Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 11 January 2024

Morning (Time: 1 hour 45 minutes)

Paper reference **WBI14/01**

Biology

International Advanced Subsidiary / Advanced Level
UNIT 4: Energy, Environment, Microbiology and Immunity

You must have:
Scientific calculator, ruler, HB pencil

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 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.*
- Questions labelled with an **asterisk** (*) marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

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P 7 3 4 5 2 A 0 1 2 8

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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 Skin flora provide a barrier, protecting the body from infection by bacteria.

(a) Which of the following also act as barriers, protecting the body from **infection** by bacteria?

(1)

☒ **A** antigens and stomach acid

☒ **B** antigens and interferon

☒ **C** interferon and skin

☒ **D** skin and stomach acid

(b) The diagrams show the effects of different methods of washing hands on skin flora.

The dark areas show the presence of microorganisms and the light areas show clean areas.

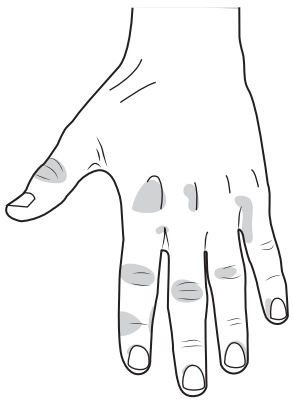
1. before washing

2. "rinse and shake"

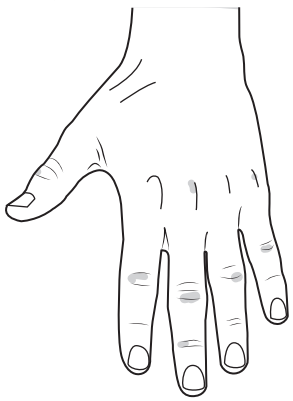
3. six seconds, no soap

4. six seconds with soap

5. fifteen seconds with soap



6. thirty seconds with soap



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(i) Describe **two** conclusions that can be made about the different methods of washing hands.

(2)

(ii) Explain the differences in the effects that these methods of washing hands have on the skin flora.

(2)

(Total for Question 1 = 5 marks)

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2 The light-independent reactions of photosynthesis use the products of the light-dependent reactions to produce simple sugars.

(a) (i) Which row of the table shows the products of the light-dependent reactions that are used in the light-independent reactions?

(1)

		ATP produced by	NADP
☒	**A**	cyclic photophosphorylation	oxidised
☒	**B**	cyclic photophosphorylation	reduced
☒	**C**	non-cyclic photophosphorylation	oxidised
☒	**D**	non-cyclic photophosphorylation	reduced

(ii) Simple sugars have the formula $C_nH_{2n}O_n$.

Name the inorganic molecule that provides each element in a simple sugar.

(2)

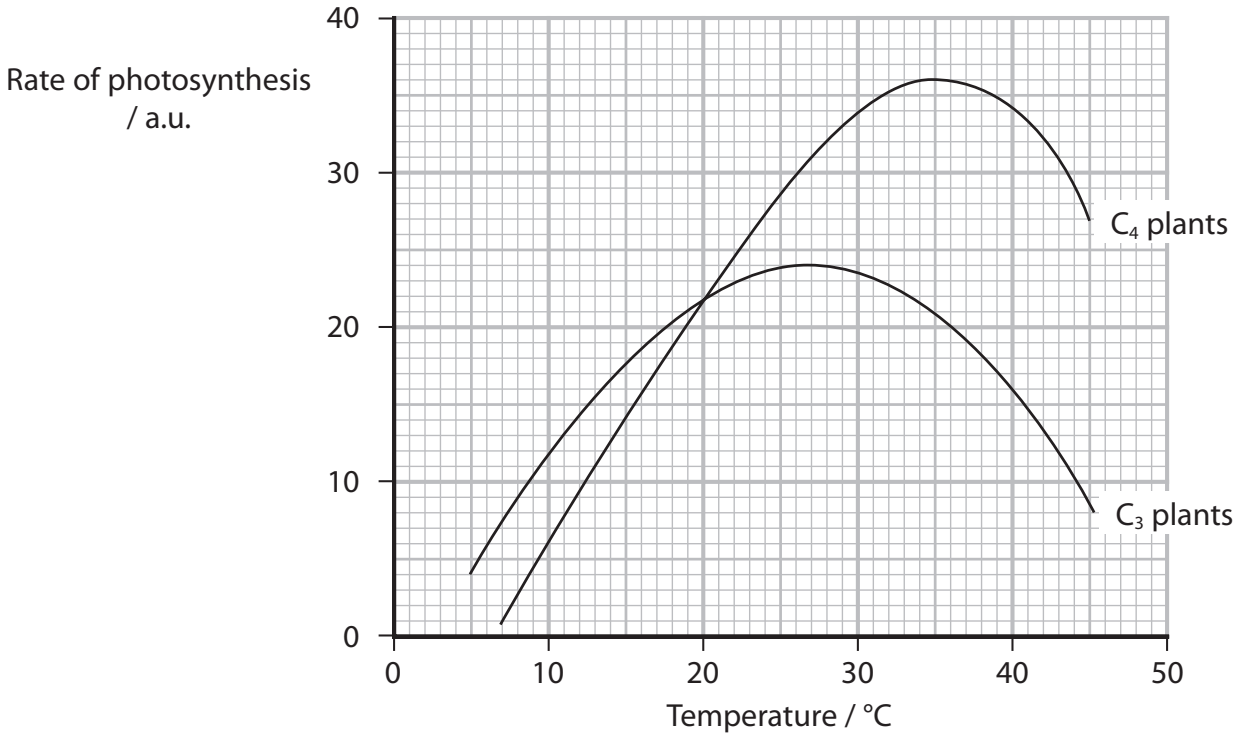
C .....

H .....

O .....

(b) Two types of plant, C_3 and C_4, have slightly different pathways of light-independent reactions.

The graph shows how the rate of photosynthesis is affected by temperature in these two types of plant.



(i) Describe **three** conclusions that can be made about the differences in the effect of temperature on the rate of photosynthesis in these two types of plant.

(3)

(ii) Calculate the Q_{10} for the enzymes in C_4 plants.

Use the formula:

$$Q_{10} = \frac{R_{t+10}}{R_t}$$

where R_t is the initial rate of reaction at 10 °C.

Give your answer as a whole number.

(2)

Answer .....

(Total for Question 2 = 8 marks)

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3 Apple maggot flies are thought to have evolved from hawthorn flies by sympatric speciation.

Hawthorn flies are native to North America. They lay their eggs in the berries of the hawthorn bush.

The eggs hatch into maggots and the maggots develop into adult flies.

(a) State the meaning of the term **sympatric speciation**.

(2)

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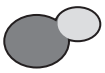
(b) Which row of the table represents sympatric speciation?

The shapes shaded dark grey represent the original species and the shapes shaded light grey represent the new species.

(1)

	Original species	First step in speciation	Final species
☒ **A**			
☒ **B**			
☒ **C**			
☒ **D**			

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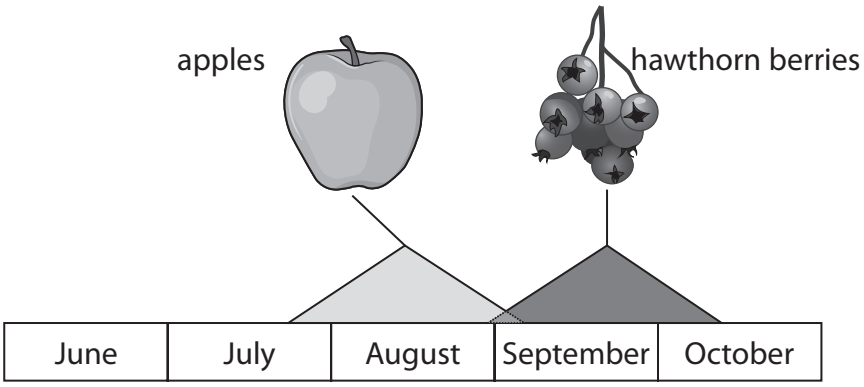
(c) Following the introduction of apple trees to North America, a small group of the hawthorn flies started laying their eggs in the apples.

The diagram shows the two types of fruit and the time of year that the fruits are produced.



(i) Suggest **two** adaptations needed for this change in behaviour of the flies.

(2)

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(ii) Explain what had to occur for changes in these flies to be inherited.

(3)

(iii) Explain why it is an advantage for the hawthorn fly and the apple maggot fly to lay their eggs in the fruits of different plants.

(2)

(iv) Suggest how these flies became reproductively isolated.

Use the information in the diagram to support your answer.

(2)

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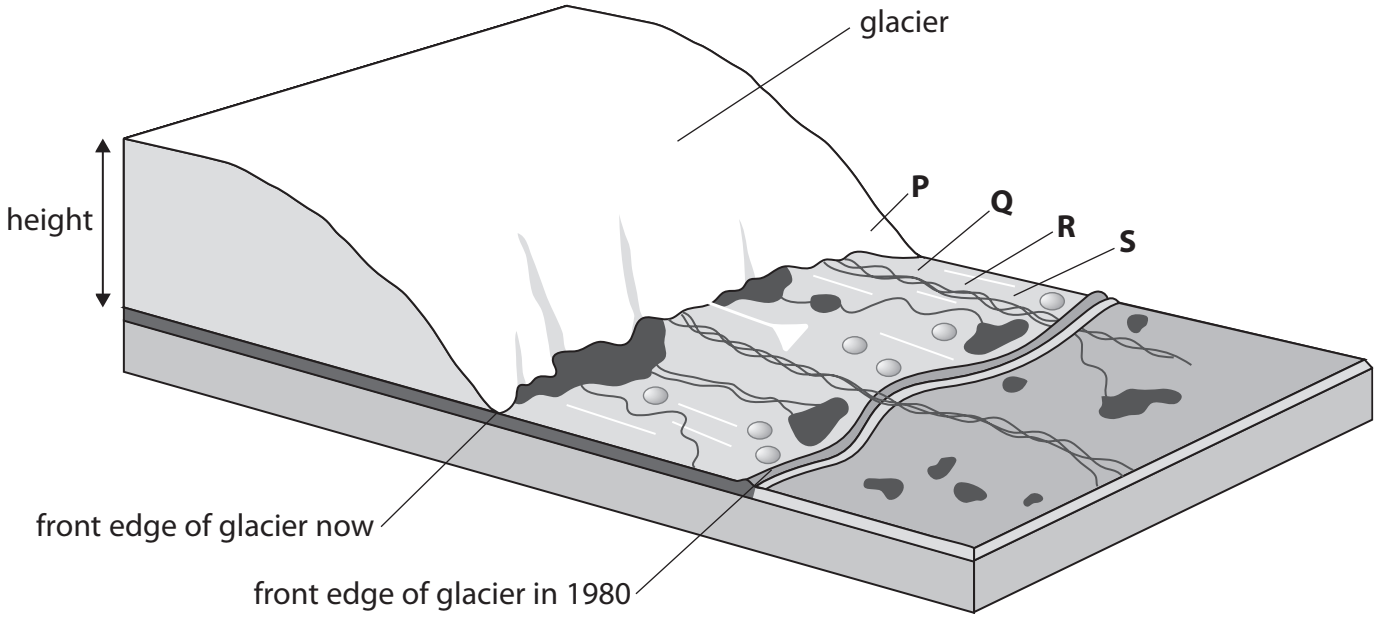
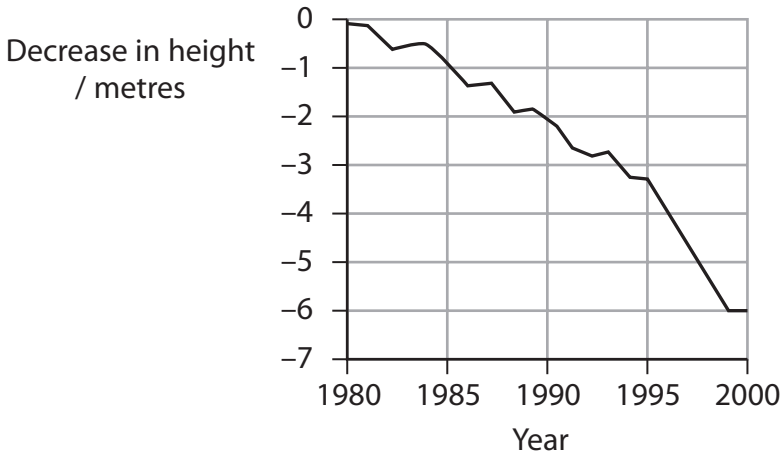
(Total for Question 3 = 12 marks)

4 Glaciers are decreasing in height and retreating due to global warming.

The diagram shows a retreating glacier.



(a) The graph shows the decrease in height of a glacier from 1980 to 2000.



(i) Calculate the mean drop in height from 1980 to 2000.

Give suitable units for your answer.

(1)

Answer .....

(ii) Explain why the decrease in height is greater from 1995 to 2000 than it is from 1980 to 1985.

(3)

(b) Which letter on the diagram indicates the location of pioneer species only?

(1)

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

(c) At different distances from the front edge of the glacier, there will be variations in soil conditions.

These soil conditions include: soil depth, the carbon : nitrogen ratio and the organisms present in the soil.

These differences depend on the length of time the ground has been exposed by the retreating glacier.

(i) Which term describes the changes in soil conditions and organisms with time?

(1)

- ☒ **A** anthropogenic
- ☒ **B** evolution
- ☒ **C** speciation
- ☒ **D** succession

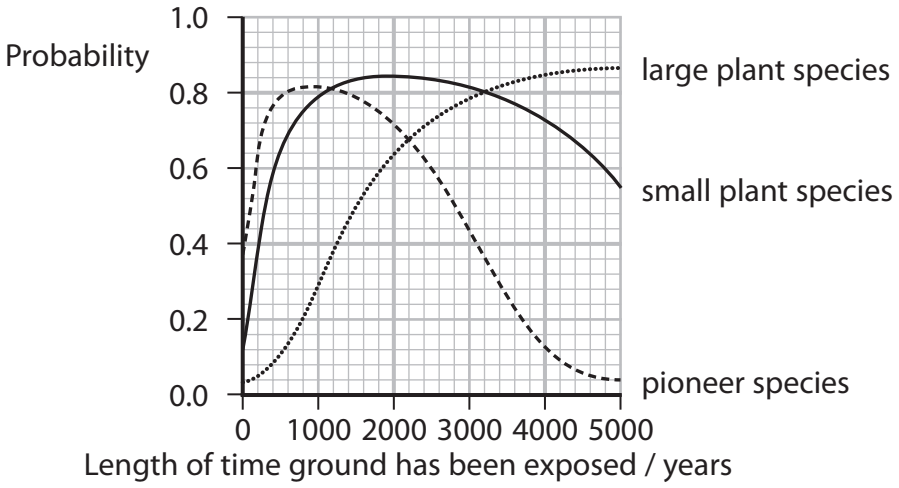
*(ii) The table shows the soil carbon : nitrogen ratio in ground exposed by a retreating glacier.

Length of time that the ground has been exposed / years	Carbon : nitrogen ratio in the soil
< 200	9.8
2 000	11.6
3 500	10.7
7 200	10.3

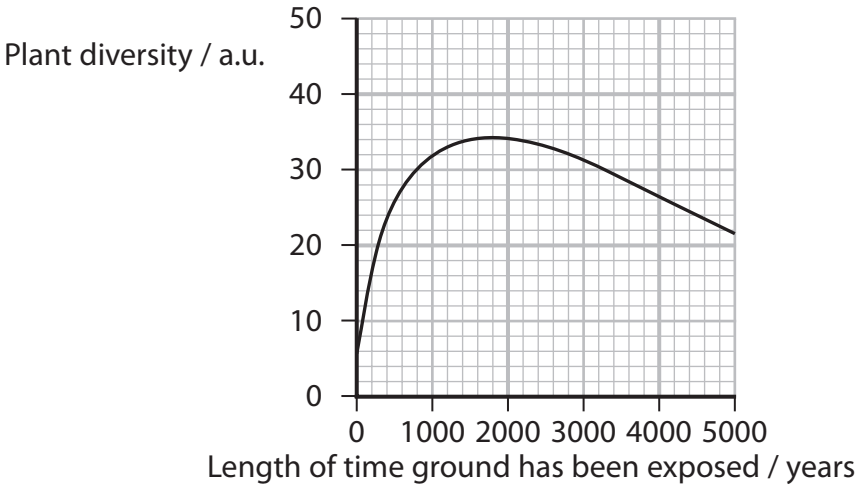
Graph 1 shows the probability that three different types of plant will be found on ground exposed for different lengths of time.

Graph 2 shows a model of plant diversity on ground exposed for different lengths of time.

Graph 1



Graph 2



Explain the variations in soil conditions and the organisms found at different distances from the front edge of the glacier.

Use the information in the question and your own knowledge to support your answer.

(6)

(Total for Question 4 = 12 marks)

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5 *Mycobacterium tuberculosis* (*Mtb*) and human immunodeficiency virus (HIV) are two pathogens that infect people.

When people infected with either pathogen become infected with the other pathogen the disease is worse.

(a) Explain why HIV infection causes tuberculosis (TB) to be worse.

(4)

(b) In one year, it was estimated that 33.4 million people were infected with HIV. It was estimated that 30 % of these people were also infected with *Mtb*.

(i) Suggest **two** reasons why these figures are only estimates.

(2)

(ii) Calculate the number of people with both infections.

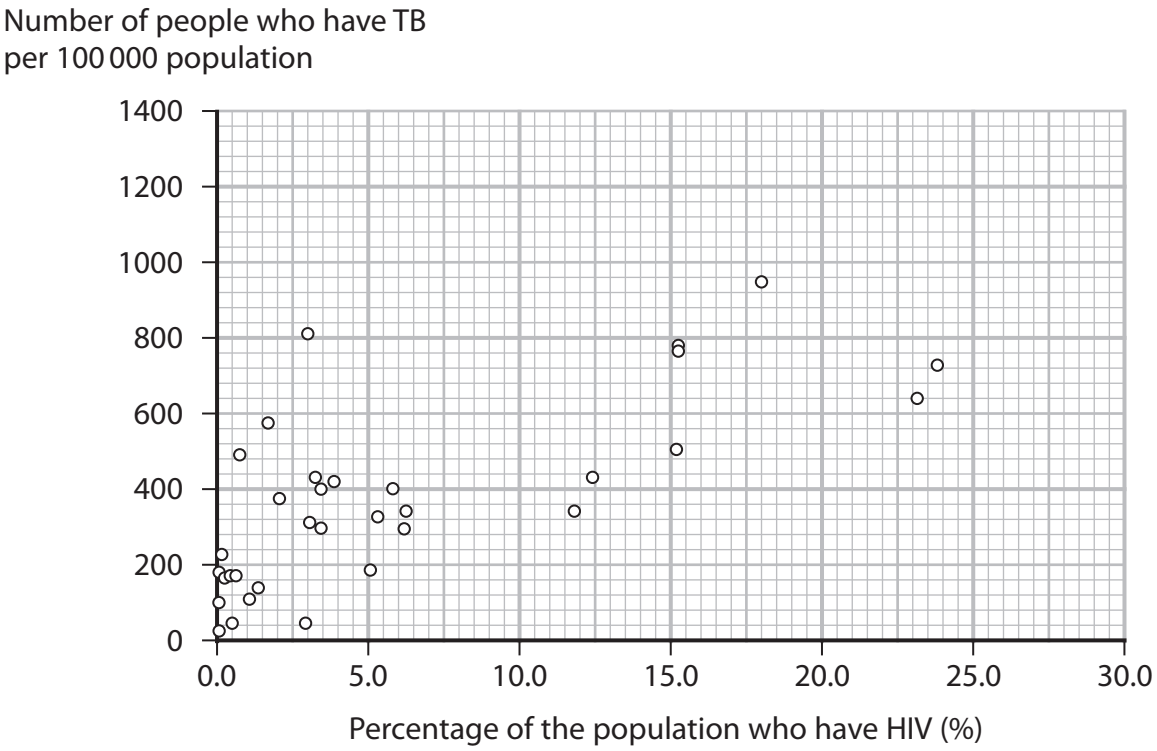
Give your answer in standard form.

(1)

Answer .....

(c) The graph shows the number of people who have TB and the percentage of the population who have HIV.

Each plotted point represents data from a different country.



(i) Comment on the relationship between the number of people who have TB and the percentage of people who have HIV.

(2)

(ii) Describe how the strength of the relationship between the number of people who have TB and the percentage of people who have HIV could be determined.

(3)

(Total for Question 5 = 12 marks)

6 The diagram shows a food chain in a southeast Asian rainforest.

Trophic level 3: Bengal tiger

(Source: © Steve Bloom Images / Alamy Stock Photo)

↑

Trophic level 2: Slender loris

(Source: © ephotocorp / Alamy Stock Photo)

↑

Trophic level 1: Young leaves of trees

(Source: © Ivan Kmit / Alamy Stock Photo)

(a) Give the meaning of each of the following terms.

Give an example from this food chain in each of your answers.

(i) Habitat

(2)

(ii) Population

(2)

(iii) Community

(2)

(b) Explain how the niche of the slender loris affects the distribution and abundance of the Bengal tigers.

(3)

(c) Southeast Asian forests are the oldest rainforests on Earth.

Explain how the age of a tree in a rainforest can be determined, without cutting it down.

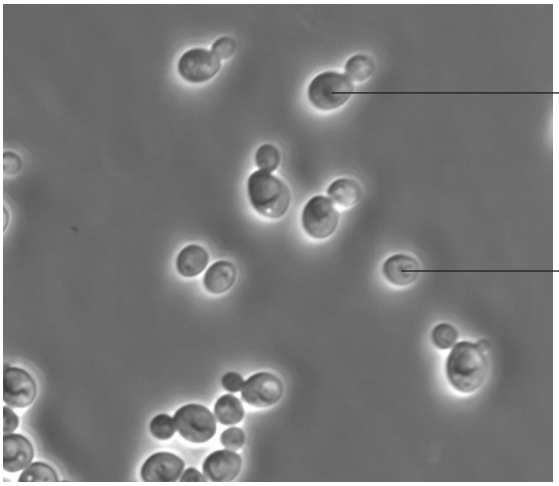
(3)

(Total for Question 6 = 12 marks)

7 Yeast are single-celled eukaryotic microorganisms.

They reproduce asexually by budding. The new yeast cell (bud) grows out of the cell of an adult yeast cell following mitosis.

The photograph shows some yeast cells.



(Source: © Andre Nantel/Shutterstock)

(a) One species of yeast, *S. cerevisiae*, has a diameter from 5 µm to 10 µm.

One type of bacteria, *S. aureus*, has a diameter from 500 nm to 1500 nm.

(i) Calculate the smallest difference between the diameters of *S. cerevisiae* and *S. aureus*.

Give suitable units with your answer.

(1)

Answer .....

(ii) The table gives some statements about cells.

For each statement, put **one** cross ☒ in the appropriate box, in each row, to show whether these statements are true for the types of microorganisms shown.

(2)

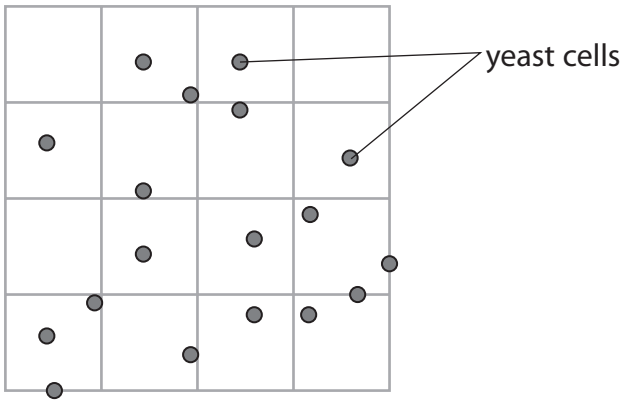
Statement about cells	**Type of microorganism**			
	both *S. cerevisiae* and *S. aureus*	*S. cerevisiae* only	*S. aureus* only	neither *S. cerevisiae* nor *S. aureus*
Contain both DNA and RNA	☒	☒	☒	☒
Have membranes around the cytoplasm and around the nucleus	☒	☒	☒	☒

(b) Yeast cells can be cultured and the rate of growth determined using a haemocytometer (counting chamber / Neubauer chamber).

(i) A student had a suspension of yeast cells in a liquid culture and wanted to determine the concentration of yeast cells in this culture.

A sample of this culture was added to the haemocytometer and observed under a light microscope.

The diagram shows yeast cells in part of the haemocytometer.



The volume of the sample covering this part of the haemocytometer is 0.00625 µl.

$1\ \mu l = 10^{-6}\ dm^3$

Explain how to calculate the concentration of yeast cells, in cells per cm^3, in the culture. Include in your answer an explanation of how the number of cells was determined from the diagram of a haemocytometer.

(3)

Explanation .....

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Answer ..... cells per cm^3

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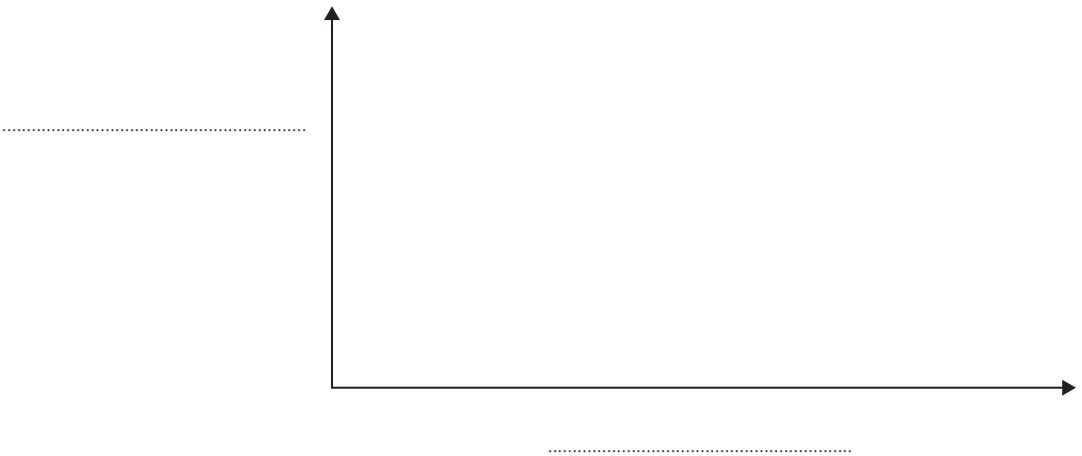
(ii) The growth curve for yeast grown in culture has four phases, similar to bacteria grown in culture.

Sketch a growth curve on the axes drawn below.

Label the axes and the four phases of the growth curve.

(4)



(iii) Describe how the student could use a growth curve to determine the exponential growth rate constant for the yeast.

(4)

(Total for Question 7 = 14 marks)

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8 Individuals develop artificial immunity either actively or passively.

(a) The table gives some statements about immunity.

For each statement, put **one** cross ☒ in the appropriate box, in each row, to show whether these statements are true for these types of immunity.

(2)

Statement	Type of artificial immunity			
	both active and passive	active only	passive only	neither active nor passive
Antigens are injected into the person	☒	☒	☒	☒
Immunity is long term	☒	☒	☒	☒

(b) Vaccination against a virus results in the production of antibodies.

Describe how antibodies are produced following activation of T cells.

(2)

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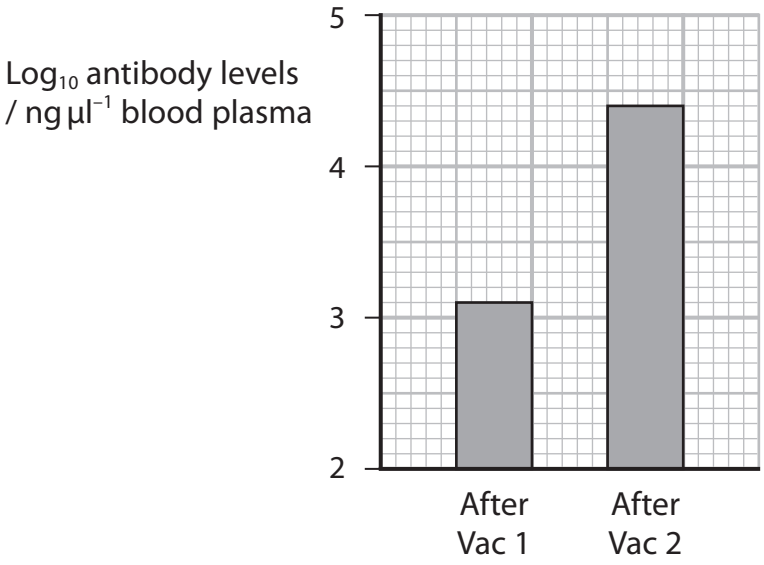
(c) The levels of antibodies following vaccinations were investigated.

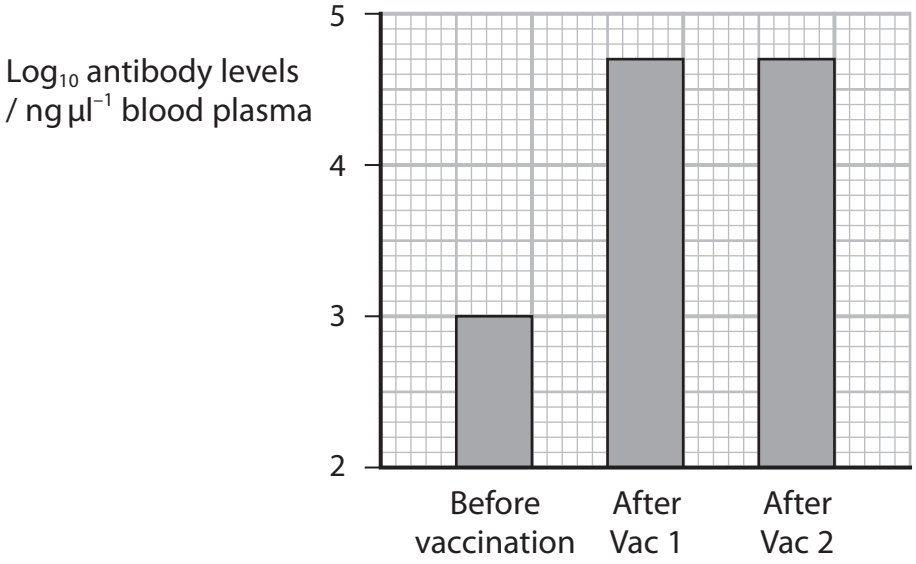
There were two groups of people. Group 1 **had not** been infected with the virus, before the vaccine was given. Group 2 **had** been infected with the virus before the vaccine was given.

Both groups of people received two vaccinations, Vac 1 and Vac 2.

The graphs show the results of this investigation.



Group 1:
People who had not been infected before the vaccine was given



Group 2:
People who had been infected with the virus before the vaccine was given

(i) Explain **two** ways in which this investigation would have to be controlled to provide valid data.

(2)

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(ii) In group 1, Vac 2 increased the levels of antibody more than Vac 1.

Calculate how many times greater this increase was.

(2)

Answer .....

(iii) Suggest why there is no data on the graph for group 1 before vaccination.

(1)

*(iv) Explain the results of this investigation.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 90 MARKS

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