



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.

01.1

What is a gene? [1 mark]

01.2

Describe how the production of messenger RNA (mRNA) in a eukaryote cell is different from the production of mRNA in a prokaryote cell. [2 marks]



[Turn over]



0	1	.	4
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Describe the role of ATP in the process of translation in protein synthesis. [2 marks]

[Turn over]

7



02.1

What term is used to describe the different structures of α -glucose and β -glucose? [1 mark]

02.2

A student investigated the difference in the reducing sugar content of two fruit juices. He performed a biochemical test on each fruit juice using Benedict's solution. He then used a colorimeter with each test result.

Describe how the results from the colorimeter can identify the fruit juice containing the higher sugar content. [1 mark]



02.3

The student controlled variables in the test using Benedict's solution.

Give TWO variables the student controlled. [2 marks]

1 _____

2 _____

[Turn over]



0 2 . 4

Apples consist of flesh tissue which surrounds core tissue where the seeds are located.

**A student has an apple with a mass of 180 g
The ratio of flesh tissue to core tissue in this apple is 5:1
8% of the whole apple is sugar.**

Calculate the mass of sugar in the flesh tissue.

Show your working. [2 marks]

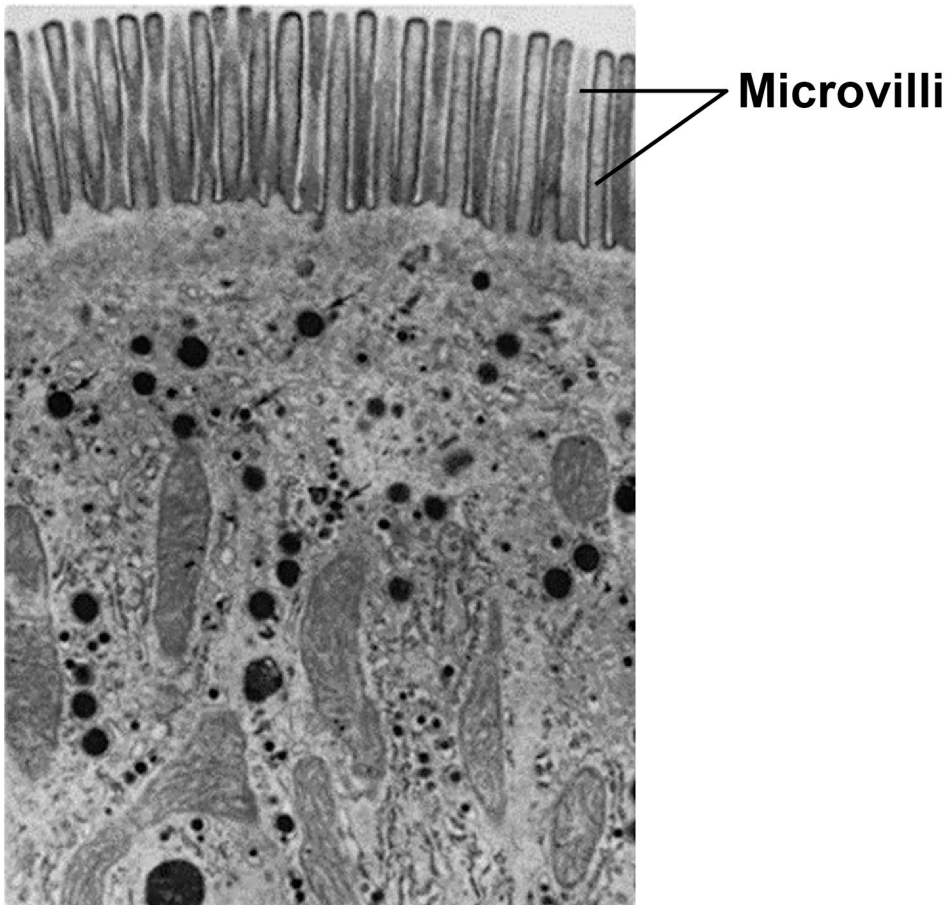
Answer _____ g



03

FIGURE 1 is an image of part of a cell lining the ileum.

FIGURE 1



0	3	.	1
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Describe and explain TWO ways that structures shown in FIGURE 1 increase the rate of absorption by this cell. [2 marks]

1

2

[Turn over]



03.2

An ileum cell **WITHOUT** microvilli has $7.85 \mu\text{m}^2$ of cell surface in contact with digested substances.

A scientist found an ileum cell with 1000 microvilli. The microvilli cover the entire cell surface in contact with digested substances.

Microvilli are $0.1 \mu\text{m}$ in diameter and $1 \mu\text{m}$ in length. The surface area of a microvillus is calculated using this equation

$$2 \pi r l + \pi r^2$$

where π is 3.14,
r is the radius,
l is the length.

Calculate the ratio of the area of the ileum cell surface **WITH** microvilli to the area of ileum cell surface **WITHOUT** microvilli.

On the opposite page, show your working. [2 marks]



Ratio _____ :1

[Turn over]



[Turn over]

7



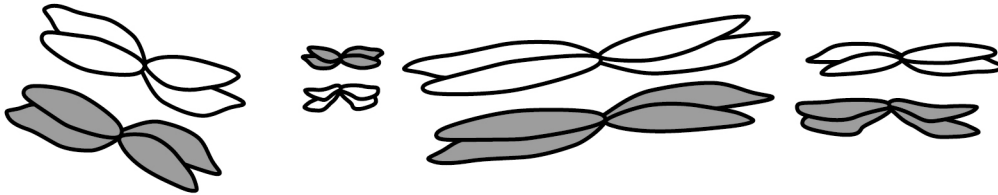
[Turn over]



04.2

FIGURE 2 shows the arrangement of chromosomes in a cell during the first meiotic division.

FIGURE 2



A scientist observed 300 cells. All of the cells were at exactly the same stage of meiosis as the cell shown in **FIGURE 2**.

Use your knowledge of the independent segregation of homologous chromosomes to calculate how many of these cells are expected to have an **IDENTICAL ARRANGEMENT** of chromosomes to those shown in **FIGURE 2**. Assume no crossing over occurs. [2 marks]



Answer _____

[Turn over]



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0	4	.	3
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Draw a diagram to show the chromosomes in one gamete produced by meiosis from the cell shown in FIGURE 2, on page 20. [1 mark]

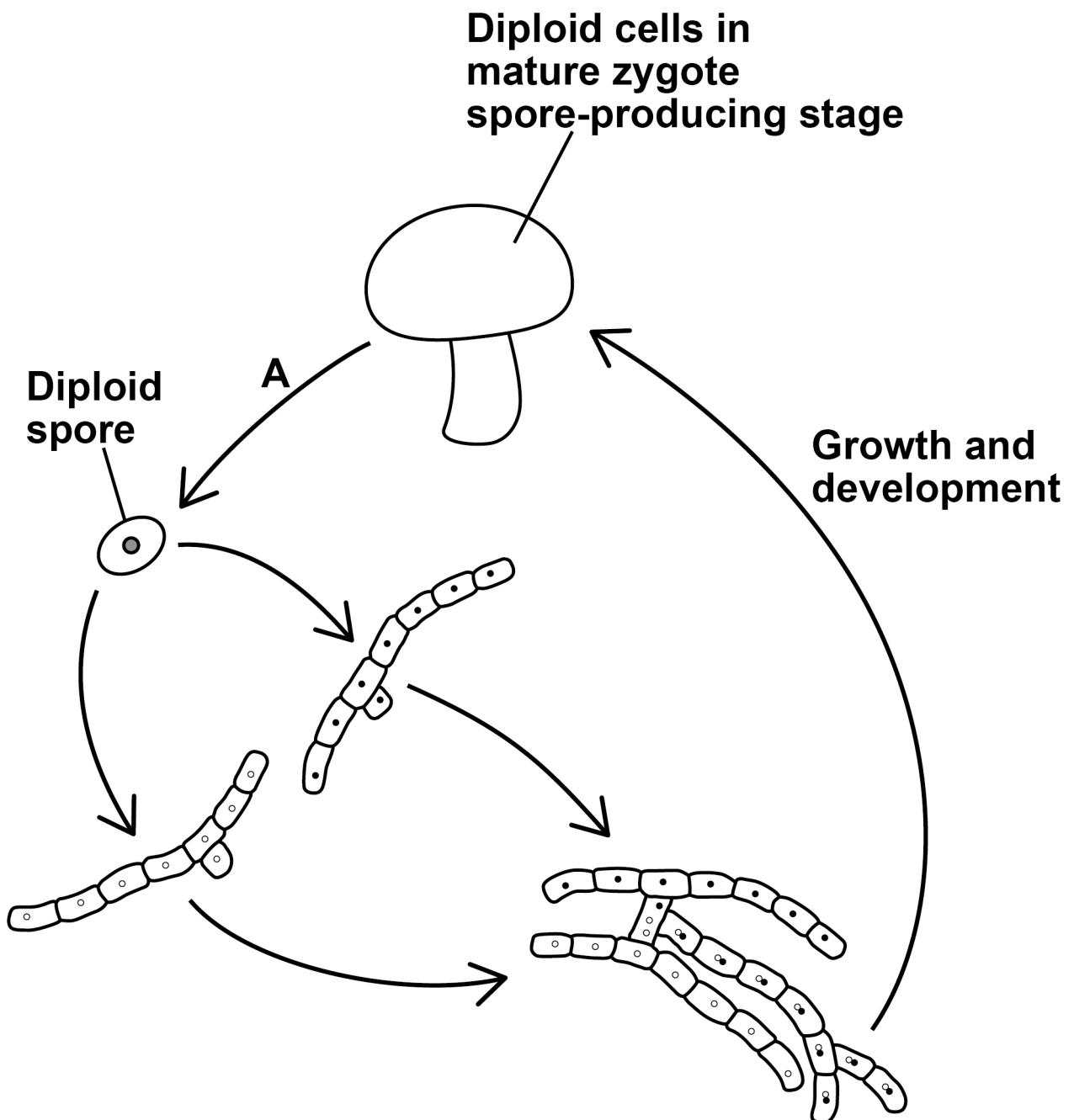
[Turn over]



04.4

FIGURE 3 shows the life cycle of a fungus. The life cycle includes sexual reproduction.

FIGURE 3



What is the name of the process shown by arrow A in FIGURE 3? [1 mark]

Tick (✓) ONE box.

Binary fission

Fertilisation

Meiosis

Mitosis

—
8

[Turn over]



05.1

Describe how organisms are grouped in a phylogenetic classification system. [2 marks]



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[Turn over]





TABLE 1 shows some of the taxa in the phylogenetic classification of a rhinoceros species.

TABLE 1

TAXON NAME	SCIENTIFIC NAME
Class	Mammalia
Order	Perissodactyla
Family	Rhinocerotidae
Genus	Rhinoceros
Species	Unicornis

FIGURE 4, on page 30, shows the relationship between the taxa in the classification of two rhinoceros species: ‘*Rhinoceros unicornis*’ and ‘*Dicerorhinus sumatrensis*’.



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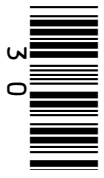
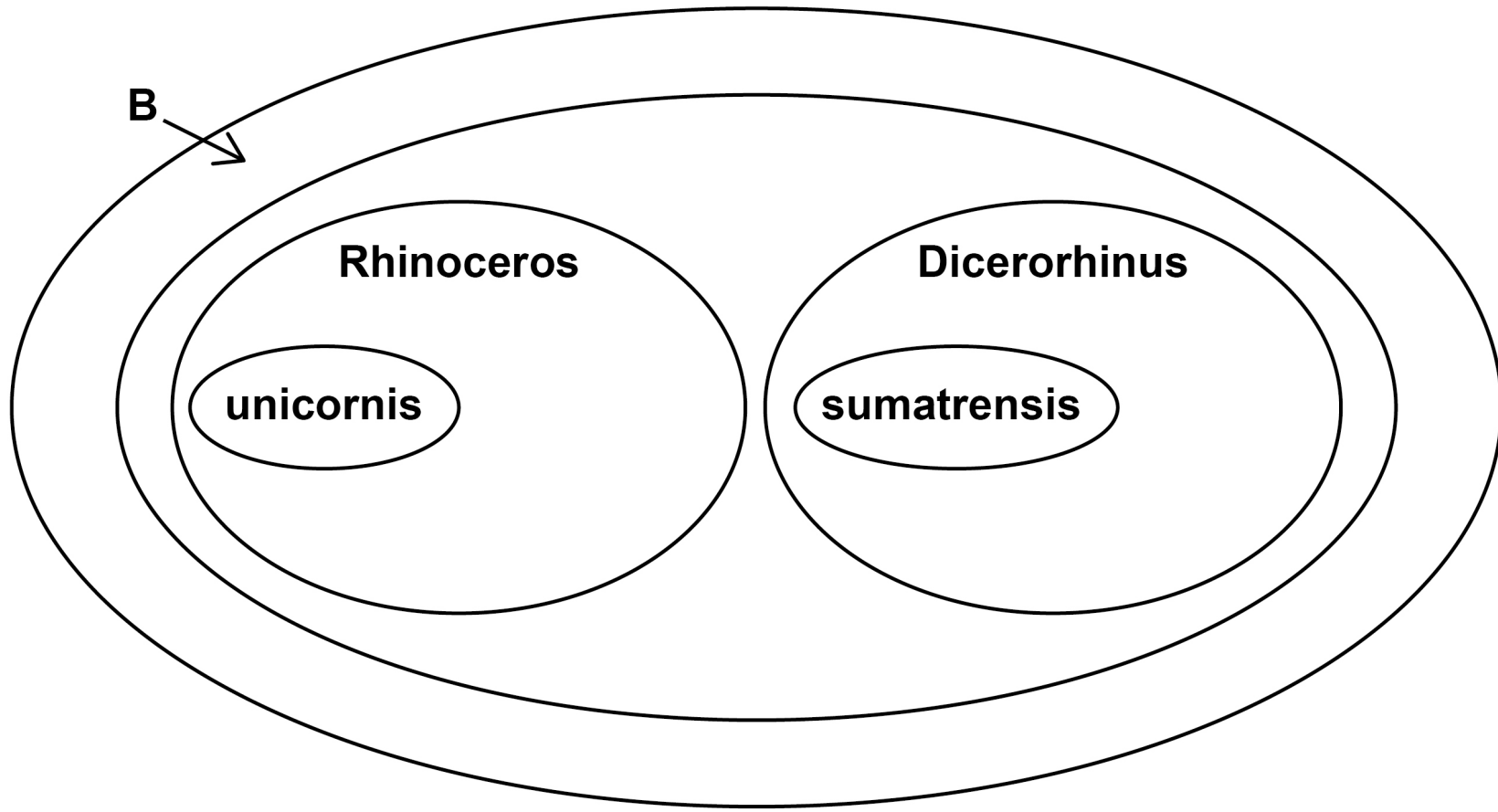


FIGURE 4





0 5 . 2

Use information in TABLE 1, on page 28, to give the SCIENTIFIC name of the taxon labelled B in FIGURE 4. [1 mark]

0 5 . 3

Draw an oval on FIGURE 4 to show the species 'Rhinoceros sondaicus'. [1 mark]

[Turn over]

Scientists investigated a phylogenetic relationship between individuals of five species of rhinoceros.

The scientists:

- determined the DNA base sequence of the 'cyt b' gene of each rhinoceros
- compared each 'cyt b' DNA base sequence with that of ONE Indian rhinoceros (called the reference rhinoceros)
- calculated the percentage difference between each 'cyt b' DNA base sequence and that of the reference rhinoceros.

TABLE 2 shows their results.

TABLE 2

Investigated species of rhinoceros	Percentage difference in DNA base sequences compared with the reference Indian rhinoceros
Indian	2
Javan	5
Sumatran	13
White	14
Black	14



05.4

What can you conclude about the likely phylogenetic relationships between these species? Evaluate your conclusion. [4 marks]

[Turn over]



05.5

A scientist obtained a rhinoceros horn confiscated from poachers and wanted to identify the species of rhinoceros that was killed for its horn.

He used the procedure described in Question 05.4 and calculated the difference in 'cyt b' DNA as 14%.

What can you conclude from this result? Explain your answer.

Suggest a change to the procedure that will more precisely identify the rhinoceros species that provided the horn. [2 marks]

Conclusion and explanation _____



Suggested change to the procedure _____

[Turn over]

10




06.1

A student dissected a sheep's heart. He prepared a risk assessment on:

- carrying a scalpel
- using a scalpel.

Complete TABLE 3 by giving THREE control measures the student must use to reduce the risks associated with carrying AND using a scalpel. [2 marks]

TABLE 3

Source	Hazard	Control measures to reduce risk
Sharp knife	 DANGER	1.
		2.
		3.



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[Turn over]



06.2

A scientist measured the changes in blood volume inside the left ventricle of a mammalian heart during one heartbeat. FIGURE 5, on the opposite page, shows her results.

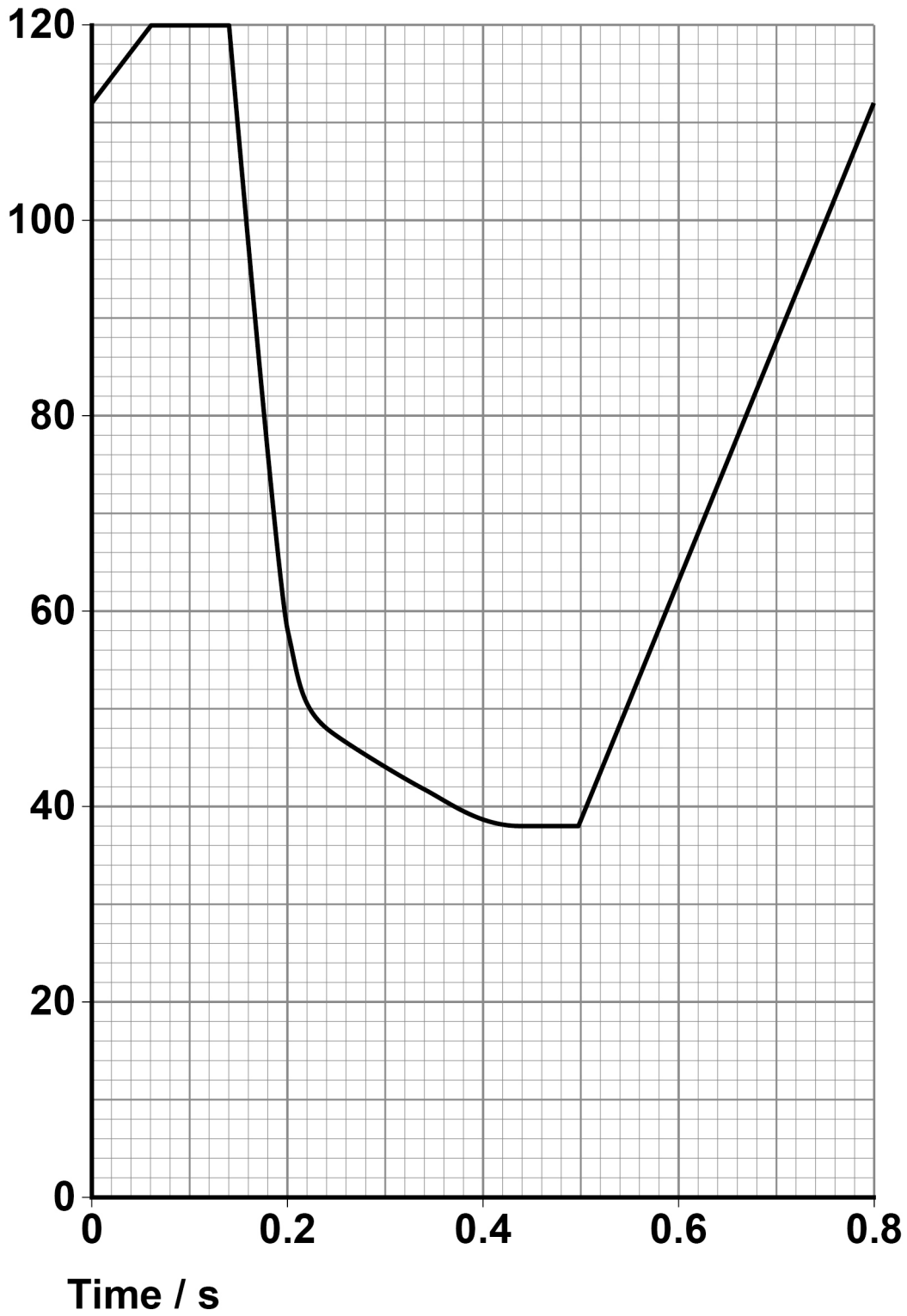
Use FIGURE 5 to calculate the total volume of blood pumped from the left ventricle in 1 minute. [2 marks]

Answer _____ **cm³**



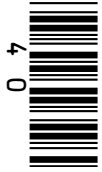
FIGURE 5

Blood volume
/ cm^3



[Turn over]





Scientists investigated the correlation between patients' blood pressure (bp) and the risk of these patients developing cardiovascular disease.

They grouped the blood pressure measurements into four health categories: low, ideal, pre-high and high blood pressure.

FIGURE 6, on the opposite page, shows the scientists' results.

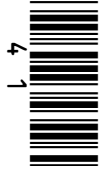
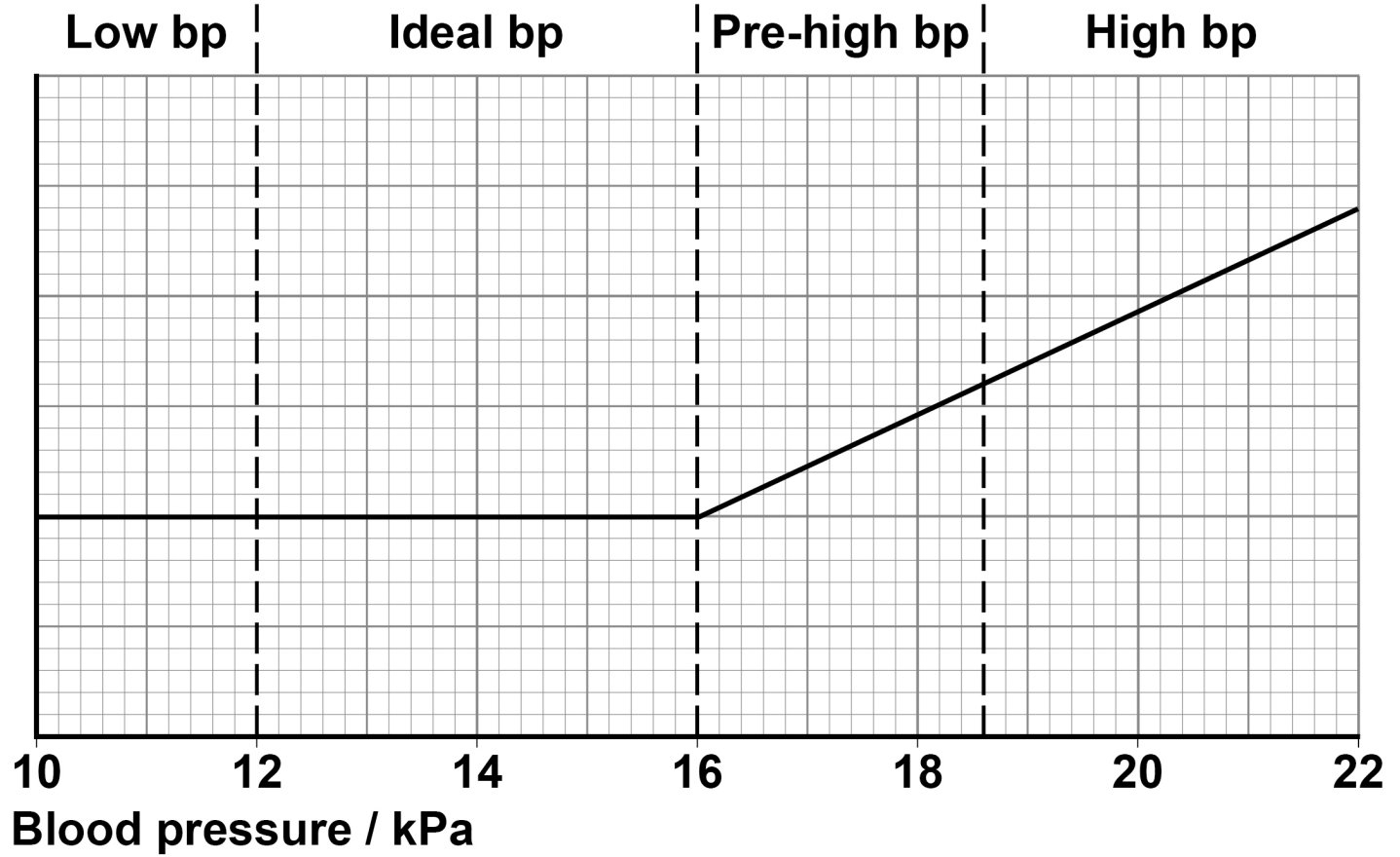


FIGURE 6

**Relative risk of
cardiovascular
disease**



[Turn over]



In a separate investigation, a doctor measured the effect of blood pressure medicines on treating a large number of patients with a mean blood pressure of 22 kPa

The doctor used two different treatments.

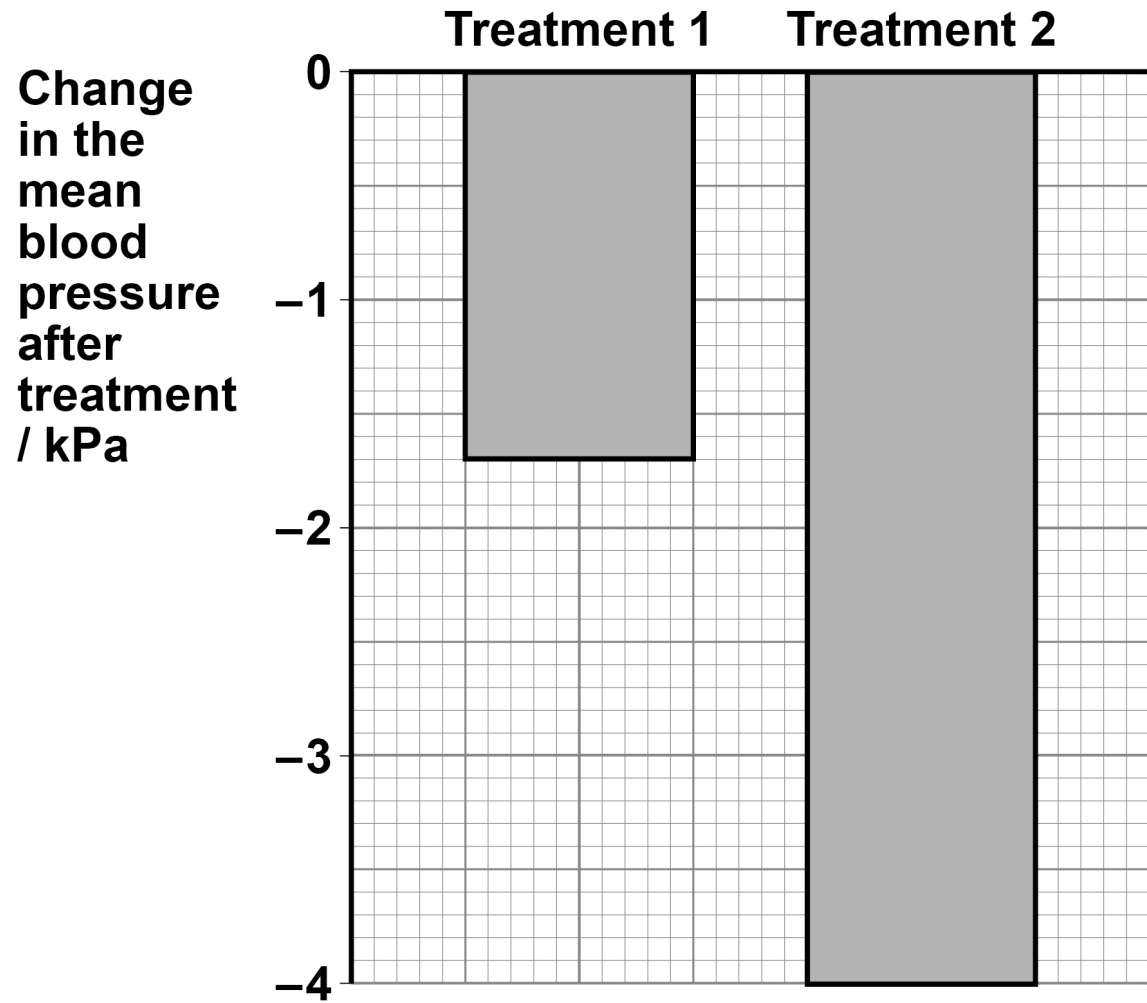
- **Treatment 1 contained one blood pressure medicine.**
- **Treatment 2 contained three blood pressure medicines.**

He measured the change in the mean blood pressure after each treatment in these patients.

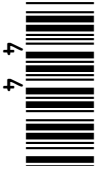
FIGURE 7, on the opposite page, shows his results.



FIGURE 7

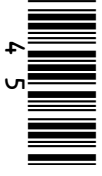


[Turn over]



0 6 . 3

Using information in FIGURE 6, on page 41, and FIGURE 7, on page 43, evaluate the effect of these treatments on reducing the risk of developing cardiovascular disease in patients with a mean blood pressure of 22 kPa [4 marks]



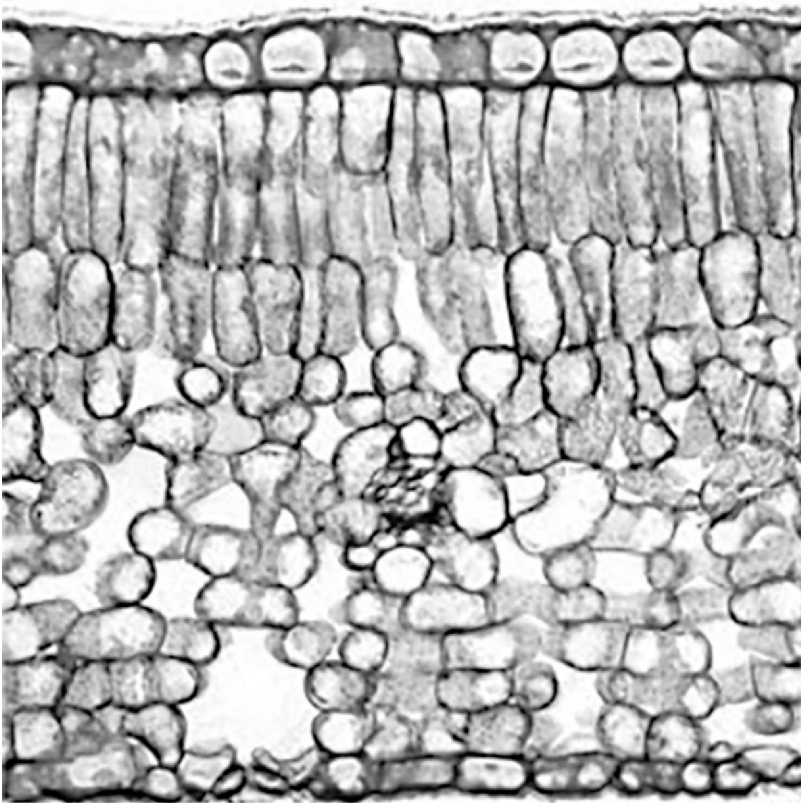
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8

07

FIGURE 8 is a photograph of a vertical section through a leaf observed using an optical microscope.

FIGURE 8

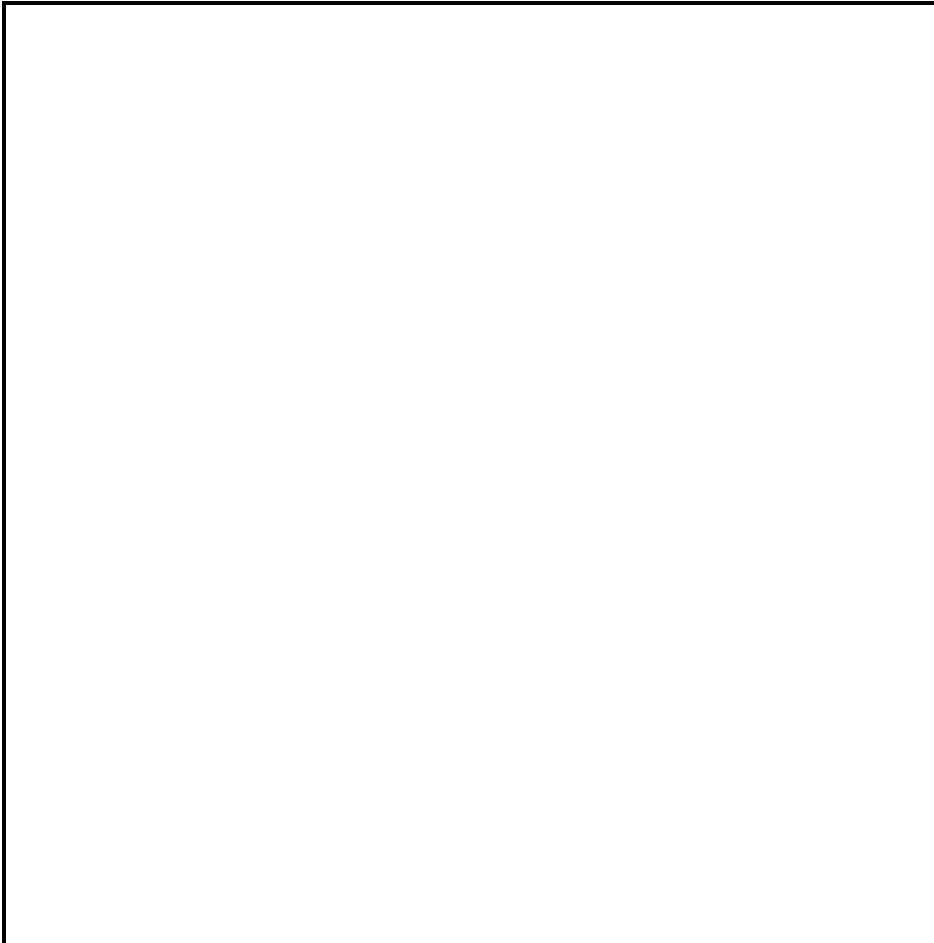


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In the box below:

- produce a scientific drawing of the arrangement of tissues shown in **FIGURE 8**, on the opposite page
- label **ONE** of the tissues in your drawing.

Do NOT draw individual cells. [3 marks]



[Turn over]



A scientist investigated factors that affect the shelf life of cut flowers.

A cut flower is the part of the stem with the flower bud attached after it has been cut from a plant.

The shelf life is the number of days the cut flowers are in good enough condition to be sold.

He:

- took 12 cut flowers from a rose plant
- determined the mean number of stomata per mm^2 on the leaves
- determined the transpiration rate for each cutting
- stored the cut flowers on a shelf in a brightly lit room
- determined the shelf life of the cut flowers.

TABLE 4 shows his results.

TABLE 4

Month cut flowers were obtained	Mean number of stomata / mm^{-2} (± 2 SD)	Mean transpiration rate / $\text{cm}^3 \text{ day}^{-1}$ (± 2 SD)	Mean shelf life / days (± 2 SD)
December	23 (± 2)	22 (± 3)	5 (± 1)
April	20 (± 3)	15 (± 2)	16 (± 2)



A value of ± 2 SD (standard deviations) from the mean includes over 95% of the data.

07.2

Using information in TABLE 4, what can you conclude about the effect of different factors on the mean shelf life of cut flowers?

Explain your conclusions. [4 marks]

[Turn over]



0 7 . 3

Other than a change in temperature, give ONE change the scientist could make to the environmental conditions to increase the cut flowers' shelf life.

Explain your answer. [3 marks]



[Turn over]

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10



08

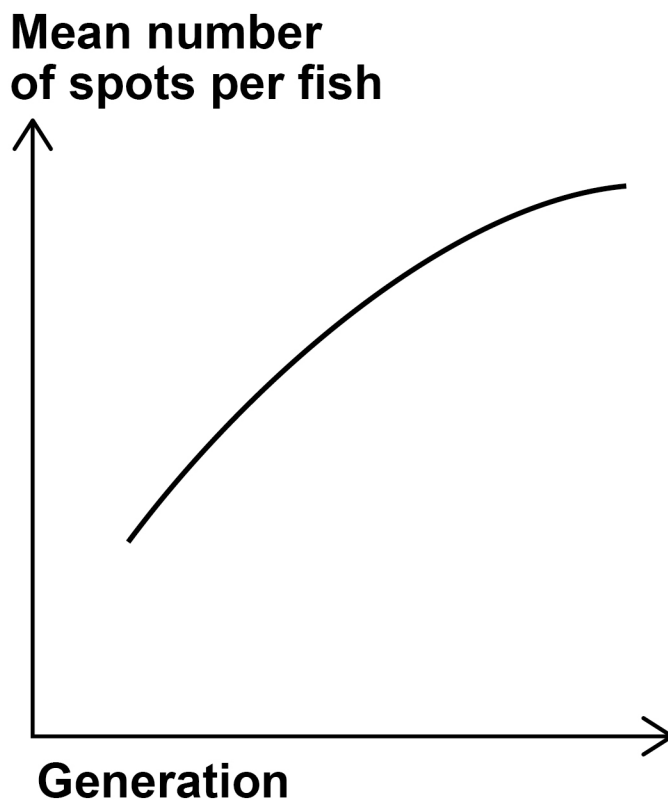
Guppies are small fish with brightly coloured spots on their body.

The number of spots on a guppy is controlled by genes.

A scientist investigated guppy breeding in a large population of guppies in a fish tank. The fish tank contained brightly coloured stones. After each generation of breeding, she counted the number of spots on every guppy.

FIGURE 9 shows her results.

FIGURE 9



0	8	.	1
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The scientist concluded that the mean number of spots on the guppies changed in this fish tank because the brightly coloured stones had affected the behaviour of the guppies.

The guppies did NOT behave aggressively towards each other and their feeding behaviour did NOT change.

Suggest ONE type of guppy behaviour that could be affected by the presence of brightly coloured stones. [1 mark]

[Turn over]



0	8	.	2
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Suggest:

- a further investigation the scientist could do to confirm that the brightly coloured stones had affected guppy behaviour
- a null hypothesis for the new investigation.

[2 marks]

Further investigation _____

Null hypothesis _____



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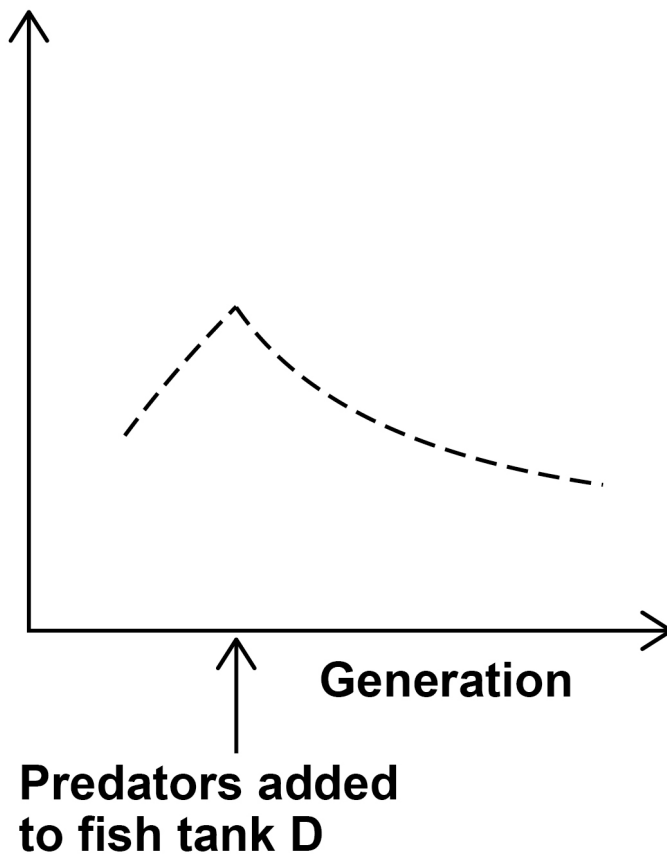
08.3

The scientist repeated the investigation of guppy breeding in an identical fish tank, but added predators of the guppies into the fish tank at the fourth generation of breeding.

FIGURE 10 shows her results.

FIGURE 10

Mean number
of spots per fish



Name the type of selection the scientist investigated in this fish tank.

Explain why this selection affected the frequency of alleles in the population of guppies in this fish tank.
[4 marks]

Type of selection _____

Explanation _____

[Turn over]



<hr/>
7



09.1

Describe how the structure of the insect gas exchange system:

- provides cells with sufficient oxygen**
- limits water loss.**

Explain your answers. [5 marks]

[Turn over]





[Turn over]



09.2

Describe how humans breathe in and out. [5 marks]

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For Examiner's Use	
Question	Mark
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