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

Friday 10 May 2024 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.

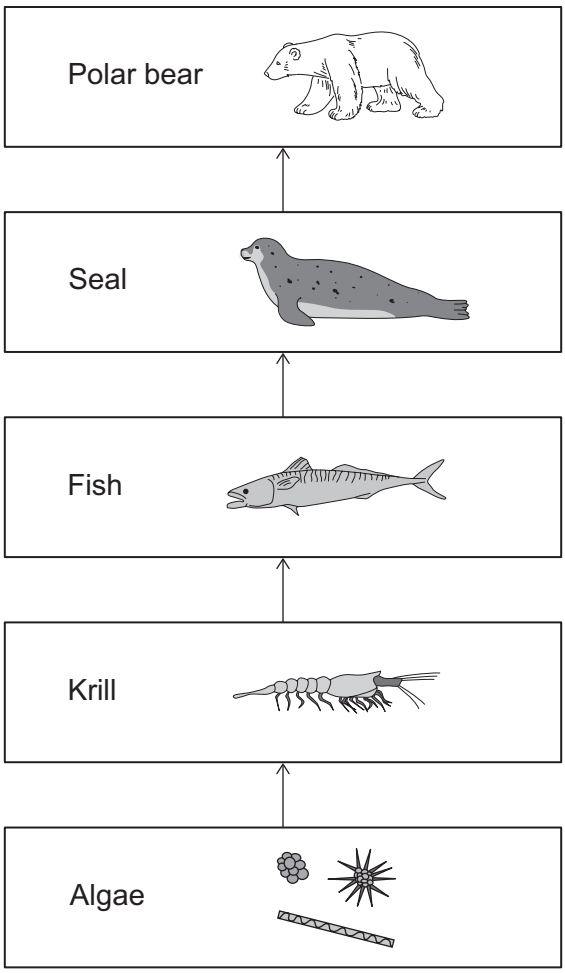
| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| **TOTAL** | |

**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 a food chain.

**Figure 1**




not to scale

**0 1 . 1** Which of the organisms in **Figure 1** is the primary consumer?

**[1 mark]**

_____

**0 1 . 2** Name the predator of the fish in **Figure 1**.

**[1 mark]**

_____

*Do not write outside the box*

**0 1 . 3** Draw **one** line from each term to the definition of the term.

**[3 marks]**

| Term | Definition |
|---|---|
| Ecosystem | All the living organisms and non-living parts of an environment. |
| Interdependence | The effect of species on each other. |
| Population | The limited resources that animals compete for. |
| | The number of individuals of one species in a habitat. |

**0 1 . 4** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **decrease** | **stay the same** | **increase** |

A decrease in the number of polar bears would cause the

number of seals to _____.

**Question 1 continues on the next page**

*Do not write outside the box*

**0 1 . 5** Food chains and food webs can be used to predict the effect of a decreasing number of polar bears.

Why is a food web more useful than a food chain?

**[1 mark]**

Tick (✓) **one** box.

Food webs show where energy is wasted. ☐

Most animals eat more than one type of prey. ☐

Producers are at the start of all food webs. ☐

**0 1 . 6** Krill eat algae.

Algae store a mass of 68 arbitrary units of carbon in 1 year.

8% of the carbon stored in algae becomes part of the carbon stored in krill.

Calculate the mass of carbon that becomes stored in krill.

Use the equation:

$$\text{mass of carbon stored in krill} = \text{mass of carbon stored in algae} \times \frac{8}{100}$$

**[2 marks]**

Mass of carbon stored in krill = _____ arbitrary units

*Do not write outside the box*

**0 1 . 7** Algae and plants need magnesium ions to grow.

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| **chlorophyll** | **glucose** | **urea** |
|---|---|---|

In algae and plants, magnesium ions become part of _____.

**0 1 . 8** The minerals in sea water are one abiotic factor that affects algae.

Which are **two** other **abiotic** factors that affect algae?

**[2 marks]**

Tick (✓) **two** boxes.

- Food availability ☐
- Light intensity ☐
- Pathogens ☐
- Prey ☐
- Temperature ☐

12

**Turn over for the next question**

Do not write outside the box

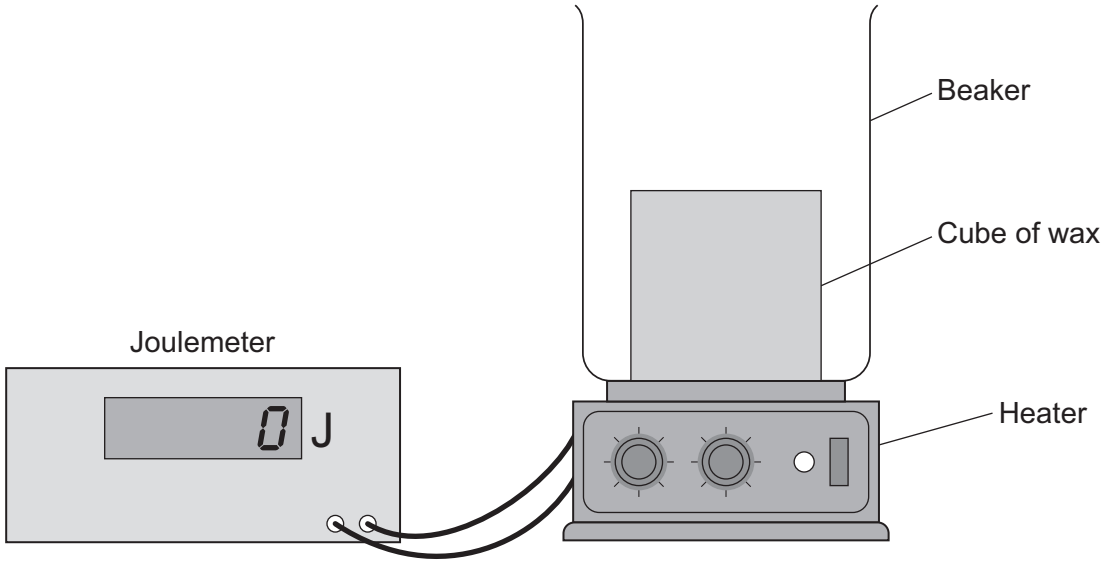
**0 2** A student investigated the heating of some wax.

This is the method used.

1. Put a cube of wax in a beaker.
2. Place the beaker on a heater connected to a joulemeter.
3. Turn on the heater.
4. When the wax begins to melt, turn on the joulemeter.
5. When all the wax has melted, record the reading shown on the joulemeter.

**Figure 2** shows the arrangement.

**Figure 2**



*Do not write outside the box*

**0 2 . 1** The mass of the cube of wax was 0.15 kg.

The energy transferred to melt the wax was 31 500 J.

Calculate the specific latent heat of fusion of wax.

Use the equation:

$$\text{specific latent heat} = \frac{\text{energy for a change of state}}{\text{mass}}$$

Choose the unit from the box.

**[3 marks]**

| | | |
|---|---|---|
| **J** | **J/kg** | **kg** |

Specific latent heat of fusion = _____ Unit _____

**0 2 . 2** Not all of the energy transferred by the heater was used to melt the wax.

What happened to the energy that was **not** used to melt the wax?

**[1 mark]**

Tick (✓) **one** box.

The energy decreased the temperature of the wax. ☐

The energy increased the mass of the wax. ☐

The energy was transferred to the surroundings. ☐

**Question 2 continues on the next page**

*Do not write outside the box*

**0 2 . 3** Which **two** of the following would increase the accuracy of the student's results?

**[2 marks]**

Tick (✓) **two** boxes.

Completing the investigation in a colder environment. ☐

Insulating the sides of the beaker that the wax was in. ☐

Stirring the wax as it was melting. ☐

Using a beaker with a larger volume. ☐

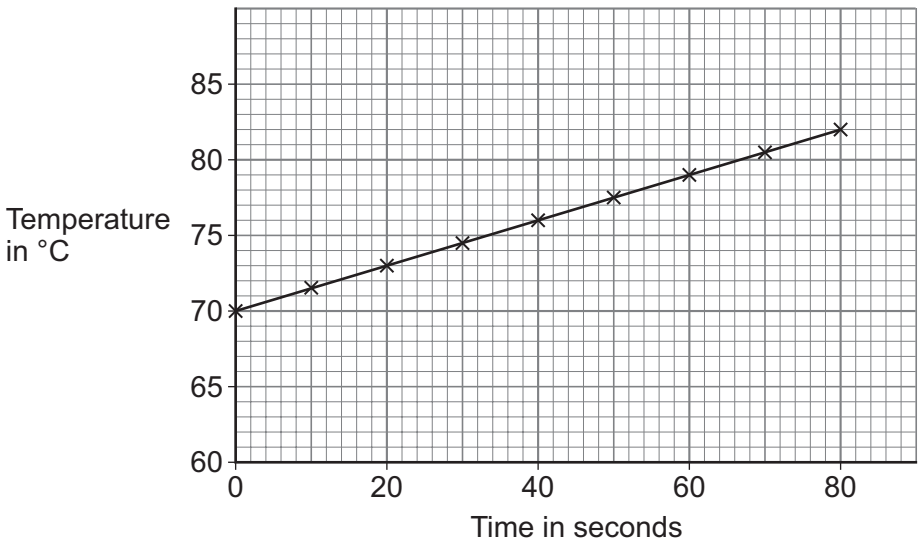
Using a smaller mass of wax. ☐

The student continued to heat the wax after it had melted.

The student measured the temperature of the wax every 10 seconds.

**Figure 3** shows how the temperature of the liquid wax varied with time.

**Figure 3**



*Do not write outside the box*

**0 2 . 4** What was the temperature change between 0 seconds and 80 seconds?

**[1 mark]**

Tick (✓) **one** box.

12 °C ☐ 70 °C ☐ 82 °C ☐

**0 2 . 5** Between 0 seconds and 80 seconds, 3600 J of energy was transferred to the wax.

The mass of wax was 0.15 kg.

Calculate the specific heat capacity of the wax using the student's data.

Use your answer to Question **02.4** and the equation:

$$\text{specific heat capacity} = \frac{\text{change in thermal energy}}{\text{mass} \times \text{temperature change}}$$

**[2 marks]**

Specific heat capacity = _____ J/kg °C

9

**Turn over for the next question**

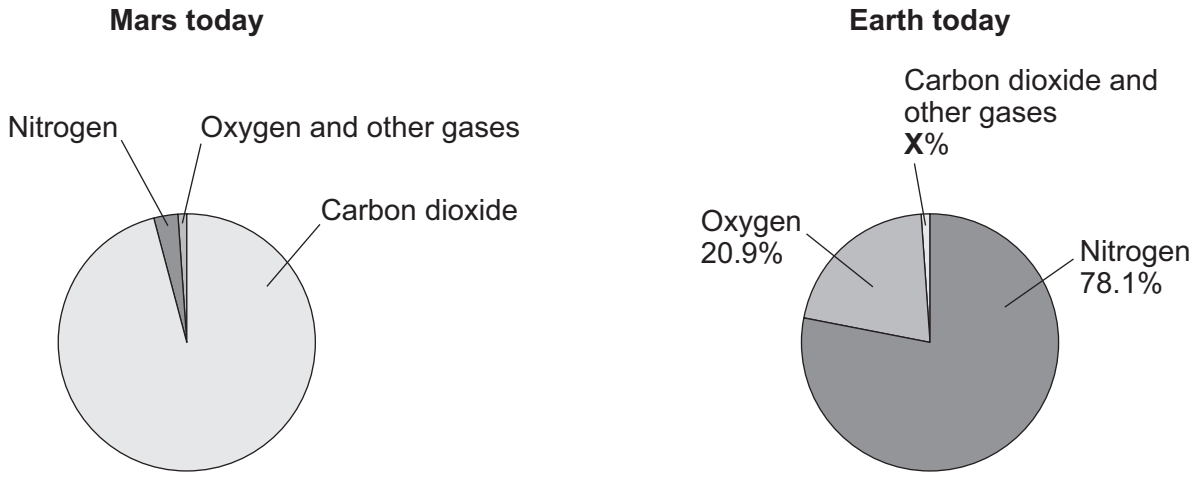
Do not write outside the box

**0 3** The atmosphere of the Earth has changed since the Earth formed.

The Earth's early atmosphere may have been similar to the atmosphere of Mars today.

**Figure 4** shows the main gases in the atmosphere of Mars today and the atmosphere of the Earth today.

**Figure 4**




**0 3 . 1** Determine percentage **X** in **Figure 4**.

**[2 marks]**

**X** = _____ %

*Do not write outside the box*

**0 3 . 2** Give **three** differences between the atmosphere of the Earth today and the atmosphere of Mars today.

Use **Figure 4**.

**[3 marks]**

1 _____

_____

2 _____

_____

3 _____

_____

**0 3 . 3** What was the source of the nitrogen in the Earth's early atmosphere?

**[1 mark]**

Tick (✓) **one** box.

Decay of dead animals ☐

Formation of sedimentary rocks ☐

Volcanic activity ☐

**0 3 . 4** Why did the formation of oceans cause the carbon dioxide concentration in the Earth's early atmosphere to change?

**[1 mark]**

Tick (✓) **one** box.

Carbon dioxide condensed to form the oceans. ☐

Carbon dioxide dissolved in the oceans. ☐

Carbon dioxide evaporated from the oceans. ☐

**Question 3 continues on the next page**

Do not write outside the box

Meteorites are rocks that fall to Earth from space.

A meteorite landed in the UK.

The water in the meteorite was analysed.

The water in the meteorite and water in the oceans contain similar ratios of hydrogen isotopes.

**0 3 . 5** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| **electrons** | **neutrons** | **protons** |
|---|---|---|

Isotopes of hydrogen are atoms of hydrogen with different

numbers of _____.

**0 3 . 6** It was important that the water in the meteorite was analysed as soon as possible.

Suggest **one** reason why.

**[1 mark]**

_____

_____

**0 3 . 7** The evolution of algae and plants changed the Earth's atmosphere.

Algae and plants photosynthesise.

Complete the word equation for photosynthesis.

**[2 marks]**

water + _____ $\xrightarrow{\text{light}}$ _____ + oxygen

11

*Do not write outside the box*

**0 4** The symptoms of a measles infection include:

- a fever
- a red skin rash.

**0 4 . 1** Why do antibiotics **not** treat measles?

**[1 mark]**

Tick (✓) **one** box.

Antibiotics cause the measles pathogen to release toxins. ☐

Antibiotics do not kill viruses. ☐

Antibiotics increase body temperature. ☐

**0 4 . 2** Cilia are small hair-like structures in the trachea and bronchi.

Describe how mucus and cilia defend against the entry of pathogens into the lungs.

**[2 marks]**

Mucus _____

_____

Cilia _____

_____

**0 4 . 3** How does stomach acid defend the body against pathogens?

**[1 mark]**

_____

_____

_____

**Question 4 continues on the next page**

*Do not write outside the box*

People can be vaccinated against measles.

**0 4 . 4** What does the measles vaccine contain?

**[1 mark]**

Tick (✓) **one** box.

- Hormones ☐
- Two types of blood cell ☐
- Weakened pathogen ☐

**0 4 . 5** Which part of the blood produces antibodies after receiving the measles vaccination?

**[1 mark]**

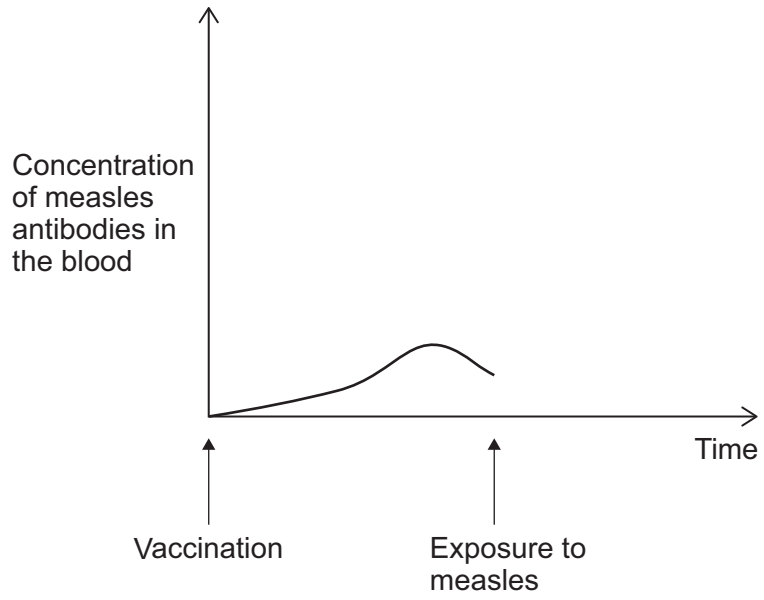
Tick (✓) **one** box.

- Platelets ☐
- Red blood cells ☐
- White blood cells ☐

*Do not write outside the box*

**0 4 . 6** **Figure 5** shows how the concentration of measles antibodies in the blood changes after vaccination.

**Figure 5**




Complete **Figure 5** to show how the concentration of measles antibodies will change after the exposure to measles pathogens.

**[2 marks]**

**Question 4 continues on the next page**

Do not write outside the box

**0 4 . 7** In one group of people:

- 25 people have been vaccinated against measles
- 5 people have **not** been vaccinated against measles.

What is the simplest ratio of people who have been vaccinated to people who have **not** been vaccinated?

**[1 mark]**

Tick (✓) **one** box.

30 : 1 ☐

25 : 1 ☐

5 : 1 ☐

**0 4 . 8** Scientists recommend that over 95% of the population should be vaccinated against measles.

What is the advantage of a large percentage of the population being vaccinated against measles?

**[1 mark]**

_____

_____

**10**

Do not write outside the box

**0 5** This question is about the nervous system.

**0 5 . 1** A person steps on a sharp object.

The person immediately moves their foot away from the object in a reflex action.

Complete the sentences.

Choose answers from the box.

**[3 marks]**

| | | |
|---|---|---|
| **a gland** | **a muscle** | **a neurone** |
| **the skin** | **the spinal cord** | |

When the person steps on the object, the receptor is

in _____.

An electrical impulse travels from the receptor

along _____.

The effector is _____.

**0 5 . 2** What is the name of the gap between two neurones?

**[1 mark]**

Tick (✓) **one** box.

A coordinator ☐

A reflex arc ☐

A synapse ☐

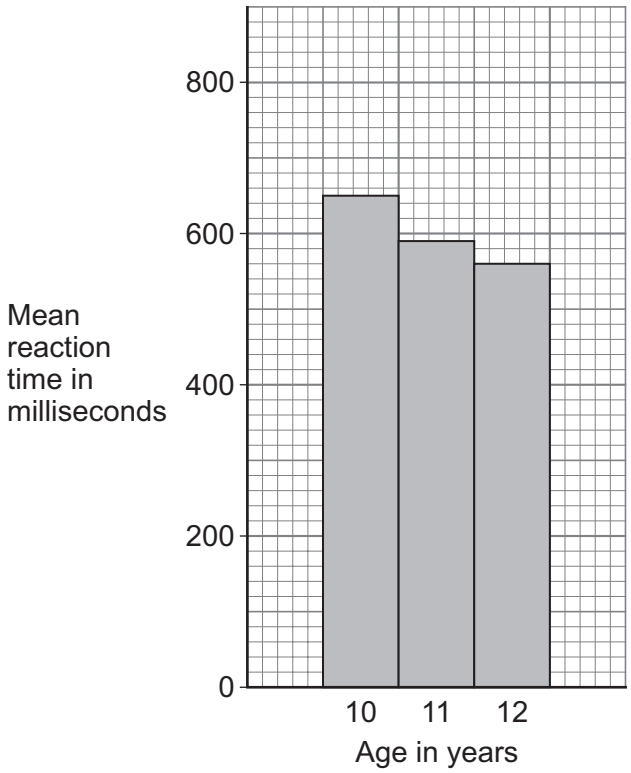
**Question 5 continues on the next page**

Do not write outside the box

A scientist investigated how age affects reaction time in a group of students.

**Figure 6** shows the results.

**Figure 6**




**0 5 . 3** The students had **not** practised the reaction time test.

Suggest **two other** control variables the scientists should have used.

**[2 marks]**

1 _____

_____

2 _____

_____

*Do not write outside the box*

**0 5 . 4** What was the mean reaction time of 10-year-olds?

Use **Figure 6**.

**[1 mark]**

Mean reaction time = _____ milliseconds

**0 5 . 5** How old were the students with the lowest mean reaction time?

Use **Figure 6**.

**[1 mark]**

Tick (✓) **one** box.

10 years old ☐

11 years old ☐

12 years old ☐

**0 5 . 6** The scientist also measured the reaction time of 35 adults.

Describe how to calculate the **mean** reaction time for the 35 adults.

**[2 marks]**

_____

_____

_____

_____

**Question 5 continues on the next page**

Do not write outside the box

**0 5 . 7** The reaction time of one adult was 450 milliseconds.

What is the reaction time of the adult in seconds?

1 second = 1000 milliseconds.

**[1 mark]**

_____

_____

Reaction time = _____ seconds

11

Do not write outside the box

**0 6** **Figure 7** shows an oak tree.

**Figure 7**

The binomial name of the oak tree is *Quercus robur*.

**0 6 . 1** What is the genus name of the oak tree?

**[1 mark]**

Tick (✓) **one** box.

Oak ☐

Quercus ☐

Robur ☐

**Question 6 continues on the next page**

Do not write outside the box

**0 6 . 2** Other species of tree are in the same genus as *Quercus robur*.

What does it mean if two species of tree are in the same genus?

**[1 mark]**

Tick (✓) **one** box.

The two species are always found in the same place. ☐

The two species are closely related to each other. ☐

The two species look exactly the same. ☐

**0 6 . 3** Oak trees grow at points where cells can divide.

Growth in oak trees happens at the tips of the branches.

Name the type of tissue at the tips of the branches.

**[1 mark]**

_____

*Do not write outside the box*

Oak trees reproduce by sexual reproduction to produce seeds.

An acorn is a nut that contains a seed.

The seed may become a new oak tree.

**0 6 . 4** Which process produces the cell that grows into the seed?

**[1 mark]**

Tick (✓) **one** box.

Evolution ☐

Fertilisation ☐

Translocation ☐

**Question 6 continues on the next page**

Do not write outside the box

One type of insect lays eggs in acorns.

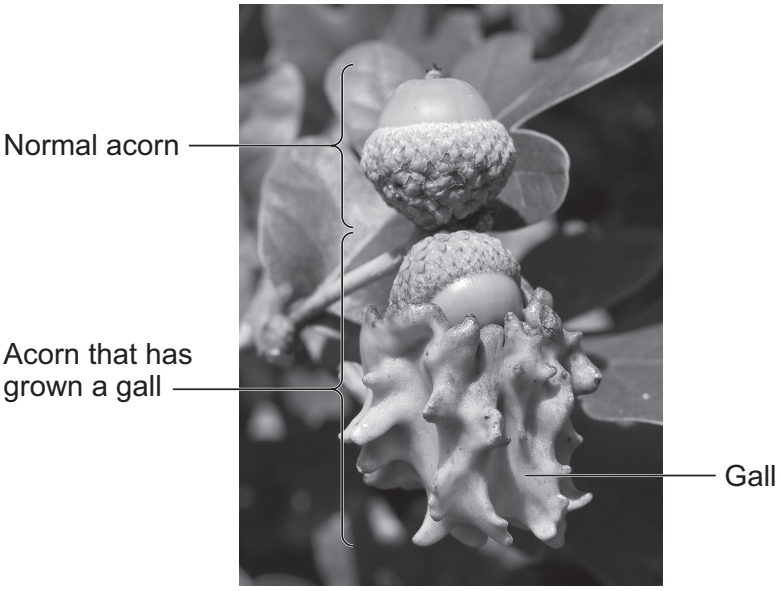
The insect eggs cause the acorn to grow abnormally.

The abnormal growth is called a gall.

Insect embryos grow inside the gall.

**Figure 8** shows a normal acorn and an acorn that has grown a gall.

**Figure 8**



*Do not write outside the box*

**0 6 . 5** The gall is made from oak tree cells that have divided.

The cells of the gall contain two sets of chromosomes.

Which process produces the cells of the gall?

**[1 mark]**

Tick (✓) **one** box.

Circulation ☐

Digestion ☐

Mitosis ☐

**0 6 . 6** The insects have changed over time and caused a gall to grow on acorns.

The gall increases the chance of survival of the insects inside the gall.

What name is given to the process of the insects changing over time?

**[1 mark]**

Tick (✓) **one** box.

Clone production ☐

Evolution ☐

Inbreeding ☐

**Question 6 continues on the next page**

*Do not write outside the box*

The oak tree transports water and nutrients to the insect embryos inside the gall.

**0 6 . 7** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **leaf cells** | **stomata** | **xylem** |

Water is transported from the roots of the tree to the gall

by the _____.

**0 6 . 8** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **chloroplasts** | **guard cells** | **phloem** |

Sugar is transported through the tree to the insect embryos

by the _____.

**0 6 . 9** Water moves from the roots to the leaves.

Name the process that moves water from the roots to the leaves.

**[1 mark]**

_____

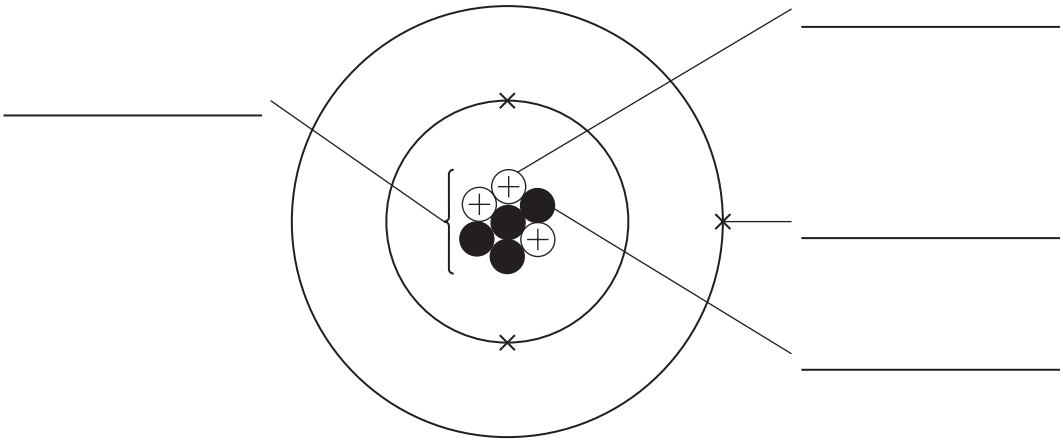
**9**

Do not write outside the box

**0 7** This question is about atoms.

**Figure 9** represents an atom.

**Figure 9**



**0 7 . 1** Label **Figure 9**.

Choose answers from the box.

**[4 marks]**

| | | |
|---|---|---|
| **electron** | **ion** | **molecule** |
| **neutron** | **nucleus** | **proton** |

**0 7 . 2** Name the element represented by **Figure 9**.

Use the periodic table.

**[1 mark]**

_____

**Question 7 continues on the next page**

Do not write outside the box

**0 7 . 3** Why does an atom have an overall electrical charge of zero?

**[1 mark]**

_____

_____

**0 7 . 4** Draw **one** line from each description of structure size to the correct structure.

**[2 marks]**

| Description of structure size | Structure |
|---|---|
| | A gold atom |
| Largest | A human skin cell |
| Smallest | A protein molecule |
| | The nucleus of a helium atom |

*Do not write outside the box*

**0 7 . 5** An atom of one element has a radius of 0.000 000 348 mm.

How should 0.000 000 348 mm be written in standard form?

**[1 mark]**

Tick (✓) **one** box.

$0.348 \times 10^{-6}$ mm ☐

$0.348 \times 10^{-7}$ mm ☐

$3.48 \times 10^{-6}$ mm ☐

$3.48 \times 10^{-7}$ mm ☐

**Question 7 continues on the next page**

Do not write outside the box

Scientists have developed different models of the atom over time.

**Figure 10** shows the Dalton model of the atom and a more recent model of the atom.

**Figure 10**

**0 7 . 6** Name the more recent model in **Figure 10**.

**[1 mark]**

_____

**0 7 . 7** Give **one** difference between the models of the atom shown in **Figure 10**.

**[1 mark]**

_____

_____

11

*Do not write outside the box*

**Turn over for the next question**

**DO NOT WRITE ON THIS PAGE**
**ANSWER IN THE SPACES PROVIDED**

*Do not write outside the box*

**0 8** Bacteria can cause disease.

Bacterial cells do **not** have a nucleus.

**0 8 . 1** Which term describes bacterial cells?

**[1 mark]**

Tick (✓) **one** box.

Eukaryotic ☐

Fungal ☐

Prokaryotic ☐

**0 8 . 2** Bacterial cells have no nucleus and are smaller than animal cells.

Give **one other** difference between bacterial cells and animal cells.

**[1 mark]**

_____

_____

Do not write outside the box

*Escherichia coli* (*E. coli*) is a type of bacterium.

*E. coli* causes symptoms of food poisoning.

**0 8 . 3** Water companies sterilise rain water to produce drinking water.

The drinking water is then transported to homes in underground pipes.

Flooding can cause contamination of the drinking water by *E. coli*.

Suggest how people should treat drinking water **at home** if there is a risk of *E. coli* contamination.

**[1 mark]**

_____

_____

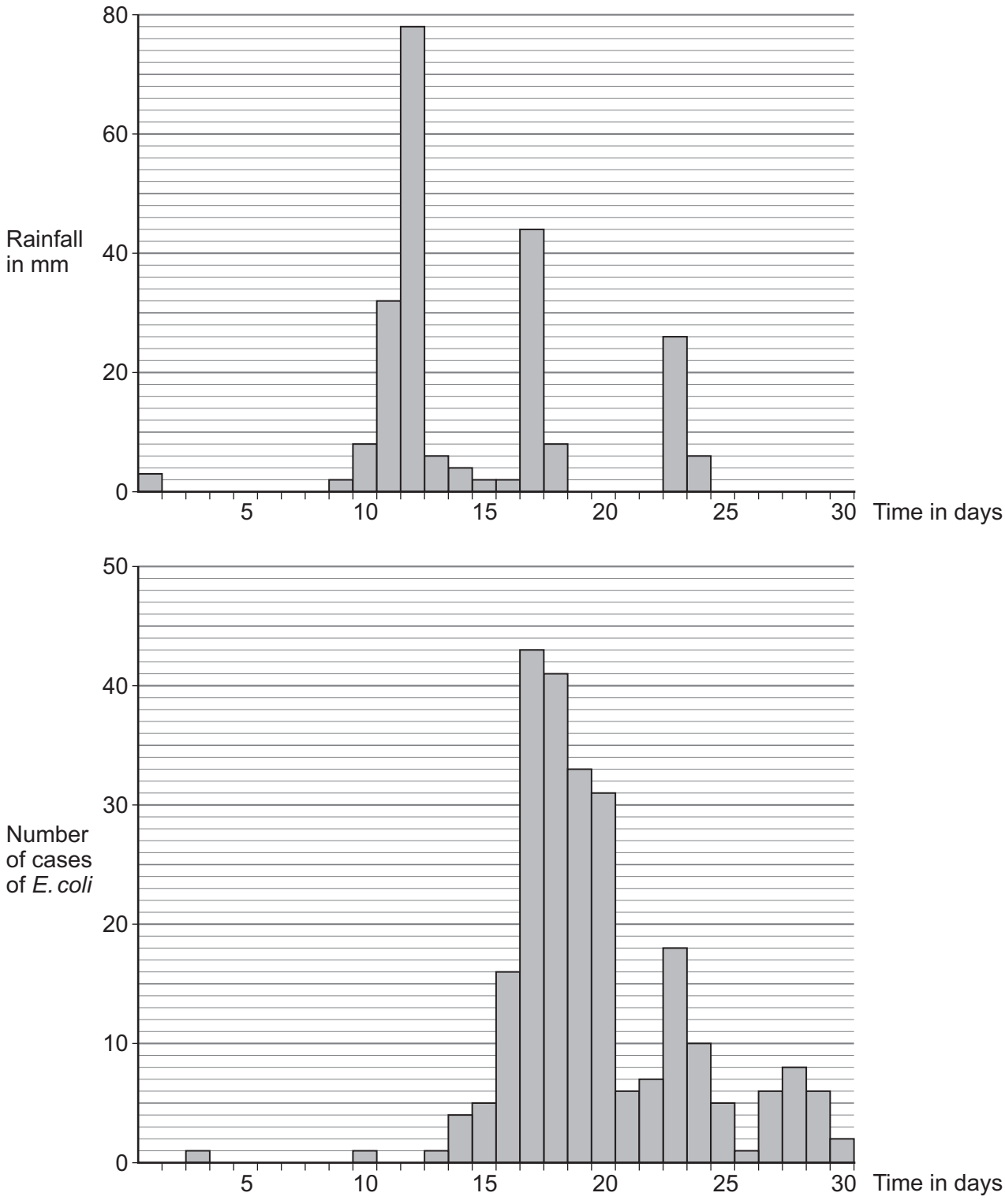
**Question 8 continues on the next page**

*Do not write outside the box*

**Figure 11** shows two graphs:

- The rainfall in one town in one month.
- The number of cases of *E. coli* in the town in the same month.

**Figure 11**



Do not write outside the box

**0 8 . 4** The **rainfall** on day 12 was greater than on day 10.

Calculate how many times greater.

**[3 marks]**

Number of times greater = _____

**0 8 . 5** Symptoms of *E. coli* infection usually occur 5 days after infection.

A scientist stated:

'Increased rainfall causes an increase in the number of cases of *E. coli*.'

Describe **one** piece of evidence from **Figure 11** that supports the scientist's statement.

**[1 mark]**

**Question 8 continues on the next page**

Do not write outside the box

**0 8 . 6** Why might the number of cases of *E. coli* infection increase in the future?

**[1 mark]**

Tick (✓) **one** box.

Climate change is causing loss of habitats for wildlife. ☐

Climate change is causing more extreme rainfall. ☐

Climate change is causing sea-levels to be lower. ☐

Climate change is caused by an increase in the concentration of greenhouse gases in the atmosphere.

Carbon dioxide is a greenhouse gas.

**0 8 . 7** Name **two** other greenhouse gases.

Do **not** refer to carbon dioxide in your answer.

**[2 marks]**

1 _____

2 _____

**0 8 . 8** Describe **one** way the rate of increase in carbon dioxide concentration in the atmosphere could be reduced.

**[1 mark]**

_____

_____

11

*Do not write outside the box*

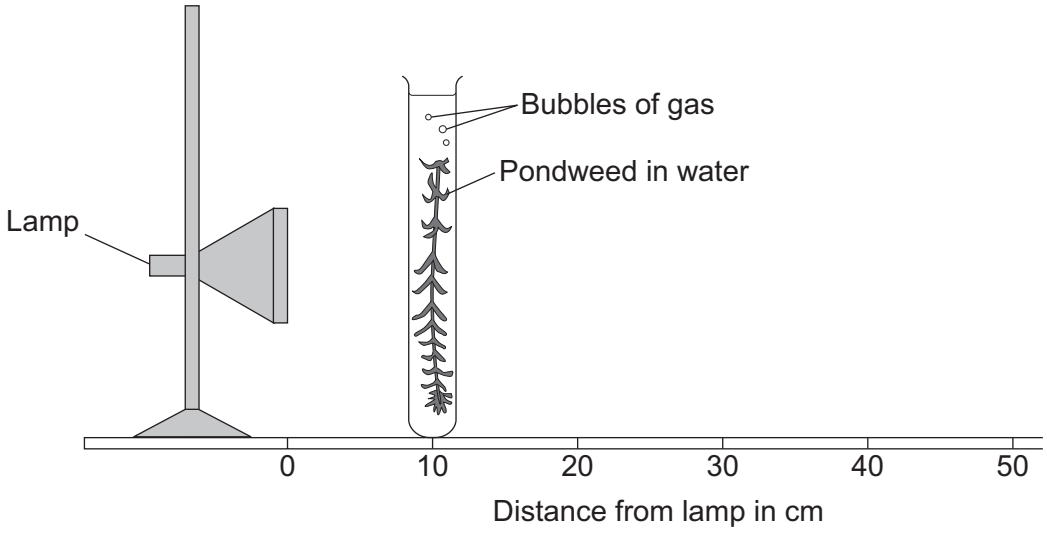
**Turn over for the next question**

**DO NOT WRITE ON THIS PAGE**
**ANSWER IN THE SPACES PROVIDED**

*Do not write outside the box*

**0 9** **Figure 12** shows equipment used to investigate how light intensity affects photosynthesis.

**Figure 12**




The light intensity can be changed by moving the pondweed to different distances from the lamp.

Describe a method to investigate the effect of light intensity on the rate of photosynthesis in pondweed.

**[6 marks]**

*Do not write outside the box*

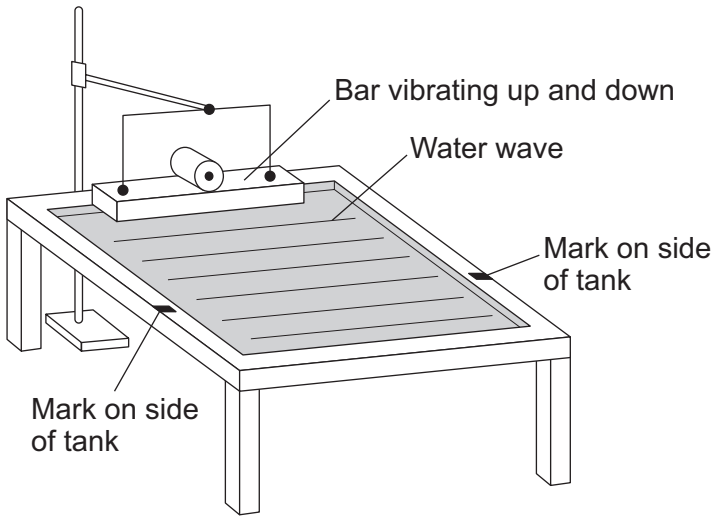
6

**Turn over for the next question**

*Do not write outside the box*

**1 0** **Figure 13** shows a ripple tank used to investigate the behaviour of water waves.

**Figure 13**




**1 0 . 1** Water waves are transverse waves.

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **parallel** | **perpendicular** | **the same** |

In transverse waves, the direction of oscillation and the direction of energy transfer are _____.

*Do not write outside the box*

**1 0 . 2** Describe a method a student could use to determine the frequency of the water waves.

**[4 marks]**

**Question 10 continues on the next page**

Do not write outside the box

Use the Physics Equations Sheet to answer Questions **10.3** and **10.4**.

**1 0 . 3** Which equation links frequency ($f$), wavelength ($\lambda$) and wave speed ($v$)?

**[1 mark]**

Tick (✓) **one** box.

$v = \frac{f}{\lambda}$ ☐

$v = f\lambda$ ☐

$v = f^2\lambda$ ☐

*Do not write outside the box*

**1 0 . 4** **Figure 14** shows the water waves in the ripple tank when viewed from above.

**Figure 14**

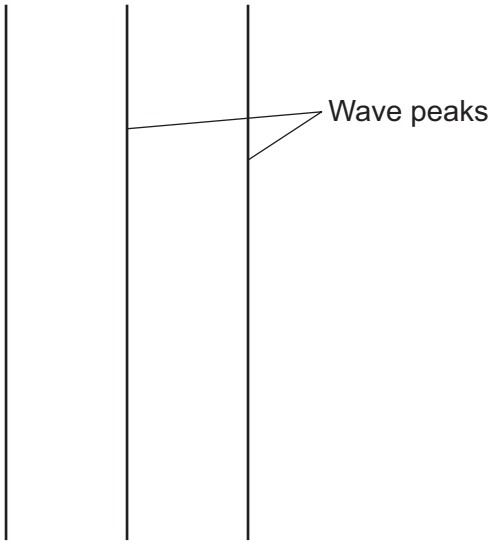



**Figure 14** has been drawn to actual size.

The water waves have a frequency of 2.5 Hz.

Calculate the wave speed of the waves in **Figure 14**.

You should take measurements from **Figure 14**.

**[4 marks]**

Wave speed = _____ m/s

10

**END OF QUESTIONS**

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