AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY

F

Foundation Tier Paper 1 Life and Environmental Sciences

Tuesday 16 May 2023 Morning Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a protractor
- a scientific calculator
- the periodic table (enclosed)
- the Physics Equations Sheet (enclosed).

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. Do not write outside the box around each page or 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).
- 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.

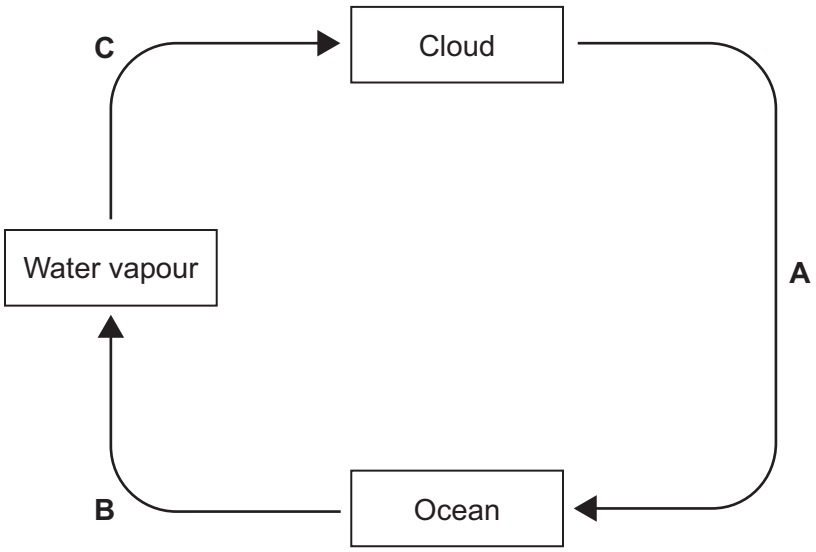
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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 write outside the box

0 1 **Figure 1** shows part of the water cycle.

Figure 1



0 1 . 1 Name processes **A**, **B** and **C**.

Choose answers from the box.

[3 marks]

absorption	**condensation**	**evaporation**
	precipitation	**transpiration**

A _____

B _____

C _____

Do not write outside the box

0 1 . 2 Drinking water can be produced from sea water.

Which process is used to produce drinking water from sea water?

[1 mark]

Tick (✓) **one** box.

Desalination ☐

Digestion ☐

Screening ☐

0 1 . 3 Why is producing drinking water from sea water expensive?

[1 mark]

Tick (✓) **one** box.

The process requires energy. ☐

The sea water must be filtered. ☐

The sea water temperature is too high. ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 Which **two** processes are used to kill bacteria during the production of drinking water?

[2 marks]

Tick (✓) **two** boxes.

- Adding chlorine ☐
- Exposure to ultraviolet light ☐
- Freezing ☐
- Grit removal ☐
- Sedimentation ☐

0 1 . 5 Why is it important to kill bacteria in water during the production of drinking water?

[1 mark]

_____

_____

8

Do not write outside the box

0 2 This question is about plants.

0 2 . 1 Meristem is a specialised tissue found at the tips of shoots and roots.

What is the function of meristem tissue?

[1 mark]

Tick (✓) **one** box.

Cell division ☐

Fertilisation ☐

Transpiration ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Xylem tissue and phloem tissue are found in plants.

Cells in phloem tissue contain sugars.

Table 1 shows some features of xylem tissue and phloem tissue.

Complete **Table 1**.

Put **one** tick (✓) in each row to show if the feature is true for:

- xylem only
- phloem only
- both xylem **and** phloem.

[4 marks]

Table 1

Feature of tissue	**Xylem only**	**Phloem only**	**Both xylem AND phloem**
Involved in transport of substances in the plant			
Transports water and mineral ions from roots to leaves			
Consists of hollow tubes of dead cells			
End walls of the cells have pores			

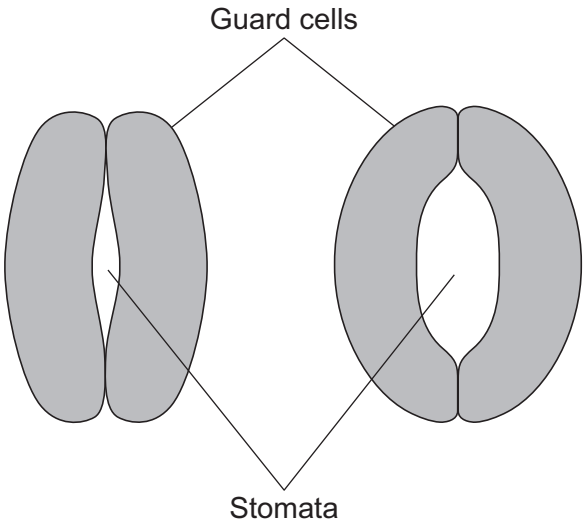
Do not write outside the box

0 2 . 3 Stomata are tiny holes in the surface of leaves.

Guard cells surround the stomata.

Figure 2 shows the shape of guard cells around stomata at different times of the day.

Figure 2



Guard cells control water loss from the leaf.

Explain what happens to the guard cells to **increase** water loss from the leaf.

Use **Figure 2**.

[2 marks]

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 Complete the sentences.

Choose answers from the box.

[3 marks]

active transport	**filtration**	**mitosis**
osmosis	**translocation**	

Water moves from the soil into the plant by _____.

Mineral ions move from a low concentration in the soil to a high concentration in the root by _____.

Sugars are transported from the leaves to other parts of the plant by _____.

10

Do not write outside the box

0 3 Carbon is an element with several isotopes.

0 3 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

electrons	**neutrons**	**protons**

Each isotope of carbon has a different number of _____.

0 3 . 2 An isotope of carbon is carbon-14

Plants contain carbon-14

How does carbon-14 pass from plants to animals?

[1 mark]

_____

_____

Question 3 continues on the next page

Do not write outside the box

Carbon-14 is radioactive.

Carbon-14 nuclei emit beta particles.

A beta particle is an electron.

0 3 . 3 Which symbol represents a beta particle?

[1 mark]

Tick (✓) **one** box.

$^{0}_{-1}e$ ☐ $^{4}_{2}He$ ☐ $^{1}_{1}H$ ☐

0 3 . 4 When a carbon-14 nucleus emits a beta particle, the atomic number changes from 6 to 7

Which element has the atomic number of 7?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

Helium ☐

Lithium ☐

Nitrogen ☐

Do not write outside the box

0 3 . 5 Which **two** of the following substances would beta particles **not** be able to penetrate?

[2 marks]

Tick (✓) **two** boxes.

1 metre of concrete ☐

10 centimetres of lead ☐

1 centimetre of air ☐

1 millimetre of aluminium ☐

0.1 millimetre sheet of paper ☐

In 1991, the frozen remains of a human body were found in a glacier.

The body was 5400 years old.

0 3 . 6 The body tissues had **not** decayed completely.

What causes the decay of body tissues?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide ☐

Microorganisms ☐

Mineral ions ☐

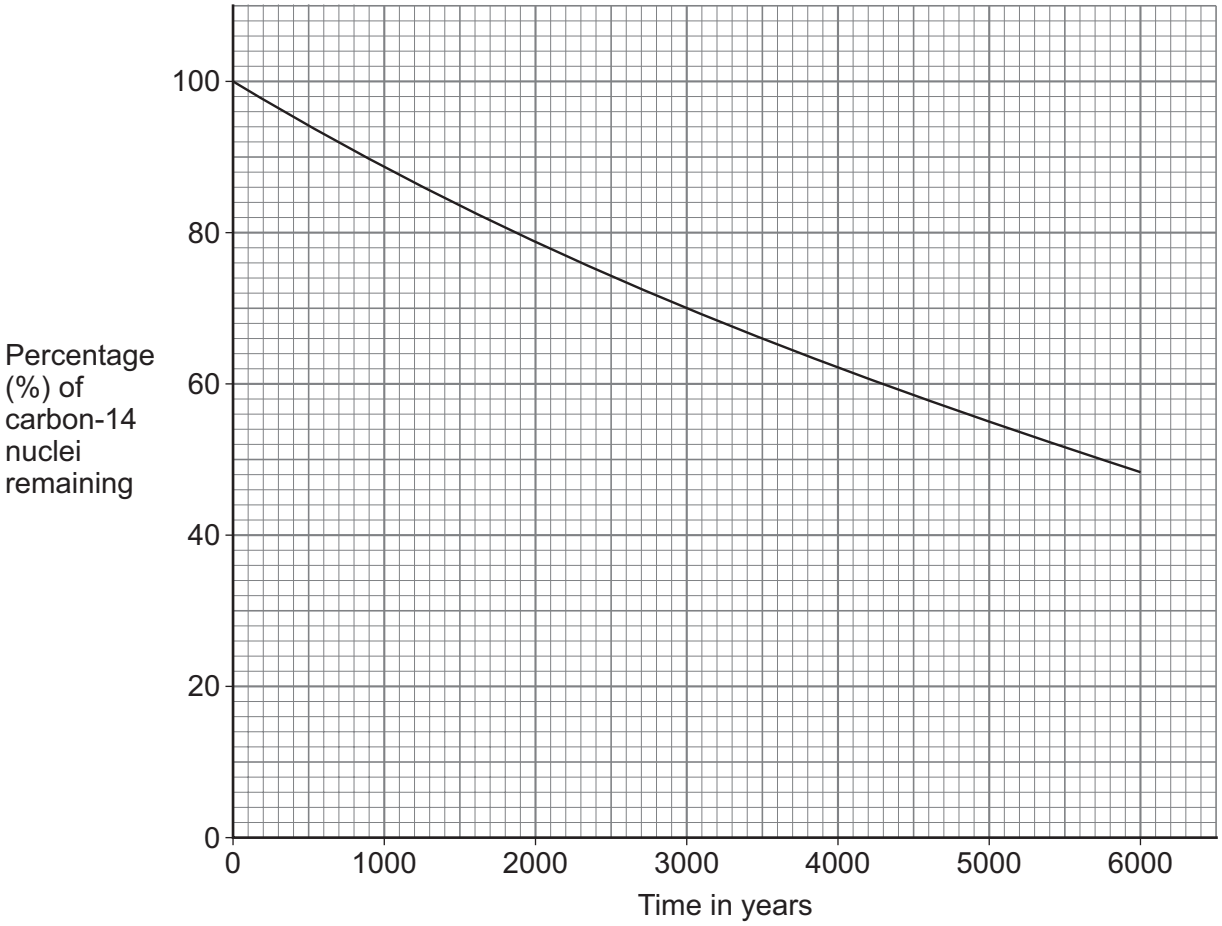
Question 3 continues on the next page

Do not write outside the box

The percentage of carbon-14 in an organism decreases after death.

Figure 3 shows how the percentage of carbon-14 nuclei remaining varies with time.

Figure 3



0 3 . 7 Determine the percentage of carbon-14 nuclei remaining in an organism after 3000 years.

Use **Figure 3**.

[1 mark]

Percentage remaining = _____ %

Do not write outside the box

0 3 . 8 The half-life of carbon-14 is the average time taken for the number of carbon-14 nuclei in a sample to halve.

Determine the half-life of carbon-14

Use **Figure 3**.

[1 mark]

Half-life = _____ years

0 3 . 9 Only a very small proportion of the carbon in an organism is carbon-14.

Scientists studying the body from the glacier were **not** concerned about the risk from beta radiation emitted by the body.

Why was the risk to the scientists low?

[1 mark]

Tick (✓) **one** box.

The beta radiation emitted by the body was a type of ionising radiation. ☐

The carbon-14 nuclei in the body had all decayed. ☐

The radiation dose absorbed by the scientists was low. ☐

10

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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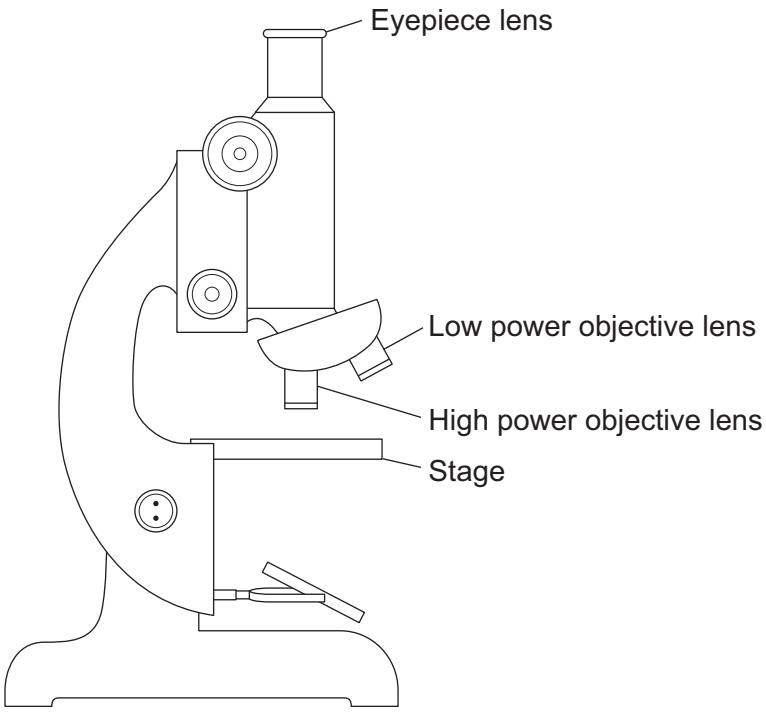
0 4 **Figure 4** shows a light microscope.

Figure 4



0 4 . 1 The eyepiece lens has a magnification of ×10

The high power objective lens has a magnification of ×40

Which calculation shows the total magnification?

[1 mark]

Tick (✓) **one** box.

10 × 40 ☐ $\frac{40}{10}$ ☐ 10 + 40 ☐

Question 4 continues on the next page

Do not write outside the box

0 4 . 2 Write down the equation which links magnification, size of image and size of real object.

[1 mark]

0 4 . 3 A student used a different microscope to view a cell.

The cell was viewed with a magnification of ×250

The size of the image of the cell was 1.5 cm.

Calculate the real size of the cell.

Give your answer in mm.

[4 marks]

Real size of cell = _____ mm

Do not write outside the box

0 4 . 4 The student focused the image for the low power objective lens and then changed to the high power objective lens.

The high power objective lens should **not** be moved **towards** the stage to focus the image.

Give **one** reason why.

[1 mark]

_____

_____

0 4 . 5 Viruses are approximately 100 times smaller than animal cells.

What type of microscope is used to view viruses?

[1 mark]

_____

Question 4 continues on the next page

Do not write outside the box

Chilli plants can be infected with tobacco mosaic virus (TMV).

Farmers grow chilli plants and sell chilli fruits.

Figure 5 shows chilli fruits growing on a chilli plant.

Figure 5

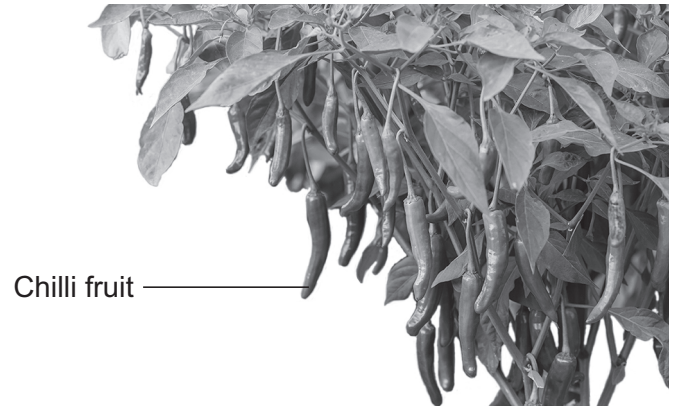
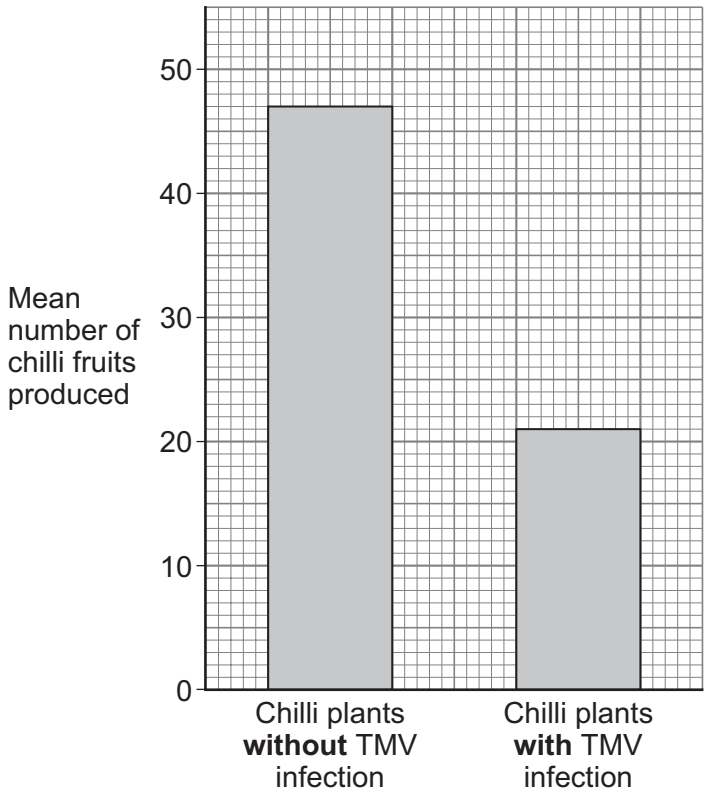


Figure 6 shows how infection with TMV affects the number of chilli fruits produced on chilli plants.

Figure 6



Do not write outside the box

0 4 . 6 Determine the decrease in the mean number of chilli fruits produced when plants are infected with TMV.

[2 marks]

Decrease = _____ fruits

0 4 . 7 Suggest **one** reason why farmers remove and destroy plants that are infected with TMV.

[1 mark]

11

Turn over for the next question

Do not write outside the box

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ANSWER IN THE SPACES PROVIDED

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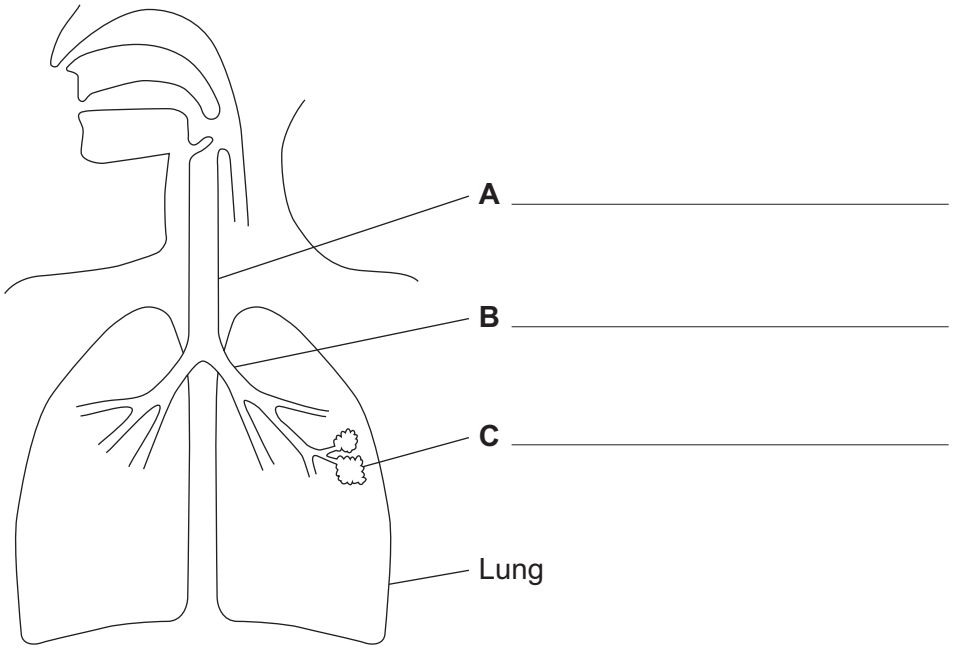
0 5 **Figure 7** shows part of the human breathing system.

Figure 7



0 5 . 1 Label structures **A**, **B** and **C** on **Figure 7**.

Choose answers from the box.

[3 marks]

alveolus	**bronchus**	**trachea**
valve	**ventricle**	

0 5 . 2 Describe **one** way that lungs are adapted for gas exchange.

[1 mark]

_____

_____

Question 5 continues on the next page

Do not write outside the box

A student investigated the effect of surface area to volume ratio on diffusion.

The student used gel cubes with different surface area to volume ratios.

The gel cubes:

- were pink at the start of the investigation
- became colourless as acid diffused into the cube.

This is the method used.

1. Cut the gel into a cube with sides that are 1 cm long.
2. Place the cube in a beaker.
3. Cover the cube with acid.
4. Keep the beaker at 20 °C.
5. Record the time taken for the cube to go colourless.
6. Repeat steps 2 to 5 with cubes of different sizes.

0 5 . 3 Draw **one** line from each type of variable to that variable in the investigation.

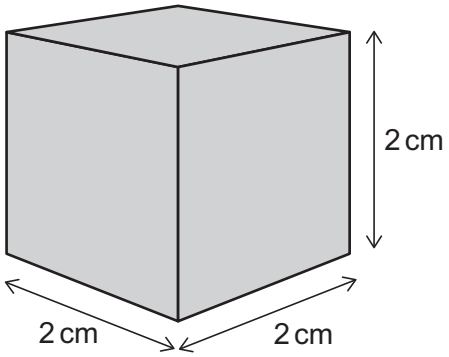
[2 marks]

Type of variable	**Variable in the investigation**
	Size of cube
Dependent variable	Temperature
Independent variable	Time taken for the cube to go colourless
	Type of acid used

Do not write outside the box

0 5 . 4 **Figure 8** shows one of the cubes.

Figure 8



Calculate the surface area to volume ratio for the cube.

[3 marks]

Complete the following steps.

The surface area of one face of the cube is 4 cm^2.

Calculate the **total** surface area of the cube _____

_____

Surface area = _____ cm^2

Calculate the volume of the cube _____

_____

Volume = _____ cm^3

Give the surface area to volume ratio of the cube _____

_____

Surface area **:** volume = _____ **:** _____

Question 5 continues on the next page

Do not write outside the box

Table 2 shows the results.

Table 2

Length of side of cube in cm	Time taken for the cube to go colourless in minutes
1	5
2	15
3	30
4	90

0 5 . 5 Describe the effect of increasing the size of the cube on the time taken for the cube to go colourless.

[1 mark]

0 5 . 6 What would be an improvement to the investigation?

[1 mark]

Tick (✓) **one** box.

Repeat the method three times and calculate a mean for each size cube. ☐

Repeat the method with 5 cubes all of the same size. ☐

Repeat the method with a different size beaker for each size cube. ☐

11

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 6 The human body protects itself from pathogens.

0 6 . 1 Describe how the **skin** and the **stomach** protect the human body from pathogens.

[4 marks]

Do not write outside the box

Earwax is produced by specialised cells in the ear.

Earwax can trap and kill bacteria.

People either have wet earwax or dry earwax.

The type of earwax people have is controlled by one gene.

0 6 . 2 Name the part of a human cell where genes are found.

[1 mark]

_____

0 6 . 3 Name the chemical that genes are made of.

[1 mark]

_____

Each person has two alleles for earwax.

0 6 . 4 Why does a person have two alleles for earwax?

[1 mark]

_____

_____

Question 6 continues on the next page

Do not write outside the box

The allele for wet earwax is dominant.

E = allele for wet earwax

e = allele for dry earwax

0 6 . 5 Which word describes a person with the alleles **Ee**?

[1 mark]

Tick (✓) **one** box.

Heterozygous ☐

Phenotype ☐

Recessive ☐

0 6 . 6 A person with the genotype **Ee** and a person with the genotype **ee** plan to have a child.

Complete **Figure 9** to determine the probability that the child will have dry earwax.

You should identify any offspring genotype that would have dry earwax.

[4 marks]

Figure 9

		Parent 1	
		E	**e**
Parent 2	**e**		
	e		

Probability that the child will have dry earwax = _____

Do not write outside the box

0 6 . 7 Type of earwax is only affected by a gene.

Height is a characteristic that is affected by genes and environmental factors.

Give **one** other human characteristic that is affected by genes **and** the environment.

Do **not** refer to height in your answer.

[1 mark]

_____

0 6 . 8 Give **one** environmental cause for the variation in the characteristic you named in Question **06.7**.

[1 mark]

_____

_____

14

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

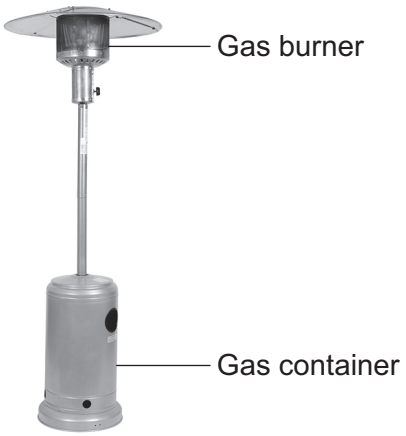
0 7 Heaters can be used to heat homes and gardens.

0 7 . 1 Gas heaters can be used to heat gardens.

The gas is stored in a container with a fixed volume.

Figure 10 shows a gas heater.

Figure 10



On a sunny day the burner is **not** lit.

The temperature of the gas in the container increases.

Complete **Table 3**.

Put **one** tick (✓) in each row.

[3 marks]

Table 3

	Increases	Stays the same	Decreases
Average kinetic energy of the gas particles			
Average speed of the gas particles			
Pressure exerted on the inside of the container			

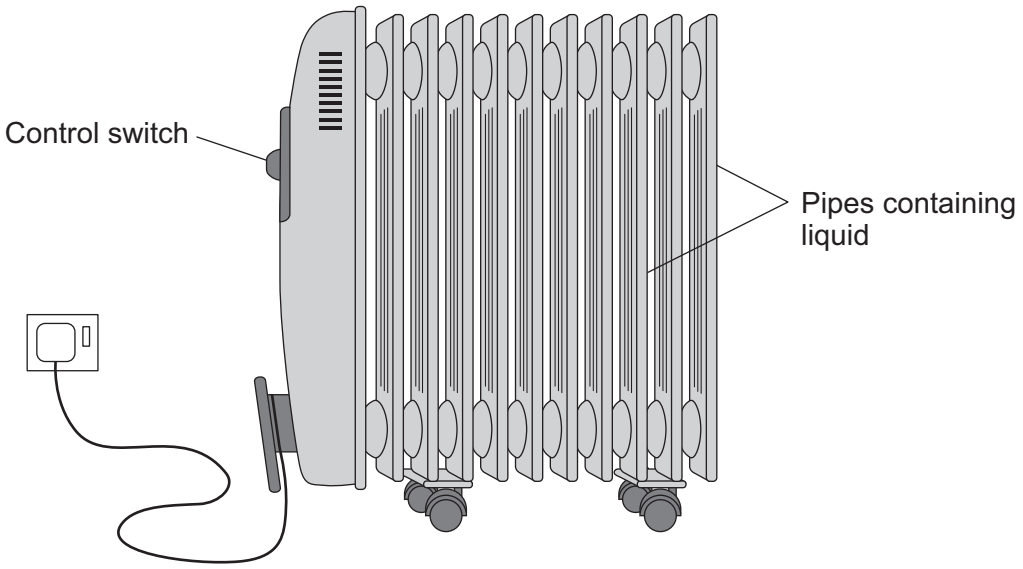
Question 7 continues on the next page

Do not write outside the box

Figure 11 shows an electric heater.

The heater is filled with a liquid.

Figure 11



0 7 . 2 When the heater is switched on, the temperature of the liquid in the heater increases.

On one day, the starting temperature of the liquid was 15.0 °C.

The final temperature of the liquid was 57.5 °C.

What was the temperature change of the liquid?

[1 mark]

Temperature change = _____ °C

Do not write outside the box

0 7 . 3 The change in thermal energy of the liquid in the heater was 892 500 J.

What was the change in thermal energy of the liquid in kJ?

1000 J = 1 kJ

[1 mark]

Change in thermal energy = _____ kJ

0 7 . 4 On another day, the temperature change of the liquid was 45.0 °C.

The mass of liquid in the heater is 5.0 kg.

specific heat capacity of liquid = 4200 J/kg °C

Calculate the change in thermal energy of the liquid in the heater in joules.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

Question 7 continues on the next page

Do not write outside the box

0 7 . 5 The liquid in the heater was replaced with a new liquid.

The new liquid had a greater specific heat capacity.

What happened to the energy required to increase the temperature of the liquid in the heater by 1 °C?

[1 mark]

Tick (✓) **one** box.

The energy required decreases. ☐

The energy required stays the same. ☐

The energy required increases. ☐

8

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 8 This question is about the blood and the circulatory system.

0 8 . 1 Give the functions of red blood cells, white blood cells and platelets.

[3 marks]

Red blood cells _____

_____

White blood cells _____

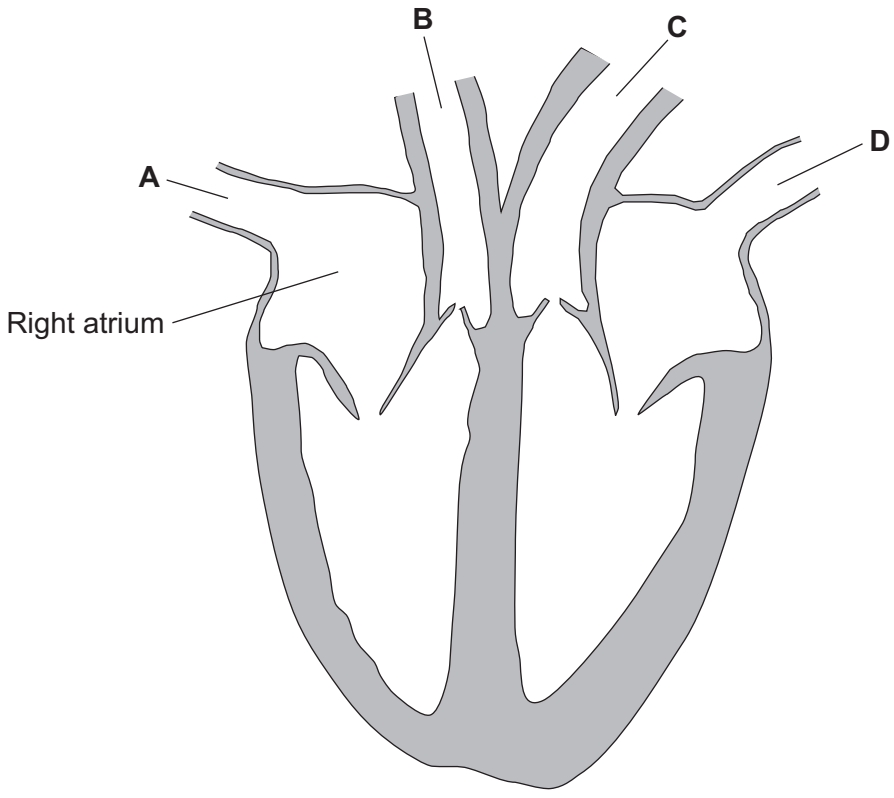
_____

Platelets _____

_____

Figure 12 shows a human heart.

Figure 12



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0 8 . 2 Draw **one** arrow on **Figure 12** to show the movement of the blood between the left atrium and the left ventricle.

[1 mark]

0 8 . 3 Which blood vessel carries blood from the lungs **into** the heart?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 8 . 4 Which blood vessel is the aorta?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 8 . 5 What structures prevent blood flowing in the wrong direction through the heart?

[1 mark]

_____

Question 8 continues on the next page

Do not write outside the box

0 8 . 6 Heart muscle cells obtain oxygen from the blood.

Which blood vessels exchange oxygen with heart muscle cells?

[1 mark]

Tick (✓) **one** box.

Arteries ☐

Capillaries ☐

Veins ☐

0 8 . 7 Heart rate is controlled by a group of cells called the pacemaker.

Where is the pacemaker in the heart?

[1 mark]

Tick (✓) **one** box.

Left atrium ☐

Left ventricle ☐

Right atrium ☐

Right ventricle ☐

Do not write outside the box

Carbon monoxide is a toxic gas.

0 8 . 8 Explain why an increase of carbon monoxide in the air increases heart rate.

[3 marks]

0 8 . 9 A person was exposed to carbon monoxide in the air for 1 hour.

During the hour the person's heart rate increased from 80 beats per minute to 130 beats per minute.

Calculate the percentage increase in heart rate.

Use the equation:

$$\text{percentage increase} = \frac{\text{final heart rate} - \text{starting heart rate}}{\text{starting heart rate}} \times 100$$

[2 marks]

Percentage increase = _____ %

14

Do not write outside the box

0 9 A species of grass has the binomial name *Lolium perenne*.

0 9 . 1 What is the genus of the grass?

[1 mark]

_____

Grass leaves look green because of a green pigment found in chloroplasts.

0 9 . 2 Name the green pigment found in chloroplasts.

[1 mark]

_____

0 9 . 3 Which mineral ion is found in the green pigment in chloroplasts?

[1 mark]

Tick (✓) **one** box.

Magnesium ion ☐

Nitrate ion ☐

Sodium ion ☐

Do not write outside the box

An area of grass changed colour after being covered by a tent.

The colour of the grass changed from green to yellow.

Figure 13 shows the area of green grass and the area of yellow grass.

Figure 13

Question 9 continues on the next page

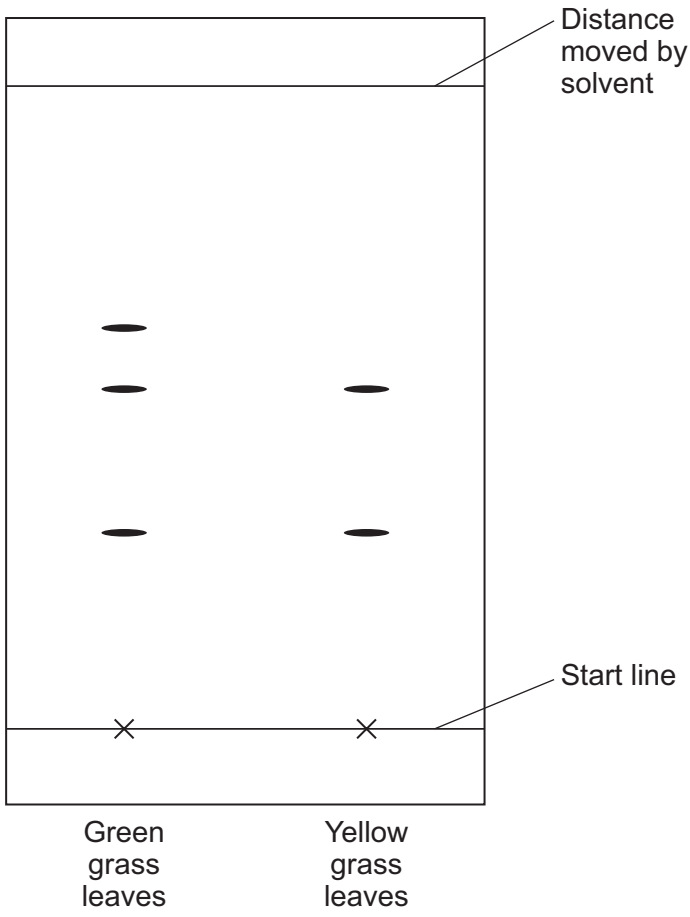
Do not write outside the box

A student used paper chromatography to investigate the pigments in grass leaves from:

- the area of green grass
- the area of yellow grass.

Figure 14 shows the results.

Figure 14



Do not write outside the box

0 9 . 4 The student crushed the grass leaves.

Describe a method to separate the pigments in the crushed grass leaves using paper chromatography.

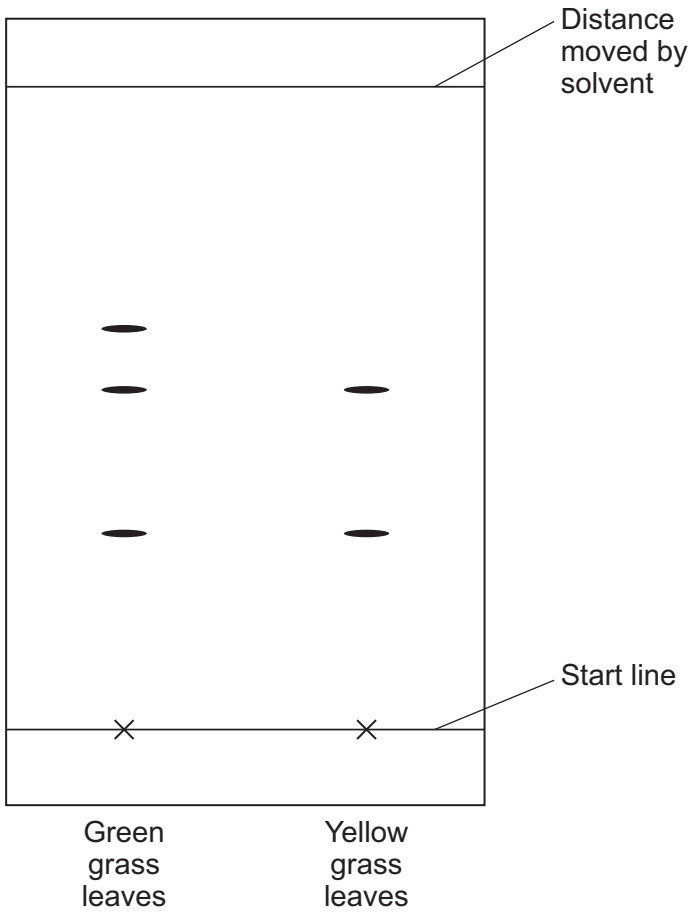
[6 marks]

Question 9 continues on the next page

Do not write outside the box

Figure 14 is repeated below.

Figure 14



Do not write outside the box

0 9 . 5 Determine the R_f value of the pigment that is found in green grass leaves but **not** found in yellow grass leaves.

Use the equation:

$$R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent}}$$

Use **Figure 14**.

[4 marks]

R_f = _____

0 9 . 6 There are fewer pigments in the yellow grass leaves than in the green grass leaves.

Suggest **one** reason why.

[1 mark]

14

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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