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

H

Higher Tier Paper 1 Life and Environmental Sciences

Tuesday 13 May 2025 Afternoon 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	
9	
TOTAL	

Do not write outside the box

0 1 Control of blood glucose concentration is an example of homeostasis.

0 1 . 1 Give **one** other condition that is controlled by homeostasis in humans.

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

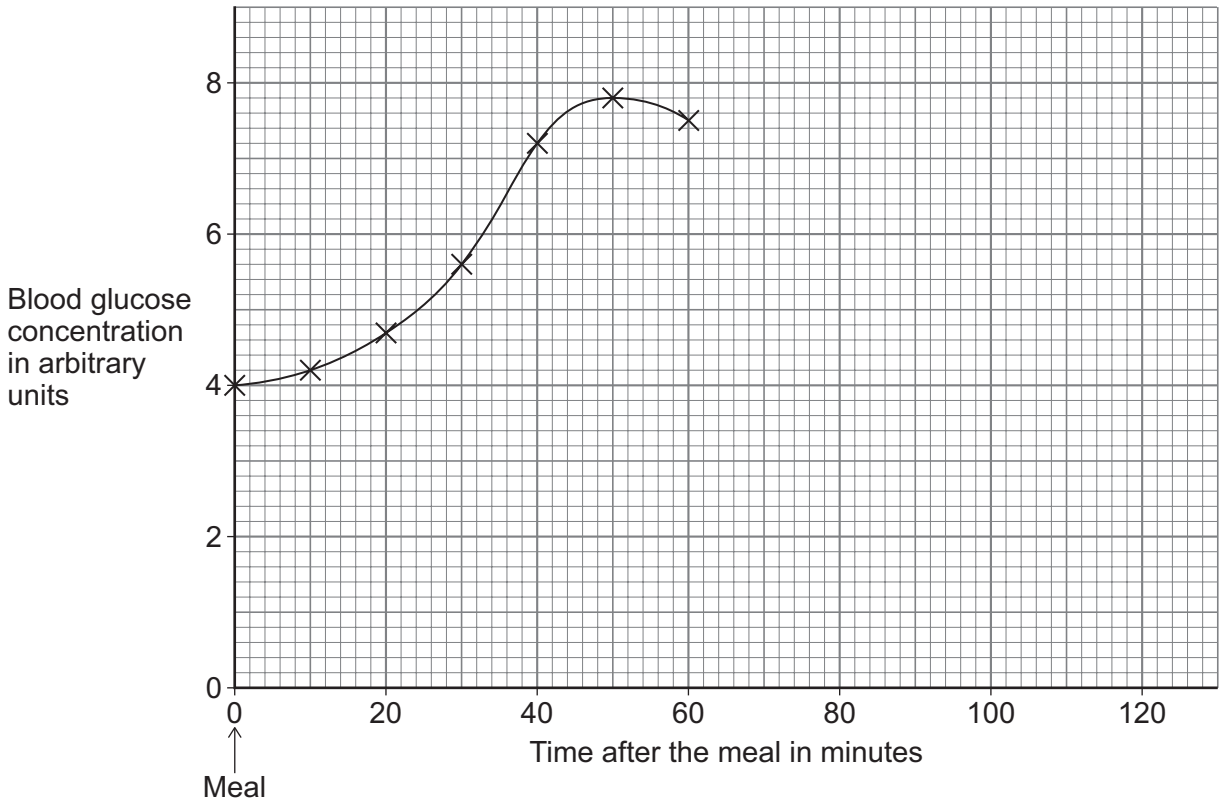
[1 mark]

_____

_____

Figure 1 shows the blood glucose concentration of a person after eating a meal.

Figure 1



Do not write outside the box

0 1 . 2 Calculate the increase in blood glucose concentration between 0 minutes and 50 minutes after the meal.

Use **Figure 1**.

[2 marks]

_____

_____

_____

Increase = _____ arbitrary units

0 1 . 3 **Table 1** shows the blood glucose concentration between 70 minutes and 120 minutes after the meal.

Table 1

Time after the meal in minutes	Blood glucose concentration in arbitrary units
70	6.2
80	5.3
90	4.7
100	4.3
110	4.1
120	4.0

Complete **Figure 1**.

You should:

- plot the data from **Table 1**
- draw a line of best fit between 60 minutes and 120 minutes.

[3 marks]

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 After a meal, the blood glucose concentration increases and then decreases.

Describe how the pancreas causes blood glucose concentration to **decrease**.

[2 marks]

_____

_____

_____

_____

0 1 . 5 Which substance do animal cells use to store glucose?

[1 mark]

Tick (✓) **one** box.

Cellulose ☐

Glycogen ☐

Lactic acid ☐

Starch ☐

0 1 . 6 People with Type 2 diabetes often have high blood glucose concentration.

Give **two** lifestyle changes to treat Type 2 diabetes.

[2 marks]

1 _____

_____

2 _____

_____

11

Do not write outside the box

0 2 Scientists used alpha particles and gold to develop the atomic model.

0 2 . 1 A gold atom can be represented as $^{197}_{79}Au$

How many electrons and neutrons are in this gold atom?

[2 marks]

Number of electrons _____

Number of neutrons _____

0 2 . 2 What is the structure of an alpha particle?

[1 mark]

_____

_____

Question 2 continues on the next page

Do not write outside the box

A scientist directed alpha particles at thin gold foil.

Table 2 shows information about the direction of the alpha particles after reaching the thin gold foil.

Table 2

Direction of alpha particles after reaching the gold foil	**Number of alpha particles**
No change in direction **or** changed direction by less than 15°	132 000
Changed direction by between 15° and 90°	40 500
Changed direction by more than 90°	196

0 2 . 3 Calculate the percentage of alpha particles that changed direction by more than 90°.

Use **Table 2**.

[3 marks]

_____

_____

_____

_____

_____

Percentage = _____ %

Do not write outside the box

0 2 . 4 Draw **one** line from each observation to the conclusion that could be made from the observation.

[2 marks]

Observation	Conclusion
	Atoms have a charged nucleus
Most alpha particles passed straight through the gold foil	Atoms are mostly empty space
Some alpha particles changed direction	Atoms contain neutral sub-atomic particles
	The mass of electrons is less than the mass of atoms

8

Turn over for the next question

Do not write outside the box

0 3 This question is about genetics.

Figure 2 shows two lions.

- One lion has brown fur.
- One lion has white fur.

Figure 2

0 3 . 1 White fur colour in lions is caused by a mutation.

How could a mutation cause white fur colour?

[1 mark]

Tick (✓) **one** box.

The mutation could cause cells to divide. ☐

The mutation could prevent the growth of cells. ☐

The mutation could stop cells producing a protein. ☐

Do not write outside the box

0 3 . 2 Lions live in areas of grass.

The dry grass is often brown.

White lions are very rare in the wild.

Explain why natural selection is likely to result in low numbers of white lions in the wild.

[3 marks]

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 The allele for brown fur is dominant.

The allele for white fur is recessive.

A heterozygous male lion and a homozygous recessive female lion produce one offspring.

Determine the probability that the offspring will have white fur.

You should:

- complete **Figure 3**
- use the symbols:
  B = allele for brown fur
  b = allele for white fur
- identify the colour of fur for each offspring genotype
- give the probability of the offspring having white fur.

[6 marks]

Figure 3

		Homozygous recessive female	
Heterozygous male			

Probability of the offspring having white fur = _____

10

Do not write outside the box

0 4 Unstable isotopes of elements decay by emitting alpha, beta or gamma radiation.

0 4 . 1 Give **one** similarity and **one** difference in the nuclei of two isotopes of the same element.

[2 marks]

Similarity _____

_____

Difference _____

_____

0 4 . 2 Describe the penetration properties of alpha, beta and gamma radiation.

[3 marks]

Alpha _____

_____

Beta _____

_____

Gamma _____

_____

0 4 . 3 Caesium-137 decays to barium by emitting beta radiation.

Complete the nuclear equation for the decay of caesium-137 ($^{137}_{55}Cs$) to barium (Ba).

[2 marks]

$$^{137}_{55}Cs \longrightarrow \frac{\quad}{\quad}Ba + \frac{\quad}{\quad}e$$

Question 4 continues on the next page

Do not write outside the box

In 2011, an accident at a nuclear power station caused the release of radioactive isotopes into the environment.

Table 3 gives information about the radioactive isotopes released.

Table 3

Radioactive isotope	Radiation emitted	Half-life
Caesium-137	Beta	30 years
Iodine-131	Beta	8 days

0 4 . 4 What is meant by 'half-life'?

[1 mark]

_____

_____

_____

Do not write outside the box

0 4 . 5 A soil sample was taken from the area around the nuclear power station just after the accident in 2011.

The soil sample was contaminated with equal numbers of atoms of caesium-137 and iodine-131

Explain how the risk linked to each isotope has changed between 2011 and 2024.

Use information from **Table 3**.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

12

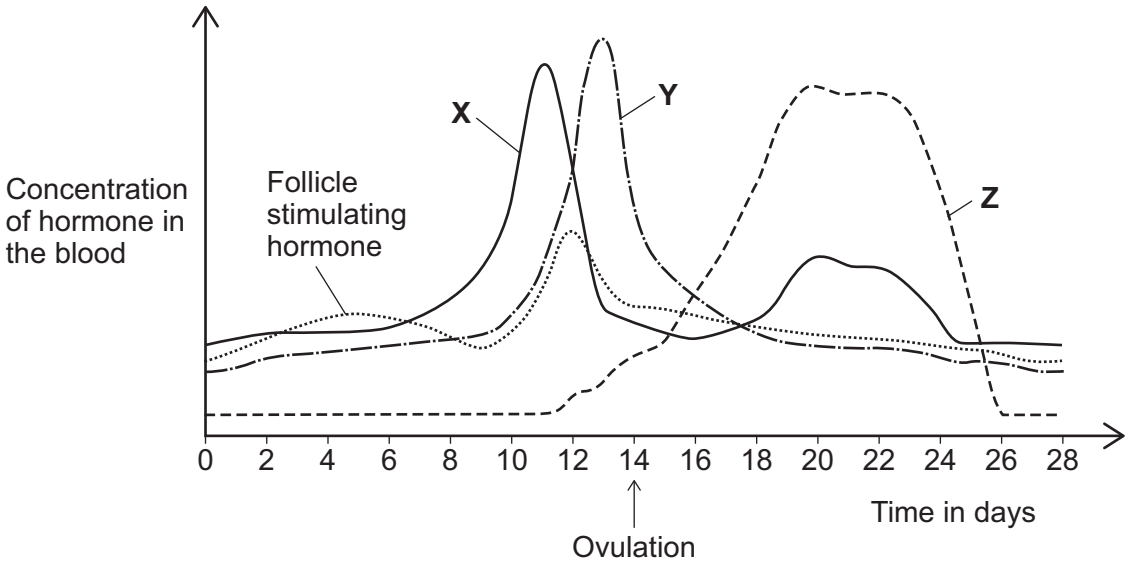
Turn over for the next question

Do not write outside the box

0 5 Hormones affect the human body in many ways.

0 5 . 1 **Figure 4** shows how the concentration of four female sex hormones changes during the menstrual cycle.

Figure 4



Do not write outside the box

Explain how hormones **X**, **Y** and **Z** can be identified from **Figure 4**.

You should include the name of each hormone.

[6 marks]

Extra space

Question 5 continues on the next page

Do not write outside the box

Endocrine disruptors are chemicals in the environment that affect the body in similar ways to hormones.

0 5 . 2 Chemical **A** is an endocrine disruptor.

Scientists investigated the effect of feeding chemical **A** to rats.

Table 4 shows the results.

Table 4

	Mean thickness of uterus lining in micrometres
Start of the investigation	250
End of the investigation	265

Calculate the percentage increase in the mean thickness of uterus lining.

[2 marks]

_____

_____

_____

Percentage increase = _____%

Do not write outside the box

White blood cells produce antibodies.

Some endocrine disruptors decrease antibody production.

0 5 . 3 The human body should still produce antibodies many years after a vaccination.

Give **one** reason why it is important that the human body produces antibodies many years after a vaccination.

[1 mark]

_____

_____

0 5 . 4 How do white blood cells reduce the symptoms of infectious diseases?

[1 mark]

Tick (✓) **one** box.

By causing blood clotting ☐

By decreasing phagocytosis ☐

By destroying antiretroviral drugs ☐

By producing antitoxins ☐

10

Turn over for the next question

Do not write outside the box

0 6 This question is about chromatography.

0 6 . 1 Explain how paper chromatography separates mixtures of coloured substances.

You should identify:

- the mobile phase
- the stationary phase.

Do **not** describe how to do the experiment.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

Do not write outside the box

0 6 . 2 A substance has an R_f value of 0.30

The solvent moved 8.0 cm from the start line.

Calculate the distance moved by the substance.

Give your answer in millimetres.

[4 marks]

Distance moved by substance = _____ mm

0 6 . 3 Describe how paper chromatography can be used to **identify** an unknown substance.

Do **not** describe how to do the experiment.

[2 marks]

10

Turn over for the next question

Do not write outside the box

0 7 Adélie penguins are one species of penguin.

Adélie penguins feed in the ocean.

0 7 . 1 The penguins are part of a food web.

Which of the following is the producer in the food web?

[1 mark]

Tick (✓) **one** box.

Algae ☐

Fish ☐

Fungi ☐

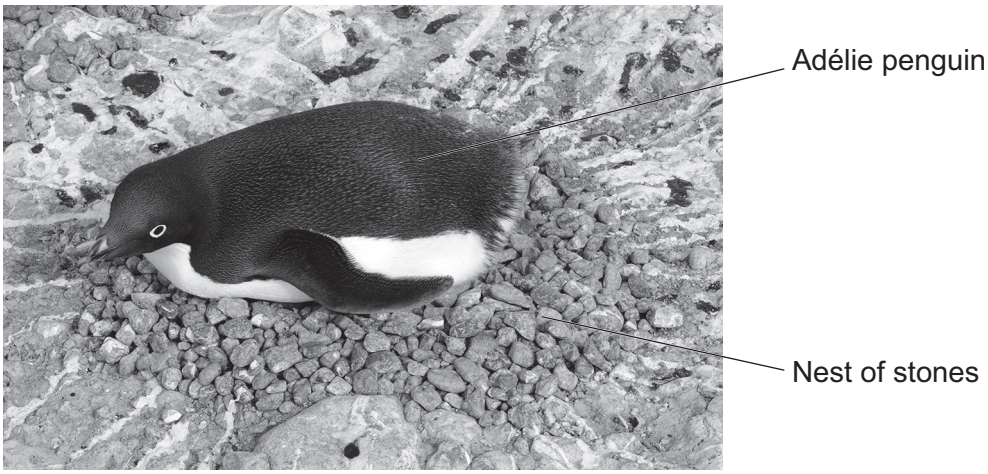
Prey ☐

Do not write outside the box

Adélie penguins nest on the ground in large groups.

Figure 5 shows an Adélie penguin on a nest made of stones.

Figure 5



0 7 . 2 Describe how **biotic** factors could affect the population of the penguins.

[4 marks]

Extra space

Question 7 continues on the next page

Do not write outside the box

0 7 . 3 Adélie penguin nests cover all the ground in one large circular area.

The number of Adélie penguin nests in the area was estimated to be 60 000

The mean area of an Adélie penguin nest is 2.0 m^2.

Calculate the radius of the large circular area covered by all of the penguin nests.

Use the equation:

$$\text{area of circle} = 3.14 \times (\text{radius})^2$$

[4 marks]

Radius = _____ m

Do not write outside the box

0 7 . 4 A scientist investigated the abundance and the distribution of a plant species near the penguin nests.

Explain why different methods are needed to sample **abundance** of a plant species and **distribution** of a plant species.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

13

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 8 Plant diseases often reduce the rate of plant growth.

0 8 . 1 Meristem tissue is found at the tips of shoots and roots in plants.

Which process happens in meristem tissue?

[1 mark]

Tick (✓) **one** box.

Fertilisation ☐

Meiosis ☐

Mitosis ☐

Transpiration ☐

Question 8 continues on the next page

Do not write outside the box

Oranges are grown on farms.

Oranges grow on trees that can become infected with bacteria.

The bacteria enter the trees when an insect feeds on the leaves.

The tree responds to the infection by blocking phloem tissue.

0 8 . 2 Suggest **one** advantage to the infected tree of blocking phloem tissue.

[1 mark]

_____

_____

0 8 . 3 Blocking phloem tissue causes oranges to contain a lower concentration of sugar than oranges from trees that are **not** infected.

Explain why.

[3 marks]

_____

_____

_____

_____

_____

_____

Do not write outside the box

0 8 . 4 Eventually, the blocked phloem tissue causes the tree to die.

Explain why blocked phloem tissue causes the tree to die.

[4 marks]

Extra space

0 8 . 5 Farmers want to reduce the spread of the bacteria between orange trees.

Explain **one** way farmers can reduce the spread of bacteria between orange trees.

[2 marks]

Question 8 continues on the next page

Do not write outside the box

0 8 . 6 Oranges can be made into fruit juice.

A student used the test for sugar to compare the concentration of sugar in five types of fruit juice.

The test for sugar produces a range of colours depending on the concentration of sugar present.

Figure 6 shows the colour chart for the test for sugar.

Figure 6

no sugar present → high sugar concentration

blue	green	yellow	orange	red

Describe a method the student could have used to compare the concentration of sugar in the different fruit juices.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

Do not write outside the box

0 8 . 7 The student's results will **not** accurately show the concentration of sugar in juice from oranges.

Explain why.

[2 marks]

_____

_____

_____

_____

17

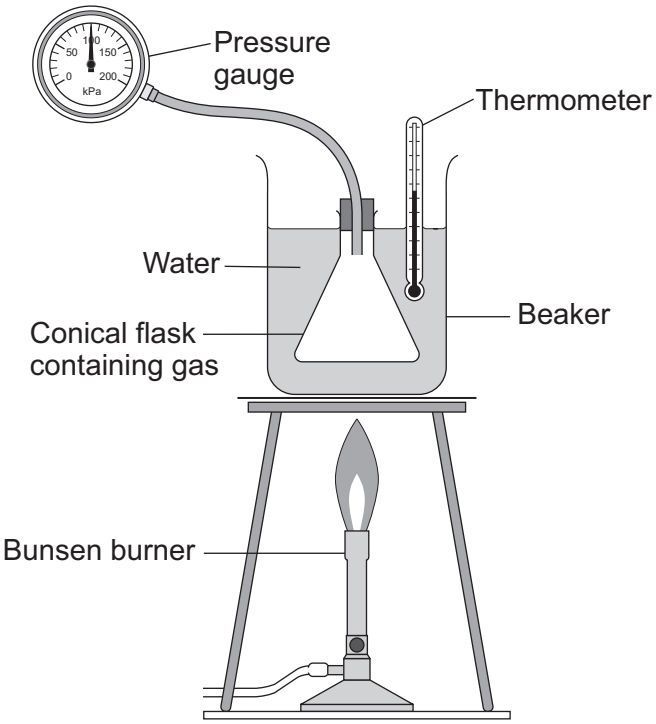
Turn over for the next question

Do not write outside the box

0 9 A teacher demonstrated how gas pressure varies with temperature.

Figure 7 shows the apparatus used.

Figure 7



Do not write outside the box

0 9 . 1 The thermal energy transferred to the water by the Bunsen burner was 63 kJ.

The water temperature changed from 22 °C to 82 °C.

Calculate the mass of water in the beaker.

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

Use the Physics Equations Sheet.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

Mass of water = _____ kg

Question 9 continues on the next page

Do not write outside the box

0 9 . 2 Increasing the temperature of the gas in the conical flask affected the gas pressure in the conical flask.

Explain why.

[4 marks]

Extra space

0 9 . 3 What name is given to the energy stored by the particles in a system?

[1 mark]

9

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

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

Copyright information

For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet.
This booklet is published after each live examination series and is available for free download from www.aqa.org.uk.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.

Copyright © 2025 AQA and its licensors. All rights reserved.