A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

BIOLOGY

H

Higher Tier **Paper 2H**

8461/2H

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]

JUN228461 2H 01

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

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided.**
- **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).**
- **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

There are two types of reproduction:

- **sexual reproduction**
- **asexual reproduction.**

0 1 . 1

Complete TABLE 1 to compare sexual reproduction with asexual reproduction.

Write a tick (✓) in the box if the statement is true.

The first row has been completed for you. [2 marks]

TABLE 1

	Sexual reproduction	Asexual reproduction
Cell division occurs	✓	✓
Fertilisation occurs		
Genes are passed on from parent to offspring		
Offspring are genetically identical to each other		

0 1 . 2

Gametes are formed in sexual reproduction.

Name the male gamete formed in flowering plants.
[1 mark]

_____

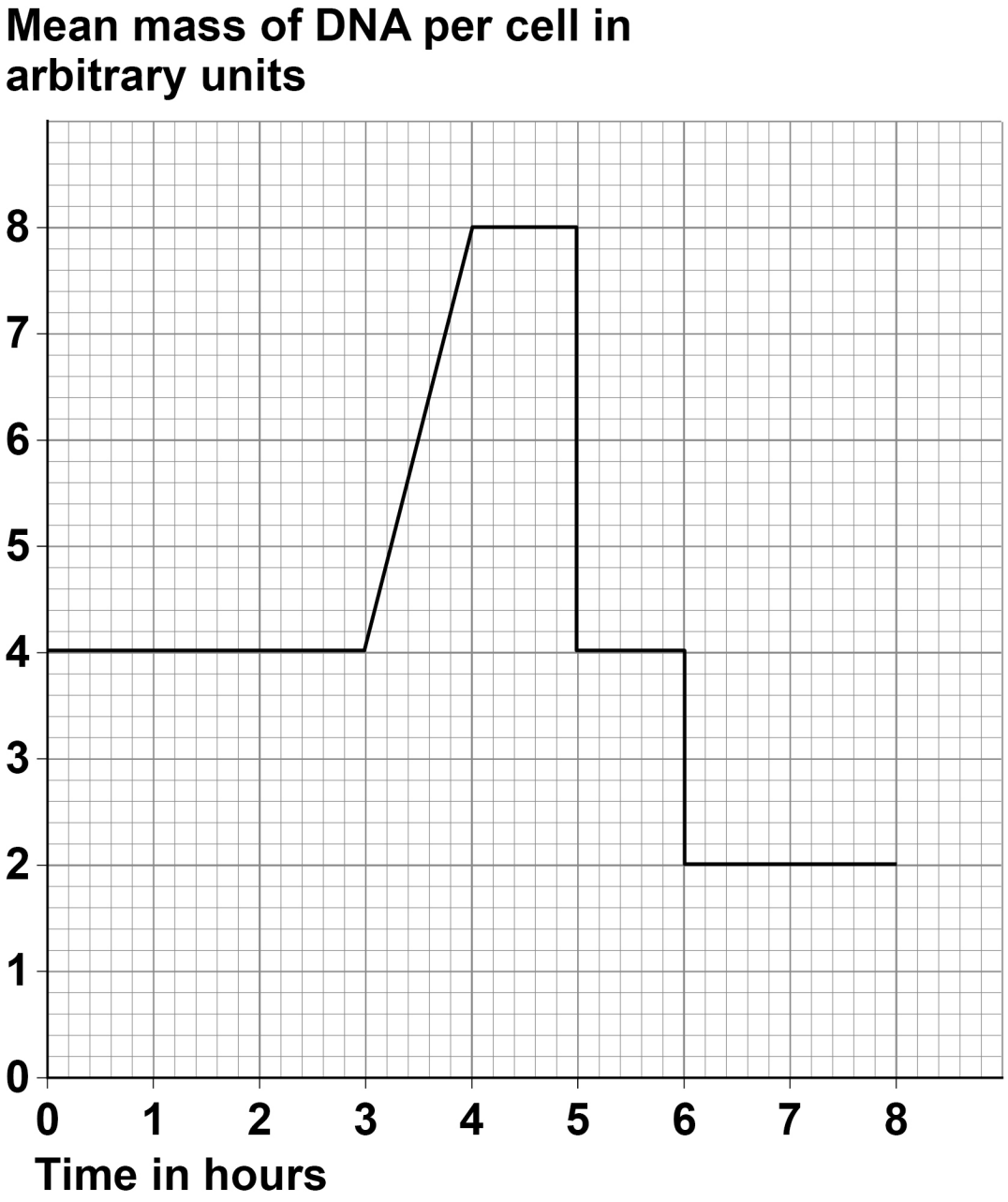
_____

[Turn over]

Cell division by meiosis forms gametes.

FIGURE 1 shows the mean mass of DNA per cell before, during and after meiosis.

FIGURE 1



Use information from FIGURE 1 to answer questions 01.3 to 01.6.

0 1 . 3

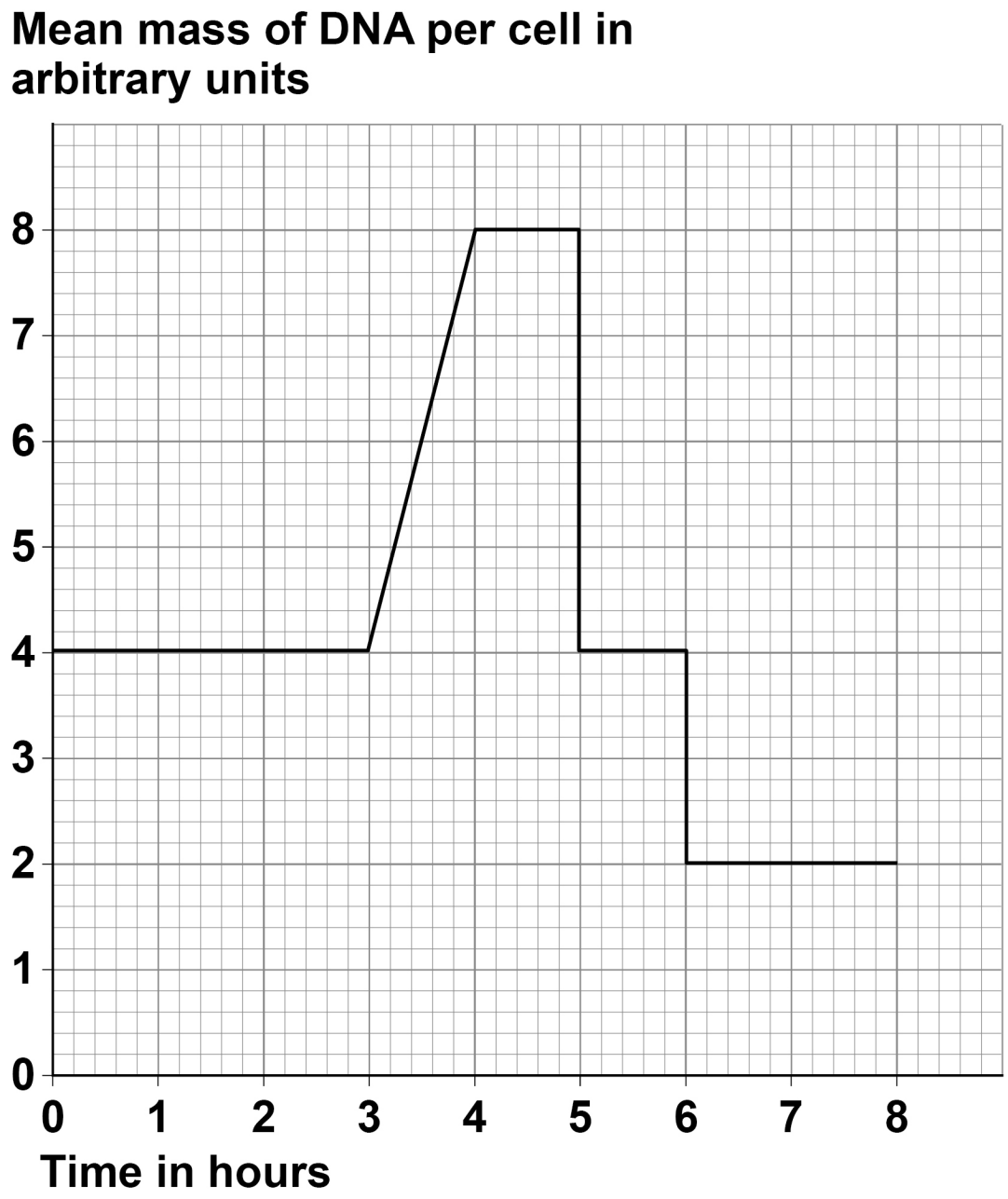
When is the DNA in the chromosomes being copied? [1 mark]

Tick (✓) ONE box.

- ☐ **Between 0 and 3 hours**
- ☐ **Between 3 and 4 hours**
- ☐ **Between 4 and 5 hours**
- ☐ **Between 5 and 6 hours**

[Turn over]

REPEAT OF FIGURE 1



0 1 . 4

Cells divide twice during meiosis.

Which TWO times in FIGURE 1 show one cell dividing into two cells? [2 marks]

Tick (✓) TWO boxes.

- ☐ **3 hours**
- ☐ **4 hours**
- ☐ **5 hours**
- ☐ **6 hours**
- ☐ **8 hours**

[Turn over]

0 1 . 5

What is the mean mass of DNA in arbitrary units in a sperm cell? [1 mark]

Tick (✓) ONE box.

- ☐ **2**
- ☐ **4**
- ☐ **8**
- ☐ **16**

0 1 . 6

What is the mean mass of DNA in arbitrary units in each cell in an embryo? [1 mark]

Tick (✓) ONE box.

- ☐ **2**
- ☐ **4**
- ☐ **8**
- ☐ **16**

[Turn over]

8

0 2

Earthworms:

- **live in soil**
- **feed on dead and decaying plant matter**
- **have soft, moist skin**
- **exchange gases through their skin.**

0 2 . 1

Give TWO abiotic factors and TWO biotic factors that could affect the size of an earthworm population.
[4 marks]

ABIOTIC FACTORS

1 _____

_____

_____

2 _____

_____

_____

BIOTIC FACTORS

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

0 2 . 2

Students investigated the populations of earthworms in the soil in two different areas:

- **Area A: a grass lawn**
- **Area B: a farmer's field.**

Chemical X can be mixed with water and poured onto the soil.

The mixture brings earthworms to the surface of the soil but does NOT harm the earthworms.

Plan an investigation using chemical X to compare the number of earthworms per m^2 in areas A and B.
[6 marks]

[Turn over]

10

BLANK PAGE

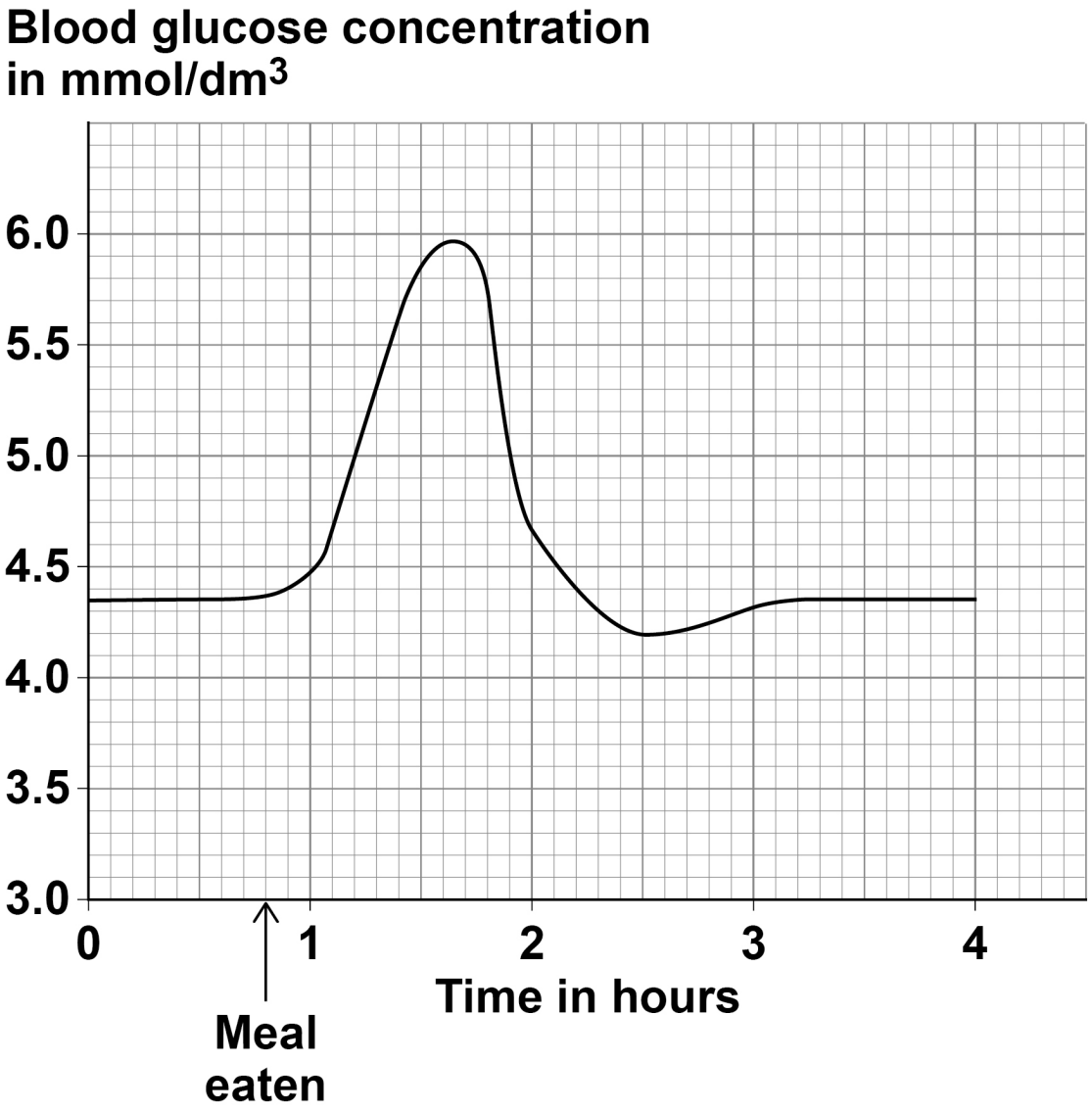
[Turn over]

0 3

It is important to control the concentration of glucose in the blood.

FIGURE 2 shows how the concentration of glucose in the blood of a person changed over 4 hours.

FIGURE 2



0 3 . 1

Give ONE time when the concentration of INSULIN in the person's blood would be high.

Use FIGURE 2. [1 mark]

Time = _____ hours

0 3 . 2

Explain the effect a high concentration of insulin has on blood glucose concentration. [3 marks]

Effect _____

_____

Explanation _____

_____

_____

_____

_____

_____

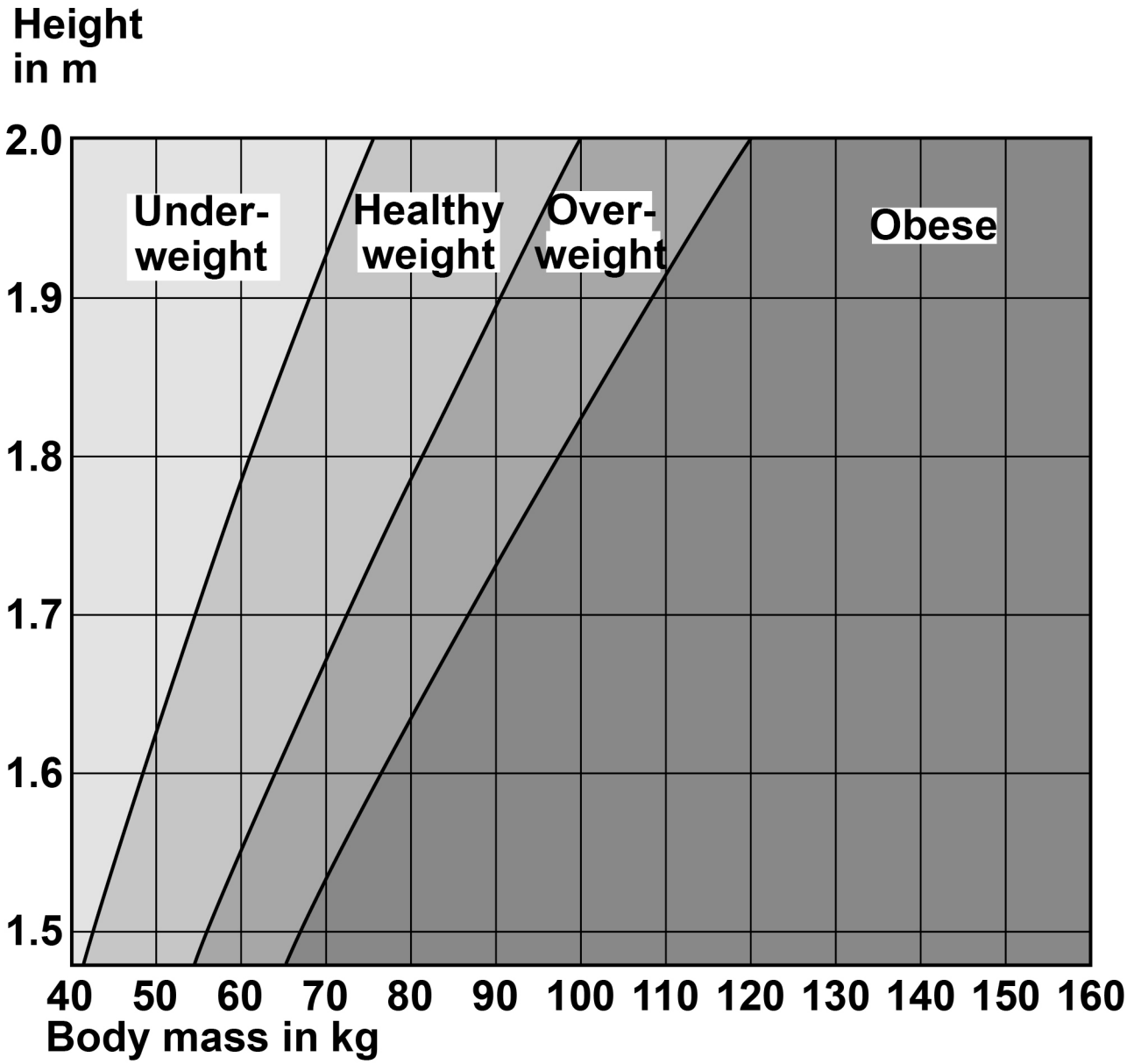
[Turn over]

People with diabetes have difficulty controlling the concentration of glucose in their blood.

Type 2 diabetes is linked to obesity.

FIGURE 3 shows how to find if an adult's body mass is healthy for their height.

FIGURE 3



0 3 . 3

Person A:

- **is 1.75 m in height**
- **has a body mass of 52 kg.**

What is person A's weight category? [1 mark]

Tick (✓) ONE box.

☐ **Underweight**

☐ **Healthy weight**

☐ **Overweight**

☐ **Obese**

0 3 . 4

Person B is 1.9 m in height.

Give the range of body masses that would put person B in the healthy weight category. [1 mark]

Range from _____ kg to _____ kg

[Turn over]

0 3 . 5

Person C is obese.

A doctor thinks that person C has Type 2 diabetes.

The doctor tests a sample of blood from person C.

TABLE 2 shows:

- **the results of the blood test**
- **the mean results for people who do NOT have diabetes.**

TABLE 2

	Concentration in blood	
	Person C	Mean for people who do not have diabetes
Cholesterol in $mmol/dm^3$	6.21	5.20
Glucose in $mmol/dm^3$	9.56	4.51
Insulin in arbitrary units	24.32	14.83

Type 2 diabetes occurs when body cells have a reduced response to insulin.

Give TWO ways the results of the blood test show that person C might have Type 2 diabetes. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

0 3 . 6

Give TWO ways that a person can reduce the chance of developing Type 2 diabetes. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

10

0 4

The rapid growth in human population means that more waste substances are released into the environment.

The release of substances into the environment can cause pollution.

0 4 . 1

Name ONE harmful substance that could cause air pollution. [1 mark]

_____

_____

0 4 . 2

Name THREE harmful substances that could cause water pollution.

Do NOT refer to plastic or to litter in your answer. [3 marks]

1 _____

2 _____

3 _____

[Turn over]

0 4 . 3

Describe how substances that pollute air and water could be harmful to humans and other living organisms. [6 marks]

[Turn over]

10

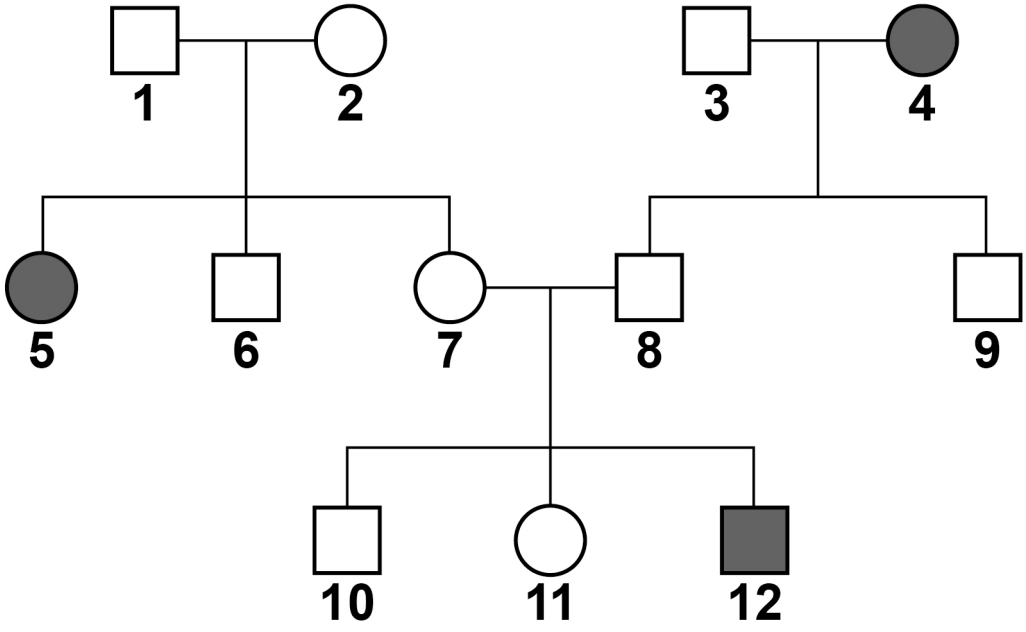
0 5

Maple syrup urine disease (MSUD) is a rare inherited human condition.

MSUD is usually diagnosed early in childhood and can be controlled by having a low-protein diet.

FIGURE 4 shows the inheritance of MSUD in one family.

FIGURE 4



KEY

Male with MSUD

Female with MSUD

Male without MSUD

Female without MSUD

The allele for MSUD is recessive.

0 5 . 1

Give ONE piece of evidence from FIGURE 4 which shows that MSUD is a recessive condition. [1 mark]

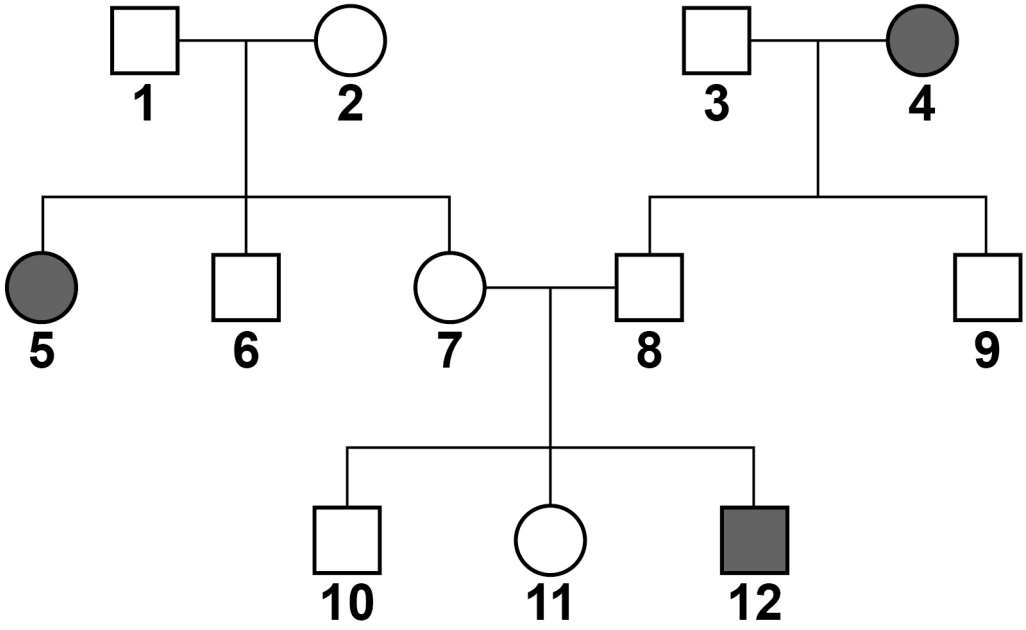
_____

_____

_____

[Turn over]

REPEAT OF FIGURE 4



KEY

- Male with MSUD
- Female with MSUD
- Male without MSUD
- Female without MSUD

0 5 . 2

Persons 7 and 8 in FIGURE 4 are expecting a fourth child.

Determine the probability that the child will have MSUD.

You should:

- **draw a Punnett square diagram**
- **identify the phenotype of each offspring genotype**
- **use the symbols:**

N = allele for NOT having MSUD

n = allele for MSUD.

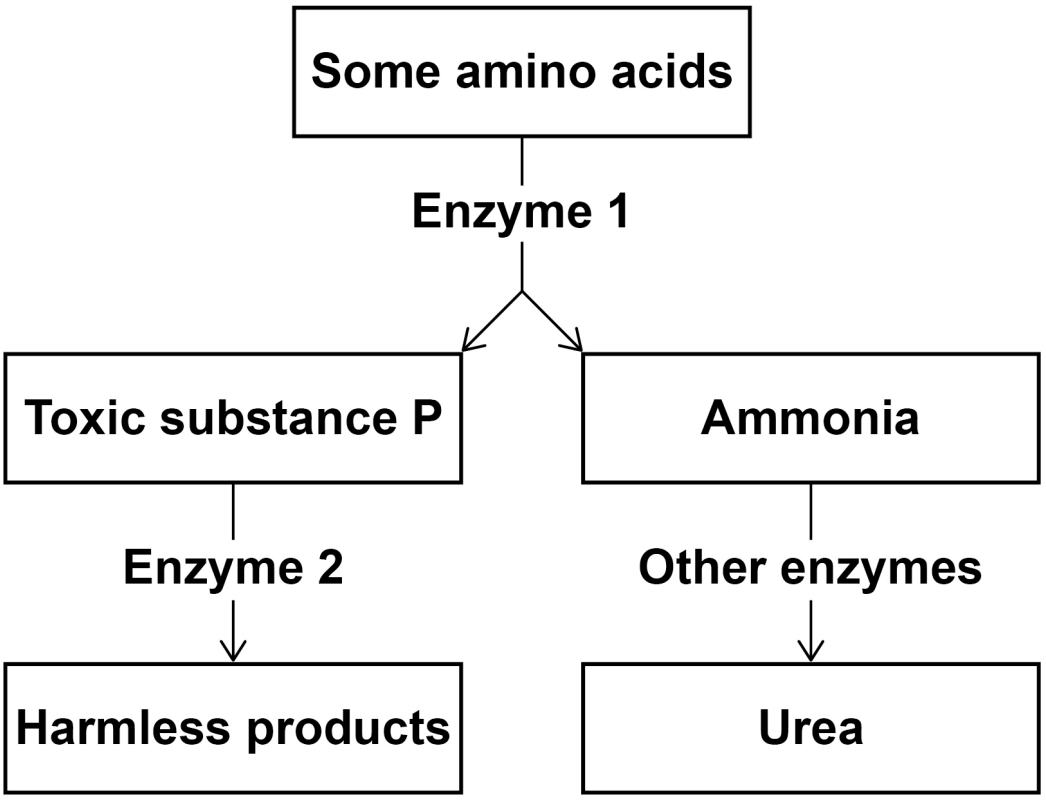
[4 marks]

Probability = _____

[Turn over]

FIGURE 5 shows chemical reactions involved in the normal breakdown of some types of amino acid inside body cells.

FIGURE 5



A person with MSUD CANNOT make ENZYME 2.

0 5 . 3

One of the final products shown in FIGURE 5 is urea.

Where in the human body are the reactions shown in FIGURE 5 most likely to occur? [1 mark]

Tick (✓) ONE box.

- ☐ **Kidney**
- ☐ **Liver**
- ☐ **Pancreas**
- ☐ **Small intestine**

[Turn over]

Scientists can analyse blood samples or urine samples to see if a person has MSUD.

The test identifies high concentrations of toxic substance P, shown in FIGURE 5.

0 5 . 4

Explain why the BLOOD of a person with MSUD will have a high concentration of toxic substance P.

Use information from FIGURE 5, on page 32. [3 marks]

0 5 . 5

Explain why the URINE of a person with MSUD will have a high concentration of toxic substance P. [2 marks]

0 5 . 6

Explain why a person with MSUD must have a low-protein diet. [3 marks]

14

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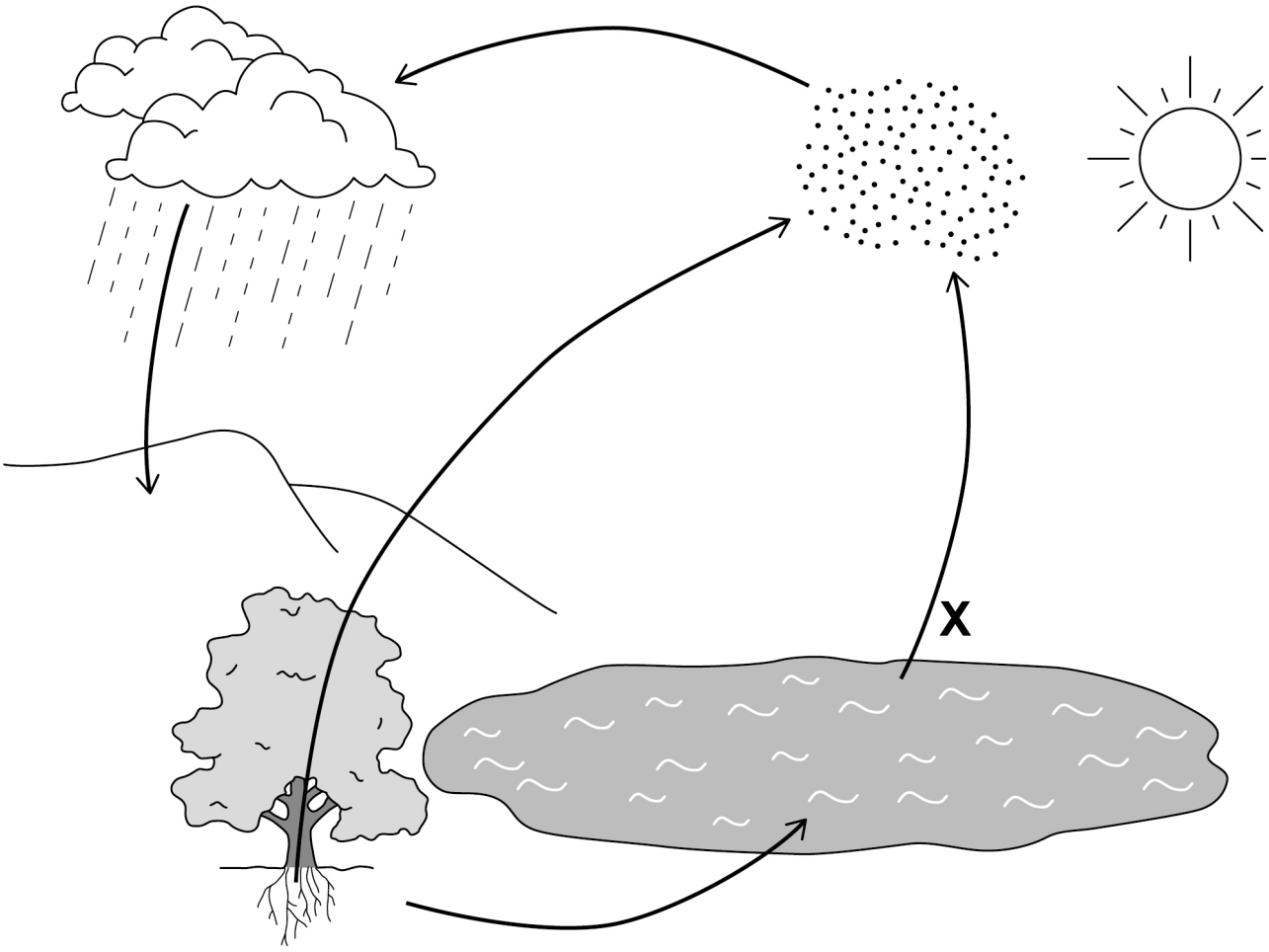
[Turn over]

0 6

Energy flows through an ecosystem and materials are recycled.

FIGURE 6 shows the water cycle.

FIGURE 6



0 6 . 1

Name process X. [1 mark]

0 6 . 2

Name the process by which water is absorbed into plant roots. [1 mark]

0 6 . 3

Give TWO uses of water in plants. [2 marks]

1

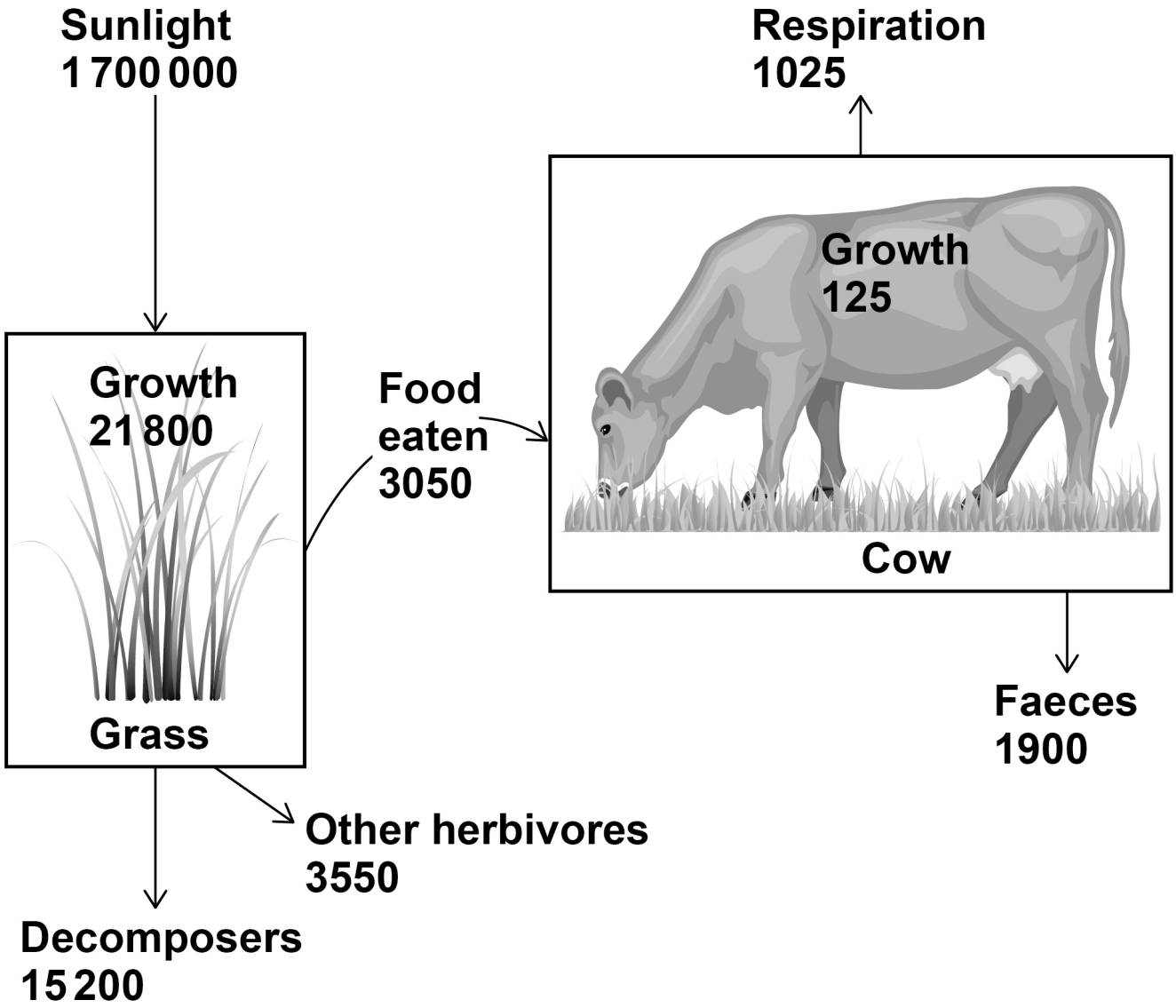
2

[Turn over]

FIGURE 7 shows the flow of energy through a food chain.

The numbers are in kilojoules/m^2/year.

FIGURE 7



0 6 . 4

The cow is more efficient than the grass at converting energy.

The energy conversion efficiency of the cow is 4.098%.

Calculate how many times more efficient the cow is at converting energy than the grass.

The equation for energy conversion efficiency is:

$$\text{energy conversion efficiency} = \frac{\text{energy used for growth}}{\text{energy input}} \times 100$$

Give your answer to 3 significant figures. [5 marks]

Number of times (3 significant figures) =

0 6 . 5

It is more energy-efficient to rear cows indoors than to rear cows outdoors.

Give TWO reasons why. [2 marks]

1

2 _____

_____

_____

0 6 . 6

Suggest TWO possible disadvantages of rearing cows indoors. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

13

0 7

A scientist found a polluted pond which had a new type of blue algae in the water.

The blue colour of the algae was caused by a mutation.

0 7 . 1

What is a mutation? [1 mark]

The scientist measured the number of blue algal cells in a sample of the pond water.

The scientist used a special slide which has a counting grid.

This is the method used.

1. **Dilute 2.5 cm^3 of pond water to a volume of 10 cm^3 with distilled water.**

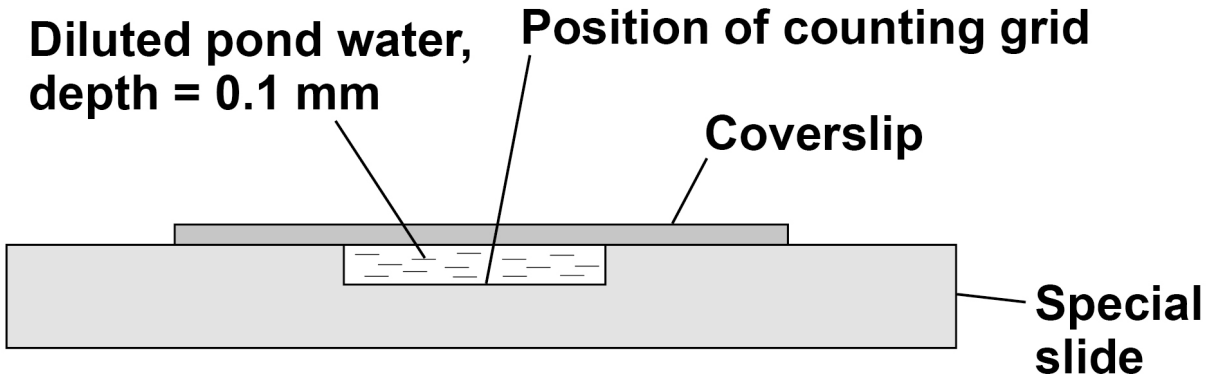
2. **Place a drop of the diluted pond water on the special slide, as shown in FIGURE 8.**

3. **Place a thick coverslip over the diluted pond water to give a depth of 0.1 mm of pond water.**

4. **Use a microscope to count the number of algal cells in a 0.2 mm × 0.2 mm square on the counting grid.**

FIGURE 8 shows a side view of the special slide.

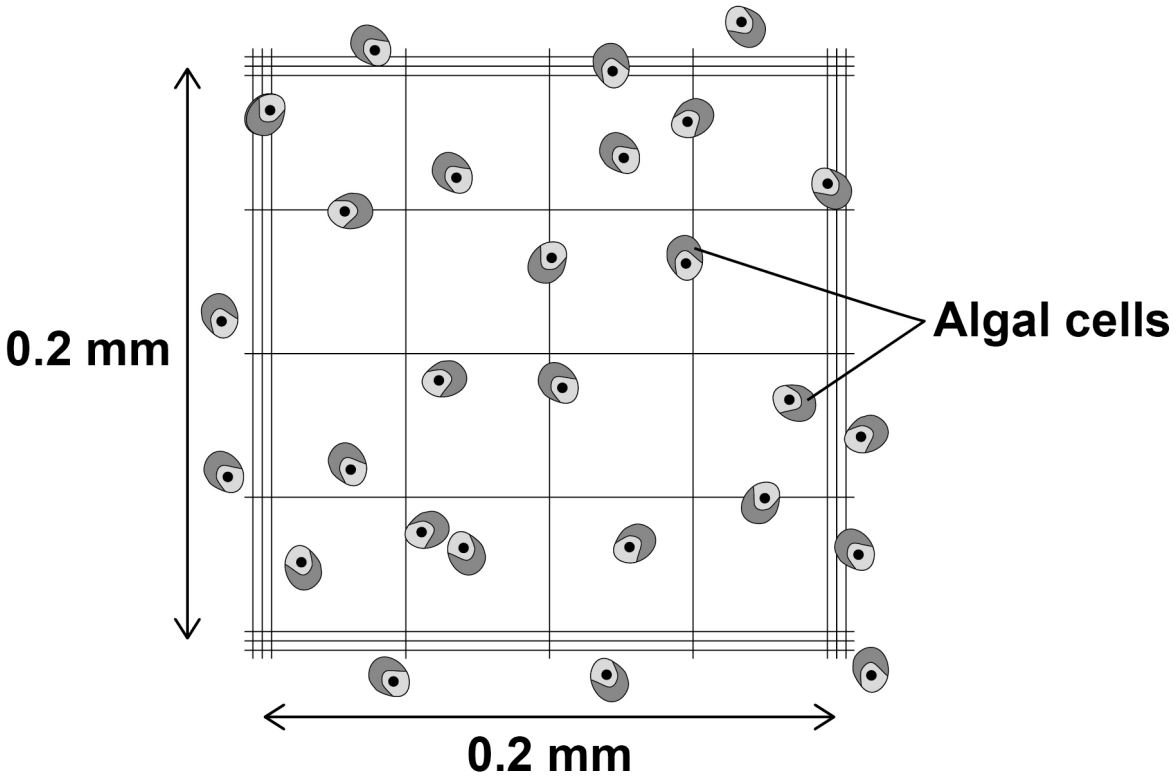
FIGURE 8



[Turn over]

FIGURE 9 shows the view of the counting grid through a microscope.

FIGURE 9



0 7 . 2

How many algal cells are in the 0.2 mm × 0.2 mm square in FIGURE 9?

Use the following procedure:

- **Count all cells that are completely within the 0.2 mm × 0.2 mm square in the counting grid.**
- **Count cells that are touching the left side or the lower side of the square.**
- **Do NOT count cells that are touching the right side or the top side of the square.**

[1 mark]

Number of algal cells in the 0.2 mm × 0.2 mm square =

_____

[Turn over]

0 7 . 3

One week later the scientist repeated the test and counted 14 cells on the 0.2 mm × 0.2 mm counting grid.

Calculate the number of algal cells in 1.0 mm^3 of UNDILUTED pond water.

Use the scientist's second count of 14 cells. [6 marks]

Number of algal cells in 1.0 mm^3 of undiluted pond water = _____

0 7 . 4

Suggest why the scientist diluted the pond water before placing it on the special slide. [1 mark]

0 7 . 5

A student repeated the scientist's method.

The student used a thin coverslip over the diluted pond water instead of the thick coverslip.

The liquid pulled the thin coverslip downwards slightly.

Explain how the use of the thin coverslip would affect the results for the cell count. [2 marks]

11

0 8

An echidna is a mammal that lives in Australia.

FIGURE 10 shows an echidna.

FIGURE 10

FIGURE 11, on page 52, shows how the body temperature of the echidna varies in warm weather and in cold weather.

[Turn over]

FIGURE 11

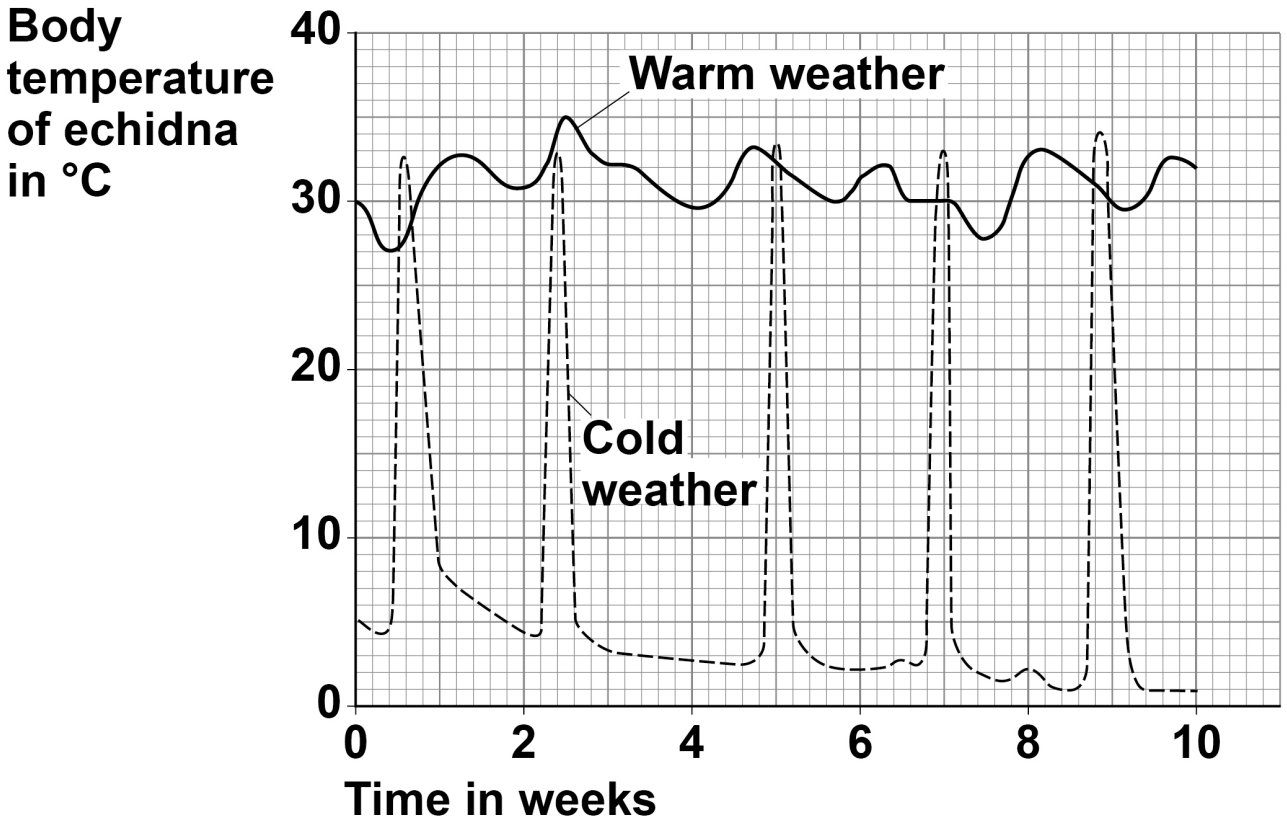
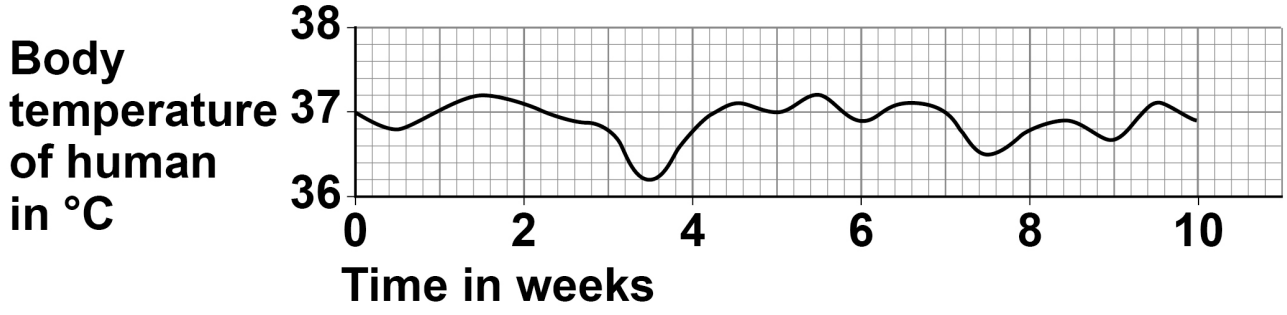


FIGURE 12 shows how human body temperature varies.

FIGURE 12



0 8 . 1

Compare the variation in body temperature of the echidna in warm weather with the variation in body temperature of the human.

Use data from FIGURE 11 and FIGURE 12. [2 marks]

[Turn over]

In the cold winter months, the echidna hibernates.

During hibernation:

- **the echidna's body temperature decreases to below 5 °C**
- **the echidna sleeps for up to 17 days at a time**
- **the echidna's rate of metabolism slows down.**

0 8 . 2

Explain why the decrease in body temperature is an advantage to the echidna during hibernation. [2 marks]

0 8 . 3

During hibernation the echidna wakes up several times.

Each time the echidna wakes up it becomes active and its body temperature increases to over 30 °C.

Explain why the echidna has a higher body temperature when it is active. [2 marks]

0 8 . 4

An echidna can dilate and constrict blood vessels in its skin.

Explain how the DILATION of blood vessels in the skin can help to decrease body temperature. [3 marks]

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[Turn over]

An athlete trained in a hot climate.

The athlete lost a large volume of water each day in sweat.

0 8 . 5

The athlete's energy intake each day from food was 20 000 kJ.

Evaporation of 1 cm^3 of sweat requires 2.5 kJ of energy.

40% of the athlete's daily energy intake was used to evaporate sweat.

Calculate the volume of sweat the athlete lost each day.

Give your answer in dm^3

1 dm^3 = 1 000 cm^3 [3 marks]

Volume of sweat lost in one day =

_____ dm^3

0 8 . 6

Suggest why the athlete was advised to take salt tablets each day. [1 mark]

13

0 9

Students investigated the response of plant shoots to one-sided light.

FIGURE 13, on the opposite page, shows how the students set up three experiments.

0 9 . 1

Suggest TWO control variables the students should have used in their investigation. [2 marks]

1 _____

_____

_____

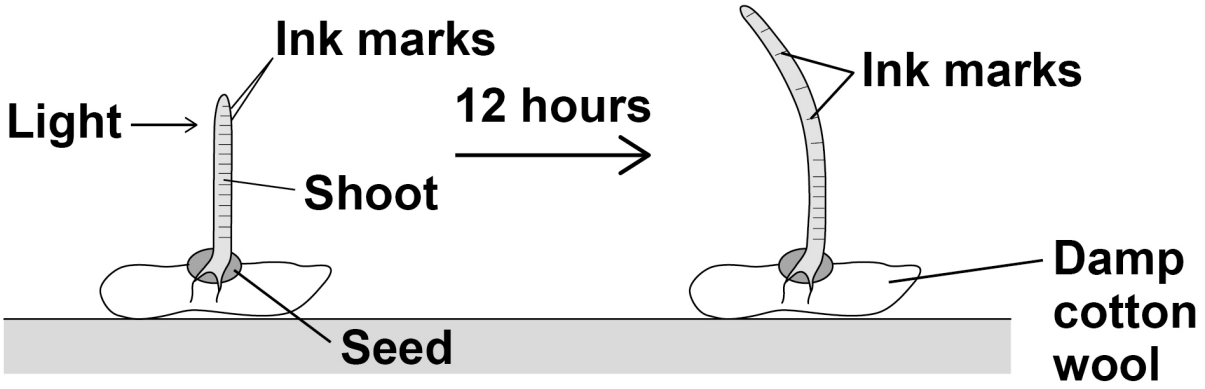
2 _____

_____

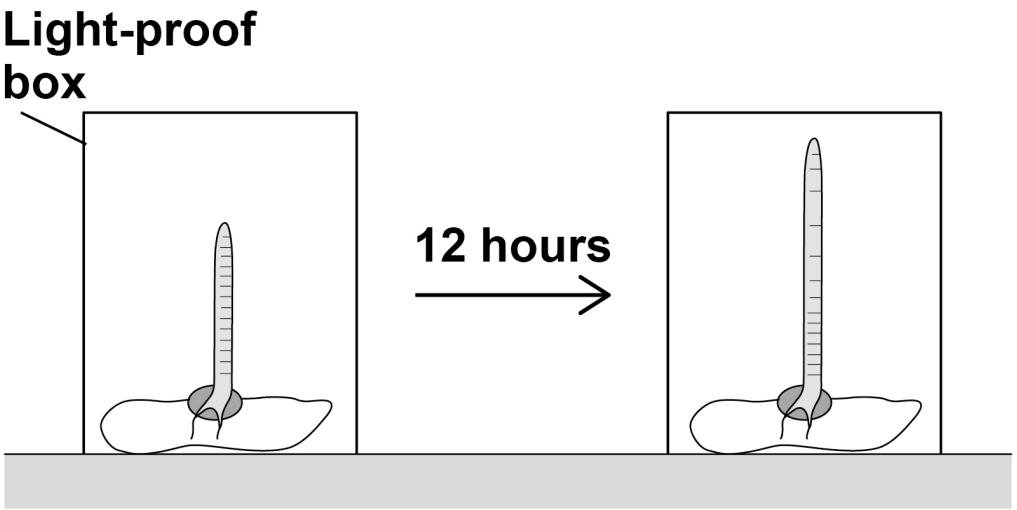
_____

FIGURE 13

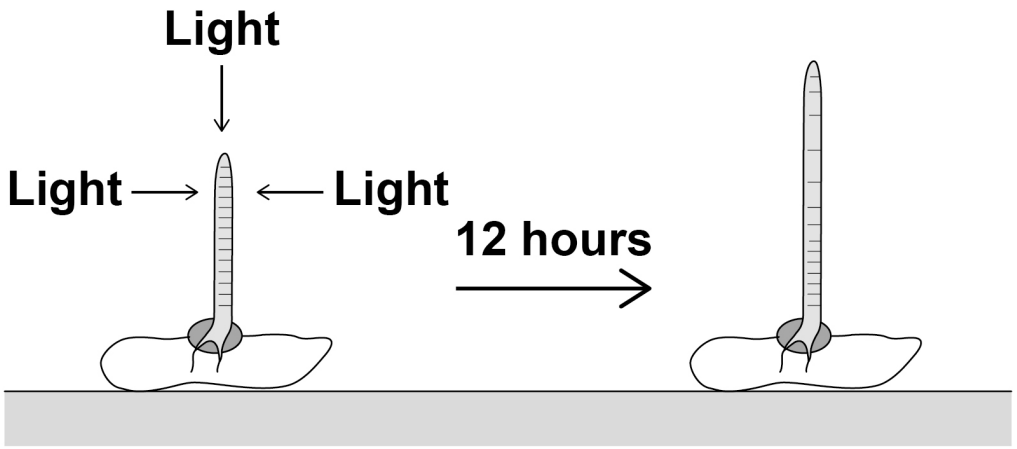
Experiment A



Experiment B



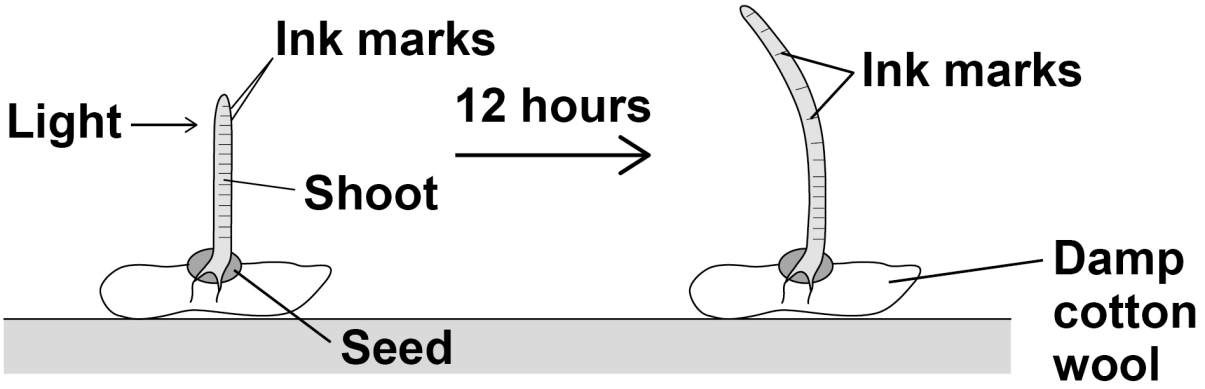
Experiment C



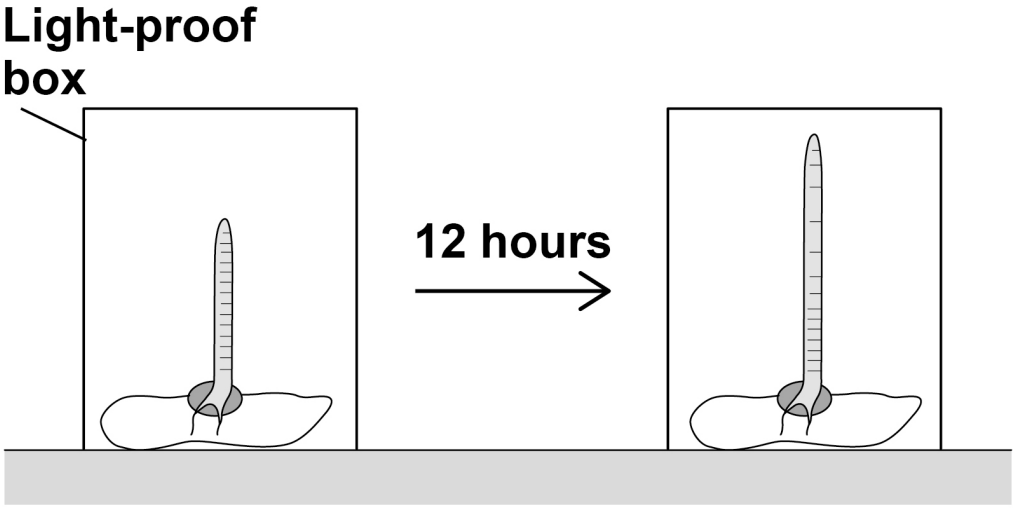
[Turn over]

REPEAT OF FIGURE 13

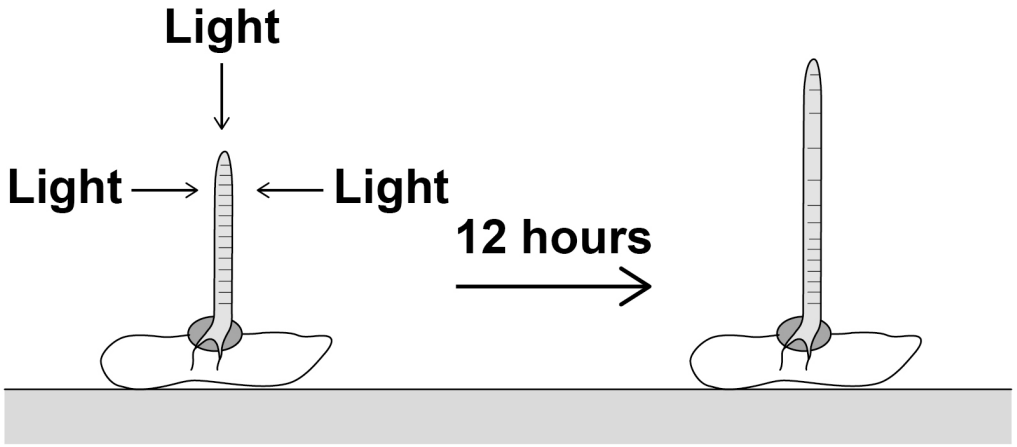
Experiment A



Experiment B



Experiment C



0 9 . 2

Describe how experiment B and experiment C acted as controls for the investigation. [2 marks]

Experiment B _____

_____

_____

Experiment C _____

_____

_____

0 9 . 3

Give TWO conclusions that the students could make from the INK MARKS on the shoot in experiment A. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 9 . 4

Name the type of response shown by the seedling in experiment A. [1 mark]

Auxin is a plant hormone. Auxin is made in the shoot tip.

Scientists investigated the role of auxin in the response of shoot tips to light.

This is the method used.

1. **Grow four seedlings in the dark for a few days.**
2. **Cut the tip off the shoot of each seedling.**
3. **Place each shoot tip on a small block of agar jelly.**
4. **Place the shoot tips and agar in different conditions as shown in FIGURE 14, on page 66.**
5. **After 24 hours, measure the mass of auxin in the agar blocks.**

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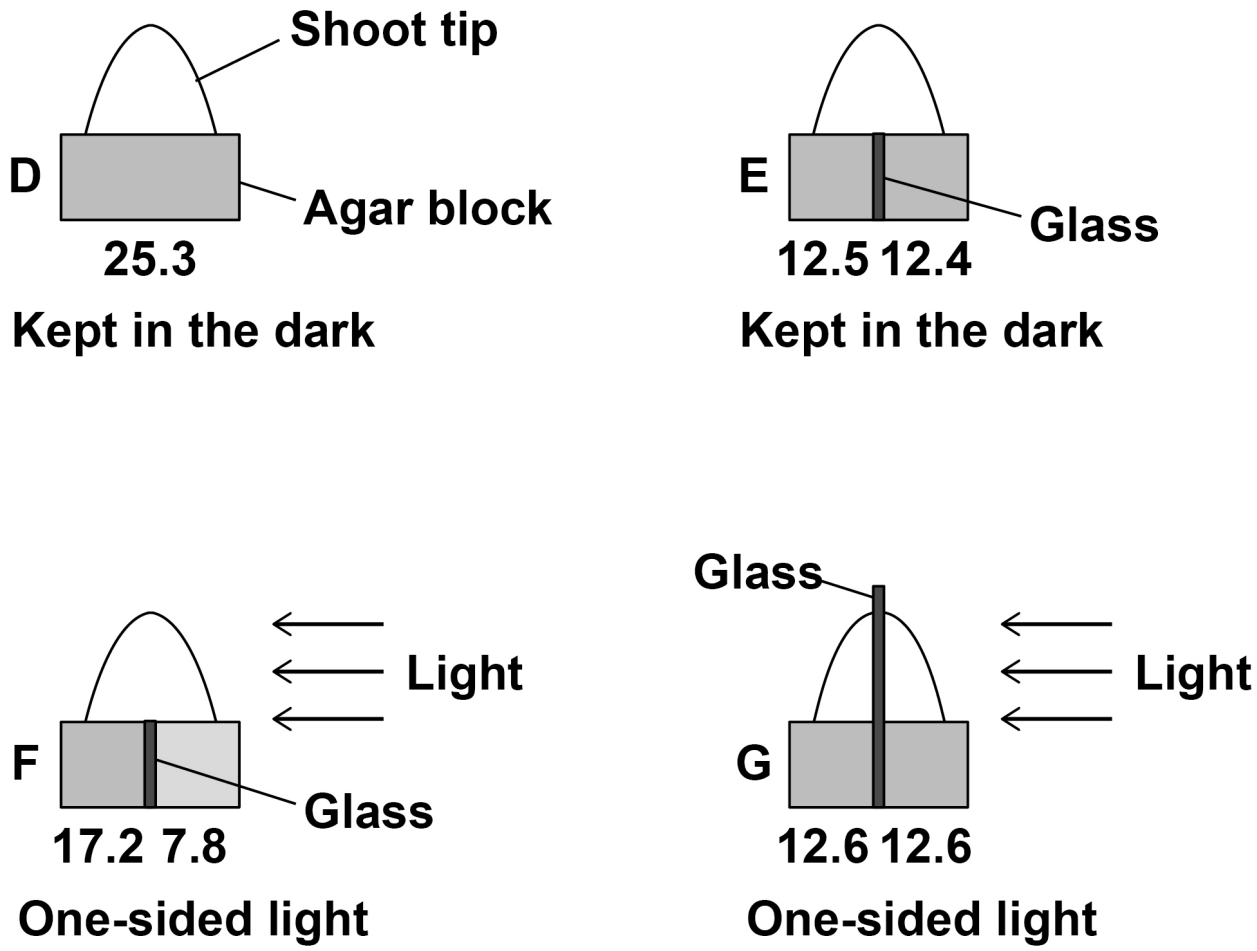
[Turn over]

FIGURE 14



The numbers under each block show the mass of auxin that diffused into the blocks from the shoot tips.

The mass of auxin is given in arbitrary units.

0 9 . 5

A scientist made a hypothesis:

‘Light causes auxin to move from the side of the shoot nearest to the light to the side furthest from the light.’

Describe the evidence from FIGURE 14 which supports the hypothesis. [3 marks]

0 9 . 6

Another scientist made a different hypothesis:

‘Light causes the breakdown of auxin.’

Give the evidence from FIGURE 14, on page 66, that shows that auxin is NOT broken down by light. [1 mark]

END OF QUESTIONS

11

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.

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	
3	
4	
5	
6	
7	
8	
9	
TOTAL	