

Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

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I declare this is my own work.

# GCSE COMBINED SCIENCE: SYNERGY

# F

Foundation Tier Paper 2 Life and Environmental Sciences

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	
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6	
7	
8	
9	
<b>TOTAL</b>	

## Information

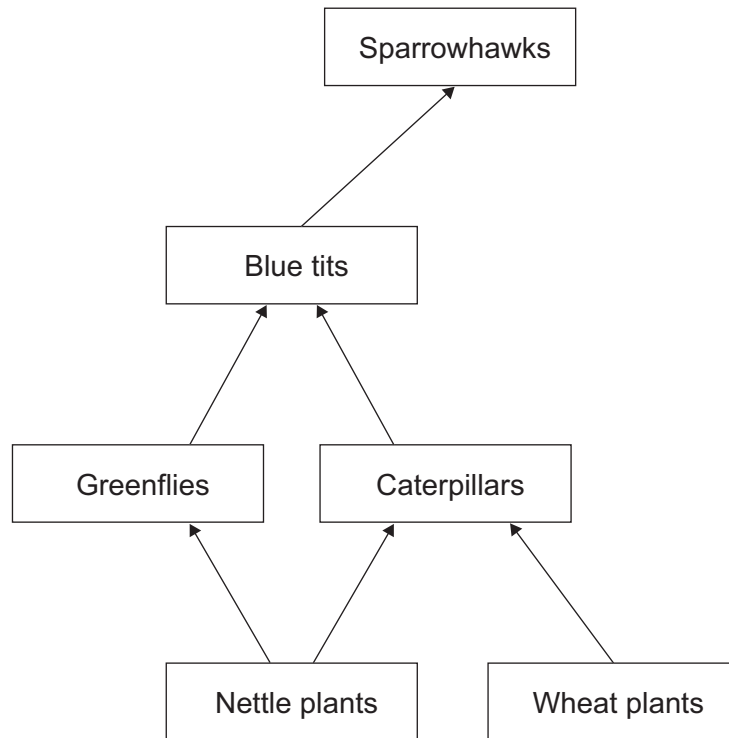
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.



0 1

Figure 1 shows part of a food web.

Figure 1



0 1 - 1

What is the source of energy for the nettle plants?

[1 mark]

Tick (✓) **one** box.

Caterpillars

Soil

Sun



**0 1 . 2** Which term describes the caterpillars in the food web?

[1 mark]

Tick (✓) **one** box.

Primary consumer

Secondary consumer

Tertiary consumer

**0 1 . 3** What is the name of **one** producer in the food web?

[1 mark]

Tick (✓) **one** box.

Blue tits

Greenflies

Sparrowhawks

Wheat plants

**0 1 . 4** Mice eat wheat plants **and** are eaten by sparrowhawks.

Complete the food web in **Figure 1** by adding mice to **Figure 1**.

[2 marks]

**Question 1 continues on the next page**

Turn over ►



**0 1 . 5** A sparrowhawk competes with other sparrowhawks for food.

Give **one** other factor sparrowhawks will compete for.

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

[1 mark]

---

**0 1 . 6** The nettle plants were removed.

Explain how removing the nettle plants will affect the number of caterpillars.

Use **Figure 1** on page 2.

[2 marks]

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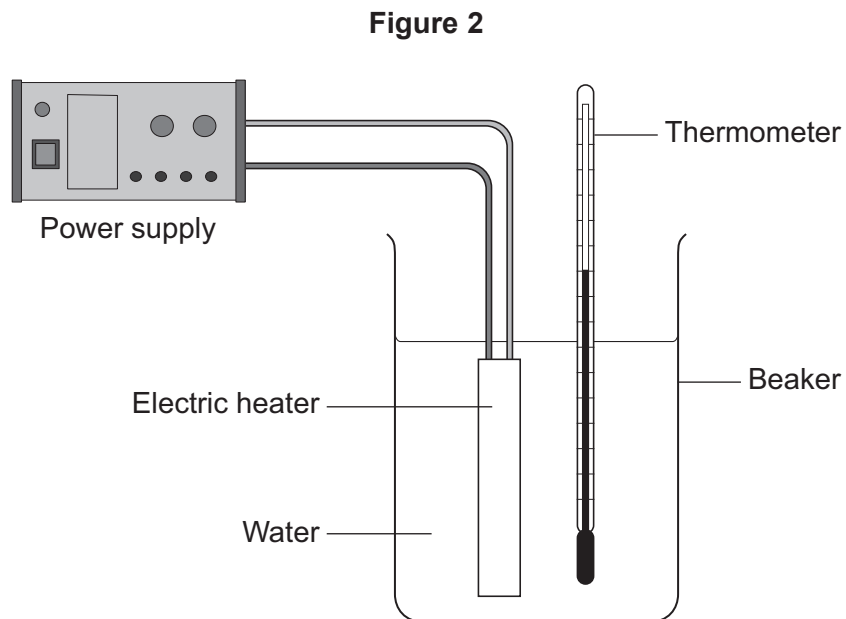


0 5

0 2

A student investigated how the temperature of water changed as it was heated.

**Figure 2** shows some of the apparatus used.



The student switched the heater on then recorded the temperature of the water every 5 minutes.

**Table 1** shows the results.

**Table 1**

Time in minutes	Temperature in °C			
	Test 1	Test 2	Test 3	Mean
0	25	25	25	25
5	31	32	33	32
10	42	45	45	<b>X</b>
15	56	54	64	58



**0 2 . 1** What was the resolution of the thermometer used in the investigation?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

0.1 °C

1 °C

10 °C

100 °C

**0 2 . 2** Calculate mean value **X** in **Table 1**.

[2 marks]

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**X** = \_\_\_\_\_ °C

**0 2 . 3** Draw a ring around the anomalous result in **Table 1**.

[1 mark]

**0 2 . 4** What should the student have done with the anomalous result?

[1 mark]

---

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**Question 2 continues on the next page**

**Turn over ►**



**0 2 . 5** Give **two** ways to reduce energy transfer from the apparatus to the surroundings.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**0 2 . 6** The water in the beaker had a mass of 0.20 kg.

The temperature increase of the water was 33 °C.

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

Calculate the change in thermal energy of the water.

Use the equation:

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

Choose the unit from the box.

**[3 marks]**

°C	cm <sup>3</sup>	J	kg
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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Change in thermal energy = \_\_\_\_\_

Unit \_\_\_\_\_





0 2 . 7

Explain what happens to the mass of water in the beaker during a test.

**[2 marks]**

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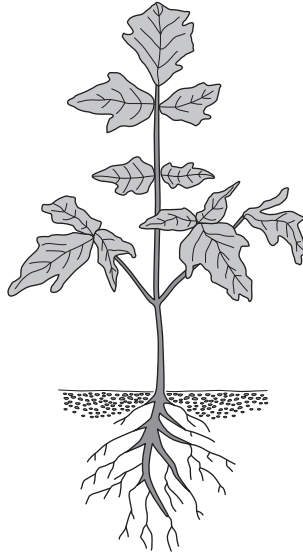
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Figure 3 shows a tomato plant.

Figure 3



0	3	.	1
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A leaf is a plant organ.

Name **one** other plant organ shown in **Figure 3**.

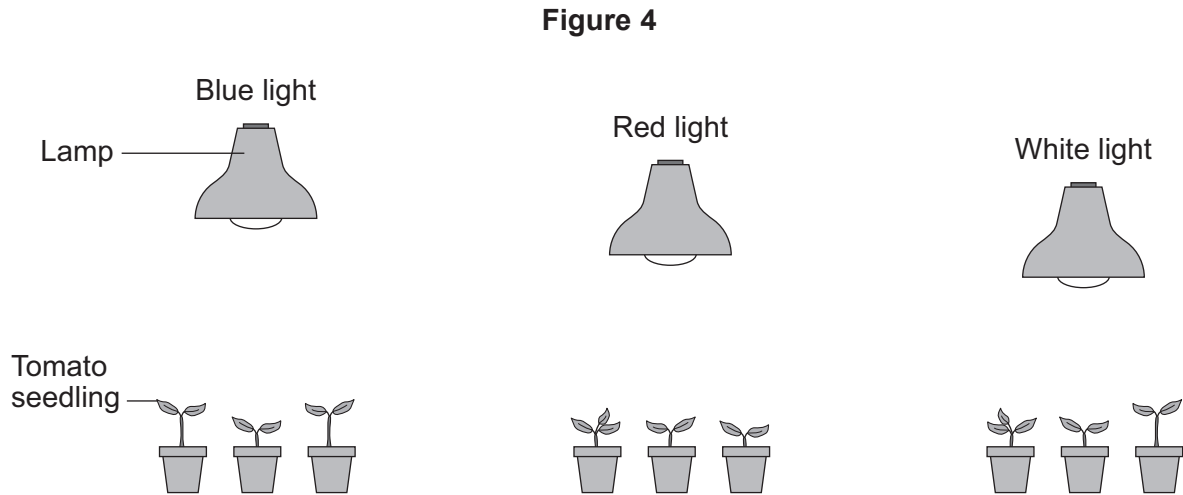
[1 mark]

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A student investigated the effect of different colours of light on the growth of tomato plant seedlings.

**Figure 4** shows the apparatus used.



This is the method used.

1. Place three tomato plant seedlings under each colour of light.
2. Water each seedling every day.
3. Measure the height of each seedling after 30 days.

0 3 . 2

Give **two** control variables the student should have used in their investigation.

**[2 marks]**

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_

**Question 3 continues on the next page**

**Turn over ►**



**0 3 . 3** The student repeated the investigation using a valid method.

**Table 2** shows the results.

**Table 2**

<b>Colour of light</b>	<b>Mean height of seedlings in cm</b>
Blue	14.5
Red	12.0
White	11.8

Give **two** conclusions from the results in **Table 2**.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

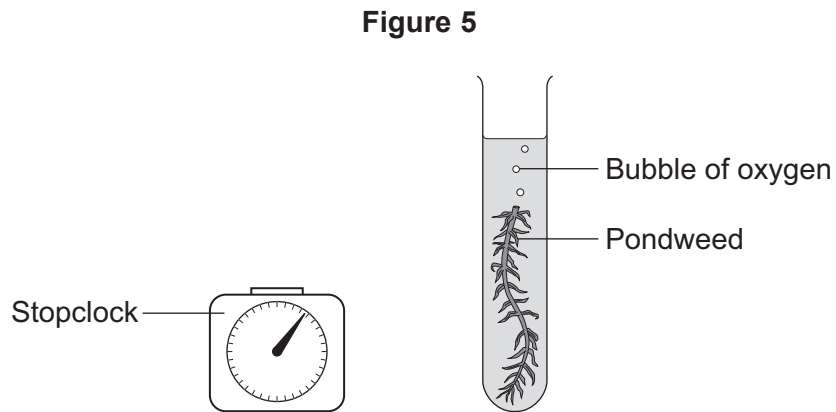
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Another student investigated the effect of light intensity on the rate of photosynthesis.

The student counted the number of bubbles of oxygen produced by pondweed at different light intensities.

**Figure 5** shows some of the apparatus used.



**0 3 . 4** Describe how the student could change the light intensity.

**[2 marks]**

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**Question 3 continues on the next page**

**Turn over ►**



**0 3 . 5** The pondweed did **not** produce many bubbles.

How could the student change the investigation to increase the number of bubbles produced?

**[1 mark]**

Tick (✓) **one** box.

Add more water to the test tube.

Use a smaller piece of pondweed.

Use water at a higher temperature.

**0 3 . 6** The student calculated the **rate** of photosynthesis.

Which equation is used to calculate the rate of photosynthesis?

**[1 mark]**

Tick (✓) **one** box.

rate of photosynthesis =  $\frac{\text{number of bubbles}}{\text{time}}$

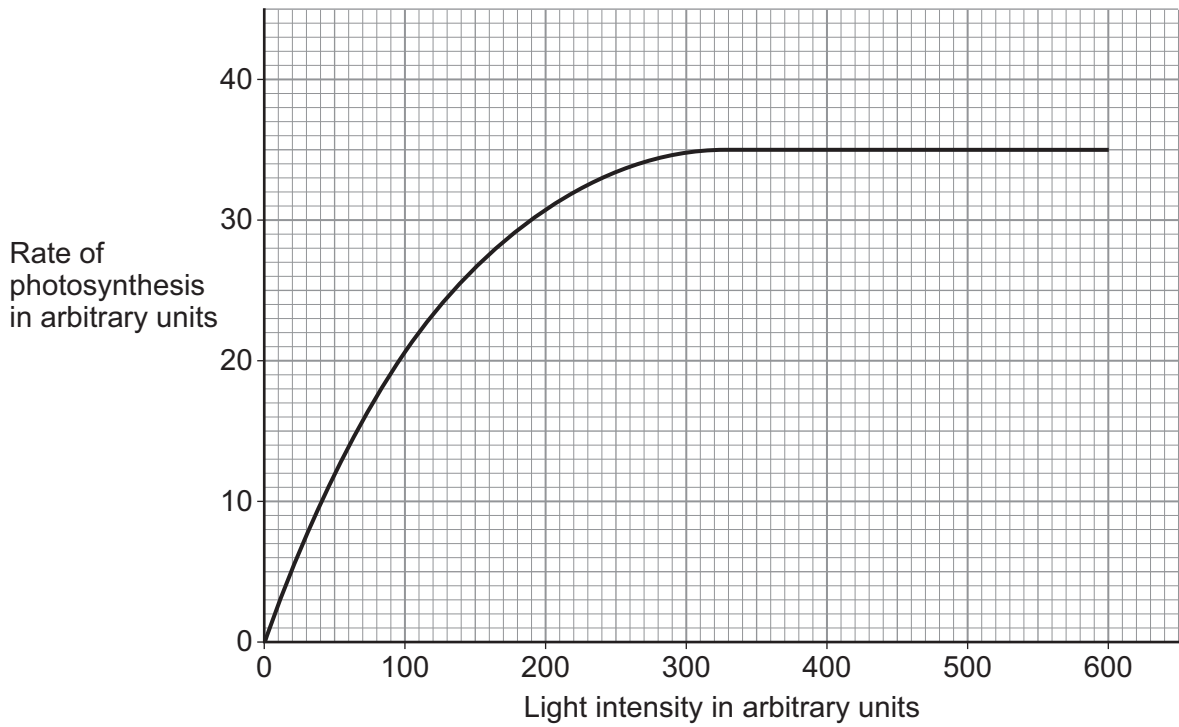
rate of photosynthesis = number of bubbles  $\times$  time

rate of photosynthesis =  $\frac{\text{time}}{\text{number of bubbles}}$



**0 3 . 7** Figure 6 shows the rate of photosynthesis at different light intensities.

**Figure 6**



Describe the pattern in **Figure 6**.

Use data from **Figure 6**.

**[2 marks]**

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11

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**0 4**

Two students investigated the effect of exercise on breathing rate.

Breathing rate was measured by counting the number of times a student breathed in during 1 minute.

This is the method used.

1. Measure the breathing rate at rest before exercise.
2. Run on the spot for 5 minutes.
3. Measure the breathing rate every minute during exercise.
4. Measure the breathing rate every minute after exercise for 10 minutes.

**0 4 . 1**

The students had different breathing rates at rest.

Suggest **two** factors that could cause the students' breathing rates at rest to be different.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**0 4 . 2**

Suggest **one** reason why the measurements for breathing rate may **not** be accurate.

**[1 mark]**

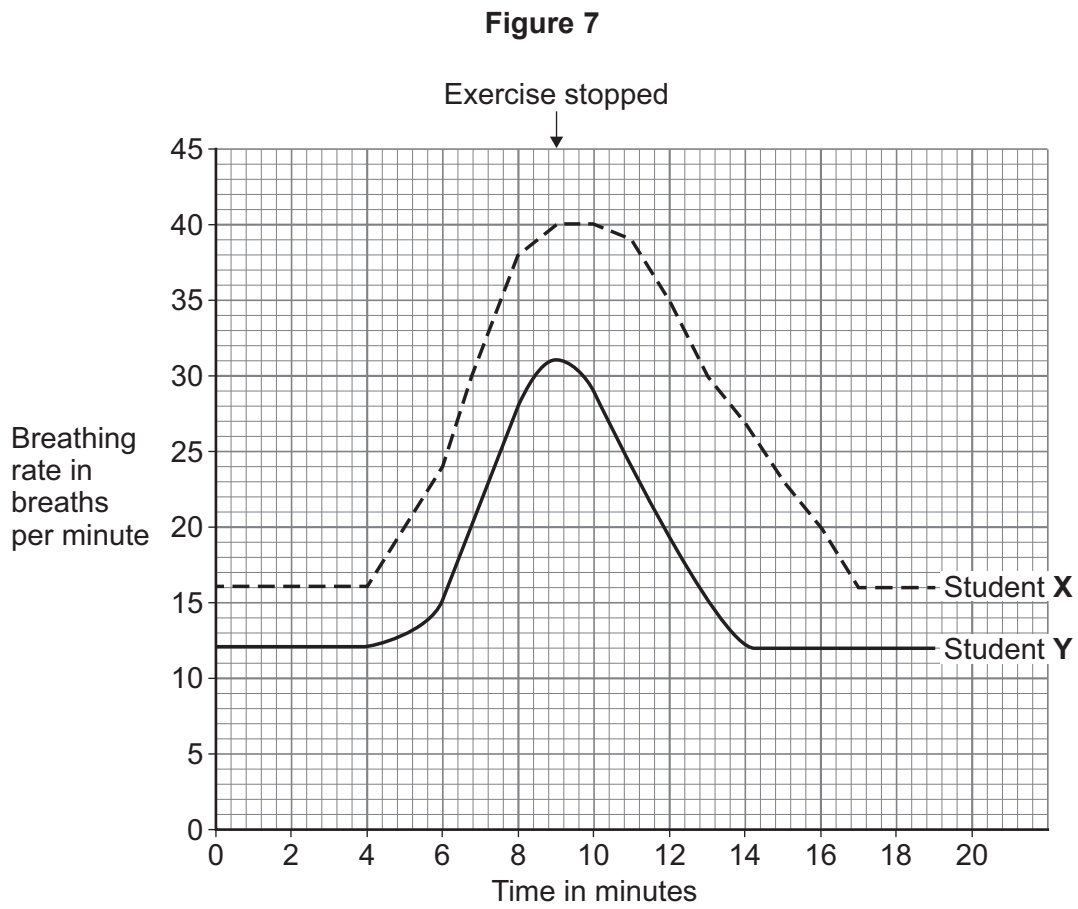
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**Question 4 continues on the next page**

**Turn over ►**

Figure 7 shows the results.



**0 4 . 3** What time did the students start exercising?

Use **Figure 7**.

[1 mark]

Time exercise started = \_\_\_\_\_ minutes

**0 4 . 4** Describe **two** differences between the results of student **X** and of student **Y**.

Use **Figure 7**.

[2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_



**0 4 . 5** Why does breathing rate change during exercise?

[1 mark]

Tick (✓) **one** box.

To increase the uptake of carbon dioxide **and** oxygen from the air

To increase the uptake of carbon dioxide from the air

To increase the uptake of oxygen from the air

**0 4 . 6** The breathing rate of the students stayed high after the exercise stopped.

Why does breathing rate stay high after exercise has stopped?

[1 mark]

Tick (✓) **one** box.

To break down amino acids

To break down fatty acids

To break down lactic acid

**0 4 . 7** Give **one** other change that happens in the body during exercise.

Do **not** refer to breathing rate.

[1 mark]

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9

Turn over ►



**0 5**

Proteins are an important part of the human diet.

**0 5 . 1**

Proteins are large food molecules that must be broken down in the digestive system.

Which enzyme breaks down proteins?

**[1 mark]**Tick (✓) **one** box.

Carbohydrase

Lipase

Protease

Proteins are digested into amino acids.

The body breaks down unwanted amino acids.

**0 5 . 2**

Which organ breaks down unwanted amino acids?

**[1 mark]**Tick (✓) **one** box.

Brain

Liver

Lung

**0 5 . 3**

What is produced by the breakdown of unwanted amino acids?

**[1 mark]**Tick (✓) **one** box.

Fat

Starch

Urea



Mycoprotein is a protein made from a fungus.

**Table 3** shows information about mycoprotein sausages and meat sausages.

**Table 3**

Nutrient	Mass of nutrient in grams per 100 grams	
	Mycoprotein sausages	Meat sausages
Protein	14.3	18.3
Carbohydrate	4.5	0.0
Fat	2.0	19.8
Salt	0.9	1.1

0 5 . 4

Give **three** differences between the nutrient content of mycoprotein sausages and meat sausages.

[3 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

3 \_\_\_\_\_

\_\_\_\_\_

**Question 5 continues on the next page**

**Turn over ►**



A student tested the mycoprotein sausage and the meat sausage for protein.

0 5 . 5 What is used to test for protein?

[1 mark]

Tick (✓) **one** box.

Biuret reagent

Iodine solution

pH indicator solution

0 5 . 6 What colour is the positive result for the test for protein?

[1 mark]

Tick (✓) **one** box.

Black

Lilac

Red

White

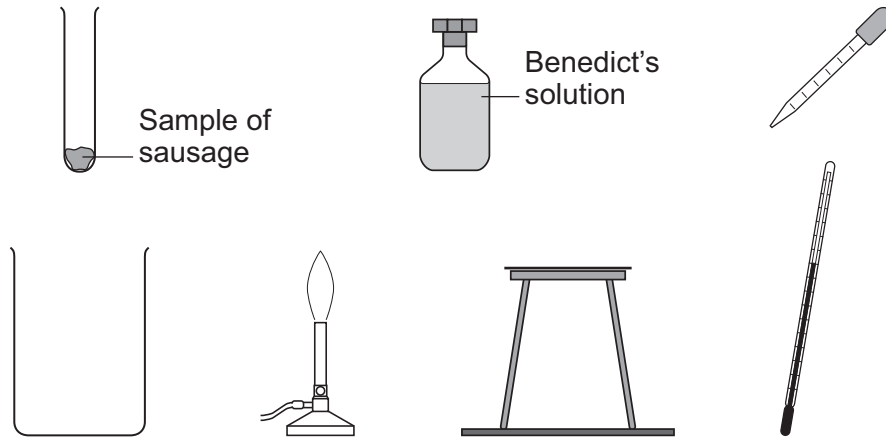


**0 5 . 7**

The student investigated the sugar content of the mycoprotein sausage and the meat sausage.

**Figure 8** shows some of the apparatus used.

**Figure 8**



Describe a method to compare the amount of sugar in the two types of sausage.

Use the apparatus in **Figure 8** in your answer.

**[6 marks]**

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**0 6**

This question is about the evolution of cats.

*Felis lunensis* is an extinct cat that lived approximately 2.5 million years ago.

**0 6 . 1**

What is the genus name of the cat *Felis lunensis*?

**[1 mark]**

Tick (✓) **one** box.

Cat

Felis

Lunensis

**0 6 . 2**

Scientists believe that modern-day cats have evolved from *Felis lunensis*.

How did modern-day cats evolve?

**[1 mark]**

Tick (✓) **one** box.

By cloning

By genetic modification

By natural selection





0 6 . 3

Give **one** type of evidence scientists can use to show that modern-day cats have evolved from *Felis lunensis*.

**[1 mark]**

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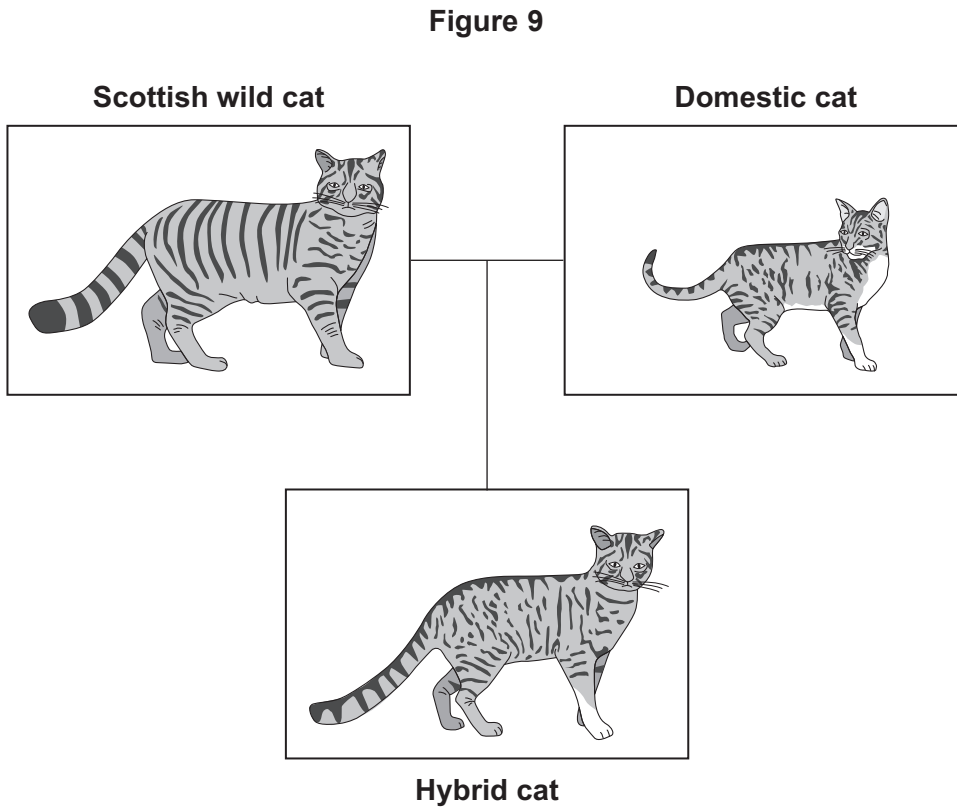
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**Turn over ►**

Scottish wild cats can breed with domestic cats to produce offspring.

The offspring is called a hybrid cat.

**Figure 9** shows a Scottish wild cat, a domestic cat and a hybrid cat.



The hybrid cat has inherited genes for different characteristics from both parents.

**0 6 . 4** How has the hybrid cat inherited genes from both parents?

**[1 mark]**

Tick (✓) **one** box.

By genetic engineering

By mitosis

By mutation

By sexual reproduction



**0 6 . 5** Which chemical are genes made from?

[1 mark]

Tick (✓) **one** box.

Cellulose

DNA

Lipid

Protein

**0 6 . 6** Give **one** characteristic that the hybrid cat has inherited from the Scottish wild cat.

Use **Figure 9**.

[1 mark]

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**0 6 . 7** Give **one** characteristic that the hybrid cat has inherited from the domestic cat.

Use **Figure 9**.

[1 mark]

---

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**Question 6 continues on the next page**

**Turn over ►**



Scientists have investigated the populations of Scottish wild cats and hybrid cats.

**0 6 . 8** Cats hunt for prey at night.

Suggest **one** reason why scientists find it difficult to identify the type of cat seen at night.

**[1 mark]**

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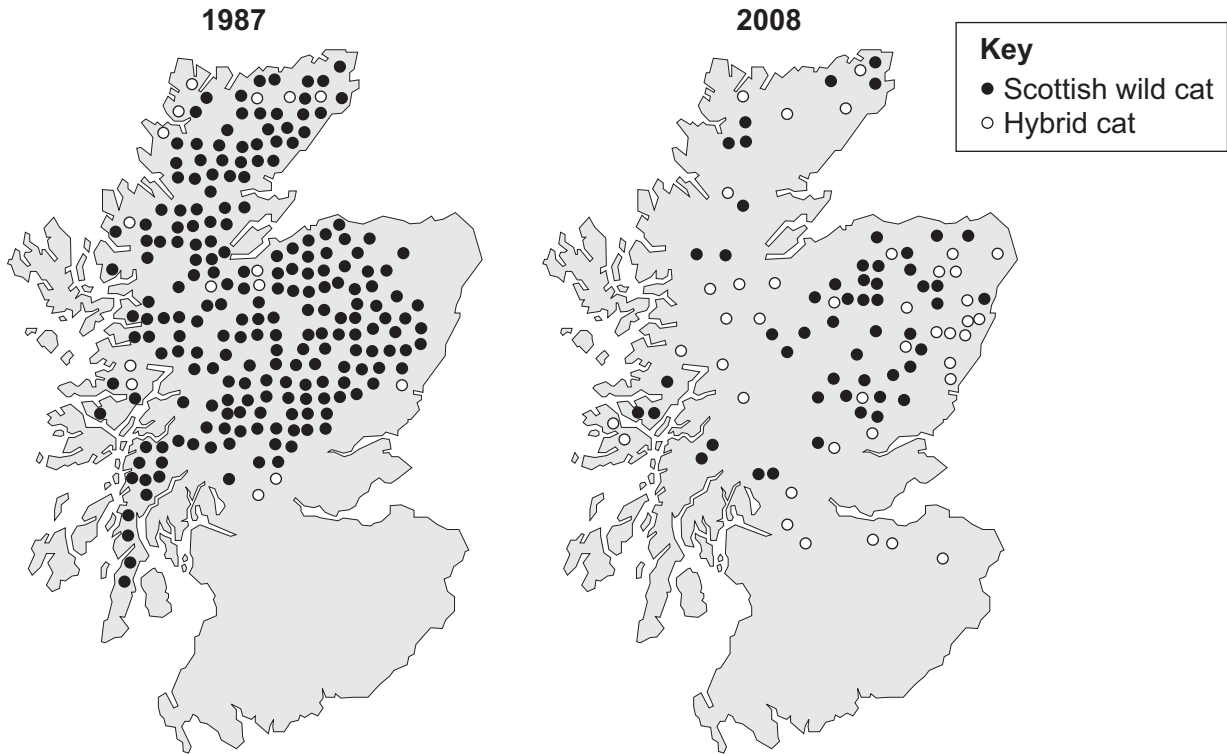
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0 6 . 9

Figure 10 shows where Scottish wild cats and hybrid cats were seen in Scotland in 1987 and 2008.

Figure 10



Describe **three** differences in the populations of cats between 1987 and 2008.

Use **Figure 10**.

[3 marks]

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_

11

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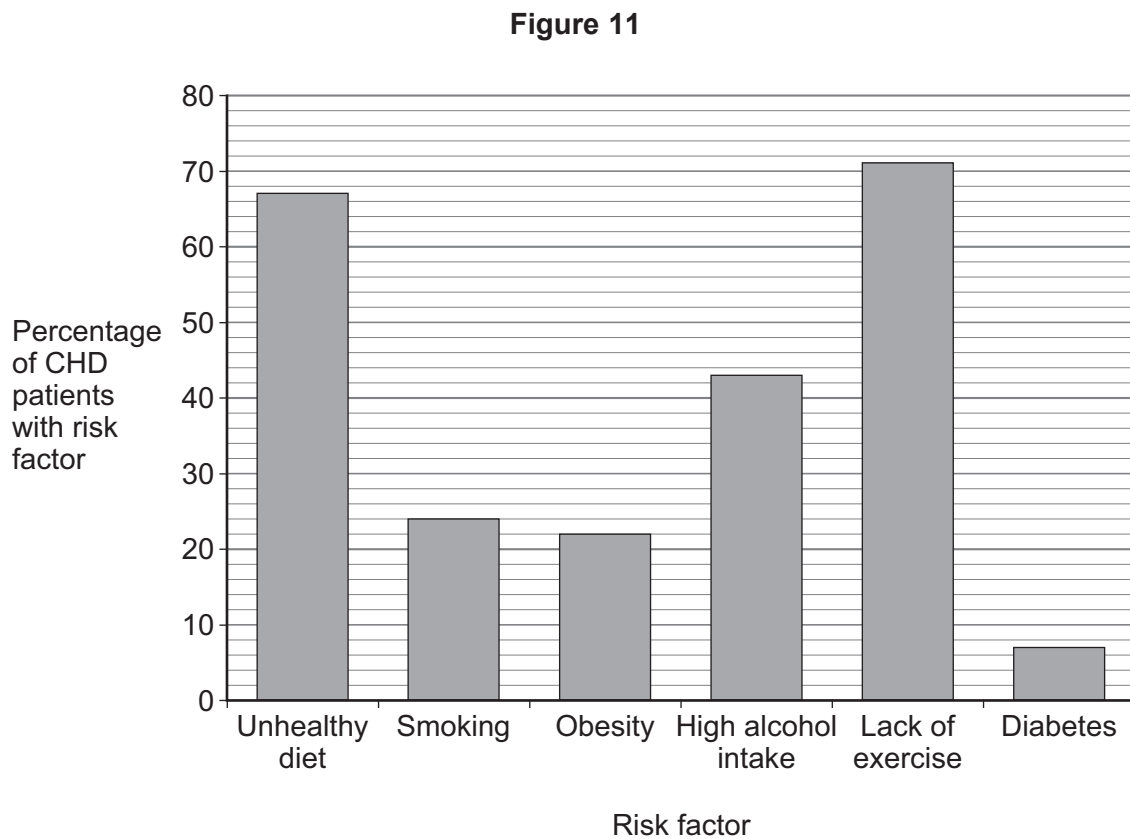


**0 7**

Coronary heart disease (CHD) is caused when fatty material builds up in the coronary arteries.

Scientists investigated risk factors for CHD.

**Figure 11** shows the percentage of CHD patients with each risk factor.

**0 7 . 1**

Which was the most common risk factor in CHD patients?

Use **Figure 11**.

**[1 mark]**

---



**0 7 . 2** What percentage of CHD patients had smoking as a risk factor?

Use **Figure 11**.

[1 mark]

Percentage = \_\_\_\_\_ %

**0 7 . 3** Give **one** other disease that smoking is a risk factor for.

Do **not** refer to CHD.

[1 mark]

---

**0 7 . 4** Suggest **two** lifestyle changes a person can make to reduce the risk of CHD.

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

[2 marks]

1 \_\_\_\_\_

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2 \_\_\_\_\_

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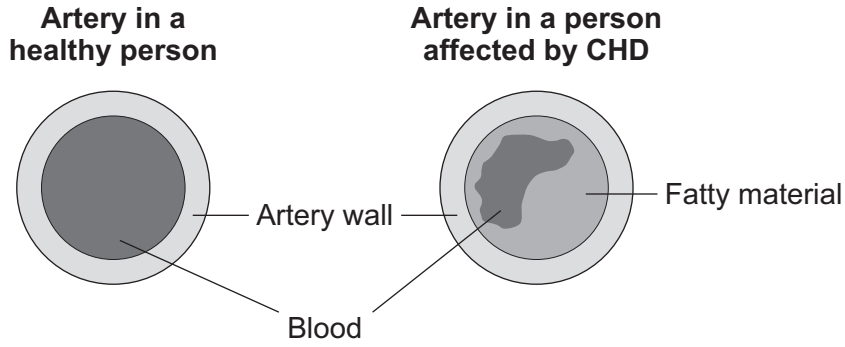
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**0 7 . 5** The coronary arteries supply the heart muscle with blood.

**Figure 12** shows two coronary arteries.

**Figure 12**



A person with CHD has a risk of having a heart attack.

A heart attack will cause the heart muscle to stop contracting.

Explain how CHD can cause a heart attack.

**[3 marks]**

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**8**





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0 8

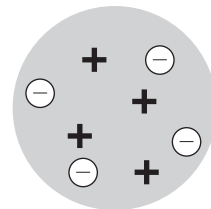
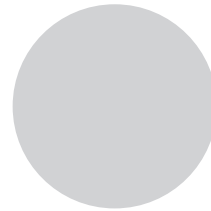
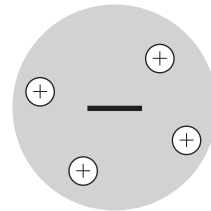
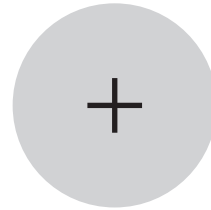
The model of the atom has changed over time.

0 8 . 1

Draw **one** line from each atomic model to the representation of that model.**[2 marks]****Atomic model****Representation of model**

Dalton atom

Plum pudding model



Scientists investigated the structure of the atom.

The scientists directed alpha particles at a thin sheet of gold foil.

**0 8 . 2** What is an alpha particle the same as?

**[1 mark]**

Tick (✓) **one** box.

A fast-moving electron

A helium nucleus

A radioactive isotope

Electromagnetic radiation

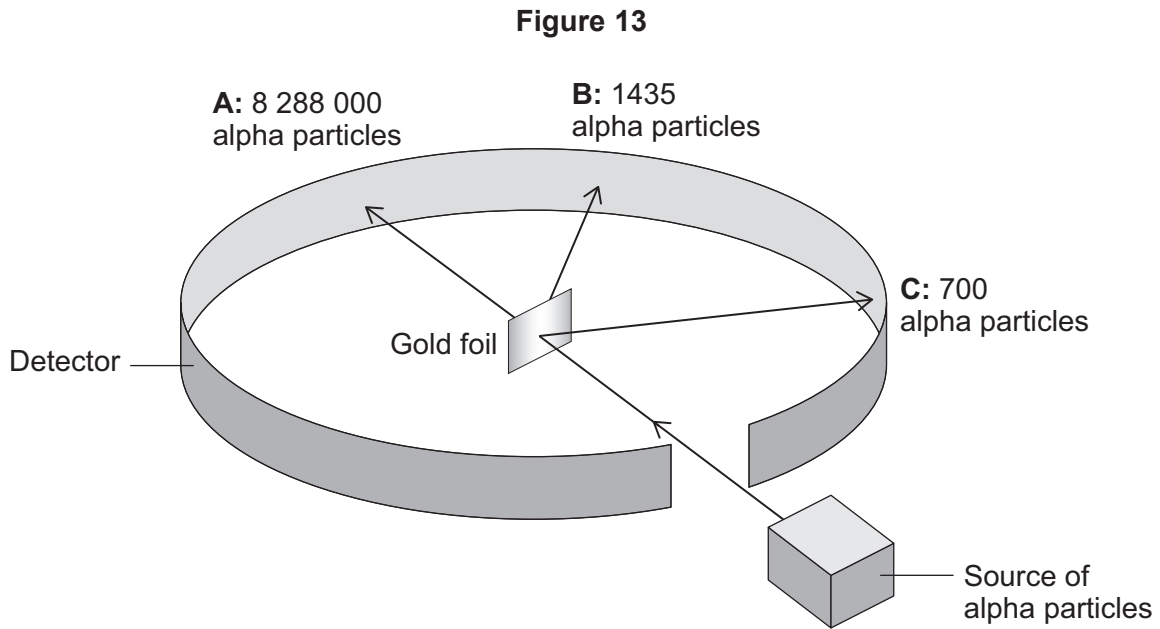
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**Figure 13** shows:

- three of the pathways the alpha particles take
- the number of alpha particles detected at positions **A**, **B** and **C**.



0 8 . 3

Determine the simplest ratio of the number of alpha particles detected at **A** to those detected at **C**.

Use **Figure 13**.

[2 marks]

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Simplest ratio of **A** : **C** = \_\_\_\_\_ : 1



The scientists concluded that a gold atom:

- is mostly empty space
- has a charged nucleus at its centre.

0 8 . 4

How do the results in **Figure 13** show that a gold atom is mostly empty space?

[1 mark]

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0 8 . 5

Explain how the results in **Figure 13** show that a gold atom contains a charged nucleus.

[2 marks]

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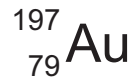
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**0 8 . 6** A gold atom can be represented as:



Describe the atomic structure of this gold atom.

You should include the numbers of each type of sub-atomic particle.

**[5 marks]**

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0 9

Some bacteria are pathogens.

0 9 . 1

What is meant by the term 'pathogen'?

[1 mark]

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Bacterial infections can be treated using antibiotics.

Some bacteria are resistant to antibiotics.

**Table 4** shows the percentage of bacteria resistant to four antibiotics.

**Table 4**

Antibiotic	Percentage (%) of bacteria resistant to antibiotic	
	2004	2018
<b>A</b>	10	23
<b>B</b>	2	11
<b>C</b>	3	14
<b>D</b>	1	2

0 9 . 2

Which antibiotic had the greatest increase in bacteria that were resistant between 2004 and 2018?

[1 mark]

Tick (✓) **one** box.

**A**       **B**       **C**       **D**





**0 9 . 3** One of the antibiotics in **Table 4** is only used for serious infections in hospitals.

Suggest which antibiotic is only used for serious infections.

Give a reason for your answer.

**[2 marks]**

Antibiotic    **A**         **B**         **C**         **D**

Reason \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Question 9 continues on the next page**

**Turn over ►**



Many strains of the bacterium *Staphylococcus aureus* (SA) are resistant to the antibiotic methicillin.

**Table 5** shows information on methicillin-resistant *Staphylococcus aureus* (MRSA) infections in England.

**Table 5**

Year	Total population	Number of people with MRSA infection	
		Total	Per 100 000 population
2008	51 800 000	1606	3.10
2012	53 400 000	398	0.75
2015	55 000 000	297	<b>X</b>
2018	55 600 000	271	0.49

**0 9 . 4** Calculate value **X** in **Table 5**.

**[3 marks]**

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**X =** \_\_\_\_\_



**0 9 . 5** The number of people with MRSA infection in hospitals decreased between 2008 and 2018.

Suggest **one** reason for the decrease.

[1 mark]

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**0 9 . 6** Scientists are trying to develop a vaccine for MRSA.

Explain how a vaccine for MRSA would make people immune to MRSA.

[6 marks]

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