A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

AS

BIOLOGY

Paper 2

7401/2

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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For this paper you must have:
- **a ruler with millimetre measurements**
- **a scientific calculator.**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write 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).**
- **Show all your working.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**

INFORMATION

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

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

0 1 . 1

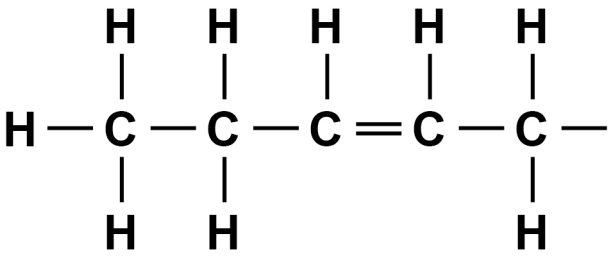
The general structure of a fatty acid is RCOOH.

Name the group represented by COOH. [1 mark]

0 1 . 2

FIGURE 1 shows the structure of a fatty acid R group.

FIGURE 1



Name the type of R group shown in FIGURE 1.

Explain your answer. [2 marks]

Type of R group _____

_____

_____

Explanation _____

_____

_____

[Turn over]

0 1 . 3

Describe how you would test for the presence of a lipid in a liquid sample of food. [2 marks]

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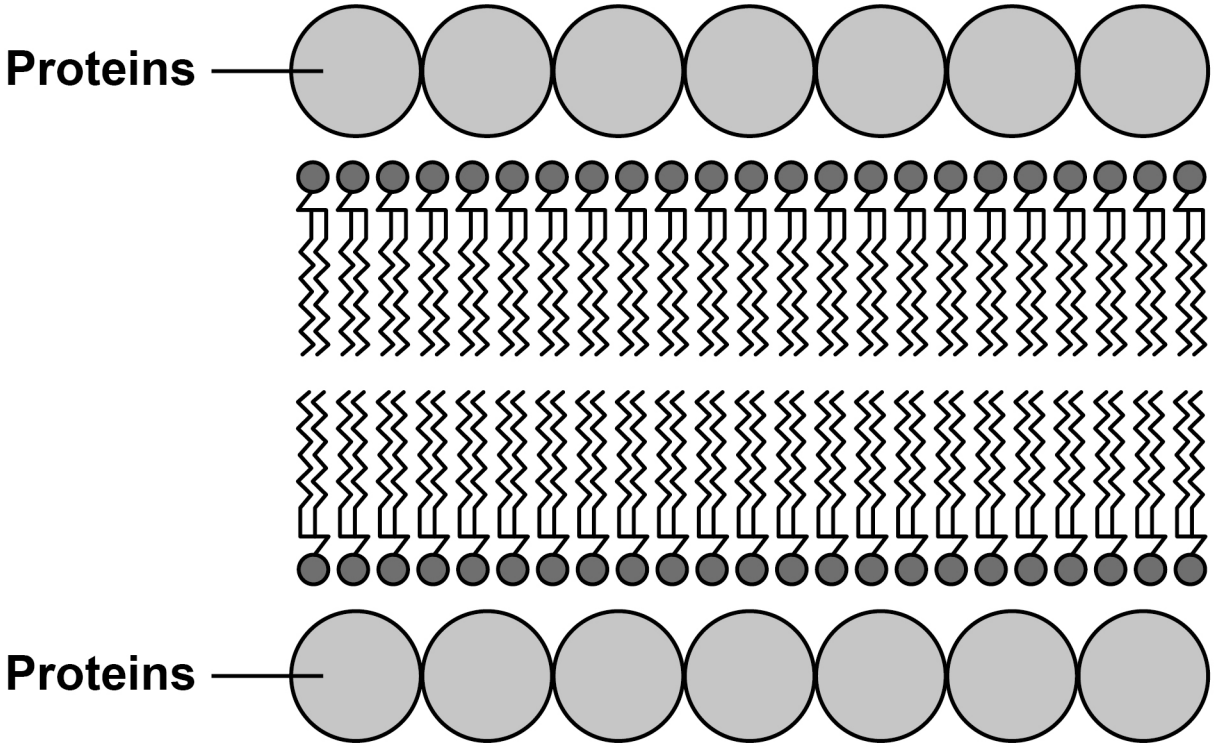
[Turn over]

In 1935, scientists suggested a model for the chemical structure of a cell-surface membrane. FIGURE 2 shows the membrane structure the scientists suggested.

FIGURE 2



0 1 . 4

Give ONE similarity and TWO differences between the membrane structure shown in FIGURE 2 and the fluid-mosaic model of membrane structure. [3 marks]

Similarity _____

_____

_____

Difference 1 _____

_____

_____

Difference 2 _____

_____

_____

[Turn over]

8

0 2 . 1

Describe and explain ONE feature of the alveolar epithelium that makes the epithelium well adapted as a surface for gas exchange. Do NOT refer to surface area or moisture in your answer. [2 marks]

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[Turn over]

Doctors measure the health of lungs by calculating the FEV_1:FVC ratio.

- **FEV_1 is the maximum volume of air exhaled in one second.**
- **FVC is the maximum volume of air exhaled in one breath.**

The minimum FEV_1:FVC ratio of healthy lungs is 0.7:1

A man with the lung disease emphysema inflated his lungs fully. He then exhaled as much of this air as quickly as possible in one breath. FIGURE 3, on the opposite page, shows how the volume of exhaled air changed during this breath.

0 2 . 2

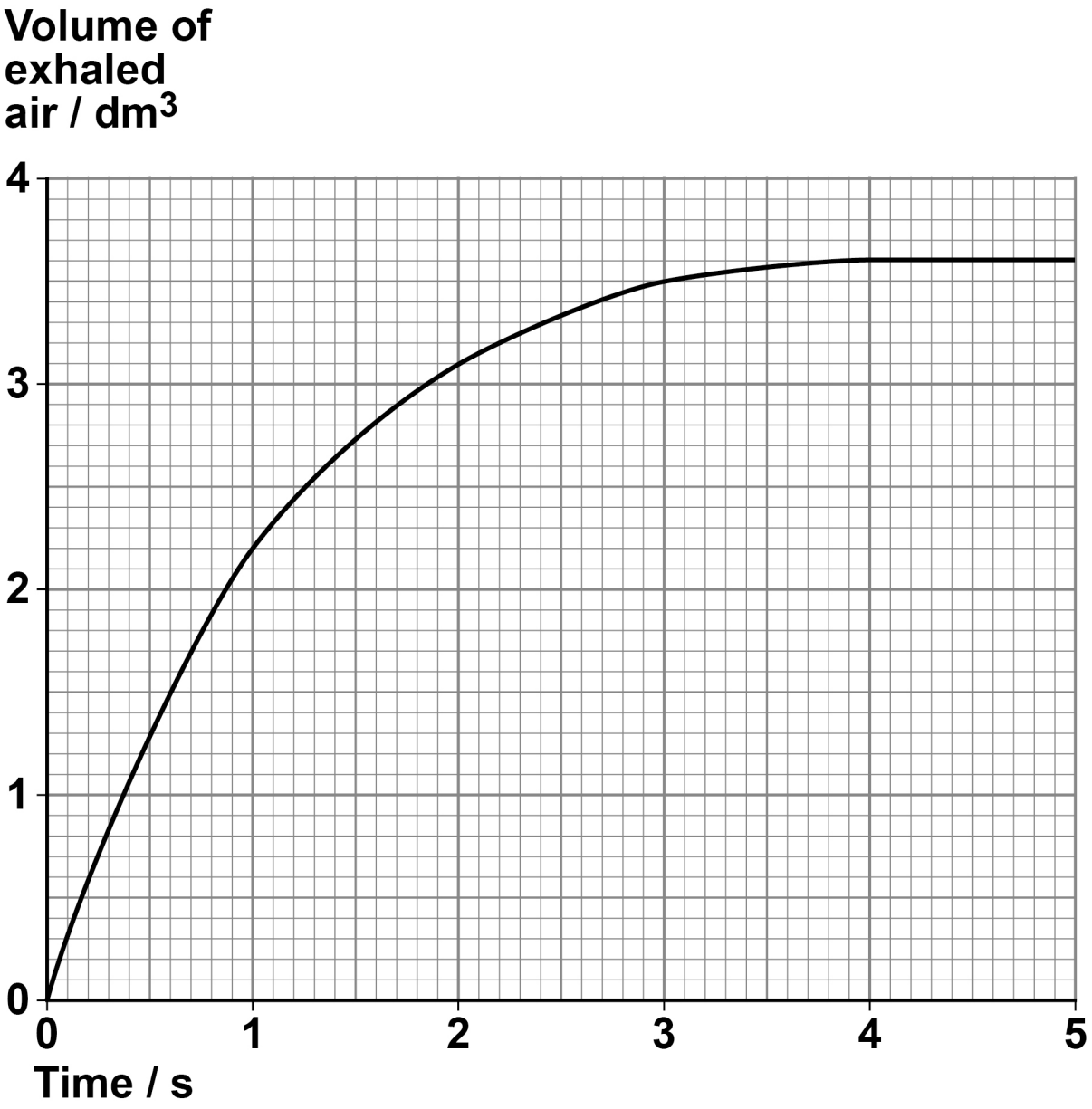
Use the information provided to determine the FEV_1:FVC ratio of this man's lungs.

Go on to determine how many times greater the minimum ratio of healthy lungs is than his ratio. [2 marks]

FEV_1:FVC ratio of man's lungs = _____

How many times greater? _____

FIGURE 3



[Turn over]

0 2 . 3

Tidal volume is the volume of air inhaled and exhaled during a single breath when a person is resting. The tidal volume in a person with emphysema is reduced compared with the tidal volume in a healthy person.

Suggest and explain how a reduced tidal volume affects the exchange of carbon dioxide between the blood and the alveoli. [3 marks]

[Turn over]

7

0 3 . 1

In taxonomy, an organism is identified by referring to the species name and the genus name.

What term is used to describe this method of naming organisms? [1 mark]

0 3 . 2

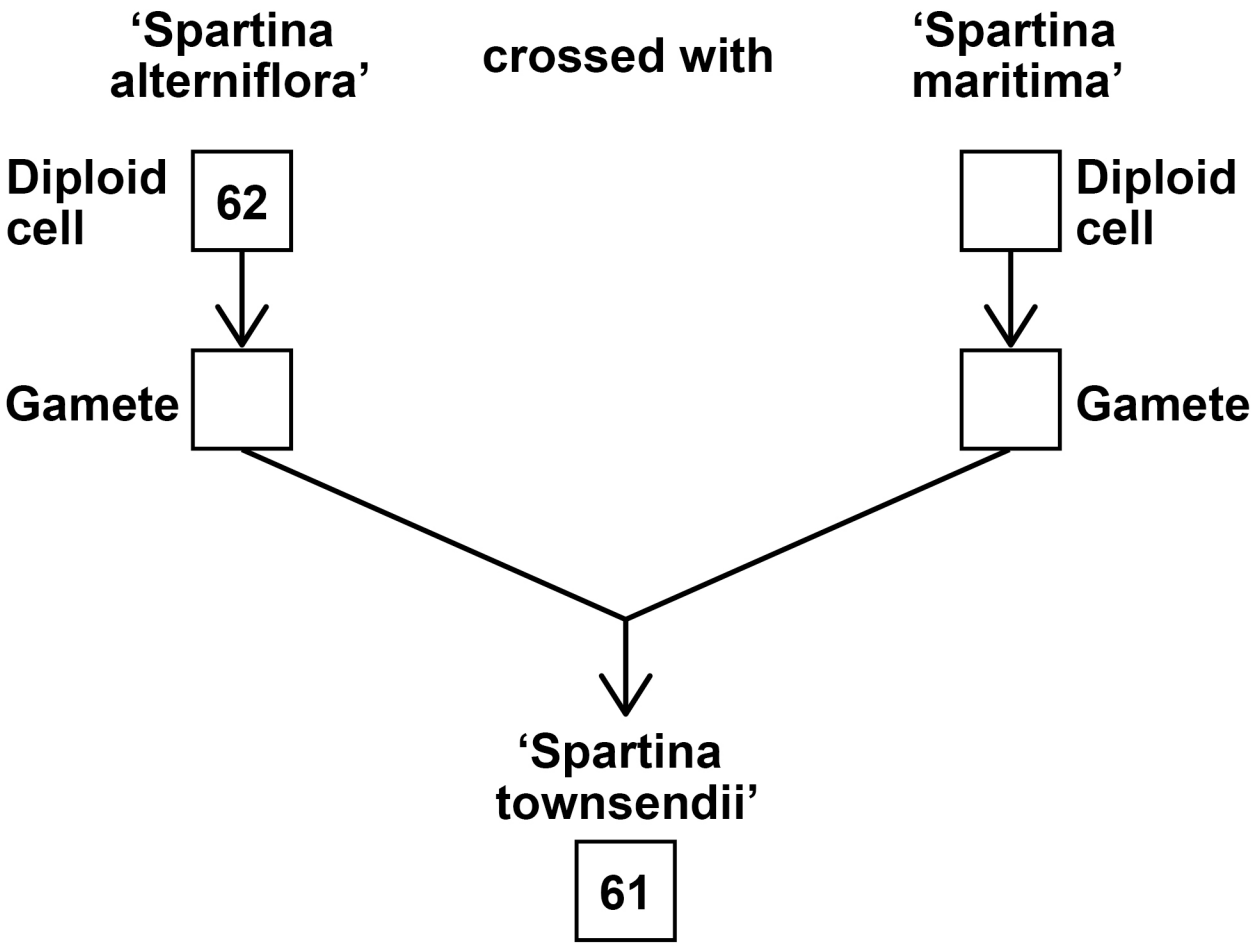
Define the term mutagenic agent. [1 mark]

0 3 . 3

FIGURE 4 shows how the species 'Spartina townsendii' is produced.

The number of chromosomes in cells is shown in some of the boxes.

FIGURE 4



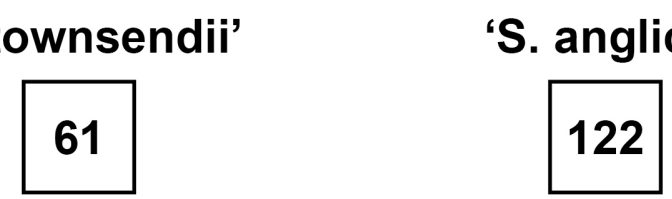
Complete FIGURE 4 by giving the correct number of chromosomes in each of the boxes. [1 mark]

[Turn over]

A mutation in the number of chromosomes in a 'S. townsendii' cell produced a new species, 'Spartina anglica'.

FIGURE 5 shows the number of chromosomes in leaf cells of these species.

FIGURE 5



0 3 . 4

Name the type of mutation that changed the number of chromosomes in 'S. townsendii' to produce 'S. anglica'. Explain your answer. [3 marks]

Name of mutation _____

_____

Explanation _____

_____

_____

_____

[Turn over]

0 3 . 5

Genetic variation within a species is increased during meiosis by crossing over and the independent segregation of homologous chromosomes.

Apart from mutation, explain ONE other way genetic variation within a species is increased. [2 marks]

8

0 4 . 1

Give TWO structures found in all prokaryotic cells and in all eukaryotic cells. [2 marks]

1 _____

_____

2 _____

_____

[Turn over]

All prokaryotic cells contain a circular DNA molecule and some prokaryotic cells contain plasmids.

0 4 . 2

Scientists have found that the rate of plasmid replication is faster in cells growing in a culture with a high concentration of amino acids than in a culture with a lower concentration of amino acids.

Suggest ONE explanation for the faster rate of plasmid replication in cells growing in a culture with a high amino acid concentration. [2 marks]

BLANK PAGE

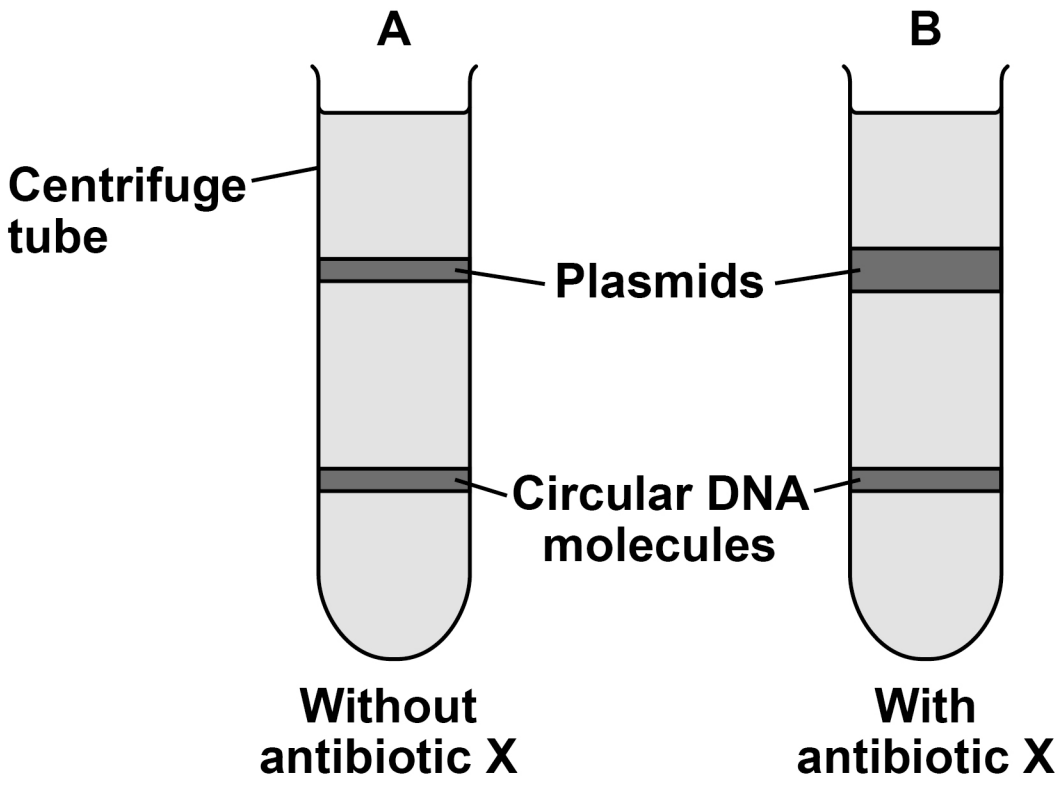
[Turn over]

A scientist prepared a culture of a bacterial species.

- **She extracted the plasmids and the circular DNA molecules from a sample of cells taken from this culture (A).**
- **She then added antibiotic X to the culture and let the cells divide for 4 hours.**
- **She then extracted the plasmids and the circular DNA molecules from a sample of these cells (B).**
- **The scientist separated the plasmids from the circular DNA molecules in A and in B using ultracentrifugation.**

FIGURE 6 shows her results.

FIGURE 6



0 4 . 3

What can you conclude from FIGURE 6 about a structural difference between the plasmids and the circular DNA? Explain your answer. [2 marks]

[Turn over]

0 4 . 4

What can you conclude from FIGURE 6, on page 22, about the effect of antibiotic X on plasmid replication and on circular DNA replication? Explain your answer. [2 marks]

8

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[Turn over]

0 5

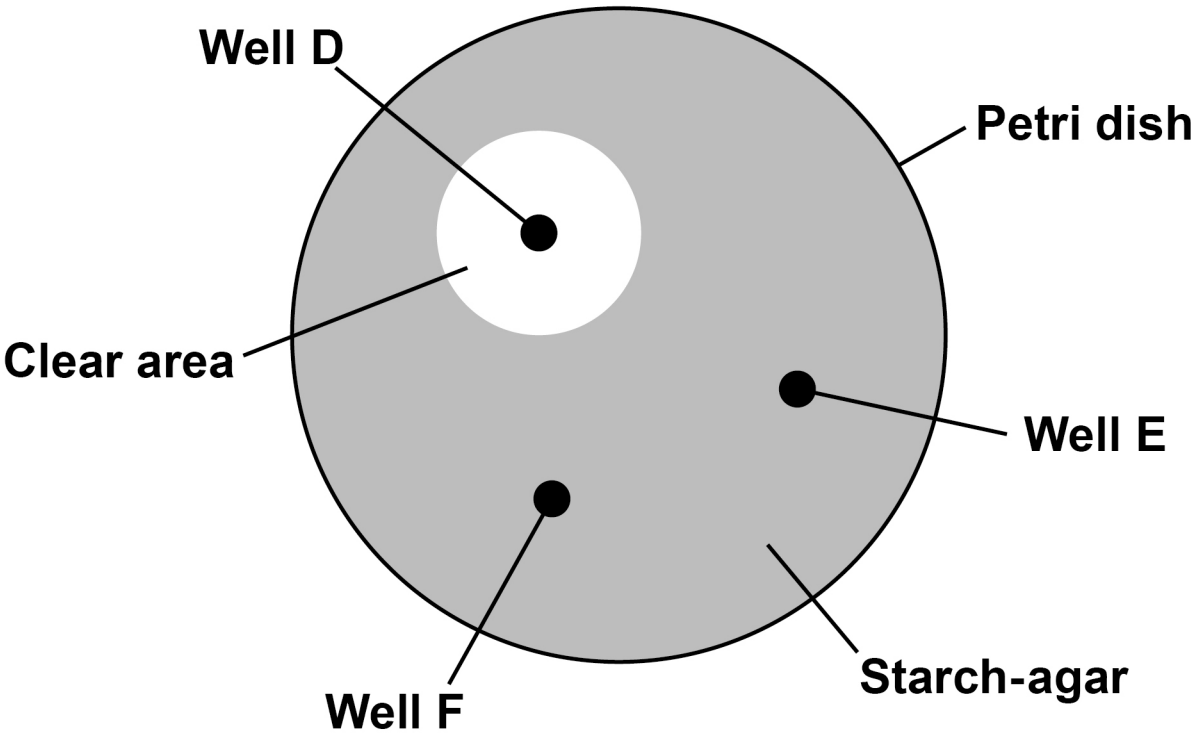
A student investigated the activity of the enzyme amylase. He cut three identical wells (D, E and F) in starch-agar in a Petri dish. He added 0.2 cm^3 of:

- **amylase solution to well D**
- **boiled amylase solution to well E**
- **water to well F.**

After 60 minutes, he covered the starch-agar with iodine solution.

FIGURE 7 shows his results.

FIGURE 7



0 5 . 1

Explain the appearance of the agar in the clear area surrounding well D. [2 marks]

[Turn over]

0 5 . 2

What can you conclude about the activity of amylase from the appearance of the agar surrounding well E and well F in FIGURE 7, on page 28? [2 marks]

0 5 . 3

The student cut out a piece of agar from the clear area surrounding well D. He obtained a solution of the substances contained in this piece of agar.

Describe a different biochemical test the student could use with this solution to confirm that amylase had affected the starch in the clear area surrounding well D. [2 marks]

The diameter of the clear area around well D is 18 mm

In a different investigation, the student prepared a dilution of the amylase solution. He did this by mixing amylase solution and water in the volumes shown in TABLE 1.

TABLE 1

Amylase solution / cm^3	Water / cm^3
1.6	2.4

He prepared a starch-agar Petri dish identical to FIGURE 7, but with a single well. He added 0.2 cm^3 of the diluted amylase solution to this well and left the Petri dish for 60 minutes.

0 5 . 4

Use all of this information to predict the diameter of the clear area that will form around the well containing the diluted amylase solution.

Give your answer to the nearest whole number.

Show your working. [2 marks]

Answer _____ **mm**

0 5 . 5

The student used a ruler to measure the diameter in mm of the clear area around well D in FIGURE 7, on page 26.

Use this information to explain why the answer to Question 05.4 should be given to the nearest whole number. [1 mark]

_____

_____

_____

_____

[Turn over]

9

0 6

The fruit fly is a species of small insect.

The fruit fly has a gene that codes for an enzyme called alcohol dehydrogenase (AD). AD catalyses the breakdown of alcohol when alcohol is in the insects' food.

The gene coding for AD has two alleles, AD^F and AD^S.

0 6 . 1

The enzyme encoded by the AD^F allele catalyses the breakdown of alcohol FASTER than the enzyme encoded by the AD^S allele. Suggest why. [3 marks]

[Turn over]

A scientist took a random sample of adult fruit flies from a population. He measured the frequency of the AD^F allele in this sample (generation 0). He then:

- selected 100 of these insects at random and kept them in a container
- fed the insects food containing alcohol
- let the insects reproduce
- repeated these steps for 45 generations of fruit fly reproduction.

The scientist measured the frequency of the AD^F allele in the 45th generation.

0 6 . 2

Suggest why the scientist took his sample from the population at random. [1 mark]

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[Turn over]

TABLE 2 shows the scientist's results.

TABLE 2

Generation of fruit fly reproduction	Frequency of AD^F
0	0.20
45	0.74

0 6 . 3

Alcohol is toxic to fruit flies. Suggest and explain why the frequency of the AD^F allele changed during the 45 generations. [4 marks]

[Turn over]

0 6 . 4

Identify the type of selection investigated in the 45 generations of fruit fly reproduction.

Tick (✓) ONE box. [1 mark]

- ☐ **No selection**
- ☐ **Directional selection**
- ☐ **Random selection**
- ☐ **Stabilising selection**

9

0 7 . 1

Describe how an ATP molecule is formed from its component molecules. [4 marks]

A scientist investigated the effect of cyanide on the rate of amino acid uptake in two types of 'Escherichia coli', G and H.

- **G cells produce enzymes involved in ATP production ONLY on their cell-surface membrane.**
- **H cells produce enzymes involved in ATP production on their cell-surface membrane AND in their cytoplasm.**

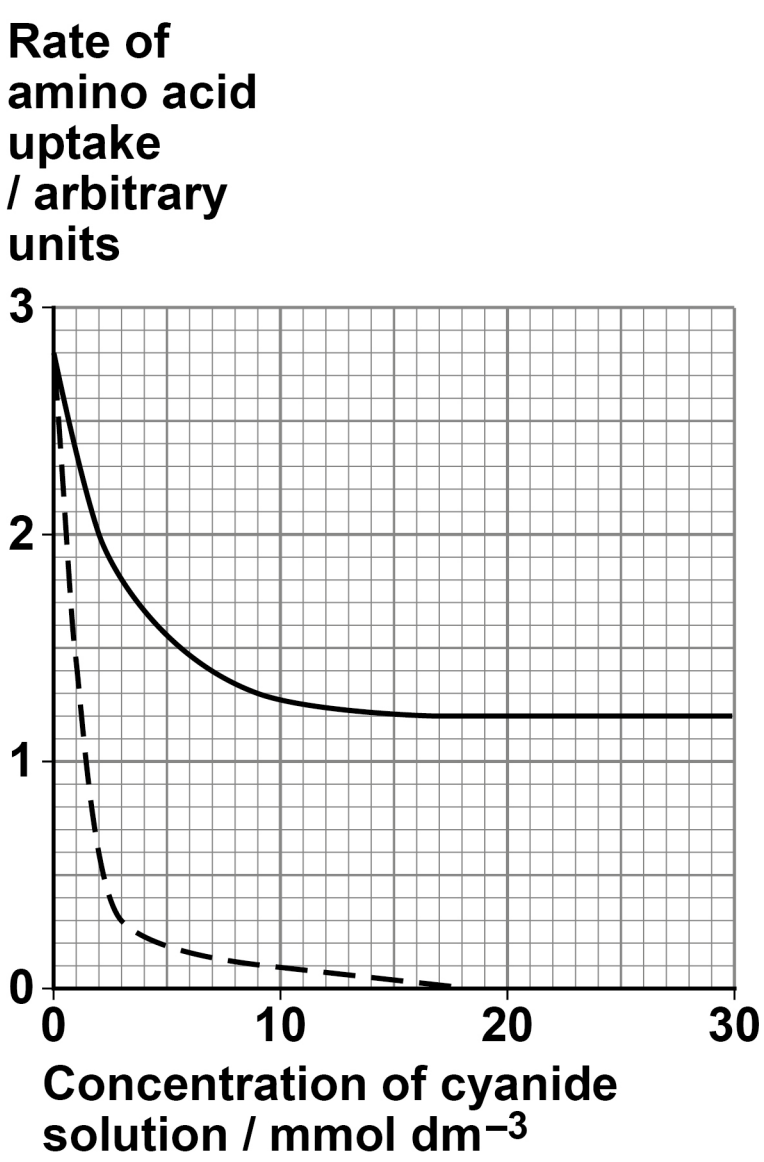
FIGURE 8, on the opposite page, shows her results.

0 7 . 2

Use FIGURE 8 to calculate the percentage decrease in the rate of amino acid absorption by H cells in 30 mmol dm^{-3} cyanide solution. [1 mark]

Answer _____ **%**

FIGURE 8



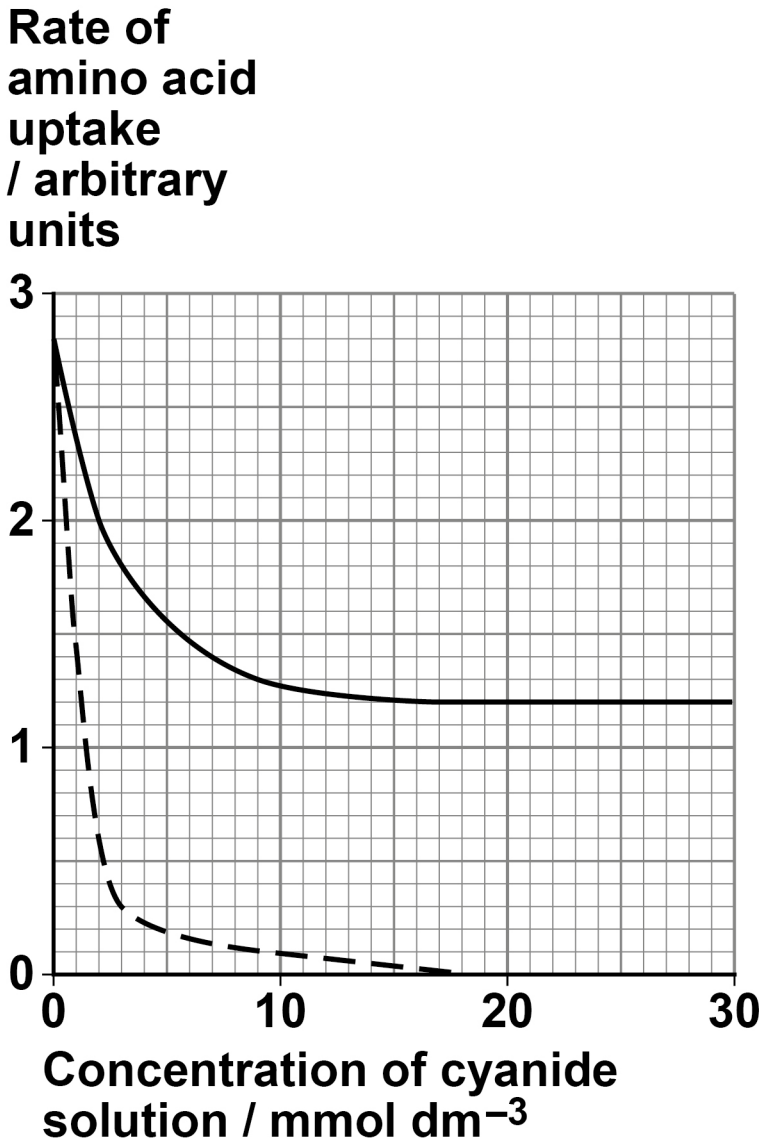
KEY

– – – G cells

——— H cells

[Turn over]

REPEAT OF FIGURE 8



KEY

– – – G cells

——— H cells

0 7 . 3

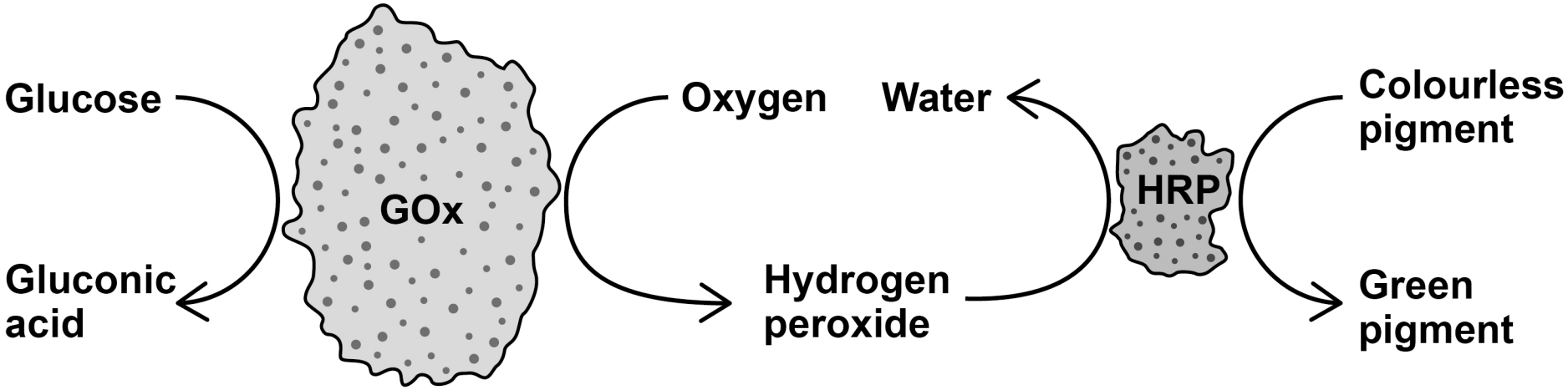
Using FIGURE 8 and the information provided, what can you conclude about amino acid uptake by G cells and by H cells? [3 marks]

8

0 8

A scientist investigated a sequence of reactions catalysed by TWO enzymes, GOx and HRP. FIGURE 9 shows this sequence of reactions.

FIGURE 9



0 8 . 1

Use FIGURE 9 to identify all of the products formed when this sequence of reactions is completed. [1 mark]

_____

_____

[Turn over]

0 8 . 2

The scientist joined DNA molecules together to make tiny cages. The cages are exactly 20 nm long, 20 nm wide and 17 nm deep.

He trapped ONE GOx molecule and ONE HRP molecule together in each cage. The GOx molecule and HRP molecule fill 9% of the cage volume.

The volume of a GOx molecule is eight times larger than an HRP molecule.

Use this information to calculate the volume of a GOx molecule. Give the appropriate unit with your answer.

Show your working. [3 marks]

Answer _____

[Turn over]

The scientist investigated the activity of GOx and HRP enzymes when they are:

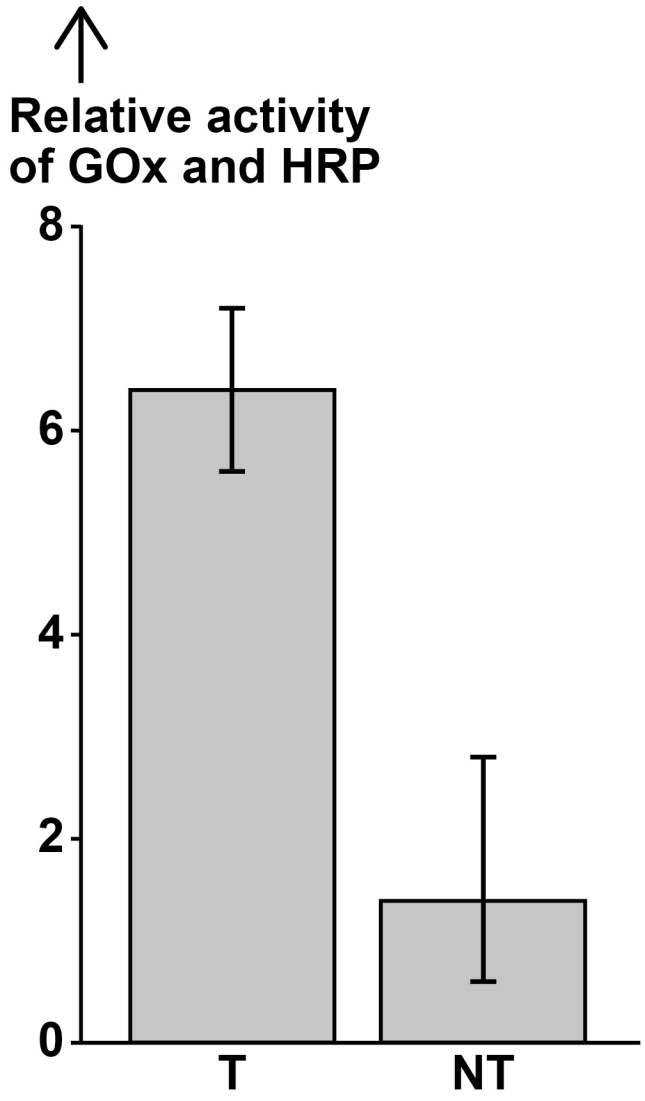
- **trapped inside cages (T) and**
- **not trapped (NT), but free in solution with no cages.**

FIGURE 10, on page 52, shows his results.

The error bars show ± 2 standard deviations.

± 2 standard deviations include 95% of the data.

FIGURE 10



0 8 . 3

What can you conclude from FIGURE 10 about the effect of trapping GOx and HRP inside cages? [3 marks]

0 8 . 4

The design of the scientist's investigation did NOT include a suitable control.

Suggest a suitable control. [1 mark]

_____

_____

_____

_____

8

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[Turn over]

0 9 . 1

Explain FIVE properties that make water important for organisms. [5 marks]

0 9 . 2

Describe the process of semi-conservative replication of DNA. [5 marks]

END OF QUESTIONS

10

Additional page, if required.
Write the question numbers in the left-hand margin.

Additional page, if required.
Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
2	
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4	
5	
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7	
8	
9	
TOTAL	