AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
BIOLOGY

H

Higher Tier Paper 2H

Time allowed: 1 hour 45 minutes

Materials

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.
- Fill in the boxes at the top of this page.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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ANSWER IN THE SPACES PROVIDED

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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]

Pollen

Question 1 continues on the next page

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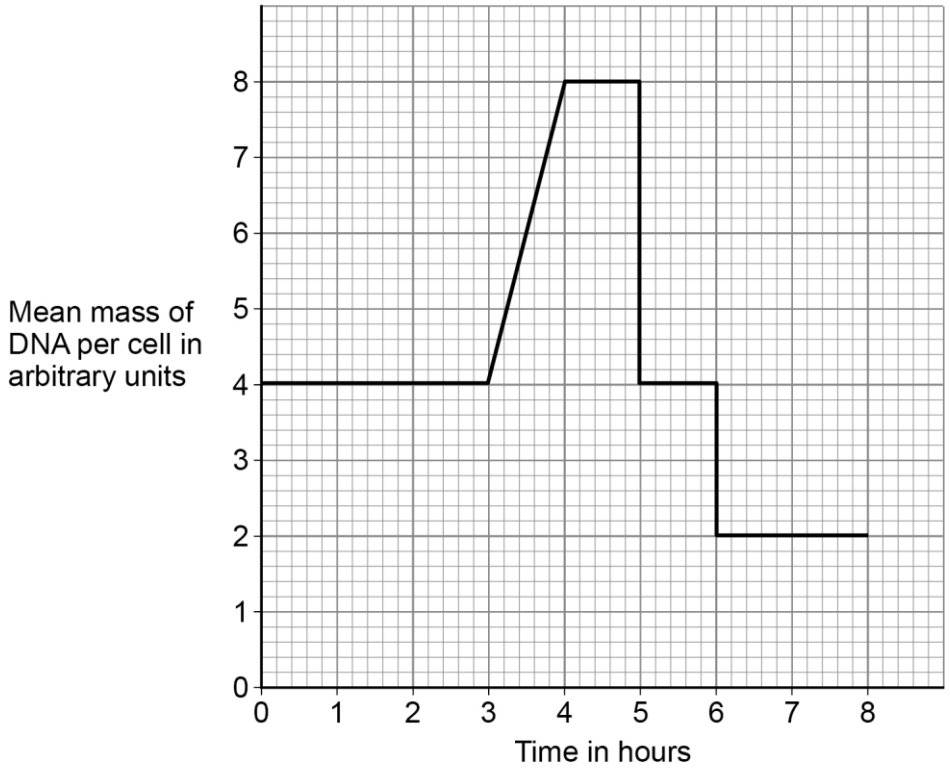
Cell division by meiosis forms gametes.

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 ☐

Do not write outside the box

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 ☐

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 ☐

8

Turn over for the next question

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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 water OR oxygen / air (in soil) OR pH (of soil) OR minerals / ions

2 temperature OR size of soil particles or texture / type of soil

Biotic factors

1 food OR predators / consumers / carnivores

2 disease / pathogens / bacteria/ fungi

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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]

same concentration of chemical / X applied to the soil

• same volume / amount of chemical / X applied to the soil

• same size of area sampled – eg 1 m2 or 0.25 m2

• use of a quadrat

• same time between application and collecting worms

• same time allowed for collecting worms after application

• each sample area selected randomly

• method of achieving randomness – eg random coordinates

• (collect and) count worms in each of areas A and B

• at least 5 repeats in each of areas A and B

• calculate mean (per unit area) or total for each of areas A and B

• compare means / totals for areas A and B

10

Turn over for the next question

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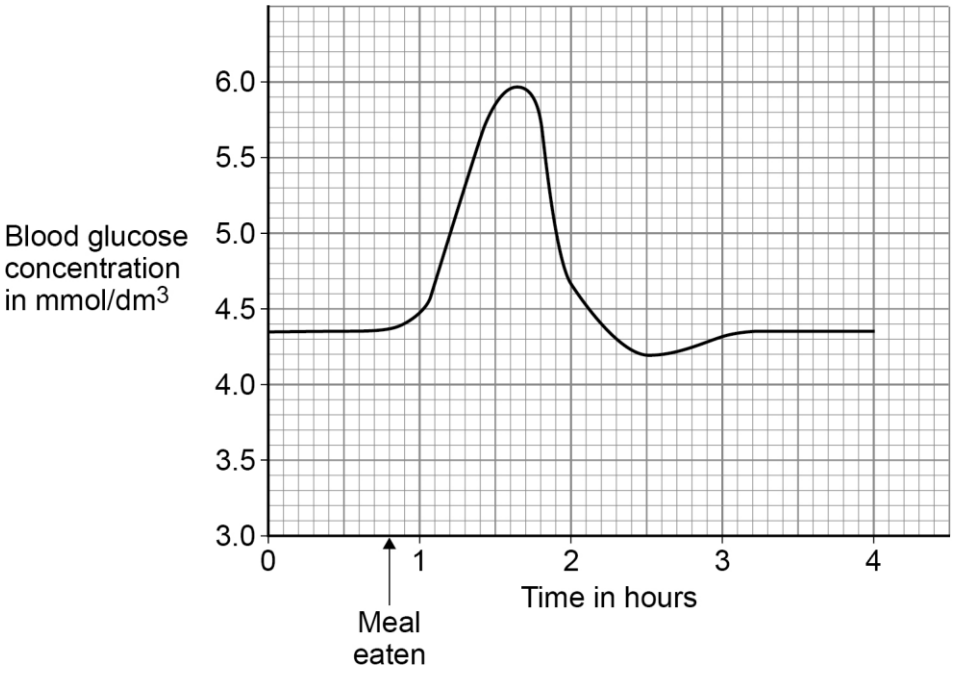
0 3 It is important to control the concentration of glucose in the blood.

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 = 1.1 to 2 hours

Do not write outside the box

0 3 . 2 Explain the effect a high concentration of insulin has on blood glucose concentration.

[3 marks]

Effect Lowered

Explanation Glucose taken in or glucose converted to glycogen or glucose used in respiration by cells / liver / muscles

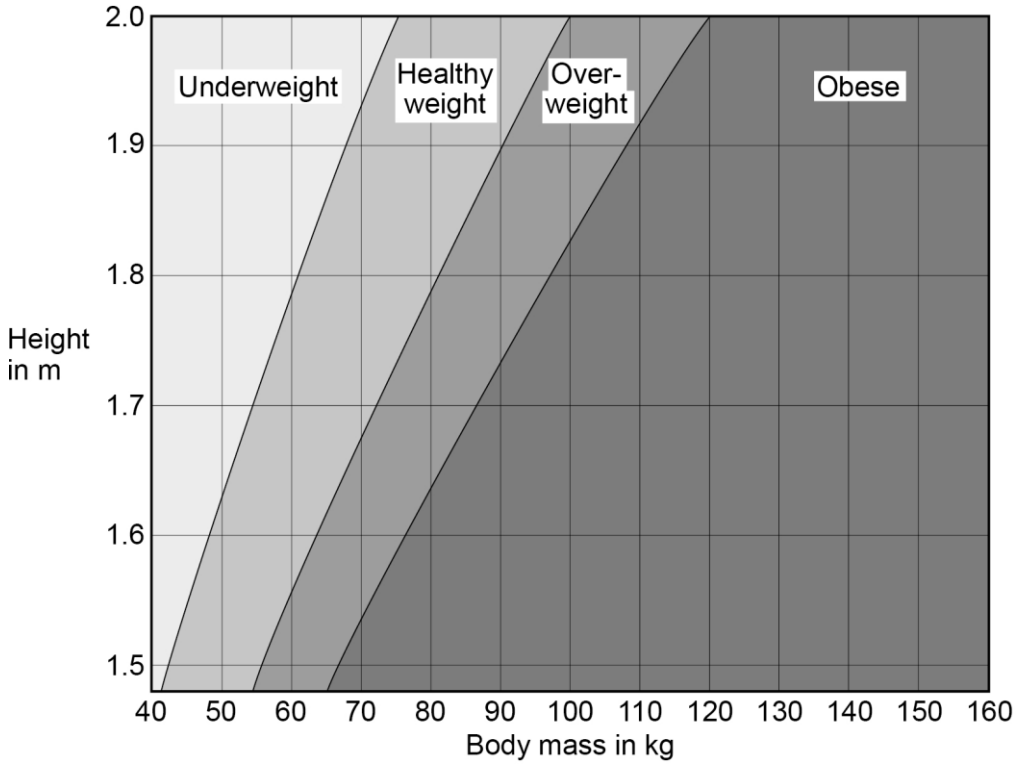
Question 3 continues on the next page

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



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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 67.5 kg to 90 kg

Question 3 continues on the next page

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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 Person C has higher glucose than mean

2 Person C has higher insulin than mean

Do not write outside the box

0 3 . 6 Give **two** ways that a person can reduce the chance of developing Type 2 diabetes.

[2 marks]

1 (more) exercise

2 eat less carbohydrate / sugar

10

Turn over for the next question

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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]

carbon dioxide

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 fertiliser

2 sewage

3 toxic chemicals

Do not write outside the box

0 4 . 3 Describe how substances that pollute air and water could be harmful to humans and other living organisms.

[6 marks]

air pollution:
(carbon dioxide or methane or greenhouse gases): global warming / climate change / traps heat.floods / fire / drought or ice caps melt or rise in sea level or extreme weather, loss of habitat / food, migration

(acidic gas / named – eg SO2 / NOx) :damage to leaves so less photosynthesis, damage to roots or alters ions in soil (/ e.g. phosphates / iron) (so) less protein manufacture ,damage to lungs breathing difficulties / bronchitis / asthma

carbon monoxide combines with haemoglobin, less oxygen carried (by haemoglobin / blood)

particulates / 'soot' cover leaves or block light, less photosynthesis so less glucose made

-damage to lungs breathing difficulties / bronchitis / asthma

water pollution:
sewage: bacteria multiply, use oxygen in respiration, water animals cannot respire
- pathogens in water

(fertiliser):algae multiply, (algae) block light so plants cannot photosynthesise
- lack of oxygen for respiration – fish die

(toxic substances) :damages / harms cells or bioaccumulation
- interferes with metabolism – e.g. respiration / protein synthesis

(plastics) entrap animals or causing internal damage if swallowed

(particles) block light, plants / algae cannot photosynthesise so less glucose made

(oil) damages birds' feathers
cannot fly so cannot find food or escape predators

(acid rain / acids): lowers pH of water , damages fish gills, bleaches coral

10

Turn over for the next question

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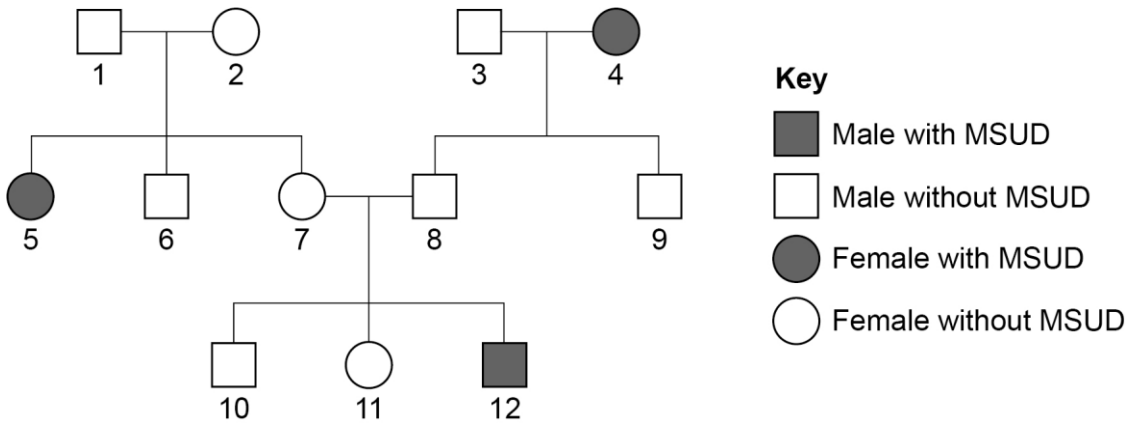
0 5 Maple syrup urine disease (MSUD) is a rare inherited human condition.

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



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]

Parents without MSUD have a child with MSUD

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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]

gametes:
N + n and N + n

correct derivation of offspring genotypes:
NN Nn Nn nn

correct probability:
0.25 / ¼ / 25% / 1 in 4

Probability = 0.25 / ¼ / 25% / 1 in 4

Question 5 continues on the next page

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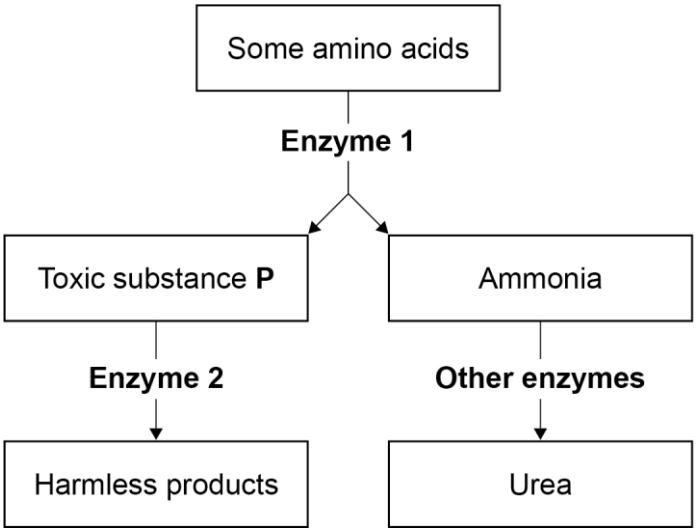
Figure 5 shows chemical reactions involved in the normal breakdown of some types of amino acid inside body cells.

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 ☐

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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**.

[3 marks]

No enzyme 2 made so cannot break down the toxic substance. The toxic substance is still made from the amino acids. Toxic substance diffuses / moves from cells into the blood.

0 5 . 5 Explain why the **urine** of a person with MSUD will have a high concentration of toxic substance **P**.

[2 marks]

The toxic substance passes through filter in kidney or P passes through filter in kidney (some / all) not reabsorbed

Question 5 continues on the next page

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0 5 . 6 Explain why a person with MSUD must have a low-protein diet.

[3 marks]

Proteins contain amino acids or proteins are made of amino acids ,must keep (certain) amino acids in low amount (so) toxic substance or P does not build up in the body and cause damage to cells / tissues / organs.

14

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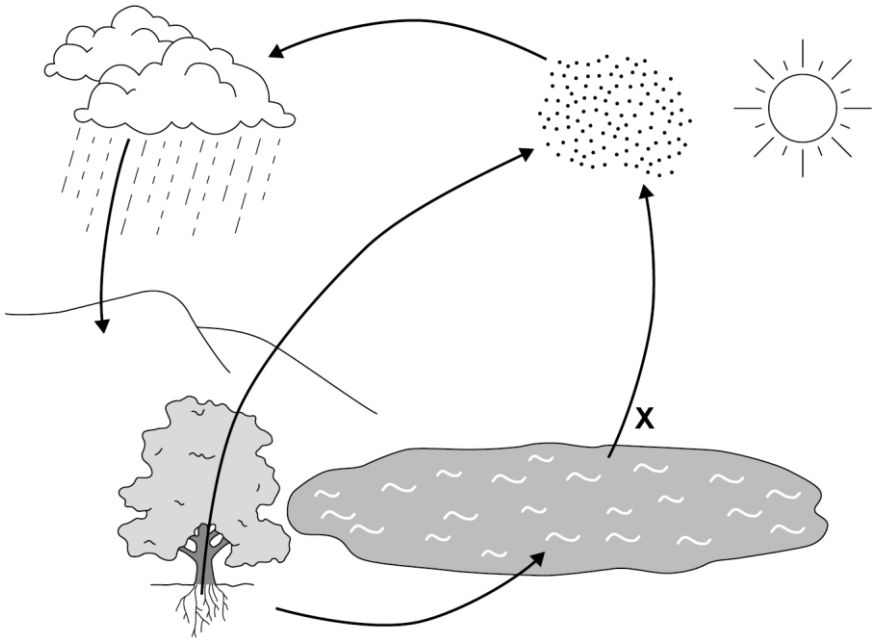
0 6 Energy flows through an ecosystem and materials are recycled.

Figure 6 shows the water cycle.

Figure 6



0 6 . 1 Name process **X**.

[1 mark]

Evaporation

0 6 . 2 Name the process by which water is absorbed into plant roots.

[1 mark]

Osmosis

0 6 . 3 Give **two** uses of water in plants.

[2 marks]

1 photosynthesis

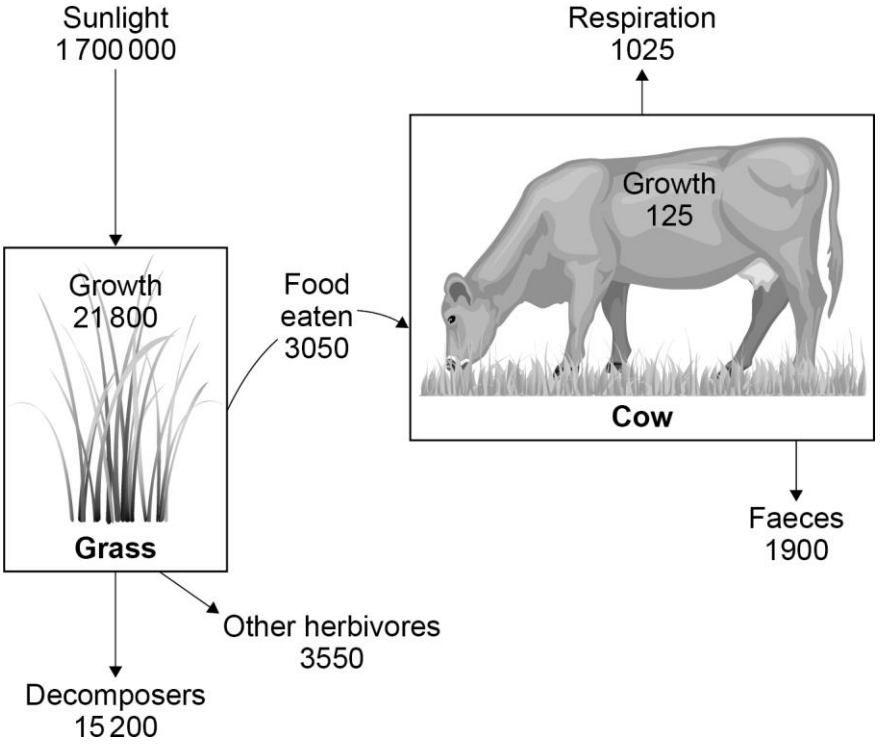
2 support OR translocation

Turn over ►

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

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

Figure 7



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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]

substitution

21 800/1 700 000 × 100 =1.282(3529)

comparative efficiency

4.098/ 1.282 =3.196.....

significant figures
3.20

Number of times (3 significant figures) = 3.20

Question 6 continues on the next page

Do not write outside the box

0 6 . 5 It is more energy-efficient to rear cows indoors than to rear cows outdoors.

Give **two** reasons why.

[2 marks]

1 Less energy lost as heat

2 Less energy lost in movement

0 6 . 6 Suggest **two** possible disadvantages of rearing cows indoors.

[2 marks]

1 Increased spread of disease

2 more antibiotics in meat / milk

13

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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]

A change in DNA OR base code or nucleotide sequence.

Question 7 continues on the next page

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

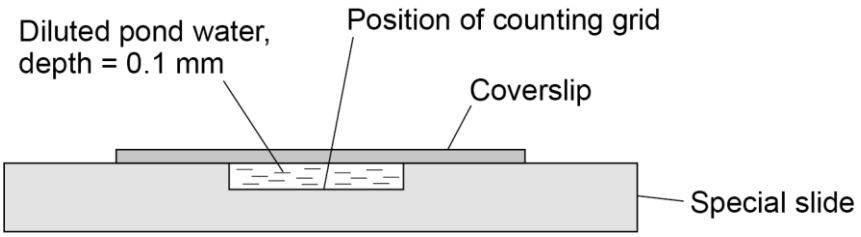
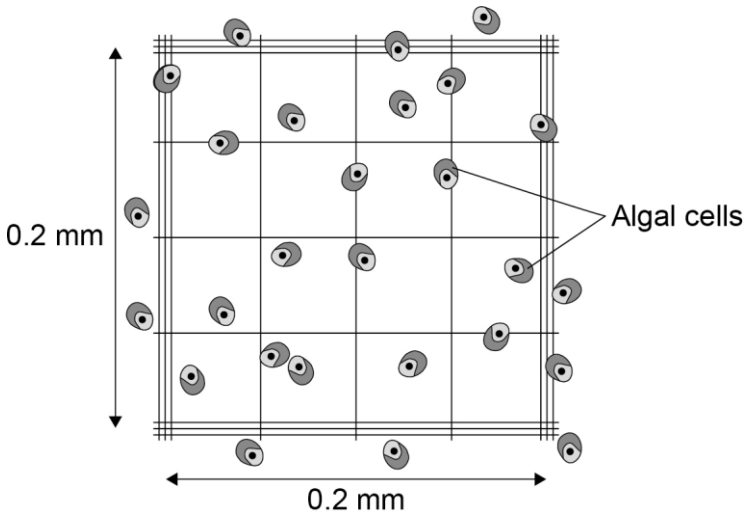


Figure 9 shows the view of the counting grid through a microscope.

Figure 9



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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 = 16

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]

Volume of sample in mm3
0.004

Number of cells in 1 mm3 diluted pond water
14 ÷ 0.004 =3 500

Correct dilution factor ¼

Number of cells in 1 mm3 undiluted pond water
3 500 × 4 =14 000

Number of algal cells in 1.0 mm^3 of undiluted pond water = 14 000

Question 7 continues on the next page

Do not write outside the box

0 7 . 4 Suggest why the scientist diluted the pond water before placing it on the special slide.

[1 mark]

To make it easier to count.

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]

Smaller volume so fewer cells.

11

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Turn over for the next question

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0 8 An echidna is a mammal that lives in Australia.

Figure 10 shows an echidna.

Figure 10

Figure 11 shows how the body temperature of the echidna varies in warm weather and in cold weather.

Figure 11

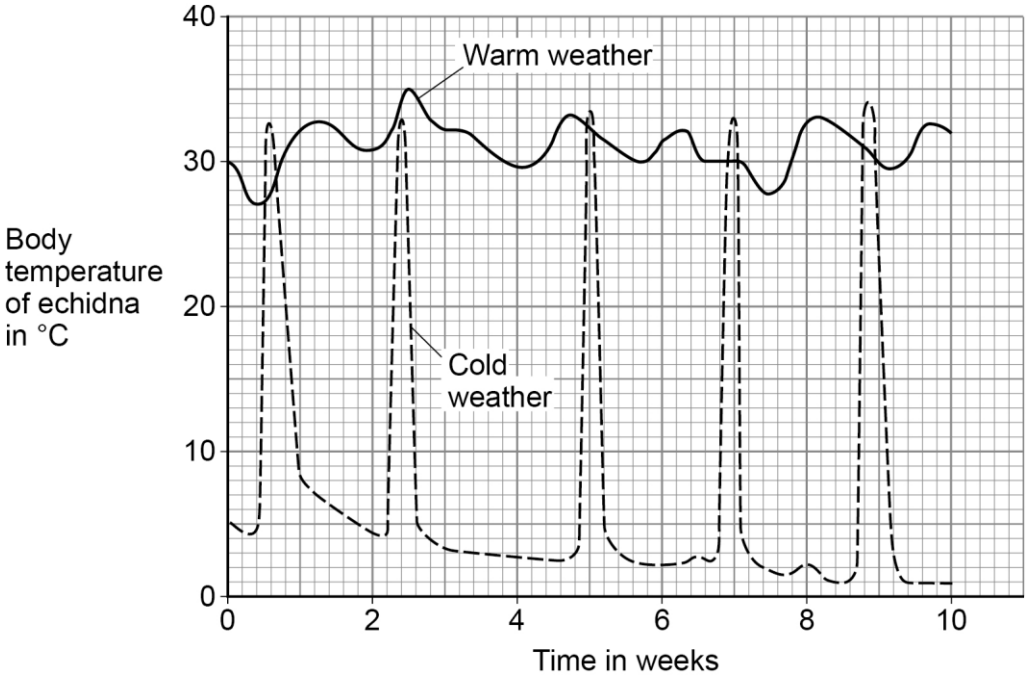
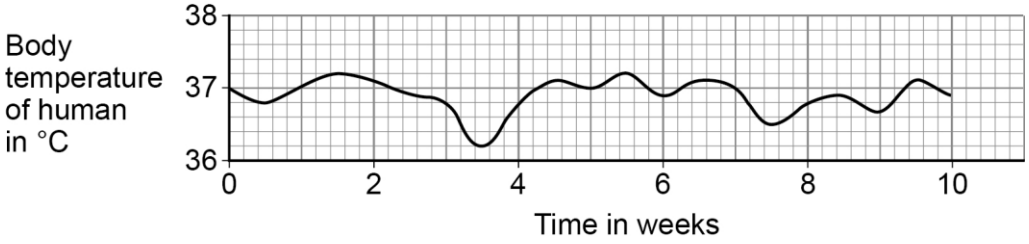


Figure 12 shows how human body temperature varies.

Figure 12



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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]

Echidna: 27 to 35 or by 8 (°C) and Human: 36.2 to 37.2 or by 1 (°C)

Echidna is more variable or human fluctuates less.

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]

Loses less energy from its body so body energy store lasts longer

Question 8 continues on the next page

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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]

Movement requires energy from respiration and) respiration / metabolism releases heat which increases body temperature.

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]

More blood flow near surface of skin or more blood flow to the skin so) more heat / energy is lost from the blood cools blood which cools the body

Do not write outside the box

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]

20 000 × 40 /100 × 2.5
or
8000/ 2.5

=3 200 (cm3)

=3.2 (dm3)

Volume of sweat lost in one day = 3.2 dm^3

0 8 . 6 Suggest why the athlete was advised to take salt tablets each day.

[1 mark]

To replace ions / salt lost in sweat

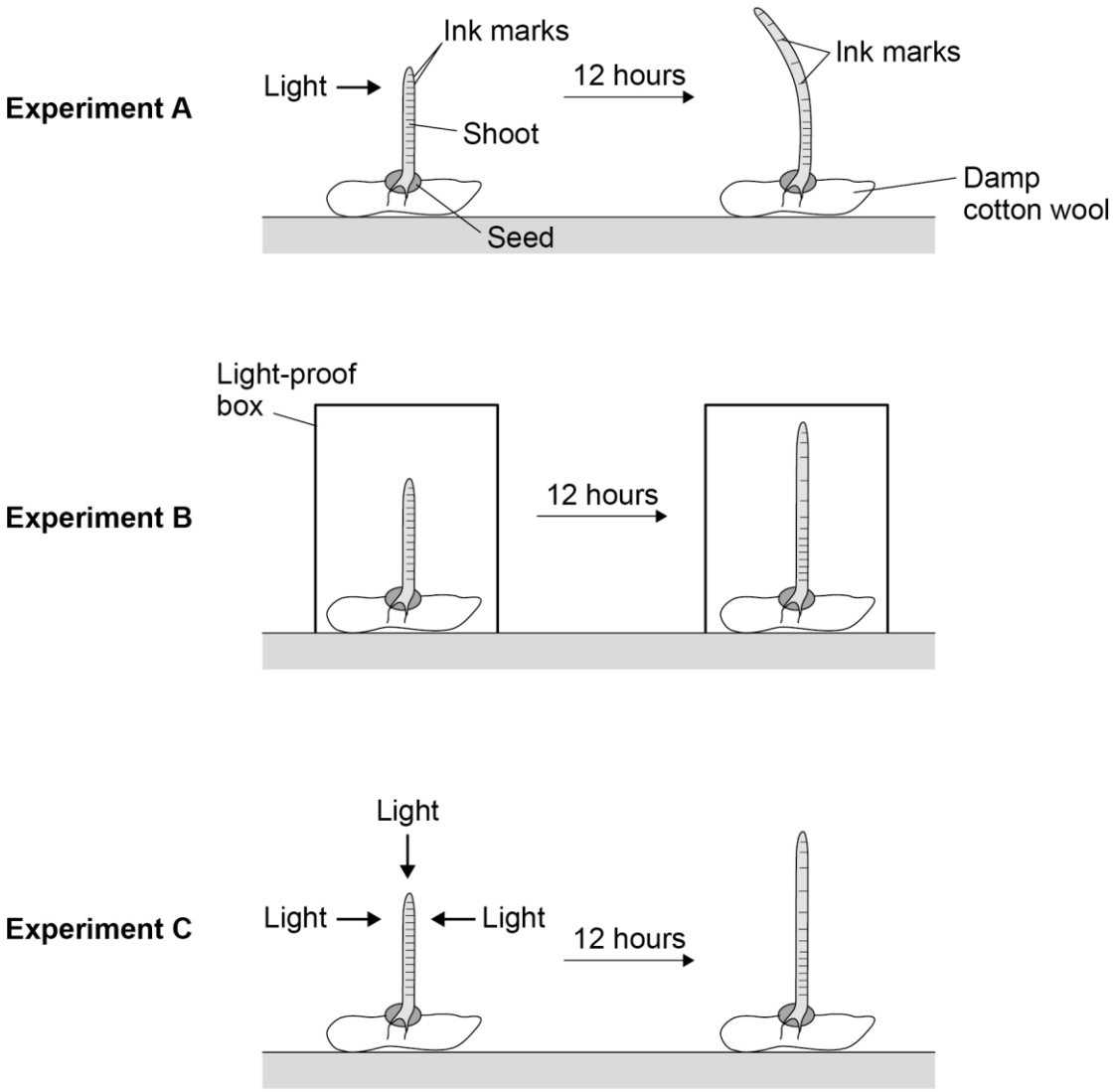
13

Turn over for the next question

0 9 Students investigated the response of plant shoots to one-sided light.

Figure 13 shows how the students set up three experiments.

Figure 13



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0 9 . 1 Suggest **two** control variables the students should have used in their investigation.

[2 marks]

1 same volume of water OR same temperature

2 same species / type of plant

0 9 . 2 Describe how experiment **B** and experiment **C** acted as controls for the investigation.

[2 marks]

Experiment **B** Shows response in A is due to light as B has no light

Experiment **C** Shows response in A is due to one-sided light as C has light from all sides

0 9 . 3 Give **two** conclusions that the students could make from the **ink marks** on the shoot in experiment **A**.

[2 marks]

1 Growth / elongation occurs behind / below / at the tip

2 Bending occurs behind / below / at the tip

0 9 . 4 Name the type of response shown by the seedling in experiment **A**.

[1 mark]

phototropism

Question 9 continues on the next page

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.

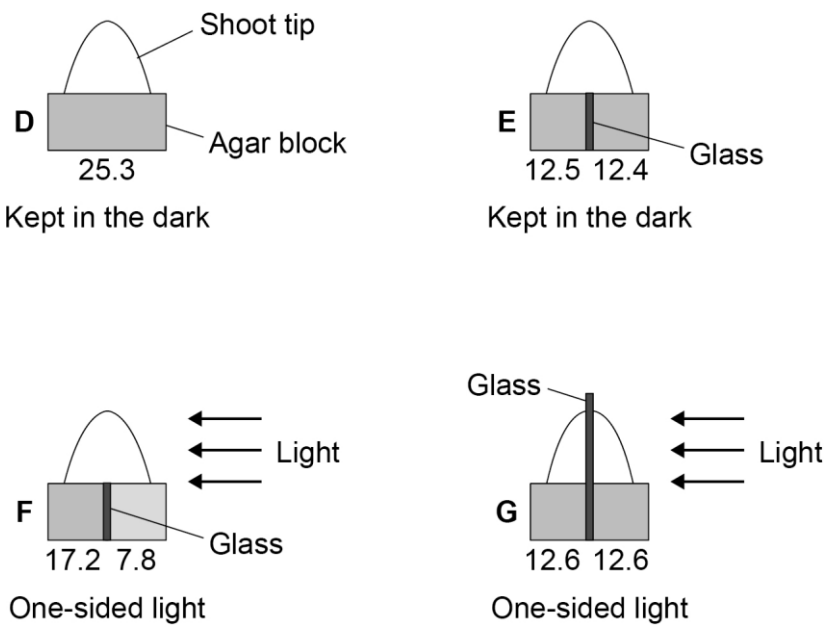
2. Cut the tip off the shoot of each seedling.

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**.

5. After 24 hours, measure the mass of auxin in the agar blocks.

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.

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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]

In F there is more auxin in the side furthest from the light and in G there is the same mass of auxin in each side .In F auxin can move through the shoot but in G the glass prevents this.

0 9 . 6 Another scientist made a different hypothesis:

'Light causes the breakdown of auxin.'

Give the evidence from **Figure 14** that shows that auxin is **not** broken down by light.

[1 mark]

All four blocks have approximately the same mass of auxin.

11

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