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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Friday 14 November 2025

Morning (Time: 1 hour 15 minutes)

Paper reference **4BI1/2B**

Biology

UNIT: 4BI1

PAPER: 2B

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 70.
- 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.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Physic Gardens

The photograph shows a physic garden. Physic gardens are places where people grow many types of plants that produce medicinal drugs.



(Source: © Paul Maguire/Alamy Stock Photo)

People have grown medicinal plants in physic gardens for thousands of years. It was estimated in 2016 that out of 30 000 plant species that are known to be useful to humans, 17 000 of these plant species have medicinal uses.

Medicinal plants produce a wide range of types of drugs including alkaloids, glycosides, terpenes and polyphenols.

Alkaloids are bitter-tasting, alkaline chemicals found in many different plant species. Alkaloids are often toxic in high doses so care needs to be taken when using them. Examples of alkaloids are caffeine and quinine. Caffeine, found in tea and coffee, can stimulate the adrenal glands. Quinine from the bark of the cinchona tree has been used for many centuries to kill the parasite that causes malaria.

An example of a glycoside drug is senna. This drug is extracted from the *Senna* plant and is used to treat constipation. The drug affects muscles in the intestine.

Terpenes are chemicals that often have strong smells. Terpenes are thought to have evolved to prevent herbivore animals from eating certain plants. An example of a plant that produces terpenes is thyme. The terpenes in thyme have an antiseptic effect which means they can be used to sterilise wounds.

Phytoestrogens are molecules found in plants such as angelica and have been used for many years to treat problems with human fertility. Examples of polyphenols are phytoestrogens, taxol and curcumin. Polyphenols have many roles within plants and many are used as medicines. Taxol is a drug extracted from yew trees and is used to prevent cell division in human body cell tumours.

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25 Curcumin is a drug produced by the turmeric plant. Curcumin can help widen the airways to the lungs so can help people with asthma breathe.

Scientists are looking to reproduce many of these drugs artificially. They are developing genetically modified bacteria containing genes that will allow these drugs to be mass produced in fermenters.

(a) Calculate the percentage of plant species useful to humans that have medicinal uses (lines 4 to 5).

Give your answer to two significant figures.

(2)

percentage = ... %

(b) (i) Which of these is the protoctist parasite that quinine is used to kill (lines 11 to 13)?

(1)

☒ **A** *Amoeba*

☒ **B** *Chlorella*

☒ **C** *Mucor*

☒ **D** *Plasmodium*

(ii) Caffeine stimulates the adrenal glands.

Explain how drinking caffeine can lead to a change in heart rate (lines 10 to 11).

(2)

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(c) Explain how the drug senna helps to reduce constipation (lines 14 to 15).

(2)

(d) Explain, referring to the theory of natural selection, how thyme has evolved to produce terpenes (lines 16 to 19).

(4)

(e) Phytoestrogens are very similar to human oestrogen.

Explain why eating phytoestrogens can help improve fertility (lines 20 to 21).

(2)

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(f) Taxol can prevent the growth of human body cell tumours.

Name the type of cell division that taxol affects in human body cell tumours (lines 23 to 24).

(1)

(g) Some people have a condition called asthma. This condition causes the person's airways to become narrow.

Explain why consuming curcumin can improve the concentration of oxygen in the blood of people who have asthma (lines 25 to 26).

(2)

(h) Scientists are trying to insert the genes for medicinal drugs into bacteria.

Describe how named enzymes are used to place genes into plasmids to transfer the genes from plants into bacteria (lines 27 to 29).

(2)

(Total for Question 1 = 18 marks)

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2 Aphids are a type of insect that are pests of many crops.

The photograph shows an aphid.



(Source: © Image Source Limited/Alamy Stock Photo)

(a) (i) Aphids feed on substances in the phloem of crops.

Name two substances, other than water, that are transported in the phloem.

(2)

1 .....

2 .....

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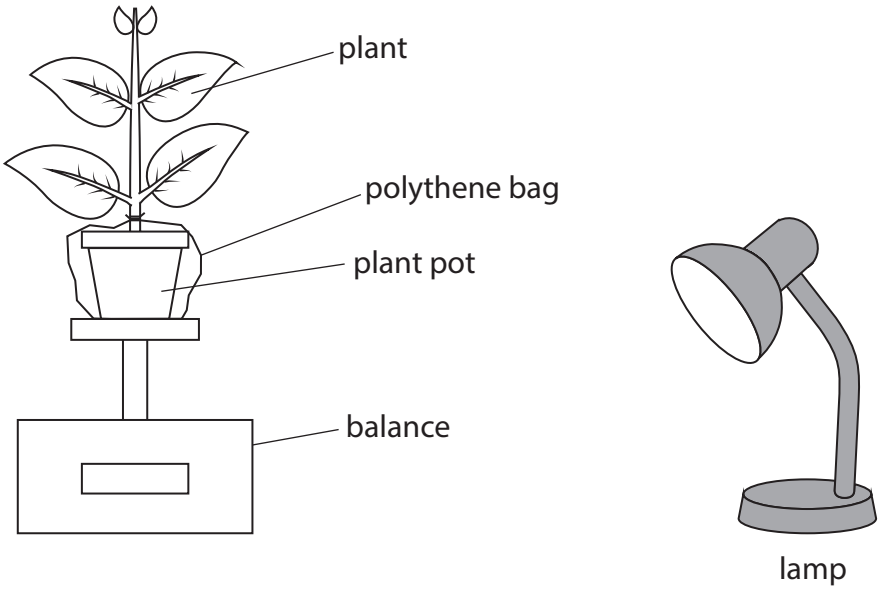
(ii) Scientists have suggested that the presence of aphids on plant leaves causes stomata to close and reduces the rate of transpiration.

The diagram shows some apparatus that can be used to measure the rate of transpiration.



(4)

Describe how a student could use this apparatus to investigate if aphids on a plant reduce the rate of transpiration.

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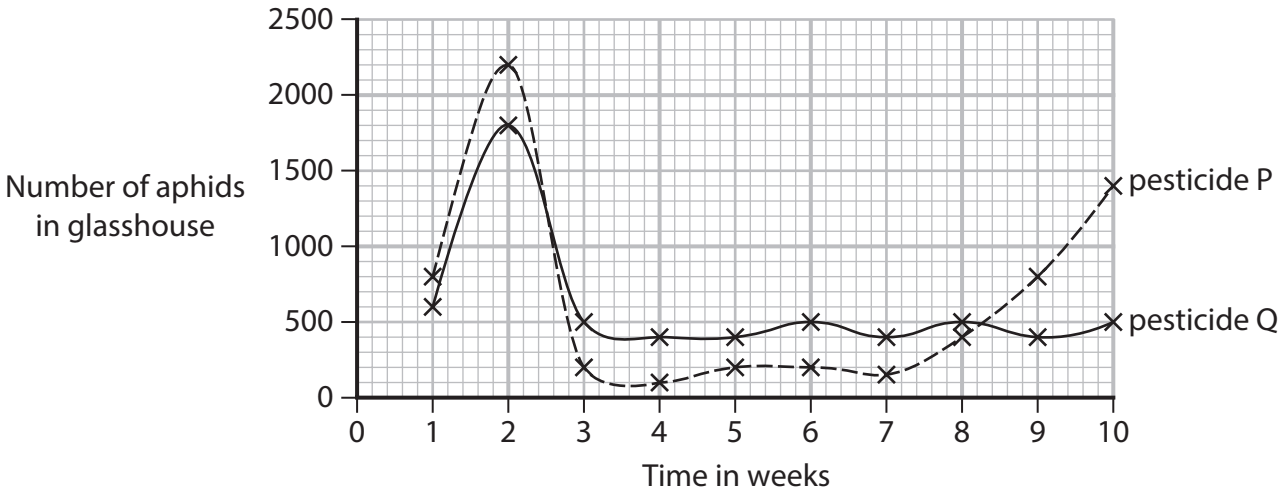
(b) Pesticides are often used to control aphid populations.

Scientists investigate the effect of using two different pesticides, P and Q, on aphid populations.

This is the scientists' method.

- grow tomato plants in two glasshouses
- place aphids into both glasshouses
- record the number of aphids in both glasshouses for two weeks
- immediately after recording the numbers of aphids in week two, spray pesticide P in one glasshouse and pesticide Q in the other glasshouse
- record the number of aphids for another eight weeks

The graph shows the scientists' results.



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Comment on the effectiveness of pesticide P and pesticide Q in reducing aphid numbers.

(4)

(Total for Question 2 = 10 marks)

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3 Diagram 1 shows the human urinary system with some structures labelled.

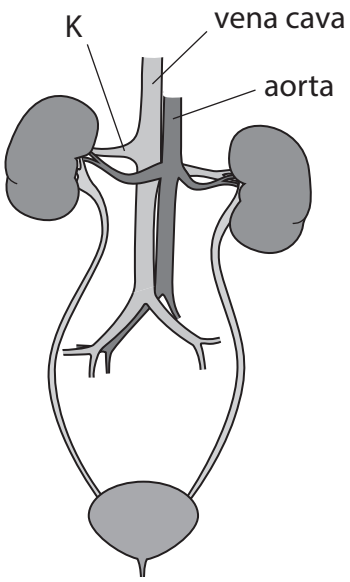

Diagram 1

(a) What is the name and the function of the structure labelled K?

(1)

- ☒ **A** renal artery transporting blood to the kidney
- ☒ **B** renal artery transporting blood away from the kidney
- ☒ **C** renal vein transporting blood to the kidney
- ☒ **D** renal vein transporting blood away from the kidney

(b) Diagram 2 shows a nephron with some parts labelled.

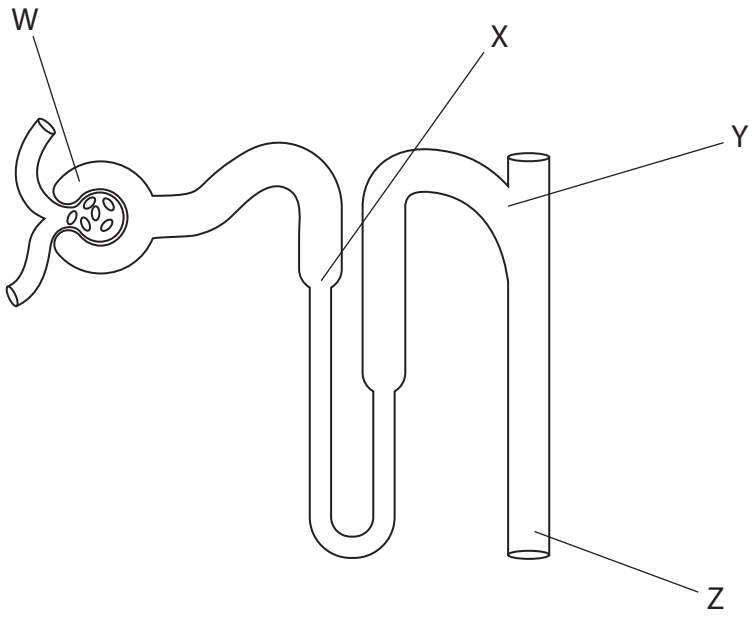

Diagram 2

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The table gives the concentrations of glucose and urea in the filtrate at parts W, X, Y and Z.

Substance	Concentration of substance in filtrate at each part in arbitrary units			
	W	X	Y	Z
glucose	20	0	0	0
urea	50	70	100	100

(i) Explain the difference in concentration of glucose between W and X.

(2)

(ii) Explain the difference in the concentration of urea between X and Y.

(2)

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(iii) The concentrations in the table are for a person who has drunk water and is not dehydrated.

Explain why the concentration of urea at Z would be different for a person who is severely dehydrated.

(4)

(Total for Question 3 = 9 marks)

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4 When potatoes are cut and exposed to the air, the cut surface turns brown.

Potato cells contain colourless chemicals called polyphenols and an enzyme called polyphenol oxidase.

When the polyphenols and polyphenol oxidase enzyme are exposed to oxygen in the air, a reaction occurs between the polyphenols and oxygen. This reaction produces brown-coloured chemicals.

(a) Carbon, hydrogen, oxygen and nitrogen are elements in biological molecules.

Which of these are in the enzyme polyphenol oxidase?

(1)

- ☒ **A** carbon, hydrogen and oxygen only
- ☒ **B** carbon, nitrogen and oxygen only
- ☒ **C** carbon, hydrogen, oxygen and nitrogen
- ☒ **D** hydrogen, oxygen and nitrogen only

(b) A student uses this method to investigate the effect of changing pH on the time taken for potatoes to turn brown.

- cut three slices of potato and place them into a beaker
- cover the slices in a pH 7 buffer solution to maintain the pH
- after five minutes, remove the pH buffer solution so the potato slices are exposed to the air
- record the time taken for each of the potato slices to turn from white to brown and calculate the mean time

The student repeats the experiment using four different pH buffer solutions.

The table shows the student's results.

pH	Time taken for potato slices to turn brown in seconds			
	slice 1	slice 2	slice 3	mean
3	240	230	260	240
5	160	140	150	150
7	60	70	40	60
9	180	200	210	200
11	270	290	260	270

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(i) State two factors that the student should keep constant in the investigation.

(2)

1 .....

2 .....

(ii) Explain how the student could improve the accuracy of the investigation.

(2)

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(iii) Explain the effect of changing pH on the times taken for the potato slices to turn brown.

(3)

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(Total for Question 4 = 8 marks)

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5 A student investigates the effect of deforestation on the biodiversity of different insect species.

The student counts the number of different insect species in 10 sample areas in a forest, and also in 10 sample areas in a deforested region.

The table shows the student's results.

Sample	Number of different insect species	
	forest	deforested region
1	12	6
2	8	6
3	6	2
4	10	1
5	8	6
6	8	3
7	12	4
8	10	3
9	11	5
10	9	2
mean		3.8
mode		6

(a) (i) Determine the mean and mode for the number of insect species in the forest.

(2)

mean = ...

mode = ...

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(ii) The student used a square quadrat of sides one metre to sample insect species.

Explain how the student could ensure that their method allows a valid comparison to be made between the forest and the deforested region.

(3)

(iii) Explain why the loss of trees in the deforested area reduced the biodiversity of insects compared with the forest.

(2)

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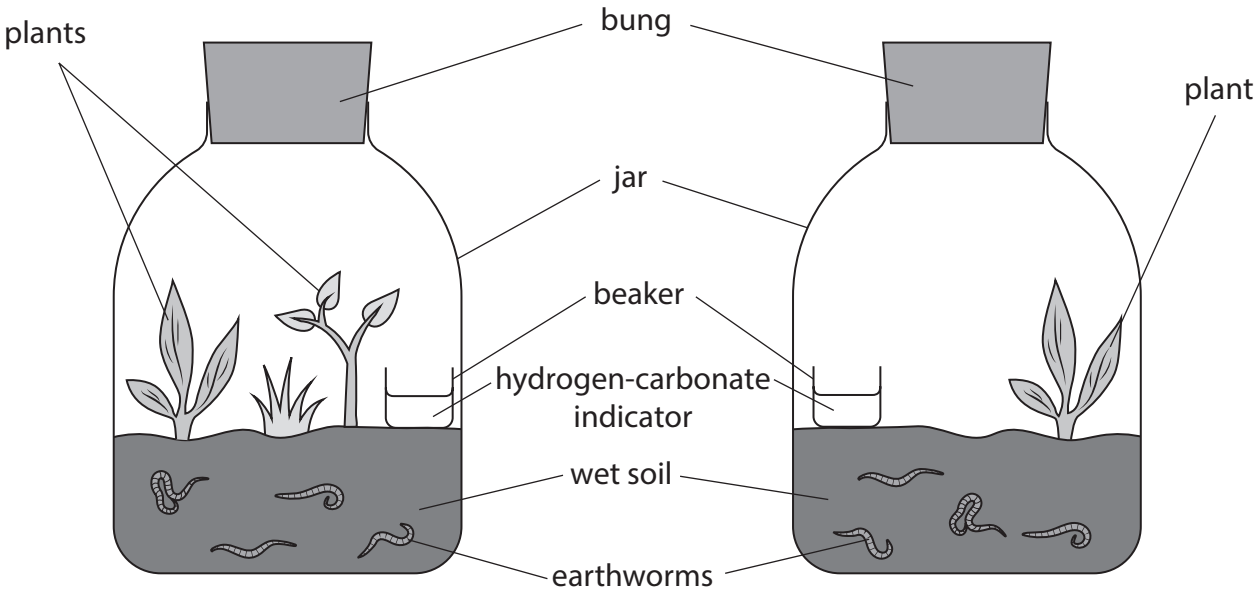
(b) The student also sets up a model experiment to investigate the effect of deforestation on gas exchange.

This is the student's method.

- place some plants, some wet soil with four earthworms, and a beaker of hydrogen-carbonate indicator into jar A
- set up an identical glass jar, jar B, with some wet soil with four earthworms and a beaker of hydrogen-carbonate indicator, but with only one plant
- seal both jars with bungs and place the jars in the light
- after one week, record the colour of the hydrogen-carbonate indicator in each jar

The diagram shows the student's apparatus.



The table shows the student's results.

Jar	Colour of hydrogen-carbonate indicator	
	at start	after one week
A	orange	orange
B	orange	yellow

(i) State the dependent variable in the student's investigation.

(1)

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(ii) Explain the results of the student's investigation.

(4)

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(iii) State one reason why the model may not represent the impact of deforestation on gas exchange in a forest.

(1)

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(Total for Question 5 = 13 marks)

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6 Hepatitis B is a virus that can infect humans. Scientists have developed edible vaccines for hepatitis B by genetically modifying potatoes.

The genetically modified (GM) potatoes produce viral hepatitis B proteins on the surface of their cells.

(a) The GM potatoes contain a viral gene that codes for a viral protein.

Describe how transcription and translation produce the viral protein in the potato cells from the viral gene.

(4)

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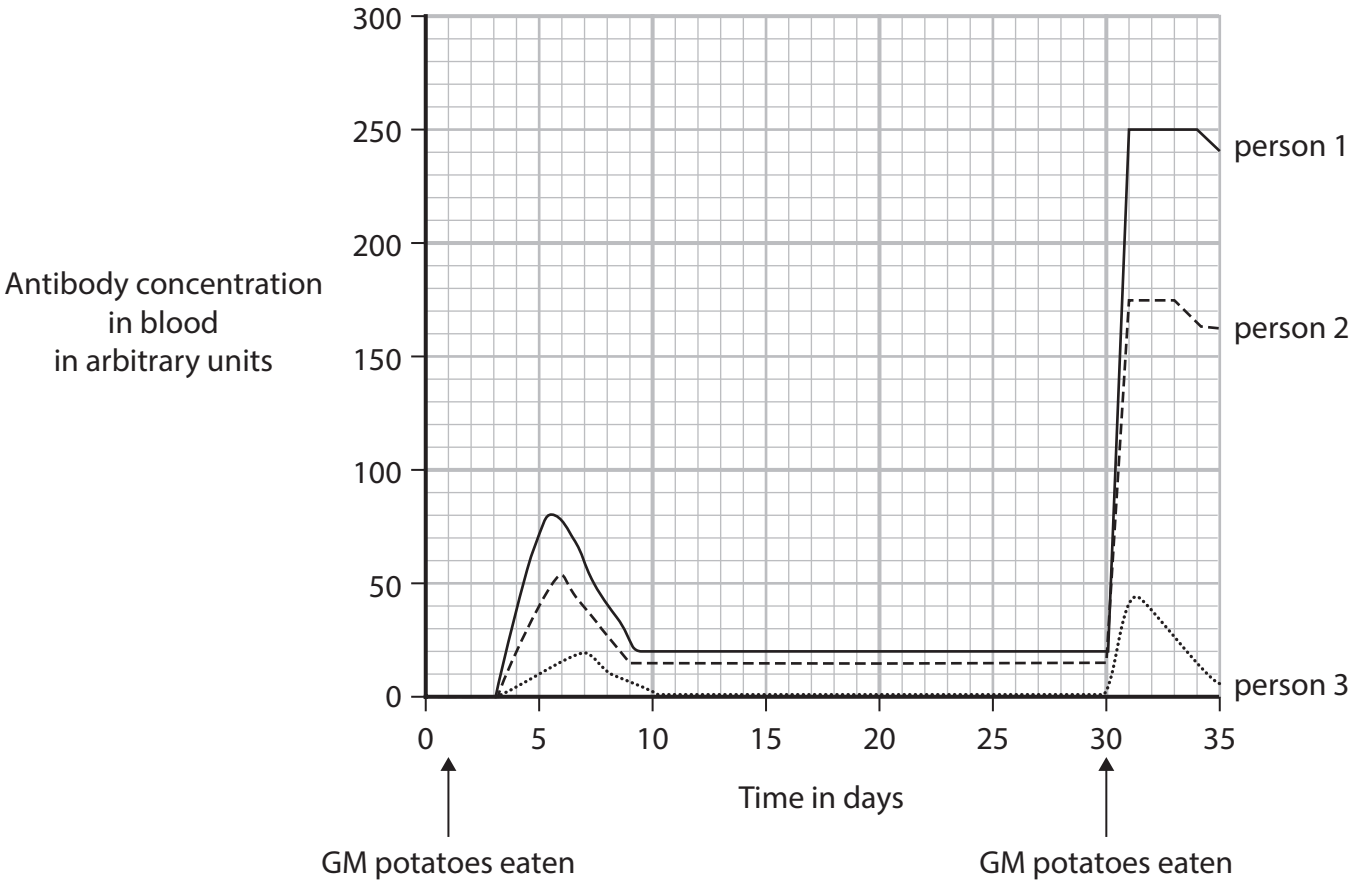
(b) When a GM potato is eaten by a person, the viral proteins are small enough to be absorbed into the blood.

A person's immune system will produce antibodies against the viral proteins when the proteins are in the blood.

Three people eat the GM potatoes containing the viral proteins. They eat the GM potatoes on day 1 and on day 30.

The graph shows the effect that eating the GM potatoes has on the antibody concentration in their blood.



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(i) For person 1, calculate the percentage increase in antibody concentration from day 29 to day 31.

(3)

percentage increase = ... %

(ii) The scientists conclude that edible vaccines could prevent the spread of many viruses in human populations.

Using the data from the graph and your own knowledge, discuss the scientists' conclusion.

(5)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 70 MARKS

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