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 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.

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 A teacher had a conical flask containing a gas.

0 1 . 1 How are the particles arranged in a gas?

[1 mark]

Tick (✓) **one** box.

Particles are all touching each other. ☐

Particles are arranged in a pattern. ☐

Particles are arranged randomly. ☐

0 1 . 2 How do the particles move in a gas?

[1 mark]

Tick (✓) **one** box.

Particles move at the same speed. ☐

Particles move in circular paths. ☐

Particles move randomly. ☐

Do not write outside the box

0 1 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

force	**speed**	**temperature**

Gas pressure is caused by gas particles colliding with a surface. During a collision with the surface, a particle exerts a _____.

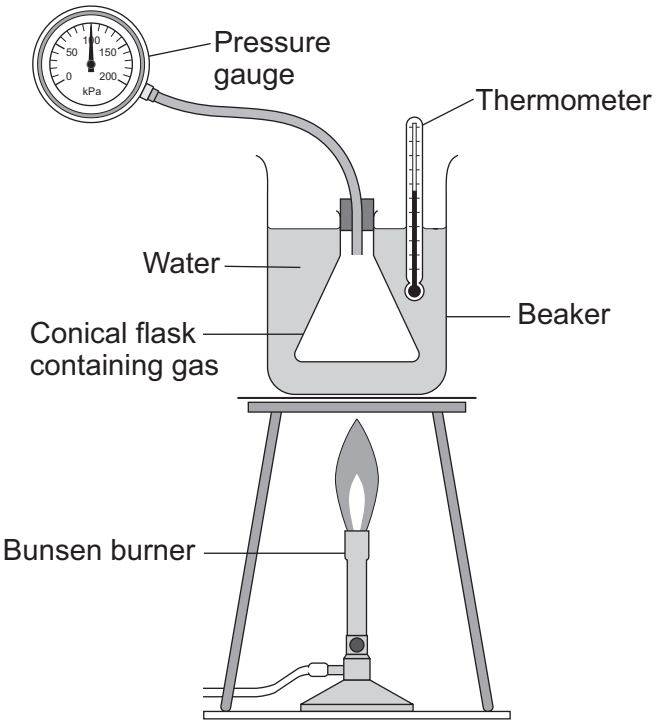
Question 1 continues on the next page

Do not write outside the box

The teacher demonstrated how gas pressure varies with temperature.

Figure 1 shows the apparatus used.

Figure 1



Do not write outside the box

0 1 . 4 The Bunsen burner transferred thermal energy to the water.

The change in thermal energy of the water was 31 500 J.

The mass of water in the beaker was 0.25 kg.

Calculate the temperature increase of the water.

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

Use the equation:

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

[2 marks]

Temperature increase = _____ °C

When the temperature of the gas in the conical flask increased, the gas pressure in the conical flask increased.

0 1 . 5 How did increasing the temperature affect the mean **speed** of the gas particles?

[1 mark]

0 1 . 6 How did increasing the temperature affect the mean **kinetic energy** of the gas particles?

[1 mark]

7

Do not write outside the box

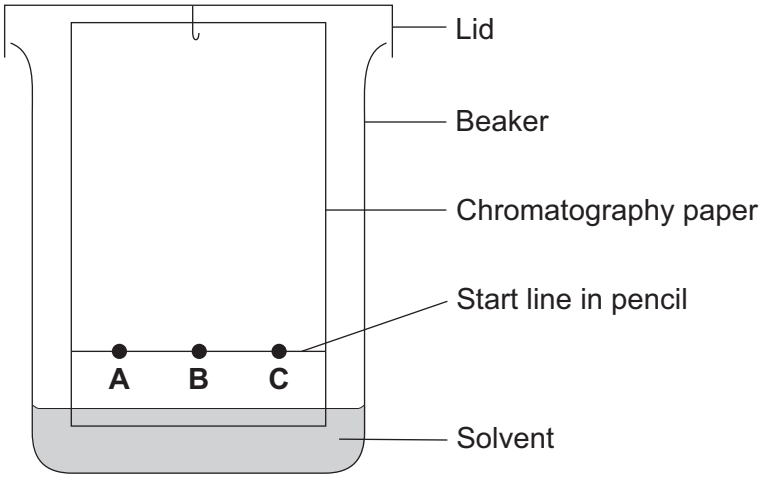
0 2 A student investigated three inks using chromatography.

The three inks used were **A**, **B** and **C**.

Inks contain different coloured dyes.

Figure 2 shows the apparatus.

Figure 2



0 2 . 1 The student used water as the solvent and then repeated the investigation with alcohol as the solvent.

- With water as the solvent, the dyes in each ink did **not** separate.
- With alcohol as the solvent, the dyes in each ink did separate.

Why did the chromatography **not** work when water was used as the solvent?

[1 mark]

Tick (✓) **one** box.

The inks were insoluble in water. ☐

Water moved up the paper too slowly. ☐

Water reacted with the paper. ☐

Do not write outside the box

0 2 . 2 Give **one** safety precaution the student should use when pouring alcohol into a beaker.

[1 mark]

_____

_____

0 2 . 3 Why is the start line drawn in pencil and **not** in ink?

[1 mark]

Tick (✓) **one** box.

A pencil line can be removed after the investigation. ☐

A pencil line will not move up the paper. ☐

The pencil is a different colour from the three inks. ☐

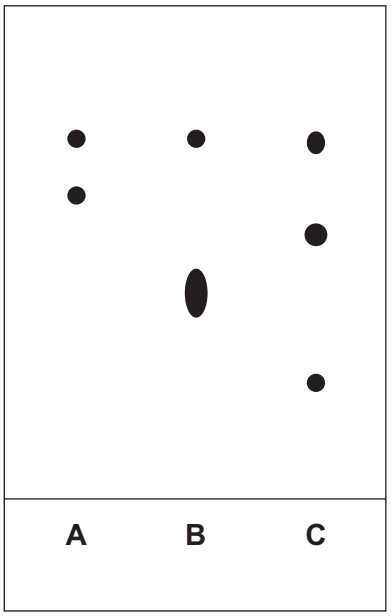
Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The student used alcohol as the solvent.

Figure 3 shows the results after 10 minutes.

Figure 3



Which ink contained three dyes?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Do not write outside the box

In a different investigation, the distance moved by a dye was 2.4 cm.

0 2 . 5 What was the distance moved by the dye in millimetres?

[1 mark]

Distance moved by the dye = _____ mm

0 2 . 6 The distance moved by the solvent was 80 mm.

Calculate the R_f value of the dye.

Use your answer from Question **02.5**.

Use the equation:

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

[2 marks]

R_f = _____

7

Turn over for the next question

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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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0 3 Unstable isotopes of elements decay by emitting nuclear radiation.

0 3 . 1 What is the difference between the atoms of isotopes of the same element?

[1 mark]

Tick (✓) **one** box.

The number of electrons in an atom ☐

The number of neutrons in an atom ☐

The number of protons in an atom ☐

0 3 . 2 Draw **one** line from each type of radiation to the description of the radiation.

[2 marks]

Type of radiation	**Description**
	A neutron
Beta	
	An electron from the nucleus
Gamma	
	Electromagnetic radiation

Question 3 continues on the next page

Do not write outside the box

A radioactive source emits alpha, beta and gamma radiation.

0 3 . 3 Which type of radiation from the source can pass through 5 mm of aluminium?

[1 mark]

_____

0 3 . 4 Which type of radiation from the source is stopped by a sheet of paper?

[1 mark]

_____

0 3 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

air	**concrete**	**paper**

Alpha, beta and gamma radiation are all absorbed by several

metres of _____.

Do not write outside the box

0 3 . 6 Caesium-137 (Cs) decays into barium-137 (Ba) by emitting beta radiation (β).

Which of the following is the decay equation for caesium-137?

[1 mark]

Tick (✓) **one** box.

$Cs + Ba \longrightarrow \beta$ ☐

$Cs \longrightarrow Ba + \beta$ ☐

$Ba + \beta \longrightarrow Cs$ ☐

Question 3 continues on the next page

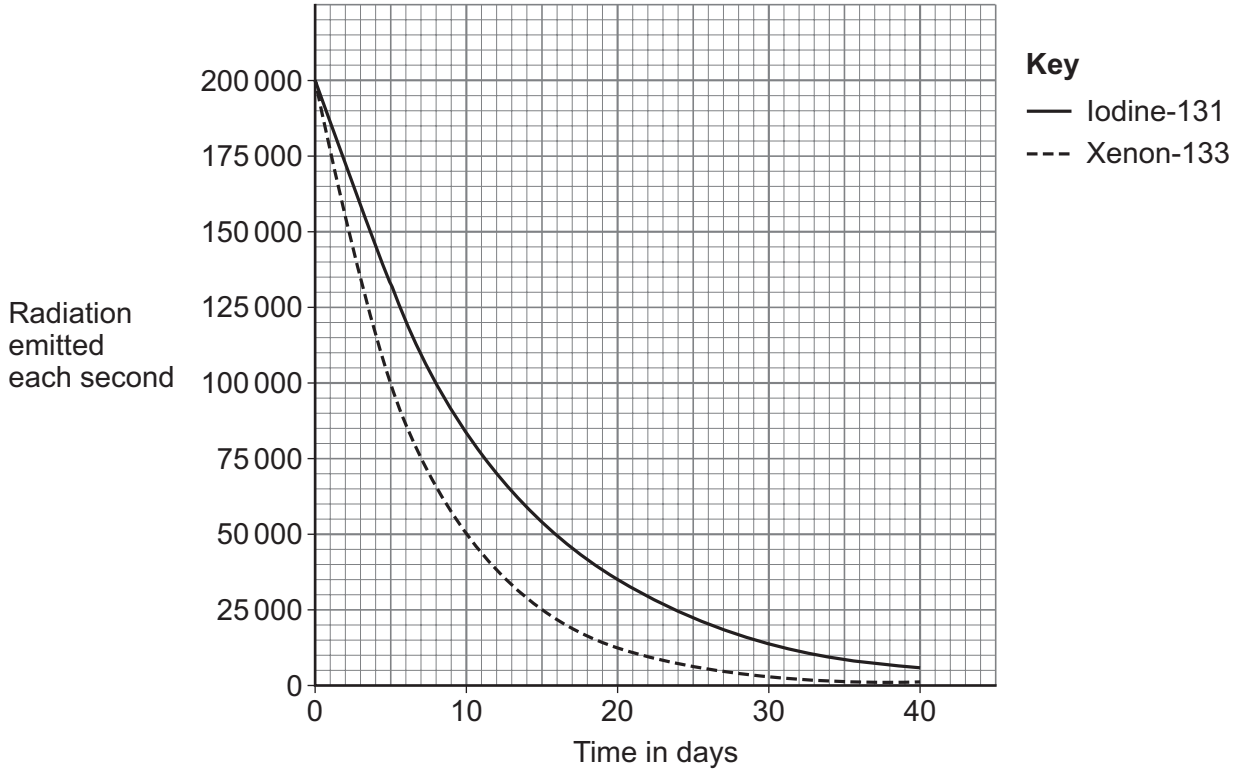
Do not write outside the box

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

Two of the radioactive elements released were iodine-131 and xenon-133

Figure 4 shows how the radiation emitted each second changes with time.

Figure 4



Do not write outside the box

0 3 . 7 How does the half-life of xenon-133 compare with the half-life of iodine-131?

Give a reason for your answer.

Use **Figure 4**.

[2 marks]

Tick (✓) **one** box.

The half-life of xenon-133 is less than the half-life of iodine-131 ☐

The half-life of xenon-133 is the same as the half-life of iodine-131 ☐

The half-life of xenon-133 is greater than the half-life of iodine-131 ☐

Reason _____

_____

_____

0 3 . 8 In the 2011 accident, the radioactive element caesium-137 was also released into the environment.

The half-life of caesium-137 is 30 years.

Why does the caesium-137 that was released still emit large amounts of radiation in 2025?

[1 mark]

Tick (✓) **one** box.

Less than one half-life has occurred since the accident. ☐

Exactly one half-life has occurred since the accident. ☐

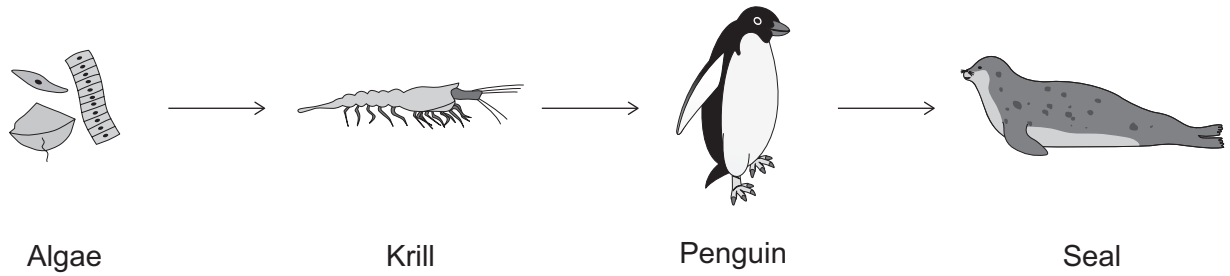
More than one half-life has occurred since the accident. ☐

10

Do not write outside the box

0 4 **Figure 5** shows a food chain.

Figure 5



0 4 . 1 What process allows algae to be producers for the food chain?

[1 mark]

_____

_____

0 4 . 2 Which animal is the secondary consumer in the food chain?

[1 mark]

_____

Do not write outside the box

0 4 . 3 Explain why a decrease in the seal population will cause a decrease in the krill population.

[3 marks]

Adélie penguins are one species of penguin.

Adélie penguins:

- feed in the ocean
- make nests on the ground using stones.

0 4 . 4 The amount of snow is an abiotic factor which affects Adélie penguins.

Which are **two biotic** factors that affect the Adélie penguins?

[2 marks]

Tick (✓) **two** boxes.

A new pathogen ☐

Acidic soil ☐

High light intensity ☐

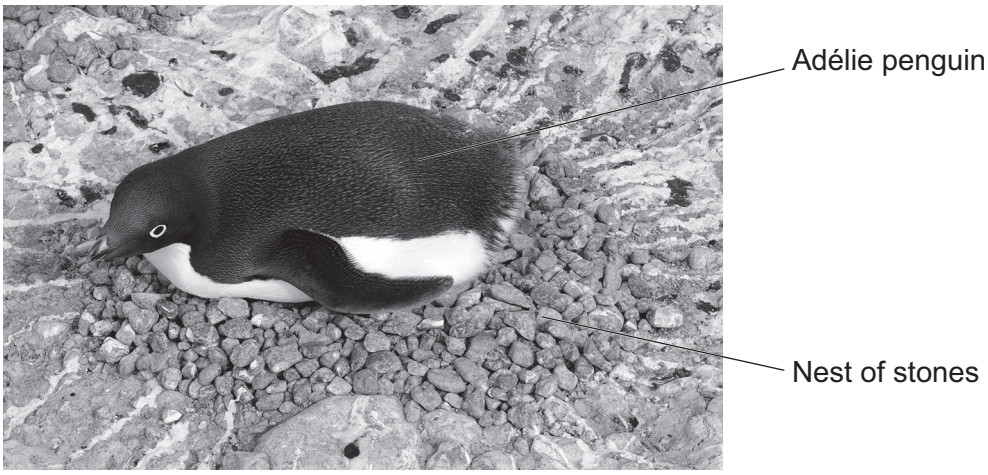
Lack of food ☐

Low temperature ☐

Do not write outside the box

Figure 6 shows an Adélie penguin on a nest made of stones.

Figure 6



0 4 . 5 Adélie penguins steal stones from nearby nests to make their own nest higher.

A higher nest gives young penguins a better chance of surviving.

What is stealing stones for nests an example of?

[1 mark]

Tick (✓) **one** box.

An ecosystem ☐

Competition ☐

Interdependence ☐

Do not write outside the box

Scientists calculated the mean area covered by one Adélie penguin nest.

The mean area of one nest is 18 000 cm^2.

0 4 . 6 Calculate the mean area of one nest in m^2.

1 m^2 = 10 000 cm^2

[1 mark]

Area of nest = _____ m^2

0 4 . 7 An area of 122 400 m^2 was covered by nests.

Calculate the maximum possible number of nests in an area of 122 400 m^2.

Use your answer from Question **04.6**.

[2 marks]

Number of nests = _____

Question 4 continues on the next page

Do not write outside the box

There are many ways of sampling animal and plant populations.

0 4 . 8 Students sample a plant population.

Which piece of equipment can the students use to sample a plant population?

[1 mark]

Tick (✓) **one** box.

A pH meter ☐

A quadrat ☐

A thermometer ☐

0 4 . 9 Students sometimes use a transect.

When should a transect method be used?

[1 mark]

Tick (✓) **one** box.

To investigate feeding relationships ☐

To investigate the distribution of a population ☐

To investigate the oxygen concentration in water ☐

13

Do not write outside the box

0 5 The endocrine system produces hormones.

0 5 . 1 The pituitary gland is part of the endocrine system.

Where is the pituitary gland?

[1 mark]

Tick (✓) **one** box.

In the head ☐

In the heart ☐

In the liver ☐

0 5 . 2 Oestrogen is a hormone.

Which organ in the female reproductive system produces oestrogen?

[1 mark]

Tick (✓) **one** box.

Kidney ☐

Ovary ☐

Stomach ☐

Question 5 continues on the next page

Do not write outside the box

Some chemicals in the environment affect the body in a similar way to hormones.

A scientist investigated the effect of feeding chemical **X** to rats.

Table 1 shows the results.

Table 1

Group	**Mean thickness of uterus lining in micrometres**
Control rats	250
Rats fed chemical **X**	265

0 5 . 3 The scientist calculated the mean thickness of the uterus lining.

First, the scientist added together the measurements for all the rats in a group.

For the control group, the total was 4500 micrometres.

Calculate how many rats were in the **control** group.

Use **Table 1**.

[2 marks]

_____

_____

_____

Number of rats = _____

Do not write outside the box

0 5 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

greater	**the same**	**less**

The mean thickness of the uterus lining in the two groups in **Table 1** was compared.

In rats fed chemical **X**, the mean thickness of the uterus lining

was _____.

Question 5 continues on the next page

Do not write outside the box

Some food packaging contains chemical **Y**.

Chemical **Y** decreases antibody production in humans.

Food packaging in landfill can release chemical **Y** into streams, rivers and lakes.

0 5 . 5 Which are **two** reasons why food packaging containing chemical **Y** is a problem?

[2 marks]

Tick (✓) **two** boxes.

Chemical **Y** could become a fossil fuel. ☐

Chemical **Y** could contaminate drinking water. ☐

Chemical **Y** could get into food. ☐

Chemical **Y** does not dissolve in water. ☐

Chemical **Y** will be broken down quickly. ☐

0 5 . 6 Which risk increases when a person produces fewer antibodies?

[1 mark]

Tick (✓) **one** box.

Developing Type 1 diabetes ☐

Getting lung cancer due to mutations ☐

Not being able to recover from infections ☐

Do not write outside the box

If a pathogen enters the body, white blood cells can engulf and digest the pathogen.

0 5 . 7 What is the name of the process where white blood cells engulf and digest a pathogen?

[1 mark]

_____

0 5 . 8 The pathogen is digested by white blood cells.

Which of the following digests large molecules into smaller molecules?

[1 mark]

Tick (✓) **one** box.

Carbohydrates ☐

Enzymes ☐

Lipids ☐

10

Turn over for the next question

Do not write outside the box

0 6 Different parts of a plant have different functions.

0 6 . 1 Draw **one** line from each part of a plant to the function of that part.

[3 marks]

Part of a plant	Function
	Changes shape to open stoma
Guard cell	
	Grows new tissue
Meristem	
	Moves starch into the leaves
Root hair	
	Takes water into the plant

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 6 . 2 Why does blocking phloem tissue decrease the rate of spread of bacteria in a tree?

[1 mark]

Tick (✓) **one** box.

- [ ] Blocking phloem increases the rate of photosynthesis.
- [ ] Blocking phloem reduces the transport of substances in the tree.
- [ ] Blocking phloem weakens the cell walls of the tree.

0 6 . 3 What can farmers do to reduce the spread of the bacteria from one tree to another tree?

[2 marks]

Tick (✓) **two** boxes.

- [ ] Destroy infected orange trees immediately.
- [ ] Plant infected orange trees closer together.
- [ ] Transport trees to another orange tree farm.
- [ ] Wash hands after touching infected orange trees.
- [ ] Water the infected orange trees more often.

Question 6 continues on the next page

Do not write outside the box

Orange juice contains sugar.

Benedict's solution is used to test for sugar.

0 6 . 4 Complete the sentences.

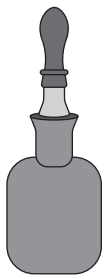
[2 marks]

When sugar is **not** present, the colour of the Benedict's test is _____.

When sugar is present, the colour of the Benedict's test is _____.

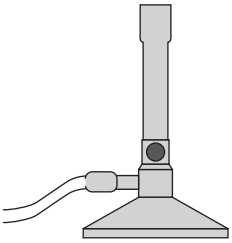
0 6 . 5 **Figure 7** shows some of the equipment used for the Benedict's test.

Figure 7

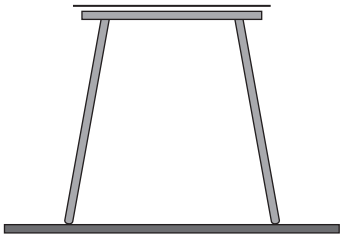


Benedict's solution

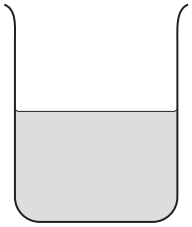
Test tube



Bunsen burner



Tripod, mat and gauze



Beaker of water

Do not write outside the box

Describe a method a student could use to test if a drink contains sugar.

You should refer to the equipment in **Figure 7**.

[4 marks]

Extra space

12

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 7 Doctors sometimes advise people with kidney disease to eat a diet that is low in protein.

0 7 . 1 How does a diet that is low in protein help people with kidney disease?

[1 mark]

Tick (✓) **one** box.

Fewer amino acids will break down to form urea. ☐

More urea will be produced and excreted in urine. ☐

Protease will be needed to digest the protein into amino acids. ☐

0 7 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

green	**purple**	**white**

When Biuret reagent is mixed with a food containing protein,

the colour seen is _____.

Question 7 continues on the next page

Do not write outside the box

Table 2 shows information about two types of bread.

Table 2

Nutrient	Mass of nutrient per 100 grams of bread in grams	
	Wholemeal bread	**Low-protein bread**
Carbohydrate	41	30
Lipids (fats and oils)	3	14

0 7 . 3 Compare the mass of each nutrient in wholemeal bread with the mass of each nutrient in low-protein bread.

Use **Table 2**.

[2 marks]

Carbohydrate _____

_____

Lipids _____

_____

0 7 . 4 One slice of low-protein bread has a mass of 40 g.

Calculate the mass of carbohydrate in the slice of bread.

Use **Table 2**.

[2 marks]

_____

_____

_____

_____

Mass of carbohydrate = _____ g

Do not write outside the box

0 7 . 5 A person eats some bread.

Describe how carbohydrates and lipids from the bread are broken down and used in cells.

You should include:

- the enzymes involved
- the molecules formed
- how the molecules are used in cells.

[6 marks]

Extra space

12

Do not write outside the box

0 8 Control of blood glucose concentration is an example of homeostasis.

0 8 . 1 Give **one** other condition that is controlled by homeostasis in humans.

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

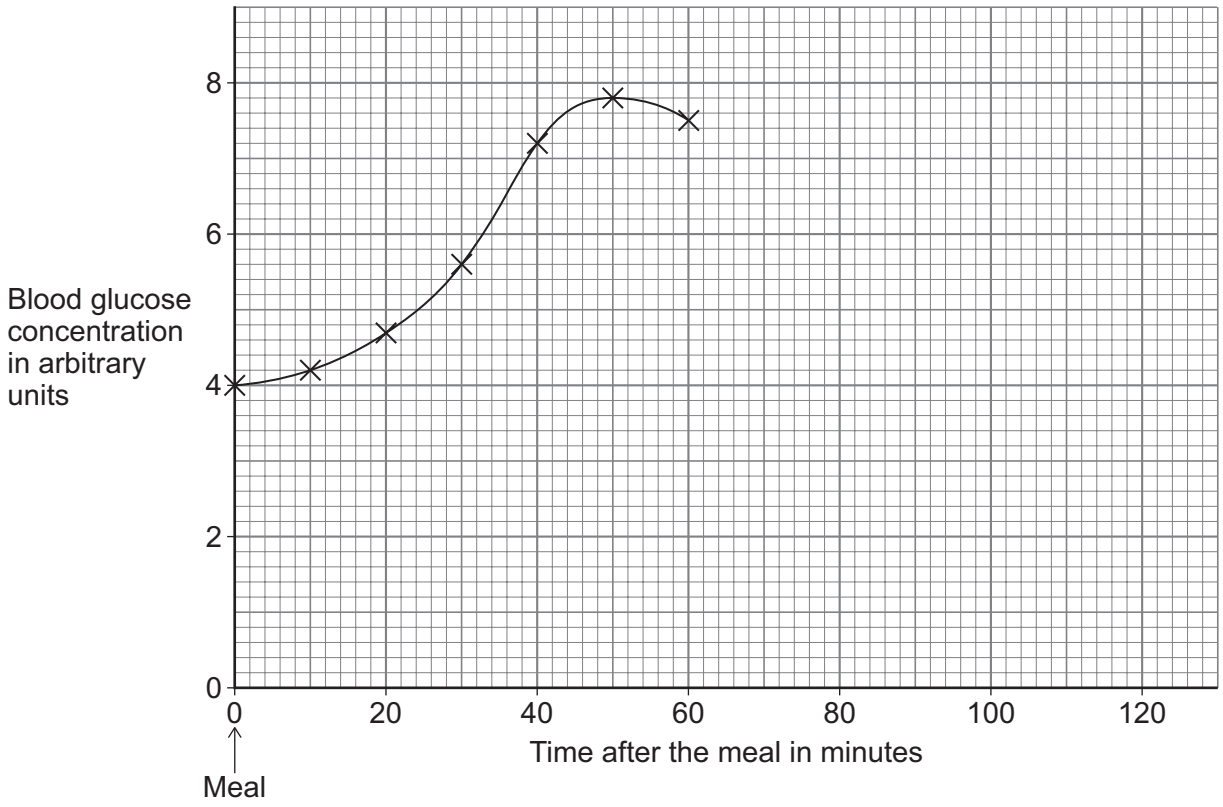
[1 mark]

_____

_____

Figure 8 shows the blood glucose concentration of a person after eating a meal.

Figure 8



Do not write outside the box

0 8 . 2 Calculate the increase in blood glucose concentration between 0 minutes and 50 minutes after the meal.

Use **Figure 8**.

[2 marks]

_____

_____

_____

Increase = _____ arbitrary units

0 8 . 3 **Table 3** shows the blood glucose concentration between 70 minutes and 120 minutes after the meal.

Table 3

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 8**.

You should:

- plot the data from **Table 3**
- draw a line of best fit between 60 minutes and 120 minutes.

[3 marks]

Question 8 continues on the next page

Do not write outside the box

0 8 . 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 8 . 5 Which substance do animal cells use to store glucose?

[1 mark]

Tick (✓) **one** box.

Cellulose ☐

Glycogen ☐

Lactic acid ☐

Starch ☐

0 8 . 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 9 Scientists used alpha particles and gold to develop the atomic model.

0 9 . 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 9 . 2 What is the structure of an alpha particle?

[1 mark]

_____

_____

Question 9 continues on the next page

Do not write outside the box

A scientist directed alpha particles at thin gold foil.

Table 4 shows information about the direction of the alpha particles after reaching the thin gold foil.

Table 4

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 9 . 3 Calculate the percentage of alpha particles that changed direction by more than 90°.

Use **Table 4**.

[3 marks]

_____

_____

_____

_____

_____

Percentage = _____ %

Do not write outside the box

0 9 . 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

1 0 This question is about genetics.

Figure 9 shows two lions.

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

Figure 9

1 0 . 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

1 0 . 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 10 continues on the next page

Do not write outside the box

1 0 . 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 10**
- 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 10

		Homozygous recessive female	
Heterozygous male			

Probability of the offspring having white fur = _____

10

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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