



**Surname** \_\_\_\_\_

**Other Names** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** \_\_\_\_\_

**Candidate Signature** \_\_\_\_\_

**GCSE**

**BIOLOGY**

**H**

**Higher Tier Paper 2H**

**8461/2H**

**Friday 7 June 2019**

**Afternoon**

**Time allowed: 1 hour 45 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**
- **a scientific calculator.**

## **INSTRUCTIONS**

- **Use black ink or black ball-point pen.**
- **Answer ALL questions in the spaces provided.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**
- **In all calculations, show clearly how you work out your answer.**



## **INFORMATION**

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

**DO NOT TURN OVER UNTIL TOLD TO DO SO**

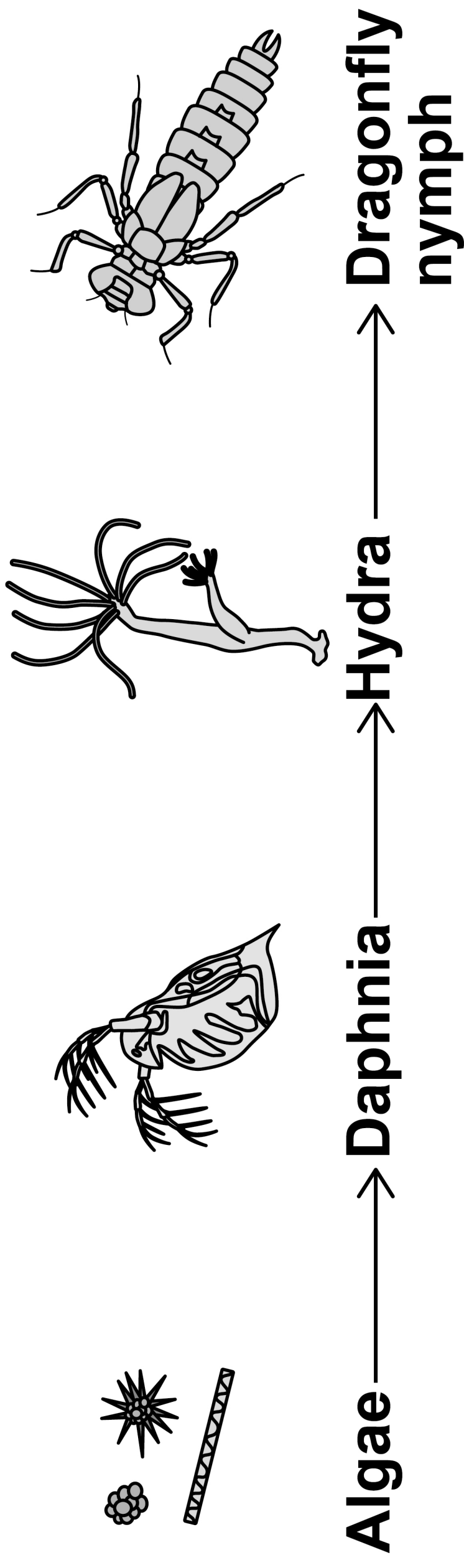


**Answer ALL questions in the spaces provided.**

**0 1**

**FIGURE 1 shows a food chain in a pond.**

**FIGURE 1**



01.1

**Which term describes the Daphnia in this food chain?**

**[1 mark]**

**Tick (✓) ONE box.**

**Apex predator**

**Primary consumer**

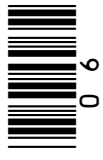
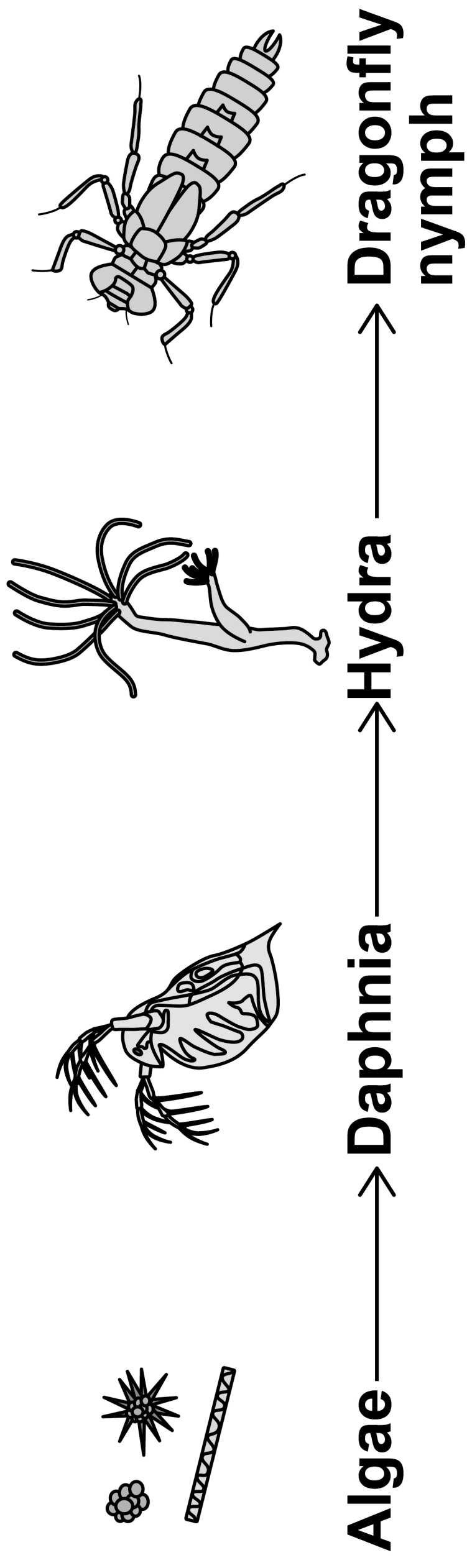
**Producer**

**Secondary consumer**

**[Turn over]**



# Repeat of FIGURE 1



**01.2**

**Draw a pyramid of biomass for the food chain.**

**Label each trophic level. [2 marks]**

**7**

**[Turn over]**



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01.3

**Give ONE reason why the total biomass of the Daphnia in the pond is different from the total biomass of the algae. [1 mark]**

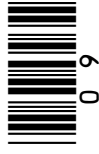
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**9**

**[Turn over]**



**Students investigated the size of the population of Daphnia in the pond.**

**This is the method used.**

- 1. Collect 1 dm<sup>3</sup> of pond water from near the edge of the pond.**
- 2. Pour the water through a fine net.**
- 3. Count the number of Daphnia caught in the net.**
- 4. Repeat steps 1–3 four more times.**

**TABLE 1 shows the results.**

**TABLE 1**

<b>Sample number</b>	<b>Number of Daphnia in 1 dm<sup>3</sup> water</b>
<b>1</b>	<b>5</b>
<b>2</b>	<b>21</b>
<b>3</b>	<b>0</b>
<b>4</b>	<b>16</b>
<b>5</b>	<b>28</b>



0	1	.	5
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**The pond was a rectangular shape, measuring:**

- **length = 2.5 metres**
- **width = 1.5 metres**
- **depth = 0.5 metres.**

**Calculate the estimated number of Daphnia in the pond.**

**Use your answer from Question 01.4 on page 11.**

**Give your answer in standard form.  
[4 marks]**

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**Rainfall can cause fertiliser to be washed from farmland into a pond.**

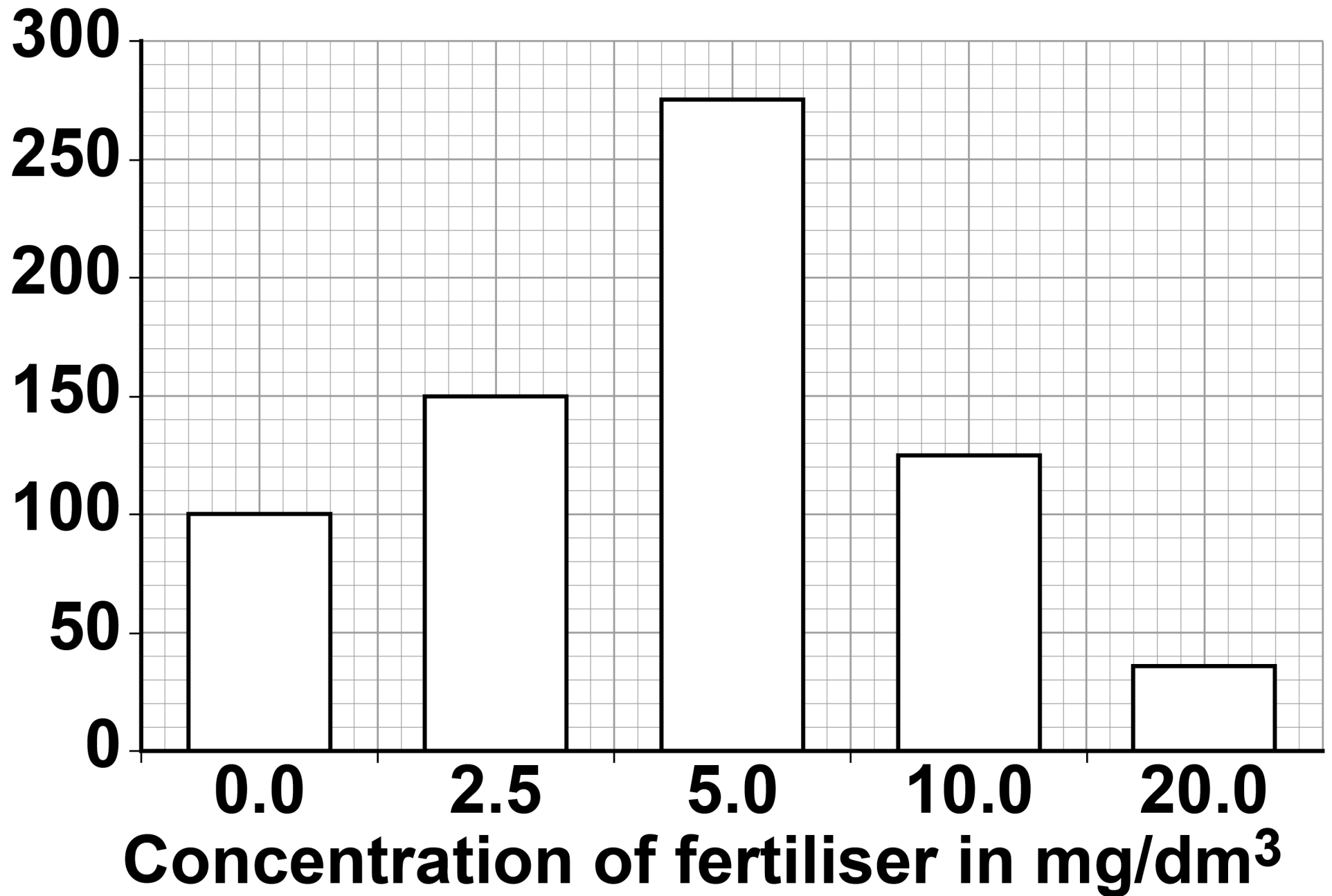
**The students investigated the effect of fertiliser on the population of Daphnia in water from the pond.**

- **The students put 20 Daphnia in each of five different concentrations of fertiliser.**
- **The students counted the total number of Daphnia in each concentration of fertiliser after 2 weeks.**

**FIGURE 2, on the opposite page, shows the results.**

**FIGURE 2**

**Total number  
of Daphnia  
after 2 weeks**



**[Turn over]**



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0	1	.	6
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**A concentration of  $5.0 \text{ mg/dm}^3$  of fertiliser caused a large increase in the population of Daphnia.**

**Explain why. [2 marks]**

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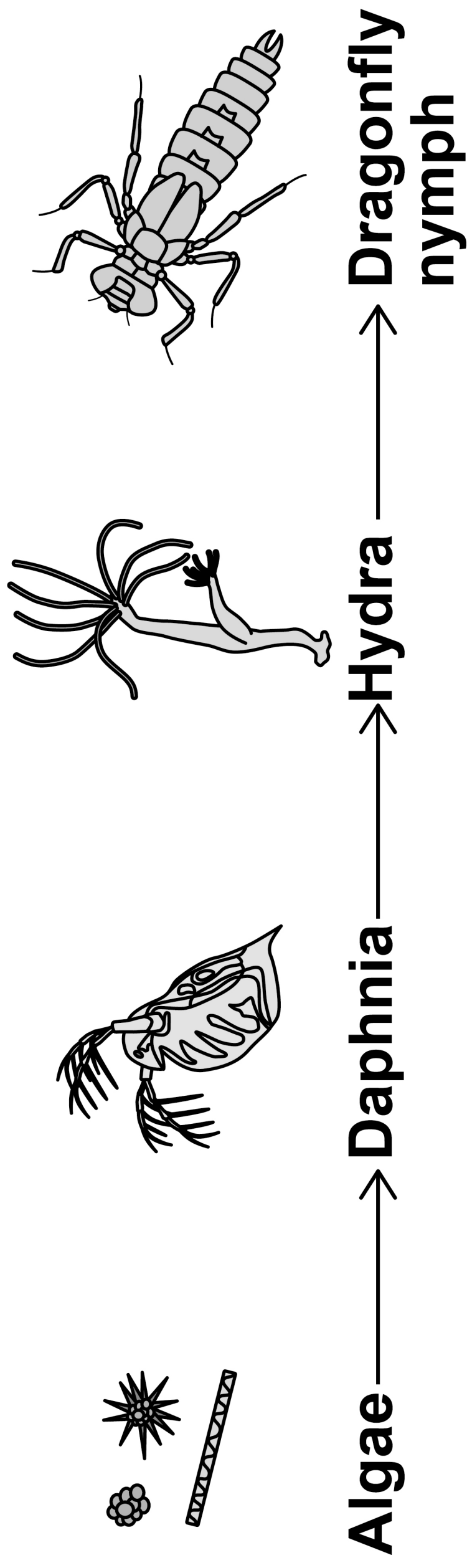
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**[Turn over]**

01.7

FIGURE 1 is repeated below.

FIGURE 1



**The population of HYDRA will decrease when 20 mg/dm<sup>3</sup> of fertiliser is added to the pond.**

**Explain why. [2 marks]**

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**[Turn over]**



**0 2**

**Genetic material is made of DNA.**

**0 2 . 1**

**Which structures in the nucleus of a human cell contain DNA? [1 mark]**

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**FIGURE 3, on the opposite page, shows part of one strand of a DNA molecule.**

**0 2 . 2**

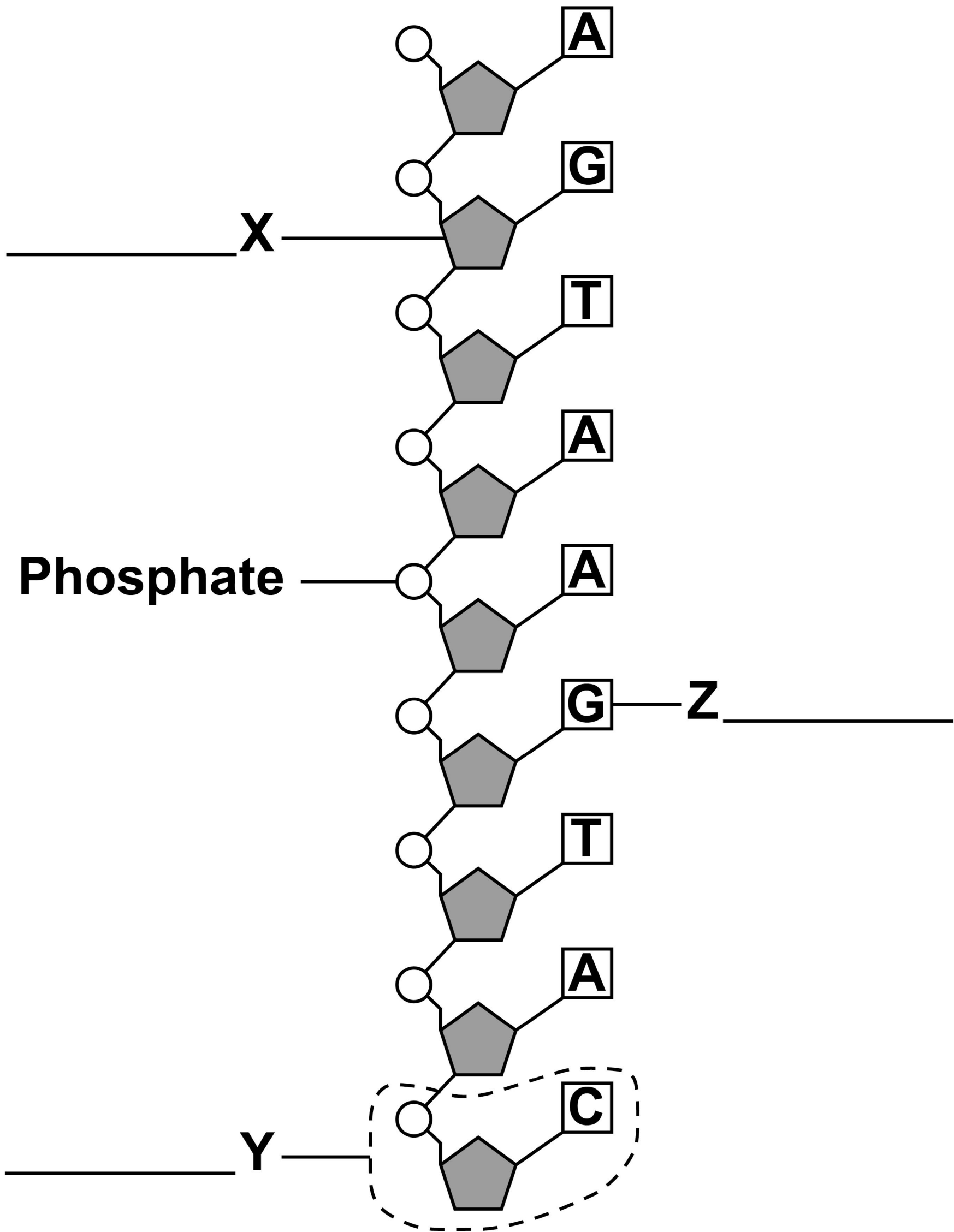
**Label parts X, Y and Z on FIGURE 3. [3 marks]**

**Choose answers from the list below.**

- **Base**
- **Fatty acid**
- **Nucleotide**
- **Sugar**
- **Glycerol**



FIGURE 3



[Turn over]



0	2	.	3
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**A complete DNA molecule is made of two strands twisted around each other.**

**What scientific term describes this structure? [1 mark]**

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**0 2 . 4**

**DNA codes for the production of proteins.**

**A protein molecule is a long chain of amino acids.**

**How many amino acids could be coded for by the piece of DNA shown in FIGURE 3 (on page 21)? [1 mark]**

**Tick (✓) ONE box.**

**2****3****9****18**

**[Turn over]**



0 2 . 5

**Scientists have now studied the whole human genome.**

**Give TWO benefits of understanding the human genome. [2 marks]**

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

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

8



03

**Phototropism is a growth response by part of a plant to light.**

03.1

**Name ONE other tropism.**

**Give the stimulus the plant responds to in the tropism you have named. [2 marks]**

**Tropism** \_\_\_\_\_

\_\_\_\_\_  
**Stimulus** \_\_\_\_\_

\_\_\_\_\_

**[Turn over]**

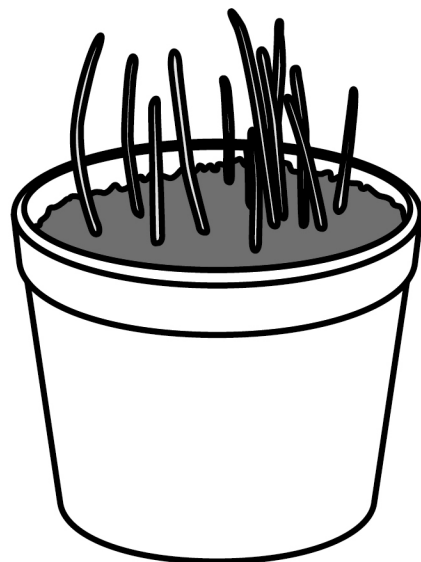
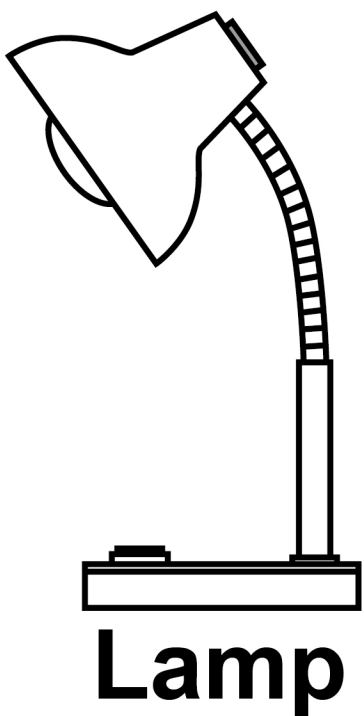
**03.2**

**Plan an investigation to show the effect of light from one direction on the growth of plant seedlings.**

**Include details of any controls needed.**

**You may use some of the equipment shown in FIGURE 4 and any other laboratory apparatus. [6 marks]**

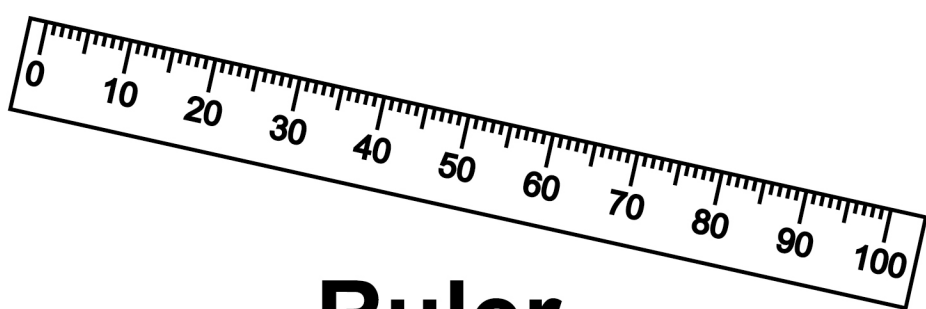
**FIGURE 4**



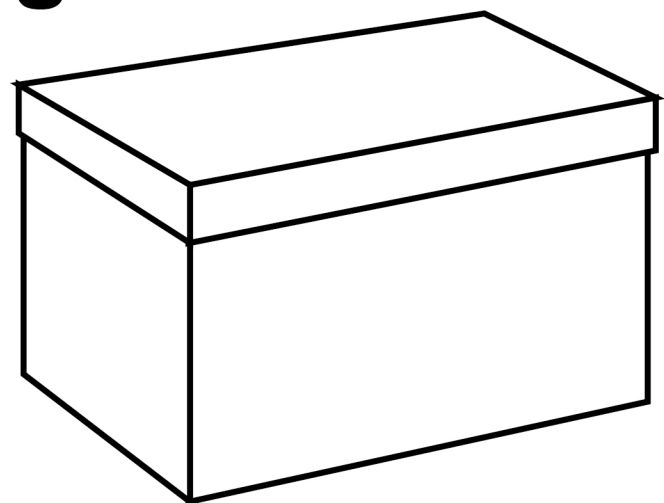
**Several pots  
of seedlings**



**Scissors**



**Ruler**



**Cardboard boxes  
with lids**







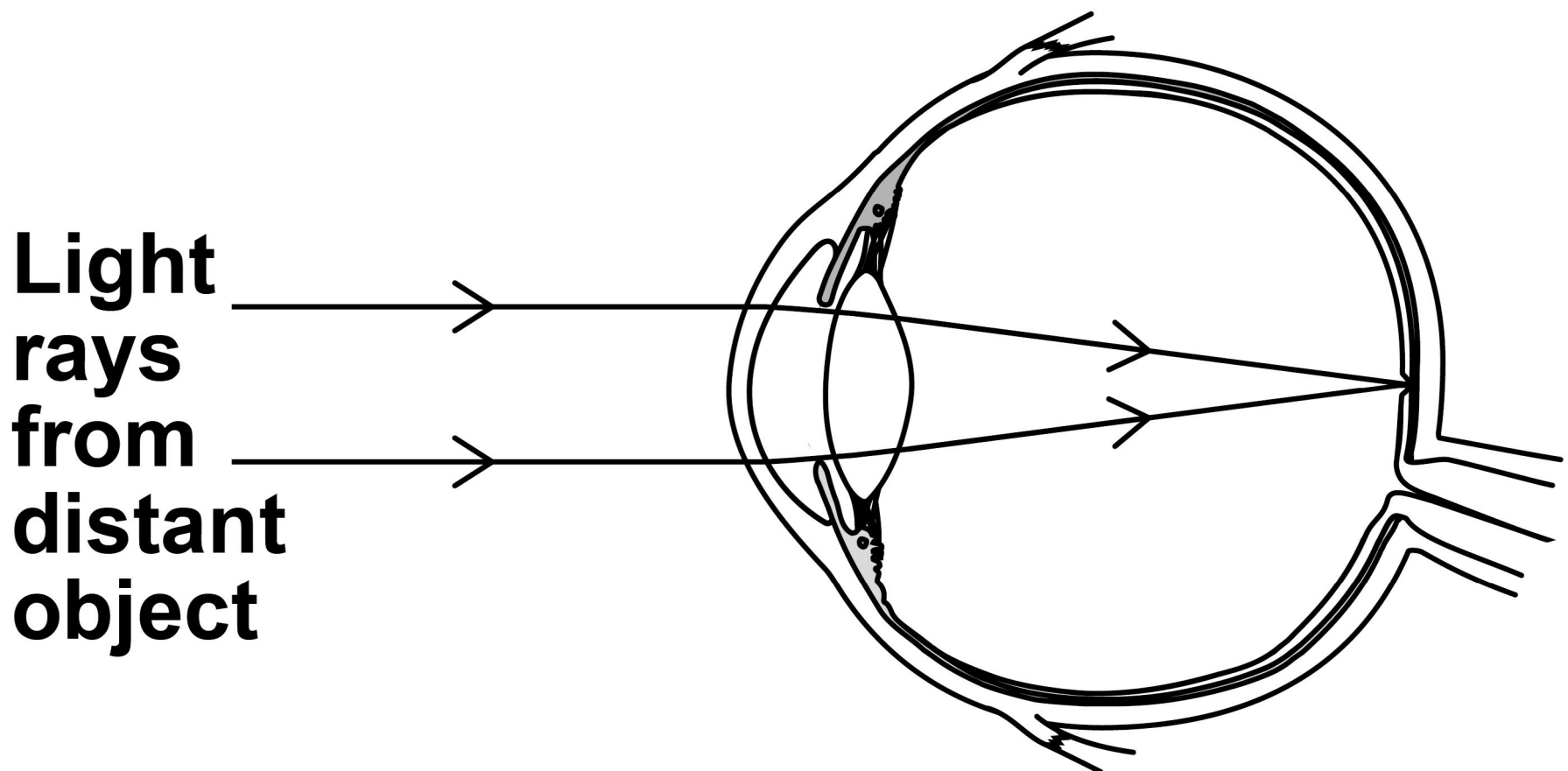


04

The human eye can focus on objects at different distances.

FIGURE 5 shows how a clear image of a **DISTANT** object is formed in a person's eye.

FIGURE 5













0	5
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**TABLE 2, on pages 36 and 37, gives the classification of four plant species.**

**[Turn over]**

**TABLE 2**

<b>Group</b>	<b>Species 1</b>	<b>Species 2</b>
<b>Kingdom</b>	<b>'Plantae'</b>	<b>'Plantae'</b>
<b>Phylum</b>	<b>'Spermatophyta'</b>	<b>'Spermatophyta'</b>
<b>Class</b>	<b>'Monocotyledonae'</b>	<b>'Dicotyledonae'</b>
<b>Order</b>	<b>'Poales'</b>	<b>'Fabales'</b>
<b>Family</b>	<b>'Cyperaceae'</b>	<b>'Fabaceae'</b>
<b>Genus</b>	<b>'Eriophorum'</b>	<b>'Pisum'</b>
<b>Species</b>	<b>'angustifolium'</b>	<b>'sativum'</b>

**TABLE 2 continued**

<b>Group</b>	<b>Species 3</b>	<b>Species 4</b>
<b>Kingdom</b>	<b>'Plantae'</b>	<b>'Plantae'</b>
<b>Phylum</b>	<b>'Spermatophyta'</b>	<b>'Spermatophyta'</b>
<b>Class</b>	<b>'Monocotyledonae'</b>	<b>'Dicotyledonae'</b>
<b>Order</b>	<b>'Poales'</b>	<b>'Scrophulariales'</b>
<b>Family</b>	<b>'Poaceae'</b>	<b>'Scrophulariaceae'</b>
<b>Genus</b>	<b>'Poa'</b>	<b>'Antirrhinum'</b>
<b>Species</b>	<b>'annua'</b>	<b>'majus'</b>

**[Turn over]**



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05.1

**Species 1 and 3 are the most closely related.**

**What information in TABLE 2, on pages 36 and 37, gives evidence for this? [1 mark]**

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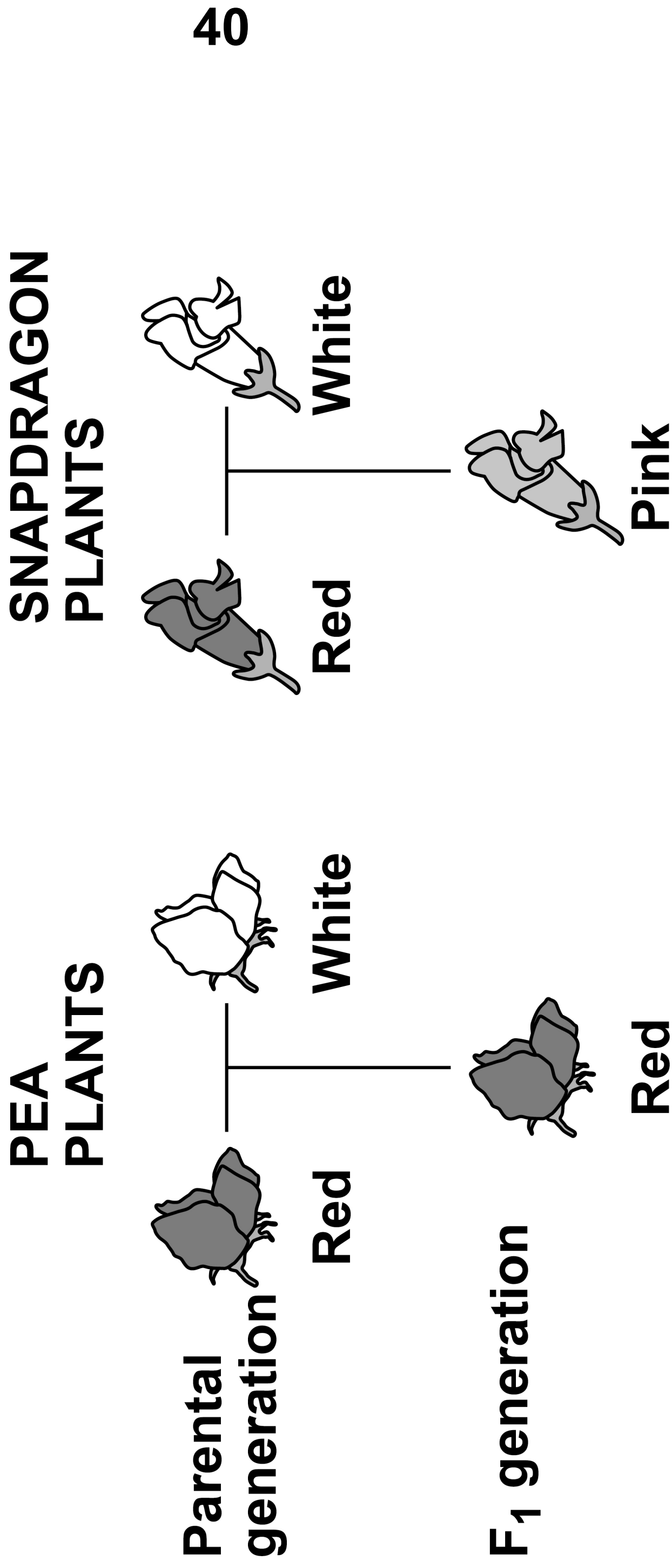
**39**

**[Turn over]**



**FIGURE 6 shows the inheritance of flower colour in two species of plant.**

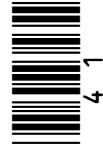
**FIGURE 6**





- **In pea plants and in snapdragon plants, flower colour is controlled by one pair of alleles.**
- **In FIGURE 6 the parental generation plants are homozygous for flower colour.**
- **In heterozygous PEA plants, the allele for red flower colour is dominant.**
- **In heterozygous SNAPDRAGON plants, the alleles for flower colour are both expressed.**

**[Turn over]**



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Use the following symbols for alleles in your answers to Questions 05.2 to 05.4:

**Pea plants**

**R = allele for red flowers**

**r = allele for white flowers**

**Snapdragon plants**

**C<sup>R</sup> = allele for red flowers**

**C<sup>W</sup> = allele for white flowers**

**05.2**

**What is the genotype of the red-flowered pea plants in the F<sub>1</sub> generation? [1 mark]**

---

**05.3**

**What is the genotype of a white-flowered snapdragon plant? [1 mark]**

---



**A gardener crossed two pink-flowered snapdragon plants.**

**0 5 . 4**

**Draw a Punnett square diagram to show why only some of the next generation plants had pink flowers.**

**Identify the phenotypes of all the offspring plants. [3 marks]**

0	5	.	5
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**What percentage of the offspring would you expect to have pink flowers? [1 mark]**

**Percentage = \_\_\_\_\_ %**

**[Turn over]**

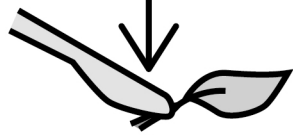


**FIGURE 7**

**Pink-flowered  
snapdragon  
plant**



**Remove leaf**

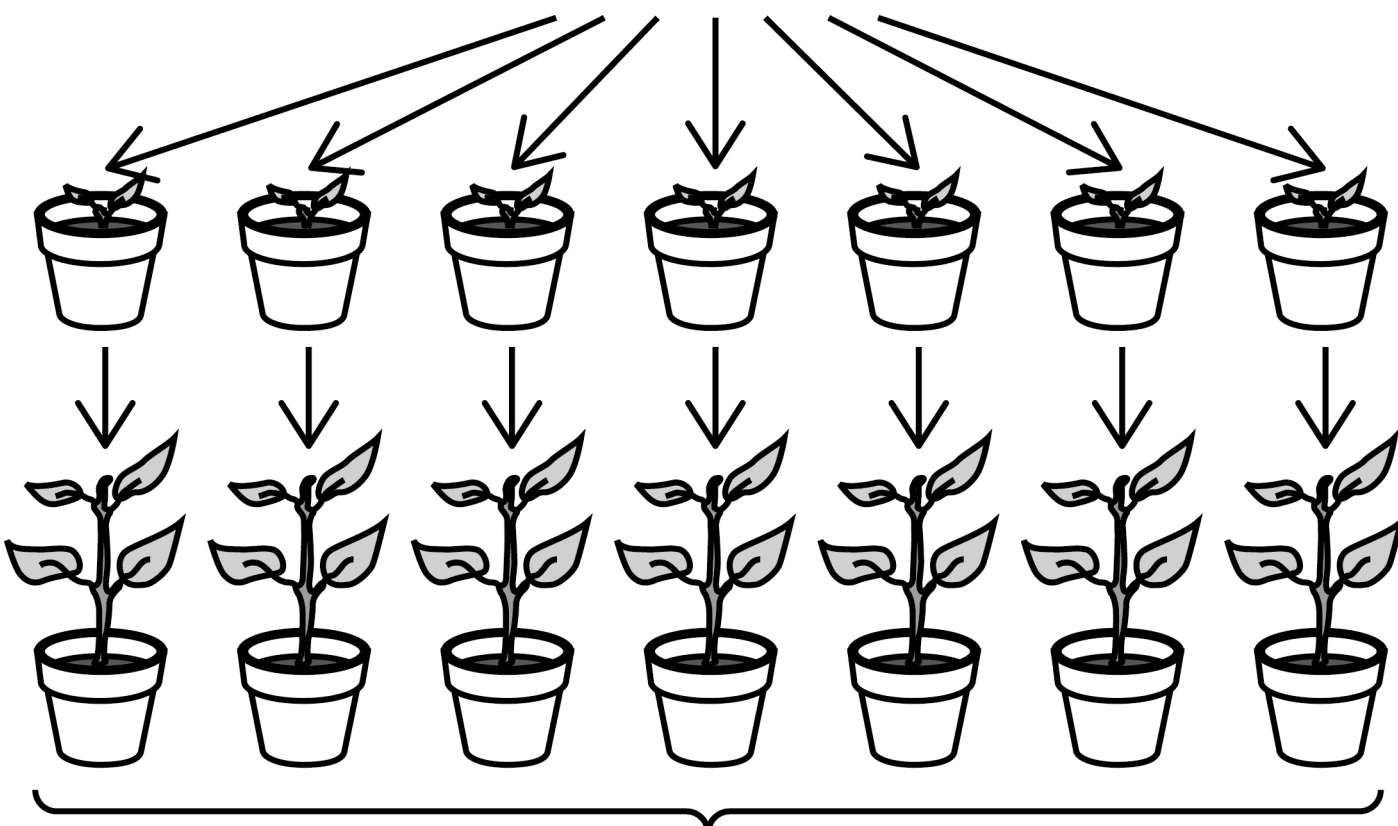


**Scrape off several  
small groups  
of cells  
onto agar jelly**

**Agar jelly  
+ nutrients  
+ hormones**



**Keep in sterile  
conditions at 20 °C**



**Many snapdragon plants,  
all with pink flowers**



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**[Turn over]**



**Commercially, hundreds of pink-flowered snapdragon plants can be produced from one pink-flowered plant.**

**FIGURE 7, on page 46, shows a tissue culture technique used for producing many plants from one plant.**

**0 5 . 6**

**Give a reason for each of the following steps shown in FIGURE 7. [5 marks]**

**SEVERAL groups of cells are scraped off the leaf:**

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**NUTRIENTS** are added to the agar jelly:

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**HORMONES** are added to the agar jelly:

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**The plant cells are kept in STERILE conditions:**

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**The plant cells are kept at 20 °C:**

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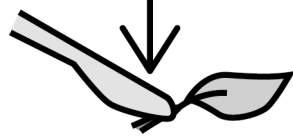
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Repeat of FIGURE 7

**Pink-flowered  
snapdragon  
plant**



**Remove leaf**

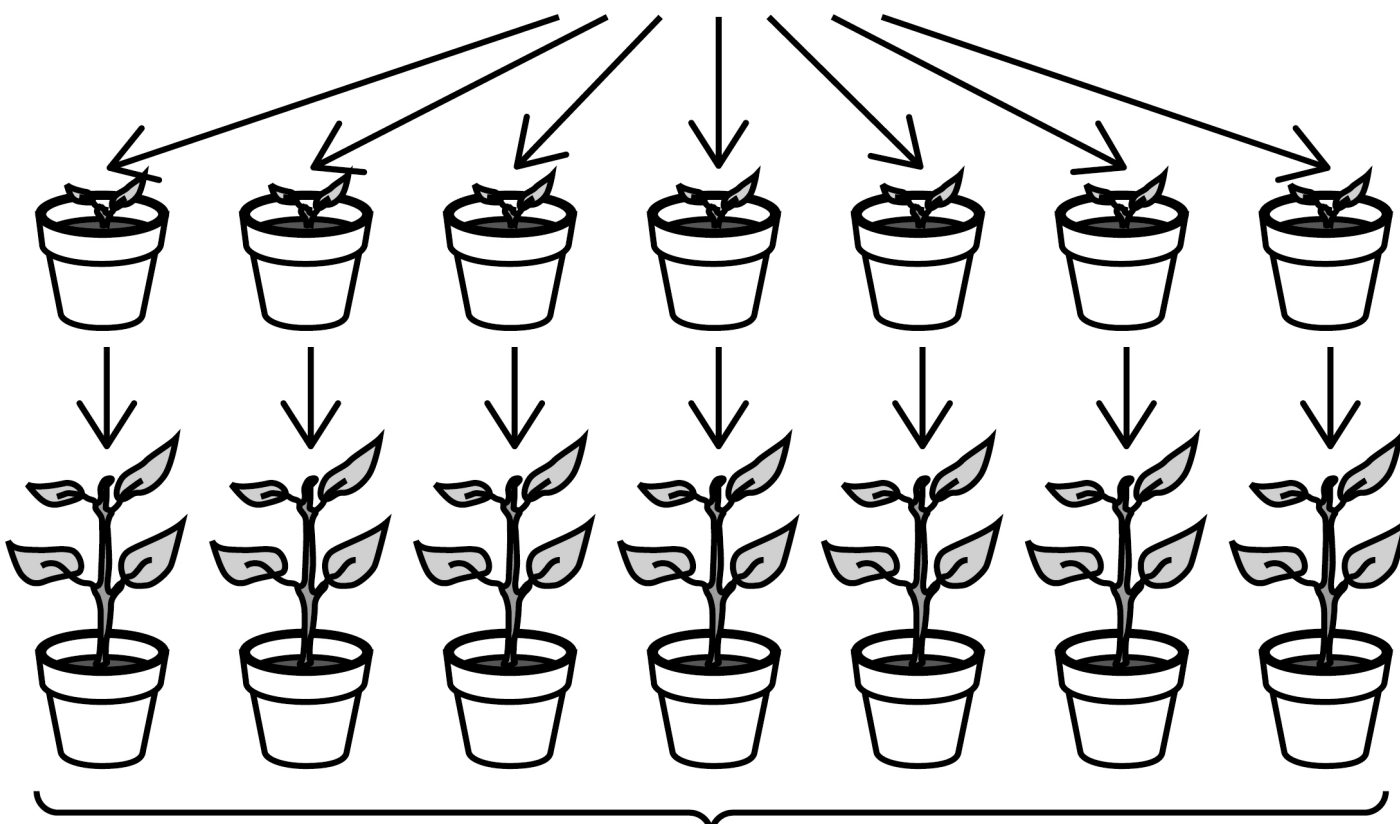


**Scrape off several  
small groups  
of cells  
onto agar jelly**

**Agar jelly  
+ nutrients  
+ hormones**



**Keep in sterile  
conditions at 20 °C**



**Many snapdragon plants,  
all with pink flowers**





0	6
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**Water conservation is important to the human body.**

0	6	.	1
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**Which gland releases the hormone that controls water loss from the body?  
[1 mark]**

**Tick (✓) ONE box.**

**Adrenal**

**Pancreas**

**Pituitary**

**Thyroid**



0	6	.	2
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**Which hormone helps the kidneys to control water loss from the body?  
[1 mark]**

**Tick (✓) ONE box.**

**ADH**

**Adrenaline**

**LH**

**Thyroxine**

**[Turn over]**





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**[Turn over]**

**0 6 . 4**

**Some people have kidney failure.**

**Doctors may treat patients with kidney failure by either:**

- **dialysis**
- **a kidney transplant.**

**Explain TWO biological reasons why most doctors think that a kidney transplant is a better method of treatment than dialysis.**

**Do NOT refer to cost or convenience.**

**[4 marks]**

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

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

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**[Turn over]**

9







**The herbicide glyphosate will kill ragwort and other weeds.**

**Scientists use bacteria for the genetic engineering of crop plants to make the crops resistant to glyphosate.**

**FIGURE 8, on the opposite page, shows the growth of a culture of the bacteria in a solution of nutrients at 25 °C**

**0 7 . 2**

**Why did the rate of reproduction increase between 2 hours and 7 hours? [1 mark]**

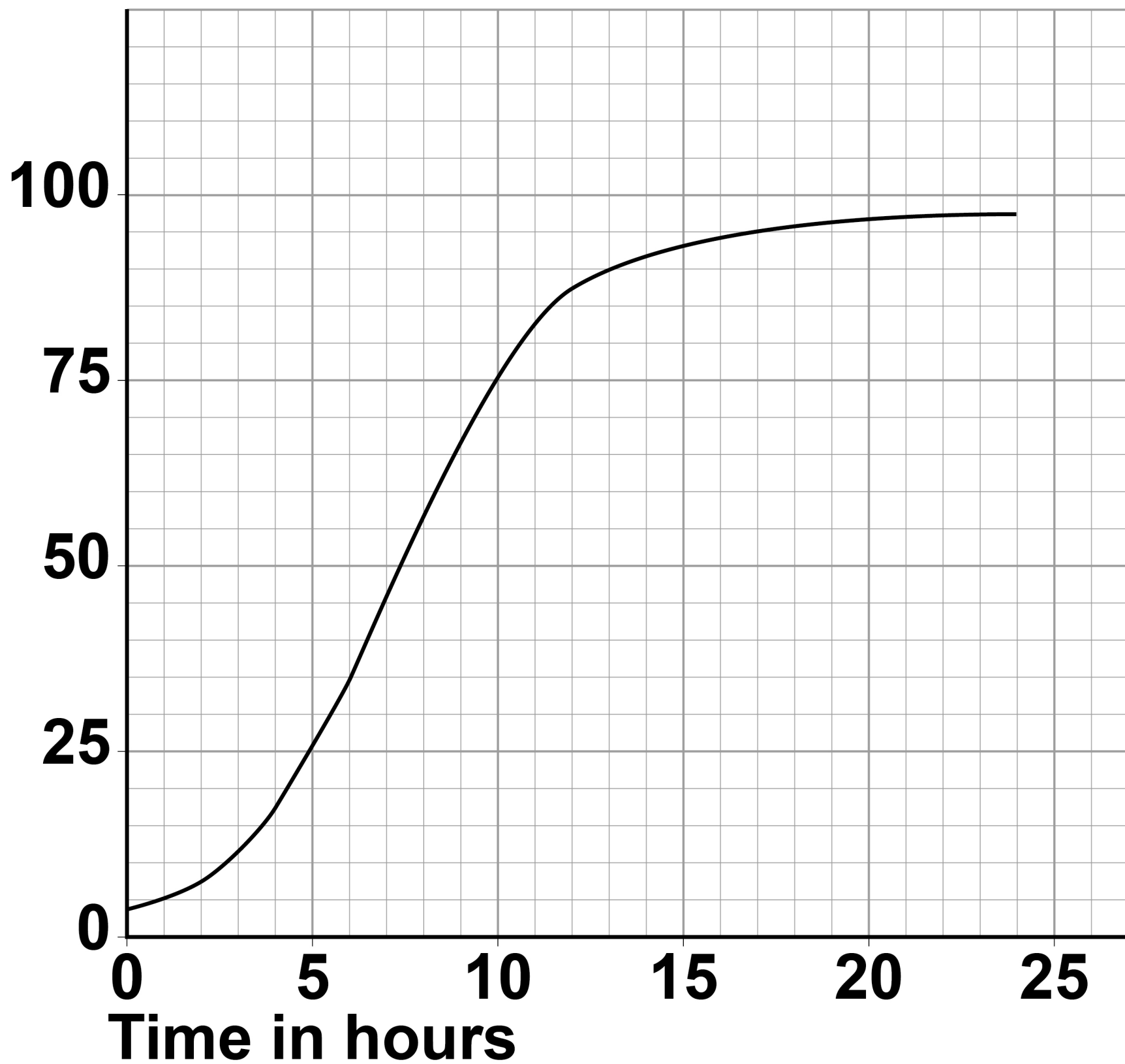
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**FIGURE 8**

**Number of  
bacterial cells  
in millions  
per cm<sup>3</sup>**



**[Turn over]**



07.3

**After 12 hours, the rate of reproduction decreased.**

**Suggest THREE ways the scientists could maintain a high rate of reproduction in the bacterial culture. [3 marks]**

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

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

**3** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_







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15

**[Turn over]**

0 8

**It is important to keep the blood glucose concentration within narrow limits.**

0 8 . 1

**A person eats a meal containing a lot of carbohydrate. This causes an increase in the person's blood glucose concentration.**

**Explain how the hormones insulin AND glucagon control the person's blood glucose concentration after the meal.**

**[5 marks]**

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**[Turn over]**



**Metformin is a drug used for treating people who have Type 2 diabetes.**

**Scientists investigated the effects of metformin and two other drugs, A and B.**

**The scientists wanted to see how the drugs affected the blood glucose concentrations of 220 people with Type 2 diabetes.**

**This is the method used.**

- 1. Put the 220 people into five groups.**
- 2. Treat each group with a different drug or combination of drugs for several weeks.**
- 3. Give each person a meal high in carbohydrate.**
- 4. Measure the blood glucose concentration of each person 30 minutes after the meal and again 3 hours after the meal.**

0	8	.	3
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**Suggest THREE variables that the scientists should have controlled in the investigation. [3 marks]**

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

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

**3** \_\_\_\_\_  
\_\_\_\_\_

**[Turn over]**



**The scientists recorded their results as a mean value for each group.**

**The scientists calculated the ‘standard deviation’ for each group’s result.**

**Standard deviation is a measure of the spread of the individual results above or below ( $\pm$ ) the mean value.**

**The scientists gave each group’s result as:**

**mean  $\pm$  standard deviation**

**The larger the standard deviation, the greater is the spread of results around the mean.**



0	8	.	4
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**Which of the results is the most precise?  
[1 mark]**

**Tick (✓) ONE box.**

**Mean = 171.6 ± 16.3**

**Mean = 177.2 ± 15.4**

**Mean = 182.5 ± 18.2**

**Mean = 205.2 ± 19.4**

**[Turn over]**



**TABLE 3, below, and FIGURE 9, on pages 76 and 77, show the scientists' results.**

**TABLE 3**

<b>Drugs used</b>	<b>Number of people</b>	<b>Mean blood glucose concentration 30 minutes after the meal in mg/100 cm<sup>3</sup> ± standard deviation</b>
<b>Metformin</b>	<b>60</b>	<b>177.2 ± 15.4</b>
<b>A</b>	<b>40</b>	<b>182.5 ± 18.2</b>
<b>B</b>	<b>25</b>	<b>171.6 ± 16.3</b>
<b>Metformin + A</b>	<b>65</b>	<b>205.2 ± 19.4</b>
<b>Metformin + B</b>	<b>30</b>	<b>206.5 ± 19.6</b>

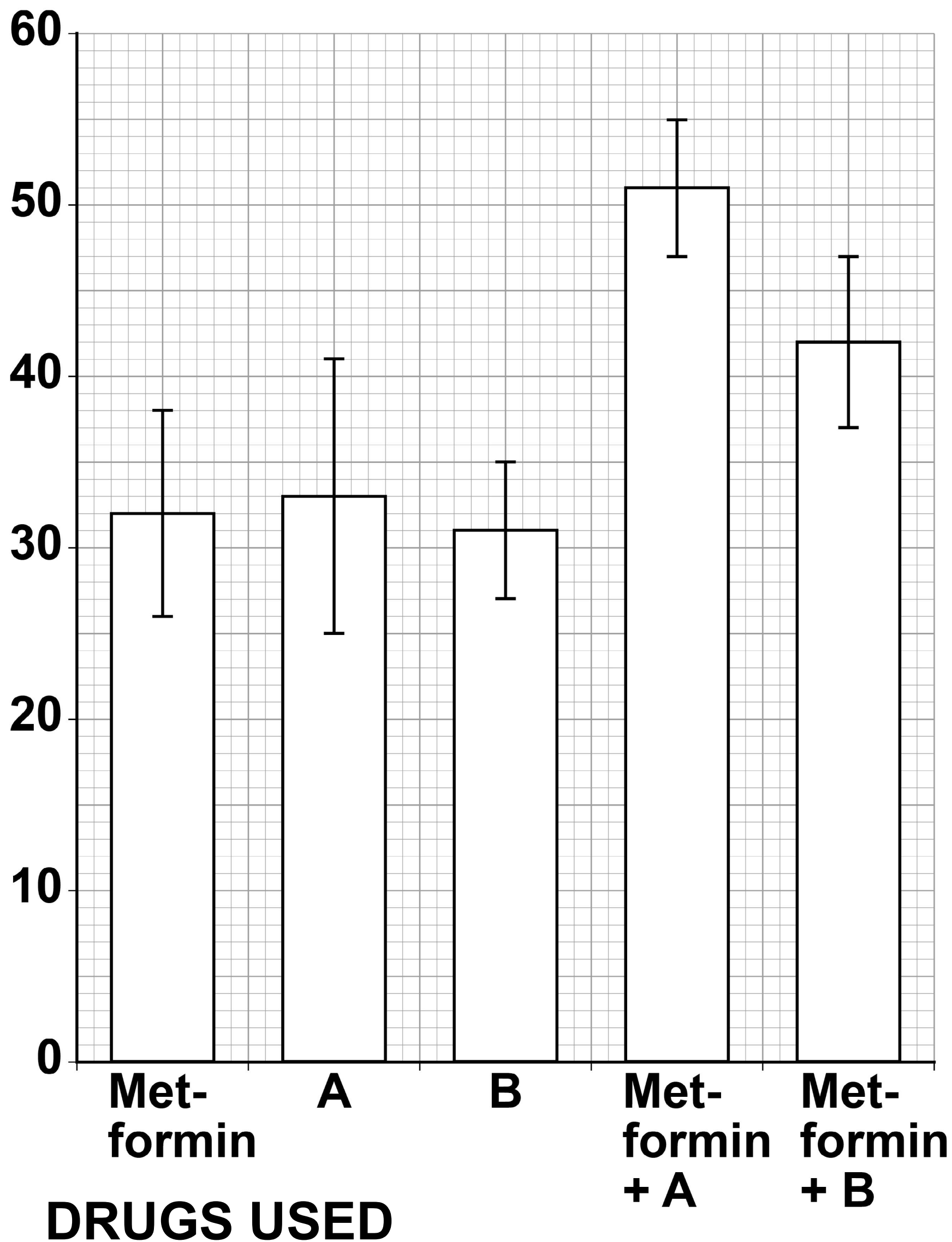
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**[Turn over]**



**FIGURE 9**

**Mean percentage reduction  
in blood glucose concentration  
3 hours after the meal**



**KEY**

**I ± standard deviation**

**Questions continues on the next page**

**[Turn over]**



**08.5**

**In TABLE 3 and FIGURE 9 some standard deviations of results overlap.**

**TABLE 3 is on page 74. FIGURE 9 is on pages 76 and 77.**

- An overlap of standard deviations shows the difference between the means is NOT significant.**
- NO overlap of standard deviations shows a significant difference between the means.**

**A student looked at the scientists' method and the results in TABLE 3 and FIGURE 9.**

**The student stated:**

**'Metformin works better when used with other drugs.'**

**Evaluate the student's statement.  
[6 marks]**







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Question	Mark
1	
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8	
<b>TOTAL</b>	

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