



Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY
8465/2F

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).

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]



J U N 2 1 8 4 6 5 2 F 0 1

BLANK PAGE



INSTRUCTIONS

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Answer ALL questions in the spaces provided. Do not write 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.

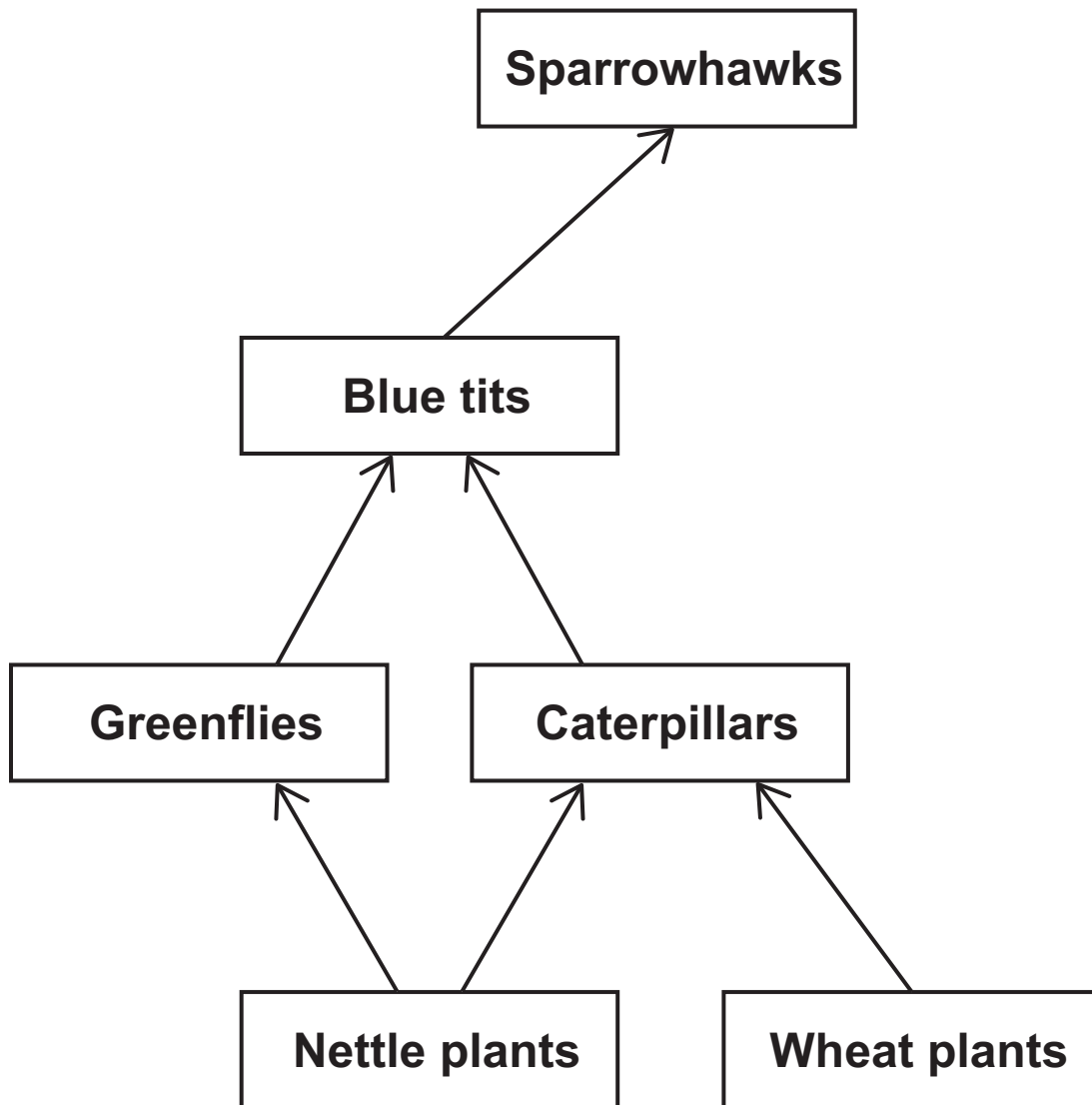
DO NOT TURN OVER UNTIL TOLD TO DO SO



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

[Turn over]



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, on page 4, by adding mice to FIGURE 1. [2 marks]



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 4. [2 marks]

[Turn over]

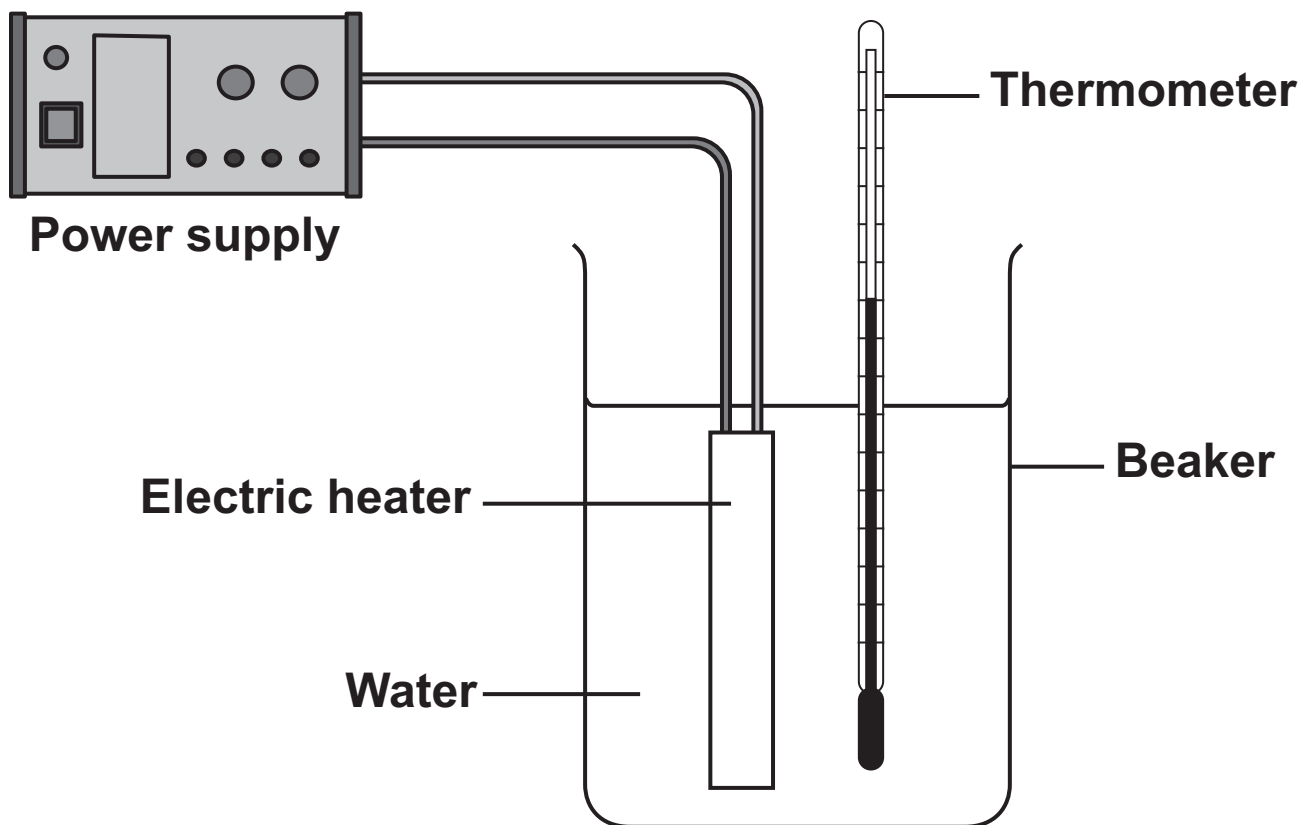


0 2

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

FIGURE 2 shows some of the apparatus used.

FIGURE 2



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	X
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

[Turn over]



0	2	.	2
---	---	---	---

Calculate mean value X in TABLE 1, on page 9. [2 marks]

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]



0	2	.	5
---	---	---	---

Give TWO ways to reduce energy transfer from the apparatus to the surroundings. [2 marks]

1 _____

2 _____

[Turn over]



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:

change in thermal energy = mass × specific heat capacity
× temperature change

Choose the unit from the list. [3 marks]

°C cm³ J kg

Change in thermal energy = _____

Unit _____



0	2	.	7
---	---	---	---

Explain what happens to the mass of water in the beaker during a test. [2 marks]

12

[Turn over]



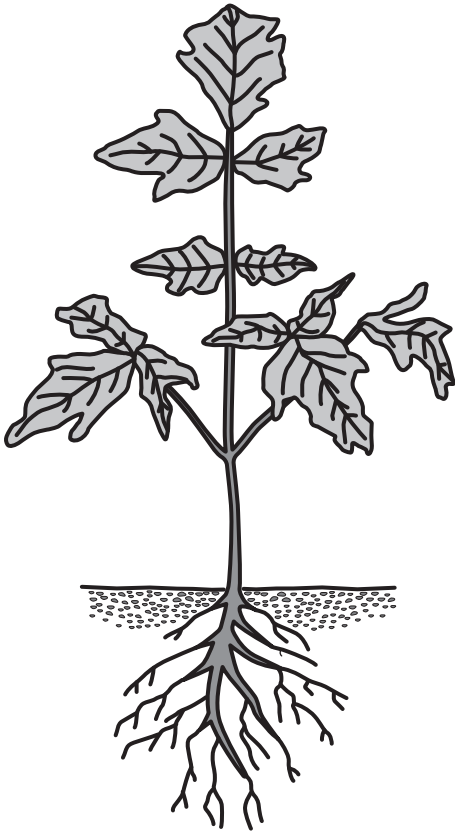
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0	3
---	---

FIGURE 3 shows a tomato plant.

FIGURE 3



0	3	.	1
---	---	---	---

A leaf is a plant organ.

Name ONE other plant organ shown in FIGURE 3.
[1 mark]

[Turn over]

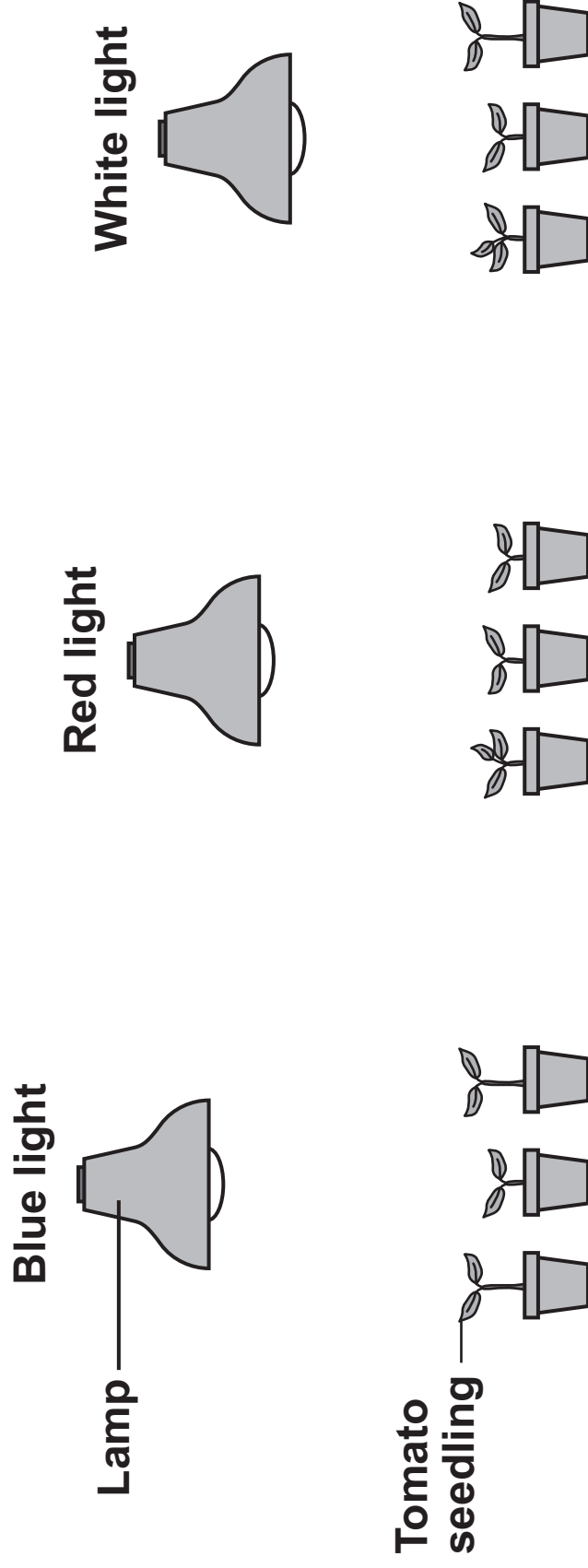




A student investigated the effect of different colours of light on the growth of tomato plant seedlings.

FIGURE 4 shows the apparatus used.

FIGURE 4



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.



03.2

Give TWO control variables the student should have used in their investigation.
[2 marks]

1 _____

2 _____

[Turn over]

0	3	.	3
---	---	---	---

The student repeated the investigation using a valid method.

TABLE 2 shows the results.

TABLE 2

Colour of light	Mean height of seedlings in cm
Blue	14.5
Red	12.0
White	11.8

Give TWO conclusions from the results in TABLE 2.
[2 marks]

1 _____

2 _____

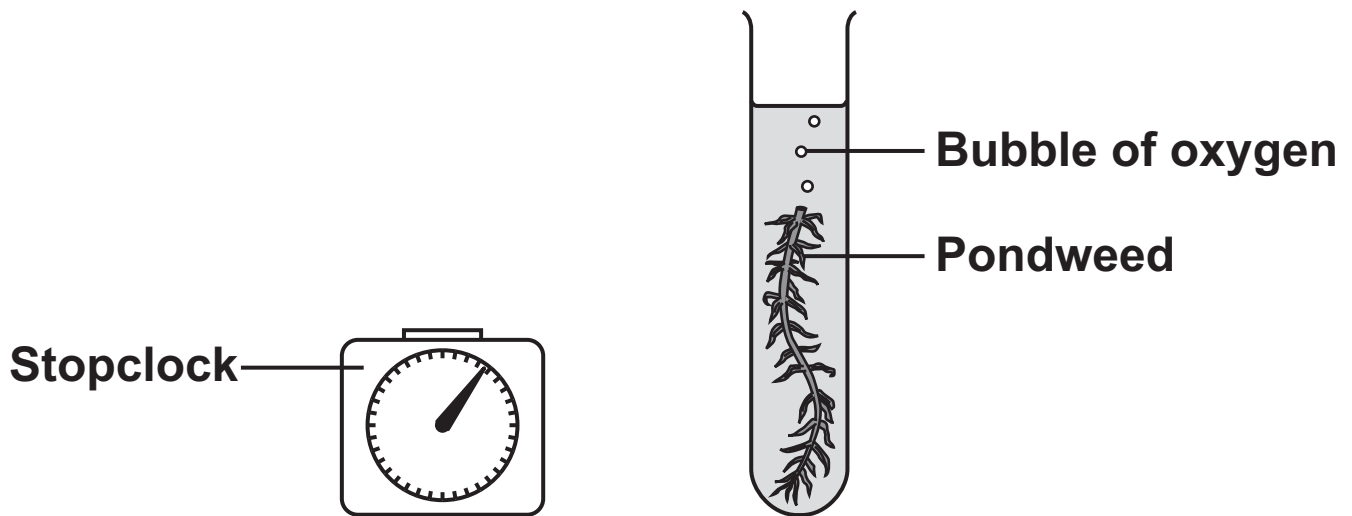


Another student investigated the effect of light intensity on the rate of photosynthesis.

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

FIGURE 5 shows some of the apparatus used.

FIGURE 5



0 3 . 4

Describe how the student could change the light intensity. [2 marks]

[Turn over]



03 . 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.

03 . 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 = $\frac{\text{time}}{\text{number of bubbles}}$



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[Turn over]

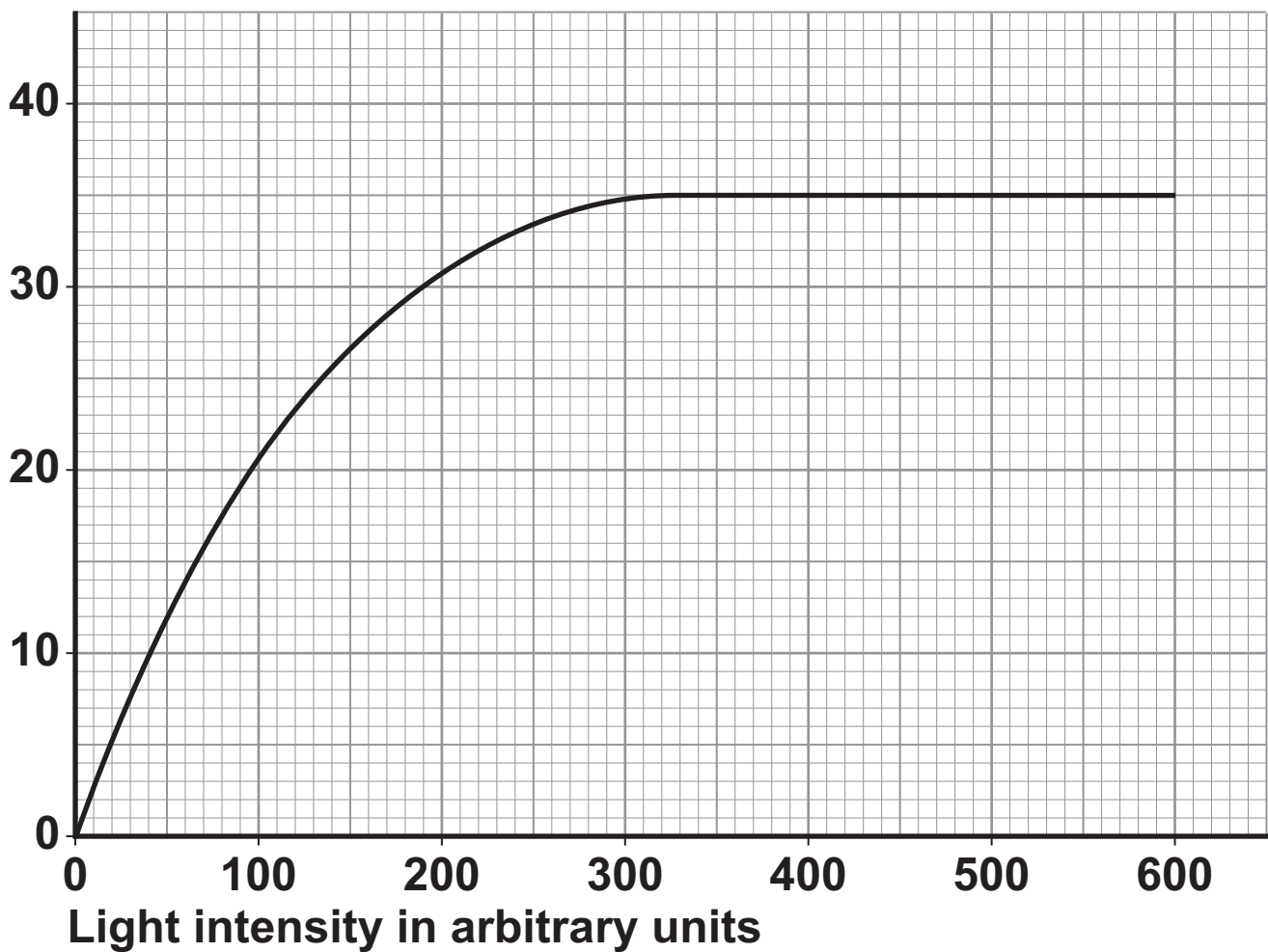


03.7

FIGURE 6 shows the rate of photosynthesis at different light intensities.

FIGURE 6

Rate of
photosynthesis
in arbitrary units



Describe the pattern in FIGURE 6, on page 22.

Use data from FIGURE 6. [2 marks]

11

[Turn over]



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]

[Turn over]

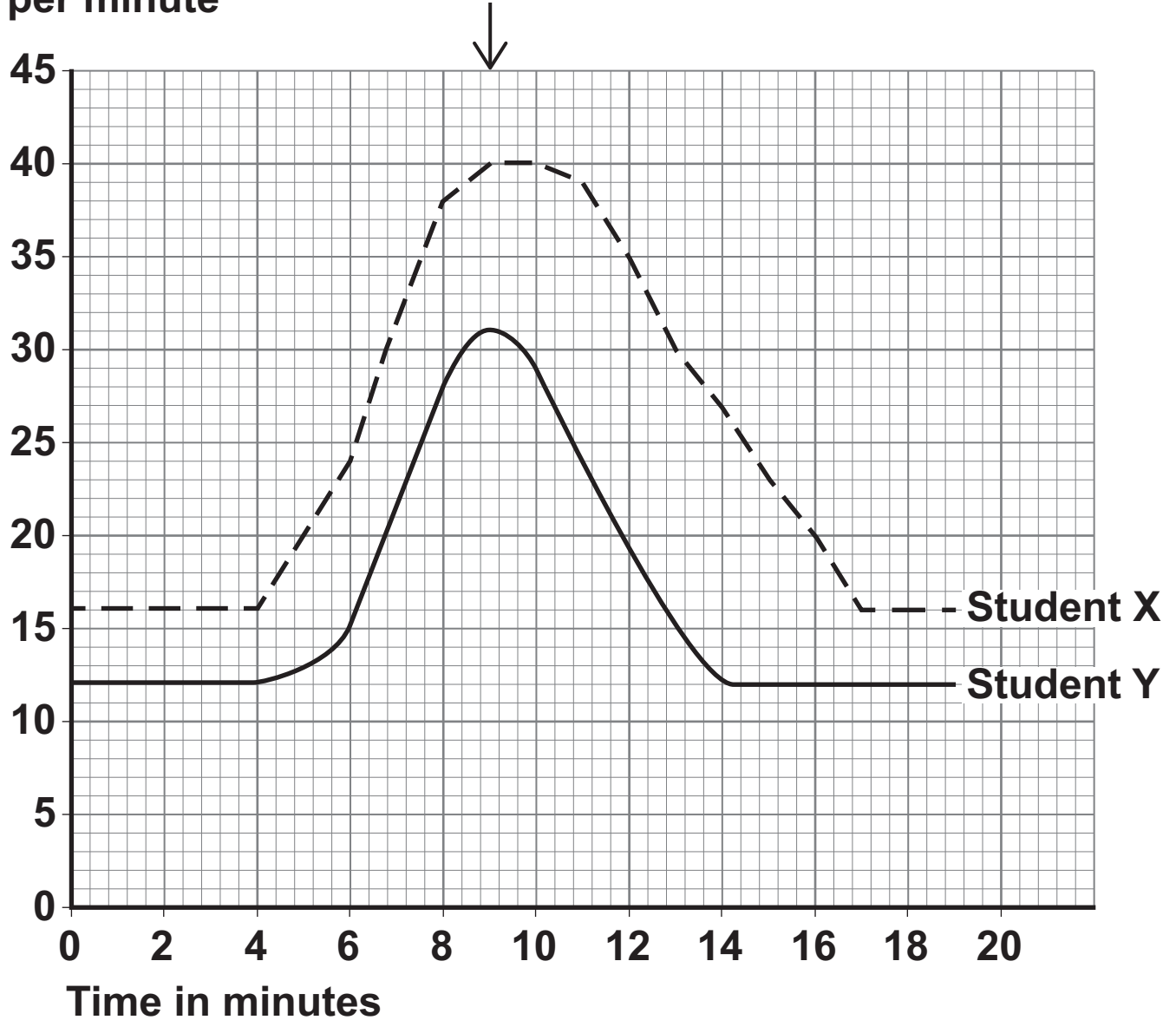


FIGURE 7 shows the results.

FIGURE 7

Breathing
rate in
breaths
per minute

Exercise stopped



0	4	.	3
---	---	---	---

What time did the students start exercising?

Use FIGURE 7, on page 26. [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 _____

[Turn over]



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]

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

[Turn over]



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 _____

[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



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[Turn over]

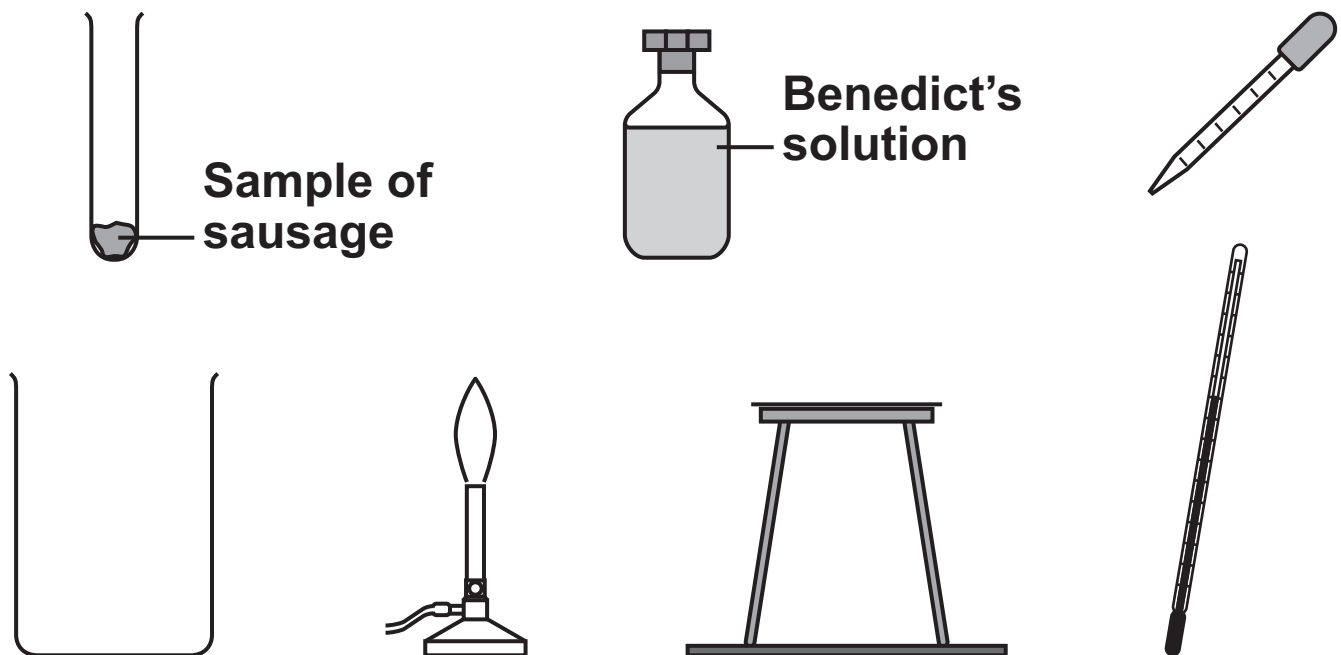


0 5 . 7

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]





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

[Turn over]



06.3

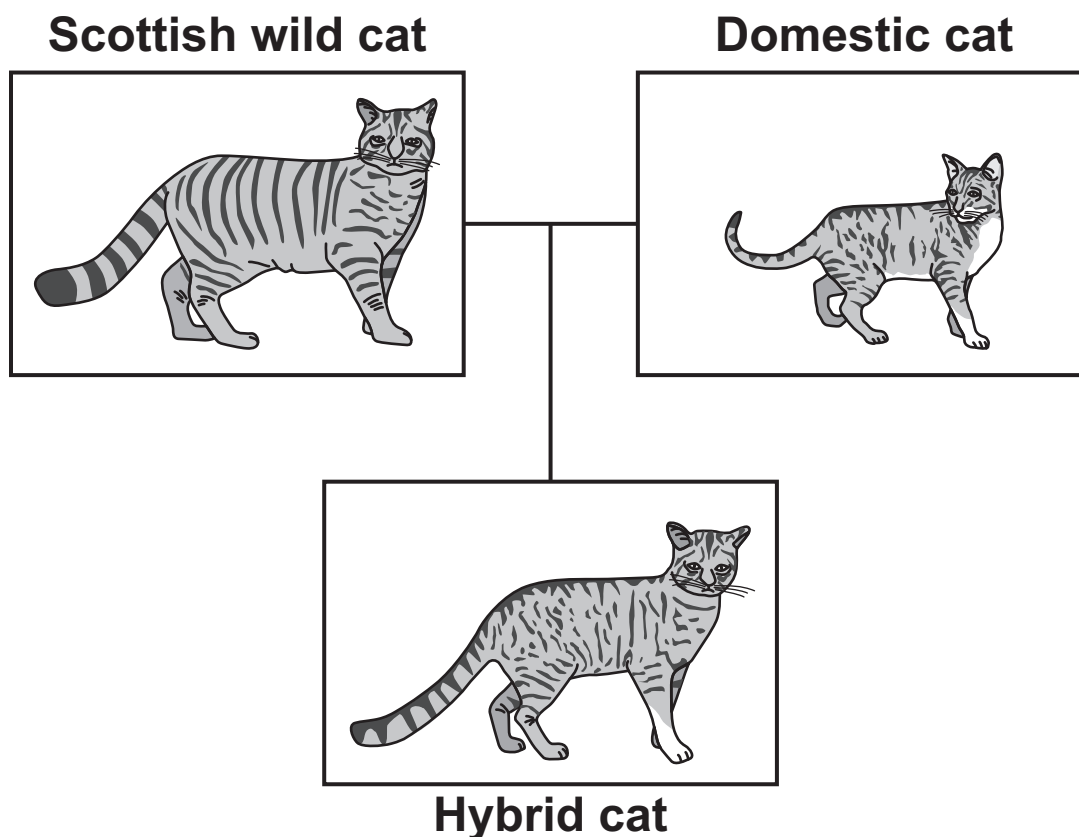
Give ONE type of evidence scientists can use to show that modern-day cats have evolved from 'Felis lunensis'.
[1 mark]

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.

FIGURE 9



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

06 . 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

[Turn over]



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, on page 40. [1 mark]**



0	6	.	7
---	---	---	---

Give ONE characteristic that the hybrid cat has inherited from the domestic cat.

Use FIGURE 9, on page 40. [1 mark]

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

0	6	.	8
---	---	---	---

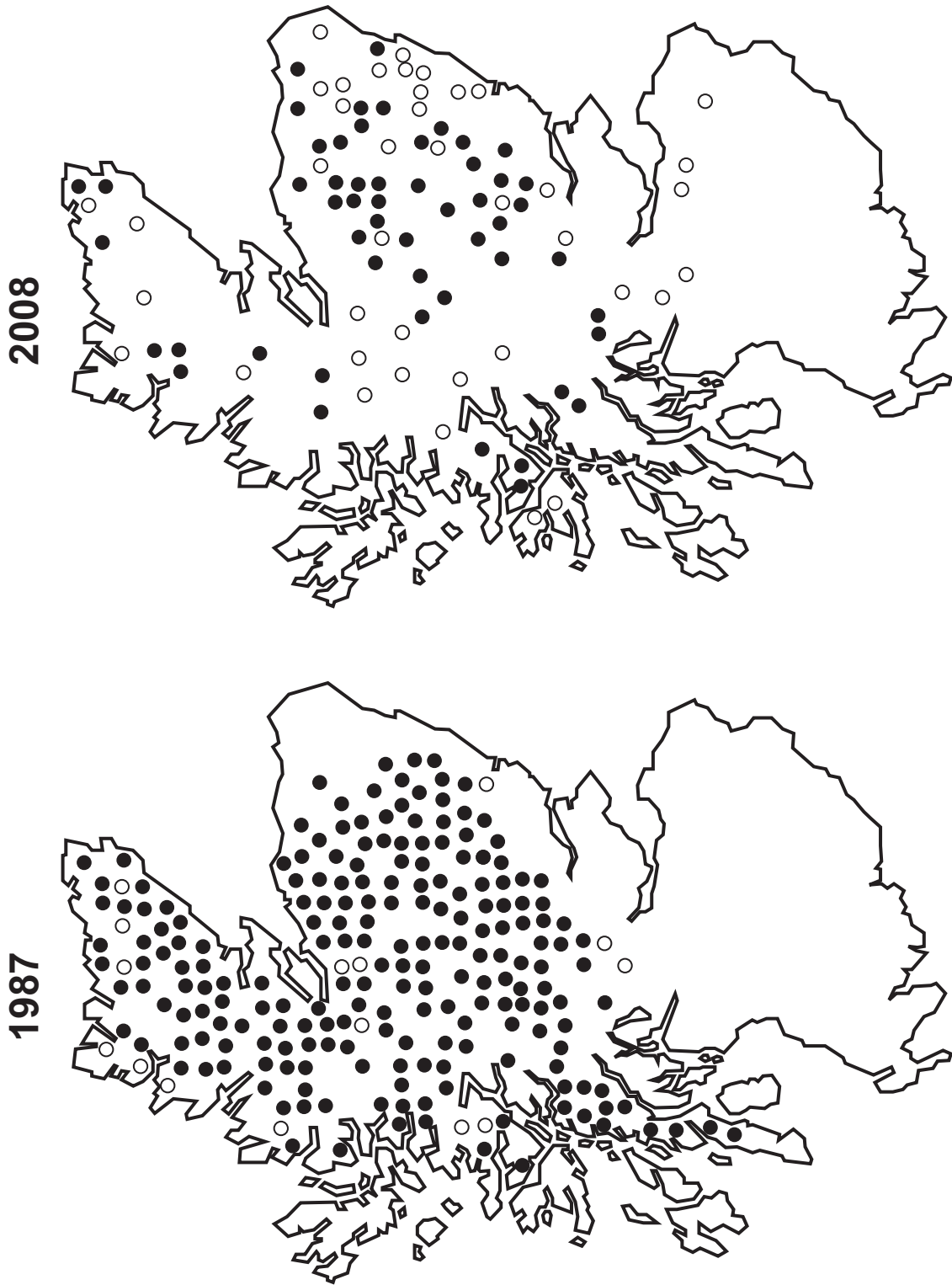
Cats hunt for prey at night.

Suggest ONE reason why scientists find it difficult to identify the type of cat seen at night. [1 mark]

[Turn over]



FIGURE 10





4 5

06.9

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

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

Use FIGURE 10, on page 44. [3 marks]

1 _____

2 _____

3 _____

11

[Turn over]

07

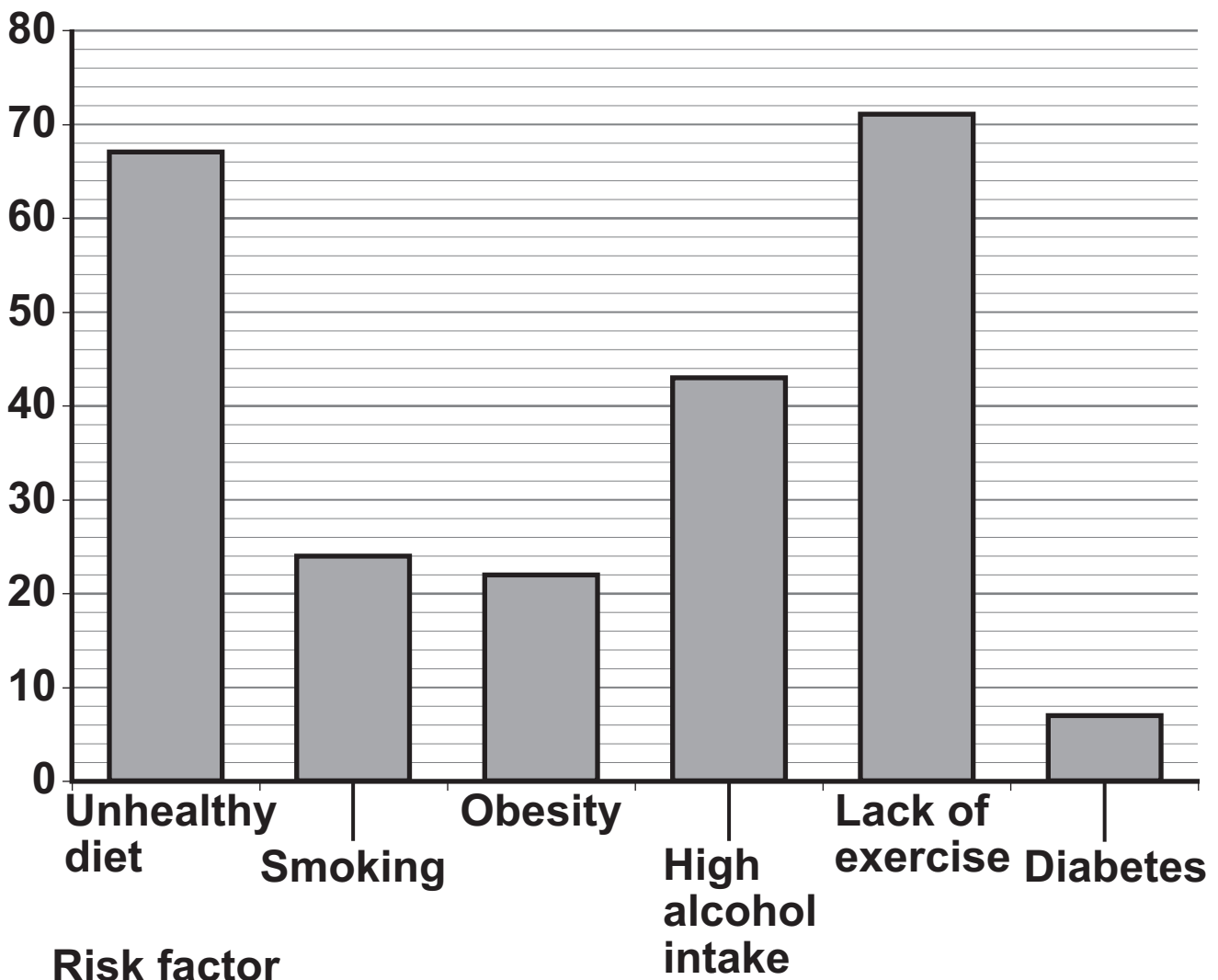
Coronary heart disease (CHD) is caused when fatty material builds up in the coronary arteries.

Scientists investigated risk factors for CHD.

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

FIGURE 11

Percentage of CHD patients with risk factor



0	7	.	1
---	---	---	---

Which was the most common risk factor in CHD patients?

Use FIGURE 11, on page 46. [1 mark]

0	7	.	2
---	---	---	---

What percentage of CHD patients had smoking as a risk factor?

Use FIGURE 11, on page 46. [1 mark]

Percentage = _____ %

0	7	.	3
---	---	---	---

Give ONE other disease that smoking is a risk factor for.

Do NOT refer to CHD. [1 mark]

[Turn over]



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 _____

2 _____



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[Turn over]



07.5

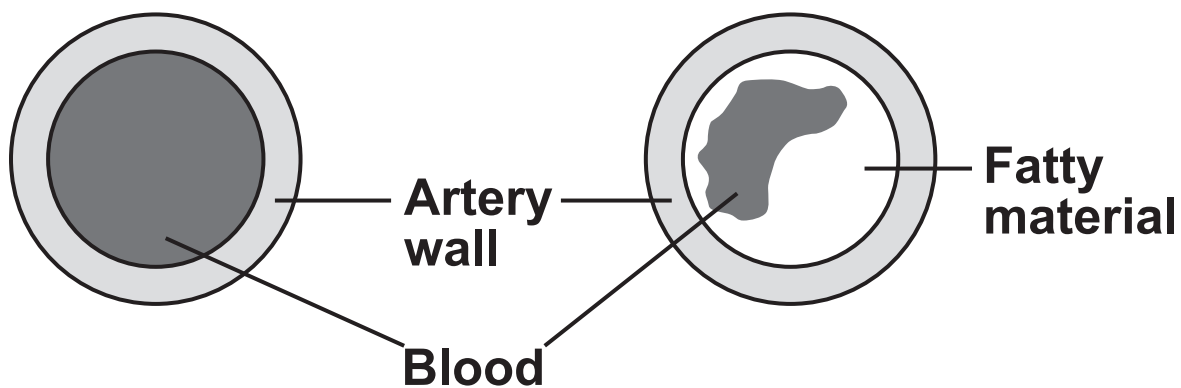
The coronary arteries supply the heart muscle with blood.

FIGURE 12 shows two coronary arteries.

FIGURE 12

**Artery in a
healthy person**

**Artery in a person
affected by CHD**



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]

[Turn over]



0	8
---	---

The model of the atom has changed over time.

0	8	.	1
---	---	---	---

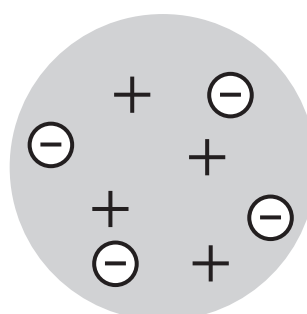
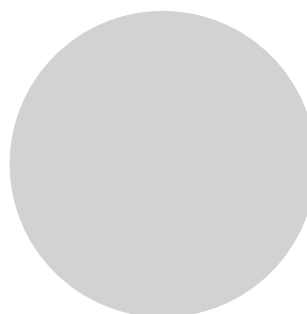
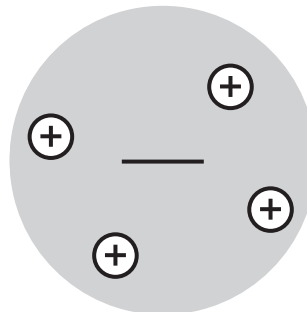
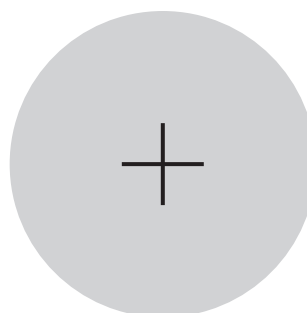
Draw **ONE** line from each atomic model to the representation of that model. [2 marks]

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

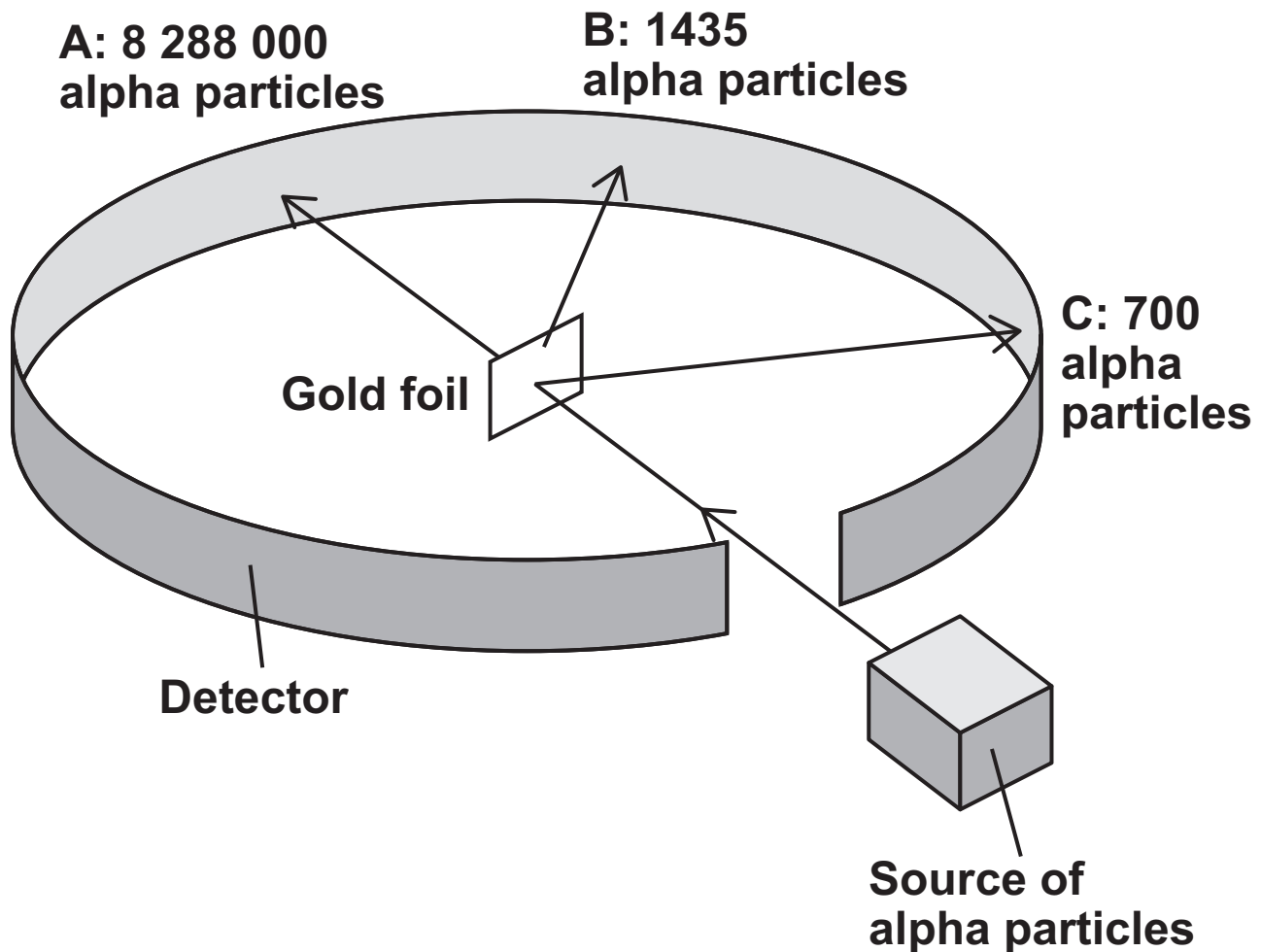
[Turn over]



FIGURE 13 shows:

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

FIGURE 13



0	8	.	3
---	---	---	---

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

Use FIGURE 13, on page 54. [2 marks]

Simplest ratio of A : C = _____ : 1

[Turn over]



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]

0 8 . 5

Explain how the results in FIGURE 13 show that a gold atom contains a charged nucleus. [2 marks]



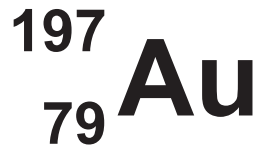
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[Turn over]



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]

[illegible]

[Turn over]



09

Some bacteria are pathogens.

09 . 1

What is meant by the term 'pathogen'? [1 mark]

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
A	10	23
B	2	11
C	3	14
D	1	2



09 . 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

09 . 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

[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	X
2018	55 600 000	271	0.49

0 9 . 4

Calculate value X in TABLE 5. [3 marks]



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]

[Turn over]



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]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

END OF QUESTIONS



Additional page, if required.

Write the question numbers in the left-hand margin.

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Additional page, if required.

Write the question numbers in the left-hand margin.

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Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
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2	
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