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

> **For this paper you must have:**
> * **a ruler**
> * **a scientific calculator.**

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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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.**

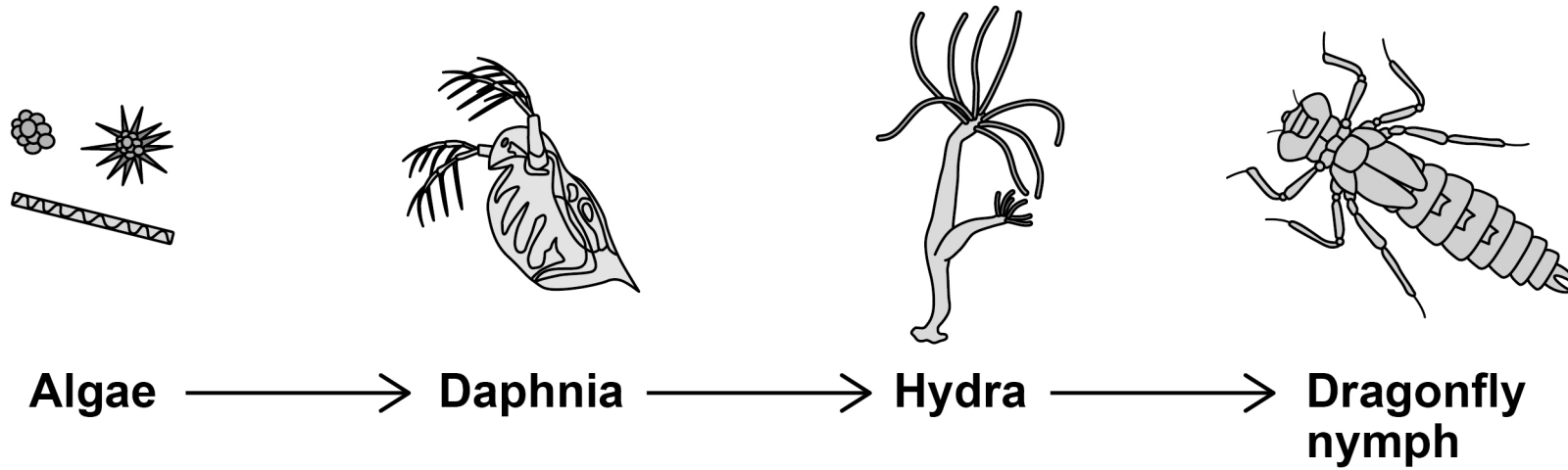- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

FIGURE 1 shows a food chain in a pond.

FIGURE 1

Algae ⟶ Daphnia ⟶ Hydra ⟶ Dragonfly nymph

0 1 . 1 Which term describes the Daphnia in this food chain? [1 mark]

Tick (✓) ONE box.

☐ Apex predator

☐ Primary consumer

☐ Producer

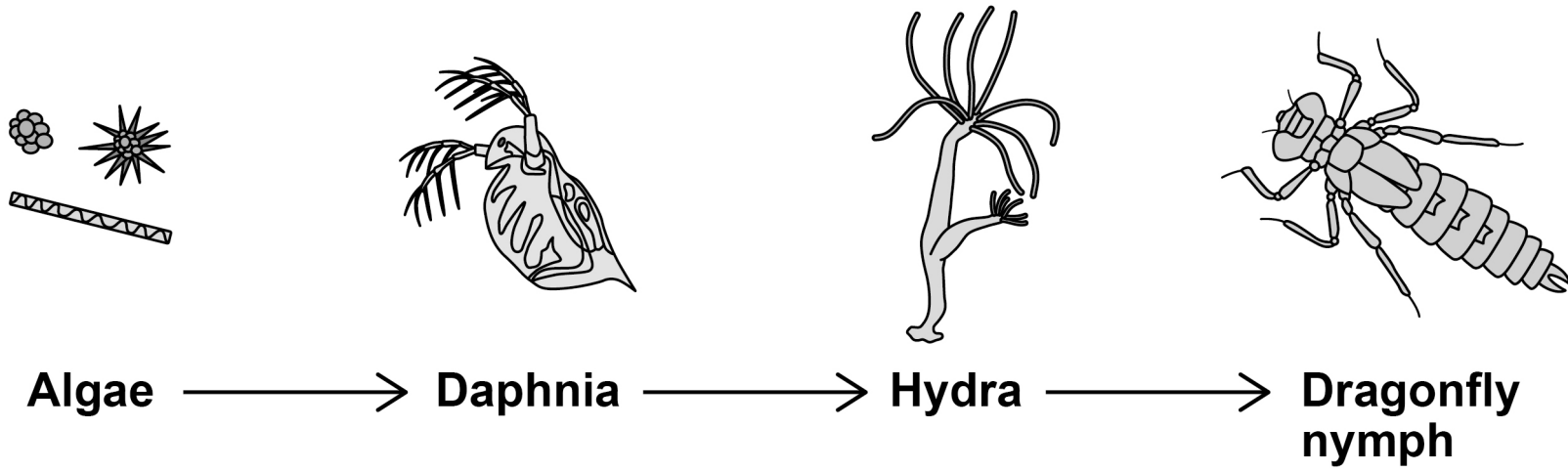☐ Secondary consumer

[Turn over]

Repeat of FIGURE 1

Algae ⟶ Daphnia ⟶ Hydra ⟶ Dragonfly nymph

0 1 . 2 **Draw a pyramid of biomass for the food chain.**

Label each trophic level. [2 marks]

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8

0 1 . 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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[Turn over]

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

This is the method used.

1. Collect 1 dm^3 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

Sample number	Number of Daphnia in 1 dm^3 water
1	5
2	21
3	0
4	16
5	28

0 1 . 4 **Calculate the mean number of Daphnia in 1 m³ of pond water.**

1 m³ = 1000 dm³

[2 marks]

_____

_____

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_____

Mean number of Daphnia in 1 m³ of pond

water = _____

[Turn over]

0 1 . 5 **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.

Give your answer in standard form. [4 marks]

_____

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Number of Daphnia in the pond =

_____

[Turn over]

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 shows the results.

FIGURE 2

Total number
of Daphnia
after 2 weeks

Concentration of fertiliser in mg/dm^3
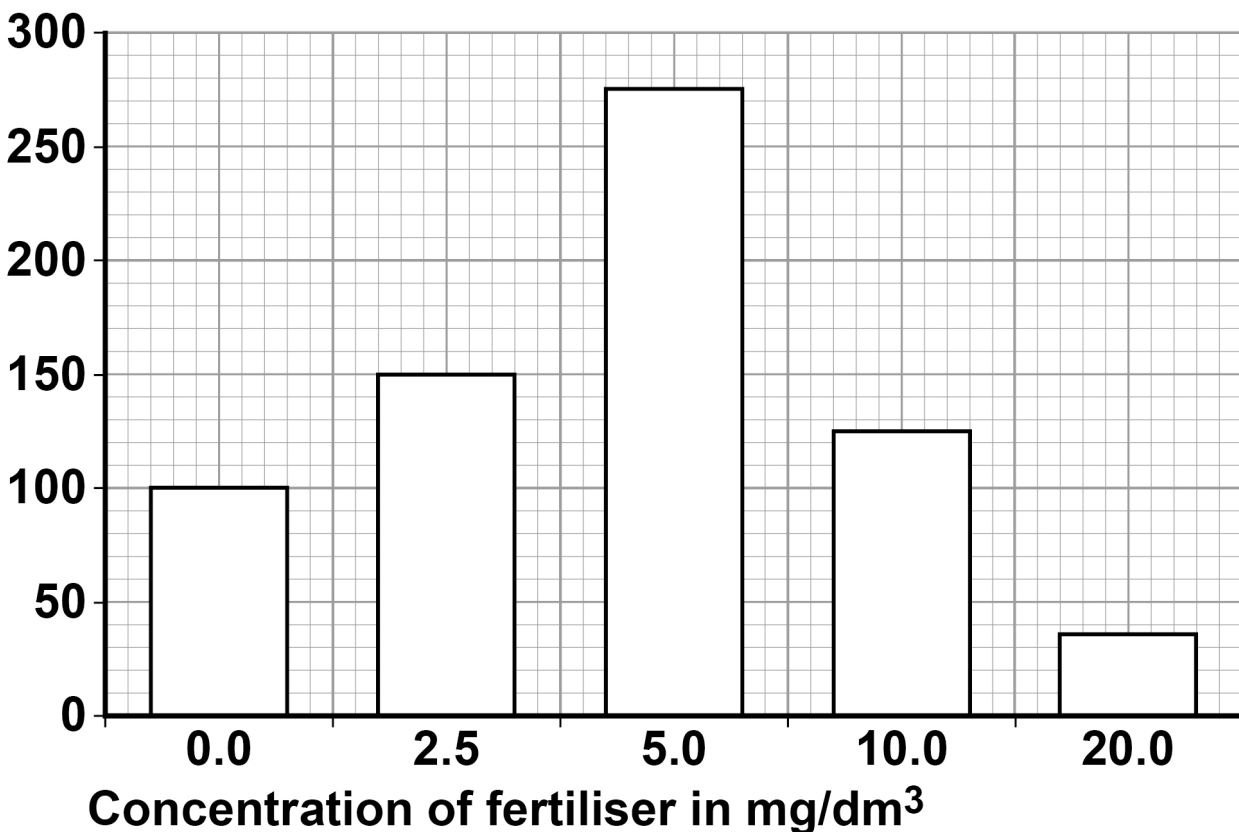
0 1 . 6 **A concentration of 5.0 mg/dm^3 of fertiliser caused a large increase in the population of Daphnia.**

Explain why. [2 marks]

_____

_____

_____
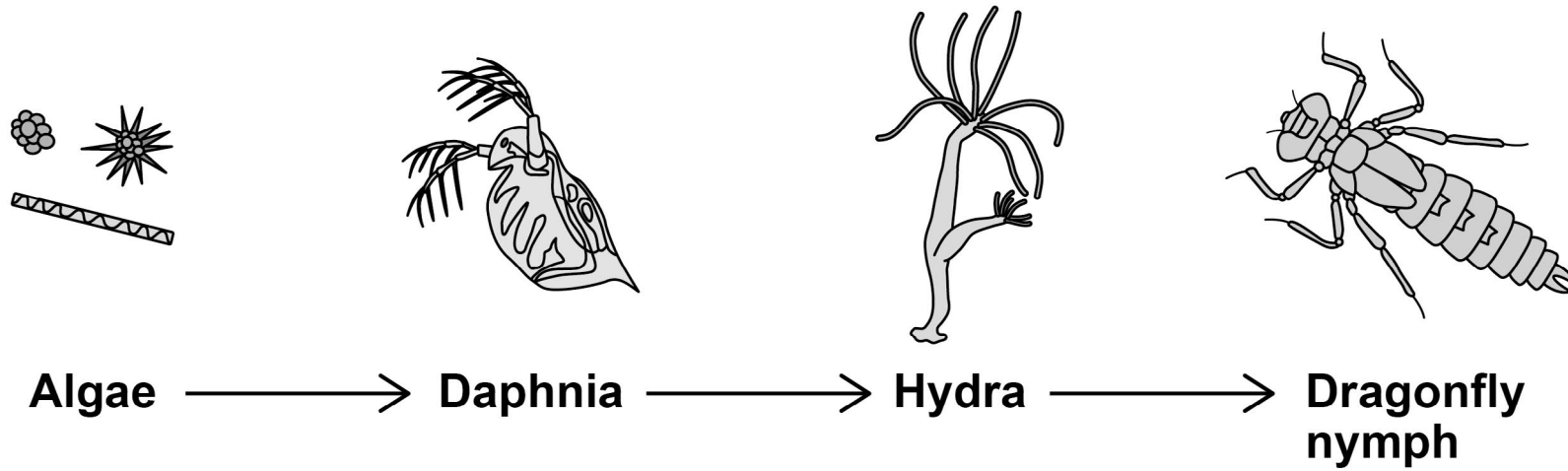
_____

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[Turn over]

0 1 . 7 **FIGURE 1 is repeated below.**

FIGURE 1

Algae ⟶ **Daphnia** ⟶ **Hydra** ⟶ **Dragonfly nymph**

The population of HYDRA will decrease when 20 mg/dm^3 of fertiliser is added to the pond.

Explain why. [2 marks]

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14

17

0 2   **Genetic material is made of DNA.**

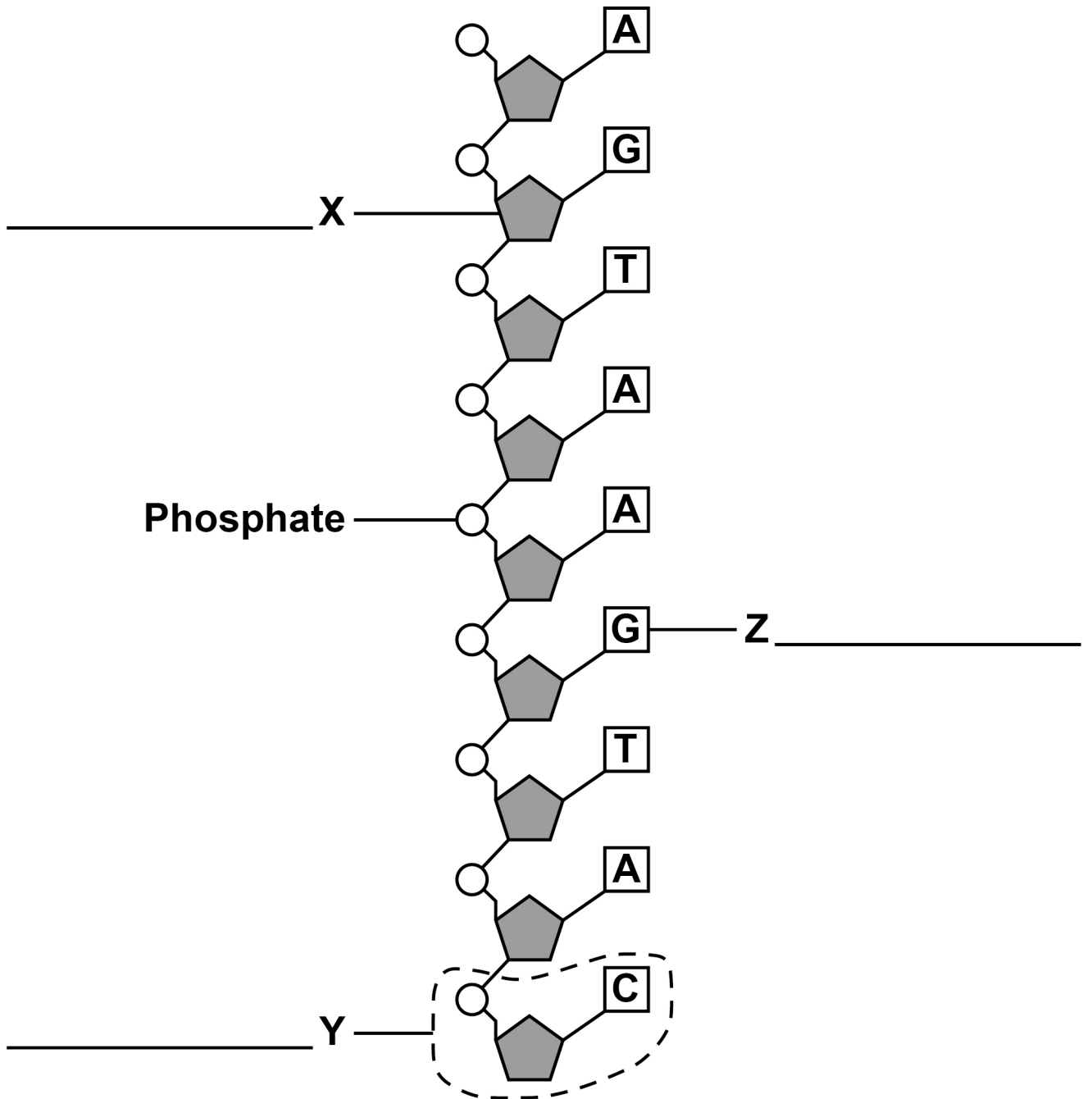**0 2 . 1**   **Which structures in the nucleus of a human cell contain DNA?**   **[1 mark]**

_____

_____

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]

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

What scientific term describes this structure? [1 mark]

_____

_____

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 19)? [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 _____

_____

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2 _____

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8

0 3 **Phototropism is a growth response by part of a plant to light.**

0 3 . 1 **Name ONE other tropism.**

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

Tropism _____

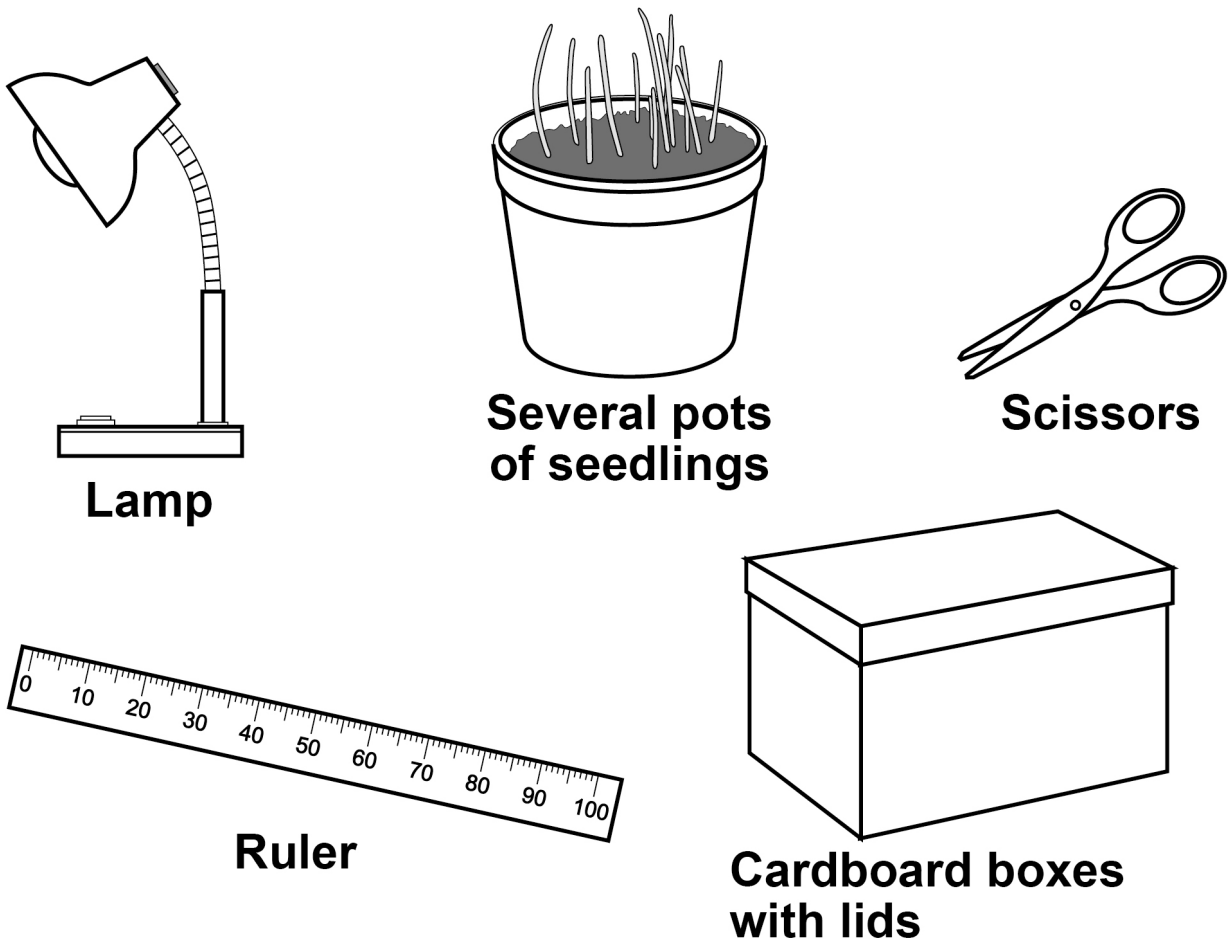_____

Stimulus _____

_____

[Turn over]

0 3 . 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

Lamp

Several pots of seedlings

Scissors

Ruler

Cardboard boxes with lids

| 0 3 | . | 3 | **Explain how phototropism in a plant shoot helps the plant to survive. [3 marks]** |

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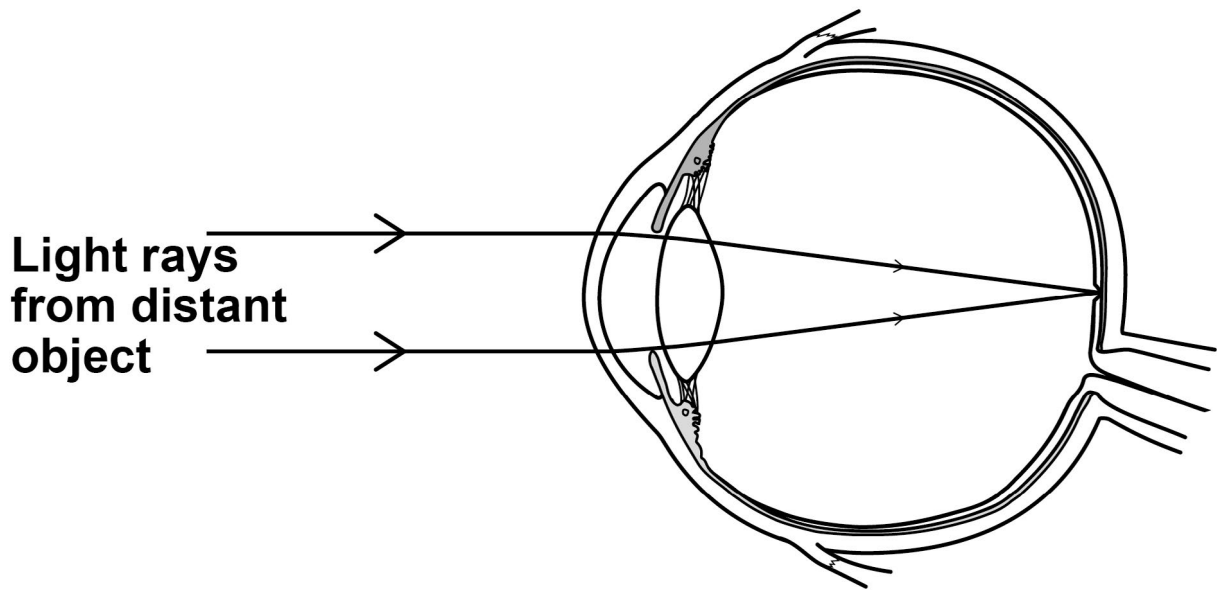
_____

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[Turn over]

11

0 4 **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

Light rays from distant object

0 4 . 1 **Explain how the person's eye could adjust to form a clear image of a NEARER object.**
[6 marks]

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[Turn over]

0 4 . 2 **Explain why a long-sighted person has difficulty seeing near objects clearly.** **[2 marks]**

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[Turn over]

0 4 . 3 **Long-sightedness can be corrected by wearing spectacles.**

Describe how spectacle lenses can correct long-sightedness. [3 marks]

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11

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[Turn over]

0 5 TABLE 2 gives the classification of four plant species.

TABLE 2

Group	Species 1	Species 2	Species 3	Species 4
Kingdom	'Plantae'	'Plantae'	'Plantae'	'Plantae'
Phylum	'Spermatophyta'	'Spermatophyta'	'Spermatophyta'	'Spermatophyta'
Class	'Monocotyledonae'	'Dicotyledonae'	'Monocotyledonae'	'Dicotyledonae'
Order	'Poales'	'Fabales'	'Poales'	'Scrophulariales'
Family	'Cyperaceae'	'Fabaceae'	'Poaceae'	'Scrophulariaceae'
Genus	'Eriophorum'	'Pisum'	'Poa'	'Antirrhinum'
Species	'angustifolium'	'sativum'	'annua'	'majus'

0 5 . 1 **Species 1 and 3 are the most closely related.**

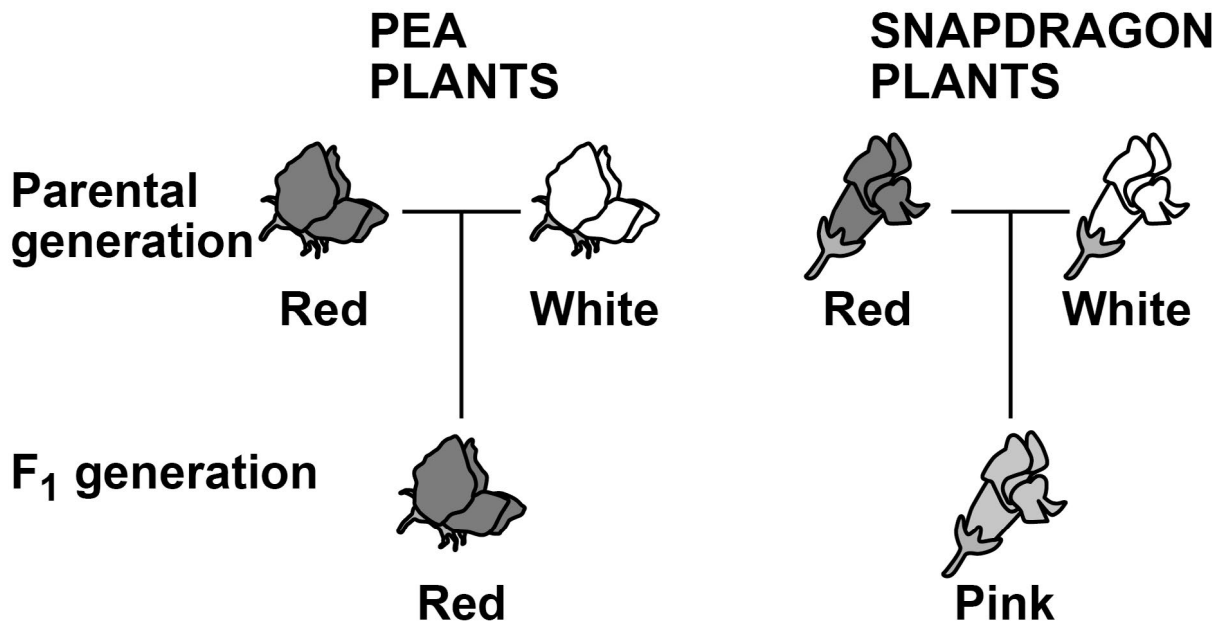**What information in TABLE 2 gives evidence for this? [1 mark]**

_____

_____

_____

[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.**

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

| Pea plants | Snapdragon plants |

R = allele for red flowers C^R = allele for red flowers
r = allele for white flowers C^W = allele for white flowers

0 5 . 2 **What is the genotype of the red-flowered pea plants in the F_1 generation? [1 mark]**

_____

0 5 . 3 **What is the genotype of a white-flowered snapdragon plant? [1 mark]**

_____

[Turn over]

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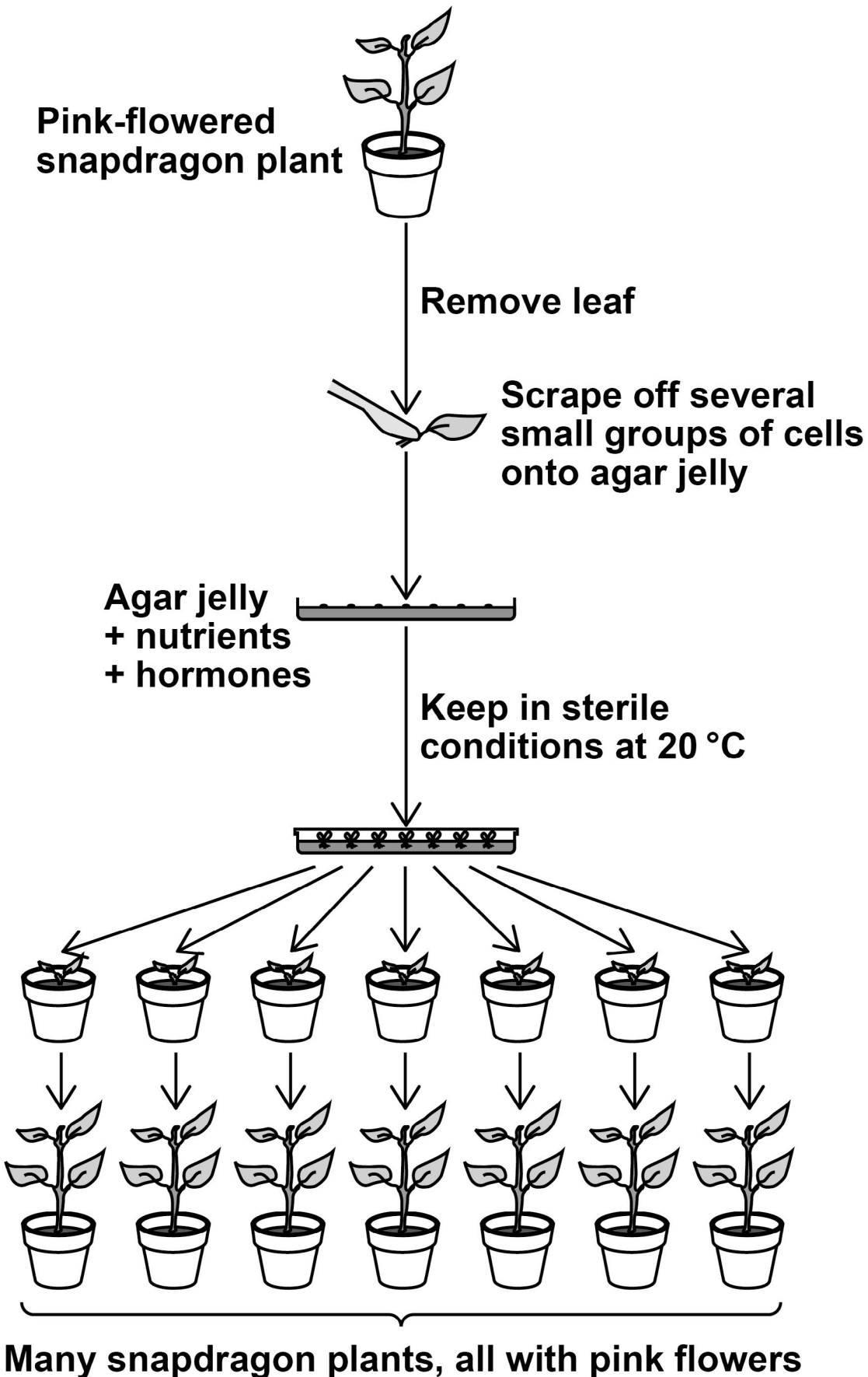
0 5 . 5   What percentage of the offspring would you expect to have pink flowers? [1 mark]

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 40, 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: _____

_____

_____

NUTRIENTS are added to the agar jelly:

_____

_____

_____

HORMONES are added to the agar jelly:

_____

_____

_____

4 2

The plant cells are kept in STERILE conditions:

_____

_____

_____

The plant cells are kept at 20 ^{o}C:

_____

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[Turn over]

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
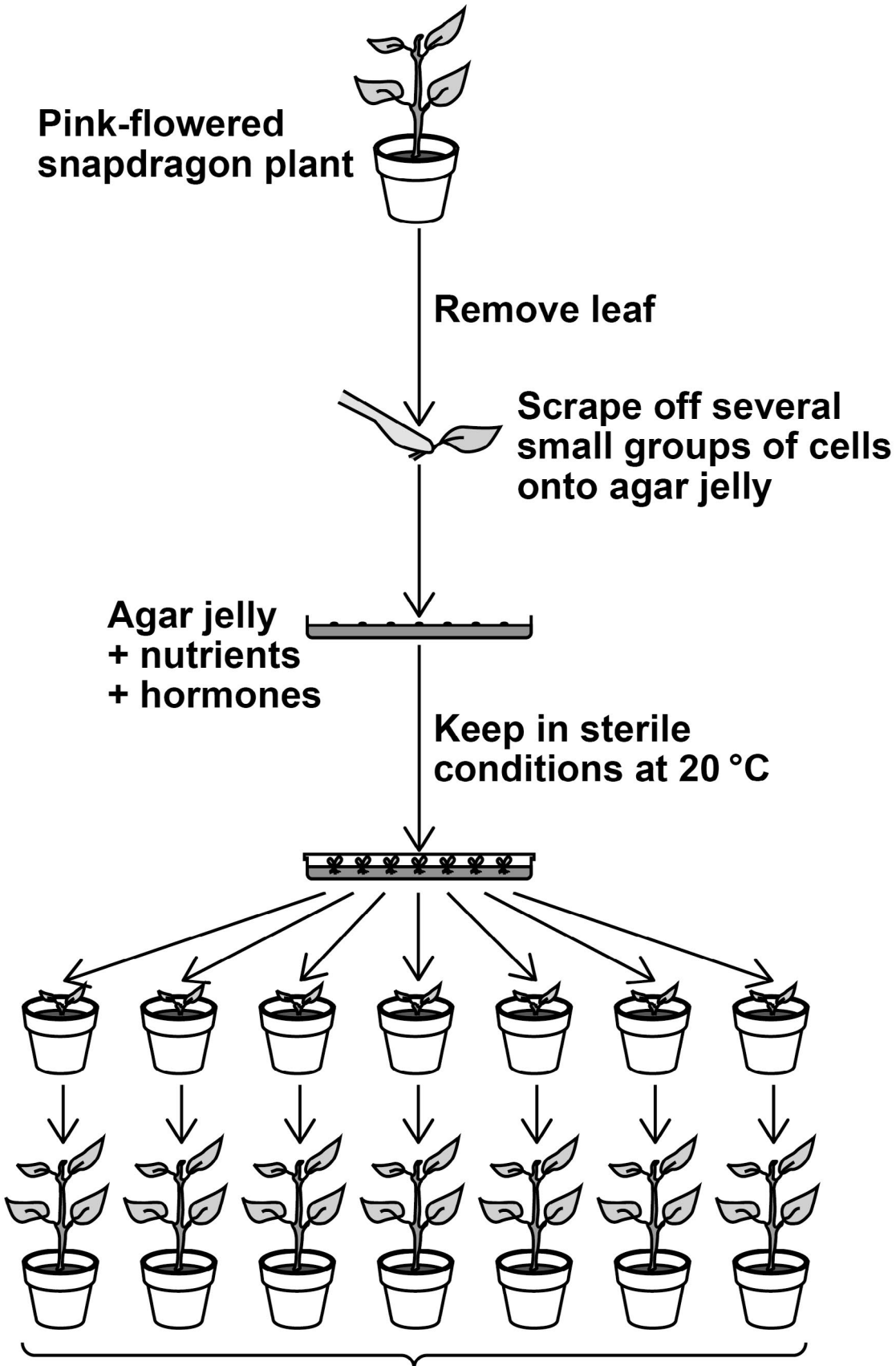
0 5 . 7 **Explain why the method shown in FIGURE 7 produces ONLY pink-flowered plants.**
[2 marks]

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[Turn over]

14

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

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

Tick (✓) ONE box.

☐   **Adrenal**

☐   **Pancreas**

☐   **Pituitary**

☐   **Thyroid**

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

Tick (✓) ONE box.

☐ **ADH**

☐ **Adrenaline**

☐ **LH**

☐ **Thyroxine**

[Turn over]

0 6 . 3 **A man is walking across a desert.**

The man has used up his supply of drinking water.

Explain how the gland you named in Question 06.1, on page 46, and the kidneys reduce water loss. [3 marks]

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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

0 7 **Ragwort is a weed that grows on farmland.**

Ragwort is poisonous to horses.

0 7 . 1 **Plan an investigation to estimate the size of a population of ragwort growing in a rectangular field on a farm. [4 marks]**

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[Turn over]

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 shows the growth of a culture of the bacteria in a solution of nutrients at 25 °C

FIGURE 8

Number of
bacterial cells
in millions
per cm^3
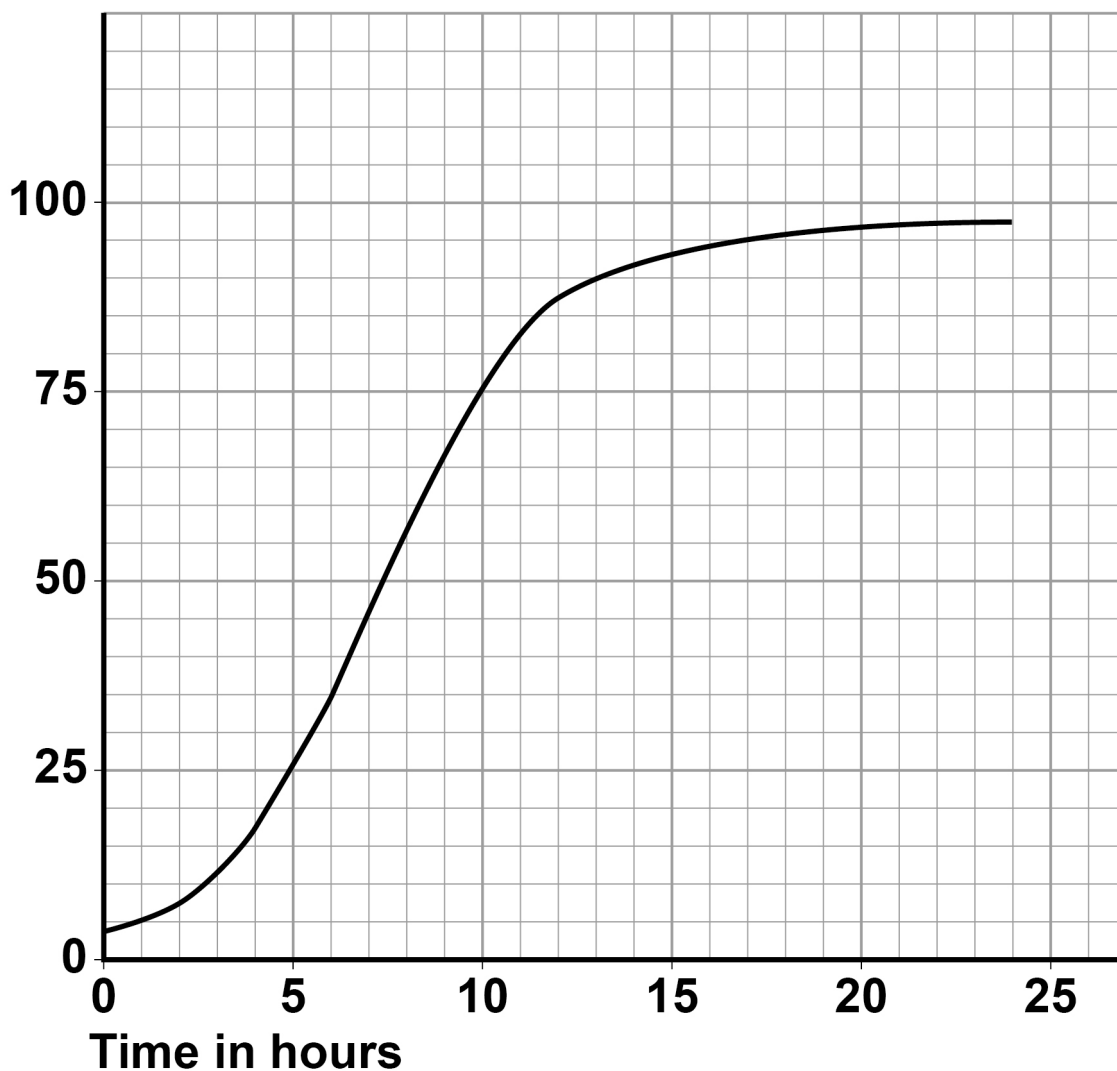
0 7 . 2 **Why did the rate of reproduction increase between 2 hours and 7 hours? [1 mark]**

_____

_____

_____

[Turn over]

0 7 . 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 _____

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_____

2 _____

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3 _____

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_____

| 0 | 7 | . | 4 | **The rate of reproduction of the bacteria is fastest at 7 hours.**

How many times faster is the rate of reproduction at 7 hours than the rate at 12 hours? [4 marks]

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Rate at 7 hours is_____ times faster.

07.5 Scientists transferred a gene for resistance to the herbicide glyphosate into the bacteria.

The genetically-modified (GM) bacteria can then transfer the glyphosate-resistance gene to a crop plant.

Explain the advantage of making crop plants resistant to glyphosate. [3 marks]

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15

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[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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0 8 . 2 **The body cells of a person with Type 2 diabetes do NOT respond to INSULIN.**

A person with Type 2 diabetes often has a higher blood INSULIN concentration than a non-diabetic person.

Explain why. [3 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 **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 (±) the mean value.

The scientists gave each group's result as:

mean ± standard deviation

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

| 0 | 8 | . | 4 |

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 the opposite page, show the scientists' results.

TABLE 3

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

FIGURE 9

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

DRUGS USED
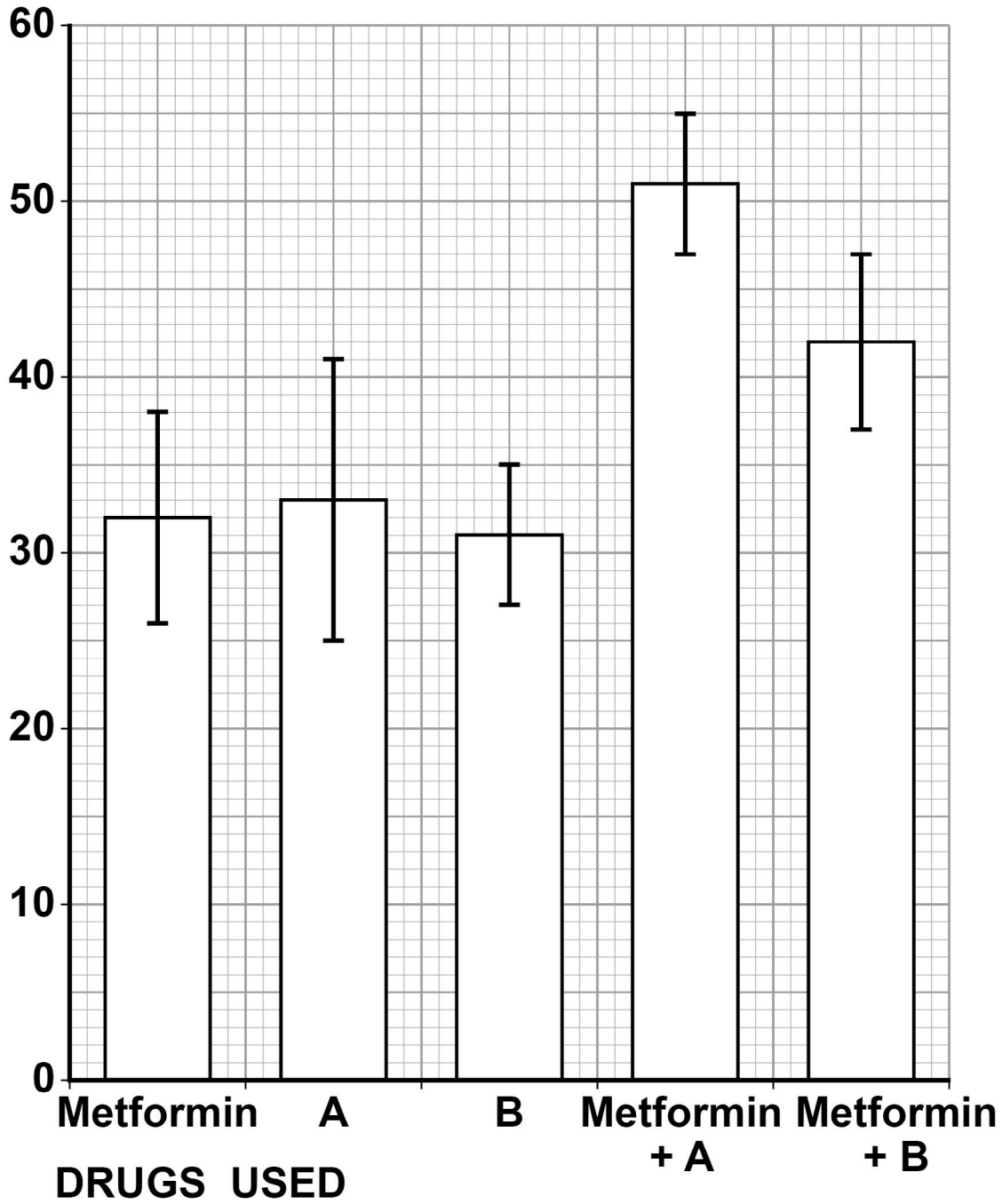
KEY ⌐ ± standard deviation

[Turn over]

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|0|8|.|5| **In TABLE 3, on page 68, and FIGURE 9, on page 69, some standard deviations of results overlap.**

- **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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[Turn over]

END OF QUESTIONS

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

74

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