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

H

Higher 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.

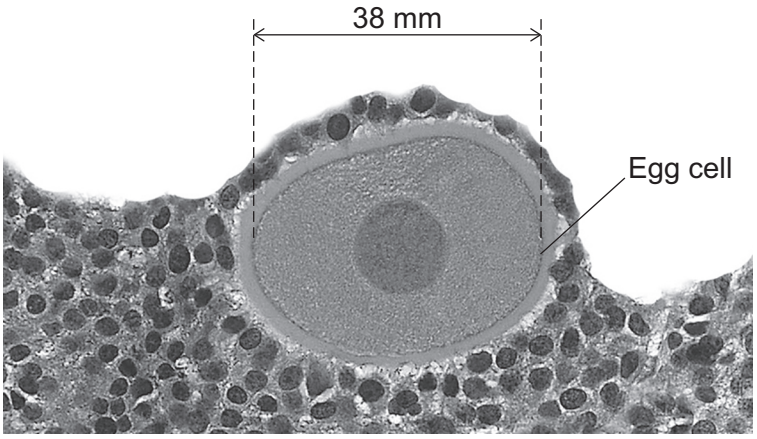
Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

Do not write outside the box

0 1 **Figure 1** shows a human egg cell viewed using a light microscope.

Figure 1



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

The magnification of **Figure 1** 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 1 . 2 Draw a simple diagram of the egg cell shown in **Figure 1**.

On your drawing:

- label **two** parts of the egg cell that are visible in **Figure 1**
- do **not** include other cells.

[2 marks]

0 1 . 3 Some parts of a human egg cell are **not** visible in **Figure 1**.

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

[1 mark]

_____

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 Name the process of cell division that produces egg cells.

[1 mark]

_____

0 1 . 5 How many chromosomes are in a human egg cell?

[1 mark]

_____

0 1 . 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 1 . 7 Which hormone stimulates the release of an egg?

[1 mark]

Tick (✓) **one** box.

FSH ☐

LH ☐

Oestrogen ☐

Question 1 continues on the next page

Do not write outside the box

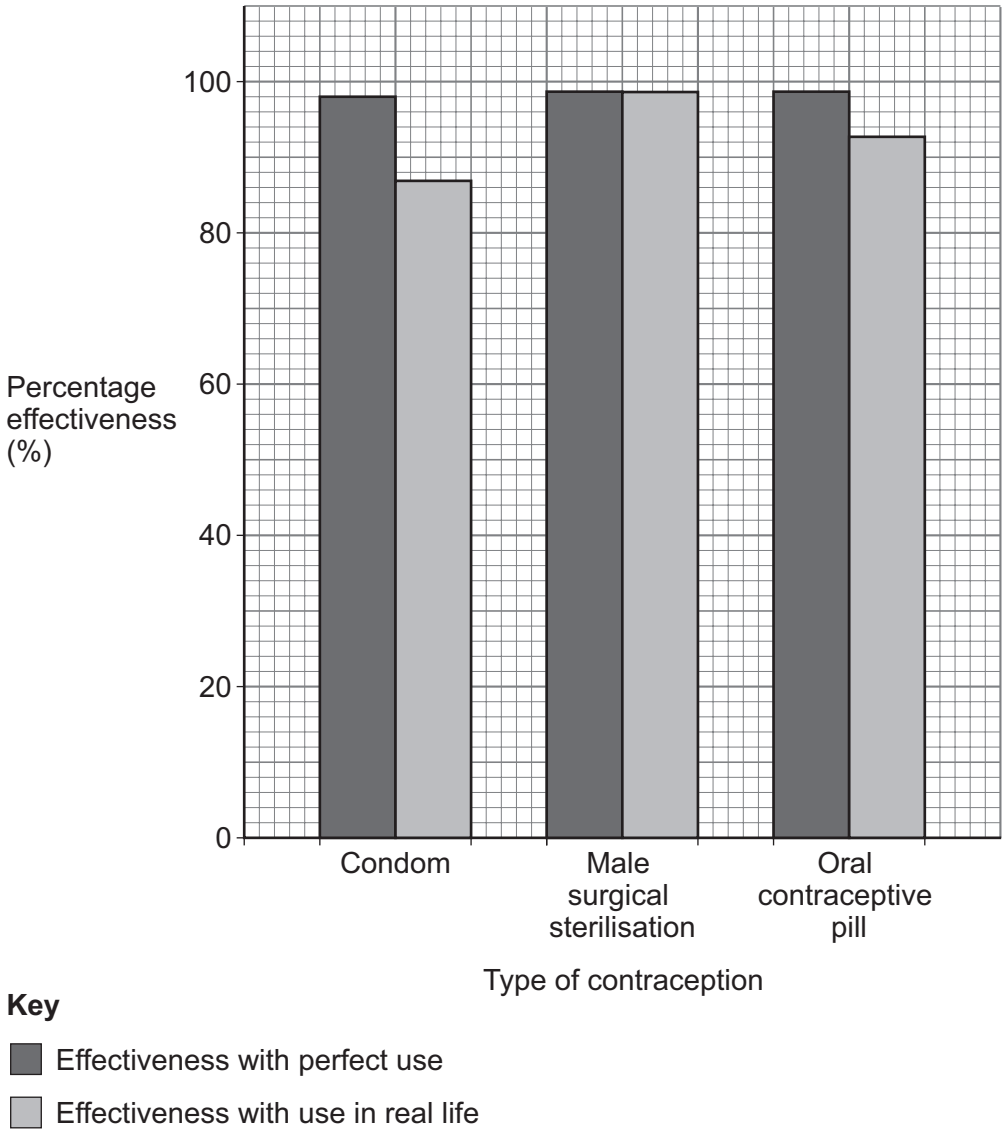
0 1 . 8 Oral contraceptive pills contain hormones that prevent the release of an egg.

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 2 shows the results.

Figure 2



Do not write outside the box

Evaluate the effectiveness of the three types of contraception shown in **Figure 2**.

Use data from **Figure 2**.

[6 marks]

Extra space

18

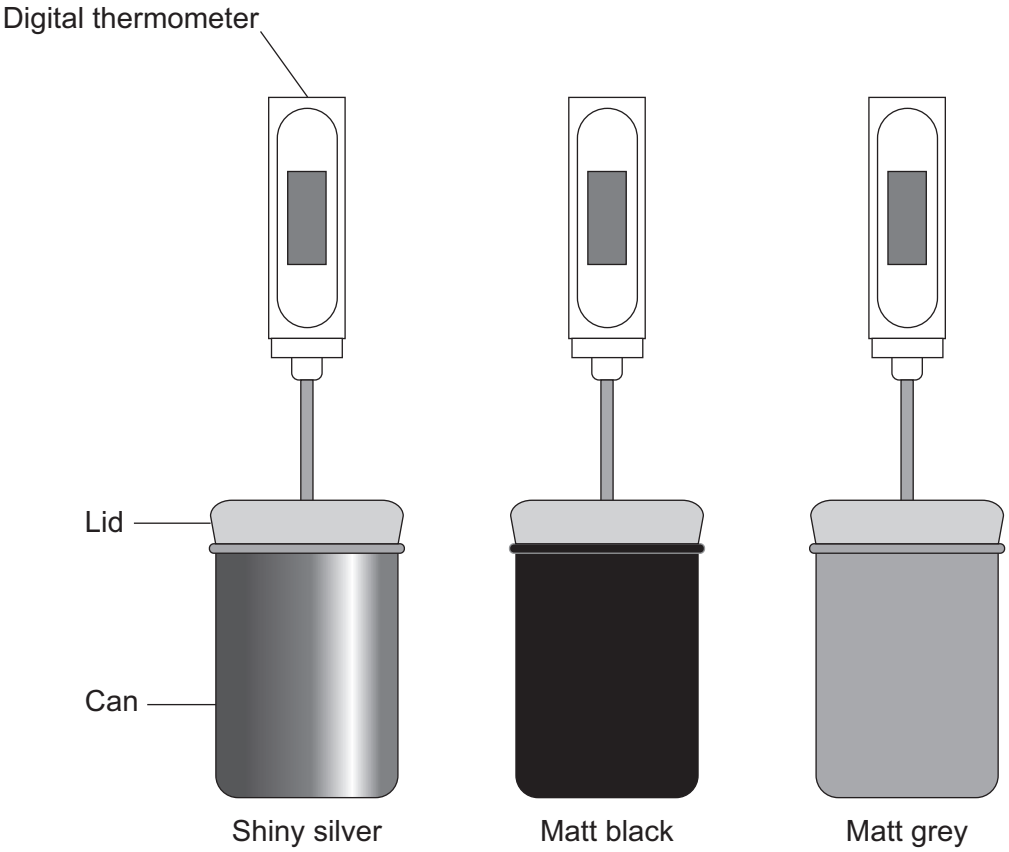
Turn over for the next question

Do not write outside the box

0 2 A student investigated the emission of infrared radiation.

Figure 3 shows some of the equipment used.

Figure 3



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

0 2 . 1 What equipment should the student have used to measure the volume of water?

[1 mark]

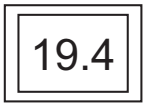
_____

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

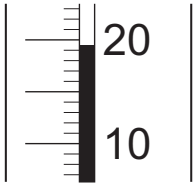
Figure 4 shows the readings on the two thermometers before being used in the investigation.

Figure 4

Thermometer **A**



Thermometer **B**



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

[2 marks]

1 _____

_____

2 _____

_____

Question 2 continues on the next page

Do not write outside the box

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

Table 1 shows the results.

Table 1

	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

0 2 . 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 1**.

[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.

0 2 . 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. ☐

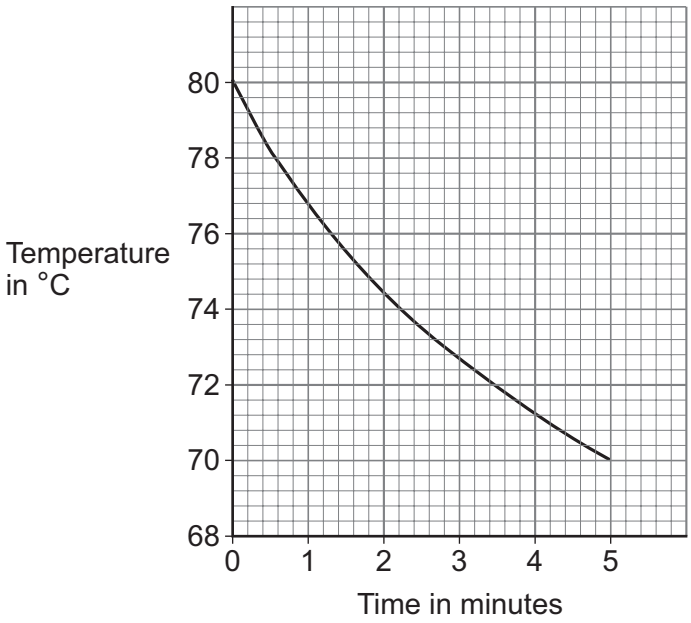
The datalogger recorded readings more frequently than a student could. ☐

Question 2 continues on the next page

Do not write outside the box

Figure 5 shows the results for the can with the matt black surface.

Figure 5



Do not write outside the box

0 2 . 5 When did the surface of the can emit infrared radiation at the greatest rate?

Give a reason for your answer.

Use **Figure 5**.

[2 marks]

Tick (✓) **one** box.

At the start of the investigation ☐

In the middle of the investigation ☐

At the end of the investigation ☐

Reason _____

_____

_____

0 2 . 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 5** to show the expected results for the can with the matt white surface.

[1 mark]

9

Turn over for the next question

Do not write outside the box

0 3 Sea water is a mixture.

0 3 . 1 Explain how pure water is obtained from sea water by distillation.

[4 marks]

Extra space

0 3 . 2 Describe how a sample of water can be checked for purity.

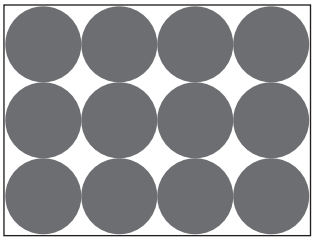
Your description should include the use of a thermometer.

[2 marks]

Do not write outside the box

0 3 . 3 **Figure 6** represents water as a solid.

Figure 6



Describe **two** limitations of **Figure 6** as a model of a solid.

[2 marks]

1 _____

_____

2 _____

_____

8

Turn over for the next question

Do not write outside the box

0 4 Photosynthesis produces glucose ($C_6H_{12}O_6$).

0 4 . 1 Write a balanced symbol equation for photosynthesis.

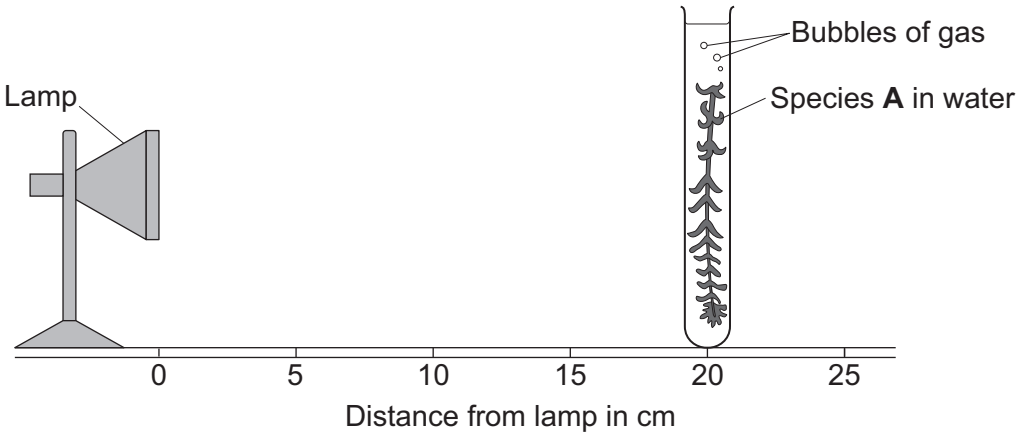
[2 marks]

_____ + _____ ⟶ _____ + _____

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

Figure 7 shows the apparatus used.

Figure 7



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** and species **C**.

Do not write outside the box

0 4 . 2 The student repeated the investigation several times.

Explain how **two** other improvements to the method would ensure the results are more valid.

[4 marks]

Improvement 1 _____

_____

Explanation _____

_____

Improvement 2 _____

_____

Explanation _____

_____

0 4 . 3 When the distance between the lamp and the plant is 20 cm, the light intensity is 0.0025 arbitrary units.

Calculate how many times greater the light intensity is at 20 cm compared with the light intensity at 60 cm.

Use the equation:

$$\text{light intensity} = \frac{1}{(\text{distance})^2}$$

[4 marks]

_____

_____

_____

_____

_____

_____

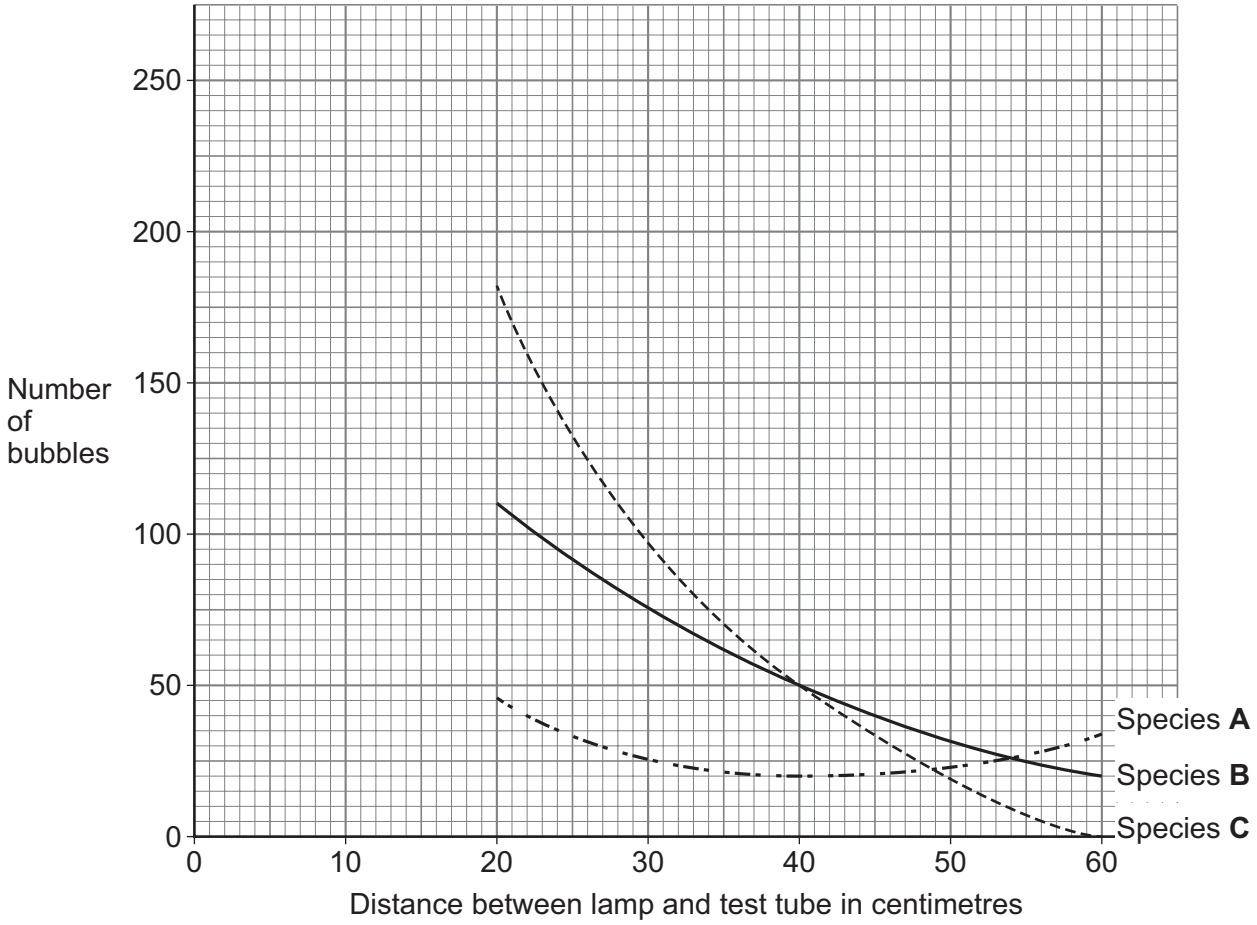
Number of times greater = _____

Do not write outside the box

The student collected valid results.

Figure 8 shows the results.

Figure 8



0 4 . 4 Predict the number of bubbles that would be produced by species **B** at 10 cm from the lamp.

You should extend the line on **Figure 8**.

[2 marks]

Number of bubbles = _____

Do not write outside the box

0 4 . 5 Species **A**, **B** and **C** grow at different depths in ponds.

Which species is most likely to be found growing near the surface of the pond?

Give the reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Reason _____

_____

Global dimming is a decrease in the sunlight reaching the Earth's surface due to particulates in the atmosphere.

0 4 . 6 Name **one** of the particulates in the atmosphere.

[1 mark]

_____

0 4 . 7 Explain why global dimming could decrease the rate of plant growth.

[3 marks]

_____

_____

_____

_____

_____

_____

18

Do not write outside the box

0 5 Coronary heart disease (CHD) is a type of cardiovascular disease.

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

The stem cells differentiate into cells of coronary arteries or heart muscle cells.

A patient with CHD was treated with stem cells.

The patient said:

'Before the treatment, I was always tired. Now I can run.

There was a gradual improvement in my health and 3 months after the treatment I felt fit.'

0 5 . 1 Explain why CHD makes it difficult for a person to exercise.

[6 marks]

Extra space

Do not write outside the box

0 5 . 2 After the stem cell treatment, the health of the patient did not improve immediately.

Suggest why the stem cell treatment only caused a **gradual** improvement in health.

[1 mark]

_____

_____

0 5 . 3 Stem cells for the treatment of CHD can come from the patient or from a donor.

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

[2 marks]

_____

_____

_____

_____

9

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 6 Radio waves are one type of electromagnetic wave.

0 6 . 1 What are **two** properties of all electromagnetic waves?

[2 marks]

Tick (✓) **two** boxes.

A thin sheet of metal stops all electromagnetic waves. ☐

All electromagnetic waves are longitudinal. ☐

All electromagnetic waves have the same speed in a vacuum. ☐

All electromagnetic waves transfer energy. ☐

Water reflects all electromagnetic waves. ☐

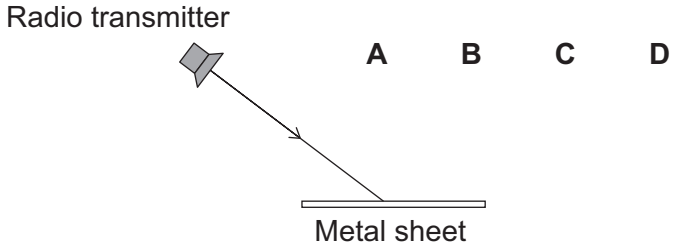
Question 6 continues on the next page

Do not write outside the box

A teacher used a radio transmitter, a metal sheet and a radio receiver to demonstrate the reflection of radio waves.

0 6 . 2 **Figure 9** shows the path of the radio waves from the transmitter to the metal sheet.

Figure 9



The teacher placed the radio receiver at positions **A**, **B**, **C** and **D**.

Which position was the radio receiver at when the radio waves were detected?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 6 . 3 The frequency of the radio wave was 2400 MHz.

The speed of the radio wave was 3.0×10^8 m/s.

Calculate the wavelength of the radio wave.

Use the Physics Equations Sheet.

[4 marks]

Wavelength = _____ m

0 6 . 4 The aerial of the receiver absorbs radio waves.

Explain why the frequency of the alternating current in the receiver circuit depends on the frequency of the radio waves.

[2 marks]

9

Do not write outside the box

0 7 An increase in the concentration of greenhouse gases in the atmosphere is causing global warming and climate change.

0 7 . 1 Explain:

- how scientists can predict future climate change
- why there are uncertainties in the predictions.

[4 marks]

Extra space

Do not write outside the box

0 7 . 2 Global warming increases the rate of evaporation of water from the sea.

Explain how increased evaporation could lead to an increasing rate of global warming.

You should refer to the interaction of radiation with matter in your answer.

[4 marks]

Extra space

Question 7 continues on the next page

Do not write outside the box

Table 2 shows information about some greenhouse gases.

Table 2

Greenhouse gas	Relative greenhouse effect per molecule of gas	Concentration in the atmosphere in arbitrary units
Carbon dioxide	1	420
Methane	30	1.9
CFCs	21 000	7.1×10^{-4}

0 7 . 3 The concentration of methane in the atmosphere is greater than the concentration of CFCs.

Calculate the number of times greater.

Give your answer to 2 significant figures.

[3 marks]

Number of times greater (2 significant figures) = _____

Do not write outside the box

0 7 . 4 Most efforts to reduce greenhouse gases refer to carbon dioxide rather than to methane or CFCs.

Suggest why.

Use **Table 2**.

[1 mark]

_____

_____

12

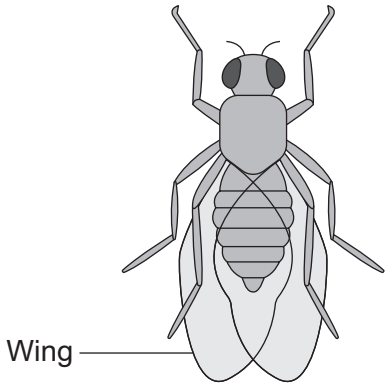
Turn over for the next question

Do not write outside the box

0 8 Fruit flies are small insects.

Figure 10 shows a fruit fly.

Figure 10



Fruit flies:

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

A scientist studied the length of fruit fly wings and the shape of fruit fly wings.

Fruit flies with short wings usually have rounder wings than fruit flies with long wings.

0 8 . 1 Explain how fruit flies can be selectively bred to produce a population with wings that are long **and** round.

[3 marks]

Do not write outside the box

0 8 . 2 The scientist produced a population that only had long and round wings.

The scientist stopped selectively breeding the fruit flies.

After several more generations, the population all had short wings.

Explain why.

[3 marks]

0 8 . 3 There are many species of fruit fly.

All species have a unique binomial name.

What is the same in the binomial name of closely related species?

[1 mark]

Question 8 continues on the next page

Do not write outside the box

Scientists have produced genetically modified (GM) fruit flies.

0 8 . 4 What is used to cut DNA in the process of producing a GM fruit fly?

[1 mark]

_____

Some fruit flies are pests of crops.

0 8 . 5 The GM fruit flies only produce male offspring.

The scientists released a large number of the GM fruit flies into the wild population.

Explain how releasing the GM fruit flies caused the population of fruit flies in the wild to decrease.

[3 marks]

_____

_____

_____

_____

_____

_____

Do not write outside the box

0 8 . 6 Explain the benefits and risks of releasing GM fruit flies.

[6 marks]

Extra space

17

END OF QUESTIONS

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