



**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]**



**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**

**What is a gene? [1 mark]**

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**0 1 . 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]**

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**[Turn over]**



**01.3**

**Scientists produced a short, single-stranded, artificial nucleic acid, called PNA. The PNA binds to a small section of DNA.**

**The scientists introduced PNA into cells and discovered that these cells produced less mRNA than cells that did not contain PNA.**

**Suggest how PNA affected the transcription of the section of DNA.  
[2 marks]**

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**[Turn over]**



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**Describe the role of ATP in the process of translation in protein synthesis.**

**[2 marks]**

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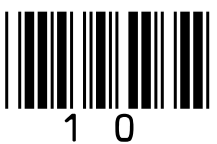


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**What term is used to describe the different structures of  $\alpha$ -glucose and  $\beta$ -glucose? [1 mark]**

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**0 2 . 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]**

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**[Turn over]**



**0 2 . 3**

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

**Give TWO variables the student controlled. [2 marks]**

**1** \_\_\_\_\_

**2** \_\_\_\_\_

**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**

**[Turn over]**



**0 2 . 5**

**Iodine solution stains fresh apple tissue black. When iodine solution is added to apples stored for a week, the stain is less black.**

**The water potential of apple juice decreases when apples are stored.**

**Suggest why the water potential of apple juice decreases when apples are stored.  
[2 marks]**

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**[Turn over]**

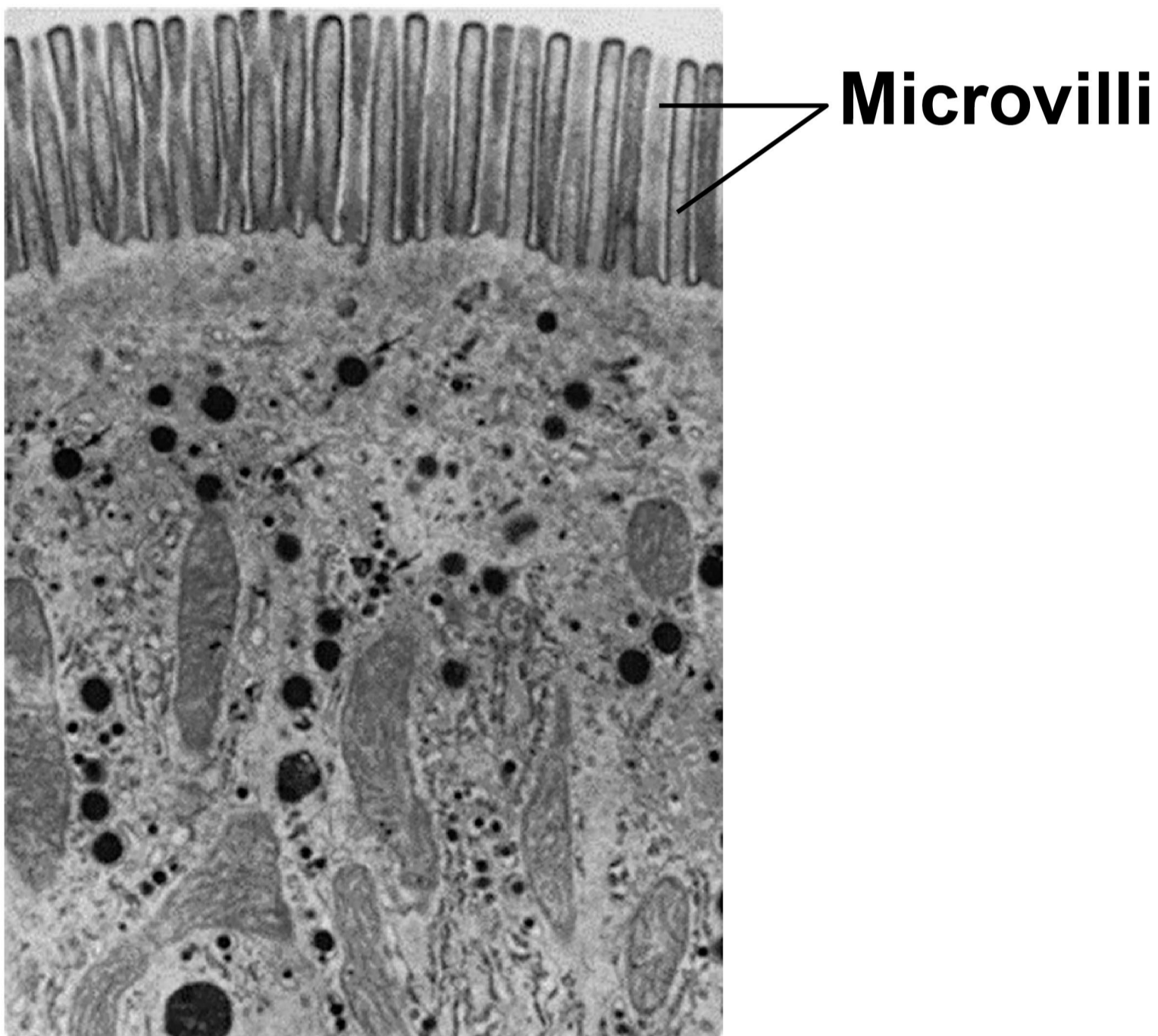
8



03

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

**FIGURE 1**





03.1

**Describe and explain TWO ways that structures shown in FIGURE 1 increase the rate of absorption by this cell.**

**[2 marks]**

1 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
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\_\_\_\_\_  
\_\_\_\_\_

**[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  $\pi$  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.**

**Show your working. [2 marks]**

**Ratio \_\_\_\_\_ :1**

**[Turn over]**



**0 3 . 3**

**The protein ZO-1 is found on the surface of ileum cells.**

**A scientist used an anti-ZO-1 monoclonal antibody to identify ileum cells in a sample of intestine observed using an optical microscope.**

**Suggest how the monoclonal antibody helped the scientist to identify ileum cells in the sample of intestine.**

**[3 marks]**

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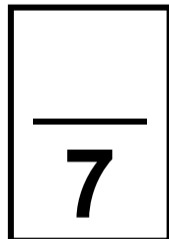
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[Turn over]



0 4 . 1

**Describe how the process of meiosis results in haploid cells.**

**Do NOT include descriptions of how genetic variation is produced in meiosis. [4 marks]**

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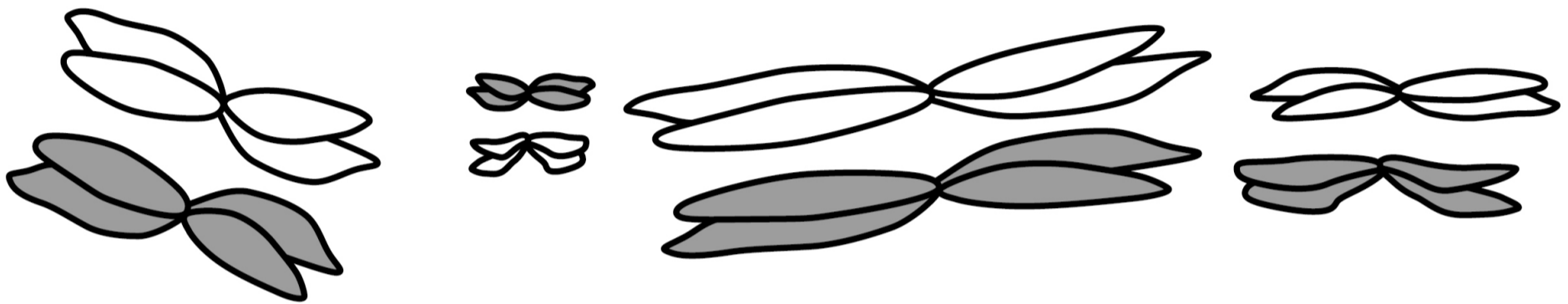
**[Turn over]**



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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**Draw a diagram to show the chromosomes in one gamete produced by meiosis from the cell shown in FIGURE 2, on page 24. [1 mark]**

**[Turn over]**



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**FIGURE 3, on the opposite page, shows the life cycle of a fungus. The life cycle includes sexual reproduction.**

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

**Tick (✓) ONE box.**

**Binary fission**

**Fertilisation**

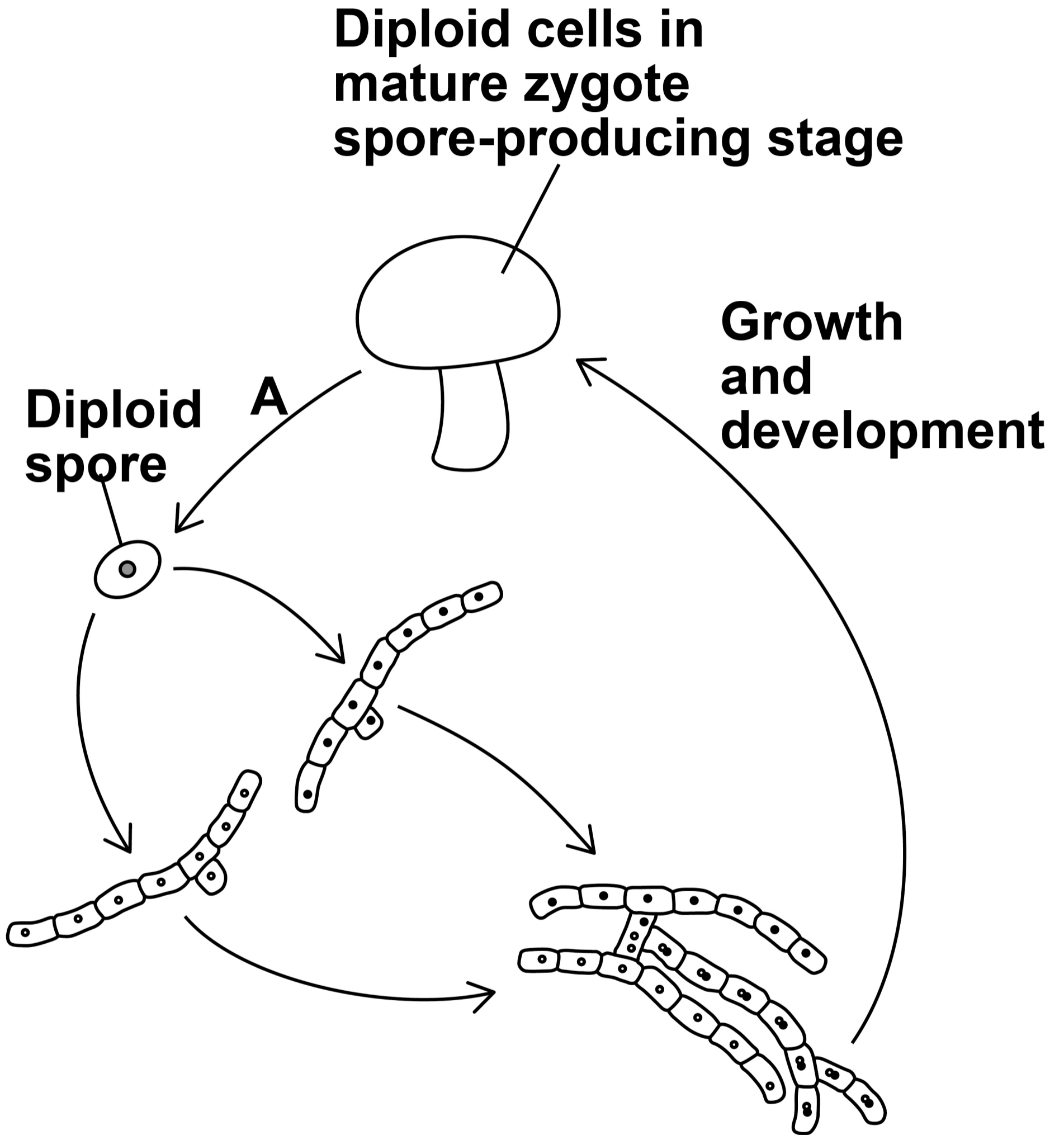
**Meiosis**

**Mitosis**

8



**FIGURE 3**



**[Turn over]**



05.1

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

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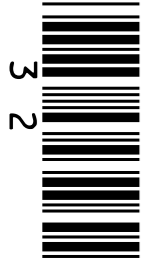
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**[Turn over]**





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

**TABLE 1**

<b>TAXON NAME</b>	<b>SCIENTIFIC NAME</b>
<b>Class</b>	<b>Mammalia</b>
<b>Order</b>	<b>Perissodactyla</b>
<b>Family</b>	<b>Rhinocerotidae</b>
<b>Genus</b>	<b>Rhinoceros</b>
<b>Species</b>	<b>Unicornis</b>

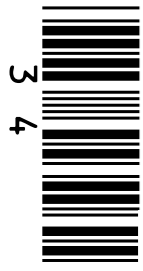
**FIGURE 4, on page 34, shows the relationship between the taxa in the classification of two rhinoceros species: 'Rhinoceros unicornis' and 'Dicerorhinus sumatrensis'.**



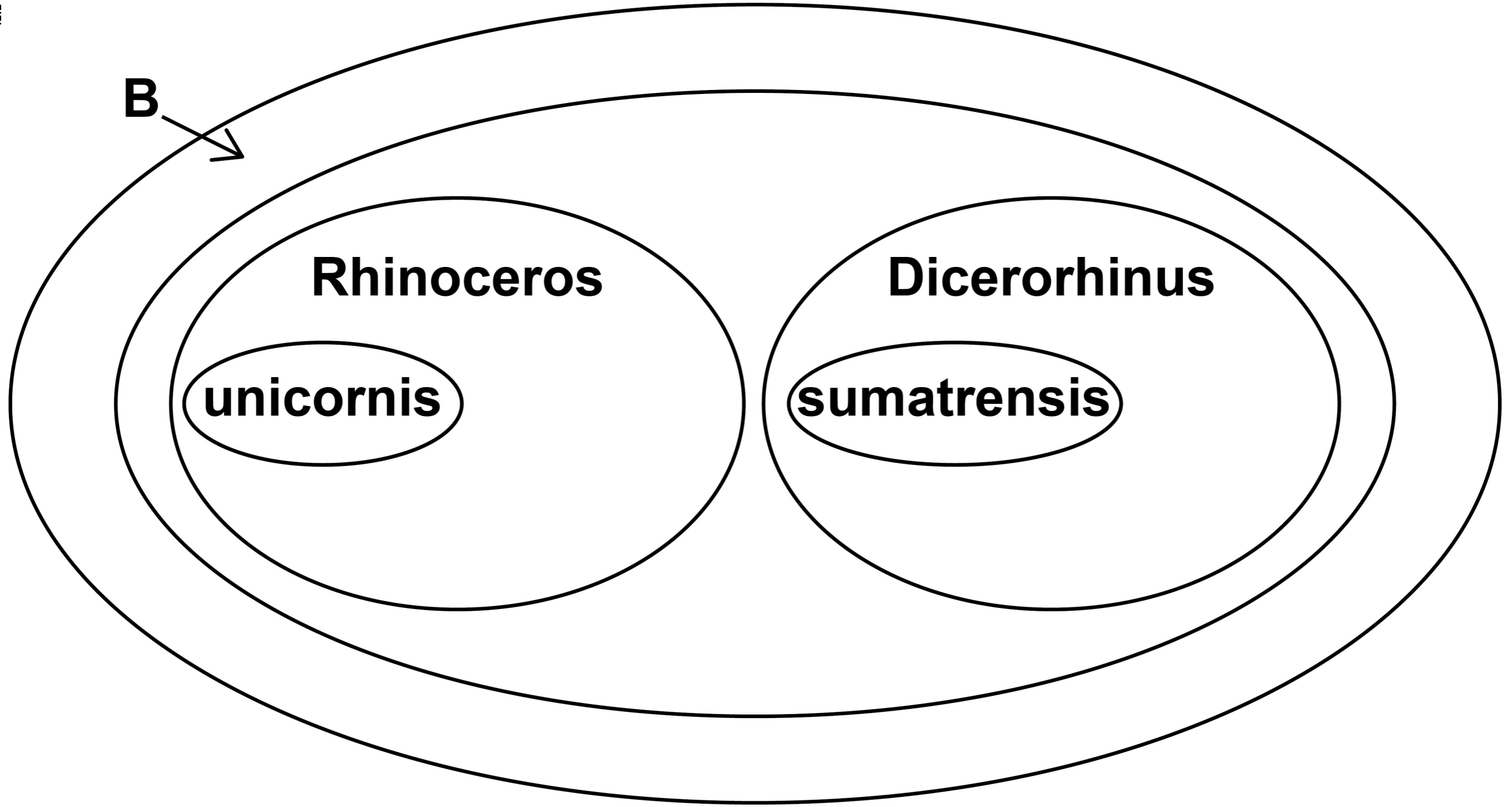


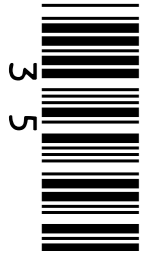
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**[Turn over]**



**FIGURE 4**





**0 5 . 2**

**Use information in TABLE 1, on page 32, to give the SCIENTIFIC name of the taxon labelled B in FIGURE 4. [1 mark]**

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**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, on the opposite page, shows their results.**



**TABLE 2**

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

**[Turn over]**

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0 5 . 4

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

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**[Turn over]**



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**[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**

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**Suggested change to the procedure**

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**[Turn over]**

<b>10</b>



**06.1**


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

- **carrying a scalpel**
- **using a scalpel.**

**Complete TABLE 3, on the opposite page, 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
<b>Sharp knife</b>	 <b>DANGER</b>	1.
		2.
		3.

**[Turn over]**



**06.2**

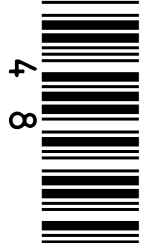
**A scientist measured the changes in blood volume inside the left ventricle of a mammalian heart during one heartbeat. FIGURE 5, on the opposite page, shows her results.**

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

**Answer** \_\_\_\_\_ **cm<sup>3</sup>**



**FIGURE 5****Blood volume  
/ cm<sup>3</sup>****[Turn over]**

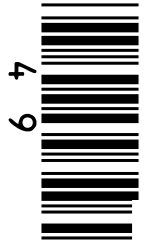


**Scientists investigated the correlation between patients' blood pressure (bp) and the risk of these patients developing cardiovascular disease.**

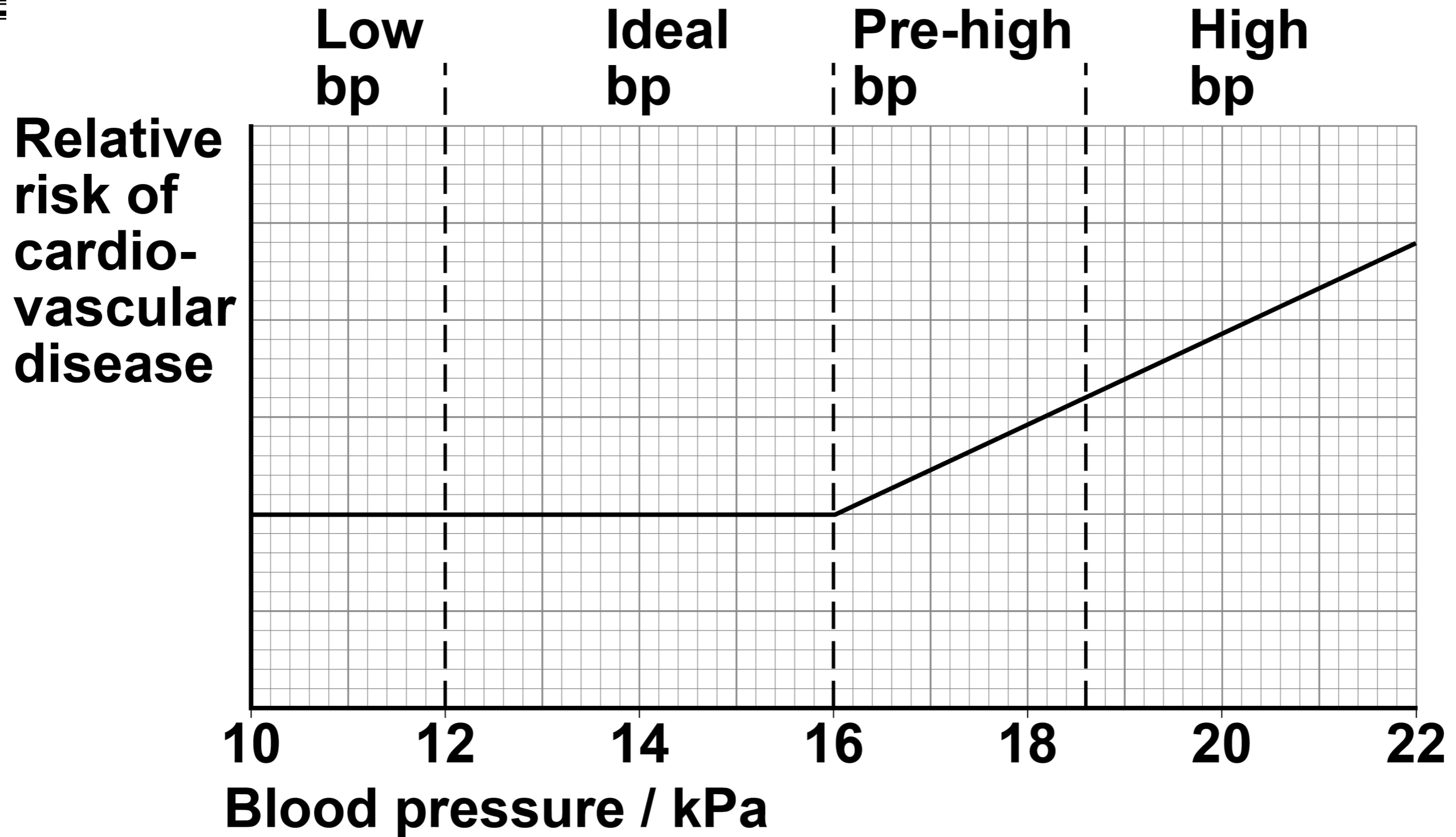
**They grouped the blood pressure measurements into four health categories: low, ideal, pre-high and high blood pressure.**

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

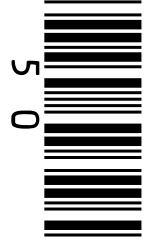




**FIGURE 6**



**[Turn over]**



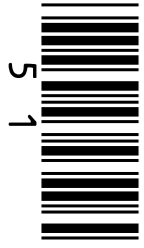
**In a separate investigation, a doctor measured the effect of blood pressure medicines on treating a large number of patients with a mean blood pressure of 22 kPa**

**The doctor used two different treatments.**

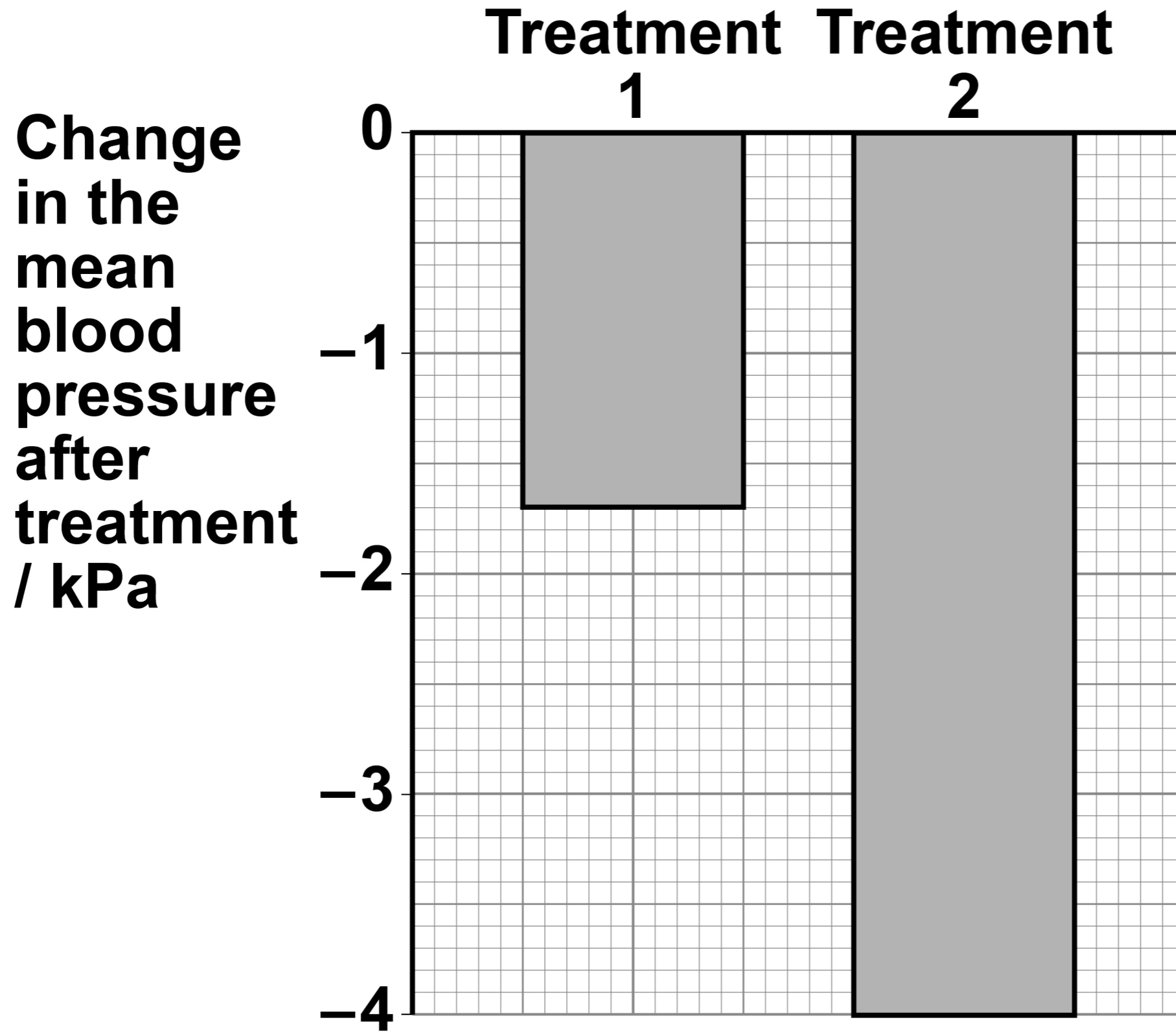
- Treatment 1 contained one blood pressure medicine.**
- Treatment 2 contained three blood pressure medicines.**

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

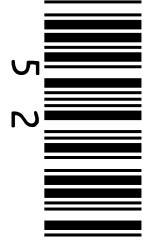
**FIGURE 7, on the opposite page, shows his results.**



**FIGURE 7**



**[Turn over]**



**0 6 . 3**

**Using information in FIGURE 6, on page 49, and FIGURE 7, on page 51, 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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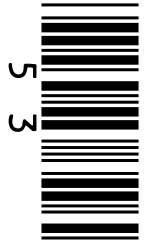
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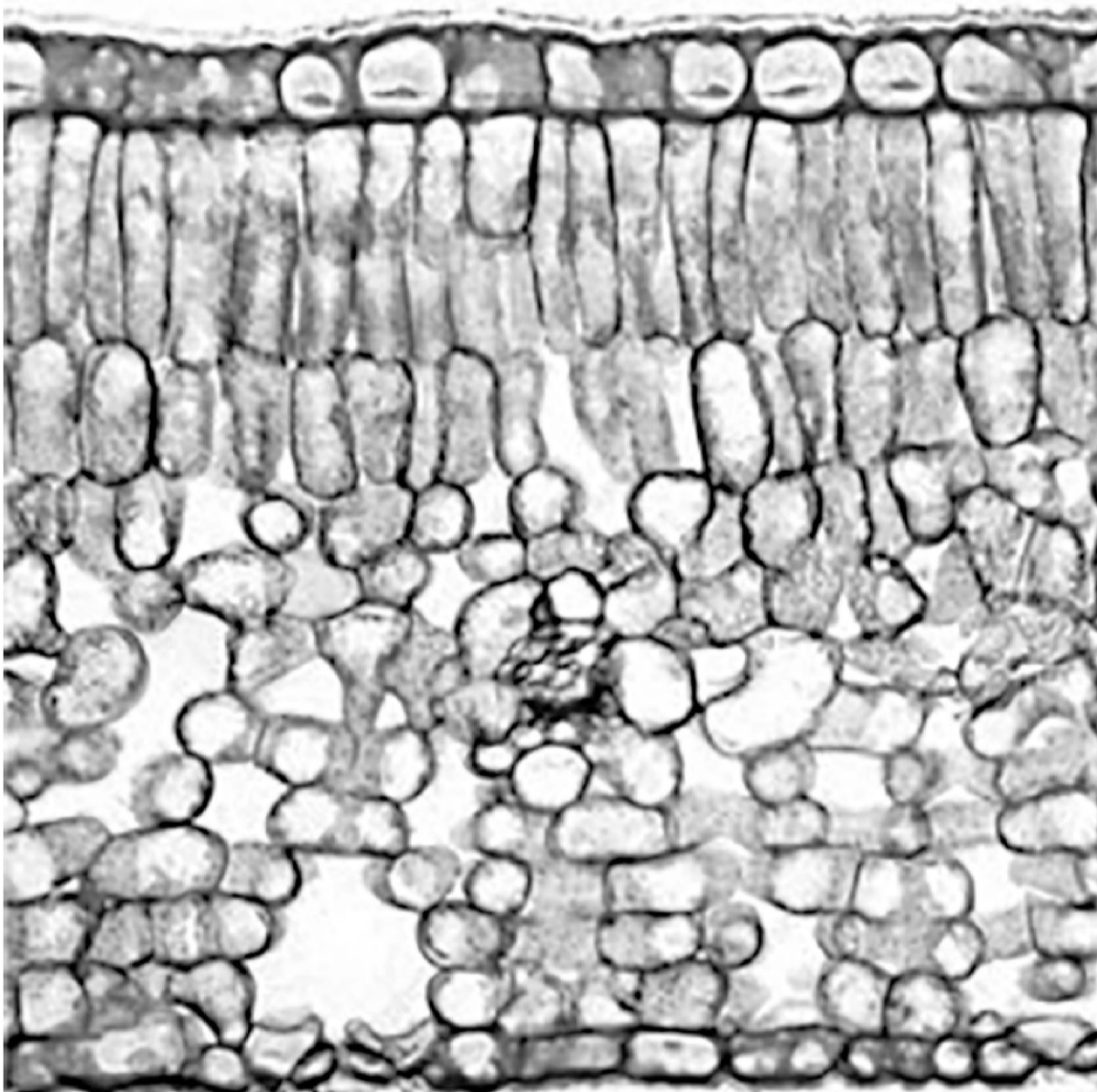
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[Turn over]

07

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

**FIGURE 8**



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**[Turn over]**



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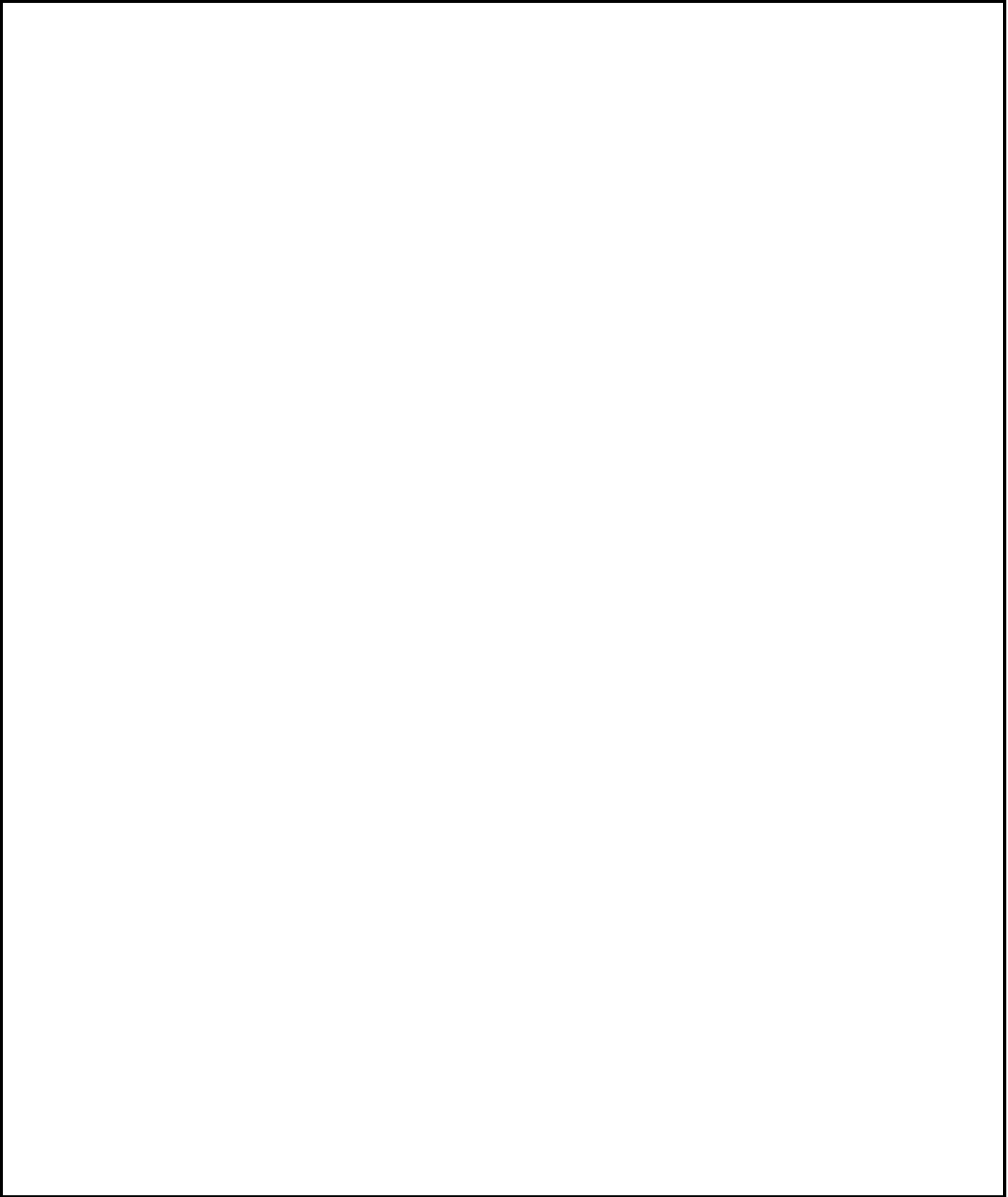
**In the box, on the opposite page:**

- **produce a scientific drawing of the arrangement of tissues shown in FIGURE 8, on page 54**
- **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<sup>2</sup> 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.**

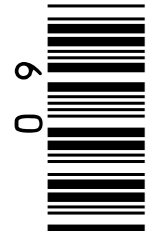
**TABLE 4, on page 60, shows his results.**



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**[Turn over]**



**TABLE 4**

<b>Month cut flowers were obtained</b>	<b>Mean number of stomata / mm<sup>-2</sup> (<math>\pm 2</math> SD)</b>	<b>Mean transpiration rate / cm<sup>3</sup> day<sup>-1</sup> (<math>\pm 2</math> SD)</b>	<b>Mean shelf life / days (<math>\pm 2</math> SD)</b>
<b>December</b>	<b>23 (<math>\pm 2</math>)</b>	<b>22 (<math>\pm 3</math>)</b>	<b>5 (<math>\pm 1</math>)</b>
<b>April</b>	<b>20 (<math>\pm 3</math>)</b>	<b>15 (<math>\pm 2</math>)</b>	<b>16 (<math>\pm 2</math>)</b>

**A value of  $\pm 2$  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]**

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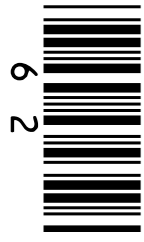
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**[Turn over]**





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**[Turn over]**

07.3

**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]**

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**[Turn over]**

<b>10</b>



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**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, on page 68, shows her results.**



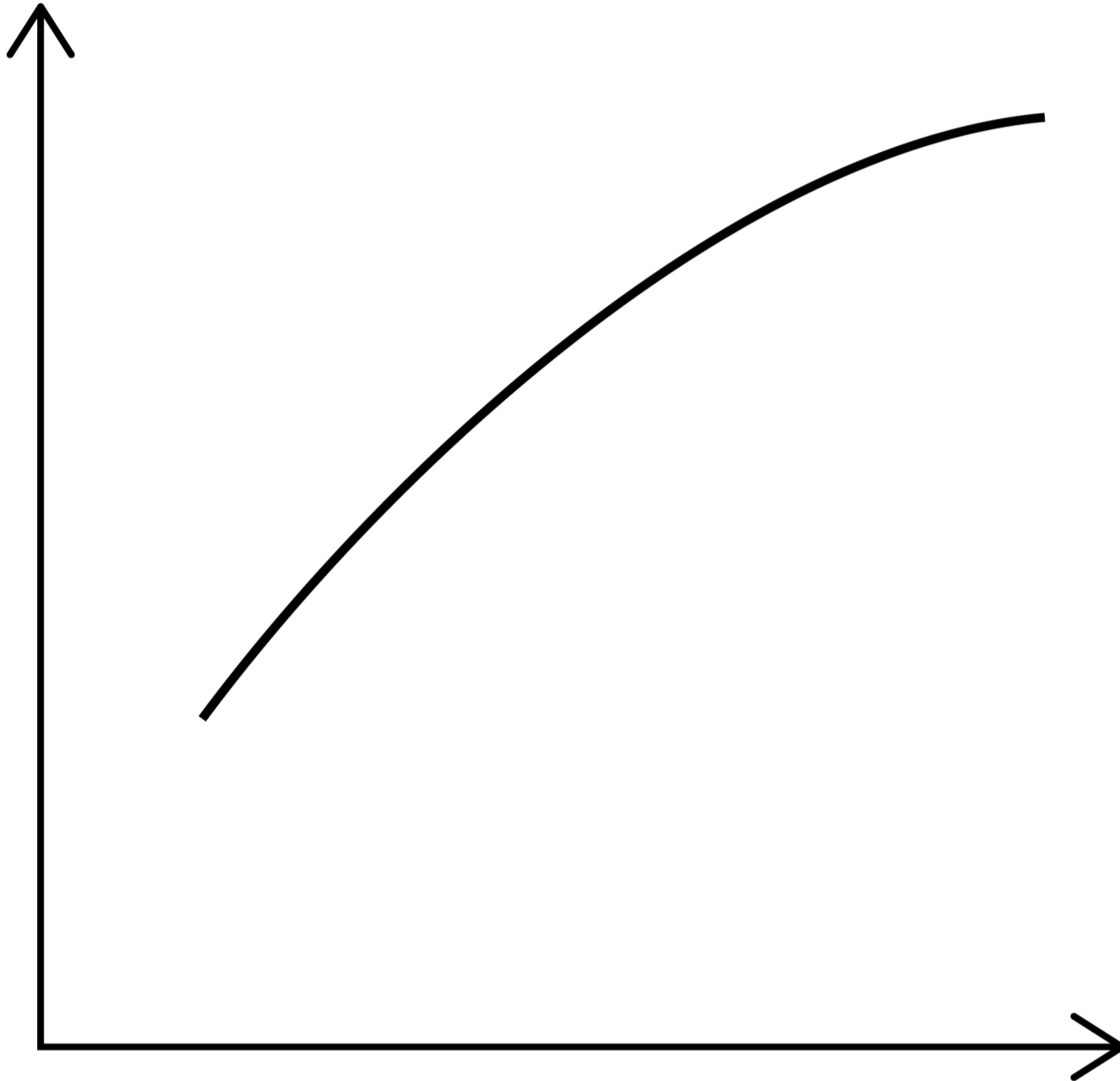
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**FIGURE 9**

**Mean number  
of spots per fish**



**Generation**



**08.1**

**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]**

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**[Turn over]**



08.2

**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** \_\_\_\_\_

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**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.**

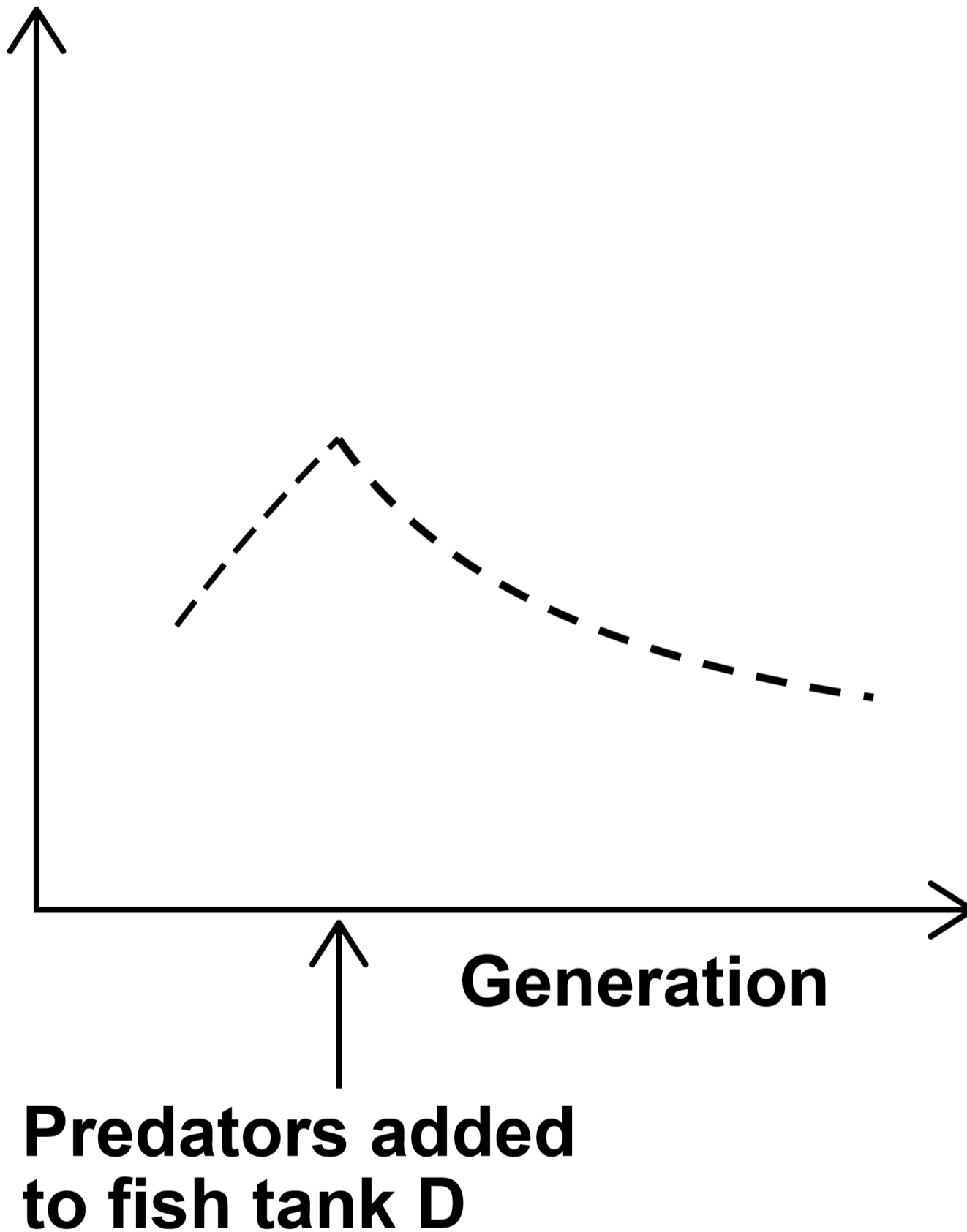
**FIGURE 10, on page 72, shows her results.**

**[Turn over]**



**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** \_\_\_\_\_

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**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]**

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**[Turn over]**



09.2

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

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**END OF QUESTIONS**

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**Additional page, if required.  
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left-hand margin.**






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For Examiner's Use	
Question	Mark
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<b>TOTAL</b>	

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