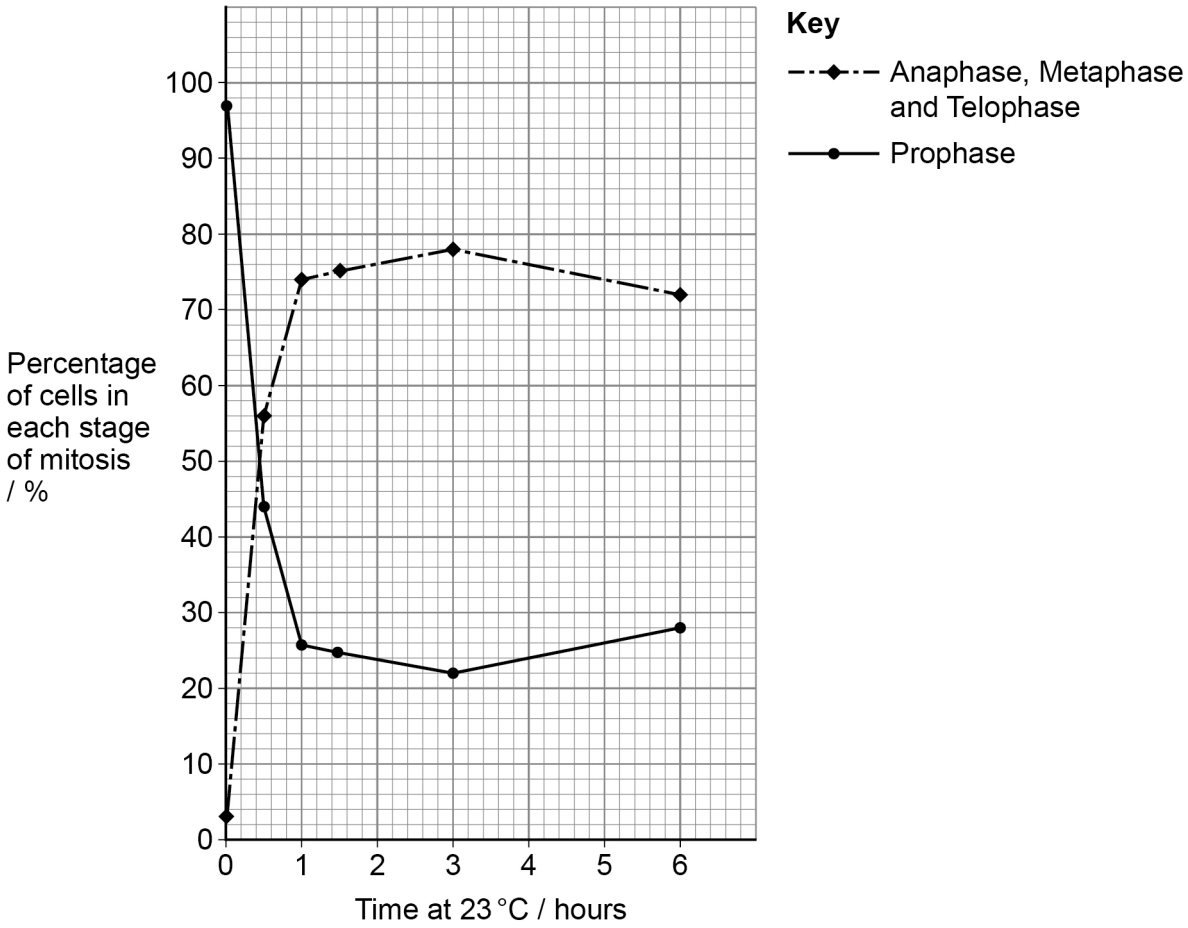
_____

_____

Do not write outside the box

Figure 6 shows the percentage of cells in prophase and the combined percentage of cells in anaphase, metaphase and telophase. The beans are first incubated for 3 hours at 4 °C then at different time intervals at 23 °C

Figure 6



0 3 . 8 The students conclude that exposure of bean seeds to 4 °C will **not** affect the long-term growth of the bean plant.

Give **one** way that the evidence supports this.

Use **Figure 5** (on page 14) and **Figure 6**.

[1 mark]

_____

_____

_____

13

Turn over for the next question

Do not write outside the box

0 4 Scientists investigate the effect on the heart of doing different sports.

0 4 . 1 The scientists measure heart rate and volume changes in the left ventricles of 90 people.

State why the scientists use people who:

[2 marks]

Are non-smokers _____

_____

_____

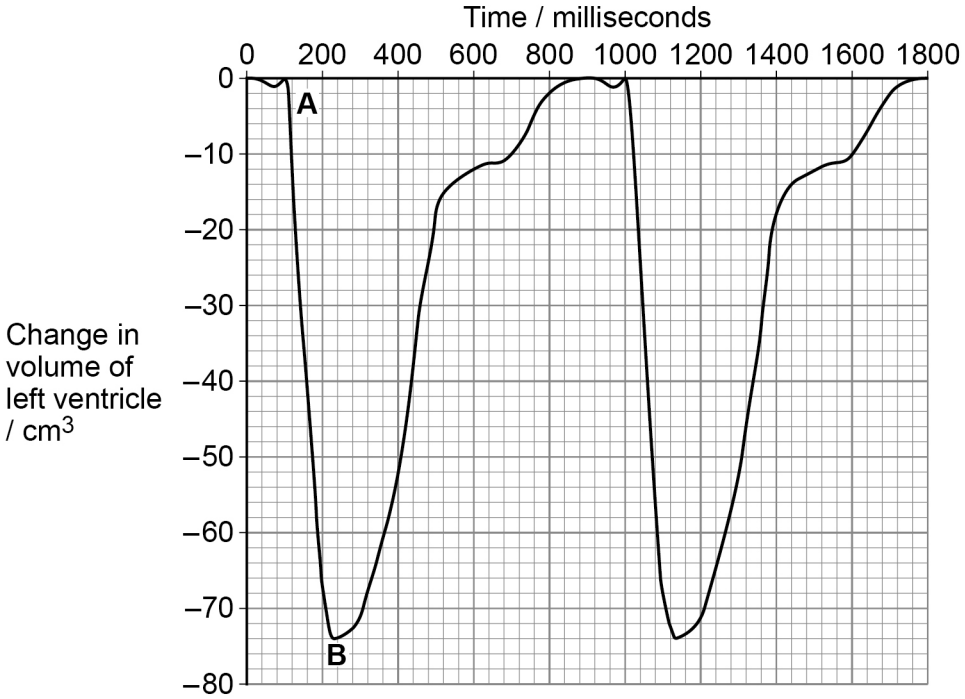
Rest before the measurements _____

_____

_____

Figure 7 shows the change in the volume of the left ventricle of one person.

Figure 7



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0 4 . 2 Describe the changes that occur in the heart between points **A** and **B** in **Figure 7**.

[4 marks]

0 4 . 3 Calculate the person's cardiac output.

Use data from **Figure 7**.

[3 marks]

Cardiac output = _____ cm^3 min^{-1}

Question 4 continues on the next page

Do not write outside the box

The scientists investigate the effect of doing different types of sport on 90 healthy non-smokers:

- 30 people play handball
- 30 people play football
- 30 people run long distances.

The scientists measure the mass of the left ventricle in each person at the start and after 6 months of regularly doing their sport.

0 4 . 4 Give **two** variables that should be controlled so that the different types of sport can be compared.

[2 marks]

1 _____

_____

2 _____

_____

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Question 4 continues on the next page

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ANSWER IN THE SPACES PROVIDED

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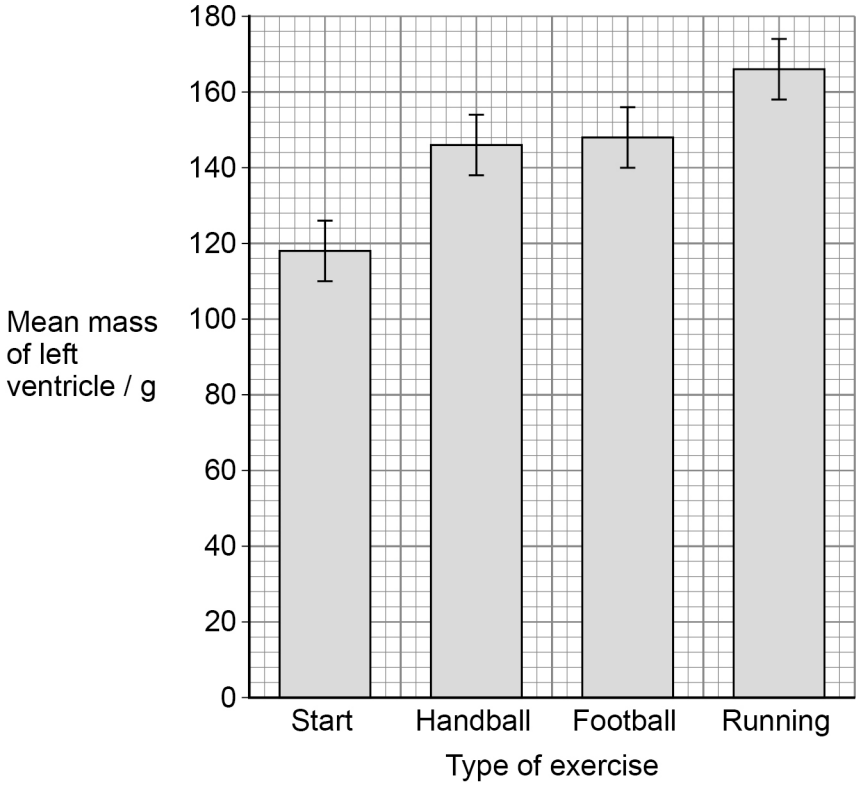
Figure 8 shows the mean mass of the left ventricle at the start and after 6 months of doing each sport.

Values are mean ± standard error.

The column labelled Start shows the mean of all 90 people.

The other columns show the mean of the 30 people who did that sport.

Figure 8



0 4 . 5 Give **two** conclusions that the scientists could make at the end of this investigation.

Use information from **Figure 8**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

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0 4 . 6 An Olympic triathlon is an endurance race. The athletes swim 1.5 km, cycle 40 km and run 10 km in 1 day.

Use information from **Figure 8** to suggest why running would best prepare the athletes' hearts for a triathlon.

[3 marks]

16

Turn over for the next question

Do not write outside the box

0 5 Food passes from the mouth to the stomach through a tube.

0 5 . 1 Name the tube that links the mouth to the stomach.

Tick (✓) **one** box.

[1 mark]

Colon ☐

Ileum ☐

Oesophagus ☐

Trachea ☐

The stomach is a muscular sac with a lining containing secretory cells. Some of these cells secrete gastric juice, a watery mixture of protease enzymes, acid and mucus.

Other cells secrete gastrin, a hormone that stimulates the release of gastric juice.

0 5 . 2 Gastrin also stimulates contraction of the muscles in the stomach wall.

Describe how the contraction of muscles in the stomach wall helps digestion.

[1 mark]

_____

_____

_____

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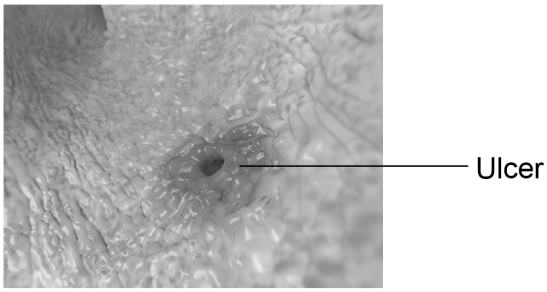
Figure 9 shows a stomach ulcer. Ulcers can form in the lining of the stomach.

Figure 9



The cause of stomach ulcers is not always clear.

Doctors have found that the number of ulcers is higher in patients who also have a species of bacterium called *Helicobacter pylori* in their stomachs.

Scientists use 18 patients to investigate how infection with *H. pylori* could cause stomach ulcers.

- 9 of the patients have stomach ulcers but do **not** have *H. pylori* infection (Not infected)
- the other 9 patients have stomach ulcers and also have *H. pylori* infection (With *H. pylori*).

The scientists measure:

- gastrin production
- pepsin (a protease enzyme) production in the stomach.

Figure 10 and **Figure 11** (on page 26) show the results.

Question 5 continues on the next page

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Figure 10 shows gastrin production in patients who are not infected and in patients infected with *H. pylori*.

Each cross represents 1 patient.

Figure 11 shows pepsin production in patients who are not infected and in patients infected with *H. pylori*.

Each cross represents 1 patient.

Figure 10

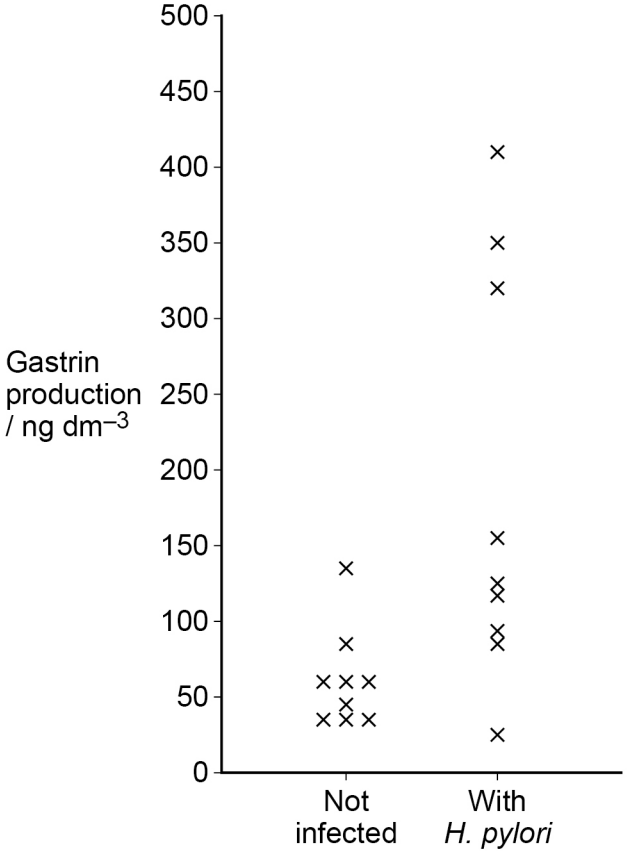
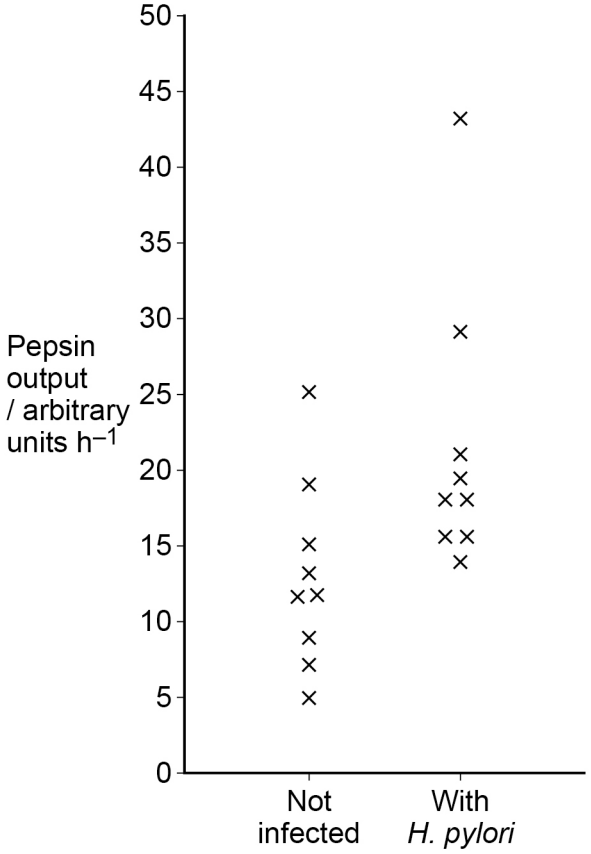


Figure 11



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0 5 . 3 One scientist concludes that:

'Infection with *H. pylori* causes stomach ulcers by increasing gastrin production.'

Explain why the scientist makes this conclusion.

Use information from **Figure 10** and **Figure 11**.

[2 marks]

0 5 . 4 Other scientists disagree with the conclusion in Question **05.3**.

They think that the data do not support the idea that infection with *H. pylori* causes stomach ulcers by increasing gastrin production.

One reason could be the small sample size.

Suggest **one other** reason why.

Use information from **Figure 10** and **Figure 11**.

[1 mark]

5

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 6 Oral rehydration solution (ORS) is used for treating dehydration caused by cholera.

Patients drink an ORS that contains several mineral ions including sodium ions.

0 6 . 1 Describe how drinking an ORS containing sodium ions could help to reduce dehydration.

[3 marks]

Question 6 continues on the next page

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Sometimes children will not drink the ORS. To encourage the children to drink the ORS, their parents mix it with other, flavoured drinks.

Some students investigate the effects of mixing standard ORS with orange juice or a sports drink. Sports drinks are advertised as helping to restore the levels of mineral ions (including sodium ions) during exercise.

Investigation 1

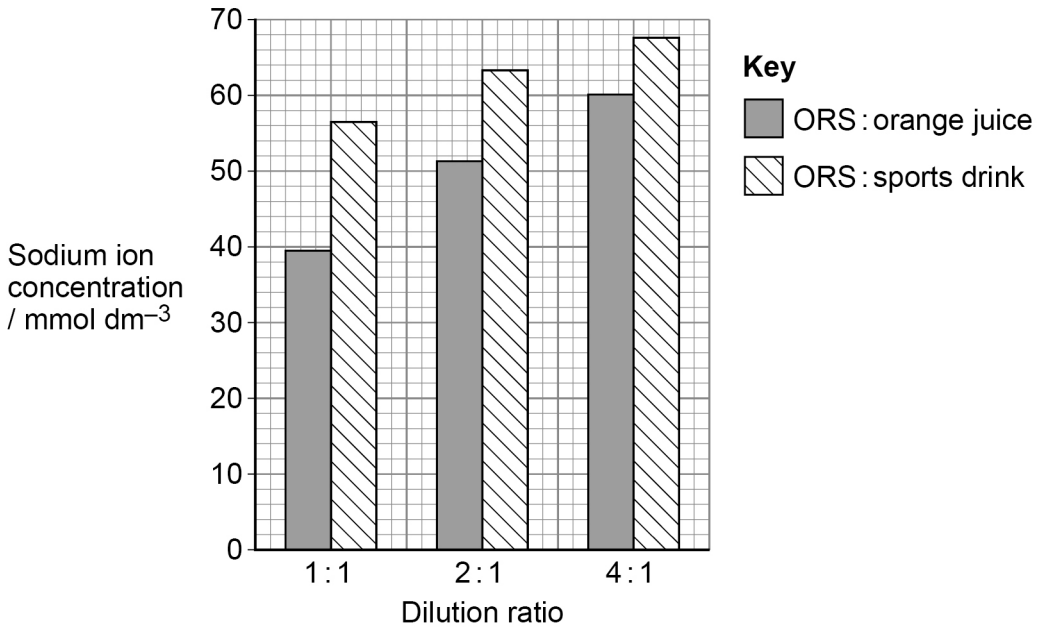
The students use a standard ORS containing sodium ions at a concentration of 75 mmol dm^{-3}

This is the method the students use:

1. Dilute the standard ORS with the orange juice, 1 part ORS : 1 part orange juice (1 : 1).
2. Dilute the standard ORS with the orange juice, 2 parts ORS : 1 part orange juice (2 : 1).
3. Dilute the standard ORS with the orange juice, 4 parts ORS : 1 part orange juice (4 : 1).
4. Measure the sodium ion concentration of the dilutions.
5. Repeat steps 1–4 with a sports drink instead of orange juice.

Figure 12 shows the sodium ion concentrations in the different dilutions.

Figure 12



Using the information from **Investigation 1** and the data in **Figure 12**, the students conclude that:

‘Diluting the ORS with the orange juice or the sports drink makes the ORS less effective.’

Do not write outside the box

0 6 . 2 Give **one** reason in support of and **one** reason against the students' conclusion.

[2 marks]

Reason in support _____

_____

_____

Reason against _____

_____

_____

Investigation 2

The students want to know if diluting the ORS improves the taste.
The students ask 100 volunteers to taste the following drinks:

- standard ORS
- one of the orange juice dilutions
- one of the sports drinks dilutions.

The volunteers:

- are a mix of adults and children
- do **not** have diarrhoea or dehydration
- rate the taste of the dilutions as better, the same or worse than the standard ORS.

0 6 . 3 The students' teacher suggests that the design of **Investigation 2** means that it might not give valid results.

Suggest why **Investigation 2** might **not** give valid results.

[2 marks]

_____

_____

_____

_____

_____

_____

Question 6 continues on the next page

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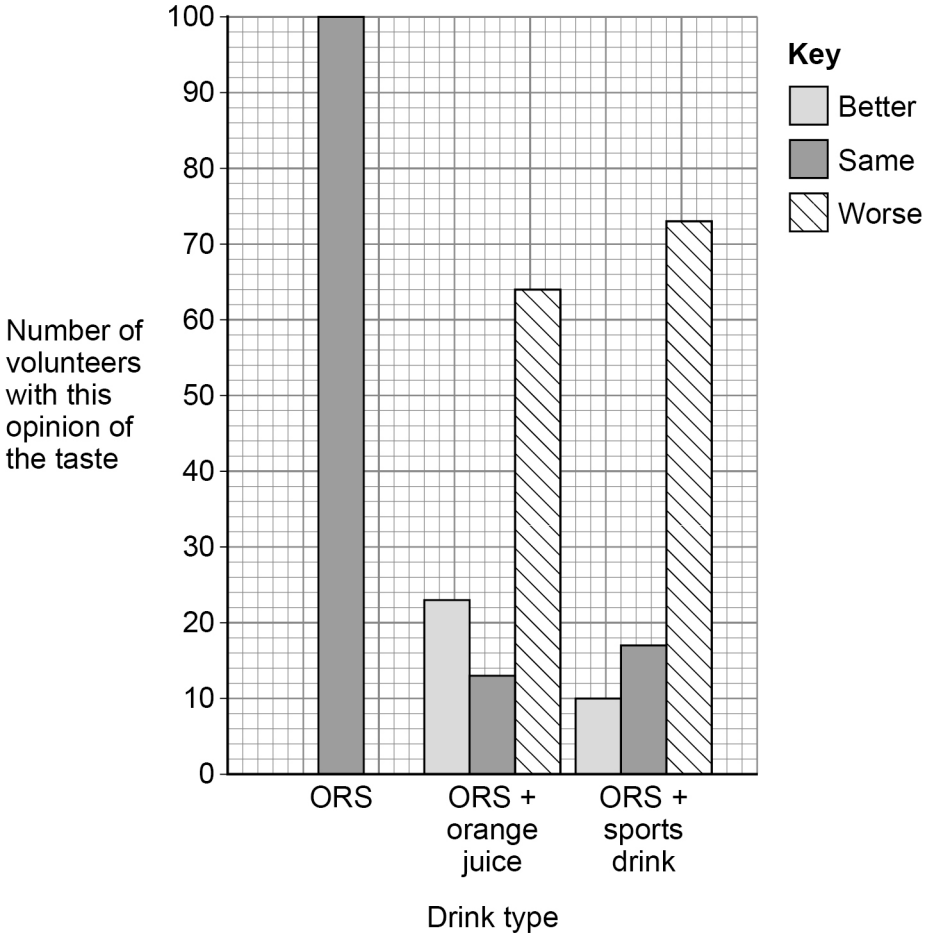
Figure 13 shows how the volunteers rate the taste of the ORS dilutions.

Figure 13



The World Health Organization (WHO) has made recommendations about the sodium ion concentration of ORS.

1. ORS containing 60–90 mmol dm^{-3} sodium ions can treat dehydration in adults and children.
2. ORS containing 75 mmol dm^{-3} sodium ions results in quicker recovery from dehydration in children.

Do not write outside the box

0 6 . 4 The students conclude that parents should **not** dilute the standard ORS with the orange juice or the sports drink for their children.

Give **two** reasons in support of this conclusion.

Use all of the information from both investigations and the WHO recommendations.

[2 marks]

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

9

Turn over for the next question

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0 7 . 1 Plants absorb water from the soil. The water then moves across the roots and into the xylem vessels.

Describe how water moves from the soil and into the xylem vessels of a plant.

Do **not** describe the movement of water up the xylem.

[5 marks]

Do not write outside the box

0 7 . 2 In mammals, molecules from the lumen of the ileum are absorbed into the bloodstream.

Describe how the structure of the ileum is adapted for absorption.

[5 marks]

10

END OF QUESTIONS

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