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 2 Life and Environmental Sciences

Thursday 22 May 2025 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.

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There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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0 1 Substances can exist in different states of matter.

The states of matter are solid, liquid and gas.

A substance has a melting point of –7 °C and a boiling point of 59 °C.

0 1 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

gas	**liquid**	**solid**

At 15 °C the state of the substance is _____.

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

gas	**liquid**	**solid**

At 70 °C the state of the substance is _____.

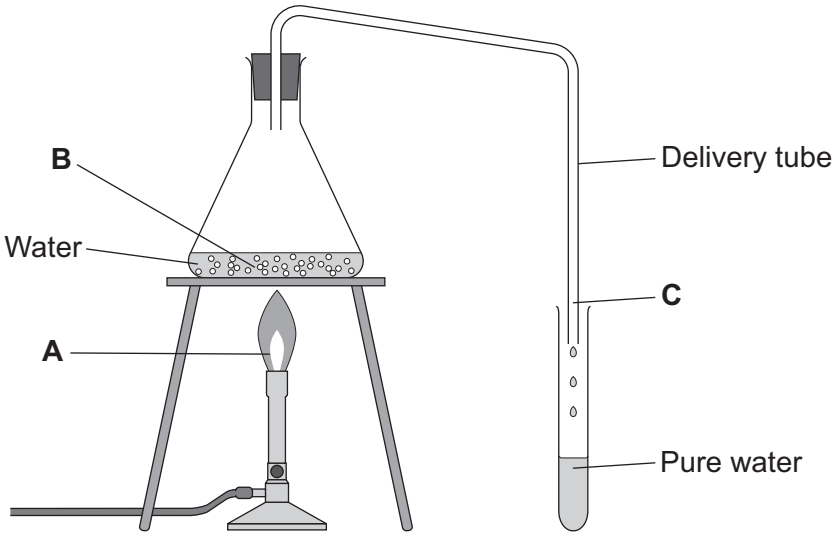
Question 1 continues on the next page

Do not write outside the box

A student purified a sample of water by distillation.

Figure 1 shows the apparatus.

Figure 1



0 1 . 3 Name the processes occurring at **A**, **B**, and **C** in **Figure 1**.

Choose answers from the box.

[3 marks]

boiling	**combustion**	**condensing**
	filtration	**freezing**

A _____

B _____

C _____

Do not write outside the box

0 1 . 4 The student wanted to collect as much pure water as possible from the sample.

Some water was lost as steam from the end of the delivery tube.

Suggest **one** improvement to the apparatus to change more of the steam to water.

[1 mark]

_____

_____

0 1 . 5 The water collected in the test tube is pure water.

Which statement is true for pure water?

[1 mark]

Tick (✓) **one** box.

Pure water boils at exactly 100 °C. ☐

Pure water contains only one type of atom. ☐

Pure water has a range of pH values. ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 6 Which **two** of the following are pure substances in chemistry?

[2 marks]

Tick (✓) **two** boxes.

Air ☐

Carbon dioxide ☐

Crude oil ☐

Oxygen ☐

Salt solution ☐

9

Do not write outside the box

0 2 An increase in the concentration of greenhouse gases in the atmosphere is causing climate change.

0 2 . 1 Which of the following is a greenhouse gas?

[1 mark]

Tick (✓) **one** box.

Chlorine ☐

Methane ☐

Nitrogen ☐

Question 2 continues on the next page

Do not write outside the box

Carbon dioxide and ozone are greenhouse gases.

Table 1 shows the concentrations of carbon dioxide and ozone in the atmosphere.

Table 1

Gas	**Concentration in the atmosphere in arbitrary units**
Carbon dioxide	420
Ozone	0.060

0 2 . 2 The concentration of carbon dioxide in the atmosphere is greater than the concentration of ozone.

Calculate how many times greater.

[2 marks]

_____

_____

_____

Number of times greater = _____

0 2 . 3 The concentration of carbon dioxide is 420 arbitrary units.

What is 420 arbitrary units to 1 significant figure?

[1 mark]

_____ arbitrary units

Do not write outside the box

0 2 . 4 Cutting down trees leads to an increase in the concentration of carbon dioxide in the atmosphere.

Give **one** other process that increases the concentration of carbon dioxide in the atmosphere.

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

[1 mark]

_____

0 2 . 5 Growing more trees could help **decrease** the concentration of carbon dioxide in the atmosphere.

Explain why.

[2 marks]

_____

_____

_____

_____

Question 2 continues on the next page

Do not write outside the box

0 2 . 6 Predictions about climate change rely on many sources of data.

Table 2 shows some statements about climate change predictions.

Complete **Table 2** to show whether each statement is an advantage or a disadvantage when predicting climate change.

Tick (✓) **one** box in each row.

[2 marks]

Table 2

Statement	**An advantage when predicting climate change**	**A disadvantage when predicting climate change**
Climate data from some parts of the world is incomplete.		
Computers can be used to model climate change.		
Data about the atmosphere has been collected for many years.		
Research using climate change data is peer reviewed.		

0 2 . 7 Which is **one** effect of climate change?

[1 mark]

Tick (✓) **one** box.

Increase in lung disease ☐

More fossil fuels available ☐

Rising sea-levels ☐

10

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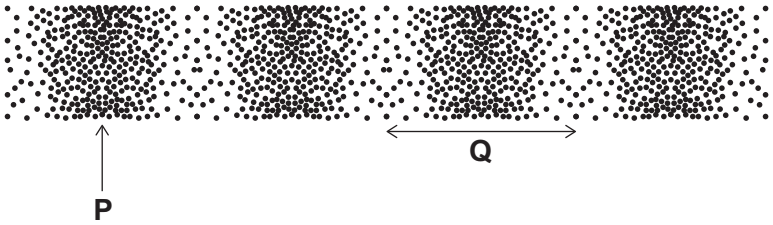
0 3 **Figure 2** shows the position of air particles in the path of a sound wave.

Figure 2



0 3 . 1 What do the labels **P** and **Q** represent?

Choose the answers from the box.

[2 marks]

amplitude	**compression**	**rarefaction**	**wavelength**

P _____

Q _____

0 3 . 2 Sound waves are longitudinal waves.

What direction are the oscillations in a longitudinal wave?

[1 mark]

Tick (✓) **one** box.

At 45° to the direction of energy transfer ☐

Parallel to the direction of energy transfer ☐

Perpendicular to the direction of energy transfer ☐

Question 3 continues on the next page

Do not write outside the box

A teacher and a student made measurements to determine the speed of sound in air.

They used a device called a 'starter pistol'.

A starter pistol makes a loud sound and produces a puff of smoke at the same time.

Figure 3 shows the teacher and the student 100 m apart.

Figure 3

This is the method used.

1. The teacher fires the starter pistol.
2. The student sees the puff of smoke and starts the stopwatch.
3. The student hears the sound from the starter pistol and stops the stopwatch.
4. The student records the time on the stopwatch.

0 3 . 3 Why did the student see the puff of smoke **before** hearing the sound?

[1 mark]

_____

_____

_____

Do not write outside the box

0 3 . 4 The teacher and student repeated the experiment several times and calculated a mean value for the times recorded.

The mean value for the time was used to calculate the speed of sound in air.

Why is it good practice to calculate a mean value in an investigation?

[1 mark]

Tick (✓) **one** box.

To reduce the effect of random errors ☐

To reduce the effect of systematic errors ☐

To reduce the effect of zero errors ☐

0 3 . 5 The sound wave produced had a wavelength of 0.12 m and a wave speed of 330 m/s.

Calculate the frequency of the sound wave.

[3 marks]

Use the equation:

$$\text{frequency} = \frac{\text{wave speed}}{\text{wavelength}}$$

Choose the unit from the box.

hertz	**newtons**	**watts**

_____

_____

_____

Frequency = _____ Unit _____

8

Do not write outside the box

0 4 One species of bacteria is resistant to most antibiotics.

- The bacteria can survive on hard surfaces and on human skin.
- People become very ill if the bacteria enter the blood.
- People who have wounds from surgery can become infected with the bacteria.

0 4 . 1 Suggest **two** ways of reducing the risk of infection with the bacteria.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 2 A hospital had 1300 patients.

39 of the patients became infected with the bacteria.

Calculate the percentage of patients that became infected with the bacteria.

[2 marks]

_____

_____

_____

Percentage = _____ %

Do not write outside the box

0 4 . 3 Having HIV makes a person more likely to become ill from infections.

Why is a person with HIV more likely to become ill if infected with the bacteria?

[1 mark]

Tick (✓) **one** box.

HIV can be treated with painkillers. ☐

HIV damages the immune system. ☐

HIV is spread by sexual contact. ☐

0 4 . 4 The bacteria can pass small rings of DNA to other bacteria.

Complete the sentence.

Choose the answer from the box.

[1 mark]

antitoxins	**chloroplasts**	**plasmids**

The small rings of DNA in bacteria are called _____.

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 A new antibiotic is being developed.

The new antibiotic is being tested in a drug trial.

Draw **one** line from each part of a drug trial to the reason for that part of the drug trial.

[3 marks]

Part of drug trial	**Reason**
Animal testing	To avoid bias
Clinical trial	To check the drug is not toxic
Double-blind trial	To find the optimum dose of the drug
	To see if the drug makes viruses multiply

9

Do not write outside the box

0 5 Two types of heart disease are:

- coronary heart disease (CHD)
- cardiovascular disease (CVD).

0 5 . 1 Most types of heart disease are **not** caused by pathogens.

Name **one** other disease in humans that is **not** caused by a pathogen.

Do **not** refer to CHD or CVD in your answer.

[1 mark]

_____

0 5 . 2 Which are **two** factors that increase the risk of CHD?

[2 marks]

Tick (✓) **two** boxes.

A diet high in fruits and vegetables ☐

Eating large amounts of fatty food ☐

Going to the gym three times each week ☐

Never smoking cigarettes ☐

Sitting down for long periods every day ☐

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 Which **two** treatments can be used to treat CHD?

[2 marks]

Tick (✓) **two** boxes.

A mechanical valve ☐

A placebo tablet ☐

A stent ☐

Insulin ☐

Statins ☐

Stem cells can be used to treat patients who have CHD.

The stem cells divide and become specialised cells in the heart.

0 5 . 4 What is the name of the process of stem cells becoming specialised?

[1 mark]

Tick (✓) **one** box.

Active transport ☐

Differentiation ☐

Fertilisation ☐

Do not write outside the box

0 5 . 5 Stem cells for treatment can come from the patient or from a donor.

Treatment using stem cells from the patient is more successful than using stem cells from a donor.

Complete the sentence.

Choose the answer from the box.

[1 mark]

immune system	**nervous system**	**respiratory system**

Stem cells from a donor may be rejected by

the _____.

0 5 . 6 Stem cell treatment may increase the risk of a malignant tumour growing.

Describe how cells from a malignant tumour can cause tumours in other parts of the body.

[2 marks]

_____

_____

_____

_____

9

Turn over for the next question

Do not write outside the box

0 6 Photosynthesis produces glucose.

0 6 . 1 Name the other product of photosynthesis.

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

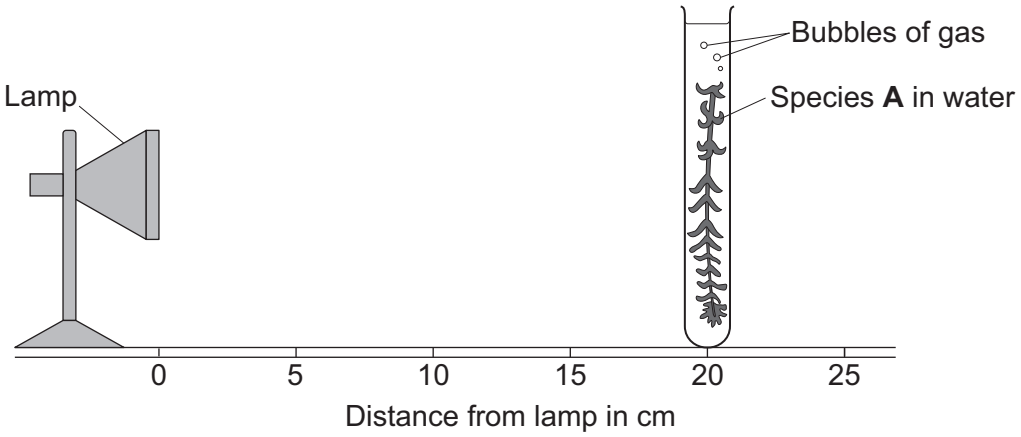
[1 mark]

_____

A student investigated the effect of light intensity on the rate of photosynthesis in two species of aquatic plant.

Figure 4 shows the apparatus used.

Figure 4



This is the method used.

1. Place species **A** in water in a test tube.
2. Leave the test tube containing species **A** in a dark room for 10 minutes.
3. Put the test tube containing species **A** 20 cm away from the lamp.
4. Record the number of bubbles produced by species **A** in 5 minutes.
5. Repeat steps 2 to 4 at different distances from the lamp.
6. Repeat steps 1 to 5 using species **B**.

Do not write outside the box

0 6 . 2 What was the independent variable in the investigation?

[1 mark]

Tick (✓) **one** box.

Light intensity ☐

Size of each plant ☐

Volume of water ☐

0 6 . 3 The lamp causes heating of the plants.

Describe how the student could reduce the heating of the plants by the lamp.

[1 mark]

_____

_____

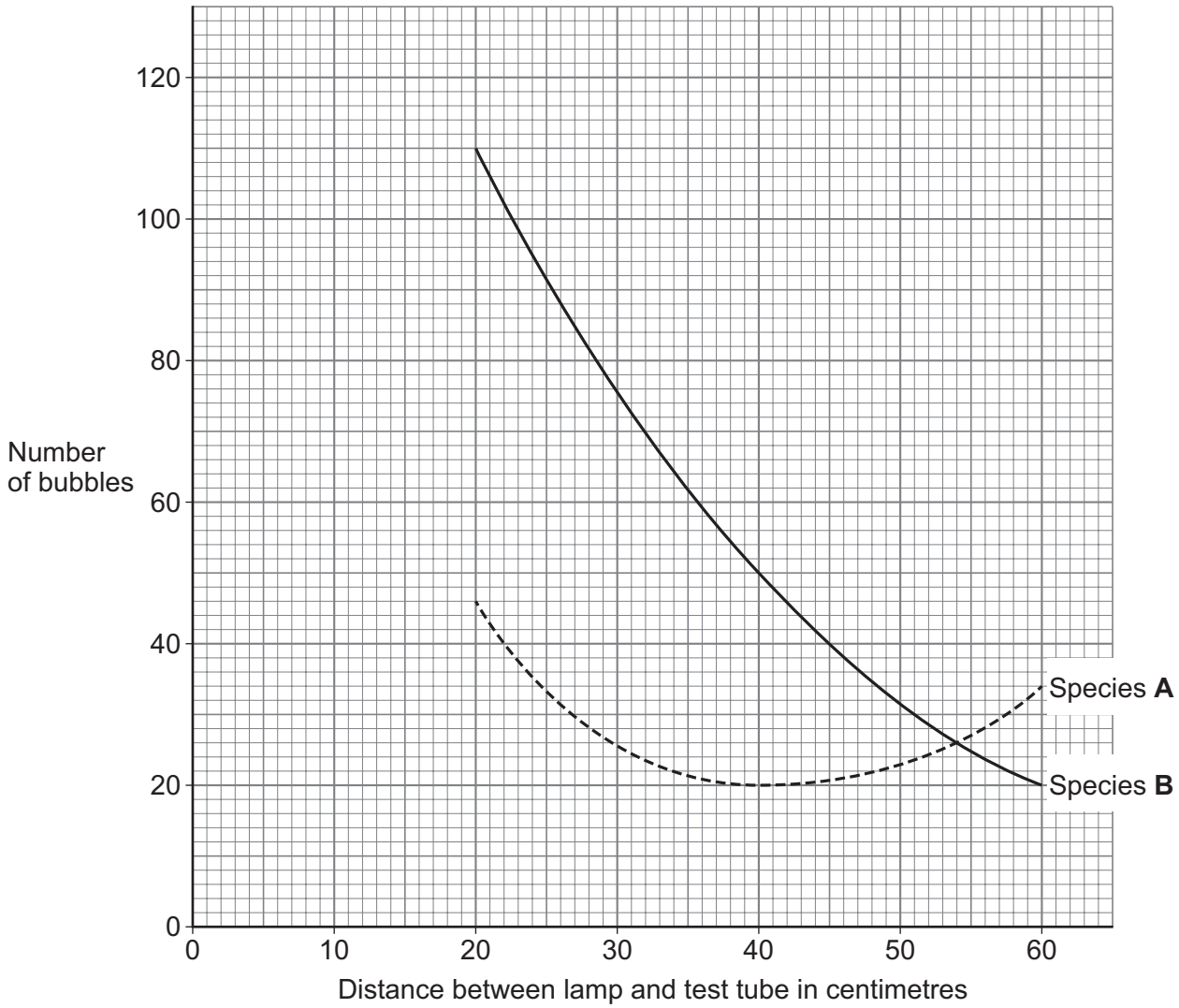
Question 6 continues on the next page

Do not write outside the box

The student collected valid results.

Figure 5 shows the results.

Figure 5



0 6 . 4 What was the number of bubbles produced by species **B** at 20 cm?

[1 mark]

Number of bubbles = _____

Do not write outside the box

0 6 . 5 What distance between the lamp and test tube would cause the same number of bubbles in both species?

Use **Figure 5**.

[1 mark]

Distance = _____ cm

0 6 . 6 As the distance between the lamp and the plant increases, the light intensity decreases.

The student concluded:

'Species **A** had a greater rate of photosynthesis at low light intensity than species **B**.'

What evidence from **Figure 5** supports the student's conclusion?

[1 mark]

Tick (✓) **one** box.

Species **A** produced more bubbles than species **B** at 60 cm. ☐

Species **A** produced 46 bubbles at 20 cm and 34 bubbles at 60 cm. ☐

Species **A** produced fewer bubbles than species **B** at 20 cm. ☐

Question 6 continues on the next page

Do not write outside the box

Global dimming decreases the sunlight reaching the plants on the Earth's surface.

Global dimming is caused by particulates in the atmosphere.

0 6 . 7 Which substance is a **particulate** emitted from diesel engines?

[1 mark]

Tick (✓) **one** box.

Carbon ☐

Carbon dioxide ☐

Carbon monoxide ☐

0 6 . 8 Complete the sentence.

Choose the answer from the box.

[1 mark]

decrease	**stay the same**	**increase**

Global dimming will cause the growth rate of most

plants to _____.

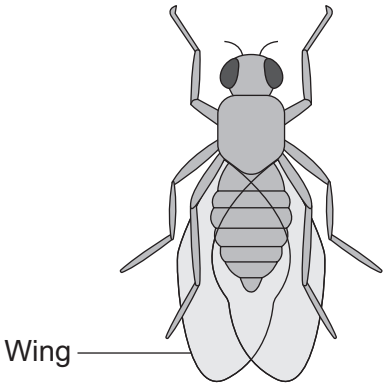
8

Do not write outside the box

0 7 Fruit flies are small insects.

Figure 6 shows a fruit fly.

Figure 6



Fruit flies:

- are easy to keep in containers
- have a short time between one generation and the next generation
- are used to study evolution.

0 7 . 1 Why is it easier to study evolution in fruit flies rather than in humans?

[2 marks]

Tick (✓) **two** boxes.

Fruit flies do not produce many offspring. ☐

Fruit flies show more different characteristics than humans. ☐

Many generations of fruit flies can be produced in less time. ☐

The environment that the fruit flies are in can be controlled. ☐

The fruit flies can fly between different places. ☐

Question 7 continues on the next page

Do not write outside the box

A scientist studied the length of fruit fly wings.

The scientist used selective breeding to produce a population of fruit flies with longer wings.

The first stages in the selective breeding process were:

- Place five female fruit flies with the longest wings in a container.
- Add five male fruit flies with the longest wings to the container.
- Let these fruit flies breed.
- Place the five female offspring with the longest wings in a new container.
- Add the five male offspring with the longest wings to the new container.

0 7 . 2 What is the next stage in the process of selective breeding?

[1 mark]

_____

_____

0 7 . 3 The scientist used inbreeding of closely related fruit flies in the selective breeding process.

Describe **one** risk when breeding closely related organisms.

[1 mark]

_____

_____

Do not write outside the box

0 7 . 4 After many generations, the offspring all had long wings.

The scientist stopped selectively breeding the fruit flies.

After a further 15 generations, the fruit flies all had short wings.

Which process may have caused the fruit flies to have short wings?

[1 mark]

Tick (✓) **one** box.

Classification ☐

Mitosis ☐

Natural selection ☐

Some fruit flies damage crops.

0 7 . 5 How can farmers kill fruit flies that damage crops?

[1 mark]

Tick (✓) **one** box.

Add fertiliser to the soil. ☐

Place compost around the plants. ☐

Spray crops with pesticide. ☐

Question 7 continues on the next page

Do not write outside the box

One species of fruit fly has been genetically modified (GM) to **only** produce male offspring.

- Scientists can release large numbers of the GM fruit flies where wild fruit flies are damaging crops.
- The GM fruit flies will breed with wild fruit flies.
- Releasing the GM fruit flies will decrease the population of wild fruit flies.

0 7 . 6 What is **one** advantage of releasing the GM fruit flies?

[1 mark]

Tick (✓) **one** box.

GM fruit flies look different to wild fruit flies. ☐

Less of the crop is damaged by fruit flies. ☐

Wild fruit flies reproduce at a faster rate. ☐

0 7 . 7 What is **one** disadvantage of decreasing the population of wild fruit flies?

[1 mark]

Tick (✓) **one** box.

Birds that eat fruit flies will have more food. ☐

Food chains and food webs will be disrupted. ☐

Fruit flies will have different characteristics. ☐

8

Do not write outside the box

0 8 This question is about the transport of substances into and out of organisms.

0 8 . 1 A plant cell is placed in pure water.

Water moves into the cell by osmosis.

Complete the sentence.

Choose the answer from the box.

[1 mark]

lower	**the same**	**greater**

Compared with the pure water, the concentration of glucose in

the cell is _____.

0 8 . 2 Glucose moves from an area with a high concentration of glucose to an area with a low concentration of glucose.

Name the process that moves the glucose.

[1 mark]

_____

Question 8 continues on the next page

Do not write outside the box

Figure 7 shows a salamander.

Figure 7

The species of salamander shown in **Figure 7** does **not** have lungs.

Gas exchange between the air and the blood of the salamander occurs through the skin.

0 8 . 3 Name the gas that moves from the air into the blood for use in respiration.

[1 mark]

_____

0 8 . 4 Explain why the blood vessels of the salamander are near the surface of the skin.

[2 marks]

_____

_____

_____

_____

Do not write outside the box

0 8 . 5 Salamanders of this species grow to a maximum length of 40 cm.

Complete the sentences.

[3 marks]

Compared to an adult human, the **surface area** of a salamander is _____.

Compared to an adult human, the **volume** of a salamander is _____.

Compared to an adult human, the **surface area : volume ratio** of a salamander is _____.

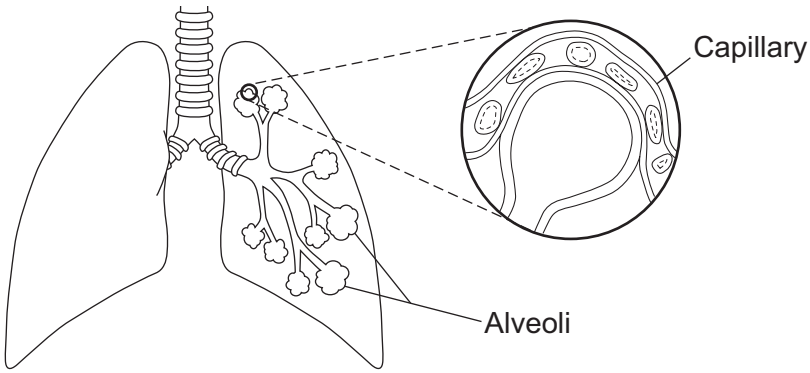
Question 8 continues on the next page

Do not write outside the box

0 8 . 6 Humans have lungs for gas exchange.

Figure 8 shows the lungs.

Figure 8



Describe how human lungs are adapted for efficient gas exchange.

[4 marks]

Extra space

12

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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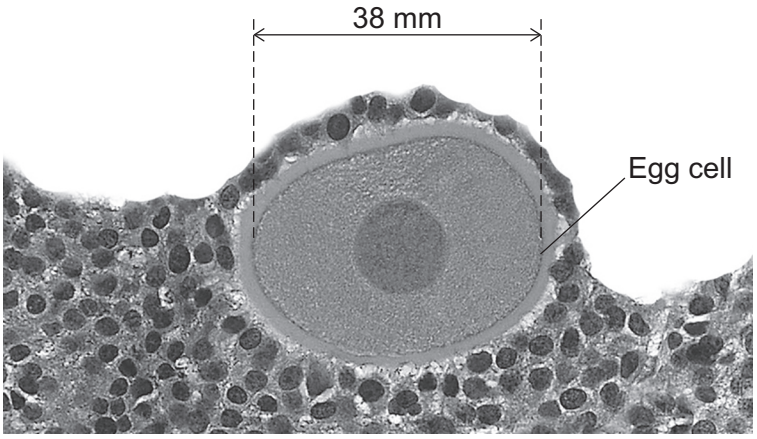
0 9 **Figure 9** shows a human egg cell viewed using a light microscope.

Figure 9



0 9 . 1 In **Figure 9**, the diameter of the image of the egg is 38 mm.

The magnification of **Figure 9** is ×400

Calculate the real diameter of the egg cell in micrometres.

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

1 millimetre = 1000 micrometres

[4 marks]

Real diameter of egg cell = _____ micrometres

Do not write outside the box

0 9 . 2 Draw a simple diagram of the egg cell shown in **Figure 9**.

On your drawing:

- label **two** parts of the egg cell that are visible in **Figure 9**
- do **not** include other cells.

[2 marks]

0 9 . 3 Some parts of a human egg cell are **not** visible in **Figure 9**.

Name **one** part of a human egg cell that is **only** visible using an electron microscope.

[1 mark]

_____

Question 9 continues on the next page

Do not write outside the box

0 9 . 4 Name the process of cell division that produces egg cells.

[1 mark]

_____

0 9 . 5 How many chromosomes are in a human egg cell?

[1 mark]

_____

0 9 . 6 Describe how a chromosome in a sperm cell determines whether the offspring that forms is male or female.

[2 marks]

_____

_____

_____

_____

Do not write outside the box

0 9 . 7 Which hormone stimulates the release of an egg?

[1 mark]

Tick (✓) **one** box.

FSH ☐

LH ☐

Oestrogen ☐

Question 9 continues on the next page

Do not write outside the box

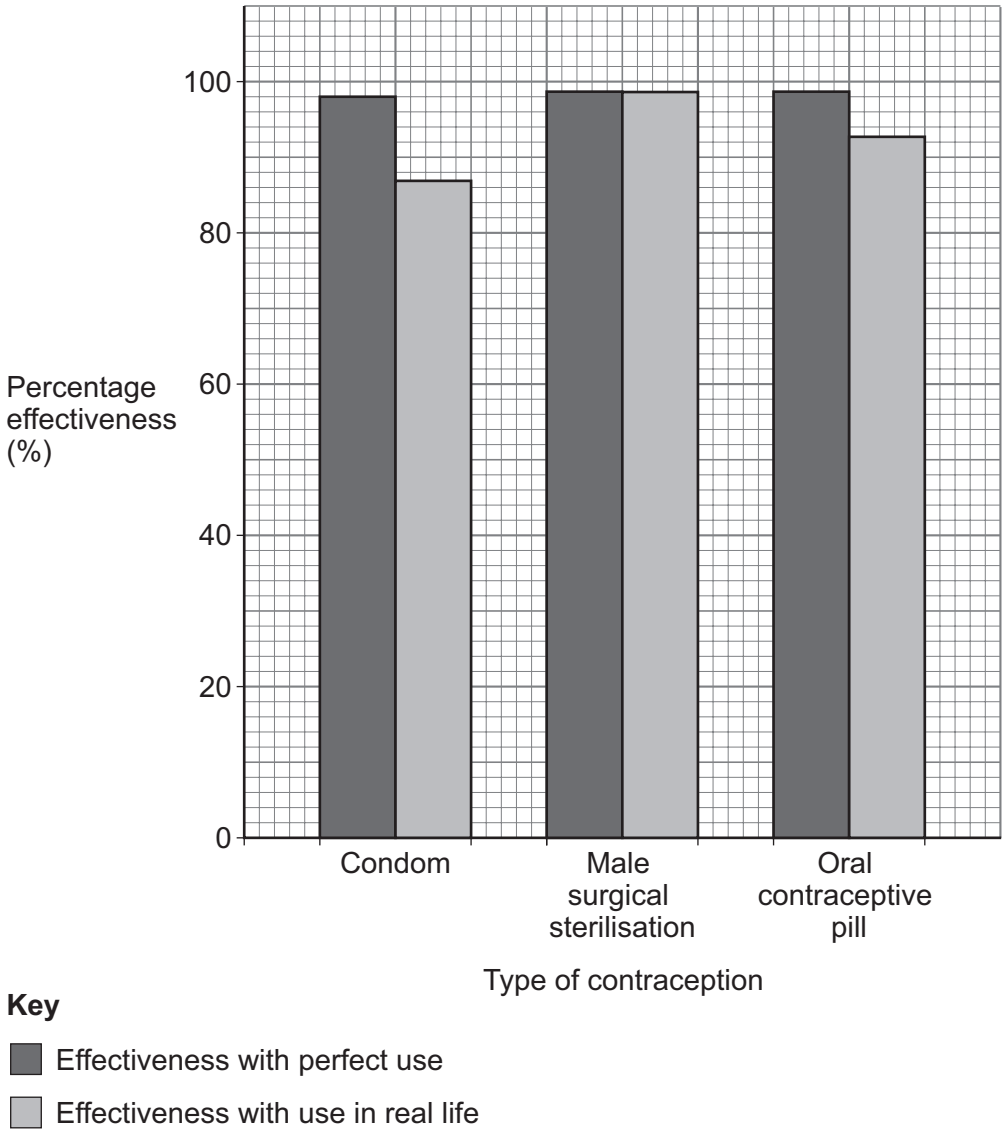
0 9 . 8 Oral contraceptive pills contain hormones that prevent the release of an egg.

Scientists studied the effectiveness of different types of contraception with perfect use and with use in real life.

- 'Perfect use' means following all the instructions.
- 'Use in real life' is what actually happens in the population. The instructions may not always be followed in real life.

Figure 10 shows the results.

Figure 10



Do not write outside the box

Evaluate the effectiveness of the three types of contraception shown in **Figure 10**.

Use data from **Figure 10**.

[6 marks]

Extra space

18

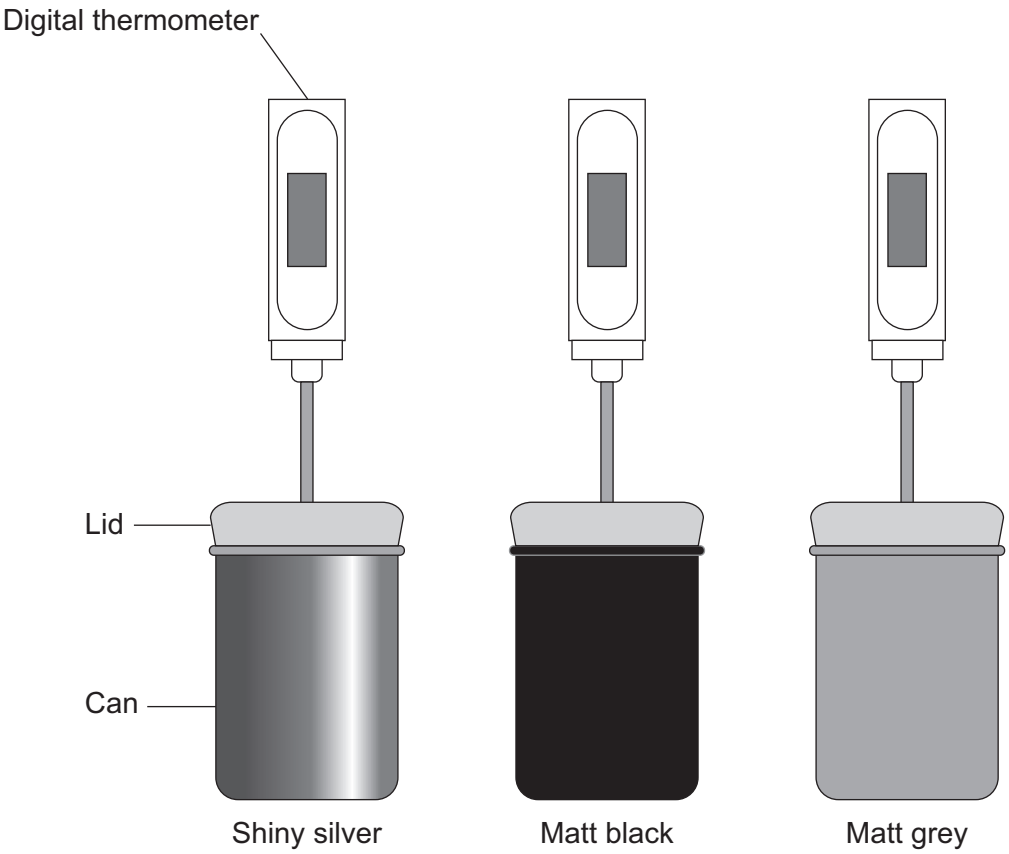
Turn over for the next question

Do not write outside the box

1 0 A student investigated the emission of infrared radiation.

Figure 11 shows some of the equipment used.

Figure 11



This is the method used.

1. Measure and then pour a volume of 100 cm^3 of very hot water into each can.
2. Place a lid on each can and insert a thermometer through each lid.
3. Record the initial temperature of the water in each can.
4. Record the temperature of the water in each can after 5 minutes.

Do not write outside the box

1 0 . 1 What equipment should the student have used to measure the volume of water?

[1 mark]

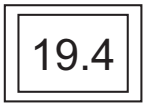
_____

1 0 . 2 The student had two different types of thermometer that could have been used.

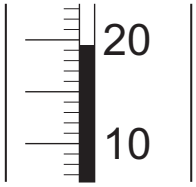
Figure 12 shows the readings on the two thermometers before being used in the investigation.

Figure 12

Thermometer **A**



Thermometer **B**



Give **two** advantages of using thermometer **A** compared with using thermometer **B**.

[2 marks]

1 _____

_____

2 _____

_____

Question 10 continues on the next page

Do not write outside the box

The student used thermometer **A** for all the temperature measurements.

Table 3 shows the results.

Table 3

	Temperature in °C		
	Shiny silver can	**Matt black can**	**Matt grey can**
Initial temperature	75.4	83.0	78.0
Final temperature	60.2	65.3	62.5

1 0 . 3 The student calculated the temperature change of the water in each can.

The student used the temperature change to conclude which surface emitted infrared radiation at the greatest rate.

Explain why the student could **not** make a valid conclusion from the results in **Table 3**.

[2 marks]

Do not write outside the box

The student repeated the investigation to observe how the temperature of the water in the can varied with time.

The student used a temperature sensor and a datalogger.

1 0 . 4 The datalogger recorded two readings each second.

What is the advantage of using the datalogger for a cooling curve?

[1 mark]

Tick (✓) **one** box.

The datalogger recorded readings less frequently than a student could. ☐

The datalogger recorded readings at the same frequency as a student could. ☐

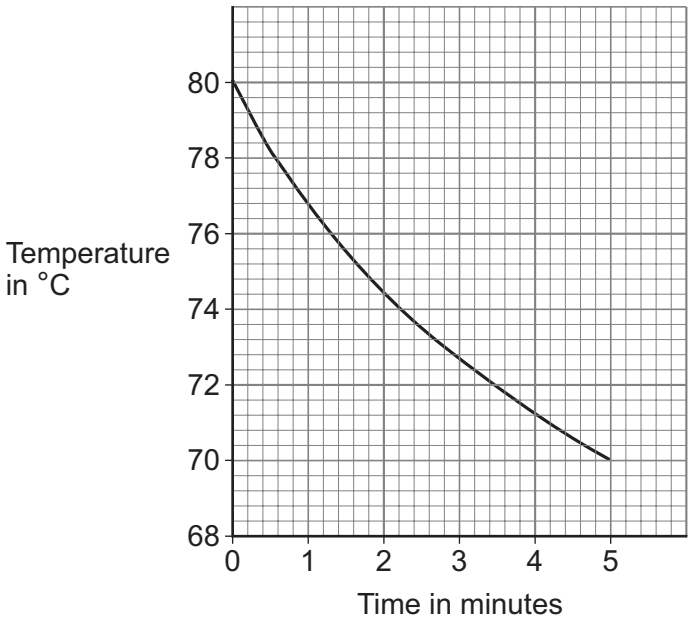
The datalogger recorded readings more frequently than a student could. ☐

Question 10 continues on the next page

Do not write outside the box

Figure 13 shows the results for the can with the matt black surface.

Figure 13



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1 0 . 5 When did the surface of the can emit infrared radiation at the greatest rate?

Give a reason for your answer.

Use **Figure 13**.

[2 marks]

Tick (✓) **one** box.

At the start of the investigation ☐

In the middle of the investigation ☐

At the end of the investigation ☐

Reason _____

_____

_____

1 0 . 6 The student also used a can with a matt white surface.

The initial temperature of the water in this can was 80 °C.

Draw a line on **Figure 13** to show the expected results for the can with the matt white surface.

[1 mark]

9

END OF QUESTIONS

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