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 40 minutes)

Paper reference **4WBI2/1B**

Biology (Modular)

UNIT 2: 4WBI2

PAPER: 1B

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 the calculations and state the units where required.

Information

- The total mark for this paper is 90.
- 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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P 8 1 5 5 6 R A 0 1 3 2

Pearson

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.

Nature's Answer to Farming in Dry Climates

Mutations in plants can result in new characteristics, such as different flower colours, larger fruits, or resistance to disease. Some mutations can help plants survive better in extreme conditions. The incidence of mutations can be increased by environmental factors. Scientists think that mutation may have led to the evolution of Crassulacean Acid Metabolism (CAM) plants.

CAM plants are a special type of plant that can grow in places with dry soil, where there is less water for them to absorb through their roots. Stomata in most plants open during the day to take in carbon dioxide for photosynthesis. CAM plants open their stomata at night instead. During the day, the higher temperatures and light levels cause an increase in transpiration rate. At night it is cool and dark, so less water is lost. CAM plants lose less water than normal plants. In fact, they can lose up to ten times less water than other plants when growing in the same dry conditions. This makes them well-adapted for deserts or areas with very little rainfall.

The photograph shows a pineapple, an example of a CAM plant.

(Source: © Pearson Asset Library)

Other well-known CAM plants include prickly pear cactus and vanilla. Since these plants are good at surviving with little water, farmers in dry or desert-like areas can grow them to help improve food supply, when other crops would fail. This can be especially helpful in places where climate change is making droughts more common.

However, there are still challenges when growing CAM plants in dry areas. While CAM plants do not need much water, they still need minerals such as nitrates to grow. In many dry areas, the soil does not have enough nitrates because of a lack of organic matter or fewer helpful microorganisms. This means CAM plants might need added fertilisers or help from farming techniques to improve the soil.

Fertilisers are already widely used in agriculture. 46 million tonnes of fertiliser were used globally in 1965, increasing to 188 million tonnes in 2022.

Scientists and farmers are working on ways to produce more food in dry places. Using CAM plants could be a sustainable way to help deal with the effects of
30 climate change, drought and food shortages.

(a) (i) State what is meant by the term **mutation** (line 1).

(1)

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.....

(ii) State two types of environmental factor that could increase the incidence of mutations in living organisms (lines 3 to 4).

(2)

1 .....

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2 .....

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(b) Explain one adaptation of a root hair cell that increases water absorption (lines 6 to 7).

(2)

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(c) The rate of transpiration is affected by temperature and light level.

State one other abiotic factor that affects the rate of transpiration (lines 10 to 11).

(1)

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(d) Explain how microorganisms increase nitrate levels in the soil (lines 23 to 24).

(3)

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(e) (i) Explain one possible disadvantage of increased fertiliser use (lines 24 to 25).

(2)

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(ii) Calculate the mean rate of increase, in million tonnes per year, of fertiliser used globally from 1965 to 2022 (lines 26 to 27).

(2)

rate = ... million tonnes per year

(Total for Question 1 = 13 marks)

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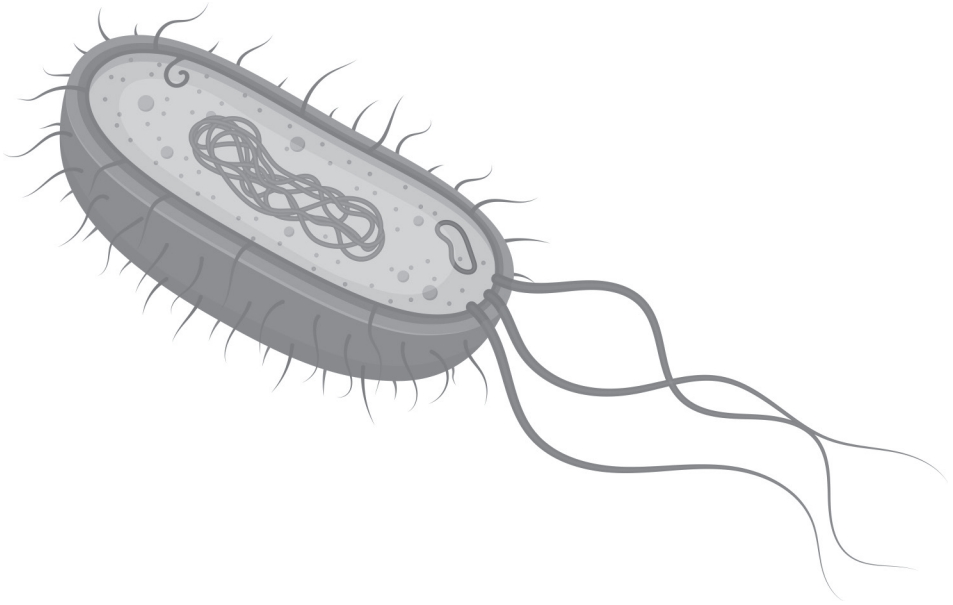
2 Genetically modified organisms can be used to produce useful substances.

(a) The diagram shows a bacterium.



(Source: © Pearson Asset Library)

Plasmids can be used in genetic modification.

Draw a label line on the diagram to show a plasmid.

(1)

(b) A bacterium containing the human insulin gene divides once every 20 minutes.

Calculate the time taken, in minutes, for the number of genetically modified bacteria produced from one starting bacterium to increase to 512.

(2)

time taken = ... minutes

(c) Describe how a fermenter allows large quantities of insulin to be manufactured from genetically modified bacteria.

(3)

(d) Genetic modification can also be used to improve crop production.

Explain one advantage of using genetically modified crop plants.

(2)

(Total for Question 2 = 8 marks)

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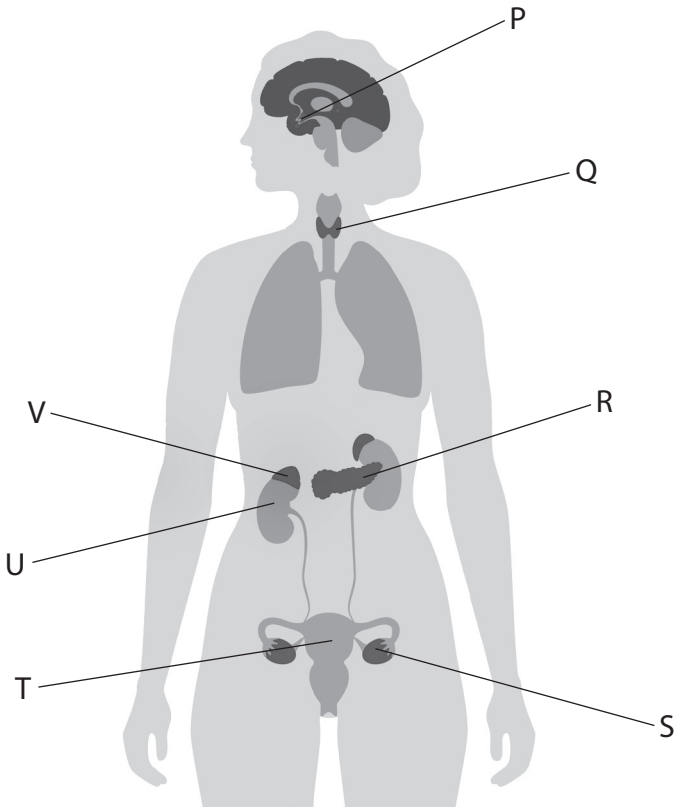
3 (a) The diagram shows some human glands and the target organs for the hormones that the glands produce.



(Source: © Pikovit/Shutterstock)

(i) Which structure produces oestrogen?

(1)

- ☒ **A** P
- ☒ **B** R
- ☒ **C** S
- ☒ **D** T

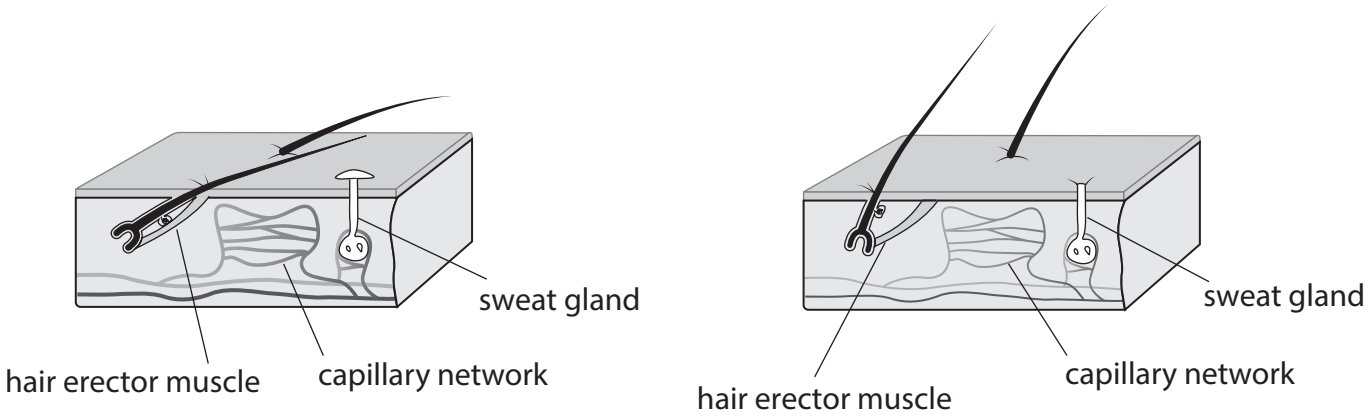
(ii) Which structure produces hormones that control blood glucose?

(1)

- ☒ **A** Q
- ☒ **B** R
- ☒ **C** S
- ☒ **D** U

(b) The skin helps to regulate the internal temperature of the body.

The diagram shows a section of the skin at two different temperatures.



Warm

Cold

Describe the changes that occur in the skin in response to warm temperatures.

(3)

(c) Describe how the hormone adrenaline affects the circulatory system.

(3)

(Total for Question 3 = 8 marks)

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4 This question is about the heart.

(a) Name the blood vessel that carries deoxygenated blood towards the heart.

(1)

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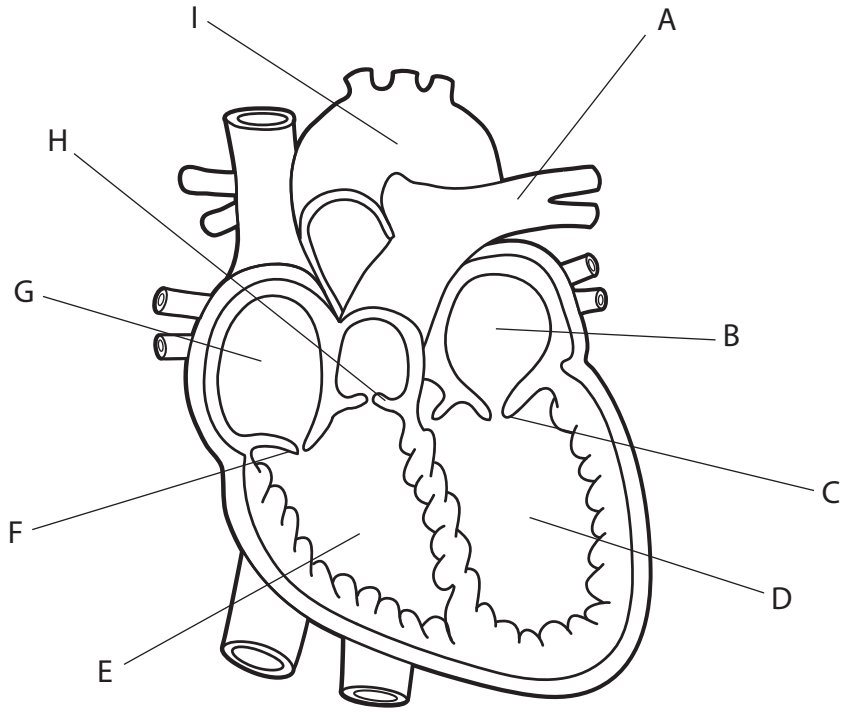
(b) The diagram shows the human heart with some structures labelled.



(Source: © Pearson Asset Library)

Using letters from the diagram, complete the table to match the correct structure to each description.

(3)

Description	Structure
vessel that carries oxygenated blood	
bicuspid valve	
chamber that pumps blood to the lungs	

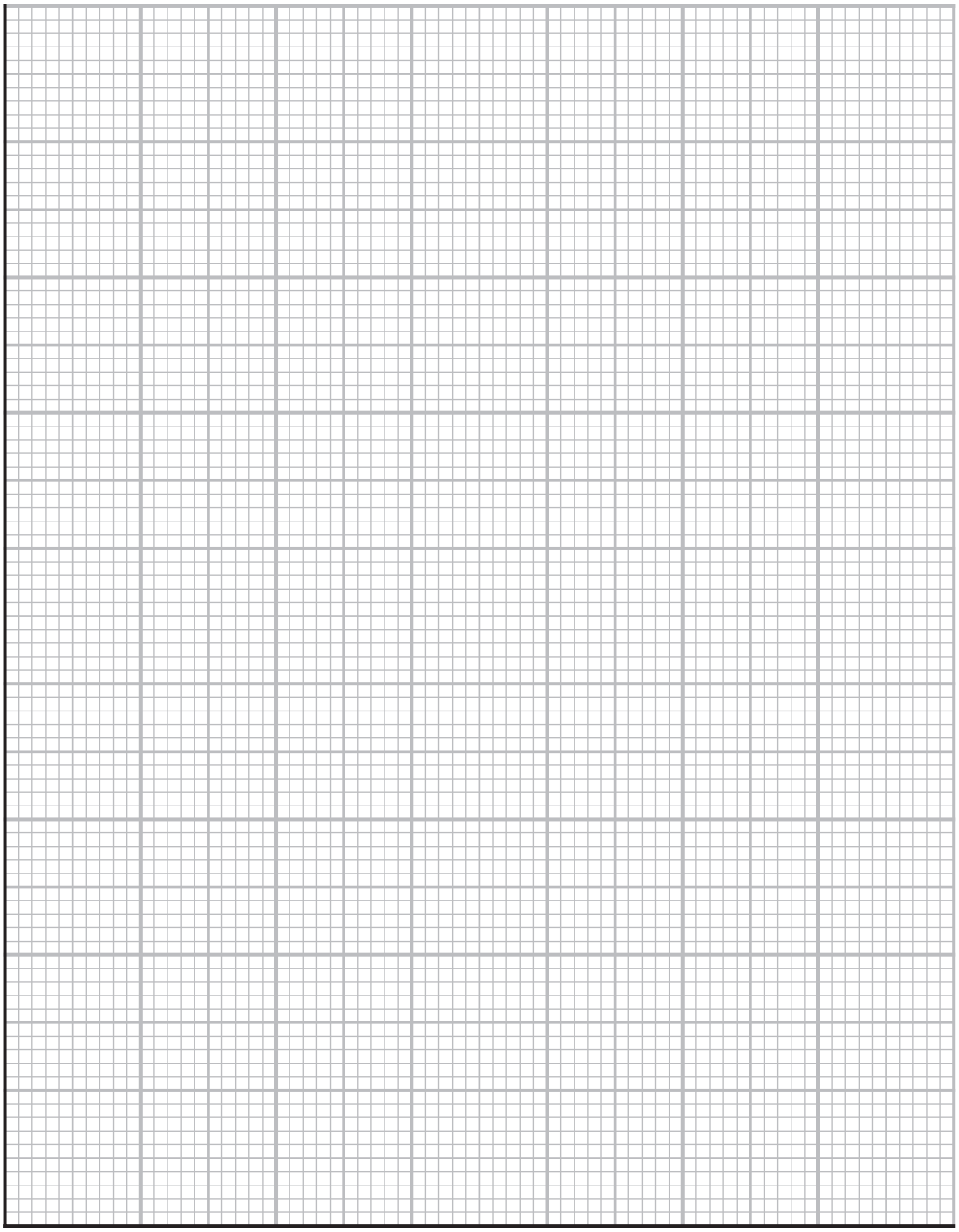
(c) A student investigates the effect of different intensities of exercise on heart rate.

The table shows the student's results.

Type of exercise	Increase in heart rate in beats per minute
walking	23
jogging	41
running	68
running uphill	87

(i) Plot the student's results as a bar chart.

(4)



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(ii) Explain the trend shown in the data.

(3)

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(Total for Question 4 = 11 marks)

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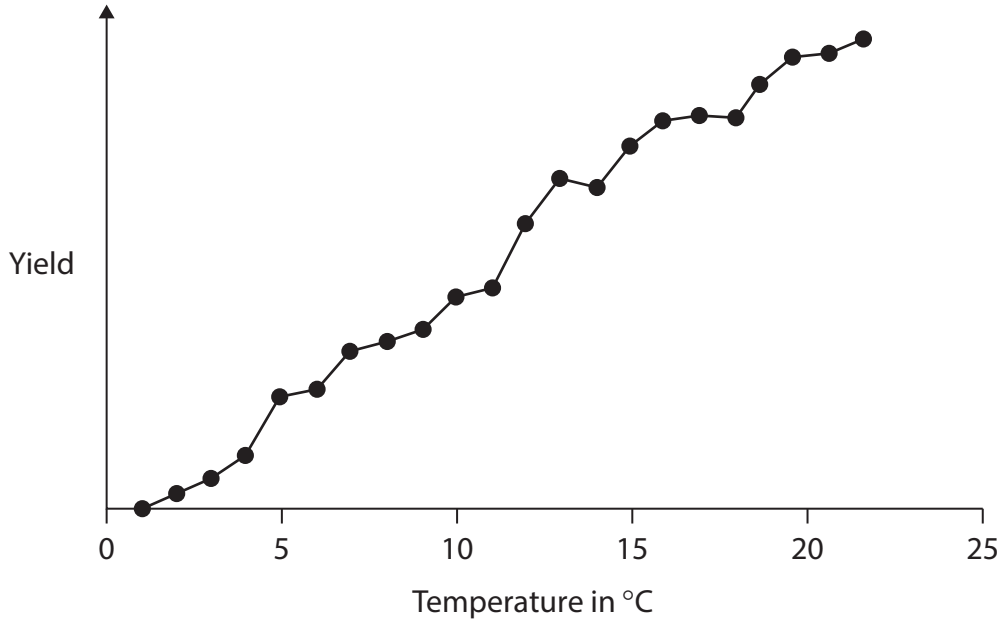
5 A farmer records the yield of tomatoes produced at different temperatures.

The graph shows the farmer's results.



Discuss the advantages and disadvantages of using a glasshouse to improve the yields of tomatoes.

(5)

(Total for Question 5 = 5 marks)

6 Cotton is an important fibre used in clothing.

Cotton fibres come from plants and can be either brown or white in colour.

The photographs show two different cotton plants.

(Source: © Cacio Murilo/Shutterstock)

Cotton plant with brown fibres

(Source: © Sabrina Janelle Gordon/ Shutterstock)

Cotton plant with white fibres

(a) The colour of the cotton fibres is genetically controlled.

The allele for white fibres (b) is recessive to the allele for brown fibres (B).

(i) State what is meant by the term **recessive allele**.

(1)

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(ii) A white cotton plant is crossed with a heterozygous brown cotton plant.

These cotton plants produce offspring.

Draw a genetic diagram to show the genotypes of the parents, the gametes they can produce and the genotypes of their possible offspring.

(3)

(b) A farmer observes that cotton plants in one field grow taller than cotton plants in another field.

The farmer concludes that the height of cotton plants is due only to environmental variation.

Comment on the farmer's conclusion.

(3)

(c) The length of cotton fibres produced by the plant is not controlled by a single gene.

Describe how selective breeding could be used to produce cotton plants with longer fibres.

(4)

(Total for Question 6 = 11 marks)

7 Industrial processes can contribute to air and water pollution.

(a) Some factories produce sulfur dioxide.

Explain how sulfur dioxide can affect living organisms.

(3)

(b) (i) Name a greenhouse gas.

(1)

(ii) Explain one effect of global warming on living organisms.

(2)

(c) Sewage is wet waste which can be produced from industry.

Sewage is usually treated before it enters waterways.

Explain the biological consequences of untreated sewage entering a river.

(6)

(Total for Question 7 = 12 marks)

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8 The photograph shows a plant called perennial ryegrass.

(Source: © Pearson Asset Library)

(a) A student investigates the germination of perennial ryegrass seeds at different temperatures.

This is the student's method.

- prepare a planting tray with soil
- spread 20 perennial ryegrass seeds in the planting tray
- cover the seeds with a layer of soil
- store the tray at a temperature of 20 °C
- water the tray daily
- count the number of seeds that have germinated after one week

Repeat the method with trays at temperatures of 30 °C and 40 °C.

The diagram shows the student's equipment.

(Source: © meechai39/Shutterstock)

(i) State the independent variable for the student's investigation.

(1)

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(ii) Several variables need to be controlled in this investigation.

Explain how two of these variables can be controlled.

(4)

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(b) The student then investigates how the depth of seed planting affects the germination of perennial ryegrass seeds.

The student plants 100 seeds at each depth and repeats this in four different trays.

After two weeks, the student counts the number of seeds that have shoots which can be seen above the soil.

The table shows the student's results.

Depth of seeds in cm	Number of seeds with shoots above the soil				
	trial 1	trial 2	trial 3	trial 4	mean
1	85	89	84	86	86
2	76	83		79	80
3	70	73	72	69	71
4	56	51	57	52	54
5	27	27	29	25	27
6	1	4	3	8	4
7	0	0	0	0	0

(i) Using information from the table, determine the missing value for the number of seeds with shoots above the soil for seeds planted at a depth of 2 cm.

(2)

number = ...

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(ii) Using information from the table, explain the disadvantages of using perennial ryegrass to reseed a large area of grassland.

(3)

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(Total for Question 8 = 10 marks)

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9 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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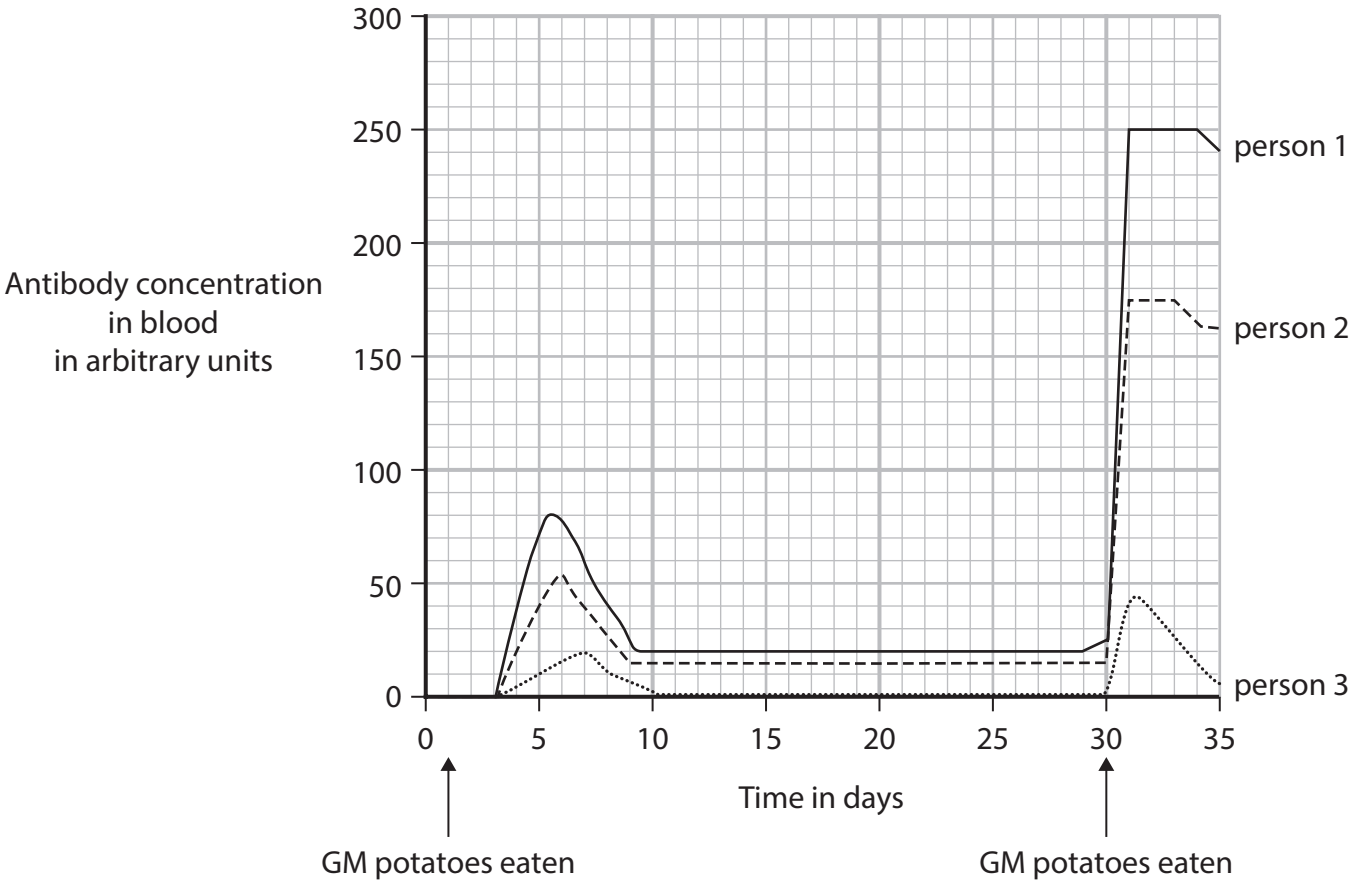
(b) When a GM potato is eaten by a person, the viral proteins are small enough to be absorbed into the blood.

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.



(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 9 = 12 marks)

TOTAL FOR PAPER = 90 MARKS

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